REVIEW OF THE ENVIRONMENTAL IMPACT STATEMENT FOR THE EQUINOR BAY DU NORD DEVELOPMENT PROJECT

Context

Equinor Canada Ltd. (Equinor Canada), and its partner Husky Oil Operations Limited (Husky Energy), are proposing to develop the Bay du Nord field, which includes Bay du Nord, Bay de Verde, Bay de Verde East and the Baccalieu discovery (collectively the Core Bay du Nord [CBdN] Development) offshore eastern Newfoundland and Labrador (NL) for the production of oil and gas. The Project is located in the Flemish Pass area of the Canada-NL Offshore Area, approximately 500 km east-northeast of St. John's, NL and is outside Canada's 200 nautical mile (NM) Exclusive Economic Zone (EEZ).

The Project Area (PA) includes three Exploration Licenses (ELs 1143, 1154, and 1156) and three Significant Discovery Licenses (SDLs 1047, 1048, and 1055) in the Flemish Pass area. The project includes the subsea development and production of crude oil from a floating production, storage, and offloading (FPSO) installation and the drilling of up to 40 wells. The Core BdN Development will occur primarily in the area as currently defined by SDL 1055 and EL 1143. The Project will include offshore construction and installation, hook-up and commissioning, production and maintenance operations, drilling and eventual decommissioning, as well as associated supporting surveys, field work, and supply and servicing activities. In addition to the Core BdN Development, the Project may also include potential future development within the Project Area. Hence, the Project includes the Core BdN Development and areas of potential future development.

The Core BdN Development has a life of field between 12 and 20 years. The PA also includes lands adjacent to the Core BdN Development Area. Equinor Canada has majority interests in other ELs and SDLs in the area of the Project with future tie-back opportunities. Should future resource potential be discovered in areas adjacent to the Core BdN Development Area, resources could be developed and produced from the production installation through the addition of subsea tie-backs. This could potentially extend the life of the Project to 30 years.

The Project requires review and approval pursuant to the requirements of the *Canadian Environmental Assessment Act* (CEAA 2012) as it has been determined to constitute a "designated project" under Section 11 of the *Regulations Designating Physical Activities.* In addition, the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) requires that a project-specific environmental assessment (EA) be completed for offshore oil and gas development projects, pursuant to the *Canada-Newfoundland and Labrador Atlantic Accord Implementation Newfoundland and Labrador Act* and the *Canada-Newfoundland Atlantic Accord Implementation Act* (the Accord Acts) and to support a Development Application. It is intended that the EA review process for the Project will satisfy the requirements of CEAA 2012 and the C-NLOPB's Accord Acts EA processes.

The Environmental Impact Statement (EIS) was prepared in accordance with requirements of the above referenced EA legislation and processes, as well as the project-specific EIS

Guidelines issued by the Canadian Environmental Assessment Agency (CEAA) on September 26, 2018, (CEAA 2018) and other generic EA guidance documents issued by the CEAA as referenced throughout. On February 18, 2019, the Fisheries Protection Program of the Ecosystems Management Branch in the Newfoundland and Labrador Region requested that Department of Fisheries and Oceans (DFO) Science undertake a review of specific sections of the Environmental Impact Statement for the Equinor CBdN Project. Science Branch undertook a Science Response Process (SRP) for this review. The information from this scientific review was provided to Ecosystems Management to help form part of the Department's response to the overall adequacy of the EIS Reports.

The objective of this review was to evaluate:

1. The sufficiency of baseline data and appropriateness of methodologies to predict effects;
2. The sufficiency of mitigation measures proposed by the Proponent;
3. The level of certainty in the conclusions reached by the Proponent on the effects;
4. The manner in which significance of the environmental effects, as they pertain to DFO's mandate, have been determined (i.e. the scientific merit of the information presented and the validity of the Proponent's methodologies and conclusions);
5. The follow-up program proposed by the Proponent; and,
6. Whether additional information is required from the Proponent to complete the technical review.

The information required for this review can be found in a number of sections throughout the EIS report, and associated appendices. The EIS and EIS Summary are available on the Agency's website.

This Science Response Report results from the regional science response process of March 19, 2019 on the Review of the Environmental Impact Statement (EIS) for Bay du Nord Development Project.

Analysis and Response

The comments provided by DFO Science, NL Region are related to the following Sections of the EIS Report:

- Chapter 5.0 Existing Physical Environment
    - Section 5.0 Existing Physical Environment (page 5-1)
    - Section 5.2 Bathymetry (pages 5-11 to 5-12)
    - Section 5.4 Oceanography (pages 5-41 to 5-70)
    - Section 5.5 Ice Conditions (pages 5-70 to 5-100)
    - In Section 5.6 Climate Change - Section 5.6.2 Oceanographic Changes (pages 5-106 to 5-112)
    - In Section 5.6 Climate Change - Section 5.6.3 Ice Conditions (pages 5-112 to 5-113)
    - In Section 5.7 Atmospheric Environment (air Quality, Light, Sound) - Section 5.7.2 Ambient Underwater Sound (pages 5-115 to 5-121)
- Chapter 6.0 Existing Biological Environment
    - Section 6.0 Existing Biological Environment (pages 6-1 to 6-2)
    - Section 6.1 Marine Fish and Fish Habitat (pages 6-3 to 6-146)
    - Section 6.3 Marine Mammals and Sea Turtles (pages 6-204 to 6-243)

  - Section 6.4 Special Areas up to and including section 6.4.2.5 Ecologically and Biologically Significant Areas (pages 6-244 to 6-257)
  - In Section 6.4-Sections 6.4.4 International Designations of Special Areas and their Management (pages 6-266 to 6-277)
  - In Section 6.4-Sections 6.4.5 NEAFC Fisheries Closure Areas (pages 6-277 to 6-279)
- Chapter 7.0 Existing Human Environment
  - Table 7.20 and proceeding paragraph (pages 7-148 to 7-150)?
- Chapter 9.0 Marine Fish and Fish Habitat: Environmental Effects Assessment (pages 9-1 to 9-105) Salmonids
- Chapter 11.0 Marine Mammals and Sea Turtles: Environmental Effects Assessment (pages 11-1 to 11-63)
- Chapter 12.0 Special Areas: Environmental Effects Assessment (pages 12-1 to 12-41)
- Chapter 15.0 Cumulative Environmental Effects
  - Section 15.0 Cumulative Environmental Effects up to and including Section 15.2 Marine Fish and Fish Habitat (including Species at Risk) (pages 15.1 to 15-32)
  - Section 15.4 Marine Mammals and Sea Turtles (including Species at Risk) (pages 15-41 to 15-55)
  - Section 15.5 Special Areas (pages 15-55 to 15-65)
  - Section 15.9 Monitoring and Follow-up (page 15-81)
- Chapter 16.0 Accidental Events
  - Sections 16.3 Spill Risk and Probabilities up to and including section 16.5 Whole SBM Spill (pages 16-22 to 16-121)
  - Sections 16.7 Accidental Events-Environmental Effects Assessment up to and including 16.7.4 Marine Fish and Fish Habitat-Accidental Events Effects Assessment (pages 16-124 to 16-148)
  - Section 16.7.6 Marine Mammals and Sea Turtles-Accidental Events Effects Assessment (pages 16-159 to 16-167)
  - Section 16.7.7 Special Areas-Accidental Events Effects Assessment (pages 16-167 to 16-182)
- Appendix D-Underwater Sound Modelling of Seismic Survey and Development Activities Off-shore Newfoundland, Equinor's Bay du Nord Development Project.
- Appendix E-Trajectory Modelling in Support of the Bay du Nord Development Project.
- Appendix F-SBM Accidental Release Modelling in Support of the Equinor Bay du Nord Development Project.
- Appendix I-Drill Cuttings Dispersion Modelling Bay du Nord Development Project.
- Appendix J-DREAM Model for Produced Water Release at the Bay du Nord Development.
- Appendix L-Marine Mammals and Sound Sources in the Flemish Pass.

Information pertaining to species at risk including Section 15.2 was not evaluated due to the unavailability of designated subject matter experts during the limited review period.

General Comments

Overall, the EIS was well organized and comprehensive in scope. It is important to highlight that a thorough and detailed review of the EIS was difficult to undertake due to the large volume of information submitted and the short review period (4 weeks). The specific comments in this Science Response should be taken as indicators of the types of problems that exist in the EIS and serve as guidance on how the EIS should be revised by the Proponent.

While completing a review of the EIS, DFO Science encountered multiple instances of mischaracterization and/or omission of available research from the referenced literature. Overall, reported baseline information was incomplete and outdated for almost all chapters reviewed by DFO Science. This installed a bias, significantly undermined the reliability and credibility of the assessment process, which sometimes led to inappropriate conclusions. In its current form, and until the problems identified in this report are addressed, the EIS is not considered a reliable source of information for decision-making processes.

Much of the scientific discussion/conclusions of residual effects were derived from other EIS documents from areas such as the Gulf of Mexico, the Adriatic Sea, and the Mediterranean Sea. There are more applicable references available from the North Sea, Norway, or from monitoring studies conducted in NL for the offshore oil and gas industry. As environment and species are different in warmer climates, it can be difficult to determine how transferrable the results are to the northwest Atlantic. Furthermore, stock status reports for individual species were often out of date, there was confusion with respect to comparing fish abundance with biomass, and the results of different fishing methodologies were improperly compared. In addition, there was an offshore oil spill at the Husky Energy SeaRose Platform in November 2018, and it would be valuable to know what types of data (if any) are being collected to help determine environmental effects.

Baseline data for small pelagics and plankton was considered adequate, although it was suggested that Capelin survey data from the Grand Banks be included in any revisions of the EIS. The level of certainty and the mitigation measures proposed for small pelagics and plankton were considered adequate.

The EIS included most relevant and recent marine mammal literature. Similar to other EISs for Canadian operations, the document concluded that there will be no significantly adverse or permanent impacts on marine mammals or sea turtles. In most cases, the conclusions were based on previous EIS documents, rather than on the results of field experiments or long-term population studies. The impacts of climate change could be difficult to differentiate from offshore development impacts with respect to marine mammal and sea turtle distribution and abundance.

The EIS process with respect to coral and sponge distributions should include standardized guidelines with map and document templates put in place to aid the reviewers. Research was omitted (e.g. DFO Sensitive Benthic Areas [SBAs], Northwest Atlantic Fisheries Organization [NAFO] Working Group on Ecosystem Science Assessments [WGESA] Reports [2008-present]), and survey methodologies were unclear and questionable.

Benthic research for corals and sponges is relatively new and has many gaps that still need to be addressed (e.g. recruitment and recovery rates, basic life history traits, sedimentation tolerance rates for adults and juveniles, etc.). The coral and sponge program at DFO has produced the majority of information for the NL Region; however, no consultation or collaboration was extended to DFO experts. The failure to accurately characterize, describe and consider SBAs and vulnerable marine ecosystems (VMEs) was a major problem in the EIS.

For the modelling exercises, the most recent understanding of the behavior of deep water blowouts was not considered. The information used to run the models was, in some instances, oversimplified and parameterization details were not completely described.

The oil spill modelling did not predict deposition of oil onto sensitive areas as was observed in the Gulf of Mexico's Deepwater Horizon (DWH) blowout. As a result, the potential effect of a subsea blowout on SBAs was discounted. The potential effects of hydrocarbon gas from a deep blowout was not modelled. As such, the consequences for planktonic organisms including the larvae of species of economic importance (shrimp, cod, etc.) and of sensitive benthic species (corals and sponges) were ignored. The potential effect of produced water discharges on these larvae was also not considered.

Fine particulates associated with the drilling wastes were assumed to be transported outside the model domain and were omitted in the effects assessment. Such fines constitute approximately 33% of the entire drilling waste stream and thus the potential far field effects of up to 35,000 t of material was not assessed. Additional simulations for drill cuttings dispersion are needed to accurately estimate their fate, and the eventual distribution of the fine-particulate material was not captured in the current model domain.

For the marine mammal sound modelling exercises conducted, the ocean model used was not verified in the PA. Acoustic modelling requires field testing to ensure that the bathymetric and geological features of the PA do not result in higher sound propagation than modelled.

While the Proponent claimed to use the most conservative approaches to effects assessment, a smaller zone of effects than was predicted by the models was sometimes used. In some instances the wider dispersal of wastes was considered a positive effect when this had not been demonstrated by the models.

The cumulative effects assessment only considered effects deemed to be significant residual effects of the current Project. The potential for additive effects within the Project and with other projects was not considered. Further exploration and development may increase the amount of the VME affected and increase the level of harm per km^2 as would any overlap in well (Zone of Effects [ZoEs]). The cumulative effects assessment did not consider past activities in the study area (e.g. residual effects from the 15 previously drilled wells and fishing within the study area). The cumulative effects conclusions with respect to marine mammals and sea turtles were not based on quantitative analyses.

The assessment criteria and metrics proposed for the Special Areas Valued Component (VC) were the same as those for fish and fish habitat. This was inappropriate, as the assessment should have been completed using criteria related to the conservation objectives and concerns for the Special Areas. In addition, the risks of cumulative small events or activities were not assessed.

Mitigation measures were summarized within the EIS; however they only encompassed standard industry guidelines with respect to ballast water, offshore waste treatment, chemical usage, sewage and food waste, geophysical surveys, and decommissioning. This Project was planned in VMEs which merit special protections. Industry standard mitigation measures were not designed with these habitat types in mind, and as such additional mitigation measures pertaining to VMEs should be included in the EIS.

Potential mitigation measures were mentioned in numerous sections within the EIS; however they were never committed to or described in detail. For example: "*Other mitigation measures to protect fish habitat and corals/sponges "may" include relocation of the subsea infrastructure and/or use of a subsea cuttings transport system.*" This is not a firm commitment to these mitigation measures. There was no decision-making rationale or process provided that outlines when and if these mitigation measures would be employed.

Other than occasional mentions within this EIS with respect to what the Proponent “may” or “will likely” conduct within a follow-up program, there were no details presented with respect to a formal “follow-up” or environmental effects monitoring (EEM) program. This would indicate that the follow-up program does not yet exist, and as such, DFO Science was not able to assess it.

The PA ecosystem is in a state of flux and has shown different ecological states over time. Focusing only on the current state of the ecosystem was inappropriate, as it provided only a partial perspective of the potential impacts of the Project. The time period of six years (2011-16) upon which the EIS is predicated was insufficient to identify and/or differentiate between natural perturbations within the ecosystem and residual environmental effects due to the Project. This is important within the context of an EIS for a project that has the capacity to be under development/production for the next three to four decades.

The information that would be required to complete an ecosystem based assessment, taking into account ecological processes and functions, including pattern and connectivity of habitat patches, natural disturbance regime, structural complexity, hydrologic/ oceanographic patterns, nutrient cycling, purification services (assimilative capacity), biotic interactions, and genetic diversity, was lacking within the EIS. As such, DFO had insufficient information to complete an ecosystem based assessment of this EIS.

Conclusions

While completing a review of the EIS, DFO Science encountered several instances in which available information was omitted and/or mischaracterized by the Proponent. As such, the foundation of the EIS and conclusions asserted within the EIS sections reviewed by DFO Science lack credibility.

In its current form, and until the problems identified in this report are addressed, the EIS is not considered a reliable source of information for decision-making processes.

This review evaluated six objectives.

1. **The sufficiency of baseline data and appropriateness of methodologies to predict effects:**

- There were multiple instances of mischaracterization and omission of available research from the referenced literature. This installed a bias in the assessment process, undermined the reliability and credibility of the assessment process, and led to inappropriate conclusions.
- Reported baseline information was incomplete and dated for almost all chapters reviewed by DFO Science. Additional details are presented within the comments on the individual sections in the body of this report.
- There were issues with terminology and methodology assessing the status of marine fish and fish habitat; stock status reports were out of date; there was confusion with respect to comparing abundance with biomass and vice versa; the results of different fishing methodologies (gear types) were improperly compared.
- There were a number of issues with respect to the assessment of risk:
  - Risks were significantly underestimated;

  - Subjective phrases such as “relatively rare” and “extremely unlikely” should be removed from all appendices and corresponding sections; and
  - Risks of cumulative small events or activities were not assessed.

- For the modelling exercises conducted, the ocean model used was not verified in the Project Area. The most recent understanding of the behavior of deep water blowouts was not considered. The information used to run the models was, in some instances, oversimplified and parameterization details were not completely described. Acoustic modelling should be field tested to ensure that the bathymetric and geological features of this area do not result in higher sound propagation than modelled.
- The lack of discharge/sound modelling with respect to effects upon non-mammalian marine species was considered a major impediment to a systemic ecosystem approach. Data gaps should be indicated within the pertinent EIS sections.
- Additional simulations for drill cuttings dispersion were required to accurately estimate their fate, and the eventual distribution of the fine-particulate material not captured in the current model domain should be assessed.
- Ongoing plans for ocean monitoring to inform precision of mitigation measures and planned and unplanned discharge trajectories are poorly described or absent.

2. The mitigation measures proposed by the Proponent:

- Mitigation measures were summarized within the EIS, however they only encompassed standard industry guidelines with respect to ballast water, offshore waste treatment, chemical usage, sewage and food waste, geophysical surveys, and decommissioning. This Project was planned in VMEs which merit special protections. Industry standard mitigation measures were not designed with these habitat types in mind, and as such additional mitigation measures pertaining to VMEs should be included in the EIS.
- Potential mitigation measures were mentioned in numerous sections within the EIS; however they were never committed to or described in detail. For example: *Other mitigation measures to protect fish habitat and corals/sponges “may” include relocation of the subsea infrastructure and/or use of a subsea cuttings transport system.* This was not a firm commitment to these mitigation measures. There was no decision-making rationale or process provided that outlined when and if these mitigation measures would be employed.

3. The level of certainty in the conclusions reached by the Proponent on the effects:

- Much of the scientific discussion/conclusions of residual effects was “cut and pasted” from other EIS documents from areas such as the Gulf of Mexico, the Adriatic Sea, and the Mediterranean Sea. There were more applicable references available from the North Sea, Norway, or from monitoring studies conducted in NL for the offshore oil and gas industry. This approach increases the uncertainty and therefore reduces the reliability of the conclusions.

4. The manner in which significance of the environmental effects, as they pertain to DFO’s mandate, have been determined (i.e. the scientific merit of the information presented and the validity of the Proponent’s methodologies and conclusions):

- The decision metrics for the determination of residual environmental effects from spills and cuttings were the same as those utilized to determine effects on fish and fish habitat. These were inappropriate for assessing effects on Special Areas.

- The potential environmental effects within Chapter 11 (Marine Mammals and Sea Turtles) were qualitative in nature. Quantitative assessments are possible and should be used.

