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June 25th, 2020

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Subject: Submission of Information Requirements and Required Clarifications Associated with the BHP Canada Exploration Drilling Project

The enclosed document provides BHP's responses to Information Requirements (IRs), Required Clarification (CLs), and Request for Additional Information received from the Impact Assessment Agency of Canada on May 22 (IRs and CLs) and June 10, 2020.

BHP is committed to ensuring that its operations are conducted in an environmentally and socially sustainable manner and in full compliance with associated regulations and permits as well as the company's own policies, position statements and standards.

Should you require any additional information please contact our Regulatory Lead, Collette Horner at 709-631-1313 or collette.horner@bhp.com.

Sincerely,

<Original signed by>

Tracey Simpson
Canada Country Manager

BHP Canada Exploration Drilling Project EL 1157 and 1158 Information Requirement Responses

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Report

June 25, 2020

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1.0 INTRODUCTION

BHP Canada (BHP) is planning to conduct petroleum exploration drilling and related activities on Exploration Licences (ELs) 1157 and 1158 in the Orphan Basin, with an initial well planned as early as 2022. ELs 1157 and 1158 are in the eastern Newfoundland offshore region.

This document provides responses to Information Requirements (IRs), Required Clarification (CLs), and Request for Additional Information and provides a response to consolidated comments received from the Impact Assessment Agency of Canada on May 22 (IRs and CLs) and June 10, 2020.

2.0 INFORMATION REQUIREMENTS

2.1 FISH AND FISH HABITAT; MARINE MAMMALS AND SEA TURTLES

2.1.1 IR-01

External Reviewer ID (as applicable)

C-NLOPB-1; KMKNO-1

Reference to EIS

Section 2.4; Section 2.6; Section 8.3; Appendices D and E

Context and Rationale

Section 2.6 of the EIS (p. 2-23) states that “there may at times be up to two MODUs working in different parts of the project area simultaneously”.

Section 2.4.1 of the EIS does not indicate whether batch drilling or simultaneous drilling is being contemplated over the course of the Project, and if so, whether the effects analysis in the EIS is applicable. This information is required to assess the potential environmental effects of the Project.

It is noted that BHP’s acoustic modelling (Appendix E – Acoustic Modelling Report) was conducted for the operation of a single drilling unit, while two drilling units may be operating simultaneously for the Project. The potential for two MODUs operating simultaneously has not been adequately considered in Appendix E or in the assessment and characterization of effects of noise on fish and fish habitat, marine mammals, and sea turtles.

Similarly, the drill cutting dispersion modelling (Appendix D) and the related effects assessment did not consider potential implications of batch drilling or simultaneous drilling should those occur.

Specific Question / Information Requirement

Clarify if batch drilling or simultaneous drilling is being considered for the Project, and if so, provide information about its frequency and duration.

Should batch drilling or simultaneous drilling be contemplated, assess the environmental effects of batch drilling and simultaneous drilling on all valued components. This must include an assessment of the effects of noise from operating multiple drilling units simultaneously. Update the modelling in Appendices D and E, if applicable.

BHP Response

BHP will not be conducting simultaneous or batch drilling during the 2022 drilling campaign. However, if additional wells are drilled in subsequent years, we cannot rule out simultaneous or batch drilling. However, BHP cannot speculate on the frequency or duration at this time. The environmental effects assessment has, however, included and assessed this potential occurrence, to be conservative and fully inclusive of all such possible scenarios, including the potential for "overlapping" or combined environmental effects to a valued component (VC) resulting from multiple, concurrent drilling campaigns occurring as part of the Project, as part of the BHP project or another operator in an adjacent licence. For example, Section 12.3.1.3 of the Environmental Impact Statement (EIS) describes potential cumulative effects associated with simultaneous drilling on Commercial Fisheries and other Ocean Users and Section 14.2.4 of the EIS details potential cumulative effects associated with concurrent drilling activities and seismic surveys. Whether the second mobile offshore drilling unit (MODU) is on an adjacent BHP licence, or on the licence of another operator will not change the cumulative effects assessment.

While the cumulative effects assessment pertained primarily to the potential for the effects of the Project to interact with those of other projects and activities in the region, many of these concepts are also applicable to the avoidance of potential "within Project" cumulative effects resulting from multiple, concurrent Project activities as well. Although the specific location of individual wellsites and the specific nature and duration of any individual drilling activity carried out as part of the Project cannot currently be defined, any simultaneous drilling activities could be occurring in different parts of the overall Project Area. This inherent spatial and temporal separation, along with the localized and short-term nature of any associated environmental disturbances, means that there is little or no potential for interaction between the environmental zones of influence of each individual and simultaneous drilling campaign, and thus, for resulting combined environmental effects upon any VC. As a result, there would be no difference in the overall nature, magnitude, extent or duration of any predicted environmental effects or required mitigation as a result of a "multiple, concurrent drilling installation scenario" as opposed to a single well being drilled any one time during the Project.

The results of the environmental effects assessment presented in the EIS are therefore fully inclusive of, and thus reflect, the potential use of multiple drilling installations at any one time during the Project.

Depending on success of initial well(s) and if a multi-well program is proposed where there may be multiple close proximity wells with similar well designs, then there may be potential operational efficiencies through batch drilling. The option of batch drilling would be considered during detailed design phase for future wells (included in the 20 well count) and would be captured through the Approval to Drill a Well authorization process with the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB).

By executing common sections of wells consecutively using batch drilling, the Project should see a reduction in the overall time to drill an individual well. The benefits of batch drilling should include:

- Health and safety - through the enhanced crew efficiency working on similar hole sections and equipment and reduction in the swapping of fluid systems
- Environment – reduced time on each well, reduced vessel activity and reduction in the swapping of fluid systems; shorter periods of noise or other disruption at each well site
- Equipment similarities – crew familiarity with well equipment reducing the time to conduct drilling operations
- Conducting weather-sensitive operations in favorable conditions, reducing potential time where drilling activity is waiting for weather to dissipate

If batch drilling is considered, it will reduce the duration of several activities (time on well, vessel movement, fluids swapping, and noise), thus reducing disturbance to VCs. With the application of mitigation presented in the EIS, the effects predictions on VCs presented in the EIS remain valid.

2.1.2 IR-02

External Reviewer ID (as applicable)

C-NLOPB-2; DFO-67

Reference to EIS

Section 2.7.2; Section 8.3; Appendix D

Context and Rationale

Section 2.6 of the EIS indicates that drilling may occur at various times during the year, yet the drill cutting dispersion modelling (Section 2.7.2 and Appendix D) only examines summer and fall drilling scenarios, without providing a clear indication on why these are chosen for modelling purposes. Drill cutting dispersion modelling should be done based on the worst-case scenarios and not the most likely.

Fisheries and Oceans Canada (DFO) also noted that water column density changes throughout the year, and that it is not possible to confirm that predicted results of the drill cutting dispersion modelling are applicable to other temporal windows if these are not assessed or the differences from the target season are not evaluated.

Specific Question / Information Requirement

Provide rationale for modelling drill cutting dispersion only in the summer and fall, including, as appropriate, why winter and spring dispersion scenarios would be similar to summer and fall scenarios. If winter and spring drill cuttings dispersion may differ from summer and fall dispersion, describe the potential differences and update the effects assessment as required. If necessary, conduct modelling for the worst-case drill cuttings dispersion scenario.

BHP Response

As described in Section 1.2 for the RPS Drill Release Risk Assessment technical report (RPS 2019a; Appendix D), currents at EL 1157 are predominantly to the southeast (see Figure 1-4 of RPS 2019a; EIS Appendix D) and currents at EL 1158 are predominantly to the east-southeast (see Figure 1-5 of RPS 2019a; EIS Appendix D) throughout the year. Rather than four seasons, there appears to be two different current regimes (i.e. summer / fall), as opposed to four (i.e., spring, summer, fall, winter). At both sites, the slowest velocities are typically observed between March and July, while the highest velocities occur between August and February. Overall, EL 1157 had more variability in current direction and slower current speed, when compared to EL 1158. RPS performed a qualitative review of the HYCOM time series between 2006-2012, comparing current statistics (speeds and directions) from each year at multiple depths for each modelled timeframe (see Figures 1-6 and 1-7 in RPS 2019a; EIS Appendix D). Lowest average and 95th

percentile monthly current speeds are typically observed during late spring and summer time periods, with highest velocities observed during the fall. BHP indicated that they had a preferred drilling period between May and November which covers both the low current period during the summer and the higher currents seen during fall. Therefore, the dispersion simulations capture both "worst cases" for deposition including thickest deposition potential during the slower current speed periods (i.e., summer) and the furthest deposition during the faster current speed time periods (i.e., fall). Current trends for the two modelled periods were congruent with the overall 7-year trend and were thus deemed suitable as a representative modelling period (RPS 2019a; EIS Appendix D).

The variations within predicted results between simulations were due to three main factors including: 1) settling velocity associated with different releases, 2) current patterns (i.e. velocity – predominantly speed) and 3) release height relative to the seabed. The discharges modelled in this study may be considered representative of other potential discharges in the Project Area, as the depth of the sites (2,047 and 2,338 m) are similar in depth to other potential sites within the Project Area. While this dispersion modelling targeted the most likely drilling window for the Project (May to November), the predicted results are applicable outside of this temporal window (RPS 2019a; EIS Appendix D) as drilling may take place at any time of year.

