PHASE 2 INITIAL BOREHOLE DRILLING AND TESTING, IGNACE AREA

WP09 Data Report - Westbay MP38 Casing Completion for IG_BH03

APM-REP-01332-0259 **January 2021**

Golder Associates Ltd.

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Nuclear Waste Management Organization
22 St. Clair Avenue East, 4th Floor
Toronto, Ontario
M4T 2S3
Canada

Tel: 416-934-9814
Web: www.nwmo.ca

REPORT

PHASE 2 INITIAL BOREHOLE DRILLING AND TESTING, IGNACE AREA

WP09 Data Report - Westbay MP38 Casing Completion for IG_BH03

Submitted to:

Nuclear Waste Management Organization
22 St. Clair Avenue East
4th Floor
Toronto, Ontario
M4T 2S3

Submitted by:

Golder Associates Ltd.
6925 Century Avenue, Suite #100, Mississauga, Ontario, L5N 7K2, Canada

+1 905 567 4444

1671632 (2911)

NWMO Report: APM-REP-01332-0259

January 2021

Distribution List

e-copy - NWMO

e-copy - Golder Associates Ltd.

WP09 DATA REPORT – WESTBAY MP38 CASING COMPLETION FOR IG_BH03

CLIENT INFORMATION

Project Name: Phase 2 Initial Borehole Drilling and Testing, Ignace Area.

Project Number: 1671632

Client PO Number: 01559 A-TGS

Document Name: 1671632A (2911) IG_BH03 WP09 Report 25Jan2021 R1a

Client: Nuclear Waste Management Organization (NWMO)
22 St. Clair Avenue East, 4th Floor
Toronto, Ontario
M4T 2S3

Client Contact:	Eric Sykes	Maria Sánchez-Rico Castejón
Email:	esykes@nwmo.ca	msanchez@nwmo.ca

ISSUE/REVISION INDEX

Issue Code	Revision					Revision Details
	No.	By	Rev'd.	App.	Date	
RR	0	ATK	GWS	-	Sept. 23, 2020	Draft for review and comment
RI	1	ATK	GWS	JLC	Jan. 25, 2021	Final report released for information

Issue Codes: RR = Released for Review and Comments, RI = Released for Information

SIGNATURES

Prepared by: _____

Adrian Kowalchuk, B.Sc., P.Geo.
Environmental Geoscientist

Reviewed by: _____

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

Approved by: _____

Joe Carvalho, Ph.D., P.Eng.
Senior Geotechnical Engineer - Principal

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

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

This project involves the drilling and testing of three deep boreholes within the northern portion of the Revell batholith. The third drilled borehole, IG_BH03, is located a direct distance of approximately 21 km southeast of the Wabigoon Lake Ojibway Nation and a direct distance of 43 km northwest of the Town of Ignace. Access to the IG_BH03 drill site is via Highway 17 and logging roads, as shown on Figure 1.

The project was carried out by a team led by Golder Associates Ltd. (Golder) on behalf of the NWMO. This report describes the methodology, activities, and results for Work Package 9 (WP09): Installation of Westbay MP38 casing at IG_BH03.

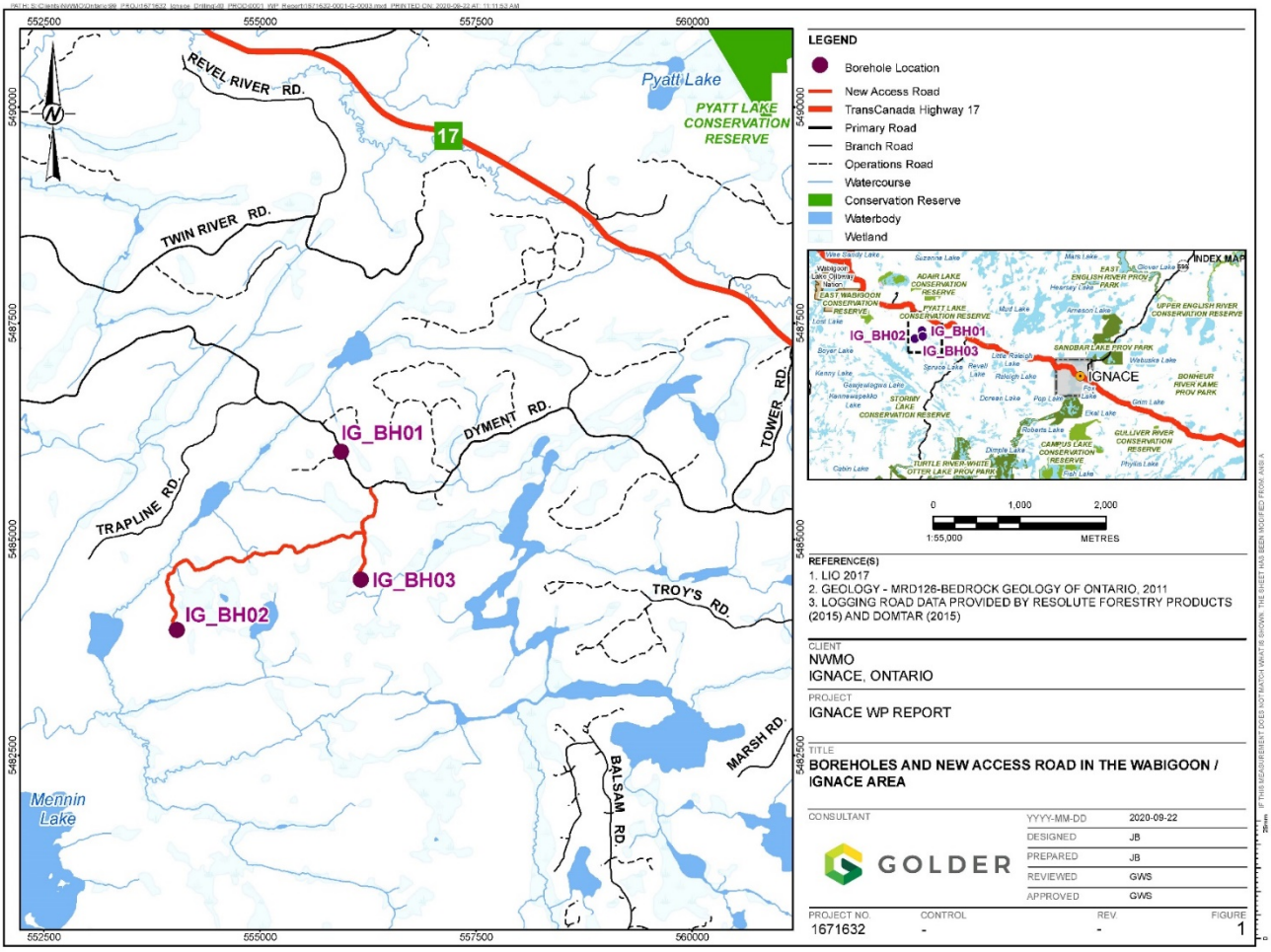


Figure 1: Location of IG_BH03 in relation to the Wabigoon / Ignace Area

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).

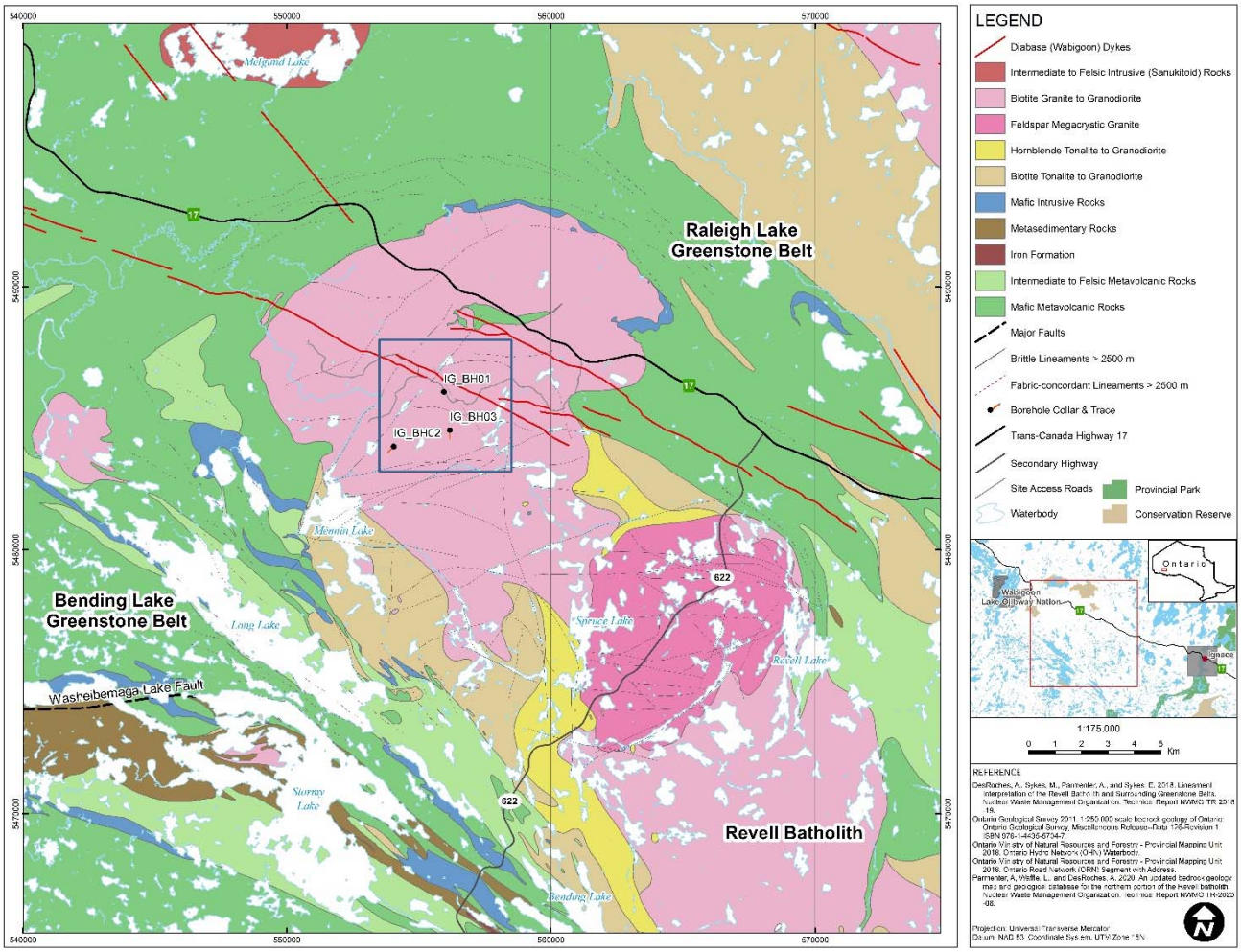


Figure 2: Geological setting and location of boreholes IG_BH01, IG_BH02 and IG_BH03 in the northern portion of the Revell batholith

IG_BH03 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_BH03 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). 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.

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).

2.2 Technical Objectives

The Westbay MP38 system is designed to isolate specific depth intervals within the inclined IG_BH03 borehole and includes 21 monitoring zones to depths to a depth of 919 metres below ground surface (mBGS) or 1000 m downhole. The Westbay system can be used for measurement of hydraulic pressures and collection of groundwater samples. The MP38 system can also be used to perform hydraulic tests in the isolated zones.

3.0 DESCRIPTION OF ACTIVITIES

Permission to drill was obtained from the Ministry of Natural Resources and Forestry (MNRF) on November 26th, 2018 with formal notification given to Golder via email from the NWMO on November 27th, 2018 with the understanding that drilling and testing would begin in the summer of 2019, following the construction of an access road and the drill site. The borehole was drilled at a nominal diameter of 98 mm (HQ size) by diamond coring methods at an initial (surveyed) azimuth and dip of approximately 185˚/-70˚with no corrections made for deviation as the drilling progressed. Drilling of IG_BH03 commenced on July 9th, 2019 and was completed on September 16th, 2019.

Borehole flushing was carried out on IG_BH03 with 100 ppb fluorescein traced fresh water from the Town of Ignace Municipal supply prior to geophysical surveys on two occasions: prior to installation and cementing of the surface casing, and at the completion of drilling. The first flush was conducted on July 22nd, 2019, prior to installing the surface casing. Approximately 8,400 litres of traced fresh water was flushed through the borehole, which at that point had been advanced to approximately 102.12 m downhole. Following flushing, optical and acoustic televiewer surveys were completed within the upper 100 m of the borehole to identify features which should be cased and cemented to seal them from the rest of the borehole. A PQ sized surface casing was advanced to a depth of 71 m downhole and cemented in place.

Once the PQ sized surface casing was cemented in place, the borehole was cored to its final depth of 919 mBGS, or 1000.54 m downhole. A second flushing event was carried out at the completion of drilling, over a two day period from September 16th to 18th, 2019. Approximately 42,700 litres of fluorescein traced fresh water was flushed through the borehole, equivalent to just under 6 borehole volumes. Following flushing, geophysical

logging and hydraulic testing was completed in the borehole. No further flushing was carried out prior to the Westbay installation, which was completed between November 14th and 24th, 2019.

Installation of Westbay MP38 multilevel monitoring casings was performed by staff of Westbay Instruments with support provided by Golder and Rodren Drilling Ltd. (Rodren), in accordance with planned installation procedures. Installation of the MP38 casing involved the following activities:

- Preparation and review of a Westbay MP38 system design.
- Layout, numbering and visual inspection of all MP38 casing components at an off-site location and at the well head, including measurement of the length of each Westbay casing section.
- Installation of an HQ guide tube downhole to protect the casing string during installation.
- Lowering and testing of MP38 casing components into the borehole in the sequence indicated on the approved Westbay Completion Log.
- Pre-inflation pressure profiling.
- Packer inflation and guide tube removal.
- Wellhead completion and post-installation pressure profiling.

These activities are described in greater detail in the following subsections.

3.1 Westbay System Components

The Westbay system consists of modular casing, packers, couplings, abrasion protectors, measurement ports, hydraulic pumping ports and magnetic location collars. Fluid samples and in-situ fluid pressures are obtained using an electronic probe that is lowered inside the casing to access the valved ports. Different system components are illustrated on Figure 3.

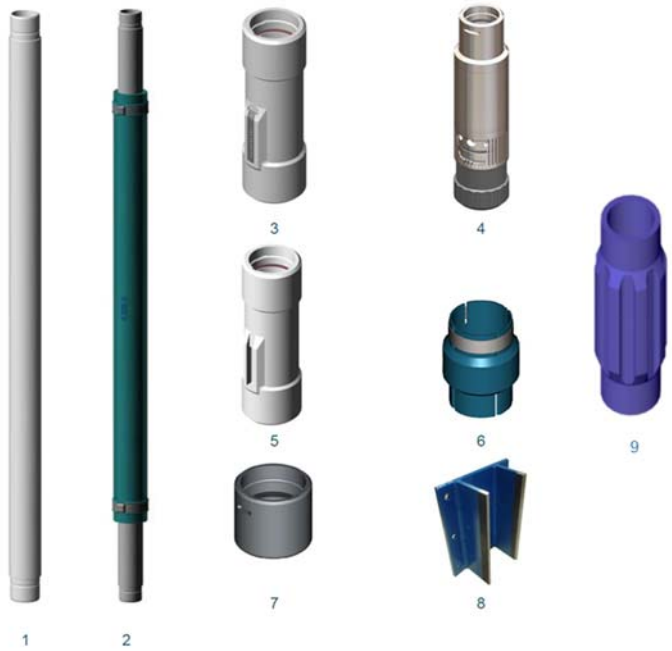


Figure 3: Westbay MP38 System Components

1 - MP38 Casing; **2 -** MP38 Packer – 74 mm (1.5 m); **3 -** MP38 Measurement Port; **4** - MP38 Hydraulic Pumping Port; **5** - MP38 Regular Coupling; **6** - Magnetic Location Collar; **7 -** MP38 End Cap; **8 -** MP38 Monopod Attachment Bracket; **9 –** MP38 Abrasion Protector.

3.2 Preparation of the Monitoring Well Design

Test intervals within the Westbay MP38 system were selected to either target specific zones in the borehole where increased frequency of structures or hydraulic flows were observed, or to broadly monitor the evolution of hydraulic pressures and groundwater chemistry in regularly spaced intervals of the rock mass with increasing depth in the borehole. The length of a test interval is defined as the distance between the bottom of the upper packer and the top of the lower packer. The selected interval lengths were a function of the characteristics of specific zones and the purpose of the planned testing for that interval.

Generally, a measurement port was placed a uniform distance below each packer to allow for pressure measurements and to permit squeeze relief venting during packer inflation. Magnetic locating collars were placed 0.6 m below measurement ports in key intervals. Pumping ports were located within intervals where hydrogeologic conditions suggested the collection of groundwater samples was possible. These intervals typically corresponded to observed in-flows during fluid flow electrical conductivity logging. Abrasion protectors were used in the inclined borehole to centralize the installation and to prevent abrasion of system components against the sides of the borehole during installation. The abrasion protectors were clamped to the outside of the Westbay casing near the following components:

- One abrasion protector above and below each MP38 Packer;
- One abrasion protector above each MP38 Pumping Port;
- Two abrasion protectors at the bottom of the Westbay casing assembly.

In addition to the use of two abrasion protectors at the bottom of the Westbay casing assembly, a special tapered end plug was attached to the bottom of the assembly.

The results of drilling (WP02), core logging (WP03), geophysical logging (WP05) and hydraulic testing (WP06) were used to finalize test interval selection. A summary of the installed test intervals with their associated selection rationale is provided in Table 1 below.

Table 1: Westbay MP38 Test Intervals and Selection Rationale

Interval No.	Depth Interval (bottom of upper packer to top of lower packer)				Test Interval Selection Rationale
	Top (m down hole)	Bottom (m down hole)	Top (mBGS)	Bottom (mBGS)	
IG_BH03_T_INT_021	70.20	162.00	65.55	150.60	Low number of structures with no dykes. Packer provides load support over a long span of borehole.
IG_BH03_T_INT_020	162.90	224.40	151.43	208.32	Moderate number of structures with two dykes.
IG_BH03_T_INT_019	225.30	247.30	209.15	229.47	High number of structures with one dyke.
IG_BH03_T_INT_018	248.20	317.30	230.30	294.01	Moderate number of structures with no dykes. Packers provides load support over a long span of borehole.
IG_BH03_T_INT_017	318.20	366.60	294.84	339.41	Moderate number of structures with no dykes. Packers provides load support over a long span of borehole.
IG_BH03_T_INT_016	367.50	417.40	340.24	386.21	Moderate number of structures with one dyke. Packers provides load support over a long span of borehole.

Interval No.	Depth Interval (bottom of upper packer to top of lower packer)				Test Interval Selection Rationale
	Top (m down hole)	Bottom (m down hole)	Top (mBGS)	Bottom (mBGS)	
IG_BH03_T_INT_015	418.30	462.20	387.04	427.48	Low number of structures with no dykes. Upper packer provides load support over a long span of borehole.
IG_BH03_T_INT_014	463.10	502.40	428.31	464.51	Moderate-high number of structures with two dykes
IG_BH03_T_INT_013	503.30	540.50	465.34	499.59	Low number of structures with no dykes. Lower packer provides load support over a long span of borehole.
IG_BH03_T_INT_012	541.40	564.00	500.42	521.23	High number of structures with two dykes
IG_BH03_T_INT_011	564.90	609.70	522.06	563.36	Moderate number of structures with no dykes
IG_BH03_T_INT_010	610.60	634.10	564.19	585.86	Isolate the zone where an anomaly was detected during the flowing fluid electrical conductivity survey.
IG_BH03_T_INT_009	635.00	672.30	586.69	621.08	Isolate the zone where an anomaly was detected during the flowing fluid electrical conductivity survey.
IG_BH03_T_INT_008	673.20	749.10	621.91	691.89	High number of structures with two dykes
IG_BH03_T_INT_007	750.00	790.60	692.70	729.88	Low-moderate number of structures with one dyke. Lower packer provides load support over a long span of borehole.
IG_BH03_T_INT_006	791.50	856.20	730.70	789.53	Moderate-high number of structures with two dykes
IG_BH03_T_INT_005	857.10	879.10	790.35	810.25	Moderate number of structures with no dykes. Isolates the fluid temperature resistivity anomaly identified in this interval.
IG_BH03_T_INT_004	880.00	920.40	811.04	847.33	Isolate an area with a high number of structures and one dyke.
IG_BH03_T_INT_003	921.30	940.20	848.14	864.98	Low number of structures with no dykes, created as a by-product of isolating the high structure zones in the intervals above and below.
IG_BH03_T_INT_002	941.10	963.10	865.78	885.30	Isolate an area with a high number of structures and two dykes.
IG_BH03_T_INT_001	964.00	1000.54	886.10	918.29	Moderate number of structures with no dykes.

Following test interval selection, the depth of packer placement was refined using data from downhole caliper logs, core logs, and televiewers to ensure packers were located in sections of borehole having a sparse fracture frequency and consistent diameter. In addition to the primary function of creating a borehole annular seal between adjacent monitoring intervals, the Westbay packers also support the weight of the Westbay completion, and loads imposed by long term or short term hydraulic gradients across packers. The maximum distance between packers should be less than 100 m for load-sharing reasons.

The well design is composed of the test interval selection and packer placement, and was used to prepare a Westbay Completion Log, which specifies the installation details of the Westbay System components in the well

including serial numbers for each packer, pumping port and measurement port coupling. A copy of the Westbay Completion Log is included in the Westbay Completion Report provided in Appendix A.

3.3 Layout of Westbay Casing Components

A pre-installation layout of Westbay casing components was carried out at an offsite warehouse in Ignace, Ontario. The required MP38 components (casing, couplings, magnetic location collars, etc.) were laid out on a raised rack. Each component was numbered and measured, beginning with the lowermost, as an aid to confirming the proper sequence of components. The appropriate Westbay System couplings were attached to each casing section according to the Westbay Completion Log, and magnetic location collars were attached 0.6 m below the top of the measurement port couplings in the monitoring intervals. To prevent damage to the equipment during assembly into the inclined borehole, abrasion protectors were also added above and below each packer, and above each pumping port (see Figure 4). The serial numbers for each packer, pumping port and measurement port coupling were recorded on the Westbay Completion Log.

Following pre-installation layout, the components were re-sealed in their respective plastic bags, labelled, and re-packaged for transportation to the drill site.

Figure 4: Photo of packer assembly on left, and abrasion protector on right. Abrasion protectors were installed directly above and below each packer, to prevent damages during assembly.

3.4 Lowering of Westbay Casing Components

Upon delivery to the IG_BH03 drill site, the MP38 System components were arranged in sequence on layout racks located within the core logging trailer and checked against the Westbay Completion Log. A temporary guide tube of steel HQ drill rods was lowered into the borehole to a depth of 778 m downhole to protect the Westbay

components from materials that could dislodge from the borehole wall during installation. The inside of each guide tube length was checked during installation to confirm that it was free of obstructions and smooth.

Each section of Westbay casing was visually inspected to confirm that the inside was clear and that the joint anchor wires were properly installed before attachment of a section of Westbay casing to the downhole casing string. The Westbay casing weight, differential pressure (both inside to outside, and outside to inside) and the buoyancy force on the casing bottom were maintained within operating limits through the regular addition of fluorescein-traced water (100 ppb) to the inside of the Westbay casing.

Each connection in the Westbay casing was pressure tested using the MP38 Joint Test Tool and the test results recorded on the Westbay Completion Log. A photo of the Joint Test Tools is provided on Figure 5. A minimum test pressure of 690 kPa and a minimum test duration of 1 minute was used for the joint testing with the test pass criteria of no observable water leakage. A record of each successful joint test and the placement of each component was noted on the Westbay Completion Log.

Figure 5: Photograph of joint testing and packer inflation tool

After the Westbay System string was lowered into the borehole, the water level inside the Westbay casing was monitored under a negative gradient (approximately 135 m) for one hour, which confirmed the hydraulic integrity of the completion. Hydraulic integrity measurements are available in Appendix A.

3.5 Pre-inflation Pressure Profile

Prior to inflating the packers, a pre-inflation pressure profile was carried out on November 17, 2019 to confirm the operation of all pressure measurement ports downhole and to establish the open hole pressure profile. These measurements were carried out using the MOSDAX pressure profile tool and are provided in Appendix B.

Figure 6 illustrates the pre-inflation pressure profile and estimated piezometric levels in formations outside measurement ports profile for IG_BH03 assuming fresh water. As shown, the head increases linearly with depth

over the entire length of the installation. This linear increase would be expected considering that the packers had not yet been inflated, and that the water within the borehole annulus was introduced during the drilling process and is not expected to contain density variations that would be observed with the native groundwaters.

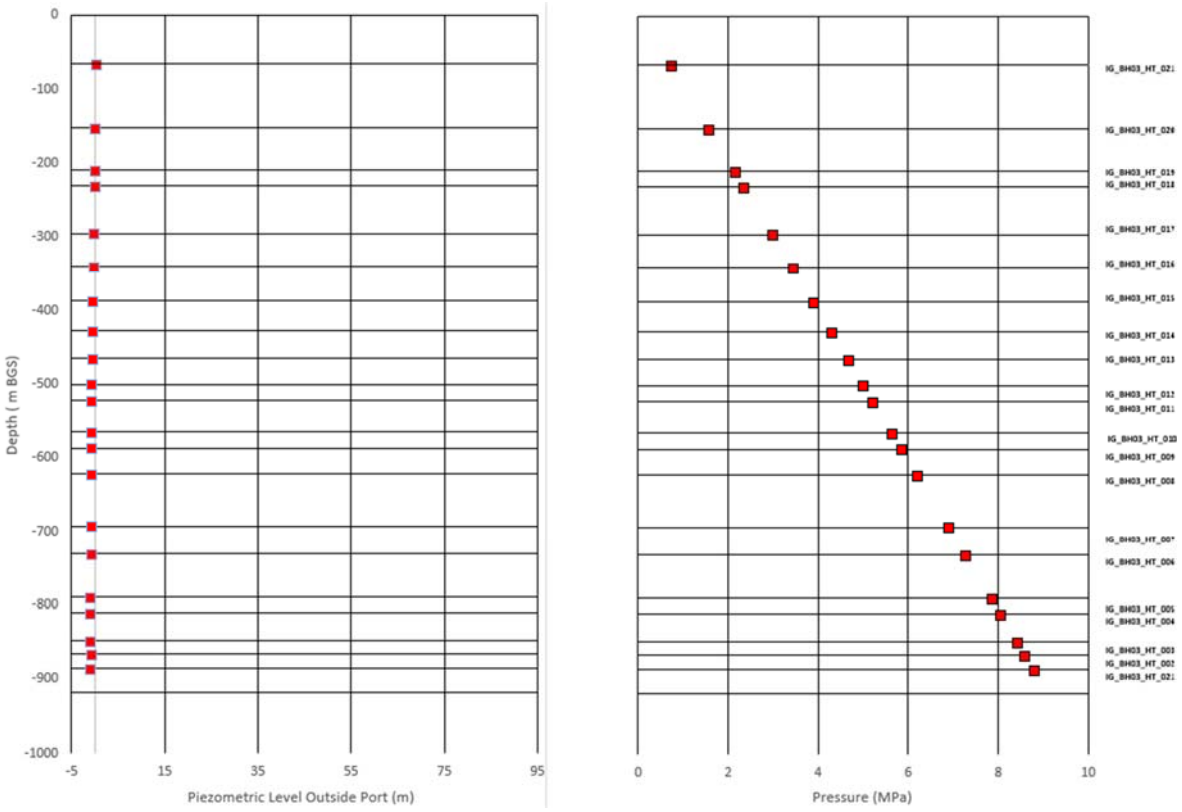


Figure 6: IG_BH03 Pre-Inflation Pressure Profile

Temperature measurements were made to an accuracy of ± 0.01 ºC during the pre-inflation pressure profiling. The resulting temperature profile (Figure 7) shows a linear increase with depth from approximately 6.09 ºC at 68 m to 12.98 ºC at 868.72 m depth. Excluding the first temperature reading at interval IG_BH03_HT_001, the temperature increased linearly. The temperature reading at IG_BH003_HT001 was the first one collected, and so the probe may not have had enough time to stabilize to the ambient temperature of the borehole prior to the collection of the reading.

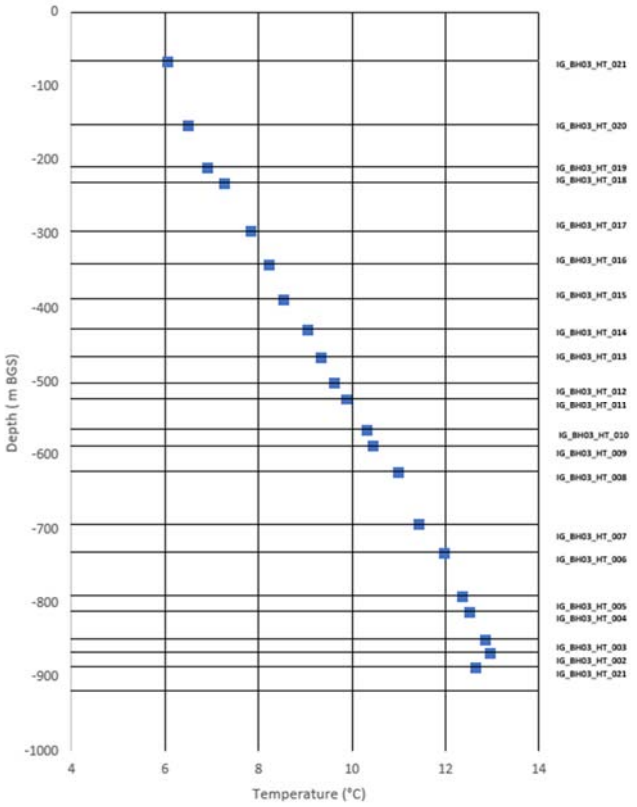


Figure 7: IG_BH03 Pre-Inflation Temperature Profile

3.6 Packer Inflation

Packers were inflated with fluorescein-traced water using the Westbay Model No. 6055 vented inflation tool, previously shown on Figure 5. The six packers exposed below the base of the guide tube were inflated in sequence beginning with the lowest. Injection pressure (packer element pressure) and pumped volume were measured at intervals (typically one reading for each 0.5 litres pumped) and manually recorded in the Packer Inflation Field Records provided in Appendix C. Following the inflation of the lowest six packers, the guide tube was raised to 156 m (down hole).

On the morning of November 19, 2019 during the process of removing HQ drill rods to raise guide tube up to 156 m, the uppermost drill rod was momentarily left unsupported and it toppled, damaging the uppermost section of the Westbay completion string. This uppermost casing section was a temporary section used manipulate the string during installation. Three fragments of this uppermost casing section, each several centimetres in size, broke off and fell into the borehole between the guide tube and Westbay completion string. Work was stopped, and a retrieval plan was developed and implemented (Appendix D) in an attempt recover the lost fragments and then continue the Westbay installation.

The largest of the three fragments was recovered but attempts to recover the two smaller fragments were unsuccessful. Based on the size of the gap between inside of the guide tube and the outside of the abrasion protectors, it was assumed that the two smaller fragments could not have dropped below 68 m downhole (the top of the uppermost abrasion protector). It was decided to resume the Westbay installation process the following

day, with the understanding that the guide tube would not be raised above this level until all of the packers below that position were successfully inflated.

On November 20, 2019, the process of raising the guide tube to 156 m downhole was completed, and packers 7 through 19 were inflated thereafter on November 21. On November 22, the guide tube was raised to 78 m downhole so that Packer 20 could be inflated, and on November 23, the guide tube was raised to just below the position of the shallowest abrasion protector so that Packer 21 could be inflated. After the final packer was inflated, the remaining guide tube was removed from the borehole. Packer inflation was completed on November 23, 2019, and all packers were functioning correctly.

3.7 Final Testing / Post-emplacement Profiling

Following the packer inflation and final measurements of the Westbay MP38 component string, a post-emplacement pressure profile was performed on November 23, 2019. The Westbay MOSDAX pressure probe was used to measure formation pressures in the packer-isolated borehole intervals outside the Westbay casing. Pressures measured by this equipment are total, or absolute pressures, which include groundwater pressure and atmospheric pressure. The atmospheric pressure component is removed from the formation pressure by measuring the atmospheric pressure with the probe at ground level and subtracting the atmospheric pressure (at the time of measurement) from the formation pressure. These pressure measurements are reported in Appendix B while a graphical presentation of the results is shown on Figure 8.

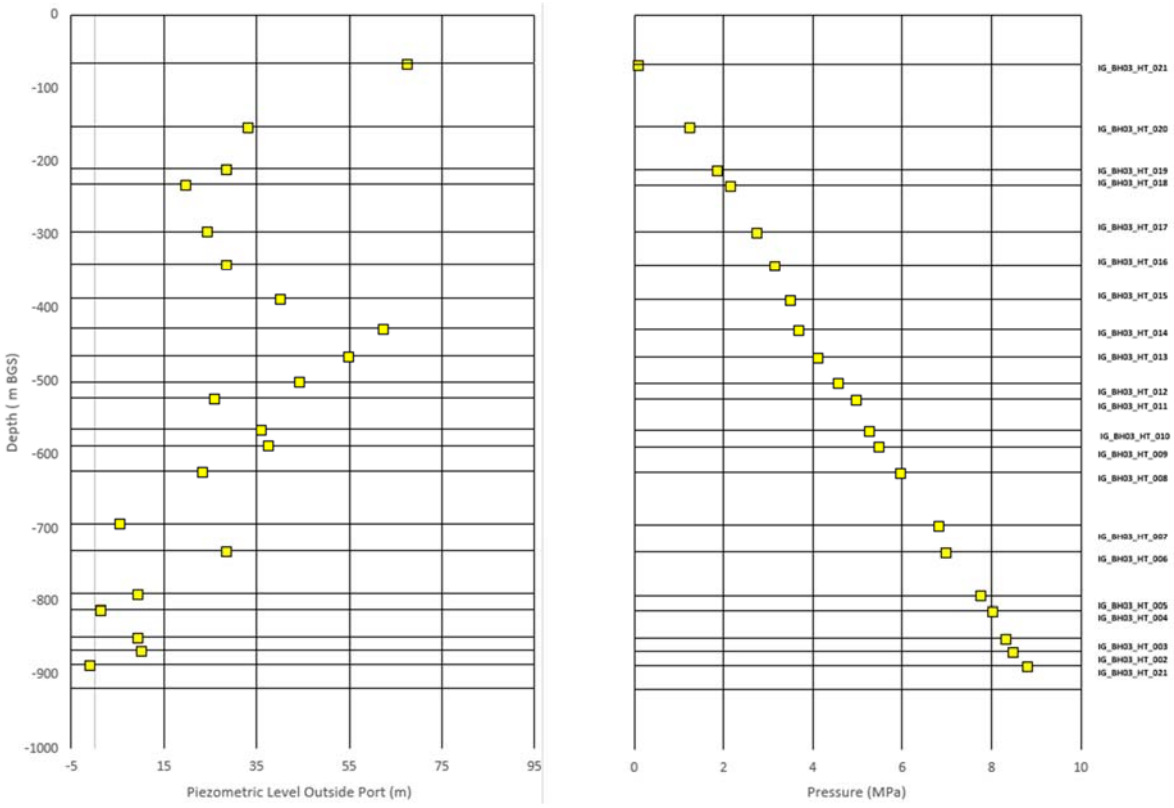


Figure 8: IG_BH03 Post-Inflation Pressure Profile from November 23, 2019

The post-inflation pressures shown above shows changes from open-hole pressures previously shown in Figure 6. These pressures were likely affected by testing and installation procedures and are not considered to be

representative of equilibrium conditions. Long-term formation pressure conditions will develop over time as packer-isolated test intervals re-equilibrate from drilling and testing disturbances. Subsequent post-emplacement pressure profile measurements were collected on December 10, 2019. A plot showing the measured interval pressures over time is provided on Figure 9, and the measurements are reported in Appendix B.

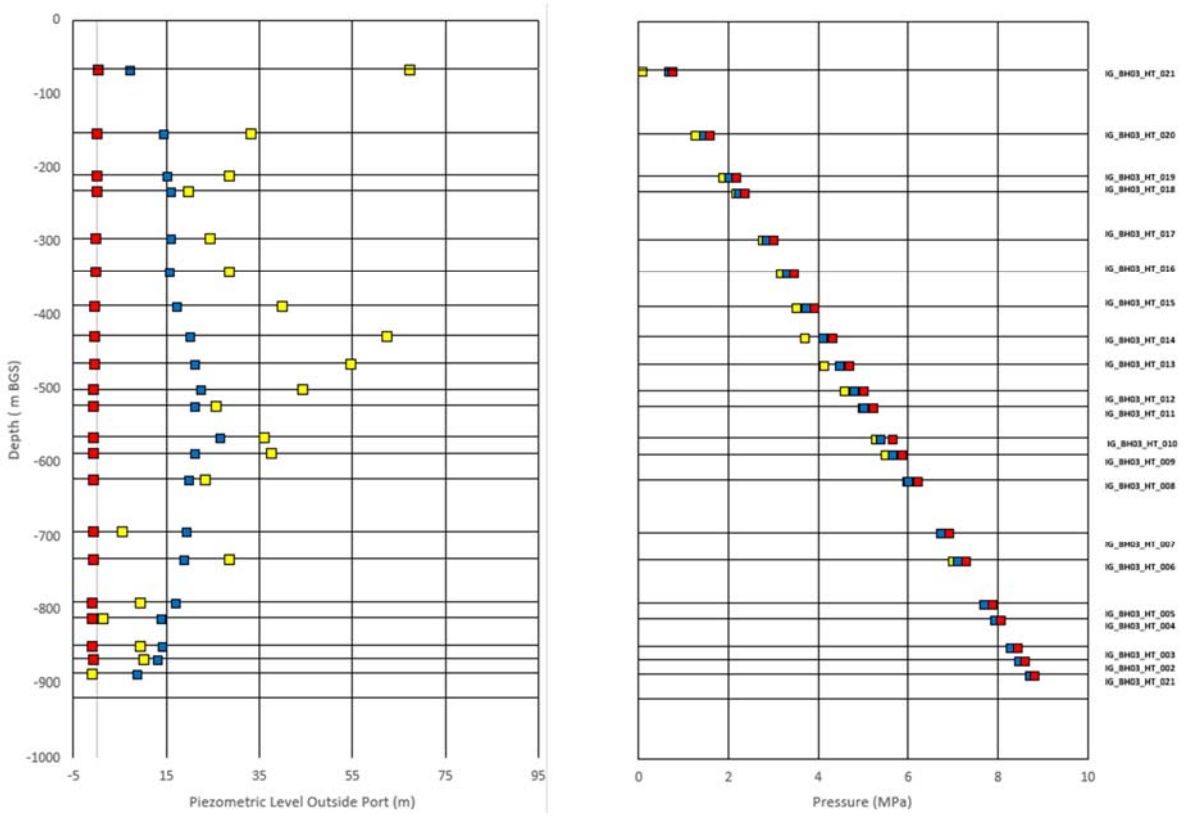


Figure 9: Changes in Pressures at IG_BH03, Pre and Post Packer Inflations, November and December 2019

Pressures measured on: November 17, 2019 (Prior to packer inflation) November 23, 2019 (Post Packer Inflation); December 10, 2019 (2 weeks post Packer inflation).

The thermal gradients from the pre and post emplacement are shown on Figure 10 below and did not vary significantly between the three monitoring events.

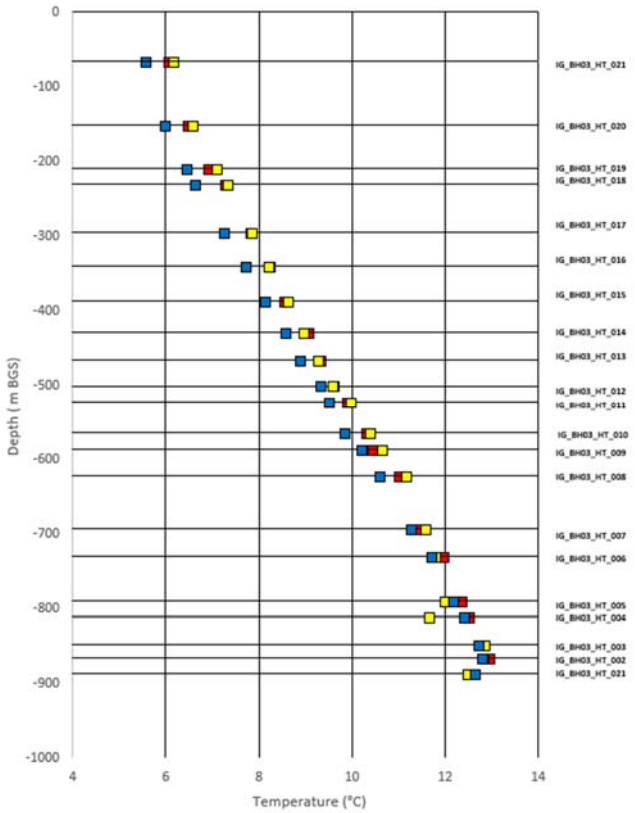


Figure 10: Changes in Temperatures at IG_BH03, Pre and Post Packer Inflations in November and December 2019

Temperatures measured on: November 17, 2019 (Prior to packer inflation) November 23, 2019 (Post Packer Inflation) December 10, 2019 (2 weeks post Packer inflation).

3.8 Wellhead Completion

Following the MP38 installation, and post-inflation pressure profiling, the wellhead was completed by emplacing a Westbay MP38 cap and threading on steel PWT riser with locking cap and monopod bracket (Figure 11).

Figure 11: IG_BH03 Wellhead with protective casing and monopod bracket installed.

The as-built borehole collar and casing installation was surveyed on January 14, 2020 by Rugged Geomatics Inc., and the as-built coordinates of IG_BH03 are presented in Table 2.

Table 2: IG_BH03 Final Surveyed Collar and Casing Coordinates

Point	Northing (m)	Easting (m)	Elevation (m)	Comment
Ground Surface (reference point during drilling)	556171.46	5484534.33	441.561	Calculated E, N & Elev
Sump weld	556171.47	5484534.50	442.02	Provided E, N & Elev
Top of conductor(PWT) casing	556171.49	5484534.62	442.36	Calculated E & N
Top PQ Weld	556171.49	5484534.63	442.38	Calculated E & N
Top of surface (PQ) casing	556171.50	5484534.81	442.88	Calculated E & N
Top of Westbay Casing	556171.50	5484534.80	442.86	Calculated E & N

Note: Elevations are Geodetic and referred to the CGVD28 Datum and coordinates are referred to UTM Zone 15, NAD 83 (CSRS).

4.0 DATA QUALITY AND USE

Data presented in this report describe the installation and completion of Westbay MP38 multilevel monitoring casings in borehole IG_BH03 as well as the rationale for selection of multilevel monitoring intervals. Initial post-inflation pressure data obtained from these completions support the conclusion that the MP38 casing systems are operating as intended.

5.0 REFERENCES

Blackburn, C.E. and Hinz, P., 1996. Gold and base metal potential of the northwest part of the Raleigh Lake greenstone belt, northwestern Ontario-Kenora Resident Geologist's District; in Summary of Field Work and Other Activities 1996, Ontario Geological Survey, Miscellaneous Paper 166, p.113-115.

DesRoches, A., Sykes, M., Parmenter, A. and Sykes, E., 2018. Lineament Interpretation of the Revell Batholith and Surrounding Greenstone Belts (Nuclear Waste Management Organization. No. NWMO-TR-2018-19.

Golder (Golder Associates Ltd.), 2019. Phase 2 Initial Borehole Drilling and Testing, Ignace Area - Initial Borehole Characterization Plan for IG_BH03.

Golder, 2019. Phase 2 Initial Borehole Drilling and Testing, Ignace Area - WP09 Test Plan - Westbay MP38 Multi-Level Groundwater Monitoring System Installation for IG BH03.

Golder and PGW (Paterson Grant and Watson Ltd.), 2017. Phase 2 Geoscientific Preliminary Assessment, Geological Mapping, Township of Ignace and Area, Ontario. NWMO Report Number: APM-REP-01332-0225.

OGS (Ontario Geological Survey), 2011. 1:250 000 scale bedrock geology of Ontario, Ontario Geological Survey, Miscellaneous Release Data 126 - Revision 1.

Parmenter, A., Waffle, L. and DesRoches, A., 2020. An updated bedrock geology map and geological database for the northern portion of the Revell batholith (No. NWMO-TR-2020-08). Nuclear Waste Management Organization.

SGL (Sander Geophysics Limited), 2015. Phase 2 Geoscientific Preliminary Assessment, Acquisition, Processing and Interpretation of High-Resolution Airborne Geophysical Data, Township of Ignace, Ontario. Prepared for Nuclear Waste Management Organization (NWMO). NWMO Report Number: APM-REP-06145-0002.

SRK (SRK Consulting, Inc). and Golder, 2015. Phase 2 Geoscientific Preliminary Assessment, Observation of General Geological Features, Township of Ignace, Ontario. Prepared for Nuclear Waste Management Organization. NWMO Report Number: APM-REP-06145-0004.

Stone, D., 2009. Geology of the Bending Lake Area, Northwestern Ontario; in Summary of Field Work and Other Activities 2009. Ontario Geological Survey. Open File Report 6240.

Stone, D., 2010a. Geology of the Stormy Lake Area, Northwestern Ontario; in Summary of Field Work and Other Activities 2010. Ontario Geological Survey, Open File Report 6260.

Stone, D., 2010b. Precambrian geology of the central Wabigoon Subprovince area, northwestern Ontario. Ontario Geological Survey, Open File Report 5422.

Stone, D., Halle, J. and Chaloux, E., 1998. Geology of the Ignace and Pekagoning Lake Areas, Central Wabigoon Subprovince; in Summary of Field Work and Other Activities 1998, Ontario Geological Survey, Misc. Paper 169.

Stone, D., Davis, D.W., Hamilton, M.A. and Falcon, A., 2010. Interpretation of 2009 Geochronology in the Central Wabigoon Subprovince and Bending Lake Areas, Northwestern Ontario, in Summary of Field Work and Other Activities 2010, Ontario Geological Survey, Open File Report 6260.