5. **The follow-up program proposed by the Proponent:**

- Other than occasional mentions within the EIS text with respect to what the Proponent *"may"* or *"will likely"* conduct within a *"follow-up"* program there were no details presented with respect to a formal "*follow-up"* or EEM program. This would indicate that perhaps the "*follow-up program"* does not yet exist, and as such, it could not be assessed by DFO Science.

6. **Whether additional information is required from the Proponent to complete the technical review:**

- The deficiencies identified throughout this SRR need to be addressed for DFO Science to complete the technical review.
- The Environmental Protection and Compliance Monitoring Plan (EPCMP) was not presented or described.
- The EEM program was not presented or described.
- Appendix A of Appendix E: Trajectory (Oil Spill) Modelling was not provided.

Ecosystem Approach

- The information that would be required to complete an ecosystem based assessment, taking into account ecological processes and functions, including pattern and connectivity of habitat patches, natural disturbance regime, structural complexity, hydrologic/ oceanographic patterns, nutrient cycling, purification services (assimilative capacity), biotic interactions, and genetic diversity, was lacking within this EIS. As such, DFO had insufficient information to complete an ecosystem based assessment of this EIS.
- The Project Area ecosystem is in a state of flux and has shown different ecological states over time. Focusing only on the current state of the ecosystem is inappropriate, as it provides only a partial perspective of the potential impacts of the Project. This could be exacerbated by potential impacts of climate change.
- The time period of six years (2011-16) upon which the EIS was predicated was insufficient to identify and/or differentiate between natural perturbations within the ecosystem and residual environmental effects due to the Project. This is important within the context of an EIS for a project that has the capacity to be under development/production for the next four decades.
- The cumulative environmental effects chapter only considered the potential for overlap of the Project's significant residual environmental effects with those of other projects. The potential for additive effects or synergistic interactions were ignored. By only assessing residual environmental effects deemed significant, the Proponent did not consider the cumulative effects of many wells in the CBdN and PA.
- There was no assessment of the within-Project cumulative environmental effects.
- There was significant uncertainty with respect to the conclusions of cumulative effects when there were multiple, acoustically overlapping seismic programs.

- Previous activities were not addressed within the cumulative effects section. For example, residual effects from the 15 previously drilled wells and fishing within the study area were ignored.
- A number of conclusions with respect to residual effects were based upon the results of previous monitoring studies. Comparisons with the effects of shallow-water production platforms on deep-water ecosystem components were invalid.

Information on International Waters

- Information with respect to the designation of VMEs and “Special Areas” within International Waters was incomplete and outdated. Numerous studies conducted by DFO and NAFO (2008-present) provide new information.
- Both DFO and NAFO have delineated operational boundaries for many ecologically and biologically significant areas (EBSAs) and VMEs, and have performed evaluations of the potential impacts of fishing on these areas; many considerations to assess potential impacts of fishing could be used to inform potential impacts of oil and gas development (including spills and blow-outs).
- Information presented in the EIS with respect to marine fish, fish habitat, and fisheries within international waters was incomplete and outdated.

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Appendix A - Specific Comments

1.0 Introduction

Page 1-8

"The Project Area is located within the Study Area for the Eastern Newfoundland Strategic Environmental Assessment (SEA) completed by the C-NLOPB in August 2014 (Amec 2014), which has comprised a key source of information for this EIS". This statement suggests that the SEA document was a foundational source of information for the EIS. Unfortunately, during its review of the SEA, DFO Science indicated that *"Suggested changes/updates resulting from this review should be considered before the document can be considered a reliable source of guidance for policy and management decision-making*" (DFO 2014). In addition, many of the shortcomings initially identified in the SEA were also present in the EIS. It was strongly recommended that the EIS be revised and updated.

2.0 Project Description

2.1 Project Scope

Page 2-3

The transshipment of oil produced by the Project was not considered within the scope of the Project. Transshipment was considered part of the *"Basin Wide Terminal and Transshipment Solution".* Clarification was required on the methods for assessing this activity.

Page 2-10

The Proponent proposes to drill five to 20 production wells and five to 20 injector wells. The footprint and waste products of these wells were assessed as part of the modeling scenarios. Clarification was required on whether pilot wells were included in the total number of wells assessed, and whether the characteristics of these wells (e.g. type of drilling mud used, depth of well sections and discharge locations) were similar to the production and injector wells modelled.

2.6.3.2 Well Drilling and Completion

Page 2-39

The possibility of batch drilling was not assessed in the drill cuttings modelling scenarios. Information was required on how batch drilling would affect cuttings dispersal and zone of impact. Further information was also required on the possibility of two drill rigs operating at the same time.

2.7.1.8 Produced Sand

Page 2-60

Reference was made to *"produced sand" (Section 2.8.2.1)*. Is this waste product discharged with the produced water (or elsewhere)? If so, information was required on its footprint and environmental effect(s). Such discharges were not assessed in the EIS.

2.10.6 Environmental Monitoring

Page 2-90

The EIS stated that an EEM "*if required*", will be used to validate EIS predictions. Details of the potential EEM program are not provided.

6.0 Existing Biological Environment

6.1 Marine Fish and Fish Habitat

6.1.1.1 Approach and Key Information Sources

Page 6-5

"This section builds upon the fish and fish habitat information presented in the SEA by summarizing critical elements, augmenting the information with more detailed or more recent information available in the literature (Table 6.1) and providing additional analyses specific to the Project Area and LSA where available". Many of the documents listed in Table 6.1 and the EIS did not encapsulate all the information contained in NAFO's Scientific Council Studies (SCS). This source of information (i.e. NAFO's SCS and supporting documents) was not thoroughly examined, collated and summarized in the EIS.

6.1.1.2 International Research Vessel Surveys

Page 6-7

The research vessel (RV) survey programs of Spain in both NAFO Divisions (Divs.) 3L and Divs. 3NO were not detailed in the EIS.

Table 6.1 Some key Information Sources Used to Describe Marine Fish and Fish Habitat

Page 6-6

"Although the multispecies surveys have been conducted for several decades, six years of recent available data (2011 to 2016) were synthesized in this summary as the Northwest Atlantic's ecosystem has experienced ecological shifts and remains in a state of flux (Dawe et al. 2012; Nogueira et al. 2015, 2017)." The use of only recent data because of ecosystem changes was highly questionable in the context of a Project that would expand over potentially four decades if approved.

6.1.1.3 Other Information Sources

Page 6-7

"The Atlantic Zone Monitoring Program (AZMP) is the largest monitoring program for the pelagic environment and conducts frequent collections (trawl surveys, fixed point stations, cross-shelf sections) at several sites in the Northwest Atlantic…" The AZMP monitors the physical, chemical properties of the water as well as primary and secondary productivity. It was suggested that the sentence in the EIS be rephrased to *"...largest monitoring program of biological (primary and secondary production), chemical (nutrients) and physical (temperature and salinity) variables.*"

6.1.1.5 Equinor Canada Seabed Surveys

Page 6-8

"No key information gaps have been identified." The EIS stated that a seabed survey may be carried out if the Project design changes. Clarification was required on how this would be determined and how the impacts of the design change would be assessed.

6.1.2 Trophic Linkages and Community Change

Page 6-11

"As a consequence of the groundfish stock collapse in the 1990s, there was an increase in the abundance of their prey including pelagic fish (e.g., sand lance, herring) and invertebrates (e.g., shrimp, snow crab)." The EIS omitted information to support this statement.

6.1.3 Key Marine Assemblages

Page 6-11

This Section did not provide sufficient details on the nested structure that characterizes the ecosystem organization in space (e.g. the bioregion, ecosystem production unit, ecoregion levels used by NAFO in describing these ecosystems), and provided a limited perspective on how these ecosystems changed over time and their current state of productivity (e.g. see NAFO 2014, 2015, 2016, 2017, Koen-Alonso et al. 2019).

This information was relevant as it was important to understand not just current, but also past states of these ecosystems to properly assess the impacts of the Project (e.g. if different states were associated with different productivity characteristics and resilience capacity [see Pedersen et al. 2017]). This information was also important in reference to the ecosystem organization at smaller spatial scales (e.g. ecoregion sensu NAFO 2014, Koen-Alonso et al. 2019) and the notion of habitat. While Section 6.1.3 mentioned habitat complexity, and used biogenic habitats such as coral and sponge aggregations as examples, it did not highlight that some of these habitats have already been delineated both by DFO (DFO 2017a, actually cited as "DFO 2017k" in Chapter 6) and NAFO (NAFO 2016), nor how integrity of these habitats (or lack thereof) may potentially impact ecological processes.

6.1.4 Plants and Macroalgae

Page 6-13

The report stated that "*the maximum depth for macroalage in the Newfoundland Region is 75 m"*. Coraline red algae have depth distributions that may significantly exceed 75 m.

6.1.5.1 Phytoplankton

Page 6-15

"The phenomenon has also been associated with poor stock condition for herring in the North Sea…." Clarification was required on what is meant by "phenomenon." Further clarification was also required on which temperate species may increase in the statement *"…distributions of temperate species may increase…", and* on the distributional shifts of phytoplankton in the statement *"…distributional shifts may affect productivity of zooplankton."*

In addition, it was recommended that "northern" be deleted in "northern Capelin" as Capelin are considered one stock on the NL continental shelves (Divs. 2J3KL).

6.1.5.2 Zooplankton

Page 6-17

"…the zooplankton community within the Atlantic zone…" The word "composition" should be added after community.

"However, copepod abundances were higher than normal on the NL Shelf…" It should be clarified in the EIS that copepod abundances, but not biomass, were higher than normal on the NL Shelf.

"Spawning of redfish occurred at the same time each year…" Clarification was required on the importance of why redfish spawn at the same time each year.

"…that reduced ice cover along the NL shelf has favored the earlier onset of spring plankton blooms." It was recommended that Buren et al. 2014 be analyzed as the paper details the mechanism (i.e. timing of ice retreat) of early or late spring blooms and how that may influence capelin biomass.

"This coupled with the later spawning of capelin observed during the last few years has contributed to reduced stock recruitment observed in the mid-1990s." It should be noted in the EIS that this coupled with the later spawning of capelin observed during the last few years may have contributed to lower capelin survival and recruitment observed in the mid-1990s.

"…and non-copepods (DFO 2017d)." This terminology was not useful. Clarification was required on what specifically was considered a "non-copepod" in the EIS.

6.1.5.3 Ichthyoplankton

Page 6-17

*"Ichthyoplankton (fish larvae) distribution **(redfish larvae in particular)** tends to be affected by environmental variables such as temperature, salinity, and currents, therefore, they are more evenly distributed across pelagic habitat*s..." It was recommended that the sentence be reworded to *"Ichthyoplankton (fish larvae) distribution tends to be affected by environmental variables such as temperature, salinity, and currents, therefore, they are more evenly distributed across pelagic habitats".*

Page 6-18

*"Different species of corals can also host eggs and/or larvae of **redfish and other** fish species."* It was recommended that the sentence be reworded to *"Different species of corals can also host eggs and/or larvae of fish species."*

6.1.6 Pelagic Macroinvertebrates

Page 6-19

"…depth of the surveys was limited to 730 m until 2003." Clarification was required on the surveys (e.g. Canada, the EU).

6.1.7 Benthic Invertebrates

6.1.7.4 Orphan Basin

Page 6-34

Regarding Orphan Basin - Shawn Meredyk's MSc. Thesis (MUN), titled *Physical Characterization and Benthic Megafauna Distribution and Species Composition on Orphan Knoll and Orphan Seamount, NW Atlantic* (2017). This document was relevant to areas adjacent to PA and should be analyzed.

Table 6.8 Dominant Invertebrate Species within the Orphan Basin

Page 6-35

Clarification is required on how dominance was inferred.

6.1.7.6 Corals and Sponges

Corals

Another model that should be considered in the EIS was Gullage et al. 2017. This model used the same data as Guijarro et al. 2016a and Kenchington et al. 2017. The results show less suitable habitat than the other models, and was restricted to a relatively narrow band on the continental slope with no extrapolation into the deep-sea floor (see Gullage et al. 2017). Of particular interest are bamboo corals that included small gorgonians (i.e. *Acanella*) and *Keratoisis flexibilus (=K. grayi*; Saucier 2016. Both bamboo coral species were present in the Flemish Pass and were important for the large-scale habitats that they create in soft mud substrates.

General Comments and Recommendations For "Special Areas"

It should be noted that the Norwegian Oil and Gas Authority (NOROG) guidelines or best practices approach for industry (2013) were not current and not relevant for the benthic communities found in the PA. These guidelines were still being referenced and the guidelines used for 2018 surveys are not clear (e.g. coral spp./m^2, height of coral >30 cm, functional group, etc.). Note that the Figures referred to in this section are located in Appendix-B, pages 65-68.

Examples of coral gardens in this region include: Sea Pen fields (Figures 16-17), *Geodia* sponge grounds (Figures 4-6), bamboo and sponge thickets (Figures 14 and 15). For the latter, the composition of the community may change with depth.

Geodia sponge grounds have been identified using high bycatch rates from RV surveys (Canadian and EU, Figures 3-6) combined with distribution models (Kenchington et al. 2016, Guijarro et al. 2016b, Prados and Murillo 2012, Gullage et al. 2017), and groundtruthing with low impact technologies, ROV, drop cameras, benthic rock dredges and box cores.

It is suggested that Canadian guidelines be developed for oil and gas EISs in order to identify SBAs and/or VMEs. Information within Cordes et al. 2016 could be used to supplement areas not covered under the NOROG guidelines (2013); i.e. Cold-seep communities, gaps in connectivity and recruitment, etc.

Glass sponges reefs found off British Columbia form new growth on top of old (Figure 2). Reef complexes can be up to 40 km in length, 15 m in height, and have been mapped using multibeam technology (Conway et al. 1991, Austin and Conway 2007).

Examples of habitat forming communities found in this region that cannot be detected using multibeam and side-scan sonar (SSS) include:

- *Geodia* sponge grounds (i.e. Boreal "Ostur" and Cold water "ostur"). These were comprised of *Geodia/Stryphnus/Stelletta* sponges with the difference being the species composition of each (see OSPAR 2010). These sponges were globular and/or spherical in shape, can be massive in size and weight (Figures 5-6). As a result, encounters were easily detected in Canadian RV survey data and for the most part the majority have been identified at depths < 1,500 m (see NAFO WGESA, 2008-17).
- Glass sponges (*Asconema spp.)* and Bamboo Coral (*Keratoisis sp.* kerD2d). These communities have not been well studied but have been identified in the Flemish Pass (Canadian RV survey, Figures 7, 12-13), and northeast Flemish Cap (ROPOS 2010 Survey, Figure 10). Note that for the latter, community assemblages changed with depth, with deeper communities dominated by bamboo corals and sponges, mixed with *Geodia* (Figure 14), to a *Geodia* dominated community at shallower sites northeast Flemish Cap (Figure 4).
- *Asconema* (Class Hexactinellida) is a genus of glass sponges (Figure 11). They are important for habitat provision and were the only glass sponges identified as structure-forming (Beazley et al. 2013). Individuals can reach 60 cm in width by 50 cm in height (see Figure 11) and are commonly observed with *Ophiuroidea spp.* within the osculum (Beazley

et al. 2013). However, compared to other structure forming sponges, large catches of *Asconema spp.* have relatively low weights (see Figures 8-9). *Asconema spp.* are thin-walled glass sponges with large oscula or openings where water exits. In situ imagery of this species shows a ruffled appearance but it can resemble small pieces of fiberglass when captured in trawl surveys or as bycatch.

- The methodology of Murillo et al. 2012 was based on sponge biomass (i.e. *Geodia* sponge grounds). As such, *Asconema* would not be captured due to the light weight of this species. WGESA work focused on catch weights to identify important concentrations. In order to see these areas, catch distribution model polygons should be added to relevant maps to highlight these important areas. Models were designed to work with catch weights (see NAFO WGESA work 2008-17).
- Sea pen fields can be comprised of many species or dominated by one or two species. For example, sea pen fields documented in Desbarre Canyon (southwestern Grand Banks) (622 colonies in 10 m video segment) spanned several kilometers and were dominated by *Pennatula* species-adults <30 cm in height (Figures 16 and 17, Baker et al. 2012). Individuals >30 cm in height, such significant biotic habitats, would not be avoided within the scope of this Project.
- Similarly to sea pens, *Acanella arbuscula* can characterise large coral fields with maximum colony height <30 cm (Figures 18 and 19, Baker et al. 2012). *Acanella* is a bamboo coral that only inhabits soft substrates. It is very light and fragile and distributed within the Flemish Pass (NAFO SCS Doc. 13/024, NAFO SCS Doc. 14/023, NAFO SCS Doc. 16/021).

It is also suggested that ROV data be groundtruthed for all contact and/or impact sites. In addition, criteria should be adjusted in order to accommodate important habitats generated by smaller species <30 cm in height.

The multibeam echo sounder primarily collects depth data, and will reveal seabed features such as ice scouring plough marks, but can also have sufficient resolution to reveal potential coral features. DFO has used multibeam and SSS to assess sites prior to ROV dives (ROPOS 2007, 2010, 2017, ArcticNet 2012, 2015-17). It can be used to determine abiotic sea bed features and some kinds of biotic features too (i.e. *Lophelia* and reef forming glass sponges).

Coral structures down to 1 m^2 are not detectable with multibeam or modern SSS (Pers. Comms 2019: Craig Brown, Evan Edinger, Vince Auger, and Peter Lawton).

It is recommended that the EIS be updated with an overview map showing licenses, PA, SBAs, fishing closures and VMEs.

Coral gardens are defined in guidelines as dense aggregations of colonies covering an area >25 m^2. This was not stated in the EIS. Rather, coral and sponge aggregations were defined as 5 or more corals larger than 30 cm in height or width. Coral garden species are non-reef builders but can form; extensive sea pen fields (Figures 16 and17), bamboo and sponge thickets (Figures 7, 14 and 15). For bamboo thickets the colonies were so inter-tangled that it is extremely difficult to quantify individuals (Figure 15). For example, *Pennatula* sea pen fields were dominated by *Pennatula* species (Figure 16, *P. aculata*). Maximum size of *P. aculata* was <30 cm which means important coral habitats may not be protected.

Impacts to corals and sponges by anchors are of great concern. Corals and sponge have a low resilience to physical forces (Hall-Spencer et al. 2002, Watling 2014), therefore it was important to survey anchor points as well as well sites for significant concentrations of corals and sponges.

It was also suggested that the definitions of ‘Condition’ or ‘Health’ be defined. For example, if gorgonian corals are damaged by fishing (e.g. tilted orientation, broken, etc.), does this fit a ‘healthy coral’ definition?

Identifications should be at the Genus level with no voucher specimen or at the species level only with a voucher specimen.

The DWH blowout provides valuable information on the effects of oil spills on benthic ecosystems. Corals in the vicinity of the spill were already being studied prior to the accident and provide a unique opportunity. As a result, there were relevant papers that should be incorporated into the EIS including Hsing P-Y. et al. (2013), Silva et al. 2015, Fisher et al. 2014, Baguley et al. (2015), Hourigan et al. (2017).