While the drill cuttings dispersion is driven primarily by currents (i.e., speed and direction) at the time of the release and currents are relatively consistent throughout the year, spring and winter dispersion scenarios would likely result in larger footprints with less depositional thickness than the summer simulation and smaller footprints with more depositional thickness, when compared to the fall dispersion simulations.

Reference

RPS. 2019a. BHP Canada Orphan Basin Region Exploration Drilling Project 2019-2028: Drill Release Risk Assessment.

2.1.3 IR-03

External Reviewer ID (as applicable)

Not applicable

Reference to EIS

Section 10.3.2.3

Context and Rationale

Section 10.1.4.1 of the EIS states that the "LAA for marine mammals and sea turtles is based on modeling results for distances to sound threshold criteria for behavioural change as well as scientific literature, and is defined as a conservative 50 km radius buffer around the project area to encompass the maximum threshold distances for all activities."

The sound modeling results estimated that distances to sound threshold criteria for behaviour change (Appendix E) could be up to >100 km in February for a semi-submersible drill rig. Therefore, wells drilled within 30 km or less of the border of an EL could have effects that extent beyond the LAA. The rationale for the LAA as a 50 km radius buffer beyond the project area is therefore not clear. Any resultant implications for the effects assessment should be considered.

Specific Question / Information Requirement

Discuss why a more conservative >100 km buffer around the ELs is not chosen for the LAA for marine mammals and sea turtles. As required, revise the effects assessment taking into account the potential >100 km distance to sound threshold criteria for behaviour change.

BHP Response

As the reviewer correctly notes, the LAA "*… consists of the Project Area and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information, including effects thresholds, predictive modelling, and professional judgement.*" The LAA considered scientific studies of marine mammal behavioural responses to non-impulsive sound sources (reviewed in EIS Section 10.3.2.3).

The 120 dB re 1 μPa SPL_{rms} behavioural criterion for non-impulsive (or continuous) sound is considered as a guide in the assessment, rather than an absolute indicator of behavioural effects occurring. As recommended in Southall et al. (2007), where species-specific information on received sound levels and marine mammal response are available, this information was considered. In short, it is unreasonable to assume that marine mammals, particularly odontocetes and seals, would avoid the MODU at distances extending to 100 km (see EIS Section 10.3.2.3). Furthermore, there was considerable variation in the modelled distances where sound levels were predicted to exceed the 120 dB re 1 μPa SPL_{rms} behavioural criterion - distances ranged from 10 km to >100 km, with most modelling scenarios estimating values less than 50 km (see EIS Table 10.5). Sound from the MODU is expected to result in localized avoidance by marine mammals. Sea turtles, considered rare in the Project Area, would be expected to exhibit localized avoidance. Based on consideration of available information, the 50 km buffer around the Project Area for the LAA is considered conservative and the use of a >100 km buffer does not fit within the bounds of the LAA definition as effects extending to this distance are not reasonably expected to occur.

References

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Lastal, D.R. Ketten, J.H. Miller, and P.E. Nachtigall. 2007. Special Issue: Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals, 33(4): 411-521.

2.2 MIGRATORY BIRDS

2.2.1 IR-04

External Reviewer ID (as applicable)

Not Applicable

Reference to EIS

Section 9.3

Context and Rationale

Bird attraction to and collisions with lit structures is a known problem; however, Environment and Climate Change Canada (ECCC) has advised that there remains uncertainty around estimates of bird strandings and mortality on offshore vessels and installations and of the effectiveness of mitigation measures. This concern has also been brought up recently through the environmental assessment being conducted for the proposed Bay du Nord Development Project, and more proactive mitigation and follow-up measures are being developed. For that project, Equinor has been required to work with the Canadian Wildlife Service (CWS) to develop specific mitigation measures, including confirming means to reduce and adjust lighting and researching potential new technologies.

Specific Question / Information Requirement

Discuss the need for additional follow-up measures and research into potential means to reduce or adjust lighting, or other potential new technologies that could further reduce the effects of light attraction and bird collisions and strandings.

BHP Response

The BHP Canada Exploration Project is currently for two wells in 2022. Any future wells are contingent on the success of the 2022 campaign. BHP will endeavour to work with the selected drilling contractor to assess the potential for lighting adjustments; however, the MODU will not be purpose built, so opportunities for modifications and new technologies will be limited. Lighting types and levels have been designed according to regulation to ensure that the safety of the MODU personnel and other ocean users.

BHP intends to consult with CWS to develop suitable follow-up seabird monitoring programs for at-sea and stranded seabirds.

2.3 SPECIES AT RISK

2.3.1 IR-05

External Reviewer ID (as applicable)

DFO-08

Reference to EIS

Section 6.1.8.1; Section 11.1

Context and Rationale

Figure 11-1 of the EIS identifies proposed critical habitat for Northern and Spotted Wolffish.

In February 2020, the final version of the Management Plan for Atlantic Wolffish (*Anarhichas lupus*), and the Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*) in Canada were published, therefore finalizing critical habitat boundaries for Northern and Spotted Wolffish.

Specific Question / Information Requirement

Confirm that figures in the EIS depicting wolffish critical habitat (e.g., Figures 6-17; 6-18; 11-1) remain accurate given the recently finalized boundaries. Similarly, confirm that the information on the overlap of wolffish critical habitat with the project area and LAA, as well as distances from spatial boundaries (e.g., ELs, project area, LAA, PSV routes) remain accurate. Update this information and these figures, as required.

(Also see CL-02 which requires the percent overlap of special areas with the ELs, including wolffish critical habitat.)

BHP Response

There is no change to spotted wolfish critical habitat between the proposed and finalized boundaries as depicted on EIS Figures 6-17, 6-19, and 11-1. Finalized northern wolffish critical habitat (where it overlaps the spotted wolfish critical habitat) was extended to the Exclusive Economic Zone (EEZ). EIS Figures 6-17 and 6-18 depict the finalized Critical Habitat. Figure 11-1 depicts the finalized Critical Habitat, although it does indicate “proposed” Critical Habitat in the legend. Revised EIS Figures 6-17, 6-18, and 11-1 are provided as Figures 1 to 3, respectively.

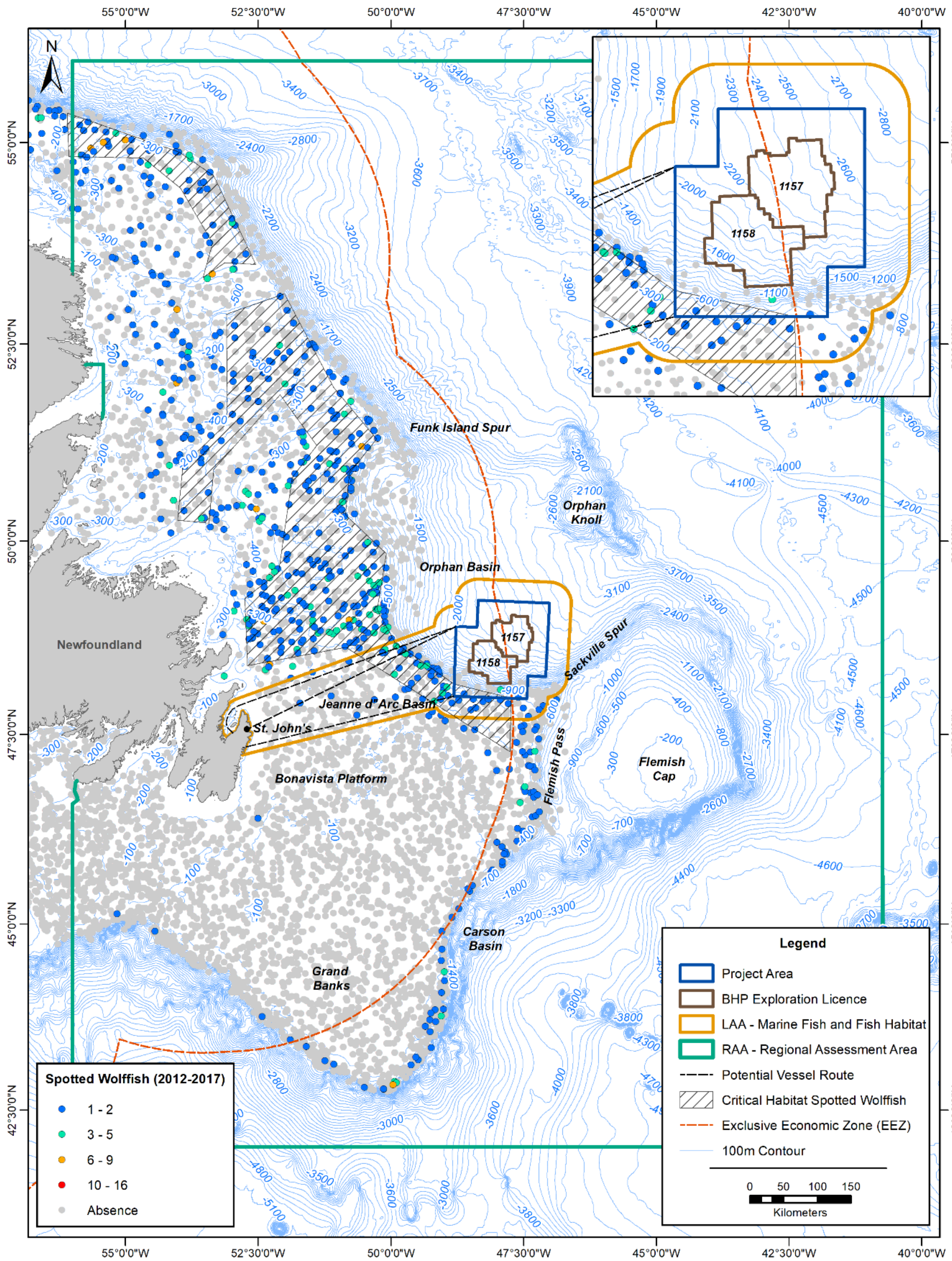

Figure 1 **Revised EIS Figure 6-17: Spotted Wolffish Distribution and Abundance Compiled from Canadian RV Trawl Survey Data (2012-2017) with Designated Critical Habitat**