ATK/GWS/JLC/sa

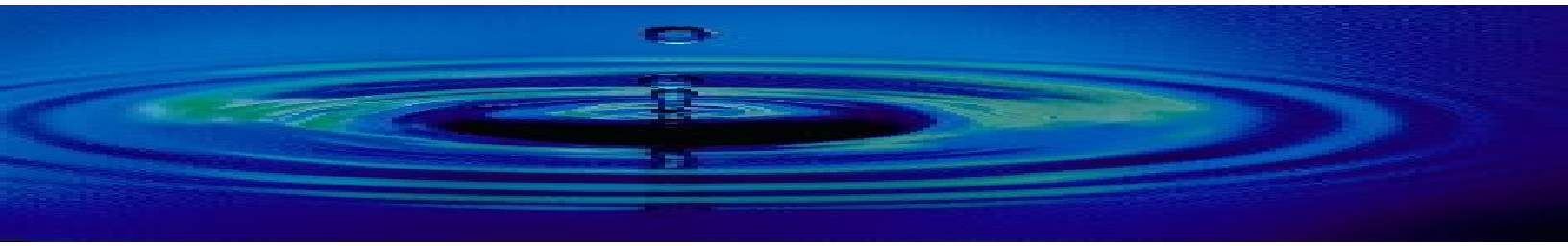
https://golderassociates.sharepoint.com/sites/13226g/technical work bh03/wp09 westbay installation/12 final report jan2021/1671632a (2911) ig_bh03 wp09 report 25jan2021 r1a.docx

APPENDIX A

Westbay MP38 Completion Report

Completion Report Rev.1

Well Name: IG_BH03



April 2, 2020

Completion Report Rev.1

Well Name: IG_BH03

Project Number: WB973

Prepared for:

Golder Associates Ltd.

Prepared by:

Westbay Instruments
A Division of Nova Metrix Ground Monitoring (Canada) Limited.
8610 Glenlyon Parkway
Unit 134
Burnaby, BC
V5J 0B6

CONTENTS

TABLES

FIGURES

APPENDICES: IG-BH03

A	Westbay Field QA Summary Form
B	Westbay Completion Log (field copy)
C	Summary Completion Log
D	Tubing Summary (field copy)
E	Summary Completion Log (field copy)
F	Pre-Inflation Pressure Profile
G	Westbay System Packer Inflation Records
H	As-Built Data Tables 6 and 7
I	Post Inflation Pressure Profile
J	Technical Memorandum - Retrieval Plan

1. Introduction

This Report and the attached Appendices document the technical services carried out by Westbay Instruments (Westbay) under contract to Golder Associates Ltd. (Golder), as part of the Phase 2 Initial Borehole Drilling and Testing, Ignace Area, for the Nuclear Waste Management Organization (NWMO). The Westbay System was installed in borehole IG_BH03, located in the Revell batholith area, 42 kilometres (km) northwest of Ignace, Ontario, Canada.

Westbay technical services representatives Mr. Mark Lessard and Mr. Tony Kim were on site for installation of the Westbay System from November 5 to November 24, 2019. Golder representative Mr. Adrian Kowalchuk was on-site to supervise the installation of the Westbay System. This report documents the installation tasks and related Quality Assurance (QA) checks. The work was carried out in accordance with the Golder Test Plan entitled "WP09 Test Plan - Westbay MP38 Multi-Level Groundwater Monitoring System - Installation for IG BH03".

2. Pre-Installation Activities

The borehole was drilled/cored at a nominal diameter of 98 mm (HQ-size) by wireline coring methods. The borehole was drilled at an azimuth of approximately 185 degrees and inclined approximately 70 degrees from horizontal. Drill water supplied from the Town of Ignace municipal water traced with 100 ug/L fluorescein was used as the water source during drilling and flushing of the borehole. A PQ surface casing with a nominal 114.3 mm outer diameter (OD) was advanced to 71 metres (m) downhole, and a PWT conductor casing (139.7 mm OD) was advanced to 5.81 m downhole. Both casings were cemented in place using positive displacement methods.

Borehole geophysical logging and hydraulic testing was carried out prior to the installation of the Westbay System in the borehole. The geophysical logging included Static Fluid Temperature / Resistivity, Flowing Fluid Electrical Conductivity (FFEC), Mechanical Caliper, Optical Televiewer, Acoustic Televiewer, Natural Gamma, Electromagnetic Induction (Apparent Conductivity), Magnetic Susceptibility, Neutron, Gamma-Gamma (Density), Full Waveform Sonic, Normal Resistivity, Spontaneous Potential and Single Point Resistance, Static and Dynamic Heat Pulse Flowmeter, Spectral Gamma, and Borehole Deviation. For the hydraulic testing, slug, pulse and constant rate pumping tests were performed.

(Note: all depths discussed in this report are depths downhole with respect to a reference point at ground surface, which was defined as "0". Reference elevations were not available at the time of writing).

3. Installation

Westbay Instruments technical services representatives Mr. Lessard and Mr. Kim, and Mr. Kowalchuk of Golder were on site to install the Westbay System in IG_BH03 as indicated below in Table 1.

(Note: Reference elevations were not available at the time of writing).

Table 1: Summary of Westbay System Installation

Well Name.	Field Installation Dates	Total Depth (m)*	MP38 Tubing Length (m)*	No. Monitoring Zones
IG_BH03	November 14 to 24, 2019	1000.6	985.8	21

** Due to the inclined nature of the borehole, depths are measured in metres downhole rather than metres below ground surface.*

The Westbay System in IG_BH03 was installed according to the procedure described below. A summary of the QA checks conducted during the installation, including the dates for each task, is documented on the Westbay Field QA Summary Form in Appendix A.

3.1 Preparation of Westbay System Design

Packer depths for the Westbay System were provided to Westbay by Golder, and a well design was created by Westbay based on these depths. The well design was used to prepare a Westbay Completion Log, which specifies the location of the Westbay System components in the well. This log was reviewed and approved in the field by Golder prior to installation of the Westbay System. The Westbay Completion Log as approved was used as an installation guide in the field. A field copy of the log is in Appendix B.

A measurement port coupling was included in 21 monitoring zones to measure groundwater formation pressures and collect groundwater formation samples. A Model 0206 hydraulic pumping port coupling was included in 11 selected zones to provide purging and hydraulic conductivity testing capabilities. Golder requested that optional geotextile filters (made of polyethylene terephthalate [PET] fabric) were to be installed over the measurement port couplings.

A summary of the installed Westbay System components is shown in Table 2 below (also in the Summary Completion Log Legend in Appendix C).

Table 2: Summary of Installed Westbay System Components

Well Name	Packers (0238)	Measurement Ports (0205)	Pumping Ports (0206)
IG_BH03	21	21	11

3.2 Layout of Westbay System Tubing Components

Prior to installation in the borehole, the Westbay System components were set out in a heated warehouse according to the sequence indicated on the Westbay Completion Log. Data collected during the layout were recorded on the Tubing Summary (field copy) in Appendix D and the Summary Completion Log (field copy) in Appendix E. Each casing length was numbered and measured beginning with the lowermost as an aid to confirming the proper sequence of components. The appropriate Westbay System couplings were attached to each casing section. Magnetic location collars were attached 0.6 m below the top of the measurement port couplings in the monitoring intervals.

Since the borehole was inclined at 70 degrees from horizontal, abrasion protectors were used to protect the packers and pumping ports from damage during deployment. The abrasion protectors were clamped to the outside of the Westbay tubing at specified positions. There were two abrasion

protectors per packer, one abrasion protector per pumping port, and two abrasion protectors for the bottom section of Westbay tubing. In addition, a special tapered end plug was attached to the bottom of the Westbay tubing.

The components were re-sealed in their plastic protective covers and re-boxed for transport to site. Once on site, the components were arranged on racks in a heated trailer.

Each component was visually inspected. Serial numbers for each packer, pumping port and measurement port coupling were recorded on the Westbay Completion Log (field copy) in Appendix B and Summary Completion Log (Field Copy) in Appendix E. The component layout was confirmed with the log before the components were lowered into the borehole.

Notes about design revisions: After the layout of Westbay components was completed, the design was modified as instructed by the on-site Golder representative and as indicated on the Westbay Completion Log (field copy).

- The component #387 was changed to 1-ft from 2-ft tubing to reduce the final height of the Westbay installation. This assisted in allowing the drill rig to be removed from the drill pad without coming into contact with the Westbay installation. The uppermost permanently installed Westbay casing item is #387 as noted on the Summary Completion Log in Appendix C, equivalent to #387 on the Westbay Completion Log (field copy) in Appendix B.

3.3 Lowering of Westbay System Components

Steel HQ drill rods (used as a guide tube) were lowered into the borehole to 778 m downhole to provide temporary protection from materials that may become dislodged from the borehole wall during installation of the Westbay tubing string. The Westbay System components were lowered into the guide tube by hand and with a hoist on the drill rig. The lowering of components started on November 14, 2019 and finished on November 17, 2019. Each joint was tested with a minimum internal hydraulic pressure of 150 pounds per square inch (psi) for one minute to confirm hydraulic seals. A record of each successful joint test and the placement of each component are noted by check marks on the Westbay Completion Log. Fluorescein-traced water supplied by Golder was added to the Westbay System when necessary to counter buoyancy effects while components were lowered into the borehole and was used for as a secondary test of joint seals during lowering.

3.4 Hydraulic Integrity Testing

On November 17, 2019, after the Westbay System string was lowered into the borehole, the water level inside the Westbay System completion was monitored at a depth different from the open borehole water level for a minimum period of thirty minutes to confirm hydraulic integrity of the completion. The data from the hydraulic integrity test are shown on the third page of the Westbay Completion Log (field copy) in Appendix B and in Table 3 below.

Table 3: Hydraulic Integrity Test

Well Name	November 17, 2019	Fluid Levels	
	Time	Inside Tubing	Outside Tubing
IG_BH03	13:30	137.50m (451.110 ft)	*0.96m (3.15 ft)
	13:40	137.50m (451.100 ft)	*Measurement was taken on

	13:50	137.49m (451.095 ft)	November 13, 2019 just prior to
	14:00	137.49m (451.095 ft)	lowering Westbay System.
	14:10	137.49m (451.095 ft)	
	14:20	137.49m (451.095 ft)	
	14:30	137.49m (451.095 ft)	

3.5 Positioning of Westbay System Completion

After the completion of hydraulic integrity testing, the Westbay System was positioned as illustrated on the Westbay Completion Log (field copy) in Appendix B. The Westbay System was supported in this position from the surface with mechanical grips while the packers were inflated. The positioning of the Westbay System components is based on the "nominal" lengths of Westbay System components. The positioning calculations do not include allowances for borehole temperature or deviation effects.

Figure 1, entitled “MOSDAX Transducer Position” illustrates how the position of the MOSDAX transducer is correlated to the reference position at the top of a measurement port. Figure 2, entitled “Dimensions of Packer Seals and Monitoring Zones” outlines the calculations used to determine the packer depths and length of each monitoring zone.

3.6 Pre-inflation Profile

On November 17, 2019 a pre-inflation pressure profile was performed prior to inflating the packers, in order to confirm the proper position and operation of measurement ports and magnetic collars. All measurement ports and magnetic collars were confirmed to be operating properly and correctly positioned within the borehole. A plot of the Pre-inflation Piezometric levels in all zones is shown on Figure 3. Note that the plot includes a reference to ‘equivalent depth to water’ which is the calculated piezometric level as defined on the Westbay Piezometric Pressures/Levels Field Data and Calculation Sheet completed for each pressure profile. The field data calculation sheets for the pre-inflation pressure profile are provided in Appendix F.

3.7 Inflation of Westbay System Packers

3.7.1 Initial packer inflation activities (Nov. 18, 2019)

The Westbay System packers were inflated sequentially beginning at the bottom of the well using fluorescein-traced water provided by Golder.

The packer inflation was coordinated with removal of the temporary guide tube. The guide tube was initially positioned to a depth of 778 m downhole, allowing the lower six packers (packers 1 through 6) to be exposed in the open borehole. Packers 1 through 6 were inflated on November 18, 2019, and three 2-ft tubing components (numbers 388, 389, and 390) were added temporarily to assist with handling of the Westbay system during completion. These three temporary components were removed after the packer inflation was complete.

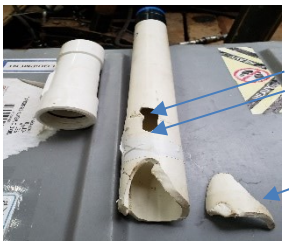
3.7.2 Component retrieval activities (Nov. 19, 2019)

On the morning of November 19, the top section of the Westbay completion (temporary component number 390) was damaged while the drilling contractor was preparing to raise the guide tube. Due to the damage, three pieces of the broken Westbay component fell in between the Westbay tubing and the guide tube. The installation operation was stopped, and this incident was reported to Golder. A conference call was set up among Westbay, Golder, and the NWMO to develop a work plan for retrieving the broken pieces. The memorandum regarding the retrieval plan is provided in Appendix J.

One large piece and two small pieces of the broken component were observed in the annulus when the incident occurred. The large piece was visible from the surface, but two small pieces fell further into the well. It was speculated that the two small pieces might have fallen to the location of the first abrasion protector, which was large enough diameter to prevent the pieces from falling any further. It was believed that two small pieces were unlikely to have passed the first abrasion protector based on the observed sizes of two pieces and the clearance between the abrasion proctor and the guide tube.

A summary of the retrieval activities to recover the broken pieces is presented in Table 4, below.

Table 4: Summary of Retrieval Activities (November 19, 2019)

Time	Activity / Comment
Around 08:00	Westbay Component # 390 (2-ft tubing) was damaged.
09:30 to 14:00	Supplies procurement for retrieval work and Conference call at 13:00.
15:45 to 16:10	Retrieval of the largest piece was successful. The retrieved piece is shown in Photo 1.  Photo 1
16:10 to 17:30	Setting up a pump and a sump for flushing the hole in attempt of retrieval of two small pieces
17:30 to 18:30	Circulated about 420 liters of water with a pump rate of 7 liters per minute but no broken segments were captured in the sump.
18:30 to 19:00	It was agreed that the flushing rate would not achieve sufficient flow to raise the broken pieces out of the borehole. The retrieval attempt for the two small pieces was abandoned, and the guide tube would continue to be raised the following morning.

3.7.3 Final packer inflation activities (Nov. 20-23, 2020)

On November 20, following the retrieval activities outlined in Section 3.7.2, the guide tube was raised to 156 m downhole and packers 7 through 19 were inflated. On November 22, following inflation of packers 7 through 19, the guide tube was raised to 78 m downhole, so that packer 20 could also be inflated.

On November 23, the guide tube was positioned just below the upper abrasion protector of the packer 21 to protect the packer from the two un-retrieved broken pieces.

The Westbay Model No. 6055 vented inflation tool was used for packer inflation. All the packers appear to have inflated properly. The data for inflation of each packer are provided on the Westbay Packer Inflation Records included in Appendix G.

3.8 De-Stressing of Westbay System

Westbay's procedure for de-stressing the Westbay tubing is used to reduce the long-term load on the upper components. In this procedure the initial hanging weight of the Westbay string is applied in increments to selected packers after they have been inflated. In this process the top of the Westbay completion is lowered, and the positions of the shallower ports and packers are affected. Thus, after all packers have been inflated, the weight of the Westbay completion is evenly distributed among the packers. The final clamp-off weight is supported at the well top. The depths of ports and packers are adjusted to account for the cumulative effect of the lowering. A summary of the de-stressing results is provided in Table 5. The final positions of the Westbay casing components (ports and packers) are shown on the Summary Completion Log (Appendix C) and Tables 6 and 7 (Appendix H).

Table 5: Summary of De-Stressing Results

Well Name	Weight after inflating 6 packers (lbs)	Final Clamp-off Weight	Total Vertical Movement at surface (m)	Beginning stick-up (m)	End stick-up (m)
IG_BH03	900	75	1.29	2.16	0.87

**Measurements of distance and weight taken from the temporary stick-up above datum before wellhead completion was built. The weight scale output is in pounds (lbs).*

4. Formation Pressure Measurements

On November 23, 2019, after all packers were inflated, formation pressures were measured at each of the 21 measurement ports. At that time, the formation pressures may not have recovered from the pre-installation activities. The effects of installation on formation pressures are more likely to occur in monitoring zones located in low-permeability geological formations, and longer-term monitoring may be required to establish representative fluid pressures.

A plot of the post-inflation piezometric pressure and groundwater levels is provided on Figure 4. Note that the plot includes a reference to 'equivalent depth to water' which is the calculated piezometric level as defined on the Westbay Piezometric Pressures/Levels Field Data and Calculation Sheet completed for each pressure profile The field data calculation sheets for the post-inflation pressure profile are provided in Appendix I.

The post-inflation data were examined to confirm proper operation of the measurement ports and to confirm the proper operation of packer seals between monitoring zones.

Future pressure profile measurements: It should be noted that for QA purposes, the post-inflation formation pressure measurements used the same port depths as the pre-inflation pressure measurements. These do not include adjustments for the effect of the de-stressing procedure whereby the as-built depths of shallower ports are slightly deeper than the pre-inflation depths. Future pressure profile measurements and calculations should use the adjusted port depths documented in Tables 6 and 7 in Appendix H.

In conclusion, the subject Westbay System completion was installed successfully as documented in this report.

Figure 1:

MOSDAX Transducer Position

In a Westbay MP38 System Measurement Port Coupling P/N 0205

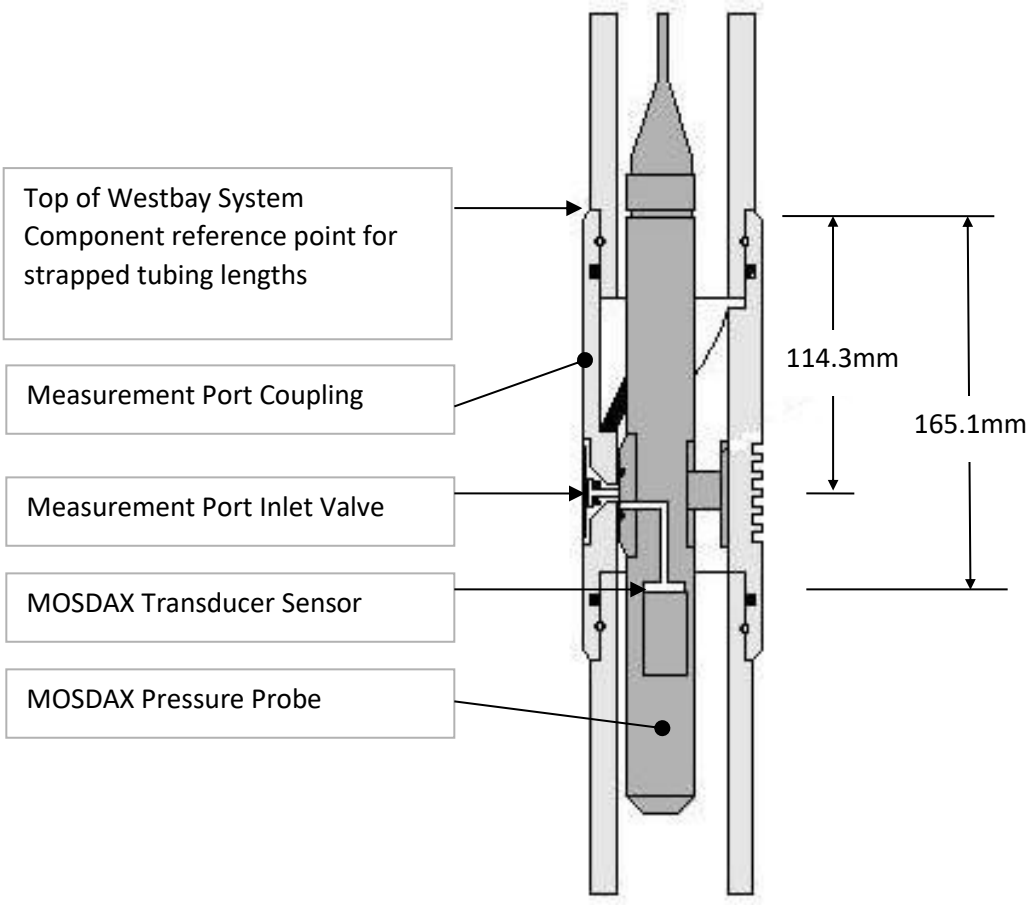
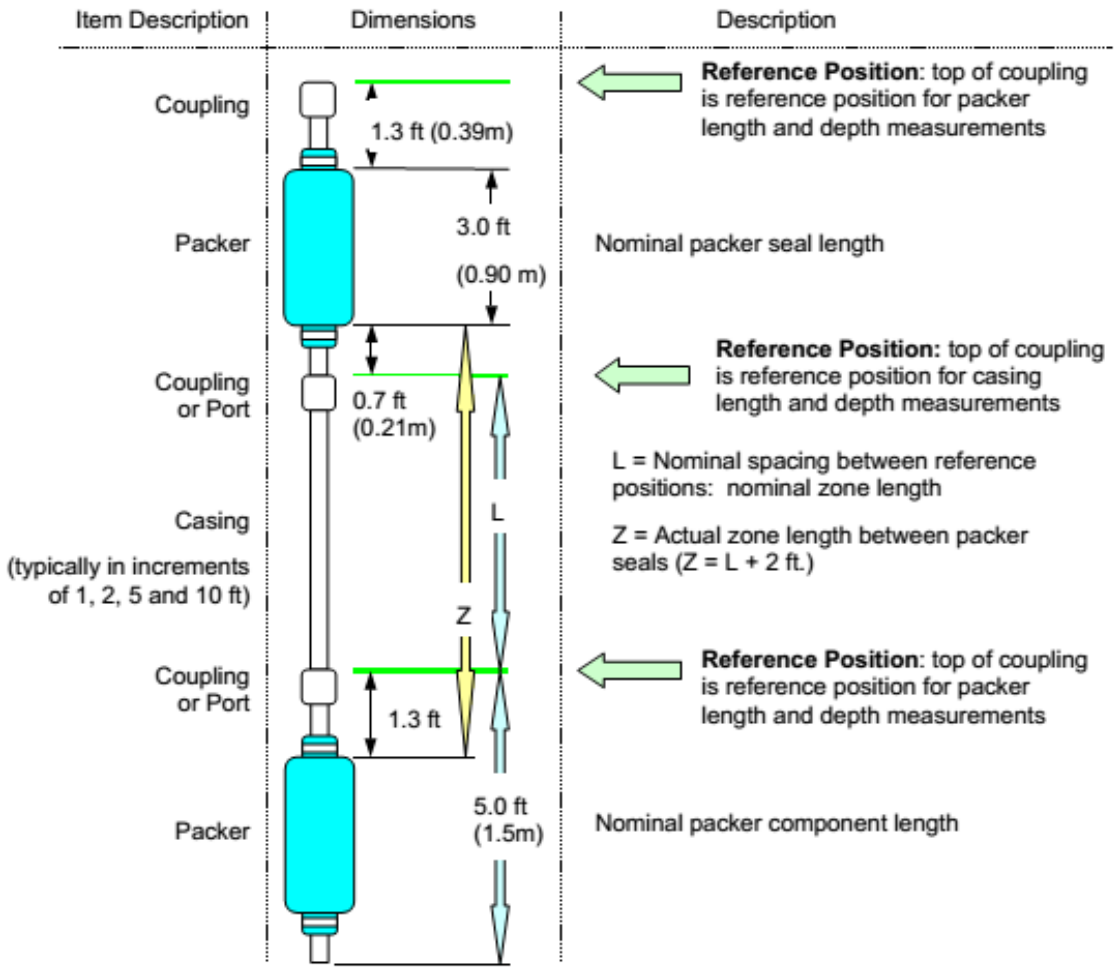


Figure 2:

Dimensions of Packer Seals and Monitoring Zones Westbay MP38 System 0238 Packers

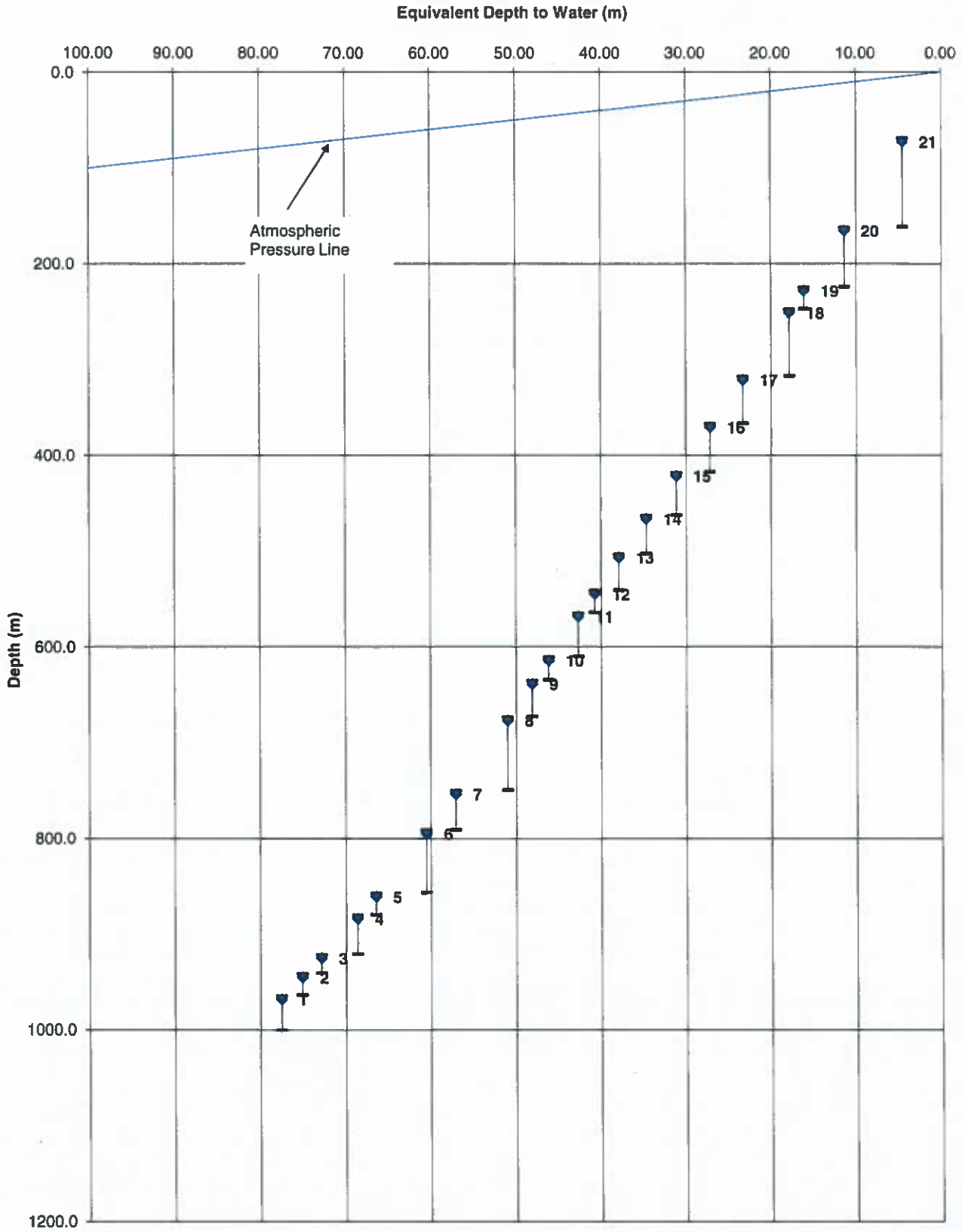


Discussion Points:

- The top of a coupling (Regular Coupling, Measurement Port or Pumping Port) is the reference point for describing nominal depths and nominal lengths. Actual positions of packer seals and zone lengths are determined with respect to the appropriate reference positions.
- Packer Position Example: A packer with a nominal depth of 50 ft (15.2m), will have a nominal packer seal position of 51.3 to 54.3 ft. (15.59 to 16.49m)
- Zone Length Example: A zone whose upper packer is at 50 ft (15.2m) and bottom packer is at 70 ft (21.3m) will have a nominal zone length of 15 ft (4.6m) and an actual zone length (between packer seals) of 15.0+1.3+0.7 = 17.0ft. (4.6 + 0.39 + 0.2 = 5.19m)
- Information on the position of Measurement Port Valve and MOSDAX Transducer sensor, used for detailed calculation of piezometric level measurements, are described separately.

Piezometric Profile:
Monitoring Well:IG_BH03

Profile Date:November 17, 2019
Comments:Pre-Inflation Profile



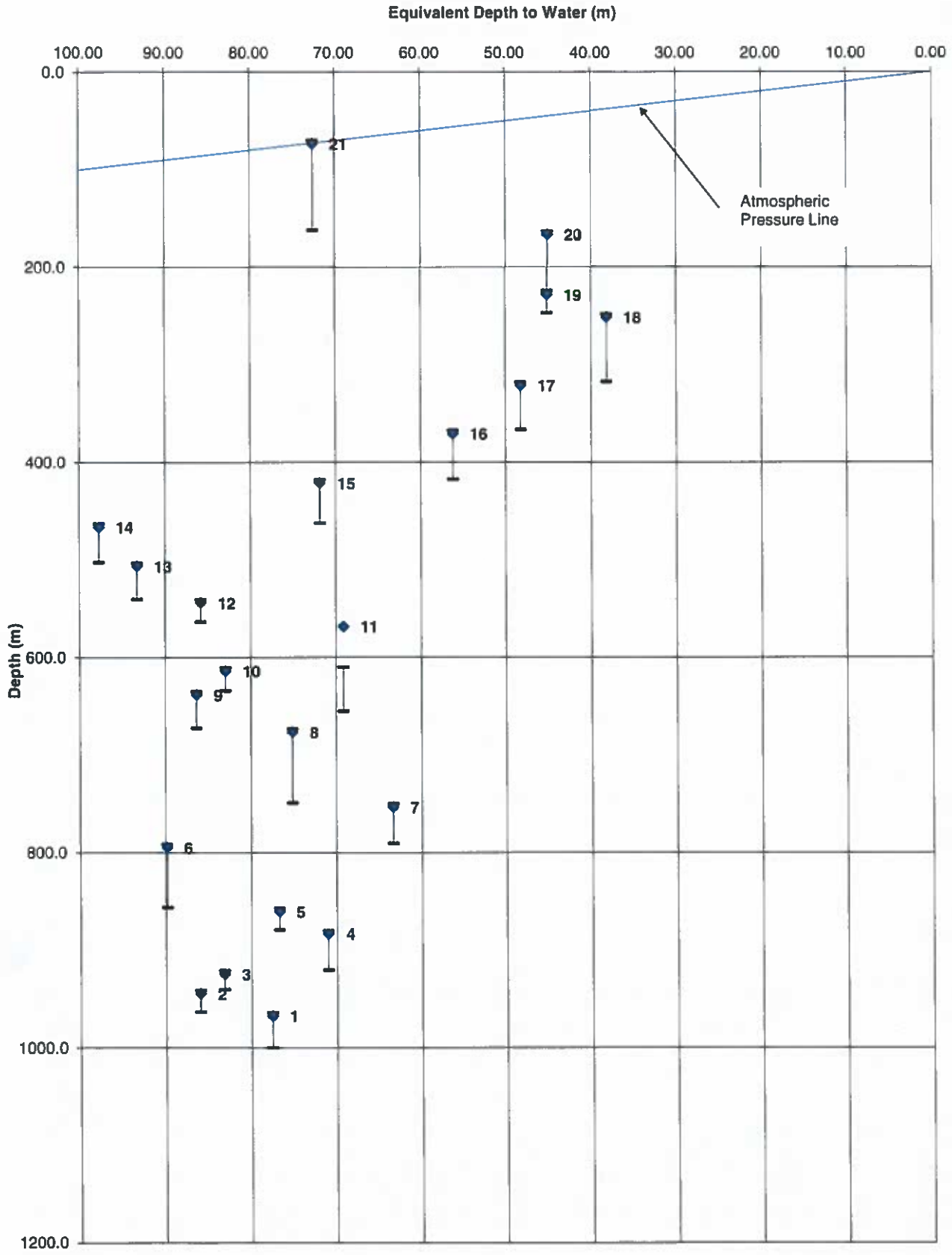
Client:Golder/NWMO
Site:Ignace, ON
Datum:Ground Level

Figure3

Plote By: TK Date: Jan 16, 2020
Checked By: DL Date: Jan 16, 2020
Westbay Project: WB 973

Piezometric Profile:
Monitoring Well:IG-BH03

Profile Date:November 23, 2019
Comments:Post-Inflation Profile



Client:Golder/NWMO
Site:Ignace, ON
Datum:Ground Level

Figure 4

Plot By: TK Date: Jan 16, 2020
Checked By: DL Date: Jan 16, 2020
Westbay Project:WB973

APPENDIX A
IG-BH03

WESTBAY FIELD QA SUMMARY FORM

Westbay Field QA Summary Form - 1 page

QA/QC Summary of Westbay System MP38 Installation

Client: Golder / NWMO Project: WB973

Well: IG-BH03

			Check ✔	Initials	Date
1	**Client Data and Approvals**				
	1.1	Client design request and Borehole/Well information	V	TK	Nov 8/19
	1.2	Client approved final design (file name: IG-BH03)	V	TK	Nov 9/19
	1.3	Client decision on filter sleeves for Measurement Ports	V	AK	Nov 13/19
	1.4	Client approval to install, including well and borehole conditions			
Comments					
	Hold Point – Design and well information are complete				
2	**Layout of Completion Components**				
	2.1	Installation Log and Confirmation Log printed from approved design (file name: IG-BH3 . wwl)	V	ML/TK	Nov 12/19
	2.2	Components taken from inventory	V	ML/SB	Nov 8/19
	2.3	Layout completed according to log, plus copy S/N and packer data)	V	ML/SB/TK	Nov 10, 15, 16/19
	2.3	Independent confirmation of layout (use Confirmation Log)	V	ML/SB/TK	Nov 10, 15, 16/19
	2.4	Independent check on laid out length vs design length	V	ML/SB/TK	Nov 10/19
Comments					
	Hold Point – Layout is good to install				
3	**Lowering of Completion String**				
	3.1	Independent staff for layout rack and installation check list	V	AK/HS	Nov 11, 15, 16/19
	3.2	Components individually verified with approved log (with call-back repeat)	V	AK/HS	Nov 11, 15, 16/19
	3.3	Pressure test tool and apparatus verified	V	ML/TK	Nov 14 2019
	3.4	Components pass pressure test	V	ML/TK	Nov 14 2019
	3.5	Tensile loads managed within system limits	V	ML/TK	Nov 14 2019
	3.6	Depth to water in Westbay tube checked and adjusted	V	ML/TK	Nov 17/19
	3.7	Hydraulic integrity test is passed	V	ML/TK	Nov 17/19
	3.8	Pre-Inflation profile is completed, analyzed and accepted	V	ML/TK	Nov 17/19
	3.9	Top of Westbay tubing is positioned according to the approved log	V	ML/TK	Nov 17/19
Comments					
	Hold Point – Completion is good to inflate packers				
4	**Packer Inflation**				
	4.1	Inflation tool and apparatus verified	V	ML/TK	Nov 18-23/19
	4.2	Inflation data recorded on forms at time of inflation	V	ML/TK	Nov 18-23/19
	4.3	Inflation V and P consistent with BH diameter and packer model	V	ML/TK	Nov 18-23/19
	4.4	De-stressing procedure followed (if required)	V	ML/TK	Nov 18-23/19
	4.5	All packers inflated normally	V	ML/TK	Nov 18-23/19
	4.6	Post inflation profile completed, analyzed and accepted	V	ML/TK	Nov 23/19
Comments					
	Hold Point – Packer inflation is complete				
5	**Documentation**				
	5.1	Wellhead completion sketch completed	V	ML/TK	Nov 24/19
	5.2	Draft completion Log and pressure profile data given to client	V	ML/TK	Nov 24/19
	5.3	Completion Report data appendix is complete	V	TK	Jan 15/20
	Installation and Documents Complete				

Signature: _____ **Date:** Jan 15 / 2020

APPENDIX B

IG-BH03

WESTBAY COMPLETION LOG (FIELD COPY)

Westbay Completion Log (field copy) - 22 pages

Westbay Completion Log

Company: Golder/NWMO
Well: IG_BH03
Site: Ignace,ON
Project: Groundwater Characterization Study

Job No: WB973
Author: TK/DL

Well Information

Reference Datum: Ground Level
Elevation of Datum: 0.00 m.
MP Casing Top: 0.00 m.
MP Casing Length: ~~985.62~~ m.
with R.C & plug.
985.79 m
Well Description:
Plastic MP38 System
Other References:
with 21 packers
Added Pumping Port in Zone 10 - Nov 8
Added Pumping Port in Zone 21 - Nov 8

Borehole Depth: 1000.00 m.
Borehole Inclination: 70 degrees
Borehole Diameter: 98.00 mm

File Information

File Name: IG_BH3.WWD
Report Date: Fri Nov 08 17:42:35 2019

File Date: Nov 08 17:37:10 2019

Comments

Zero reference is 0.38m Below top of PWT (GS) - ATK
Filter socks to be used on measurement ports - ATK
Guide tube at 778m from zero reference - ATK
Borehole water level: 0.96m below GS

Log Information

Borehole condition confirmed.	(method) Geophysics	Date: Nov 11/19
MP well design & preparation.	By: TK / ML	Date: Nov 8/19
MP well design checked.	By: ATK / GWS	Date: NOV. 9, 2019
MP well and borehole approved to install.	By: ATK	Date: NOV. 14, 2019

Legend

(Qty) MP Components
(Library - WD Library 04/29/15)

(2) 020101 - MP38 Casing 4 (1F/0.3M)

(10) 020102 - MP38 Casing 3 (2F/0.6M)

(86) 020105 - MP38 Casing 2 (5F/1.5M)

(268) 020110 - MP38 Casing 1 (10F/3M)

(21) 0238 - MP38 Packer - 74mm (5F/1.5M)

(1) 020305 - Tapered End Plug

(356) 0202 - MP38 Regular Coupling

(21) 0205 - MP38 Measurement Port

(11) 0206 - MP38 Hydraulic Pumping Port

(22) 0216 - Magnetic Location Collar

Geology

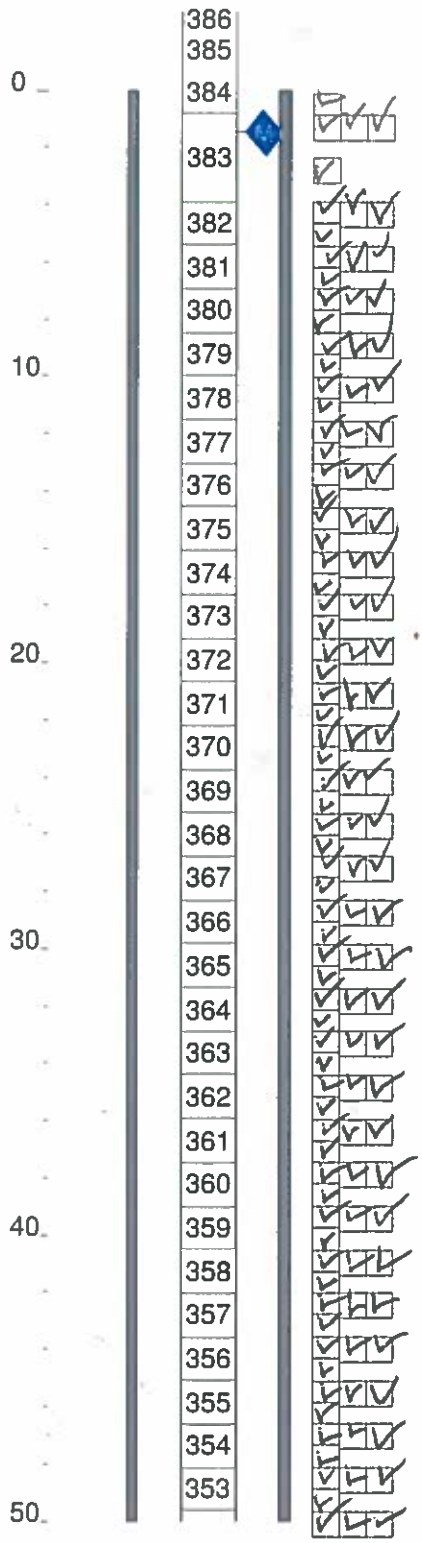
Backfill/Casing

Mild Steel

Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03

R: #387 elevations changed to 1 ft on Nov 24/2019 TK



WB Tubing Description	Serial Numbers
020105 - MP38 Casing 2 (5F/1.5M)	
020110 - MP38 Casing 1 (10F/3M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	

* 387 2ft ✓
386 1ft ✓
385 2ft ✓

12:15 · Nov 17/2019
finished lowering to #387

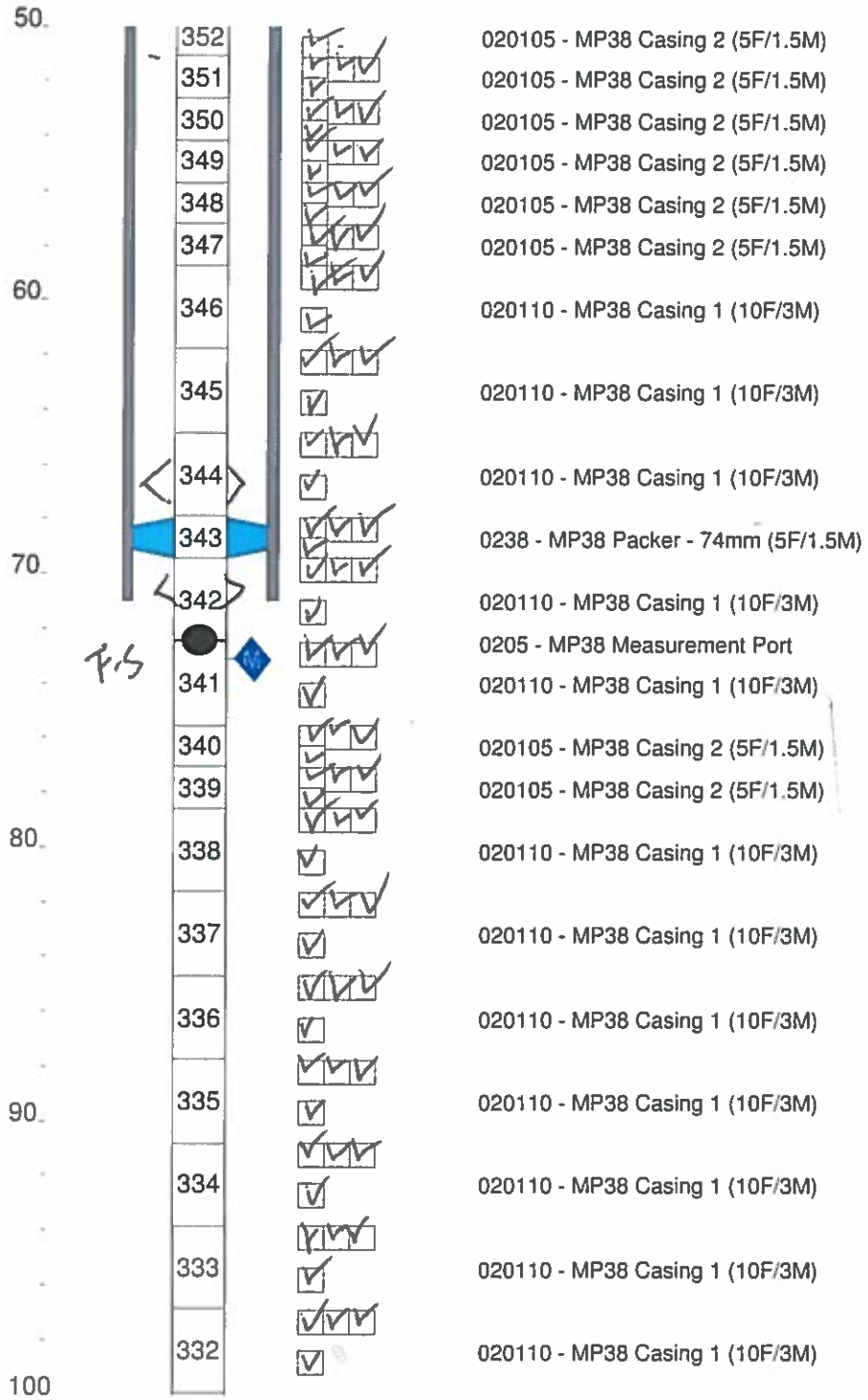
Hydraulic Integrity Test

13:30	451.110	ft
13:40	451.100	ft
13:50	451.095	ft
13:55	451.095	ft
14:00	451.095	ft
14:10	451.095	ft
14:20	451.095	ft

WB is water tight.
Nov 17/2019
TK/ML

Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



Fri Nov 08 17:53:50 2019

Westbay Completion Log
Golder/NWMO

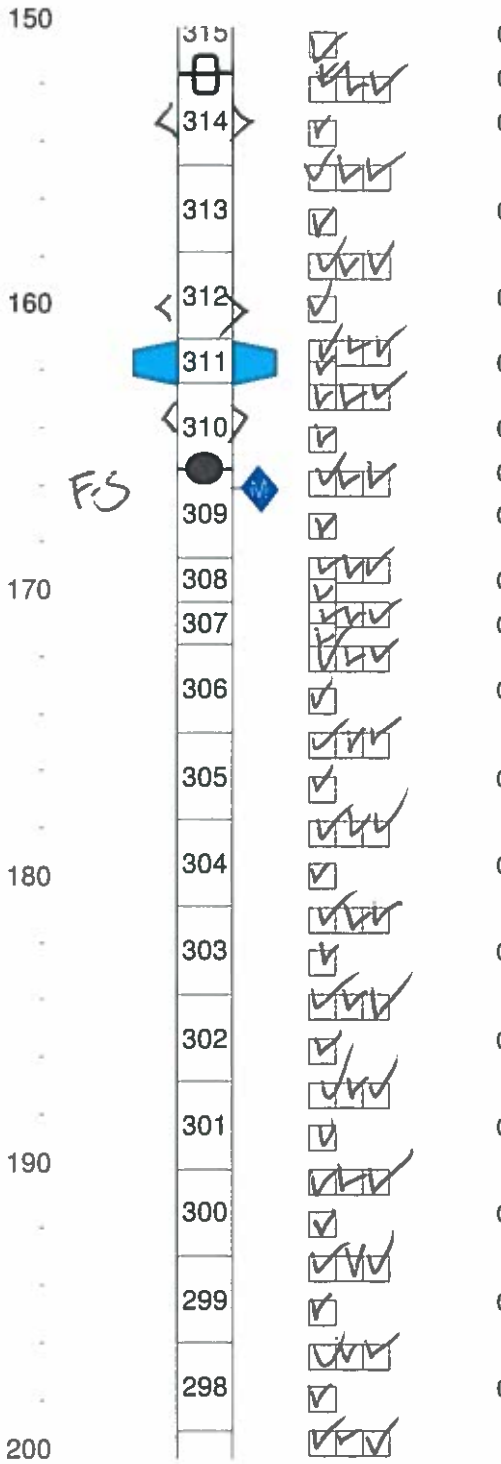
Job No: WB973
Well: IG_BH03

Scale Meters	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
100				
	331		020110 - MP38 Casing 1 (10F/3M)	
	330		020110 - MP38 Casing 1 (10F/3M)	
	329		020110 - MP38 Casing 1 (10F/3M)	
110	328		020110 - MP38 Casing 1 (10F/3M)	
	327		020110 - MP38 Casing 1 (10F/3M)	
	326		020110 - MP38 Casing 1 (10F/3M)	
120	325		020110 - MP38 Casing 1 (10F/3M)	
	324		020110 - MP38 Casing 1 (10F/3M)	
	323		020110 - MP38 Casing 1 (10F/3M)	
	322		020110 - MP38 Casing 1 (10F/3M)	
130	321		020110 - MP38 Casing 1 (10F/3M)	
	320		020110 - MP38 Casing 1 (10F/3M)	
	319		020110 - MP38 Casing 1 (10F/3M)	
140	318		020110 - MP38 Casing 1 (10F/3M)	
	317		020110 - MP38 Casing 1 (10F/3M)	
	316		020110 - MP38 Casing 1 (10F/3M)	
150				

Nov 17, 2019 Resumed @ 7:45
Adding 7 buckets & starting w #331
@ 8:10
→ #330 in the well stopped lowering Nov 16/2019.
18:20

Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



Fri Nov 08 17:53:50 2019

Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03

PP: 287.