6.1.7.1 Grand Banks Shelf

Page 6-25

The information presented in this section was outdated and was based upon 20 year-old studies.

“In the Flemish Pass, this is shown by the shift in benthic communities at the depth range 1,000-1,300 m where there is a distinct change in the density of sponges (Table 6.6).” The data presented in the table does not support this statement, or the depth range is incorrect in the text.

DFO currently focuses on protecting and conserving habitat-forming species such as Astrophoridae sponges (*Geodia* spp., *Stryphnus*, *Stelletta* sp.) and sea pen fields (*Pennatula spp*). These groups of habitat-forming taxa dominate the PA and were an important source of habitat complexity. The EIS document makes several references to low habitat complexity in mud dominated ecosystems, despite habitat-forming species being observed in high abundance in the surveyed areas. For example on Page 6-36, *“Very little habitat complexity was observed along the transects.”* Habitat complexity was a relative term when comparing soft and hard substrate ecosystems. It was referring to substrate only and not accounting for large scale habitat-forming species (e.g. *Pennatula* fields, *Acanella* fields, and *Keratoisis* thickets).

6.1.7.5 Equinor Canada Seabed Surveys

2018 Seabed Surveys

Page 6-36

Baccalieu F-89 wellsite tables need to include information on size class structure, patchiness, and relative abundance. Maps or images would be more useful.

Habitat maps illustrating community structure and abundance per wellsite should be included in the EIS to show proximity of large concentrations (e.g. *Geodia* sponge and sea pen communities) in relation to the PA.

Sea pens were identified in 76% of the survey for the Baccalieu well site. This is significant. *Halipteris* sea pens can grow to >1 m in height and form concentrations referred to as fields. Similarly, *Anthoptilum* sea pens can reach >0.7 m and are shown to act as nurseries for redfish larvae.

Page 6-37

P4b had the highest sea pen (*Pennatula* spp.) abundance and is located east and down current from other proposed sites (see Figure 5.6). Based on its locality, this concentration would be at risk if there was a spill.

6.1.7.6 Corals and Sponges

Page 6-39

The EIS poorly described the relationship between corals and sponges, EBSAs, SBAs, and VMEs. While section 6.1.7.6 summarized some of the available information on corals and sponges (e.g. Figures 6.8 to 6.11), including some relevant results from the Equinor Canada Seabed Survey, it overlooked the SBAs identified by DFO (DFO 2017a) and the VMEs delineated by NAFO (NAFO 2016).

In relation to impacts affecting biogeochemical cycles and nutrient recycling, DFO 2017b states *"These types of ecosystem services are a function of the areal extent of the SBA habitats, and hence, significant reductions in areal extent would have direct impacts on these processes. Depending on the scale of the impacts and the original size of the [SBA] habitat, these perturbations could affect overall ecosystem productivity."* These types of considerations were relevant for oil and gas impacts, but this analyses was not considered in the EIS.

Figures 6-8-Summary of Regional Coral Distributions Compiled from Canadian RV Data (2004 to 2015)

Page 6-49

It is recommended that coral data be displayed on individual maps based on functional groups or species level data where possible. It was difficult to determine what groups occur where, and in what densities.

Page 6-52

While the recording and identification of some invertebrate taxa data were curated in the PA (e.g. commercial invertebrates, corals and sponges), the vast majority of invertebrate records were not.

Page 6-55

"Sedimentation has also been shown to have effects on sponge distribution through impacts on feeding and larval settling, however some soft bottom sponge species are highly resistant (Bell et al. 2015)." This statement was misleading. For example, Bell et al. 2015 also states *"sedimentation is thought to have a generally negative impact on sponges"* and *"Despite our review demonstrating there are generally negative effects of suspended and settled sediment on sponges, many species have adaptive mechanisms. However, these mechanisms are still poorly understood in nearly all cases, as are the energetic consequences and ecological trade-offs of these mechanisms, and both should be a focus of future study."*

Table 6.12 Summary of Coral Species from Equinor Canada Seabed Survey
Table 6.17 Summary of Sponge Species from 2018 Equinor Canada Seabed Survey

Page 6-57 (Table 6.17)

Table 6.17 showed massive/globular (*Astrophoridae spp.)* sponge percentages in P1-P3, P8, and P10. The ROV survey for P3 had 1,073 *Geodias* observed over a 1,082 m transect (1 Geodia/per meter). This calculation assumed observed *Geodias* were spaced evenly, which is inaccurate, and did not factor in the other sponges (n=113) and corals (n=747 *Nephtheidaes*) documented during the transect. This area is significant and should be investigated further.

The following information or points of clarification were suggested:

- Unidentified animals, particularly if found in significant numbers (Table 6.12 and 6.17), should be identified. For example, in site P4b (Wellsite), 86% of the observed sponges were unidentified.
- All video should be analyzed, as only 11% of video was selected for analysis (13 minutes per two hour transect). If submitted, DFO could assist with the verification of species.
- The IDs in Table 6.12 are questionable and should be verified. For example, there are two species of *Anthoptilum* that cannot be determined from imagery, unless there was close inspection of the base of polyps. Even more challenging was the identification of *Alcyoniina spp*. with up to six species of *Alcyoniidae* known in the region (including the PA), none of which can be separated from a top only view.
- There were six other species of Nephtheidae soft corals known in the region, which were not necessarily restricted to hard substrates as mentioned throughout the EIS (e.g. *Gersemia fruticosa* can be found living directly on soft bottoms). The EIS should be updated to reflect this information.
- It should be noted that Pseudoanthomastus agaricus is Anthomastus agaricus.

"AUV surveys were flown ~4 m off sea bed." Sea pen fields are dominated by *Pennatula* spp. such as *P. aculata,* of which adults can reach 30 cm in height (with up to 10 cm of that buried in the mud). At a 4 m distance, smaller habitat-forming sea pens would not have been seen, and in particular recruits for determining recovery rates were not observable at this resolution. This was a significant information gap. As such, the total abundance numbers provided here were likely underestimated (see Table 6.12).

Long-term monitoring plans need to be developed prior to Project commencement and should include sampling of biological material before, during, and after the project concludes.

Page 6-79

"Currently no critical habitat has been established for Atlantic cod, however the Southeast Shoal and Tail of the Banks, Virgin Rocks, and Burgeo Banks EBSAs are considered important spawning areas for cod (Templeman 2007)." Atlantic cod were also a key feature of the Northeast Slope EBSA (see below for more info). This EBSA should be added to Figure 6-14.

Generic comments (pertaining to Chapter-6 selection of "dominant" species)

A functional group is a grouping of species based on general size and known food habits. The following fish species dominated their respective functional groups (in terms of average kg/tow in DFO's RV surveys, which was a more accurate metric for determining dominance than mean abundance) and were found in relatively high densities within the local study area (LSA) and/or the core CBdN development area, as indicated in the last column. At-risk species that were also found in the LSA and core areas were included at the bottom of the table. As some of these species have very specific habitat preferences, it was important to consider the environmental impacts on them in the LSA and core area.

Functional group	Common name	Species name	Area found
Small benthivores	Mailed Sculpin	*Triglops sp.*	LSA
	Common grenadier	*Nezumia bairdi*	LSA/core
	Lumpsuckers	*Eumicrotremus sp.*	LSA

Functional group	Common name	Species name	Area found
	Hookear sculpin	*Artediellus sp.*	LSA
	Spatulate Sculpin	*Icelus spatula*	LSA
Medium benthivores	Witch Flounder	*Glyptocephalus cynoglossus*	LSA/core
	Blue Hake	*Antimora rostrate*	LSA/core
Large benthivores	American Plaice	*Hippoglossoides platessoides*	LSA/core
	Thorny Skate	*Raja radiate*	LSA/core
	Roughhead Grenadier	*Macrourus berglax*	LSA/core
	Atlantic wolffish	*Anarhichas lupus*	LSA
Piscivores	Atlantic Cod	*Gadus morhua*	LSA/core
	Greenland Halibut (Turbot)	*Reinhardtius hippoglossoides*	LSA/core
Plank-piscivores	Redfish*	*Sebastes mentella**	LSA/core
Planktivores	Sand Lance	*Ammodytes dubius*	LSA
	Capelin	*Mallotus villosus*	LSA
At-risk species	Northern shrimp	*Pandalus borealis*	LSA/core
	Northern Wolffish	*Anarhichas denticulatus*	LSA/core
	Smooth Skate	*Malacoraja senta*	LSA/core
	Spotted Wolffish	*Anarhichas minor*	LSA/core

Table 6.14 Percentage of Trawls with Coral Catches based on Canadian RV Surveys (2004 to 2015) Within the Project Area and Fig 6-13 Summary of Regional Sponge Distributions Compiled from EU RV Data (2002-2013)

Page 6-61

Table 6.14 was not useful and the maps were outdated (2002-13).Many of the maps should be combined to enhance clarity (i.e. Canadian and EU data). It was worth noting Canadian trawl survey coverage in the Flemish Pass has been limited in recent years, with most species' information collected during the 2006-08 period.

Table 6.16 Summary of Sponge Groups from 2018 Equinor Canada Seabed Survey and Table 6.17 Summary of Sponge Species from 2018 Equinor Canada Seabed Survey

Page 6-55 and 6-57

Equinor Canada Seabed Surveys (2016 to 2018) indicated that *Geodia sp*. was the most abundant sponge species in the Core CBdN development area, occasionally forming dense aggregations (more than 0.75 individuals/m2) (Table 6.16 and Table 6.17). This was significant and should be further investigated.

6.1.7.7 Project Area Key Invertebrate Species Information and Distribution

Table 6.20 Abundance and Biomass of Invertebrate Species in the Project Area Based on Canadian RV Surveys (2011 to 2016)

Page 6-62

There was no indication in this table that the estimates reported considered the random-stratified design of the RV survey.

6.1.8 Finfish (Demersal and Pelagic Species)

6.1.8.1 Grand Bank Shelf and Flemish Pass

Page 6-63 and 6-65

It should be noted that direct comparisons of data derived from different fishing methodologies (trawl vs. longline as well as different trawls with different characteristics) should not be conducted.

Clarification is required on whether the deepwater longlines were baited.

The EIS stated no data beyond 1,000 m. This should be 732 m.

There should be a note in the EIS detailing that the results were conditional on the selectivity of the trawl (our survey uses a Campelen shrimp trawl w/ small-mesh liner), as that influences the rates of capture by size for each species, and different gear types would yield different compositions. It should not be interpreted that these numbers represent the percentage of all benthic resources.

In addition, it should be noted that the DFO RV surveys covered only a portion of the Flemish Pass.

Table 6.21 Numerically Dominant Fish Species by Depth Zone (Canadian RV Surveys, 2011 to 2016)

The title of the Table did not indicate that the data represents information collected from the Grand Bank and Flemish Pass.

Clarification was required on the number of individual sets the data was based upon for each slope depth range. Clarification was also required on whether the "*Contribution (%)*" from Table 6.21 was the same as "*Percent Abundance (%)"* from Table 6.22. If so, the terminology between the tables should be consistent. It should also be noted that the depth ranges are different between Tables 6.21 and 6.22.

Table 6.22 Dominant Species by Depth Zone Found in Flemish Cap, Flemish Pass, and Grand Banks Slope Deepwater Longline Surveys

The table caption stated *"Percent Abundance is based on 64 longline hauls collected from 708 m to 3,028 m."* It was unclear if the data presented were collected up to 1,500 m (as stated in the table) or 3, 028 m. It was also unclear if the data was weighted to account for the missing hauls between 1,500 m and 3, 028 m.

Clarification was required on the number of individual longline hauls for each depth range, and whether there was location information included within Mura and Cardenas (2005) that delineates where the longline hauls were located.

The table title indicated sampling occurred along the slopes of Flemish Cap, Flemish Pass, and Grand Banks but it was not possible to differentiate between these areas.

In addition, information on whether there were there any noticeable differences between fish distributions in the different areas should be included in the EIS.

Page 6-67

"*Some species showed increased abundance or biomass…."* It should be noted that abundance refers to numbers while biomass refers to weight, and that they should not be used interchangeably.

It was not clear from the text if abundance or biomass (or both) increased with sponge density, although Table 6.23 mentioned fish abundance only.

Table 6.23 Fish Species Associated with Sponge Ground Densities Based on Fish Abundance

The table should be updated to include the location (e.g. Flemish Pass, Flemish Cap) and whether the data was from RV surveys or another methodology.

It was assumed that Contribution (%) was referring to % abundance. The terminology should be comparable between tables.

6.1.8.2 Flemish Cap

Page 6-69

In paragraph 1, clarification was required on whether the halibut referred to was Atlantic or Greenland.

It should be noted that there was no directed fishery for American plaice as it is currently bycatch only. In addition, the survey gear used in EU RV surveys was different than that of DFO RV surveys. Therefore comparisons (implied or direct) of the species composition and/or abundance cannot be made.

6.1.8.3 Migratory and Transient Species

Page 6-70

The statement that pelagic spp were "*in many cases*" represented in bottom trawl data was highly questionable and should be validated.

Table 6.26 Fish Groups Observed in the Core CBdN Development Area during the 2018 Equinor Canada Seabed Survey

Page 6-73

The caption contains the text: "*Contribution to survey: Reported percentage of total abundance, biomass, or trawl presence in the survey*." It was unclear what this was referring to as only "*Sections Present (%)*" was listed as a column label. Clarification is required on whether the sections were standardized with respect to time and distance. Note that abundance and biomass were compared to each other.

Table 6.27 Fish Species Observed in the Core CBdN Development Area - 2018 Equinor Canada Seabed Survey

It was unclear whether the individual transects were of equal time and length. If not, the times and/or distances should be included in the table and the calculations should be weighted to reflect this.

The presence of a number of unidentified fish raised concern, particularly in the context of such small overall numbers (also in Table 6.26). There is expertise within DFO that can be availed of to identify fish species from either video still photographs or video footage.

6.1.8.5 Project Area Key Species Information and Distributions

Figure 6-6 Northern Shrimp Distribution and Abundance on the Flemish Cap as Compiled from EU RV Trawl Survey Data (2013 to 2016)

The figure(s) should be updated to include latitudes and longitudes.

Page 6-76

In the second paragraph, it should be noted that Atlantic cod and American plaice were not listed previously within the paragraph as a dominant species.

Page 6-78

"The stock remains a small percentage (less than three percent) of historical levels ….". What "stock(s)" of Atlantic Cod is this statement referring to (e.g. Northern cod in NAFO Divs. 2J3KL?).

It should be noted that Flemish Cap cod have fully recovered and stock levels were at an all-time high. In addition, distributional data for Canadian surveys was presented as abundance (numbers per tow), while the European data from the Flemish Cap is presented as biomass (kg per tow).

Page 6-78

"…as they travel from offshore to inshore areas in the spring to feed on capelin before returning in the fall…" Clarification is required on whether they travel from offshore to inshore areas in the spring to feed on capelin before returning to the offshore in the fall.

The notes were outdated, and there have been several reports in the past decade which stated different findings than were noted in the EIS. The numbers indicated herein (e.g., <3% historical) need to be revised.

Page 6-79

Information on the inshore was overlooked. For example, the largest known spawning aggregation of cod was in Smith Sound throughout the late-1990s and early-2000s, not the offshore as implied. Additionally, juvenile rearing areas are located in abundance in many inshore and coastal areas through this period, and into the present day (Rose 2003).

Blue Hake

Page 6-82

Clarification was required on whether there was information on Blue hake distributions from the EU surveys.

Greenland halibut

Page 6-84

It should be noted that distributional data for Canadian surveys was presented as abundance (numbers per tow), while the European data from the Flemish Cap was presented as biomass (kg per tow).

"*Greenland halibut contributed approximately two percent of fish abundance in Canadian RV surveys and less than one percent of fish abundance in EU RV surveys (Nogueira et al. 2017; Table 6.28)."* Due to the significantly different characteristics of the trawls employed in each survey, these catch data were not comparable.

It should be noted that low to high catch biomass has been recorded within the PA, Core CBdN development area, and the Project Location by the EU RV Surveys.

The description of Greenland halibut should be expanded.

Redfish (Acadian, Deepwater, Golden)

Page 6-96

“Golden redfish has the lowest depth range (130 m to 631 m) of the three species and was another key species in shallow slope assemblages on the Flemish Cap…” It is recommended that the sentence be rephrased as “Golden redfish has a shallow depth range (130 m to 631 m) compared to the other two species and is a key species in shallow slope assemblages on the Flemish Cap…”

Fig-6-25 and 6-27, and Pages 6-97 and 6-99

It should be noted that distributional data for Canadian surveys was presented as abundance (numbers per tow), while the European data from the Flemish Cap is presented as biomass (kg per tow).

Other Species of Commercial, Socioeconomic, or Indigenous Importance

Page 6-102

“In the northwest Atlantic marine environment, the alewife diet is majority northern krill and related zooplankton…”

Clarification is required on what is meant by “related zooplankton.”

Capelin

Page 6-105

“Capelin are found at their highest concentrations along the shelf of the Grand Banks (Figure 6-32) with high concentrations of over 89,000 fish per tow in places.” RV bottom trawl surveys were not the best practice to sample pelagic species such as capelin (i.e. acoustic surveys are used for estimating pelagic species biomass). The EIS should avoid providing numbers in the document as capelin data from the RV surveys were primarily used for presence/absence rather than biomass estimates.

Information was required on capelin and herring distributions from EU RV Surveys conducted on the Flemish Cap.

Herring

Page 6-105

“Herring are a schooling, benthopelagic, planktivorous (e.g., copepods, amphipods, and euphausiids) species that occurs in inshore and offshore waters from surface to 364 m…” It is recommended that this statement be rephrased as “Herring are a schooling, benthopelagic, planktivorous (e.g., feeds on copepods, amphipods, and euphausiids) species that occurs in inshore and offshore waters from surface to 364 m.”

“Herring adults and eggs are an important prey species of predatory fish, marine mammals, and seabirds…” It is recommended that this statement be rephrased as “Herring adults, juveniles, and eggs are an important prey species of predatory fish, marine mammals, and seabirds…”

Mackerel

Page 6-108

“Herring were not captured in Canadian RV surveys in the Project Area and were not a key species on the Flemish Cap.” Herring should be replaced with Mackerel.

This Section should include a statement that bottom trawls were not an appropriate method for sampling Mackerel (a pelagic species).

6.1.8.6 Key Reproduction Times and Areas

Table 6.30 Spawning Periods and Locations of Some Key Fish Species

Page 6-112

There was no indication in the EIS that Atlantic cod spawn on the Flemish cap (Div. 3M cod).