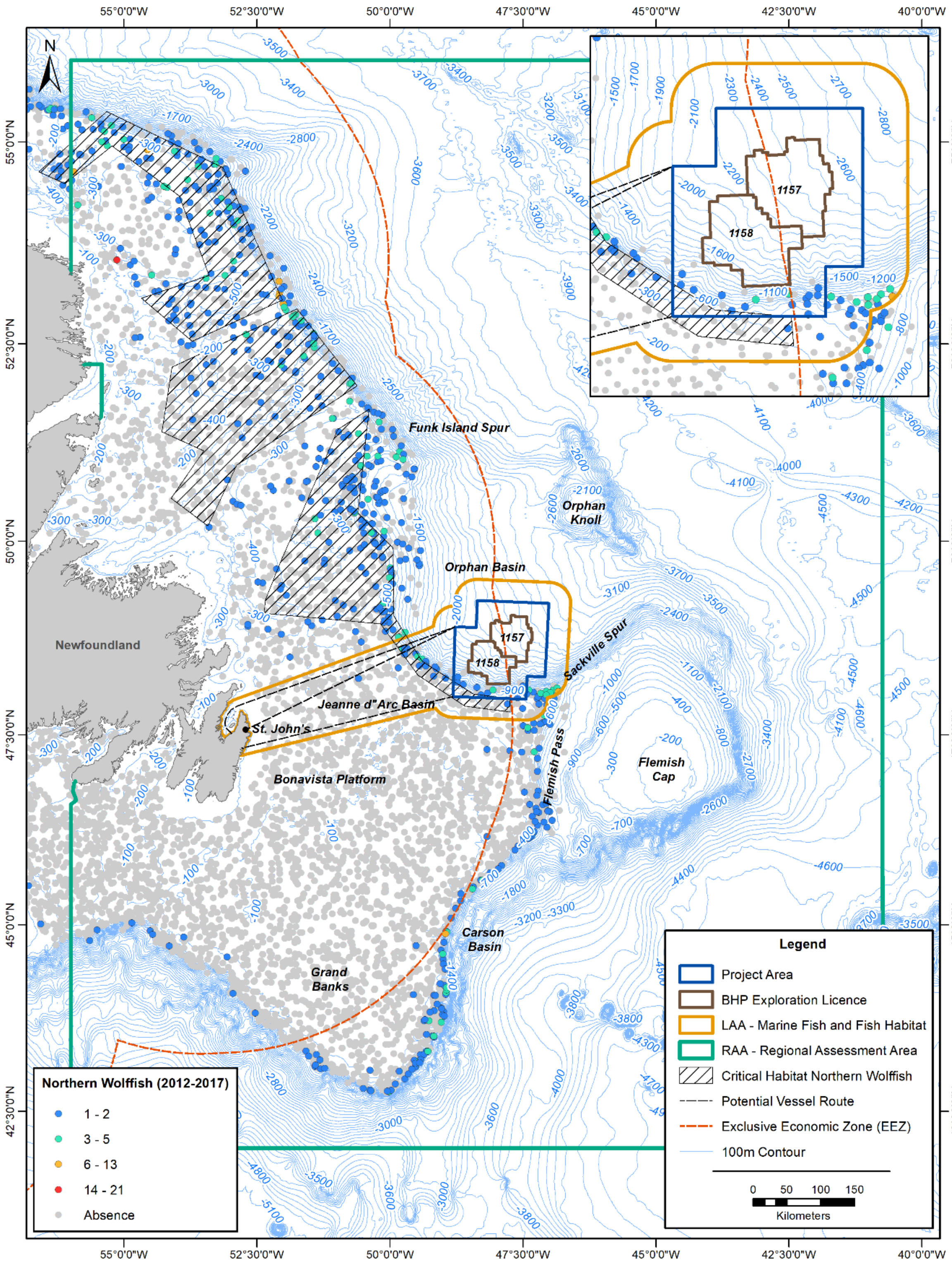

Figure 2 **Revised EIS Figure 6-18: Northern Wolffish Distribution and Abundance Compiled from Canadian RV Trawl Survey Data (2012-2017) with Designated Critical Habitat**

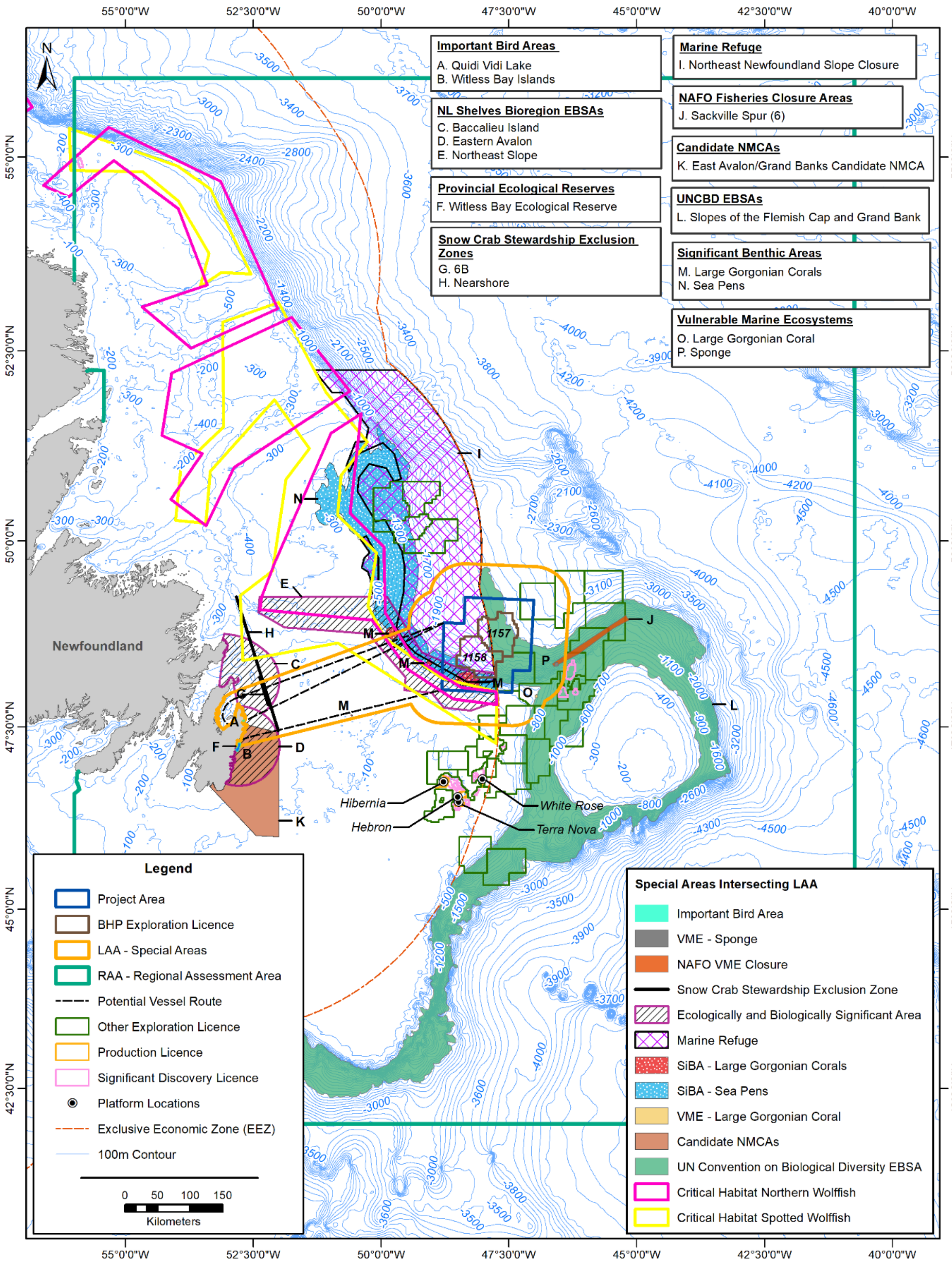

Figure 3 **Revised EIS Figure 11-1: Special Areas in the LAA**

2.3.2 IR-06

External Reviewer ID (as applicable)

Not applicable

Reference to EIS

Section 6.1.8

Context and Rationale

The LAA and a small portion of the project area overlap with critical habitat for Northern and Spotted Wolffish; however, the EIS states that these species of wolffish are “unlikely to be within the project area” (p. 6-56 & 6-60). It is unclear on what information the proponent is basing this statement.

Specific Question / Information Requirement

Provide an explanation as to why BHP is of the view that these species of wolffish would not likely be found in the project area despite the project area overlapping with their identified critical habitat. If it is determined that wolffish may frequent the project area, update the proposed mitigation and follow-up, effects predictions, and conclusion on the effects of the Project on wolffish, as appropriate.