⇒ 15:10 Nov 16/19 adding ~8 buckets
Resumed lowering at 15:30 with #289.

→ stopped #287 for 3rd layout 12:40 Nov 16/19.

P: 19622.
MP: 9278

PP: 286

P: 19621

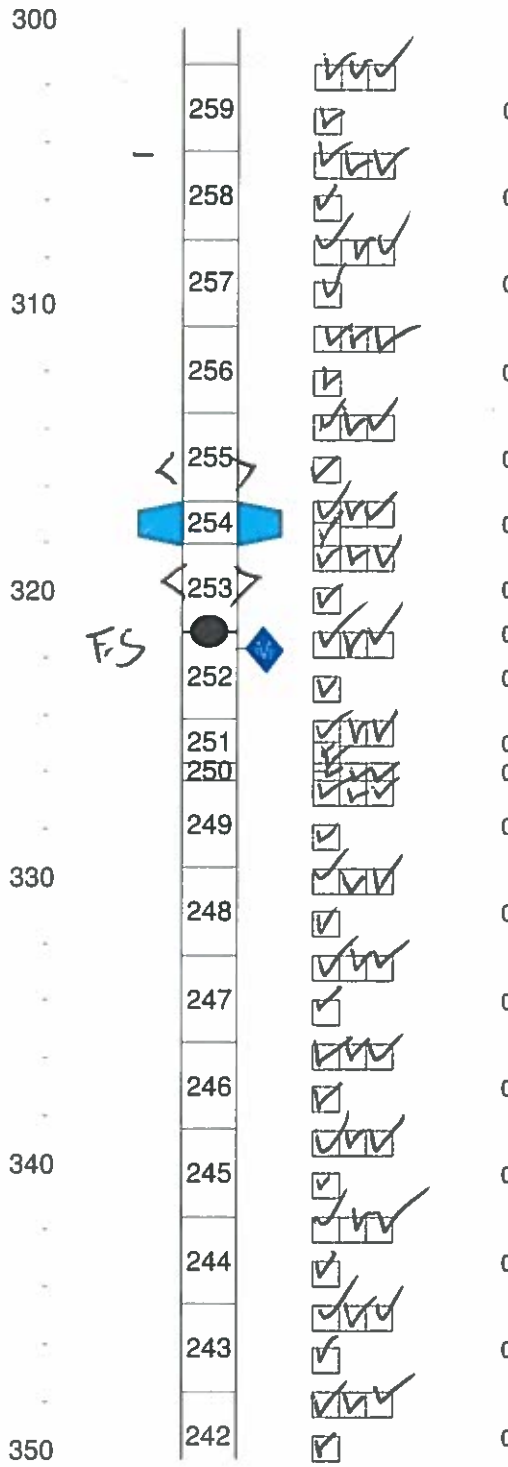
Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03

Scale Meters	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
250				
	F.S	☑	0205 - MP38 Measurement Port	MP: 9270
	276	☑	020110 - MP38 Casing 1 (10F/3M)	
	275	☑	020105 - MP38 Casing 2 (5F/1.5M)	
	274	☑	020110 - MP38 Casing 1 (10F/3M)	
260	273	☑	020110 - MP38 Casing 1 (10F/3M)	
	272	☑	020110 - MP38 Casing 1 (10F/3M)	
	271	☑	020110 - MP38 Casing 1 (10F/3M)	
270	270	☑	020110 - MP38 Casing 1 (10F/3M)	
	269	☑	020110 - MP38 Casing 1 (10F/3M)	
	268	☑	020110 - MP38 Casing 1 (10F/3M)	
	267	☑	020110 - MP38 Casing 1 (10F/3M)	
280	266	☑	020110 - MP38 Casing 1 (10F/3M)	
	265	☑	020110 - MP38 Casing 1 (10F/3M)	
	264	☑	020110 - MP38 Casing 1 (10F/3M)	
290	263	☑	020110 - MP38 Casing 1 (10F/3M)	
	262	☑	020110 - MP38 Casing 1 (10F/3M)	
	261	☑	020110 - MP38 Casing 1 (10F/3M)	
300	260	☑	020110 - MP38 Casing 1 (10F/3M)	

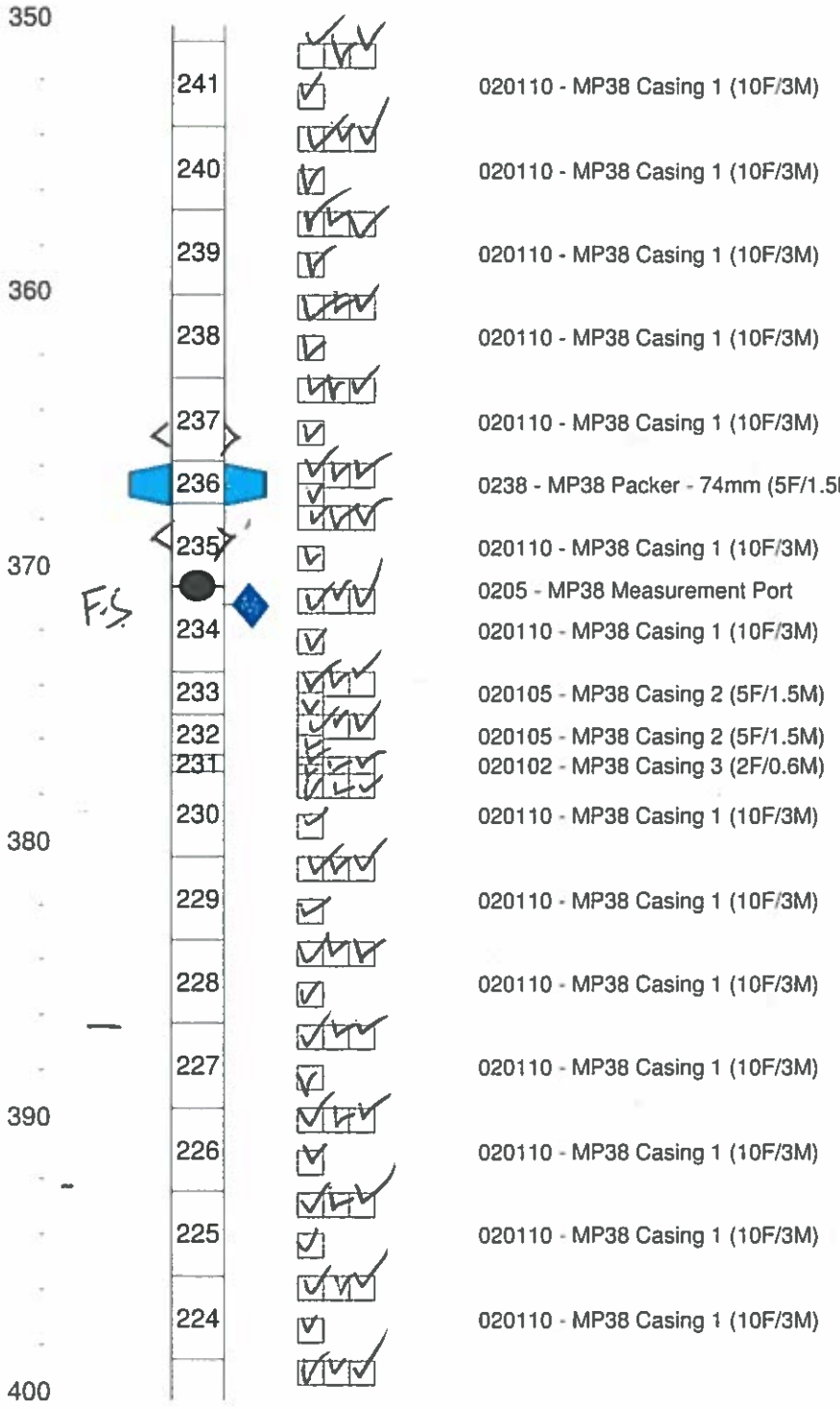
Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



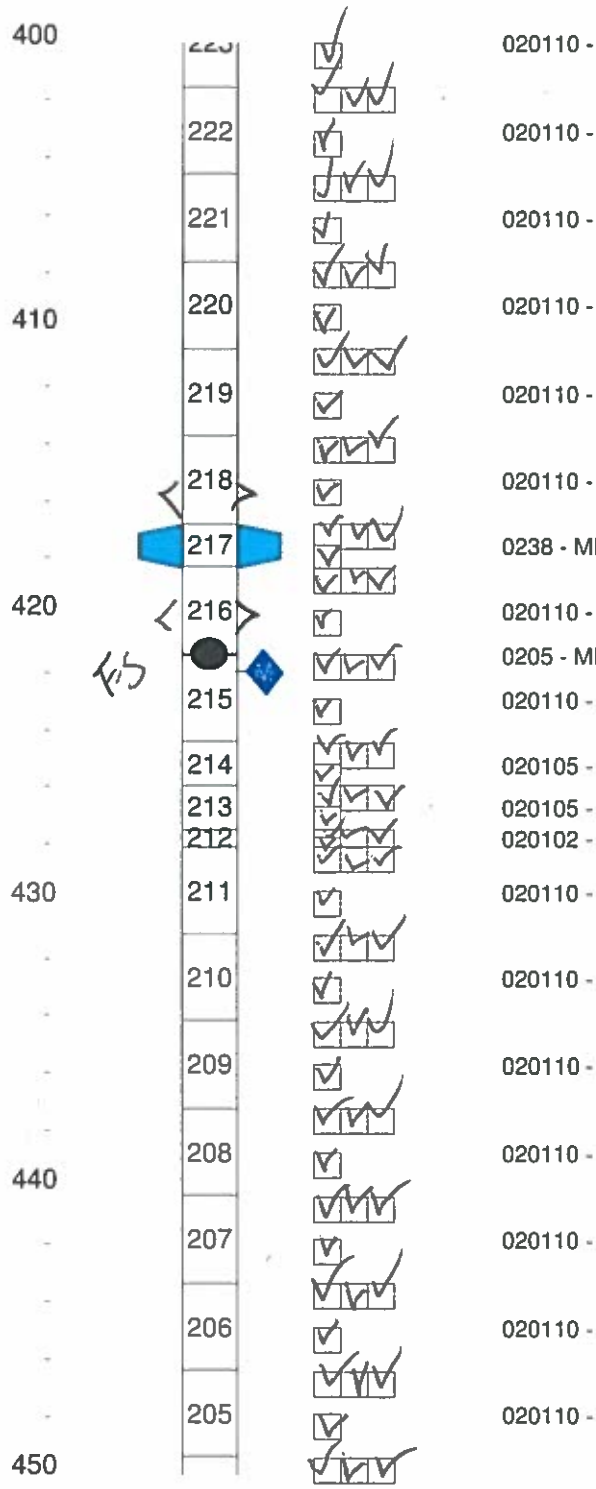
Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



Westbay Completion Log
Golder/NWMO

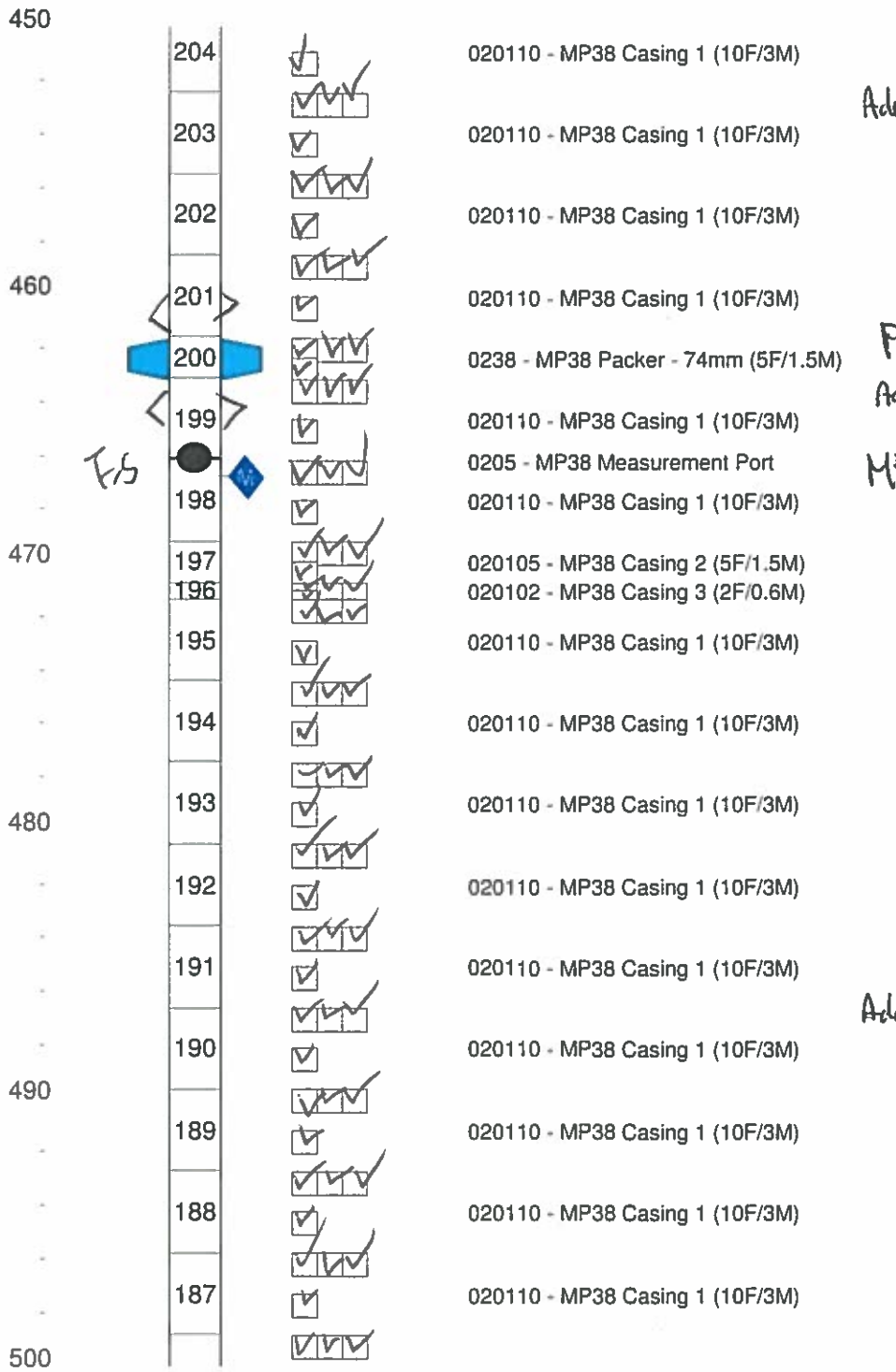
Job No: WB973
Well: IG_BH03



Fri Nov 08 17:54:59 2019

Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



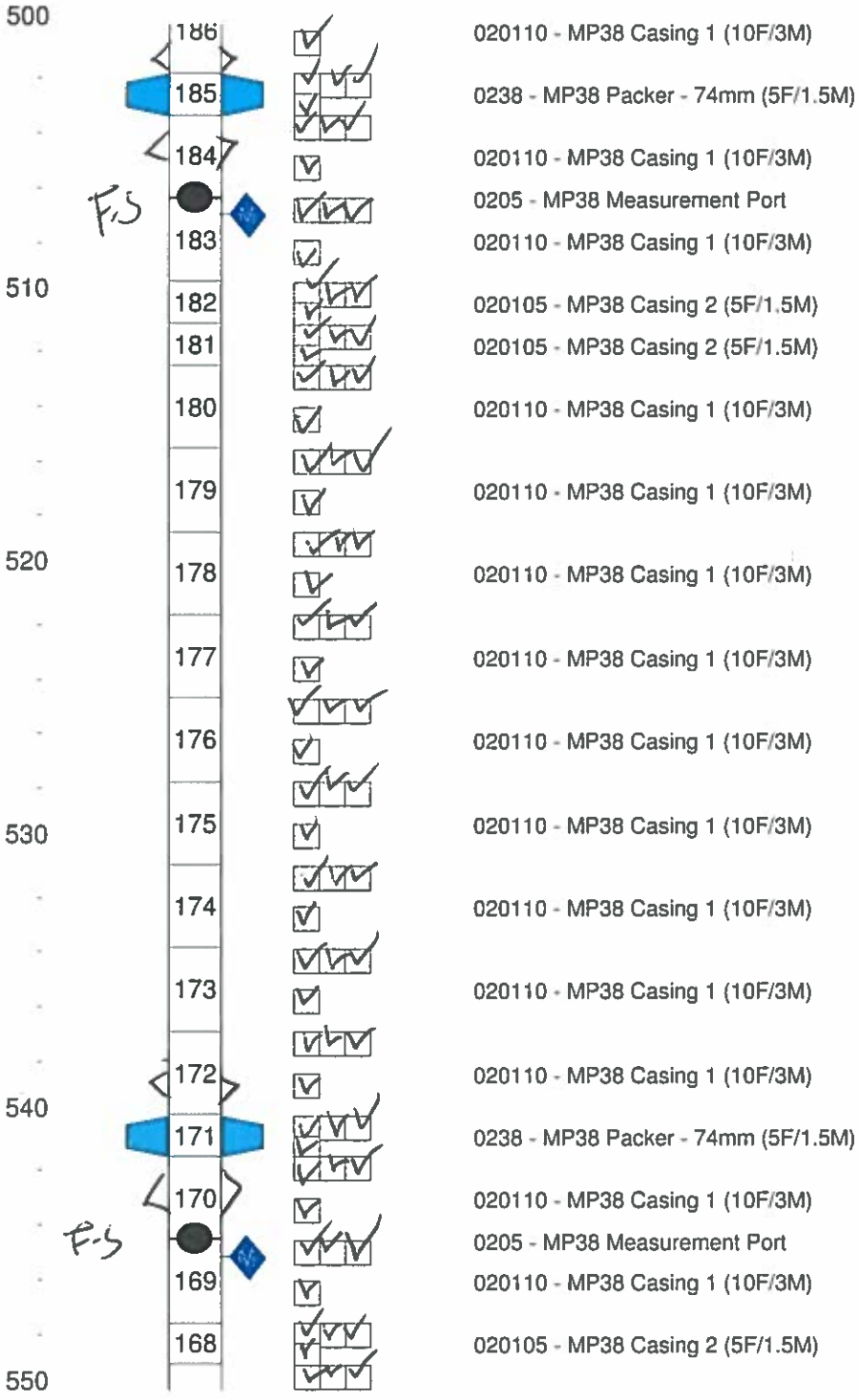
Adding water ~30 l.

P: 19617
Adding water ~15 l.
MP: 9279

Adding water ~ 15 l.

Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



P: 19616

Adding water ~ 15 L.

MP: 9260

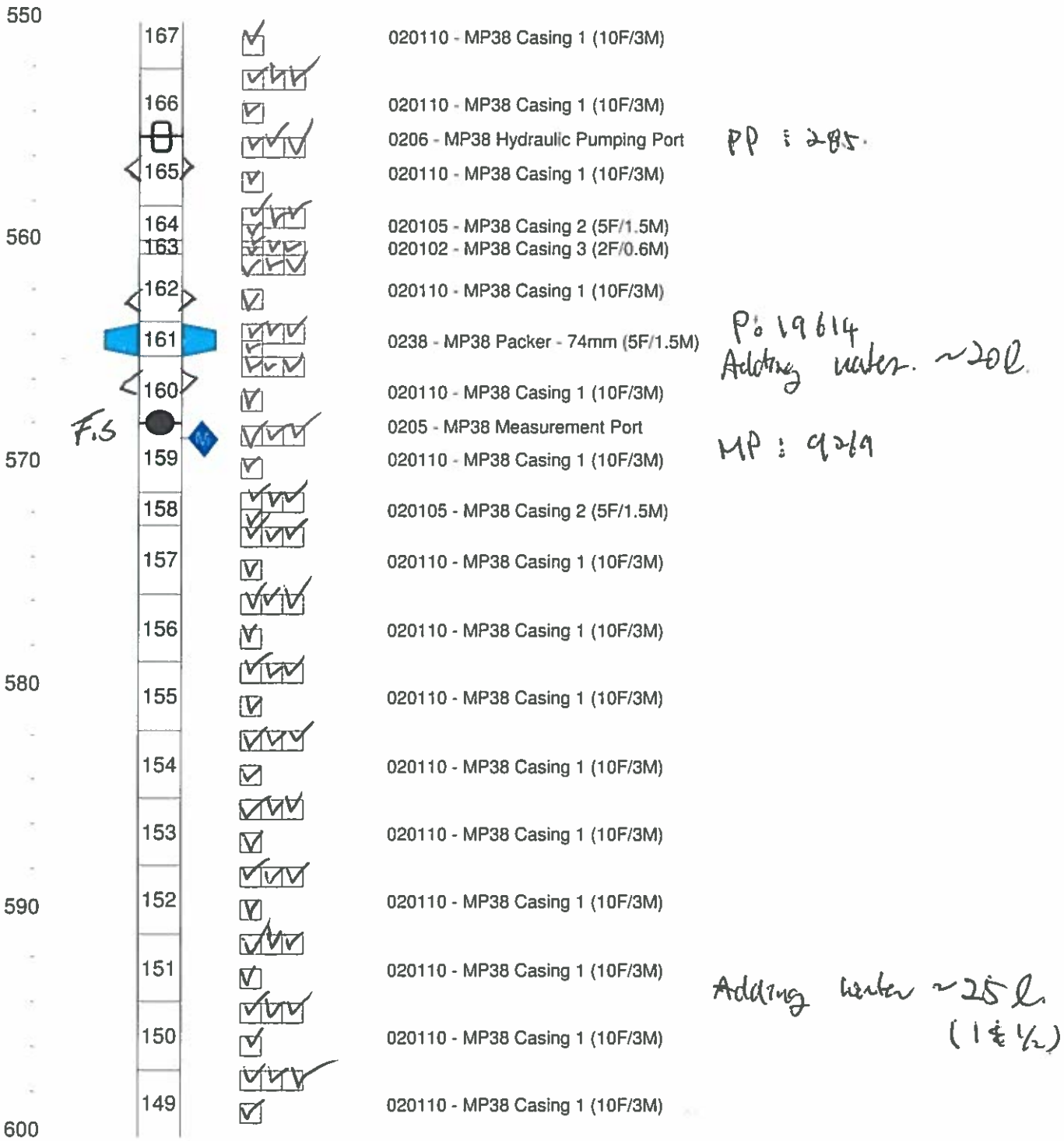
Adding water ~ 10 L

P: 19615
Adding water. ~ 10 L.

MP: 9261

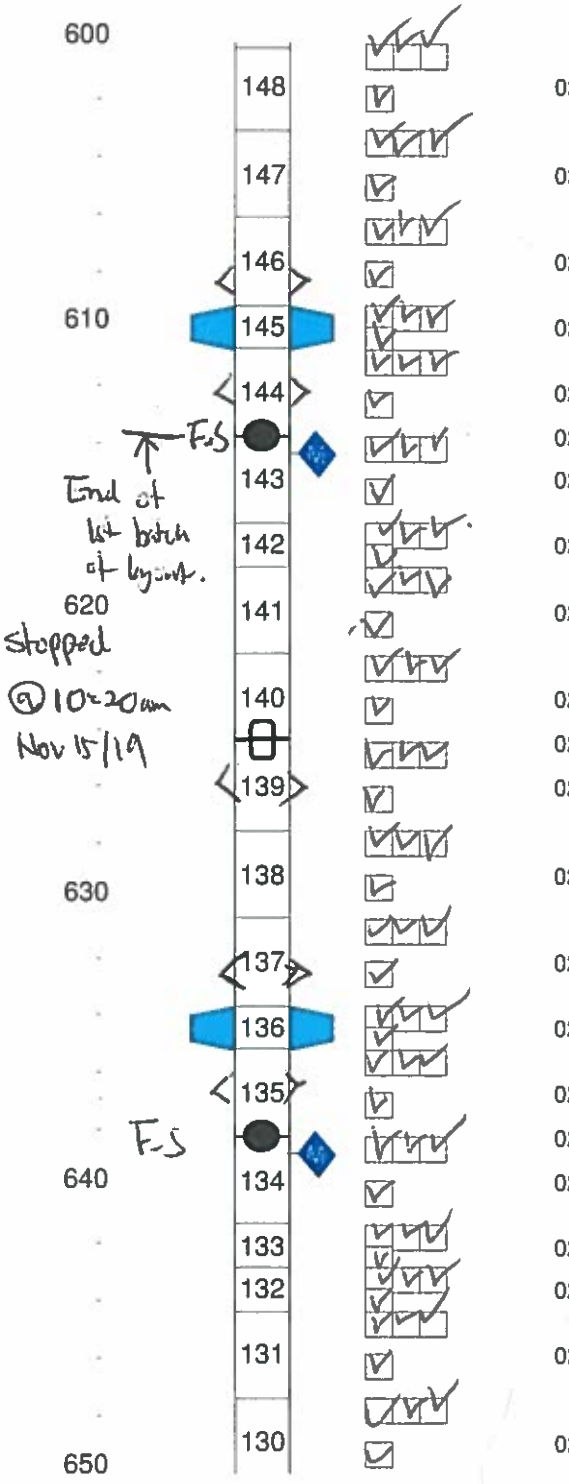
Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



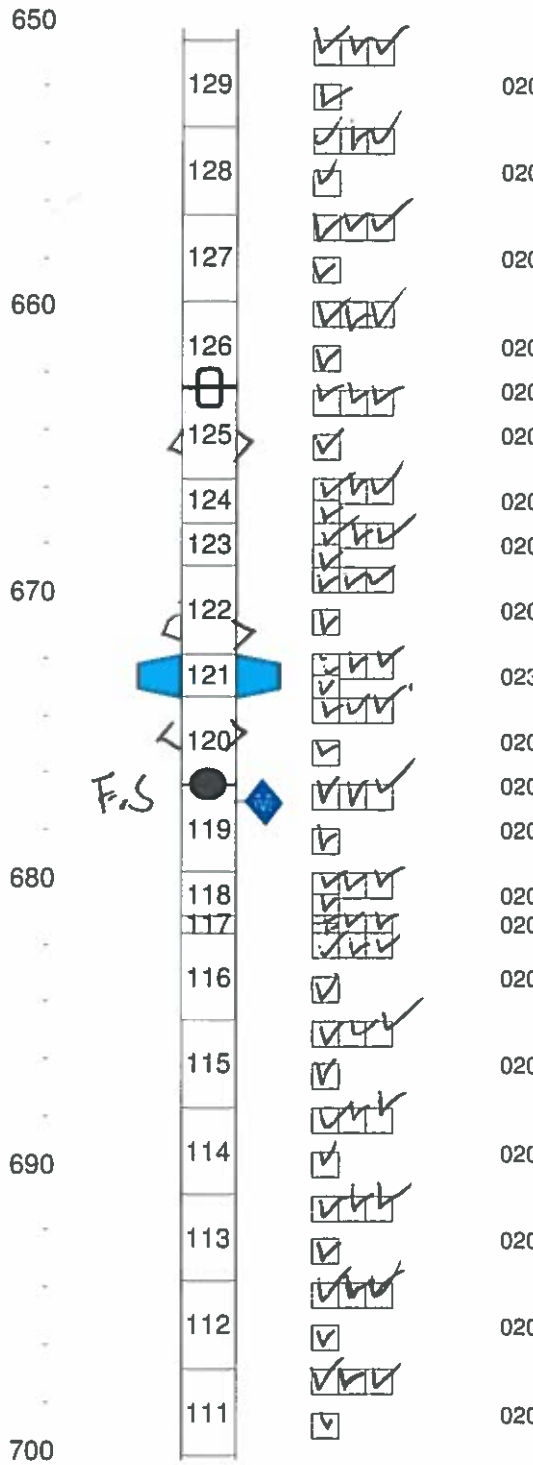
Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03

Scale Meters	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers	
700					
	110	☑	020110 - MP38 Casing 1 (10F/3M)		
	109	☑	020110 - MP38 Casing 1 (10F/3M)		
	108	☑	020110 - MP38 Casing 1 (10F/3M)		Adding water ~10 L Resume with #108 8:40am Nov 15/19
710	107	☑	020110 - MP38 Casing 1 (10F/3M)		#107 in the well 10:22 pm Nov 14/2019
	106	☑	020110 - MP38 Casing 1 (10F/3M)		
	105	☑	020110 - MP38 Casing 1 (10F/3M)		
720	104	☑	020110 - MP38 Casing 1 (10F/3M)		Adding water ~10 L
	103	☑	020110 - MP38 Casing 1 (10F/3M)		
	102	☑	020110 - MP38 Casing 1 (10F/3M)		
730	101	☑	020110 - MP38 Casing 1 (10F/3M)		
	100	☑	020110 - MP38 Casing 1 (10F/3M)		
	99	☑	020110 - MP38 Casing 1 (10F/3M)		Adding water ~10 L.
	98	☑	020110 - MP38 Casing 1 (10F/3M)		
740	97	☑	020110 - MP38 Casing 1 (10F/3M)		
	96	☑	020110 - MP38 Casing 1 (10F/3M)		
	95	☑	020110 - MP38 Casing 1 (10F/3M)		Adding water ~10L
750	94	☑	0238 - MP38 Packer - 74mm (5F/1.5M)		PS 19610

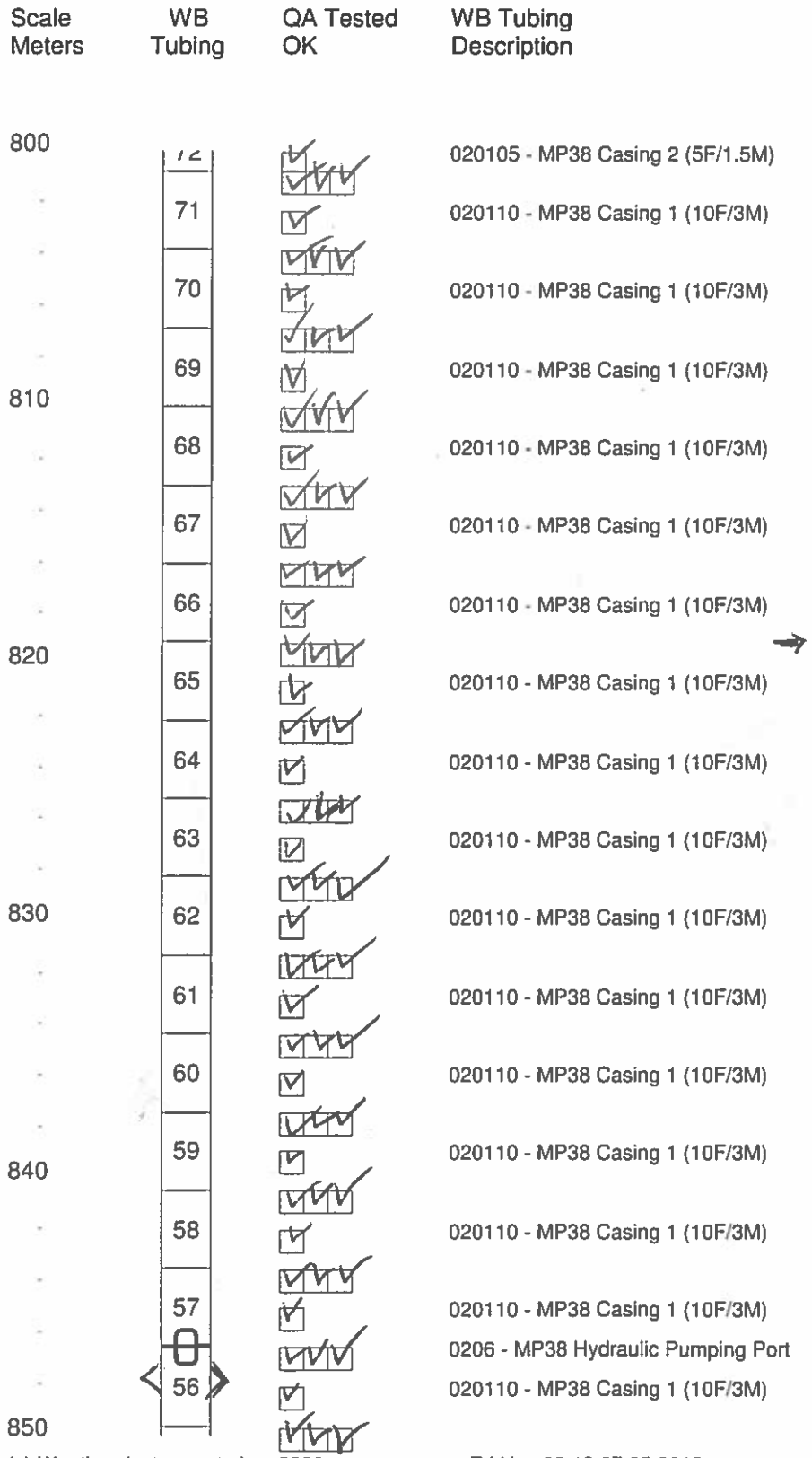
Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03

Scale Meters	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
750				
	93	☑	020110 - MP38 Casing 1 (10F/3M)	
	F.S	☑	0205 - MP38 Measurement Port	MP: 9267
	92	☑	020110 - MP38 Casing 1 (10F/3M)	
	91	☑	020105 - MP38 Casing 2 (5F/1.5M)	
	90	☑	020105 - MP38 Casing 2 (5F/1.5M)	
760	89	☑	020102 - MP38 Casing 3 (2F/0.6M)	Adding water ~10 L.
	88	☑	020102 - MP38 Casing 3 (2F/0.6M)	
	87	☑	020110 - MP38 Casing 1 (10F/3M)	
	86	☑	020110 - MP38 Casing 1 (10F/3M)	
	85	☑	020110 - MP38 Casing 1 (10F/3M)	
770	84	☑	020110 - MP38 Casing 1 (10F/3M)	
	83	☑	020110 - MP38 Casing 1 (10F/3M)	
	82	☑	020110 - MP38 Casing 1 (10F/3M)	Adding water ~10 L.
780	81	☑	020110 - MP38 Casing 1 (10F/3M)	
		☑	0206 - MP38 Hydraulic Pumping Port	PP: 282
	80	☑	020110 - MP38 Casing 1 (10F/3M)	
	79	☑	020105 - MP38 Casing 2 (5F/1.5M)	
	78	☑	020102 - MP38 Casing 3 (2F/0.6M)	
	77	☑	020110 - MP38 Casing 1 (10F/3M)	P: 19609
790	76	☑	0238 - MP38 Packer - 74mm (5F/1.5M)	Adding water ~10 L.
	75	☑	020110 - MP38 Casing 1 (10F/3M)	
	F.S	☑	0205 - MP38 Measurement Port	MP: 9252
	74	☑	020110 - MP38 Casing 1 (10F/3M)	
	73	☑	020105 - MP38 Casing 2 (5F/1.5M)	
800				

Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



Adding water ~10 L.

Adding water ~10 L.

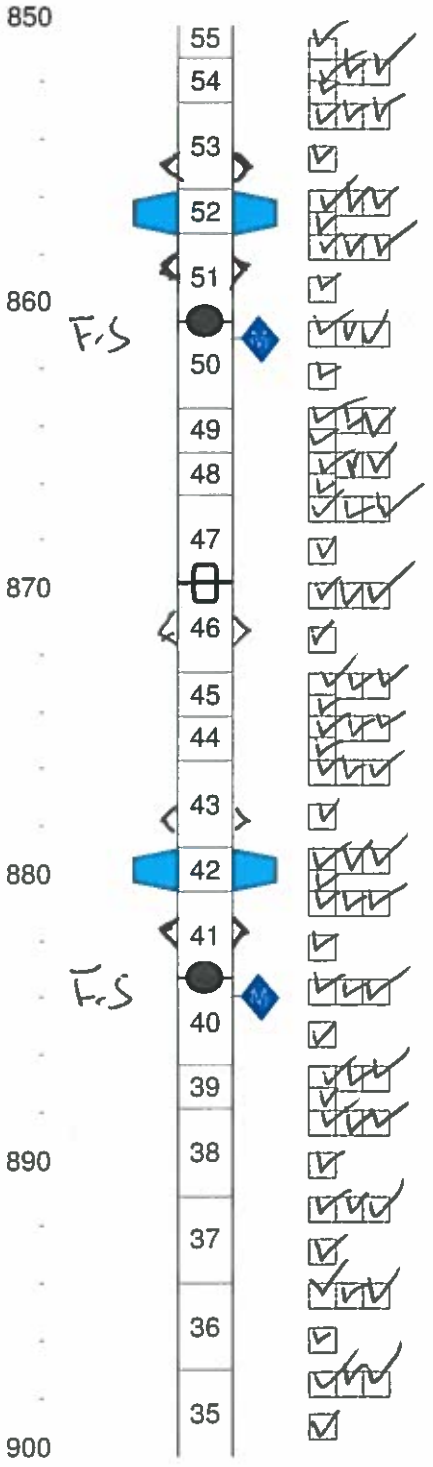
Adding water ~10 L.

Adding water ~10 L.

PP: 281

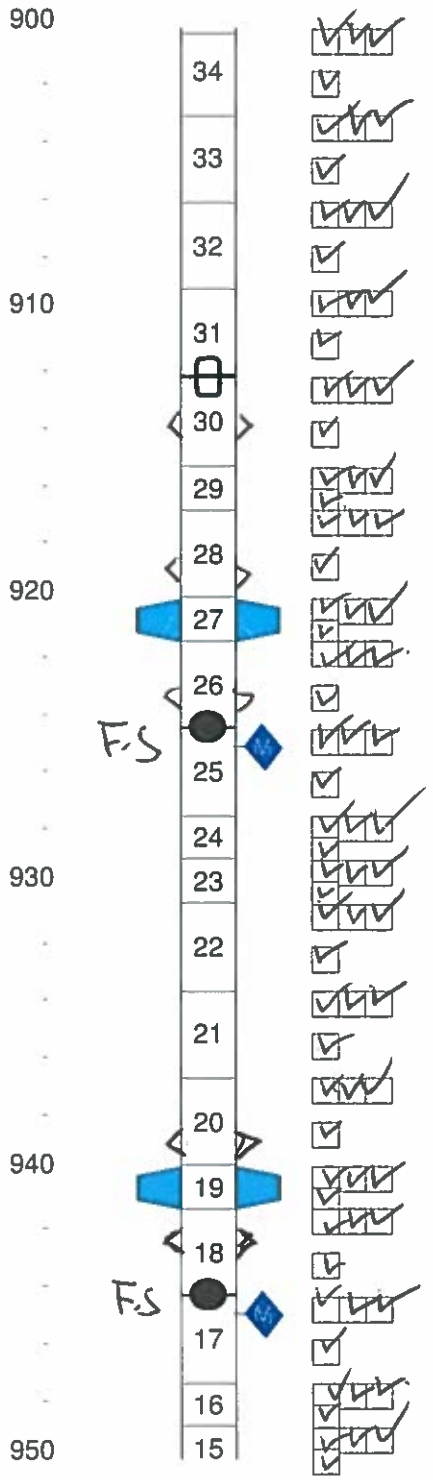
Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



WB Tubing Description	Serial Numbers
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	
0206 - MP38 Hydraulic Pumping Port	
020110 - MP38 Casing 1 (10F/3M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020110 - MP38 Casing 1 (10F/3M)	
0238 - MP38 Packer - 74mm (5F/1.5M)	
020110 - MP38 Casing 1 (10F/3M)	
0205 - MP38 Measurement Port	
020110 - MP38 Casing 1 (10F/3M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	
0238 - MP38 Packer - 74mm (5F/1.5M)	
020110 - MP38 Casing 1 (10F/3M)	
0205 - MP38 Measurement Port	
020110 - MP38 Casing 1 (10F/3M)	
020105 - MP38 Casing 2 (5F/1.5M)	
020105 - MP38 Casing 2 (5F/1.5M)	

Adding water ~10 L.

Adding water ~10 L.
PP: 192.

P: 19606
Adding water ~10 L.

MP: 9265

Adding water ~10 L
P: 19605.

MP: 9266

Westbay Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03

Scale Meters	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
950				
	14		020110 - MP38 Casing 1 (10F/3M)	Adding water ~10l.
			0206 - MP38 Hydraulic Pumping Port	PP 171.
	13		020110 - MP38 Casing 1 (10F/3M)	
	12		020105 - MP38 Casing 2 (5F/1.5M)	
	11		020105 - MP38 Casing 2 (5F/1.5M)	
960				
	10		020110 - MP38 Casing 1 (10F/3M)	
	9		0238 - MP38 Packer - 74mm (5F/1.5M)	P = 19604.
				Adding water ~10l
	8		020110 - MP38 Casing 1 (10F/3M)	
	F.S		0205 - MP38 Measurement Port	MP : 9274
	7		020110 - MP38 Casing 1 (10F/3M)	
970				
	6		020105 - MP38 Casing 2 (5F/1.5M)	
	5		020105 - MP38 Casing 2 (5F/1.5M)	
				Add water. ~ 10l.
	4		020110 - MP38 Casing 1 (10F/3M)	
	3		020110 - MP38 Casing 1 (10F/3M)	
980				
	2		020110 - MP38 Casing 1 (10F/3M)	
				Adding water ~ 5l.
	1		020110 - MP38 Casing 1 (10F/3M)	
	RC plug		0203 - MP38 End ~~Cap~~ plug	11:30 am start lowering Nov 14/2019
990				
1000				

APPENDIX C

IG-BH03

SUMMARY COMPLETION LOG

Summary Completion Log - 5 pages

Summary Completion Log

Company: Golder/NWMO
Well: IG_BH03
Site: Ignace,ON
Project: Groundwater Characterization Study

Job No: WB973
Author: TK/DL

Well Information

Reference Datum: Ground Level
Elevation of Datum: 0.00 m.
MP Casing Top: 0.00 m.
MP Casing Length: 985.79 m.