Fig 6-35 Northern Wolffish Distribution and Abundance as Compiled from Canadian RV Trawl Survey Data (2011 to 2016)

Page 6-118

The indication of *"critical habitat…",* based on the distribution of fish provided was inaccurate. Northern Wolffish were indicated in this figure as being a species associated with the shelf break. While the indicated "critical habitat" includes some of these areas, most of it was not occupied, and was therefore unlikely to be critical for the species.

6.1.9.7 Atlantic Bluefin Tuna

Page 6-139-140

It should be noted that the text indicated that tuna were present on the Flemish Cap; however Figure 6-45 does not indicate this.

6.1.9.9 Atlantic cod

Page 6-141

It should be noted that EU RV surveys within Div. 3M have indicated that Atlantic Cod occur and spawn on the Flemish Cap.

6.1.9.11 Redfish

Page 6-143

Paragraph's 2, 3, 4, and 5 were not related to Redfish. Information from EU RV surveys should be incorporated into this section as the lack of species within the Core CBdN development area may be more related to a lack of sampling effort in this area by Canadian RV Surveys.

Fig 6-47 Overall Abundance of Organisms (Fish and Invertebrates) Inventoried from Canadian RV Trawl Survey Data (2011 to 2016).

Page 6-144

This figure (6-47) was misleading, as the most numerically abundant species would dominate the figure, blurring important aspects of the distributions of individual species. This figure, in addition to the two subsequent figures 6-48 & 49 are recommended to be removed.

6.4 Special Areas

Pages 6-245 to 6-265

Vulnerable Marine Ecosystems represented in these maps (Figures 6-67 to 6-75) were from 2008. NAFO Closure #10 was created several years later and makes the maps misleading.

It is recommended that the EIS include a concise map of Project activities such as the map drafted below by DFO (Figure 1). The map should highlight existing well sites (light blue) and planned well sites for the CBDN Project.

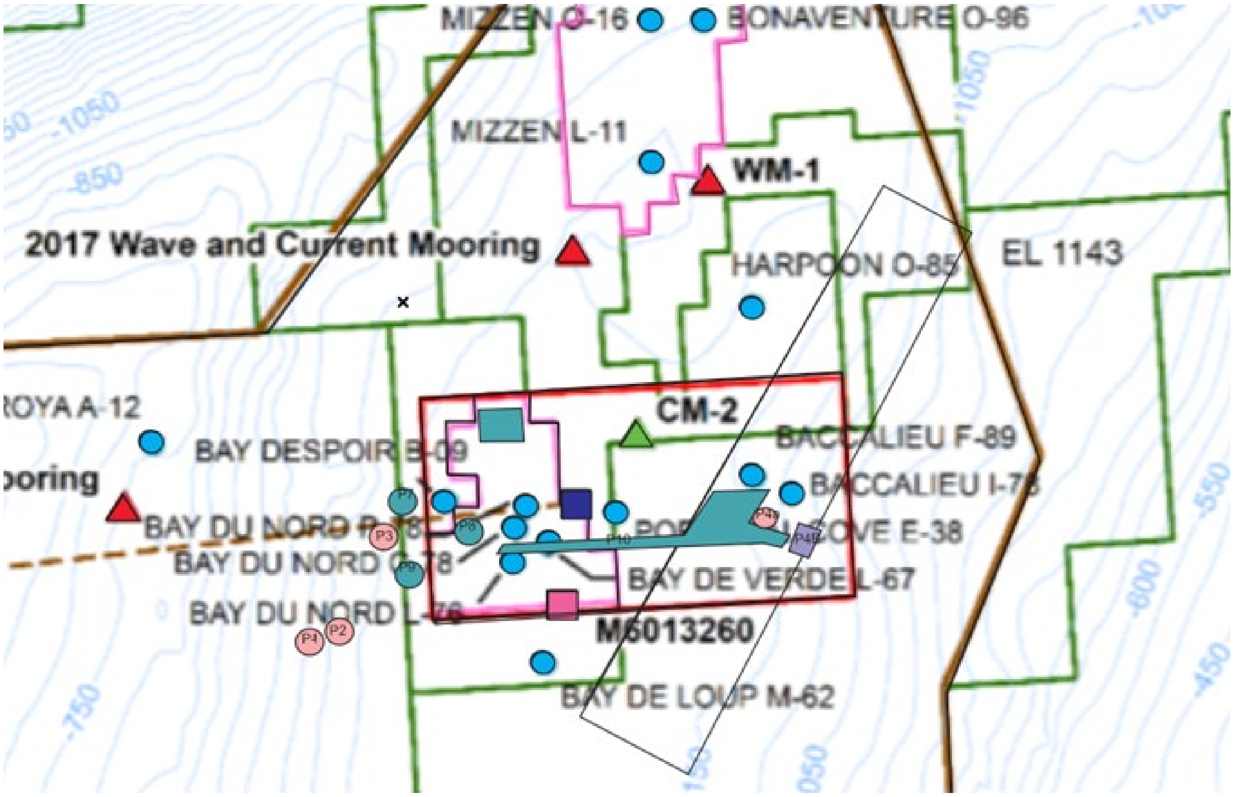

Figure 1: Project activities indicating existing wells (light blue) and planned wells for the CBDN Site.

Page 6-269

The EIS does not include SBAs delineated by DFO, and the most recent VMEs delineated by NAFO (2016). This should be addressed.

The EIS did not analyze Equinor Canada's Seabed Survey results in the context of the identified coral and sponge habitats, and hence, it was not possible to characterize the risks for these Valued Components.

7.0 Existing Human Environment

7.1.5 International Fisheries

Figure 7-15 NRA Foreign and Domestic Fishing Effort locations and Intensity 2008 to 2012.

Page 7.21

The EIS provided an incomplete perspective of the international fisheries on the nose and tail of the Grand Bank and Flemish Cap. Figure 7.15 in particular, and Section 7.1.5 in general provide a limited perspective of the fishing activities on the Flemish Cap. The Significant Adverse Impact assessment of fishing activities on VMEs tabled at NAFO Scientific Council in 2016 (NAFO

2016) provides complete description of fisheries in the NAFO Regulatory Area (NRA) and should be incorporated into the EIS.

"As described in Section 7.1.1, NAFO manages most fisheries in the NRA, but also has management responsibilities for several species within the Canadian EEZ. These are primarily straddling stocks, which typically span domestic and international waters." This text should be clarified, as NAFO does not manage spp. that are exclusively within the Canadian EEZ. NAFO manages only stocks that straddle the EEZ.

7.1.6.1 Groundfish

Page 7-22

Greenland Halibut

"Within the RSA, NAFO sets Greenland halibut quotas for Divisions 3LMNO and DFO for 2J3K." This is incorrect. NAFO sets the quota for the 2+3KLMNO stock. A fixed share of this is managed exclusively by Canada within 2+3K (i.e. entirely within the EEZ), and Canada also has a share of the 3LMNO allocation.

Atlantic Cod

"*…though NAFO planned a quota reduction to 8,182 tonnes for 2019.*" This is incorrect. The quota for Cod in Div. 3M for 2019 was established in September, 2018 at 17,500 t (NAFO 2018).

9.0 Marine Fish And Fish Habitat

9.1.4 Approach and Methods

Drill Cuttings Dispersion Modelling

Page 9-7

Clarification of characteristics of the run scenario indicated as Nedwed (2004) was required.

Page 9-7

"During drilling activities, cuttings discharges will likely be redirected to reduced accumulations, therefore the modelling approach is deemed very conservative to support the effects assessment." This sentence is unclear. Clarification is required on whether the statement means that cuttings discharges will be redirected or may be redirected.

The drilling waste dispersal scenarios assumed single discharge point for each well or group of eight wells. However, the Proponent stated that the drill cuttings will likely be displaced to reduce accumulations. If so, the drill cuttings pile would be lower but the cuttings would be spread over a larger area with a concomitantly larger zone of effect. Modelling a single discharge point is conservative for the size of the zone of effects.

9.1.5.2 Summary of Mitigation Measures

Page 9-20

"*Equinor Canada will collect fish habitat and/or coral and sponge data in areas where data may be deficient*." Clarification was required on who will make the determination on whether the data were deficient.

"*Mitigation measures to reduce potential impacts to fish habitat may include relocation of subsea infrastructure, relocation of the subsea templates and/or use of subsea cuttings* *transport system."* Clarification is required on whether the Proponent is committed to utilizing these mitigation measures if required.

9.2.1.1 Offshore Construction and Installation

Installation of Subsea Infrastructure (including Potential Protection)

Page 9-22

"*Should protection measures be required, installation of subsea infrastructure protection may include activities such as rock placement, trenching and/or installation of concrete mattresses.*" It was unclear from the text when protection measures may be required. What scenarios would require protection measures?

9.2.1.3 Summary of Environmental Effects

Offshore Construction and Installation

"*In summary, with the application of mitigation measures, the residual environmental effects on Marine Fish and Fish Habitat resulting from offshore construction and installation are predicted to be adverse, low in magnitude, localized, short-term in duration, occurring regularly when these activities are ongoing, and reversible."* Clarification was required on whether the residual environmental effects of protection measures such as rock placement, trenching, or concrete mattresses were reversible.

9.2.2.1 Presence of FPSO and Subsea Infrastructure

Pages 9-24 and 9-25

This section provided a good overview of the benefits of increasing habitat complexity through the addition of hard substrate. However, there was no mention of the changes in species composition due to a change in available substrate. For example, there was a lot of soft mud substrate within the Core CBdN development area (Flemish Pass). A shift to hard complex substrates would likely alter the benthic community composition.

The section on aquatic invasive species only considered ballast water as a vector. Hull fouling communities may also introduce invasive species and this vector should also be assessed.

Lighting

Page 9-25

"*For example, swordfish and other pelagic fishes have been shown to be attracted to marine, including oil platforms, fish farms, and offshore wind turbines (Franks 2000; Fayram and de Risi 2007; Arechavala-Lopez et al. 2013)."* It should be noted that Arechavala-Lopez et. al. (2013) describes one incident of one swordfish observed beneath a fish farm located in the Western Mediterranean. This does not support the statement attached to it.

"*Other fishes, such as cod, pollock, and mackerel have also been observed in higher numbers around offshore platforms in the North Sea (Valdermarsen 1979; Soldal et al. 2002)".* It should be noted that the Soldal et. al. (2002) reference examined only decommissioned platforms in the North Sea, not active oil and gas installations. The Valdermarsen (1979) reference conducted investigations in the Adriatic Sea, not the North Sea. These references do not support the text statement.

It should be noted that it was difficult to distinguish between fish that are attracted to a structure versus true structure productivity.

It is recommended that all references within 9.2.1.3 Summary of Environmental Effects be verified.

Sound

Page 9-26

"*However, there is no direct evidence of mortality to fishes and invertebrates as a result of exposure to continuous underwater sound from these types of activities (Popper and Hastings 2009; Popper et al. 2014).*"

This is a direct quote from Popper and Hastings (2009) "Findings suggest that human-generated sounds, even from very high intensity sources, might have no effect in some cases or might result in effects that range from small and temporary shifts in behavior all the way to immediate death." This does not support the statement in the text.

It is suggested not to describe the effects as *"positive."* It is difficult to conclude that an effect is positive or negative without fully understanding the cascade effect of attraction of a species to structure/vessel lights without a thorough understanding of the implications of such shifts on the food web. Such information is not described in the EIS.

9.2.2.1 Waste Management-Marine Discharges and Emissions

Produced Water

Page 9-28

1st paragraph

"*Produced water will be treated using best treatment practices that are commercially available and economically feasible and discharged to the marine environment*."

This statement should be expanded to explain the best treatment practices that are commercially available and economically feasible.

9.2.5.1 Geophysical Activities

Non-Lethal Injury

Page 9-52

It should be noted that Christian et al. (2003) is referenced but its results are not presented in the EIS.

Installation of Subsea Infrastructure (Including potential protection)

Magnitude–It was suggested that **L (Low) be changed to M (Medium)** as the subsea infrastructure was likely the largest in terms of residual effects, particularly if protection measures such as trenching, concrete mattresses, etc. were employed.

Duration–It was suggested that **S (short term) be changed to L (long term)** as the subsea infrastructure will likely remain in place for the duration of the project or longer if decommissioning entails leaving the infrastructure in place.

Reversibility–It was suggested that **R (Reversible) be changed to R-I (Reversible-Irreversible)** due to the uncertainty with respect to decommissioning requirements.

Certainty–It was suggested that the **H (High) designation be changed to M (Moderate)** due to the uncertainty with respect to decommissioning requirements.

Drill Cuttings

Magnitude–It was suggested to change **L (low)** to **M (Medium)** given the current uncertainty with respect to potentially toxic constituents of drill cuttings, the number of wells, and the extent of cuttings dispersal.

Marine Discharges

Duration–There was no R category for Duration. It is recommend to change **S-R to S (short-term).**

PRODUCTION AND MAINTENANCE OPERATIONS

Other Waste Discharges

Frequency–It was suggested to change **S-R (Sporadic–Regular)** to **R (Regular)** as the discharge of other wastes is likely to be a regular activity during production.

SUPPORTING SURVEYS

Environmental, Geotechnical, Geological, and ROV\AUV Surveys

Presence of Vessels–It was suggested to change **N (Neglible)** to **L (Low)** given that the presence of vessels receives an L ranking in all other sections. While the supporting survey vessels may not be present for extended periods, they should be ranked the same in terms of residual environmental effects.

DECOMMISSIONING

Decommissioning of FPSO

Frequency–It was suggested that the frequency category be changed from **R (Regular Basis) to S (Sporadically)**. It was unclear whether decommissioning of the FPSO will occur more than once depending upon field development plans. If it occurs only once, then a designation of **O (Once)** would be appropriate.

Decommissioning of Subsea Infrastructure

Duration–It was suggested that the Duration category be changed from **S-M (Short-Medium Term) to S-M-L (Short-Medium-Long Term)** to reflect the uncertainty currently associated with decommissioning requirements.

Frequency–It was suggested that **R (Regular) be changed to S (Sporadically)** to reflect the uncertainty with respect to end of Project requirements.

Reversibility–It was suggested that **R (Reversible) be changed to R-I (Reversible-Irreversible)** to reflect the potential (depending on decommissioning requirements) for the subsea infrastructure to be left in place.

Certainty–It was suggested that **H (High) be changed to M (Moderate)** to reflect the fact that there was uncertainty with respect to decommissioning requirements.

Table 9.13 Marine Fish Species at Risk: Potential Interactions with Project Components by Life History Stage

Page 9-73

The only potential for a direct interaction between Atlantic Salmon and the proposed activity would be during the at–sea migration. However, the table suggested that the impact may be on eggs and fry (larvae).

Table 9.16 Environmental Effects Assessment Summary: Marine Fish and Fish Habitat (including SAR)–Potential Future Development.

Page 9-103

Offshore Construction and Installation

Magnitude–It was suggested to change **L (Low) to M (Medium)** to reflect the uncertainty with respect to installation of subsea infrastructure (trenching, concrete mattresses etc.)

Reversibility–It was suggested to change **R (Reversible) to R-I (Reversible-Irreversible)** to reflect the uncertainty with respect to the removal or leaving in place of subsea infrastructure.

Certainty–It was suggested to change **H (High) to M-H (Moderate-High**) to reflect the uncertainty with respect to the removal or leaving in place of subsea infrastructure.

Decommissioning

Magnitude–It was suggested to change **N-L (Negligible-Low) category to L-M (Low to Medium)** to reflect the uncertainty with respect to the removal or leaving in place of subsea infrastructure.

Reversibility–It was suggested to change **R (Reversible) to R-I (Reversible-Irreversible)** to reflect the uncertainty with respect to the removal or leaving in place of subsea infrastructure.

Certainty–It was suggested to change **H (High) to M-H (Moderate-High**) to reflect the uncertainty with respect to the removal or leaving in place of subsea infrastructure.

11.0 Marine Mammals and Sea Turtles: Environmental Effects Assessment

11.1 Environmental Effects Assessment Study Areas and Effects Evaluation

11.1.1 Spatial Boundaries

Page 11-2

Explanation was required on why JASCO modelled sound exposure levels for OTARIID seals when there are none in the NW Atlantic.

11.1.4 Approach and Methods

Types of Effects Related to Sound Considered in the Assessment

Page 11-7

Measuring changes in behaviour and distribution sufficient to be "biologically important" would be difficult to define, particularly if the resultant stress levels of exposed mammals continue long-term.

For a recent large-scale review of some of the influences on animals' responses to anthropogenic sound, please see Gomez et al. 2016.

Table 11.3 Potential Project-Related Environmental Changes and Effects: Marine Mammals and Sea Turtles

Page 11-11

This EIS lists all assessments for potential environmental effects as "qualitative". It should be noted that ship strike risk could be quantified. In addition, the EIS should consider the changes in prey availability (see McCauley et al. 2017) for the possible effects of seismic operations on krill density and survival).

Table 11.4 Potential Project-VC Interactions and Associated Effects: Marine Mammals and Sea Turtles.

Lighting of permanent offshore structures and attendant vessels could result in changes of habitat "quality" or use by marine mammals as these lights could attract prey or displace light-averse marine mammals.

11.1.5.2 Summary of Mitigation Measures

Page 11-15

"Equinor Canada will develop a marine mammal and sea turtle observation plan for 4D seismic surveys which will be provided to Fisheries and Oceans Canada (DFO) for review and acceptance."

Explanation was required on what actions the Proponent will take if DFO does not accept the "marine mammal and sea turtle observation plan for 4D seismic surveys."

Page 11-16

"Given that vessels engaged in construction and installation activities will be either stationary or transiting at slow speeds, the potential for ship strikes is considered low."

There have been several reports to DFO of supply or crew vessels striking large whales on route to/from offshore oil installations (J. Lawson, DFO, Pers. Comm. 2019). There were also a number of dead large whales sighted on the Grand Banks that did not show evidence of net entanglement. These events suggest that ship strikes may be an issue that, while seemingly a rarely-occurring event, could nonetheless be significant if a ship strikes a SARA-listed species. What mitigation measures were proposed for this source of risk? Dedicated observers on the crew? Increased vessel reporting of marine mammals sightings so that other vessels can potentially be better able to avoid feeding aggregations of whales, such as surface active groups of right whales?

11.2.2.1 Presence of FPSO and Subsea Infrastructure

Sound

Page 11-19

In the study area the data (sightings data are biased by most records being collected by observers ON the Banks, rather than off) did not support the conclusion of the EIS that baleen whales *"are typically more abundant on the continental shelf".* Sound will not propagate as well onto the shelf, but the sound fields around the FPSO and other vessels sources will still likely result in mammal displacement and masking in an area tens of kilometres in diameter. No mitigation measures were described to address this noise issue. Further, it bears repeating that the sounds field mapping within Appendix D were based on acoustic modelling. As a monitoring and mitigation measure, such acoustic modelling should be field tested to ensure that the bathymetric and geological features of this area do not result in higher sound propagation than modelled. This applies to the relevant sound discussions in every subsection.