BHP Response

ELs 1157 and 1158 are located off the Northeast Newfoundland slope in the Orphan Basin, at water depths ranging from approximately 1,175 to 2,575 m. According to DFO (2020), the depth range for northern wolffish is 38 to 1,504 m (mainly at >500 m to 1,000 m), spotted wolffish from 56 to 1,046 m (mainly at 200 to 750 m), and Atlantic wolffish from nearshore to 918 m (mainly in 150 to 350 m). Therefore, there is little potential for overlap between the ELs and the known depth range of wolffish. Research vessel wolffish collection data in the area confirms the low potential for overlap (refer to figures in IR-05 response).

The Project Area includes a 20 km buffer around BHP ELs that does overlap slightly with identified critical habitat. However, the nearest distance between a licence boundary (i.e., potential wellsite) and a critical habitat boundary is 12.4 km. The predicted deposition of drill cuttings to 1.5 mm thickness is a maximum of 580 m from the wellsite (RPS 2019a, EIS Appendix D). No change to the effects assessment for wolfish is therefore deemed necessary. Please refer to the response to IR-07 for further details.

References

DFO (Fisheries and Oceans Canada). 2020. Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada. Fisheries and Oceans Canada, Ottawa, ON. vii + 81 pp.

RPS. 2019a. BHP Canada Orphan Basin Region Exploration Drilling Project 2019-2028: Drill Release Risk Assessment.

2.3.3 IR-07

External Reviewer ID (as applicable)

DFO-27

Reference to EIS

Section 8.3.3

Context and Rationale

Section 8.3.3 of the EIS briefly describes changes in habitat quality and use that could occur for wolffish, including critical habitat for Northern and Spotted Wolffish. The EIS lacks detail regarding the specific changes that could occur to wolffish critical habitat, change in habitat use by wolffish, which specific mitigation measures would reduce the impacts to wolffish and its critical habitat, and the residual effects on wolffish and its critical habitat. In addition, there is a lack of consideration regarding how the Project could affect the recovery of wolffish and the Project's overall contribution or impairment to the measures and goals outlined in the Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*) and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada.

Specific Question / Information Requirement

Provide additional detail on the unique features of the wolffish critical habitat, specify which mitigation measures would mitigate effects on this habitat and how these measures are anticipated to be effective, and describe if and how the Project could affect these features and wolffish critical habitat in general. Discuss if and how the Project could affect the recovery of wolffish and how the Project contributes or impairs the measures and goals outlined in the Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada. As required, update the mitigation and follow-up as well as the prediction of residual effects to wolffish and its critical habitat.

BHP Response

Mitigation measures listed in Section 8.3.1.2 for the Fish and Fish Habitat VC would be applicable to wolffish and their habitat. These mitigation measures are standard for exploration and development drilling in Canada and have been proven effective through the EEM programs conducted to assess the effects of drilling on fish and fish in the Newfoundland offshore, since 1997. Drill cuttings dispersion modelling was performed for the Project to assess the footprint, spatial extent, and thickness of discharged drill cuttings (EIS Section 8.3.1.3). Modelled thicknesses above the 6.5 mm threshold were not predicted to occur at either site, with the maximal depositional thickness of 5.45 and 4.75 mm predicted for EL 1157 and EL 1158, respectively. For EL 1157, dispersion sediment thicknesses of 1.5 mm or greater are predicted to reach a maximum extent up to 450 m from the discharge point and up to 580 m at EL 1158, and to cover an area less than 0.12 km² at either EL (RPS 2019a; EIS Appendix D).

Critical habitat has been delineated for the spotted and northern wolffish as part of their recovery and management plans. These delineated areas are located along the northeast Newfoundland shelf and slope, based on their known temperature and depth preferences (DFO 2020). Northern wolffish critical habitat has been delineated by depths from 118 to 636 m. Spotted wolffish critical habitat has been delineation by depths of 82 to 346 m. These areas do not overlap with the BHP licences and just intersect the western boundary of the LAA. Drilling activities will not change water depth or thermal habitat within the critical habitat of northern or spotted wolffish and therefore will not jeopardize the recovery of these species. Atlantic wolffish prefer shallower water and are concentrated on the southern Grand Bank, so are not likely to occur near the LAA.

References

DFO (Fisheries and Oceans Canada). 2020. Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada. Fisheries and Oceans Canada, Ottawa, ON. vii + 81 pp.

RPS. 2019a. BHP Canada Orphan Basin Region Exploration Drilling Project 2019-2028: Drill Release Risk Assessment.

2.4 ACCIDENTS AND MALFUNCTIONS – SPILL SCENARIOS, MODEL INPUTS, & MODEL RESULTS

2.4.1 IR-08

External Reviewer ID (as applicable)

Not applicable

Reference to EIS

Section 15.4.2

Context and Rationale

The EIS Guidelines state that results of the fate and behaviour modelling “should include a projection for spills originating at the site and followed until the slick volume is reduced to a negligible amount or until a shoreline is reached.” Modelling in the EIS indicates that up to 20% of the released oil could travel outside the model domain. There is no discussion of the limitations associated with the model domain/area or the potential effects of oil travelling outside the model domain.

Specific Question / Information Requirement

Provide a discussion of the fate and behaviour of oil that is noted to leave the model domain, and provide an assessment of related potential environmental effects, including the potential for an oil spill to contact shorelines outside the model domain to the east. Include the potential locations of shoreline oiling.

BHP Response

Completely unmitigated 30- and 120-day subsurface blowouts totaling 639,949 and 2,464,303 m^3 (4 million and 15.5 million barrels of oil), respectively, were simulated at EL 1157 and EL 1158 for a total of 160 days. Based upon prevailing winds and currents in the region, oil was generally predicted to be transported to the east. Stochastic footprints, generated from the 688 individual simulations (e.g., with spatially and temporally variable currents, winds) were included within the RPS Oil Spill Trajectory and Fate Assessment technical report (RPS 2019b; EIS Appendix F). Typically, there is >90% chance that surface floating oil >0.04 µm (highly conservative socio-economic threshold) will leave the edge of the model domain, which is located over 2,300 km to the east of the release location. From these same stochastic simulations, oil exceeding 10 µm (ecological threshold) may occur as much as 25% of the time. The representative deterministic simulations (95^{th} percentile worst cases for surface floating oil, water column oil, and shoreline oil) did have between 3.2 to 22.1% (average 9%) of the total release volume predicted to leave the model domain in the form of persistent surface oil (i.e., highly weathered emulsifications and tarballs) at the end of 160 days. However, the *minimum* time it took oil to leave the model domain was between one to two months (but allowed to continue for a further three to four months). At this point, the oil would be patchy, discontinuous, and highly weathered. The lighter ends would have evaporated, dissolved, and degraded long before the oil reached this boundary. The highly volatile nature and large proportion of lower molecular weight compounds in the BdN oil resulted in large percentages of evaporated (>41%) and degraded (31 to 43%) oil, accounting for up to 87% of each modelled release over each 160-day simulation. The amount of oil predicted to remain on the water surface or within the water column totaled 2 to 17%, understanding that entrainment and resurfacing can result in surface and entrained oil "see-sawing" between the two environmental compartments based upon wind/wave conditions on hourly timescales.

In respect of the EIS Guidelines text, the patchy and discontinuous nature of the released oil after a month would not be considered a "slick." Furthermore, the timeframe for oil to reach shorelines (from the stochastic simulations) was closer to 7 to 60 days for the eastern shores of Newfoundland and southeastern shores of Labrador. However, the simulation was allowed to continue for another 100 days following this point, resulting in oil leaving the model domain. If the simulation was terminated at the time oil began to impact shorelines, much less or even no oil would be predicted to leave this large model domain.

The potential for environmental effects following a release typically diminish with time as natural processes disperse and degrade the oil. While the effects may be non-zero, the patchy, discontinuous, and highly weathered oil would likely have limited effects to biota. Regions that would have the potential for oil to reach their shorelines include areas to the east such as the Azores.

References

RPS. 2019b. BHP Canada Orphan Basin Exploration Drilling Project 2019-2028: Oil Spill Trajectory and Fate Assessment.

2.5 ACCIDENTS AND MALFUNCTIONS – PREVENTION AND RESPONSE

2.5.1 IR-09

External Reviewer ID (as applicable)

ECCC-3

Reference to EIS

Section 15.6.2.1

Context and Rationale

ECCC stated that the proponent's synthesis of the effects of dispersants on marine and migratory birds provides conflating information and does not provide sufficient evidence to support the conclusion that "dispersant mitigates the potential adverse effects of oil on birds compared to untreated oil". While applying dispersants may be beneficial for migratory birds in some situations, they may prove to be more harmful in others.

It is difficult to compare the results of the Whitmer et al. 2018 study (conducted in a laboratory) to what may occur in the offshore areas of NL. Specifically, in Whitmer et al. 2018, post-exposure birds were kept out of the water and in ambient temperatures of 15.5°C-18.3°C, whereas any birds exposed to dispersants in the project area would be confined to water in much colder temperatures.

Specific Question / Information Requirement

In light of the views expressed by ECCC, consider the effects of dispersants in colder water temperatures and revise the effects assessment, as necessary. Update the proposed mitigation and follow-up and conclusion on the effects of dispersants on marine and migratory birds, as appropriate.

