PHASE 2 INITIAL BOREHOLE DRILLING AND TESTING, IGNACE AREA

WP02 Data Report - Drilling and Coring for IG_BH05

APM-REP-01332-0243 **November 2022**

Golder Associates Ltd.

nwmo
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REPORT

PHASE 2 INITIAL BOREHOLE DRILLING AND TESTING AT IG_BH04/05/06, IGNACE AREA

WP02 Data Report - Borehole Drilling and Coring for IG_BH05

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WP02 DATA REPORT
BOREHOLE DRILLING AND CORING FOR IG_BH05

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1.0 INTRODUCTION

The Phase 2 Initial Borehole Drilling and Testing at IG_BH04/05/06 project in the Ignace area of Ontario, is part of the Phase 2 Geoscientific Preliminary Field Investigations of the NWMO's Adaptive Phased Management (APM) Site Selection Phase.

This project involves testing of deep borehole IG_BH04 and the drilling and testing of deep boreholes IG_BH05 and IG_BH06 in the Ignace area within the identified Potential Repository Area (PRA). The fifth drilled borehole, IG_BH05, is located a direct distance of approximately 23 km southeast of the Wabigoon Lake Ojibway Nation and a direct distance of 42 km northwest of the Town of Ignace. Access to the IG_BH05 drill site is via Highway 17 and primary logging roads, as shown on Figure 1.

The work comprised of a total of eleven work packages and was carried out by a team led by Golder Associates Ltd. (Golder) on behalf of the NWMO. The IG_BH05 program is described in the Borehole Characterization Plan (BCP) for IG_BH05 (Golder, 2021a).

This data report describes the methodology, activities and results for Work Package 2 (WP02): Borehole Drilling and Coring for IG_BH05, which includes: borehole drilling, coring and casing installation, borehole deviation, and drilling fluid management and use of tracers.

2.0 BACKGROUND INFORMATION

2.1 Geological Setting

The approximately 2.7 billion year old Revell batholith is located in the western part of the Wabigoon Subprovince of the Archean Superior Province. The batholith is roughly elliptical in shape trending northwest, is approximately 40 km in length, 15 km in width, and covers an area of approximately 455 km^2. Based on geophysical modelling, the batholith is approximately 2 km to 3 km thick through the center of the northern portion (SGL, 2015). The batholith is surrounded by supracrustal rocks of the Raleigh Lake (to the north and east) and Bending Lake (to the southwest) greenstone belts (Figure 2).

IG_BH05 is located within an investigation area of approximately 19 km^2 in size, situated in the northern portion of the Revell batholith. Bedrock exposure in the area is generally very good due to minimal overburden, few water bodies, and relatively recent logging activities. Ground elevations generally range from 400 to 450 m above sea level. The ground surface broadly slopes towards the northwest as indicated by the flow direction of the main rivers in the area. Local water courses tend to flow to the southwest towards Mennin Lake (Figure 1).

Four main rock units are identified in the supracrustal rock group: mafic metavolcanic rocks, intermediate to felsic metavolcanic rocks, metasedimentary rocks, and mafic intrusive rocks (Figure 2). Sedimentation within the supracrustal rock assemblage was largely synvolcanic, although sediment deposition in the Bending Lake area may have continued past the volcanic period (Stone, 2009; Stone, 2010a; Stone, 2010b). All supracrustal rocks are affected, to varying degrees, by penetrative brittle-ductile to ductile deformation under greenschist- to amphibolite-facies metamorphic conditions (Blackburn and Hinz, 1996; Stone et al., 1998). In some locations, primary features, such as pillow basalt or bedding in sedimentary rocks are preserved, in other locations, primary relationships are completely masked by penetrative deformation. Uranium-lead (U-Pb) geochronological analysis of the supracrustal rocks produced ages that range between 2734.6 +/-1.1 Ma and 2725 +/-5 Ma (Stone et al. 2010).

Three main suites of plutonic rock are recognized in the Revell batholith, including, from oldest to youngest: a Biotite Tonalite to Granodiorite suite, a Hornblende Tonalite to Granodiorite suite, and a Biotite Granite to Granodiorite suite (Figure 2). Plutonic rocks of the Biotite Tonalite to Granodiorite suite occur along the southwestern and northeastern margins of the Revell batholith. The principal type of rock within this suite is a white to grey, medium-grained, variably massive to foliated or weakly gneissic, biotite tonalite to granodiorite. One sample of foliated and medium-grained biotite tonalite produced a U-Pb age of 2734.2+/-0.8 Ma (Stone et al. 2010). The Hornblende Tonalite to Granodiorite suite occurs in two irregularly-shaped zones surrounding the central core of the Revell batholith. Rocks of the Hornblende Tonalite to Granodiorite suite range compositionally from tonalite through granodiorite to granite and also include significant proportions of quartz diorite and quartz monzodiorite. One sample of coarse-grained grey mesocratic hornblende tonalite produced a U-Pb age of 2732.3+/-0.8 Ma (Stone et al. 2010). Rocks of the Biotite Granite to Granodiorite suite underlie most of the northern, central and southern portions of the Revell batholith. Rocks of this suite are typically coarse-grained, massive to weakly foliated, and white to pink in colour. The Biotite Granite to Granodiorite suite ranges compositionally from granite through granodiorite to tonalite. A distinct potassium (K)-Feldspar Megacrystic Granite phase of the Biotite Granite to Granodiorite suite occurs as an oval-shaped body in the central portion of the Revell batholith (Figure 2). One sample of coarse-grained, pink, massive K-feldspar megacrystic biotite granite produced a U-Pb age of 2694.0+/-0.9 Ma (Stone et al. 2010).

The bedrock surrounding IG_BH05 is composed mainly of massive to weakly foliated felsic intrusive rocks that vary in composition between granodiorite and tonalite, and together form a relatively homogeneous intrusive complex. Bedrock identified as tonalite transitions gradationally into granodiorite and no distinct contact relationships between these two rock types are typically observed (SRK and Golder, 2015; Golder and PGW, 2017). Massive to weakly foliated granite is identified at the ground surface to the northwest of the feldspar-megacrystic granite. The granite is observed to intrude into the granodiorite-tonalite bedrock, indicating it is distinct from, and younger than, the intrusive complex (Golder and PGW 2017).

West-northwest trending mafic dykes interpreted from aeromagnetic data extend across the northern portion of the Revell batholith and into the surrounding greenstone belts. One mafic dyke occurrence, located to the northwest of IG_BH01, is approximately 15-20 m wide (Figure 2). All of these mafic dykes have a similar character and are interpreted to be part of the Wabigoon dyke swarm. One sample from the same Wabigoon swarm produced a U-Pb age of 1887+/-13 Ma (Stone et al., 2010), indicating that these mafic dykes are Proterozoic in age. It is assumed based on surface measurements that these mafic dykes are sub-vertical (Golder and PGW 2017).

Long, narrow valleys are located along the western and southern limits of the investigation area (Figure 1). These local valleys host creeks and small lakes that drain to the southwest and may represent the surface expression of structural features that extend into the bedrock. A broad valley is located along the eastern limits of the investigation area and hosts a more continuous, un-named water body that flows to the south. The linear and segmented nature of this waterbody's shorelines may also represent the surface expression of structural features that extend into the bedrock.

Regional observations from mapping have indicated that structural features are widely spaced (typical 30 to 500 cm spacing range) and dominantly comprised of sub-vertical joints with two dominant orientations, northeast and northwest trending (Golder and PGW 2017). Interpreted bedrock lineaments generally follow these same dominant orientations in the northern portion of the Revell batholith (Figure 2; DesRoches et al., 2018). Minor sub-horizontal joints have been observed with minimal alteration, suggesting they are younger and perhaps related to

glacial unloading. One mapped regional-scale fault, the Washeibemaga Lake fault, trends east and is located to the west of the Revell batholith (Figure 2). Ductile lineaments, also shown on Figure 2, follow the trend of foliation mapped in the surrounding greenstone belts. Additional details of the lithological units and structures found at surface within the investigation area are reported in Golder and PGW (2017).

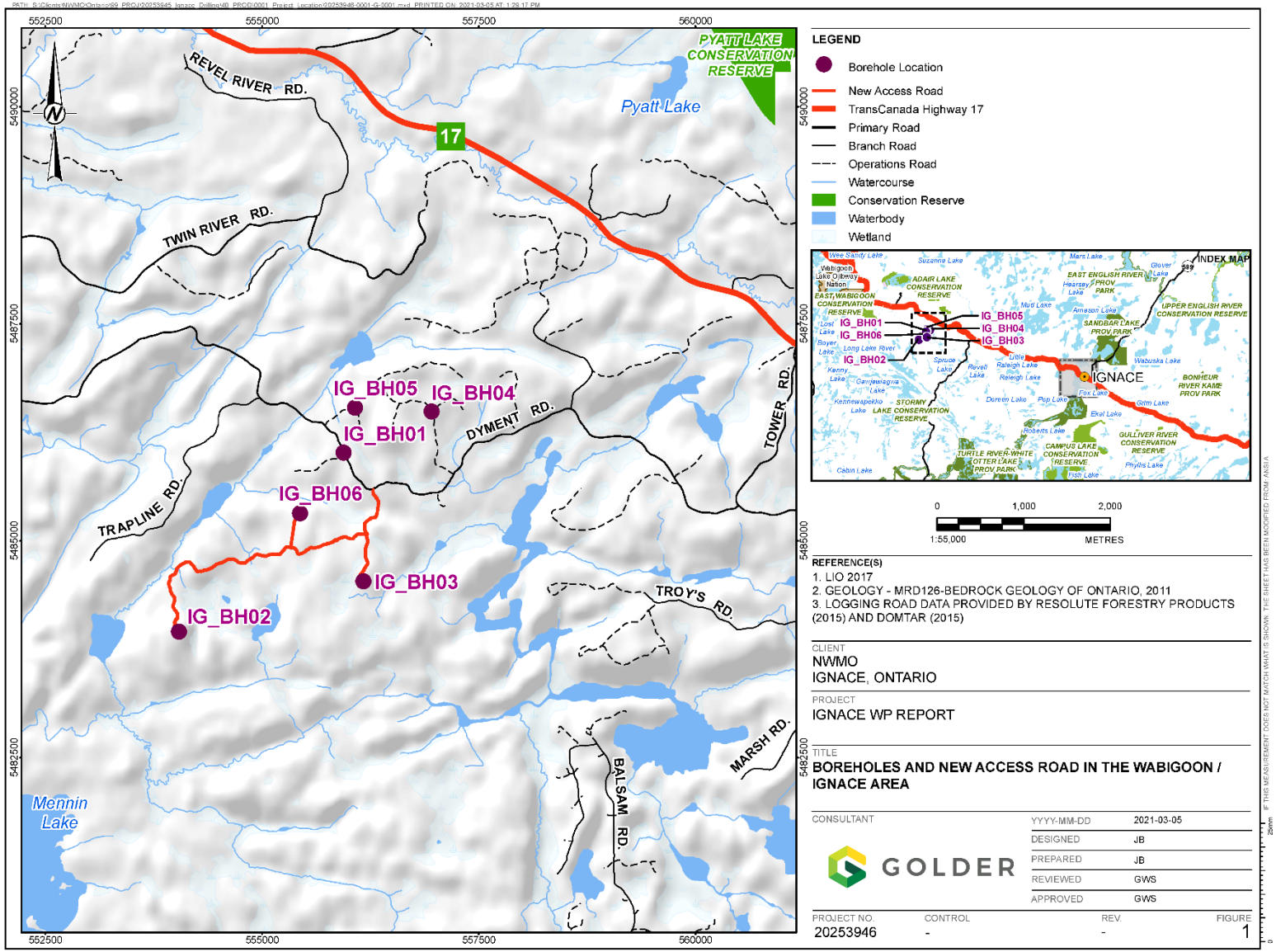


Figure 1: Location of IG_BH05 in relation to the Ignace Area

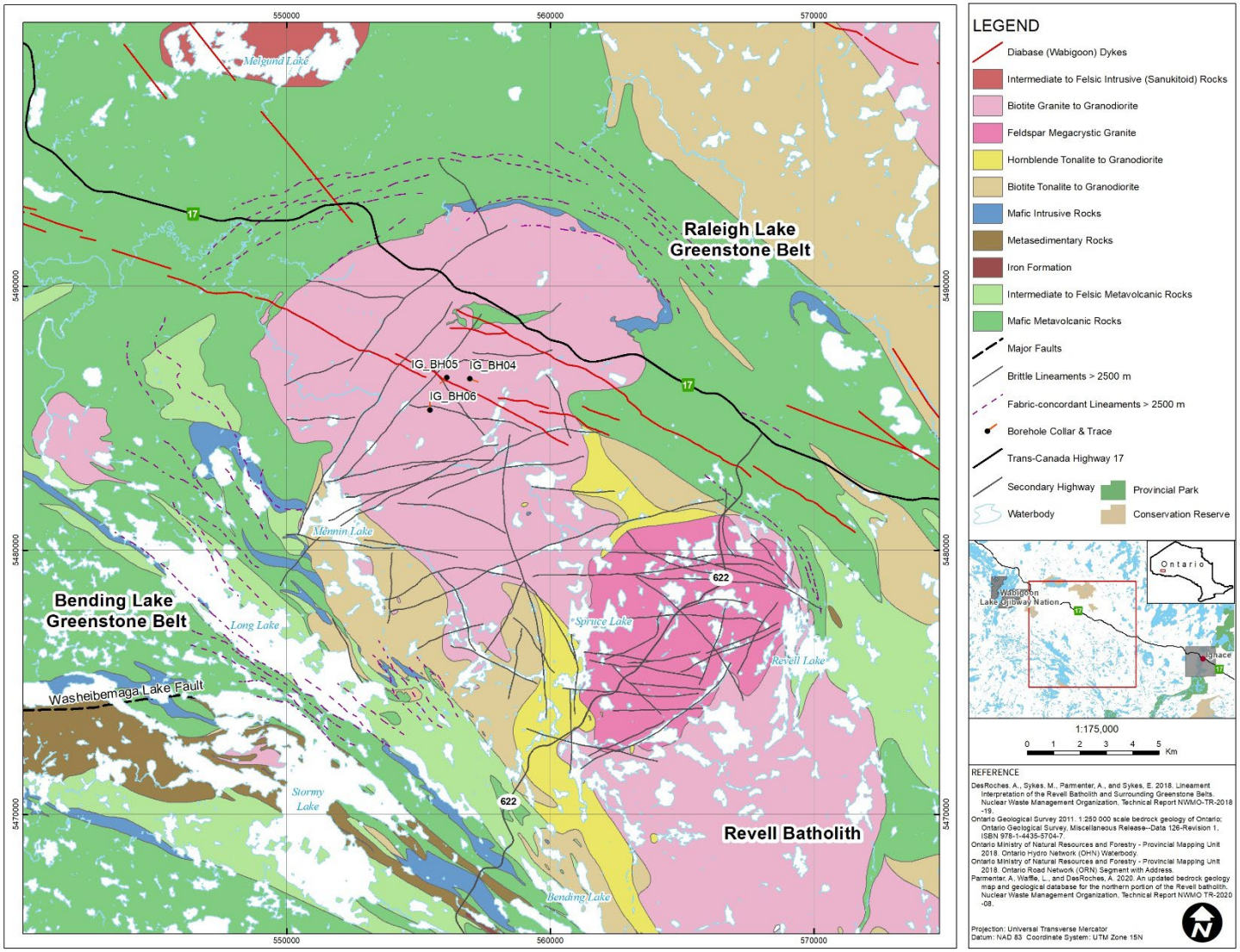


Figure 2: Geological Setting and Location of Boreholes IG_BH04, IG_BH05, and IG_BH06 in the Northern Portion of the Revell Batholith

2.2 Technical Objectives

The technical objectives of the borehole drilling, coring and casing installation activities are:

- The collection of high quality bedrock core, which will allow geological and geotechnical core logging and the collection of core samples. Core samples will be used for laboratory testing programs to characterize the bedrock environment;
- To provide opportunity to complete supplementary studies such as borehole geophysical logging, hydraulic testing and opportunistic groundwater sampling while drilling; and
- To provide stable borehole walls to allow for future testing and monitoring.

The main objectives of the Drilling Fluid Management and Use of Tracers activities are:

- Optimize drilling to minimize borehole deterioration;
- Effectively remove any cuttings to maintain efficient drilling; and
- Trace the drilling fluids using a fluorescein tracer and measure fluid parameters (e.g., temperature, density and electric conductance) in order to recognize drilling fluid contamination of groundwater (to be discussed in the WP07 Report – Opportunistic Groundwater Sampling for IG_BH05, Golder 2022b) and porewater extraction samples (to be discussed in the WP04C Report – Porewater Extraction and Analysis for Petrographic Analysis for IG_BH05, Golder 2022a).

3.0 DESCRIPTION OF ACTIVITIES

Activities were overseen by Lead Contractor Golder Associates with Rodren Drilling Ltd. (Rodren), based in Winnipeg, Manitoba, contracted by Golder to carry out the drilling for IG_BH05.

Permission to drill was obtained from the Ministry of Northern Development, Mines, Natural Resources and Forestry (MNDMNRF) on September 24th, 2019 and formal notification given to Golder from the NWMO on February 11th, 2021 with the understanding that the drilling would begin in May 2021. Drilling of IG_BH05 commenced immediately following completion of WP01 activities at IG_BH05.

Drilling was carried out on a 24 hour, 7 days per week basis. Day shifts ran from 7 am to 7 pm, with night shifts from 7 pm to 7 am. A driller and helper were on site for each day and night shift, and a drilling foreman was typically present during the day shifts, or as required. A Golder drilling supervisor was present on site for all drilling activities. Both the Golder drilling supervisor and the Golder core logger from WP03 followed the same shift schedule as the drillers. Shifts were shortened to manage fatigue once per week where the number of site hours was reduced to 20 for a 24 hour period, that is, a 10 hour day shift and a 10 hour night shift. The Golder site supervisors (WP01) were on site during the 4 hour rest window, however the drillers also adhered to the fatigue management schedule. When the Golder site supervisor was not on site, the drilling supervisor took over this role. This was documented in the daily tail gate sign-in sheet located in the Golder trailer at the site entrance.

The Golder drilling supervisor's responsibilities were divided between two main activities: (1) Drilling, Coring and Casing (2) Drilling Fluid Management and Use of Tracers. These activities included the following actions:

Drilling, Coring and Casing

- Verifying drill rig setup;
- Tracking and recording borehole deviation;
- Supervising installation and cementing casing(s);
- Tracking depth of the borehole;
- Monitoring drilling parameters during drilling; and
  - Managing drill cutting collection and disposal.

Drilling Fluid Management and Use of Tracers

- Testing all fresh source water added to the drill fluid system;
- Monitoring and recording drill fluid parameters and volume changes during drilling;
- Identifying any triggers for an opportunistic ground water sample;
- Collecting and archiving drill fluid samples every 50 m;
- Supervising borehole flushing prior to geophysical survey (WP05); and
- Recording observed drilling parameters and measured volume changes, drill fluid parameters and borehole depth for each run.

3.1 Health and Safety

The Ignace drilling and testing program conformed to applicable health and safety standards for the duration of the program. A comprehensive “pre-drill” drill rig inspection was originally completed by Rodren prior to the start of drilling IG_BH05 on May 9th, 2021. This inspection included the following checks:

- Emergency switches are in working order;
- Equipment and protective guards are in place;
- Cables, chains, pulleys, cable winches, latches / lifting devices are in proper working order;
- Drill string (coring rods) are manufacturer recommended;
- Mast is unmodified from manufacturer and regularly inspected;
- Drill controls are appropriate and free from obstructions;
- Hydraulic lines are secure and not bent or pinched;
- Pump lines (water hoses) are in good condition with whip checks, where required;
- Fire prevention supplies are present;
- Exhaust piping is directed appropriately;
- Fuel is properly stored; and

- Other general items including maintenance logs to confirm inspections were available.

Rodren continued to complete daily rig inspections to ensure that rig safety was maintained throughout the drilling program.

Once drilling commenced, a Casella Sound Level Meter was used to establish zones where hearing protection was required, that is, all areas with an equivalent sound exposure level exceeding 83 dBA (O.Reg. 851/139) due to the prolonged exposure of 12-hour shifts. The area inside of the drill rig and surrounding support shacks was established as requiring hearing protection, as well as the area adjacent to the light tower close to site entrance.

An RKI Model GX-2012, 4-Gas Monitor was installed in the drill rig and used to monitor for levels of oxygen, carbon monoxide, hydrogen sulphide and combustible gases during drilling. The gas monitor was bump checked by the Golder site supervisor daily. No exceedances of safe limits of these gases were encountered during drilling of IG_BH05.

Health and safety toolbox meetings were held at the beginning of each shift (day and night), where attendance of all site personnel was mandatory. The meeting reviewed all activities to be completed during that shift, and identified the hazards and mitigation efforts to reduce risk of injury. Any visitors on site, who did not participate in the toolbox meetings, were required to review and acknowledge the toolbox report before allowed to perform work on site.

3.2 Quality Confirmation

Cross-shifts between day and night shift were carried out to transfer knowledge and information about the previous shift activities. These were typically 10-15 minutes, but longer when more specific knowledge needed to be relayed. When the crews did not cross on site, during shortened fatigue management shifts, the knowledge transfer was done in Ignace or over the phone. Cross-shifts were also carried out between crews switching rotations and typically involved spending an entire shift together on site to ensure procedures were kept consistent.

Quality Confirmation was completed for each 24-hour period by the drilling supervisors and included tracking of the drilled depth at the start and end of each day and night shift, verification of the drilling parameters recorded, verification and comments for drill fluid parameter triggers and volume loss observations, as well as drill fluid samples collected, and borehole orientation surveys conducted.

Drilling supervisors ensured all tools were properly calibrated before the start of the project and performed daily calibration checks of all instruments to be used at the start of each 24-hour period. If a tool not anticipated to be used became necessary during the shift, it was calibration checked as required prior to use.

4.0 SUMMARY OF DRILLING, CORING AND CASING

Drilling of IG_BH05 commenced on May 10th, 2021 and was completed on August 6th, 2021. The overall drilling progress and key activities are shown on Figure 3.

The borehole was advanced to 1000.63 metres below ground surface (mbgs) drilled depth (along hole) based on the rod count and measured stickup of the drill rods on the final drill run. The final true vertical depth of the borehole, calculated using the measured actual orientation of the borehole, is 931.89 mbgs. Further details of the borehole orientation are discussed in Section 4.4.

Coring progress over the program was variable due to bit changes or other drilling related maintenance including drill cuttings management and WP07 ground water sampling attempts. The overall progress is shown graphically on Figure 3, and the daily progress by shift is shown on Figure 4. The maximum meterage attained for a single shift was 18.00 m on July 2 and July 3 2021 night shift, but the average rate per shift was 7.36 m (excluding WP07 sampling activities, conductor and surface casing installation and cementing, installation of the centrifuge and extended drill maintenance period).

Drilling of IG_BH05 was completed on the night shift of August 6, 2021. This was followed by the final borehole Reflex SPRINT-IQ™ gyro survey, borehole flushing, rod removal and preparation for geophysical logging. The core logging and sampling supplies were relocated to the site of IG_BH06, though some duplicate monitoring equipment related to WP02 remained at the IG_BH05 site to allow for continued monitoring of drilling fluid during WP05 and WP06 activities.

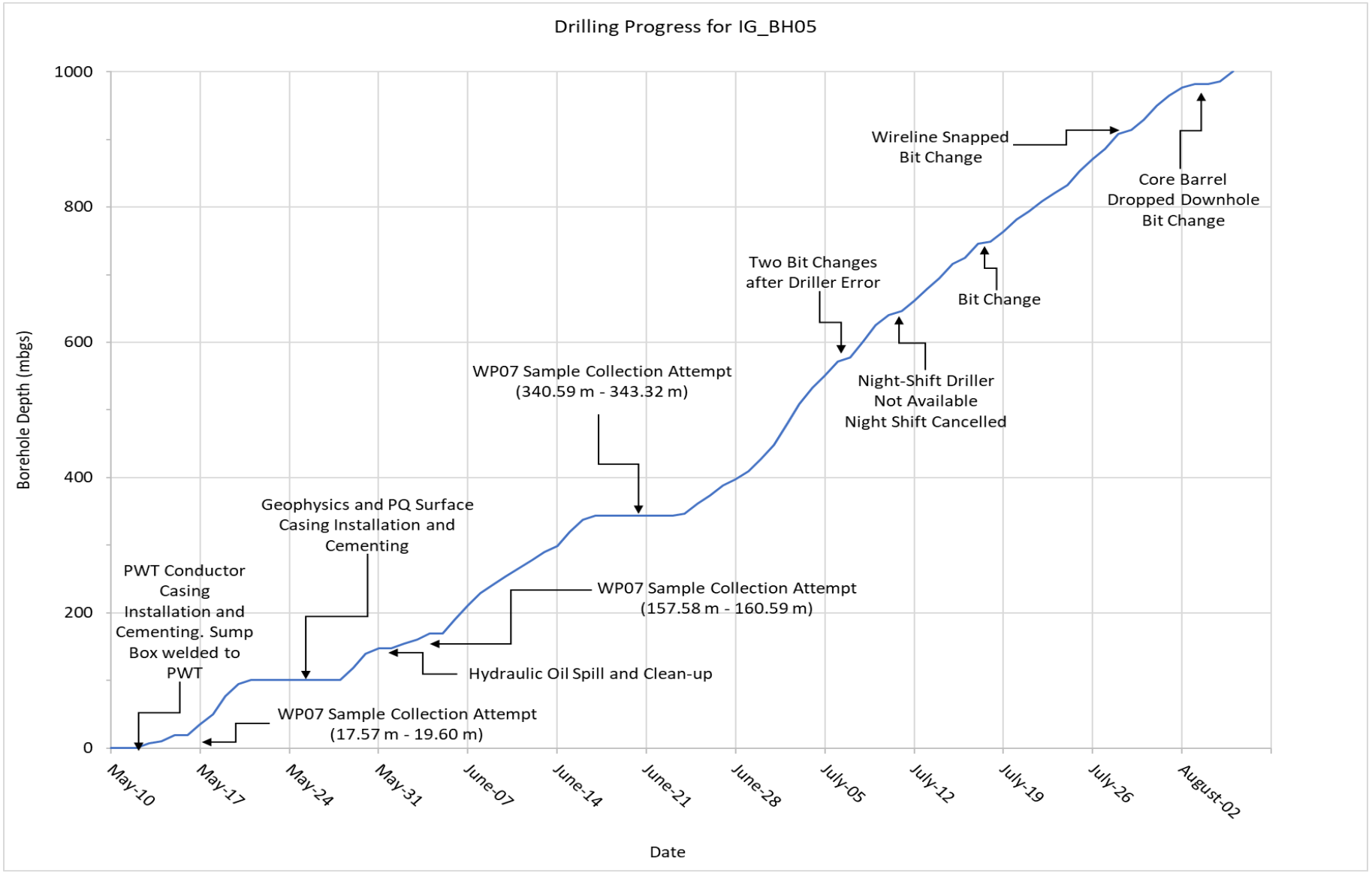


Figure 3: IG_BH05 Drilling Progress and Activities

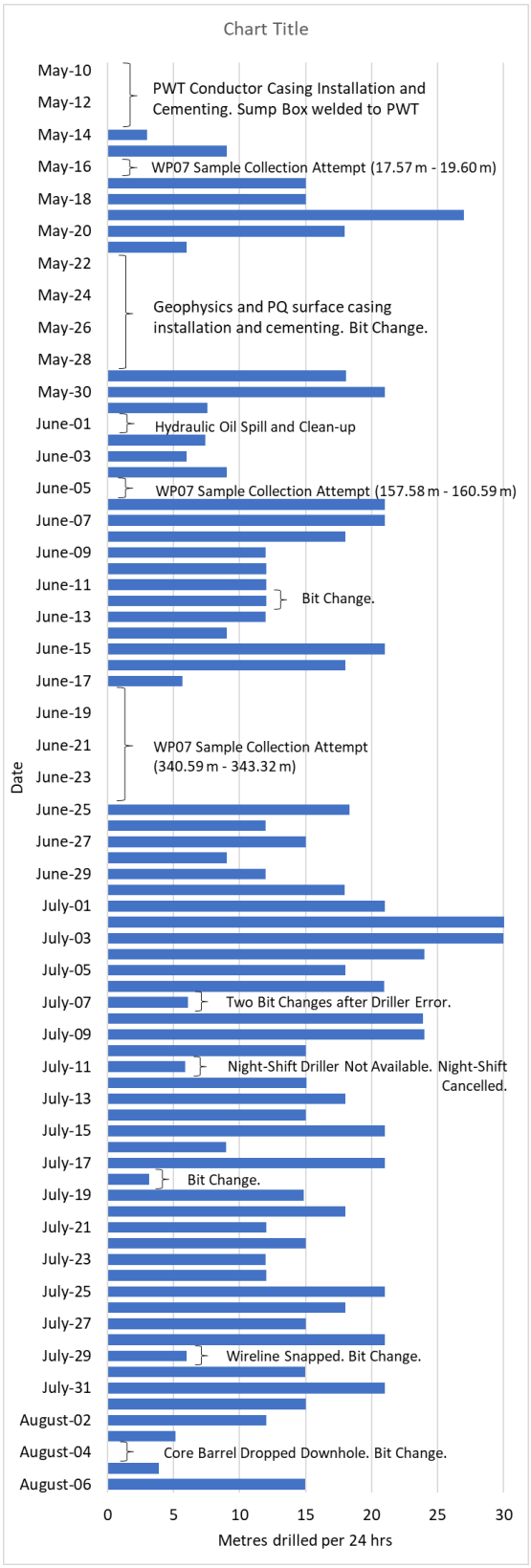


Figure 4: IG_BH05 Daily Progress

4.1 Drilling Details

4.1.1 Drill Rig Setup

A skid mounted Discovery Diamond Drill model EF-100 was used for the program, set up with secondary containment to minimize drill fluid entering the environment. Drilling was carried out with a constant water flush (as necessary), with the drill water (drill fluid) recycled using a Solids Removal System™ (SRU) from Australian Mud Company Pty Ltd. (AMC). This system utilized a centrifuge to remove cuttings from the return drill fluid and is shown in Figure 5.



Figure 5: Solids Removal Unit – Centrifuge Used to Remove Cuttings from Drill Fluid Return

Set-up of the drill rig commenced once the drill pad was prepared as described in the WP01 Commissioning Report (Golder, 2021b). The construction of the drill pad included lining an area of approximately 225 m^2 to provide secondary containment beneath the drill and all support equipment including the centrifuge, the wastewater and fluorescein water tanks, as well as all connecting hoses and lines. The drill pad was prepared with a gentle slope towards the borehole collar, so that all fluid contained by the liner was directed to the borehole collar (i.e., the “lower sump”), where it was pumped to a wastewater tank via a submersible sump pump. Prior to the commencement of drilling, an “upper” metal sump box was welded to the outside of the PWT casing at the

collar of the hole, further described in Section 4.2. The metal sump box is used to contain the return drill fluid from the casing during drilling and flushing activities.

The as-built collar azimuth and dip for IG_BH05 was 220˚/-70˚. Once the drill pad was constructed and the rig matting in place, the drill was moved into place using an excavator and sighted into alignment using surveyor stakes set in the ground. The stakes were positioned by surveyors using the coordinates of the borehole to set a stake to the north of the rig and two stakes to the south of the rig at 180˚ from each other. This allowed the WP02 staff to use the stakes and the drill mast to sight the azimuth (Figure 6). The dip of the borehole was set by confirming the mast dip at -70˚ using both digital and analogue angle finders, as shown in Figure 6.