11.2.3.1 Presence of Drilling Installation

Sound

Page 11-22

"Sound attenuates less rapidly in the shallow Beaufort Sea where these experiments were conducted than in temperate waters with greater depths."

This statement was incorrect; generally sound attenuates more rapidly in shallower waters.

11.2.4.1 Marine Vessels

Sound

Page 11-28

The report keeps concluding various operational impacts would be unlikely given *"the implementation of mitigation measures".* In the case of ship strikes we cannot determine what mitigation measures would be applicable - other than *"use of common routes"*. The EIS states that they will report ship strikes to DFO, but how is that mitigation? Also they will not enact slowdowns and will travel at speeds at the discretion of the captains. The EIS correctly states that *"it is possible that groups of foraging marine mammals may be encountered along the route during summer months";* to potentially mitigate the risk of ship strike, reporting of such aggregations to DFO and more importantly to vessels operating or planning to transit the area, would likely have some benefit for the whales (assuming the vessel would slow down when an aggregation is detected, or lookouts would be posted on other transmitting vessels).

11.2.5.1 Geophysical Activities

Sound

Disturbance

Page 11-35

The conclusion that a seismic array operation might result in *"avoidance responses…typically localised and temporary"* was not strictly true. There have been studies that have demonstrated a reduced density of marine mammals near seismic array operations, and this displacement can last for days or weeks (Lawson et al. 2017, Castelotte et al. 2012, Richardson et al. 1999; Mate et al. 1994). Where this may be particularly problematic is when there are multiple seismic operations detectable in an area of the Grand Banks (such as in the northern Flemish Pass study area during 2018 when our acoustic receiver recorded multiple, overlapping seismic pulses for many weeks). In this case it was difficult to imagine how a low-frequency hearer, such as a baleen whale, could respond in a way that would reduce its exposure to the many seismic pulses, and yet remain in this area to feed or migrate. The fact that some marine mammals remain in areas exposed to multiple seismic pulses highlights the likely importance of these areas to these whales.

Page 11-36

The statement that "Because of the intermittent nature and low duty cycle of seismic pulses, marine mammals and sea turtles can receive and emit (in the case of marine mammals) sounds in the relatively quiet intervals between pulses" might only be true close to the array (and not further away where acoustic "smearing" can fill the interpulse period with some sound) or when only one array is operating. In the case of the Grand Banks areas, and for many years, multiple concurrent seismic operations have rendered false the statement that "Situations with prolonged strong reverberation are considered infrequent". The recent ESRF report by JASCO (Delarue et al. 2018) was cited in which they have figures illustrating the multiple, overlapping seismic pulses from the three concurrent seismic surveys undertaken on the Grand Banks that year. This must be a cautionary point that seismic activities in Newfoundland and Labrador have profound impacts on the acoustic environment and deserve further consideration-and mitigation by not allowing acoustic overlap by multiple arrays or long-term shooting.

12.0 Special Areas: Environmental Effects Assessment

12.1 Environmental Assessment Study Areas and Effects Evaluation Criteria

12.1.5.1 Potential Project-Related Environmental Changes and Effects

Page 12-7

"*Equinor Canada is currently in a Canadian Environmental Assessment Act, 2012 (CEAA 2012) EA process for the Drilling EIS (Statoil 2017) and has received comments related to Special Areas.*"

It seems from this sentence that the EIS for Statoil 2017 referred to previously has not yet been completed. It cannot therefore serve as a valid comparison of effects for the current EIS.

Table 12.3 Potential Project VC-Interactions and Associated Effects: Special Areas

Page 12-9 & 12.10

There was potential for interactions between most of these project components and the VCs, in terms of causing changes in environmental features. This applies mostly to EBSAs, as some of these areas were identified based on high densities of various taxonomic groups (i.e. corals, sponges, fish, marine birds, marine mammals, other invertebrates) occurring in the area.

Table 12.3 does not acknowledge that many of the VCs that occur in these special areas were identified as important or significant in this particular area for a variety of reasons. For example, EBSAs are identified based on uniqueness, fitness consequences, and/or aggregation. They are a tool for calling attention to an area that has particularly high Ecological or Biological Significance-to facilitate provision of a greater-than-usual degree of risk aversion in management of all activities in these areas (DFO 2004).

EBSA identification was considered a relative process, not an absolute one – sites were considered more or less significant when compared to one another, based on the biological and ecological properties of these areas, and not the perceived threats and risks to those sites. "Significant" means if the area or species were perturbed, the ecological consequences would be ***greater than an equal perturbation of most other areas***. "Value" to humans is not a major consideration in identification (DFO 2004).

It is particularly important to draw attention to the EBSA criterion of fitness consequences, which applies to areas where the life history activities undertaken make a major contribution to the fitness of the population or species present. EBSAs where at-risk species occur are considered to have high fitness consequences if the area is perturbed because of the vulnerable nature of these populations. The Northeast Slope EBSA is an important area for 8 at-risk species: American plaice, Atlantic cod, Atlantic wolffish, Northern wolffish, Spotted wolffish, Thorny skate, Smooth skate, and Roughhead grenadier. In addition to important capelin spawning areas, the Eastern Avalon EBSA has significant colonies and foraging areas for several species of marine birds. Additionally, American plaice and Killer Whale are at-risk species that are features of this EBSA.

None of the waste discharges have been identified as changing the environment for special areas. This is incorrect. It is well recognized that eutrophication and contamination of the pelagic environment directly affects the benthic environment through benthic-pelagic coupling. This deficiency should be addressed.

12.2.2 Production and Maintenance Operations

Page 12-17

The Proponent states that produced water and other waste discharges won't intersect with the benthos and therefore will not have any effect on sensitive benthic areas or species. This is incorrect. Not only will benthic pelagic coupling transfer enhanced primary production resulting from eutrophication to the benthos and flocculation processes transport contaminants to the bottom but also many sensitive benthic species have pelagic larvae that will be vulnerable to contaminants in produced water and other waste streams. This deficiency should be addressed.

12.2.1.2 Summary of Environmental Effects

Offshore Construction and Installation

Page 12-18

"In summary, with the application of mitigation measures, the residual environmental effects on Special Areas from "XYZ" are predicted to be adverse, [negligible/negligible to low/low/low to medium] in magnitude, [localized/within the Project Area/within the LSA], [short-term/medium-term/medium- to long-term/long-term] in duration, occurring [regularly/sporadically] [when these activities are ongoing], and reversible. This prediction is made with a [moderate/moderate to high/high] level of confidence."

Has the effect of all of these activities related to this specific project been considered cumulatively?

The report states that the effect will be *"short term in duration"* but the last sentence of paragraph 4 says that coral and sponge biogenic habitats are fragile and recover slowly. This contradicts the assessment of duration.

12.2.6.1 Decommissioning of Subsea Infrastructure

Page 12-28

This section does not consider how the decommissioning process may affect corals and sponges. This deficiency should be addressed. Decommissioning would likely result in further disturbance of already disturbed sensitive and vulnerable habitats.

12.3.3 Drilling Activities

Page 12-31

This section states that an individual well may have ZoE for drilling wastes of up to 2 km with most effects above the predicted no effect threshold (PNET) of 1.5 mm within 1 km in diameter (similar analysis is presented in the assessment of effects for fish and fish habitat P9-42). Beyond 2 km cuttings deposition will be patchy. If we assume as the Proponent does, that there is a 1 km ZoE with no overlap for each well this would mean that for 40 wells proposed plus the 8 exploration wells already drilled within the CCBdN the area affected would be 155 km^2. Which represents approximately 35% of the CCBdN. Approximately 50% of the Northwest Flemish Cap VME (10) is within the CCBdN. If effects are spread uniformly through the CCBdN then the NWFC 10 could see almost 20% of its area impacted. The potential for further exploration and development would increase the amount of the VME affected and might also increase the level of harm per km^2 as would any overlap in well ZoEs.

12.4 Significance of Residual Effects of the Project

12.4.1 Residual Environmental Effects Summary

Page 12-33

"The potential effects of planned Project activities (e.g., seabed contact, sound, light, marine discharges) on Marine Fish and Fish Habitat, Marine and Migratory Birds, and Marine Mammals and Sea Turtles such as those found in the Special Areas, were discussed in Chapters 9, 10 and 11 of the EIS. Project activities have the potential to result in residual effects on defining features of special areas that intersect with the Project Area or LSA but none of these effects are predicted to be significant. A number of Planned Project activities may result in injury or mortality to benthic species, but the introduction of hard surfaces may result in benefits through increased colonization."

Referring to the statement above about EBSAs being identified based on their ecological or biological significance and how the ecological consequences of perturbation in these areas were expected to be greater than an equal perturbation of most other areas. Also, the last sentence in this paragraph is disingenuous at best, as there has been no quantification of the impacts on benthic species compared to the benefits of the introduction of hard surfaces.

Section 12.4.1 predicts no significant residual effects. This conclusion is based on the same criteria for significance as for fish and fish habitat which had a high threshold of harm in area, duration and population level effects before they were considered significant. Special areas need to be assessed using metrics based on the criteria that make them special (i.e. the objectives of the closure or designation). An area that is protected because of vulnerability to disturbance needs to be assessed on the amount of biological protection that it offers and the further potential for disturbance predicted for the project. An area that was protected for its productive capacity needs to be assessed based on the potential to reduce or alter that capacity. This entire section needs to be re-assessed using the appropriate metrics and criteria.

The use of appropriate metrics for assessment will also provide metrics to be used for the proposed EEM program for the Special Areas VC.

Page 12-34

"The implementation of mitigation measures outlined throughout this EIS to reduce direct or indirect potential effects on the Marine Fish and Fish Habitat, Marine and Migratory Birds, and Marine Mammals and Sea Turtles VCs will apply to reduction or elimination of environmental effects on the defining features of th*ese special areas."* Same comment as above regarding ecological consequences in EBSAs.

Table 12.6 Defining Features of Special Areas Intersecting the LSA Along the Vessel Traffic Route.

Page 12-21

Table 12.6 has outdated information pertaining to EBSAs. Here is the list of key features that were described for each EBSA found within the RSA. The key features were categorized using the three main EBSA criteria of uniqueness, aggregation, and fitness consequences. The Northeast Slope EBSA, Eastern Avalon EBSA, and Baccalieu Island EBSA intersect the LSA

Key features of each EBSA found within the RSA.

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
Bonavista Bay (3L)	• Sea Lamprey spawning population	• Eelgrass habitat • Salmon • Sea duck functional group • Killer Whale • Mysticetes functional group • Harbour Seal	• Capelin spawning • Sea Lamprey spawning • Significant colonies/foraging - Black-legged Kittiwake - Tern sp.	• Salmon • Killer Whale
Smith Sound (3L)	• Expansive eelgrass bed	• Eelgrass habitat • Killer Whale • Mysticetes functional group • Small cetaceans functional group	• Capelin spawning • Significant colonies/foraging - Atlantic Puffin - Black-legged Kittiwake - Tern sp.	• Killer Whale
Baccalieu Island (3L)	-	• Killer Whale • Mysticetes functional group • Capelin • Shrimp • Plankpiscivores (fish) • Spotted Wolffish • Pursuit-diving piscivores (seabird functional group) • Surface-seizing plankpiscivores (seabird functional group)	• Capelin spawning • Significant colonies/foraging - Atlantic Puffin - Razorbill - Black-legged Kittiwake	• Spotted Wolffish • Killer Whale

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
Eastern Avalon (3L)	• Atlantic Puffin colonies • Common Murre colonies • Thick Billed Murre colonies • Northern Fulmar colonies	• Eelgrass habitat • Capelin • American Plaice • Killer Whale • Mysticetes functional group • Plunge-diving Piscivores (seabird functional group) • Pursuit-diving piscivores (seabird functional group) • Surface, shallow-diving piscivores (seabird functional group)	• Capelin spawning • Significant colonies/foraging - Atlantic Puffin - Common Murre - Razorbill - Thick-billed Murre - Black-legged Kittiwake - Northern Fulmar	• American Plaice • Killer Whale
St. Mary's Bay (3L)	• Common Murre colonies • Northern Gannet colonies • Harlequin Duck	• Eelgrass habitat • Salmon • Common Eider (sea duck) • Harlequin Duck (sea duck; SARA SC) • Capelin • Mysticetes functional group • Hooded Seal • Leatherback Turtle • Plunge-diving piscivores (seabird functional group)	• Capelin spawning • Significant colonies/foraging - Common Murre - Razorbill - Black-legged Kittiwake - Northern Gannet**	• Salmon • Harlequin Duck • Leatherback Turtle
Northeast Slope (3L)	• Shrimp • Greenland Halibut • Northern Wolffish • Spotted Wolffish • Roughhead Grenadier • Black corals	• Capelin • Shrimp • Greenland Halibut • Witch Flounder • American Plaice • Atlantic Cod • Atlantic Wolffish • Northern Wolffish • Spotted Wolffish • Thorny Skate • Smooth Skate • Roughhead Grenadier • Piscivores (fish)		• American Plaice • Atlantic Cod • Atlantic Wolffish • Northern Wolffish • Spotted Wolffish • Thorny Skate • Smooth Skate • Roughhead Grenadier

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
		• Planktivores (fish) • Plankpiscivores (fish) • Small benthivores (fish) • Medium benthivores (fish) • Large benthivores (fish) • Large gorgonian corals • Sea pens • Black corals • Soft corals • Sponges • Common Murre (seabird; pursuit-diving piscivore; non-breeding) • Thick-billed Murre (seabird; pursuit-diving piscivore; non-breeding) • Hooded Seal		
Virgin Rocks (3LO)	• Unique geomorphological feature	• Sand Lance • Capelin • American Plaice • Sooty Shearwater • Thick-billed Murre • Killer Whale	• -	• American Plaice • Killer Whale
Lilly Canyon-Carson Canyon (3N)	Roughhead Grenadier	• Snow Crab • Greenland Halibut • American Plaice • Redfish • Roughhead Grenadier • Thorny Skate • Small benthivores (fish) • Common Murre • Sooty Shearwater • Shallow pursuit generalists (seabirds)	• -	• American Plaice • Redfish • Roughhead Grenadier • Thorny Skate • Blue Whale

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
		• Surface, shallow-diving piscivores (seabirds) • Blue Whale • Harp Seals (winter feeding) • Soft corals • Sponges		
Southeast Shoal (3NO)	• Offshore Capelin spawning • Yellowtail Flounder (juveniles, spawning, feeding) • American Plaice spawning	• Sand Lance • Yellowtail Flounder • Witch Flounder • American Plaice • Atlantic Cod • Atlantic Wolffish • Northern Wolffish • Thorny Skate • White Hake • Medium benthivores (fish) • Large benthivores (fish) • Shallow pursuit generalists (seabirds)	• Capelin spawning • Yellowtail Flounder (juveniles, spawning, feeding) • American Plaice spawning	• American Plaice • Atlantic Cod • Atlantic Wolffish • Northern Wolffish • Thorny Skate • White Hake
Southwest Slope (3OPs)	• Small gorgonian corals • Roundnose Grenadier • Haddock feeding and spawning • Redfish spawning	• Witch Flounder • Atlantic Halibut • American Plaice • Atlantic Cod • Northern Wolffish • Redfish • Roundnose Grenadier • Smooth Skate • Thorny Skate • White Hake • Winter Skate • Small benthivores (fish) • Large benthivores (fish) • Planktivores (fish) • Plankpiscivores (fish) • Piscivores (fish) • Surface, shallow-diving piscivores (seabirds)	• American Plaice spawning • Redfish spawning • Haddock feeding and spawning	• American Plaice • Atlantic Cod • Redfish • Northern Wolffish • White Hake • Smooth Skate • Roundnose Grenadier • Thorny Skate • Winter Skate • Blue Whale

EBSA (NAFO Div)	Uniqueness	Aggregation	Fitness Consequences*	At-risk species
		• Blue Whale • Black corals • Small gorgonian corals • Large gorgonian corals • Stony cup corals • Sea pens		
Haddock Channel Sponges (3O)	Largest sponge SBA on the shelf in the study area	• Sponges • Capelin • American Plaice	-	• American Plaice

The following information will be published in a DFO research document in the coming months. Methods used to identify new EBSAs in the Placentia Bay-Grand Banks area followed those of Wells et al. 2017 and Ollerhead et al. 2017. For the purpose of this review, only EBSAs that intersect the LSA or the core CBdN development area are described below.

Baccalieu Island (3L)

The Baccalieu Island EBSA was centered on the island itself and extended north to Bonavista and south to Pouch Cove. This EBSA was identified because of important seabird colonies that were found on the Island. The foraging range of Atlantic Puffin, Black-legged Kittiwake and Common Murre (60 km) was used to delineate the seaward boundary. There were also several other key features in surrounding waters including Important Areas (IAs) for Capelin, Shrimp, Plank-Piscivorous fish, Spotted wolffish and marine mammals.

Baccalieu Island was recognized as an Important Bird Area (IBA) as it hosts the world's largest known nesting colony of Leach's Storm-Petrel. Approximately 3.4 million breeding pairs have been estimated, which represents approximately 40% of the global population and about 70% of the western Atlantic population of this species.

The island also supports continentally and globally significant populations of Atlantic Puffin (30,000 pairs-approximately 7% of the eastern North America population); Black-legged Kittiwake (~13,000-approximately 5 to 7% of the western Atlantic breeding population); and Northern Gannet (1,712 pairs-approximately 2.4% of the North American population). The island has the greatest abundance and species diversity of seabirds in eastern North America. Other seabirds nesting on the island include Common Murre, Thick-billed Murre, Razorbill, Black Guillemot, Northern Fulmar, Herring Gull and Great Black-backed Gull. Baccalieu Island is the largest protected seabird island in Newfoundland and Labrador-the Baccalieu Island Ecological Reserve.

The enduring presence of such significant populations of mostly piscivorous seabirds was a strong indicator that surrounding waters were persistently highly productive and provide ample food for these colonies to thrive. This is confirmed by the presence of Capelin spawning areas at each of the three headlands captured within the boundaries of this EBSA. Also, Capelin and Shrimp IAs were found within the foraging range of these seabirds. Plank-Piscivore and Spotted wolffish IAs were also found in this EBSA. All fish and shrimp IAs were located near the seaward boundary of the EBSA. DFO RV trawl survey data were not collected in shallow nearshore waters (i.e. closest set to Baccalieu Island is ~20 km away) so information on all fish and shrimp species was not available in these areas. However, acoustic surveys have been conducted closer to shore in this area and have confirmed the presence of Capelin aggregations (Mowbray 2014).

Killer Whales and Mysticetes IAs were found here based on sightings data. These cetacean species were also likely taking advantage of the highly productive waters in the area.

