FINAL

# EL 1165A DRILLING DISCHARGES FOLLOW-UP PROGRAM: DRILL CUTTINGS MEASUREMENTS AND MONITORING 2020 REPORT

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| Document Name | Document No. | Revision | Prepared By | Reviewed By | Date |
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| EL 1165A Drill Cuttings Monitoring Report | TA1913215-01 | 1.0 | LM | MT | 25 June 2020 |
| EL 1165A Drill Cuttings Monitoring Report | TA1913215-02 | 2.0 | LM | CH/RD | 08 July 2020 |
| EL 1165A Drill Cuttings Monitoring Report | TA1913215-03 | 3.0 | LM | MT | 10 Dec 2020 |
| EL 1165A Drill Cuttings Monitoring Report | TA1913215-04 | 4.0 | KM | JS | 23 Feb 2021 |

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### ABBREVIATIONS

| | |
|---|---|
| % | percent |
| C-NLOPB | Canada-Newfoundland & Labrador Offshore Petroleum Board |
| cm | centimeters |
| EA | Environmental assessment |
| EIS | Environmental impact statement |
| EL | Exploration license |
| EMCL | ExxonMobil Canada Ltd. |
| HD | High definition |
| km | kilometers |
| m | meters |
| mm | millimeters |
| MODU | Mobile offshore drilling unit |
| NAD 83 | North American Datum 1983 |
| ROV | Remotely operated vehicle |
| SBM | Synthetic-based mud |
| UTM | Universal Transverse Mercator |
| WBM | Water-based mud |

# 1.0 INTRODUCTION

Wood Canada Environment & Infrastructure, a division of Wood Canada Limited (Wood), was contracted by ExxonMobil Canada Ltd. to conduct seabed surveys at target locations on the eastern slopes of the Flemish Pass within Exploration Licence (EL) 1165A formerly EL 1134 (Figure 1-1, EMCL 2019). This is part of the follow-up monitoring program for fish and fish habitat as set out in the Eastern Newfoundland Offshore Exploration Drilling Project Environment Impact Statement (EIS) (EMCL 2017) and commitments set out in the *Canadian Environmental Assessment Act* (2012) (CEA Agency 2019). The follow-up program is based upon a regulatory agency approved monitoring plan (EMCL 2020) that was submitted in March 2020.

The follow-up monitoring results are reported as part of a series of reports. The Drill Cuttings Monitoring Report provides details on the synthetics on cuttings monitoring, and drill cuttings deposition sampling and visual survey and addresses Decision Statement Conditions 3.12.1, 3.12.2.1, and 3.12.2.3. The Benthic Habitat Monitoring Report (Wood 2020) provides details on benthic faunal observations and addresses Decision Statement Conditions 3.12.2.2.

## 1.1 Scope

The objective of this follow-up program is to meet conditions 3.12.1, 3.12.2, 3.12.2.1, 3.12.2.2, and 3.12.2.3 of the Decision Statement (Table 1.1) and verify the accuracy of the predictions made during the environmental assessment as it pertains to marine fish and fish habitat and determine the effectiveness of the mitigation measures (CEA Agency 2019). Mitigation measures are outlined in the post-drilling survey plan (EMCL 2020). This report will focus on the effectiveness of the mitigations pertaining to drill cuttings including determining the drill cuttings disposition extent and thickness post-drilling, and to verify the drilling cuttings modeling from visual observations. Due to the reduced drilling program (only the top hole drilled) and after consultation with the board, the 200 by 200 m grid was surveyed and assessed. The effectiveness of the proposed mitigation measures for benthic fauna will also be evaluated and discussed in the benthic habitat monitoring report (see Wood 2020). The post-drilling survey pattern overlaps with the pre-drilling survey layout. This report will present the drill cutting observations results pertaining to conditions 3.12.1, 3.12.2.1, and 3.12.2.3.

**Table 1.1 Conditions met by this Survey**

| Condition | Condition Details |
|---|---|
| 3.12.1[3] | For every well, measure the concentration of synthetic-based drilling fluids retained on discharged drilling cuttings as described in the Offshore Waste Treatment Guidelines (OWTG) to verify that the discharge meets the minimum limits set out in the Guidelines (and any applicable legislative requirements) and report the results to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB); |
| 3.12.2[1, 2] | For the first well in each exploration licence, and for any well where drilling is undertaken in an area determined by coral and sponge surveys to be sensitive benthic habitat, and for any well located within a special area designated as such due to the presence of sensitive coral and sponge species, or a location near a special area where drill cuttings dispersion modelling predicts that drill cuttings deposition may have adverse effects, develop and implement, in consultation with Fisheries and Oceans Canada and the C-NLOPB, follow-up requirements to verify the accuracy of the environmental assessment and effectiveness of mitigation measures as they pertain to the effects of cuttings discharges on benthic habitat. Follow-up shall include: |
| 3.12.2.1[1] | Measurement of sediment deposition extent and thickness post-drilling to verify the drill waste deposition modeling predictions |
| 3.12.2.2[2] | Benthic fauna surveys to verify the effectiveness of mitigation measures |
| 3.12.2.3[1, 2] | Report the information collected as identified in conditions 3.12.2.1 and 3.12.2.2, including a comparison of modelling results to *in situ* results, to the C-NLOPB within 60 days following the drilling of the first well in each exploration licence. |

[1]Condition assessed in this report
[2]Condition assessed in the Benthic Habitat Report (Wood 2020)
[3]Condition no longer applicable; see Section 1.3.

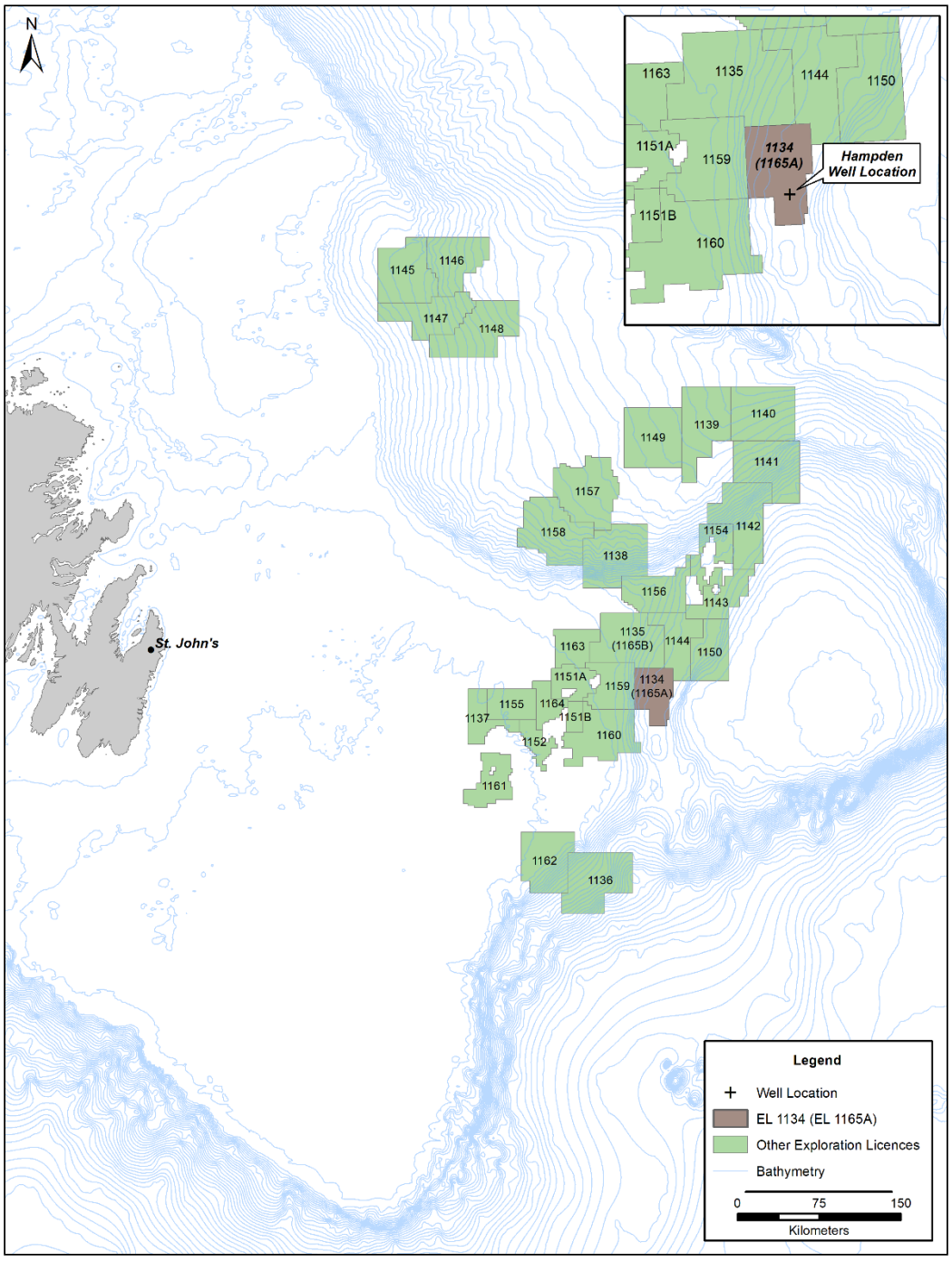


**Figure 1-1 Area map of EL 1165A Hampden K-41 well location.**

## 1.2 Drill Cuttings Modelling

A combined drill cutting model of four seasonal models was used to predict the extent of released water-based muds (WBM) and synthetic-based muds (SBM) (Figure 1-2) (Wood 2018). From the combined model, discharged cuttings would drift primarily to the south and southeast of the drill center. The majority of cuttings were predicted to be deposited within 1 km of the wellhead. A reduced drilling program occurred between April and May 2020 where only a top hole was drilled. The two drilling muds are typically used at separate points during the drilling process. While drilling the top hole only WBM were used, observations were compared to the combined drill cutting model. However, SBMs were not used during the reduced drilling program and Condition 3.12.1 is not applicable for this follow-up report. The pre-drilling survey was designed in consideration of the drill cuttings model (RPS 2018). Due to a change in program scope for the K-41 well, the full drilling program plan was not implemented and only a top hole was drilled. In consultation with C-NLOPB, due to the reduced drilling program (e.g. shortened drilling time, less cuttings, no SBM use), only the 200 by 200 m boundary was surveyed and assessed in May 2020.