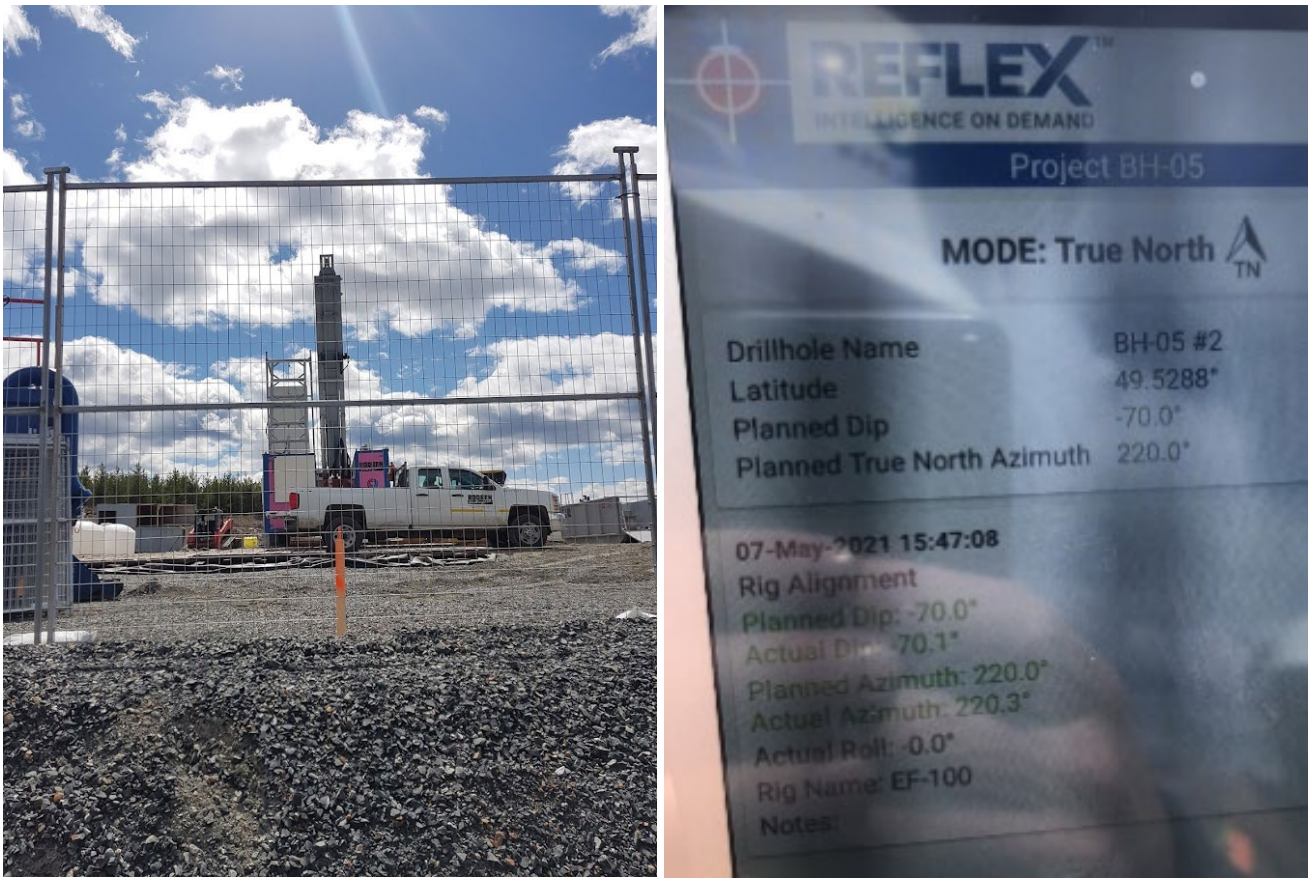


Figure 6: Confirming Azimuth and Dip of the Drill Prior to Drilling.

Golder WP02 staff mobilized to site around May 5th, 2021. During the initial days on site, Golder unpacked and set up the site trailers and carried out equipment calibrations, while Rodren prepared their support equipment. The overall view of the IG_BH05 site is shown in Figure 7, and an image of the drill rig shown in Figure 8.



Figure 7: View of IG_BH05 Drill Site Facing North



Figure 8: Select Photographs of the Rodren Drill Rig. Left: Inside of Drill Rig preparing to Drill Conductor Casing; Right: Rodren Core Extraction and Support Shack

4.1.2 Drill Rig and Equipment Maintenance

Throughout the drilling and advancement of IG_BH05 several operational issues were encountered, leading to extended delays. The issues encountered are detailed in Table 1.

Table 1: Operational Issues Encountered during the Advancement of IG_BH05

Category	Date	Description
Borehole Centralizers	May 17	During the initial drilling of IG_BH05, regular spaced fracturing was occurring in the recovered core, which was suspected to be the result of vibrational resonance from stabilizer rods placed after every 3 m HQ rod to help ensure the borehole was drilled within the required straightness tolerance. At a depth of 31.62 m, the stabilizers rods were removed from the drill string, which eliminated the core fracturing problem. The borehole remained within the required straightness tolerance and the stabilizers were not needed.
Drill Tower Oil Leak	May 31 – June 2	On May 31, 2021, there was a hydraulic oil leak from a loose fitting on the winch motor on top of the drill mast, which sprayed between 15 to 30L of hydraulic oil into the air, impacting the north east side of the site. Drilling was paused while a site wide clean-up of the sprayed oil was completed.
Hydraulic Line Left Open	July 7	A routine bit change was completed at a depth of 575.20 mbgs. After completing the bit change, the core extraction hydraulic line was left open, resulting in false readings on the drilling gauges. The bit was immediately worn out and needed to be changed again at a depth of 577.71 mbgs. The hydraulic core extraction was not used after this event. The core runs were manually extracted from the inner tubes to prevent a recurrence of this event.
Wireline Breaking / Issues Pulling Core Tube	July 29	The wireline broke while retrieving CR324. The drillers proceeded to remove the drill string from the borehole to retrieve the core barrel, repair the wireline, and perform a bit change while the rods were already out of the borehole.
Core Barrel Dropped Downhole	August 3 – August 4	The drillers removed the drill rods from the hole to change to drill bit. The core barrel was stuck in the drill chuck and fell down the borehole. The drillers lowered the drill rods with a rod tap and retrieved the detached core barrel.
Centrifuge Maintenance	May – August	Routine maintenance was completed on a daily basis to maintain the efficiency of the SRU. The centrifuge was opened and cleaned at the end of each shift in addition to being refuelled at regular intervals during operation (after ~3-4 core runs). This process typically required 0.5 – 1 hour to refuel the SRU, and 0.5 – 1 hour to clean the SRU.
Main Generator Maintenance	May – August	Every 3-4 days the main site generator required refuelling. To complete this task, the generator was shut down, disconnecting the entire site from the power source. This process typically required 0.5 – 1 hour to complete, and drilling was paused during these periods.

4.1.3 Tracking Borehole Depth

The depth of the borehole was monitored on a per run basis by the drilling supervisors. This was done by measuring the stickup of the drill rods from a fixed reference point at the completion of each run plus the fixed

stick up of that reference point from the ground surface, which was subtracted from the length of the drill string (core barrel plus the drill rods). The chosen reference point was the base of the drill rig mast, which was 1.13 m above ground surface (along hole). During drilling, the depth of the borehole was monitored as meters below ground surface along the hole and throughout this report depths are referred to as mbgs (along hole).

The core barrel assembly was measured as 4.14 m long and included the barrel, a reaming shell and the drill bit. All drill rods on site were confirmed as 3.0 m long (metric) HQ rods. No rod grease was used during the coring process; however, thread lubricant was used on the rod threads as they were added to the drill string. As described above, the borehole depth was tracked by the number of rods added to the drill string.

A rod count was performed by WP02 supervisors during the final rod pull, where the total number of HQ coring rods used was verified as 333.

4.1.4 Drill Cuttings Management and Disposal

At the outset of the field program, the drill fluid recycling system was set up using the SRU™ (centrifuge). The drill fluid return containing cuttings from the borehole was pumped directly to the centrifuge, where the fine solids were separated from the water and directed to buckets that were emptied into plastic lined containment bags to await disposal. The performance of the centrifuge was observed to vary throughout drilling of IG_BH05, with the drill cuttings frequently containing more drill fluid and contributing to fluid losses. During the drilling, there were frequent periods of inactivity due to a backlog in WP03 activities and operational issues that may have contributed to the inefficiencies of the SRU™.

These solid drill cuttings were sampled on June 13, 2021 and August 12, 2021 and sent to Bureau Veritas Laboratories in Mississauga to be analyzed according to Ontario Regulation 558. The results indicated that the drill cuttings were safe for disposal and were accepted by the Ignace landfill.

4.2 Casing Installation and Cementing Details

Prior to commencing coring activities, PWT conductor casing was installed and cemented to a depth of 9.56 mbgs (along hole), to prevent drill fluid from escaping through the fractured upper bedrock. While fill materials from construction of the drill pad were present at the borehole collar, no overburden was encountered or recovered during the casing installation process. In order to contain the return drill fluid, a metal sump box was then welded to the PWT casing at the collar of the hole as the cement cured.

The PQ surface casing was then advanced just beyond the PWT conductor casing to provide smaller diameter casing to stabilize the HQ sized drill rods during coring. As coring advanced, it was necessary to continue to ream the PQ casing to an intermediate depth of 14.21 mbgs (along hole). This was done to add more weight to the PQ string, helping to mitigate spinning of the PQ, while also providing additional stabilization for the HQ coring.

Routine coring activities then commenced and were halted when the borehole was advanced to 100.57 mbgs (along hole). At this depth, the borehole was flushed and prepared for the televiewer survey. Once the parameters of the flush water were within acceptable criteria (see Section 4.6), the HQ drill rods were removed from the borehole and optical and acoustic televiewer surveys were completed.

The PQ surface casing installation depth was determined, in coordination with NWMO, once the first 100 m of geophysical survey images were reviewed. This depth was selected so that runs with drill fluid volume measurements > 100 L were cased and cemented to seal them from the rest of the hole. Additionally, this casing installation depth covered features observed in the core logging and televiewer surveys with iron staining and

aperture. The installation and cementing of the surface casing served to prevent mixing of the ground water from these shallow zones with the rest of the borehole. Golder supervised Rodren throughout the installation of the PQ surface casing and cementing activities.

The surface casing installation process involved first reaming the borehole with a PQ advancer bit to the desired depth of 68.30 mbgs (along hole). The PQ casing rods were then removed from the borehole and a Van Ruth plug installed in the HQ hole below the planned casing depth. The advancer bit was replaced with a casing shoe bit, and the rods re-lowered. The PQ casing was lifted slightly in order to create space for the cement mixture to flow between the PQ casing shoe and the borehole wall.

The cement mixture was batched on surface and approximately 200 litres pumped down the inside of the PQ casing. Rodren provided Type HS High Sulphate resistant cement by Lafarge, which is a hydraulic cement that provides high sulphate resistance. The grout was pumped down the hole and chased with a wiper plug, at which point the grout mixture could be observed returning to surface through the annular space between the outside of the PQ casing and the inside of the PWT conductor casing (Figure 9). A sample of the cement mixture was collected from the mixing tank and from the annular return in order to confirm proper curing of the cement at surface. During the curing process, the grout was observed to settle slightly in the annular space, and an additional grout mix was batched and used to top up the annular space from surface. Providing this confinement to surface was considered important to protect the PQ casing from excess rattling and vibration from the HQ rods during coring.

The cement was left to cure for approximately 48 hours, at which time the Van Ruth plug was retrieved. The remainder of the HQ rods required to continue regular coring activities were then added to the drill string and coring resumed for the remainder of the borehole to 1000.63 mbgs (along hole). The final IG_BH05 borehole schematic is shown in Figure 10.



Figure 9: Grout return through annulus of PWT and PQ casings

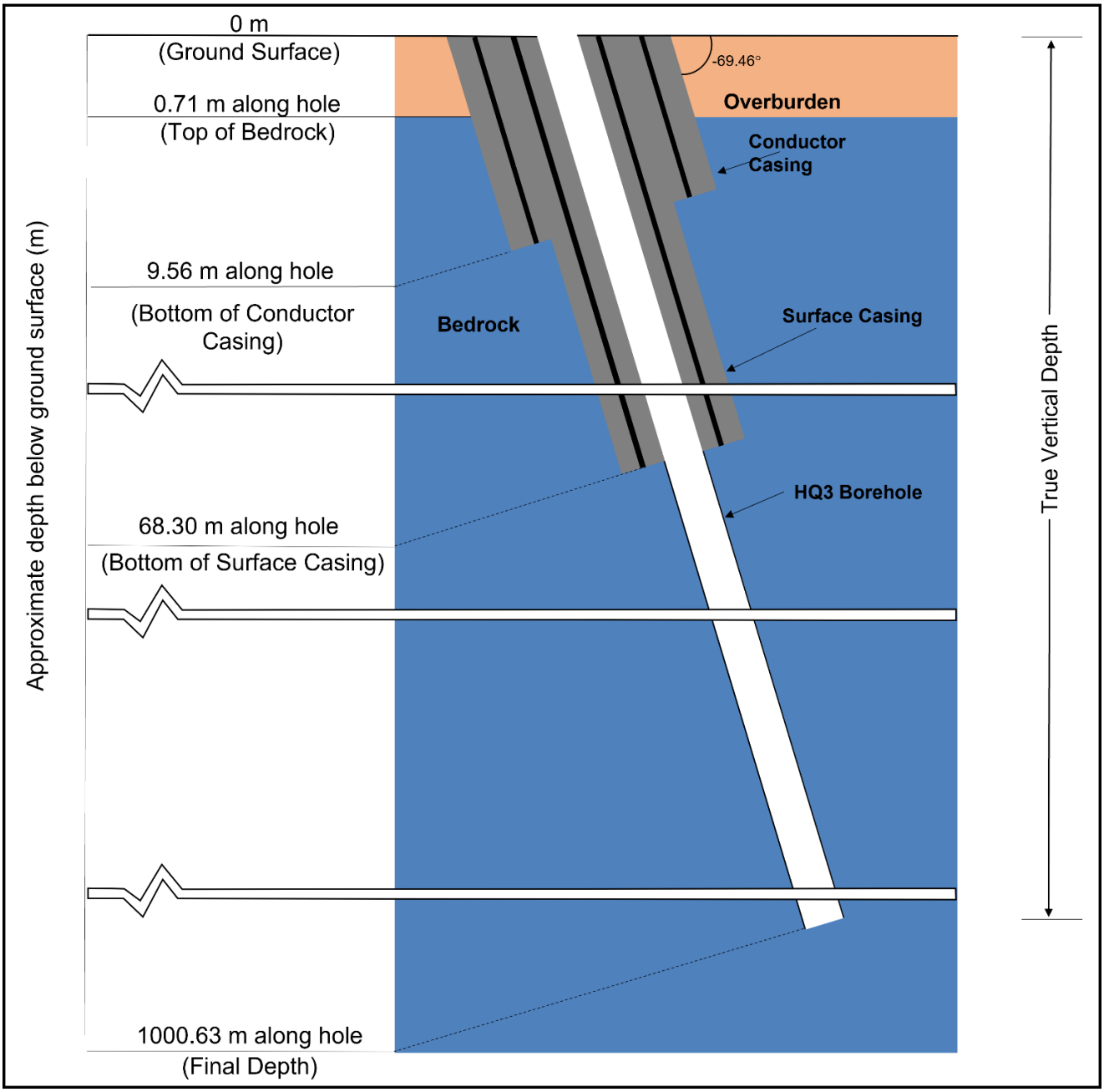


Figure 10: Final IG_BH05 Schematic

4.3 Coring Details

Three (3) metre long HQ sized drill rods were added manually to the drill string one rod at a time as drilling progressed. As with standard deep drilling programs, two core tubes were available at all times, so that when one was removed with a drilled run, the second could be lowered and locked in place while the core was extracted from the first tube. Core tubes were lowered and retrieved using a wireline system in which an overshot tool locked on to the top of the core tube. The core tube was pumped down and locked into the core barrel using the downhole pump; the drillers monitored when it was locked into place by observing a spike in the downhole fluid

pressure. This time required to pump and lock the core tube into place to continue coring increased with the depth of hole; having a second tube to start this process while the core was extracted from the first was valuable for efficiency.

After the conductor casing was installed, the borehole was advanced using a triple tube wireline drilling system for the entirety of the hole to minimize disturbance to the recovered drill core. Triple tube coring involves using steel, split core liners to line the inside of the core recovery tube which is locked within the core barrel during drilling. The core tube is recovered using the wireline at the completion of each drill run, with the split liners removed from the core tube on surface. The split liners help reduce the volume of drill fluid that can circulate within the core tube, helping to prevent the drilled core from being disturbed and to retain fine grained materials encountered. Table 2 presents the details of the casing and coring rods used to complete IG_BH05, while Table 3 presents the borehole diameter details.

Table 2: Details of Casing and Coring Rods used by Rodren for IG_BH05

Casing Type	Outer Diameter (mm)	Inner Diameter (mm)	Joint Torque (Nm)	Weight (kg/m)
Conductor (PWT) Casing	139.7	127.0	N/A	21.4
Surface (PQ) Casing	114.3	101.6	N/A	17.4
PQ Advancing Bit	121.0	94.2	N/A	N/A
PQ Shoe Bit	117.5	100.5	N/A	N/A
HQ Drill Rods	88.9	77.8	2000	11.44
HQ3 Drill Bit	96.0[1]	61.1[2]	N/A	N/A

[1]Open borehole diameter. [2]HQ3 core diameter size.

Table 3: IG_BH05 Borehole Diameter Details

Depth from (mbgs along hole)	Depth to (mbgs along hole)	Casing Type	Outer Borehole Diameter (mm)	Inner Diameter Within Casing (mm)
0	9.56	Conductor (PWT) Casing and Surface (PQ) Casing	143.76	101.6
9.56	68.30	Surface (PQ) Casing	121.0	101.6
68.30	1000.63	Open Borehole (HQ size)	96.0	96.0

4.3.1 Ground Conditions

In general, ground conditions were good and did not cause problems with the drilling process; several occurrences of core tube blockage were caused by natural structures, typically moderately to steeply inclined to the core axis, as shown in Figure 11.



Figure 11: CR347 Stopped Short as a Result of Core Blockage

4.3.2 Core Quality

In IG_BH05, there were no lost core occurrences. The instances of naturally broken core zones identified by the core loggers were confirmed by televiewer and can be reconciled to the individual intersecting structures over narrow widths (3 cm to 8 cm). Two instances of broken core with widths of 8 cm and 3 cm occurred at 717.96 mbgs and 790.90 mbgs (along hole), respectively. These two zones were confirmed by the televiewer survey to be a dense network of intersecting open structures occurring near amphibolite dykes.

Instances of mechanically broken core were also occasionally encountered. These typically occurred where the presence of sand sized ground core within the split tube resulted in the drill core becoming jammed in the core tube. When this occurred, drillers had to use mechanical force on surface to remove the inner split tube, causing damage to the rock core in the process. Ribbing (uneven or wavy core diameter) of the core tends to occur as the drill bit becomes worn down and increased torque is required to continue coring. Drillers were typically aware when this occurred due to noticeably reduced rates of penetration and verified suspicions by inspecting the core for these signs. Bit sharpening involved momentarily increasing torque or cutting off the water supply to sharpen the drill bit by exposing fresh diamonds, but results in increased ribbing. Drillers commonly carry out bit sharpening to maintain performance during the life of the bit. Efforts were made to restrict bit sharpening to the start or end of a drill run so that uneven diameter core was not present within the central part of a core run (mainly for aesthetic purposes).

4.3.3 Drill Bit Changes

Drill bit changes were required as coring advanced, and the drill bit became worn down. Bit changes involved removing the core tube from the rods, then using the rod handler on the drill rig to remove all the drill rods from the borehole, typically two at time. These stands of rods were stacked in the drill shack during the bit change so that they were easily accessed by the rod handler to go back down the borehole. When all the rods were removed, the core barrel was inspected for damage and signs of wear, and the bit replaced. Drilling in this relatively hard rock required frequent bit changes (approximately 1 every 100 m of drilling). A summary of the drill bit types used during the drilling program are shown in Table 4.

Table 4: Summary of Drill Bits used for Coring of IG_BH05

Drill Bit Name	Depth used from (mbgs)	Depth used to (mbgs)	Total drilled length used (m)	Reason for Bit Change
Pilot Series 300	0	31.62	31.62	While rods were pulled to remove centralizers

Drill Bit Name	Depth used from (mbgs)	Depth used to (mbgs)	Total drilled length used (m)	Reason for Bit Change
Pilot Series 300	31.62	100.57	68.95	While rods were pulled for geophysics
Pilot Series 300	100.57	268.89	168.32	Core run blocked, water pressure spiking
Pilot Series 300	268.89	575.20	306.31	Core run blocked, water pressure spiking
Pilot Series 300	575.20	577.71	2.51	Hydraulic line was left open, gauges misreading leading to a burnt bit
Pilot Series 300	577.71	748.73	171.02	Water pressure spiking
Pilot Series 300	748.73	910.65	161.92	Wireline broke while retrieving core. Pulled remainder of rods since majority of the drill string was already out of the borehole
Pilot Series 300	910.65	981.77	71.12	Water pressure spiking
Pilot Series 300	981.77	1000.63	18.86	End of borehole

4.4 Borehole Location and Orientation Details

The planned drill site for IG_BH05 was surveyed Rugged Geomatics Inc. This original site survey involved the use of a local reference points (ORPs) derived from GPS observations using the Precise Point Positioning service from Natural Resources Canada.

The as-built borehole points were surveyed on December 2, 2021 by Rugged Geomatics Inc. Elevation data was measured for the various tops of casings, the sump weld (the point on the conductor (PWT) casing where the sump box was installed) as well as a ground surface point.

Given the as-built coordinates of the top of the surface (PQ) casing, the along hole distance between the top of the PQ and the reference ground level (from WP02 field notes, see Figure 12) as well as the casing orientation of 220˚ / -70˚, the following relationships were used to translate the Northing, Easting and elevation of the PQ casing to the PWT, sump weld and the reference ground level:

Northing: cos(70˚)*cos(220˚)
Easting: cos(70˚)*sin(220˚)
Elevation: -sin(70˚)

The calculated and provided as-built coordinates of IG_BH05 are presented in Table 5. The borehole collar reference ground level was initially calculated incorrectly. The details of the miscalculation and the correction are described in Appendix D.

Table 5: IG_BH05 Final Surveyed Collar and Casing Coordinates

Point	Northing (m)	Easting (m)	Elevation (m)	Comment
Borehole Collar - Reference Ground Level (Ref. Pt. for drilling)	5486535.85	556069.05	432.29	Calculated E, N & Elev
Sump weld	5486535.98	556069.17	432.78	Provided E, N & Elev
Top of surface (PQ) casing	5486536.07	556069.23	433.05	Provided E, N & Elev

Note: Elevations are Geodetic and referred to the CGVD2013 Datum and coordinates are referred to UTM Zone 15, NAD 83 (CSRS).
Borehole Collar – Reference Ground Level refers to the pre-drilling ground surface level and has since been regraded

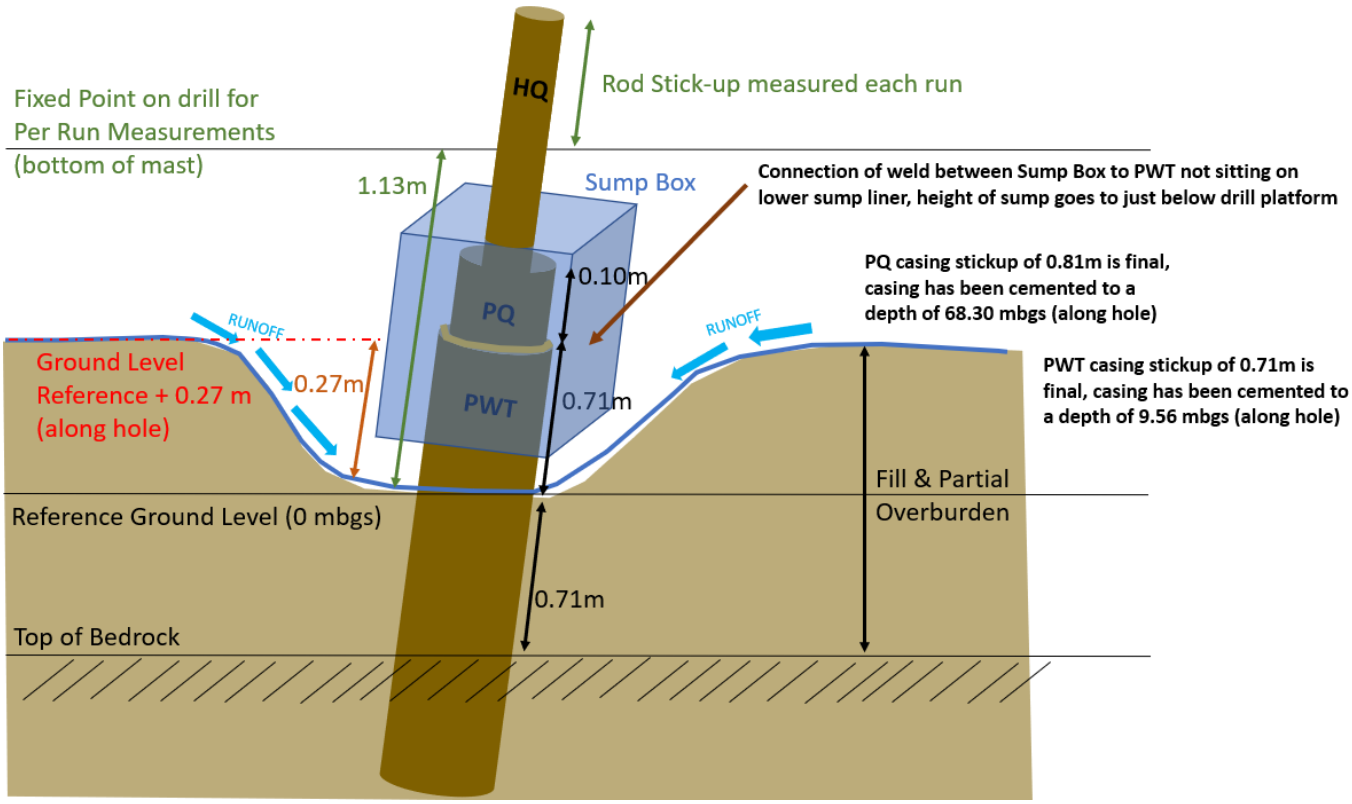


Figure 12: IG_BH05 Borehole Construction Schematic prior to PQ Surface casing extension.

4.4.1 Borehole Orientation

The borehole was planned to be drilled with an azimuth and inclination of 220˚ / -70˚ with no correction made for deviation as the drilling progressed.

The borehole was surveyed approximately every 9 m during drilling with a Reflex Gyro Sprint-IQ™ survey tool. The Sprint-IQ tool sits approximately 3.63 m above the drilled depth, as it cannot pass beyond the core barrel landing ring. The recorded depth was then taken at the mid-point of the survey tool, an additional 0.7 m for a total of 4.33 m from the drilled depth, shown in Figure 13.

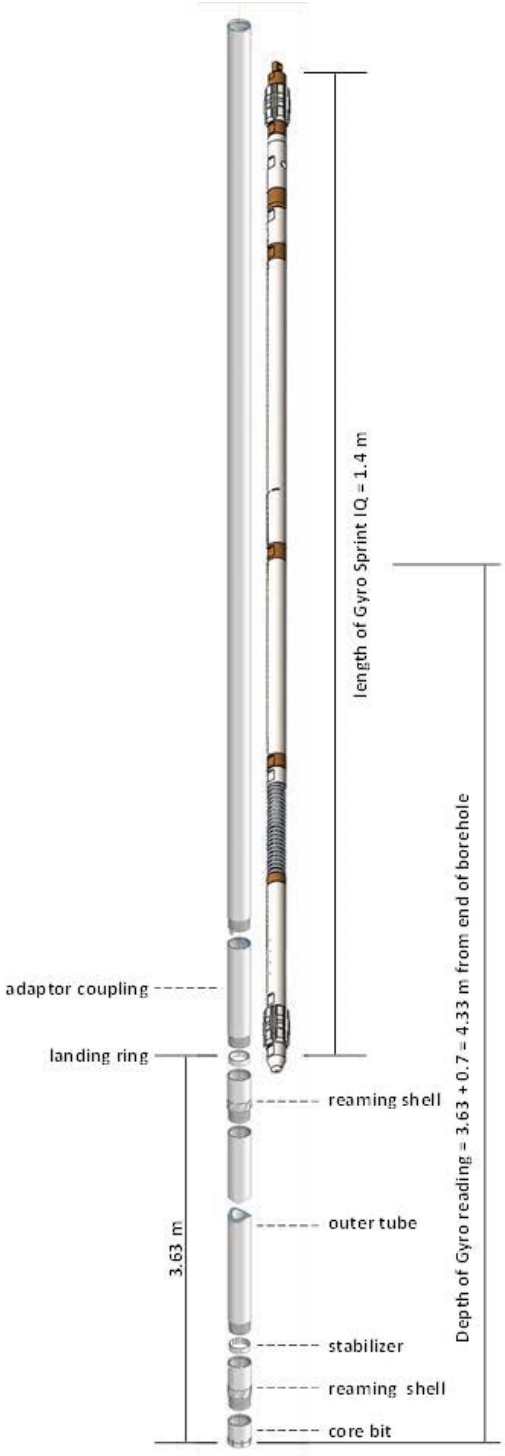


Figure 13: Gyro Sprint-IQTM Depth Measurement Schematic

The Sprint-IQ was calibration checked once every 24-hours on surface and the tool lowered into the borehole to perform the survey. Rodren then presented the survey results to Golder and they were entered into the acQuire database. The tool's accuracy from the manufacturer is listed as ±1° for azimuth and ±0.3° for dip.

A final borehole survey, using the Sprint-IQ was carried out upon completion of drilling, with a measurement point taken every 5 m. The tool was set to collect a reading every 5 m, collecting measurements both entering and exiting the borehole. The control unit of the tool automatically collects a measurement based on the wireline encoder depth tracker as the tool moves along the borehole.

The interim survey data collected during drilling at approximately 9 m increments and the final survey collected approximately every 5 m upon completion of drilling are consistent, and the final survey is presented in Table B-1 (Appendix B). Figure 14 presents the borehole deviation graphically, calculated using the minimum curvature method. Inspection of Figure 14 shows the borehole deviating 15.8 m to the West and 15.7 m to the South from the planned end location.

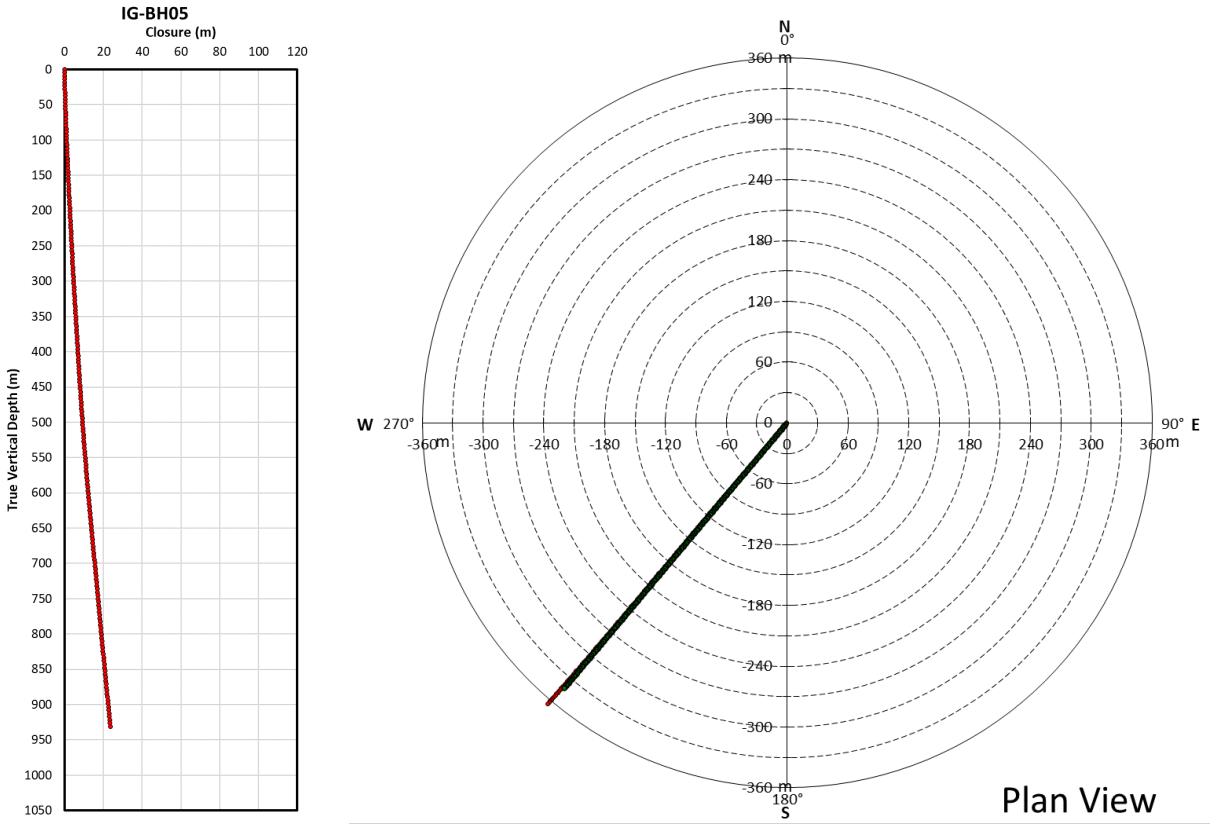


Figure 14: Borehole Deviation (left) and Deviation Plan View (right) from Final SPRINT-IQ™ Survey: red plot lines show the actual borehole trajectory, and the black plot line (Right Plot) indicates the planned borehole trajectory

4.5 Monitoring Drilling Parameters

Drilling supervisors were stationed at the rig during drilling, to observe the drilling parameters during drilling as well as any occurrences of drill fluid spills or maintenance related activities. The drill parameters included torque, thrust or down pressure, fluid injection pressure and downhole fluid flow. These parameters were observed from the gauges at the drill controls.