Eastern Avalon (3L)

The Eastern Avalon EBSA was located on the eastern side of the Avalon Peninsula and extends from the southern boundary of Chance Cove Provincial Park north to Pouch Cove. The seaward boundary was delineated based on the foraging range (60 km) of piscivorous seabirds that occupy colonies within Witless Bay. This EBSA was identified based on a combination of coastal data, including capelin spawning beaches, waterfowl areas and seabird colonies (with additional key features identified based on offshore data).

Eelgrass habitat was not particularly common in this EBSA but one area was found in Deadmans Bay and Blackhead Bay, just north of Cape Spear. Capelin spawning was more prevalent along the coast in this EBSA. The most northerly Capelin spawning beach was in Flatrock and the most southerly one was in Cappahayden. 27 other spawning sites have been identified between these two sites.

American plaice IAs were found toward the outer boundary of this EBSA (and extending out on Grand Bank) during the Engel time series. IAs for this species have primarily been distributed on the Southeast Shoal and in Halibut Channel during the Campelen years. As with all EBSAs on the east coast of Newfoundland, Killer Whales and Mysticetes were commonly sighted in the Eastern Avalon EBSA.

At least 10 species of seabirds had important colonies in this area, including the only significant Northern Fulmar colony in the Placentia Bay-Grand Banks Study Area (PBGBSA), near Bauline East. Furthermore, this area contains the Witless Bay Islands IBA, which supports the largest colony of Atlantic Puffins in eastern North America. Significant colonies for six species were found on islands within Witless Bay. In addition to the only Northern Fulmar colony in the top decile being found here, two of three Atlantic Puffin colonies, three of five Razorbill colonies, five of 14 Black-legged Kittiwake colonies, one of two Common Murre colonies, and both Thick-billed Murre colonies in the top decile for each respective species were located within this EBSA.

A high count of dabbling ducks observed within one coastal block polygon within the EBSA was believed primarily to be the result of anthropogenic rather than natural food resources in the vicinity of the city of St. John’s. Consequently, this information was not considered in the evaluation of this EBSA.

In addition, pelagic seabird transect survey data confirm IAs for several seabird functional groups in this EBSA: plunge-diving piscivores, pursuit-diving piscivores and surface shallow-diving piscivores. These birds rely on forage fish prey in the waters surrounding these islands and adjacent areas on the Grand Bank. Acoustic surveys have shown that Capelin were found in this area, with some years having higher densities than others (Mowbray 2014). This was confirmed by the presence of Capelin IAs in this area, however only the Engel fall IA took up a large portion of the EBSA.

Northeast Slope (3L)

The Northeast Slope EBSA was found on the northeast edge of Grand Bank and extended from the Trinity Basin east and south along the shelf edge and slope to the Sackville Spur. This EBSA was delineated based on the composite layer (spring RV survey data only). The northwest boundary was extended westward based on the composite layer including both spring and fall RV survey data, as well as IAs for sponges, Atlantic cod, Shrimp, Greenland Halibut, and Spotted Wolffish. The northeast portion of this EBSA, which includes the Labrador Slope and part of the Trinity Trough, was adjacent to the southern boundary of the Orphan Spur EBSA (DFO 2013). The key data layers that contributed to this area include those for Capelin, Shrimp, Greenland Halibut, Witch flounder, American plaice, Atlantic cod, all three species of Wolffish, Thorny skate, Smooth skate, Roughhead grenadier, all six fish functional groups, sea pens, black corals, soft corals, sponges, Common and Thick-billed Murre and Hooded Seals. Several other species or functional groups were also found here.

Most species or functional groups were identified here based on the aggregation criterion. However, six species were identified based on the uniqueness criterion: two core fish species (Greenland Halibut, Shrimp), three at-risk species (Northern & Spotted Wolffish and Roughhead Grenadier) and a coral functional group (black corals). This was the only IA for Greenland Halibut on the Engel fall data layer. While Greenland Halibut were found outside this EBSA boundary on other data layers (i.e. Campelen fall, Campelen spring, Engel spring), the majority of all high concentration areas for Greenland Halibut were found in this area. Similarly for Shrimp, the IA on the Campelen fall data layer was found in this area, but extends southwest and southeast beyond the EBSA boundary. One of two Shrimp IAs on the Campelen spring data layer had a similar distribution. The other, much smaller, IA for Shrimp is found along the South Coast of Newfoundland. Most of the IAs for all the threatened Northern Wolffish data layers (except Campelen spring) were found within this EBSA and extended from the Trinity Basin area along the shelf edge and onto the Labrador Slope. Spotted Wolffish (also threatened) had shown a similar distribution and this area was confirmed as being important for this species by Kulka et al. (2004). Roughhead Grenadier (special concern under COSEWIC) IAs were found on the Slope in this EBSA with distributions extending to the Sackville Spur. The only Roughhead Grenadier IAs found in the PBGBSA on the Engel fall data layer were found in this EBSA. Finally, black corals, which are a rare, non-aggregating species, were found in this EBSA. Only two black coral IAs were found in the PBGBSA: in this EBSA along the Labrador Slope and in the SW Slope EBSA (see below); both were small in size.

Five other at-risk species were found here as key biological features, meaning the fitness consequences criterion applies to them, along with the three at-risk species discussed above. American Plaice IAs were generally distributed across the Grand Bank during Engel years, with one large IA being found on the shelf edge in the NE Slope EBSA. In the Campelen years IAs identified for this species shifted southward towards the Southeast Shoal, with the exception of one small IA which was found in the NE Slope EBSA. Large IAs for Atlantic Cod were found in this EBSA in three of four data layers. Cod IAs on the Campelen spring layer were found in 3NOP only. Atlantic Wolffish IAs were found in two main areas in the PBGBSA – the NE Slope EBSA and the SE Shoal EBSA. A few other IAs were found outside of these EBSAs but not consistently across data layers like those found in the NE Slope and SE Shoal areas. Smooth Skate and Thorny Skate IAs were found in the NE Slope EBSA during the Engel years but IAs for these species were only found in more southern areas (SW Slope, Laurentian Channel for both species; SE Shoal for Thorny Skate) during the Campelen years.

Other core fish species found here include Capelin and Witch Flounder. Capelin IAs were mainly found throughout the northern portion of NAFO Division 3L, including the NE Slope EBSA, on all data layers except Engel spring, which showed a more southerly distribution. It was noted by Carscadden et al. (2013) that Capelin distributions have changed over the last few decades. However, the methods used to find IAs may not be sufficient to see the finer-scale spatial and temporal changes for this species that appear to be influenced by factors such as temperature and population abundance. Witch flounder IAs were mainly found throughout the NE Slope EBSA, the SW Slope EBSA and the Laurentian Channel EBSA and this pattern was consistently found on all data layers for this species.

The majority of fish functional group IAs were found in EBSAs that were identified on shelf edges and slopes, including the NE Slope EBSA. Small benthivore IAs were found in this EBSA on all four data layers. Planktivore IAs were found here only on Campelen data layers. Medium benthivores and piscivores were found here on only fall data layers. Large benthivores were found here only on the Engel fall data layer. Plankpiscivores were found here on all data layers except Campelen spring. Piscivore IAs were found here only on fall layers. A review of all Piscivore IAs revealed that the Laurentian Channel and SW Slope are more important areas for this functional group.

Other than black corals, two other coral groups, plus sponges, are found in this EBSA. Large gorgonian IAs were found in patches along the Labrador Slope in this EBSA and the same areas were identified as SBAs (Kenchington et al. 2016). Soft coral IAs were found all along the Labrador Slope to the EEZ boundary. Sponge IAs were found near the Trinity Moraine/Trinity Basin end of this EBSA; however this IA was not confirmed by the presence of a sponge SBA.

During non-breeding, Common Murre were found in the eastern half of this EBSA, as well as areas north and south, with concentrations occurring there during early and late winter. Thick-billed Murre were found throughout the middle of this EBSA and as far south as the Virgin Rocks EBSA during early winter. Finally, Hooded Seals were found in this EBSA in the Labrador Slope area as well as areas north and south. They fed primarily on squid, Arctic Cod, Atlantic Cod, Greenland Halibut and Redfish in the deep waters along the shelf edge during the winter (December to late February) prior to pupping and in late April-May after pupping was finished (Hammill and Stenson 2000, Stenson, pers. comm. 2019).

13.0 Commercial Fisheries and Other Ocean Users: Environmental Effects Assessment

Table 13.2 Potential Project-Related Environmental Changes and Potential Effects: Commercial Fisheries and Other Ocean Uses

Pages 13-7 & 13.8

1st row:

The loss of survey areas could alter information available for fisheries management and research studies.

Table 13.3 Potential Project-VC Interactions and Associated Effects: Commercial Fisheries and Other Ocean Uses

Pages 13-9

Lighting would likely impact many pelagic spp. and sound could have even broader impacts. Discharge and installation would also have some level of impact. We would suggest that all of these items should have a check in the first portion of this table.

15.0 Cumulative Environmental Effects

15.1 Approach and Methods

Page 15-1

The cumulative effects assessment only considers the potential for overlap of the project's residual environmental effects with those of other projects. Although not specified in the methods section, only those residual effects deemed significant were considered. Thus the potential for additive or synergistic interactions with other projects were ignored. Similarly, this rationale allows the Proponent to avoid consideration of the within project cumulative effects. Only the effects of a single well or an 8 well template were modelled and assessed. Because the deposition of drilling wastes is predicted to have a very limited footprint no significant residual effects were anticipated. As a result, the cumulative project footprint of these wastes was not considered as was the eventual fate of the quantity of fine particulates that were transported outside the model domain (see comments on the drilling waste dispersion models below). By only assessing residual environmental effects deemed significant, the Proponent avoids the need to consider the cumulative effects of many wells in the CBdN and PA. Such a fragmented approach perpetuates the potential for habitat destruction as "death by a thousand cuts" (Laurance 2010 in Navjot et al. 2010). This is a major deficiency.

As a general comment there does not appear to be an attempt to assess the potential cumulative environmental effects within the Project Area where up to 40 wells could be drilled, or geophysical/seismic surveys conducted in support of potential future development.

Section 9.0 is mentioned within the text, however cumulative effects sections are difficult to locate (multiple statements regarding residual effects on VC's). It is suggested that a section be created within Section 15.0 Cumulative Environmental Effects that addresses the within project cumulative residual environmental effects.

Table 15.1 Environmental Components Included in the Cumulative Effects Assessment

Page 15-2

There is agreement with the statement, *"…little potential to adversely affect marine plants…"* but only under normal operations of the development. This situation would not necessarily hold in the event of a spill. Perhaps a context paragraph should be added.

15.1.3 Sources of Potential Cumulative Effects

Page 15-6

The Proponent considers that the effects of past activities (Fishing, exploratory drilling etc.) constitute part of the baseline environment (Section 15.1.4) and that the project itself would not contribute to further degrade or disturb the environment. Since significant portions of the CCBdN and the PA are special areas that merit protection from disturbance this assumption seems contradictory. The last paragraph of P15-6 states that projects whose temporal scope expires in 2019 are not considered within the assessment. As a result the potential for cumulative effects of the 15 wells already drilled in the PA (8 in the CCBdN) were not considered. In this way the EIS circumvents presenting any monitoring information (compliance or EEM) from these past activities that would support the determination that they had no residual effect on the environment.

Table 15.2 Ongoing and Future Projects Considered in this Cumulative Effects Assessment

Page 15-7, 15-8, & 15-9

Exploratory Drilling in the Flemish Pass was stated to be 56 km from CCBdN and 88 km from the PA. Information from the project description indicates that these activities may be within the PA and possibly the CCBdN.

Table 15.3 Overview of Past, Present, and Future Projects and Other Physical Activities Considered in the Cumulative Effects Assessment

Page 15-11

The section on exploratory drilling should include the number of wells drilled to date in the CCBdN and in the PA as well as any currently proposed for those areas.

Figure 15-1 Other Project Activities Considered in the Cumulative Effects Assessment-Distances from Core CBdN Development area and Project Area

Page 15-13

It is unclear what “Fishing Intensity All Species-2016” represents. Was this based upon effort (fishing days, Catch per Unit Effort (CPUE)) or catch rates? What do the numbers mean?

15.2 Marine Fish and Fish Habitat (including Species at Risk)

This entire section is insufficient as it appears to completely miss what cumulative effects are, at least for fish. It is recommended that this section, at least for this Chapter be refocused and rewritten.

15.2.1 Past and Ongoing Effects (Baseline)

Page 15-17

“Overfishing and extreme climate conditions have collectively contributed to the collapse of the Atlantic cod and other groundfish stocks in the North Atlantic in the early 1990s (Kulka 2011; Christensen et al. 2014; Nogueira et al. 2017), which coincided with an increase in prey species, including snow crab and shrimp, on the Grand Banks and Flemish Cap. Recently, these prey species have, in turn, declined in response to the recovering groundfish stocks and other factors (Nogueira et al. 2015, 2017).”

Overfishing and extreme climate conditions have collectively contributed to the collapse of the Atlantic cod and other groundfish stocks in the North Atlantic in the early-1990s (Kulka 2011; Christensen et al. 2014; Nogueira et al. 2017), which coincided with an increase in invertebrate species, including snow crab and shrimp, on the Grand Banks and Flemish Cap. Recently, these invertebrate species have, in turn, declined in response to the recovering groundfish stocks and other factors (Nogueira et al. 2015, 2017).

This pattern is more likely related to environmental changes than recovery of groundfish. Recovery of groundfish has been linked to improved capelin abundance in the offshore but capelin populations are still low compared to 1980s.

15.2.2 Potential Project Related Contributions to Cumulative Effects

Page 15-18

2nd Paragraph

The text states: *“…the installation of subsea infrastructure would add colonizing substrate to a habitat limited area”.*

While this statement is true, the natural habitat will be altered and there will also be species that "lose" in the process.

The text states: *"These potential effects are addressed through standard mitigation measures and are not anticipated to adversely affect this VC."*

We assume mitigations mentioned within the text were referring to Section 9.1.5.2 Summary of Mitigation Measures. If this is the case,it is suggested that a reference to Section 9.1.5.2 be included whenever mitigations are discussed.

Page 15-18

3rd Paragraph

"As with secure species, planned mitigation measures will be used to avoid or reduce such adverse interactions."

DFO Science is unsure of the definition of a secure species. If not previously defined, more explanation is needed.

Pages 15-8 and 15-9

The predicted zone of effects used throughout this chapter to assess cumulative effects, was inconsistent.

Page 15-18 Paragraph 2:

The Proponent states that the deposition of drill cuttings would be limited to within 200 m of the well site. This contradicts the information provided in the assessment of potential effects of drill cuttings on fish and fish habitat (P9-42) which concludes that the PNET of 1.5 mm deposition may extend to 1 or 2 km depending on the particle size distribution and behavior used in the dispersal model. It also contradicts the conclusion of paragraph 3 (Page15-19) that the zone of effects for exploratory drilling is mainly within 1km. This reduction in the predicted zone of effects from 1-2 km to 200 m allows the potential for cumulative effects to be moderated. Similarly the first paragraph of Page 15-19 minimizes the potential for ecological or population level effects. This overlooks the potential for direct cumulative effects on habitat by fragmentation, alteration or contamination.

15.2.3 Other Projects and Activities and Their Effects

Page 15-19

3rd Paragraph

There is no mention of mitigations with respect to drill cuttings.

Page 15-19

4th Paragraph

There is no discussion of the potential of seismic surveys to negatively interfere with commercial fishing or potential mitigation measures that could be employed to reduce this effect such as a Best Practices Document.

15.4 Marine Mammals and Sea Turtles (Including Species at Risk)

15.4.4 Potential Cumulative Environmental Effects

15.4.4.1 Change in Injury/Mortality Levels

Pages 15-45; 15-46

"It is uncertain how many marine mammals may be struck by vessels in the RSA. Since 2002, there have been two reports of supply vessels striking a whale at night on the Grand Banks; however, the whales were not re-sighted to allow confirmation of the incidents and such ship strikes are considered rare (Lawson, J., pers. comm., June 2019)."

We would agree that offshore ship strikes by large vessels were rarely detected and/or reported, this is not the same as concluding that such events are rare overall. Worldwide, few whales that die at sea of manmade causes (or otherwise) were detected, and there were reports elsewhere of large vessels being unaware they have struck whales until they arrive back at port with a dead animal wrapped on their bows. Given these factors, it would be highly recommended that the Proponent implement a reporting system to alert vessels transiting the project area of whale aggregations or feeding animals.

15.4.3 Other Projects and Activities and Their Effects

Pages. 15-44; 15-46; 15-48; 15-54

Table 15.9 Marine Mammals and Sea Turtles: Other Projects and Activities and their Potential Environmental Effects

Page 15-44

"Air source sound from multiple concurrent seismic surveys in the RSA has the potential to contribute to cumulative effects. However, the nature and magnitude of these cumulative effects on Marine Mammals and Sea Turtles are not known with certainty. ***Potential effects are likely minimized by the minimum separation distance typically required between seismic surveys*** *(i.e., 30 km; see LGL 2017)."*

Page 15-46

"spatial separation between seismic surveys (typically a minimum of 30 km; LGL 2017)." and "In recent years, there has been as many as three concurrent 3D seismic surveys in slope waters around the Project Area with a concurrent 2D seismic survey offshore Labrador (LGL 2017). It is uncertain how a marine mammal will respond to sound arriving from multiple sources and possibly from multiple directions*"*

15.4.4.2 Change in Habitat Quality or Use (Behavioral Effects)

Page 15-48

"Situations with prolonged strong reverberation are considered infrequent. The degree to which reverberation will contribute to potential masking for marine mammals in and near the Project Area is uncertain."

Table 15.10 Summary of Potential Cumulative Environmental Effects: Marine Mammals and Sea Turtles

Page 15-54

"The effects of a single geophysical seismic survey are expected to result in localized and temporary behavioural effects on marine mammals (and sea turtles which may occur in the

area); however, there is some uncertainty in how marine mammals will respond to potentially, multiple concurrent seismic surveys."

Comment for Pages. 15-44; 15-46; 15-48; 15-54

There was significant uncertainty around the conclusions of cumulative impacts when there were multiple, acoustically-overlapping seismic programmes. The supporting Appendices detailing recorded sounds in the study area demonstrated that reverberation and multipath effects result in almost no "quieter" periods between received seismic shots over large areas of offshore Newfoundland and Labrador when concurrent array firing was occurring. The only approach that might mitigate this would be to greatly enlarge the separation of such operations, or eliminate concurrent seismic operations altogether. Further acoustic monitoring is essential to better understand this acoustic regime.

Page 15-47

"There is potential that some marine mammals may exhibit longer-term avoidance of the Sackville Spur area. However, most evidence of marine mammal response to long-term marine projects and/or anthropogenic activities is that they habituate to underwater sound in the area."