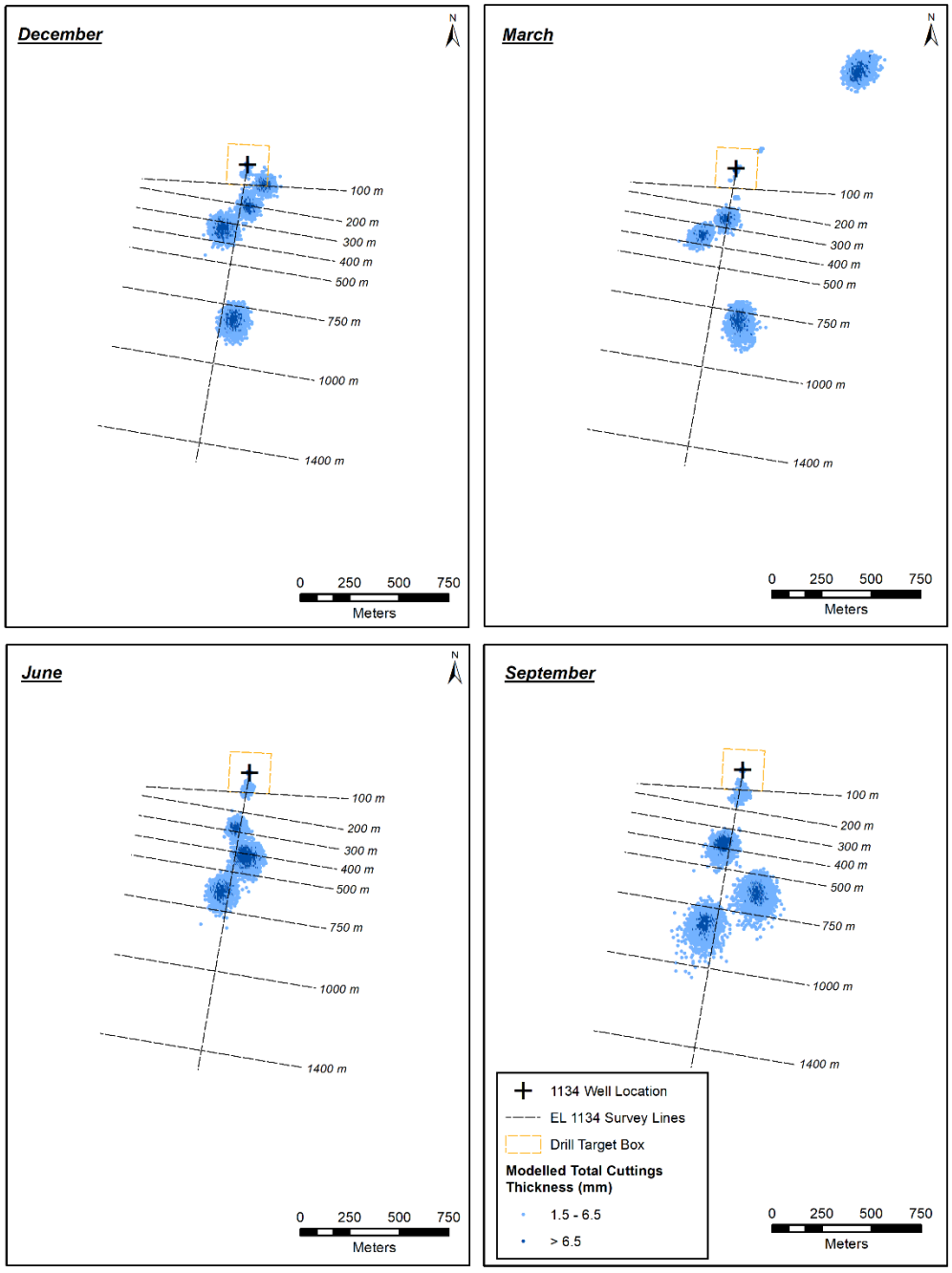


**Figure 1-2 Summary of drill cuttings model results for four seasonal scenarios (December, March, June, and September) in relation to pre-drilling survey plan.**

# 2.0 METHODOLOGY

## 2.1 Synthetic on Cuttings (Condition 3.12.1)

As part of the Offshore Waste Treatment Guidelines (OWTG), the concentration of non-aqueous synthetic based muds (SBM) retained on discharged drilling solids from all sources should be measured. However, due to the shortened drilling program, only the top hole was drilled, and only WBM was used. No SBMs were used during the Hampden K-41 drilling program.

## 2.2 Pre-Drilling Survey (2018)

The Hampden K-41 wellsite was previously surveyed in 2018 to assess the wellsite area against the C-NLOPB's guidance for coral colonies (RPS 2018, EMCL 2019). The Hampden K-41 wellsite is in approximately 1,180 m water depth. At this water depth the mobile offshore drilling unit (MODU) West Aquarius maintained position using a dynamic positioning system. Anchors were not used at this site and were thus not included in the survey design. From the pre-drilling survey, it was determined that there were no *L. pertusa* complexes however, there were two C-NLOPB defined coral colonies of soft corals observed within the 200 by 200 m boundary at the Hampden K-41 wellsite. The drill center location was selected to ensure the colonies were avoided and therefore drilling was authorized and proceeded at the site in the spring of 2020 (April to May). The pre-drilling survey was conducted from the MV Paul A. Sacuta with a Millennium remotely operated vehicle (ROV) (Figure 2-1).

The pre-drilling survey design consisted of a 200 by 200 m gridbox centered around the proposed drill center with 30 horizontal transect lines (200 m in length) running east to west and spaced approximately 7 m apart. The survey also included 1,000 m long transects positioned at 100 m, 200 m, 300 m, 400 m, 500 m, 750 m, 1,000 m, and 1,400 m within the proposed drill cutting footprint (RPS 2018).

## 2.3 Post-Drilling Survey (2020)

The post-drilling survey was conducted from the MV Paul A. Sacuta with a Millennium 191 remotely operated vehicle (ROV) from May 25$^{th}$ to May 26$^{th}$, 2020 (Figure 2-1). The ROV was equipped with a forward-facing pan/tilt/zoom high-definition (HD) camera which was used to collect high-definition video during the duration of the survey. Still images were taken opportunistically. Video and still imagery were used to identify the benthic fauna (including corals and sponges). Scaling line lasers were spaced 10 cm apart. Due to turbidity in the water column, grid line G-6 was surveyed multiple times to collect appropriate video data. Data presented from this line consists of non-overlapping video sections.

ExxonMobil Canada Ltd. was responsible for chartering the vessel and Oceaneering Canada Ltd. was responsible for the operation of the ROV. Wood provided onboard biologists responsible for providing direction to ROV operators to ensure collection of video and images appropriate for characterizing cold-water corals and sponge groups and general characterization of fish and other invertebrates.

The survey video and imagery were geo-referenced using the ships Hi-PAP system. The HD video was encoded with a digital overlay that displayed depth (m), coordinates (UTM and NAD83), heading, date and time, and altitude above seafloor. Still images were encoded with a date/time stamp and numbered sequentially.