BHP Response

A more careful examination of the Whitmer et al. (2018) study reveals reported exposures of dispersant-only (Corexit 9500) concentrations ranging from 5.6 to 971 ppm. The author then concludes that "*…accidental exposure of birds to pure, high-concentration dispersant, such as during aerial or boat-based application, may result in high morbidity and mortality*". This statement was based on the DISP-H (high concentration dispersant) exposure experiment, which involved concentrations of 918 to 971 ppm. Hypothetically, if a dispersant aircraft were to spray dispersants onto clean seawater (rather than targeting an oil slick), concentrations would range somewhere between 3 to 10 ppm for minutes to possibly a few hours (National Academies of Sciences Engineering and Medicine [NASEM] 2019). These concentrations are based on the operational dispersant spray system limits of approximately 9.4 to 93.5 litres per hectare (1 to 10 gallons per acre) and would rapidly dilute to below detection limits within a few more hours. However, the Whitmer research drew conclusions of what might happen to dispersant-only exposed birds at unrealistically high concentrations (10x to 100x higher) than typically observed and measured in the field.

Even the low concentration dispersant exposure pathways in the study are not expected to occur during an open ocean oil spill response, since direct application of dispersants on adult birds or developing eggs is contrary to best management practices. Dispersant delivery aircraft use mitigation measures to avoid areas of flocking birds, and best management practices stipulate that application should be paused if flocks of birds are observed. As a result, the concern with dispersant use is the hazard posed by untreated oil slicks compared to chemically dispersed oil, not from effects of the dispersant themselves. This point has been emphasized in two state-of-the-science publications on dispersants (National Research Council 2005; NASEM 2019). If birds are on the water's surface within a slick, they will already be exposed to the untreated floating oil before dispersants are applied and will likely succumb to oiling before any response option can be initiated.

Much of the literature on the toxicity of dispersants and dispersed oil is based on 48- or 96-hr LC_{50} studies where the test organisms are exposed to a constant concentration of dispersant or dispersed oil for relatively prolonged periods. Prolonged and constant exposure to very high concentrations of dispersed oil in a laboratory setting (in order calculate LC_{50} values) is considerably different from the likely exposure regime experienced by marine organisms in the open sea following an oil spill, as evidenced by analytical results from several field trials conducted in the North Sea to assess fate and effects of dispersant use on an open ocean oil slick (Bejarano et al. 2014). Following the initial application of dispersants, the surface oil slick will transform into elevated concentrations of small, dispersed oil microdroplets, which will dilute quickly to below 1 ppm (mg/L = ppm). Field experiments and the subsequent chemical characterization conducted in large scale open ocean experiments in the North Sea in 1994, 1995, and 1996 showed rapid (within one hour) dilution of dispersed oil concentrations following dispersant application (AEA Technology 1994, 1995; Jones and Petch 1995; Strøm-Kristiansen et al. 1997; Coelho et al. 1998).

Further evidence of the swift dilution of dispersed oil can be found from extensive studies during the Deepwater Horizon spill (Operational Science Advisory Team 2010) [inter-agency team formed to compile, analyze and interpret the data generated from the 2010 Deepwater Horizon oil spill large-scale sampling and monitoring program]), in which more than 11,397 water and sediment samples were analyzed. Findings indicated that less than 1% of these water samples exceeded US EPA aquatic toxicity benchmarks. These data are a strong indication of the benefits that dispersant use can have by removing oil from the surface quickly (within hours) to reduce the overall hazard posed by untreated surface slicks, which can persist for weeks, resulting in ongoing potential fouling of surface water wildlife, such as marine and migratory birds. Even the Whitmer et al. (2018) manuscript acknowledged, "*…it is clearly understood and acknowledged that surface oiling constitutes a great risk to seabirds in a spill, and effective chemical dispersion of a surface slick (resulting in distribution of oil into the water column) can lead to decreasing the overall concentration of oil to which a given bird might be exposed.*"

Mitigation

- The potential impacts of dispersant-only exposure to marine and migratory birds are mitigated through BMPs, which typically require trained wildlife observers to confirm the absence of birds on the water within 1 km of aerial dispersant application operations (NASEM 2019).

- Dispersant spraying aircraft and spotter aircraft operate at very low altitudes (approximately 30 to 50 m above the sea surface for the spraying aircraft, higher for the spotter plane). At these altitudes both the dispersant and the spotter aircraft will be closely monitoring for bird flight activity, since a bird strike poses significant threat to aircraft safety.
- Any offshore dispersant spraying operation should be directed by a spotter aircraft flying at sufficient altitude (300 to 600 m) above the spraying aircraft to assess the spatial scale of the oil slick, using trained observers who can guide the aircraft or vessels to the area of the slick containing the thickest oil. Trained observers in the spotter aircraft can then instruct the dispersant spraying aircraft when to start and stop the spraying operation. Since the locations of the thick oil will change as oil slicks drift, it is necessary for the spotter aircraft and spraying aircraft (or spray vessel) to act in tandem to target oil. Further, dispersant operations are conducted at the lowest altitude and speed possible to ensure accurate delivery to the sea surface, since spraying at high altitudes may result in the dispersant drifting off- target, particularly if the aircraft is operating in a cross-wind. Flying low and slow, with appropriate coordination with a spotter aircraft, should ensure proper application to thick oil.

References

AEA Technology. 1994. International calibration of laboratory dispersant test methods against sea trials. Oxfordshire, UK: AEA Technology.

AEA Technology. 1995. International calibration of laboratory dispersant test methods against sea trials. Field trial report. July 1995 sea trials. Oxfordshire, UK: AEA Technology.

Bejarano, A.C., J.R. Clark and G.M. Coelho. 2014. Issues and challenges with oil toxicity data and implications for their use in decision making: A quantitative review. Environmental Toxicology and Chemistry, 33(4): 732-742.

Coelho, G.M., D.V. Aurand, G.S. Petch and D.M. Jones. 1998. Toxicity bioassays on dispersed oil in the North Sea: June 1996 field trials. Ecosystem Management & Associates, Inc., Purcellville, VA. EM&A Report 96-02.

Jones, M. and S. Petch. 1995. A report on the analysis of hydrocarbons in sea waters and associated samples from trial oil spills off eastern England, July 1995. University of Newcastle upon Tyne, Newcastle upon Tyne, UK.

NASEM (National Academies of Sciences Engineering and Medicine). 2019. The use of dispersants in marine oil spill response. National Academies Press. Washington DC.

National Research Council. 2005. Oil spill dispersant efficacy and effects. National Academy Press. Washington DC.

Operational Science Advisory Team. 2010. Unified Area Command summary report for sub-sea and sub-surface oil and dispersant detection: sampling and monitoring. US Coast Guard, Washington, DC.

Strøm-Kristiansen, T., J.N. Hokstad, A. Lewis and P.J. Brandvik. 1997. NOFO 1996 oil on water exercise –analysis of sample material. SINTEF Data report number STF66 A97050. Trondheim, Norway.

Whitmer, E.R., B.A. Elias, D.J. Harvey and M.H. Ziccardi. 2018. An experimental study of the effects of chemically dispersed oil on feather structure and waterproofing in common murres (*Uria aalge*). Journal of Wildlife Diseases, 54(2): 315-328. https://doi.org/10.7589/2017-01-016.

2.5.2 IR-10

External Reviewer ID (as applicable)

MTI-28

Reference to EIS

Section 15.5

Context and Rationale

The EIS Guidelines require the proponent to identify the probability of potential accidents and malfunctions related to the Project and the contingency and emergency response procedures that would be put in place. MTI has requested additional detail on how spills would be detected, and has raised related concerns regarding the time it would take to deploy spill contingency measures such as booms, berms, and other barriers that may be used to contain a spill or protect sensitive habitats.

Specific Question / Information Requirement

Provide additional detail regarding how spills would be detected, including the time it could take between detection and deployment of spill contingency methods. If there is a possibility of a spill going undetected, provide a description of these scenarios and comment on the potential implications regarding the resultant effects.

BHP Response

Various different types of spill incidents were considered in Chapter 15 of the EIS. Details of the detection methods used for each spill type are provided below. Oil spill response procedures and estimated deployment timelines will be contained in the Oil Spill Response Plan (OSRP), which is currently under development. Consultation with Indigenous groups will be conducted as part of plan development and it must be approved by the C-NLOPB, prior to it becoming a public document.

Blowout

A blowout can occur if both primary and secondary well control are lost, resulting in a spill of reservoir hydrocarbons. A spill of this type is very rare. The well is constantly monitored during drilling operations, 24 hours per day, by trained and competent personnel using instrumentation onboard the MODU. Regular drills are held to verify that crews respond immediately to any indications of a loss of well control. Procedures are detailed in a Well Control Bridging Document, developed and approved jointly by BHP and the Drilling Contractor.

Batch Spill

The scenario of a fuel tank leak to sea other than through collision is not credible given the build standards imposed by MARPOL Annex 1, Regulation 12 which will apply to any vessel chartered by BHP to support the program. Specifically, modern vessels have fuel tanks inboard of water ballast tanks so potential for leak to sea is only though external damage. Engine room control panel instrumentation would alert to unplanned drops in tank levels. Any leak inboard would be to the bilge; bilge alarms would sound and the engine room crew would respond as necessary.