Borehole Depth: 1000.00 m.
Borehole Inclination: 70 degrees
Borehole Diameter: 98.00 mm

Well Description:
Plastic MP38 System
Other References:
with 21 packers
Added Pumping Port in Zone 10 - Nov 8
Added Pumping Port in Zone 21 - Nov 8

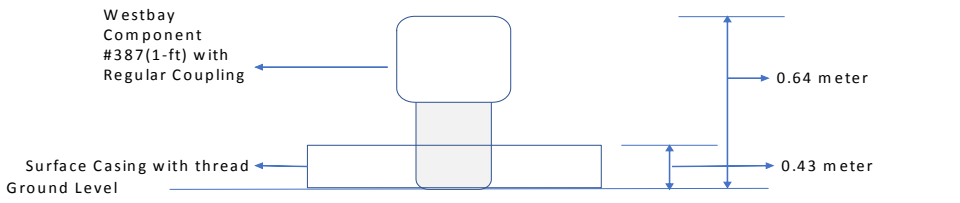
File Information

File Name: IG_BH3AB.WWD
Report Date: Sat Dec 07 10:59:54 2019

File Date: Dec 07 09:42:41 2019

Sketch of Wellhead Completion

IG_BH03 Completion Sketch



Not to Scale

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)

(2) 020101 - MP38 Casing 4 (1F/0.3M)

(10) 020102 - MP38 Casing 3 (2F/0.6M)

(86) 020105 - MP38 Casing 2 (5F/1.5M)

(268) 020110 - MP38 Casing 1 (10F/3M)

(21) 0238 - MP38 Packer - 74mm (5F/1.5M)

(1) 020305 - Tapered End Plug

(356) 0202 - MP38 Regular Coupling

(21) 0205 - MP38 Measurement Port

(11) 0206 - MP38 Hydraulic Pumping Port

(22) 0216 - Magnetic Location Collar

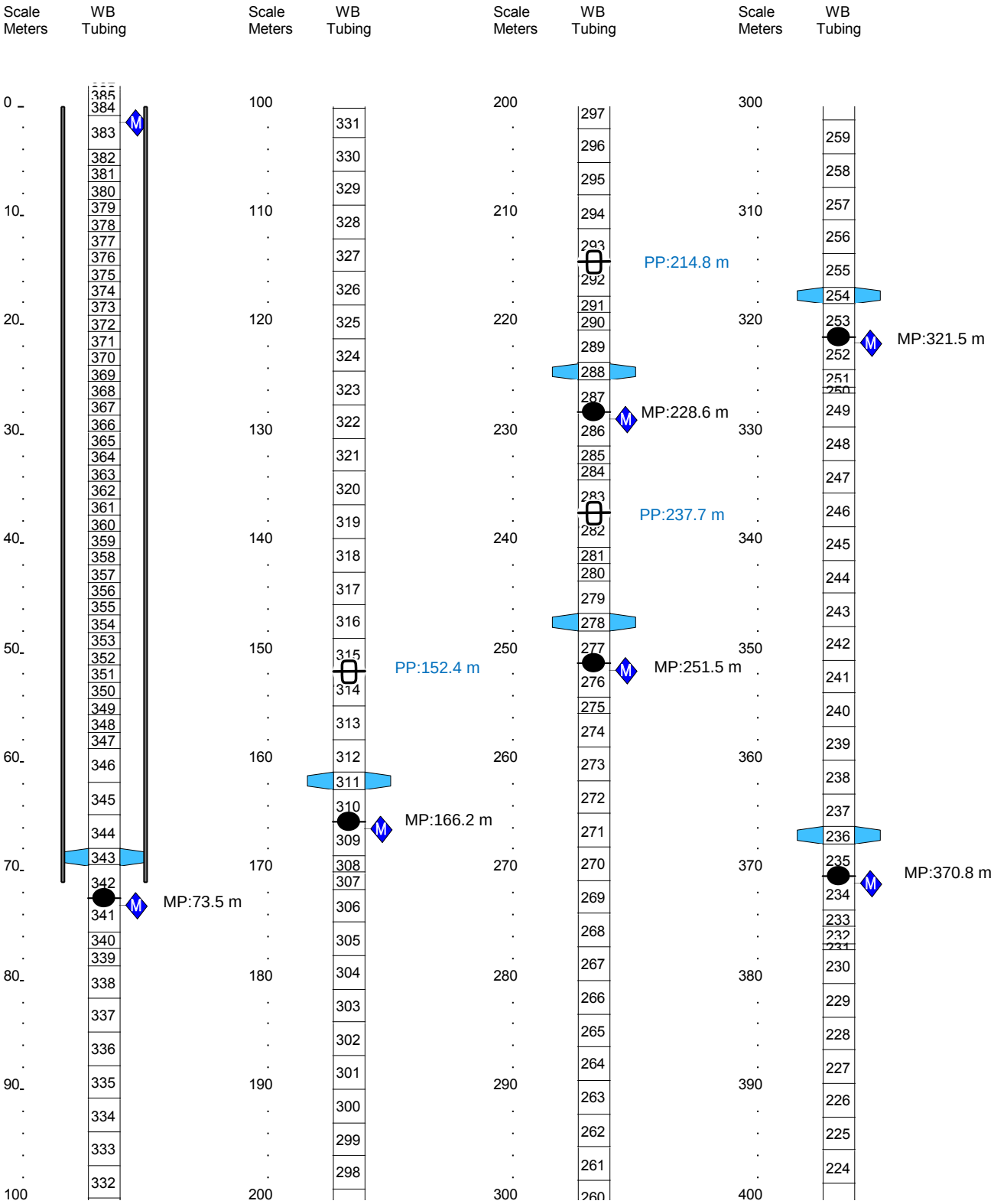
Geology

Backfill/Casing

Mild Steel

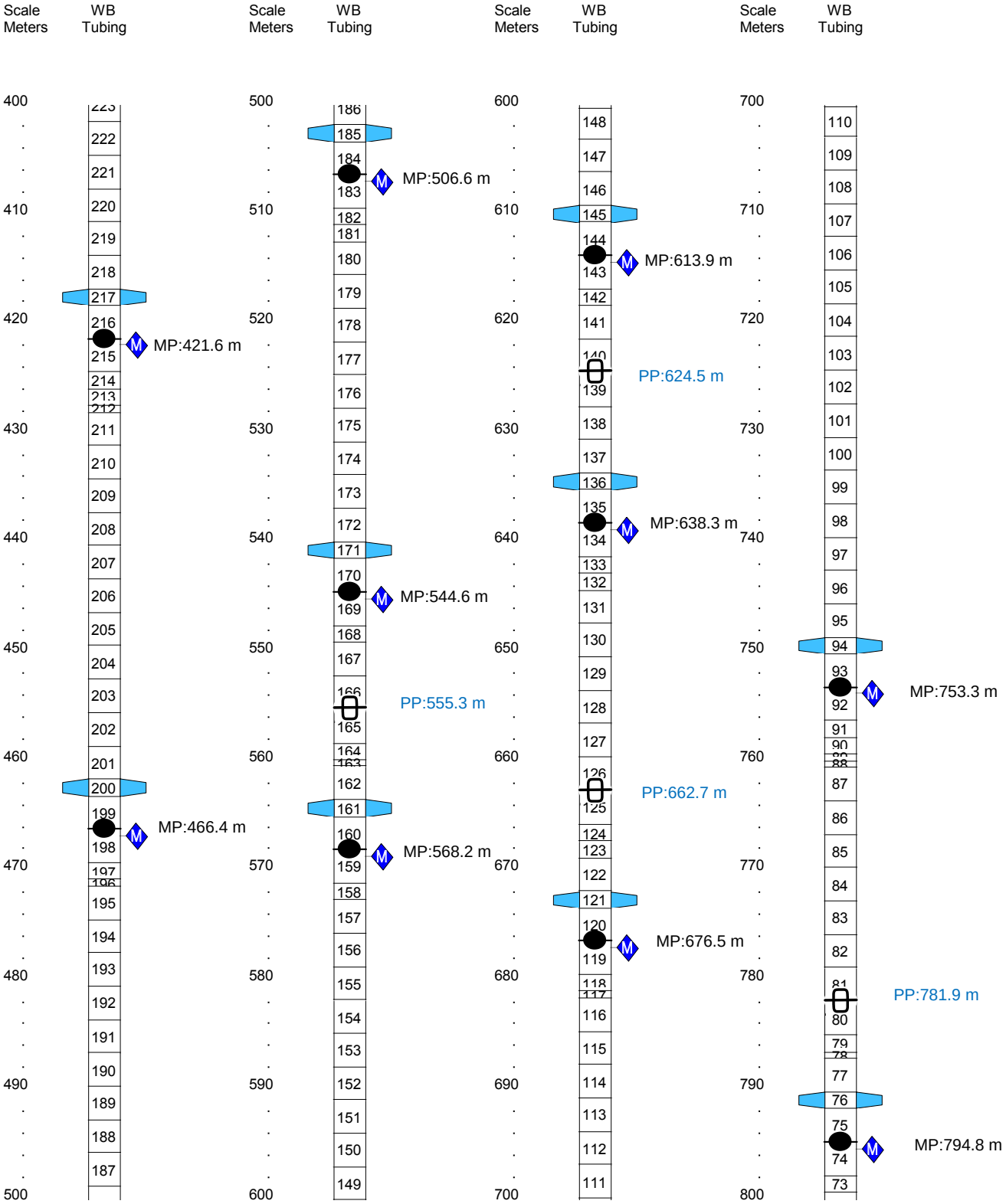
Summary Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



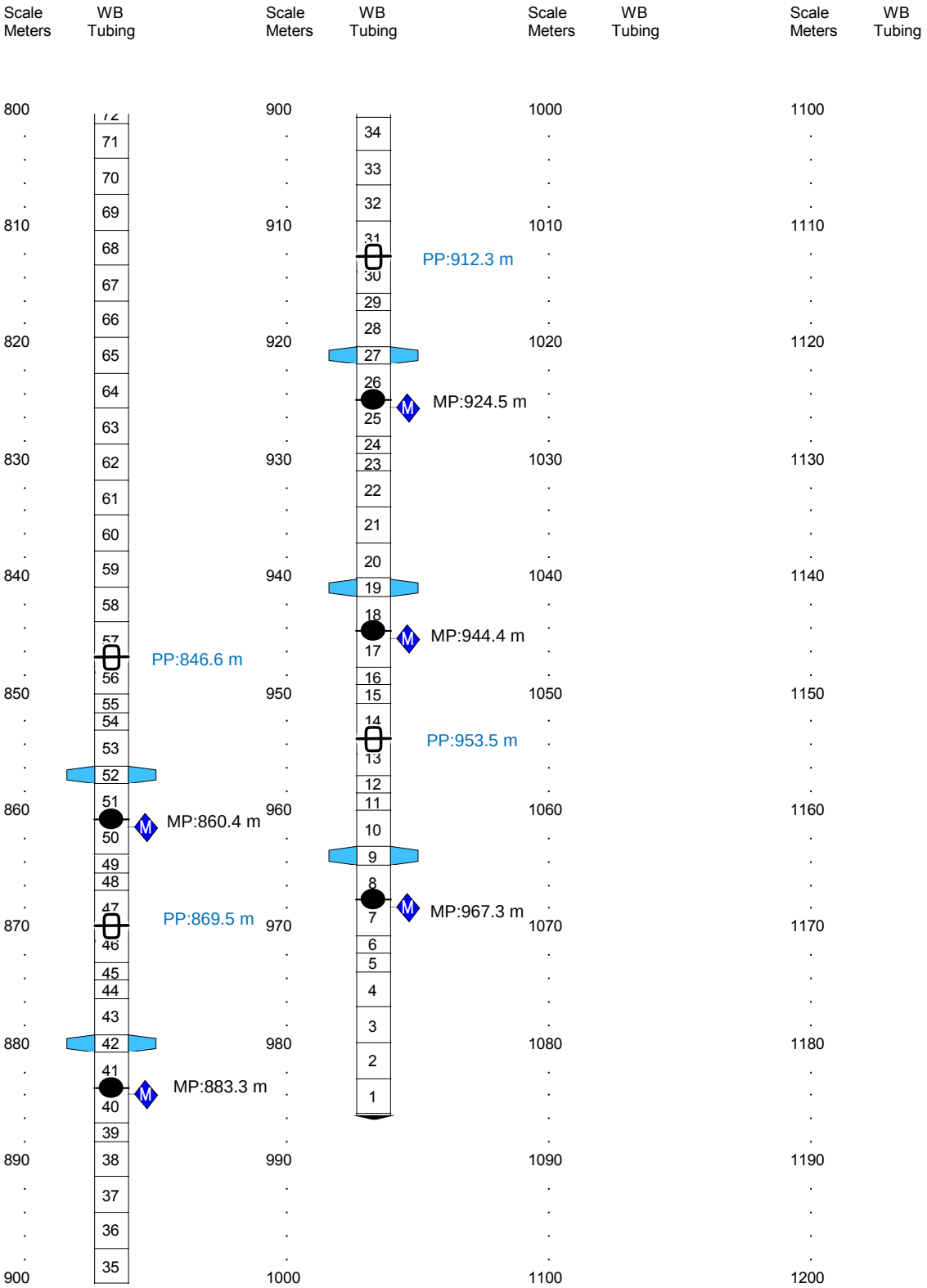
Summary Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



Summary Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



APPENDIX D

IG_BH03

TUBING SUMMARY (FIELD COPY)

Tubing Summary (field copy) - 9 pages

IG-BH03 Tubing Summary (field copy)

No.	Comp. Part #	Coupling Part #	Accessory Part #	Depth	Packer Top	Packer Bottom	Measured Length
388	0203			-3.2781			
387	020102	0202		-3.2303			
386	020102	0202		-2.6207			
385	020102	0202		-2.0111			
384	020105	0202		-0.4872			1.521
383	020110	0202	0216	1.0367			3.047
382	020105	0202		4.0846			1.522
381	020105	0202		5.6085			1.521
380	020105	0202		7.1324			1.521
379	020105	0202		8.6564			1.522
378	020105	0202		10.18			1.521
377	020105	0202		11.704			1.521
376	020105	0202		13.228			1.521
375	020105	0202		14.752			1.521
374	020105	0202		16.276			1.521
373	020105	0202		17.8			1.522
372	020105	0202		19.324			1.521
371	020105	0202		20.848			1.521
370	020105	0202		22.372			1.521
369	020105	0202		23.896			1.521
368	020105	0202		25.42			1.521
367	020105	0202		26.943			1.521
366	020105	0202		28.467			1.521
365	020105	0202		29.991			1.522
364	020105	0202		31.515			1.522
363	020105	0202		33.039			1.522
362	020105	0202		34.563			1.521
361	020105	0202		36.087			1.521
360	020105	0202		37.611			1.522
359	020105	0202		39.135			1.522
358	020105	0202		40.659			1.522
357	020105	0202		42.183			1.522
356	020105	0202		43.707			1.522
355	020105	0202		45.231			1.522
354	020105	0202		46.754			1.521
353	020105	0202		48.278			1.522
352	020105	0202		49.802			1.522
351	020105	0202		51.326			1.522
350	020105	0202		52.85			1.522
349	020105	0202		54.374			1.522
348	020105	0202		55.898			1.522
347	020105	0202		57.422			1.521

21.00

23.00

346	020110	0202		58.946			3.047
345	020110	0202		61.994			3.047
344	020110	0202		65.042			3.046
343	0238	0202		68.089			1.522
342	020110	0202		69.613			3.047
341	020110	0205	0216	72.661			3.046
340	020105	0202		75.709			1.522
339	020105	0202		77.233			1.522
338	020110	0202		78.757			3.046
337	020110	0202		81.805			3.047
336	020110	0202		84.853			3.046
335	020110	0202		87.9			3.046
334	020110	0202		90.948			3.046
333	020110	0202		93.996			3.046
332	020110	0202		97.044			3.046
331	020110	0202		100.09			3.046
330	020110	0202		103.14			3.046
329	020110	0202		106.19			3.047
328	020110	0202		109.24			3.047
327	020110	0202		112.28			3.047
326	020110	0202		115.33			3.046
325	020110	0202		118.38			3.046
324	020110	0202		121.43			3.046
323	020110	0202		124.47			3.047
322	020110	0202		127.52			3.046
321	020110	0202		130.57			3.046
320	020110	0202		133.62			3.045
319	020110	0202		136.67			3.046
318	020110	0202		139.71			3.045
317	020110	0202		142.76			3.047
316	020110	0202		145.81			3.045
315	020110	0202		148.86			3.046
314	020110	~~0202~~ 0206		151.91			3.045 3.122
313	020110	0202		154.95			3.046
312	020110	0202		158			3.046
311	0238	0202		161.05			1.522
310	020110	0202		162.57			3.046
309	020110	0205	0216	165.62			3.047
308	020105	0202		168.67			1.522
307	020105	0202		170.19			1.522
306	020110	0202		171.72			2.046
305	020110	0202		174.76			3.046
304	020110	0202		177.81			3.046
303	020110	0202		180.86			3.046
302	020110	0202		183.91			3.046
301	020110	0202		186.96			3.045
300	020110	0202		190			3.046

185

299	020110	0202		193.05			~~1.521~~	3.047
298	020110	0202		196.1			3.047	
297	020110	0202		199.15			3.046	
296	020110	0202		202.19			3.048	
295	020110	0202		205.24			3.047	
294	020110	0202		208.29			3.047	
293	020110	0202		211.34			3.048	
292	020110	0206		214.39			3.121	
291	020105	0202		217.51			1.521	
290	020105	0202		219.03			1.522	
289	020110	0202		220.56			3.045	
288	0238	0202		223.61			1.521	
287	020110	0202		225.13			3.046	
286	020110	0205	0216	228.18			3.046	
285	020105	0202		231.23			1.522	
284	020105	0202		232.75			1.521	
283	020110	0202		234.27			3.046	
282	020110	0206		237.32			3.124	
281	020105	0202		240.45			1.521	
280	020105	0202		241.97			1.521	
279	020110	0202		243.49			3.046	
278	0238	0202		246.54			1.522	
277	020110	0202		248.07			3.045	
276	020110	0205	0216	251.11			3.046	
275	020105	0202		254.16			1.522	
274	020110	0202		255.68			3.045	
273	020110	0202		258.73			3.046	
272	020110	0202		261.78			3.046	
271	020110	0202		264.83			3.046	
270	020110	0202		267.88			3.045	
269	020110	0202		270.92			3.046	
268	020110	0202		273.97			3.046	
267	020110	0202		277.02			3.046	
266	020110	0202		280.07			3.046	
265	020110	0202		283.12			3.046	
264	020110	0202		286.16			3.045	
263	020110	0202		289.21			3.046	
262	020110	0202		292.26			3.046	
261	020110	0202		295.31			3.046	
260	020110	0202		298.35			3.046	
259	020110	0202		301.4			3.045	
258	020110	0202		304.45			3.045	
257	020110	0202		307.5			3.045	
256	020110	0202		310.55			3.045	
255	020110	0202		313.59			3.046	
254	0238	0202		316.64			1.522	
253	020110	0202		318.17			3.047	

252	020110	0205	0216	321.21			3.047
251	020105	0202		324.26			1.522
250	020102	0202		325.79			0.608
249	020110	0202		326.39			3.045
248	020110	0202		329.44			3.046
247	020110	0202		332.49			3.046
246	020110	0202		335.54			3.046
245	020110	0202		338.59			3.046
244	020110	0202		341.63			3.048
243	020110	0202		344.68			3.046
242	020110	0202		347.73			3.046
241	020110	0202		350.78			3.045
240	020110	0202		353.83			3.046
239	020110	0202		356.87			3.046
238	020110	0202		359.92			3.046
237	020110	0202		362.97			3.046
236	0238	0202		366.02			1.522
235	020110	0202		367.54			3.045
234	020110	0205	0216	370.59			3.046
233	020105	0202		373.64			1.522
232	020105	0202		375.16			1.521
231	020102	0202		376.68			0.609
230	020110	0202		377.29			3.045
229	020110	0202		380.34			3.046
228	020110	0202		383.39			3.046
227	020110	0202		386.44			3.048
226	020110	0202		389.49			3.047
225	020110	0202		392.53			3.046
224	020110	0202		395.58			3.049
223	020110	0202		398.63			3.048
222	020110	0202		401.68			3.048
221	020110	0202		404.72			3.046
220	020110	0202		407.77			3.048
219	020110	0202		410.82			3.049
218	020110	0202		413.87			3.046
217	0238	0202		416.92			1.521
216	020110	0202		418.44			3.048
215	020110	0205	0216	421.49			3.048
214	020105	0202		424.54			1.521
213	020105	0202		426.06			1.520
212	020102	0202		427.58			0.610
211	020110	0202		428.19			3.049
210	020110	0202		431.24			3.048
209	020110	0202		434.29			3.047
208	020110	0202		437.34			3.047
207	020110	0202		440.38			3.047
206	020110	0202		443.43			3.048

205	020110	0202		446.48			3.047
204	020110	0202		449.53			3.048
203	020110	0202		452.58			3.047
202	020110	0202		455.62			3.048
201	020110	0202		458.67			3.047
200	0238	0202		461.72			1.522
199	020110	0202		463.24			3.048
198	020110	0205	0216	466.29			3.050
197	020105	0202		469.34			1.522
196	020102	0202		470.86			0.610
195	020110	0202		471.47			3.047
194	020110	0202		474.52			3.047
193	020110	0202		477.57			3.046
192	020110	0202		480.62			3.046
191	020110	0202		483.66			3046
190	020110	0202		486.71			3.046
189	020110	0202		489.76			3.046
188	020110	0202		492.81			3.046
187	020110	0202		495.86			3.047
186	020110	0202		498.9			3.046
185	0238	0202		501.95			1.522
184	020110	0202		503.48			3.045
183	020110	0205	0216	506.52			3.047
182	020105	0202		509.57			1.521
181	020105	0202		511.09			1.522
180	020110	0202		512.62			3.047
179	020110	0202		515.67			3.047
178	020110	0202		518.71			3.048
177	020110	0202		521.76			3.047
176	020110	0202		524.81			3.046
175	020110	0202		527.86			3046
174	020110	0202		530.91			3046
173	020110	0202		533.95			3.046
172	020110	0202		537			3.045
171	0238	0202		540.05			1.522
170	020110	0202		541.57			3.045
169	020110	0205	0216	544.62			3.047
168	020105	0202		547.67			1.522
167	020110	0202		549.19			3.046
166	020110	0202		552.24			3.046
165	020110	0206		555.29			3.184
164	020105	0202		558.41			1.522
163	020102	0202		559.94			0.609
162	020110	0202		560.55			3.046
161	0238	0202		563.59			1.522
160	020110	0202		565.12			3.046
159	020110	0205	0216	568.17			3.047

22.0

158	020105	0202		571.21			1.522
157	020110	0202		572.74			3.048
156	020110	0202		575.79			3.048
155	020110	0202		578.83			3.046
154	020110	0202		581.88			3.046
153	020110	0202		584.93			3.045
152	020110	0202		587.98			3.046
151	020110	0202		591.02			3.045
150	020110	0202		594.07			3.046
149	020110	0202		597.12			3.046
148	020110	0202		600.17			3.046
147	020110	0202		603.22			3.048
146	020110	0202		606.26			3.045
145	0238	0202		609.31			1.521
144	020110	0202		610.84			3.046
143	020110	0205	0216	613.88			3.046
142	020105	0202		616.93			1.508
141	020110	0202		618.46			3.045
140	020110	0202		621.5			3.046
139	020110	~~0202~~ 0206		624.55			~~3.048~~ 3.123
138	020110	0202		627.6			3.046
137	020110	0202		630.65			3.045
136	0238	0202		633.69			1.522
135	020110	0202		635.22			3.045
134	020110	0205	0216	638.27			3.046
133	020105	0202		641.31			1.503
132	020105	0202		642.84			1.522
131	020110	0202		644.36			3.046
130	020110	0202		647.41			3.047
129	020110	0202		650.46			3.047
128	020110	0202		653.51			3.047
127	020110	0202		656.55			3.047
126	020110	0202		659.6			3.047
125	020110	0206		662.65			3.124
124	020105	0202		665.77			1.523
123	020105	0202		667.3			1.522
122	020110	0202		668.82			3.046
121	0238	0202		671.87			1.522
120	020110	0202		673.39			3.046
119	020110	0205	0216	676.44			3.046
118	020105	0202		679.49			1.522
117	020102	0202		681.01			0.610
116	020110	0202		681.62			3.049
115	020110	0202		684.67			3.049
114	020110	0202		687.72			3.048
113	020110	0202		690.77			3.046
112	020110	0202		693.81			3.048

111	020110	0202		696.86			3.046
110	020110	0202		699.91			3.046
109	020110	0202		702.96			3.048
108	020110	0202		706			3.046
107	020110	0202		709.05			3.050
106	020110	0202		712.1			3.046
105	020110	0202		715.15			3.047
104	020110	0202		718.2			3.047
103	020110	0202		721.24			3.046
102	020110	0202		724.29			3.046
101	020110	0202		727.34			3.045
100	020110	0202		730.39			3.045
99	020110	0202		733.44			3.046
98	020110	0202		736.48			3.045
97	020110	0202		739.53			3.045
96	020110	0202		742.58			3.045
95	020110	0202		745.63			3.046
94	0238	0202		748.67			1.522
93	020110	0202		750.2			3.045
92	020110	0205	0216	753.25			3.047
91	020105	0202		756.29			1.525
90	020105	0202		757.82			1.523
89	020102	0202		759.34			0.608
88	020102	0202		759.95			0.610
87	020110	0202		760.56			3.046
86	020110	0202		763.61			3.046
85	020110	0202		766.66			3.045
84	020110	0202		769.7			3.045
83	020110	0202		772.75			3.047
82	020110	0202		775.8			3.046
81	020110	0202		778.85			3.046
80	020110	0206		781.9			3.124
79	020105	0202		785.02			1.522
78	020102	0202		786.54			0.608
77	020110	0202		787.15			3.046
76	0238	0202		790.2			1.521
75	020110	0202		791.73			3.046
74	020110	0205	0216	794.77			3.096
73	020105	0202		797.82			1.523
72	020105	0202		799.35			~~3.045~~ 1.521
71	020110	0202		800.87			3.044
70	020110	0202		803.92			3.046
69	020110	0202		806.96			3.046
68	020110	0202		810.01			3.046
67	020110	0202		813.06			3.046
66	020110	0202		816.11			3.046
65	020110	0202		819.16			3.046

64	020110	0202		822.2			3.047
63	020110	0202		825.25			3.047
62	020110	0202		828.3			3.047
61	020110	0202		831.35			3.047
60	020110	0202		834.4			3.047
59	020110	0202		837.44			3.047
58	020110	0202		840.49			3.047
57	020110	0202		843.54			3.047
56	020110	0206		846.59			3.124
55	020105	0202		849.71			1.522
54	020105	0202		851.23			1.522
53	020110	0202		852.76			3.046
52	0238	0202		855.81			1.522
51	020110	0202		857.33			3.046
50	020110	0205	0216	860.38			3.047
49	020105	0202		863.43			1.521
48	020105	0202		864.95			1.523
47	020110	0202		866.47			3.046
46	020110	0206		869.52			3.123
45	020105	0202		872.65			1.523
44	020105	0202		874.17			1.522
43	020110	0202		875.69			3.046
42	0238	0202		878.74			1.522
41	020110	0202		880.27			3.046
40	020110	0205	0216	883.31			3.047
39	020105	0202		886.36			1.522
38	020110	0202		887.89			3.046
37	020110	0202		890.93			3.046
36	020110	0202		893.98			3.046
35	020110	0202		897.03			3.047
34	020110	0202		900.08			3.045
33	020110	0202		903.12			3.046
32	020110	0202		906.17			3.047
31	020110	0202		909.22			3.047
30	020110	0206		912.27			3.124
29	020105	0202		915.39			1.522
28	020110	0202		916.92			3.046
27	0238	0202		919.96			1.522
26	020110	0202		921.49			3.046
25	020110	0205	0216	924.54			3.046
24	020105	0202		927.58			1.522
23	020105	0202		929.11			1.522
22	020110	0202		930.63			2.046
21	020110	0202		933.68			3.047
20	020110	0202		936.73			3.045
19	0238	0202		939.77			1.522
18	020110	0202		941.3			3.046

17	020110	0205	0216	944.35			3.046
16	020105	0202		947.39			1.522
15	020105	0202		948.92			1.522
14	020110	0202		950.44			3.046
13	020110	0206		953.49			3.123
12	020105	0202		956.61			1.521
11	020105	0202		958.14			1.522
10	020110	0202		959.66			3.045
9	0238	0202		962.71			1.522
8	020110	0202		964.23			3.046
7	020110	0205	0216	967.28			3.046
6	020105	0202		970.33			1.522
5	020105	0202		971.85			1.522
4	020110	0202		973.38			3.046
3	020110	0202		976.43			3.046
2	020110	0202		979.47			3.046
1	020110	0202		982.52			3.046
0	0203			985.57			

+ 0.222

22.1

T
6 7/8"
+
−

17.6 cm
4.6 cm
22.2 cm

− 982.52
− 985.587

APPENDIX E

IG-BH03

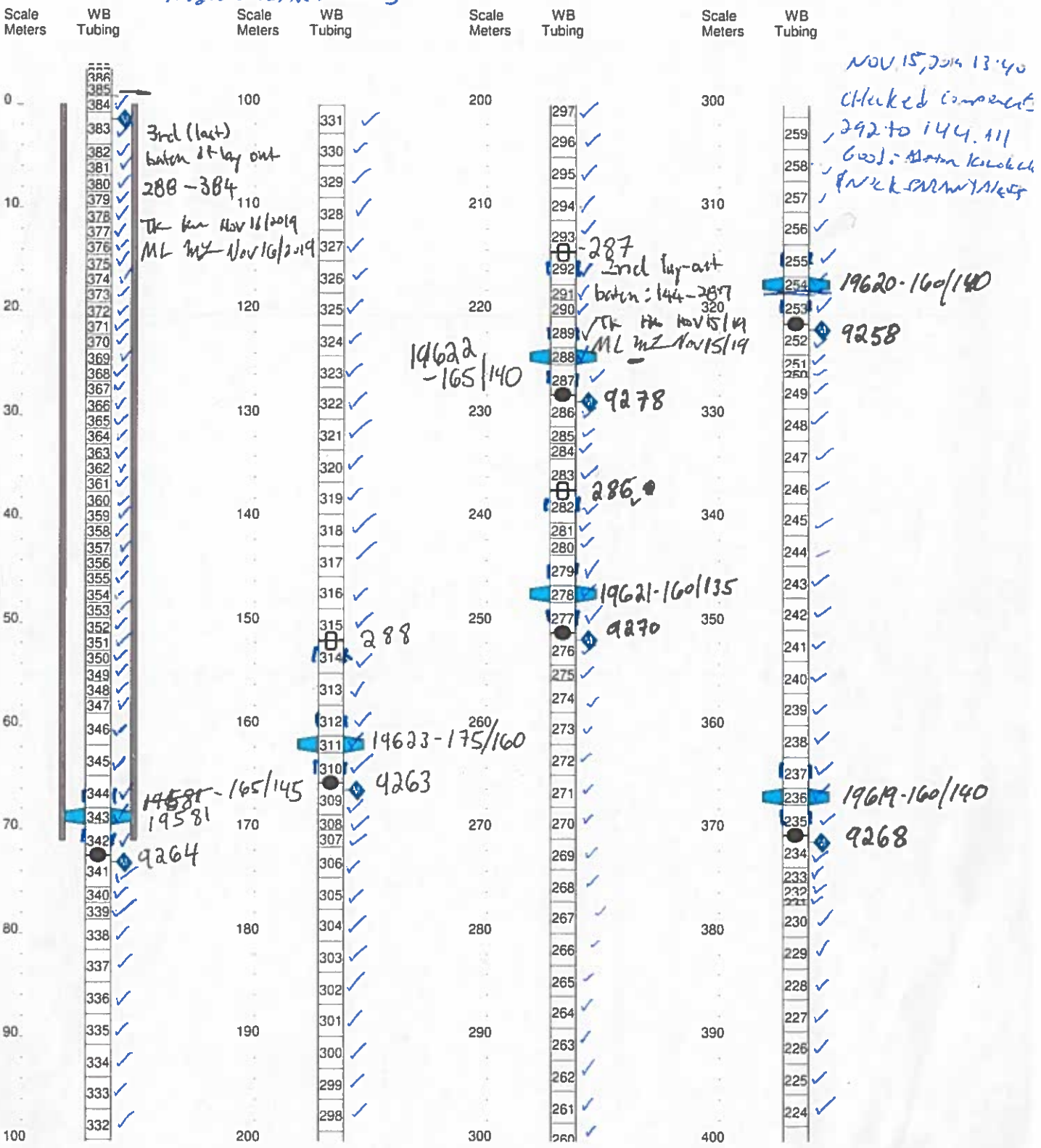
SUMMARY COMPLETION LOG (FIELD COPY)

Summary Completion Log (field copy) - 3 pages

Summary Completion Log
Golder/NWMO

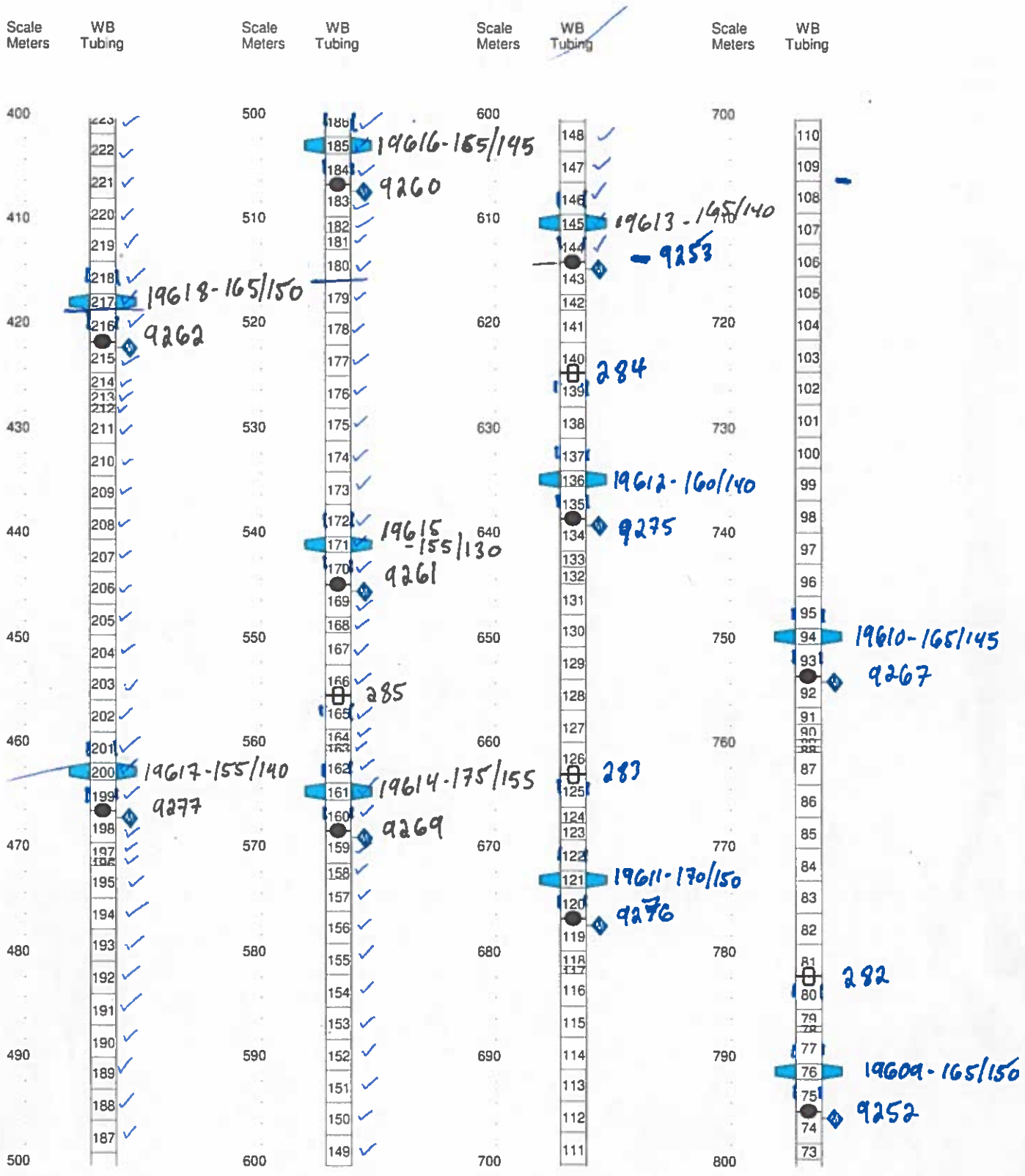
Job No: WB973
Well: IG_BH03

Nov. 16 14:30 2019
Checked components 292 to 384
All Good. - Checked by Adrian Kowalchuk
and Nick Sarmiento



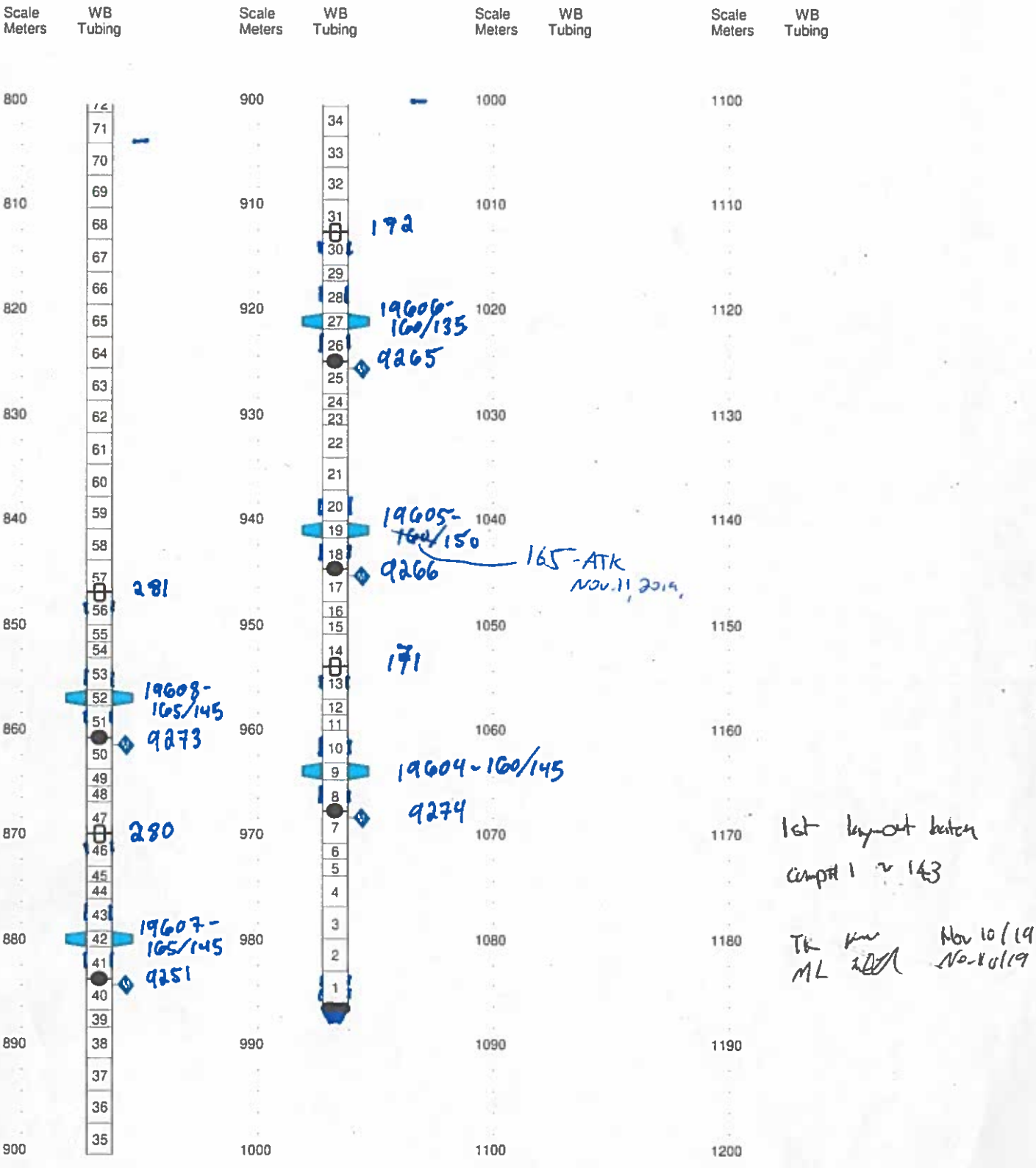
Summary Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



Summary Completion Log
Golder/NWMO

Job No: WB973
Well: IG_BH03



APPENDIX F
IG-BH03

PRE-INFLATION PRESSURE PROFILE

Pre-Inflation Field Data and Calculation Sheet (November 17, 2019) - 2 pages

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

1/2

Well No.: IG-BH03
Datum: Ground Level
Elev. G.S.: N/A
Height of Westbay above G.S.: N/A
Elev. top of Westbay Casing: N/A
Reference Elevation: N/A
Borehole angle: 70°

Probe Type: Sampler (c/c)
Serial No.: EMS 5230
Probe Range: 2000 PSI
Westbay Casing Type: MP38
Sampler Valve Position: closed

Date: Nov 17 / 2019
Client: Golder / NWMO
Job No.: WB 973
Location: Ignace, ON
Weather: snow/rain/overcast
Operator: ML / TK

Note. "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

		Start:	Finish:
Pressure		14.01	14.08
Temp		14.94	6.12
Time		14:30	17:25

P_{atm} 14.01 psi

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
1	967.3	963.8		1106.38	1279.18	15:10	12.68	1106.39	889.71	77.58	Rot 16
2	946.4	940.7		1077.28	1250.12	15:25	12.98	1077.29	869.27	75.12	Rot 16
3	924.5	921.3		1052.01	1224.98	15:32	12.87	1052.02	851.59	72.90	Rot 16 Beep 921.3
4	883.3	880.4		994.00	1172.43	15:38	12.55	994.04	814.64	68.66	Rot 16 Beep 880.4
5	860.4	857.6		969.41	1142.98	16:01	12.40	969.43	793.93	66.46	Rot 16 Beep = 857.6
6	794.8	792.3		884.09	1058.16	16:07	12.01	884.08	734.28	60.52	Rot 16 Beep = 792.3
7	753.3	750.9		829.69	1003.99	16:15	11.45	829.71	696.19	57.11	Rot 16 Beep = 750.9
8	676.4	674.5		728.36	903.29	16:21	11.03	728.35	625.37	51.03	Rot 16 Beep = 674.5
9	638.3	636.5		677.97	853.23	16:26	10.47	679.98	590.17	48.13	Rot 16 Beep = 636.5
10	613.8	612.2		645.71	821.15	16:32	10.35	645.73	567.61	46.19	Rot 16 Beep = 612.2
11	568.1	566.7		585.33	761.18	16:36	9.92	585.37	525.44	42.67	Rot 16 Beep = 566.7
12	544.5	543.3		554.27	730.33	16:40	9.64	554.28	503.74	40.76	Rot 16 Beep = 543.3
13	506.5	505.3		504.02	680.34	16:43	9.36	504.04	468.58	37.91	Rot 16 Beep = 505.3
14	466.2	465.3		451.02	627.60	16:47	9.09	451.06	431.50	34.70	Rot 16 Beep = 465.3
15	421.4	420.7		391.96	568.92	16:51	8.57	391.98	390.23	31.17	Rot 16 Beep = 420.7

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

2/2

Well No.: IG - BH 03
Datum: Ground Level
Elev. G.S.: N/A
Height of Westbay above G.S.: N/A
Elev. top of Westbay Casing: N/A
Reference Elevation: N/A
Borehole angle: 70°

Probe Type: Sampler (O/C)
Serial No.: EM5 5230
Probe Range: 2000 PSI
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Date: Nov 17 / 2019
Client: Golder / NWMO
Job No.: WB973
Location: Ignace
Weather: Snow / Rain / overcast
Operator: ML / TK.

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure	14.01	Finish:	14.08
Temp	14.94		6.12
Time	14:30		17:25

P_{atm} 14.01 psi

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments	
16	370.5	370.0		324.84	502.20	16:55	8.26	324.82	343.31	27.19	Rot 16	Beep: 370.0
17	321.1	320.9		259.74	437.49	16:59	7.86	259.72	297.79	23.31	Rot 16	Beep: 320.9
18	251.0	250.9		167.31	345.52	17:04	7.31	167.32	233.13	17.87	Rot 16	Beep: 250.9
19	228.1	228.2		137.04	315.41	17:07	6.94	137.04	211.95	16.14	Rot 16	Beep: 228.2
20	165.5	165.9		54.27	233.15	17:12	6.55	54.26	154.11	11.39	Rot 16	Beep: 165.9
21	72.5	73.2		14.17	110.64	17:18	6.09	14.20	67.95	4.55	Rot 16	Beep: 73.2

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

APPENDIX G
IG-BH03

WESTBAY SYSTEM PACKER INFLATION RECORDS

Westbay System Packer Inflation Records - 22 pages

Sheet 1 of 22.