**Figure 2-1 Millennium 191 ROV used for the 2018 and 2020 EL 1165A post-drilling survey.**

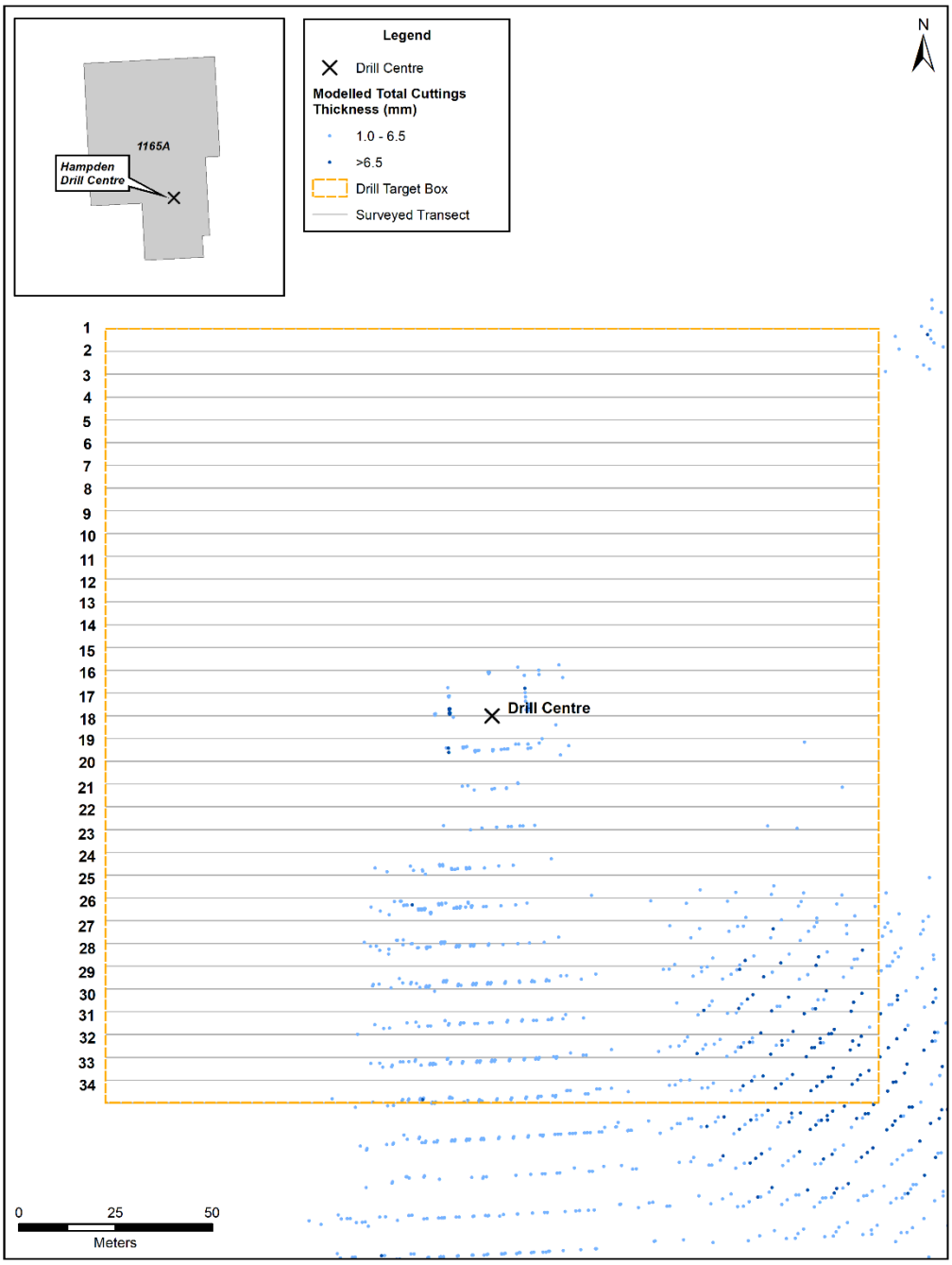


**Figure 2-2 Post-drilling survey design at EL1165A.**

### 2.3.1 Survey Design

Similar to the 2018 baseline survey, the survey consisted of a 200 m by 200 m grid composed of 34 horizontal surveys lines (running east to west) spaced 6 m apart centered around the wellhead (Figure 2-2). The ROV operated in two modes: survey and sampling (measuring). Survey mode was used to describe the characteristics and extent of the drill cutting footprint and sampling mode was where the ROV took physical measurements of the seafloor with a ruler.

### 2.3.2 Visual Analysis

Benthic video imagery was analyzed visually for the presence or absence of deposited drill cuttings (Figure 2-3, B), which can be visibly distinct from undisturbed seafloor sediments (Figure 2-3, A) (Gates et al. 2017, Jones et al. 2019, Cochrane et al. 2019). Areas of visually distinct drill cuttings were geo-referenced and mapped. The start and end of continuous drill cuttings or consolidated patches are depicted by lines. Surficial geology, invertebrate, and fish taxa presence were analyzed along each grid transect in 50 m increments and summarized in the benthic report (Wood 2020).

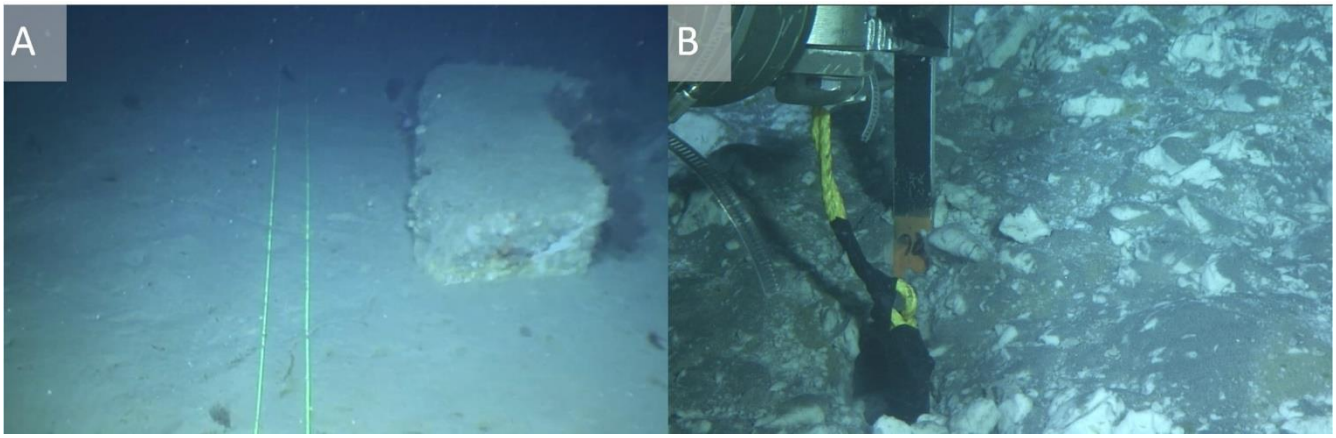


**Figure 2-3 Representative images of A) undisturbed seafloor sediments and B) deposited drill cuttings.**

### 2.3.3 Sediment Measurements

The visual analysis of the drill cuttings extent was further quantified and supplemented by depth penetration measurements. In consultation with C-NLOPB, due to the reduced drilling program, survey methods of the 200 x 200 m boundary were in keeping with those outlined in the Plan (EMCL 2020) with the exception that sediment cores collection was removed from the program.

A ruler (in 10 cm increments) was used to penetrate the seafloor using the ROV manipulator arm at opportune times to determine the depth of refusal which is the depth where the ruler will no longer penetrate the seafloor (Figure 2-4). These measurements are not necessarily a measurement of drill cuttings overburden thickness but may be used as an indication area with drill cuttings. Measurements were taken at the start and end of all transects within the 200 by 200 m grid survey with additional physical measurements taken opportunistically in the center of the survey lines.

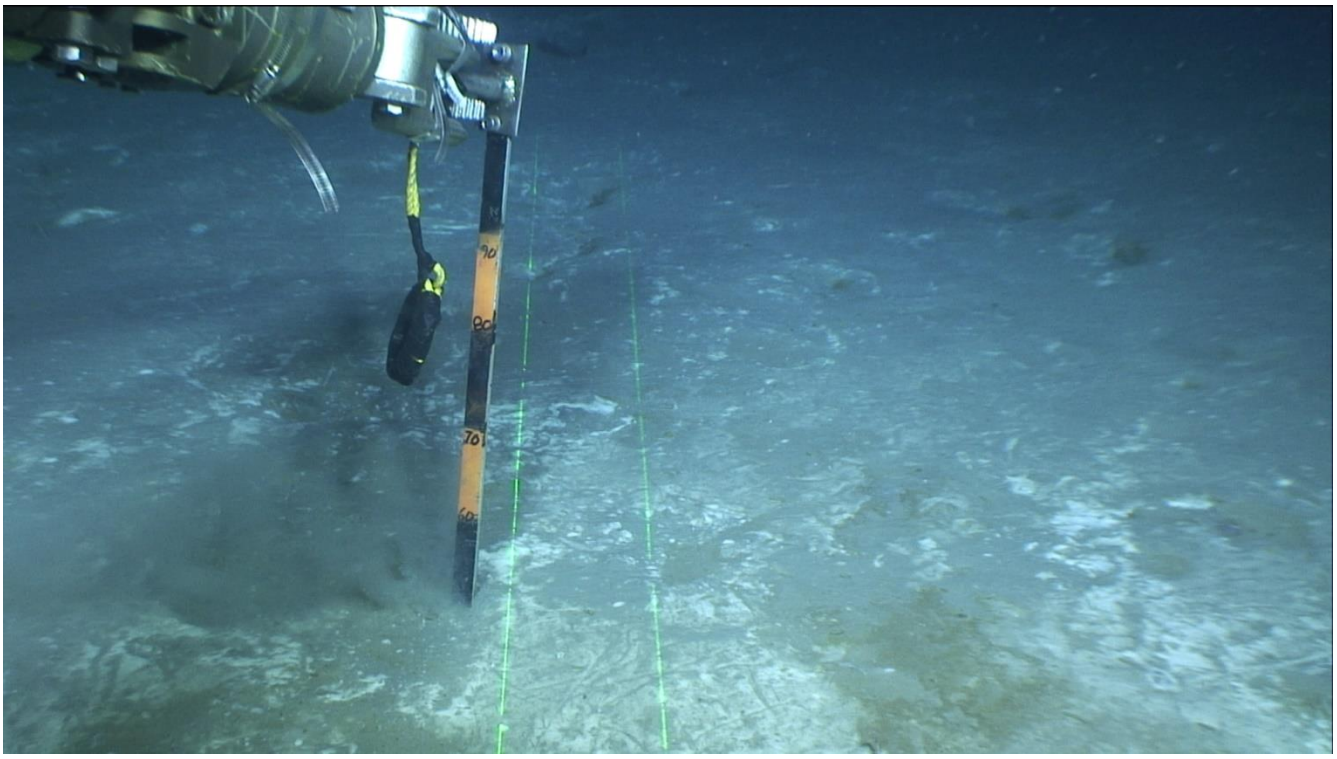

**Figure 2-4 Depth penetration measurement in patchy drill cuttings with the Millennium 191 ROV.**

## 2.4 Mapping

The ROV transects were plotted using GIS software ArcGIS 10.5 (ESRI) in NAD83 datum. Fixes were taken for start and end of each transect and when measurements were taken. Overlay coordinates were used for drill cuttings delineation (visual analysis). The start and end of large drill cutting patches are depicted by lines and consolidated drill cutting patches are depicted by points. Areas within drill cutting patches that were part of the drill cutting pile were identified and mapped as points. Drill cutting transition interfaces (transitioning to natural sediment or to a different texture of drill cuttings) were also noted and mapped.