Results of the drilling parameters collected are presented in Table A-1 (Appendix A) and shown graphically in Figure B-1 (Appendix B). General observations are listed below.

- Rate of Penetration was observed to be relatively consistent at ~4 metres/hour, with a slight overall decreasing trend with depth. The rate of penetration increased between 270 mbgs and 340 mbgs, corresponding to the intersection of a diabase dyke.
- Bit Rotation Speed was observed to be consistent over the drilling of the entire borehole at ~600 rpm. The gauge for monitoring the bit rotation speed malfunctioned and values could not be collected for core runs (CR) 266 through to CR273.
- Torque and down pressure remained consistent to a depth of approximately 500 mbgs (along hole), where they were observed to steadily increase for the remainder of the borehole.
- Pump pressure increased with depth as a higher pump rate was required to adequately flush the hole.
- Fluid injection rate was consistent throughout the program at ~55 L/min.

It should be noted for that day shift and night shift drillers had different approaches to their drilling technique and fluctuations in all observed parameters are a reflection of those differences.

4.6 Borehole Flushing

Borehole flushing was carried out on IG_BH05 on three occasions: prior to installation and cementing of the surface casing, at the completion of drilling and prior to the geophysical surveys (WP05 activities), and again prior to the installation of the West Bay system (WP09 activities).

The fresh water was circulated into the borehole through the drill rods until the return fluid was clear and had water quality indicator parameters that were targeted to be within 10% of the source water for turbidity, dissolved oxygen and electrical conductivity, within 20% of the source water fluorescein concentration (if traced water was used) and within 0.5 of pH of that of the fresh water used. After this point, drill rods were withdrawn from the borehole, and the flushed water in the borehole allowed to “settle”, targeting 12 hours before geophysical logging took place.

Prior to surface casing installation, flushing was carried out on May 21, 2021, with the borehole at a depth of 100.57 mbgs (along hole) and an approximate volume of 728 litres. Approximately 6,800 litres of fresh, untraced water (over 9 borehole volumes with HQ rods in place), mixed with a flocculant to remove particles out of suspension was flushed through the borehole. The fluid parameters were consistently monitored to determine when they were within specified indicator parameters of the fresh water. The final fluid parameters were within 10% of the source water for turbidity, electrical conductivity. pH and dissolved oxygen were slightly over the specified tolerance of 0.5 and 10%, respectively, however as these parameters would not affect the quality of the televiewer image, flushing was stopped at this point.

The flushing of IG_BH05 prior to the completion of geophysics (WP05 activities) was carried out over a two-day period, from August 7 to 8, 2021. Approximately, 27,300 litres representing over 3.5 borehole volumes (borehole volume without HQ rods) of 100 ppb traced water were flushed through the borehole. The final fluid parameters were within 10% of the source water for turbidity. Electrical conductivity, pH, and fluorescein were observed to stabilize, indicating a relatively homogeneous borehole water. Once the parameters had stabilized, approximately 5000 L of 100 ppb traced fresh water was mixed with flocculant and flushed through the borehole.

Due to the use of flocculant prior to geophysics for borehole column clarity, additional flushing of IG_BH05 prior to the installation of the West Bay system (WP09 activities) was carried out. On November 1, 2021, approximately

22,100 litres, representing over 3.0 borehole volumes (borehole volume without HQ rods) of 100 ppb traced water were flushed through the borehole. The final fluid parameters were within 10% of the source water temperature, electrical conductivity, and dissolved oxygen. The final fluid parameters were also within 20% of the initial fluorescein concentration and within 0.5 of the initial pH. ORP and turbidity were slightly above the initial parameters once flushing was terminated.

Appendix C presents the water quality parameters for the borehole flushing completed prior to the geophysical surveys and the West Bay installation.

5.0 SUMMARY OF DRILL FLUID MANAGEMENT AND USE OF TRACERS

Monitoring of the drill fluid volume losses and gains during coring was planned and initially carried out through use of manual tank measurements and ultrasonic sensors, however the margin of error encountered through use of the sensors was found to be too large to identify actual drill fluid volume changes consistently. The sensors employed during the program were found to produce variable readings, and manual measurements of the volume of the drill fluid system components were observed to be the most reliable means of monitoring the drill fluid volume changes. The drill fluid recycling system and volume monitoring methods, as well as the results of the drill fluid parameter and volume monitoring are described in the subsequent sections.

5.1 Drill Fluid Closed System

The drill fluid system consisted of three components: a centrifuge (SRU™) tank, a plastic mixing tank in the rig and the borehole itself. The centrifuge tank (approximate capacity of 2.60 m^3) pumped water to the tank in the drill rig (approximate capacity of 0.65 m^3) using a submersible pump, from which water was pumped downhole using the rig's pump. The drill water returning to surface was pumped via a submersible pump, located in the steel sump box sealed at the collar of the hole to the centrifuge where the cuttings were removed, and the cleaned water fell back into the centrifuge tank. This provided a closed system where fresh water was only introduced after confirmation from the Golder drilling supervisor. A schematic representing this closed drill fluid system is shown in Figure 15.

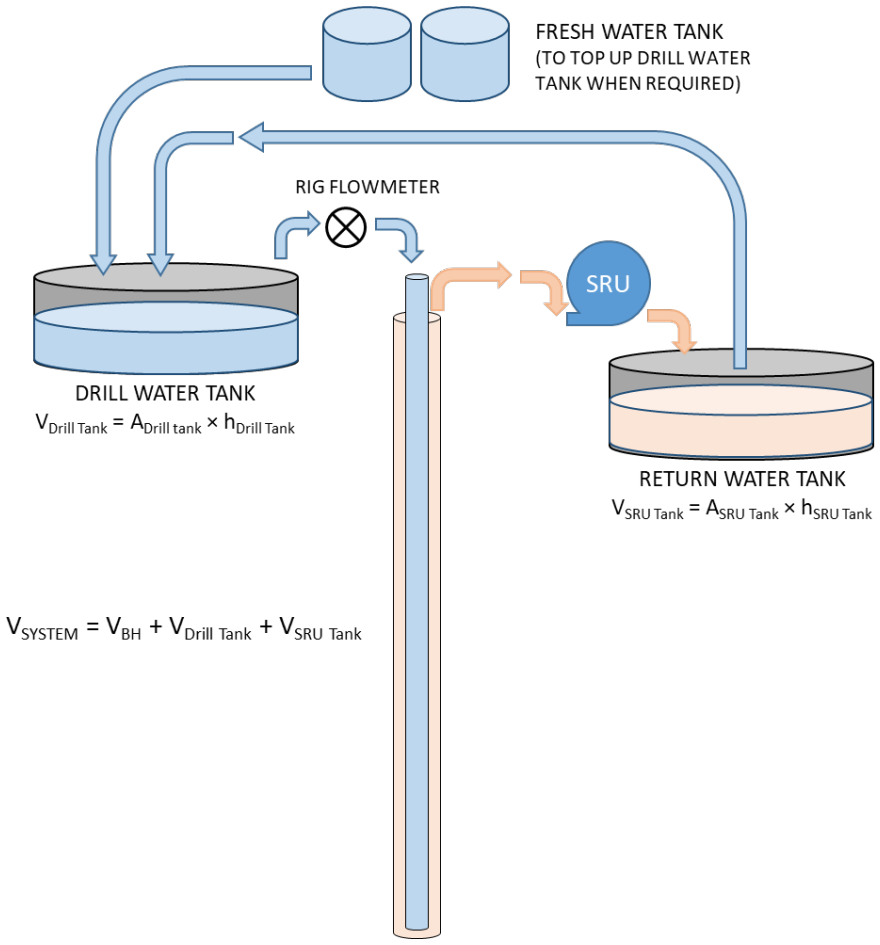


Figure 15: Diagram of IG_BH05 Drill Fluid System

5.1.1 Drill Fluid Volume Monitoring Methods

The volume of water used during drilling was tracked using manual tank readings collected throughout the drilling of IG_BH05. The volume of the system was monitored by measuring the depth of water in the borehole, the drill tank and the centrifuge tank, once all bypasses and pumps were temporarily off so that all water levels were steady. System volumes were measured at the end of each run, as well as at the start of every run when there was a significant delay in drilling, and when fresh water was added into the system. Fresh water was added to the drill system as water was lost to the formation and as the volume of the system increased relative to the volume of drill water in the system (that is, as the hole was deepened, the available volume of the system increased). A baseline reading of the new drill fluid volume in the system was recorded when this was done, so that subsequent fluid losses to the rock could be identified as potential groundwater sampling triggers. More details of the volume monitoring can be found in Section 5.5.

5.2 Fresh Water Management and Sampling

Fresh water was stored in two 28,350 litre Baker tanks located on the north side of the site. Fresh water was collected from a municipal source in Ignace and transported to site via a local water truck service. Ignace has a water treatment plant, and municipal water is treated to adhere to Ontario drinking water standards. The municipal water is sourced from Lake Michel, which is located approximately 1 km north of Ignace, and undergoes filtration

and chlorination at the water treatment plant. Where possible, two individual tanks of fresh water were circulated together using a submersible pump, in order to mix them into a single batch of fresh water for sampling. Each batch of fresh water was individually sampled before being introduced to the drill water system and entering the borehole. All fresh water batches were termed “water source” and designated for sample collection as IG_BH05_WSXXX.

5.2.1 Water Source Samples and Testing

Water source samples were collected from all batches of fresh water delivered to site, prior to fluorescein addition and prior to introducing the water to the drill system. Water was collected from the storage tanks into a clean, triple rinsed 19 litre (5 gallon) bucket, and then transferred into labelled bottles using new syringes, or new tubing with a peristaltic pump. Samples were collected for submission to Bureau Veritas (BV), Isotope Tracer Technologies (IT2) and the University of Ottawa (UofO) as per Table 6, and in-field geochemistry analyses were carried out on the samples.

In-field geochemistry analyses methodologies are described in the WP07 Report – Opportunistic Groundwater Sampling for IG_BH05 (Golder 2022b) and include alkalinity, sulphide, ferrous iron and dissolved oxygen analyses.

Table 6: Sample Preservation Requirements for Bureau Veritas, Isotope Tracer Technologies, and the University of Ottawa

Parameter Group	Parameter List	Bottle Type Requirement	Sample Volume Requirement	Head Space Requirement	Field Filtering Requirement	Preservative Requirement
Major Elements & Metals (BV)	Na, K, Ca, Mg, Sr, Li, Si, Al, B, S Total, Fe Total Diss (Dissolved Metals by ICPMS)	HDPE plastic bottles	120 mL	Fill Line	Yes, 0.45 µm filter	Trace grade nitric acid
Trace Elements, Anions & Nutrients (BV)	Cu, Ni, Zn, Pb, Cd, Al, As, Se, Bi, U, Cs, Rb, Ba, Cr, Co, Th, Zr					
	SiO2 & I	HDPE plastic bottles	250 mL	None	Yes, 0.45 µm filter	None
	S2-	HDPE plastic bottles	125 mL	Fill Line	Yes, 0.45 µm filter	Zinc acetate and sodium hydroxide solution
	NH4 (ammonium), NH3 + NH4 (total ammonia)	Clear glass vial	40 mL	Fill to neck	Yes, 0.45 µm filter	Trace grade sulphuric acid
	N total, P total, TOC	HDPE plastic bottles	120 mL	Fill Line	Yes, 0.45 µm filter	Trace grade sulphuric acid

Parameter Group	Parameter List	Bottle Type Requirement	Sample Volume Requirement	Head Space Requirement	Field Filtering Requirement	Preservative Requirement
	DOC	HDPE plastic bottles	120 mL	None	Yes, 0.45 µm filter	None
	Br, F, Cl, I, SO4, PO4, NO3, NO2, HCO3	HDPE plastic bottles	500 mL	None	Yes, 0.45 µm filter	None
Physical – Chemical (BV)	pH, Alkalinity, TIC					
Rare Earth Elements (BV)	Ce to Y	HDPE plastic bottles	2 X 1 L	None	Yes, 0.45 µm filter	None
Radioisotopes (BV)	238U, 234U, 40K, 222Rn, 223Ra, 224Ra, 226Ra, 228Ra, 227Th, 232Th, 230Th, Gross Alpha & Beta, 210Po, 210Pb, 90Sr		5 X 1 L	Fill Line	Yes, 0.45 µm filter	Trace grade nitric acid
Stable Isotopes (IT2)	δ18O, δ2H	HDPE plastic bottles	60 mL	No headspace	Yes, 0.45 µm filter	None
	87Sr/86Sr	HDPE plastic bottle	1000 mL	No headspace	Yes, 0.45 µm filter	None
	δ13C DIC	Amber glass vials, Teflon cap	2 x 40 mL glass vials with septa caps (x2 per sample)	No headspace	Yes, 0.45 µm filter	Zinc chloride
	37Cl	HDPE plastic bottle	1000 mL	No headspace	Yes, 0.45 µm filter	None
Radioisotopes (IT2)	36Cl					
	129I	HDPE plastic bottle	500 mL	No headspace	Yes, 0.45 µm filter	None
	14C-DIC	Glass bottle	1000 mL	No headspace	Yes, 0.45 µm filter	Zinc chloride
	E3H	HDPE plastic bottle	500 mL	No headspace	Yes, 0.45 µm filter	None
Noble gas concentration & isotopic ratios (UofO)	He, Ar, Ne	Copper Tubing	-	-	None	None
	(3,4He, 20,22Ne, 21,22Ne, 40,36Ar)					

A total of 8 water source samples were collected during the drilling program as follows:

- IG_BH05_WS001 to IG_BH05_WS006 were collected and used during regular drilling and flushing activities.
- IG_BH05_WS007 was assigned to account for a water source delivery transferred from IG_BH06 for WP06 activities.
- IG_BH05_WS008 was collected for additional flushing prior to WP09 activities.

All water source data (including in-field parameters, in-field analyses and laboratory results) are included in the Opportunistic Groundwater Sampling WP07 report for IG_BH05 (Golder 2022b).

5.2.2 Fluorescein Addition

After a sample was collected from the fresh water tank or tanks, water was transferred to a 5000 L poly tank. Fluorescein was measured using an analytical scale (due to the small mass of powdered fluorescein required for each tank) and added to the poly tank. The tank was continuously circulated to mix in the fluorescein using a submersible pump. The water was tested for fluorescein concentration using the AquaFluor fluorometer until the desired concentration was achieved. Once the fluorescein concentration was close to the specified target (100 ppb for all activities), the water was transferred to the drill system as required.

Given the large volume of water required for the end of borehole flushing, the two large baker tanks were traced with fluorescein. Due to their large capacity, the tanks were generally left to circulate and mix for the majority of a 12-hour shift, or until consistent concentration readings were collected. Figure 16 below shows the tracer being added to the source water in one of the freshwater tanks used in the drilling of a previous borehole.



Figure 16: Fluorescein Tracer Being Added to the Source Water

5.3 Drill Fluid Field Parameters

At the end of the core run, drilling supervisors communicated with the drillers to time the collection of drill fluid with the completion of the run, to pause to allow a rod stick-up measurement, followed by the temporary shutting off of pumps to measure the fluid volumes in the tanks and collect the ultrasonic sensor readings. Drillers and drill supervisors developed a workflow to communicate when the drillers could proceed to the next activity, that is,

when measurements and sample collection were complete, and the drillers could lower the overshot to retrieve the inner tube.

Drill fluid field parameters were measured using a Horiba U-52 multiparameter water quality meter. A baseline reading was taken prior to the start of drilling, and all subsequent occasions when fresh water was added to the system. New baseline readings were typically from the centrifuge tank when the system was switched. At the end of each drill run, a sample of water for field parameters was collected from the return drill fluid from the outlet of the centrifuge that drained into the tank. This system allowed a sample of water directly from the borehole to be collected and tested, providing the most representative parameters possible for that run.

Fluorescein concentration was also measured from this sample. The presence of cuttings in the drill water was observed to mask the fluorescein concentration readings measured with the AquaFluor, and drill fluid samples were therefore filtered using an inline high volume 0.45 µm filter prior to collecting readings.

The field parameters of the drill fluid measured each run, and the corresponding triggers to initiate a WP07 opportunistic groundwater sample collection attempt, are presented in Table 7. These parameters were monitored each run, and if a trigger was considered valid, Golder and the NWMO would coordinate to initiate an opportunistic groundwater sample (WP07).

Table 7: Drill Fluid Monitoring Parameters and WP07 Triggers

Field Parameter	Instrument	Trigger to Initiate WP07 / Target ranges for borehole flushing
Fluorescein dye (tracer)	Aquafluor Handheld Fluorometer/Turbidimeter	20% change in concentration from previous drill fluid source Note: Minimum detection limit of the fluorometer (0.4 ppb)
Turbidity	Horiba U52-2 multiparameter water quality meter	10% change from the previous drill fluid source
Dissolved Oxygen		10% change from the previous drill fluid source
Electrical conductivity		10% change from the previous drill fluid source
pH		change of at least 0.5 from previous drill fluid source
Temperature		N/A
Density	Hydrometer	N/A

5.3.1 Drill Fluid Parameter Data

The drill fluid parameter data is presented in Table A-2 (Appendix A) and shown graphically on Figures B-2 and B-3 (Appendix B). General observations and comments are listed below.

- Fluorescein concentration required frequent adjustment in the drill fluid system, with fluorescein added about every 10-15 runs. As the borehole depth and drill fluid system volume increased, the time for the fluorescein readings to equalize in the system when extra fluorescein was added increased, and concentration readings occasionally varied over 20% from run to run. In general, the fluorescein concentration of the drill fluid remained between 80 and 120 ppb. The fluorescein concentration began fluctuating an increasing amount beyond a depth of 100 mbgs, when the drilling additive was added to the drill fluid system. The addition of Pure-Vis made it

difficult to filter the core run drill fluid samples. The resulting turbidity had a significant effect on the measured fluorescein concentration. The concentration fell in the system at a depth of 360 mbgs. Fluorescein was then added to the system, causing a concentration spike to a concentration of approximately 200 ppb. The concentration proceeded to decrease until it reached the initial 80 ppb to 120 ppb range at an approximate depth of 550 mbgs. The frequent fluorescein adjustments were necessary as the concentration in the drill fluid decreased as the fluid was processed through the centrifuge and cuttings were removed.

- Density of the drill fluid increased as the saturation with cuttings increased. When the density is observed to drop back closer to 1 g/cm^3, this generally corresponds with the addition of fresh water to the system.
- Turbidity remained above the Horiba's measurement range (1000 NTU) for the majority of the program as the drill fluid became saturated with drill cuttings.
- There are a few notable changes in the drill fluid electrical conductivity and pH. The spikes occurring at the very top of the borehole, around 100 mbgs (along hole) and just above 400 mbgs (along hole) are related to the initial casing installation, the surface casing installation and the groundwater sample attempt at an approximate depth of 350 mbgs. After each spike, electrical conductivity returned to levels below 1 mS/cm, but was observed to gradually rise above 1mS/cm for the final 100 m drilled. The gradual increase from about 900 mbgs (along hole) to the end of the borehole is likely related to the frequent addition of drilling additive to reduce the torque on the drill string and help lift the cuttings to surface.
- Dissolved oxygen (DO) fluctuated continuously in the sensor's range.
- The temperature of the drill fluid system was generally between 15-20 ˚C.

5.4 Drill Fluid Additives

At a depth of 100.57 mbgs (along hole), prior to the completion of geophysics, a flocculant, INSTA-CLEAR™ DRY, was added to the flush water to remove particles out of suspension and create a clear borehole column for televiewer imagery. Given the characteristics of the flocculant water, the additive was denoted as a water source sample, IG_BH05_WS002. The flocculant was used again for the end of borehole flushing, prior to the completion of the geophysical surveys.

After the borehole flushing at 100.57 mbgs, and cementing of the PQ surface casing, the HQ rods experienced an increase in torque. A bio-degradable polymer-based drilling additive, AMC Pure-Vis, was added to the drill fluid via the drill tank in the rig. This additive generally improves the ability of the fluid to lift cuttings from the drill bit and out of the borehole, helping to manage the drill bit binding with cuttings and causing spikes in the torque. This additive was the third drill fluid sample, IG_BH05_DW003, collected. This drill fluid sample underwent the full suite of analytical laboratory testing as part of WP07.

No other drill fluid additives were used besides AMC Pure-Vis and INSTA-CLEAR™ DRY.

5.5 Drill Fluid Return Volume Monitoring Data

Drill fluid volumes were monitored continuously during coring activities by manually checking the water levels in the centrifuge, drill tank and borehole. Ultrasonic sensors were also installed in the centrifuge and drill tank in an attempt to collect continuous readings and automate the volume monitoring process. When losses or gains greater than 100 litres were observed, the Golder WP07 lead was contacted following the opportunistic groundwater sampling protocol as described in WP07. If a volume change was observed, the drillers were

instructed not to proceed with setting up for the next core run until the core was extracted and could be observed for indications of water bearing features. The system volume gradually increased as the hole was deepened, and water was occasionally lost on surface due to human error, as well as bound in the cuttings. Gradual system losses required occasional topping up of the system with fresh, fluorescein water. Table A-2 includes volume changes for each drill run and these can be observed graphically in Figure B-2.

Following cementing of the surface casing after a depth of 100 mbgs (along hole), typically, losses greater than 100 litres could be attributed to a system overflow or more fluid extracted in the cuttings.

5.6 Drill Fluid Archive Samples and Testing

Drill fluid samples were collected and archived in 1 litre amber bottles every 50 m during drilling. These samples were generally collected from the return drill fluid prior to entering the centrifuge outlet into a clean, triple rinsed 19 litre (5 gallon) bucket, which was taken to the sampling area and transferred into the labelled bottles using new syringes, or new tubing with a peristaltic pump.

A complete list of drill water sample field parameters collected under WP02 are provided in Table A-3.

6.0 OPPORTUNISTIC GROUNDWATER SAMPLE LOCATIONS

Three opportunistic groundwater samples were attempted and abandoned during drilling of IG_BH05.

Complete details of the attempted sample intervals are presented in the WP07 Opportunistic Groundwater Sampling Report (Golder, 2022b).

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APPENDIX A

Table A-1: IG_BH05 Final and Interim Borehole Orientation Measurements

Table A-2: IG_BH05 Drilling and Drill Fluid Parameters

Table A-3: IG_BH05 Field Parameters of Archived Drill Water Samples

Depth	[1]Survey Type	Azimuth (°)	Dip (°)
0.00	Planned	220.3	-70.1
5.25	GyroSp-IQD	220.0	-69.7
15.27	GyroSp-IQD	219.5	-69.8
20.25	GyroSp-IQD	219.5	-69.8
27.29	GyroSp-IQD	219.2	-69.8
39.22	GyroSp-IQD	219.9	-69.5
48.25	GyroSp-IQD	220.4	-69.7
57.28	GyroSp-IQD	220.2	-69.8
66.27	GyroSp-IQD	221.0	-69.7
75.27	GyroSp-IQD	220.6	-69.7
84.27	GyroSp-IQD	220.3	-69.6
93.27	GyroSp-IQD	220.3	-69.6
96.24	GyroSp-IQD	220.1	-69.6
105.24	GyroSp-IQD	220.5	-69.5
114.33	GyroSp-IQD	220.8	-69.5
123.28	GyroSp-IQD	219.9	-69.6
132.32	GyroSp-IQD	220.6	-69.5
141.26	GyroSp-IQD	222.0	-69.5
142.86	GyroSp-IQD	221.0	-69.5
153.25	GyroSp-IQD	220.9	-69.4
162.31	GyroSp-IQD	221.1	-69.4
171.29	GyroSp-IQD	220.3	-69.2
180.30	GyroSp-IQD	220.6	-69.2
189.28	GyroSp-IQD	220.4	-69.1
198.31	GyroSp-IQD	220.5	-69.2
207.30	GyroSp-IQD	220.7	-69.2
216.28	GyroSp-IQD	220.5	-69.2
225.33	GyroSp-IQD	220.8	-69.0
234.32	GyroSp-IQD	220.9	-69.1
243.29	GyroSp-IQD	220.1	-69.1
252.27	GyroSp-IQD	220.8	-69.1
261.33	GyroSp-IQD	220.9	-69.1
270.31	GyroSp-IQD	220.1	-69.1
279.30	GyroSp-IQD	220.8	-69.2
288.28	GyroSp-IQD	220.6	-69.1
297.32	GyroSp-IQD	221.4	-69.0
306.29	GyroSp-IQD	220.6	-69.1
315.32	GyroSp-IQD	220.4	-69.1
324.30	GyroSp-IQD	219.9	-69.1
333.32	GyroSp-IQD	220.1	-69.1
342.31	GyroSp-IQD	220.4	-69.0
351.29	GyroSp-IQD	220.9	-69.0
360.30	GyroSp-IQD	220.5	-69.0
369.29	GyroSp-IQD	220.8	-69.1
378.27	GyroSp-IQD	220.1	-69.0
387.27	GyroSp-IQD	220.7	-69.0
396.22	GyroSp-IQD	219.8	-69.1
405.30	GyroSp-IQD	220.9	-69.1
414.21	GyroSp-IQD	220.7	-69.1

Depth	[1]Survey Type	Azimuth (°)	Dip (°)
423.27	GyroSp-IQD	221.0	-69.1
432.31	GyroSp-IQD	220.6	-69.0
441.29	GyroSp-IQD	220.3	-69.1
450.22	GyroSp-IQD	220.9	-68.8
459.28	GyroSp-IQD	219.9	-69.0
468.30	GyroSp-IQD	220.1	-68.9
477.23	GyroSp-IQD	220.5	-68.8
486.22	GyroSp-IQD	220.4	-68.9
495.29	GyroSp-IQD	220.4	-68.9
504.31	GyroSp-IQD	220.2	-68.8
513.21	GyroSp-IQD	220.6	-68.7
522.31	GyroSp-IQD	220.0	-68.7
531.20	GyroSp-IQD	220.7	-68.7
540.20	GyroSp-IQD	220.7	-68.7
549.19	GyroSp-IQD	220.7	-68.7
558.18	GyroSp-IQD	220.1	-68.6
567.27	GyroSp-IQD	220.8	-68.6
576.20	GyroSp-IQD	219.9	-68.5
585.31	GyroSp-IQD	219.9	-68.5
594.32	GyroSp-IQD	220.2	-68.5
603.23	GyroSp-IQD	220.4	-68.5
612.25	GyroSp-IQD	220.6	-68.5
621.29	GyroSp-IQD	220.1	-68.4
630.23	GyroSp-IQD	220.4	-68.4
639.21	GyroSp-IQD	219.7	-68.4
648.18	GyroSp-IQD	220.1	-68.4
657.28	GyroSp-IQD	220.4	-68.4
666.27	GyroSp-IQD	221.0	-68.3
675.27	GyroSp-IQD	220.3	-68.4
684.25	GyroSp-IQD	220.4	-68.3
693.27	GyroSp-IQD	220.4	-68.3
702.29	GyroSp-IQD	220.4	-68.3
711.28	GyroSp-IQD	220.5	-68.3
720.27	GyroSp-IQD	220.6	-68.3
729.26	GyroSp-IQD	220.4	-68.3
738.29	GyroSp-IQD	220.5	-68.4
747.22	GyroSp-IQD	220.2	-68.3
756.29	GyroSp-IQD	220.5	-68.4
765.20	GyroSp-IQD	220.8	-68.3
774.31	GyroSp-IQD	221.0	-68.4
783.21	GyroSp-IQD	220.7	-68.3
792.24	GyroSp-IQD	220.5	-68.4
801.28	GyroSp-IQD	220.7	-68.4
810.21	GyroSp-IQD	220.4	-68.3
819.21	GyroSp-IQD	220.2	-68.3
828.33	GyroSp-IQD	220.3	-68.4
837.22	GyroSp-IQD	220.9	-68.3
846.32	GyroSp-IQD	220.9	-68.4
855.19	GyroSp-IQD	220.6	-68.3

Depth	[1]Survey Type	Azimuth (°)	Dip (°)
864.32	GyroSp-IQD	220.9	-68.4
873.18	GyroSp-IQD	220.6	-68.3
882.32	GyroSp-IQD	220.6	-68.3
891.20	GyroSp-IQD	220.6	-68.3
900.33	GyroSp-IQD	220.6	-68.3
909.32	GyroSp-IQD	220.3	-68.3
918.31	GyroSp-IQD	221.2	-68.3
927.30	GyroSp-IQD	220.9	-68.2
936.31	GyroSp-IQD	220.8	-68.3
945.31	GyroSp-IQD	221.0	-68.3
954.28	GyroSp-IQD	221.5	-68.3
963.30	GyroSp-IQD	220.8	-68.3
972.32	GyroSp-IQD	221.1	-68.3
0.00	GyroSp-IQP	219.84	-69.46
5.01	GyroSp-IQP	219.52	-69.34
10.02	GyroSp-IQP	219.90	-69.40
15.01	GyroSp-IQP	219.95	-69.41
20.03	GyroSp-IQP	220.36	-69.46
25.04	GyroSp-IQP	220.34	-69.45
30.02	GyroSp-IQP	220.38	-69.40
35.01	GyroSp-IQP	220.21	-69.52
40.00	GyroSp-IQP	219.98	-69.34
45.01	GyroSp-IQP	220.40	-69.45
50.01	GyroSp-IQP	220.33	-69.37
55.01	GyroSp-IQP	220.51	-69.33
60.00	GyroSp-IQP	219.96	-69.42
65.00	GyroSp-IQP	220.37	-69.27
70.04	GyroSp-IQP	219.87	-69.34
75.00	GyroSp-IQP	219.83	-69.33
80.01	GyroSp-IQP	219.79	-69.31
85.02	GyroSp-IQP	219.78	-69.30
90.04	GyroSp-IQP	220.12	-69.35
95.02	GyroSp-IQP	220.42	-69.33
100.03	GyroSp-IQP	220.40	-69.20
105.02	GyroSp-IQP	219.88	-69.24
110.03	GyroSp-IQP	219.95	-69.21
115.00	GyroSp-IQP	219.86	-69.21
120.03	GyroSp-IQP	219.84	-69.20
125.02	GyroSp-IQP	220.38	-69.16
130.00	GyroSp-IQP	220.41	-69.18
135.04	GyroSp-IQP	220.45	-69.15
140.02	GyroSp-IQP	219.98	-69.15
145.00	GyroSp-IQP	220.50	-69.13
150.02	GyroSp-IQP	220.53	-69.13
155.02	GyroSp-IQP	220.53	-69.11
160.02	GyroSp-IQP	220.55	-69.09
165.00	GyroSp-IQP	220.57	-69.07
170.04	GyroSp-IQP	220.54	-69.06
175.01	GyroSp-IQP	220.51	-69.05

Depth	[1]Survey Type	Azimuth (°)	Dip (°)
180.04	GyroSp-IQP	220.18	-69.04
185.02	GyroSp-IQP	220.58	-69.11
190.03	GyroSp-IQP	220.53	-69.10
195.01	GyroSp-IQP	220.57	-69.08
200.00	GyroSp-IQP	220.60	-69.06
205.02	GyroSp-IQP	220.61	-69.06
210.00	GyroSp-IQP	220.62	-69.05
215.03	GyroSp-IQP	220.63	-69.05
220.02	GyroSp-IQP	220.65	-69.03
225.03	GyroSp-IQP	220.68	-69.01
230.03	GyroSp-IQP	220.68	-69.00
235.01	GyroSp-IQP	220.66	-69.00
240.02	GyroSp-IQP	220.53	-68.99
245.01	GyroSp-IQP	220.52	-68.98
250.00	GyroSp-IQP	220.50	-68.99
255.02	GyroSp-IQP	220.47	-69.00
260.01	GyroSp-IQP	220.38	-69.01
265.00	GyroSp-IQP	220.33	-69.02
270.01	GyroSp-IQP	220.33	-69.01
275.02	GyroSp-IQP	220.32	-68.99
280.01	GyroSp-IQP	220.29	-68.97
285.02	GyroSp-IQP	220.28	-68.94
290.04	GyroSp-IQP	220.27	-68.91
295.03	GyroSp-IQP	220.32	-68.91
300.04	GyroSp-IQP	220.24	-68.84
305.02	GyroSp-IQP	220.24	-68.84
310.00	GyroSp-IQP	220.24	-68.84
315.01	GyroSp-IQP	220.16	-68.79
320.02	GyroSp-IQP	219.80	-68.82
325.01	GyroSp-IQP	219.79	-68.82
330.01	GyroSp-IQP	219.78	-68.83
335.02	GyroSp-IQP	219.84	-68.82
340.03	GyroSp-IQP	219.86	-68.81
345.02	GyroSp-IQP	219.86	-68.81
350.01	GyroSp-IQP	219.88	-68.81
355.01	GyroSp-IQP	219.90	-68.81
360.00	GyroSp-IQP	219.91	-68.81
365.00	GyroSp-IQP	219.93	-68.81
370.00	GyroSp-IQP	219.96	-68.82
375.00	GyroSp-IQP	220.30	-68.82
380.03	GyroSp-IQP	220.28	-68.83
385.00	GyroSp-IQP	220.26	-68.84
390.02	GyroSp-IQP	220.24	-68.83
395.01	GyroSp-IQP	220.24	-68.83
400.00	GyroSp-IQP	220.25	-68.83
405.00	GyroSp-IQP	220.25	-68.84
410.00	GyroSp-IQP	220.14	-68.82
415.01	GyroSp-IQP	219.95	-68.87
420.00	GyroSp-IQP	219.94	-68.85