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK / ML | Date Inflated: Nov 18 / 2019

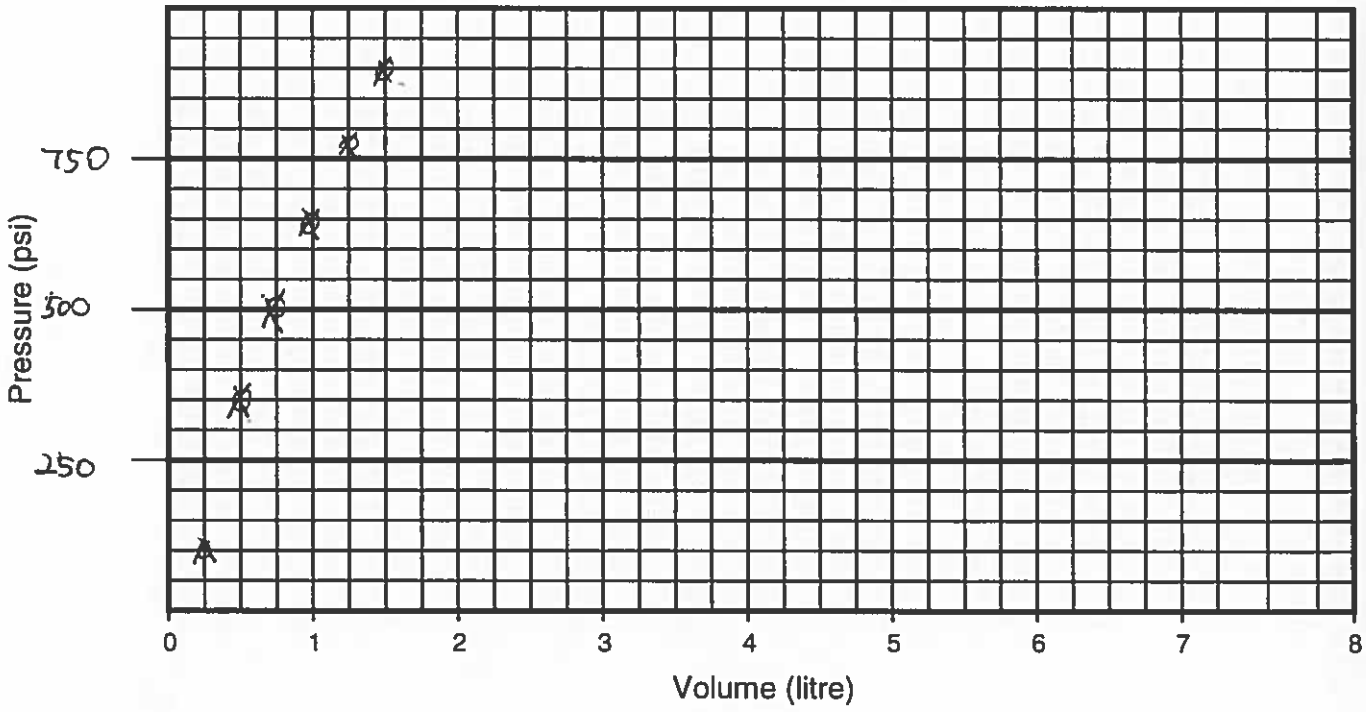
Packer No. Blank wall | Depth (m): 919.2 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 0 psi | Final Line Pressure, P_L: N/A psi | Tool Pressure, P_T: 540 psi

Borehole Water Level: 1 (m) = 1.4 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = N/A psi

Volume, litres	0.25	0.5	0.75	1.0	1.25	1.5	0.5			
Pressure, psi	200	350	500	650	770	900	0			
Volume, litres										
Pressure, psi										



Comments: Blank wall | Time - 12:23

Sheet 2 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 18/2019

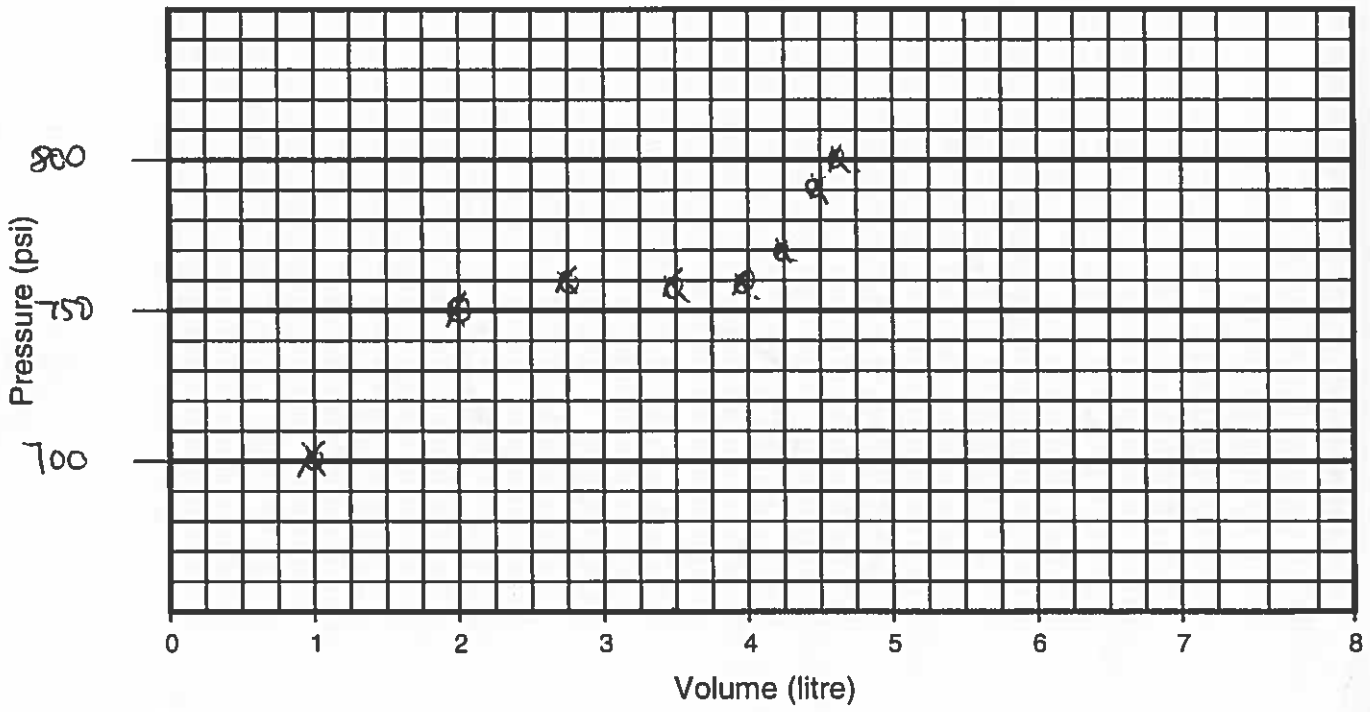
Packer No. #1, comp 9, S/N: 196044 | Depth (m): 962.71 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 800 psi | Tool Pressure, P_T: 540 psi

Borehole Water Level: 1 (m) = 1.4 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 115 psi

Volume, litres	1.0	1.5	2.0	2.5	3.0	3.25 ~~3.5~~	3.5	3.75	4.0	4.25
Pressure, psi	700	740	750	760	760	760	760	760	760	770
Volume, litres	4.4	4.5	4.55	3.7						
Pressure, psi	780	790	800	Ø						



Comments: Packer #1 | Time - 13:07

Sheet 3 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 18 | 2019

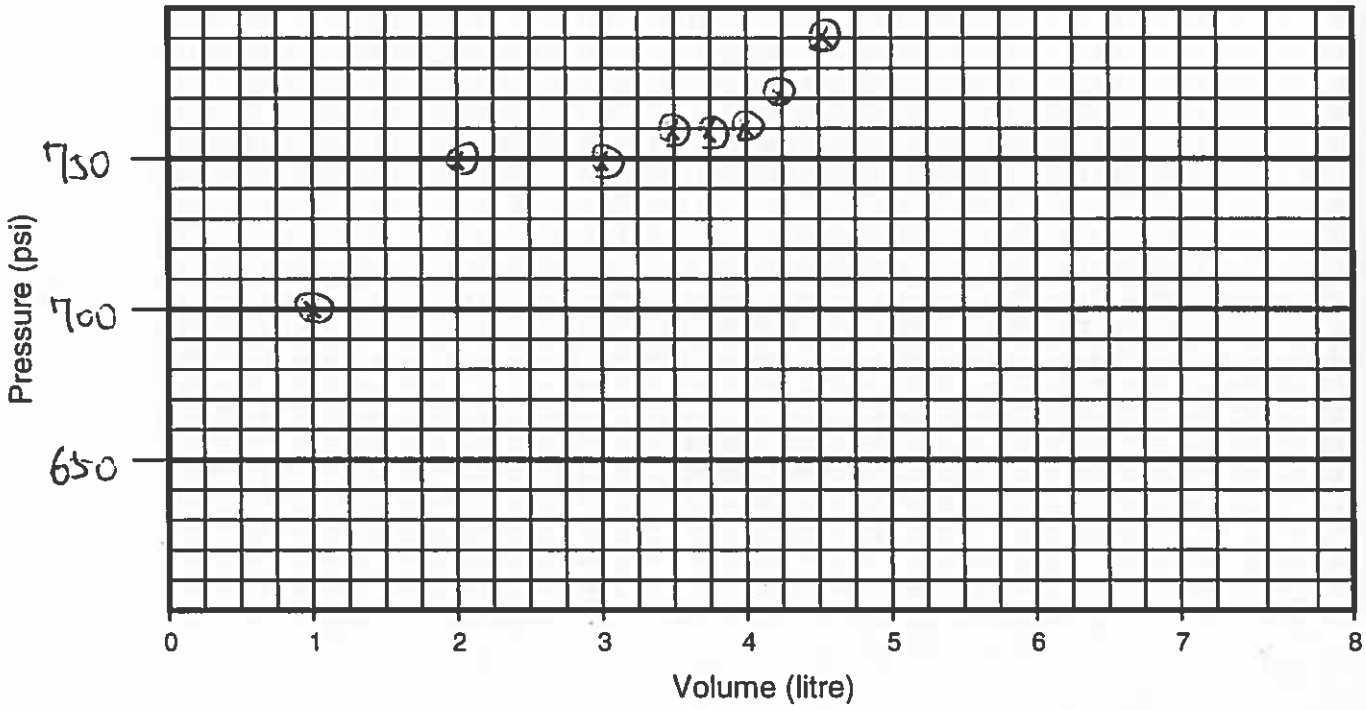
Packer No.: #2, comp #14, SN 19605 | Depth (m): 939.78 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 790 psi | Tool Pressure, P_T: 540 psi

Borehole Water Level: 1 (m) = 1 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 100 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	3.75	4.0	4.25	4.5	3-6
Pressure, psi	700	750	750	750	760	760	760	770	790	Ø
Volume, litres										
Pressure, psi										



Comments: Packer #2. Time - 13:43

Sheet 4 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 18/2019

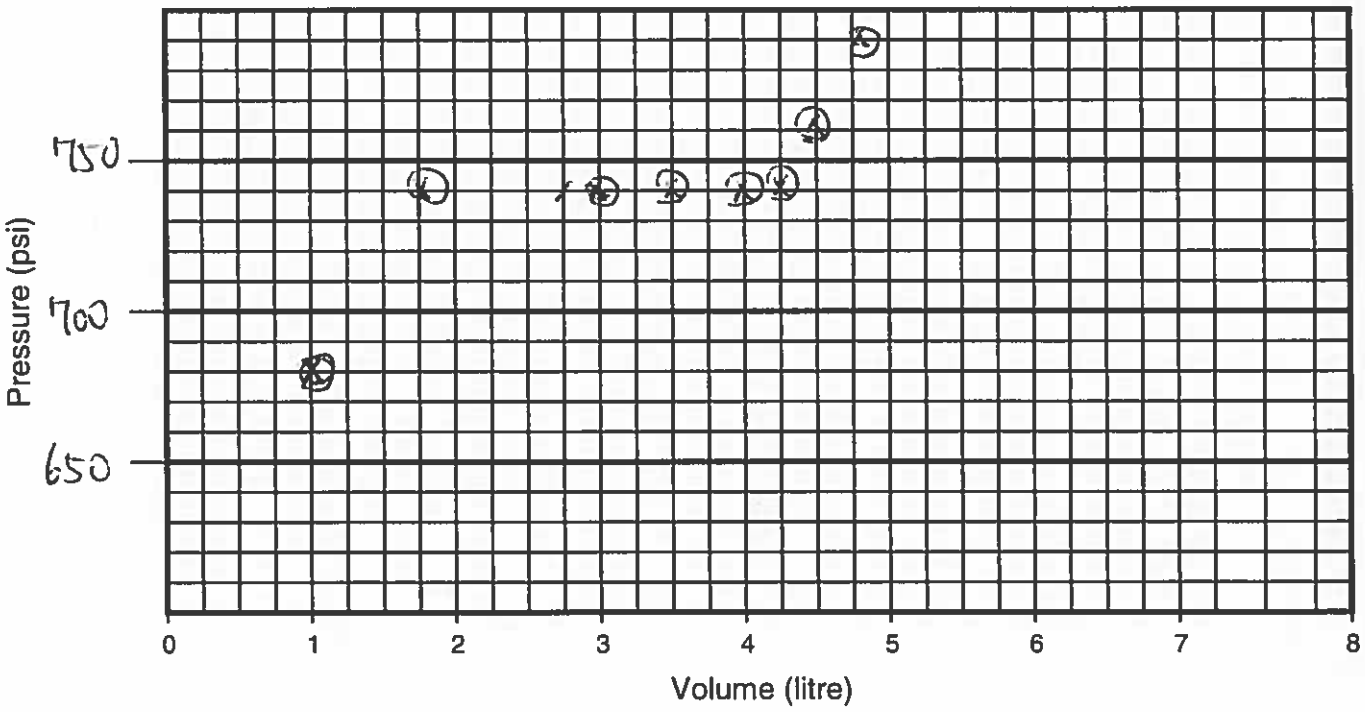
Packer No. #3, Comp# 27, SN 19606 | Depth (m): ~~999.96~~ 919.96 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 135 psi | Final Line Pressure, P_L: 790 psi | Tool Pressure, P_T: 540 psi

Borehole Water Level: 1 (m) = 1.5 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 115 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.25	4.5	4.55	3.65	
Pressure, psi	680	740	740	740	740	740	760	790	Ø	
Volume, litres										
Pressure, psi										



Comments: Packer #3 | Time - 14:15

Sheet 5 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TB/M | Date Inflated: Nov 18/2019

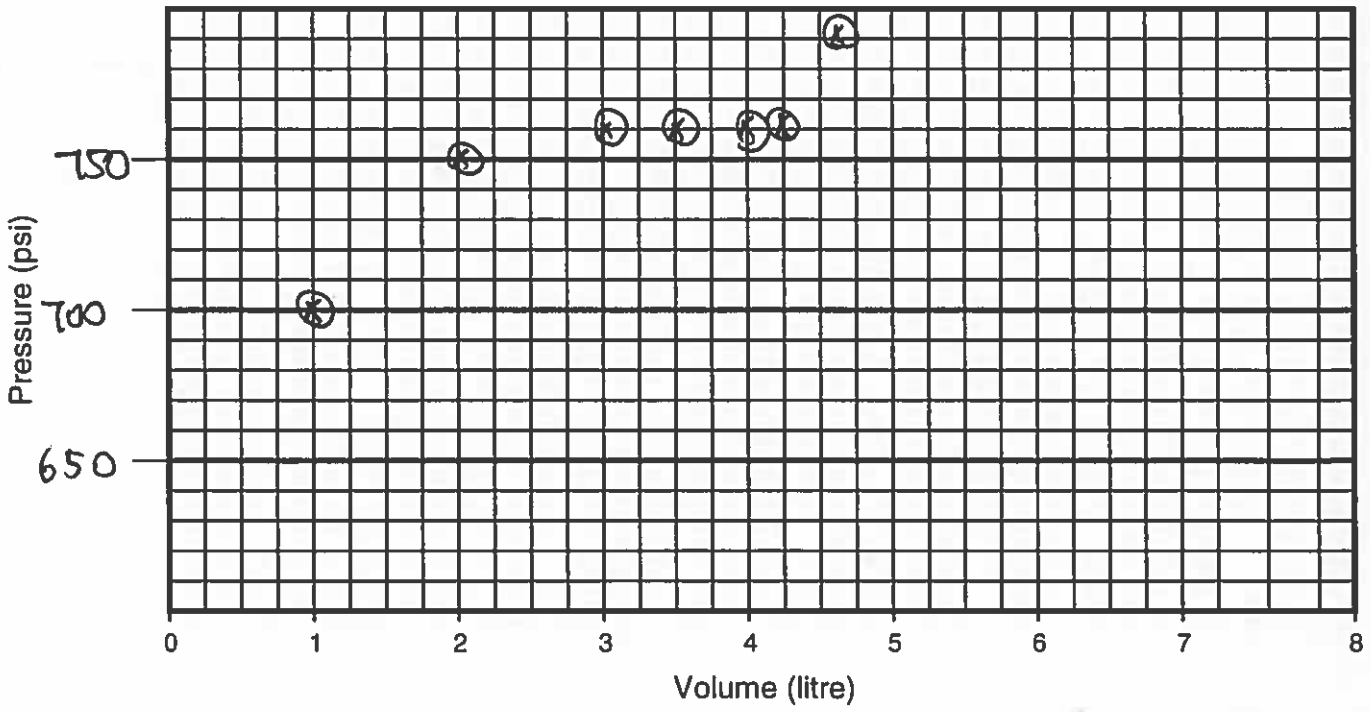
Packer No.: #4, comp# 42, SN 19607 | Depth (m): 878.74 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 790 psi | Tool Pressure, P_T: 540 psi

Borehole Water Level: 1 (m) = 1.4 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.25	4.5	4.6	3.7	
Pressure, psi	700	750	760	760	760	760	770	790	ø	
Volume, litres										
Pressure, psi										



Comments: Packer #4 | Time - 14:50

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ HL | Date Inflated: Nov 18 | 2019

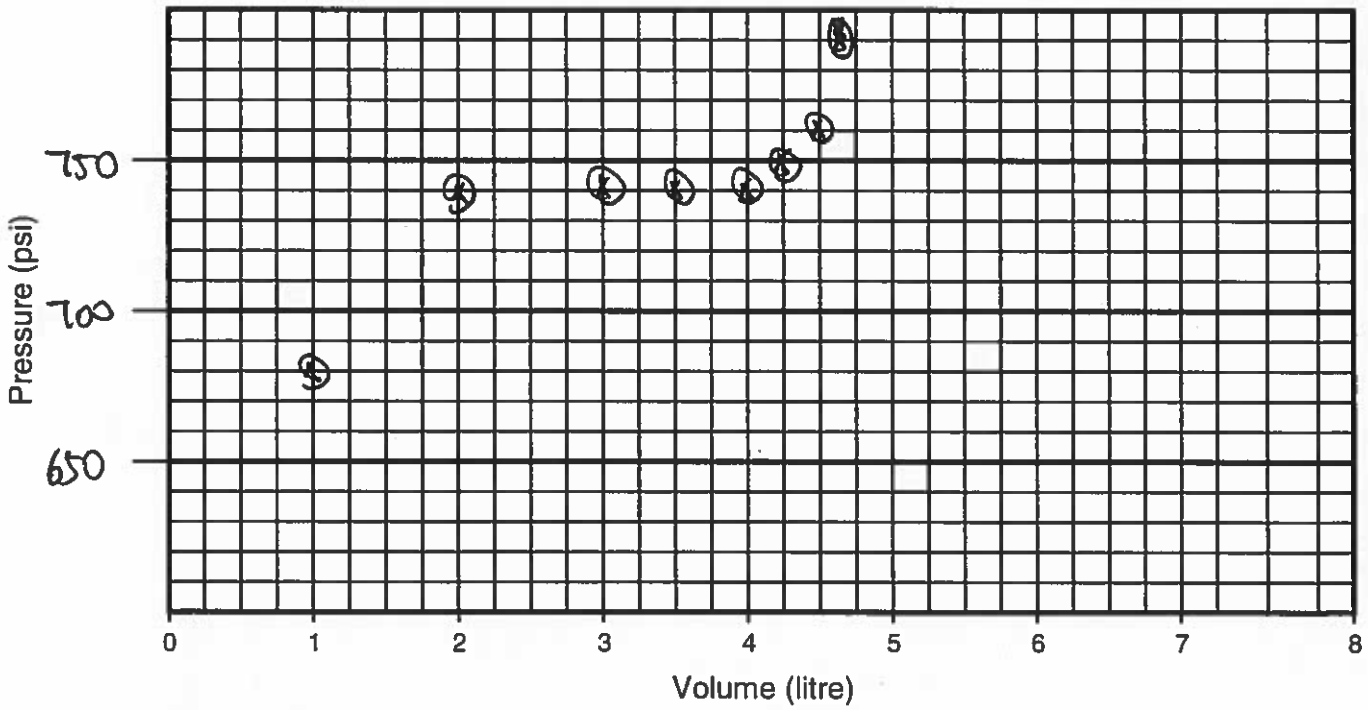
Packer No.: #5, Comp# 52, SN 19608 | Depth (m): 855.81 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 790 psi | Tool Pressure, P_T: 540 psi

Borehole Water Level: 1 (m) = 1.4 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.25	4.5	4.6	3.65	
Pressure, psi	680	740	740	740	740	750	760	790	Ø	
Volume, litres										
Pressure, psi										



Comments: Packer #5. Time - 15:22

Sheet 7 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 18/2019

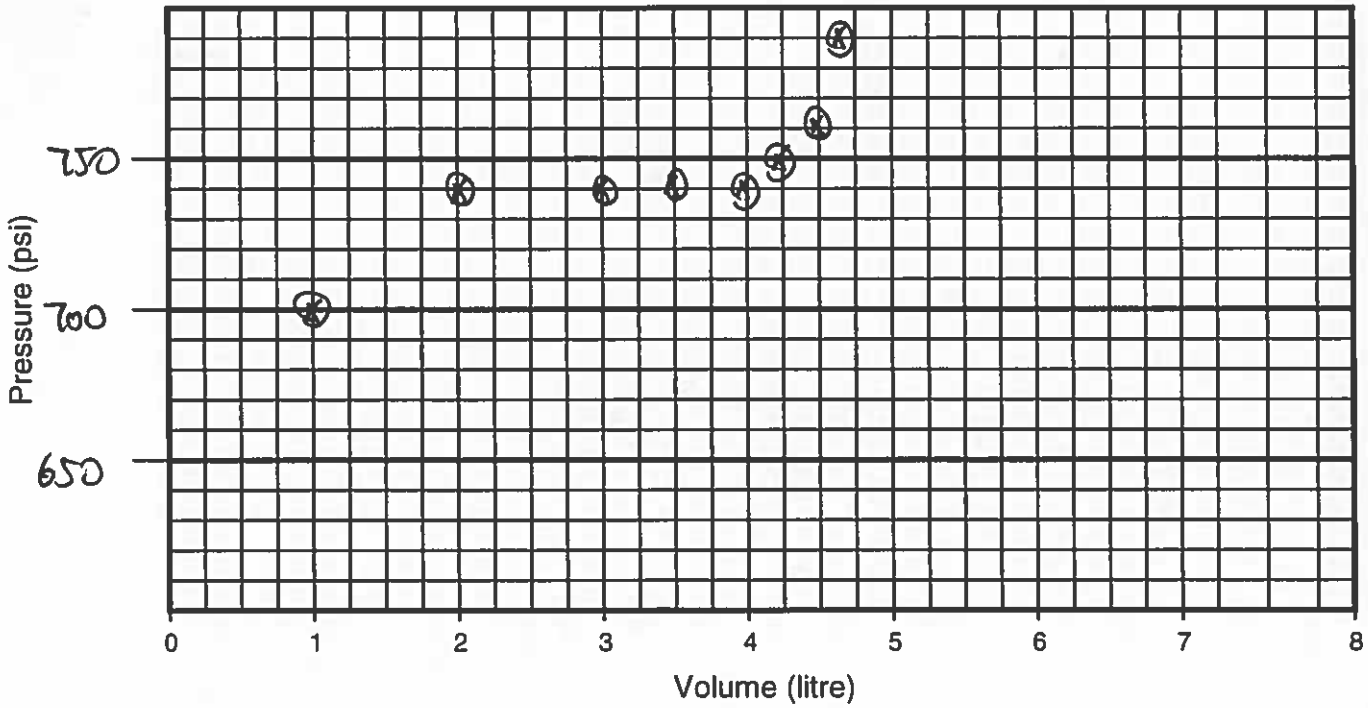
Packer No.: #6, comp#76, SN 19609 | Depth (m): 790.20 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 780 psi | Tool Pressure, P_T: 540 psi

Borehole Water Level: 1 (m) = 1.4 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 90 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.25	4.5	4.6	3.65	
Pressure, psi	700	740	740	740	740	750	760	780	Ø	
Volume, litres										
Pressure, psi										



Comments: parker 6 Time - 16:02

Westbay Packer Inflation Record

Westbay Instruments

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: ML / TK | Date Inflated: Nov 21 / 19

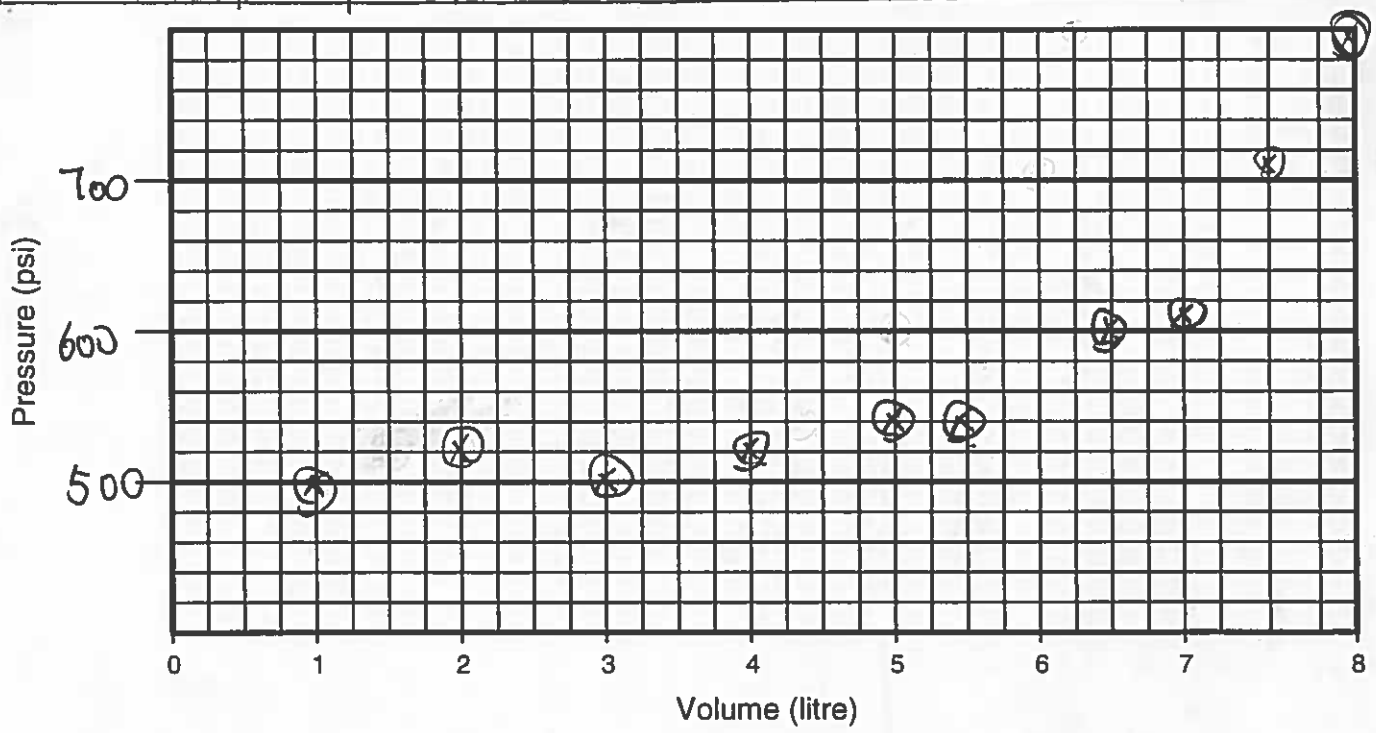
Packer No. 7, Comp 94, SN 19610 | Depth (m): 748.68 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 800 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~134 (m) = ~188 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = ~~385~~ 313 psi

Total Pumped Vol :	1.0	2.0		3.0	4.0		5.0	5.5		6.5
Volume, litres	1.0	2.0	(1.5)	1.0	2.0	(1.5)	1.0	1.5	(1.2)	1.0
Pressure, psi	500	520	Ø	500	520	Ø	540	540	Ø	600
Volume, litres	1.5	2.0	2.5	(2.0)	*6.2					
Pressure, psi	610	710	800	Ø	Ø					
Total Pumped Vol	7.0	7.5	8.0			* Net Vol Pumped = 1.5 + 1.5 + 1.2 + 2.0 = 6.2 ℓ				



Comments: * Borehole water level was calculated based on pressure reading Time - 11:08

Note :- Inflation tool was tripped out of hole to verify it's function b/c the expected pressure was too low.

- It was determined that BTW level changed after guide tube removal.

Sheet 9 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 21/2014

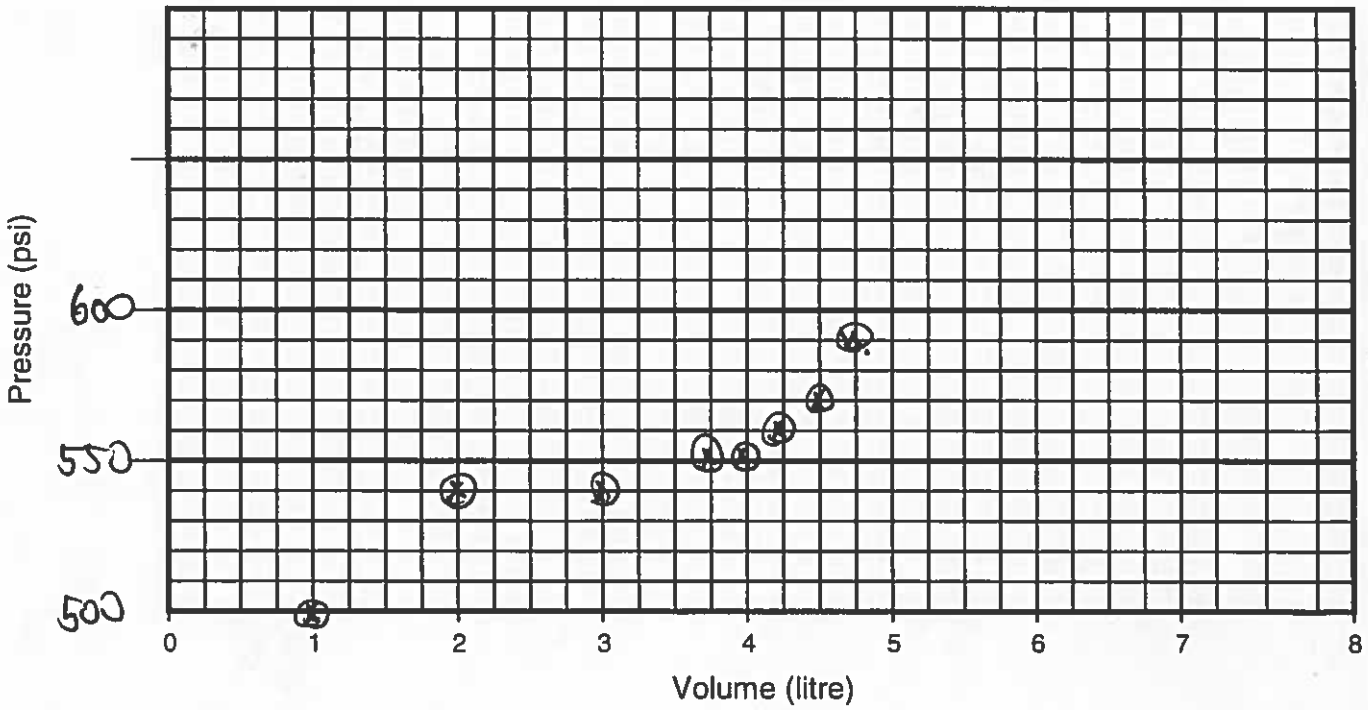
Packer No. 8, comp 121, SN 19611 | Depth (m): 671.87 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 590 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~~~134~~ (m) = ~~~~180~~ psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 98 psi

Volume, litres	1.0	1.5	2.0	2.5	3.0	3.5	3.75	4.0	4.25	4.5
Pressure, psi	500	540	540	540	540	540	560	550	560	570
Volume, litres	4.75	4.0								
Pressure, psi	590	ø								



Comments: Packer #8 Time - 16:16

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK / HL | Date Inflated: Nov 21 2019

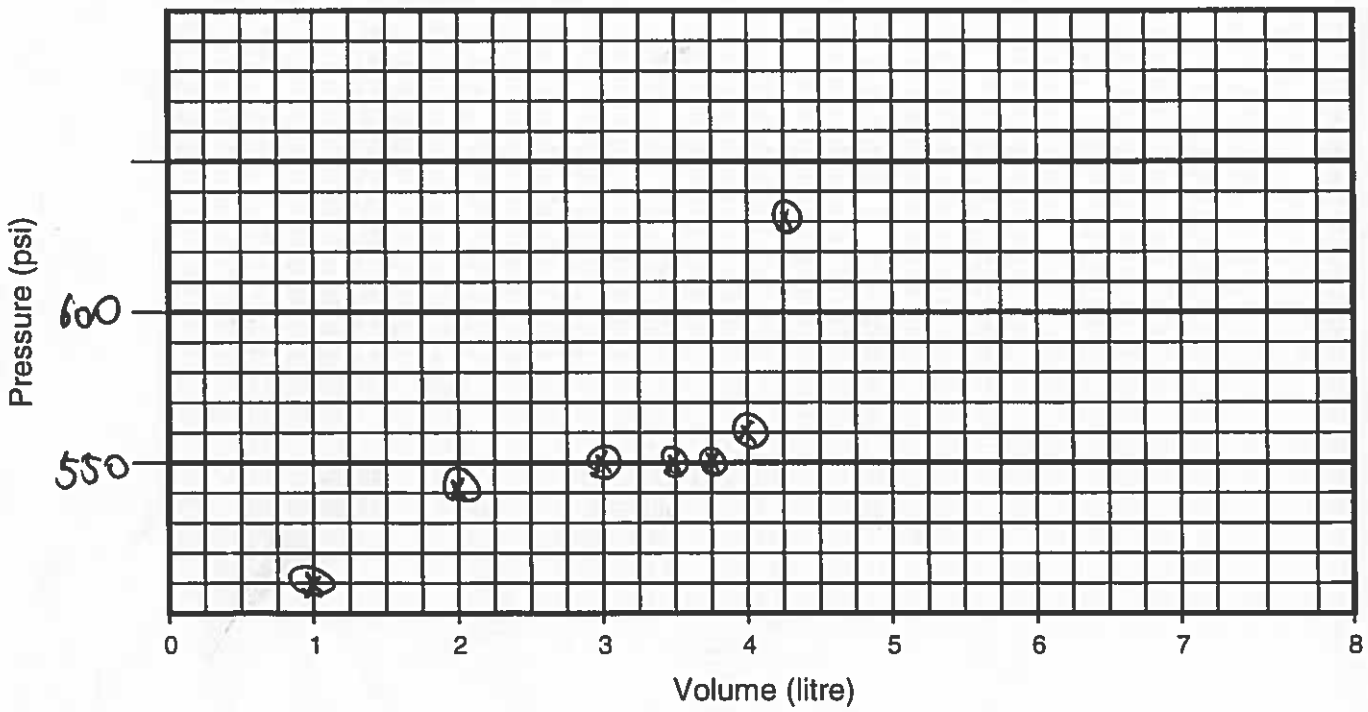
Packer No. 9, comp 136, SN 19612 | Depth (m): 633.69 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 630 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: a/134 (m) = 188 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 148 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	3.75	4.0	4.5	3.7	
Pressure, psi	510	540	550	550	550	550	560	630	ø	
Volume, litres										
Pressure, psi										



Comments: Packer #9. Time - 17:14

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK / HL | Date Inflated: Nov 21/19

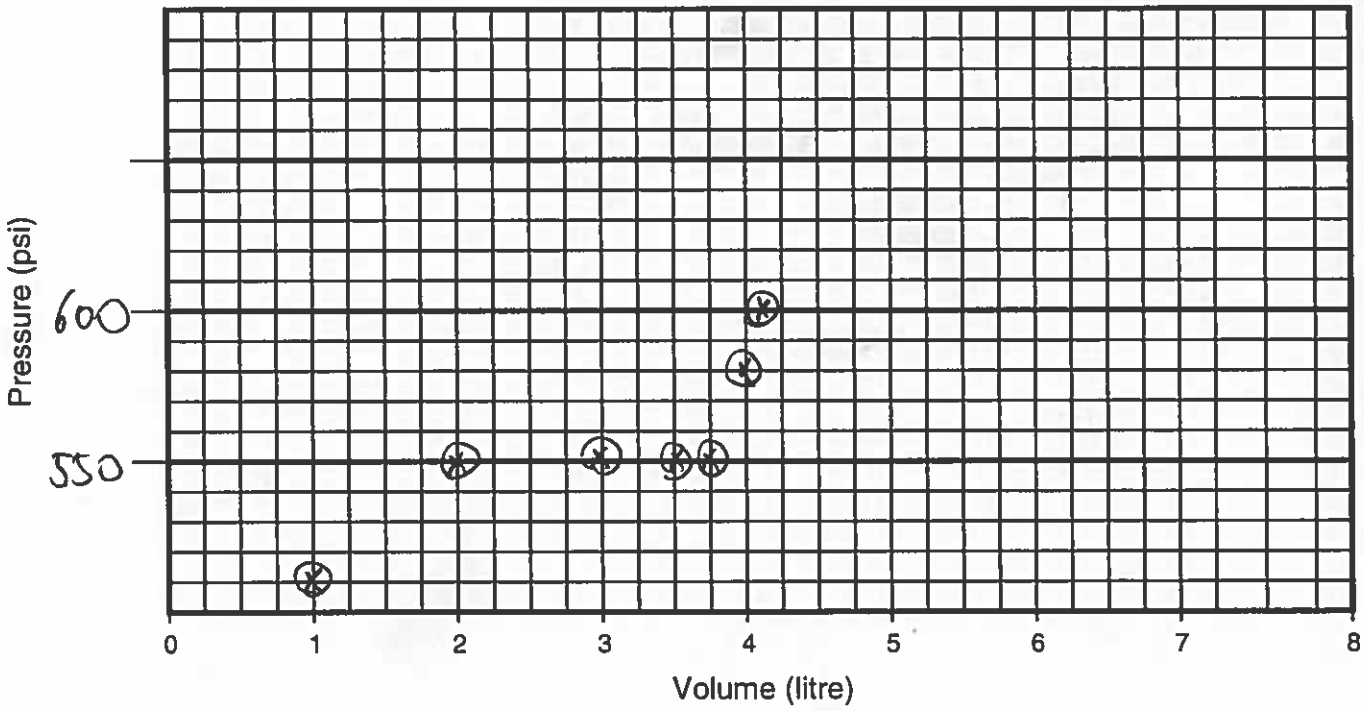
Packer No. #10, comp #146, SN 19613 | Depth (m): 609.24 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: 1134 (m) = 168 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 118 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	3.75	4.0	4.1	3.6	
Pressure, psi	510	550	550	550	550	550	580	600	0	
Volume, litres										
Pressure, psi										



Comments: Packer #10

Time - 17:46

Sheet 12 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: ML/ITK | Date Inflated: Nov 21 19

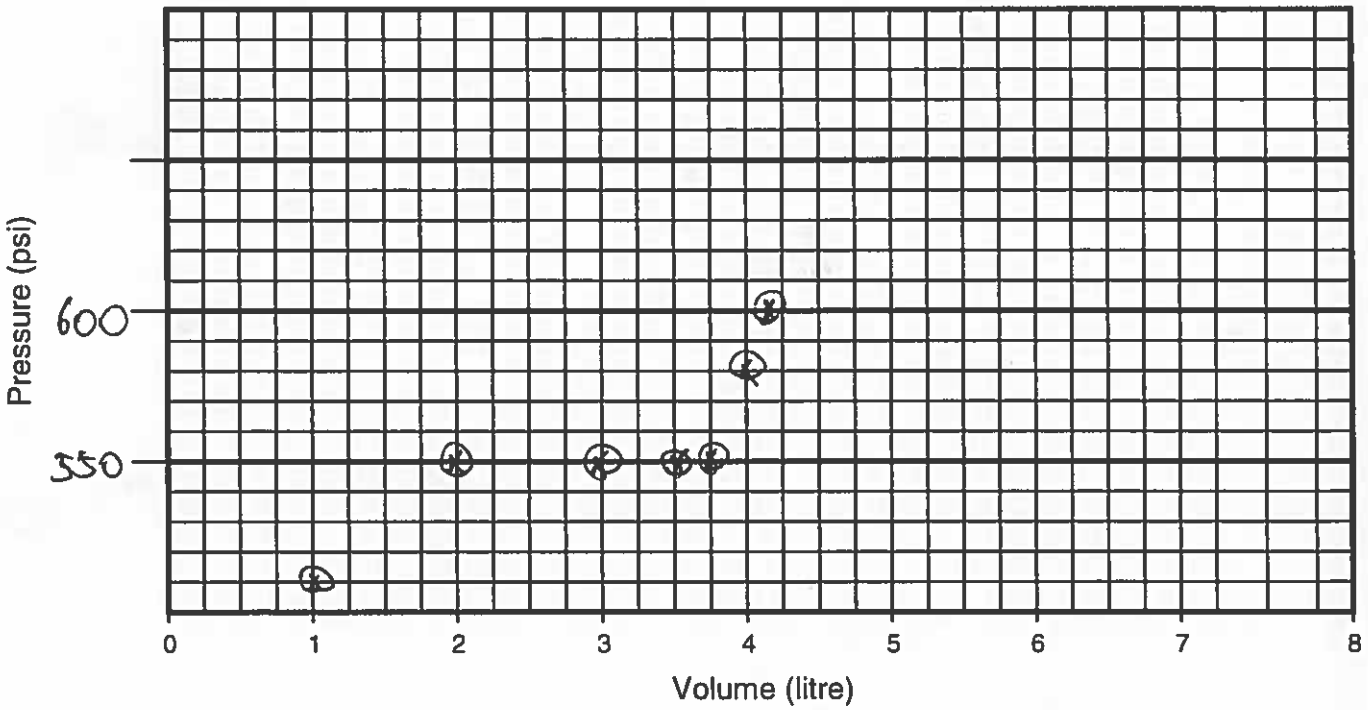
Packer No. 11, comp #161, SN 19614 | Depth (m): 563.52 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 155 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~134 (m) = ~~188~~ psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = ~~103~~ 95 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	3.75	4.0	4.1	3.6	
Pressure, psi	510	550	550	550	550	550	580	600	∅	
Volume, litres										
Pressure, psi										



Comments: Packer # 11 | Time - 18:32

Sheet 13 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 22/19

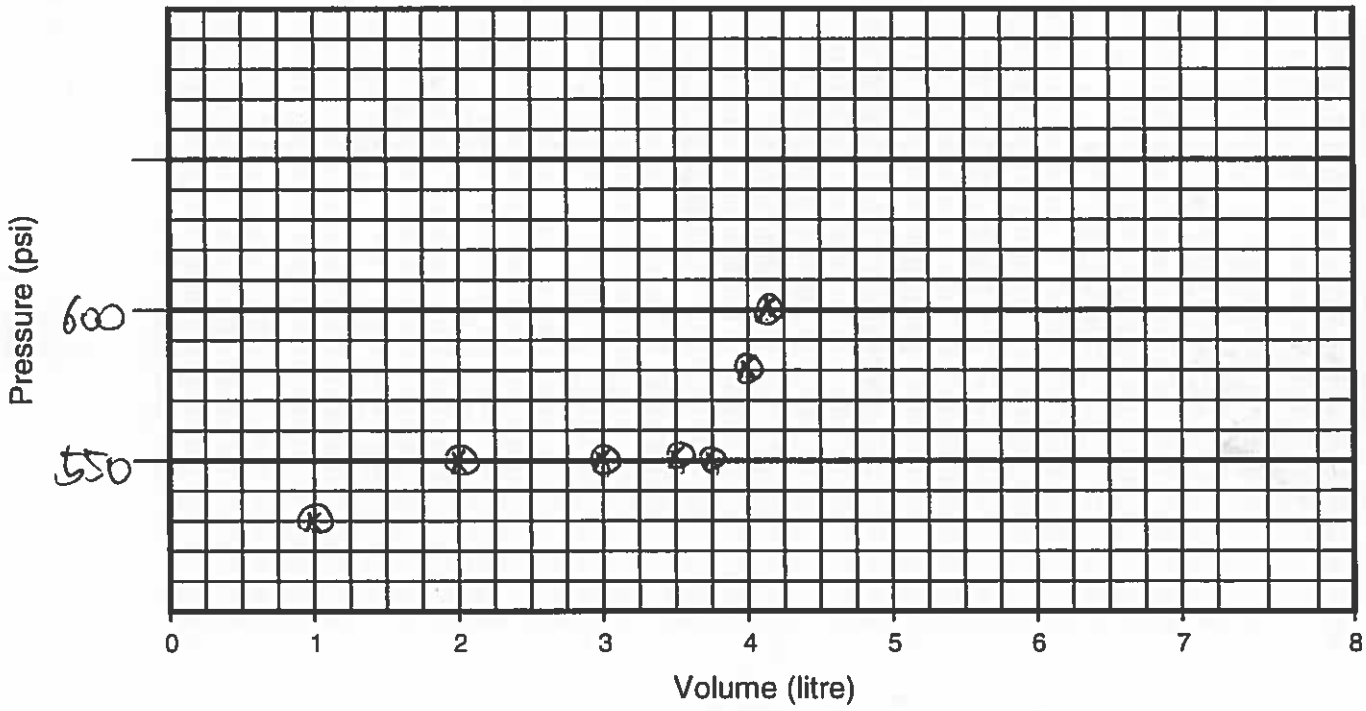
Packer No. 12, comp 171, SN 19615 | Depth (m): 539.97 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 130 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~134 (m) = 1320 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 128 psi

Volume, litres	1.0	2.0	3.5	3.0	3.5	3.75	4-0	4-1	3.6	
Pressure, psi	530	550	550	550	550	550	580	600	Ø	
Volume, litres										
Pressure, psi										



Comments: Packer #12 | Time - 8-22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 22/19

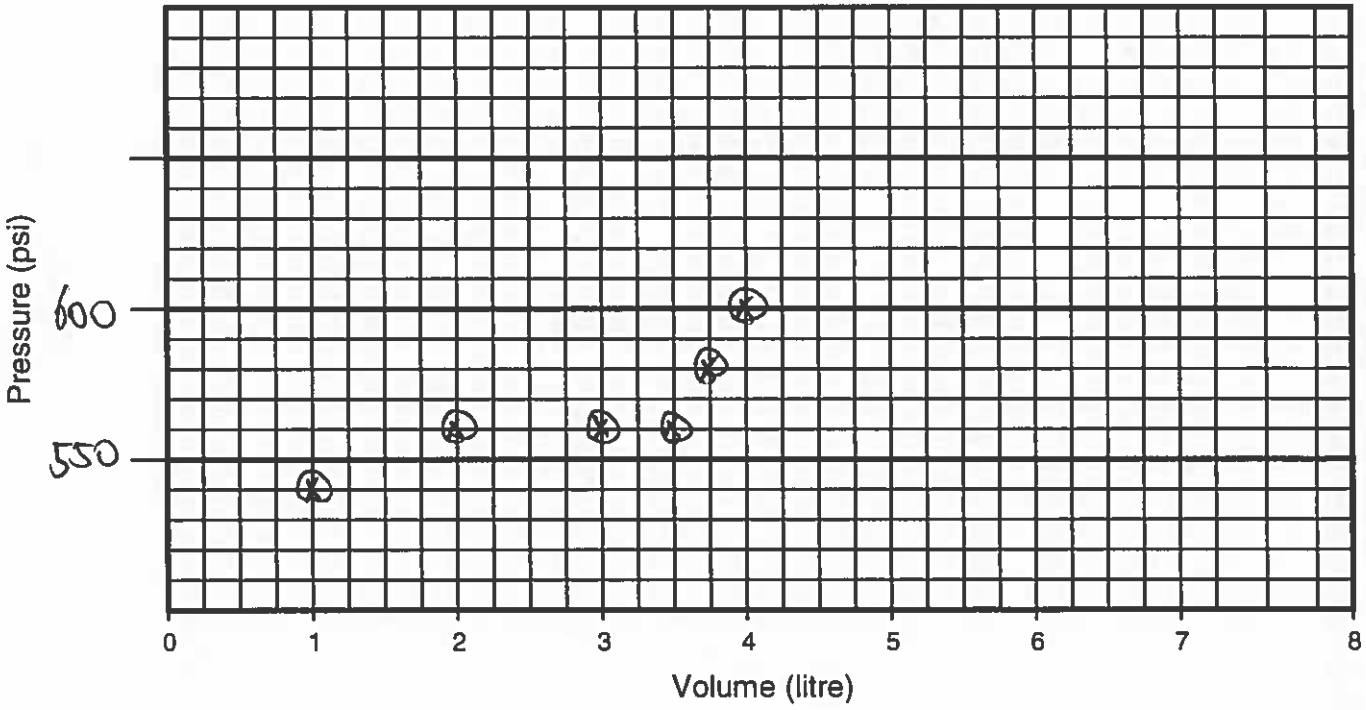
Packer No. 13, comp 185, SN 19616 | Depth (m): 501.88 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~134 (m) = 188 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 113 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	3.75	4.00	3.55		
Pressure, psi	540	560	560	560	560	580	600	Ø		
Volume, litres										
Pressure, psi										



Comments: Packer with 13 | Time - 9:04

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 22/19

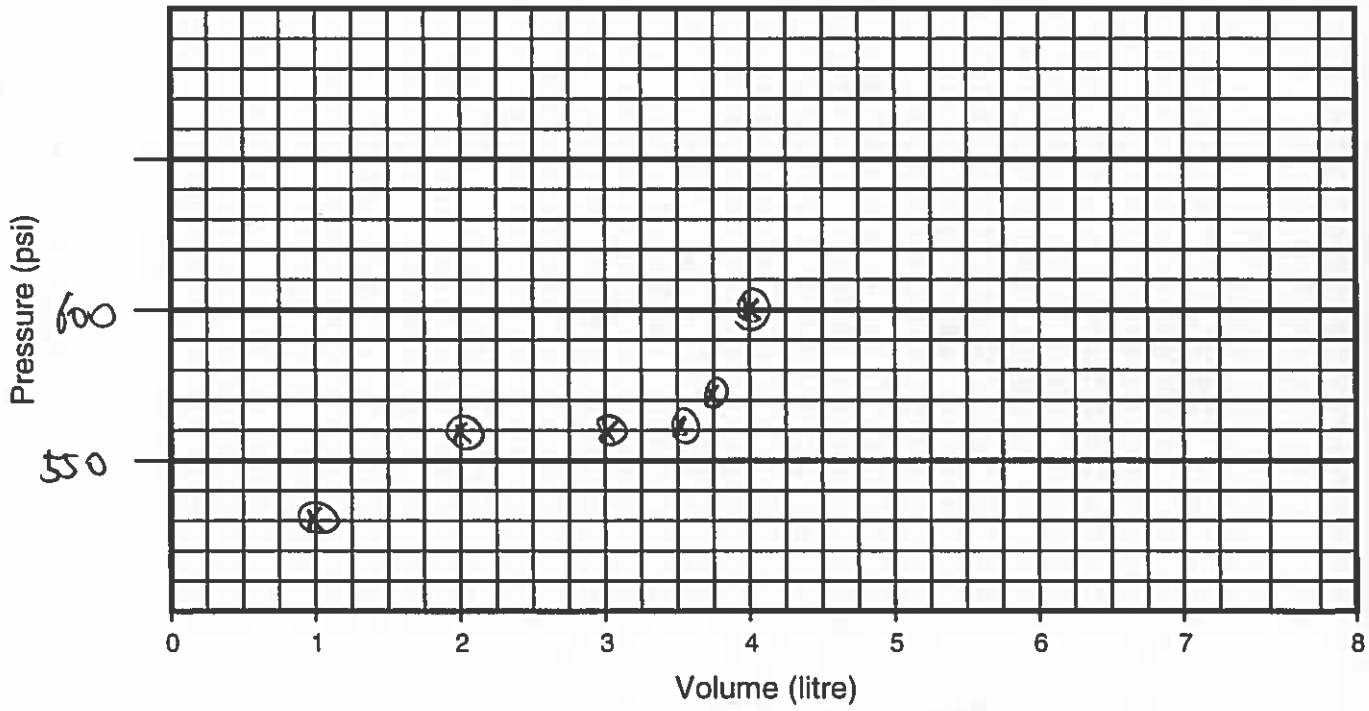
Packer No: #14, comp #200 SN 19617 | Depth (m): 461.64 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~134 (m) = 188 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 118 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	3.75	4.0	3.55		
Pressure, psi	530	560	560	560	560	570	600	Ø		
Volume, litres										
Pressure, psi										



Comments: Packer #14 Time - 9:35

Sheet 16 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 22/19

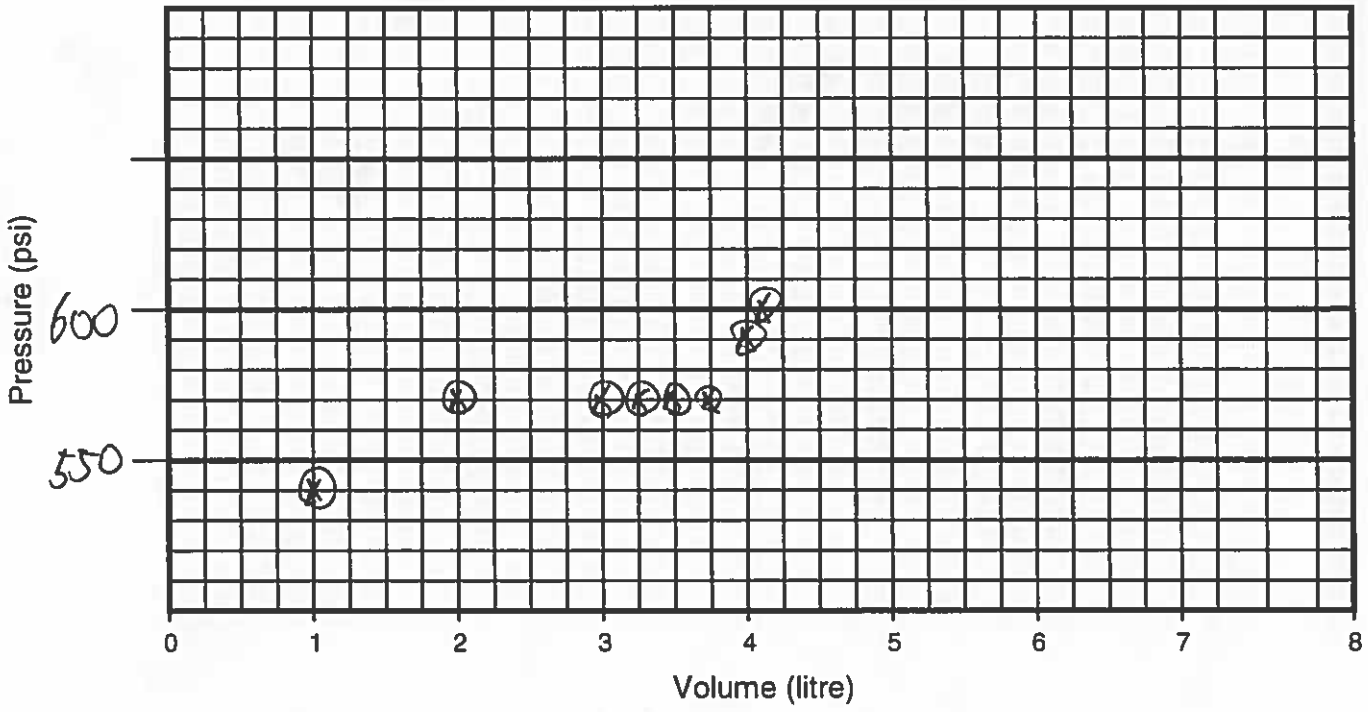
Packer No. 15, comp 217, SN 1961B | Depth (m): 416.64 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: 284 (m) = 1998 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 1068 psi

Volume, litres	1.0	2.0	2.5	3.0	3.25	3.5	3.75	4.0	4.1	3.55
Pressure, psi	540	570	570	570	570	570	570	590	600	∅
Volume, litres										
Pressure, psi										



Comments: Packer #15.