# 3.0 RESULTS

## 3.1 Synthetic on Cuttings (Condition 3.12.1)

Due to a modified drilling program, only the top hole was drilled at Hampden K-41. During the drilling of the top hole, only WBM were used and released. Condition 3.12.1 concerns the release of SBM during drilling operations and thus the condition is no longer applicable.

## 3.2 Pre-Drilling Survey (2018)

While the pre-drilling survey included both a 200 x 200 m gridbox around the drill center and transects within the proposed drill cutting footprint, only observations from the 200 x 200 m gridbox will be described for comparison to the post-drilling survey. Surficial substrate within the 200 x 200 m gridbox was pre-dominantly undisturbed fine substrate types (93%) (Figure 3-1) with sporadic coarse (4.1%) and medium (2.83%) substrate (Wood 2020). Benthic fauna including deep-sea corals and sponges were observed throughout the survey area with full result reported in RPS 2018 and Wood 2020. From the pre-drilling survey, two C-NLOPB coral groups were identified consisting of two groups of six soft corals. Both coral groups were observed outside of the predicted drill cuttings footprint (see Section 3.3) and drilling preceded at the site.

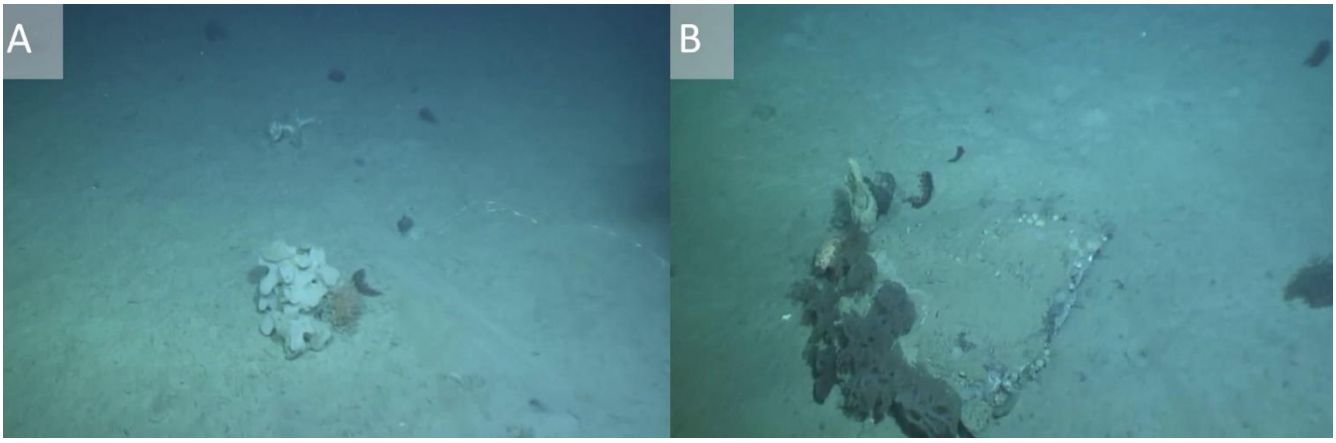


**Figure 3-1 Representative pre-drilling survey gridbox seabed images of A) fine substrate and B) hard substrate.**

## 3.3 Post-Drilling Survey (2020)

Drill cuttings were visibly distinct from seafloor sediments in color, texture, and particle size. Two types of drill cuttings were observed within the survey area pile cuttings and fine-grained cuttings. The pile cuttings consisted of loosely condensed white clumps (Figure 3-3, B to D). These cuttings were easily disturbed by the ROV and the clumps remained intact as they rolled across the seafloor. Fine-grained drill cuttings were dense and did not easily disperse in the water column. When touched by the ruler, the cuttings had a dense viscous consistency that stayed close to the seafloor (Figure 3-3, F). Drill cuttings were observed in three types of distributions (Figure 3-2):

- Patchy distribution was defined as occasional observations of drill cuttings <2m$^2$ in extent and >2 m apart,
- Dis-continuous distribution is where drill cuttings either occurred more frequently and/or in patches >2 m$^2$ in size and/or less than <2 m apart,
- Continuous distribution is where drill cuttings are continuous, in a drill cuttings pile, or patches are <1 m apart.

There was a concentration of drill cuttings <50 m radius around the well head with cuttings > 50 m were mostly observed to the south and southeast of the drill center, a direction consistent with predictions from the drill cuttings dispersion model (Figure 3-2). Visibly distinct drill cuttings were observed in various distribution types starting along transect G-10 to G-34. The drill cuttings model depicted in Figure 3-2 shows the predicted dispersion of both WBM and SBM although only WBM were used for this drilling campaign.

A total of 105 measurements were taken during the 2020 survey. As the physical measurements involved the depth of penetration of a ruler into the seafloor (e.g., depth of refusal) which only occurred post-drilling, measurements include and could not distinguish drill cutting accumulations and natural sediment deposition. However, several observations can be made about the drill cutting accumulations. When physical measurements were taken in visibly distinct drill cutting accumulations, the sediment appeared to be less compacted than native seafloor allowing the ROV to push the ruler more easily into the seafloor.

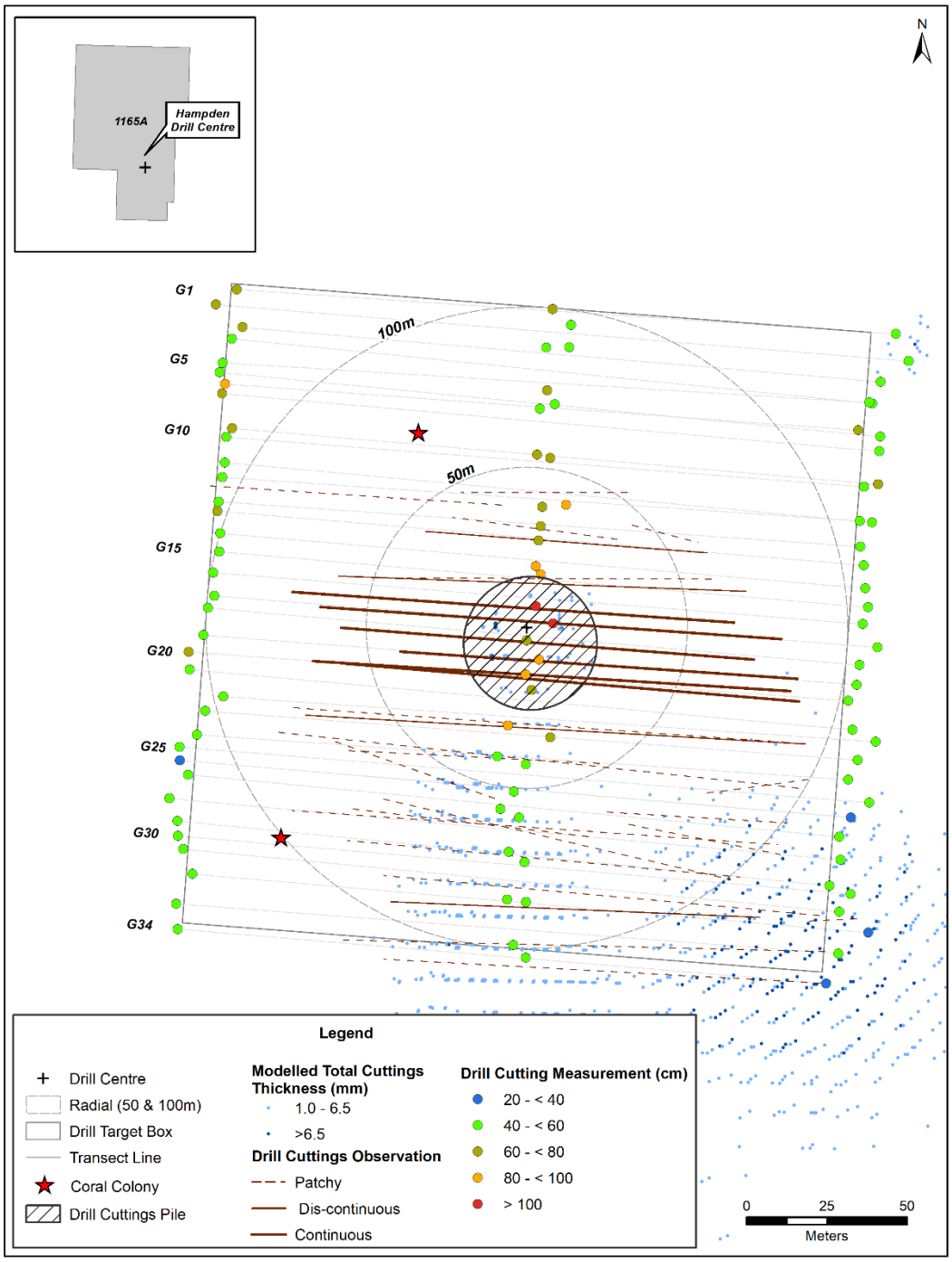


**Figure 3-2 Distribution of drill cutting observations in relation to the drill center and the predicted drill cutting footprint and sediment penetration measurements.**