Depth	[1]Survey Type	Azimuth (°)	Dip (°)
425.02	GyroSp-IQP	219.92	-68.84
430.04	GyroSp-IQP	219.91	-68.84
435.02	GyroSp-IQP	219.91	-68.83
440.01	GyroSp-IQP	219.92	-68.82
445.02	GyroSp-IQP	219.96	-68.81
450.03	GyroSp-IQP	219.96	-68.80
455.02	GyroSp-IQP	219.91	-68.83
460.04	GyroSp-IQP	219.91	-68.82
465.05	GyroSp-IQP	219.88	-68.81
470.03	GyroSp-IQP	219.88	-68.79
475.00	GyroSp-IQP	220.10	-68.85
480.03	GyroSp-IQP	220.17	-68.76
485.00	GyroSp-IQP	220.15	-68.75
490.00	GyroSp-IQP	220.14	-68.74
495.01	GyroSp-IQP	219.84	-68.73
500.00	GyroSp-IQP	219.84	-68.71
505.03	GyroSp-IQP	219.82	-68.69
510.00	GyroSp-IQP	220.16	-68.67
515.01	GyroSp-IQP	220.16	-68.65
520.02	GyroSp-IQP	220.18	-68.63
525.01	GyroSp-IQP	220.17	-68.62
530.04	GyroSp-IQP	220.16	-68.60
535.00	GyroSp-IQP	220.17	-68.59
540.01	GyroSp-IQP	220.17	-68.58
545.01	GyroSp-IQP	220.19	-68.56
550.03	GyroSp-IQP	219.90	-68.54
555.00	GyroSp-IQP	219.89	-68.52
560.02	GyroSp-IQP	219.88	-68.49
565.00	GyroSp-IQP	219.88	-68.47
570.00	GyroSp-IQP	219.86	-68.45
575.03	GyroSp-IQP	219.82	-68.43
580.04	GyroSp-IQP	220.06	-68.46
585.03	GyroSp-IQP	220.00	-68.45
590.02	GyroSp-IQP	219.72	-68.47
595.01	GyroSp-IQP	219.73	-68.46
600.01	GyroSp-IQP	219.69	-68.45
605.03	GyroSp-IQP	219.69	-68.44
610.03	GyroSp-IQP	219.74	-68.42
615.00	GyroSp-IQP	219.76	-68.42
620.03	GyroSp-IQP	219.86	-68.35
625.02	GyroSp-IQP	219.88	-68.33
630.02	GyroSp-IQP	219.91	-68.31
635.03	GyroSp-IQP	219.89	-68.31
640.04	GyroSp-IQP	219.91	-68.29
645.02	GyroSp-IQP	219.92	-68.28
650.04	GyroSp-IQP	219.95	-68.25
655.03	GyroSp-IQP	219.98	-68.24
660.05	GyroSp-IQP	220.01	-68.23
665.04	GyroSp-IQP	219.98	-68.24

Depth	[1]Survey Type	Azimuth (°)	Dip (°)
670.00	GyroSp-IQP	220.06	-68.22
675.00	GyroSp-IQP	220.13	-68.21
680.02	GyroSp-IQP	220.17	-68.21
685.01	GyroSp-IQP	220.21	-68.20
690.02	GyroSp-IQP	220.26	-68.18
695.02	GyroSp-IQP	220.32	-68.17
700.01	GyroSp-IQP	220.35	-68.16
705.03	GyroSp-IQP	220.41	-68.16
710.01	GyroSp-IQP	220.45	-68.15
715.00	GyroSp-IQP	220.46	-68.15
720.02	GyroSp-IQP	220.42	-68.15
725.04	GyroSp-IQP	220.42	-68.14
730.02	GyroSp-IQP	220.42	-68.15
735.03	GyroSp-IQP	220.42	-68.17
740.03	GyroSp-IQP	220.43	-68.19
745.05	GyroSp-IQP	220.45	-68.19
750.04	GyroSp-IQP	220.80	-68.22
755.03	GyroSp-IQP	220.45	-68.20
760.01	GyroSp-IQP	220.44	-68.21
765.03	GyroSp-IQP	220.45	-68.21
770.01	GyroSp-IQP	220.45	-68.21
775.00	GyroSp-IQP	220.48	-68.21
780.00	GyroSp-IQP	220.48	-68.21
785.02	GyroSp-IQP	220.49	-68.21
790.00	GyroSp-IQP	220.52	-68.22
795.02	GyroSp-IQP	220.49	-68.21
800.00	GyroSp-IQP	220.49	-68.21
805.02	GyroSp-IQP	220.52	-68.21
810.02	GyroSp-IQP	220.54	-68.21
815.04	GyroSp-IQP	220.55	-68.20
820.03	GyroSp-IQP	220.55	-68.20
825.03	GyroSp-IQP	220.59	-68.19
830.02	GyroSp-IQP	220.59	-68.19
835.00	GyroSp-IQP	220.59	-68.18
840.03	GyroSp-IQP	220.62	-68.17
845.00	GyroSp-IQP	220.66	-68.15
850.00	GyroSp-IQP	220.66	-68.15
855.01	GyroSp-IQP	220.70	-68.16
860.02	GyroSp-IQP	220.75	-68.17
865.00	GyroSp-IQP	221.01	-68.17
870.02	GyroSp-IQP	220.78	-68.18
875.01	GyroSp-IQP	220.80	-68.18
880.00	GyroSp-IQP	220.83	-68.17
885.03	GyroSp-IQP	220.84	-68.17
890.02	GyroSp-IQP	220.86	-68.16
895.03	GyroSp-IQP	220.84	-68.14
900.02	GyroSp-IQP	220.86	-68.13
905.00	GyroSp-IQP	220.86	-68.12
910.02	GyroSp-IQP	220.90	-68.12

Depth	[1]Survey Type	Azimuth (°)	Dip (°)
915.01	GyroSp-IQP	220.94	-68.12
920.04	GyroSp-IQP	220.98	-68.12
925.03	GyroSp-IQP	221.03	-68.09
930.03	GyroSp-IQP	221.02	-68.11
935.01	GyroSp-IQP	221.02	-68.11
940.03	GyroSp-IQP	221.33	-68.20
945.03	GyroSp-IQP	221.05	-68.12
950.03	GyroSp-IQP	221.05	-68.12
955.01	GyroSp-IQP	221.03	-68.12
960.00	GyroSp-IQP	221.04	-68.12
965.02	GyroSp-IQP	221.36	-68.11
970.01	GyroSp-IQP	221.08	-68.13
975.02	GyroSp-IQP	221.11	-68.13
980.01	GyroSp-IQP	221.07	-68.13
985.01	GyroSp-IQP	221.14	-68.10
990.02	GyroSp-IQP	221.01	-68.12
995.01	GyroSp-IQP	221.01	-68.11
1000.02	GyroSp-IQP	221.11	-68.11

Notes:

[1]GyroSp-IQD measurements were collected during drilling of IG_BH05, GyroSp-IQP measurements were collected post drilling of IG_BH05

Date (End of Run)	Time (End of Run)	Run #	Top of Run	Bottom of Run	Drill Fluid Volume Change (L)	Fluorescein Concentration			Temp	Density		Elec. Cond.		pH		Dissolved Oxygen		Turbidity		ORP	ROP	Bit Rotation Speed	Torque	WOB (estimate)	Holdback Pressure (Down-	Fluid Injection (pump) Pressure	Downhole Fluid Flow Rate	Comments
						Inlet	Outlet	Change				Reading	Change	Reading	Change	Reading	Change	Reading	Change									
dd-mmm-yy	hh:mm	-	(mbgs)	(mbgs)	>100 L	(ppb)	(ppb)	>20% change	(°C)	API Gravity	SG	(mS/cm)	>10% change	-	>0.5 Change	(mg/L)	>10% Change	(NTU)	>10% Change	(mV)	m/hr	RPM	psi	lbs	psi	psi	L/min	
13-May-21	23:25	-	0.00	0.00	-	97.9	104.2		16.88	10.0	1.00	0.28		11.13		5.64		27.1		93								Initial readings
14-May-21	00:08	1	0.71	1.62	92	96.6	91.4	-5%	17.50	10.0	1.00	2.030	625%	12.02	0.89	7.02	24%	1000	3590%	23	1.82	500	1100	9620	500	20	40	0.91 m of core. Drilling through cement and rock within casing
14-May-21	02:30	2	1.62	3.93	80	94.2	93.5	-1%	19.20	10.0	1.00	1.900	-6%	11.94	-0.08	4.98	-29%	1000	0%	15	1.39	500	1000	5964	310	30	50	Polished bit and had to stop before end of run. Drilling through rock within casing
14-May-21	03:33	3	3.93	4.61	-17	94.1	93.3	-1%	19.17	10.0	1.00	1.840	-3%	11.93	-0.01	6.41	29%	1000	0%	3	4.08	600	1100	9235	480	10	40	
14-May-21	05:20	4	4.61	7.58	52	94.3	91.5	-3%	18.64	10.0	1.00	2.170	18%	12.01	0.08	10.23	60%	1000	0%	-1	4.46	600	1500	3463	180	30	40	
14-May-21	15:10	5	7.58	9.41	21	94.4	92.0	-3%	22.26	10.1	1.00	2.570	18%	11.92	-0.09	5.38	-47%	463	-54%	-7	3.66	900	1400	2886	150	60	60	Core run within cemented casing interval.
14-May-21	16:38	6	9.41	10.58	52	92.8	91.4	-1%	23.33	10.2	1.00	2.380	-7%	11.86	-0.06	5.51	2%	530	14%	-8	3.51	800	1450	4810	250	60	58	Drilled past bottom of PWT casing and into fresh rock. Core run still partially within casing.
15-May-21	11:23	7	10.58	11.47	6	80.8	80.5	0%	20.11	10.0	1.00	3.610	52%	12.18	0.32	3.87	-30%	437	-18%	-27	5.34	800	1500	6734	350	30	40	Drilled within surface casing, could not pass casing shoe cleanly
15-May-21	12:59	8	11.47	12.60	3	81.8	82.5	1%	21.40	10.1	1.00	2.840	-21%	12.05	-0.13	5.73	48%	439	0%	-29	5.22	700	1250	7696	400	20	42	Drilled within surface casing with regular core barrel to try and pass casing shoe
15-May-21	14:44	9	12.60	15.58	25	80.9	82.6	2%	22.49	10.2	1.00	2.520	-11%	11.97	-0.08	4.75	-17%	421	-4%	-23	4.06	750	1600	7696	400	40	44	Surface casing pulled down with run (total of 0.48 m)
15-May-21	23:25	10	15.58	16.60	46	83.4	96.4	16%	21.04	10.1	1.00	2.040	-19%	11.87	-0.10	9.27	95%	669	59%	-21	2.45	500	1500	9235	480	10	35	New water added to the system before drilling
16-May-21	01:15	11	16.60	19.60	152	94.3	96.9	3%	21.15	10.0	1.00	1.820	-11%	11.84	-0.03	0.22	-98%	466	-30%	-28	3.83	500	2000	9235	480	20	40	Loss of drill fluid above 100 L limit.
17-May-21	10:12	12	19.60	21.58	28	93.3	91.7	-2%	20.02	10.1	1.00	1.600	-12%	11.82	-0.02	9.78	4345%	124	-73%	-10	3.60	600	1650	3848	200	50	40	
17-May-21	11:38	13	21.58	24.58	179	90.9	92.0	1%	23.38	10.1	1.00	1.380	-14%	11.66	-0.16	9.78	0%	623	402%	-12	4.29	600	2250	4810	250	40	50	Loss of drill fluid above 100 L limit.
17-May-21	16:06	14	24.58	25.58	72	91.3	91.0	0%	21.08	10.1	1.00	1.340	-3%	11.69	0.03	4.66	-52%	956	53%	-12	5.00	600	2250	8658	450	40	40	System volume loss close to 100L limit.
17-May-21	17:20	15	25.58	28.58	96	92.1	91.5	-1%	32.91	10.2	1.00	1.260	-6%	11.43	-0.26	7.70	65%	570	-40%	-10	5.00	600	2500	7696	400	80	58	System volume loss close to 100L limit.
17-May-21	23:30	16	28.58	31.62	176	88.0	85.8	-3%	25.50	10.2	1.00	0.751	-40%	11.32	-0.11	9.06	18%	1000	75%	12	3.04	500	2000	9235	480	100	50	
18-May-21	02:45	17	31.62	34.64	355	92.3	87.6	-5%	23.70	10.2	1.00	0.617	-18%	11.21	-0.11	5.05	-44%	1000	0%	25	4.13	700	1500	3848	200	25	40	Removed the centralizers and mechanical fractures stopped.
18-May-21	11:20	18	34.64	36.95	25	91.3	92.6	1%	22.11	10.2	1.00	0.416	-33%	10.87	-0.34	4.04	-20%	1000	0%	56	3.47	600	1250	4810	250	30	30	
18-May-21	15:06	19	36.95	37.57	-18	96.5	95.3	-1%	21.71	10.0	1.00	0.408	-2%	10.94	0.07	4.35	8%	1000	0%	50	3.10	600	1000	11544	600	40	34	
18-May-21	17:38	20	37.57	40.40	26	92.2	93.7	2%	22.48	10.0	1.00	0.422	3%	10.92	-0.02	4.91	13%	1000	0%	57	3.77	600	1200	3848	200	30	31	
18-May-21	23:00	21	40.40	43.55	7	67.5	85.2	26%	22.93	9.8	1.00	0.407	-4%	10.69	-0.23	5.54	13%	1000	0%	71	3.15	600	1250	1924	100	55	35	
19-May-21	02:15	22	43.55	46.59	14	92.5	94.7	2%	21.38	10.0	1.00	0.388	-5%	10.72	0.03	6.63	20%	1000	0%	81	3.32	650	1400	2886	150	40	35	
19-May-21	03:23	23	46.59	49.65	-240	100.2	93.6	-7%	22.24	9.8	1.00	0.403	4%	10.58	-0.14	10.30	55%	1000	0%	85	2.96	610	1250	1924	100	40	35	Good core quality
19-May-21	10:14	24	49.65	52.58	12	96.0	93.5	-3%	20.64	9.6	1.00	0.377	-6%	10.39	-0.19	9.66	-6%	1000	0%	91	3.26	600	1250	3367	175	50	31	Good core quality
19-May-21	12:27	25	52.58	55.60	4	90.8	89.7	-1%	22.42	9.5	1.00	0.379	1%	10.29	-0.10	9.40	-3%	1000	0%	93	3.02	600	1250	5291	275	40	31	Good core quality
19-May-21	14:05	26	55.60	58.57	18	81.3	79.9	-2%	22.80	9.4	1.00	0.391	3%	10.29	0.00	9.17	-2%	1000	0%	90	4.35	600	1250	5772	300	50	31	
19-May-21	16:40	27	58.57	61.61	-19	82.0	82.4	0%	22.40	9.5	1.00	0.387	-1%	10.24	-0.05	5.99	-35%	1000	0%	97	3.38	600	1400	2886	150	50	31	
19-May-21	22:01	28	61.61	64.61	23	83.8	90.8	8%	22.22	9.4	1.00	0.388	0%	10.19	-0.05	9.68	62%	1000	0%	111	3.33	610	1400	5002	260	60	35	
19-May-21	23:31	29	64.61	67.66	42	91.3	91.8	1%	22.92	9.6	1.00	0.395	2%	10.16	-0.03	6.64	-31%	1000	0%	111	3.16	610	1400	3848	200	50	35	
20-May-21	01:20	30	67.66	70.60	46	91.0	93.5	3%	22.75	9.6	1.00	0.417	6%	10.18	0.02	6.10	-8%	1000	0%	104	3.53	650	1300	3848	200	60	35	
20-May-21	03:10	31	70.60	73.64	12	93.6	93.0	-1%	23.32	9.3	1.00	0.418	0%	10.11	-0.07	10.17	67%	1000	0%	98	3.65	700	1450	4810	250	50	35	
20-May-21	04:56	32	73.64	76.64	42	93.3	91.0	-2%	23.46	9.4	1.00	0.435	4%	10.11	0.00	8.30	-18%	1000	0%	103	3.21	700	1500	4810	250	50	35	
20-May-21	11:04	33	76.64	79.60	28	92.9	92.7	0%	20.64	9.2	1.01	0.433	0%	10.06	-0.05	11.30	36%	1000	0%	125	2.50	600	1400	3848	200	50	31	
20-May-21	14:14	34	79.60	82.60	40	92.9	89.8	-3%	22.91	9.1	1.01	0.446	3%	10.02	-0.04	4.89	-57%	1000	0%	118	2.57	600	1450	3848	200	50	31	
20-May-21	16:20	35	82.60	85.60	90	94.1	72.3	-23%	22.22	9.0	1.01	0.458	3%	9.98	-0.04	10.66	118%	1000	0%	124	3.83	600	1500	3848	200	50	31	New 0.45ug filter applied for Fluoro Conc. In the outlet grab sample.
20-May-21	17:59	36	85.60	88.60	154	76.7	64.7	-16%	23.11	9.0	1.01	0.474	3%	10.01	0.03	3.99	-63%	1000	0%	109	3.53	600	1500	5291	275	40	31	Measurements were off by water level imbalance between drill tank and centrifuge tank
21-May-21	00:20	37	88.60	91.60	-32	96.7	114.0	18%	20.60	9.0	1.01	0.428	-10%	9.97	-0.04	9.43	136%	1000	0%	118	3.00	620	1250	4810	250	50	35	Additional fluorescein concentration (30 ml) was necessary in order to meet the ~100 ppb criteria
21-May-21	04:43	38	91.60	94.61	79	116.0	118.1	2%	21.34	9.3	1.00	0.339	-21%	9.89	-0.08	11.28	20%	1000	0%	135	2.58	680	1500	4233	220	70	35	Fluid pressure momentarily dropped midway, but went back up at 0.4 m of drilling
21-May-21	11:03	39	94.61	97.60	66	105.8	104.4	-1%	21.69	9.0	1.01	0.364	7%	9.86	-0.03	10.25	-9%	1000	0%	134	2.56	600	1500	5772	300	70	33	
21-May-21	14:31	40	97.60	100.57	-266	97.6	88.6	-9%	21.66	9.0	1.01	0.381	5%	9.90	0.04	8.80	-14%	1000	0%	119	3.07	600	1500	4810	250	60	33	
29-May-21	11:47	41	100.57	103.56	97	99.2	94.5	-5%	15.06	10.0	1.00	5.990	1472%	12.12	2.22	7.22	-18%	98	-90%	-4	5.98	600	1500	4810	250	90	38	Drill water has been modified as it now has purevis drilling additive
29-May-21	14:14	42	103.56	106.61	169	93.9	96.1	2%	15.76	9.9	1.00	5.510	-8%	12.07	-0.05	4.46	-38%	109	11%	4	3.98	600	1500	6734	350	100	38	run took approximately 46 min when deducting downtime. An additional 2L of Pure-Vis added to the system and flushed the hoel for about 25 min. This may have attributed to water loss.
29-May-21	17:02	43	106.61	109.57	88	93.0	91.2	-2%	16.78	10.0	1.00	5.310	-4%	12.07	0.00	9.66	117%	1000	817%	-20	3.78	600	1200	1924	100	100	56	
29-May-21	21:20	44	109.57	111.08	40	92.4	92.1	0%	17.26	10.0	1.00	4.880	-8%	11.99	-0.08	10.16	5%	1000	0%	2	2.59	600	1350	3848	200	180	40	Blocked Run / Added 0.5 L of Pure-Vis
29-May-21	23:01	45	111.80	112.64	51	95.4	96.2	1%	17.56	10.0	1.00	4.790	-2%	11.99	0.00	9.67	-5%	1000	0%	-5	2.02	580	1250	5772	300	200	45	Added 0.5 L of Pure-Vis
30-May-21	00:56	46	112.64	115.60	53	95.8	92.7	-3%	17.46	9.9	1.00	4.650	-3%	11.97	-0.02	8.89	-8%	1000	0%	6	3.86	600	1350	4810	250	250	50	Added 0.5 L of Pure-Vis
30-May-21	03:20	47	115.60	118.66	260	96.3	97.4	1%	17.13	9.8	1.00	3.470	-25%	11.79	-0.18	9.74	10%	1000	0%	12	3.34	600	1400	4810	250	220	50	Added 0.5 L of Pure-Vis
30-May-21	11:09	48	118.66	121.57	88	84.5	59.2	-30%	16.14	9.9	1.00	3.490	1%	12.11	0.32	10.68	10%	1000	0%	-15	2.24	575	1350	4810	250	220	52	
30-May-21	14:55	49	121.57	124.56	47	89.8	70.7	-21%	17.07	10.4	1.00	3.470	-1%	12.11	0.00	11.47	7%	1000	0%	2	3.04	600	1400	4810	250	200	53	
30-May-21	16:59	50	124.56	127.61	65	108.8	120.9	11%	17.50	10.5	1.00	3.240	-7%	12.09	-0.02	10.44	-9%	1000	0%	0	2.95	600	1250	5772	300	180	53	
30-May-21	22:45	51	127.61	130.65	69	127.9	124.9	-2%	16.74	10.0	1.00	3.000	-7%	12.04	-0.05	12.70	22%	1000	0%	3	3.32	600	1300	5772	300	250	50	Added 0.5 L of Pure-Vis
31-May-21	00:34	52	130.65	133.65	25	129.5	127.7	-1%	17.02	10.1	1.00	2.740	-9%	12.00	-0.04	12.27	-3%	1000	0%	-5	3.40	600	1300	5387	280	250	50	Added 0.5 L of Pure-Vis
31-May-21	02:21	53	133.65	136.65	25	125.2	128.0	2%	17.26	10.1	1.00	2.660	-3%	11.97	-0.03	11.38	-7%	1000	0%	-8	4.29	600	1300	5772	300	240	50	Added 0.5 L of Pure-Vis
31-May-21	04:45	54	136.55	139.65	54	119.2	118.8	0%	16.40	10.1	1.00	2.080	-22%	11.87	-0.10	10.48	-8%	1000	0%	-2	3.87	600	1400	3848	200	250	50	Added 0.5 L of Pure-Vis
31-May-21	10:01	55	139.65	142.60	81	68.6	75.6	10%	16.32	9.7	1.00	1.810	-13%	12.02	0.15	10.78	3%	1000	0%	5	3.85	600	1350	4810	250	220	54	
31-May-21	12:34	56	142.60	145.59	322	85.0	65.6	-23%	16.49	9.9	1.00	1.650	-9%	11.97	-0.05	10.72	-1%	1000	0%	11	3.52	550	1400	4810	250	220	54	Fluid loss attributed to overflow at drill tank.
31-May-21	14:34	57	145.59	147.19	-152	64.9	48.1	-26%	16.50	9.4	1.00	1.610	-2%	11.96	-0.01	10.81	1%	1000	0%	12	3.10	550	1350	4810	250	220	54	
03-Jun-21	00:55	58	147.19	148.63	18	129.1	127.3	-1%	16.95	10.0	1.00	0.260	-84%	11.02	-0.94	11.40	5%	1000	0%	106	2.16	600	1500	4810	250	220	50	Added 1.5 L of Pure-Vis
03-Jun-21	02:39	59	148.63	151.65	55	137.6	137.4	0%	18.62	10.0	1.00	0.409	57%	11.08	0.06	5.17	-55%	1000	0%	82	3.42	600	1400	6734	350	240	50	Added 1.0 L of Pure-Vis / Got approx 6 L of drill fluid for '150 m' archive
03-Jun-21	04:45	60	151.65	154.60	51	130.0	129.6	0%	18.75	10.1	1.00	0.437	7%	10.91	-0.17	8.95	73%	1000	0%	86	3.54	600	1450	6734	350	220	50	Added 1.0 L of Pure-Vis
03-Jun-21	10:51	61	154.60	157.58	67	81.5	56.3	-31%	18.08	10.4	1.00	0.500	14%	10.66	-0.25	8.75	-2%	1000	0%	90	4.16	600	1200	6734	350	400	58	
03-Jun-21	13:40	62	157.58	160.59	155	92.4	69.4	-25%	17.59	8.5	1.01	0.485	-3%	10.63	-0.03	12.47	43%	1000	0%	97	4.40	600	1350	7696	400	200	52	Added 1.0 L of Pure-Vis half way through run
04-Jun-21	16:58	63	160.59	163.57	-21	76.4	113.2	48%	21.93	9.1	1.01	0.371	-24%	10.15	-0.48	10.96	-12%	1000	0%	120	4.58	600	1250	6734	350	320	52	SRU tank filled up with traced water prior to run
05-Jun-21	04:02	64	163.57	166.64	9	104.2	84.9	-19%	19.06	8.5	1.01	0.429	16%	10.26	0.11	9.83	-10%	1000	0%	95	4.72	600	1300	5291	275	350	50	sump tank overflowed, may have contributed to drill fluid loss
05-Jun-21	06:26	65	166.64	169.63	18	86.7	107.3	24%	18.22	7.0	1.02	0.443	3%	10.19	-0.07	3.15	-68%	1000	0%	2	5.98	600	1400	4810	250	350	50	
06-Jun-21	00:35	66	169.63	172.59	69	114.1	128.7	13%	18.99	9.5	1.00	0.475	7%	9.98	-0.21	8.16	159%	1000	0%	42	5.22	600	1400	4810	250	350	50	
06-Jun-21	10:28	67	172.59	175.62	-31	126.4	129.4	2%	17.99	8.5	1.01	0.479	1%	10.06	0.08	9.09	11%	1000	0%	41	3.56	600	1250	5772	300	300	52	
06-Jun-21	14:05	68	175.62	175.77	-50	149.3	136.5	-9%	20.97	8.0	1.01	0.497	4%	9.96	-0.10	5.09	-44%	1000	0%	14	0.75							Blocked run due to damaged core tube ring
06-Jun-21	17:02	69	175.77	178.61	-22	144.9	148.6	3%	19.20	8.6	1.01	0.577	16%	9.76	-0.20	8.76	72%	1000	0%	46	3.16	600	1300	3848	200	220	42	

