Geotechnical Investigation

Golden Plough Lodge - Long Term Care Redevelopment
555 Courthouse Road, Cobourg, Ontario

Submitted to:

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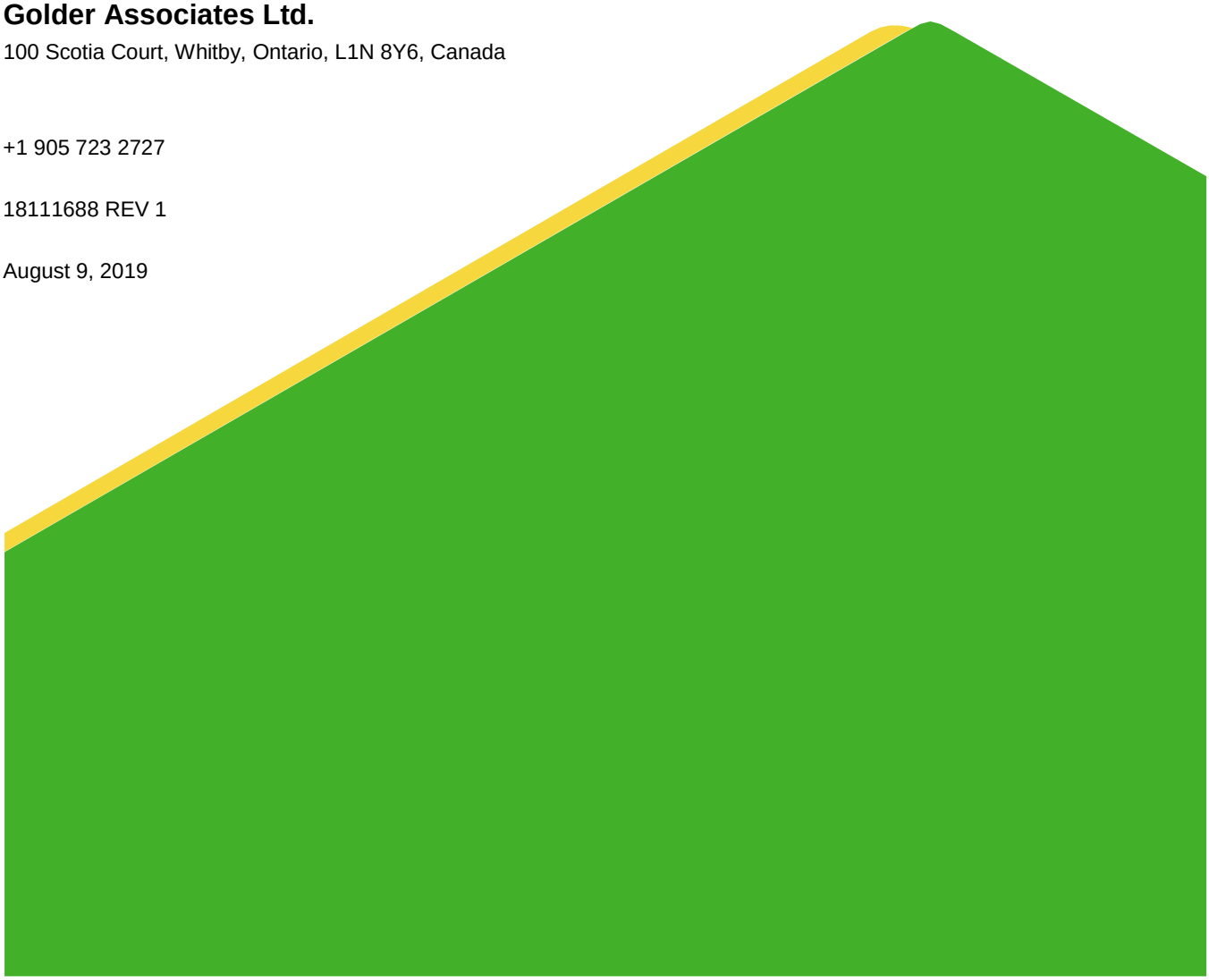

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APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by the County of Northumberland (the County) to carry out a geotechnical investigation for the proposed Golden Plough Lodge long term care redevelopment, in Cobourg, Ontario as shown on the Key Plan on Figure 1.

The purpose of the geotechnical investigation was to obtain information on the general subsurface soil and groundwater conditions at the site by means of a limited number of boreholes and based on our interpretation of the collected information, provide geotechnical recommendations for the design and construction of the proposed development.

The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within eighteen months of the date of the report, Golder should be given an opportunity to confirm that the recommendations are still valid. In addition, this report should be read in conjunction with the attached *"Important Information and Limitations of This Report"*, included in Appendix A. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

2.0 BACKGROUND

Golder previously completed a preliminary geotechnical investigation at the site and the results were presented in our report entitled, '*Proposed Long Term Care Facility, 555 Courthouse Road, Cobourg, Ontario'* dated June 28, 2017 (Project No. 1655862). As part of the preliminary geotechnical investigation, Golder drilled a total of six (6) boreholes (identified as 16-1 to 16-6) at the site. The locations of the previous boreholes are shown on the Borehole Location Plan, Figure 2, and the results of these boreholes are incorporated in this report.

3.0 SITE AND PROJECT DESCRIPTION

The site is an irregular 'L' shaped parcel of land, approximately 6.0 hectares (14.7 acres) in area and is located at the northwest corner of the intersection of Elgin Street West and Burnham Street, in Cobourg, Ontario, with the site boundaries as shown on Figure 2. A drainage ditch traverses the site from the centre of the site extending to the northern limits where it outlets into an off-site pond. Grass coverage is present across the site except to the east and south portions of the site where pavement and building structures are present. Residential dwellings located along the south side of Courthouse Road, proposed to be removed from site, are present at the southern limits of the site. Based on the existing topography of the site, the site generally slopes down towards the north, with the existing grade ranging in elevations from approximately Elev. 109 m (near the southern boundary) to Elev. 104 m (near the northern boundary).

4.0 INVESTIGATION PROCEDURE

The field work for this geotechnical investigation was carried out between December 17 to 21, 2018 during which time twenty-one boreholes (18-1 to 18-17 and 18-19 to 18-22) were advanced at the site. Borehole 18-18 was eliminated from our drilling program due to the presence of undetectable underground utilities in the area. As previously noted, six boreholes (Boreholes 16-1 to 16-6) were previously advanced at the site as part of the preliminary geotechnical investigation. In addition, subsequent to the drilling fieldwork, Golder revisited the site on April 10 and 11, 2019 and carried out eight in-situ Cone Penetration tests (CPTs) near the locations of Boreholes 16-4, 18-1, 18-3, 18-5, 18-6, 18-7, 18-9 and 18-12. In addition, four Shelby tube samples of the clayey and till-like deposit were obtained from new boreholes advanced adjacent to Boreholes 18-1, 18-3, 18-6 and 18-7. The

locations of the current and previous boreholes, twenty-seven boreholes and eight CPTs in total, are shown on the Borehole Location Plan, Figure 2, attached.

The boreholes were drilled using a track-mounted drill rig supplied and operated by specialist drilling contractors, subcontracted to Golder. Soil samples were obtained at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm outside diameter split-spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586). The split-spoon samplers used in the investigation limit the maximum particle size that can be sampled and tested to about 38 mm. Therefore, particles or objects that may exist within the soils that are larger than this dimension would not be sampled or represented in the grain size distributions. Field vane shear tests using standard 'N' size vanes (ASTM D2573) were carried out in soft cohesive soils to assess the undrained shear strengths of the cohesive soils. The results of the in-situ field tests (i.e., SPT 'N'-values and undrained shear strengths) as presented on the borehole records and in Section 5.0 of this report are uncorrected.

The CPT, an in-situ testing technique used for the nearly continuous characterization of the subsurface soils, was carried out by Conetec Investigations Ltd. (Conetec), under our supervision, from the existing ground surface to refusal, which was encountered at depths ranging from about 3.4 m to 11.9 m below the existing ground surface. The results of the CPT testing prepared by Contec are provided in Appendix B.

The shallow groundwater conditions were noted in the open boreholes during drilling and six 50 mm diameter monitoring wells were installed in Boreholes 16-1, 16-2, 18-8, 18-13, 18-15 and 18-22 and one 19 mm diameter piezometer was installed in Borehole 16-4 to allow for further monitoring of groundwater levels. The remaining boreholes were backfilled and sealed upon completion of drilling in accordance with current environmental regulations.

The field work for this investigation was directed by a member of our engineering staff, who also logged the boreholes and took custody for the recovered soil samples. All soil samples obtained during this investigation were brought to our Whitby laboratory for further examination, natural water content testing and selective soil classification testing. Select soil samples were submitted to AGAT Laboratories Ltd. (AGAT) in Mississauga for analytical testing and corrosivity testing and the results contained in Appendix C. In addition, one-dimensional consolidation (oedometer) tests were carried out on four relatively undisturbed Shelby tube samples from the clayey deposit as tested in our Mississauga laboratory and the results are contained in Appendix D.

The as-drilled borehole locations for the preliminary geotechnical investigation were surveyed by the County and the corresponding ground elevations were provided to Golder in an email dated June 13, 2016. The as-drilled borehole locations for the 2018 geotechnical investigation were surveyed by Golder using a Trimble Geo 7X H-Star GPS capable of 0.1 m accuracy, and as such, the corresponding ground surface elevations should be considered to be approximate. The ground surface elevations are referenced to geodetic datum. The ground surface elevations at the CPT locations were advanced from approximately the same ground elevation as the nearby boreholes.

5.0 SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes, CPTs as well as the results of the in situ and laboratory testing are shown in detail on the Record of Borehole sheets following the text of this report. Golder's *"Methods of Soil Classification*", "*Abbreviations and Terms Used on Records of Boreholes and Test Pits"* and *"List of Symbols"* are attached to assist in the interpretation of the borehole records. Soil laboratory test results are shown on Figures 3 to 9 and the results of the oedometer testing are shown on Figures

D1 to D4 in Appendix D. It should be noted that the boundaries between the soil strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summarized account of the subsurface conditions encountered in the boreholes drilled during this investigation, followed by more detailed descriptions of the major soil strata and shallow groundwater conditions.

The fill materials containing organic materials generally extended to depths ranging from about 0.6 m to 2.9 m below existing ground surface in all boreholes. A localized "probable fill" layer was encountered in Borehole 18-5 which extended to a depth of about 4.0 m below existing ground surface. Underlying topsoil and fill materials, the native subsoil conditions within majority of the north portion of the site generally consist of deposits of cohesive very stiff to soft silty clay and till-like clayey sand to silty sand. The silty clay and till-like deposit are variable and generally become thicker and deeper towards the north, extending to depths of up to about 11.7 m (Borehole 18-3) below the existing ground surface. Glacial till ranging in gradation from sandy silty clay till to silty sand till was encountered below the silty clay and till-like deposit in the majority of the boreholes. The subsurface soil conditions underlying the fill within the southern portion of the site consist of shallow deposits of silty clay overlying extensive deposits of dense to very dense silty sand till. The groundwater level ranges from just below ground surface to about 3 m below ground surface. The results of the CPT testing, as contained in Appendix B, are generally consistent with the results of the boreholes.

5.1 Topsoil Fill

Surficial topsoil fill was encountered at all twenty-seven borehole locations with thicknesses ranging from approximately 50 mm to 700 mm. The approximate thickness of the topsoil fill encountered at each borehole location are provided in the table below.

Borehole No.	Topsoil Fill Thickness (mm)	Borehole No.	Topsoil Fill Thickness (mm)
16-1	130	18-9	180
16-2	690	18-10	690
16-3	610	18-11	410
16-4	450	18-12	130
16-5	610	18-13	690
16-6	610	18-14	250
18-1	250	18-15	150
18-2	50	18-16	200
18-3	150	18-17	690
18-4	150	18-19	690

Borehole No.	Topsoil Fill Thickness (mm)	Borehole No.	Topsoil Fill Thickness (mm)
18-5	130	18-20	690
18-6	200	18-21	690
18-7	690	18-22	690
18-8	200	-	

5.2 Fill Materials

Inorganic dark brown to brown and grey fill materials consisting silty clay and clayey silt, sand and silty sand, containing organic materials and rootlets, were encountered below the topsoil fill in all boreholes except 16-6, 18-17 and 18-19 and 18-20. Buried pockets of topsoil/organics was encountered within the fill in Borehole 18-2, 18-4, 18-6, 18-8, 18-10 and 18-11, between depths of 1.6 m and 2.0 m below existing ground surface. The existing fill extended to depths ranging from 0.6 m to 2.9 m below existing ground surface. Probable fill was encountered in Borehole 18-5 and extended from a depth of 2.1 m to a depth of 4.0 m below the existing ground surface. It should be noted that this probable fill encountered in Borehole 18-5 may be native and should be confirmed within the excavations during construction. Standard penetration tests carried out within the cohesive fill measured 'N'-values ranging from 2 blows to 36 blows per 0.3 m penetration, indicating a soft to hard consistency. Standard penetration tests carried out within the non-cohesive fill measured 'N'-values ranging from 6 blows to 22 blows per 0.3 m penetration, indicating a loose to compact compactness. The in-situ water contents of the cohesive fill samples ranged from about 7 percent to 27 percent, whereas the in-situ water contents of the non-cohesive fill samples ranged from about 8 percent to 18 percent.

5.3 Sandy Silt

Localized non-cohesive deposits of brown sandy silt were encountered below the fill materials in Boreholes 16-1, 16-2, 16-3 and 18-16 at the north portion of the site and extended to depths ranging from 1.4 m to 2.9 m below existing ground surface. Standard penetration tests carried out within the sandy silt measured 'N'-values ranging from 9 blows to 19 blows per 0.3 m of penetration, indicating a loose to compact state of compactness. The natural water contents of the sandy silt samples ranged from about 14 percent to 22 percent. A single grain size distribution curve for a sample of the sandy silt, from the 2016 investigation, is shown on Figure 3.

5.4 Silty Clay

Cohesive deposits of brown to grey silty clay were encountered in all boreholes, with exception to Boreholes 16-5, 18-13, 18-20, 18-20 and 18-22. The silty clay was generally encountered below the existing fill materials and extended to depths widely ranging from 1.4 m to 10.1 m below ground surface. Boreholes 16-1, 16-2, 18-14, 18-15 and 18-17 were terminated within the silty clay. Standard penetration tests carried out within the silty clay deposit measured 'N'-values ranging from 2 blows to 28 blows per 0.3 m of penetration. In-situ shear vane testing carried out within the silty clay deposit measured undrained shear strengths ranging from 24 kPa to 68 kPa with 5 tests recording greater than 96 kPa. The SPT 'N'-values together with the undrained shear strengths indicate the silty clay has a soft to very stiff consistency.