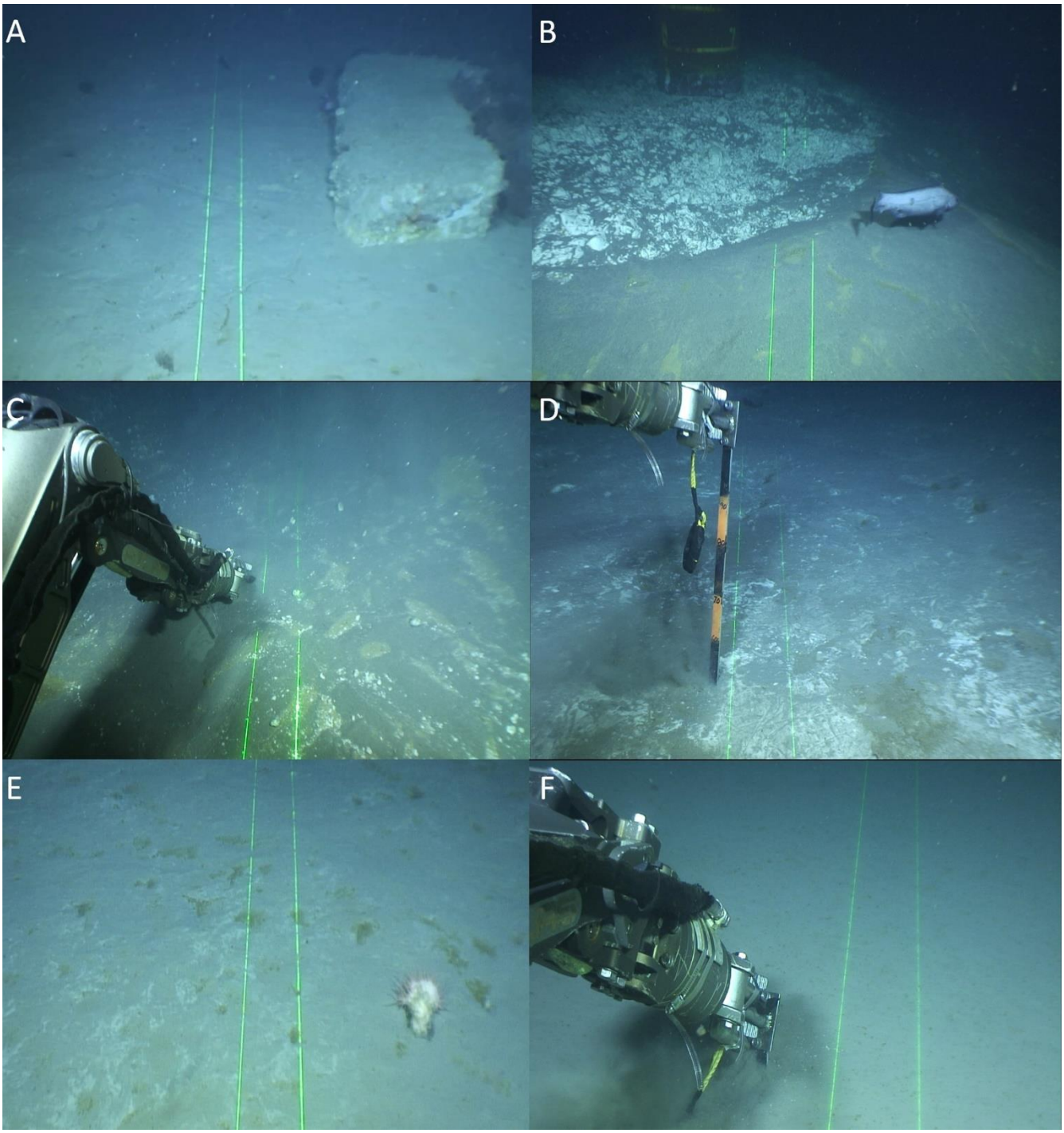


**Figure 3-3 Representative images of drill cutting observations within the surveyed area: A) undisturbed seafloor without drill cuttings, B) Hampden K-41 well head and drill cutting pile, C) drill cuttings adjacent to the wellhead, D) drill cuttings, E) patchy drill cutting distribution, F) fine-grained drill cutting deposit. Lasers are 10 cm apart.**

### 3.3.1 Grid box (<50 m from Wellhead)

Visibly distinct drill cuttings were observed in various distribution types within 50 m of the wellhead from transect G-10 to G-26 (Figure 3-2). Patchy drill cutting distributions were noted from G-10 to G-12 and G14. The drill cutting pile was centered around the wellhead on transect G17 and extended into transects G16 and G18 to G20 (Figure 3-2). Based on measurements of known structure sizes of the wellhead and distances to the seafloor, drill cutting deposition was approximately 300 cm high at the wellhead. Sediment measurements taken within the drill cutting pile (Figure 3-4 A&B) ranged between 75 to >100 cm (the length of the ruler was 100 cm) (Appendix B, Table B 1). Measurements taken along the center of each gridline are presented in Figure 3-5. While both drill cutting and natural sedimentation could not be distinguished from the single measurement at each location, there is a notable increase in penetration within 50 m of the wellhead with the deepest penetrations occurring in drill cuttings pile. Measurements in the fine-grained drill cuttings adjacent to the drill cuttings pile ranged in depth from 70 to 95 cm and there is a noticeable decrease after transect G-23. Based on these observations, measurements > 80cm appear to be related to drill mud accumulations and sediment accumulations on the order of 10s of cm appear to be restricted between G13 to G21. While benthic invertebrates were absent from the drill cuttings pile, there were corals (sea pens) present on the fine-grained drill cuttings adjacent to the pile. Other pelagic fauna including blue hake were present (Figure 3-3, B).

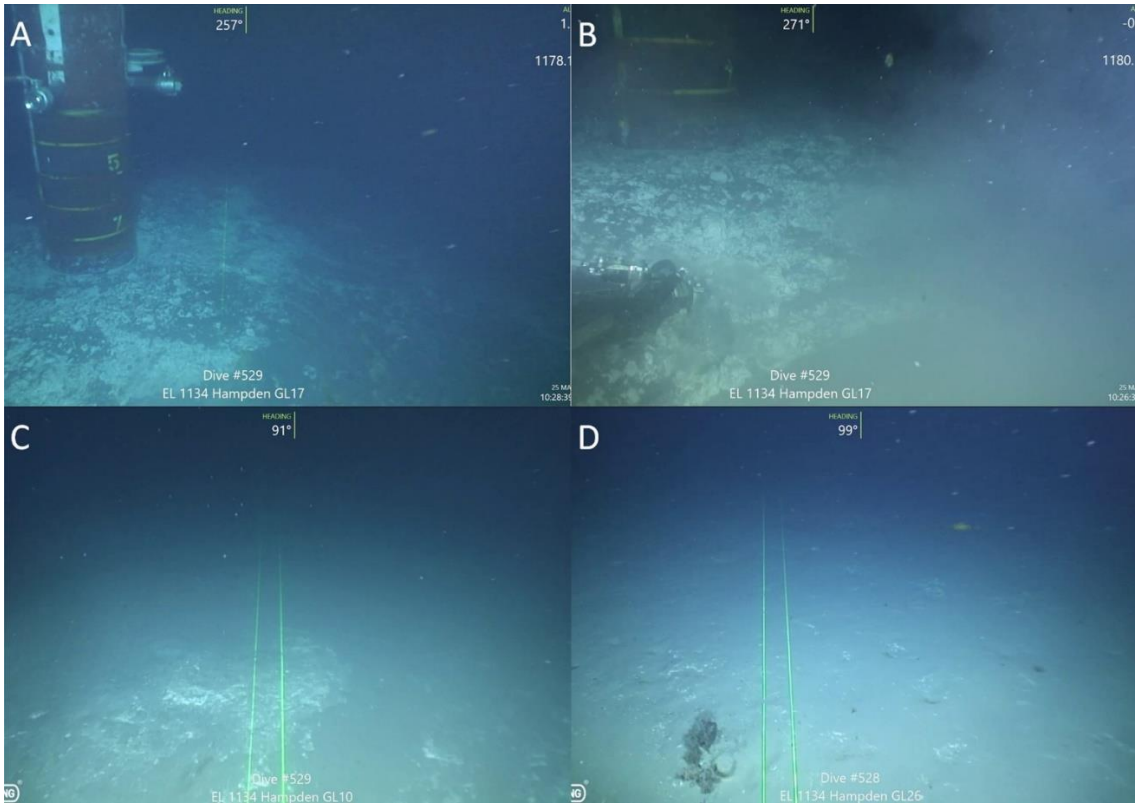

**Figure 3-4 Drill cutting observations within 50 m of the wellhead: A&B) Drill cutting pile at the wellhead, C) patchy drill cuttings on transect G-10 (north of the wellhead), and D) patchy drill cuttings on transect G-26 (south of the wellhead).**