WSP GOLDER

Date (End of Run)	Time (End of Run)	Run #	Top of Run	Bottom of Run	Drill Fluid Volume Change (L)	Fluorescein Concentration			Temp	Density		Elec. Cond.		pH		Dissolved Oxygen		Turbidity		ORP	ROP	Bit Rotation Speed	Torque	WOB (estimate)	Holdback Pressure (Down-	Fluid Injection (pump) Pressure	Downhole Fluid Flow Rate	Comments
						Inlet	Outlet	Change				Reading	Change	Reading	Change	Reading	Change	Reading	Change									
dd-mmm-yy	hh:mm	-	(mbgs)	(mbgs)	>100 L	(ppb)	(ppb)	>20% change	(°C)	API Gravity	SG	(mS/cm)	>10% change	-	>0.5 Change	(mg/L)	>10% Change	(NTU)	>10% Change	(mV)	m/hr	RPM	psi	lbs	psi	psi	L/min	
06-Jun-21	21:39	70	178.61	181.64	-33	92.5	109.6	18%	20.43	10.1	1.00	0.573	-1%	9.74	-0.02	6.94	-21%	1000	0%	71	4.66	600	1400	3848	200	350	50	
07-Jun-21	00:12	71	181.64	184.63	5	122.4	105.7	-14%	18.33	8.5	1.01	0.516	-10%	9.77	0.03	7.68	11%	1000	0%	52	6.19	600	1400	4810	250	350	50	`
07-Jun-21	03:30	72	184.63	187.68	6	115.0	108.4	-6%	17.45	7.0	1.02	0.552	7%	9.68	-0.09	2.00	-74%	1000	0%	56	3.21	600	1400	7696	400	350	50	
07-Jun-21	05:32	73	187.68	190.63	-8	104.3	106.1	2%	17.63	7.4	1.02	0.560	1%	9.64	-0.04	4.11	106%	1000	0%	49	4.12	600	1300	5772	300	350	50	
07-Jun-21	10:33	74	190.63	193.61	-3	124.6	84.9	-32%	17.90	8.0	1.01	0.578	3%	9.64	0.00	9.88	140%	1000	0%	37	3.37	600	1350	3848	200	320	55	Added 0.5 L of Pure-Vis
07-Jun-21	15:59	75	193.61	196.62	-191	127.2	137.2	8%	19.38	7.7	1.02	0.594	3%	9.51	-0.13	8.35	-15%	1000	0%	54	2.70	600	1300	3848	200	300	50	Added 0.5 L of Pure-Vis; Sump pump stopped working, drilling mud lost from SRU (discharged with cuttings)
07-Jun-21	21:52	76	196.62	199.64	-21	121.4	111.0	-9%	22.42	8.8	1.01	0.535	-10%	9.49	-0.02	7.22	-14%	1000	0%	136	3.77	600	1500	4810	250	300	40	Added 0.5 L of Pure-Vis
07-Jun-21	23:40	77	199.64	202.65	-81	106.9	101.6	-5%	20.07	6.7	1.02	0.566	6%	9.36	-0.13	8.93	24%	1000	0%	151	5.30	600	1500	3848	200	300	40	Added 0.5 L of Pure-Vis
08-Jun-21	01:27	78	202.65	205.65	0	112.1	98.7	-12%	19.67	6.2	1.03	0.611	8%	9.32	-0.04	7.12	-20%	1000	0%	141	4.87	600	1400	3848	200	300	40	Added 0.5 L of Pure-Vis
08-Jun-21	02:55	79	205.65	208.63	2	100.2	118.8	19%	19.68	5.5	1.03	0.626	2%	9.22	-0.10	7.98	12%	1000	0%	145	4.35	600	1450	3848	200	300	40	
08-Jun-21	04:46	80	208.63	211.64	-8	104.8	114.8	10%	20.49	5.5	1.03	0.604	-4%	9.20	-0.02	9.21	15%	1000	0%	190	3.84	600	1400	6734	350	400	40	Added 1.0 L of Pure-Vis due to low drill fluid density
08-Jun-21	10:57	81	211.64	214.64	-168	107.6	122.0	13%	18.59	6.0	1.03	0.696	15%	9.08	-0.12	8.35	-9%	1000	0%	92	3.16	600	1350	4810	250	380	56	Added 2.0 L of Pure-Vis (1.0 L before start of run and 1.0 L during run); Approx. 150 L of drilling mud lost from SRU (discharged with cuttings)
08-Jun-21	15:11	82	214.64	217.62	10	120.7	108.5	-10%	18.68	6.9	1.02	0.708	2%	9.05	-0.03	8.86	6%	1000	0%	134	2.98	600	1350	3848	200	380	54	Added 1.5 L of Pure-Vis
08-Jun-21	17:40	83	217.62	220.61	-105	118.5	49.6	-58%	20.31	5.0	1.04	0.795	12%	8.95	-0.10	8.90	0%	1000	0%	-175	3.20	600	1250	3848	200	340	50	Sump pump and centrifuge not working efficiently. Fluor sample from inlet was clear, but sample from outlet was turbid even after filtering with new filter
09-Jun-21	00:27	84	220.61	223.65	76	88.2	100.6	14%	19.55	7.9	1.02	0.748	-6%	8.99	0.04	8.42	-5%	1000	0%	131	4.24	600	1400	4810	250	400	40	
09-Jun-21	02:30	85	223.65	226.63	-95	96.3	92.3	-4%	19.14	5.0	1.04	0.733	-2%	9.02	0.03	8.17	-3%	1000	0%	-125	3.51	600	1450	4810	250	400	40	
09-Jun-21	04:21	86	226.63	229.66	-12	95.5	79.3	-17%	19.90	7.8	1.02	0.791	8%	9.01	-0.01	8.84	8%	1000	0%	153	3.78	600	1400	4810	250	350	40	
09-Jun-21	16:13	87	229.66	232.64	13	88.9	99.6	12%	19.79	7.5	1.02	0.602	-24%	9.75	0.74	7.32	-17%	1000	0%	96	2.75	600	1350	4810	250	300	50	SRU tank emptied and filled with traced water prior to run. Added 2.0 L of Pure-Vis during run.
09-Jun-21	22:38	88	232.64	235.66	-3	56.4	66.2	17%	20.89	8.9	1.01	0.557	-7%	9.64	-0.11	6.72	-8%	1000	0%	108	4.21	600	1500	3848	200	300	40	Drill fluid very turbid after filtering. Added 0.5 L of Pure-Vis during run.
10-Jun-21	00:22	89	235.66	238.65	-16	69.2	82.1	19%	21.06	9.0	1.01	0.585	5%	9.59	-0.05	7.31	9%	1000	0%	112	4.38	600	1500	4810	250	300	40	Added 0.5 L of Pure-Vis during run.
10-Jun-21	02:06	90	238.65	241.65	-2	64.3	56.6	-12%	20.96	8.7	1.01	0.555	-5%	9.65	0.06	6.51	-11%	1000	0%	110	4.86	600	1500	3848	200	250	40	Drill fluid very turbid after filtering.
10-Jun-21	12:13	91	241.65	244.61	-48	84.5	53.3	-37%	19.00	7.0	1.02	0.591	6%	9.57	-0.08	8.37	29%	1000	0%	-370	2.61	600	1450	4810	250	300	50	Added 0.5 L of Pure-Vis prior to run. Fluor sample from inlet was clear, but sample from outlet was turbid even after filtering with new filter
10-Jun-21	14:47	92	244.61	247.62	-124	95.5	103.6	8%	18.75	7.0	1.02	0.640	8%	9.52	-0.05	6.65	-21%	1000	0%	91	2.08	600	1400	3848	200	280	50	Added 2.0 L of Pure-Vis during run. ~127L false loss while circulating and pumping the inner tube downhole resulting in 124L gain over the core run.
10-Jun-21	22:27	93	247.62	250.63	2	94.9	98.9	4%	19.91	9.1	1.01	0.624	-3%	9.41	-0.11	7.89	19%	1000	0%	110	3.69	600	1550	3848	200	300	40	
11-Jun-21	03:55	94	250.63	253.66	16	96.2	86.2	-10%	17.99	7.9	1.02	0.651	4%	9.34	-0.07	8.46	7%	1000	0%	108	4.13	600	1550	4810	250	350	40	Added 0.5 L of Pure-Vis during run.
11-Jun-21	10:00	95	253.66	256.60	-22	104.3	106.5	2%	16.74	7.9	1.02	0.658	1%	9.35	0.01	8.80	4%	1000	0%	84	3.09	600	1550	4810	250	300	48	
11-Jun-21	14:37	96	256.60	256.72	-28	102.3	111.6	9%	17.03	6.5	1.03	0.665	1%	9.21	-0.14	4.84	-45%	1000	0%	87	1.20							Blocked run due to damaged core tube ring
11-Jun-21	17:05	97	256.72	259.64	-67	108.7	109.2	0%	17.02	6.0	1.03	0.665	0%	9.27	0.06	6.79	40%	1000	0%	61	3.19	600	1600	5772	300	300	47	
11-Jun-21	22:20	98	259.64	262.66	22	78.5	80.9	3%	18.88	6.0	1.03	0.562	-15%	9.29	0.02	7.23	6%	1000	0%	-110	2.35	600	1550	4810	250	300	40	Added 0.5L Pure-Vis
12-Jun-21	00:01	99	262.66	265.66	-64	87.7	86.8	-1%	17.68	5.9	1.03	0.639	14%	9.18	-0.11	7.12	-2%	1000	0%	-390	3.46	600	1550	3848	200	400	40	
12-Jun-21	10:18	100	265.66	268.61	-6	89.1	95.7	7%	17.85	7.4	1.02	0.702	10%	9.27	0.09	7.47	5%	1000	0%	114	4.21	600	1500	4810	250	380	49	
12-Jun-21	11:43	101	268.61	268.89	-94	99.4	99.3	0%	17.32	6.5	1.03	0.668	-5%	9.02	-0.25	3.26	-56%	1000	0%	104	1.53	600	1450	5772	300	400	48	Blocked run
12-Jun-21	21:31	102	268.89	271.65	-20	75.4	89.3	18%	17.48	5.3	1.03	0.684	2%	9.13	0.11	2.45	-25%	1000	0%	-5	5.02	600	1400	4810	250	350	40	
12-Jun-21	23:02	103	271.65	274.64	25	88.9	99.4	12%	17.91	5.2	1.04	0.668	-2%	9.03	-0.10	4.23	73%	1000	0%	-90	4.08	600	1300	5772	300	300	40	
13-Jun-21	02:05	104	274.64	277.67	43	85.9	83.8	-2%	17.35	6.5	1.03	0.679	2%	8.98	-0.05	7.09	68%	1000	0%	148	4.33	600	1600	9620	500	300	40	
13-Jun-21	10:05	105	277.67	280.61	-295	92.5	106.5	15%	16.06	6.5	1.03	0.694	2%	8.97	-0.01	9.55	35%	1000	0%	133	4.01	700	1350	5772	300	280	48	Volume gain due to adding drill fluid from cuttings bag into SRU during core run
13-Jun-21	17:34	106	280.61	283.63	-115	87.9	92.9	6%	18.04	8.3	1.01	0.394	-43%	9.40	0.43	8.55	-10%	1000	0%	71	4.21	700	1550	4810	250	250	50	False loss while circulating and pumping the inner tube downhole resulting in 115L gain over the core run.
13-Jun-21	22:35	107	283.63	286.64	-19	80.5	80.5	0%	18.43	8.2	1.01	0.414	5%	9.59	0.19	7.58	-11%	1000	0%	121	5.64	600	1500	4810	250	250	40	
14-Jun-21	03:21	108	286.64	289.65	-16	75.4	80.6	7%	16.88	8.1	1.01	0.406	-2%	9.60	0.01	6.75	-11%	1000	0%	113	7.22	600	1500	9620	500	300	40	Added 0.5L Pure-Vis
14-Jun-21	15:21	109	289.65	292.61	-7	93.4	87.1	-7%	15.95	6.9	1.02	0.463	14%	9.64	0.04	6.23	-8%	1000	0%	67	6.12	700	1450	8658	450	300	50	
15-Jun-21	00:50	110	292.61	295.64	-19	75.6	80.6	7%	16.81	4.5	1.04	0.474	2%	9.65	0.01	7.22	16%	1000	0%	-352	6.99	600	1500	9620	500	300	40	Added 0.5L Pure-Vis
15-Jun-21	02:22	111	295.64	298.66	2	80.9	88.9	10%	15.81	6.1	1.03	0.414	-13%	9.66	0.01	6.98	-3%	1000	0%	-497	6.47	600	1400	11544	600	250	50	Added 0.5L Pure-Vis
15-Jun-21	09:47	112	298.66	301.65	-17	81.2	91.4	13%	15.97	8.0	1.01	0.425	3%	9.42	-0.24	1.95	-72%	1000	0%	65	5.61	700	1500	11544	600	280	48	Added 0.5L Pure-Vis prior to run
15-Jun-21	13:37	113	301.65	304.64	-224	82.6	95.4	16%	16.80	7.8	1.02	0.444	4%	9.71	0.29	7.01	259%	1000	0%	68	7.48	700	1400	11544	600	280	50	Volume gain due to adding drill fluid from cuttings bag into SRU during core run
15-Jun-21	16:48	114	304.64	307.62	-15	101.5	75.0	-26%	17.79	7.6	1.02	0.425	-4%	9.70	-0.01	5.22	-26%	1000	0%	67	8.51	700	1550	10582	550	280	50	
15-Jun-21	22:26	115	307.62	310.62	190	110.4	107.5	-3%	17.43	9.2	1.01	0.431	1%	9.74	0.04	8.45	62%	1000	0%	137	7.50	600	1500	9235	480	300	40	Volume loss due to drill fluid overflow on drill tank during post drilling circulation. Added 0.5 L of Pure-Vis
16-Jun-21	01:15	116	310.62	313.63	15	101.2	99.3	-2%	17.38	9.1	1.01	0.437	1%	9.63	-0.11	9.81	16%	1000	0%	137	6.69	600	1500	9620	500	300	40	Added 0.5 L of Pure-Vis
16-Jun-21	02:40	117	313.63	316.64	4	122.6	112.4	-8%	16.08	8.5	1.01	0.477	9%	9.64	0.01	9.71	-1%	1000	0%	72	6.69	600	1480	9620	500	320	40	
16-Jun-21	04:41	118	316.64	319.65	-12	112.2	107.0	-5%	16.51	8.5	1.01	0.453	-5%	9.53	-0.11	9.61	-1%	1000	0%	159	7.52	600	1500	9620	500	300	40	Added 0.5 L of Pure-Vis
16-Jun-21	10:58	119	319.65	322.58	-26	77.2	79.0	2%	17.49	7.0	1.02	0.455	0%	9.74	0.21	6.79	-29%	1000	0%	73	7.33	700	1600	9620	500	320	52	
16-Jun-21	13:52	120	322.58	325.63	4	86.2	86.5	0%	17.92	7.6	1.02	0.443	-3%	9.80	0.06	8.29	22%	1000	0%	21	6.78	700	1550	10582	550	300	50	
16-Jun-21	16:03	121	325.63	328.63	29	88.6	76.9	-13%	19.35	7.5	1.02	0.464	5%	9.78	-0.02	6.85	-17%	1000	0%	17	6.67	700	1600	9620	500	280	48	
16-Jun-21	22:09	122	328.63	331.63	-48	102.4	105.3	3%	18.72	8.6	1.01	0.456	-2%	9.61	-0.17	9.60	40%	1000	0%	177	7.20	600	1500	9620	500	300	40	Added 1.3 L of Pure-Vis prior to coring
17-Jun-21	00:44	123	331.63	334.63	-28	95.6	94.4	-1%	17.97	8.5	1.01	0.381	-16%	9.39	-0.22	10.27	7%	1000	0%	179	6.92	600	1500	9620	500	300	40	Added 0.5 L of Pure-Vis
17-Jun-21	03:25	124	334.63	337.65	-40	93.7	92.1	-2%	18.27	8.4	1.01	0.449	18%	9.68	0.29	10.50	2%	1000	0%	142	5.85	600	1500	5772	300	300	40	Added 0.5 L of Pure-Vis
17-Jun-21	13:32	125	337.65	340.59	-18	59.8	90.1	51%	18.85	7.9	1.02	0.475	6%	9.44	-0.24	8.04	-23%	1000	0%	73	4.41	700	1600	7696	400	180	38	
17-Jun-21	16:40	126	340.59	343.32	134	68.8	82.6	20%	18.79	7.6	1.02	0.468	-1%	9.34	-0.10	7.41	-8%	1000	0%	57	4.20	700	1650	4810	250	180	40	
25-Jun-21	04:01	127	343.32	343.65	-9	82.8	73.9	-11%	17.04	11.4	0.99	0.086	-82%	8.60	-0.74	10.00	35%	1000	0%	183	2.47	600	1650	5772	300	250	40	Added 0.5 L of Pure-Vis prior to coring. API Gravity calculated from S.G. calculated using the analytical scale.
25-Jun-21	05:27	128	343.65	346.64	-44	82.7	79.4	-4%	16.42	7.2	1.02	0.172	100%	9.50	0.90	7.89	-21%	1000	0%	117	5.61	600	1500	7696	400	250	40	Added 0.5 L of Pure-Vis prior to coring. API Gravity calculated from S.G. calculated using the analytical scale.
25-Jun-21	11:53	129	346.64	349.62	19	63.2	60.5	-4%	18.04	10.7	1.00	0.161	-6%	9.31	-0.19	4.62	-41%	1000	0%	119	2.93	700	1800	8177	425	220	46	API Gravity calculated from S.G. calculated using the analytical scale.
25-Jun-21	13:50	130	349.62	352.64	17	74.0	61.9	-16%	19.20	11.7	0.99	0.179	11%	9.45	0.14	4.09	-11%	1000	0%	82	3.48	700	1850	8658	450	270	52	API Gravity calculated from S.G. calculated using the analytical scale.
25-Jun-21	16:22	131	352.64	355.62	33	72.2	60.0	-17%	18.40	14.4	0.97	0.246	37%	9.49	0.04	6.12	50%	1000	0%	92	3.73	600	1400	7696	400	370	56	API Gravity calculated from S.G. calculated using the analytical scale.

Date (End of Run)	Time (End of Run)	Run #	Top of Run	Bottom of Run	Drill Fluid Volume Change (L)	Fluorescein Concentration			Temp	Density		Elec. Cond.		pH		Dissolved Oxygen		Turbidity		ORP	ROP	Bit Rotation Speed	Torque	WOB (estimate)	Holdback Pressure (Down-	Fluid Injection (pump) Pressure	Downhole Fluid Flow Rate	Comments
						Inlet	Outlet	Change				Reading	Change	Reading	Change	Reading	Change	Reading	Change									
dd-mmm-yy	hh:mm	-	(mbgs)	(mbgs)	>100 L	(ppb)	(ppb)	>20% change	(°C)	API Gravity	SG	(mS/cm)	>10% change	-	>0.5 Change	(mg/L)	>10% Change	(NTU)	>10% Change	(mV)	m/hr	RPM	psi	lbs	psi	psi	L/min	
25-Jun-21	23:56	132	355.62	358.62	-30	104.2	92.7	-11%	17.84	10.1	1.00	0.313	27%	9.43	-0.06	8.90	45%	1000	0%	120	4.86	600	1200	9428	490	470	50	API Gravity calculated from S.G. calculated using the analytical scale.
26-Jun-21	02:21	133	358.62	361.64	-22	86.2	16.4	-81%	17.99	13.5	0.98	0.349	12%	9.35	-0.08	9.21	3%	1000	0%	122	5.66	600	1450	5772	300	360	50	API Gravity calculated from S.G. calculated using the analytical scale.
26-Jun-21	10:40	134	361.64	364.63	22	28.6	20.8	-27%	16.17	14.0	0.97	0.348	0%	9.24	-0.11	6.60	-28%	1000	0%	80	3.09	650	1550	7696	400	380	52	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration abnormaly low - suspected due to very high turbidity due to pure-vis concentration.
26-Jun-21	13:19	135	364.63	367.61	-103	63.5	30.9	-51%	17.20	10.9	0.99	0.427	23%	9.03	-0.21	5.87	-11%	1000	0%	120	3.20	650	1300	6734	350	500	54	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration abnormaly low - suspected due to very high turbidity due to pure-vis concentration.
26-Jun-21	15:38	136	367.61	370.62	42	150.1	44.9	-70%	17.58	15.0	0.97	0.466	9%	9.04	0.01	6.28	7%	1000	0%	125	4.01	600	1200	8658	450	520	54	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration abnormaly low - suspected due to very high turbidity due to pure-vis concentration.
26-Jun-21	17:34	137	370.62	373.62	101	188.4	56.3	-70%	17.59	16.6	0.96	0.455	-2%	9.25	0.21	5.77	-8%	1000	0%	114	4.50	600	1300	5772	300	450	50	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration abnormaly low - suspected due to very high turbidity due to pure-vis concentration.
27-Jun-21	10:35	138	373.62	376.61	9	61.8	46.8	-24%	16.14	12.3	0.98	0.482	6%	9.06	-0.19	4.51	-22%	1000	0%	172	4.27	700	1400	6734	350	440	50	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration abnormaly low - suspected due to very high turbidity due to pure-vis concentration.
27-Jun-21	12:16	139	376.61	379.63	23	30.5	20.6	-33%	16.55	13.1	0.98	0.501	4%	8.90	-0.16	3.08	-32%	1000	0%	141	4.90	700	1400	6734	350	450	52	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration abnormaly low - suspected due to very high turbidity due to pure-vis concentration.
27-Jun-21	14:52	140	379.63	382.60	86	24.4	22.9	-6%	16.48	12.7	0.98	0.487	-3%	8.92	0.02	5.23	70%	1000	0%	172	4.05	700	1250	6734	350	420	48	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration abnormaly low - suspected due to very high turbidity due to pure-vis concentration.
27-Jun-21	17:11	141	382.60	385.63	24	20.5	14.2	-31%	16.31	15.1	0.97	0.508	4%	8.81	-0.11	2.66	-49%	1000	0%	165	4.23	700	1350	5772	300	440	48	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration abnormaly low - suspected due to very high turbidity due to pure-vis concentration.
28-Jun-21	01:17	142	386.63	388.65	-45	7.1	14.2	100%	15.94	10.8	0.99	0.538	6%	8.70	-0.11	9.51	258%	1000	0%	183	3.56	600	1300	5772	300	480	48	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration abnormaly low - suspected due to very high turbidity due to pure-vis concentration. Added 0.5 L of Pure-Vis
28-Jun-21	11:39	143	388.65	391.60	68	24.2	17.1	-29%	16.62	10.0	1.00	0.541	1%	9.00	0.30	7.70	-19%	1000	0%	139	3.40	650	1250	7696	400	500	50	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration abnormaly low - suspected due to very high turbidity due to pure-vis concentration. Added 0.5 L of Pure-Vis
28-Jun-21	16:08	144	391.60	394.60	-9	39.1	112.3	187%	17.80	8.2	1.01	0.667	23%	8.91	-0.09	7.05	-8%	1000	0%	87	3.40	650	1250	7696	400	550	50	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration significantly increased due to different filtering technique.
29-Jun-21	02:02	145	394.60	397.66	-52	194.0	197.8	2%	16.06	18.4	0.94	0.631	-5%	8.55	-0.36	8.63	22%	1000	0%	183	3.83	600	1300	9620	500	590	48	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration significantly increased due to different filtering technique.
29-Jun-21	10:35	146	397.66	400.55	30	148.9	133.4	-10%	16.44	15.7	0.96	0.617	-2%	8.70	0.15	7.78	-10%	1000	0%	168	3.85	600	1200	5772	300	700	60	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration significantly increased due to different filtering technique.
29-Jun-21	13:56	147	400.55	403.52	168	177.7	179.2	1%	18.36	8.9	1.01	0.645	5%	8.78	0.08	8.67	11%	1000	0%	106	3.56	600	1200	7696	400	600	60	API Gravity calculated from S.G. calculated using the analytical scale. Fluor concentration significantly increased due to different filtering technique. Drill tank and tub overflowed during run.
29-Jun-21	16:47	148	403.52	406.56	78	180.0	148.6	-17%	19.85	10.6	1.00	0.361	-44%	9.50	0.72	6.82	-21%	1000	0%	108	3.65	600	1150	8658	450	600	60	API Gravity calculated from S.G. calculated using the analytical scale. Centrifuge emptied/cleaned, and re-filled with new drill fluid affecting drill fluid parameters as compared to last run.
30-Jun-21	03:55	149	406.56	409.63	17	84.5	83.4	-1%	16.97	7.1	1.02	0.471	30%	8.50	-1.00	5.50	-19%	1000	0%	177	4.39	600	1450	7696	400	450	48	API Gravity calculated from S.G. calculated using the analytical scale.
30-Jun-21	10:07	150	409.63	412.56	29	99.3	118.3	19%	18.42	8.8	1.01	0.516	10%	8.78	0.28	3.05	-45%	1000	0%	128	3.74	600	1250	8658	450	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
30-Jun-21	11:54	151	412.56	415.56	49	135.4	155.7	15%	17.84	8.6	1.01	0.514	0%	8.94	0.16	6.66	118%	1000	0%	143	4.29	600	1250	7696	400	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
30-Jun-21	13:30	152	415.56	418.54	37	159.5	136.8	-14%	18.59	9.3	1.00	0.537	4%	8.84	-0.10	4.84	-27%	1000	0%	148	3.89	600	1250	7696	400	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
30-Jun-21	15:41	153	418.54	421.56	38	153.0	161.6	6%	19.03	9.1	1.01	0.556	4%	8.86	0.02	3.44	-29%	1000	0%	137	3.70	600	1250	8177	425	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
30-Jun-21	17:46	154	421.56	424.54	38	157.7	173.3	10%	19.99	10.9	0.99	0.551	-1%	8.69	-0.17	5.84	70%	1000	0%	190	3.65	600	1250	7696	400	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
01-Jul-21	01:50	155	424.54	427.60	0	151.5	152.4	1%	18.06	8.8	1.01	0.463	-16%	8.17	-0.52	6.09	4%	1000	0%	219	3.83	600	1450	6734	350	400	48	API Gravity calculated from S.G. calculated using the analytical scale. Drillers filled centrifuge with new water, cauing pH to change.
01-Jul-21	12:31	156	427.60	430.56	9	103.2	122.4	19%	18.66	11.9	0.99	0.662	43%	8.60	0.43	6.54	7%	1000	0%	153	2.91	600	1350	6734	350	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
01-Jul-21	14:54	157	430.56	433.56	15	158.9	128.1	-19%	18.01	15.1	0.97	0.498	-25%	8.44	-0.16	5.41	-17%	1000	0%	178	3.60	600	1400	6734	350	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
01-Jul-21	21:28	158	433.56	436.64	2	152.6	148.7	-3%	18.43	12.1	0.99	0.546	10%	8.12	-0.32	11.72	117%	1000	0%	239	4.11	600	1450	5772	300	450	48	API Gravity calculated from S.G. calculated using the analytical scale.
01-Jul-21	23:32	159	436.64	439.67	-19	127.8	141.2	10%	17.98	8.9	1.01	0.571	5%	8.09	-0.03	11.58	-1%	1000	0%	213	5.68	600	1500	6734	350	450	48	API Gravity calculated from S.G. calculated using the analytical scale.
02-Jul-21	01:20	160	439.67	442.65	-34	127.4	117.3	-8%	18.19	11.4	0.99	0.566	-1%	8.51	0.42	9.21	-20%	1000	0%	197	5.11	600	1400	5772	300	400	48	API Gravity calculated from S.G. calculated using the analytical scale.
02-Jul-21	02:55	161	442.65	445.62	-32	131.3	142.6	9%	18.01	12.0	0.99	0.562	-1%	8.38	-0.13	10.41	13%	1000	0%	202	4.46	600	1500	5772	300	400	50	API Gravity calculated from S.G. calculated using the analytical scale.
02-Jul-21	05:00	162	445.62	448.60	-71	135.6	126.8	-6%	17.26	17.0	0.95	0.567	1%	8.51	0.13	9.98	-4%	1000	0%	197	5.11	600	1400	7696	400	400	50	API Gravity calculated from S.G. calculated using the analytical scale.
02-Jul-21	10:09	163	448.60	451.53	-24	94.7	113.6	20%	17.68	10.8	0.99	0.614	8%	8.57	0.06	10.28	3%	1000	0%	160	3.38	600	1300	5772	300	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
02-Jul-21	11:59	164	451.53	454.55	-87	162.0	150.6	-7%	18.22	10.1	1.00	0.661	8%	8.34	-0.23	9.30	-10%	1000	0%	156	3.36	600	1400	4810	250	450	60	API Gravity calculated from S.G. calculated using the analytical scale.

WSP GOLDER

Date (End of Run)	Time (End of Run)	Run #	Top of Run	Bottom of Run	Drill Fluid Volume Change (L)	Fluorescein Concentration			Temp	Density		Elec. Cond.		pH		Dissolved Oxygen		Turbidity		ORP	ROP	Bit Rotation Speed	Torque	WOB (estimate)	Holdback Pressure (Down-	Fluid Injection (pump) Pressure	Downhole Fluid Flow Rate	Comments
						Inlet	Outlet	Change				Reading	Change	Reading	Change	Reading	Change	Reading	Change									
dd-mmm-yy	hh:mm	-	(mbgs)	(mbgs)	>100 L	(ppb)	(ppb)	>20% change	(°C)	API Gravity	SG	(mS/cm)	>10% change	-	>0.5 Change	(mg/L)	>10% Change	(NTU)	>10% Change	(mV)	m/hr	RPM	psi	lbs	psi	psi	L/min	
02-Jul-21	14:39	165	454.55	457.54	-94	98.1	84.3	-14%	18.91	11.3	0.99	0.691	5%	8.64	0.30	8.00	-14%	1000	0%	146	3.04	600	1400	4810	250	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
02-Jul-21	17:23	166	457.54	460.52	-74	96.7	98.1	1%	19.53	12.9	0.98	0.685	-1%	8.62	-0.02	8.72	9%	1000	0%	144	2.75	600	1400	4810	250	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
02-Jul-21	21:43	167	460.52	463.61	-67	113.7	137.8	21%	20.28	8.7	1.01	0.666	-3%	8.36	-0.26	10.56	21%	1000	0%	155	4.12	600	1500	5772	300	450	48	API Gravity calculated from S.G. calculated using the analytical scale. Fluor Traced water was added to SRU before CR167 to top up system.
02-Jul-21	23:44	168	463.61	466.62	-99	88.8	64.6	-27%	19.96	11.4	0.99	0.559	-16%	8.24	-0.12	10.53	0%	1000	0%	160	3.84	600	1500	3848	200	400	50	API Gravity calculated from S.G. calculated using the analytical scale.
03-Jul-21	01:16	169	466.62	469.64	-15	57.7	53.1	-8%	19.68	10.9	0.99	0.664	19%	8.28	0.04	9.73	-8%	1000	0%	154	4.53	600	1450	8658	450	450	50	API Gravity calculated from S.G. calculated using the analytical scale.
03-Jul-21	02:35	170	469.64	472.63	-34	56.4	53.2	-6%	19.50	14.3	0.97	0.616	-7%	8.38	0.10	10.82	11%	1000	0%	152	5.61	600	1500	7696	400	400	50	API Gravity calculated from S.G. calculated using the analytical scale.
03-Jul-21	04:27	171	472.63	475.64	-18	54.5	40.2	-26%	19.37	14.2	0.97	0.659	7%	8.28	-0.10	11.17	3%	1000	0%	154	4.63	600	1500	5772	300	450	50	API Gravity calculated from S.G. calculated using the analytical scale.
03-Jul-21	06:03	172	475.63	478.63	13	53.8	50.8	-5%	19.45	12.9	0.98	0.649	-2%	8.28	0.00	11.15	0%	1000	0%	154	4.39	600	1500	5772	300	450	50	API Gravity calculated from S.G. calculated using the analytical scale.
03-Jul-21	10:35	173	478.63	481.56	9	36.8	124.0	237%	19.76	11.1	0.99	0.703	8%	8.65	0.37	10.98	-2%	1000	0%	-118	2.84	600	1350	4810	250	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
03-Jul-21	12:41	174	481.56	484.55	10	128.6	135.7	6%	20.02	12.6	0.98	0.732	4%	8.59	-0.06	7.55	-31%	1000	0%	183	3.82	600	1500	5772	300	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
03-Jul-21	14:55	175	484.55	487.54	-71	140.8	138.4	-2%	21.46	11.4	0.99	0.723	-1%	8.71	0.12	7.12	-6%	1000	0%	160	2.89	600	1250	9139	475	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
03-Jul-21	17:07	176	487.54	490.55	-1	127.9	136.8	7%	21.58	10.7	0.99	0.742	3%	8.59	-0.12	8.09	14%	1000	0%	182	3.61	600	1300	8658	450	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
03-Jul-21	21:01	177	490.55	493.61	-55	146.1	144.0	-1%	21.22	12.9	0.98	0.763	3%	8.34	-0.25	8.60	6%	1000	0%	214	4.48	600	1500	5772	300	450	50	API Gravity calculated from S.G. calculated using the analytical scale.
03-Jul-21	22:44	178	493.61	496.64	-65	152.8	158.8	4%	20.47	9.3	1.01	0.686	-10%	8.46	0.12	10.14	18%	1000	0%	187	3.87	600	1500	5772	300	400	50	API Gravity calculated from S.G. calculated using the analytical scale.
04-Jul-21	00:10	179	496.64	499.62	-56	146.0	148.5	2%	20.34	12.6	0.98	0.792	15%	8.52	0.06	9.54	-6%	1000	0%	167	4.97	600	1500	5772	300	400	50	API Gravity calculated from S.G. calculated using the analytical scale.
04-Jul-21	02:10	180	499.62	502.65	-2	142.5	142.0	0%	20.03	11.1	0.99	0.724	-9%	8.53	0.01	9.70	2%	1000	0%	173	4.23	600	1500	5772	300	400	50	API Gravity calculated from S.G. calculated using the analytical scale.
04-Jul-21	03:39	181	502.65	505.63	8	130.6	128.9	-1%	20.46	13.2	0.98	0.754	4%	8.48	-0.05	9.76	1%	1000	0%	142	4.58	600	1500	4810	250	450	50	API Gravity calculated from S.G. calculated using the analytical scale.
04-Jul-21	05:02	182	505.63	508.64	-12	133.6	132.8	-1%	20.65	8.7	1.01	0.732	-3%	8.52	0.04	9.67	-1%	1000	0%	130	4.51	600	1500	7696	400	400	50	API Gravity calculated from S.G. calculated using the analytical scale.
04-Jul-21	12:10	183	508.64	511.54	8	120.2	114.4	-5%	21.11	12.8	0.98	0.734	0%	8.43	-0.09	7.32	-24%	1000	0%	87	2.81	600	1500	9139	475	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
04-Jul-21	13:50	184	511.54	514.54	25	122.8	124.7	2%	21.46	12.8	0.98	0.735	0%	8.43	0.00	8.06	10%	1000	0%	81	3.60	600	1500	4810	250	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
04-Jul-21	15:22	185	514.54	517.54	5	107.3	124.2	16%	20.60	10.7	1.00	0.707	-4%	8.45	0.02	7.22	-10%	1000	0%	-201	4.09	600	1500	4810	250	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
04-Jul-21	17:57	186	517.54	520.54	-54	120.2	123.8	3%	20.24	10.6	1.00	0.729	3%	8.36	-0.09	7.92	10%	1000	0%	119	3.83	600	1500	5291	275	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
04-Jul-21	21:00	187	520.54	523.62	-36	127.7	122.7	-4%	21.28	9.2	1.01	0.717	-2%	8.44	0.08	7.45	-6%	1000	0%	125	5.78	600	1550	4810	250	400	50	API Gravity calculated from S.G. calculated using the analytical scale.
04-Jul-21	23:02	188	523.62	526.64	12	129.0	134.2	4%	20.53	12.5	0.98	0.682	-5%	8.61	0.17	8.01	8%	1000	0%	110	5.85	600	1550	6734	350	400	52	API Gravity calculated from S.G. calculated using the analytical scale.
05-Jul-21	01:30	189	526.64	529.64	42	122.1	126.0	3%	20.09	13.4	0.98	0.724	6%	8.50	-0.11	8.12	1%	1000	0%	111	5.29	600	1550	6734	350	400	50	API Gravity calculated from S.G. calculated using the analytical scale.
05-Jul-21	04:45	190	529.64	532.64	-2	112.9	122.1	8%	20.08	3.8	1.05	0.719	-1%	8.65	0.15	8.48	4%	1000	0%	127	4.74	600	1550	5772	300	450	50	API Gravity calculated from S.G. calculated using the analytical scale.
05-Jul-21	12:01	191	532.64	535.53	-22	113.1	110.1	-3%	19.05	11.4	0.99	0.718	0%	8.50	-0.15	8.68	2%	1000	0%	113	4.69	600	1400	7696	400	500	55	API Gravity calculated from S.G. calculated using the analytical scale.
05-Jul-21	14:02	192	535.53	538.53	10	104.3	120.0	15%	19.69	12.6	0.98	0.745	4%	8.40	-0.10	6.86	-21%	1000	0%	81	4.62	600	1500	6253	325	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
05-Jul-21	15:59	193	538.53	541.53	19	118.1	115.6	-2%	19.82	11.5	0.99	0.743	0%	8.48	0.08	8.20	20%	1000	0%	72	4.00	600	1500	5772	300	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
05-Jul-21	18:09	194	541.53	544.53	-19	105.5	115.8	10%	19.72	9.8	1.00	0.755	2%	8.40	-0.08	8.08	-1%	1000	0%	97	3.83	600	1550	4810	250	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
06-Jul-21	02:22	195	544.53	547.63	-94	114.3	115.9	1%	19.42	4.9	1.04	0.730	-3%	8.37	-0.03	9.15	13%	1000	0%	118	3.21	650	1700	6734	350	500	58	API Gravity calculated from S.G. calculated using the analytical scale. 500L of traced water added to SRU prior to drilling
06-Jul-21	04:52	196	547.63	550.65	40	108.3	100.6	-7%	18.15	12.5	0.98	0.711	-3%	8.66	0.29	8.96	-2%	1000	0%	107	2.79	600	1700	5772	300	500	58	API Gravity calculated from S.G. calculated using the analytical scale.
06-Jul-21	10:18	197	550.65	553.52	-91	104.9	110.8	6%	17.31	10.2	1.00	0.711	0%	8.42	-0.24	9.96	11%	1000	0%	-90	3.91	600	1700	5772	300	500	60	API Gravity calculated from S.G. calculated using the analytical scale.
06-Jul-21	12:28	198	553.52	556.51	-10	98.7	87.1	-12%	17.23	10.6	1.00	0.546	-23%	8.47	0.05	8.65	-13%	1000	0%	74	3.38	600	1725	7696	400	400	60	API Gravity calculated from S.G. calculated using the analytical scale.
06-Jul-21	15:14	199	556.51	559.53	12	93.5	90.7	-3%	17.69	11.0	0.99	0.496	-9%	8.70	0.23	4.70	-46%	1000	0%	99	2.88	600	1700	8658	450	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
06-Jul-21	17:38	200	559.53	562.51	-16	81.5	89.7	10%	18.69	12.7	0.98	0.517	4%	8.87	0.17	8.49	81%	1000	0%	74	2.71	600	1600	5772	300	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
06-Jul-21	22:24	201	562.51	565.61	5	74.2	84.0	13%	18.14	10.9	0.99	0.537	4%	8.46	-0.41	8.59	1%	1000	0%	76	3.51	600	1700	5772	300	450	58	API Gravity calculated from S.G. calculated using the analytical scale.
07-Jul-21	02:15	202	565.61	568.59	0	99.0	104.8	6%	17.15	9.0	1.01	0.545	1%	8.54	0.08	8.76	2%	1000	0%	72	3.89	600	1700	7696	400	500	58	API Gravity calculated from S.G. calculated using the analytical scale.
07-Jul-21	03:53	203	568.59	571.60	-76	101.8	108.1	6%	16.89	11.4	0.99	0.553	1%	8.33	-0.21	8.68	-1%	1000	0%	68	3.61	600	1700	7696	400	500	58	API Gravity calculated from S.G. calculated using the analytical scale.
07-Jul-21	10:23	204	571.60	574.55	-12	97.8	99.9	2%	15.23	13.2	0.98	0.588	6%	8.50	0.17	8.21	-5%	1000	0%	103	3.28	600	1800	5772	300	450	58	API Gravity calculated from S.G. calculated using the analytical scale.
07-Jul-21	11:43	205	574.55	575.20	25	88.7	97.5	10%	15.05	12.7	0.98	0.576	-2%	8.37	-0.13	8.75	7%	1000	0%	-136	1.56							API Gravity calculated from S.G. calculated using the analytical scale. Drillers stop mid-run to determine if bit is done.
07-Jul-21	21:33	206	575.20	577.64	14	93.8	97.9	4%	19.16	8.3	1.01	0.531	-8%	8.60	0.23	8.65	-1%	1000	0%	147	4.44	600	1650	11544	600	400	60	API Gravity calculated from S.G. calculated using the analytical scale.