The natural water contents of the silty clay samples ranged from about 13 percent to 28 percent. Seven grain size distribution curves for samples of silty clay, five from the 2018 and 2019 investigations and two from the 2016

investigation, are shown on Figures 4 and 5. Atterberg limits testing was performed on seven selected samples of the silty clay, five from the 2018 and 2019 investigations and two from the 2016 investigation, and the results are shown on Figure 6. The results indicated plastic limits ranging from about 14 percent to 17 percent, liquid limits of ranging from about 25 percent to 35 percent and plasticity indices ranging from about 9 percent to 17 percent, resulting in classification as a silty clay of low to intermediate plasticity.

The result of oedometer testing for two samples of the silty clay from Boreholes 18-6 and 18-7 are shown on Figures D3 and D4 in Appendix D.

5.5 Till-Like Clayey Sand to Silty Sand

Cohesive till-like deposits of a grey clayey sand to silty sand were encountered in Boreholes 16-3, 18-1, 18-3, 18-5, 18-6, 18-7, and 18-16. The till-like materials have a similar gradation to a glacial till but are generally of much softer consistency than tills. The till-like material was generally encountered below the silty clay and extended to depths ranging from 5.0 m to 11.7 m below the existing ground surface. Boreholes 16-3, 18-1, 18-6 and 18-16 were terminated within the till-like deposit. Standard penetration tests carried out within the till-like deposit measured ‘N’-values ranging from 4 blows to 19 blows per 0.3 m of penetration. A single in-situ shear vane testing carried out within the till-like deposit measured a shear strength of about 43 kPa. The SPT ‘N’-values together with the undrained shear strengths indicate that the deposit has a firm to very stiff consistency. The natural water contents of the till-like samples ranged from about 8 percent to 18 percent. Two grain size distribution curves for samples of till-like clayey sand to silty sand are shown on Figure 7. A plasticity chart showing the results of Atterberg limits testing performed on two selected samples of the till-like clayey sand to silty sand are shown on Figure 8. The results indicated plastic limits of about 9 percent, liquid limits ranging from about 12 percent to 13 percent and plasticity indices ranging from about 3 percent to 4 percent, indicating that the fines have slight plasticity.

The result of oedometer testing for two samples of the till-like clayey sand to silty sand from Boreholes 18-1 and 18-3 are shown on Figures D1 and D2 in Appendix D.

5.6 Sandy Silty Clay Till

Cohesive deposits of a brown sandy silty clay till were encountered generally below the silty clay in Boreholes 16-4, 18-9 and 18-10 and extended to depths ranging from 5.5 m to 7.1 m below ground surface. Borehole 16-4 was terminated within the silty clay till at a depth of 6.6 m below existing ground surface. Standard penetration tests carried out within the silty clay till measured ‘N’-values ranging from 18 blows to 31 blows per 0.3 m of penetration, indicating a very stiff to hard consistency. The natural water contents of the silty clay till samples ranged from about 8 percent to 15 percent.

5.7 Silty Sand Till

Non-cohesive strata of brown to grey (gravelly) silty sand till were encountered in all boreholes, with exception to Boreholes 16-1 through 16-4, 18-1, 18-6 and 18-14 through 18-17. The silty sand till was generally encountered below the existing fill materials in the southern portions of the site or below the silty clay in the northern portions of the site. Boreholes 16-3, 16-4, 18-2 though 18-5, 18-8 through 18-13 and 18-19 through 18-22 were terminated within the silty sand till. Standard penetration tests carried out within the silty sand till measures ‘N’-values ranging from 18 blows per 0.3 m of penetration to greater than 50 blows per 0.05 m of penetration, indicating a compact to very dense state of compactness.

The natural water contents of the silty sand till samples generally ranged from about 4 percent to 10 percent, however two samples had natural water contents of 15 per cent and 22 percent. Four grain size distribution curves for samples of silty sand till, three from the 2018 investigation and one from the 2016 investigation, are shown on Figure 9. Atterberg limits testing performed on three samples of the silty sand till returned a non-plastic result.

5.8 Shallow Groundwater

Details of the observed groundwater conditions encountered during and upon completion of drilling are provided on the Record of Borehole sheets. Subsequent groundwater levels measured within the monitoring wells and piezometer were taken on May 27, May 31 and June 3, 2016 and January 4, 2019. The results of the subsequent groundwater levels readings are provided in the table below.

Borehole No.	Ground Surface Elevation (m)	Water Level on May 27, 2016		Water Level on May 31, 2016		Water Level on June 3, 2016		Water Level on Jan 4, 2019	
		Below Ground Surface (m)	Elevation Above Sea Level	Below Ground Surface (m)	Elevation Above Sea Level	Below Ground Surface (m)	Elevation Above Sea Level	Below Ground Surface (m)	Elevation Above Sea Level
16-1	104.4	4.7	99.7	4.9	99.5	4.8	99.6	0.3	104.1
16-2	106.0	1.8	104.2	1.8	104.2	1.8	104.2	0.8	105.2
16-4	106.9	1.5	105.4	-	-	2.5	104.4	1.3	105.6
18-8	106.5	-	-	-	-	-	-	2.6	103.9
18-13	108.3	-	-	-	-	-	-	1.4	106.9
18-15	105.0	-	-	-	-	-	-	2.8	102.2
18-22	107.7	-	-	-	-	-	-	1.9	105.8

It should be noted that these observations reflect the shallow groundwater conditions encountered at the borehole locations during the time of the field investigation and some seasonal fluctuations should be anticipated.

5.9 Analytical Laboratory Testing

During our investigation, there was no evidence of potential environmental impact on the recovered soil samples, including: staining, and discolouration or odours that are potentially associated with petroleum hydrocarbons or other contaminants. However, eight soil samples were collected for analytical testing from the subject site for metals and inorganics. The samples were placed into laboratory supplied sampling containers and stored on ice/refrigerated until delivered, under chain-of-custody documentation, to AGAT for testing. A summary of the completed analytical testing and sampling locations is presented in the table below.

Analytical Laboratory Test Package	Number of Tests	Sampling Location
Metals and Inorganics O. Reg. 153	8	18-1, 18-3, 18-10 18-11, 18-13, 18-20

5.9.1 Environmental Chemical Analysis

Golder submitted eight fill/native soil samples from the site to assess the general chemical quality of the soil materials and to assess the suitability of any excess soil materials for off-site reuse and/or disposal. The samples were delivered to AGAT for analysis of metals and inorganics. The analytical results were compared to the Ontario Ministry of the Environment ("MOE"[1]) *"Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act"*, April 15, 2011, Table 1 Full Depth Background Site Condition Standards for Residential / Parkland / Institutional / Industrial / Commercial / Community Property Use (Table 1 Standards). The laboratory certificates of analysis are provided in Appendix C and a summary of the soil sampling program (including exceedances) is presented in the table below.

Borehole	Sample	Soil Description	Sample Depth (mbgs)	Parameters in Exceedance
				MOE Table 1
18-1	2	Silty Clay Fill	0.8 – 1.2	None
18-3	1	Silty Clay Fill	0.0 – 0.6	None
18-10	2	Silty Clay Fill	0.8 – 1.2	None
18-10	5	Silty Clay	3.1 – 3.5	None
18-11	4	Silty Clay Fill	2.3 – 2.7	None
18-13	1	Topsoil/Topsoil Fill	0.0 – 0.6	None
18-13	3	Silty Sand Till	1.5 – 2.0	None
18-20	1	Topsoil/Topsoil Fill	0.0 – 0.6	None

In summary, the reported concentrations for all parameters of the eight soil samples were below the values listed on Table 1 Standards. Further comments on off-site disposal and reuse of the soil are provided in Section 6.8

[1] MOE was recently renamed the Ministry of the Environment, Conservation and Parks ("MECP"); however, the generic site condition standards and associated guidance documents were released by the MOE and the standards are still legally referred to as the MOE standards.

6.0 DISCUSSION

6.1 General

This section of the report provides engineering information for the geotechnical design aspects of the project, based on our interpretation of the borehole information and on our understanding of the project requirements. The information in this portion of the report is provided for the guidance of the design engineers and professionals. Where comments are made on construction, they are provided only in order to highlight aspects of construction that could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report. However, a limited environmental chemical analysis has been carried out on selected samples as discussed further below.

6.2 Project Description

It is understood that the County is at the detailed stage of the design and planning of a new long-term care facility, The Golden Plough Lodge. The project will consist of a structure (maximum 3 stories high) along with the associated above ground parking, driveway and underground servicing. It is understood that the proposed structure will be designed as a slab-on-grade type structure (i.e. without a basement) for majority of the building footprint, with exception to the northeast portion of the building where one lower level with a walk-out is proposed, as shown on Figure 2.

The finished floor elevation of the building floor slab on the main level is noted to be at Elev. 108.9 m, whereas the finished floor level for the lower level/walk-out portion is noted to be at Elev. 104.9 m. The existing ground surface across the site ranges from approximately Elev. 109 m (near the southern boundary) to Elev. 104 m (near the northern boundary). Based on the preliminary site grading plan drawing provided and the finished floor levels, the final grade within the main level of the building will generally match existing grade at the south at about Elev. 109 m, and will be raised transitioning to the north of the site, with the maximum grade raise being in the order of 3.5 m above the existing grade near the north end of the proposed building. Based on the existing grade and the finished floor level of the lower level/walk-out portion of the building, the construction of the lower level of the building will require excavations in the range of 1.5 m to 3.5 m below the existing ground surface for the construction of the floor slab and footings.

The proposed inverts for the underground servicing are currently unknown, however, it is assumed that the excavations for the servicing will require excavations in the range of 1.5 m to 4 m below the existing ground surface.

6.3 Preliminary Foundation Design for the Proposed Building

Based on the result of our geotechnical investigation, the subsurface soil conditions within the proposed building footprint consist of existing fill which extends to depths ranging from 0.6 m to 2.9 m below the existing ground surface across the building footprint. A localized “probable fill” was encountered in Borehole 18-5 which extends

to a depth of about 4 m below ground surface. The existing fill is undocumented (i.e. no source records or placement/compaction records) and is therefore unsuitable to support the building foundations or floor slabs. In addition, the existing fill is generally underlain by soft to very stiff silty clay and weak till-like deposits with variable thickness, depth and consistency. Due to the presence of the compressible soils, the proposed grade raise will result in consolidation (i.e. time dependent) settlement which will necessitate the need for pre-loading prior to the construction of the floor slab and foundations.

In this regard, the following two options, discussed further below, are currently being considered for supporting the building foundations and floor slabs:

- Option 1 - Conventional Construction on Engineered Fill. This will involve the removal of the existing fill and replacing with engineered fill to the finished grade level, and preloading until the majority of the consolidation settlement of the underlying compressible deposits is dissipated prior to construction of the foundations and floor slabs; and
- Option 2 - Construction on Existing Fill Using Ground Improvement Technologies. The use of ground improvement technologies, such as rammed aggregate piers, will allow for support of the building foundations and floor slab as well as assist with reducing consolidation settlement. However, even with piers extending to below the weaker silty clay and till-like materials, preloading will likely still be required but the duration of the consolidation settlement may be shorter than for Option 1.

6.3.1 Option 1 – Conventional Construction on Engineered Fill

6.3.1.1 Engineered Fill

Under this option, the existing topsoil and all existing fill materials must be excavated and removed from the building footprints and replaced with engineered fill. This engineered fill should also be used to raise to the finished grade and act as the preload fill.

Prior to placing any engineered fill for the proposed buildings, the topsoil and all fill within the proposed building footprints must first be stripped to expose the native soils. As minimum, the extent of the excavations must extend beyond the building footprint by the equivalent of the excavation depth plus one metre. The excavations must allow (as a minimum) for safe 1 horizontal:1 vertical (1H:1V) temporary slopes under OHSA for Type 3 soils. The excavated base should then be proofrolled in conjunction with an inspection by Golder to confirm that the exposed soils are native, undisturbed and competent, and have been adequately cleaned of ponded water and all disturbed, loosened, softened, organic and other deleterious material. Remedial work (i.e. sub-excavation and replacement) should be carried out as directed by Golder.

Given the variability of the soils within the building footprint, in order to achieve relatively uniform soil support for the foundations and the floor slab, and to prevent large differential settlements, it is recommended that the engineered fill consist of granular soils (e.g. OPSS.PROV 1010 Granular ‘B’ Type I or II). Other fill types could be considered in consultation with Golder.

Due to the clayey nature of the existing on-site soils, their reuse as engineered fill will result in lower soil bearing resistances to support the foundations, and as such, larger footing dimensions would be required. With larger footings, foundation loads will be transferred deeper and into the weak deposits at depth and will result in larger total and differential settlements. In this regard, the excavated existing fill and native soils are not considered to be suitable for use as engineered fill within the building envelope.

The approved materials for engineered fill should be placed in maximum 300 mm loose lifts and uniformly compacted to at least 100 percent of standard Proctor maximum dry density throughout. The engineered fill should be placed to the finished floor level of the building. The placement of engineered fill must be monitored by Golder personnel on a full-time basis. As the loading of the engineered fill will result in consolidation (time-dependent) settlement of the underlying weaker clayey soils, the construction of the floor slab and foundation must be delayed until the consolidation settlement has dissipated, through pre-loading, as described further below in Section 6.3.1.2

Permanent engineered fill slopes, if any, and the preload should be 2H:1V or flatter and should be covered with topsoil and sodded or otherwise treated to reduce surface erosion. Maintenance will be required over the first several years until the vegetative mat has taken root.

The final surface of the engineered fill should be protected as necessary from construction traffic and should be sloped to provide positive drainage for surface water during and following the construction period. Water must not be allowed to pond on the engineered fill. During periods of freezing weather, additional soil cover should be placed above final subgrade to provide for frost protection. Prior to placing any additional engineered fill, the surface of the existing engineered fill must be re-inspected by Golder.

6.3.1.2 Consolidation Settlement

Deposits of compressible silty clay and till-like materials with variable thicknesses and consistency were encountered within the proposed building footprint, with the thickest deposits being in the northern portion of the building where the largest grade raise is proposed. Four oedometer tests were carried out on samples of the compressible silty clay and till-like deposits extracted from the following boreholes. The results, which are shown on Figures D1 to D4 included in Appendix D, were used to assess the deformation parameters for the calculation of consolidation settlement of the underlying compressible deposits under the anticipated loads of the grade raise.