Leak During Hydrocarbon Fluid Transfers from PSV to MODU

A leak of diesel fuel or SBM could occur during transfer from the Project support vessel (PSV) to the MODU. A spill of this type would be small in volume (hose contents) due to the use of dry break couplings with non-return valves. It would be detected by:

- Loss of pressure in the transfer line, which is continuously monitored onboard the PSV
- Visually by personnel onboard either the PSV or MODU; who would be continuously monitoring the transfer line during the operation – floating hoses are used so any leak would be immediately visible

SBM Spill

A leak of SBM spill could also occur from the riser due to failure of the slip joint packer, riser failure or inadvertent lower marine riser package unlatch. A spill of this type would be detected by one or more of the following:

- Visually in the case of the slip joint packer, which is located in the MODU moonpool. The MODU has not been selected yet but typically TV cameras are located to allow this to be monitored remotely
- Status lights and alarm in the case of a riser failure or inadvertent lower marine riser package unlatch. It would also be immediately confirmed visually using the moonpool TV cameras and personnel onboard
- Fluid volume monitoring instrumentation onboard the MODU
- Loss of pressure at mud pumps circulating drilling fluid around the well during drilling operations

2.5.3 IR-11

External Reviewer ID (as applicable)

Not applicable

Reference to EIS

Section 15.5

Context and Rationale

The EIS Guidelines require the proponent to discuss the use, availability (including nearest location), timing (testing and mobilizing) and feasibility of a capping stack to stop a blowout and resultant spills. Page 15-85 of the EIS states "the most likely timing for mobilization and installation [of a capping stack]…is calculated to be 13 days (summer) to 17 days (winter).” Later on the same page, it states that “BHP estimates that the earliest a well could be capped would be 17 days after an incident”. Based on these two statements, it is unclear if mobilization and installation of a capping stack would likely take between 13 and 17 days, or if it would take 17 days or more.

Specific Question / Information Requirement

Please confirm the estimated earliest and longest time it would take to cap a well following a blowout incident.

BHP Response

As stated in section 15.5.3.3 of the Environmental Impact Statement, in the event of a source control incident BHP’s primary plan is to use the OSRL capping stack stored in Stavanger, Norway. BHP would immediately assess the most expedient route for capping the well, either through direct mobilization from Stavanger via marine transport to the wellsite or through air to St. John’s or Gander Airport on an Antonov AN-124 aircraft and mobilizing it from there to wellsite in a suitable Installation Vessel.

The most likely timing for mobilization and installation by sea on an Installation Vessel from Stavanger is estimated to be 13 days (summer) and 17 days (winter), however metocean conditions at the time will dictate transit speeds and installation timing.

Not all well blowout incidents will be the same, therefore it is difficult to identify a maximum well capping time. There are many variables that could sway the scenario that affect the response time or even dictate whether or not a well capping stack is suitable. Some of these factors may include, but not limited to, vessel availability, amount and complexity of debris at the well location, metocean conditions, regulatory permitting, etc., therefore BHP can only estimate that the earliest a well could be capped would be 13 days after an incident.

2.6 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

2.6.1 IR-12

External Reviewer ID (as applicable)

NG-01

Reference to EIS

Section 15.4; Section 16

Context and Rationale

The Nunatsiavut Government raised concern regarding spill risk and probabilities as a result of severe weather events, and noted that it appears as though the number of disconnections required for other nearby projects has increased with the increase in severe weather events. The Nunatsiavut Government raised concern that more frequent disconnections may increase the probability of an accident or malfunction. The

Nunatsiavut Government also noted that climate change could further exacerbate this risk, which should be more thoroughly considered in the assessment.

Specific Question / Information Requirement

Discuss whether disconnecting and reconnecting the MODU, as may be required in severe weather, could result in an accident or malfunction. Discuss whether increases in the frequency of severe weather events could influence the risk of an accident or malfunction.

BHP Response

Although disconnecting the MODU for severe weather is an infrequent activity, the MODU equipment is designed to do this safely as a planned and controlled operation. Disconnection from the well is done in order to reduce the spill risk associated with severe weather.

The MODU will always suspend operations and secure the well with the well control equipment remaining in place prior to the onset of severe weather. A risk assessment and barrier analysis are conducted prior to suspension of operations and disconnection from the well. Multiple, verified barriers are required to provide redundancy and isolate any hydrocarbon reservoirs.

Weather conditions that require disconnection are defined in the MODU's Safety Case and detailed procedures are in place and crews trained and competent to carry them out. The required equipment is fit for purpose, certified and regularly inspected. It is tested on the surface prior to deployment. Following disconnection for severe weather, the MODU will wait until the weather has subsided sufficiently to allow reconnection. The required weather conditions for reconnection are again defined in the Safety Case and detailed procedures in place. Following reconnection, blowout preventer equipment is tested prior to the resumption of operations.

Consequently, any increase in risk from increased frequency of severe weather events is considered to be minimal.

3.0 REQUIRED CLARIFICATIONS

3.1 SPECIAL AREAS

3.1.1 CL-01

External Reviewer ID (as applicable)

Not applicable

Reference to EIS

Table 11.1

Context and Rationale

Table 11.1 of the EIS lists special areas in the LAA. The LAA for special areas is defined as the project area and adjacent areas within a 50 km buffer zone where Project-related environmental effects are reasonably expected to occur based on available information. The LAA also includes transit routes to and from the project area with a 10 km zone of influence. However, the Agency notes that the sound modelling results estimated that distances to sound threshold criteria for behavioural change (Appendix E) could be up to >100 km in February for a semi-submersible drill rig.

Specific Question / Information Requirement

Revise Table 11.1 to include all special areas within the maximum potential distance to sound threshold criteria (i.e. >10 km) from the ELs.

BHP Response:

As per the response to IR-03, based on consideration of available information, the 50 km buffer around the Project Area for the LAA is considered conservative and the use of a >100 km buffer does not fit within the bounds of the LAA definition as effects extending to this distance are not reasonably expected to occur. However, for completeness, Table 1 (revised EIS Table 11.1) has been revised to include Special Areas within 100 km (indicated in **bold**).

Table 1 Revised Table 11.1: Special Areas in the LAA

Special Area	Defining Features	Nearest Distance to Special Area (km)			
		EL 1157 / 1158	Project Area	LAA	Potential PSV Routes
East Avalon/Grand Banks Candidate National Marine Conservation Area (NMCA)	Detailed description not available. Overlaps Eastern Avalon EBSA, Witless Bay Ecological Reserve and Witless Bay Islands IBA. Assumed an important area for seabirds.	278	248	Overlap	Overlap
Northeast Newfoundland Slope Closure Marine Refuge	High biodiversity. High density of corals and sponges. Bottom contact fishing activities prohibited to protect corals and sponges.	Overlap	Overlap	Overlap	Overlap
SiBA - Sea Pens	Fisheries and Oceans Canada (DFO) modelling shows high predicted presence probability of indicated species.	Overlap	Overlap	Overlap	Overlap
SiBA - Large Gorgonian Corals		Overlap	Overlap	Overlap	Overlap
Northeast Slope Canadian EBSA	Concentrations of corals. High aggregations of Greenland halibut and spotted wolffish (species at risk (SAR)) in spring. Aggregations of marine mammals (e.g., harp seals, hooded seals and pilot whales).	Overlap	Overlap	Overlap	Overlap
Eastern Avalon Canadian EBSA	Seabird feeding areas. Cetaceans, leatherback turtles and seals feed in the area from spring to fall.	281	250	Overlap	Overlap
Orphan Spur Canadian EBSA	**Area of high diversity. High concentrations of corals, marine mammals and seabirds. Densities of sharks and species of conservation concern (e.g., northern, spotted and striped wolffish, skates, roundnose grenadier, American plaice, redfish). Aggregations of several fish functional groups.**	**105**	**71**	**21**	**50**
Baccalieu Island Canadian EBSA	Capelin spawning area. Aggregations of killer whales, shrimp, piscivores, spotted wolffish. Foraging area for seabird species: Atlantic puffin, black-legged kittiwake and razorbill.	259	237	Overlap	Overlap
Critical Habitat Northern Wolffish	Critical habitat has been identified in areas containing features (e.g., depth and sea bottom temperatures) that allow for the recovery and survival of these species.	17	Overlap	Overlap	Overlap
Critical Habitat Spotted Wolffish		12	Overlap	Overlap	Overlap

Table 1 Revised Table 11.1: Special Areas in the LAA

Special Area	Defining Features	Nearest Distance to Special Area (km)			
		EL 1157 / 1158	Project Area	LAA	Potential PSV Routes
6B Snow Crab Stewardship Exclusion Zone	Crab fishing closure area.	281	255	Overlap	Overlap
Near Shore Snow Crab Stewardship Exclusion Zone		277	248	Overlap	Overlap
Witless Bay Seabird Ecological Reserve	North America's largest Atlantic puffin colony. World's second largest Leach's storm-petrel colony.	337	306	Overlap	Overlap
VMEs - Sponge	Concentrations of sponges and or corals.	62	35	Overlap	201
VMEs - Large Gorgonian Coral		63	35	Overlap	179
VME – Sea Pens	**High concentrations of sea pens**	**96**	**64**	**14**	**211**
Orphan Knoll Seamount Closure	**Closed to protect seamounts**	**113**	**89**	**39**	**222**
Flemish Pass / Eastern Canyon (2) NAFO Fisheries Closure Area (FCA)	**Extensive sponge grounds and areas of large gorgonian corals in the Flemish Pass**	**123**	**93**	**43**	**198**
Northwest Flemish Cap (10) NAFO Fisheries Closure Area (FCA)	**High coral and sponge concentrations, as well as areas of sea pens**	**104**	**71**	**21**	**228**
Northwest Flemish Cap (11) NAFO Fisheries Closure Area (FCA)		**122**	**90**	**40**	**226**
Northwest Flemish Cap (12) NAFO Fisheries Closure Area (FCA)		**116**	**88**	**38**	**264**
Sackville Spur (6) NAFO Fisheries Closure Area (FCA)	High sponge and coral concentration area where bottom fishing activities are prohibited.	59	32	Overlap	204