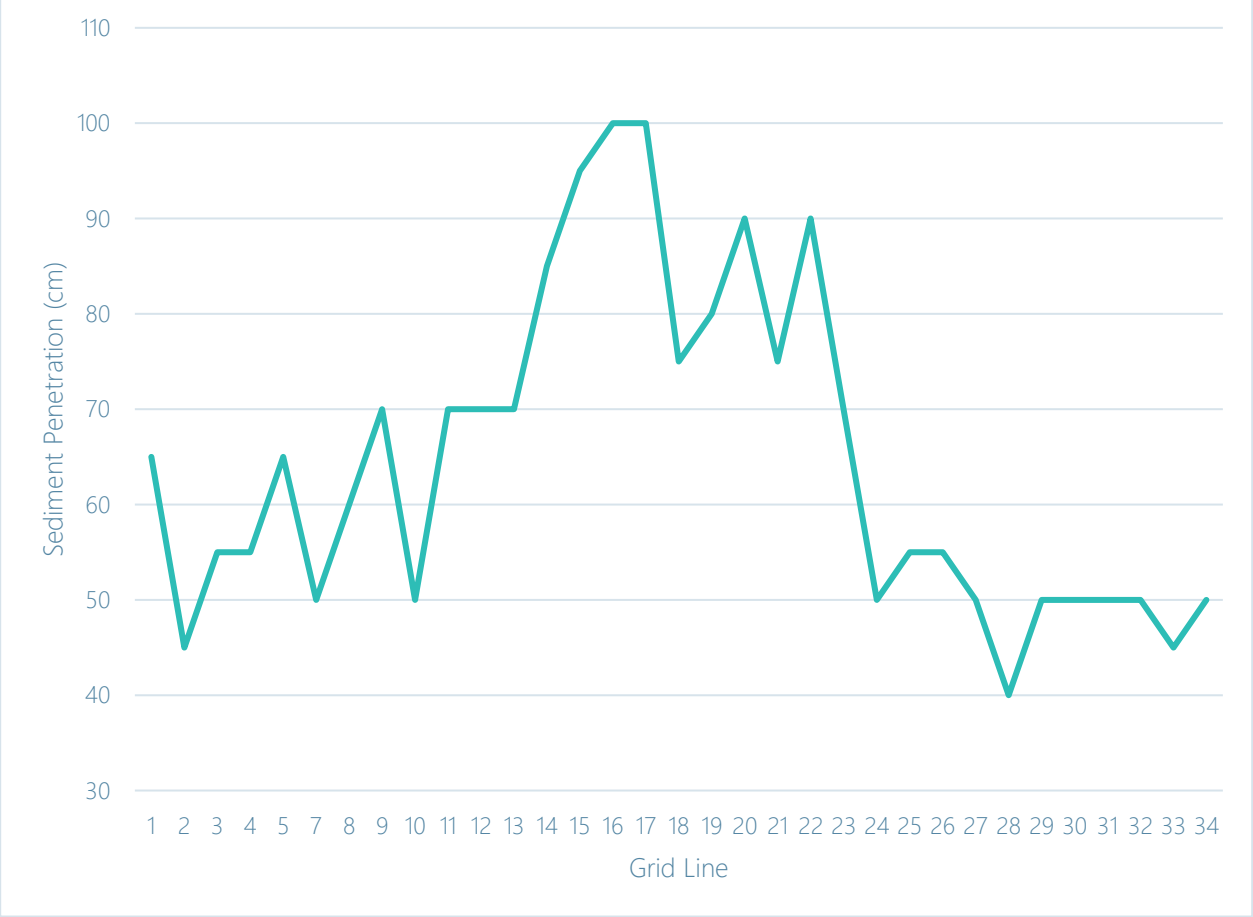


**Figure 3-5 Sediment penetration (cm) measurements taken at the center point of each line. The well head is located on G-17. Note: measurements exceeding the length of the ruler were rounded down to 100 cm.**

### 3.3.2 Grid box (>50 m from Wellhead up to the 200 by 200 m boundary)

Outside of the 50 m radius from the wellhead, observations of visibly distinct drill cuttings were patchy and occurred mostly to the south and southeast (Figure 3-6 B and C). There were no visibly distinct drill cuttings in transects G-1 to G-9 (north of the wellhead). Sediment measurements within the center of the transect lines ranged between 45 to 70 cm to the north of the wellhead and 40 to 50 cm to the south (Figure 3-2). Along the east and west borders of the grid box, sediment measurements ranged between 20 to 80 cm with most measurements ranging between 40 to <60 cm (Appendix B, Table B 1).

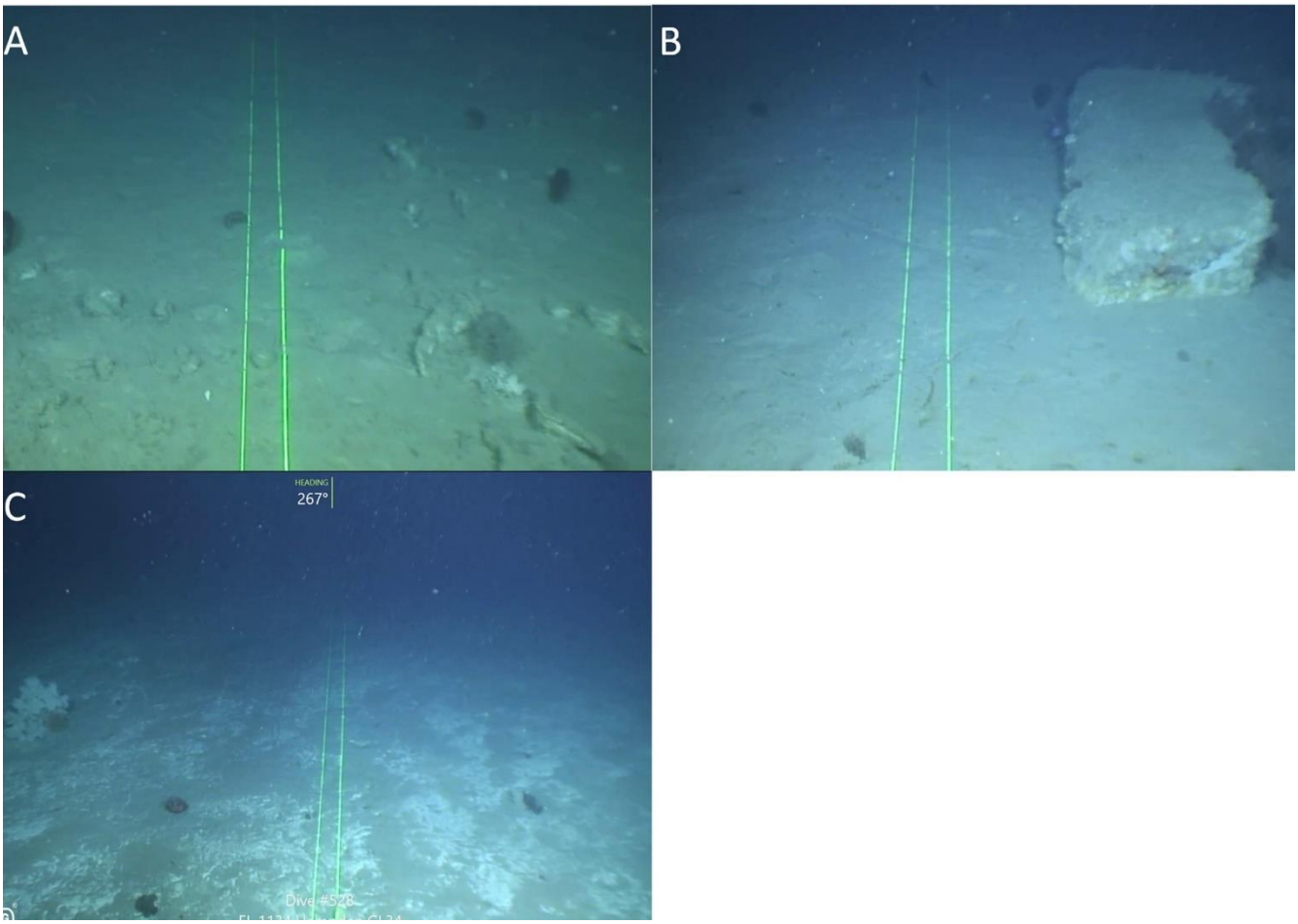


**Figure 3-6 Seafloor observations > 50 m from the wellhead: A) Natural sedimentation (G-3), B) No visible drill cuttings transect (G-34), and C) Patchy drill cutting distribution (G-34).**

## 3.4 Assessment of Model Predictions

Survey results were comparable to the combined drill cuttings model, particularly prediction models for December and March (Figure 1-2). The model predicted that accumulations of drill cuttings >6.5 mm would occur to the south/southeast of the drill center (December model) with some patches occurring to the north/northeast (March model). Local bottom current variances with the changing seasons could account for the discrepancies in the modelled versus *in situ* observations. Drill cuttings were visibly mounded adjacent to the wellhead and accumulations appear to be 300 cm thickness <30 m from wellhead (based on comparisons with infrastructure). If the assumption that all the penetration measurements above 70 cm are related to drill muds, then it appears that those accumulations are limited to G-13 to G-23 (~36 m from wellhead). Further from the wellhead, drill cuttings observations were patchy and discontinuous in nature.

## 4.0 SUMMARY

The objective of this follow-up program is to meet conditions 3.12 of the Decision Statement and verify the accuracy of the predictions made during the environmental assessment (EA). The following summarizes the follow-up monitoring results with the specific Conditions.

***Condition 3.12.1*** *– for every well, measure the concentration of synthetic-based drilling fluids retained on discharged drilling cuttings as described in the Offshore Waste Treatment Guidelines (OWTG) to verify that the discharge meets the minimum limits set out in the Guidelines (and any applicable legislative requirements) and report the results to the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB);*

As detailed in Section 2.1, the modified drilling program's lack of SBM use means this condition is no longer applicable.