Borehole	Soil Description	Approximate Sample Depth Below Ground Surface (m)	Approximate Sample Elevation (m)
18-1	Till-Like Clayey Sand to Silty Sand	7.0 – 7.5	98.3 – 97.8
18-3	Till-Like Clayey Sand to Silty Sand	10.4 – 10.9	95.2 – 94.7
18-6	Silty Clay	5.5 – 5.9	100.5 – 100.1
18-7	Silty Clay	7.5 – 7.9	99.0 – 98.6

Based on the parameters obtained from empirical correlations with laboratory index testing, CPT results, and oedometer testing, placement of up to 3.5 m of engineered fill above the existing grade will result in consolidation settlement (i.e. time dependent settlement) of the underlying silty clay and till-like strata.

Utilizing the parameters, grade raises of up to 3.5 m above the current ground levels will result in estimated total settlement of up to on the order of 50 mm (i.e. consolidation settlement of up to 20 mm, and immediate settlement of up to 30 mm). As the thickness of the compressible deposits is variable across the site, the actual amounts of settlement under the proposed grade raise will also vary, which will result in in differential settlement along the

length of the building and across the building footprint if mitigation measures (i.e. such as preloading and/or ground improvement) are not carried out.

Further, based on the results of our analysis, the calculated time for 90 percent of the consolidation settlement to take place is estimated to range between 4 months and 6 months. However, based on our local experience, the calculated values frequently overestimate the actual time for 90 percent consolidation and the actual time required to reach 90 percent consolidation may be shorter (i.e. in the order of about 3 months). In this regard, we strongly recommend that sufficient number of settlement plates be installed at the site during construction for monitoring of the settlement progress and to confirm sufficient degree of consolidation has occurred prior to construction of the foundations and floor slabs. The time for consolidation should be taken into account in scheduling of construction for the proposed development. It is recommended that the construction of the foundations and floor slab under Option 1 be delayed until at least 90 percent of the consolidation settlement has taken place.

6.3.1.3 Building Foundations on Engineered Fill

Once the engineered fill is placed and the consolidation settlement of the underlying clayey soils has essentially dissipated, the proposed building may then be founded on conventional shallow spread and/or continuous strip footings bearing in the engineered fill at a minimum depth of 1.4 m below the finished grade. Based on the preliminary foundation layout drawing entitled "*Golden Plough Lodge Redevelopment, Foundation Plan*" Drawing No. S1-01 prepared by Stephenson Engineering, the strip footings no greater than 1.5 m in width and square column footings of no greater than 3.0 m in width founded within the engineered fill or upper native soils (at or above Elev. 103.5 m) may be designed using a geotechnical reaction at Serviceability Limit States (SLS) of 150 kPa for up to 25 mm of settlement and a factored resistance at Ultimate Limit States (ULS) of 225 kPa. As the footing dimensions, depths and the soil conditions will vary across the building footprint, differential settlements of up to 20 mm should also be expected. The above bearing pressures assume a minimum strip footing width of 0.45 m and a minimum column spread footing dimension of 1.0 m. These recommendations should be reviewed by Golder once the final foundation layout is complete.

Higher bearing resistances are available for footings constructed within the dense to very dense glacial tills at the site generally within the southern portion of building.

Depending on the width of the footings, and the finalized layout of the foundations, there could be overlap/interaction of the stress bulbs of the different foundations which could result in the foundation loads being transferred deeper and into the weak deposits at depth and resulting in larger total and differential settlements. This would require further iterative analysis between Golder and the structural engineer once the detailed foundation layout is developed to confirm whether the stresses overlap.

The above bearing pressures assume a minimum strip footing width of 450 mm and a minimum column spread footing dimension of 1000 mm.

If stepped spread footings are constructed at different founding levels, the difference in elevation between individual footings should not be greater than one half the clear distance between the footings. In addition, the lower footings should be constructed first so that if it is necessary to construct the lower footings at a greater depth than anticipated, the elevations of the upper footings can be adjusted accordingly. Stepped strip footings, if required, should be constructed in accordance with the Ontario Building Code (OBC), Section 9.15.3.9.

In general, for any strip footings placed wholly or in part on engineered fill, it is recommended that the foundations be provided with nominal reinforcement, consisting of reinforcing steel at the top and bottom of the foundation walls.

However, the need for and design of any reinforcement can be determined during the design stage by the structural engineer, in consultation with Golder.

The founding materials are susceptible to disturbance by construction activity especially during wet weather and care should be taken to preserve the integrity of the materials as bearing strata. Prior to pouring concrete for the footings, the foundation excavations **must** be inspected by Golder to confirm that the footings are located in competent and undisturbed engineered fill or competent native deposits which has been cleaned of ponded water and loosened or softened material. If the concrete for the footings on the engineered fill or native soils cannot be placed immediately after excavation and inspection, it is highly recommended that a working mat of lean concrete be placed in the excavation immediately to protect the integrity of the bearing stratum. As such, additional sub excavation should be carried out to allow for the placement of the working mat. The bearing soil and fresh concrete must be protected from freezing during cold weather construction. All exterior footings and footings in unheated areas should be provided with at least 1.4 m of cover after final grading, in order to minimize the potential for damage due to frost action.

The perimeter basement walls of the lower level should be backfilled with a free draining, non-frost susceptible granular material (e.g. Granular B, Type I) carefully placed and compacted in lifts. The walls should be designed using a lateral earth pressure coefficient at rest, K_o, of 0.5 and a unit weight of backfill of 21 kN/m^3. Alternatively, where site excavated material is to be reused for exterior basement wall of the lower level (i.e. where the floor slab level will be below the surrounding exterior grade) backfill, an approved geocomposite drainage system should be used directly against the wall. The upper 0.3 m of backfill should be clayey material to provide a relatively impermeable cap and should be sloped away from the house. Properly filtered perimeter drains at foundation level leading to a permanent outlet, such as a continuously pumped sump or a direct outlet to a sewer line, should be provided.

6.3.1.4 Floor Slabs on Engineered Fill

Under this option, the exposed soil subgrade will likely consist of engineered fill for the main level slab and the lower level slab. The exposed subgrade (i.e. engineered fill) should be proofrolled with a heavy roller, in conjunction with an inspection by qualified geotechnical personnel. Remedial work (e.g. sub-excavation and replacement) should be carried out on disturbed, softened, organic or deleterious zones as directed by geotechnical personnel.

The areas should then be brought to within 300 mm of the underside of the floor slab, as required, using OPSS.PROV 1010 Granular B, Type I or II material, placed in maximum 300 mm loose lifts and uniformly compacted to 100 percent of standard Proctor maximum dry density. The final lift directly beneath the floor slab should consist of a minimum of 200 mm of OPSS Granular A material, uniformly compacted to at least 100 percent of standard Proctor maximum dry density. This should provide a modulus of subgrade reaction, for a 1 foot square plate, k_1, of approximately 25 MPa/m.

Special care should be taken to ensure compaction around columns and adjacent to foundations walls. The floor slab should be structurally separate from the foundation walls and columns. Sawcut control joints should be provided at regular intervals and along column lines to minimize shrinkage cracking and to allow for differential settlement of the floor slab.

Where the floor slab is at or above the exterior final grade, perimeter drainage at the footing level is not required. However, for the lower level floor slab which will be below the surrounding grade, perimeter and underslab

drainage should be provided. The type of foundation drainage should be confirmed by Golder once the finalized site grading plans are available, as part of the final design process.

6.3.2 Option 2 – Construction on Existing Fill Using Ground Improvement

Given the presence of the existing undocumented fill at the site in combination with compressible silty clay and till-like deposits which extend to depths of up to 11.7 m below ground surface, as an alternative to supporting the building foundation and floor slabs on engineered fill, and to manage the risk of differential settlement, consideration could be given to supporting the building foundations and floor slab on the existing fill and/or silty clay deposit through ground improvement technologies (e.g. rammed aggregate piers). This would permit the use of conventional footings and slab-on-grade, without the need for replacing the fill, although engineered fill will still be required to raise to the final grade in some areas. The actual bearing support using ground improvement methods are typically provided by the supplier. It is likely that the piers would have to extend through the fill and the clayey and till-like soils and be founded within the native dense to very dense glacial tills at depth. Given the grade raise anticipated at the site within the proposed building footprint, consolidation settlement of the underlying soils is till expected and preloading still required. However, the duration of the preloading will likely be shorter with the installation of the aggregate piers.

6.4 Foundation Excavations

It is anticipated that shallow foundation excavations at the site will consist of temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical (1H:1V). However, depending on the construction procedures adopted by the contractor and weather conditions at the time of construction, some local flattening of the slopes may be required, especially within relatively soft zones of the existing fill materials. For the anticipated excavations of 1.5 m to 3.5 m below the existing ground surface for the foundations and floor slab and for placement of engineered fill, the excavations are anticipated to be generally carried through the silty clay fill and likely reach the upper native glacial till or silty clay deposit. Based on the groundwater conditions encountered in the boreholes during drilling, groundwater seepage into the shallow foundation excavations excavated through the clayey soils is expected to be minimal and can be handled, if required, by pumping from sumps located within the excavations but outside of the footing areas.

Care should be taken to direct surface water away from the open excavations and all excavations should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. Under the Act, the existing fill and the native silty clay within the upper 3.5 m from existing ground surface may be classified as Type 3 soils. In addition, care must be taken during excavation to ensure that adequate support is provided for any existing structures and underground services located adjacent to the excavations.

6.5 Seismic Consideration

The Ontario Building Code (OBC) contains updated seismic analysis and design methodology. Seismic hazard is defined for an earthquake with a 2 percent probability of exceedance in 50 years (i.e. a return period of 2,400 years) which encompasses a larger earthquake hazard than in prior editions of the OBC. Design earthquakes are commonly defined by an earthquake magnitude, distance, and peak ground acceleration (PGA). The OBC uses the uniform hazard spectra (UHS) to define the response of the structure to the design earthquake and also considers the effects of the localized site conditions on the structural response. The OBC also uses a refined site classification system defined by the average soil/bedrock properties in the top 30 metres of the subsurface profile beneath the structure(s). There are 6 site classes designated as A to F related to decreasing ground stiffness from A for hard rock to E for soft soil and site class F for problematic soils (e.g. sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain acceleration and velocity-based

site coefficients, Fa and Fv, respectively, used to modify the reference UHS to account for the effects of site-specific soil conditions in design.

Based on the results of the investigation at this site and the proposed development plans, the proposed structure at this site is anticipated to be underlain by engineered fill, very stiff to soft silty clay underlain by dense to very dense glacial tills. Based on these conditions and using the OBC methodology, the foundations at this site may be designed using a conservative Site Class D designation.

It is possible that the site class could be improved by in situ geophysical testing. Should optimization of the site class be recommended by the structural engineer, in situ geophysical testing can be carried out at the site by Golder.

6.6 Site Servicing

6.6.1 Excavations and Groundwater Control

The proposed servicing depths and invert elevations are currently unavailable; however, it is assumed that the excavations for the proposed sewer and watermain will require excavations in the range of 1.5 m to 4.0 m below the existing ground surface.

Based on the results of this investigation, the founding soils for the pipes will be variable ranging from existing fill to native stiff silty clay or dense to very dense silty sand till. The native subsoils (i.e. underlying the shallow fill materials) are generally considered to be suitable for supporting the pipes, provided the integrity of the base can be maintained during construction. The suitability of the existing fill materials to support the pipes, where encountered at the base of the trench, should be further assessed by Golder during construction. This will require inspection during construction by qualified geotechnical personnel, to determine the suitability of any existing fills for supporting the pipes. Some difficulty may be encountered in excavating the very dense tills (near the southern portion of the site). In addition, cobbles and boulders should be anticipated to be encountered in the tills, as typical of the tills in this area.

Based on the groundwater conditions encountered in the boreholes and considering the trench excavation depths (i.e. up to about 4 m), the pipe inverts will generally be near or below the local water table. Groundwater control during excavation within the predominant glacial till and silty clay can be handled, if required, by pumping from properly constructed and filtered sumps located within the excavations. However, more significant groundwater seepage may be expected locally near or at the interface of the existing fill and native deposits, as well as the sandy silt deposit encountered in the northern portion of the site.

It should be noted that water takings in excess of 50,000 L/day are regulated by the Ministry of the Environment, Conservation and Parks (MECP). Certain takings of groundwater and stormwater for construction dewatering purposes with a combined total less than 400,000 L/day qualify for self-registration on the MECP's Environmental Activity and Sector Registry (EASR). Registry on the EASR replaces the need to obtain a PTTW for water taking and a Section 53 approval for discharge of water to the environment. A "Water Taking Plan" and a "Discharge Plan" are required by the MECP if water is taken in accordance with an EASR. In all cases, discharge under the EASR must be in accordance with a Discharge Plan (to be developed by a qualified professional). The contractor will be responsible for obtaining any required discharge approvals. A Category 3 PTTW would be required for water takings in excess of 400,000 L/day. It should be noted that a hydrogeological assessment was not within this scope of work, as such, the assessment for groundwater discharge during construction was not carried out.

It is anticipated that the trench excavations will consist of conventional temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical. However, depending upon the construction procedures adopted by the contractor, actual groundwater seepage conditions, the success of the contractor's groundwater control methods (if required) and weather conditions at the time of construction, some flattening and/or blanketing of the slopes may be required, especially where localized seepage is encountered. Care should be taken to direct surface runoff away from the open excavations and all excavations should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. According to OHSA, the soils at the site within the proposed excavation depths would be classified as Type 2 soils.

Where side slopes of excavations are required to be steepened to limit the extent of the excavation, some form of trench support system may be required. It must be emphasized that a trench liner box provides protection for construction personnel but does not provide any lateral support for the adjacent excavation walls, underground services or existing structures. It is imperative that any underground services or existing structures adjacent to the excavations be accurately located prior to construction and adequate support provided where required. In addition, steepened excavations should be left open for as short a duration as possible and completely backfilled at the end of each working day. Care should be taken to direct surface runoff away from the open excavations and all excavations should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.

It is imperative that underground services and existing structures adjacent to the trench excavations be accurately located prior to construction and adequate support such as an engineered shored system be provided where required.

6.6.2 Pipe Bedding and Cover

The bedding for the underground services should be compatible with the type and class of pipe, the surrounding subsoil and anticipated loading conditions and should be designed in accordance with Municipal and Regional standards. Where granular bedding is deemed acceptable, it should consist of at least 150 mm of OPSS Granular A or 19 mm crusher run limestone material. Depending upon the success of the contractor's groundwater control method and actual sewer invert depths, a thicker bedding layer, (in the order of additional up to 300 mm), may be required where pipes are to be founded in the wet/soft subgrade soils, to facilitate the pipe installations. From the springline to 300 mm above the obvert of the pipe, sand cover may be used. All bedding and cover materials should be placed in maximum 150 mm loose lifts and should be uniformly compacted to at least 100 percent of standard Proctor maximum dry density (SPMDD). If additional bedding thickness is added to improve the basal stability, the bedding should be placed in a single lift and uniformly compacted to 100 percent of SPMDD.