Time - 10:23

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: ML / TK | Date Inflated: Nov 22/19

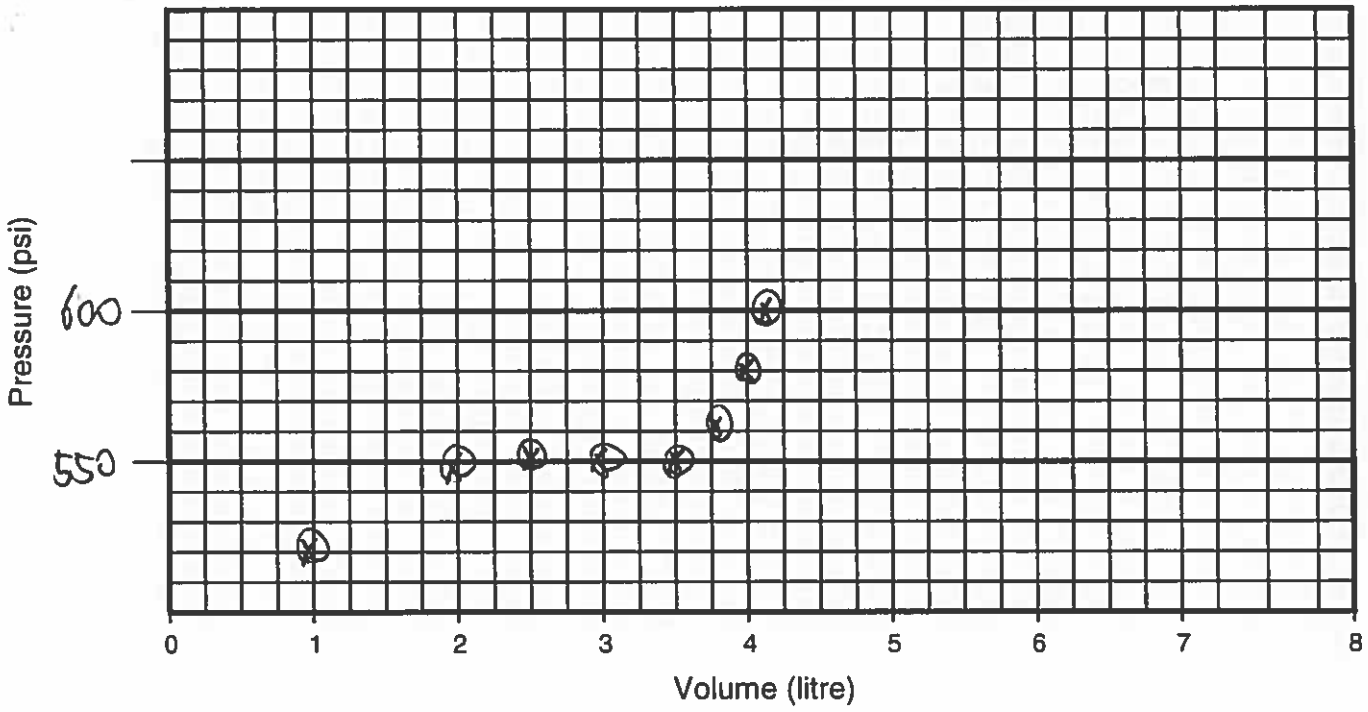
Packer No. 16, comp # 236, SN 19619 | Depth (m): 365.94 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~134 (m) = 188 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 118 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	3.75	4.0	4.1	3.55	
Pressure, psi	520	550	550	550	550	560	580	600	∅	
Volume, litres										
Pressure, psi										



Comments: Packer #16 | Time - 10:55

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: MLTK | Date Inflated: Nov 22/19

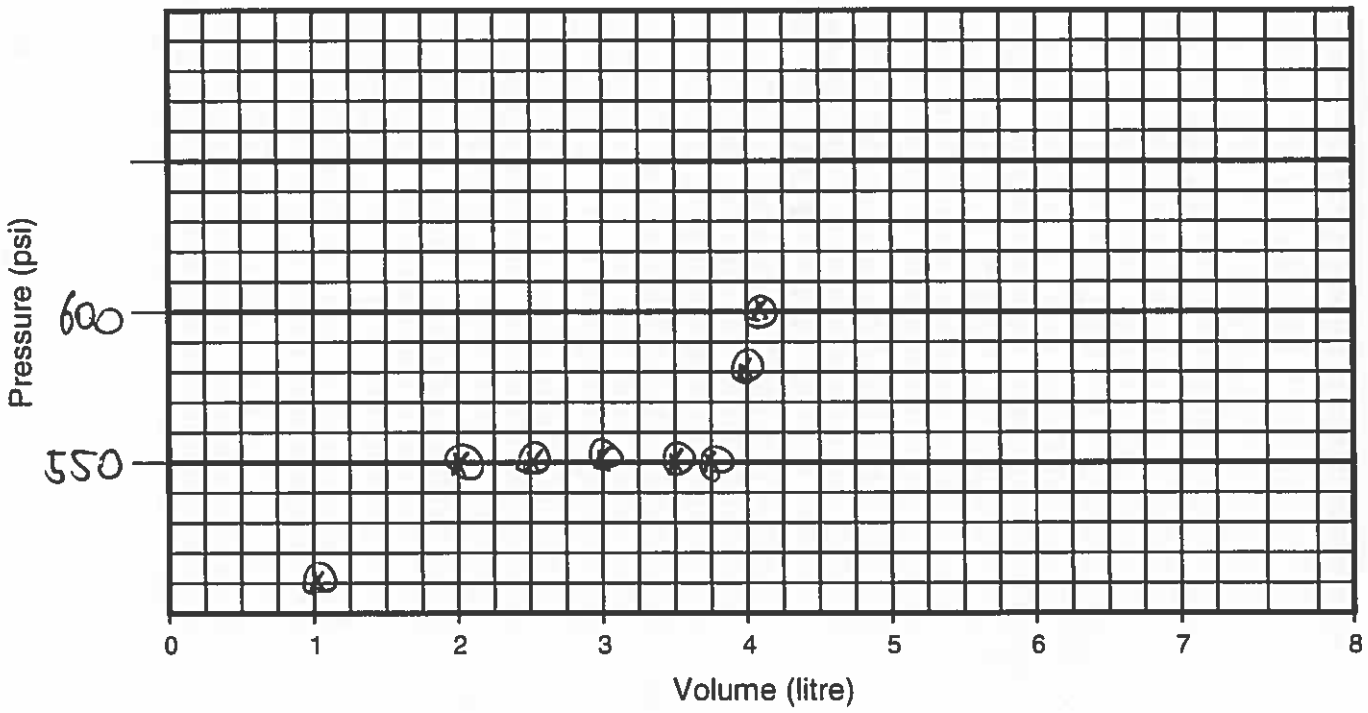
Packer No. 17, comp# 254, SN 19620 | Depth (m): 316.37 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~134 (m) = 188 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 118 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	3.75	4.0	4.1	3.55	
Pressure, psi	510	550	550	550	550	550	580	600	∅	
Volume, litres										
Pressure, psi										



Comments: Packer #17 | Time - 11:43

Sheet 19 of 20

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK / ML | Date Inflated: Nov 22/19

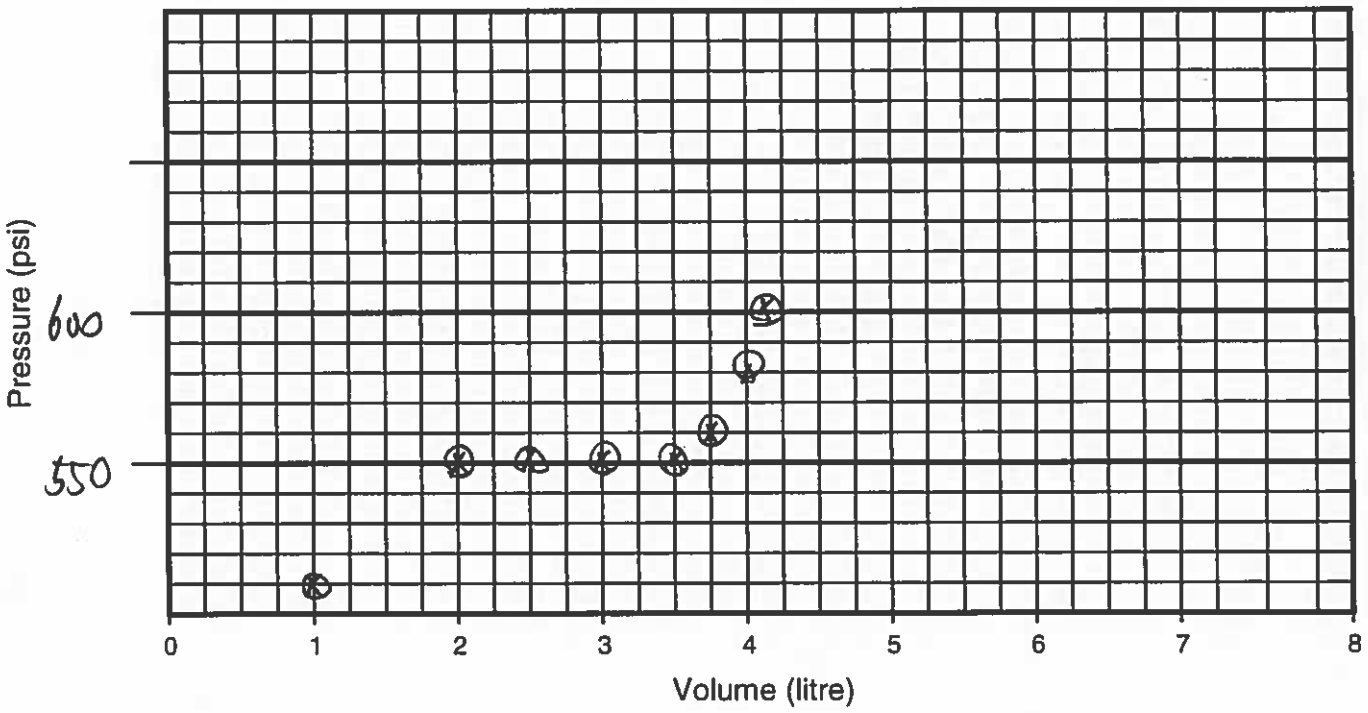
Packer No. 18, Comp # 2718, SN 19621 | Depth (m): 246.47 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 135 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 330 psi

Borehole Water Level: ~134 (m) = 1088 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 123 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	3.75	4.0	4.1	3.55	
Pressure, psi	510	550	550	550	550	560	580	600	0	
Volume, litres										
Pressure, psi										



Comments: Packer # 18

Time - 12:25

Sheet 20 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 22/19

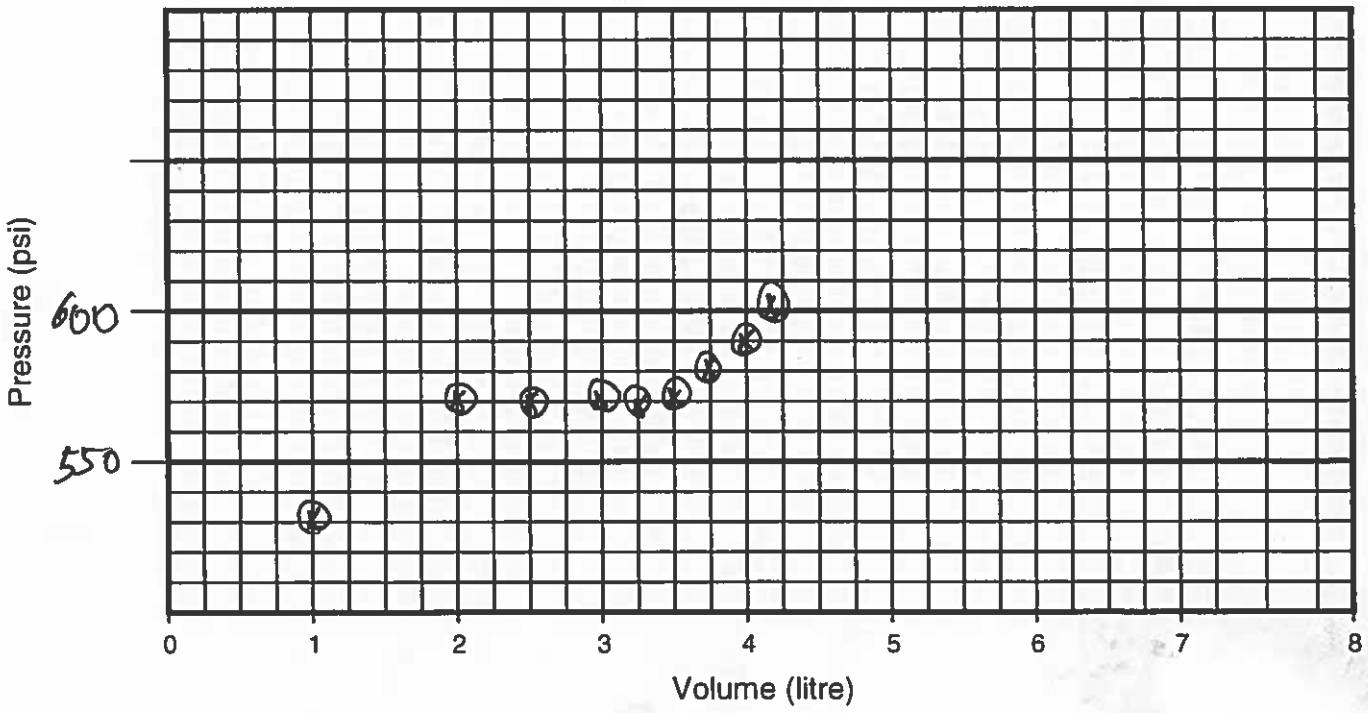
Packer No. 19, comp 288, SN 19622 | Depth (m): 223.53 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~134 (m) = 188 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 118 psi

Volume, litres	1.0	2.0	2.5	3.0	3.25	3.5	3.75	4.0	4.15	3.6
Pressure, psi	530	570	570	570	570	570	580	590	600	∅
Volume, litres										
Pressure, psi										



Comments: Packer #19 | Time - 14:05

Sheet 21 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: | Date Inflated: Nov 22/19

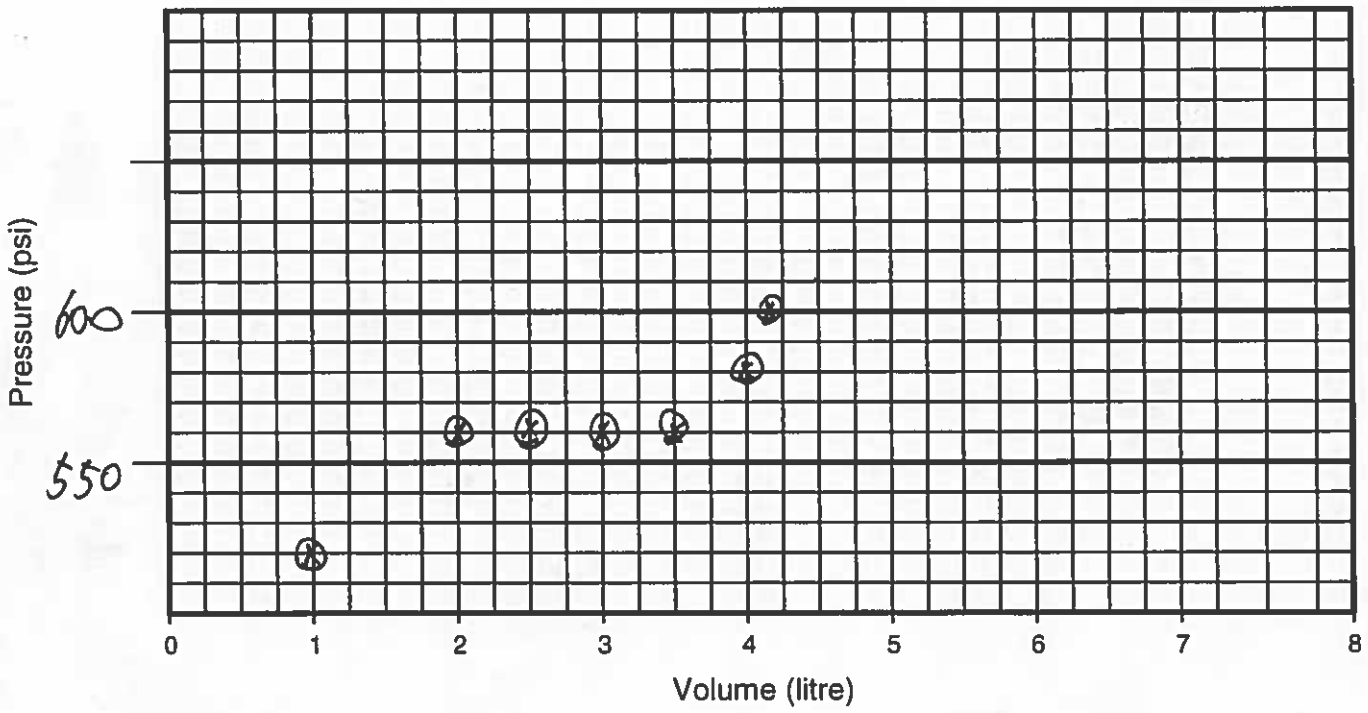
Packer No. 20, comp 311 SN19623 | Depth (m): 160.97 | Inflation Tool No.: TIW3197

Packer Valve Pressure, P_V: 160 psi | Final Line Pressure, P_L: 600 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~134 (m) = 188 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 98 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	3.75	4.0	4.2	3.6	
Pressure, psi	520	560	560	560	560	570	580	600	0	
Volume, litres										
Pressure, psi										



Comments: Packer #20 | Time - 14:47

Sheet 22 of 22

Westbay Packer Inflation Record

Project: Golder / NWMO | Project No.: WB973 | Well No.: IG_BH03

Location: Ignace, Ontario | Completed by: TK/ML | Date Inflated: Nov 23/19

Packer No. 21, Comp343, SN 19581 | Depth (m): 67.94 | Inflation Tool No.: TIW3197

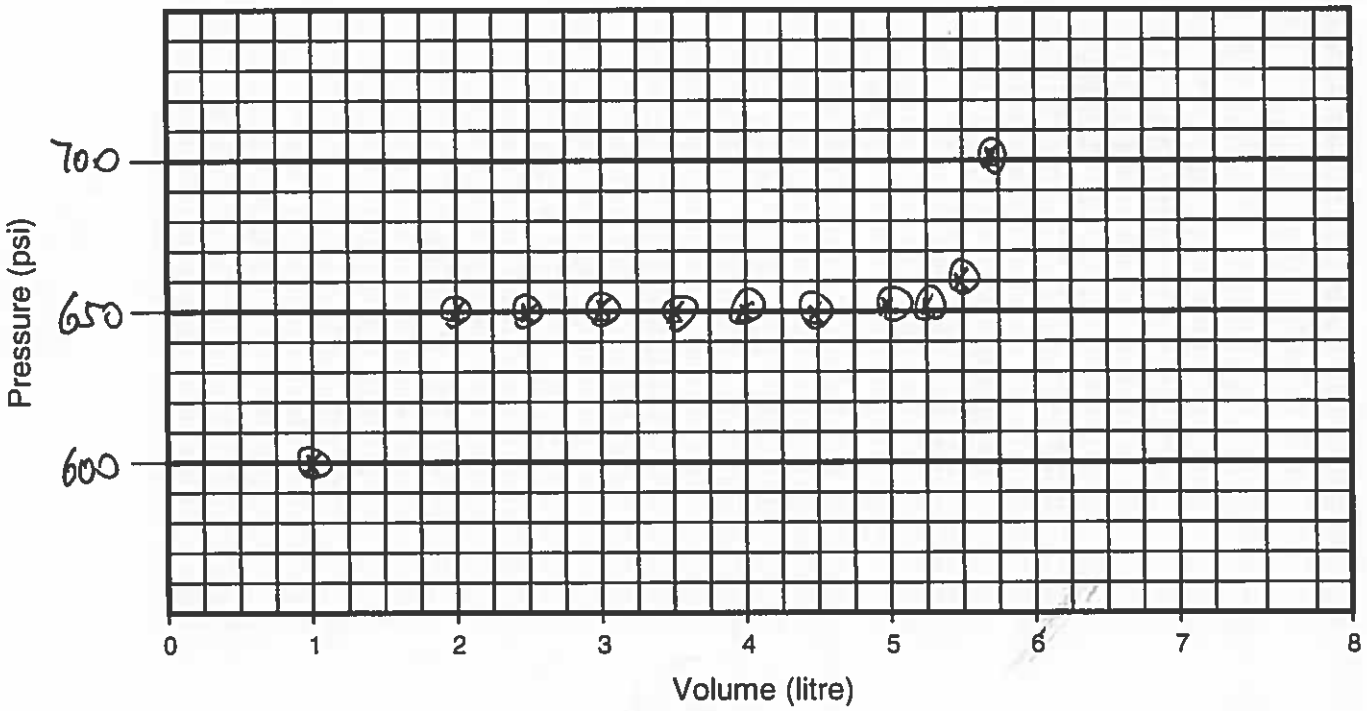
Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 700 psi | Tool Pressure, P_T: 530 psi

Borehole Water Level: ~50 (m) = ~70 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 95 psi

Volume, litres	1.0	1.5	~~2.0~~	1.75	2.0	2.25	2.5	2.75	3.0	3.25
Pressure, psi	600	620	/	640	650	650	650	650	650	650
Volume, litres	3.5	3.75	4.0	4.25	4.5	4.75	5.0	5.25	5.5	5.65
Pressure, psi	650	650	650	650	650	650	650	650	660	700

4.9 Ø



Comments: Packer #21, IN HWT casing. Time - 12:55

APPENDIX H
IG-BH03

AS-BUILT TABLES 6 AND 7

As-Built Packer and Port Summary (Table 6)	- 1 page
As-Built Tubing Summary (Table 7)	- 7 pages

TABLE 6
As-Built Packer and Port Summary

Interval No.	Measurement Port Depth (m)	Pumping Port Depth (m)	Magnetic Collar Depth (m)	Top of Interval (m)	Bottom of Interval (m)	Comments
1	967.3		967.9	964.0	1000.54	
2	944.4	953.5	945.0	941.1	963.1	
3	924.5		925.1	921.3	940.2	
4	883.3	912.3	883.9	880.0	920.4	
5	860.4	869.5	861.0	857.1	879.1	
6	794.8	846.6	795.4	791.5	856.2	
7	753.3	781.9	753.9	750.0	790.6	
8	676.5		677.1	673.2	749.1	
9	638.3	662.7	638.9	635.0	672.3	
10	613.9	624.5	614.5	610.6	634.1	
11	568.2		568.8	564.9	609.7	
12	544.6	555.3	545.2	541.4	564.0	
13	506.6		507.2	503.3	540.5	
14	466.4		467.0	463.1	502.4	
15	421.6		422.2	418.3	462.2	
16	370.8		371.4	367.5	417.4	
17	321.5		322.1	318.2	366.6	
18	251.5		252.1	248.2	317.3	
19	228.6	237.7	229.2	225.3	247.3	
20	166.2	214.8	166.8	162.9	224.4	
21	73.5	152.4	74.1	70.2	162.0	

Note 1: All depth measurements are not corrected for borehole angle.
Note 2: All depth measurements in meters below ground surface along the borehole axis.
Note 3: All depth measurements use 'Nominal' casing lengths.
Note 4: Not corrected for borehole deviation or borehole temperature effects.
Note 5: All Westbay Port depth measurements to upper edge of coupling item.
Note 6: Depths for top and bottom of zone based on packer seal position.

IG_BH03 As-Built Tubing Summary

Item No.	Component P/N	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Mag Collar (m)	Initial Depth (m)	Nominal Length (m)	Measured Lenghts (m)	Final Depth (m)
387	020101		0202				-1.9	0.30	N/A	-0.6
386	020101		0202				-1.6	0.30	N/A	-0.3
385	020102		0202				-1.2	0.61	N/A	0.0
384	020105		0202				-0.6	1.52	1.521	0.6
383	020110		0202		0216		0.9	3.05	3.047	2.1
382	020105		0202				3.9	1.52	1.522	5.1
381	020105		0202				5.5	1.52	1.521	6.6
380	020105		0202				7.0	1.52	1.521	8.2
379	020105		0202				8.5	1.52	1.522	9.7
378	020105		0202				10.0	1.52	1.521	11.2
377	020105		0202				11.6	1.52	1.521	12.7
376	020105		0202				13.1	1.52	1.521	14.2
375	020105		0202				14.6	1.52	1.521	15.8
374	020105		0202				16.1	1.52	1.521	17.3
373	020105		0202				17.6	1.52	1.522	18.8
372	020105		0202				19.2	1.52	1.521	20.3
371	020105		0202				20.7	1.52	1.521	21.8
370	020105		0202				22.2	1.52	1.521	23.4
369	020105		0202				23.7	1.52	1.521	24.9
368	020105		0202				25.3	1.52	1.521	26.4
367	020105		0202				26.8	1.52	1.521	27.9
366	020105		0202				28.3	1.52	1.521	29.4
365	020105		0202				29.8	1.52	1.522	30.9
364	020105		0202				31.4	1.52	1.522	32.5
363	020105		0202				32.9	1.52	1.522	34.0
362	020105		0202				34.4	1.52	1.521	35.5
361	020105		0202				35.9	1.52	1.521	37.0
360	020105		0202				37.5	1.52	1.522	38.5
359	020105		0202				39.0	1.52	1.522	40.1
358	020105		0202				40.5	1.52	1.522	41.6
357	020105		0202				42.0	1.52	1.522	43.1
356	020105		0202				43.6	1.52	1.522	44.6
355	020105		0202				45.1	1.52	1.522	46.1
354	020105		0202				46.6	1.52	1.521	47.6
353	020105		0202				48.1	1.52	1.522	49.2
352	020105		0202				49.7	1.52	1.522	50.7
351	020105		0202				51.2	1.52	1.522	52.2
350	020105		0202				52.7	1.52	1.522	53.7
349	020105		0202				54.2	1.52	1.522	55.2
348	020105		0202				55.7	1.52	1.522	56.8
347	020105		0202				57.3	1.52	1.521	58.3
346	020110		0202				58.8	3.05	3.047	59.8
345	020110		0202				61.8	3.05	3.047	62.8
344	020110		0202				64.9	3.05	3.046	65.9
343	0238	19581	0202				67.9	1.52	1.522	68.9
342	020110		0202				69.5	3.05	3.047	70.4
341	020110		0205	9264	0216		72.5	3.05	3.046	73.5
340	020105		0202				75.6	1.52	1.522	76.5
339	020105		0202				77.1	1.52	1.522	78.0
338	020110		0202				78.6	3.05	3.047	79.5
337	020110		0202				81.7	3.05	3.046	82.6
336	020110		0202				84.7	3.05	3.046	85.6
335	020110		0202				87.7	3.05	3.046	88.7
334	020110		0202				90.8	3.05	3.046	91.7
333	020110		0202				93.8	3.05	3.046	94.7

IG_BH03 As-Built Tubing Summary

Item No.	Component P/N	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Mag Collar (m)	Initial Depth (m)	Nominal Length (m)	Measured Lenghts (m)	Final Depth (m)
332	020110		0202				96.9	3.05	3.046	97.8
331	020110		0202				99.9	3.05	3.046	100.8
330	020110		0202				103.0	3.05	3.047	103.8
329	020110		0202				106.0	3.04	3.047	106.9
328	020110		0202				109.1	3.05	3.047	109.9
327	020110		0202				112.1	3.05	3.046	112.9
326	020110		0202				115.2	3.05	3.046	116.0
325	020110		0202				118.2	3.04	3.046	119.0
324	020110		0202				121.3	3.05	3.046	122.1
323	020110		0202				124.3	3.05	3.047	125.1
322	020110		0202				127.4	3.05	3.046	128.1
321	020110		0202				130.4	3.05	3.046	131.2
320	020110		0202				133.5	3.04	3.045	134.2
319	020110		0202				136.5	3.05	3.046	137.2
318	020110		0202				139.6	3.05	3.045	140.3
317	020110		0202				142.6	3.05	3.047	143.3
316	020110		0202				145.7	3.05	3.045	146.4
315	020110		0202				148.7	3.04	3.046	149.4
314	020110		0206	288			151.8	3.13	3.122	152.4
313	020110		0202				154.9	3.04	3.046	155.6
312	020110		0202				157.9	3.05	3.046	158.6
311	0238	19623	0202				161.0	1.53	1.522	161.6
310	020110		0202				162.5	3.04	3.046	163.1
309	020110		0205	9263	0216		165.5	3.05	3.047	166.2
308	020105		0202				168.6	1.53	1.522	169.2
307	020105		0202				170.1	1.52	1.522	170.7
306	020110		0202				171.6	3.05	3.046	172.3
305	020110		0202				174.7	3.05	3.046	175.3
304	020110		0202				177.7	3.04	3.046	178.4
303	020110		0202				180.8	3.05	3.046	181.4
302	020110		0202				183.8	3.05	3.046	184.4
301	020110		0202				186.9	3.05	3.045	187.5
300	020110		0202				189.9	3.05	3.046	190.5
299	020110		0202				193.0	3.04	3.047	193.6
298	020110		0202				196.0	3.05	3.047	196.6
297	020110		0202				199.1	3.05	3.046	199.6
296	020110		0202				202.1	3.05	3.048	202.7
295	020110		0202				205.2	3.04	3.047	205.7
294	020110		0202				208.2	3.05	3.047	208.8
293	020110		0202				211.3	3.05	3.048	211.8
292	020110		0206	287			214.3	3.12	3.121	214.8
291	020105		0202				217.4	1.53	1.521	218.0
290	020105		0202				219.0	1.52	1.522	219.5
289	020110		0202				220.5	3.05	3.045	221.0
288	0238	19622	0202				223.5	1.52	1.521	224.0
287	020110		0202				225.1	3.05	3.046	225.6
286	020110		0205	9278	0216		228.1	3.05	3.046	228.6
285	020105		0202				231.2	1.52	1.522	231.6
284	020105		0202				232.7	1.53	1.521	233.2
283	020110		0202				234.2	3.05	3.046	234.7
282	020110		0206	286			237.3	3.12	3.124	237.7
281	020105		0202				240.4	1.52	1.522	240.8
280	020105		0202				241.9	1.53	1.521	242.4
279	020110		0202				243.4	3.04	3.046	243.9
278	0238	19621	0202				246.5	1.53	1.522	246.9
277	020110		0202				248.0	3.05	3.045	248.4
276	020110		0205	9270	0216		251.0	3.04	3.046	251.5
275	020105		0202				254.1	1.53	1.522	254.5

IG_BH03 As-Built Tubing Summary

Item No.	Component P/N	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Mag Collar (m)	Initial Depth (m)	Nominal Length (m)	Measured Lenghts (m)	Final Depth (m)
274	020110		0202				255.6	3.05	3.045	256.0
273	020110		0202				258.7	3.04	3.046	259.1
272	020110		0202				261.7	3.05	3.046	262.1
271	020110		0202				264.8	3.05	3.046	265.2
270	020110		0202				267.8	3.05	3.045	268.2
269	020110		0202				270.9	3.05	3.046	271.3
268	020110		0202				273.9	3.04	3.046	274.3
267	020110		0202				276.9	3.05	3.046	277.3
266	020110		0202				280.0	3.05	3.046	280.4
265	020110		0202				283.0	3.05	3.046	283.4
264	020110		0202				286.1	3.04	3.045	286.5
263	020110		0202				289.1	3.05	3.046	289.5
262	020110		0202				292.2	3.05	3.046	292.6
261	020110		0202				295.2	3.05	3.046	295.6
260	020110		0202				298.3	3.05	3.046	298.6
259	020110		0202				301.3	3.04	3.045	301.7
258	020110		0202				304.4	3.05	3.045	304.7
257	020110		0202				307.4	3.05	3.045	307.8
256	020110		0202				310.5	3.05	3.045	310.8
255	020110		0202				313.5	3.05	3.046	313.9
254	0238	19620	0202				316.6	1.52	1.522	316.9
253	020110		0202				318.1	3.05	3.047	318.4
252	020110		0205	9258	0216		321.1	3.05	3.047	321.5
251	020105		0202				324.2	1.52	1.522	324.5
250	020102		0202				325.7	0.61	0.608	326.0
249	020110		0202				326.3	3.05	3.045	326.6
248	020110		0202				329.4	3.04	3.046	329.7
247	020110		0202				332.4	3.05	3.046	332.7
246	020110		0202				335.5	3.05	3.046	335.8
245	020110		0202				338.5	3.05	3.046	338.8
244	020110		0202				341.6	3.05	3.048	341.9
243	020110		0202				344.6	3.04	3.046	344.9
242	020110		0202				347.7	3.05	3.046	347.9
241	020110		0202				350.7	3.05	3.045	351.0
240	020110		0202				353.8	3.05	3.046	354.0
239	020110		0202				356.8	3.05	3.046	357.1
238	020110		0202				359.9	3.04	3.046	360.1
237	020110		0202				362.9	3.05	3.046	363.2
236	0238	19619	0202				365.9	1.52	1.522	366.2
235	020110		0202				367.5	3.05	3.045	367.7
234	020110		0205	9268	0216		370.5	3.05	3.046	370.8
233	020105		0202				373.6	1.52	1.522	373.8
232	020105		0202				375.1	1.53	1.521	375.3
231	020102		0202				376.6	0.61	0.609	376.9
230	020110		0202				377.2	3.05	3.045	377.5
229	020110		0202				380.3	3.04	3.046	380.5
228	020110		0202				383.3	3.05	3.046	383.5
227	020110		0202				386.4	3.05	3.048	386.6
226	020110		0202				389.4	3.05	3.047	389.6
225	020110		0202				392.5	3.04	3.046	392.7
224	020110		0202				395.5	3.05	3.049	395.7
223	020110		0202				398.6	3.05	3.048	398.8
222	020110		0202				401.6	3.05	3.048	401.8
221	020110		0202				404.7	3.05	3.046	404.9
220	020110		0202				407.7	3.04	3.048	407.9
219	020110		0202				410.7	3.05	3.049	410.9
218	020110		0202				413.8	3.05	3.046	414.0
217	0238	19618	0202				416.8	1.52	1.521	417.0

IG_BH03 As-Built Tubing Summary										
Item No.	Component P/N	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Mag Collar (m)	Initial Depth (m)	Nominal Length (m)	Measured Lenghts (m)	Final Depth (m)
216	020110		0202				418.4	3.05	3.048	418.6
215	020110		0205	9262	0216		421.4	3.05	3.048	421.6
214	020105		0202				424.5	1.52	1.521	424.6
213	020105		0202				426.0	1.53	1.52	426.2
212	020102		0202				427.5	0.61	0.61	427.7
211	020110		0202				428.1	3.04	3.049	428.3
210	020110		0202				431.2	3.05	3.048	431.3
209	020110		0202				434.2	3.05	3.047	434.4
208	020110		0202				437.3	3.05	3.047	437.4
207	020110		0202				440.3	3.05	3.047	440.5
206	020110		0202				443.4	3.04	3.048	443.5
205	020110		0202				446.4	3.05	3.047	446.6
204	020110		0202				449.5	3.05	3.048	449.6
203	020110		0202				452.5	3.05	3.047	452.7
202	020110		0202				455.6	3.05	3.048	455.7
201	020110		0202				458.6	3.04	3.047	458.7
200	0238	19617	0202				461.6	1.53	1.522	461.8
199	020110		0202				463.2	3.05	3.048	463.3
198	020110		0205	9277	0216		466.2	3.04	3.05	466.4
197	020105		0202				469.3	1.53	1.522	469.4
196	020102		0202				470.8	0.61	0.61	470.9
195	020110		0202				471.4	3.04	3.047	471.5
194	020110		0202				474.4	3.05	3.047	474.6
193	020110		0202				477.5	3.05	3.046	477.6
192	020110		0202				480.5	3.05	3.046	480.7
191	020110		0202				483.6	3.05	3.046	483.7
190	020110		0202				486.6	3.04	3.046	486.8
189	020110		0202				489.7	3.05	3.046	489.8
188	020110		0202				492.7	3.05	3.046	492.9
187	020110		0202				495.8	3.05	3.047	495.9
186	020110		0202				498.8	3.04	3.046	498.9
185	0238	19616	0202				501.9	1.53	1.522	502.0
184	020110		0202				503.4	3.05	3.045	503.5
183	020110		0205	9260	0216		506.5	3.04	3.047	506.6
182	020105		0202				509.5	1.53	1.521	509.6
181	020105		0202				511.0	1.52	1.522	511.1
180	020110		0202				512.5	3.05	3.047	512.6
179	020110		0202				515.6	3.05	3.047	515.7
178	020110		0202				518.6	3.05	3.048	518.7
177	020110		0202				521.7	3.04	3.047	521.8
176	020110		0202				524.7	3.05	3.046	524.8
175	020110		0202				527.8	3.05	3.046	527.9
174	020110		0202				530.8	3.05	3.046	530.9
173	020110		0202				533.9	3.05	3.046	534.0
172	020110		0202				536.9	3.04	3.045	537.0
171	0238	19615	0202				540.0	1.53	1.522	540.1
170	020110		0202				541.5	3.04	3.045	541.6
169	020110		0205	9261	0216		544.5	3.05	3.047	544.6
168	020105		0202				547.6	1.53	1.522	547.7
167	020110		0202				549.1	3.04	3.046	549.2
166	020110		0202				552.2	3.05	3.046	552.2
165	020110		0206	285			555.2	3.13	3.124	555.3
164	020105		0202				558.3	1.52	1.522	558.4
163	020102		0202				559.9	0.61	0.609	559.9
162	020110		0202				560.5	3.05	3.046	560.6
161	0238	19614	0202				563.5	1.52	1.522	563.6
160	020110		0202				565.0	3.05	3.046	565.1
159	020110		0205	9269	0216		568.1	3.05	3.047	568.2

IG_BH03 As-Built Tubing Summary										
Item No.	Component P/N	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Mag Collar (m)	Initial Depth (m)	Nominal Length (m)	Measured Lenghts (m)	Final Depth (m)
158	020105		0202				571.1	1.52	1.522	571.2
157	020110		0202				572.7	3.05	3.048	572.7
156	020110		0202				575.7	3.05	3.048	575.8
155	020110		0202				578.8	3.04	3.046	578.8
154	020110		0202				581.8	3.05	3.046	581.9
153	020110		0202				584.9	3.05	3.045	584.9
152	020110		0202				587.9	3.05	3.046	588.0
151	020110		0202				591.0	3.05	3.045	591.0
150	020110		0202				594.0	3.04	3.046	594.1
149	020110		0202				597.0	3.05	3.046	597.1
148	020110		0202				600.1	3.05	3.046	600.2
147	020110		0202				603.1	3.05	3.048	603.2
146	020110		0202				606.2	3.05	3.045	606.3
145	0238	19613	0202				609.2	1.52	1.521	609.3
144	020110		0202				610.8	3.05	3.046	610.8
143	020110		0205	9253	0216		613.8	3.05	3.046	613.9
142	020105		0202				616.9	1.52	1.522	616.9
141	020110		0202				618.4	3.05	3.045	618.4
140	020110		0202				621.4	3.04	3.046	621.5
139	020110		0206	284			624.5	3.13	3.123	624.5
138	020110		0202				627.6	3.05	3.046	627.7
137	020110		0202				630.7	3.04	3.045	630.7
136	0238	19612	0202				633.7	1.53	1.522	633.7
135	020110		0202				635.2	3.05	3.045	635.3
134	020110		0205	9275	0216		638.3	3.04	3.046	638.3
133	020105		0202				641.3	1.53	1.523	641.4
132	020105		0202				642.8	1.52	1.522	642.9
131	020110		0202				644.4	3.05	3.046	644.4
130	020110		0202				647.4	3.05	3.047	647.5
129	020110		0202				650.5	3.05	3.047	650.5
128	020110		0202				653.5	3.04	3.047	653.6
127	020110		0202				656.6	3.05	3.047	656.6
126	020110		0202				659.6	3.05	3.047	659.6
125	020110		0206	283			662.7	3.12	3.124	662.7
124	020105		0202				665.8	1.53	1.523	665.8
123	020105		0202				667.3	1.52	1.522	667.3
122	020110		0202				668.8	3.05	3.046	668.9
121	0238	19611	0202				671.9	1.52	1.522	671.9
120	020110		0202				673.4	3.05	3.046	673.4
119	020110		0205	9276	0216		676.4	3.05	3.046	676.5
118	020105		0202				679.5	1.52	1.522	679.5
117	020102		0202				681.0	0.61	0.61	681.0
116	020110		0202				681.6	3.05	3.049	681.7
115	020110		0202				684.7	3.05	3.049	684.7
114	020110		0202				687.7	3.05	3.048	687.7
113	020110		0202				690.8	3.04	3.046	690.8
112	020110		0202				693.8	3.05	3.048	693.8
111	020110		0202				696.9	3.05	3.046	696.9
110	020110		0202				699.9	3.05	3.046	699.9
109	020110		0202				703.0	3.04	3.048	703.0
108	020110		0202				706.0	3.05	3.046	706.0
107	020110		0202				709.1	3.05	3.05	709.1
106	020110		0202				712.1	3.05	3.046	712.1
105	020110		0202				715.2	3.05	3.047	715.2
104	020110		0202				718.2	3.04	3.047	718.2
103	020110		0202				721.2	3.05	3.046	721.3
102	020110		0202				724.3	3.05	3.045	724.3
101	020110		0202				727.3	3.05	3.045	727.4