***Condition 3.12.2.1*** *- Measurement of sediment deposition extent and thickness post drilling to verify the drill waste deposition modeling predictions;*

Due to the limited drilling program (only top hole drilled), the post-drilling survey was focused within the 200 by 200 m gridbox. The deposition model predicted drill cutting accumulations of >6.5 mm at distances > 50 m from the drill center. Post-drilling sediment deposition and thickness were determined through both visual assessments and depth penetration measurements. Based on these combined methods, the greatest depositions of drill cuttings formed a mound around the wellhead with accumulations of approximately 300 cm thickness (based on comparisons with infrastructure). Drill cutting accumulations > 50 m from the drill center were mainly patchy in distribution Overall, the observed drill cuttings deposition within a 30 m radius from the wellhead were greater in thickness relative to model predictions.

The EA predictions indicated that the physical and chemical effects of drill cuttings was anticipated to have localized habitat disturbances less than two km from the well site. As the primary mechanism for environmental effects on benthic organisms is burial and smothering (EMCL 2017) and visible drill cuttings deposition was limited to within 100 m of the wellhead, the potential effects are within what was assessed for the Eastern Newfoundland Offshore Exploration Drilling Program.

***Condition 3.12.2.2*** *- Benthic fauna surveys to verify the effectiveness of mitigation measures;*
This condition is discussed in the EL1165A Benthic Habitat Monitoring Report (Wood 2020). The report concluded that pre- and post-drilling surveys observed similar benthic fauna species presences and abundances.

***Condition 3.12.2.3*** *– Report the information collected as identified in conditions 3.12.2.1 and 3.12.2.2, including a comparison of modelling results to in situ results, to the C-NLOPB within 60 days following the drilling of the first well in each exploration licence.*

As identified directly above and in the preceding sections of this report, model results were compared to in situ results and found that cuttings were more localized with higher thicknesses relative the model's predictions.

## 5.0 CONCLUSION

Based on knowledge gained from EMCL's operations experience completing various drilling operations in the Jeanne d'Arc Basin, it is reasonable to conclude that the risks associated with drill cuttings release seen in the Flemish Pass are inconsequential. This conclusion is further supported by the following:

- Smothering effects of drill cuttings have been demonstrated through our operations to be limited to within 500 m of a release site based on effects monitoring in the shallow water of the Jeanne d'Arc Basin,
- Relative to releases in shallow water, the seafloor thickness can be expected to be less due to longer residence time in the water column and increased lateral dispersion and loss of fines to the water column,
- Relative to releases in shallow water, the SOC concentration reaching the seafloor can also be expected to be less due to longer residence time in the water column and transition of fluid into the water phase, and
- In shallow water such as the Jeanne d'Arc Basin, effects associated with multiple years of drilling by multiple operators have been demonstrated to be limited, minor and acceptable to the C-NLOPB. These conclusions were reached when SOC limit were at 15% whereas the present day limit is 6.9%.

If additional measurements required to inform mitigations for future exploration campaigns, consideration could be given to affixing graduated posts to the seafloor at predetermined intervals (ex. 100m, 250m, and 500m) during the initial pre-drill survey. This would provide a zero-reference baseline and during the post-drill survey the amount of cuttings dispersed at each point could be visually estimated.

## 6.0 CLOSURE

This report of the drill cutting extent observed at EL 1165A has been prepared for the exclusive use of ExxonMobil Canada Ltd.. The project was conducted using standard practices by qualified Wood staff and in accordance with verbal and written requests from the client.

Yours sincerely,

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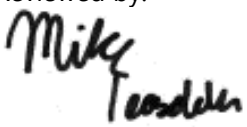

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# APPENDIX A: SURVEY COORDINATES

**Table A-1 Start and end coordinates for the central box grid surveyed in EL 1165A**

| Transect | Length (m) | UTM Coordinates (NAD83, Zone 22) | | | |
|---|---|---|---|---|---|
| | | Start Easting | Start Northing | End Easting | End Northing |
| G-01 | 205.9 | 814268.37 | 5214530.6 | 814474.54 | 5214532.6 |
| G-02 | 216.7 | 814478.97 | 5214524.6 | 814262.7 | 5214525.5 |
| G-03 | 200 | 814271.12 | 5214519.1 | 814471.12 | 5214517.3 |
| G-04 | 200.6 | 814468.65 | 5214510.6 | 814268.31 | 5214515.2 |
| G-05 | 201.9 | 814265.67 | 5214507.5 | 814467.61 | 5214510.5 |
| G-06 | 151 | 814467.69 | 5214501.5 | 814267.32 | 5214502.2 |
| G-07 | 205.7 | 814471.95 | 5214495.6 | 814266.74 | 5214499.5 |
| G-08 | 202.2 | 814270.64 | 5214487.1 | 814472.34 | 5214485.1 |
| G-09 | 200 | 814467.96 | 5214484.2 | 814268.14 | 5214483.9 |
| G-10 | 202.5 | 814269.04 | 5214476.9 | 814471.74 | 5214473.3 |
| G-11 | 200 | 814467.9 | 5214473.6 | 814268.2 | 5214471.5 |
| G-12 | 200.5 | 814268.1 | 5214464.1 | 814468.6 | 5214465.9 |
| G-13 | 202.1 | 814469.6 | 5214460 | 814267.4 | 5214461 |
| G-14 | 201.8 | 814269.2 | 5214454.3 | 814471 | 5214453 |
| G-15 | 202.9 | 814472.2 | 5214446.9 | 814268.9 | 5214448.5 |
| G-16 | 203.1 | 814267.8 | 5214442 | 814470.8 | 5214441.7 |
| G-17 | 207.3 | 814476.2 | 5214434.8 | 814269 | 5214435.1 |
| G-18 | 203.9 | 814266.9 | 5214431 | 814471.3 | 5214428.3 |
| G-19 | 204.3 | 814470.9 | 5214422.5 | 814266.4 | 5214422.6 |
| G-20 | 206.1 | 814262 | 5214416.8 | 814468.5 | 5214417.4 |
| G-21 | 207.4 | 814472.1 | 5214408.2 | 814262.9 | 5214411.3 |
| G-22 | 203.9 | 814273.7 | 5214403.8 | 814477.9 | 5214405.3 |
| G-23 | 203.9 | 814472.7 | 5214399.1 | 814268.5 | 5214399.1 |
| G-24 | 203.4 | 814266.8 | 5214391.2 | 814470.5 | 5214392.7 |
| G-25 | 215.7 | 814477.2 | 5214386.2 | 814262.4 | 5214387.2 |
| G-26 | 209.9 | 814261.9 | 5214382.9 | 814471.8 | 5214381.2 |
| G-27 | 200 | 814269.8 | 5214382.9 | 814467.9 | 5214374.9 |
| G-28 | 210 | 814469.8 | 5214368.1 | 814259.4 | 5214370.9 |
| G-29 | 204.3 | 814262.4 | 5214364 | 814467.3 | 5214359.3 |
| G-30 | 210.5 | 814473.9 | 5214357.5 | 814263.3 | 5214359.4 |
| G-31 | 205.5 | 814265.3 | 5214355.4 | 814470.4 | 5214351.7 |
| G-32 | 211.5 | 814480.3 | 5214346 | 814268.3 | 5214348.1 |
| G-33 | 206.9 | 814264.3 | 5214338.2 | 814471.8 | 5214338.8 |
| G-34 | 202.8 | 814468.1 | 5214329 | 814265.5 | 5214330.4 |