Clear stone bedding material should not be used in any case for pipe bedding or to stabilize the excavation base.

6.6.3 Trench Backfill

The excavated materials from the site will generally consist of clayey (cohesive) to sandy/silty (non-cohesive) subsoils. The glacial till soils and some of the silty clay native soils within the upper 4 m from the existing grade are generally near their estimated optimum water contents for compaction and may be reused for trench backfill. However, some of the existing fill and the native silty clay are generally wet of their estimated optimum water content for compaction and may require some drying prior to placement. The excavated subsoils at suitable water contents may be reused as trench backfill provided, they are free of significant amounts of topsoil, organics

or other deleterious material and are placed in minimum 300 mm loose lifts and compacted to 95 percent of SPMDD. All topsoil and organic materials should be wasted or used for landscaping purposes.

Alternatively, if placement water contents at the time of construction are too high, or if there is a shortage of suitable in-situ material, then an approved imported sandy material which meets the requirements for OPSS Select Subgrade Material (SSM) could be used. It should be placed in loose lift thicknesses as indicated above. Backfilling operations during cold weather should avoid inclusions of frozen lumps of material, snow and ice.

Normal post-construction settlement of the compacted trench backfill should be anticipated, with the majority of such settlement taking place within about 6 months following the completion of trench backfilling operations. This settlement will be reflected at the ground surface and may be compensated for, where necessary, by placing additional granular material prior to asphalt paving. Alternatively, if the asphalt binder course is placed shortly following the completion of trench backfilling operations in roadway areas, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of binder asphalt or by padding. If scheduling permits, the surface course asphalt should not be placed over the binder course asphalt for at least 12 months.

6.7 Pavement Design

It is understood that pavement on grade for the access routes and loading/unloading areas (heavy duty) as well as ground parking lot (light duty) are proposed as part of the proposed development.

The traffic data is currently unavailable; however, based on the Town of Cobourg minimum design standards and the results of our investigation, the following preliminary pavement design is recommended:

Material		Thickness of Pavement Elements (mm)	
		Heavy Duty and Access Routes	Light Duty Parking Lots
Asphaltic Material (OPSS 1150)	HL3	40	40
	HL8	100 mm (Placed in two 50 mm lifts)	50
Granular Material (OPSS 1010)	Granular ‘A’ Base or 19 mm Crusher Run Limestone	200	150
	Granular ‘B’ Subbase	450	300
		Prepared and Approved Subgrade	

In preparation for paved areas, any remaining topsoil and deleterious materials should be stripped to expose the native, undisturbed subsoils or existing fills. Prior to placing any granular material, the exposed soil subgrade should be heavily proof-rolled in conjunction with an inspection by Golder technical staff. The suitability of the existing fill at the subgrade level, where encountered, should be assessed during construction as directed by

Golder. It should be noted that Borehole 18-18 which was proposed to be drilled along the access road near the centre of the site was eliminated from our drilling program due to presence of undetectable underground utilities. As such, careful inspection of the subgrade soils would be required, by Golder, during construction to assess the suitability of the subgrade soils in this area. Remedial work (i.e. further sub-excavation and replacement) should be carried out on any disturbed, softened or poorly performing areas, as directed by Golder.

The granular subbase and base materials should be uniformly compacted to 100 percent of their standard Proctor maximum dry densities. The asphalt materials should be compacted to between 92 and 96.5 percent of their Marshall Maximum Relative Densities, as measured in the field using a nuclear density gauge.

It should be noted that adequate surface and subsurface drainage is critical to the longevity of the pavements. The drainage system could consist of a system of catch basins connected to sub-drains draining to a permanent storm water outlet. In this regard, the asphalt surface should be graded to drain towards the catch basins and the subgrade should be carefully proof-rolled to a smooth surface and sloped towards the catch-basins to prevent ponding or entrapment of water in the subbase which would lead to weakened sections and general poor performance. Short (5 to 6 m long) perforated stubdrains should be provided at internal catch basin locations on all four sides of the catch basins.

Consideration should also be given to providing continuous subdrains along the sides of access routes and perimeter edges of the parking areas to promote drainage of the granular materials, provided that the curbs direct overland flow.

Positive drainage should be provided to the subgrade. Stub drains and subdrains should be a minimum of 300 mm below the bottom of the granular subbase and connected to the catch basins. The drains should consist of 100 mm or 150 mm diameter geotextile wrapped perforated pipe, surrounded on all sides by at least 150 mm of clean free draining material such as concrete sand. The pipes should be placed such that the top of the sand filter is at subgrade level in contact with the sub-base material.

It should be noted that in some cases, even though the compaction requirements have been met, the subgrade strength may not be adequate to support heavy construction loading especially during wet weather or where backfill materials wet of optimum have been placed. In this regard, the design Granular B subbase thickness may not be sufficient for a construction haul road and additional Granular B (in the order of 300 mm) may be required. In any event, the subgrade should be proofrolled and inspected by the geotechnical engineer prior to placing the Granular B subbase and additional granular placed, as required, consistent with the prevailing weather conditions and anticipated use by construction traffic.

Where new pavement abuts existing pavement (i.e. at the entrance and drive-through), transvers step joints should be provided at the tie-ins by 40 mm in depth and 2 m in width. The existing asphalt edges should be provided with a proper saw cut edge prior to keying in the new asphalt. Any undermining or broken edges resulting from the construction activities should be removed by the saw cut.

6.8 Excess Soil Disposal

A total of eight soil samples were submitted to AGAT for analytical testing, none of which had exceedances of the MOE Table 1 Standards, as summarized in Section 5.9.1. Based on the analytical results, the soil appears to be environmentally suitable for reuse on site.

Any excess material generated during construction activities that is of similar environmental quality to the tested samples noted in Section 5.9.1, may be reused as backfill provided:

- There is no evidence of potential environmental impact, including: staining, and discolouration or odours that are potentially associated with petroleum hydrocarbons or other contaminants;
- It is free of other wastes, which are prohibited in any amount, including: putrescible material (e.g., organic materials, wood), concrete, cement fines, rebar, plastic, scrap metal, asphalt, shingles, rubbish, glass, and garbage; and
- It is geotechnically suitable and approved for use as a backfill material by a geotechnical engineer.

Alternatively, any excess material may be removed off-site to a receiving site, such as a property appropriately permitted in accordance with the applicable bylaw of the local municipality or a waste management facility permitted in accordance with Part V of the Environmental Protection Act. It is advisable to review a potential receiving site's acceptable fill protocol to determine what documentation must be submitted to facilitate acceptance by the receiving site.

Furthermore, consideration could be given to re-testing the soil once excavated and stockpiled to better characterize it before its re-use. Prior to the removal of the excavated material from the property, available analytical data pertaining to this material should be forwarded to the potential receiver for review. Written authorization, indicating that this data was received and reviewed, and that the receiver accepts the excavated materials, should be provided to the site representative by the potential receiver. Additionally, movement of soil to a site that has a Record of Site Condition on file with the MOE may require that specific testing protocols are followed and that the materials must satisfy the applicable standards. If excess soil fill and/or native materials vary from the samples tested by Golder, additional testing is recommended to determine suitability for disposal.

6.9 Corrosivity Test Results

Two soil samples were collected and submitted to AGAT for analysis of parameters used to assess corrosion potential to steel and degradation to concrete, including analysis of pH value, resistivity, sulphate content, and chloride content. The results of analytical testing on soil samples from the site are provided in Appendix B. A summary of the results of the corrosivity testing is presented in the following table:

Borehole	Sample	Sample Depth (mbgs)	Parameter Concentrations				
			Chloride (µg/g)	Sulphate (µg/g)	Conductivity (µmho/cm)	Resistivity (ohm-cm)	pH
18-3	4	2.3 – 2.7	880	14	3,400	300	7.82
18-13	3	1.5 – 2.0	3,000	170	10,000	100	7.39

The corrosivity results were compared to the American Water Works Association (AWWA) C-105 (2005) Standard, "Polyethylene Encasement for Ductile-Iron Pipe Systems". Based on the results, the corrosivity potential is considered to be low at the locations of Boreholes 18-3 and 18-13 and buried steel elements installed at the site will therefore not require specialized protection from corrosion.

The analytical results at the locations tested indicate that the potential for sulphate attack is negligible, and that concrete made with Type GU Portland cement should be acceptable for below grade concrete elements.

These recommendations are provided as guidance only; the civil engineer should take the results of the laboratory testing, the potential for corrosion and the ultimate selection of materials into consideration.

7.0 MONITORING AND TESTING

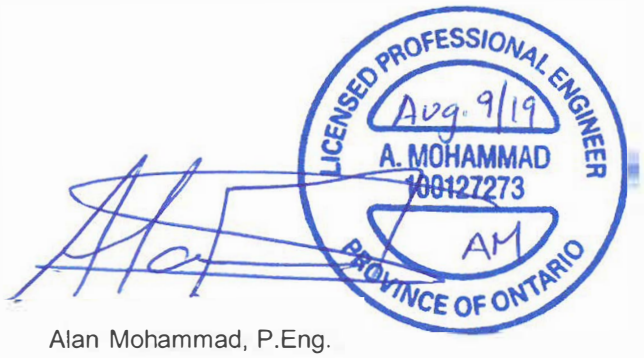
The geotechnical aspects of the final design drawings and specifications should be reviewed by this office prior to tendering and construction, to confirm that the intent of this report has been met. During construction, full-time engineered fill monitoring, consolidation settlement monitoring, sufficient foundation inspections, subgrade inspections and in-situ materials testing should be carried out to confirm that the conditions exposed are consistent with those encountered in the boreholes and to monitor conformance to the pertinent project specifications.

8.0 CLOSURE

We trust that this report provides sufficient information to facilitate the design of this project. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact the undersigned

Signature Page

Golder Associates Ltd.



Alan Mohammad, P.Eng.
Geotechnical Engineer

Sarah Poot, P.Eng., Associate
Senior Geotechnical Engineer

MJB/AM/AJH/rl;ljv

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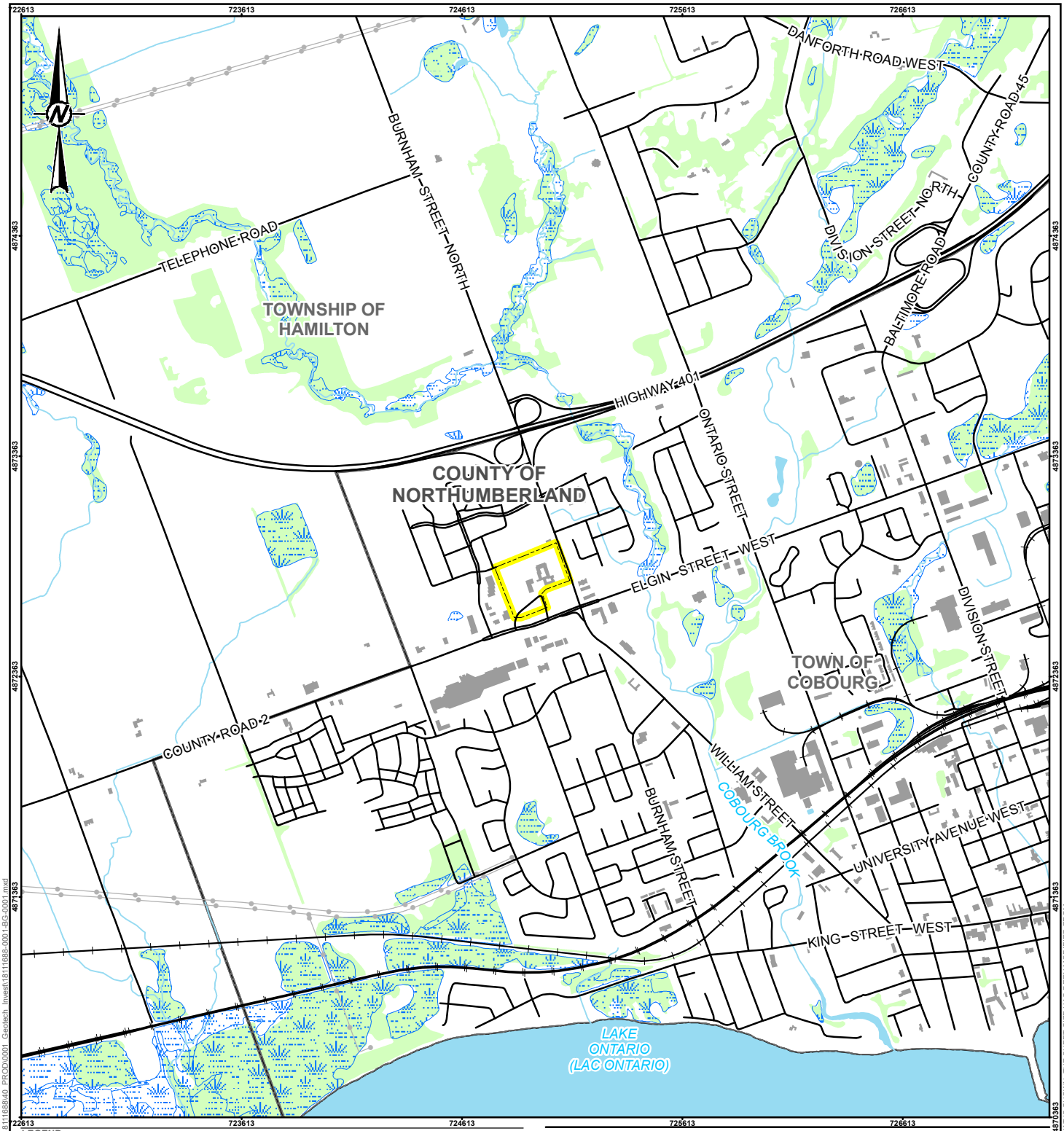

LEGEND

- RAILWAY
- ROAD
- UTILITY LINE
- WATERCOURSE
- APPROXIMATE PROJECT BOUNDARY
- BUILDING
- MUNICIPAL BOUNDARY
- WATERBODY
- WETLAND
- WOODED AREA

0 500 1,000

1:25,000 METRES

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2016
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2019
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
COUNTY OF NORTHUMBERLAND