Date (End of Run)	Time (End of Run)	Run #	Top of Run	Bottom of Run	Drill Fluid Volume Change (L)	Fluorescein Concentration			Temp	Density		Elec. Cond.		pH		Dissolved Oxygen		Turbidity		ORP	ROP	Bit Rotation Speed	Torque	WOB (estimate)	Holdback Pressure (Down-	Fluid Injection (pump) Pressure	Downhole Fluid Flow Rate	Comments
						Inlet	Outlet	Change				Reading	Change	Reading	Change	Reading	Change	Reading	Change									
dd-mmm-yy	hh:mm	-	(mbgs)	(mbgs)	>100 L	(ppb)	(ppb)	>20% change	(°C)	API Gravity	SG	(mS/cm)	>10% change	-	>0.5 Change	(mg/L)	>10% Change	(NTU)	>10% Change	(mV)	m/hr	RPM	psi	lbs	psi	psi	L/min	
07-Jul-21	22:50	207	577.57	577.71	45	99.7	99.9	0%	19.40	9.8	1.00	0.529	0%	8.60	0.00	8.73	1%	1000	0%	139	0.35	600	1800	5772	300	300	58	API Gravity calculated from S.G. calculated using the analytical scale. Drillers stop mid-run to determine why there was such high pressure in torque. It appeared to have left a separate hydraulic line open.
08-Jul-21	12:16	208	577.71	580.53	11	107.2	105.8	-1%	17.44	11.8	0.99	0.569	8%	8.37	-0.23	7.82	-10%	1000	0%	-158	3.85	600	1500	8658	450	400	60	API Gravity calculated from S.G. calculated using the analytical scale.
08-Jul-21	14:46	209	580.53	583.52	-25	92.8	101.5	9%	17.90	10.6	1.00	0.579	2%	8.30	-0.07	8.33	7%	1000	0%	-560	4.60	600	1500	9620	500	450	60	API Gravity calculated from S.G. calculated using the analytical scale.
08-Jul-21	16:32	210	583.52	586.50	24	98.4	98.6	0%	18.26	13.1	0.98	0.590	2%	8.34	0.04	8.86	6%	1000	0%	161	3.65	600	1550	5772	300	400	55	API Gravity calculated from S.G. calculated using the analytical scale.
08-Jul-21	21:33	211	586.50	589.64	-12	104.1	101.6	-2%	17.87	8.5	1.01	0.598	1%	8.32	-0.02	8.92	1%	1000	0%	207	3.14	600	1550	4810	250	450	58	API Gravity calculated from S.G. calculated using the analytical scale.
08-Jul-21	23:23	212	589.64	592.63	-20	106.8	110.6	4%	17.85	7.0	1.02	0.599	0%	8.24	-0.08	9.04	1%	1000	0%	207	4.49	600	1550	5772	300	450	58	API Gravity calculated from S.G. calculated using the analytical scale.
09-Jul-21	00:56	213	592.63	595.63	-39	104.4	104.8	0%	17.96	5.9	1.03	0.606	1%	8.26	0.02	8.60	-5%	1000	0%	203	4.09	600	1550	6734	350	450	58	API Gravity calculated from S.G. calculated using the analytical scale.
09-Jul-21	03:18	214	595.63	598.65	-80	106.2	104.6	-2%	17.60	7.5	1.02	0.626	3%	8.31	0.05	8.97	4%	1000	0%	190	3.42	600	1600	5772	300	450	58	API Gravity calculated from S.G. calculated using the analytical scale.
09-Jul-21	05:52	215	598.65	601.62	-56	102.4	100.8	-2%	17.51	7.5	1.02	0.620	-1%	8.34	0.03	8.36	-7%	1000	0%	154	3.87	600	1600	5772	300	450	58	API Gravity calculated from S.G. calculated using the analytical scale.
09-Jul-21	09:51	216	601.62	604.52	-78	98.3	102.3	4%	17.77	7.8	1.02	0.659	6%	8.53	0.19	9.00	8%	1000	0%	141	5.61	600	1550	10582	550	450	55	API Gravity calculated from S.G. calculated using the analytical scale.
09-Jul-21	11:17	217	604.52	607.56	-39	94.4	102.7	9%	18.31	12.6	0.98	0.651	-1%	8.63	0.10	10.37	15%	1000	0%	175	6.08	600	1600	9620	500	450	55	API Gravity calculated from S.G. calculated using the analytical scale.
09-Jul-21	13:11	218	607.56	610.54	-44	94.4	99.2	5%	18.85	8.1	1.01	0.676	4%	8.66	0.03	8.04	-22%	1000	0%	163	6.17	600	1550	8658	450	450	55	API Gravity calculated from S.G. calculated using the analytical scale.
09-Jul-21	15:03	219	610.54	613.56	-15	93.8	103.2	10%	19.19	10.5	1.00	0.683	1%	8.72	0.06	9.76	21%	1000	0%	162	6.04	600	1600	8658	450	450	55	API Gravity calculated from S.G. calculated using the analytical scale.
09-Jul-21	16:28	220	613.56	616.58	-44	85.4	101.8	19%	19.62	13.3	0.98	0.670	-2%	8.76	0.04	9.39	-4%	1000	0%	165	5.49	600	1550	9620	500	450	55	API Gravity calculated from S.G. calculated using the analytical scale.
10-Jul-21	00:37	221	616.58	619.63	-11	105.3	98.3	-7%	18.94	4.8	1.04	0.663	-1%	8.37	-0.39	9.57	2%	1000	0%	193	5.38	600	1650	8658	450	475	58	API Gravity calculated from S.G. calculated using the analytical scale. Roughly 500L of traced water was added to centrifuge prior to starting run.
10-Jul-21	02:34	222	619.63	622.64	8	102.6	108.7	6%	18.93	11.6	0.99	0.541	-18%	8.35	-0.02	9.58	0%	1000	0%	191	4.51	600	1550	10582	550	500	58	API Gravity calculated from S.G. calculated using the analytical scale.
10-Jul-21	04:06	223	622.64	625.62	-91	99.3	105.4	6%	18.99	8.2	1.01	0.667	23%	8.37	0.02	9.71	1%	1000	0%	187	3.97	600	1600	8658	450	450	58	API Gravity calculated from S.G. calculated using the analytical scale.
10-Jul-21	10:03	224	625.62	628.56	-21	76.5	75.5	-1%	18.57	11.1	0.99	0.643	-4%	8.57	0.20	10.30	6%	1000	0%	128	5.88	600	1750	14430	750	400	55	API Gravity calculated from S.G. calculated using the analytical scale.
10-Jul-21	13:42	225	628.56	631.54	-44	81.4	80.0	-2%	19.20	9.8	1.00	0.710	10%	8.50	-0.07	8.11	-21%	1000	0%	112	5.26	600	1600	9620	500	400	55	API Gravity calculated from S.G. calculated using the analytical scale.
10-Jul-21	15:41	226	631.54	634.56	-23	90.9	98.2	8%	19.22	13.1	0.98	0.695	-2%	8.51	0.01	8.16	1%	1000	0%	124	5.66	600	1550	10582	550	450	55	API Gravity calculated from S.G. calculated using the analytical scale.
11-Jul-21	03:38	227	634.56	637.62	-19	87.3	91.4	5%	18.56	8.2	1.01	0.739	6%	8.53	0.02	8.15	0%	1000	0%	150	5.10	600	1600	7696	400	425	58	API Gravity calculated from S.G. calculated using the analytical scale.
11-Jul-21	05:04	228	637.62	640.65	-4	89.2	101.4	14%	19.01	7.7	1.02	0.723	-2%	8.42	-0.11	8.25	1%	1000	0%	145	4.54	600	1600	8658	450	425	58	API Gravity calculated from S.G. calculated using the analytical scale.
11-Jul-21	11:54	229	640.65	643.54	84	71.0	88.2	24%	17.64	12.3	0.98	0.718	-1%	8.53	0.11	8.88	8%	1000	0%	59	4.03	600	1600	8658	450	450	56	API Gravity calculated from S.G. calculated using the analytical scale.
11-Jul-21	14:59	230	643.54	646.54	12	79.2	88.1	11%	18.62	13.7	0.97	0.724	1%	8.44	-0.09	8.40	-5%	1000	0%	34	3.75	600	1550	9620	500	450	56	API Gravity calculated from S.G. calculated using the analytical scale.
12-Jul-21	11:04	231	646.54	649.53	24	93.6	84.9	-9%	18.41	10.5	1.00	0.743	3%	8.31	-0.13	7.57	-10%	1000	0%	57	3.52	600	1650	7696	400	450	56	API Gravity calculated from S.G. calculated using the analytical scale.
12-Jul-21	13:28	232	649.53	652.51	2	70.3	62.1	-12%	18.82	13.3	0.98	0.762	3%	8.20	-0.11	7.74	2%	1000	0%	46	5.11	600	1700	7696	400	475	56	API Gravity calculated from S.G. calculated using the analytical scale.
12-Jul-21	15:46	233	652.51	655.58	29	83.7	87.0	4%	20.32	13.2	0.98	0.788	3%	8.46	0.26	7.53	-3%	1000	0%	78	5.26	600	1600	10582	550	500	56	API Gravity calculated from S.G. calculated using the analytical scale.
13-Jul-21	00:58	234	655.58	658.64	-19	92.6	80.2	-13%	19.12	11.5	0.99	0.683	-13%	8.20	-0.26	9.68	29%	1000	0%	101	2.27	600	1500	13468	700	480	57	API Gravity calculated from S.G. calculated using the analytical scale.
13-Jul-21	03:09	235	658.64	661.61	20	83.9	95.9	14%	18.97	12.3	0.98	0.778	14%	8.42	0.22	10.04	4%	1000	0%	65	4.46	600	1550	13468	700	440	57	API Gravity calculated from S.G. calculated using the analytical scale.
13-Jul-21	10:20	236	661.61	664.55	1	96.1	84.9	-12%	19.31	11.6	0.99	0.722	-7%	8.24	-0.18	6.25	-38%	1000	0%	80	4.41	600	1700	11544	600	475	56	API Gravity calculated from S.G. calculated using the analytical scale.
13-Jul-21	12:23	237	664.55	667.51	21	97.1	87.4	-10%	19.22	11.9	0.99	0.792	10%	8.13	-0.11	6.05	-3%	1000	0%	43	4.67	600	1700	8658	450	475	56	API Gravity calculated from S.G. calculated using the analytical scale.
13-Jul-21	15:07	238	667.51	670.60	45	87.8	91.0	4%	19.28	11.4	0.99	0.744	-6%	8.40	0.27	6.13	1%	1000	0%	70	3.63	600	1700	11544	600	450	56	API Gravity calculated from S.G. calculated using the analytical scale.
13-Jul-21	22:22	239	670.60	673.58	6	84.0	98.8	18%	19.31	11.2	0.99	0.782	5%	8.21	-0.19	8.33	36%	1000	0%	92	2.75	600	1520	14430	750	440	56	API Gravity calculated from S.G. calculated using the analytical scale.
14-Jul-21	00:36	240	673.58	676.56	19	99.7	98.7	-1%	19.13	11.6	0.99	0.711	-9%	8.23	0.02	7.49	-10%	1000	0%	79	2.38	600	1600	13468	700	440	56	API Gravity calculated from S.G. calculated using the analytical scale.
14-Jul-21	03:08	241	676.56	679.60	65	102.0	100.0	-2%	19.09	10.8	0.99	0.758	7%	8.21	-0.02	7.49	0%	1000	0%	88	2.10	600	1560	13468	700	440	56	API Gravity calculated from S.G. calculated using the analytical scale.
14-Jul-21	10:30	242	679.60	682.54	35	81.3	76.0	-7%	17.83	11.4	0.99	0.747	-1%	8.21	0.00	7.59	1%	1000	0%	87	3.46	600	1700	12506	650	500	56	API Gravity calculated from S.G. calculated using the analytical scale.
14-Jul-21	12:26	243	682.54	685.56	30	71.4	64.9	-9%	18.14	11.2	0.99	0.767	3%	8.25	0.04	6.34	-16%	1000	0%	53	4.42	600	1650	8658	450	500	56	API Gravity calculated from S.G. calculated using the analytical scale.
14-Jul-21	14:20	244	685.56	688.58	27	80.8	85.2	6%	18.50	11.0	0.99	0.848	11%	8.41	0.16	5.93	-6%	1000	0%	83	5.02	600	1700	8658	450	500	56	API Gravity calculated from S.G. calculated using the analytical scale.
14-Jul-21	17:19	245	688.58	691.56	59	82.8	64.6	-22%	18.47	9.9	1.00	0.802	-5%	8.30	-0.11	5.39	-9%	1000	0%	54	4.26	600	1700	10582	550	500	56	API Gravity calculated from S.G. calculated using the analytical scale. Second fluor sample was more turbid.
15-Jul-21	00:14	246	691.56	694.62	10	76.4	90.6	19%	18.02	10.9	0.99	0.796	-1%	8.34	0.04	8.70	61%	1000	0%	132	3.17	600	1550	11544	600	450	56	API Gravity calculated from S.G. calculated using the analytical scale.
15-Jul-21	11:36	247	694.62	697.60	-14	90.3	57.8	-36%	17.35	10.7	1.00	0.859	8%	8.29	-0.05	7.34	-16%	1000	0%	85	4.82	600	1750	8658	450	575	58	API Gravity calculated from S.G. calculated using the analytical scale. Second fluor sample was more turbid.

Date (End of Run)	Time (End of Run)	Run #	Top of Run	Bottom of Run	Drill Fluid Volume Change (L)	Fluorescein Concentration			Temp	Density		Elec. Cond.		pH		Dissolved Oxygen		Turbidity		ORP	ROP	Bit Rotation Speed	Torque	WOB (estimate)	Holdback Pressure (Down-	Fluid Injection (pump) Pressure	Downhole Fluid Flow Rate	Comments
						Inlet	Outlet	Change				Reading	Change	Reading	Change	Reading	Change	Reading	Change									
dd-mmm-yy	hh:mm	-	(mbgs)	(mbgs)	>100 L	(ppb)	(ppb)	>20% change	(°C)	API Gravity	SG	(mS/cm)	>10% change	-	>0.5 Change	(mg/L)	>10% Change	(NTU)	>10% Change	(mV)	m/hr	RPM	psi	lbs	psi	psi	L/min	
15-Jul-21	14:08	248	697.60	700.60	35	61.6	59.1	-4%	17.72	13.1	0.98	0.831	-3%	8.29	0.00	8.41	15%	1000	0%	84	4.62	600	1750	9620	500	500	56	API Gravity calculated from S.G. calculated using the analytical scale. Second fluor sample was more turbid.
15-Jul-21	16:15	249	700.60	703.56	8	85.7	75.9	-11%	17.98	11.6	0.99	0.869	5%	8.19	-0.10	6.67	-21%	1000	0%	114	4.13	600	1600	12506	650	500	56	API Gravity calculated from S.G. calculated using the analytical scale. Second fluor sample was more turbid.
16-Jul-21	00:12	250	703.56	706.62	-3	84.8	82.4	-3%	18.87	10.8	0.99	0.882	1%	8.35	0.16	8.92	34%	1000	0%	125	3.40	600	1500	13468	700	450	56	API Gravity calculated from S.G. calculated using the analytical scale.
16-Jul-21	02:38	251	706.62	709.58	7	96.0	94.4	-2%	18.95	11.2	0.99	0.737	-16%	8.20	-0.15	8.09	-9%	1000	0%	138	2.86	600	1500	11544	600	450	56	API Gravity calculated from S.G. calculated using the analytical scale.
16-Jul-21	04:18	252	709.58	712.63	-8	93.4	101.0	8%	19.08	10.6	1.00	0.840	14%	8.29	0.09	7.59	-6%	1000	0%	123	3.52	600	1500	14430	750	450	56	API Gravity calculated from S.G. calculated using the analytical scale.
16-Jul-21	06:09	253	712.63	715.61	-29	95.1	92.1	-3%	19.03	10.5	1.00	0.800	-5%	8.22	-0.07	8.09	7%	1000	0%	115	2.93	600	1500	11929	620	480	56	API Gravity calculated from S.G. calculated using the analytical scale.
16-Jul-21	11:37	254	715.61	718.10	17	103.1	94.2	-9%	19.57	12.5	0.98	0.855	7%	8.13	-0.09	2.26	-72%	1000	0%	74	3.25	600	1500	14430	750	550	56	API Gravity calculated from S.G. calculated using the analytical scale.
16-Jul-21	13:32	255	718.10	718.52	33	97.4	95.6	-2%	19.34	10.4	1.00	0.860	1%	8.42	0.29	0.00	-100%	1000	0%	-232	2.10	600	1550	12506	650	500	56	API Gravity calculated from S.G. calculated using the analytical scale.
16-Jul-21	15:32	256	718.52	721.57	32	102.3	85.1	-17%	20.47	8.9	1.01	0.866	1%	8.22	-0.20	6.48	#DIV/0!	1000	0%	127	4.25	600	1650	14430	750	575	56	API Gravity calculated from S.G. calculated using the analytical scale.
17-Jul-21	03:01	257	721.57	724.60	-25	96.2	108.0	12%	19.66	10.5	1.00	0.783	-10%	8.40	0.18	10.67	65%	1000	0%	160	2.22	600	1550	12506	650	450	56	API Gravity calculated from S.G. calculated using the analytical scale.
17-Jul-21	10:16	258	724.60	727.57	-1	98.4	107.8	10%	18.92	12.1	0.99	0.825	5%	8.28	-0.12	8.63	-19%	1000	0%	99	3.13	600	1600	13468	700	500	56	API Gravity calculated from S.G. calculated using the analytical scale.
17-Jul-21	12:33	259	727.57	730.59	57	100.5	103.0	2%	19.71	12.0	0.99	0.828	0%	8.24	-0.04	7.71	-11%	1000	0%	102	4.41	600	1650	9620	500	500	56	API Gravity calculated from S.G. calculated using the analytical scale.
17-Jul-21	14:35	260	730.59	733.59	52	98.4	100.7	2%	19.58	12.0	0.99	0.854	3%	8.23	-0.01	7.86	2%	1000	0%	76	3.61	600	1650	9620	500	550	58	API Gravity calculated from S.G. calculated using the analytical scale.
17-Jul-21	17:40	261	733.59	736.55	24	98.8	97.9	-1%	29.07	12.2	0.98	0.832	-3%	8.22	-0.01	7.89	0%	1000	0%	112	3.12	600	1650	10582	550	500	56	API Gravity calculated from S.G. calculated using the analytical scale.
17-Jul-21	22:28	262	736.55	739.63	-27	107.3	112.2	5%	18.91	9.8	1.00	0.854	3%	8.31	0.09	10.48	33%	1000	0%	122	2.68	600	1550	11544	600	460	56	API Gravity calculated from S.G. calculated using the analytical scale.
18-Jul-21	00:22	263	739.63	742.62	9	106.2	108.8	2%	19.36	10.5	1.00	0.880	3%	8.27	-0.04	10.34	-1%	1000	0%	116	2.85	600	1550	13468	700	550	56	API Gravity calculated from S.G. calculated using the analytical scale.
18-Jul-21	04:11	264	742.62	745.60	-70	107.6	108.2	1%	19.18	9.6	1.00	0.897	2%	8.34	0.07	9.86	-5%	1000	0%	113	2.21	600	1550	13468	700	580	56	API Gravity calculated from S.G. calculated using the analytical scale.
18-Jul-21	11:22	265	745.60	748.51	10	95.6	95.6	0%	21.16	10.7	0.99	0.946	5%	8.44	0.10	8.75	-11%	1000	0%	136	2.03	600	1550	11544	600	625	62	API Gravity calculated from S.G. calculated using the analytical scale.
18-Jul-21	12:53	266	748.51	748.73	-5	94.0	92.0	-2%	20.10	11.1	0.99	0.983	4%	8.22	-0.22	2.20	-75%	1000	0%	-227	2.64							API Gravity calculated from S.G. calculated using the analytical scale. Bit RPM gauge malfunctioning, no reading.
19-Jul-21	12:01	267	748.73	751.55	7	93.0	86.0	-8%	19.23	12.3	0.98	0.888	-10%	8.26	0.04	5.86	166%	1000	0%	40	4.69		1450	10582	550	700	56	API Gravity calculated from S.G. calculated using the analytical scale. Bit RPM gauge malfunctioning, no reading.
19-Jul-21	14:25	268	751.55	754.54	8	96.4	97.6	1%	18.23	13.0	0.98	0.893	1%	8.14	-0.12	5.95	2%	1000	0%	42	5.13		1550	11544	600	700	56	API Gravity calculated from S.G. calculated using the analytical scale. Bit RPM gauge malfunctioning, no reading.
19-Jul-21	16:31	269	754.54	757.52	23	91.0	80.7	-11%	18.45	12.6	0.98	0.857	-4%	8.22	0.08	6.96	17%	1000	0%	73	4.16		1550	9620	500	700	58	API Gravity calculated from S.G. calculated using the analytical scale. Bit RPM gauge malfunctioning, no reading.
19-Jul-21	21:31	270	757.52	757.90	6	98.8	94.5	-4%	18.06	11.3	0.99	0.874	2%	8.14	-0.08	5.78	-17%	1000	0%	155	1.20		1500	13468	700	700	56	API Gravity calculated from S.G. calculated using the analytical scale. Bit RPM gauge malfunctioning, no reading.
19-Jul-21	22:53	271	757.90	758.09	13	96.1	91.1	-5%	18.11	12.1	0.99	0.860	-2%	8.21	0.07	6.20	7%	1000	0%	118	1.43		1500	13468	700	700	56	API Gravity calculated from S.G. calculated using the analytical scale. Bit RPM gauge malfunctioning, no reading.
20-Jul-21	01:19	272	758.09	760.62	31	98.1	102.8	5%	17.80	11.3	0.99	0.816	-5%	8.07	-0.14	8.28	34%	1000	0%	118	1.85		1350	15007	780	800	56	API Gravity calculated from S.G. calculated using the analytical scale. Bit RPM gauge malfunctioning, no reading.
20-Jul-21	04:01	273	760.62	763.60	7	101.9	94.1	-8%	17.54	11.1	0.99	0.855	5%	8.18	0.11	8.59	4%	1000	0%	130	2.55		1400	13468	700	720	56	API Gravity calculated from S.G. calculated using the analytical scale. Bit RPM gauge malfunctioning, no reading.
20-Jul-21	09:57	274	763.60	766.56	-40	94.8	88.6	-7%	16.56	10.5	1.00	0.938	10%	8.05	-0.13	6.75	-21%	1000	0%	96	4.93	600	1500	12506	650	725	56	API Gravity calculated from S.G. calculated using the analytical scale.
20-Jul-21	12:36	275	766.56	769.53	133	93.6	88.4	-6%	17.32	11.6	0.99	0.950	1%	8.13	0.08	6.60	-2%	1000	0%	116	4.56	600	1550	9620	500	750	56	API Gravity calculated from S.G. calculated using the analytical scale.
20-Jul-21	15:05	276	769.53	772.53	4	92.6	85.2	-8%	17.81	11.2	0.99	0.933	-2%	8.05	-0.08	7.73	17%	1000	0%	128	6.22	600	1550	11544	600	800	62	API Gravity calculated from S.G. calculated using the analytical scale.
20-Jul-21	23:28	277	772.53	775.64	-36	97.0	96.3	-1%	17.75	11.8	0.99	0.947	2%	8.23	0.18	7.57	-2%	1000	0%	162	2.92	600	1450	13468	700	700	58	API Gravity calculated from S.G. calculated using the analytical scale.
21-Jul-21	01:54	278	775.64	778.64	-35	95.5	98.1	3%	17.60	11.7	0.99	0.931	-2%	8.01	-0.22	8.12	7%	1000	0%	165	2.69	600	1400	13468	700	800	58	API Gravity calculated from S.G. calculated using the analytical scale.
21-Jul-21	04:07	279	778.64	781.60	8	99.3	95.6	-4%	17.39	11.1	0.99	0.965	4%	8.11	0.10	8.18	1%	1000	0%	140	3.62	600	1400	13468	700	800	58	API Gravity calculated from S.G. calculated using the analytical scale.
21-Jul-21	11:54	280	781.60	784.57	8	93.2	92.7	-1%	16.90	13.1	0.98	0.891	-8%	8.07	-0.04	7.41	-9%	1000	0%	104	5.09	600	1550	12506	650	800	56	API Gravity calculated from S.G. calculated using the analytical scale.
21-Jul-21	14:02	281	784.57	787.54	-20	92.8	89.2	-4%	17.46	11.7	0.99	0.923	4%	8.20	0.13	6.20	-16%	1000	0%	104	4.82	600	1500	12506	650	750	56	API Gravity calculated from S.G. calculated using the analytical scale.
21-Jul-21	16:37	282	787.54	790.57	47	94.4	92.4	-2%	17.86	12.0	0.99	0.887	-4%	8.26	0.06	6.15	-1%	1000	0%	133	4.54	600	1450	13468	700	800	56	API Gravity calculated from S.G. calculated using the analytical scale.
22-Jul-21	03:37	283	790.57	793.62	73	100.5	104.3	4%	17.06	12.9	0.98	0.896	1%	8.43	0.17	9.12	48%	1000	0%	157	3.45	600	1450	13468	700	780	56	API Gravity calculated from S.G. calculated using the analytical scale.
22-Jul-21	10:38	284	793.62	796.57	75	96.5	97.1	1%	17.69	12.3	0.98	0.921	3%	8.24	-0.19	7.04	-23%	1000	0%	73	4.54	600	1500	10582	550	800	52	API Gravity calculated from S.G. calculated using the analytical scale.
22-Jul-21	13:54	285	796.57	799.53	36	91.3	95.5	5%	17.74	12.8	0.98	0.831	-10%	8.25	0.01	6.01	-15%	1000	0%	75	4.33	600	1550	12506	650	700	56	API Gravity calculated from S.G. calculated using the analytical scale.
22-Jul-21	22:53	286	799.53	802.64	44	100.0	102.0	2%	19.26	12.8	0.98	0.915	10%	8.21	-0.04	9.41	57%	1000	0%	140	3.52	600	1500	13468	700	800	56	API Gravity calculated from S.G. calculated using the analytical scale.
23-Jul-21	00:56	287	802.64	805.61	94	103.9	97.4	-6%	18.31	12.6	0.98	0.809	-12%	8.29	0.08	8.96	-5%	1000	0%	123	3.18	600	1500	11544	600	750	56	API Gravity calculated from S.G. calculated using the analytical scale.
23-Jul-21	04:01	288	805.61	808.64	30	104.3	95.8	-8%	18.48	13.7	0.97	0.936	16%	8.09	-0.20	8.72	-3%	1000	0%	139	3.50	600	1500	13468	700	780	56	API Gravity calculated from S.G. calculated using the analytical scale.
23-Jul-21	10:10	289	808.64	811.52	7	95.7	93.8	-2%	18.36	12.9	0.98	0.916	-2%	8.22	0.13	5.38	-38%	1000	0%	143	3.59	600	1550	12506	650	750	56	API Gravity calculated from S.G. calculated using the analytical scale.
23-Jul-21	14:37	290	811.52	814.54	44	96.2	105.8	10%	20.13	11.9	0.99	0.988	8%	8.07	-0.15	3.90	-28%	1000	0%	141	4.12	600	1500	11544	600	750	56	API Gravity calculated from S.G. calculated using the analytical scale.