# APPENDIX B: PHYSICAL MEASUREMENT DATA

## Table B 1 Physical measurements with ROV deployed ruler.

| Grid | Measurement_ID | Northing (m) | Easting (m) | Depth (m) | Measurement (cm) | Drill Cutting (Y/N/DCP) |
|---|---|---|---|---|---|---|
| GL-34 | Measurement 1 | 5214328.938 | 814468.218 | 1178.736 | 20 | Y |
| GL-34 | Measurement 2 | 5214329.805 | 814374.269 | 1178.833 | 50 | Y |
| GL-34 | Measurement 3 | 5214330.416 | 814265.399 | 1178.483 | 40 | N |
| GL-33 | Measurement 4 | 5214338.221 | 814264.357 | 1178.811 | 45 | N |
| GL-33 | Measurement 5 | 5214333.399 | 814370.081 | 1179.661 | 45 | Y |
| GL-33 | Measurement 6 | 5214338.542 | 814471.303 | 1178.542 | 50 | Y |
| GL-32 | Measurement 7 | 5214345.766 | 814480.153 | 1178.92 | 35 | Y |
| GL-32 | Measurement 8 | 5214347.187 | 814373.075 | 1180.316 | 50 | Y |
| GL-32 | Measurement 9 | 5214347.918 | 814268.631 | 1180.227 | 50 | N |
| GL-31 | Measurement 10 | 5214355.405 | 814265.179 | 1180.323 | 50 | N |
| GL-31 | Measurement 11 | 5214347.482 | 814367.084 | 1180.165 | 50 | Y |
| GL-31 | Measurement 12 | 5214351.551 | 814470.652 | 1180.411 | 50 | Y |
| GL-30 | Measurement 13 | 5214357.409 | 814473.731 | 1180.089 | 50 | Y |
| GL-30 | Measurement 14 | 5214359.472 | 814371.625 | 1180.367 | 50 | Y |
| GL-30 | Measurement 15 | 5214359.398 | 814263.257 | 1180.191 | 45 | N |
| GL-29 | Measurement 16 | 5214364.041 | 814262.687 | 1180.662 | 40 | N |
| GL-29 | Measurement 17 | 5214362.293 | 814366.465 | 1180.508 | 50 | Y |
| GL-29 | Measurement 18 | 5214359.46 | 814466.982 | 1180.388 | 50 | N |
| GL 28 | Measurement 19 | 5214367.754 | 814469.773 | 1180.906 | 50 | Y |
| GL 28 | Measurement 20 | 5214373.204 | 814368.789 | 1180.312 | 40 | Y |
| GL 28 | Measurement 21 | 5214370.819 | 814259.748 | 1180.726 | 50 | N |
| GL-27 | Measurement 22 | 5214378.663 | 814264.921 | 1180.494 | 55 | N |
| GL-27 | Measurement 23 | 5214375.467 | 814362.874 | 1179.934 | 50 | Y |
| GL-27 | Measurement 24 | 5214374.861 | 814468.802 | 1179.992 | 45 | N |
| GL-26 | Measurement 25 | 5214381.162 | 814471.988 | 1180.793 | 30 | N |
| GL-26 | Measurement 26 | 814366.624 | 5214381.213 | 1180.041 | 55 | Y |
| GL-26 | Measurement 27 | 5214382.948 | 814262.09 | 1180.244 | 35 | N |
| GL-25 | Measurement 28 | 5214386.217 | 814477.357 | 1180.622 | 45 | N |
| GL-25 | Measurement 29 | 5214389.949 | 814369.608 | 1180.081 | 55 | Y |
| GL-25 | Measurement 30 | 5214387.07 | 814261.654 | 1180.456 | 50 | N |
| GL-24 | Measurement 31 | 5214391.3 | 814266.788 | 1180.431 | 50 | N |
| GL-24 | Measurement 32 | 5214391.682 | 814360.606 | 1180.336 | 50 | Y |
| GL-24 | Measurement 33 | 5214392.829 | 814470.167 | 1180.117 | 45 | N |
| GL-23 | Measurement 34 | 5214399.19 | 814472.695 | 1180.336 | 45 | N |
| GL-23 | Measurement 35 | 5214398.817 | 814376.574 | 1180.085 | 70 | Y |
| GL-23 | Measurement 36 | 5214398.864 | 814268.779 | 1180.264 | 50 | N |
| GL-22 | Measurement 37 | 5214403.758 | 814273.994 | 1180.555 | 45 | N |
| GL-22 | Measurement 38 | 5214401.527 | 814363.208 | 1180.372 | 90 | Y |
| GL-22 | Measurement 39 | 5214405.299 | 814477.866 | 1180.74 | 50 | N |
| GL-21 | Measurement 40 | 5214408.429 | 814470.342 | 1180.676 | 50 | N |
| GL-21 | Measurement 41 | 5214413.149 | 814369.695 | 1180.651 | 75 | Y |
| GL-21 | Measurement 42 | 5214411.377 | 814262.914 | 1180.436 | 45 | N |
| GL-20 | Measurement 43 | 5214416.85 | 814262.252 | 1180.033 | 70 | N |
| GL-20 | Measurement 44 | 5214417.857 | 814367.447 | 1179.986 | 90 | DCP |
| GL-20 | Measurement 45 | 5214417.373 | 814468.375 | 1180.405 | 50 | N |
| GL-19 | Measurement 46 | 5214422.567 | 814470.631 | 1180.366 | 50 | N |
| GL-19 | Measurement 47 | 5214422.872 | 814371.267 | 1179.727 | 80 | DCP |
| GL-19 | Measurement 48 | 5214422.395 | 814266.381 | 1180.558 | 50 | N |
| GL-18 | Measurement 49 | 5214430.989 | 814267.174 | 1180.151 | 40 | N |
| GL-18 | Measurement 50 | 5214428.456 | 814366.945 | 1179.019 | 75 | DCP |
| GL-18 | Measurement 51 | 5214428.742 | 814471.03 | 1179.739 | 45 | N |
| GL-17 | Measurement 52 | 5214434.732 | 814476.152 | 1179.796 | 45 | N |
| GL-17 | Measurement 53 | 5214434.43 | 814374.713 | 1177.987 | >100 | DCP |
| GL-17 | Measurement 54 | 5214434.861 | 814268.89 | 1179.783 | 50 | N |
| GL-16 | Measurement 55 | 5214442.068 | 814267.923 | 1179.621 | 50 | N |
| GL-16 | Measurement 56 | 5214439.326 | 814369.021 | 1178.874 | >100 | DCP |
| GL-16 | Measurement 57 | 5214441.61 | 814471.032 | 1179.653 | 50 | N |
| GL-15 | Measurement 58 | 5214446.92 | 814472.243 | 1179.778 | 55 | N |
| GL-15 | Measurement 59 | 5214449.282 | 814369.814 | 1179.975 | 95 | DCP |
| GL-15 | Measurement 60 | 5214448.72 | 814269.371 | 1180.143 | 55 | Y |
| GL-14 | Measurement 61 | 5214454.448 | 814269.153 | 1180.101 | 50 | N |
| GL-14 | Measurement 62 | 5214451.759 | 814368.023 | 1179.777 | 85 | DCP |
| GL-14 | Measurement 63 | 5214452.772 | 814470.92 | 1179.621 | 50 | N |
| GL-13 | Measurement 64 | 5214459.876 | 814469.959 | 1179.559 | 50 | N |
| GL-13 | Measurement 65 | 5214459.849 | 814368.336 | 1180.089 | 70 | DCP |
| GL-13 | Measurement 66 | 5214461.302 | 814267.818 | 1180.345 | 65 | N |
| GL-12 | Measurement 67 | 5214464.26 | 814267.963 | 1180.486 | 50 | N |
| GL-12 | Measurement 68 | 5214464.308 | 814368.591 | 1180.613 | 70 | DCP |
| GL-12 | Measurement 69 | 5214465.596 | 814468.475 | 1180.688 | 55 | N |
| GL-11 | Measurement 70 | 5214473.568 | 814467.672 | 1180.95 | 50 | N |
| GL-11 | Measurement 71 | 5214470.359 | 814368.661 | 1180.419 | 70 | DCP |
| GL-11 | Measurement 72 | 5214471.942 | 814268.518 | 1180.407 | 50 | N |
| GL-10 | Measurement 73 | 5214476.588 | 814268.94 | 1180.783 | 55 | N |
| GL-10 | Measurement 74 | 5214471.578 | 814375.958 | 1180.236 | 90 | N |
| GL-10 | Measurement 75 | 5214473.343 | 814471.459 | 1180.62 | 55 | N |
| GL-09 | Measurement 76 | 5214484.282 | 814468.169 | 1180.569 | 50 | N |
| GL-09 | Measurement 77 | 5214485.777 | 814369.907 | 1180.563 | 70 | - |
| GL-09 | Measurement 78 | 5214484.543 | 814268.789 | 1180.469 | 55 | N |
| GL-08 | Measurement 79 | 5214487.409 | 814270.329 | 1180.714 | 60 | N |
| GL-08 | Measurement 80 | 5214486.526 | 814365.797 | 1180.608 | 60 | N |
| GL-08 | Measurement 81 | 5214485.4 | 814472.513 | 1180.264 | 60 | N |
| GL-07 | Measurement 82 | 5214495.677 | 814472.084 | 1180.064 | 45 | N |
| GL-07 | Measurement 83 | 5214502.633 | 814370.045 | 1180.42 | 50 | N |
| GL-07 | Measurement 84 | 5214497.946 | 814266.39 | 1179.525 | 60 | N |
| GL-06 | Measurement 85 | 5214504.482 | 814265.099 | 1179.796 | 45 | N |
| GL-06 | Measurement 86 | 5214500.81 | 814365.539 | 1179.747 | 45 | N |
| GL-06 | Measurement 87 | 5214500.268 | 814472.033 | 1180.141 | 50 | N |
| GL-06 | Measurement 103 | 5214501.751 | 814465.004 | 1179.401 | 70 | N |
| GL-06 | Measurement 104 | 5214502.496 | 814359.493 | 1178.963 | * | N |
| GL-06 | Measurement 105 | 5214500.988 | 814267.14 | 1179.031 | 80 | N |
| GL-05 | Measurement 100 | 5214507.53 | 814265.828 | 1178.819 | 50 | N |
| GL-05 | Measurement 101 | 5214506.653 | 814367.349 | 1179.085 | 65 | N |
| GL-05 | Measurement 102 | 5214510.623 | 814467.751 | 1178.951 | 40 | N |
| GL-04 | Measurement 97 | 5214510.389 | 814468.734 | 1179.505 | 55 | N |
| GL-04 | Measurement 98 | 5214520.658 | 814373.164 | 1179.337 | 55 | N |
| GL-04 | Measurement 99 | 5214515.242 | 814268.148 | 1179.349 | 50 | N |
| GL-03 | Measurement 94 | 5214519.041 | 814271.162 | 1179.184 | 70 | N |
| GL-03 | Measurement 95 | 5214519.943 | 814366.036 | 1178.666 | 55 | N |
| GL-03 | Measurement 96 | 5214517.325 | 814470.75 | 1179.103 | 55 | N |
| GL-02 | Measurement 91 | 5214524.441 | 814479.062 | 1178.783 | 55 | N |
| GL-02 | Measurement 92 | 5214527.566 | 814373.208 | 1179.182 | 45 | N |
| GL-02 | Measurement 93 | 5214525.445 | 814262.397 | 1179.123 | 70 | N |
| GL-01 | Measurement 88 | 5214530.644 | 814268.491 | 1179.598 | 65 | N |
| GL-01 | Measurement 89 | 5214532.115 | 814367.19 | 1179.213 | 65 | N |
| GL-01 | Measurement 90 | 5214532.562 | 814474.397 | 1178.745 | 55 | N |

DCP- measurment taken within the Drill Cutting Pile
Y- Yes, measurement was taken within visible drill cuttings
N- No, measurement was not taken within visible drill cuttings
*- ruler not visible