PROJECT
GEOTECHNICAL INVESTIGATION
GOLDEN PLOUGH LODGE – LONG TERM CARE FACILITY
555 COURTHOUSE ROAD, COBOURG, ONTARIO

TITLE
KEY PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-07
DESIGNED	JT
PREPARED	JT
REVIEWED	AM
APPROVED	SEMP

PROJECT NO.	CONTROL	REV.	FIGURE
18111688	0001		1

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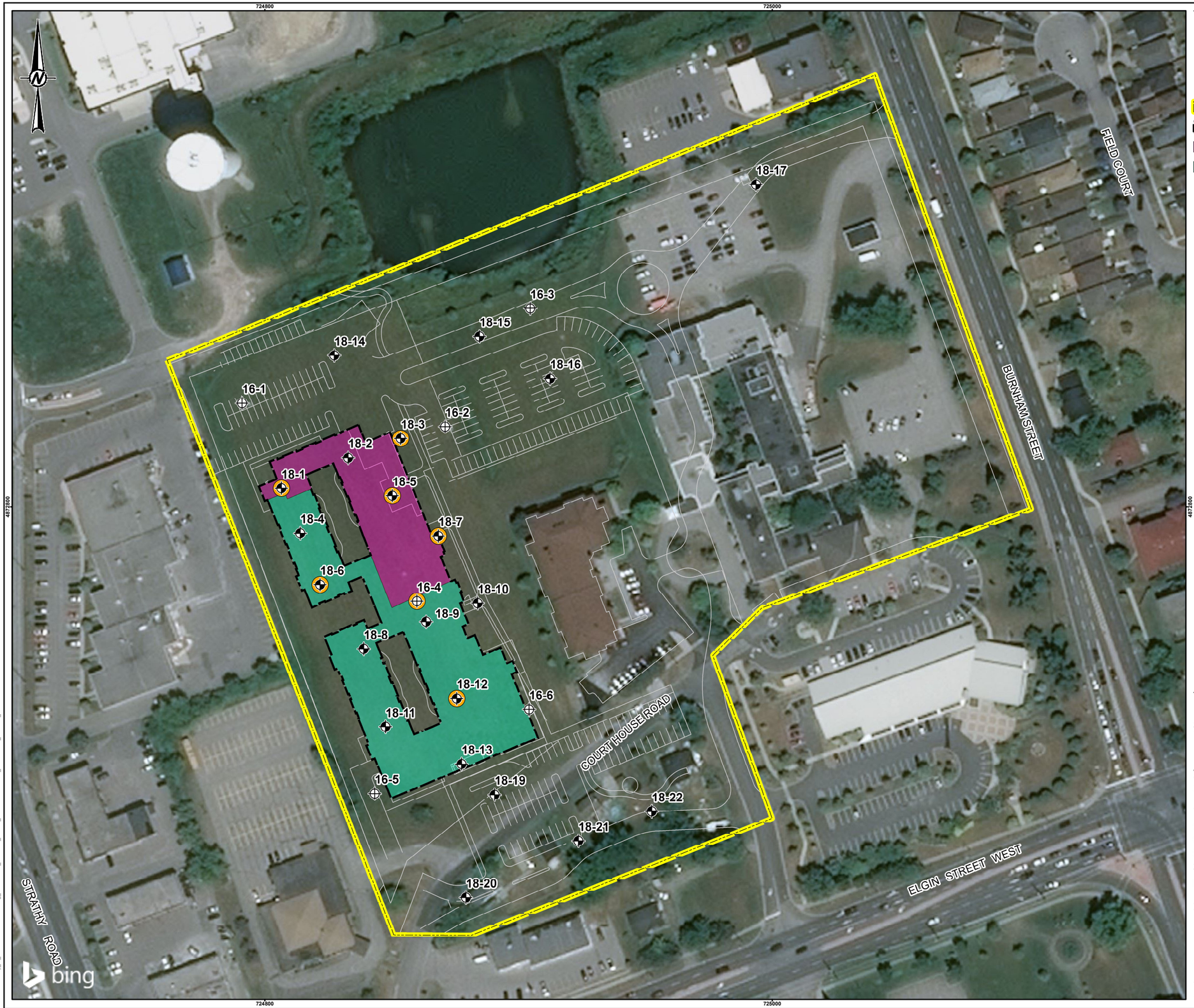

LEGEND

- APPROXIMATE BOREHOLE LOCATION (2018)
- APPROXIMATE BOREHOLE LOCATION (2016)
- BOREHOLE WITH CPT TESTING (2019)
- APPROXIMATE PROJECT BOUNDARY
- PROPOSED BUILDING FOORPRINT
- FFE (UNDERGROUND/WALKOUT PLAN) = 104.9 M
- FFE (MAIN BUILDING) = 108.9 M

0 50 100

1:1,500 METRES

REFERENCE(S)

1. IMAGERY: © 2019 MICROSOFT CORPORATION © 2019 DIGITALGLOBE ©CNES (2019) DISTRIBUTION AIRBUS DS
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
COUNTY OF NORTHUMBERLAND

PROJECT
GEOTECHNICAL INVESTIGATION
GOLDEN PLOUGH LODGE – LONG TERM CARE FACILITY
555 COURTHOUSE ROAD, COBOURG, ONTARIO

TITLE
BOREHOLE LOCATION PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-07
DESIGNED	SO
PREPARED	SO/JT
REVIEWED	AM
APPROVED	SEMP

PROJECT NO.	CONTROL	REV.	FIGURE
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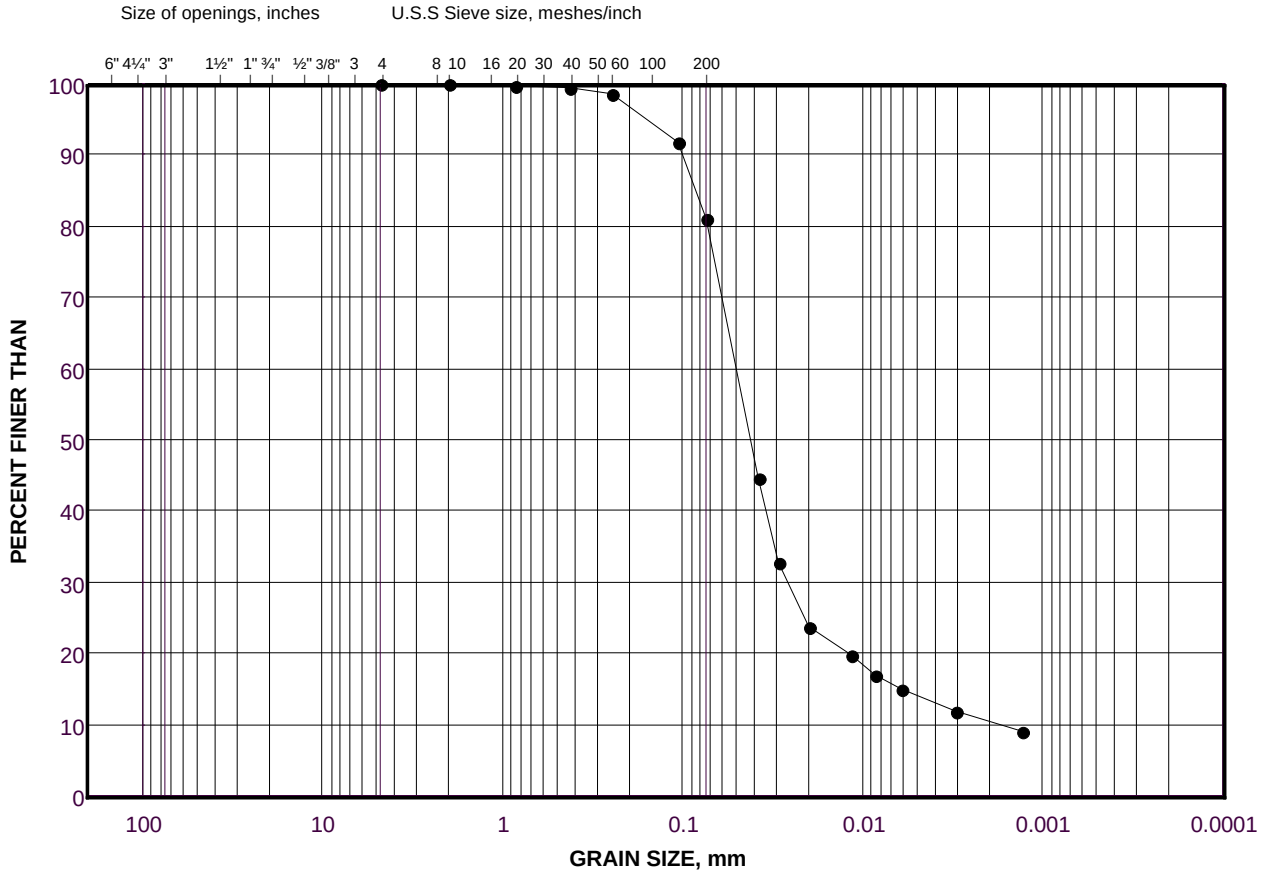
GRAIN SIZE DISTRIBUTION

(ML) sandy SILT

FIGURE 3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	16-1	2	0.8 - 1.2

Project Number: 18111688

Checked By: AM

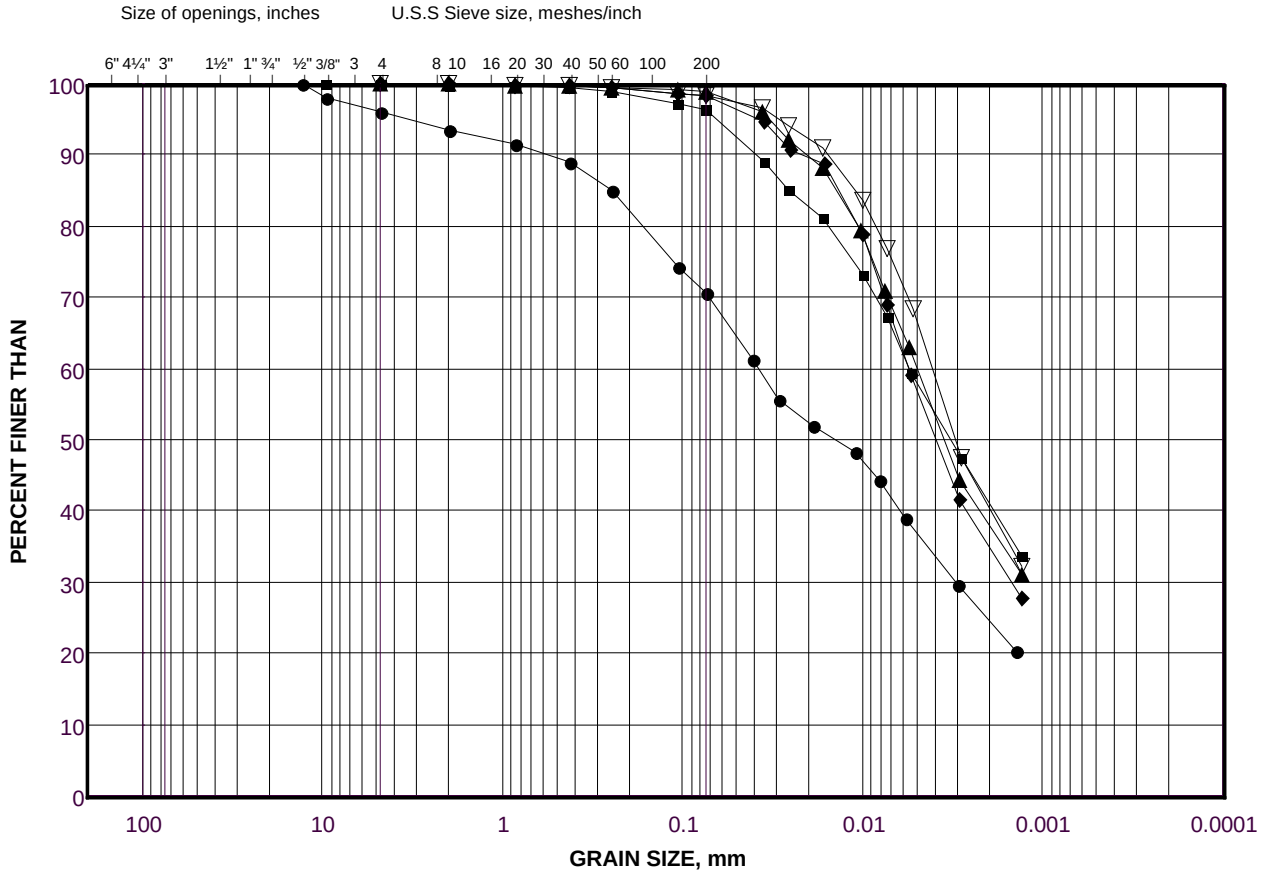
Golder Associates

Date: 28-Mar-19

GRAIN SIZE DISTRIBUTION

(CL-CI) SILTY CLAY to sandy SILTY CLAY

FIGURE 4



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	18-9	4	2.3 - 2.7
■	18-5	6	4.6 - 5.0
◆	18-1	7	6.1 - 6.6
▲	18-7	TW	7.5 - 7.9
▽	18-6	TW	5.5 - 5.9

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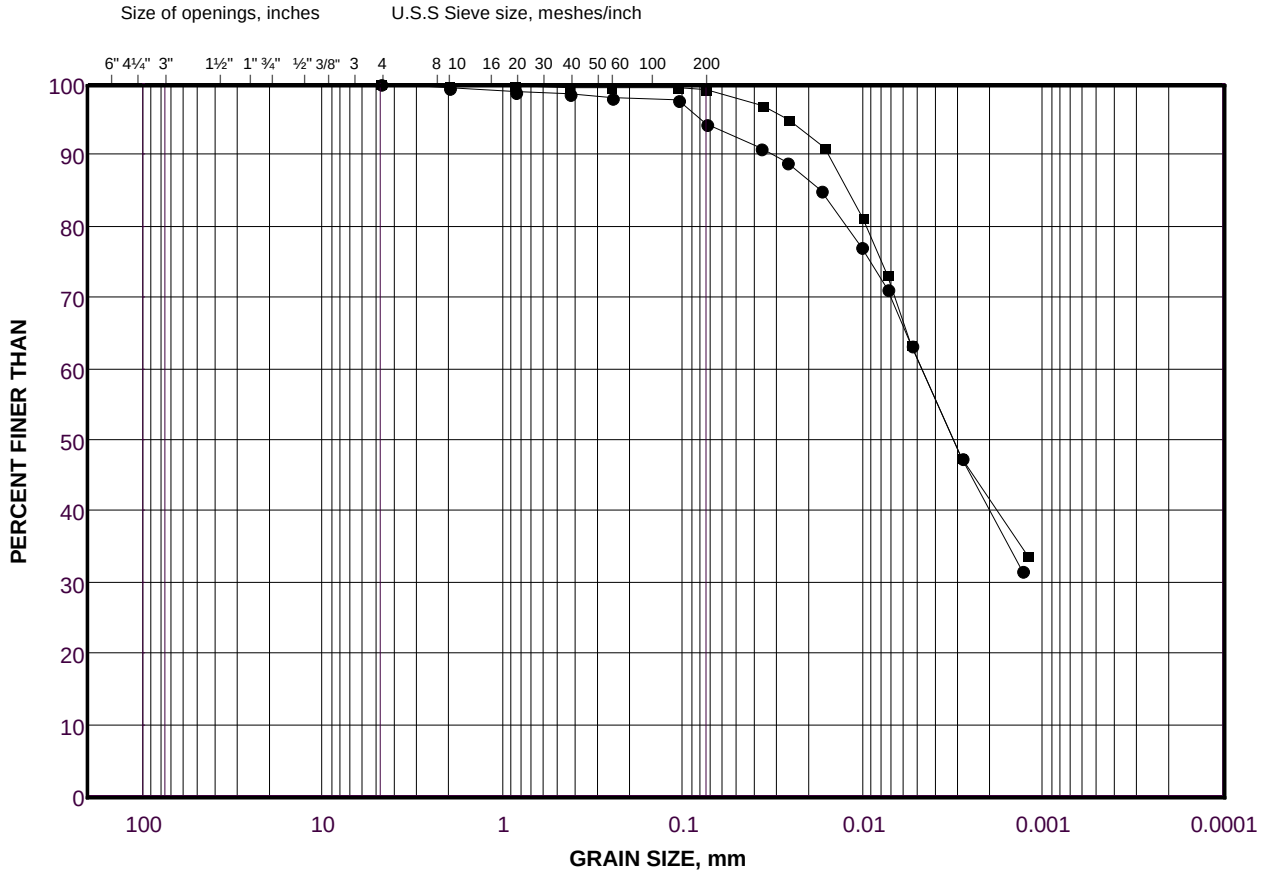
Date: 04-Jun-19