There were cases where there has been permanent changes in marine mammal distribution or habitat use when exposed to loud anthropogenic sound, so not all species might "habituate" in the Study Area. But we would only know this with long-term monitoring.

Page 15-48

"It is also unlikely that short-term and localized effects experienced by a marine mammal at Jeanne d'Arc production fields would lead to additive cumulative effects for that individual that may move to the Project Area."

Support or rationale for this statement is requested. If animals were displaced from one area and face equal effects in another area, how can this not result in cumulative impacts?

15.5.1 Past and Ongoing Effects (Baseline)

Page 15-56

The metrics used to assess the potential for cumulative effects on special areas were not appropriate. The Proponent recognizes that *"direct and indirect changes…from project related activities… may affect the key environmental characteristics and processes that define and distinguish these areas*" and these special areas are designated to "*conserve the pristine nature of … or help prevent further damage to already affected sensitive environmental features and components*." But the Proponent did consider metrics that quantify potential effects on key characteristics and processes as related to the stated objectives of the special area designation such as productive capacity, area protected versus area damaged etc. The Bay du Nord project has the potential to further damage areas that were previously damaged but are now protected from damage by other human activities. This cumulative effect needs to be assessed as it may significantly affect the integrity and function of the protected areas in question.

15.5.4 Potential Cumulative Effects

Page 15-61

The findings of the cuttings deposition models as being less than 200 m (see previous comment) is misrepresented.

15.5.5 Cumulative Effects Summary and Evaluation

Page 15-64

This section concludes that" *the project is not likely to result in significant adverse environmental effects on Special Areas in combination with other projects or activities that have been or will be carried out."*

The existing effects of past projects were not assessed and it was only noted that they exist and may have had an effect related to fishing; exploratory drilling was considered not significant on the special areas.

15.9 Monitoring and Follow-up

Page 15-81

"No additional follow-up is required or proposed related specifically to potential cumulative environmental effects"

This statement was in contrast to a precautionary approach in which potentially problematic issues were addressed further, such as through directed studies and a change in the way the CNLOPB approves multiple concurrent seismic programmes.

The EIS does not propose any additional monitoring for cumulative effects beyond what is already indicated for each VC. It is recommended that this gap be addressed.

Hydrocarbon and metal levels have been tested within scallop near oil production platforms. Implementation of such testing would be beneficial as part of the environmental effects monitoring (EEM).

16.0 Accidental Events

Page 16-1

"During Project activities, operational discharges are managed in accordance with Equinor Canada's Environmental Protection and Compliance Monitoring Plan (EPCMP)."

The EPCMP for Equinor Canada was not made available for review.

16.1.2.1 Contingency Planning

Page 16-5

The proposed aerial and subsea dispersants to be used and the associated potential for toxicity to marine organisms were not described.

Table 16.1 Spill Response Tactics

Page 16-10

The toxicity profiles for Corexit (EC9500A and EC9580A) were not described.

16.3 Spill Risk and Probabilities

Page 16-22

"The results of the analyses show that the probability of a well blowout is extremely low, with the probability increasing for batch spills. The analyses also show that if a blowout or batch spill was

to occur, the chances are great that it would be a small volume of spillage rather than a very large event with high consequences." This statement is subjective and should be verified.

16.3.4 Probabilities of Blowouts from the Project:

"The probability of a blowout occurring in the volume of the modelled blowout scenarios is between 1.7 x 10^9 to 3.4 x 10^9." This statistic is misleading because it referred to one specific scenario in a hypothetical situation where a single well was drilled. This would mean roughly one chance in 2 billion. Has there been more than 2 billion wells drilled worldwide in the history of oil and gas exploration? If not, the way this statistic was derived is incorrect, because such accidents have already occurred throughout history.

This statement is misleading as the only number reported was that of the "impossible" and the authors have not presented more relevant statistics. A more relevant statement would be, given the number of wells projected (10 to 40, see p.16-24) and the duration of the project (12-30 years, see p.16-24), the probability of a "large spill" ranged between 2% and 28% and the probability of a "very large spill" between 2% and 25%. We can also push the reflection further and affirm that if 40 wells are drilled in 30 years, the probability of an "Extremely large spill" was 16%. All these numbers are reported in Table 16.8 for Site 1. These statistics provided are much more relevant than those presented.

16.3.7 Cumulative Probability of Spill Occurrences in Flemish Pass Area:

Page 16-38

Since the SBA and current VME habitats have been omitted from the EIS, there was no assessment of environmental effects at the spatial scale of these habitats. Furthermore, Chapter 9 was focused on planned/regular operational activities, leaving accidental events for Chapter 16. However, consistent with the calculations in the EIS, the cumulative probability of small/moderate batch spills is 97% (Table 16.17). Even acknowledging the caveats indicated in Section 16.3.7, page 16.39 that support the statement that this figure was likely overestimated, such high probability indicates that at the very least, batch spills should not be considered an unexpected event, but a regular unplanned event associated with planned operations. Cordes et al (2016) (cited in Chapter 16), which provides a detailed review of environmental impacts of offshore oil and gas aimed at providing guidance for management strategies for the industry, actually makes this very point by stating *"While all of these examples represent accidental discharges, the frequency at which they occur in offshore waters suggests that they can be expected during "typical" operations".* Assuming these spills will not happen as part of regular operations was disingenuous; these "unplanned but regularly occurring" events should be presented as part of regular operations, and integrated into the analyses of Chapter 9.

Without getting into the details of the different spill modelling exercises detailed in Chapter 16 (and some of them, like SBM with its limited consideration of the local oceanography and seascape, are highly questionable), it was fair to say that all those spill trajectory exercises indicated that, to a greater or lesser degree, the most significant exposures would be expected along the Flemish Pass to the south of the two sites modelled, and on the Flemish Cap proper. These areas contain significant and extensive coral and sponge habitats (the afore-mentioned SBAs and VMEs) which would be exposed to the most severe impacts associated with spills. Since these habitats have been omitted from the assessment of environmental impacts, the conclusion of the EIS with respect to these important components was incomplete, and hence, the associated conclusions unreliable.

16.3.5.1 Batch Spills from FPSO

Page 16-34

"A review of the history of FPSO spills indicates that these incidents are relatively rare. [...] For spills less than 1,000 bbl (158 m^3) (for which no international data exists)"

The acronym FPSO is not defined (first appeared in Section 16.3.5).

Relatively rare is subjective and should be removed.

It should not be stated that such spills were rare if no international data exists for anything smaller than 1,000 bbl.

1,000 bbl (158 m^3) is a large spill (largest in NL history is about 250 m^3). What about the probability of a smaller spill? If one extends the results from Table 16.10 to the probability of a 100 bbl spill (0.013 or 0.025 per year depending on the production rate because these statistics seem linear with the size), we obtain a spill probability between 39% and 75% if the project lasts 30 years. These should not be considered as "rare events".

16.3.5.2 Other Batch Spills

Table 16.13 Probabilities of Batch Spills by Volume Category

Page 16-36

Table 16.13 indicates that the probability of a moderate to large spill is 0.0073/well/year. In this case, counting 40 wells over 30 years operation (maximum projected operation size and time) means that we should expect ~9 spills to occur between 100 to 1,000 bbl. Again, these are not *rare* incidents.

16.3.6 SBM Spills

Page 16-36

SBM Spills: SBM not defined

Table 16.37 Summary of Residual Accidental Event-Related Environmental Effects on Fish and Fish Habitat

Page 16-93

Would the conclusions presented in this table change if a dispersant was utilized?

16.4 Fate and Behavior of Potential Spills

Page 16-39

See comments on Appendix E.Proponent16.5 Spill Risk and Probabilities

See comments on Appendix E.

16.7 Accidental Events-Environmental Effects Assessment

Page 16-124

"….potential environmental effects that may occur in the unlikely event that an accident…"

The word *unlikely*, unless quantified, is subjective and inadequate in a scientific study.

Page 16-28

"The extremely unlikely and unmitigated subsurface blowouts at Sites 1 and 2" [...] in these extremely low probability cases, the total hydrocarbon concentration [...]"

See comment above where it was mentioned that if 40 wells are drilled in 30 years, the probability of an "Extremely large spill" was 16% (reported in Table16-8). This is not "extremely unlikely". This statement should be removed and, more realistic statistics should be reported.

16.7.4.2 Potential Issues and Interactions

Page 16-130

Guidance provided by FAO (2009) in relation to fishing impacts on VMEs defines temporary impacts as *"recovery to the pre-impact state should be within 5-20 years*," and that *"recovery times longer than 20 years should be deemed permanent."* Within Section 16.7.4.2 of the EIS, a modelling study by Girard et al. (2018) was referenced and stated *"The model predicted that the majority of corals that were impacted would be fully recovered within a decade with the more heavily impacted corals taking up to three decades to reach a state where all remaining branches appear healthy (Girard et al. 2018).*" Considering FAO's timelines for impacts, the EIS suggests that most impacts could be considered temporary, while only the most severe ones could be deemed permanent. Impacts to corals and sponges were mischaracterized in the EIS, as Girard et al. 2018, stated that *"Overall, our model overestimates recovery, but branch loss estimates were reliable. Thus, the available growth rate data suggest that hundreds of years may be necessary for impacted communities to grow back to their initial biomass."* As such, the impacts to corals and sponges could be deemed permanent.

16.7.4.3 Effects of Hydrocarbons on Marine Fish and Fish Habitat

Plankton and Microbes

Page 16-134

The text describes the effects of oil exposure on two copepod species-*Calanus glacialis* and *C. finmarchicus*-which were reported as having different sensitivities to exposure. The ecological implications of this situation were overlooked in the EIS. The latter species-*C. finmarchicus*-is the most sensitive to oil of the two, but is also of greater importance as a food source. Reporting that one species was more sensitive than another omitted the ecological context in which the finding must be interpreted. Annual variability in *C. finmarchicus* abundance has been shown in several research studies to be correlated with substantial changes in survival and biomass of many fish species.

Plants and Macroalgae

Page 16-135

The report did not address potential impacts to eelgrass ecosystems in the event of an oil spill reaching the shore. Eelgrass is a documented Ecologically Significant Species (ESS) (DFO 2009 CSAS report) and habitat dominated by this plant are the functional nursery areas for several coastal and offshore species of commercial and cultural significance.

16.7.4.6 Residual Environmental Effects Assessment and Evaluation

Subsurface Blowout

16.7.4.8 Determination of Significance

The wording "*extremely unlikely*" appeared numerous times in Chapter 16. This wording was inappropriate and should be removed as it was not substantiated in the document (e.g. statistics in Table 16-8 show the opposite and that such spill accidents were likely to occur in the lifetime of the Project).

The prediction of minimal interactions with benthic habitat (Section 16.7.4.8) was not supported by the observations in the Gulf of Mexico after the DWH blowout.

The Flemish Pass has been shown to be a critical area for the dispersal of the larvae of economically important invertebrates like shrimp (Le Corre et al. 2018) and vulnerable benthic organisms such as corals and sponges (Kenchington et al. 2018). As such, it provides connectivity for vulnerable marine ecosystems and for shrimp recruitment. The effect of an oil spill on this connectivity should have been assessed.

Comments on Individual Report Appendices

Comments On Report Appendix A

Page 6

"The model will run with either two- or three-dimensional current fields. Two–dimensional fields may be either steady or time varying, supplied from hydrodynamic models or estimated by the user from local knowledge or current atlases. Three–dimensional time-varying fields from hydrodynamic models can be imported for selected formats."

A rationale for using time-varying but spatially uniform currents (from a single point) was required. This approach was the same as in Appendix I. Currents from a 3D model (e.g., HYCOM, such as in Appendix F) should have been used. The simulations should be repeated using HYCOM forcing.

Comments On Report Appendix D

Underwater Sound Modelling of Seismic Survey and Development Activities Offshore Newfoundland, Equinor's Bay du Nord Development Project (Zykov 2019)

Overall, the report was well detailed and the methods, modelling, and interpretation was reasonable. However, these results would be more useful had field measurements been made available to confirm the model estimates.

The metrics (SEL and SPL) were useful, and the sound field resolution was also acceptable. The source model volume (5,085 cubic inches) used as part of the modelling exercise was likely applicable and many other seismic surveys (2D or 3D) use smaller source volumes. Some of the tables (i.e. Tables 9, 10, 12, and 13) in the report should include units for distance, i.e. meters and scale bar should be included for Figures 21 and 22.

Seismic modelling conducted for a single airgun array source, as seen in Appendix L, indicate that turtles could be exposed to louder and more frequent sound energy than the single modelled seismic array. In the literature, multipath propagation and more importantly multiple concurrent seismic programmes are common. For seismic, there was some evidence of effects, particularly for mammals, and there was a growing global "concern" that seismic could potentially impact marine life beyond mammals.

Considering the impacts of sound in the overall context of the Project, it was assumed that subtle changes in behaviour in response to sound could likely affect general fish habitat interactions. When considering the noise sources assessed (i.e. vessel noise, sub-bottom profiling, multi-beam sampling, and seismic), the primary noise source of concern in the EIS was seismic surveying. While vessels generate considerable noise, it was not anticipated that the vessel(s) in the Project were substantially different, or were producing substantially different noise levels, compared to other oceanic ships.

The EIS was narrow in scope and did not consider an ecosystem approach. There was limited information available to assess the impacts of seismic, or noise in general, on marine life other than marine mammals and therefore the EIS should acknowledge this absence of information as an important information gap.

The assessment methods used for mammals was very similar to those applied to humans. The evolutionary process and development of hearing in humans and mammals is more similar than the evolution of hearing both within and among different groups of fish or invertebrates. It is well known that the organs and mechanisms of hearing used by fish and invertebrates are different from humans, unfortunately information to determine how fish and invertebrates could be impacted by excessive noise was not available.

Regardless of the established guidelines and noise levels established, the report should indicate the raw data including frequency bandwidth measurements and associated energy measurements. It is recommended that the EIS remove mammal specific categories, or provide additional reporting on the raw metrics such that the information could be more applicable to other taxa. This could aid future work to make relevant comparisons, if or when noise assessments consider marine life other than marine mammals.

Comments On Report Appendix E

The model failed to consider the observations from the DWH blowout that a significant portion of the oil was found on deepwater coral and sponge reefs in the area.

The model only considered oil but did not asses the behavior, fate and potential effects of the hydrocarbon gasses associated with oil. The DWH spill demonstrated that the effects of such gas may be significant for planktonic organisms. This gap needs to be addressed in the EIS.

On page 40 of the EIS, it was stated that the use of a dispersant (SSDI) will increase the exposure of organisms inhabiting the deep water; however densities of fish and invertebrates in deep water are much lower "*mitigating this potential impact.*" This is incorrect. The impact is a function of the population affected not their density.

Two models were used to predict the potential effects of a deep water blowout resulting from the Bay du Nord Project. The first, OILMAPDeep, predicted the initial behavior of the oil and gas released by the blowout until it reaches a trapping height determined by a combination of water column density and hydrocarbon characteristics. The two outputs of this model, plume location and droplet size, fed into the second model SIMAP which then predicted the spread and eventual fate of the oil. Both models were validated against a number of oil spills including most recently the DWH blowout in the Gulf of Mexico. The DWH event is particularly relevant to the understanding of potential blowout scenarios for Bay du Nord. Unfortunately, the results of the validation exercises for OILMAPDeep (Spaulding et al. 2017) were not reported in Appendix A of Appendix E and the references cited for SIMAP (French McCay et al 2018a[1] and b[2] [in

[1] French McCay, D. Jayko, D.K., Li, Z., Horn, M., Isaji, T. and M. Spaulding. 2018a. Volume II: Appendix II - Oil Transport and Fates Model Technical Manual. In: Galagan, C.W., D. French- McCay, J. Rowe, and L. McStay, editors. Simulation Modeling of Ocean Circulation and Oil Spills in the Gulf of Mexico. Prepared by RPS ASA for the US Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM.

[2] French McCay, D., Horn, M., Li, Z., Crowley, D., Spaulding, M., Mendelsohn, D., Jayko, K., Kim, Y., Isaji, T., Fontenault, J., Shmookler, R. and J. Rowe. 2018b. Volume III: Data Collection, Analysis and Model Validation. In: Galagan, C.W., D. French-McCay, J. Rowe, and L. McStay, editors. Simulation Modeling of Ocean Circulation and Oil Spills in the Gulf of Mexico. Prepared by

press]) are not published. In a presentation to Bureau of Ocean Energy Management(BOEM) regarding the results of this study, French McCay (2017) demonstrated that the SIMAP model of the DWH blowout performed well for water column (above the 1,200 trapping depth), surface and shoreline oiling but significantly underestimated the oil deposited within sediment by about 7%.

In the DWH event, follow up surveys Stout et al. (2017) found evidence of spilt oil in the sediments up to 155 km from the Macondo well and estimated that it covered an area between 1,030 and 1,910 km^2 and represented between 6.7 and 7.7% of the total oil spilled. Some of the oil within ~2 km may be related to the attempted use of synthetic based mud to cap the blowout (Stout and Payne 2017). The remainder was attributed to use of dispersants (Stout et al. 2017) which may have increased trapping at depth and flocculation with marine snow (Passow et al. 2012).

An important feature of the DWH blowout was the significant quantity of oil that remained trapped at depth. A 35 km plume was observed at approximately 1,100 m depth with monoaromatic petroleum hydrocarbon concentrations in excess of 50 ug/l (Camilli et al. 2010). The OILMAPDeep model results agreed well with observations following the DWH blowout (Spaulding et al. 2017). Model predictions of the percentage of oil retained in the deep intrusion layer were consistent with observed levels. It was likely that the hydrocarbons in this deep plume flocculated during the subsequent marine snow events and contributed to the contamination of and long-term damage to the surrounding benthos (Girard et al. 2018).

The modelling exercise carried out for the deep water blowout scenarios for the Project did not report the output of the OILMAPDeep models nor did they consider the potential for hydrocarbons to remain trapped at depths as was observed for the DWH blowout (10-20%, Spaulding et al. 2017). In addition, the SIMAP model continued to predict that only very small fractions (<0.01%) of oil would affect the benthos after a blowout. Ignoring this component and not incorporating the full output of the OILMAPDeep model significantly underestimated the potential effect of a blowout on the benthic environment, particularly in locations with sensitive benthic species. This oversight needs to be corrected in the EIS.

SIMAP requires the user to input the water column concentration of suspended sediment in order to calculate the potential for flocculation of oil in the water column. The data used to parameterize this term for the Bay du Nord area were not provided in Appendix E.

Page viii

"*Footprints depicting higher probability contours (90%) are much smaller than the total footprint (>1%), which range from 526,900-1,436,000 km^2 depending on the scenario."* These numbers were inaccurate because the spill patch was truncated by the model domain that is too small in many scenarios.