IG_BH03 As-Built Tubing Summary										
Item No.	Component P/N	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Mag Collar (m)	Initial Depth (m)	Nominal Length (m)	Measured Lenghts (m)	Final Depth (m)
100	020110		0202				730.4	3.05	3.045	730.4
99	020110		0202				733.4	3.04	3.046	733.5
98	020110		0202				736.5	3.05	3.045	736.5
97	020110		0202				739.5	3.05	3.045	739.5
96	020110		0202				742.6	3.05	3.045	742.6
95	020110		0202				745.6	3.04	3.046	745.6
94	0238	19610	0202				748.7	1.53	1.522	748.7
93	020110		0202				750.2	3.05	3.045	750.2
92	020110		0205	9267	0216		753.3	3.04	3.047	753.3
91	020105		0202				756.3	1.53	1.525	756.3
90	020105		0202				757.8	1.52	1.523	757.8
89	020102		0202				759.3	0.61	0.608	759.3
88	020102		0202				760.0	0.61	0.61	760.0
87	020110		0202				760.6	3.05	3.046	760.6
86	020110		0202				763.6	3.05	3.046	763.6
85	020110		0202				766.7	3.04	3.045	766.7
84	020110		0202				769.7	3.05	3.045	769.7
83	020110		0202				772.8	3.05	3.047	772.8
82	020110		0202				775.8	3.05	3.046	775.8
81	020110		0202				778.9	3.05	3.046	778.9
80	020110		0206	282			781.9	3.12	3.124	781.9
79	020105		0202				785.0	1.52	1.522	785.0
78	020102		0202				786.5	0.61	0.608	786.5
77	020110		0202				787.2	3.05	3.046	787.2
76	0238	19609	0202				790.2	1.53	1.521	790.2
75	020110		0202				791.7	3.04	3.046	791.7
74	020110		0205	9252	0216		794.8	3.05	3.046	794.8
73	020105		0202				797.8	1.53	1.523	797.8
72	020105		0202				799.4	1.52	1.521	799.4
71	020110		0202				800.9	3.05	3.044	800.9
70	020110		0202				803.9	3.04	3.046	803.9
69	020110		0202				807.0	3.05	3.046	807.0
68	020110		0202				810.0	3.05	3.046	810.0
67	020110		0202				813.1	3.05	3.046	813.1
66	020110		0202				816.1	3.05	3.046	816.1
65	020110		0202				819.2	3.04	3.046	819.2
64	020110		0202				822.2	3.05	3.047	822.2
63	020110		0202				825.3	3.05	3.047	825.3
62	020110		0202				828.3	3.05	3.047	828.3
61	020110		0202				831.4	3.05	3.047	831.4
60	020110		0202				834.4	3.04	3.047	834.4
59	020110		0202				837.4	3.05	3.047	837.4
58	020110		0202				840.5	3.05	3.047	840.5
57	020110		0202				843.5	3.05	3.047	843.5
56	020110		0206	281			846.6	3.12	3.124	846.6
55	020105		0202				849.7	1.52	1.522	849.7
54	020105		0202				851.2	1.53	1.522	851.2
53	020110		0202				852.8	3.05	3.046	852.8
52	0238	19608	0202				855.8	1.52	1.522	855.8
51	020110		0202				857.3	3.05	3.046	857.3
50	020110		0205	9273	0216		860.4	3.05	3.047	860.4
49	020105		0202				863.4	1.52	1.521	863.4
48	020105		0202				865.0	1.52	1.523	865.0
47	020110		0202				866.5	3.05	3.046	866.5
46	020110		0206	280			869.5	3.13	3.123	869.5
45	020105		0202				872.7	1.52	1.523	872.7
44	020105		0202				874.2	1.52	1.522	874.2
43	020110		0202				875.7	3.05	3.046	875.7

IG_BH03 As-Built Tubing Summary

Item No.	Component P/N	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Mag Collar (m)	Initial Depth (m)	Nominal Length (m)	Measured Lenghts (m)	Final Depth (m)
42	0238	19607	0202				878.7	1.53	1.522	878.7
41	020110		0202				880.3	3.04	3.046	880.3
40	020110		0205	9251	0216		883.3	3.05	3.047	883.3
39	020105		0202				886.4	1.53	1.522	886.4
38	020110		0202				887.9	3.04	3.046	887.9
37	020110		0202				890.9	3.05	3.046	890.9
36	020110		0202				894.0	3.05	3.046	894.0
35	020110		0202				897.0	3.05	3.047	897.0
34	020110		0202				900.1	3.04	3.045	900.1
33	020110		0202				903.1	3.05	3.046	903.1
32	020110		0202				906.2	3.05	3.047	906.2
31	020110		0202				909.2	3.05	3.047	909.2
30	020110		0206	172			912.3	3.12	3.124	912.3
29	020105		0202				915.4	1.53	1.522	915.4
28	020110		0202				916.9	3.04	3.046	916.9
27	0238	19606	0202				920.0	1.53	1.522	920.0
26	020110		0202				921.5	3.05	3.046	921.5
25	020110		0205	9265	0216		924.5	3.04	3.046	924.5
24	020105		0202				927.6	1.53	1.522	927.6
23	020105		0202				929.1	1.52	1.522	929.1
22	020110		0202				930.6	3.05	3.046	930.6
21	020110		0202				933.7	3.05	3.047	933.7
20	020110		0202				936.7	3.04	3.045	936.7
19	0238	19605	0202				939.8	1.53	1.522	939.8
18	020110		0202				941.3	3.05	3.046	941.3
17	020110		0205	9266	0216		944.4	3.04	3.046	944.4
16	020105		0202				947.4	1.53	1.522	947.4
15	020105		0202				948.9	1.52	1.522	948.9
14	020110		0202				950.4	3.05	3.046	950.4
13	020110		0206	171			953.5	3.12	3.123	953.5
12	020105		0202				956.6	1.53	1.521	956.6
11	020105		0202				958.1	1.52	1.522	958.1
10	020110		0202				959.7	3.05	3.045	959.7
9	0238	19604	0202				962.7	1.52	1.522	962.7
8	020110		0202				964.2	3.05	3.046	964.2
7	020110		0205	9274	0216		967.3	3.05	3.046	967.3
6	020105		0202				970.3	1.52	1.522	970.3
5	020105		0202				971.9	1.53	1.522	971.9
4	020110		0202				973.4	3.05	3.046	973.4
3	020110		0202				976.4	3.04	3.046	976.4
2	020110		0202				979.5	3.05	3.046	979.5
1	020110		0202				982.5	3.05	3.046	982.5
0	020305		0202				985.6			985.6

Depths are with respect to the ground level.

****The final depth measurements are not corrected for the borehole angle.**

* Component positions are referenced to the top of the subject Westbay System coupling.

* Packer positions are referenced to the top Westbay System coupling on the packer.

Monitoring zone dimensions are determined as described on the attached “Dimensions of Packer Seals and Monitoring Zones”.

The position of a MOSDAX Transducer in a Measurement Port is illustrated in the attached “MOSDAX Transducer Position”.

This information may be used in calculating piezometric levels.

APPENDIX I
IG-BH03

POST INFLATION PRESSURE PROFILE

Post-Inflation Field Data and Calculation Sheet (November 23, 2019) - 2 page

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

1/2

Well No.: IH-BH03
Datum: G.L
Elev. G.S.:
Height of Westbay above G.S.:
Elev. top of Westbay Casing:
Reference Elevation:
Borehole angle: 70°

Probe Type: Sampler (O/C)
Serial No.: EMS 5230
Probe Range: 2000 psi
Westbay Casing Type: MP 38
Sampler Valve Position: closed

Date: Nov 23 / 2019
Client: Golder / NWMO
Job No.: WR973
Location: Iqaluit, NU
Weather: Sun
Operator: TK / ML

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

		Start	Finish
	Pressure	13.94	14.01
	Temp	6.75	6.04
	Time	14:40	17:43

P_{atm} 13.94 psi

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments	
1	967.3	964.0		1189.76	1279.15	15:12	12.52	1189.78	889.74	77.56	Rot 16	Beep: 964.0
2	944.4	941.2		1160.61	1234.55	15:16	12.86	1160.59	858.38	86.02	Rot 16	Beep 941.2
3	924.5	921.5		1135.34	1210.25	15:19	12.87	1135.34	841.29	83.21	Rot 16	Beep: 921.5
~~4~~	~~883.3~~	~~880.4~~		~~1082.23~~		~~15:23~~					Broken shoe	Beep: 880.4
4	883.3	880		1082.25	1169.01	16:32	11.68	1082.25	812.29	71.01	Rot 15	Beep: 880.0
5	860.4	857.2		1052.66	1128.32	16:36	12.03	1052.65	783.67	76.73	Rot 15	Beep: 857.2
6	744.8	791.9		966.93	1016.36	16:43	11.82	967.01	704.44	89.86	Rot 15	Beep: 791.9
7	753.3	750.5		912.52	995.02	16:47	11.62	912.53	689.93	63.37	Rot 15	Beep: 750.5
8	676.4	674.2		811.07	869.06	16:52	11.17	811.05	601.35	75.05	Rot 15	Beep: 674.2
9	638.3	636.3		760.66	796.82	16:55	10.69	760.69	551.95	86.35	Rot 15	Beep: 636.3
10	613.8	611.8		728.24	768.92	16:59	10.41	728.28	530.93	82.87	Rot 15	Beep: 611.8
11	568.1	566.3		667.84	723.57	17:02	10.01	667.87	499.04	69.06	Rot 15	Beep: 566.3
12	544.5	542.7		636.74		17:05					Rot 18	Beep: 542.7
~~13~~	~~506.5~~			636.79	666.24	17:07	9.62	636.79	458.72	85.78	Rot 15	Relanded
13	506.5	504.9		586.46	601.72	17:11	9.31	586.48	413.35	93.15	Rot 15	Beep: 504.9

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Westbay Instruments

2/2

Well No.: IG. BH 03
Datum: G.L.
Elev. G.S.:
Height of Westbay above G.S.:
Elev. top of Westbay Casing:
Reference Elevation:
Borehole angle: 70°

Probe Type: Sampler (O/C)
Serial No.: ZIM S 5230
Probe Range: 2000 psi
Westbay Casing Type: MP38
Sampler Valve Position: closed

Date: Nov 23/19
Client: Golder / NWMO
Job No.: WB 973
Location: Ignace, ON
Weather:
Operator: TL / ML

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 13.94 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

		Start	Finish
Pressure		13.94	14.01
Temp		6.75	6.04
Time		14:40	17:43

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments	
14	466.2	464.8		533.27	536.22	17:15	9.00	533.46	368.69	97.33	Rot. 16	Beep = 464.8
15	421.4	420.2		474.46	511.34	17:18	8.67	474.42	349.79	71.61	Rot 15	Beep = 420.2
16	370.5	369.6		407.24	461.30	17:22	8.23	407.29	314.60	55.90	Rot. 15	Beep = 369.6
17	321.1	320.5		342.37	402.51	17:25	7.87	342.34	273.26	47.84	Rot 15	Beep = 320.5
18	251.0	250.8		249.97	317.30	17:29	7.36	249.95	213.33	37.66	Rot. 15	Beep = 250.8
19	228.1	228.0		219.67	274.81	17:32	7.12	219.68	183.45	44.65	Rot 15	Beep = 228.0
20	165.5	165.5		136.98	186.14	17:35	6.61	136.97	121.10	44.4	Rot 15	Beep = 165.5
21	72.5	73.0		14.09	15.28	17:39	6.20	14.09	0.94	71.5	Rot 15	Beep = 73.0

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

APPENDIX J
IG-BH03

TECHNICAL MEMORANDUM-RETRIEVAL PLAN

Technical Memorandum-Retrieval Plan (November 19, 2019) - 3 page

TECHNICAL MEMORANDUM

DATE November 19, 2019 **Project No.** 1671632A

TO Eric Sykes, Martin Sykes, Maria Sanchez-Rico Castejon, Sarah Hirschorn, Elise Leroux
NWMO

CC Tony Kim, Dave Larssen, Rachel Gould, Joe Carvalho

FROM George Schneider, Adrian Kowalchuk **EMAIL george_schneider@golder.com**

RETRIEVAL PLAN – LOST PVC FRAGMENTS – WESTBAY SYSTEM INSTALLATION AT IG_BH03 – BOREOHLE DRILLING AND TESTING – IGNACE AREA

INTRODUCTION

On the morning of November 19, 2019 the top of the Westbay PVC installation was inadvertently damaged and broken off when the drillers were adding an HQ drill rod to the top of the rod string that was acting as a guide tube for the installation of the Westbay system in IG_BH03 (damaged installation shown below).

In the days immediately prior to this, the guide tube had been lowered and the Westbay system installed down the borehole through the guide tube, and the lowermost exposed packers had been successfully inflated. The process of raising the guide tube had just begun when the damaged occurred.

Figure 1: Broken Westbay PVC extension (top and bottom)

It is presumed that three pieces of PVC are likely to have fallen into the annulus; one larger piece several cm in size, which is visible about 1.5 m below surface in the annulus, and two smaller pieces are presumed to have

Golder Associates Ltd.
210 Sheldon Drive, Cambridge, Ontario, N1T 1A8, Canada T: +1 519 620 1222 F: +1 519 620 9878

fallen further down the annulus. The two other pieces may have fallen as deep as ~68m and have come to rest on top of the abrasion protectors at that depth, approximately 60 cm above the upper packer. As shown in the figure below, these fragments are unlikely to have fallen any deeper, based on the size of the fragments relative to the size of the annulus.

The water level in the annulus was last measured to be approximately 4.2 m below surface. The Westbay casing has already been secured to ensure it does not move during the extraction process and cause the fragment to fall further down the annulus.

Figure 2: Illustration of how abrasion protector fits inside HQ rods

RETRIEVAL PLAN

Retrieval of Large Fragment

- An attempt to retrieve the large fragment near surface will be made by lowering an inspection camera with a retrieval hook down the annulus, attaching to the large fragment, and retrieving it to surface
- The retrieval hook will be modified to have an adhesive pad on it
- The pad will be lowered past the fragment and the fragment contacted from the bottom and allowed to bond to the hook
- Several adhesive options will be tested at surface to assess suitability and drying time
- The adhesive pad will be securely fastened to the hook, to minimize chances of losing it during the retrieval attempt
- A dry run will be made without an adhesive to get a closer look at the fragment with the inspection camera
- If the adhesive option does not work, a second attempt will be made using a small grappling tool designed for retrieving objects from drains

Retrieval of Smaller Fragments

- An attempt will be made to retrieve the smaller fragments by flushing the hole with traced drill fluid

- We will set up a sump with drill fluid at surface so the fluid can be recirculated
- Drill fluid will be pumped using the 2” Grundfos pump and 5/8” poly tubing with a “straight” leader made of thin walled steel tubing to help guide it down the annulus
- The tremie line will be lowered down to the top of the abrasion protector – that depth needs to be calculated and the tubing measured off to ensure we are at the sufficient depth prior to starting the flow of water
- Once at the desired depth, the pump will be started and the borehole will be flushed, slowly increasing pump flow to full speed (~7L / min)
- The annulus will be flushed for a period sufficient to potentially raise all of the fragments to surface, if possible – this may take several hours
- The fluid return needs to be monitored carefully to ensure any fragments are recovered and accounted for
- Any fragments retrieved will be “fit” with the other pieces at surface, in order to assess whether or not all of the fragments have been retrieved
- If after several hours, all of the fragment cannot be retrieved, then then flushing will be stopped – that duration to be determined by Golder with concurrence from the NWMO
- It may be that the remaining missing fragments fell down the center of the Westbay pipe itself and are not in the annulus
- While we cannot confirm or refute this possibility, we will probe the center of the Westbay casing with the MOSDAX probe to establish some assurance that the center of the installation is free of obstructions and will function correctly, once the remaining installation is successfully completed

POST-RETRIEVAL

- If all fragments are retrieved, then the installation will proceed in accordance with the test plan
- If some fragments are suspected to remain down the annulus, then in the final stages of installation there will be an additional installation step, as noted herein
- The guide tube will be raised just enough to expose the uppermost packer, but leaving the abrasion protector (located 60 cm above it) inside the guide tube
- Then, the last packer will be inflated prior to raising the guide tube past the abrasion protector
- The purpose of this additional step is to help ensure that the final packer is correctly inflated before the last abrasion protector is exposed, as there is a risk that the smaller fragments may pass below the abrasion protectors in the large casing annulus and become lodged between the packer and the casing wall, which could compromise the upper packer

DOCUMENTATION

- All retrieval activities will be documented by Golder and Westbay personnel using detailed field notes and representative photographs
- The Westbay system installation report will include a section that specifically documents these retrieval activities


Westbay
Instruments

APPENDIX B

Pressure Measurement Records

GOLDER

NWMO IGNACE DRILLING
WESTBAY SYSTEM
PIEZOMETRIC PRESSURES/LEVELS

Project No.:
1671632A (2911)

IG_BH03 - Pre Inflation

Datum: Weld on PWT
Elev. G.S.: 441.561
Height of Westbay above G.S.: 1.30
Elev. Top of Westbay Casing: 442.86
Reference Elevation: 442.02
Borehole angle: 70

Probe Type: Open/close Sampler
Serial No.: EMS5230
Probe Range: 2000 psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Weather: Snow/rain/overcast
Operator: ML/TK
Date: 17-Nov-19

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure 96.60
Temp. 14.94
Time 14:30

Finish: Pressure 97.08
Temp. 6.12
Time 17:25

P_{atm} 96.84

Specific wt. of water (kN/m3) 9.804
Gravitational Acceleration (m/s^2) 9.8065

Note:
"Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piez

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1) (psi)	Inside Casing (P1) (kPa)	Outside Casing (P2) (psi)	Outside Casing (P2) (kPa)	Time (H:M:S)	Probe Temp. (°C)	Inside Casing (P1) (psi)	Inside Casing (P1) (kPa)	Pressure Head Outside Port (m) H=(P2-Patm)/w	Piezo Level Outside Port (m) Dz = Dp-H	Comments		Avg. Water Density (kg/m3)	Env Head (m)	Z: Elev of pressure measurement port (mASL)	Freshwater Head (mASL)
1	967.3	963.8	889.02	1106.38	7628.22	1279.18	8819.64	15:10:00	12.68	1106.39	7628.29	889.72	-0.70			Not Available	Not Availat	-447.00	442.72
2	944.4	940.7	868.72	1077.28	7427.59	1250.12	8619.28	15:25:00	12.98	1077.29	7427.66	869.28	-0.56			Not Available	Not Availat	-426.70	442.58
3	924.5	921.3	851.01	1052.01	7253.36	1224.98	8445.94	15:32:00	12.87	1052.02	7253.43	851.60	-0.59			Not Available	Not Availat	-408.99	442.61
4	883.3	880.4	814.02	994.00	6853.39	1172.43	8083.62	15:58:00	12.55	999.04	6888.14	814.65	-0.63			Not Available	Not Availat	-372.00	442.65
5	860.4	857.6	793.33	969.41	6683.85	1142.98	7880.57	16:01:00	12.4	969.43	6683.99	793.93	-0.61			Not Available	Not Availat	-351.31	442.63
6	794.8	792.3	733.71	884.09	6095.59	1058.16	7295.76	16:07:00	12.01	884.08	6095.52	734.28	-0.57			Not Available	Not Availat	-291.69	442.59
7	753.3	750.9	695.74	829.69	5720.51	1003.99	6922.27	16:15:00	11.45	829.71	5720.65	696.19	-0.45			Not Available	Not Availat	-253.72	442.47
8	676.5	674.5	624.95	728.36	5021.87	903.29	6227.97	16:21:00	11.03	728.35	5021.80	625.37	-0.42			Not Available	Not Availat	-182.93	442.44
9	638.3	636.5	589.73	677.97	4674.44	853.23	5882.82	16:26:00	10.47	677.98	4674.51	590.17	-0.44			Not Available	Not Availat	-147.71	442.46
10	613.9	612.2	567.23	645.71	4452.02	821.15	5661.63	16:32:00	10.35	645.73	4452.15	567.60	-0.37			Not Available	Not Availat	-125.21	442.39
11	568.2	566.7	525.10	585.33	4035.71	761.18	5248.15	16:36:00	9.92	585.37	4035.99	525.43	-0.33			Not Available	Not Availat	-83.08	442.35
12	544.6	543.3	503.37	554.27	3821.56	730.33	5035.45	16:40:00	9.64	554.28	3821.63	503.73	-0.37			Not Available	Not Availat	-61.35	442.39
13	506.6	505.3	468.38	504.02	3475.10	680.34	4690.78	16:43:00	9.36	504.04	3475.23	468.58	-0.20			Not Available	Not Availat	-26.36	442.22
14	466.4	465.3	431.35	451.02	3109.67	627.60	4327.15	16:47:00	9.09	451.06	3109.95	431.49	-0.14			Not Available	Not Availat	10.67	442.16
15	421.6	420.7	390.08	391.96	2702.47	568.92	3922.57	16:51:00	8.57	391.98	2702.61	390.22	-0.14			Not Available	Not Availat	51.94	442.16
16	370.8	370.0	343.28	324.84	2239.69	502.20	3462.55	16:55:00	8.26	324.82	2239.56	343.30	-0.02			Not Available	Not Availat	98.74	442.04
17	321.5	320.9	297.88	259.74	1790.84	437.47	3016.25	16:59:00	7.86	259.72	1790.71	297.78	0.10			Not Available	Not Availat	144.14	441.92
18	251.5	250.9	233.35	167.31	1153.56	345.52	2382.28	17:04:00	7.31	167.32	1153.63	233.11	0.24			Not Available	Not Availat	208.67	441.78
19	228.6	228.2	212.20	137.04	944.86	315.41	2174.68	17:07:00	6.94	137.04	944.86	211.94	0.26			Not Available	Not Availat	229.82	441.76
20	166.2	165.9	154.48	54.27	374.18	233.15	1607.51	17:12:00	6.51	54.26	374.11	154.09	0.40			Not Available	Not Availat	287.54	441.62
21	73.5	73.2	68.62	14.17	97.70	110.64	762.84	17:18:00	6.09	14.2	97.91	67.93	0.69			Not Available	Not Availat	373.40	441.33

Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20
Signature Date

Approved by:

18-Jan-20
Signature Date

Form ID: NWMO-IGNACE-1671632-WP09-F005

GOLDER

NWMO IGNACE DRILLING
WESTBAY SYSTEM
PIEZOMETRIC PRESSURES/LEVELS

Project No.:
1671632A (2911)

IG_BH03 - Post Inflation

Datum: Weld on PWT
Elev. G.S.: 441.561
Height of Westbay above G.S.: 1.30
Elev. Top of Westbay Casing: 442.86
Reference Elevation: 442.02
Borehole angle: 70

Probe Type: Open/close sampler
Serial No.: EMS5230
Probe Range: 2000 psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Weather: Sunny
Operator: TK/ML
Date: 23-Nov-19

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure 96.11
Temp. 6.75
Time 14:40

Finish: Pressure Not Recorded
Temp. Not Recorded
Time Not Recorded

P_{atm} 96.11

Specific wt. of water (kN/m3) 9.804
Gravitational Acceleration (m/s^2) 9.8065

Note:
"Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piez

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1) (psi)	Inside Casing (P1) (kPa)	Outside Casing (P2) (psi)	Outside Casing (P2) (kPa)	Time (H:M:S)	Probe Temp. (°C)	Inside Casing (P1) (psi)	Inside Casing (P1) (kPa)	Pressure Head Outside Port (m) H=(P2-Patm)/w	Piezo Level Outside Port (m) Dz = Dp-H	Comments		Avg. Water Density (kg/m3)	Env Head (m)	Z: Elev of pressure measurement port (mASL)	Freshwater Head (mASL)
1	967.3	964.0	889.02	1189.76	8203.11	1279.15	8819.43	15:12:00	12.52	1189.78	8203.25	889.77	-0.75			Not Available	Not Availat	-447.00	442.77
2	944.4	941.2	868.72	1160.61	8002.13	1234.55	8511.93	15:16:00	12.86	1160.59	8001.99	858.41	10.32			Not Available	Not Availat	-426.70	431.70
3	924.5	921.5	851.01	1135.34	7827.90	1210.25	8344.38	15:19:00	12.87	1135.34	7827.90	841.32	9.69			Not Available	Not Availat	-408.99	432.33
4	883.3	880.0	814.02	1082.25	7461.85	1169.01	8060.04	16:32:00	11.68	1082.25	7461.85	812.31	1.70			Not Available	Not Availat	-372.00	440.32
5	860.4	857.2	793.33	1052.66	7257.84	1128.32	7779.50	16:36:00	12.03	1052.65	7257.77	783.70	9.63			Not Available	Not Availat	-351.31	432.39
6	794.8	791.9	733.71	966.93	6666.75	1016.36	7007.56	16:43:00	11.82	967.01	6667.30	704.96	28.75			Not Available	Not Availat	-291.69	413.27
7	753.3	750.5	695.74	912.52	6291.61	995.02	6860.42	16:47:00	11.62	912.53	6291.68	689.95	5.78			Not Available	Not Availat	-253.72	436.24
8	676.5	674.2	624.95	811.07	5592.13	869.06	5991.96	16:52:00	11.19	811.05	5592.00	601.37	23.58			Not Available	Not Availat	-182.93	418.44
9	638.3	636.3	589.73	760.66	5244.57	798.82	5507.67	16:55:00	10.69	760.69	5244.77	551.97	37.76			Not Available	Not Availat	-147.71	404.26
10	613.9	611.8	567.23	728.24	5021.04	768.92	5301.52	16:59:00	10.41	728.28	5021.32	530.95	36.28			Not Available	Not Availat	-125.21	405.74
11	568.2	566.3	525.10	667.84	4604.60	723.57	4988.84	17:02:00	10.01	667.87	4604.80	499.05	26.05			Not Available	Not Availat	-83.08	415.97
12	544.6	542.7	503.37	636.77	4390.38	666.24	4593.56	17:07:00	9.62	636.79	4390.51	458.74	44.63			Not Available	Not Availat	-61.35	397.39
13	506.6	504.9	468.38	586.46	4043.50	601.72	4148.71	17:11:00	9.31	586.48	4043.64	413.36	55.02			Not Available	Not Availat	-26.36	387.00
14	466.4	464.8	431.35	533.27	3676.77	538.22	3710.90	17:15:00	9.00	533.46	3678.08	368.71	62.64			Not Available	Not Availat	10.67	379.38
15	421.6	420.2	390.08	474.46	3271.29	511.34	3525.57	17:18:00	8.67	474.42	3271.01	349.80	40.28			Not Available	Not Availat	51.94	401.74
16	370.8	369.6	343.28	407.24	2807.82	461.30	3180.55	17:22:00	8.23	407.29	2808.17	314.61	28.67			Not Available	Not Availat	98.74	413.35
17	321.5	320.5	297.88	342.37	2360.56	402.51	2775.21	17:25:00	7.87	342.34	2360.35	273.27	24.61			Not Available	Not Availat	144.14	417.41
18	251.5	250.8	233.35	249.97	1723.48	317.30	2187.71	17:29:00	7.36	249.95	1723.35	213.34	20.01			Not Available	Not Availat	208.67	422.01
19	228.6	228.0	212.20	219.67	1514.57	274.81	1894.75	17:32:00	7.12	219.68	1514.64	183.46	28.74			Not Available	Not Availat	229.82	413.28
20	166.2	165.5	154.48	136.98	944.44	186.14	1283.39	17:35:00	6.61	136.97	944.38	121.10	33.38			Not Available	Not Availat	287.54	408.64
21	73.5	73.0	68.62	14.09	97.15	15.28	105.35	17:39:00	6.20	14.09	97.15	0.94	67.68			Not Available	Not Availat	373.40	374.34

Golder Senior Reviewer & Approver Sign-off

Reviewed by:

Signature

17-Jan-20
Date

Approved by:

Signature

18-Jan-20
Date

Form ID: NWMO-IGNACE-1671632-WP09-F005

GOLDER

NWMO IGNACE DRILLING
WESTBAY SYSTEM
PIEZOMETRIC PRESSURES/LEVELS

Project No.:
1671632A (2911)

IG_BH03 - Two Weeks Post Inflation

Datum: Weld on PWT
Elev. G.S.: 441.561
Height of Westbay above G.S.: 1.30
Elev. Top of Westbay Casing: 442.86
Reference Elevation: 442.02
Borehole angle: 70

Probe Type: Open/close sampler
Serial No.: EMS5230
Probe Range: 2000 psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Weather: Sunny (-27 C)
Operator: Adrian Kowalchuk/Matthew Bowman
Date: 10-Dec-19

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure 97.49
Temp. 7.48
Time 12:37

Finish: Pressure 97.91
Temp. 5.53
Time 17:57

P_{atm} 97.70

Specific wt. of water (kN/m3) 9.804
Gravitational Acceleration (m/s^2) 9.8065

Note:
xdometer due to malfunctioning controller. Port position in angled boreholes refers to position along drillhole. True depth (Dp) needs to be calculated using borehole angl

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1) (psi)	Inside Casing (P1) (kPa)	Outside Casing (P2) (psi)	Outside Casing (P2) (kPa)	Time (H:M:S)	Probe Temp. (°C)	Inside Casing (P1) (psi)	Inside Casing (P1) (kPa)	Pressure Head Outside Port (m) H=(P2-Patm)/w	Piezo Level Outside Port (m) Dz = Dp-H	Comments		Avg. Water Density (kg/m3)	Env Head (m)	Z: Elev of pressure measurement port (mASL)	Freshwater Head (mASL)
1	967.3	963.5	889.02	1189.64	8202.28	1265.74	8726.97	13:35:00	12.68	1189.72	8202.83	880.18	8.84			Not Available	Not Availat	-447.00	433.18
2	944.4	940.8	868.72	1160.50	8001.37	1230.67	8485.17	13:42:00	12.82	1160.56	8001.78	855.52	13.21			Not Available	Not Availat	-426.70	428.81
3	924.5	920.5	851.01	1135.25	7827.28	1204.00	8301.29	13:47:00	12.75	1135.31	7827.69	836.76	14.25			Not Available	Not Availat	-408.99	427.77
4	883.3	878.4	814.02	1082.29	7462.13	1151.83	7941.59	13:55:00	12.44	1082.30	7462.20	800.07	13.95			Not Available	Not Availat	-372.00	428.07
5	860.4	857.0	793.33	1052.61	7257.49	1118.00	7708.34	14:00:00	12.20	1052.03	7253.49	776.28	17.05			Not Available	Not Availat	-351.31	424.97
6	794.8	791.8	733.71	967.01	6667.30	1030.39	7104.29	14:12:00	11.73	967.03	6667.44	714.67	19.05			Not Available	Not Availat	-291.69	422.97
7	753.3	750.6	695.74	912.58	6292.02	975.62	6726.67	14:22:00	11.30	912.62	6292.30	676.15	19.59			Not Available	Not Availat	-253.72	422.43
8	676.5	674.0	624.95	811.07	5592.13	874.28	6027.95	14:33:00	10.63	811.11	5592.41	604.88	20.07			Not Available	Not Availat	-182.93	421.95
9	638.3	636.4	589.73	760.70	5244.84	822.59	5671.56	14:41:00	10.23	760.68	5244.71	568.53	21.20			Not Available	Not Availat	-147.71	420.82
10	613.9	612.1	567.23	728.32	5021.59	782.60	5395.84	15:06:00	9.87	728.33	5021.66	540.41	26.83			Not Available	Not Availat	-125.21	415.19
11	568.2	566.5	525.10	667.95	4605.35	730.55	5036.97	15:13:00	9.55	667.93	4605.22	503.80	21.30			Not Available	Not Availat	-83.08	420.72
12	544.6	543.4	503.37	636.89	4391.20	697.97	4812.34	15:18:00	9.36	636.86	4391.00	480.89	22.48			Not Available	Not Availat	-61.35	419.54
13	506.6	505.6	468.38	586.61	4044.54	650.08	4482.15	15:30:00	8.92	586.62	4044.60	447.21	21.17			Not Available	Not Availat	-26.36	420.85
14	466.4	466.4	431.35	533.54	3678.63	598.59	4127.13	15:49:00	8.60	533.55	3678.70	411.00	20.35			Not Available	Not Availat	10.67	421.67
15	421.6	421.9	390.08	474.49	3271.49	543.97	3750.54	15:58:00	8.16	474.47	3271.36	372.59	17.49			Not Available	Not Availat	51.94	424.53
16	370.8	371.9	343.28	407.33	2808.44	479.77	3307.90	16:06:00	7.76	407.36	2808.65	327.44	15.85			Not Available	Not Availat	98.74	426.17
17	321.5	322.9	297.88	342.35	2360.42	414.69	2859.19	16:17:00	7.28	342.36	2360.49	281.67	16.21			Not Available	Not Availat	144.14	425.81
18	251.5	252.8	233.35	249.79	1722.24	323.09	2227.63	16:29:00	6.67	249.96	1723.41	217.25	16.10			Not Available	Not Availat	208.67	425.92
19	228.6	230.0	212.20	219.77	1515.26	294.25	2028.78	16:35:00	6.49	219.76	1515.19	196.97	15.23			Not Available	Not Availat	229.82	426.79
20	166.2	168.0	154.48	136.93	944.10	213.16	1469.69	16:44:00	6.01	137.04	944.86	139.94	14.54			Not Available	Not Availat	287.54	427.48
21	73.5		68.62	14.38	99.15	101.51	699.89	16:59:00	5.59	14.34	98.87	61.42	7.20			Not Available	Not Availat	373.40	434.82

Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20
Signature Date

Approved by:

18-Jan-20
Signature Date

Form ID: NWMO-IGNACE-1671632-WP09-F005

APPENDIX C

Packer Inflation Records

GOLDER

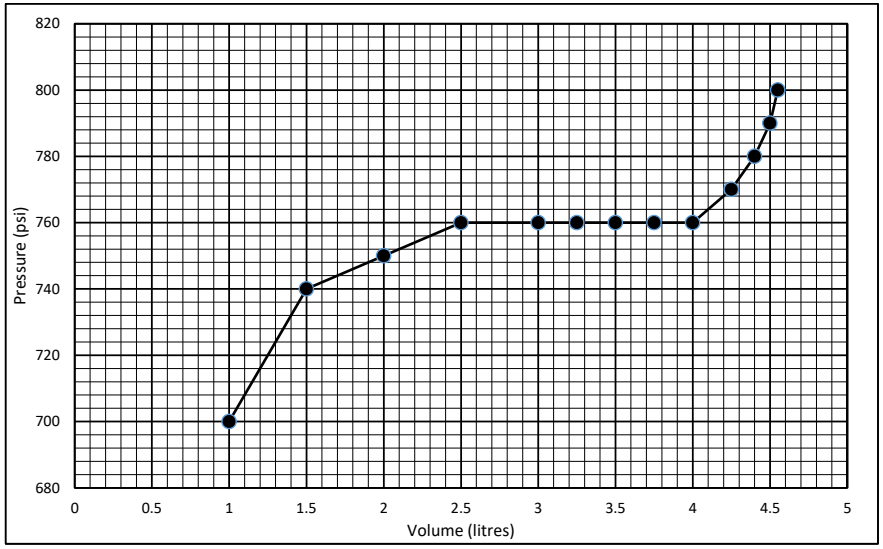
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_001

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	1 s/n 19604	145.0	800.0	540.0	1.0	1.4	116.4	*2019-11-18; 13:07*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	700
1.5	740
2	750
2.5	760
3	760
3.25	760
3.5	760
3.75	760
4	760
4.25	770
4.4	780
4.5	790
4.55	800



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

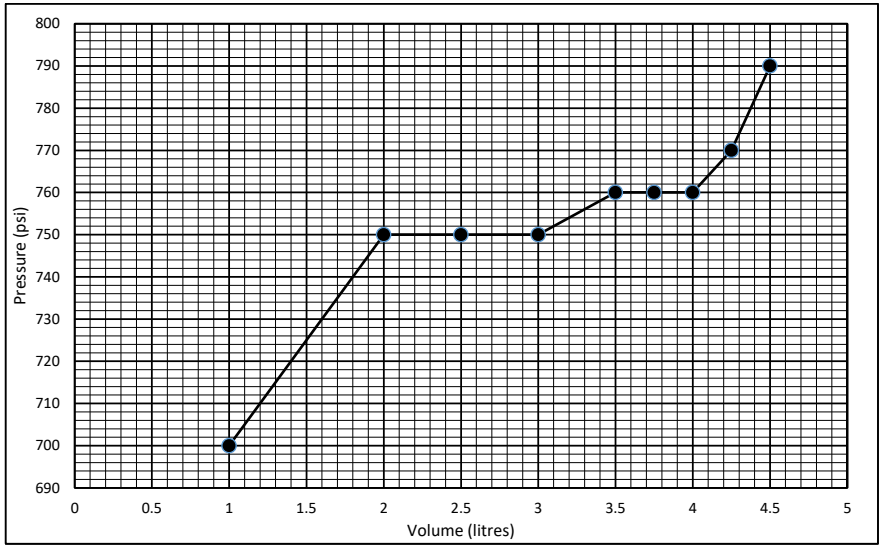
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_002

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	2 s/n 19605	150.0	790.0	540.0	1.0	1.4	101.4	*2019-11-18; 13:43*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	700
2	750
2.5	750
3	750
3.5	760
3.75	760
4	760
4.25	770
4.5	790



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

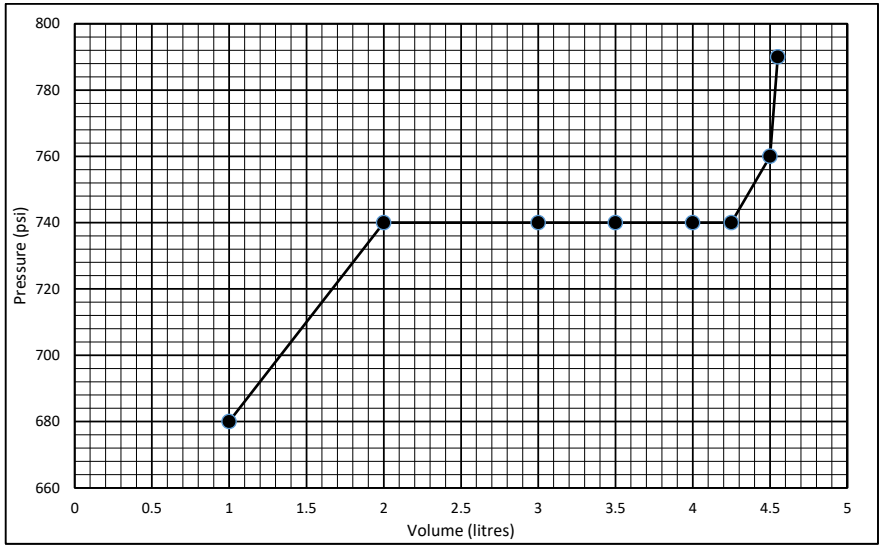
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_003

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	3 s/n 19606	135.0	790.0	540.0	1.0	1.4	116.4	*2019-11-18; 14:15*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	680
2	740
3	740
3.5	740
4	740
4.25	740
4.5	760
4.55	790



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

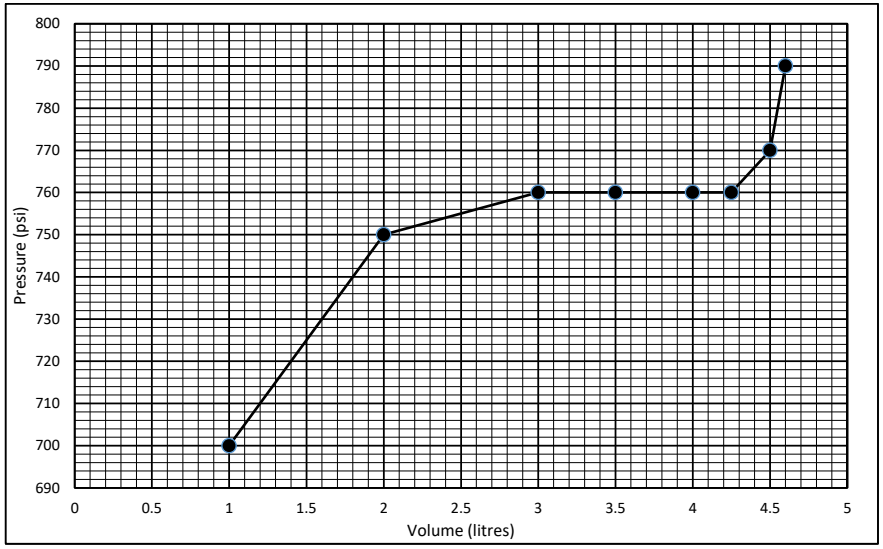
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_004

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	4 s/n 19607	145.0	790.0	540.0	1.0	1.4	106.4	*2019-11-18; 14:50*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	700
2	750
3	760
3.5	760
4	760
4.25	760
4.5	770
4.6	790



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

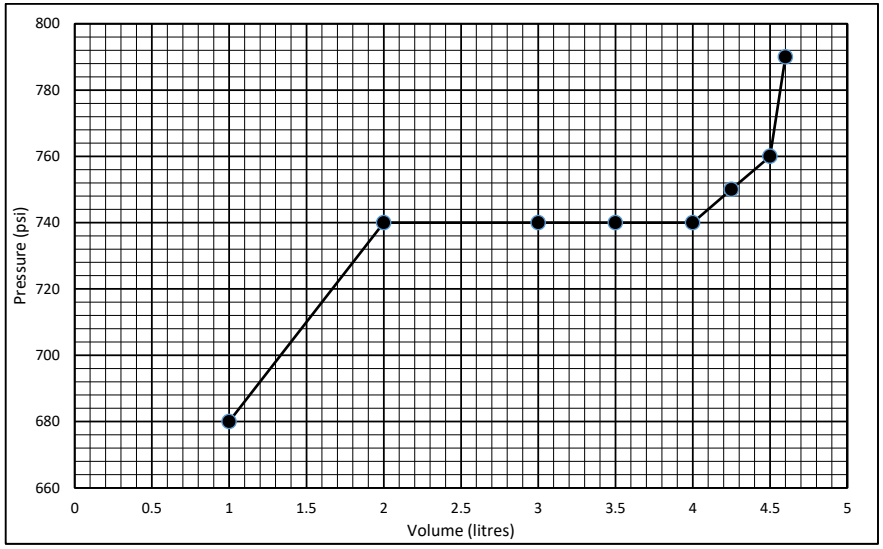
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_005

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	5 s/n 19608	145.0	790.0	540.0	1.0	1.4	106.4	*2019-11-18; 15:22*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	680
2	740
3	740
3.5	740
4	740
4.25	750
4.5	760
4.6	790



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

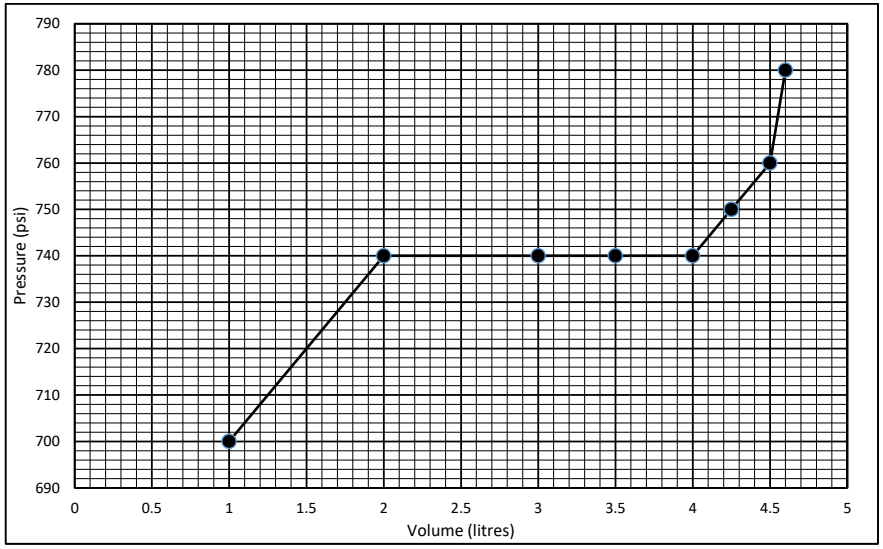
Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER	**WP9 - Westbay MP38 Casing Installation** **Record of Packer Inflation**	**Project No.:** **1671632A (2911)**

Test # IG_BH03_HT_006

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	6 s/n 19609	150.0	780.0	540.0	1.0	1.4	91.4	*2019-11-18; 16:02*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	700
2	740
3	740
3.5	740
4	740
4.25	750
4.5	760
4.6	780



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

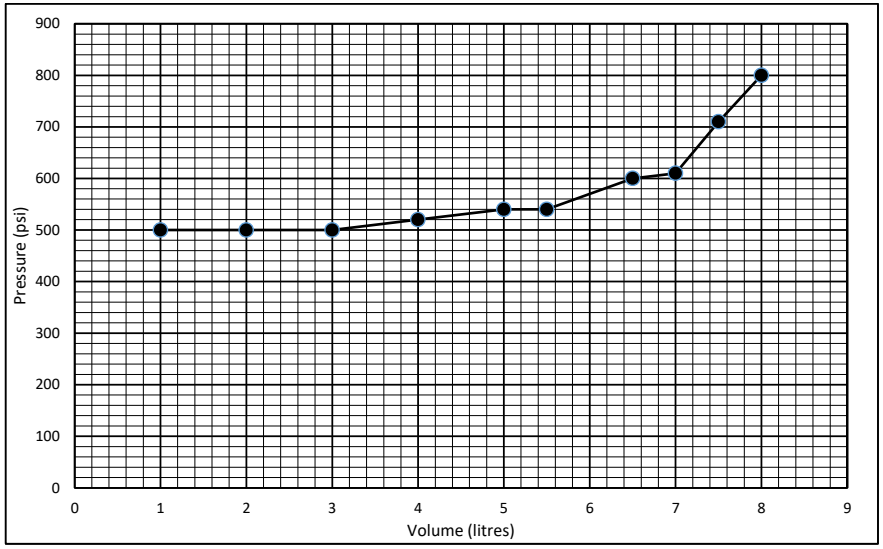
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_007

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	7 s/n 19610	145.0	800.0	530.0	1.0	1.4	126.4	*2019-11-21; 11:08*	*TK/ML*
Other (explain)	Note - draft revised inflation data provided by Westbay on 17-Jan-2020.								