GRAIN SIZE DISTRIBUTION
(CL-CI) SILTY CLAY

FIGURE 5



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	16-4	6	4.6 - 5.0
■	16-1	6	4.6 - 5.0

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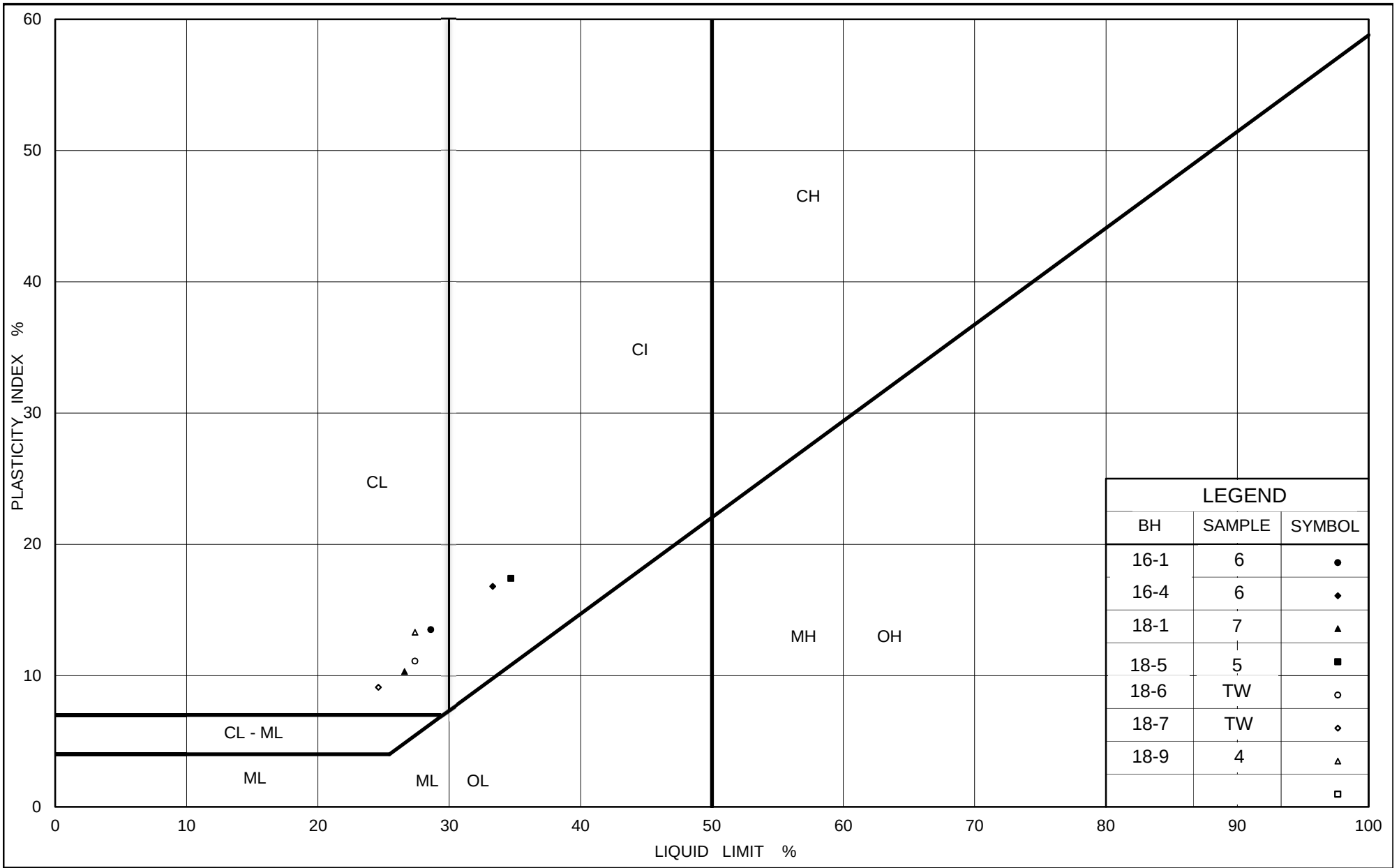


GOLDER

PLASTICITY CHART

(CL-CI) SILTY CLAY to sandy SILTY CLAY

Figure No. 6

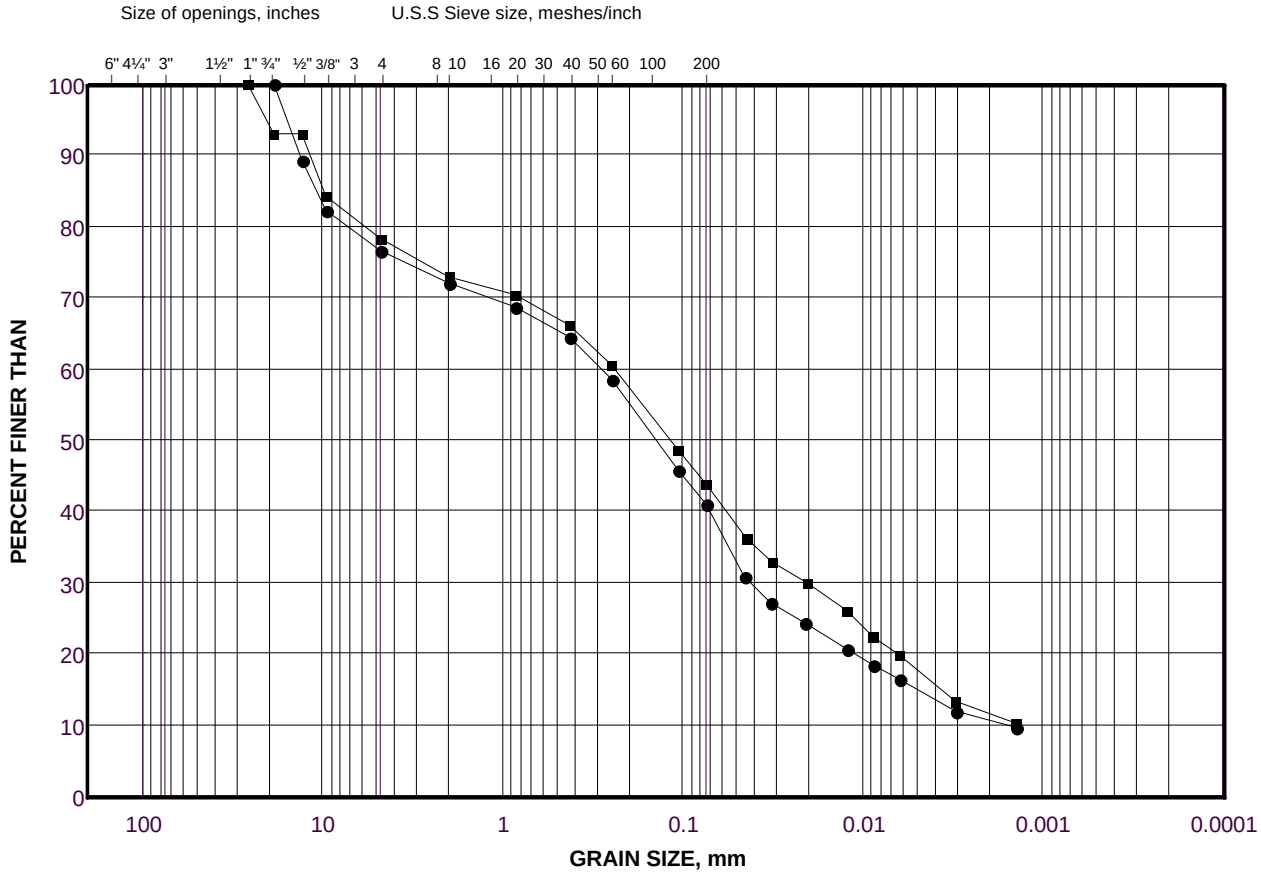
Project No. 18111688

Checked By: AM

GRAIN SIZE DISTRIBUTION

(CS/SM) CLAYEY SAND to SILTY SAND (TILL-LIKE)

FIGURE 7



LEGEND

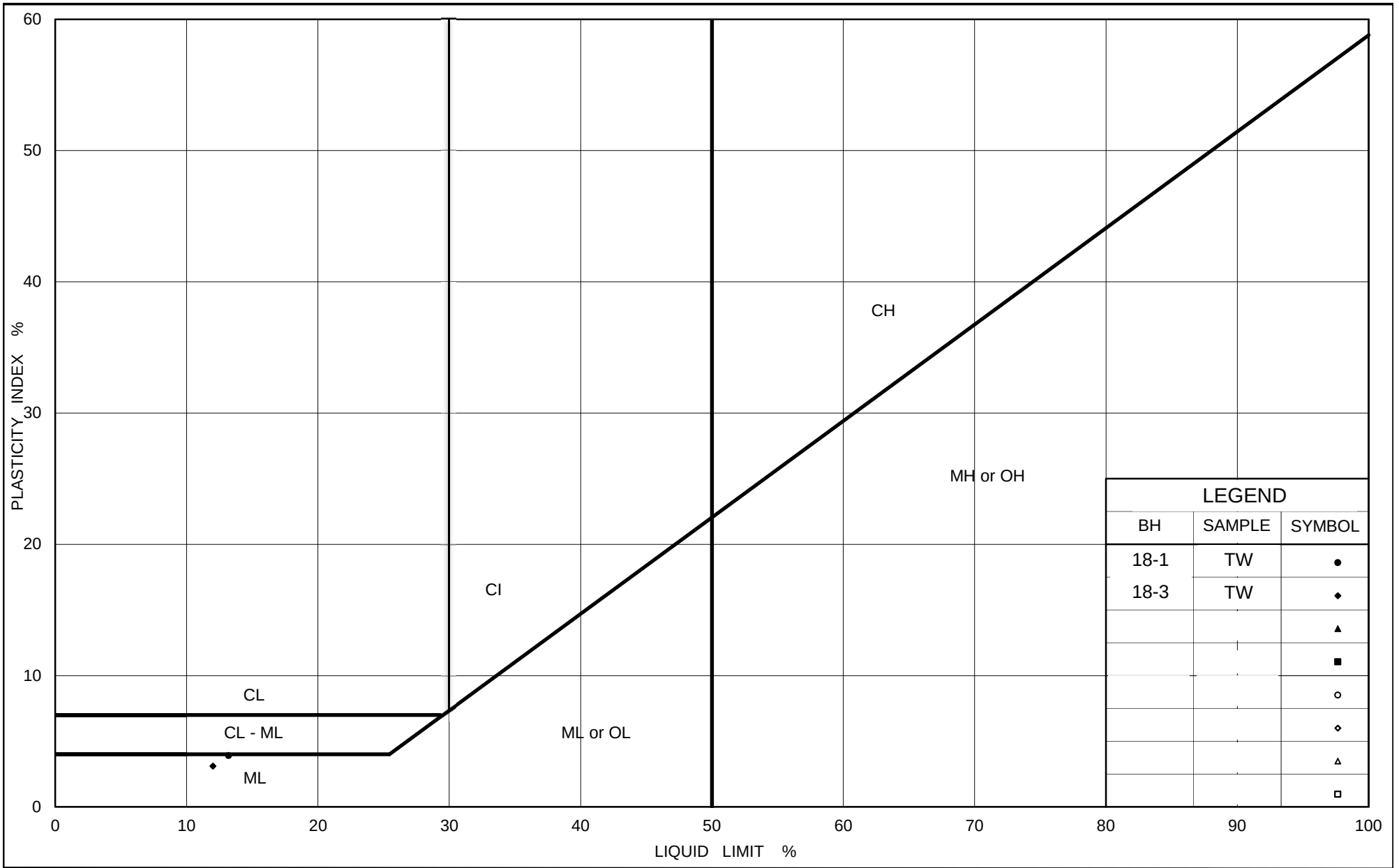
SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	18-3	TW	10.4 - 10.9
■	18-1	TW	7.0 - 7.5

Project Number: 18111688

Checked By: AM

Golder Associates

Date: 04-Jun-19



GOLDER

PLASTICITY CHART

(CS/SM) CLAYEY SAND to SILTY SAND (TILL-LIKE)