Date (End of Run)	Time (End of Run)	Run #	Top of Run	Bottom of Run	Drill Fluid Volume Change (L)	Fluorescein Concentration			Temp	Density		Elec. Cond.		pH		Dissolved Oxygen		Turbidity		ORP	ROP	Bit Rotation Speed	Torque	WOB (estimate)	Holdback Pressure (Down-	Fluid Injection (pump) Pressure	Downhole Fluid Flow Rate	Comments
						Inlet	Outlet	Change				Reading	Change	Reading	Change	Reading	Change	Reading	Change									
dd-mmm-yy	hh:mm	-	(mbgs)	(mbgs)	>100 L	(ppb)	(ppb)	>20% change	(°C)	API Gravity	SG	(mS/cm)	>10% change	-	>0.5 Change	(mg/L)	>10% Change	(NTU)	>10% Change	(mV)	m/hr	RPM	psi	lbs	psi	psi	L/min	
23-Jul-21	17:29	291	814.54	817.54	57	101.7	97.6	-4%	19.36	12.6	0.98	0.690	-30%	8.20	0.13	6.63	70%	1000	0%	115	3.21	600	1600	10582	550	750	58	API Gravity calculated from S.G. calculated using the analytical scale.
24-Jul-21	00:10	292	817.54	820.63	6	100.3	106.1	6%	18.33	13.7	0.97	0.958	39%	8.22	0.02	8.85	33%	1000	0%	181	3.09	600	1500	13468	700	700	56	API Gravity calculated from S.G. calculated using the analytical scale.
24-Jul-21	14:30	293	820.63	823.54	-20	97.5	95.3	-2%	17.70	13.3	0.98	1.180	23%	8.00	-0.22	8.12	-8%	1000	0%	182	3.29	600	1550	10582	550	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
24-Jul-21	17:02	294	823.54	826.51	21	91.8	89.7	-2%	18.35	16.0	0.96	1.430	21%	7.93	-0.07	8.08	0%	1000	0%	149	2.97	600	1600	8658	450	550	58	API Gravity calculated from S.G. calculated using the analytical scale.
24-Jul-21	22:45	295	826.51	829.66	-6	96.2	91.2	-5%	19.09	14.1	0.97	1.300	-9%	7.87	-0.06	7.66	-5%	1000	0%	73	2.03	600	1500	12506	650	600	56	API Gravity calculated from S.G. calculated using the analytical scale.
25-Jul-21	01:30	296	829.66	832.66	-21	70.2	83.8	19%	17.74	20.1	0.93	1.330	2%	7.98	0.11	8.11	6%	1000	0%	70	3.10	600	1650	12506	650	600	54	API Gravity calculated from S.G. calculated using the analytical scale.
25-Jul-21	09:23	297	832.66	835.55	-40	85.5	84.6	-1%	17.70	16.7	0.96	1.320	-1%	7.72	-0.26	8.20	1%	1000	0%	145	4.33	600	1650	13468	700	600	56	API Gravity calculated from S.G. calculated using the analytical scale.
25-Jul-21	11:11	298	835.55	838.53	34	86.3	93.2	8%	18.03	10.7	1.00	1.280	-3%	7.63	-0.09	8.25	1%	1000	0%	172	4.26	600	1650	13468	700	625	58	API Gravity calculated from S.G. calculated using the analytical scale.
25-Jul-21	15:31	299	838.53	841.55	6	90.2	94.5	5%	17.41	13.6	0.98	1.340	5%	7.57	-0.06	8.56	4%	1000	0%	188	4.53	600	1550	15392	800	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
25-Jul-21	17:43	300	841.55	844.51	20	95.7	95.0	-1%	17.79	13.2	0.98	1.390	4%	7.75	0.18	8.26	-4%	1000	0%	166	4.55	600	1600	11544	600	650	58	API Gravity calculated from S.G. calculated using the analytical scale.
25-Jul-21	21:12	301	844.51	844.60	92	90.6	106.8	18%	18.72	10.9	0.99	1.420	2%	7.47	-0.28	4.59	-44%	1000	0%	93	0.54	600	1500	14430	750	650	56	API Gravity calculated from S.G. calculated using the analytical scale. Roughly 500L of traced water was added to centrifuge prior to starting run.
25-Jul-21	23:24	302	844.60	847.66	-69	103.7	94.8	-9%	17.66	20.1	0.93	1.460	3%	7.78	0.31	6.18	35%	1000	0%	28	3.28	600	1500	11544	600	600	56	API Gravity calculated from S.G. calculated using the analytical scale.
26-Jul-21	01:19	303	847.66	850.65	-37	81.6	97.4	19%	18.60	13.9	0.97	1.150	-21%	7.72	-0.06	6.38	3%	1000	0%	87	3.26	600	1750	11544	600	600	56	API Gravity calculated from S.G. calculated using the analytical scale.
26-Jul-21	04:53	304	850.65	853.65	-187	97.6	90.6	-7%	17.40	17.7	0.95	1.480	29%	7.74	0.02	6.58	3%	1000	0%	39	3.60	600	1550	13468	700	650	48	API Gravity calculated from S.G. calculated using the analytical scale.
26-Jul-21	10:52	305	853.65	856.60	-42	88.1	90.3	3%	16.85	9.5	1.00	1.190	-20%	7.83	0.09	9.26	41%	1000	0%	128	4.43	600	1650	16354	850	600	48	API Gravity calculated from S.G. calculated using the analytical scale.
26-Jul-21	15:35	306	856.51	859.52	104	85.4	91.5	7%	17.79	11.5	0.99	1.230	3%	7.49	-0.34	8.49	-8%	1000	0%	94	4.10	600	1550	16354	850	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
26-Jul-21	22:00	307	859.52	862.64	47	93.7	89.5	-5%	16.62	12.9	0.98	1.380	12%	7.89	0.40	5.80	-32%	1000	0%	93	3.82	600	1550	14430	750	600	60	API Gravity calculated from S.G. calculated using the analytical scale.
27-Jul-21	00:01	308	862.64	865.65	-33	85.9	90.4	5%	16.69	9.9	1.00	1.410	2%	7.79	-0.10	7.05	22%	1000	0%	33	3.11	600	1500	14430	750	600	52	API Gravity calculated from S.G. calculated using the analytical scale.
27-Jul-21	02:16	309	865.65	868.65	-64	96.3	89.8	-7%	16.31	17.8	0.95	1.400	-1%	7.78	-0.01	7.81	11%	1000	0%	2	2.54	600	1550	14430	750	600	54	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
27-Jul-21	06:06	310	868.65	871.64	-1	80.9	89.9	11%	16.69	12.7	0.98	1.410	1%	7.79	0.01	7.05	-10%	1000	0%	33	2.33	600	1500	13468	700	650	50	API Gravity calculated from S.G. calculated using the analytical scale.
27-Jul-21	11:32	311	871.64	874.51	109	84.7	81.9	-3%	18.66	9.0	1.01	1.200	-15%	7.92	0.13	7.26	3%	1000	0%	137	1.85	600	1600	15392	800	650	60	API Gravity calculated from S.G. calculated using the analytical scale. Roughly 500L of traced water was added to centrifuge prior to starting run.
27-Jul-21	14:29	312	874.51	877.51	19	84.7	83.9	-1%	18.53	12.0	0.99	1.280	7%	7.94	0.02	7.47	3%	1000	0%	141	3.53	600	1550	17316	900	550	48	API Gravity calculated from S.G. calculated using the analytical scale.
27-Jul-21	16:50	313	877.51	880.54	24	87.6	89.8	3%	18.59	6.2	1.03	1.140	-11%	7.95	0.01	7.18	-4%	1000	0%	128	3.31	600	1600	15392	800	650	60	API Gravity calculated from S.G. calculated using the analytical scale.
27-Jul-21	22:13	314	880.54	883.66	1	93.7	84.7	-10%	18.35	15.5	0.96	1.410	24%	7.79	-0.16	6.43	-10%	1000	0%	17	2.43	600	1500	11544	600	600	54	API Gravity calculated from S.G. calculated using the analytical scale. Roughly 500L of traced water was added to centrifuge prior to starting the run.
28-Jul-21	00:03	315	883.66	885.68	36	86.7	89.4	3%	18.29	9.0	1.01	1.140	-19%	7.89	0.10	6.02	-6%	1000	0%	145	2.63	600	1550	15392	800	600	50	API Gravity calculated from S.G. calculated using the analytical scale.
28-Jul-21	03:55	316	885.68	886.65	-2	91.4	93.3	2%	17.72	10.2	1.00	1.260	11%	7.71	-0.18	5.22	-13%	1000	0%	58	2.91	600	1500	13468	700	600	48	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
28-Jul-21	10:04	317	886.65	889.65	2	91.4	94.9	4%	17.91	8.1	1.01	1.340	6%	7.91	0.20	7.41	42%	1000	0%	174	3.40	600	1650	16354	850	450	48	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
28-Jul-21	12:05	318	889.53	892.53	16	90.4	88.9	-2%	18.91	6.1	1.03	1.300	-3%	7.80	-0.11	6.89	-7%	1000	0%	169	3.83	600	1600	13468	700	500	48	API Gravity calculated from S.G. calculated using the analytical scale.
28-Jul-21	14:05	319	892.53	895.53	17	92.3	93.7	2%	18.55	15.0	0.97	1.400	8%	7.64	-0.16	7.49	9%	1000	0%	176	3.53	600	1450	18278	950	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
28-Jul-21	16:35	320	895.53	898.53	10	92.9	94.6	2%	18.44	11.6	0.99	1.320	-6%	7.72	0.08	6.81	-9%	1000	0%	165	5.14	600	1600	13468	700	500	50	API Gravity calculated from S.G. calculated using the analytical scale.
28-Jul-21	22:02	321	898.53	901.65	-1	97.7	100.9	3%	18.36	11.6	0.99	1.510	14%	7.83	0.11	5.90	-13%	1000	0%	148	3.34	600	1500	13468	700	650	50	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
29-Jul-21	00:04	322	901.65	904.66	12	96.7	104.8	8%	17.96	9.2	1.01	1.420	-6%	7.72	-0.11	3.58	-39%	1000	0%	85	3.41	600	1500	11544	600	600	48	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
29-Jul-21	04:08	323	904.66	907.65	-21	110.0	105.0	-5%	18.06	12.9	0.98	1.500	6%	7.84	0.12	5.75	61%	1000	0%	183	3.15	600	1500	14430	750	600	48	API Gravity calculated from S.G. calculated using the analytical scale.
29-Jul-21	11:09	324	907.65	910.65	-73	100.8	101.2	0%	17.03	6.5	1.03	1.370	-9%	7.73	-0.11	9.57	66%	1000	0%	242	3.91	600	1700	19240	1000	550	50	API Gravity calculated from S.G. calculated using the analytical scale. While trying to receive core run 3242 the wire line broke at a spliced connection. The core then fell back down the drill string. Once the drillers had pulled roughly 600m of rods the driller decided to pull entire drill string to replace drill bit for the last portion of the borehole.
30-Jul-21	04:54	325	910.65	913.65	-91	90.0	92.9	3%	16.17	8.2	1.01	2.110	54%	7.50	-0.23	5.75	-40%	1000	0%	8	3.60	600	1600	16354	850	600	56	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
30-Jul-21	11:32	326	913.65	916.62	-40	92.7	93.9	1%	16.23	6.2	1.03	1.580	-25%	7.50	0.00	12.93	125%	1000	0%	265	3.87	600	1750	13468	700	600	58	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
30-Jul-21	15:10	327	916.62	919.64	-65	95.9	95.3	-1%	18.05	7.8	1.02	1.910	21%	8.00	0.50	11.69	-10%	1000	0%	194	4.03	600	1750	15392	800	600	58	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
30-Jul-21	23:23	328	919.64	922.64	-28	84.0	85.9	2%	19.92	13.4	0.98	1.720	-10%	7.89	-0.11	7.01	-40%	1000	0%	78	3.46	600	1650	17316	900	600	58	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
31-Jul-21	02:18	329	922.64	925.63	-43	82.3	84.1	2%	19.92	10.3	1.00	1.420	-17%	7.78	-0.11	8.91	27%	1000	0%	121	2.30	600	1700	13468	700	600	48	API Gravity calculated from S.G. calculated using the analytical scale.

Date (End of Run)	Time (End of Run)	Run #	Top of Run	Bottom of Run	Drill Fluid Volume Change (L)	Fluorescein Concentration			Temp	Density		Elec. Cond.		pH		Dissolved Oxygen		Turbidity		ORP	ROP	Bit Rotation Speed	Torque	WOB (estimate)	Holdback Pressure (Down-	Fluid Injection (pump) Pressure	Downhole Fluid Flow Rate	Comments
						Inlet	Outlet	Change				Reading	Change	Reading	Change	Reading	Change	Reading	Change									
dd-mmm-yy	hh:mm	-	(mbgs)	(mbgs)	>100 L	(ppb)	(ppb)	>20% change	(°C)	API Gravity	SG	(mS/cm)	>10% change	-	>0.5 Change	(mg/L)	>10% Change	(NTU)	>10% Change	(mV)	m/hr	RPM	psi	lbs	psi	psi	L/min	
31-Jul-21	04:33	330	925.63	928.63	19	82.8	81.3	-2%	18.17	10.3	1.00	1.830	29%	7.82	0.04	9.93	11%	1000	0%	115	2.69	600	1700	13468	700	600	50	API Gravity calculated from S.G. calculated using the analytical scale.
31-Jul-21	09:35	331	928.63	931.65	-19	100.8	101.6	1%	17.58	9.1	1.01	1.770	-3%	7.71	-0.11	10.78	9%	1000	0%	209	4.31	600	2100	11544	600	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
31-Jul-21	13:43	332	931.63	934.62	3	98.6	99.7	1%	18.97	11.4	0.99	1.730	-2%	7.77	0.06	10.82	0%	1000	0%	178	4.17	600	2000	13468	700	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
31-Jul-21	16:23	333	934.63	937.63	-51	100.0	99.9	0%	18.56	6.4	1.03	1.760	2%	7.69	-0.08	10.73	-1%	1000	0%	155	3.91	600	1650	18278	950	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
31-Jul-21	21:34	334	937.63	940.64	-10	81.0	82.2	1%	19.50	12.3	0.98	1.810	3%	7.87	0.18	6.33	-41%	1000	0%	140	3.54	600	1700	12506	650	600	48	API Gravity calculated from S.G. calculated using the analytical scale.
01-Aug-21	00:16	335	940.64	943.63	8	80.4	81.8	2%	17.63	13.3	0.98	1.660	-8%	7.84	-0.03	7.41	17%	1000	0%	15	2.89	600	1600	13468	700	600	48	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
01-Aug-21	02:35	336	943.63	946.64	-69	77.6	83.4	8%	18.02	10.9	0.99	1.930	16%	7.71	-0.13	7.42	0%	1000	0%	5	2.51	600	1750	11544	600	600	48	API Gravity calculated from S.G. calculated using the analytical scale. 1L of pure-vis added prior to starting run
01-Aug-21	05:08	337	946.54	949.64	-18	81.2	82.3	1%	17.39	9.0	1.01	1.790	-7%	7.82	0.11	7.94	7%	1000	0%	146	3.32	600	1750	11544	600	600	48	API Gravity calculated from S.G. calculated using the analytical scale.
01-Aug-21	10:34	338	949.64	952.63	-68	98.7	98.6	0%	17.29	12.5	0.98	1.800	1%	7.55	-0.27	11.22	41%	1000	0%	221	3.74	600	1850	13468	700	650	58	API Gravity calculated from S.G. calculated using the analytical scale.
01-Aug-21	12:20	339	952.64	954.90	-34	89.6	92.2	3%	18.35	10.4	1.00	1.930	7%	7.73	0.18	11.48	2%	1000	0%	178	4.84	600	1750	15392	800	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
01-Aug-21	14:22	340	954.90	955.63	-29	89.6	90.2	1%	17.70	10.0	1.00	1.680	-13%	7.47	-0.26	11.62	1%	1000	0%	171	2.31	600	1800	15392	800	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
01-Aug-21	12:20	341	955.63	958.61	-43	87.6	87.0	-1%	18.07	5.2	1.04	1.970	17%	7.64	0.17	11.30	-3%	1000	0%	199	3.58	600	1700	17316	900	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
02-Aug-21	01:36	342	958.61	960.68	-56	105.8	95.7	-10%	19.32	9.1	1.01	1.870	-5%	7.82	0.18	7.72	-32%	1000	0%	139	3.03	600	1700	16354	850	650	46	API Gravity calculated from S.G. calculated using the analytical scale.
02-Aug-21	03:06	343	960.68	961.65	-12	92.2	93.9	2%	16.68	14.6	0.97	2.070	11%	7.57	-0.25	8.10	5%	1000	0%	29	2.91	600	1700	13468	700	600	48	API Gravity calculated from S.G. calculated using the analytical scale. 0.5L of pure-vis added prior to run
02-Aug-21	05:08	344	961.65	964.64	-96	91.4	87.8	-4%	17.91	14.2	0.97	2.040	-1%	7.66	0.09	7.75	-4%	1000	0%	130	3.04	600	1600	13468	700	600	46	API Gravity calculated from S.G. calculated using the analytical scale.
02-Aug-21	11:57	345	964.64	967.63	-94	88.8	89.3	1%	18.45	10.1	1.00	1.760	-14%	7.56	-0.10	11.34	46%	1000	0%	174	2.89	600	1700	15392	800	550	58	API Gravity calculated from S.G. calculated using the analytical scale. Prior to run drillers flushed the drill tank and centrifuge with clean water and remixed mud.
02-Aug-21	14:55	346	967.63	970.63	-30	88.8	94.8	7%	18.89	9.8	1.00	1.450	-18%	7.58	0.02	11.38	0%	1000	0%	168	2.81	600	1950	12506	650	600	60	API Gravity calculated from S.G. calculated using the analytical scale.
02-Aug-21	21:50	347	970.63	972.58	59	96.1	93.9	-2%	18.34	8.6	1.01	1.810	25%	7.52	-0.06	3.67	-68%	1000	0%	76	2.85	600	1550	11544	600	1000	46	API Gravity calculated from S.G. calculated using the analytical scale.
02-Aug-21	23:17	348	972.58	973.63	65	89.4	85.1	-5%	17.72	14.4	0.97	1.420	-22%	7.46	-0.06	3.26	-11%	1000	0%	7	3.94	600	1500	13468	700	600	46	API Gravity calculated from S.G. calculated using the analytical scale.
03-Aug-21	02:59	349	973.63	976.65	47	85.6	89.3	4%	17.70	11.7	0.99	1.760	24%	7.61	0.15	5.50	69%	1000	0%	68	3.02	600	1500	16354	850	600	46	API Gravity calculated from S.G. calculated using the analytical scale.
03-Aug-21	09:43	350	976.65	979.65	-43	99.6	100.1	1%	17.84	8.3	1.01	1.540	-13%	7.58	-0.03	10.11	84%	1000	0%	173	4.00	600	1700	19240	1000	600	58	API Gravity calculated from S.G. calculated using the analytical scale. Roughly 200L of traced water added to centrifuge prior to drilling.
03-Aug-21	11:55	351	979.65	981.71	-28	99.6	97.5	-2%	17.84	23.2	0.91	1.640	6%	7.62	0.04	11.06	9%	1000	0%	1	2.69	600	1700	13468	700	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
03-Aug-21	13:45	352	981.71	981.77	1																0.33							API Gravity calculated from S.G. calculated using the analytical scale. Was unable to collect drill parameters and fluid parameters due to length of drill run and time of drill run.
05-Aug-21	11:10	353	981.77	982.59	-19	119.1	117.3	-2%	19.74	8.8	1.01	10.500	#DIV/0!	6.51	6.51	7.67	#DIV/0!	1000	#DIV/0!	210	1.07	600	1800	21164	1100	500	56	API Gravity calculated from S.G. calculated using the analytical scale.
05-Aug-21	13:41	354	982.59	985.64	18	110.6	109.6	-1%	18.74	5.2	1.04	1.560	-85%	7.00	0.49	8.76	14%	1000	0%	211	3.00	600	1700	14430	750	600	58	API Gravity calculated from S.G. calculated using the analytical scale. Helper advise me that he removed 10L from the drill tank while drilling.
06-Aug-21	09:05	355	985.64	988.61	-45	90.4	90.5	0%	17.11	20.6	0.93	5.190	233%	6.80	-0.20	8.00	-9%	1000	0%	101	4.82	600	1650	14430	750	625	58	API Gravity calculated from S.G. calculated using the analytical scale.
06-Aug-21	11:04	356	988.61	991.63	39	90.3	89.7	-1%	17.33	7.1	1.02	5.570	7%	6.56	-0.24	9.84	23%	1000	0%	265	4.77	600	1700	14430	750	600	56	API Gravity calculated from S.G. calculated using the analytical scale.
06-Aug-21	13:20	357	991.63	994.61	83	99.8	100.4	1%	17.40	10.5	1.00	4.550	-18%	6.80	0.24	11.02	12%	1000	0%	261	3.31	600	1800	14430	750	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
06-Aug-21	16:02	358	994.61	997.63	7	99.8	101.4	2%	18.00	9.5	1.00	5.570	22%	6.79	-0.01	11.77	7%	1000	0%	237	2.79	600	1600	13468	700	600	58	API Gravity calculated from S.G. calculated using the analytical scale.
06-Aug-21	22:20	359	997.63	1000.63	-81	77.7	69.1	-11%	17.70	6.8	1.02	5.650	1%	6.73	-0.06	6.65	-44%	1000	0%	296	2.65	600	1500	14430	750	600	46	API Gravity calculated from S.G. calculated using the analytical scale.

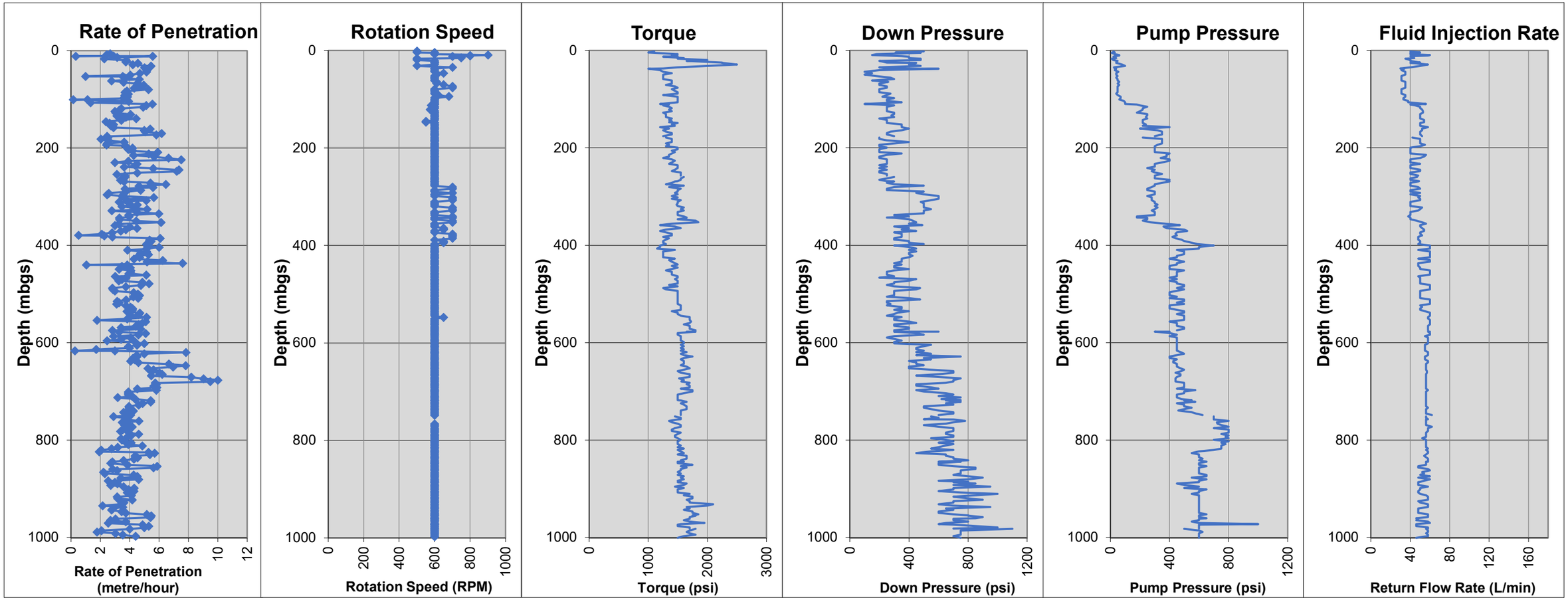
Sample ID	From	To	Date	Fluorescein	Density	Temp	EC	pH	DO	ORP	Turbidity
-	mbgs	mbgs	dd-mmm-yy	ppb	g/cm^3	°C	mS/cm	-	mg/L	mV	NTU
IG_BH05_DW001	49.65	52.58	19-May-21	93.50	1.00	20.64	0.377	10.39	9.66	91	1000
IG_BH05_DW002	97.60	100.57	21-May-21	88.64	1.01	21.66	0.381	9.9	8.80	119	1000
IG_BH05_DW004	148.63	151.65	03-Jun-21	137.40	1.00	18.62	0.409	11.08	5.17	82	1000
IG_BH05_DW005	196.62	199.64	07-Jun-21	111.00	1.01	22.42	0.535	9.49	7.22	136	1000
IG_BH05_DW006	250.63	253.66	11-Jun-21	86.23	1.02	17.99	0.651	9.34	8.46	108	1000
IG_BH05_DW007	298.66	301.65	15-Jun-21	91.40	1.01	15.97	0.425	9.42	1.95	65	1000
IG_BH05_DW008	346.64	349.62	25-Jun-21	60.46	1.00	18.04	0.161	9.31	4.62	119	1000
IG_BH05_DW009	397.66	400.55	29-Jun-21	133.43	0.96	16.44	0.617	8.7	7.78	168	1000
IG_BH05_DW010	448.60	451.53	02-Jul-21	113.56	0.99	17.68	0.614	8.57	10.28	160	1000
IG_BH05_DW011	499.62	502.65	04-Jul-21	142.00	0.99	20.03	0.724	8.53	9.70	173	1000
IG_BH05_DW012	547.63	550.65	06-Jul-21	100.60	0.98	18.15	0.711	8.66	8.96	107	1000
IG_BH05_DW013	598.65	601.62	09-Jul-21	100.80	1.02	17.51	0.620	8.34	8.36	154	1000
IG_BH05_DW014	649.53	652.51	12-Jul-21	62.05	0.98	18.82	0.762	8.2	7.74	46	1000
IG_BH05_DW015	700.60	703.56	15-Jul-21	75.92	0.99	17.98	0.869	8.19	6.67	114	1000
IG_BH05_DW016	748.73	751.55	19-Jul-21	85.99	0.98	19.23	0.888	8.26	5.86	40	1000
IG_BH05_DW017	799.53	802.64	22-Jul-21	102.00	0.98	19.26	0.915	8.21	9.41	140	1000
IG_BH05_DW018	847.66	850.65	26-Jul-21	97.40	0.97	18.60	1.130	7.72	6.38	87	1000
IG_BH05_DW019	898.53	901.65	28-Jul-21	100.90	0.99	18.36	1.51	7.83	5.90	148	1000
IG_BH05_DW020	949.64	952.63	01-Aug-21	98.59	0.98	17.29	1.80	7.55	11.22	221	1000
IG_BH05_DW021	997.63	1000.63	06-Aug-21	69.13	1.02	17.70	5.65	6.73	6.65	296	1000

APPENDIX B

Figure B-1: Drilling Parameters

Figure B-2: Drill Fluid Parameters

Figure B-3: Drill Fluid Parameters



NOTES

1. Gaps in data appear where readings were not available.

CONSULTANT

WSP GOLDER

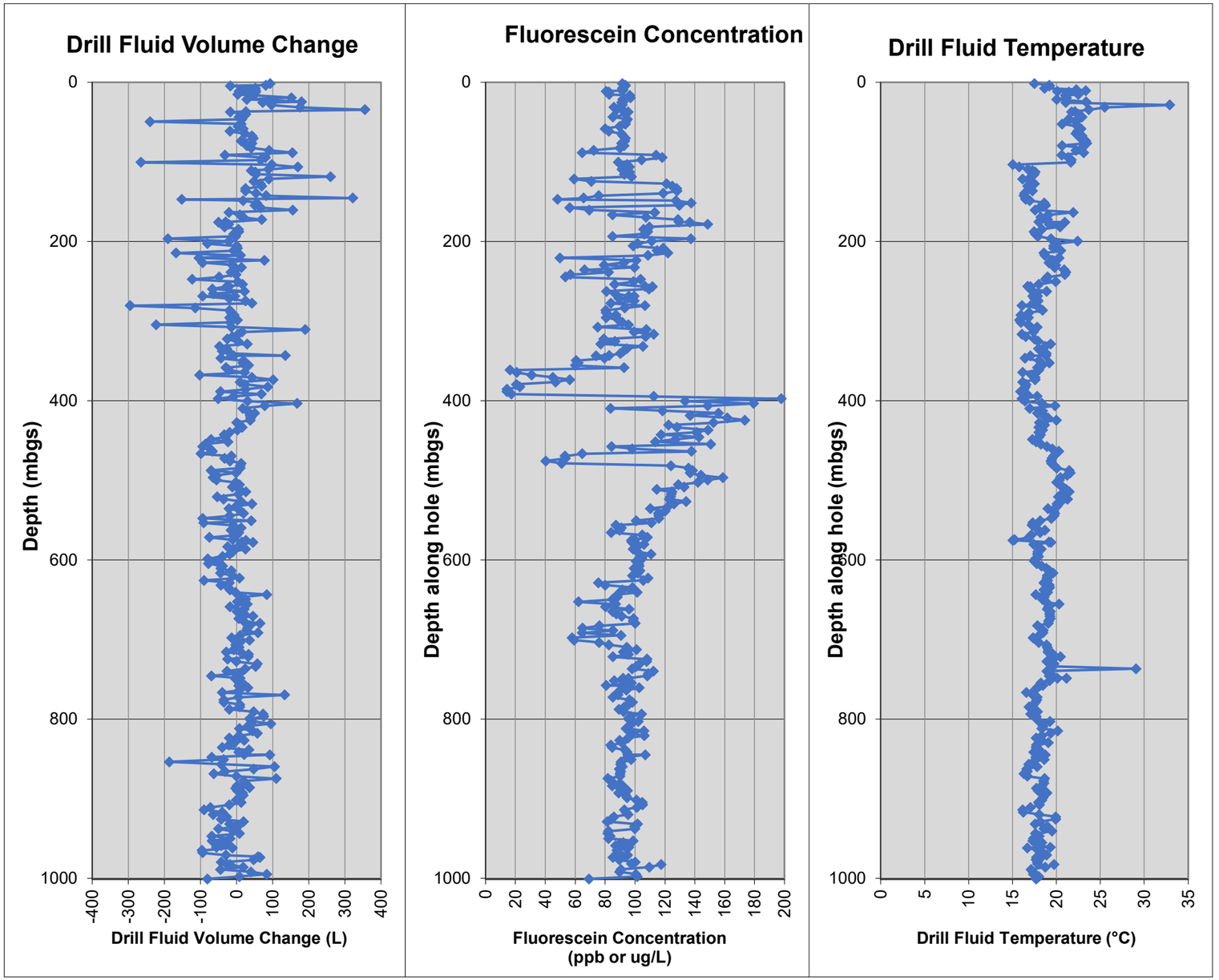
CLIENT
NWMO Ignace Drilling IG_BH05

TITLE
Figure B-1: Drilling Parameters

DATE
November 2022

DRAWN/REV
AKV / JLC

PROJECT NO.
20253946 (5020)



NOTES

1. Gaps in data appear where readings were not available.

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CLIENT

NWMO Ignace Drilling IG_BH05

TITLE

Figure B-2: Drill Fluid Parameters

DATE

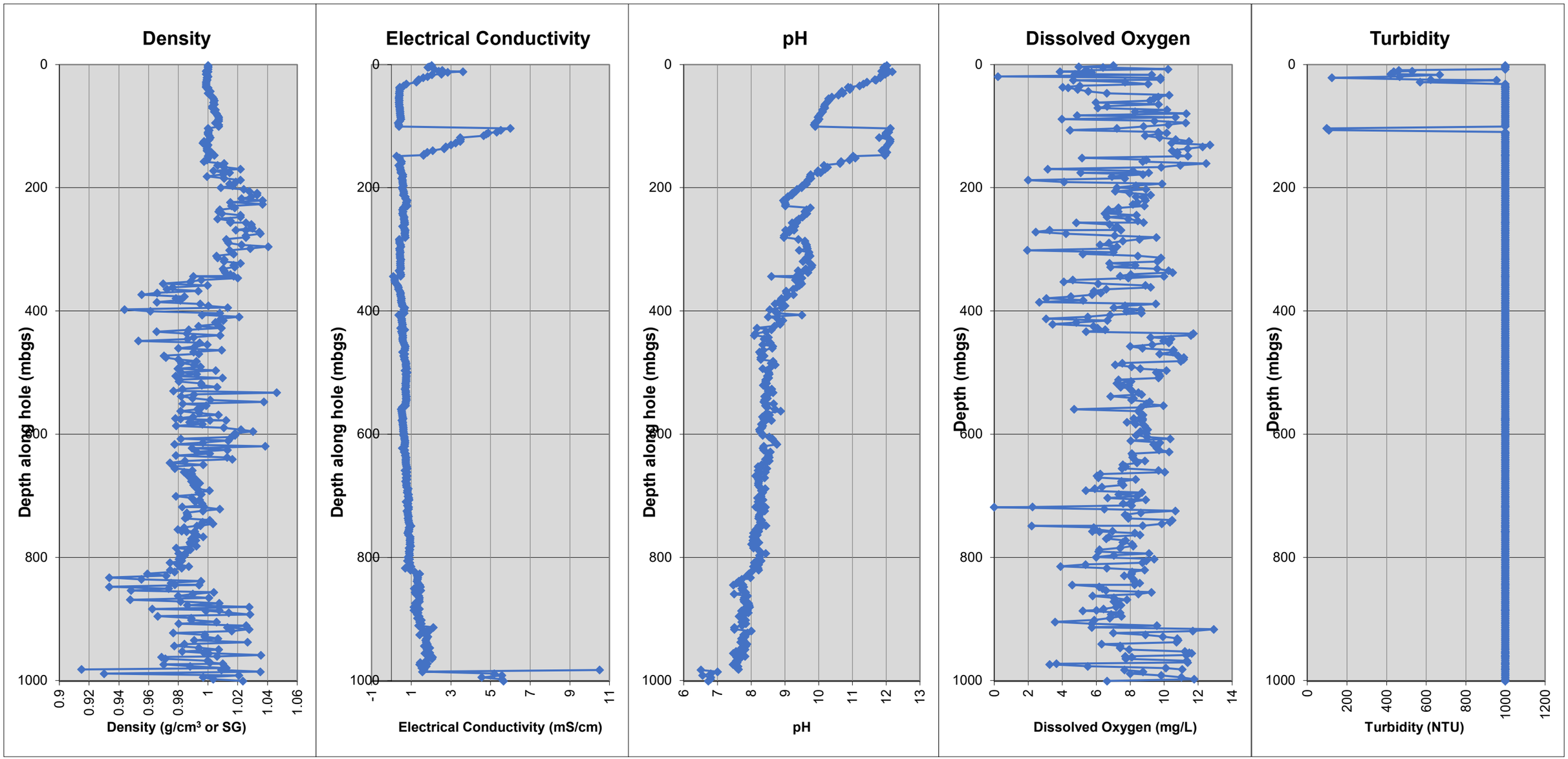
November 2022

DRAWN/REV

AKV / JLC

PROJECT NO.

20253946 (5020)



NOTES

1. Gaps in data appear where readings were not available.

CONSULTANT

WSP GOLDER

CLIENT

NWMO Ignace Drilling IG_BH05

TITLE

Figure B-3: Drill Fluid Parameters

DATE

November 2022

DRAWN/REV

AKV / JLC

PROJECT NO.