Table 1 Revised Table 11.1: Special Areas in the LAA

Special Area	Defining Features	Nearest Distance to Special Area (km)			
		EL 1157 / 1158	Project Area	LAA	Potential PSV Routes
Orphan Knoll UN Convention on Biological Diversity EBSA	**Seamounts typically support endemic populations and unique faunal assemblages. This seamount is an island of hard substratum with uniquely complex habitats that rise from the seafloor of the surrounding deep, soft sediments of the Orphan Basin. Although close to the adjacent continental slopes, Orphan Knoll is much deeper and appears to have distinctive fauna. Fragile and long-lived corals and sponges have been observed and a Taylor Cone circulation provides a mechanism for retention of larvae.**	**129**	**98**	**48**	**245**
Seabird Foraging Zone in the Southern Labrador Sea UN Convention on Biological Diversity EBSA	**Supports globally significant populations of marine vertebrates, including an estimated 40 million seabirds annually. Important foraging habitat for seabirds, including 20 populations of over-wintering black-legged kittiwakes, thick-billed murres and breeding Leach's storm-petrels. Encompasses the pelagic zone of the Orphan Basin, continental shelf, slope and offshore waters inside and outside the Canadian EEZ.**	**87**	**52**	**2**	**227**
Slopes of the Flemish Cap and Grand Bank UN Convention on Biological Diversity EBSA	Aggregations of corals and sponges, high diversity of marine taxa including SAR Greenland halibut fishery grounds.	Overlap	Overlap	Overlap	110
Quidi Vidi Lake IBA	Daytime resting site for gulls (e.g., herring, great black-backed, Iceland, glaucous, common black-headed) late fall to early spring; reported locally rare ring-billed gull, mew gull and lesser black-backed gull; waterfowl (e.g., American black ducks, mallards and northern pintails) common in winter.	320	292	Overlap	Overlap

BHP

Table 1 Revised Table 11.1: Special Areas in the LAA

Special Area	Defining Features	Nearest Distance to Special Area (km)			
		EL 1157 / 1158	Project Area	LAA	Potential PSV Routes
Witless Bay Islands IBA	Globally significant numbers of breeding seabirds, including more than half of eastern North American Atlantic puffin population and almost 10% of global Leach's storm-petrel population. Large numbers of nesting common murre, black-legged kittiwake and herring gull. Smaller numbers of nesting great black-backed gull, northern fulmar, thick-billed murre, razorbill and black guillemot. Important area for sea ducks (e.g., white-winged scoter, surf scoter, long-tailed duck and common eider during fall migration.	307	337	Overlap	Overlap
Distances are calculated in NAD83 UTM Zone 23N Projection					

3.1.2 CL-02

External Reviewer ID (as applicable)

Not applicable

Reference to EIS

Section 11.3.1.

Context and Rationale

Section 11.3.1.3 of the EIS provides the percent overlap between special areas and the project area. However, information is not provided on the percent overlap between special areas and ELs.

Specific Question / Information Requirement

Provide the percent overlap of special areas with the ELs.

BHP Response:

No special areas identified for the presence of marine and migratory birds or sea turtles, or their habitats overlap with the Project Area or LAA (other than the PSV route). Thus, this discussion is focused on marine fish and fish habitat and marine mammals in special areas that overlap with the Project Area and LAA as identified in EIS Table 11.1 (see Table 1 in response to CL-01). These include Northeast Newfoundland Slope Closure marine refuge (12.6% overlap with Project Area, 1.18% overlap with EL 1157, and 4.58% overlap with EL 1158), SiBA identified for sea pens (5.9% overlap with Project Area, 0% overlap with EL 1157, and 0.64% overlap with EL 1158), SiBA identified for large gorgonian corals (100.0% overlap with Project Area, 0% overlap with EL 1157, and 2.98% overlap with EL 1158), Northeast Slope EBSA (13.0% overlap with Project Area, 0% overlap with EL 1157, and 1.34% overlap with EL 1158), Slopes of the Flemish Cap and Grand Bank EBSA (5.6% overlap, 2.12% overlap with EL 1157, and 0.33% overlap with EL 1158), and proposed critical habitat for northern and spotted wolffish (1.5% and 0.9% overlap with the Project Area, respectively).

3.2 ACCIDENTS AND MALFUNCTIONS – SPILL SCENARIOS, MODEL INPUTS, AND MODEL RESULTS

3.2.1 CL-03

External Reviewer ID (as applicable)

C-NLOPB-4

Reference to EIS

Table 15.3

Context and Rationale

Table 15.3 of the EIS (p. 15-12) provides details on the hypothetical subsurface release locations, parameters, and stochastic scenario information. It expresses release rate and volume in bpd and bbl respectively. It is preferred that volumes are expressed as litres or cubic metres rather than bbl.

Specific Question / Information Requirement

Revise Table 15.3 as requested.

BHP Response:

See Table 2 for revised EIS Table 15.3.

Table 2 Revised EIS Table 15.3: Hypothetical Subsurface Release Location, Parameters, and Stochastic Scenario Information

Scenario Parameter	Release Locations of Stochastic Scenarios				
Block / Release Location	**EL 1157**		**EL 1158**		**Vessel Route**
Latitude	48.825889 N		48.491786 N		47.550842 N
Longitude	47.851234 W		48.06617 W		52.522011 W
Water Depth of Release	2,338 m		2,047 m		Surface
Released Product	Bay du Nord (BdN)				Marine Diesel
Gas to Oil Ratio	400 scf/bbl (71.24 m^3/m^3)				-
Pipe Diameter	31.12 cm (12.25 in.)				-
Oil Discharge Temperature	85°C				-
Release Duration	30 d	120 d	30 d	120 d	Near-Instantaneous
Release Rate	21,476 m^3/day	20,531 m^3/day	21,464 m^3/day	20,531 m^3/day	-
Total Released Volume	644,278 m^3	2,463,740 m^3	643,908 m^3	2,463,661 m^3	3,200 L (3.2 m^3)
Model Duration	160 d				30 d
Number of Simulations within Stochastic Analysis	172 annual (79 winter & 93 summer) for each scenario				

3.2.2 CL-04

External Reviewer ID (as applicable)

Not applicable

Reference to EIS

Section 15.3; Appendix F

Context and Rationale

Table 15.7 of the EIS (Table 4-3 of Appendix F) indicates that shoreline contamination probabilities are identical for the 'oil exposure exceeding 1 g/m^2 for all shorelines' (i.e., the socio-economic threshold) and the 'oil exposure exceeding 100 g/m^2 for all shorelines' (i.e., the ecological threshold) (except for the vessel route location). Given the difference between the socio-economic and ecological thresholds for shoreline oiling, it is not clear how shoreline oiling probabilities are identical for both oil exposure exceeding 1 g/m^2 and exceeding 100 g/m^2.

Specific Question / Information Requirement

Confirm that the values in Table 15.7 of the EIS (Table 4-3 of Appendix F) are accurate or provide updated values.

BHP Response:

The shoreline contamination probabilities for the socio-economic and ecological thresholds were the same for these BdN simulations. This is the result of a combination of the crude oil type, the high release volumes, trajectory and fate processes, the environment into which this oil was simulated to be released in, and the timeframes over which this was investigated. When oil is fresh, it is less viscous and can form sheens and thin slicks. However, as time passes (hours to days), the natural dispersion and degradation processes that weather and degrade the oil remove the lighter ends forming more viscous and therefore thicker globules of weathered oil. With the addition of wind-induced waves and the potential for emulsification, the oil becomes even more viscous, of greater volume (due to the added water content of the emulsification), and therefore even thicker. Due the timeframes involved for oil to reach shorelines (>7 days in all simulations), the volume of oil being discharged, and the long (160-day) duration of the simulations, when oil did impact shorelines, it was always >100 g/m^2. For the marine diesel releases simulated at the vessel route location, the lighter product (forming thinner slicks and sheens) and the rapid weathering processes resulted in oil exposure above the socio-economic threshold, but never above the ecological threshold.

4.0 REQUEST FOR ADDITIONAL INFORMATION

4.1 FISH AND FISH HABITAT; MARINE MAMMALS AND SEA TURTLES

External Reviewer ID (as applicable)

DFO-62; DFO-63; DFO-67; DFO-68; DFO-69; DFO-72

Reference to EIS

Appendix D

Context and Rationale

Section 3.1 of the EIS Guidelines state that the EIS must describe the nature, composition and fate (e.g. areal extent) of drilling wastes at various water depths and at various stages of drilling using dispersion modelling.