Volume (L)	Pressure (psi)
1	500
2	500
3	500
4	520
5	540
5.5	540
6.5	600
7	610
7.5	710
8	800



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

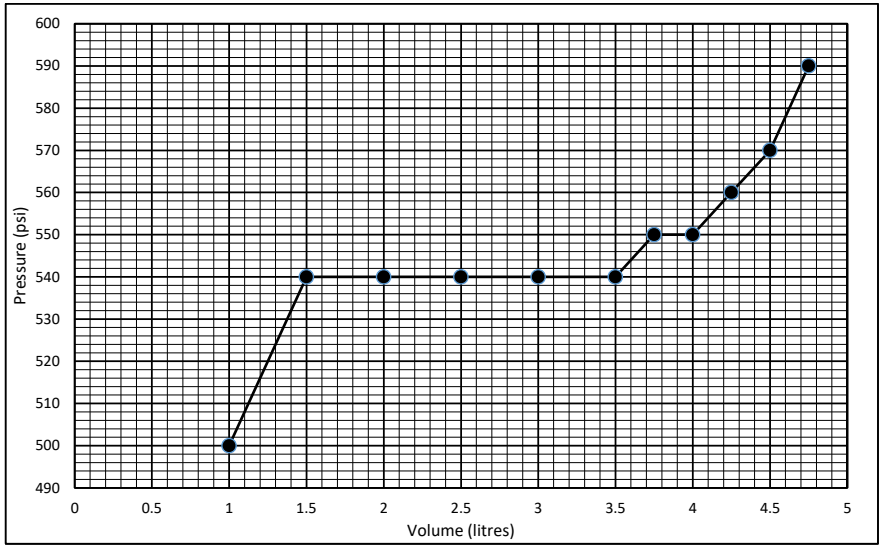
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_008

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	8 s/n 19611	150.0	590.0	530.0	1.0	1.4	-88.6	*2019-11-21; 16:16*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	500
1.5	540
2	540
2.5	540
3	540
3.5	540
3.75	550
4	550
4.25	560
4.5	570
4.75	590



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

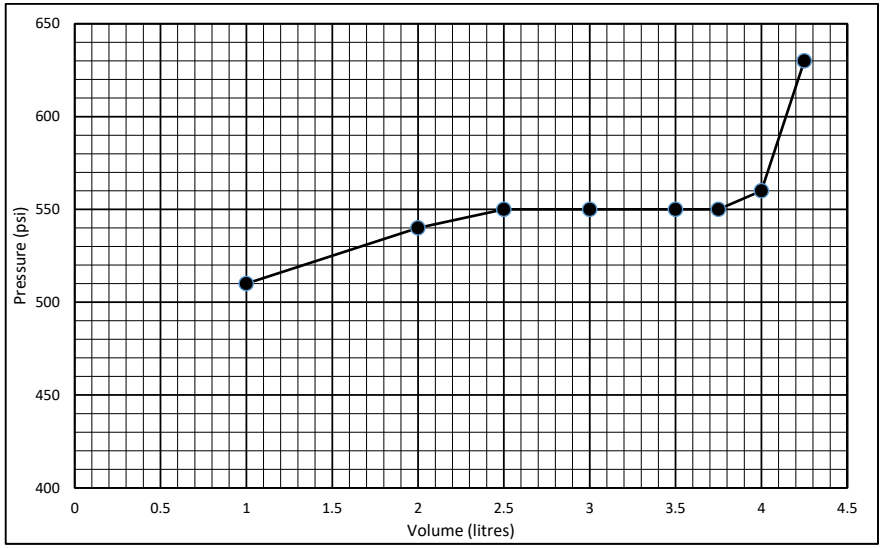
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_009

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	9 s/n 19612	140.0	630.0	530.0	1.0	1.4	-38.6	*2019-11-21; 17:14*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	510
2	540
2.5	550
3	550
3.5	550
3.75	550
4	560
4.25	630



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

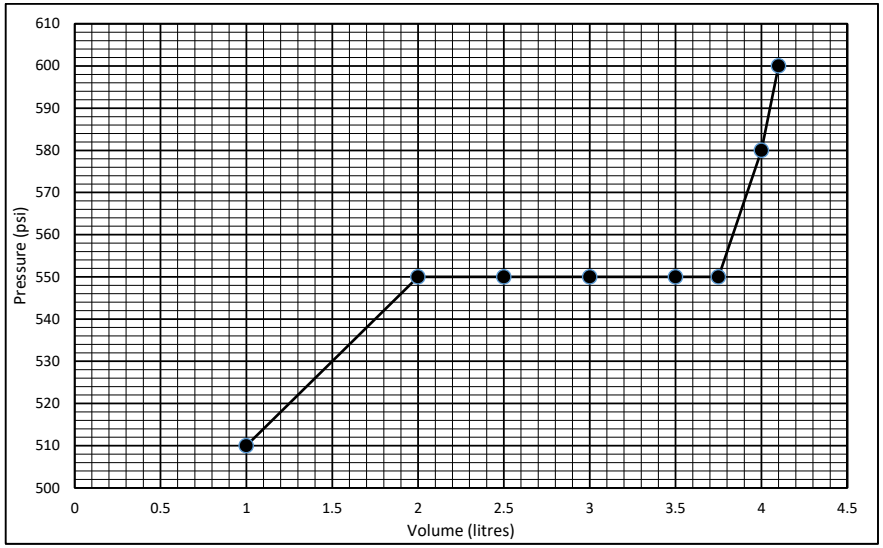
Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER	**WP9 - Westbay MP38 Casing Installation** **Record of Packer Inflation**	**Project No.:** **1671632A (2911)**

Test # IG_BH03_HT_010

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	10 s/n 19613	140.0	600.0	530.0	1.0	1.4	-68.6	*2019-11-21; 17:46*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	510
2	550
2.5	550
3	550
3.5	550
3.75	550
4	580
4.1	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

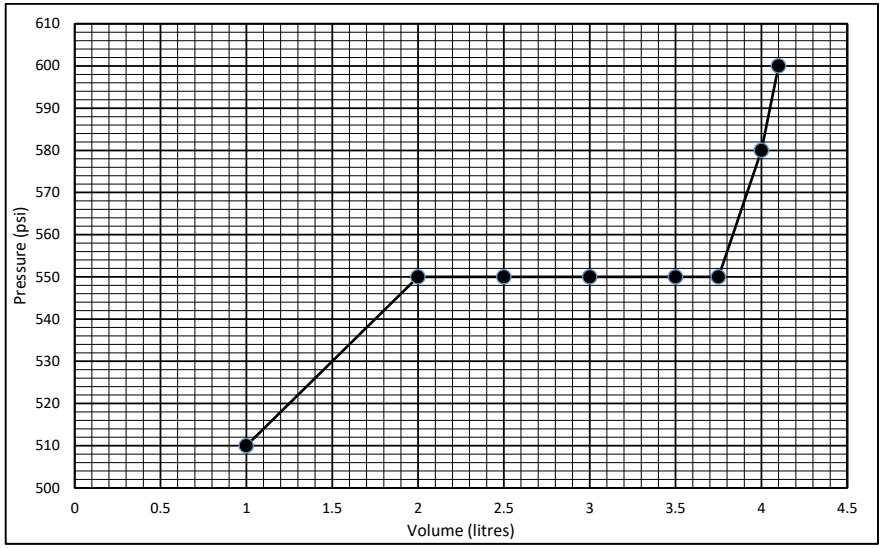
Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER	**WP9 - Westbay MP38 Casing Installation** **Record of Packer Inflation**	**Project No.:** **1671632A (2911)**

Test # IG_BH03_HT_011

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	11 s/n 19614	155.0	600.0	530.0	1.0	1.4	-83.6	*2019-11-21; 18:32*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	510
2	550
2.5	550
3	550
3.5	550
3.75	550
4	580
4.1	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

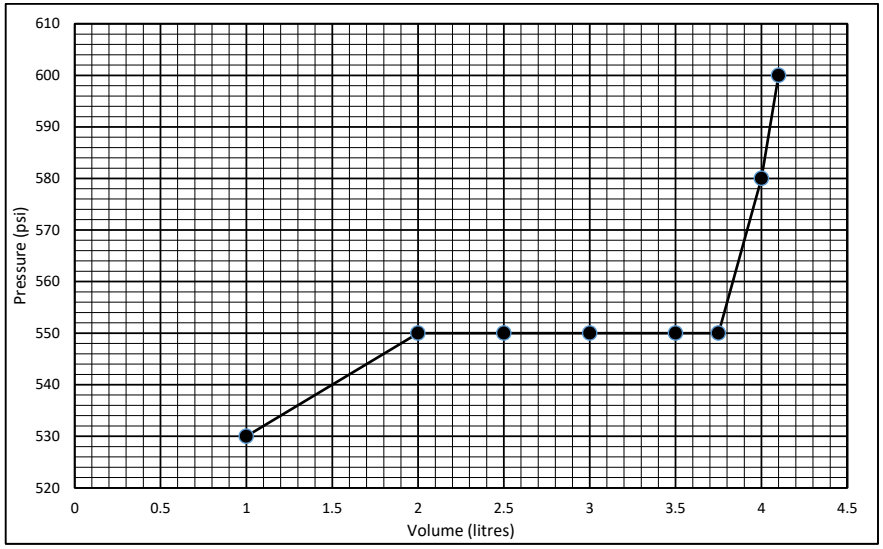
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_012

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	12 s/n 19615	130.0	600.0	530.0	1.0	1.4	-58.6	*2019-11-22; 8:22*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	530
2	550
2.5	550
3	550
3.5	550
3.75	550
4	580
4.1	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

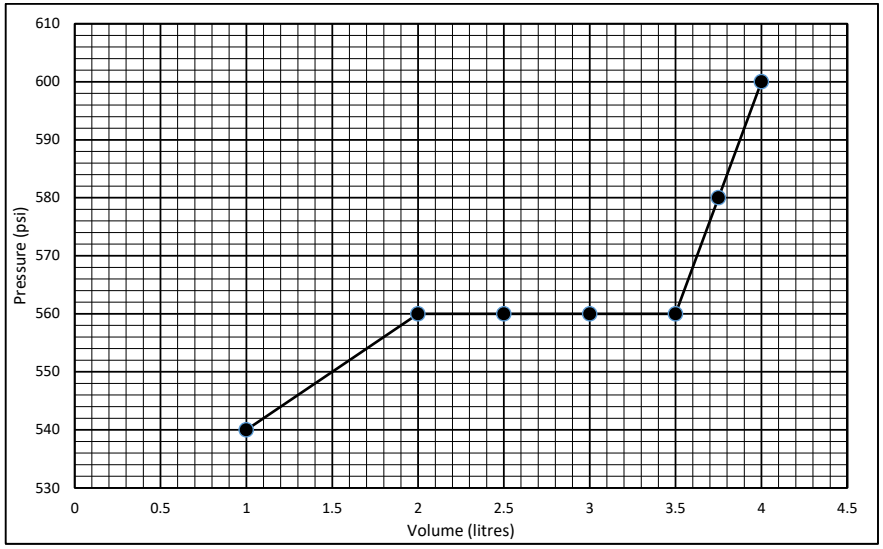
Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER	**WP9 - Westbay MP38 Casing Installation** **Record of Packer Inflation**	**Project No.:** **1671632A (2911)**

Test # IG_BH03_HT_013

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	13 s/n 19616	145.0	600.0	530.0	1.0	1.4	-73.6	*2019-11-22; 9:04*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	540
2	560
2.5	560
3	560
3.5	560
3.75	580
4	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

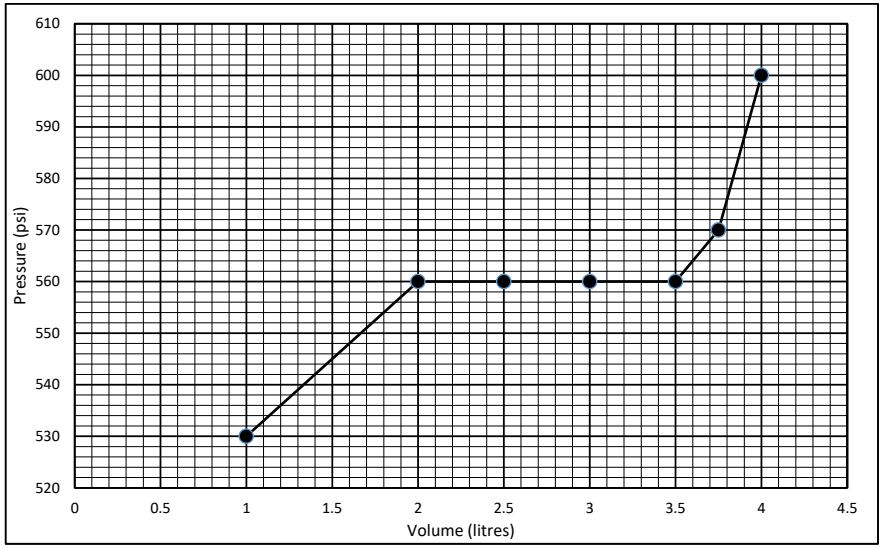
Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER	**WP9 - Westbay MP38 Casing Installation** **Record of Packer Inflation**	**Project No.:** **1671632A (2911)**

Test # IG_BH03_HT_014

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	14 s/n 19617	140.0	600.0	530.0	1.0	1.4	-68.6	*2019-11-22; 9:35*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	530
2	560
2.5	560
3	560
3.5	560
3.75	570
4	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

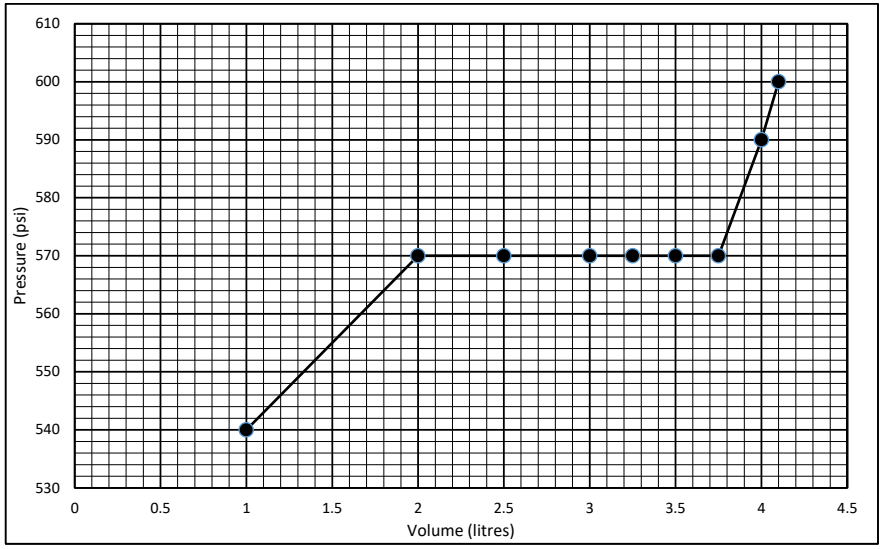
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_015

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	15 s/n 19618	150.0	600.0	530.0	1.0	1.4	-78.6	*2019-11-22; 10:23*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	540
2	570
2.5	570
3	570
3.25	570
3.5	570
3.75	570
4	590
4.1	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

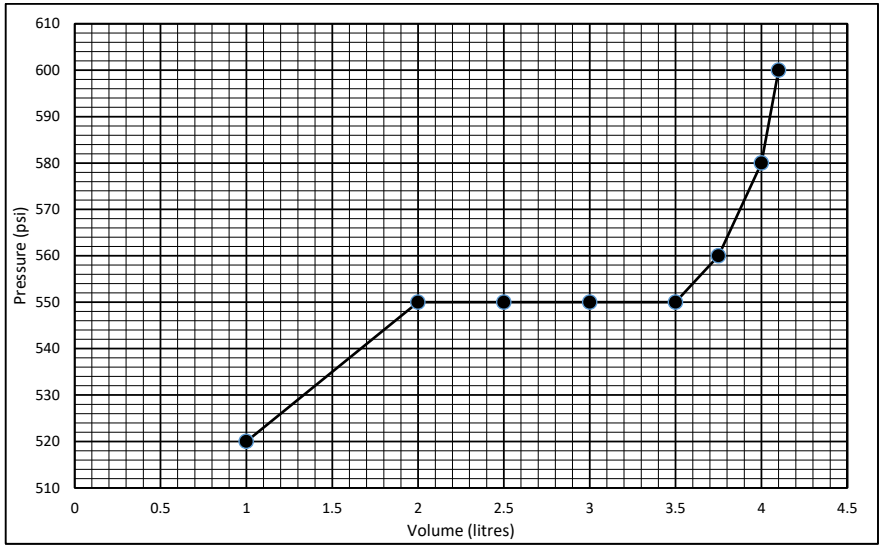
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_016

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	16 s/n 19619	140.0	600.0	530.0	1.0	1.4	-68.6	*2019-11-22; 10:55*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	520
2	550
2.5	550
3	550
3.5	550
3.75	560
4	580
4.1	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

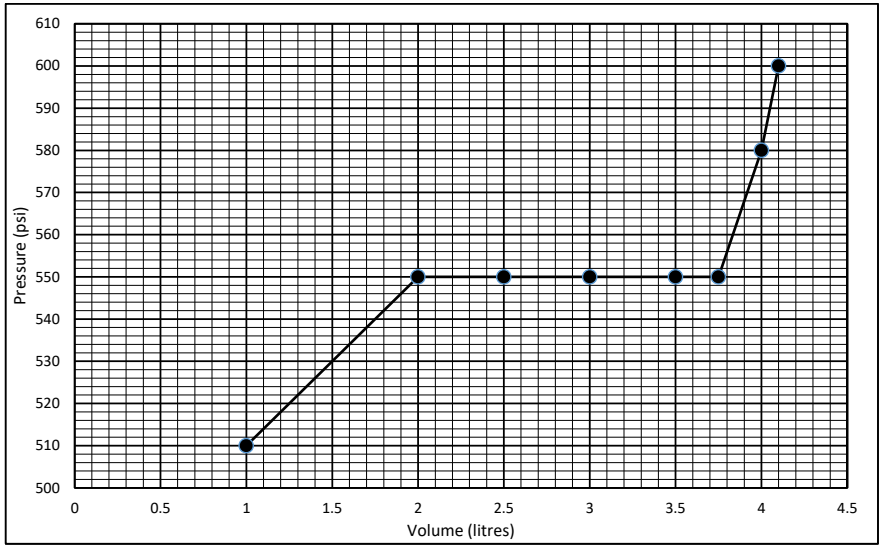
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_017

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	17 s/n 19620	140.0	600.0	530.0	1.0	1.4	-68.6	*2019-11-22; 11:43*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	510
2	550
2.5	550
3	550
3.5	550
3.75	550
4	580
4.1	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

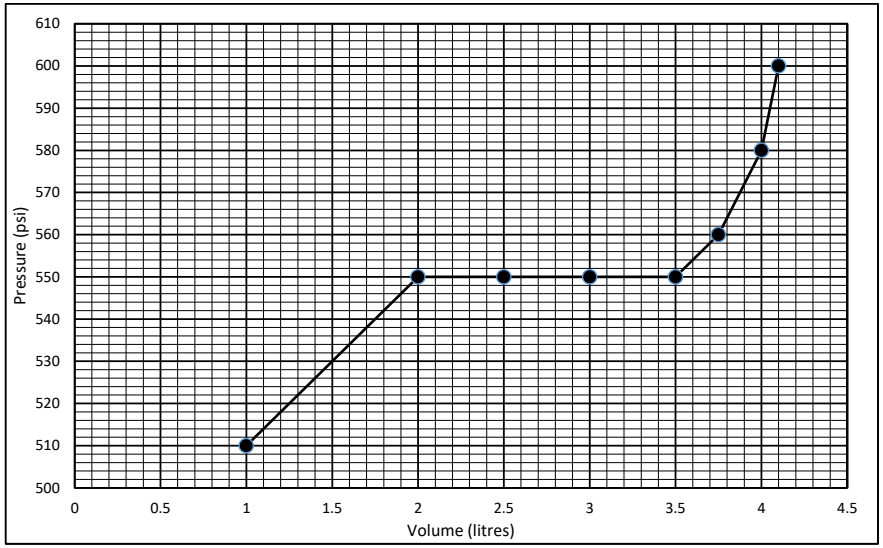
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_018

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	18 s/n 19621	135.0	600.0	530.0	1.0	1.4	-63.6	*2019-11-22; 12:25*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	510
2	550
2.5	550
3	550
3.5	550
3.75	560
4	580
4.1	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER

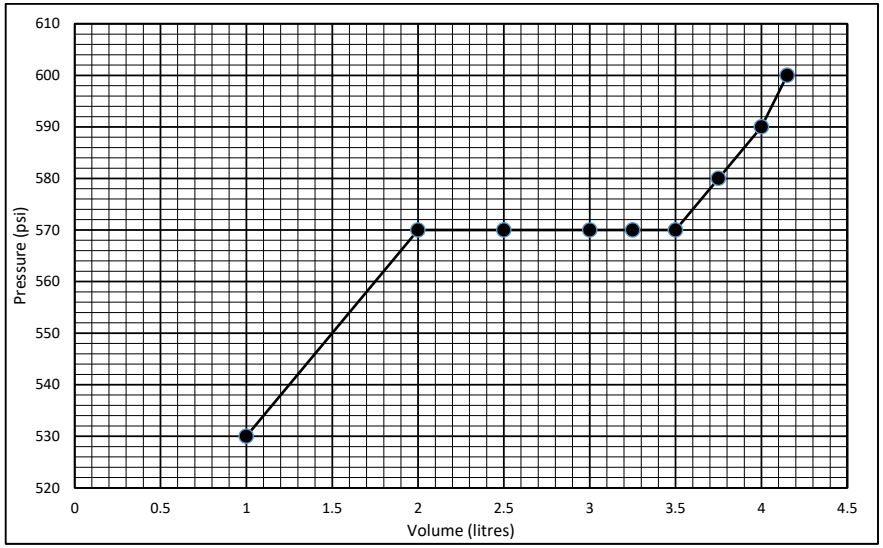
WP9 - Westbay MP38 Casing Installation
Record of Packer Inflation

Project No.:
1671632A (2911)

Test # IG_BH03_HT_019

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	19 s/n 19622	140.0	600.0	530.0	1.0	1.4	-68.6	*2019-11-22; 14:05*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	530
2	570
2.5	570
3	570
3.25	570
3.5	570
3.75	580
4	590
4.15	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

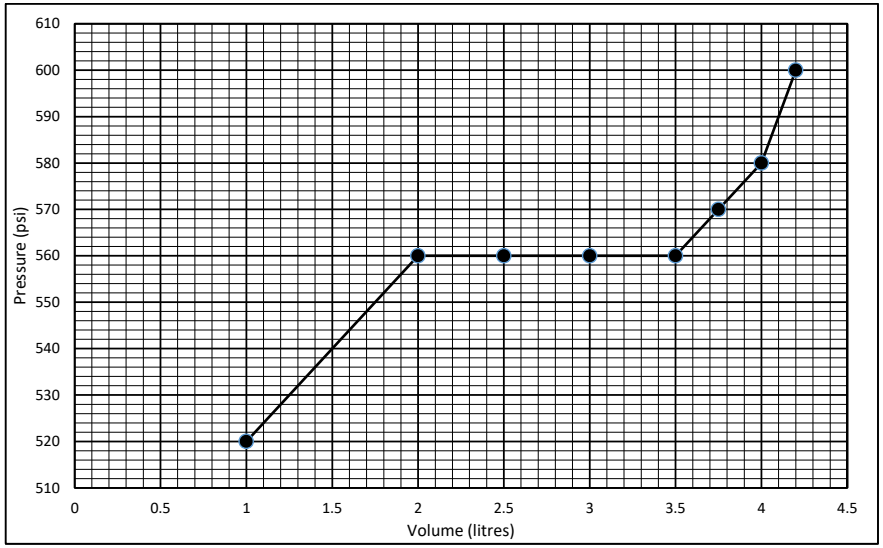
Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER	**WP9 - Westbay MP38 Casing Installation** **Record of Packer Inflation**	**Project No.:** **1671632A (2911)**

Test # IG_BH03_HT_020

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	20 s/n 19623	160.0	600.0	530.0	1.0	1.4	-88.6	*2019-11-22; 14:47*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	520
2	560
2.5	560
3	560
3.5	560
3.75	570
4	580
4.2	600



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

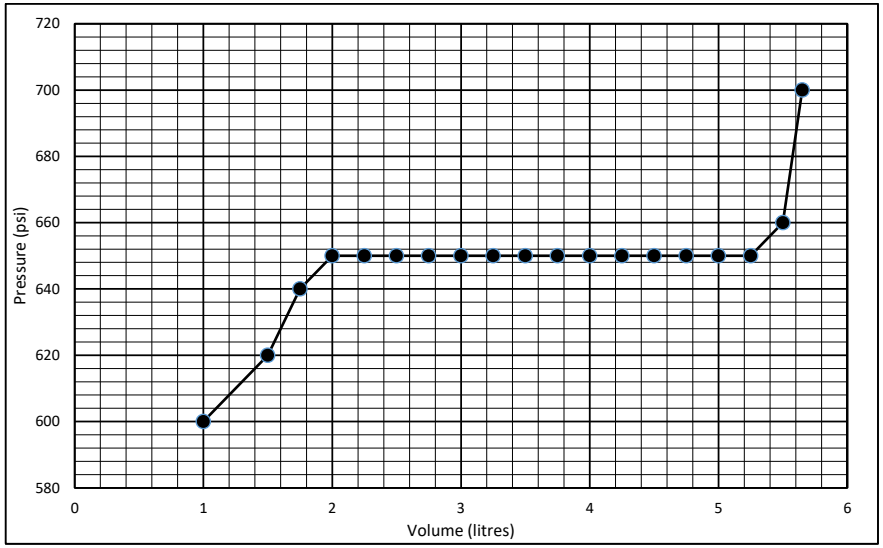
Form: NWMO-IGNACE-BH03-1671632-WP09-F004

GOLDER	**WP9 - Westbay MP38 Casing Installation** **Record of Packer Inflation**	**Project No.:** **1671632A (2911)**

Test # IG_BH03_HT_021

	Packer No.	Packer Valve Pressure, P_V (psi)	Final Line Pressure, P_L (psi)	Tool Pressure, P_T (psi)	Borehole Water Level (m)	Equivalent Borehole Pressure, P_W (psi)	Calc. Packer Element Pressure $P_E = P_L + P_W - P_V - P_T$ (psi)	Date and Time	Initials
Packers and Inflation Line	21 (s/n) 19581	145.0	700.0	530.0	50.0	71.1	96.1	*2019-11-23; 12:55*	*TK/ML*
Other (explain)	Note - Pw and Pe are calculated in this sheet								

Volume (L)	Pressure (psi)
1	600
1.5	620
1.75	640
2	650
2.25	650
2.5	650
2.75	650
3	650
3.25	650
3.5	650
3.75	650
4	650
4.25	650
4.5	650
4.75	650
5	650
5.25	650
5.5	660
5.65	700



Golder Senior Reviewer & Approver Sign-off

Reviewed by:

17-Jan-20

Signature Date

Approved by:

17-Jan-20

Signature Date

Form: NWMO-IGNACE-BH03-1671632-WP09-F004

APPENDIX D

Retrieval Plan

TECHNICAL MEMORANDUM

DATE November 19, 2019 **Project No.** 1671632A

TO Eric Sykes, Martin Sykes, Maria Sanchez-Rico Castejon, Sarah Hirschorn, Elise Leroux
NWMO

CC Tony Kim, Dave Larssen, Rachel Gould, Joe Carvalho

FROM George Schneider, Adrian Kowalchuk **EMAIL george_schneider@golder.com**

RETRIEVAL PLAN – LOST PVC FRAGMENTS – WESTBAY SYSTEM INSTALLATION AT IG_BH03 – BOREOHLE DRILLING AND TESTING – IGNACE AREA

INTRODUCTION

On the morning of November 19, 2019 the top of the Westbay PVC installation was inadvertently damaged and broken off when the drillers were adding an HQ drill rod to the top of the rod string that was acting as a guide tube for the installation of the Westbay system in IG_BH03 (damaged installation shown below).

In the days immediately prior to this, the guide tube had been lowered and the Westbay system installed down the borehole through the guide tube, and the lowermost exposed packers had been successfully inflated. The process of raising the guide tube had just begun when the damaged occurred.

Figure 1: Broken Westbay PVC extension (top and bottom)

It is presumed that three pieces of PVC are likely to have fallen into the annulus; one larger piece several cm in size, which is visible about 1.5 m below surface in the annulus, and two smaller pieces are presumed to have

Golder Associates Ltd.
210 Sheldon Drive, Cambridge, Ontario, N1T 1A8, Canada T: +1 519 620 1222 F: +1 519 620 9878

fallen further down the annulus. The two other pieces may have fallen as deep as ~68m and have come to rest on top of the abrasion protectors at that depth, approximately 60 cm above the upper packer. As shown in the figure below, these fragments are unlikely to have fallen any deeper, based on the size of the fragments relative to the size of the annulus.

The water level in the annulus was last measured to be approximately 4.2 m below surface. The Westbay casing has already been secured to ensure it does not move during the extraction process and cause the fragment to fall further down the annulus.

Figure 2: Illustration of how abrasion protector fits inside HQ rods

RETRIEVAL PLAN

Retrieval of Large Fragment

- An attempt to retrieve the large fragment near surface will be made by lowering an inspection camera with a retrieval hook down the annulus, attaching to the large fragment, and retrieving it to surface
- The retrieval hook will be modified to have an adhesive pad on it
- The pad will be lowered past the fragment and the fragment contacted from the bottom and allowed to bond to the hook
- Several adhesive options will be tested at surface to assess suitability and drying time
- The adhesive pad will be securely fastened to the hook, to minimize chances of losing it during the retrieval attempt
- A dry run will be made without an adhesive to get a closer look at the fragment with the inspection camera
- If the adhesive option does not work, a second attempt will be made using a small grappling tool designed for retrieving objects from drains

Retrieval of Smaller Fragments

- An attempt will be made to retrieve the smaller fragments by flushing the hole with traced drill fluid

- We will set up a sump with drill fluid at surface so the fluid can be recirculated
- Drill fluid will be pumped using the 2” Grundfos pump and 5/8” poly tubing with a “straight” leader made of thin walled steel tubing to help guide it down the annulus
- The tremie line will be lowered down to the top of the abrasion protector – that depth needs to be calculated and the tubing measured off to ensure we are at the sufficient depth prior to starting the flow of water
- Once at the desired depth, the pump will be started and the borehole will be flushed, slowly increasing pump flow to full speed (~7L / min)
- The annulus will be flushed for a period sufficient to potentially raise all of the fragments to surface, if possible – this may take several hours
- The fluid return needs to be monitored carefully to ensure any fragments are recovered and accounted for
- Any fragments retrieved will be “fit” with the other pieces at surface, in order to assess whether or not all of the fragments have been retrieved
- If after several hours, all of the fragment cannot be retrieved, then then flushing will be stopped – that duration to be determined by Golder with concurrence from the NWMO
- It may be that the remaining missing fragments fell down the center of the Westbay pipe itself and are not in the annulus
- While we cannot confirm or refute this possibility, we will probe the center of the Westbay casing with the MOSDAX probe to establish some assurance that the center of the installation is free of obstructions and will function correctly, once the remaining installation is successfully completed

POST-RETRIEVAL

- If all fragments are retrieved, then the installation will proceed in accordance with the test plan
- If some fragments are suspected to remain down the annulus, then in the final stages of installation there will be an additional installation step, as noted herein
- The guide tube will be raised just enough to expose the uppermost packer, but leaving the abrasion protector (located 60 cm above it) inside the guide tube
- Then, the last packer will be inflated prior to raising the guide tube past the abrasion protector
- The purpose of this additional step is to help ensure that the final packer is correctly inflated before the last abrasion protector is exposed, as there is a risk that the smaller fragments may pass below the abrasion protectors in the large casing annulus and become lodged between the packer and the casing wall, which could compromise the upper packer

DOCUMENTATION

- All retrieval activities will be documented by Golder and Westbay personnel using detailed field notes and representative photographs
- The Westbay system installation report will include a section that specifically documents these retrieval activities

Schneider, George

From: Carvalho, Joe
Sent: November 19, 2019 4:03 PM
To: Schneider, George; Kowalchuk, Adrian; Tony Kim
Cc: Lemon, Michael; Gould, Rachel; 1671632, NWMO Drilling Ignace
Subject: RE: WB 973 Westbay installation issue - Drawings

Hi George,

Here are the sizes for the different casings and hole:

	OD (mm)	ID (mm)
HWT Casing	114.3	101.6
HWT Shoe Bit	117.6	99.82
PQ Casing (measured at site)	117	100
PQ Shoe Bit (measured at site)	117	100

The borehole itself is 96 mm. (inner diam = 61.1 mm – core size)

Regards,

Joe Carvalho (B.A.Sc.(Honours), M.A.Sc., Ph.D., P.Eng.)
Mining & Rock Mechanics, Principal

GOLDER
Golder Associates Ltd.
6925 Century Avenue, Suite #100, Mississauga, Ontario, Canada L5N 7K2
T: +1 905 567 4444 | **D:** +1 905 567-6100 x1312 | **C:** +1 647 280-7378 | golder.com
LinkedIn | Facebook | Twitter

Work Safe, Home Safe

From: Schneider, George <George_Schneider@golder.com>
Sent: November 19, 2019 3:51 PM
To: Kowalchuk, Adrian <Adrian_Kowalchuk@golder.com>; Tony Kim <Hkim@westbay.com>
Cc: Carvalho, Joe <Joe_Carvalho@golder.com>; Lemon, Michael <Michael_Lemon@golder.com>; Gould, Rachel <Rachel_Gould@golder.com>; 1671632, NWMO Drilling Ignace <SMO-17131RCYG@golder.com>
Subject: FW: WB 973 Westbay installation issue - Drawings

Adrian / Tony - some useful drawings from Westbay – I am considering adding them to the draft retrieval plan.

Joe – do you know the ID of the deep casing and the ID of the open borehole?

G

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

Golder Associates Ltd.
210 Sheldon Drive, Cambridge, Ontario, Canada N1T 1A8
T: +1 519 620 1222 | **D:** +1 519 620 8182 x6532 | **C:** +1 647 203 5838 | **golder.com**
LinkedIn | Facebook | Twitter

Work Safe, Home Safe

From: Walter Salden <wsalden@westbay.com>
Sent: November 19, 2019 3:41 PM
To: Schneider, George <George_Schneider@golder.com>
Cc: Genevieve Simmonds <gsimmonds@westbay.com>; Dave Larssen <dlarssen@westbay.com>
Subject: WB 973 Westbay installation issue - Drawings

EXTERNAL EMAIL

George,

We have prepared two drawings to help with the discussions and field activities at IG-BH03.

Attached are section drawings showing the clearance around an Abrasion Protector and a Packer, both inside of HQ drill rods. The components have been offset to reflect a possible configuration in an angle borehole. There will be some manufacturing tolerances, so the dimensions are should not be considered accurate to the three decimal places shown.

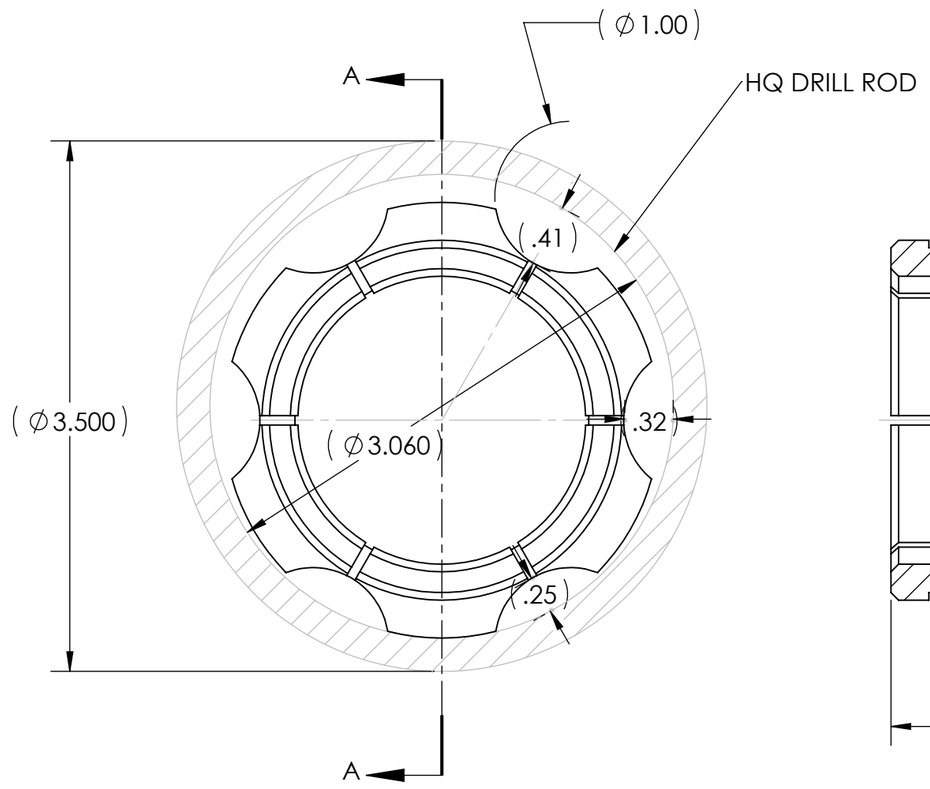
You are free to distribute these as required to support the remediation activities.

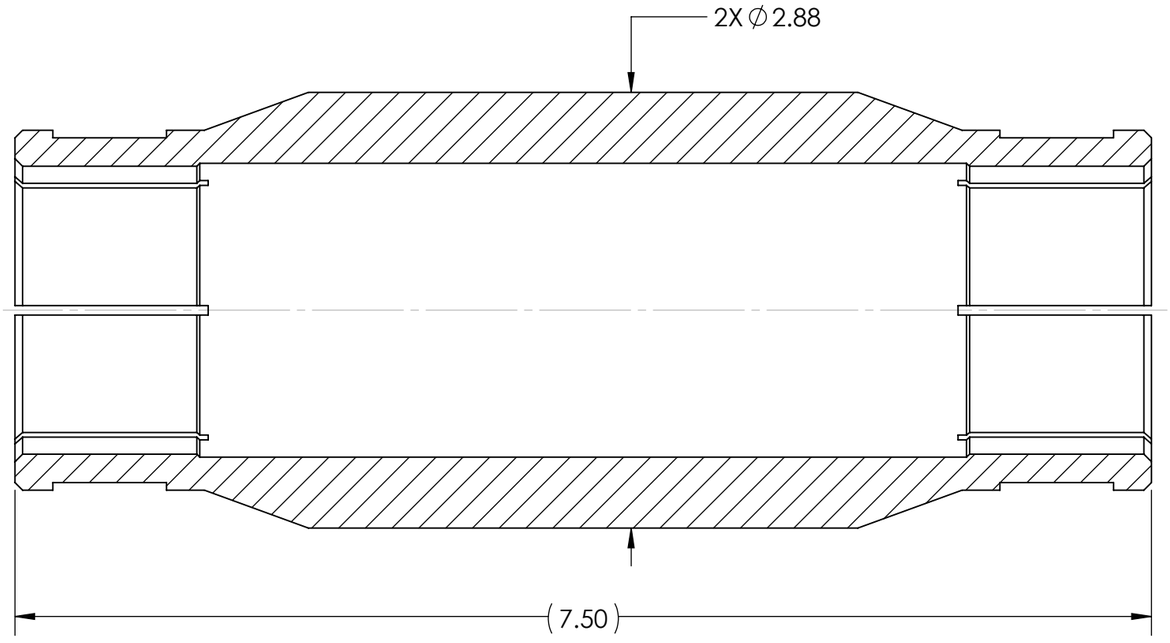
Walter

Walter Salden
Service Quality Engineer / Geoscientist
Westbay Instruments

Division of Nova Metrix Ground Monitoring (Canada) Ltd.
www.westbay.com

Tel. +1.(604).430.4272 ext 217
Fax. +1.(604).430.3538
8610 Glenlyon Parkway, Suite 134
Burnaby, BC, V5J 0B6 Canada





SECTION A-A

NOTES:
EXAMPLE SHOWING ABRASION PROTECTOR 025002C2 INSIDE HQ DRILL PIPE.

REFERENCE DOCUMENTS:	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL: ± 1/32
ANGULAR: ± 1/2°
TWO PLACE DECIMAL ± .015
THREE PLACE DECIMAL ± .005

INTERPRET GD&T PER:
ASME Y14.5M-1994

MATERIAL

FINISH

DO NOT SCALE DRAWING

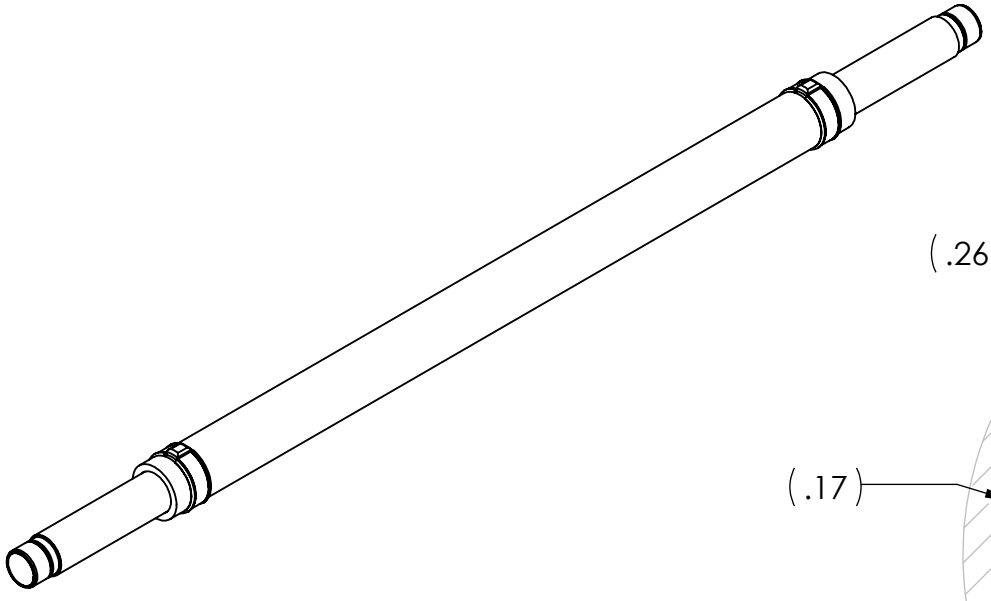
	NAME	DATE
DRAWN	JH	11-19-2019
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

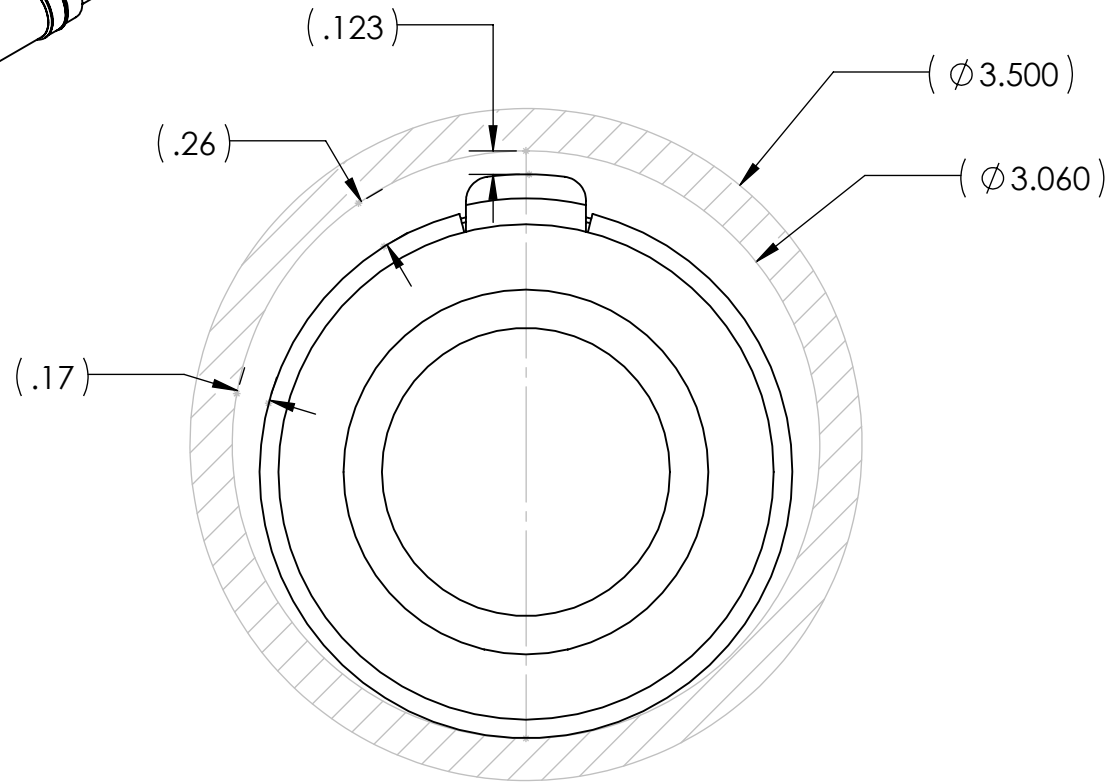
Westbay Instruments

TITLE:
Abrasion Protector (MP38 Plastic)

SIZE	DWG. NO.	REV
B		AA

SCALE: 1:1	WEIGHT:	SHEET 1 OF 1





NOTES:
EXAMPLE SHOWING 0238 MP38 PACKER INSIDE HQ DRILL PIPE.

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL: ± 1/32
ANGULAR: ± 1/2°
TWO PLACE DECIMAL ± .015
THREE PLACE DECIMAL ± .005
REMOVE BURRS AND SHARP EDGES
.015 MAX RADIUS OR CHAMFER
SURFACE FINISH: Ra 125 MAX

INTERPRET GD&T PER:
ASME Y14.5M-1994

MATERIAL

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	JH	11-19-2019
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

Westbay Instruments

TITLE:

Packer MP38

SIZE	DWG. NO.	REV
A		

SCALE:	WEIGHT:	SHEET 1 OF 1

5 4 3 2 1

golder.com