20253946 (5020)

APPENDIX C

Table C-1: Water Quality Parameters Collected During Pre WP05 IG_BH05 Flushing

Table C-2: Water Quality Parameters Collected During Pre WP09 IG_BH05 Flushing

Date / Time	Elapsed Time (Hours)	Approx. Volume (L)	Fluorescein (ppb)	Temperature (°C)	pH	ORP (mV)	Conductivity (mS/cm)	Turbidity (NTU)	DO (mg/L)
07-Aug-21 / 17:00	NA	NA	129.0	21.22	7.25	49	0.070	0	5.59
07-Aug-21 / 17:00	0	0	56.14	17.65	5.97	354	4.350	>1000	16.01
07-Aug-21 / 17:30	0.5	1800	49.42	17.86	6.76	286	0.326	193	7.32
07-Aug-21 / 18:00	1.0	3600	59.64	17.85	6.77	163	0.134	81.70	6.56
07-Aug-21 / 18:30	1.5	4800	56.16	17.91	8.36	49	0.117	64.30	4.93
07-Aug-21 / 19:00	2.0	6000	61.43	17.92	8.53	41	0.109	44.10	4.32
07-Aug-21 / 19:30	2.5	7200	91..38	18.28	8.35	42	0.091	12.60	4.30
07-Aug-21 / 20:00	3.0	8400	110.60	18.08	8.65	51	0.086	13.70	3.68
07-Aug-21 / 20:30	3.5	9600	112.50	18.16	8.87	139	0.114	52.70	4.93
07-Aug-21 / 21:30	4.0	10500	108.90	18.04	8.73	68	0.092	5.20	4.22
07-Aug-21 / 22:00	4.5	11400	95.34	17.63	8.72	61	0.090	30.80	4.33
07-Aug-21 / 22:30	5.0	12300	118.40	17.87	8.59	132	0.089	8.40	5.83
07-Aug-21 / 23:00	5.5	13200	137.40	17.75	8.68	74	0.090	9.10	4.92
07-Aug-21 / 23:30	6.0	13650	114.80	17.24	8.37	162	0.088	8.30	6.50
08-Aug-21 / 00:00	6.5	14100	125.30	16.93	8.51	119	0.084	0.00	4.93
08-Aug-21 / 00:30	7.0	14550	118.20	16.66	8.25	176	0.082	0.00	3.20
08-Aug-21 / 01:00	7.5	15000	124.40	16.90	8.32	173	0.090	0.00	5.98
08-Aug-21 / 01:30	8.0	15450	123.50	16.39	8.40	166	0.091	3.00	6.40
08-Aug-21 / 02:00	8.5	15900	121.50	16.22	8.39	178	0.088	4.10	6.10
08-Aug-21 / 02:30	9.0	16350	118.10	16.36	8.48	191	0.092	0.00	1.96
08-Aug-21 / 03:00	9.5	16800	130.8	16.07	8.53	150	0.095	4.4	5.61
08-Aug-21 / 03:30	10.0	17400	130.20	16.03	8.67	107	0.092	14.30	1.74
08-Aug-21 / 04:00	10.5	18000	129.90	16.09	8.62	116	0.091	7.20	2.88
08-Aug-21 / 04:30	11.0	18600	121.30	15.71	8.51	112	0.094	8.90	7.63
08-Aug-21 / 05:00	11.5	19200	124.60	15.62	8.50	131	0.091	5.30	6.69
08-Aug-21 / 05:30	12.0	19500	129.90	15.51	8.58	133	0.089	0.00	6.44
08-Aug-21 / 06:00	12.5	19800	127.50	15.46	8.48	139	0.088	0.00	6.76
08-Aug-21 / 06:30	13.0	20100	124.00	15.35	8.78	45	0.087	0.00	4.63
08-Aug-21 / 07:00	13.5	20400	125.40	15.28	8.53	139	0.092	0.00	5.01
08-Aug-21 / 07:30	14.0	20700	119.70	15.66	8.46	19	0.083	0.00	2.48
08-Aug-21 / 08:00	14.5	21000	126.80	15.87	8.66	38	0.087	0.00	0.00
08-Aug-21 / 08:30	15.0	21300	121.80	15.97	8.58	119	0.092	0.00	0.00
08-Aug-21 / 09:00	15.5	22500	114.00	16.06	8.04	74	0.122	15.80	0.00
08-Aug-21 / 09:30	16.0	23700	111.40	16.02	8.88	296	0.107	36.40	0.50
08-Aug-21 / 10:00	16.5	24900	106.00	17.45	8.87	49	0.089	12.30	0.00
08-Aug-21 / 10:30	17.0	26100	111.30	18.48	8.87	40	0.083	7.90	0.00
08-Aug-21 / 11:00	17.5	27300	109.10	17.71	8.89	76.00	0.080	8.40	0.00

Note:

Indicates baseline readings for water source

Date / Time	Elapsed Time (Hours)	Approx. Volume (L)	Fluorescein (ppb)	Temperature (°C)	pH	ORP (mV)	Conductivity (mS/cm)	Turbidity (NTU)	DO (mg/L)
01-Nov-21 / 10:14	NA	NA	33.28	7.98	7.41	207	0.063	2.2	7.81
01-Nov-21 / 12:45	NA	NA	122.00	7.81	7.63	196	0.063	2.1	8.83
01-Nov-21 / 09:40	0.0	0.000	23.45	9.89	7.00	-67	1.57	3.4	9.45
01-Nov-21 / 10:03	0.4	1725	50.50	8.29	7.12	-122	1.63	1.7	8.09
01-Nov-21 / 13:01	3.3	15075	125.90	8.10	7.46	178	0.069	2.5	6.69
01-Nov-21 / 13:24	3.7	16800	124.40	7.71	7.53	189	0.066	2.7	6.55
01-Nov-21 / 13:42	4.0	18150	127.30	7.42	7.51	181	0.067	1.4	6.14
01-Nov-21 / 13:53	4.2	18975	124.30	7.61	7.70	183	0.072	37.9	6.93
01-Nov-21 / 14:09	4.5	20175	125.30	7.10	7.72	183	0.070	33.7	6.20
01-Nov-21 / 14:22	4.7	21150	124.10	7.22	7.73	169	0.068	20.8	6.55
01-Nov-21 / 14:35	4.9	22125	123.80	7.47	7.66	172	0.067	13.2	8.01

Note:
Indicates baseline readings for water source

APPENDIX D

Technical Memo – Correction to Reference Ground Surface Elevation Datum – IG_BH05 – Phase 2 Initial Borehole Drilling and Testing at IG_BH04/05/06, Ignace Area

TECHNICAL MEMORANDUM

DATE September 27, 2022 **Project No.** 20253946

TO Warwick Watt
Nuclear Waste Management Organization

CC Andrew Verok, Matt Bowman, Kyle Matter, Jennifer Hlookoff, Natacha Lugo Bizarro

FROM George Schneider, Joe Carvalho, Natalie Solis **EMAIL george.schneider@wsp.com**

CORRECTION TO REFERENCE GROUND SURFACE ELEVATION DATUM – IG_BH05 – PHASE 2 INITIAL BOREHOLE DRILLING AND TESTING AT IG_BH04/05/06, IGNACE AREA

Mr. Watt

While the WP09 team was preparing the data report for IG_BH05, we came across a discrepancy in the position of the **ground surface elevation reference datum** stated in the WP02 data report issued in June 2022 relative to the survey results provided by Rugged Geomatics in their letter dated January 11, 2022.

In an effort to resolve this discrepancy, we took a very close look at the following data sources, which we have annotated with comments and provided as attachments to this memorandum.

- Attachment 1 – Drilling Equipment Dimensions and Nomenclature from IG_BH05 WP02 Test Plan
- Attachment 2 – Collar and Casing Coordinates and Construction Schematic from IG_BH05 WP02 Data Report
- Attachment 3 – Summary Completion Log Sketch from the Westbay Completion Report
- Attachment 4 – Sketch of Extension to IG_BH05 surface casing and Westbay riser pipe (by Site Supervisor)
- Attachment 5 – Rugged Geomatics Survey Letter
- Attachment 6 – Composite sketch of reference points – Pre-extension (during drilling, testing and Westbay install) and Post-extension (as surveyed)

Based on our review of the above noted attachments, we have concluded that the surveyed position of the HWT (PQ) surface casing reported in the letter from Rugged Geomatics was inadvertently mistaken to be the position of the HWT (PQ) surface casing as it was during drilling, testing and Westbay installation. However, prior to being surveyed by Rugged Geomatics in December 2022, this original casing was extended after the installation of the Westbay system in order to complete the well head with a monopod bracket and protective casing.

The original position of the HWT (PQ) surface casing prior to it being extended was also surveyed, and was identified by Rugged Geomatics as survey point 20052 “bh5 welded joint of pqt casing”.

Using that information, we have calculated the correct **ground surface elevation reference datum for IG_BH05** relative to the original position of the HWT (PQ) casing.

The calculation is presented in Table 1 (attached) and the corrected coordinates are as follows.

Easting (m)	Northing (m)	Elevation (masl)	Note
556069.05	5486535.85	432.29	Updated (corrected) Calculated Ground Surface Reference Datum
556069.23	5486536.09	432.93	Previous (incorrect) Calculated Ground Surface Reference Datum
-0.18	-0.24	-0.64	Difference

CGVD 2013 datum

We have corrected this datum in the IG_BH05 WP09 data deliverable (revision R4b) and will be re-issuing it to the NWMO, and we have used the corrected datum in the draft IG_BH05 WP09 data report, which will be issued shortly.

We will be informing our Work Package Leads of this correction to the datum, and ask them to identify which data packages and reports are affected and propose corrective actions.

This incident has been entered as a non-conformance in our Quality Management System. This preliminary investigation has already yielded some valuable lessons learned, which can inform future investigations and help prevent a similar occurrence.

If you have any questions, please contact the undersigned.

Golder Associates Ltd.

George Schneider, M.Sc., P.Geo.
Senior Geoscientist - Principal

Joe Carvalho, Ph.D., P.Eng.
Mining & Rock Engineering - Principal

Natalie Solis, P.Eng.
Project Manager

GWS/JLC/NAS

Distribution: WSP Golder, Westbay Instruments, NWMO

Attachments: Table 1 – Calculation of Original Ground Surface Reference Datum Position from Rugged Geomatics Survey Data IG_BH05

Attachments 1 to 6

https://golderassociates.sharepoint.com/sites/142487/project files/5 qaqc/07 qaqc ncrs/10 ncr gnd surface reference datum/bh05 gen memo/20253946 elev ref datum correction 27sep2022 r2a.docx

Table 1
Calculation of Original Ground Surface Reference Datum Position from Rugged Geomatics Survey Data
IG_BH05

Surveyed Point	Easting (m)	Northing (m)	Elevation (masl)	Note
20052	556069.23	5486536.07	433.05	Original HWT (PQ) casing as surveyed by Rugged Geomatics (high side)

CGVD 2013 datum

Field Measured Parameter	Value
Borehole azimuth (^{0}) final gyro survey	219.84
Borehole dip (^{0}) final gyro survey	-69.46
Ground Surface Reference Datum (m along hole)	0.000
PWT Conductor Casing Stick-up (m along hole)	0.710
HWT (PQ) Surface Casing Stick-up (m along hole)	0.810
HWT (PQ) Surface Casing Extension (m)	0.658
Westbay Riser Pipe Stick-up (m along hole)	1.240
Westbay Riser Pipe Extension (m)	0.167

A - Vertical distance between Ground Surface Reference Datum and top of original HWT (PQ) casing
= HWT Surface Casing Stick-up * SIN(BH dip)
= 0.759 m

B - Elevation of Reference Datum (masl)
= Elevation of top of original HWT (PQ) casing - A
= 432.291 masl

C - Horizontal shift of reference datum relatvie to surveyed top of original HWT (PQ) casing (m)
= A* TAN(90 - BH dip)
= 0.284 m

D - Shift in Easting relative to original HWT (PQ) casing (m)
= C * SIN(BH azimuth)
= -0.182 m

D - Shift in Northing relative to original HWT (PQ) casing (m)
= C * COS(BH azimuth)
= -0.218 m

Calculated Point	Easting (m)	Northing (m)	Elevation (masl)	Note
N/A	556069.05	5486535.85	432.29	Original Ground Surface Reference Datum

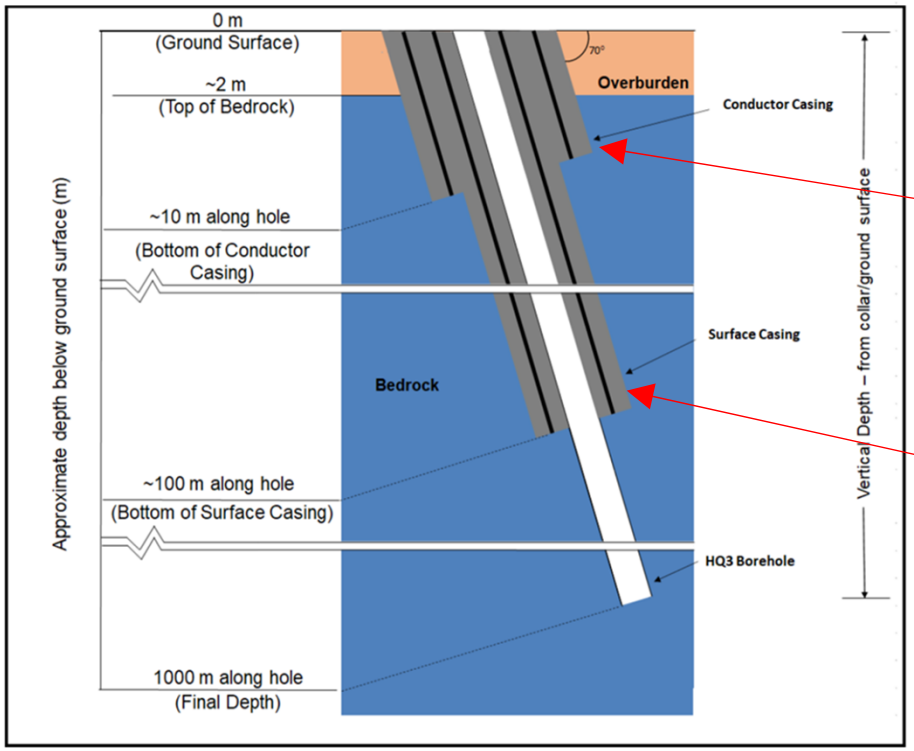
CGVD 2013 datum

Attachment 1 – Drilling Equipment Dimensions and Nomenclature from IG_BH05 WP02 Test Plan

Table 3: Dimensions of all Drilling Equipment and Core

Rod/Casing Size	Outer Diameter (mm)	Inner Diameter (mm)	Hole Size (mm)	Approximate Depth in Borehole
PWT Casing	139.70	127.00	N/A	surface to ~10 m into bedrock
PWT Shoe Bit	143.76	122.94	143.76	surface to ~10 m into bedrock
PQ Casing (Rods)	114.30	101.60	N/A	up to 100 m into bedrock[1]
PQ Shoe Bit	117.50	100.5	117.50	up to 100 m into bedrock[1]
PQ Casing Advancer Pilot Bit	121.0	94.2	121.0	up to 100 m into bedrock[1]
HQ Rods	88.90	77.80	N/A	0 – 1000 m
HQ3 Bit	96.00	61.10	96.00	0 – 1000 m
HQ3 Core	61.10	N/A	N/A	0 – 1000 m

[1]Final depth will depend on the bedrock conditions encountered.



PWT Conductor Casing

HWT (PQ) Surface Casing

Figure 2: Borehole Schematic

Attachment 2 - Comments on Collar and Casing Coordinates and Construction Schematic from IG_BH05 WP02 Data Report

A – Calculated incorrectly – Golder initially used the wrong survey data point in the calculation of the reference elevation

B – Sump weld - surveyed correctly by Rugged but not used

C – Incorrectly labelled by Rugged – this is the top of extended Westbay riser pipe as surveyed by Rugged

D - Top of HWT (PQ) surface casing as surveyed by Rugged after extension was added – this is where the error originated – should have used survey of the "casing joint"

Table 5: IG_BH05 Final Surveyed Collar and Casing Coordinates Previous (incorrect) Table 5

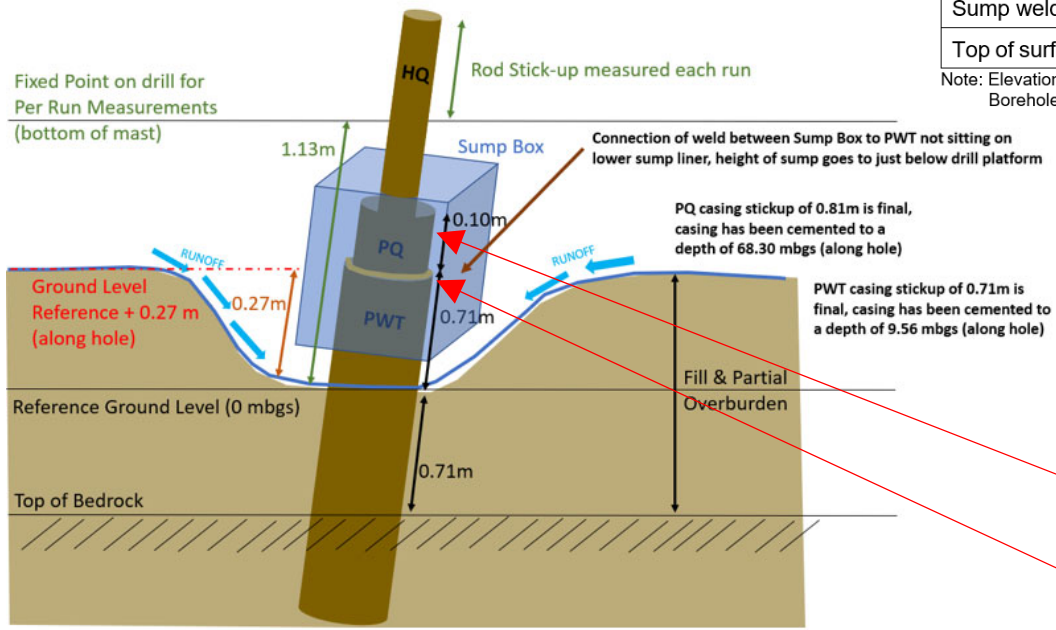
Point	Northing (m)	Easting (m)	Elevation (m)	Comment
Borehole Collar - Reference Ground Level (RP for drilling)	5486536.09	556069.23	432.93	Calculated E, N & Elev
Sump weld	5486535.98	556069.17	432.78	Provided E, N & Elev
Top of conductor (PWT) casing	5486536.28	556069.39	433.60	Provided E, N & Elev
Top of surface (PQ) casing	5486536.26	556069.38	433.67	Provided E, N & Elev

Note: Elevations are Geodetic and referred to the CGVD2013 Datum and coordinates are referred to UTM Zone 15, NAD 83 (CSRS).
Borehole Collar – Reference Ground Level refers to the pre-drilling ground surface level and has since been regraded

Table 5: IG_BH05 Final Surveyed Collar and Casing Coordinates Updated (correct) Table 5

Point	Northing (m)	Easting (m)	Elevation (m)	Comment
Borehole Collar - Reference Ground Level (RP for drilling)	5486535.85	556069.05	432.29	Calculated E, N & Elev
Sump weld	5486535.98	556069.17	432.78	Provided E, N & Elev
Top of surface (PQ) casing	5486536.07	556069.23	433.05	Provided E, N & Elev

Note: Elevations are Geodetic and referred to the CGVD2013 Datum and coordinates are referred to UTM Zone 15, NAD 83 (CSRS).
Borehole Collar – Reference Ground Level refers to the pre-drilling ground surface level and has since been regraded



HWT (PQ) Surface Casing

PWT Conductor Casing

Figure 12: IG_BH05 Borehole Construction Schematic prior to PQ Surface casing extension

Borehole Orientation

The borehole was planned to be drilled with an azimuth and inclination of 220° / -70° with no correction made for deviation as the drilling progressed.

Attachment 3 – Comments on the Summary Completion Log Sketch from the Westbay Completion Report

Summary Completion Log

Company: Golder/NWMO
Well: IG_BH05
Site: Ignace,ON
Project: Groundwater Characterization Study

Job No: WB981
Author: TK/DL

Elevation datum used (provided by Golder from WP02 – needs to be correct)

Well Information

Reference Datum: Ground Level
Elevation of Datum: 432.93 masl
MP Casing Top: 0.00 m.
MP Casing Length: 994.45 m.

Borehole Depth: 1000.63 m.
Borehole Inclination: 70 degrees
Borehole Diameter: 98.00 mm

Well Description:
Plastic MP38 System
Other References:
Revision after Oct 14,2021 meeting
Approval on R3 via e-mail on Oct 25

File Information

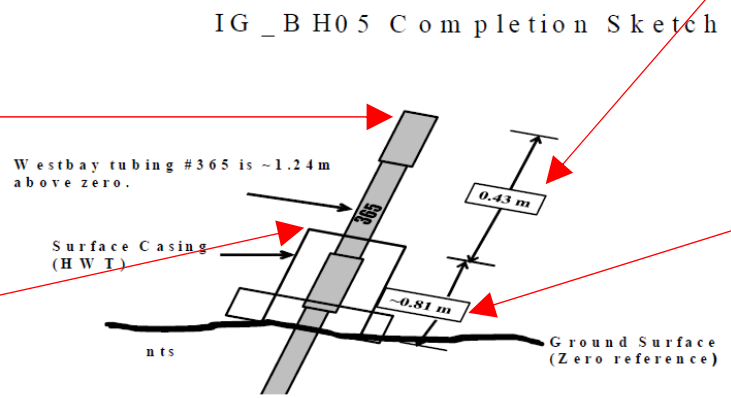
File Name: IGBH05AB.WWD
Report Date: Wed Nov 24 08:46:28 2021

File Date: Nov 24 08:43:06 2021

Sketch of Wellhead Completion

Distance along hole between original HWT casing and top of Westbay riser pipe (0.43 m)

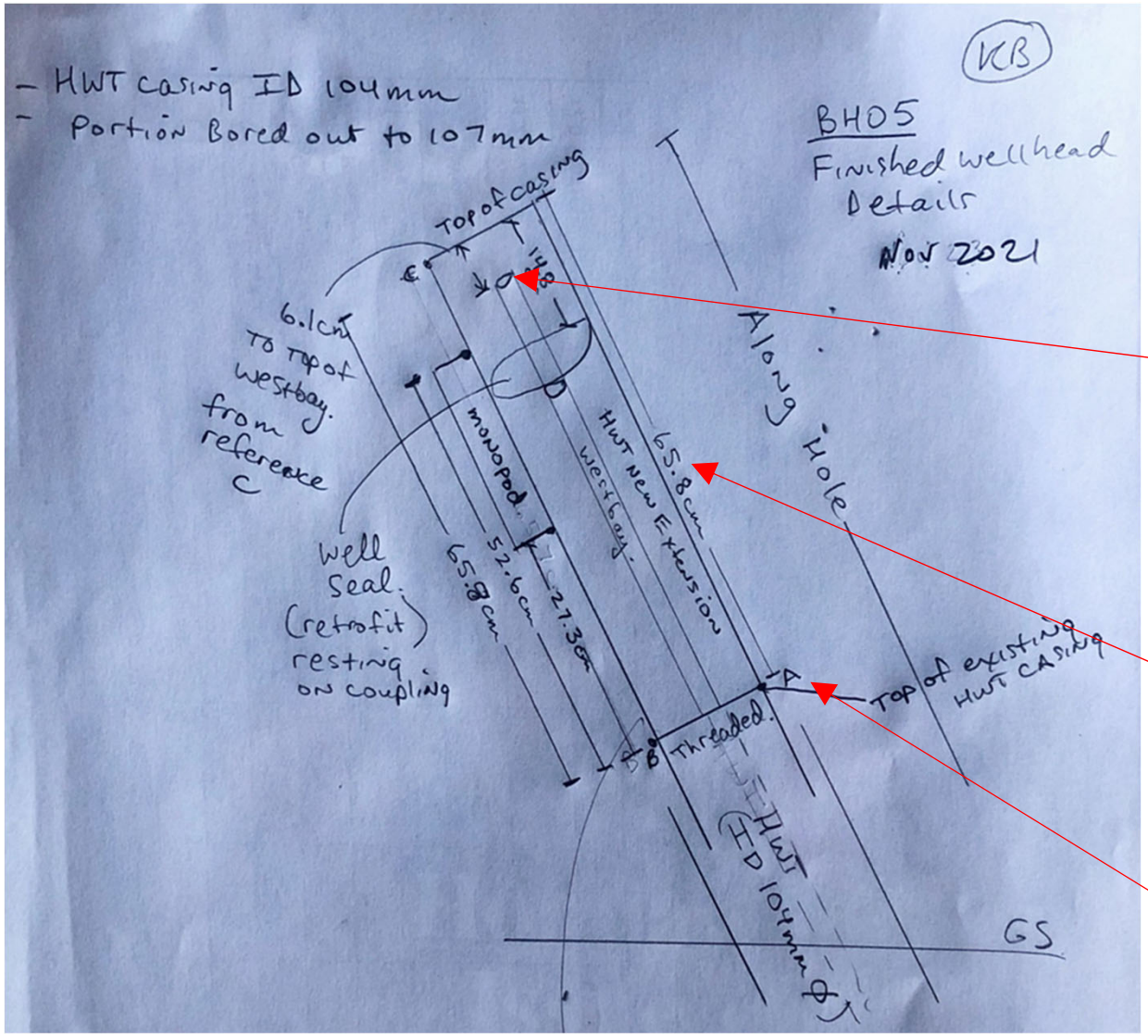
Top of Westbay riser pipe (before extension was added)



Distance along hole between original HWT casing and ground surface reference point (0.81m)

HWT (PQ) Surface Casing

Attachment 4 – Sketch of Extension to IG_BH05 surface casing and Westbay riser pipe (by Site Supervisor)



Top of Westbay riser pipe (after extension was added)
Net length of extension = 0. 167 m

Length of HWT extension added = 0.658 m

Top of HWT (PQ) Surface Casing during drilling and testing, prior to extension added – this is the surveyed reference point to use

Attachment 5 – Comments on Rugged Geomatics Survey Letter (2022-01-12)

RE: As-built Survey
Borehole IG_BH05
Nuclear Waste Management Organization
Dyment Site
Our File No. SK18128

Below please find the UTM Zone 15 Coordinates and geodetic elevations(CGVD**2013** Datum) for various components of the borehole. Golder's Shady Hashem, P. Eng. instructed us on site during the survey with respect to coding and identification of the points below. The coordinate for a ground shot in close proximity to the drill hole is also included.

Point	Easting	Northing	Elevation	code
20056	556066.00	5486531.39	432.60	ground
20050	556069.39	5486536.28	433.60	bh5 top casing
20051	556069.38	5486536.26	433.67	bh5 top pqt casing
20052	556069.23	5486536.07	433.05	bh5 welded joint of pqt casing
20054	556069.17	5486535.98	432.78	bh5 sumpbox

Ground = nearby ground surface shot – not used

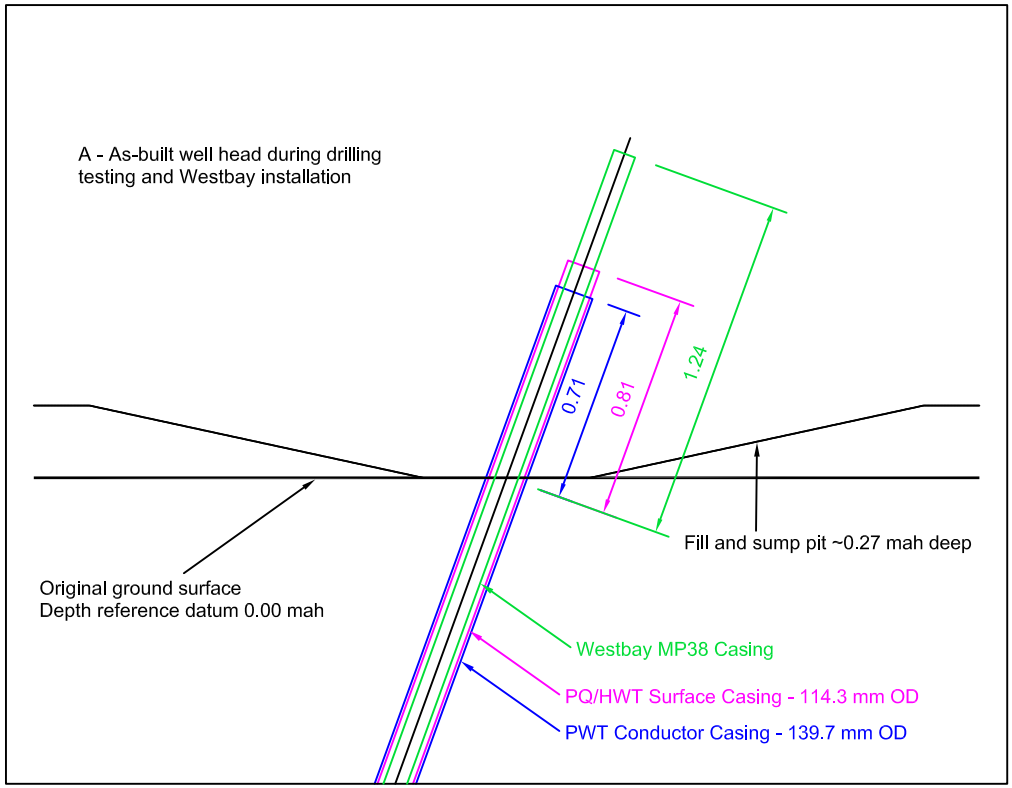
bh5 top casing = top of extended Westbay pipe

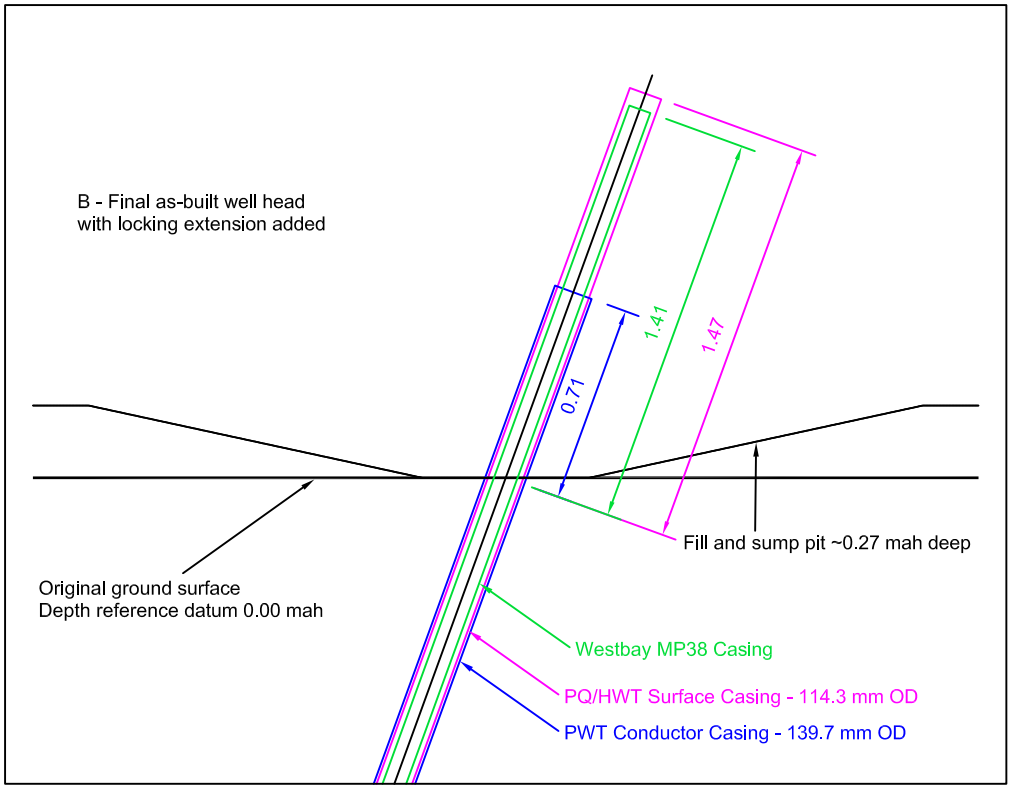
bh5 top pqt casing = top of extended HWT (PQ) surface casing

bh5 welded joint of pqt casing = top of original HWT (PQ) surface casing (prior to casing extension) – this is the surveyed reference point to use

bh05 sump box = welded points on the PWT conductor casing where the sump box was located

Attachment 6 - Composite sketch of reference points - Pre-extension (during drilling, testing and Westbay install) and Post-extension (as surveyed)







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