Figure No. 8

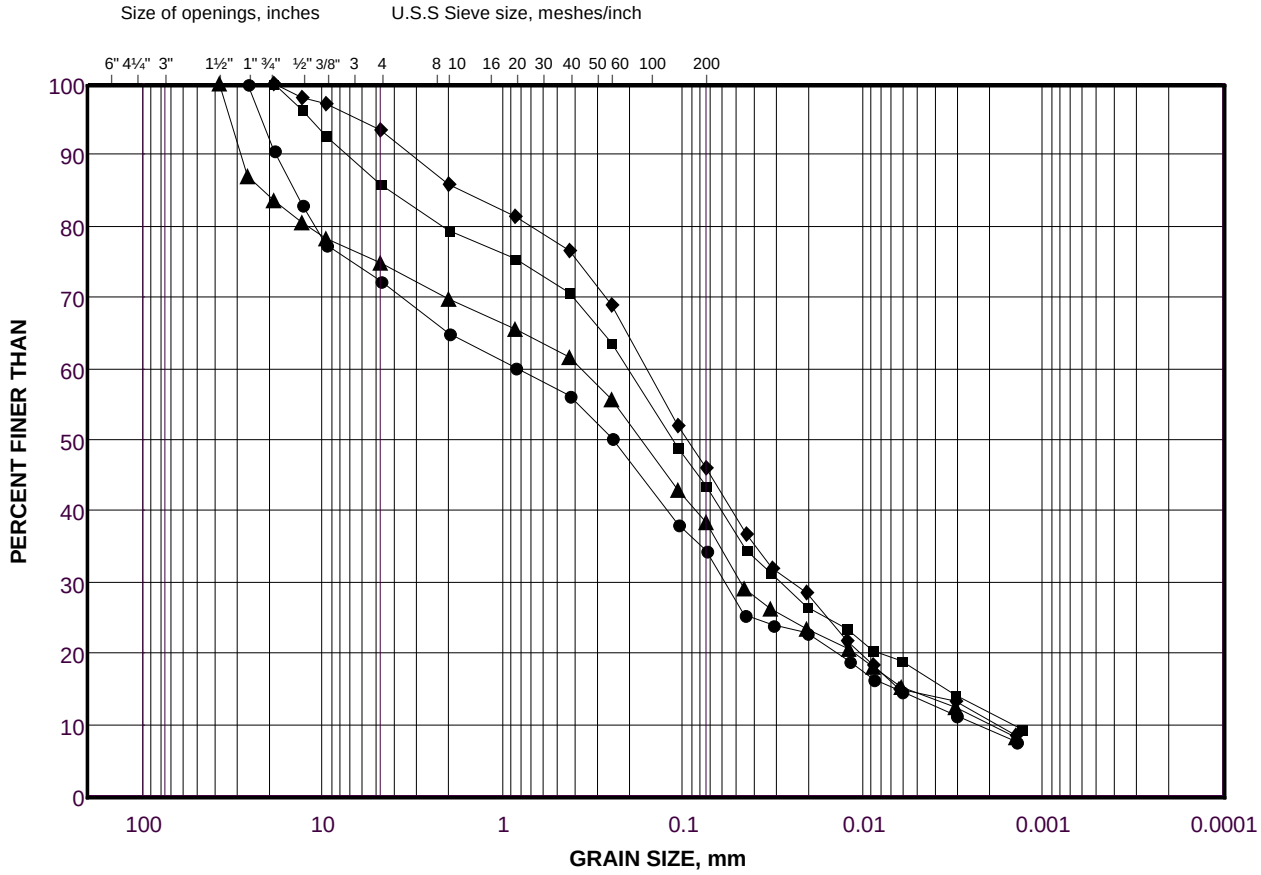
Project No. 18111688

Checked By: AM

GRAIN SIZE DISTRIBUTION

(SM) gravelly SILTY SAND to SILTY SAND (TILL)

FIGURE 9



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	18-7	12	12.2 - 12.7
■	16-5	3	1.5 - 2.0
◆	18-13	4	2.3 - 2.7
▲	18-2	9	10.7 - 11.1

Project Number: 18111688

Checked By: AM

Golder Associates

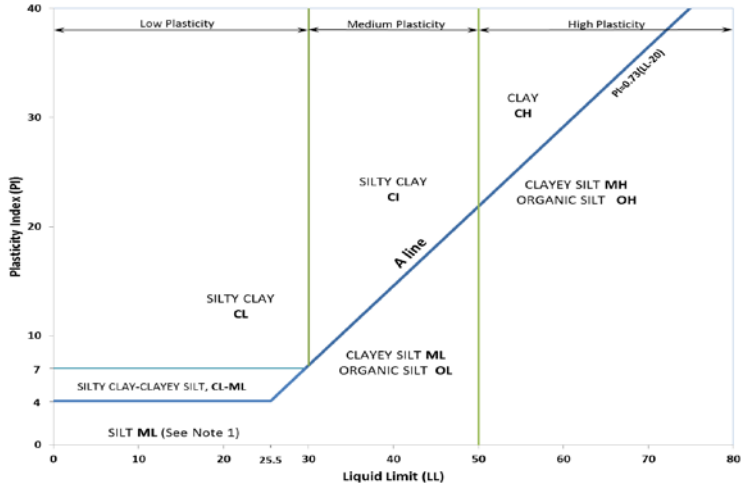
Date: 28-Mar-19

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.
Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.
For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.
For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.
A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.).

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
FS	Foil sample
GS	Grab Sample
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size
TP	Thin-walled, piston – note size
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 - 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects.
2. Definition of compactness terms are based on SPT-'N' ranges as provided in Terzaghi, Peck and Mesri (1996) and correspond to typical average N_{60} values. Many factors affect the recorded SPT-'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), groundwater conditions, and grainsize. As such, the recorded SPT-'N' value(s) should be considered only an approximate guide to the compactness term. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

PROJECT: 1655832

LOCATION: See Figure 2

RECORD OF BOREHOLE: 16-1

SHEET 1 OF 1

BORING DATE: May 19, 2016

DATUM: Geodetic

DRILL RIG: CME 55 Track Mount Auger

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION / GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		GROUND SURFACE		104.43							50mm Dia. Monitoring Well
0	CME-55 Track-Mounted Power Auger 200 mm Dia. Hollow Stem Augers	FILL - TOPSOIL		0.00							
		FILL - (CL) SILTY CLAY, some sand; dark brown, organic staining, rootets; cohesive, w<PL, firm		0.13 / 103.82	1	SS	5				January 4, 2019
1		(ML) sandy SILT (fine grained), some clay; brown, oxidation staining; non-cohesive, moist, compact		0.61 / 103.06	2	SS	14			MH	
		(CL-ML) sandy SILTY CLAY to sandy CLAYEY SILT; brown, oxidation staining, zones of sandy silt; cohesive, w>PL, very stiff		1.37 / 102.30	3	SS	19				
2		(CL-CI) SILTY CLAY, trace to some sand; brown to grey at 3.3 m; cohesive, w~PL to w>PL, stiff		2.13	4	SS	14				Bentonite
3					5	SS	11				
4											Sand
					6	SS	9			MH	
5											Screen
6					7	SS	11				
				97.88							
		END OF BOREHOLE		6.55							
7		NOTES:									
		1. Water encountered during drilling at a depth of 5.5 m below ground surface, May 19, 2016.									
8		2. Water level in monitoring well at a depth of 4.72 m below ground surface, May 27, 2016.									
		3. Water level in monitoring well at a depth of 4.87 m below ground surface, May 31, 2016.									
9		4. Water level in monitoring well at a depth of 4.48 m below ground surface, June 3, 2016.									
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: EW/MB

CHECKED: AH

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PROJECT: 1655832

LOCATION: See Figure 2

RECORD OF BOREHOLE: 16-2

SHEET 1 OF 1

BORING DATE: May 19, 2016

DATUM: Geodetic

DRILL RIG: CME 55 Track Mount Auger

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W WI) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION / GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		GROUND SURFACE		105.98							50mm Dia. Monitoring Well
0	CME-55 Track-Mounted Power Auger 200 mm Dia. Hollow Stem Augers	FILL - TOPSOIL mixed with CLAYEY SILT		0.00	1	SS	8				
				105.29							
1		FILL - (CL) SILTY CLAY, some sand, trace to some gravel; brown; cohesive, w~PL, stiff		0.69	2	SS	8				January 4, 2019 Bentonite
				104.61							
		FILL - (CL-ML) CLAYEY SILT and SAND; brown to dark brown, organic inclusions; cohesive, w>PL, stiff		1.37	3	SS	9				
2				103.85							Sand
		(ML) sandy SILT (fine grained); brown, oxidation stained; non-cohesive, wet, compact		2.13	4	SS	11				
				103.08							
3		(CL-CI) SILTY CLAY, trace to some sand; brown to grey, oxidation staining to 4.0 m; cohesive, w~PL to w>PL, stiff to very stiff		2.90	5	SS	23				Screen
4											Sand
											Bentonite
5					6	SS	13				Cuttings
6											
					7	SS	20				
				99.43							
		END OF BOREHOLE		6.55							
7		NOTES:									
		1. Water encountered during drilling at a depth of 2.3 m below ground surface, May 19, 2016.									
		2. Water level in monitoring well at a depth of 1.78 m below ground surface, May 27, 2016.									
8		3. Water level in monitoring well at a depth of 1.77 m below ground surface, May 31, 2016.									
		4. Water level in monitoring well at a depth of 1.83 m below ground surface, June 3, 2016.									
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: EW/MB

CHECKED: AH

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PROJECT: 1655832

LOCATION: See Figure 2

RECORD OF BOREHOLE: 16-3

SHEET 1 OF 2

BORING DATE: May 19, 2016

DATUM: Geodetic

DRILL RIG: CME 55 Track Mount Auger

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION / GRAIN SIZE DISTRIBUTION (%)
		GROUND SURFACE		105.88							GR SA SI CL
0	CME-55 Track-Mounted Power Auger, 150 mm Dia. Solid Stem Augers	FILL - TOPSOIL mixed with sandy SILT		0.00	1	SS	9				
				105.27							
		FILL - (CL) SILTY CLAY; grey and brown, oxidation staining, organic inclusions; cohesive, w>PL, firm		0.61							
1						SS	6				
				104.23	3A						
		(ML) sandy SILT; brown, oxidation staining; non-cohesive, moist, compact		1.65	3B	SS	19				
2				103.59							
		(CL) SILTY CLAY; brown; cohesive, w>PL, stiff		2.29	4A						
				2.44	4B	SS	11				
		(ML) SILT and SAND; brown; non-cohesive, wet, compact		2.59	4C						
		(CL) SILTY CLAY, trace sand; grey, oxidation staining; cohesive, w>PL to w~PL, stiff to very stiff			5	SS	16				
4				101.77							
		(CL-CI) SILTY CLAY, trace sand; grey, varved 55 mm; w>PL, cohesive, stiff to firm		4.11	6	SS	12				
5											
6					7	SS	8				
7								⊕ +	+		
		- Zones of sand and gravel at 7.8 m			8	SS	6				
8				97.50							
		(CL) sandy SILTY CLAY, trace gravel; grey (TILL-LIKE); cohesive, w>PL, stiff		8.38				⊕ +	+		
9					9	SS	9				
				96.28							
		END OF BOREHOLE		9.60							
10		NOTE:									
		CONTINUED NEXT PAGE									

DEPTH SCALE

1 : 50

GOLDER

LOGGED: EW/MB

CHECKED: AH

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PROJECT: 1655832

LOCATION: See Figure 2

RECORD OF BOREHOLE: 16-3

SHEET 2 OF 2

BORING DATE: May 19, 2016

DATUM: Geodetic

DRILL RIG: CME 55 Track Mount Auger

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION / GRAIN SIZE DISTRIBUTION (%)
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									GR SA SI CL
		1. Water encountered during drilling at a depth of 4.6 m below ground surface, May 19, 2016.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: EW/MB

CHECKED: AH

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PROJECT: 1655832

LOCATION: See Figure 2

RECORD OF BOREHOLE: 16-4

SHEET 1 OF 1

BORING DATE: May 19, 2016

DATUM: Geodetic

DRILL RIG: CME 55 Track Mount Auger

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W WI) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION / GRAIN SIZE DISTRIBUTION (%)
		GROUND SURFACE		106.92							150 mm Dia. Piezometer
0	CME-55 Track-Mounted Power Auger, 150 mm Dia. Solid Stem Augers	FILL - TOPSOIL mixed with sandy SILT		0.00	1	SS	13				
				106.47							
		FILL - (CL) SILTY CLAY, trace sand, trace gravel; brown, oxidation staining, organic inclusions at 1.7 m; cohesive, w<PL to w>PL, stiff to firm		0.45	2	SS	10				
1											
		- Organic inclusions at a depth of 1.7 m below ground surface			3	SS	6				January 4, 2019
2											Bentonite
				104.63							
		FILL - (CL-ML) SILTY CLAY to CLAYEY SILT; brown, oxidation staining, organic and peat pockets; cohesive w>PL, stiff		2.29	4	SS	14				
				104.18							
		(CL-Cl) SILTY CLAY, trace sand, trace gravel; brown to grey, oxidation staining; cohesive, w>PL, stiff to very stiff		2.74							
3					5	SS	13				
4											Sand
					6	SS	24			MA	
5											Screen
6					7A						
				100.60		SS	23				
		(CL) Sandy SILTY CLAY, trace to some gravel; grey (TILL); w<PL, very stiff		6.32	7B						
				100.37							
		END OF BOREHOLE		6.55							
7		NOTES:									
		1. Water level in borehole at a depth of 3.4 m below ground surface upon completion of drilling, May 19, 2016.									
8		2. Water level in piezometer at a depth of 1.5 m below ground surface, May 27, 2016.									
		3. Water level in piezometer at a depth of 2.50 m below ground surface, June 3, 2016.									
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: EW/MB

CHECKED: AH

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PROJECT: 1655832

LOCATION: See Figure 2

RECORD OF BOREHOLE: 16-5

SHEET 1 OF 1

BORING DATE: May 19, 2016

DATUM: Geodetic

DRILL RIG: CME 55 Track Mount Auger

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION / GRAIN SIZE DISTRIBUTION (%)
		GROUND SURFACE		107.79							GR SA SI CL
0	CME-55 Track-Mounted Power Auger 150 mm Dia. Solid Stem Augers	FILL - TOPSOIL mixed with SANDY SILT		0.00	1	SS	7				
				107.18							
1		FILL - (CL) Sandy SILTY CLAY, trace gravel; dark brown to brown, organic inclusions; w>PL, firm		0.61	2A	SS	35				
				106.57	2B						
		(SM) gravelly SILTY SAND, some clay; brown, becoming grey below 5.5 m, oxidation staining, containing cobbles and boulders (TILL); non-cohesive, dense to very dense		1.22							
2					3	SS	53				
					4	SS	50/ 0.08				
3					5	SS	50/ 0.1				
4											
					6	SS	50/ 0.03				
5											
6											
				101.57	7	SS	50/ 0.13				
		END OF BOREHOLE		6.22							
7		NOTE:									
		1. Borehole open and dry upon completion of drilling, May 19, 2016.									
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: EW/MB

CHECKED: AH

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PROJECT: 1655832

LOCATION: See Figure 2

RECORD OF BOREHOLE: 16-6

SHEET 1 OF 1

BORING DATE: May 19, 2016

DATUM: Geodetic

DRILL RIG: CME 55 Track Mount Auger

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION / GRAIN SIZE DISTRIBUTION (%)
		GROUND SURFACE		108.36							GR SA SI CL
0	CME-55 Track-Mounted Power Auger 150 mm Dia. Solid Stem Augers	FILL - TOPSOIL mixed with sandy SILT		0.00	1	SS	14				
				107.75							
		(CL) SILTY CLAY; brown, oxidation staining; cohesive, w~PL, stiff		0.61							
1					2	SS	13				
					3	SS	13				
2											
				106.07							
		(SM) SILTY SAND, gravelly to some gravel; brown, containing cobbles and boulders (TILL); non-cohesive, moist, dense to very dense		2.29	4	SS	39				
3											
					5	SS	50/ 0.10				
4											
					6	SS	50/ 0.10				
5											
6				102.16	7	SS	50/ 0.10				
		END OF BOREHOLE		6.20							
7		NOTE: 1. Borehole open and dry upon completion of drilling, May 19, 2016.									
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: EW/MB