Page 23

"From 0 to ~30% coverage, the ice has no effect on the advection or weathering of surface floating oil. From approximately 30 to 80% ice coverage, oil advection is forced to the right of ice motion in the northern hemisphere, surface oil thickness generally increases due to ice-restricted spreading, and evaporation and entrainment are both reduced by damping/shielding the water surface from wind and waves. Above 80% ice coverage, surface oil moves with the

RPS ASA for the US Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM.

ice and evaporation and entrainment cease." A reference is required for these behaviors as it was unclear why advection should be directed to the right of the ice motion.

Comments On Report Appendix F

SBM Accidental Release Modelling in Support of the Equinor, Bay du Nord, Development Project (RPS 2018)

The term SBM needs to be defined. Table 3.1 provides cuttings fall velocity. Clarification was needed on whether the release was being modelled on synthetic based mud (SBM or SBM with cuttings).

Page vi

"*Appendix A, which provides a detailed description of the MUDMAP model, fates processes, and algorithms used.*" Appendix A of Appendix F was not included. Without Appendix A the model cannot be completely evaluated.

Page 3

"Each simulation covered a minimum period of approximately 6 hours to allow ample time for dispersion and settling." The timeframe of six hours appears short for the sedimentation of finer particles. A reference is required to support this statement. For example, Figures 3 to10 suggest possible settling velocities smaller than 0.05m/s. This leads to ~1,000 m settling vertical distance in six hours (Table 3-2 reports settling velocities of ~600 m in 24 hours).

Comments On Report Appendix I

The EIS modelled the dispersal of drill cuttings using four scenarios for one well and two for an eight well template. The scenarios used particle size distributions based on those from a nearby exploratory well (Bay de Verde F67) with and without flocculate of the <1 um fines, from a Norwegian operation (Troll A) or from a general analysis by Nedwed (2004). The modelled domain grid was 16 x 16 km. Based on these parameterizations, a third of the fine particulates did not settle within the modelled area and the fate and effects of this fraction of the drill cuttings was not assessed. The cumulative effects of this fraction from multiple wells was not discussed or assessed.

The proportion of the seafloor within the model domain where cuttings deposition exceeds 6.5 or 1.5 mm was considered, which was the threshold of effects for the assessment. The latter (1.5 mm) was consistent with recent findings that even limited amounts of cuttings can affect sensitive benthic species (e.g. Trannum et al. 2010). Each well was assumed to create between 2.3 and 2.6 x 10^3 tonnes of cuttings. If a third of this amount is dispersed beyond the model domain this would represent 30 to 35 x 10^3 tonnes of cuttings for the proposed 40 wells of the Project. Further development and other exploratory wells would also contribute to the unaccounted for material.

The model included one scenario with flocculation of fines but did not include disaggregation or resuspension processes. Although bottom currents are low in the deep waters of this part of the Flemish Pass, they are variable and resuspension will have an effect on the eventual distribution of the finer particles.

The Proponent indicated that a cuttings dispersal system may be used to move the cuttings away from the well head and to disperse the pile. This was argued to reduce the overall effect of the cuttings since the height of the pile will be reduced. The potential for such a system to spread out the zone of influence farther from the drilling site was not addressed.

Table 3.2 includes a *"washout factor"* of 10-20% for WBM. Clarification is required on the definition of a washout factor and how was it used in the calculation of amounts of WBM and the particle size distribution.

Overall, these simulations were inadequate. The advection-diffusion of a distribution of particle approach used in Appendix F should be used instead**.**

Page 4

PSD was not defined. A definition is required.

There was no explanation of the relevance for using simulations from other sites. The total depth was a major factor for settling distance. An explanation as to how the depth at these sites compare to the Bay du Nord situation is suggested.

"Ocean currents were characterized for the model with measurements available from a current mooring equipped with Acoustic Doppler Current Profiler (ADCP) and Recording Current Meter (RCM) instruments at a location CM-2 about 10 km to the northwest of the drill cuttings modelling location in the Core CBdN Development Area. The CM-2 mooring was part of an Equinor Canada met-ocean monitoring program from July 2014 to May 2016 in the northern Flemish Pass in a water depth of 1,120 m. A continuous hourly time series of currents for depths 23, 150, 794 and 1,156 m was assembled from the 2014-2016 measurement record to represent the current profile and are assumed to be representative over the 16 km x 16 km model grid centered in the Core CBdN Development Area." Currents are highly variable over short distances in the area (see for example Figure 5-34 in Chapter 5 or Figure 3-3 in Appendix F or Figure 3-10 in Appendix I). Currents may not be representative of a whole grid cell. HYCOM currents should be used as in Appendices E and F.

Page 5

"*For the two Bay du Nord base case simulations, just less than two thirds of the cuttings material settles within the 16-km model grid domain, most of this within 2 km. The remaining unsettled material includes the finer silts and clays with settling times of about two weeks or longer at a distance of almost 60 km or more (especially for the clays in the no flocculation input); these results are for a horizontal current input of 5 cm/s."* Clarification was required on why velocities from a single point in space were chosen when particles can travel more than 60 km in two weeks.

"While the two base case simulations estimate about 3 to 5.8 percent material settling at the wellsite, the two Troll A Platform PSD simulations result in much greater material at the wellhead, on the order of 27 to 34 percent with the Nedwed simulation yielding a similar 32 percent." Due to the difference, clarification on the purpose of showing results from other sites in the North Sea was required.

"Considering all five simulations, median (most likely) cuttings thicknesses are predicted to range from about 170 to 1,900 mm at the wellsite to 9 to 25 mm out to 100 m." This conclusion was unfounded as there were only two simulations that were relevant for this Project. These numbers were incorrect for this specific EIS, especially given that simulations from CBdN were those with much less retention of the cuttings near the drilling site (thus a larger area was impacted with likely a thinner layer). Unless rationales were provided, numbers given in p. 5 and 6 should only include CBdN scenarios.

Page 14

This algorithm was by definition unable to follow a particle cloud with both time and space varying currents. It is suggested to update to a new model such as in Appendices F or J.

Page 18

"*Ocean currents are assembled based on nearest available measurements, from the CM-2 current mooring measurements, and are assumed representative of conditions at and near the drilling location.*" This is incorrect, as:

1) Currents from a location different to the particle positions were used; and

2) Currents from the same fixed station were used when particles move. Currents vary in time and space, thus time-varying and space-varying current input was required. This assumption may hold on very small distances, but it was stipulated that some cuttings travelled as far as 60 km (page 5). This holds true for the fine fraction (silts and clays which were the largest fraction in the release; see Table 3-6) that remains in the water column for a longer period. This approach is not recommended with existing numerical tools. An approach such as in Appendix F should be used.

Page 41

"A seven year (2006-2012) record of HYCOM daily current hindcasts was obtained for a location at 47.9432°N, 46.4336°W, 11 km southwest of CM-2 and 16.7 km west of the drill cuttings modelling location." Since they are available, 3D HYCOM currents (time and space varying) should have been used for the simulations.

Page 58

For CBdN, 37% of the material was unaccounted for during the simulations.

Page 74

"*All eight of the individual deterministic model run outputs that were input to the stochastic analysis.*" Eight simulations is a low number for stochastic analysis. In addition, the differences between the eight runs (called eight wells in the Section title) are not specified.

Comments On Report Appendix J

The frequency of release occurrences was not clear. Clarification is requested on whether there were any *additional* effects from one release to the next. This aspect should be addressed as the concentration of a certain release would add to the next one and change the concentrations reported.

The model predicted the potential plume of produced water in the month of June. This month was selected to represent the most vulnerable period for planktonic organisms based on plankton records and discussions with DFO. It should be noted, however, that invertebrates such as shrimp spawn in April (Le Corre et al. 2018) and that while very few of the spawning periods for sensitive benthic species are well known, the only species known to spawn in June are in the water column for a short period of time (Kenchington et al. 2018). In addition, the currents recorded in this area at this time were significantly lower than at any other time of year. While lower currents will result in less dilution of the plume, the potential distance of the effects may be greater.

The constituents of produced water used to parameterize DREAM are standard average profiles observed by Equinor from their existing developments. Clarification is required on why constituent profiles from the existing Grand Banks production fields were not used.

Table 2.1 indicated that a salinity of 33 ppt was used for the model. Rationale for the selection of this value is requested. Salinities of Hibernia produced water ranges between 46 and 195% (Ayers and Parker 2001 as cited in Neff et al. 2011). Salinity of the discharge will determine its density and thus its behavior once it enters the sea. Highly saline produced water will be denser than seawater and will sink. For example, Nui et al. (2016) used field observations and DREAM modeling and found that the produced water plume (salinity 204 ppt) from the Venture platform on the Scotian Shelf sunk and intersected the bottom (Z=~25 m) almost directly underneath or very close to the platform. Clarification is needed on how a more realistic salinity would alter the behavior of the plume.

The effect of produced water release into the waters of the Flemish Pass on the connectivity of vulnerable marine ecosystems and economically important invertebrate stocks needs to be assessed.

Comments On Appendix A of Report Appendix J

P 12-13 Adsorption/Desorption Partitioning

It was not clear from the description if this was turned on for the Bay du Nord modelling exercise. Produced water is complex and variable in composition, and significant flocculation is known to occur when it is introduced into the receiving environment. Clarification was needed on whether flocculation of produced water components would result in sedimentation of contaminated flocculants. Clarification was also needed on the zone of effect of such material.

Comments On Report Appendix L

The study of the marine mammal and ambient noise measures in Appendix L were based on a limited number of stations from approximately five years ago, and with at least one station providing limited data due to low-frequency flow noise. Despite these limitations, which could be addressed using new recording efforts during the Project, the results were still useful. It would also be valuable to manually validate more than 5% of the acoustic auto-detections made using the JASCO software.

Seismic survey sounds dominate the acoustic environment (Figure 16). This creates further concern regarding the EIS statements in Chapter 11 such as how there would be “*quieter interpulse intervals*”. Multipath propagation and concurrent seismic programmes make a complex and noisy deep water environment (Figures 18, 20). Such anthropogenic noise could result in behaviour and distributional changes in a variety of marine species, and as described in the EIS, Project monitoring will not adequately measure this.

The seismic pulse reverberation (described in Section 4.2) likely masks the communication and feeding functions of marine mammal sounds, but also had a strong effect on the recall performance of the JASCO auto-detectors and may have resulted in fewer mysticete detections. This supports a higher level of manual validation of recorded underwater calls than has been conducted (5%).

Appendix B - Science Response Figures

Figure B1: Lophelia reefs Norway.

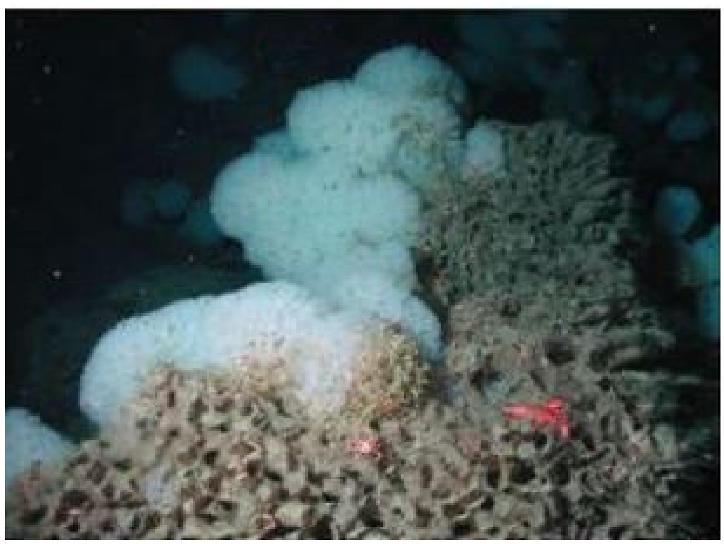

Figure B2: Ancient glass sponge reefs British Columbia, Canada.

Figure B3: Sponge bycatch (dominated by Geodia spp.), Flemish Pass.

Figure B4: Geodia sponge grounds in situ NE Flemish Cap.

Figure B5: Geodia sponge ground encounter Flemish Pass (~500 kg).

Figure B6: Geodia sponge (2.4 kg) Orphan Basin.

Figure B7: Sponge and coral bycatch from south Flemish Cap. Catch dominated by glass sponge (Asconema) and bamboo coral (Keratoisis flexibilus). Community composition is believed to be a cross between Fig. 10 and Fig. 11 examples.

Figure B8: Asconema bycatch Flemish Pass.

Figure B9: Somewhat intact Asconema sample from Flemish Pass (~0.720 kg).

Figure B10: Keratoisis thickets, SW Grand Banks of Newfoundland.

Figure B11: In situ Asconema glass sponge (60 cm x 50 cm).

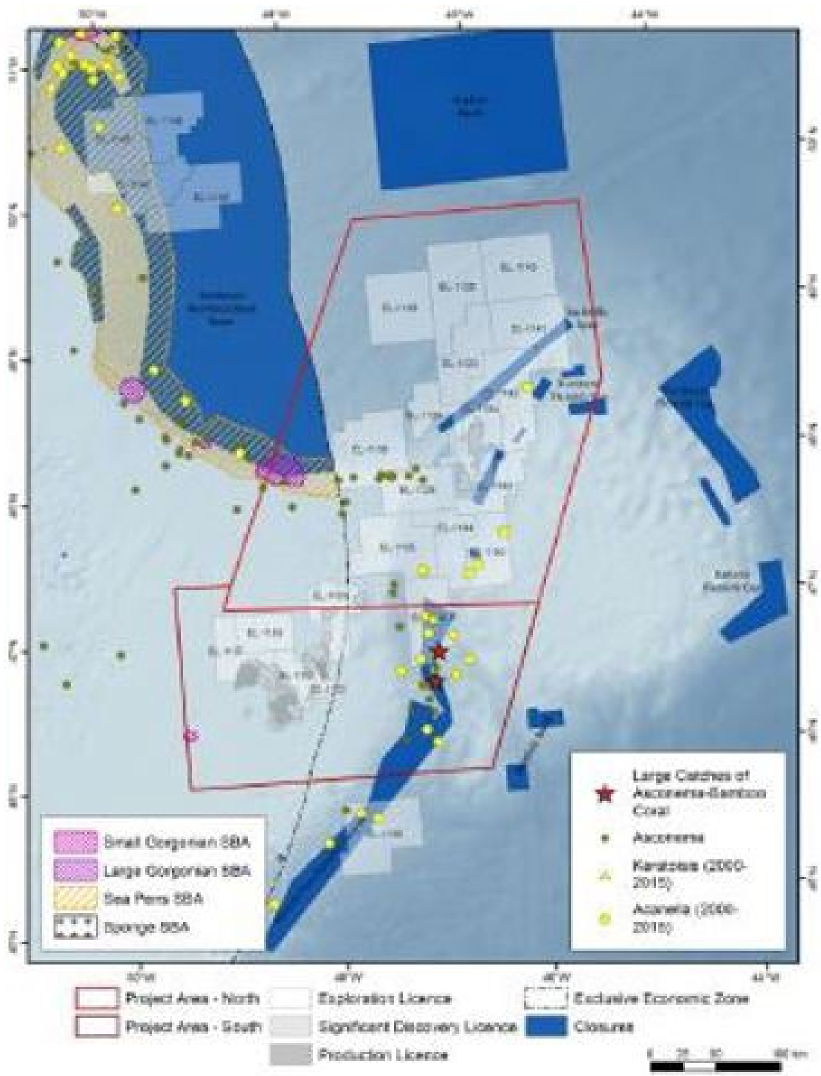

Figure B12: Bamboo corals (keratoisis spp. And Acanella arbuscula) and Asconema sponge catches in the Flemish Pass.

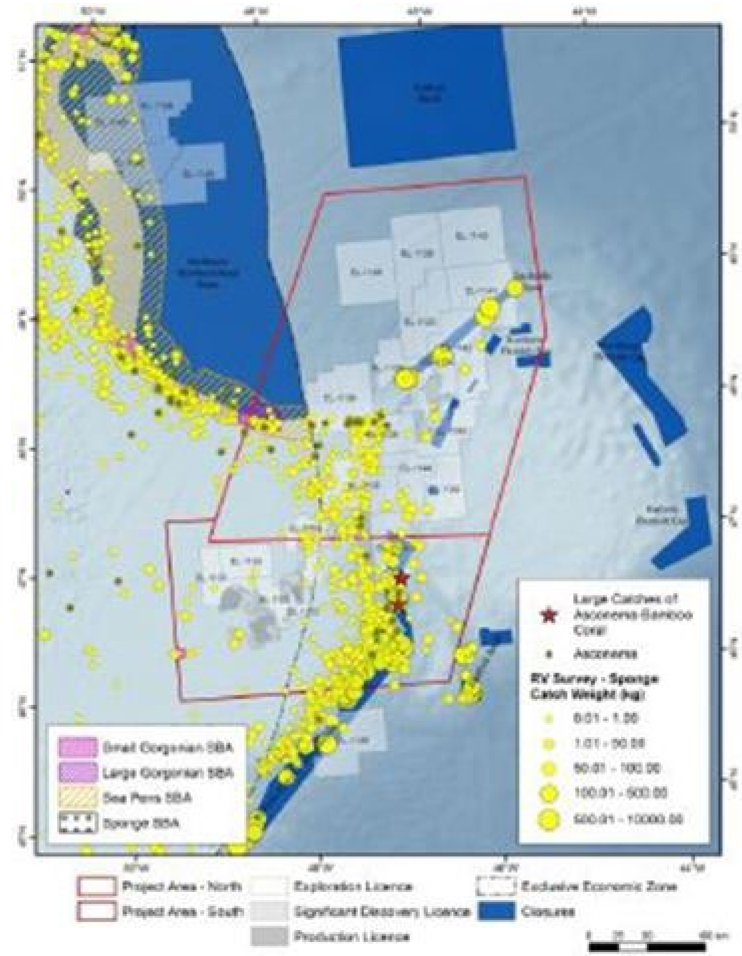

Figure B13: Sponge bycatch by weight with Asconema and unique Asconema-bamboo coral communities highlighted (red stars).

Figure B14: In situ coral (bamboo coral) and sponge grounds, NE Flemish Cap. Note community assemblages, hence diversity, changed with depth.

Figure B15: In situ bamboo coral forest in soft muds Disko Fan. Initial observations suggest community diversity is low but within the forest many smaller species are using the bamboo coral as substarte.

Figure B16: In situ sea pen field document by Pennatula aculeata SW Grand Banks.

Figure B17: In situ sea pen field dominated Halipteris finmarchia, Scotia Shelf.

Figure B18: In situ of a Acanella arbuscula observed in a large fields with up to 77 colonies per 10 m transect sgment (Baler et al. 2012).

Figure B19: Acanella arbuscula bycatch (~30 kgs) documented from a gillnet set. Average weight of individual Acanella ~0.0126 kgs.

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