Fisheries and Oceans Canada reviewed the modeling completed (Appendix D - Drill Cutting Dispersion Modelling Report) and raised several issues related to the methods and specific inputs used, including:

- The model and forcing have not been validated and the results are based on a single run using HYCOM currents from 2012 (one run for spring and one for summer).
- There remains unanswered questions such as a clear indication of the vertical resolution of the HYCOM model and if it adequately resolves the vertical structure and/or is adequate for the ocean conditions (e.g., currents/density fields) within the Project Area.
- The choice of daily current output has not been justified, particularly in regions like the Project Area where high frequency motions (e.g. winds, tides, inertial oscillations) are common.
- The report does not provide adequate information on the resolution of the model (the grid, time steps) relative to horizontal diffusivity (K_h) and vertical diffusivity (K_z) in highly energetic areas.
- Particle size distribution of cuttings are unknown, however, a single distribution (rather than a range of possibilities) was used in the model without a rationale for using this distribution.
- The settling velocities taken from a study in the Gulf of Mexico (Brandsma and Smith 1999), which has a very different density structure than the Project Area, has not been justified.

Specific Question / Information Requirement

Provide a rationale for how the inputs (horizontal and vertical diffusivity coefficients, mixing parameters, single distribution particle size, and daily current output) using only one year (2012) of the HYCOM currents data are justified and adequate for the Project Area and therefore adequate for predicting drill cutting dispersion.

Justify the rationale for applying settling velocities based on data from the Gulf of Mexico and provide reference.

BHP Response

- *The model and forcing have not been validated and the results are based on a single run using HYCOM currents from 2012 (one run for fall and one for summer).*

  The MUDMAP model has been validated on numerous occasions, through past projects (client confidential) and publications (Burns et al. 1999; King and McAllister 1998). MUDMAP is also a software package that was developed by and is currently being maintained by RPS, as the current state of scientific knowledge evolves and advances. The HYCOM model has been validated and verified comprehensively by the U.S. Navy using variables such as temperature, salinity, sea surface height, and current velocity (Metzger et al. 2008, 2010). In these validation studies, data from the HYCOM model were compared with in situ measurements from multiple data sources.

  RPS has performed a qualitative review of the HYCOM time series between 2006-2010 and 2006-2012, comparing current statistics (speeds and directions) from each year at multiple depths for each modelled timeframe (see RPS MUDMAP technical report; Tajalli-Bakhsh et al. 2018). Current trends for the two model periods during 2012 were congruent with the overall seven-year trend and were thus deemed suitable as a representative modelling period. The two periods chosen represented worst-case discharges for both extent of discharge (during periods with higher current velocities and enhanced sediment transport) and overall depositional thickness (during periods with lower current velocities and increased sediment accumulation).

- *There remains unanswered questions such as a clear indication of the vertical resolution of the HYCOM model and if it adequately resolves the vertical structure and/or is adequate for the ocean conditions (e.g., currents/density fields) within the Project Area.*

  The vertical resolution of the HYCOM data used in this assessment was the same in number and thickness between sites. There were 36 vertical layers at EL 1157 and EL 1158, which were 2,338 m and 2,047 m deep, respectively. Vertical layers were of finer scale resolution near the sea surface, becoming coarser as depth increased. The resolution was identical for each layer between the two hypothetical drilling locations, based upon the depth of each location. Layer resolution includes:

  HYCOM layers used in modelling:

  1-6: 2 metres each
  7: 3 metres
  8-14: 5 metres each
  15-19: 10 meters each
  20-21: 25 metres each
  22-26: 50 metres each
  27-33: 100 metres each
  34-35: 250 metres each
  36: 500 metres

- *The choice of daily current output has not been justified, particularly in regions like the Project Area where high frequency motions (e.g. winds, tides, inertial oscillations) are common.*

  While the Project Area is dynamic, some of the high frequency motions stated above do not substantially affect drilling discharge transport and fate. Winds predominantly affect surface waters and tidal forcing is more relevant closer to shore. However, the Project Area is approximately 350 km northeast of St. John's, Newfoundland, and both tidal forcing and inertial oscillations are not uni-directional but would oscillate around the point. Therefore, not considering them is more conservative and maximizes depositional footprint thickness. The majority of these discharges occur at or near the seabed, where currents are of lower velocity (<30% of surface speeds on average; see Figures 1-7 and 1-8 of RPS 2019a; EIS Appendix D). However, for some of the releases, the discharge occurs within HYCOM Layer 3 at approximately 5 m depth. For fine grain materials that are released near the surface, settling times are measured in weeks (>23 days, which corresponds with tens to hundreds of kilometres of transport and negligible depositional thickness). Therefore, the provided depositional footprints are the result of the larger grain materials, which would have settled out in a matter of hours or days. While daily HYCOM current files have been used, the actual current modelled at each time step is a linear interpolation between the two daily currents bounding the exact point in time. Furthermore, for Project consistency, the same environmental forcing was used between the oil spill and the drilling discharge assessments.

- *The report does not provide adequate information on the resolution of the model (the grid, time steps) relative to horizontal diffusivity (K_h) and vertical diffusivity (K_z) in highly energetic areas.*

  The horizontal diffusivity used in the RPS modelling was 2 m^2/s throughout the entire grid, with a vertical diffusivity of 0.001 m^2/s. While the spatial coverage of the modelling grid was over 10,000 km^2 (100 km by 100 km), the depositional footprints were post-processed and provided on a 10 km x 10 km grid with a resolution 5 m per grid cell. Ultimately, the area with substantial deposition was on a spatial scale of 2 to 5 km. The variability of hydrodynamics at sub-2 km grid resolution is not captured by the HYCOM model. The 1/12° equatorial resolution of the HYCOM model provides gridded ocean data with an average spacing of approximately 7 to 8 km between each point.

- *Particle size distribution of cuttings are unknown, however, a single distribution (rather than a range of possibilities) was used in the model without a rationale for using this distribution.*

  This Project is an exploration drilling project and therefore, no drilling has occurred, and no particle size distributions could have been measured. The particle size distribution used in this modelling was based on cuttings particle size distributions from laser diffraction data by Weatherford Laboratories of cuttings samples from the Statoil Canada Ltd. et al Bay de Verde F-67 well in 2014. Averages for particles were classified as coarse sand through fine silts-clays based on the Wentworth Scale (Wentworth 1922). These measured distributions were also used in the Equinor Flemish Pass exploration Drilling project, a project that has already been approved using this distribution and modelling approach. Because the particle sizes were from a past study in the Newfoundland region, they could be considered representative of other locations within the area.

- *The settling velocities taken from a study in the Gulf of Mexico (Brandsma and Smith 1999), which has a very different density structure than the Project Area, has not been justified.*

  Brandsma and Smith (1999) settling velocities were only used to define the settling of water-based muds used during drilling. This study focused on fall velocity classes adapted from O'Reilly et al. (1989) and incorporated real-world field data and measurements of muds. This approach was used because there is a lack of settling velocity field data for cuttings / muds in the Newfoundland region and because it does not depend on the density structure in the Project Area, which is unknown. For the cuttings settling velocities, RPS used the Sleath (1984) approach, which is a simpler conceptual model that investigates cuttings velocities based upon an assumption of spherical particles.

References

Brandsma, M.G. and J.P. Smith. 1999. Offshore Operators Committee mud and produced water discharge model – report and user guide. Exxon Production Research Company, December 1999.

Burns, K.A., S. Codi, M. Furnas, D. Heggie, D. Holdway, B. King and F. McAllister. 1999. Dispersion and Fate of Produced Formation Water Constituents in Australian Northwest Shelf Shallow Water Ecosystem. Marine Pollution Bulletin, 38(7): 593-603.

King, B. and F.A. McAllister, 1998. Modeling the dispersion of produced water discharges. APPEA Journal 1998: 681-691.

Metzger, E.J., H.E. Hurlburt, A.J. Wallcraft, J.F. Shriver and O.M. Smedstad. 2008. Validation Test Report for the Global Ocean Prediction System V3.0 – 1/12° HYCOM/NCODA: Phase I. Naval Research Laboratory. Report Number: NRL/MR/7320--08-9148.

Metzger, E.J., O.M. Smedstad, P.G. Thoppil, H.E. Hurlburt, D.S. Franklin, G. Peggion, J.F. Shriver, T.L. Townsend and A.J. Wallcraft. 2010. Validation Test Report for the Global Ocean Forecast System V3.0 – 1/12° HYCOM/NCODA: Phase II. Naval Research Laboratory. Report Number: NRL/MR/7320--10-9236.

O'Reilly, J., T.C. Sauer, Jr., R.C. Ayers, Jr., R.P. Meek and M.G. Brandsma. 1989. "OOC Mud Discharge Model: Field Verification Study". In: F.R. Engelhardt, J.P. Ray and A.H. Gillam (eds.). Drilling Wastes, Elsevier Applied Science. New York. 1989.

RPS. 2019a. BHP Canada Orphan Basin Region Exploration Drilling Project 2019-2028: Drill Release Risk Assessment.

Sleath, J.F.A. 1984. Sea Bed Mechanics. Published by John Wiley & Sons.

Tajalli-Bakhsh, T., M. Horn and M. Monim. 2018. Metocean Analysis Offshore Newfoundland: An investigation of HYCOM currents and CFSR winds. Prepared for ExxonMobil Canada Ltd., Nexen Energy ULC, and Statoil Canada Ltd. 35 pp.

Wentworth, C.K. 1922. A Scale of Grade and Class Terms for Clastic Sediments. The Journal of Geology, 30(5): 377-392.