CHECKED: AH

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PROJECT: 18111688

LOCATION: N 4872807.32; E 724806.53

RECORD OF BOREHOLE: 18-1

BORING DATE: December 18, 2018

SHEET 1 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		105.27							
0	Track Mount CME55 / 150 mm Solid Stem Augers	FILL - Topsoil		0.00 / 105.02	1A						
		FILL - sandy SILTY CLAY; brown, oxidation staining, organic inclusions; cohesive, w~PL, firm to stiff		0.25	1B	SS	12				
1					2	SS	10				
					3	SS	6				
2				103.14							
		(CL-CI) SILTY CLAY, trace to some sand; trace gravel; brown to grey, oxidation staining; cohesive, w~PL to w>PL, stiff to very stiff		2.13	4	SS	15				
3					5	SS	24				
4		- Oxidation staining to 4.0 m									
					6	SS	14				
5		- Becoming grey at 5.6 m									
6					7	SS	9			MH	
				98.27							
7		(SC/SM) CLAYEY SAND to SILTY SAND, some gravel to gravelly; grey (TILL-LIKE); cohesive, w>PL, firm		7.00							
					8	SS	6			MH C	
8				97.19							
		END OF BOREHOLE		8.08							
		NOTES: 1. Water encountered during drilling at a depth of 3.1 m, December 18, 2018 2. Borehole caved to a depth of 5.5 m upon completion of drilling, December 18, 2018 3. Water measured in open portion of borehole at a depth of 3.2 m upon completion of drilling, December 18, 2018									
9											
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872807.32; E 724806.53

RECORD OF BOREHOLE: 18-1

BORING DATE: December 18, 2018

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									
		4. A thin walled Shelby tube sample was obtained from a borehole within 2 m from borehole 18-1 from a depth of 7 m to 7.5 m below ground surface, April 11, 2019									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

PROJECT: 18111688

LOCATION: N 4872819.36; E 724832.83

RECORD OF BOREHOLE: 18-2

BORING DATE: December 18, 2018

SHEET 1 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		105.27							
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00 0.05	1A	SS	8				
		FILL - (CL) SILTY CLAY, some sand; brown and black, organic inclusions, oxidation staining, rootlets; cohesive, w<PL, firm to stiff			1B						
1					2	SS	8				
					3	SS	13				
2		- Zones of organics at 2.0 m		103.14							
		(CL-CI) SILTY CLAY, some sand; brown to grey, oxidation staining; cohesive, w~PL, stiff to very stiff		2.13	4	SS	14				
3					5	SS	20				
4		- Oxidation staining to 4.0 m - Becoming grey at 4.0 m									
5					6	SS	13				
6					7	SS	12				
7											
8					8	SS	10				
9											
		(SM) gravelly SILTY SAND; grey, (TILL); non-cohesive, moist, very dense		95.74 9.53							
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872819.36; E 724832.83

RECORD OF BOREHOLE: 18-2

BORING DATE: December 18, 2018

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp ○ W WI) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount CME55 150 mm Solid Stem Augers	(SM) gravelly SILTY SAND; grey, (TILL); non-cohesive, moist, very dense		94.14	9	SS	67		○	MH	
11		END OF BOREHOLE		11.13							
		NOTES:									
		1. Water encountered during drilling at a depth of 4.6 m, December 18, 2018									
12		2. Borehole caved to a depth of 5.2 m upon completion of drilling, December 18, 2018									
		3. Water measured in open portion of borehole at a depth of 3.4 m upon completion of drilling, December 18, 2018									
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872826.96; E 724853.57

RECORD OF BOREHOLE: 18-3

BORING DATE: December 20, 2018

SHEET 1 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		105.63							
0		FILL - Topsoil		0.00							
		FILL - (CL) sandy SILTY CLAY, some gravel; brown, rootlets, organic inclusions to 0.7 m, oxidation staining; cohesive, w~PL, stiff		0.15	1	SS	13				
1					2	SS	9				
					3	SS	9				
2				103.50							
		(CL-CI) SILTY CLAY, trace to some sand; trace gravel; brown to grey, oxidation staining; cohesive, w~PL to w>PL, very stiff to soft		2.13	4	SS	14				
3					5	SS	17				
4		- Oxidation staining at 4.0 m									
					6	SS	10				
5	Track Mount CME55 150 mm Solid Stem Augers										
		- Becoming grey at 5.6 m									
6					7	SS	11				
7											
					8	SS	5				
8											
9					9	SS	2				
10				95.63							
		CONTINUED NEXT PAGE									

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872826.96; E 724853.57

RECORD OF BOREHOLE: 18-3

BORING DATE: December 20, 2018

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount CME55 150 mm Solid Stem Augers	(SC/SM) CLAYEY SAND to SILTY SAND, some gravel to gravelly; grey (TILL-LIKE); cohesive, w>PL, firm		10.00							
11					10	SS	6		W	MH C	
				93.97							
12		(SM) gravelly SILTY SAND; grey, (TILL); non-cohesive, moist, very dense		11.66	11	SS	50/ 0.13				
13											
14				91.46	12	SS	88				
		END OF BOREHOLE		14.17							
15		NOTES:									
		1. Water encountered during drilling at a depth of 7.6 m, December 20, 2018									
		2. Borehole caved to a depth of 9.1 m upon completion of drilling, December 20, 2018									
		3. Water measured in open portion of borehole at a depth of 8.9 m, December 20, 2018									
16		4. A thin walled Shelby tube sample was obtained from a borehole within 2 m from borehole 18-3 from a depth of about 10.4 m to 10.9 m below ground surface, April 11, 2019									
17											
18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872789.57; E 724813.95

RECORD OF BOREHOLE: 18-4

BORING DATE: December 18, 2018

SHEET 1 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		105.68							
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00							
		FILL - sandy SILTY CLAY, trace gravel; brown and black, oxidation staining; cohesive, w~PL, soft to stiff		0.15	1A	SS	11				
					1B						
1					2	SS	4				
				104.11							
		FILL - ORGANIC / TOPSOIL		1.57							
				103.88	3	SS	14				
2		(CL-CI) SILTY CLAY, some sand, trace gravel; brown to grey, oxidation staining; cohesive, w~PL to w>PL, stiff to very stiff		1.80							
					4	SS	15				
3					5	SS	18				
4		- Oxidation staining at 4.0 m									
					6	SS	16				
5		- Becoming grey at 5.6 m									
6					7	SS	8				
7											
					8	SS	5				
8		- Isolated wet sand and gravel pockets within silty clay at 8 m depth									
9					9	SS	14				
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872789.57; E 724813.95

RECORD OF BOREHOLE: 18-4

BORING DATE: December 18, 2018

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount CME55 150 mm Solid Stem Augers	(SM) gravelly SILTY SAND; grey, (TILL); non-cohesive, moist, very dense		95.55 10.13	10	SS	52		○		
11		END OF BOREHOLE		94.55 11.13							
12		NOTES: 1. Water encountered during drilling at a depth of 4.6 m, December 18, 2018 2. Borehole caved to a depth of 8.2 m upon completion of drilling, December 18, 2018 3. Water measured in open portion of borehole at a depth of 3.5 m, December 18, 2018									
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872804.40; E 724850.25

RECORD OF BOREHOLE: 18-5

BORING DATE: December 19, 2018

SHEET 1 OF 3

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		106.04							
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00							
		FILL - (CL) sandy SILTY CLAY, some gravel; brown and black, rootlets, organic inclusions to 0.7 m; cohesive, w~PL, stiff		0.13	1	SS	10				
1					2	SS	11				
					3	SS	56/ 0.28				
2				103.91							
		PROBABLE FILL - (CL) SILTY CLAY, some sand, some gravel; brown, oxidation staining; cohesive to w~PL, firm		2.13	4	SS	6				
3					5	SS	7	⊕ +			
4				102.00							
		(CL-CI) SILTY CLAY, trace sand, trace gravel; grey; cohesive, w~PL to w>PL, firm to very stiff		4.04	6	SS	17			MH	
5											
6					7	SS	13	⊕ +			
7											
					8	SS	6	+			
8				97.43							
		(CS/SM) CLAYEY SAND to SILTY SAND, some gravel; grey (TILL-LIKE); cohesive, w~PL, firm to very stiff		8.61							
9					9	SS	5				
10								⊕ +			
		CONTINUED NEXT PAGE									

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872804.40; E 724850.25

RECORD OF BOREHOLE: 18-5

BORING DATE: December 19, 2018

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount CME55 150 mm Solid Stem Augers	(CS/SM) CLAYEY SAND to SILTY SAND, some gravel; grey (TILL-LIKE); cohesive, w~PL, firm to very stiff									
11					10	SS	19		○		
				94.44							
		(SM) gravelly SILTY SAND; grey (TILL); non-cohesive, moist, compact to very dense		11.60							
12					11	SS	19		○		
13											
14					12	SS	47		○		
15					13	SS	33		○		
16											
17					14	SS	83		○		
18											
				87.29	15	SS	48		○		
		END OF BOREHOLE		18.75							
19		NOTES:									
		1. Water encountered during drilling at a depth of 4.6 m, December 19, 2018									
		2. Borehole caved to a depth of 14.3 m upon completion of drilling, December 19, 2018									
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872804.40; E 724850.25

RECORD OF BOREHOLE: 18-5

BORING DATE: December 19, 2018

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20		*--- CONTINUED FROM PREVIOUS PAGE ---*									
		3. Water measured in open portion of borehole at a depth of 2.9 m, December 19, 2018									
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

PROJECT: 18111688

LOCATION: N 4872769.29; E 724821.75

RECORD OF BOREHOLE: 18-6

BORING DATE: December 18, 2018

SHEET 1 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		105.99							
0	Track Mount CME55 / 150 mm Solid Stem Augers	FILL - Topsoil		0.00 / 105.79	1A						
		FILL - (CL) SILTY CLAY, trace sand, trace gravel; brown, organic inclusions; cohesive, w~PL to w>PL		0.20	1B	SS	7				
1					2	SS	7	⊕ +			
					3	SS	36				
2		- Organic inclusions at 1.9 m		103.86							
		(CL-CI) SILTY CLAY, trace sand; brown to grey, oxidation staining; cohesive, w~PL to w>PL, stiff to very stiff		2.13	4	SS	16				
3					5	SS	21				
4					6	SS	14				
5		- Becoming grey at 5.6 m - Oxidation staining to 5.6 m								MH C	
6					7	SS	7				
7				98.90				⊕ +			
		(CS/SM) CLAYEY SAND to SILTY SAND, some gravel; grey, (TILL-LIKE); cohesive, w<PL, very stiff to stiff		7.09	8	SS	19				
8											
9					9	SS	13				
				96.39							
		END OF BOREHOLE		9.60							
		NOTES:									
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872769.29; E 724821.75

RECORD OF BOREHOLE: 18-6

BORING DATE: December 18, 2018

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									
		1. Water encountered during drilling at a depth of 3.1 m, December 18, 2018 2. Borehole caved to a depth of 6.8 m upon completion of drilling, December 18, 2018 3. Water measured in open portion of borehole at a depth of 3.0 m, December 18, 2018 4. A thin walled Shelby tube sample was obtained from a borehole within 2 m from borehole 18-6 from a depth of 5.5 m to 5.9 m below ground surface, April 11, 2019									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

PROJECT: 18111688

LOCATION: N 4872788.46; E 724868.39

RECORD OF BOREHOLE: 18-7

BORING DATE: December 20, 2018

SHEET 1 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		106.48							
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00	1	SS	10				
				105.79							
		FILL - (CL) SILTY CLAY, some sand; brown, rootlets; cohesive, w~PL, firm		0.69	2	SS	7				
1					3	SS	5				
2				104.35							
		FILL - (ML) SILT and SAND; grey; non-cohesive, moist, compact		2.13	4	SS	11				
				103.58							
3		(CL-CI) SILTY CLAY, trace to some sand, trace gravel; brown to grey, oxidation staining; cohesive, w~PL, to w>PL, stiff to very stiff		2.90	5	SS	14				
4		- Oxidation staining to 4.0 m			6	SS	19				
5											
6		- Becoming grey at 6.0 m			7	SS	13				
7											
					8	SS	6			MH C	
8											
				97.68							
9		(CS/SM) CLAYEY SAND to SILTY SAND, some gravel; grey (TILL-LIKE); cohesive, w~PL, soft		8.80	9	SS	4				
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872788.46; E 724868.39

RECORD OF BOREHOLE: 18-7

BORING DATE: December 20, 2018

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount CME55 150 mm Solid Stem Augers	(SM) gravelly SILTY SAND; grey, (TILL); non-cohesive, moist, compact		96.35 10.13							
11					10	SS	26		○		
12					11	SS	89		○	MH	
13											
14					12	SS	62		○		
		END OF BOREHOLE		92.31 14.17							
15		NOTES: 1. Water encountered during drilling at a depth of 7.6 m, December 20, 2018 2. Borehole caved to a depth of 9.8 m upon completion of drilling, December 20, 2018 3. Water measured in open portion of borehole at a depth of 8.3 m, December 20, 2018 4. A thin walled Shelby tube sample was obtained from a borehole within 2 m from borehole 18-7 from a depth of 7.5 m to 7.9 m below ground surface, April 11, 2019									
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

PROJECT: 18111688

LOCATION: N 4872743.97; E 724838.98

RECORD OF BOREHOLE: 18-8

BORING DATE: December 18, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		106.46							
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00 106.26							
		FILL - (CL) SILTY CLAY, trace to some gravel, trace to some sand; brown, rootlets, organic inclusions to 0.7 m; cohesive, w~PL, very soft to stiff		0.20	1	SS	8				
1					2	SS	12				50 mm Monitoring Well
					3	SS	8				
2		- Pockets of organic at 2.0 m									Bentonite
					4	SS	2				▽ January 4, 2019
				103.56							
3		(CL-CI) SILTY CLAY, some sand; brown; cohesive, w~PL, very stiff		2.90	5	SS	28				
4											
					6	SS	23				
5											Sand
				100.96							
		(SM) gravelly SILTY SAND; grey (TILL); non-cohesive, moist, compact to very dense		5.50							
6					7	SS	21				
7											Screen
					8	SS	50/0.13				
				98.56							
8		END OF BOREHOLE		7.90							
		NOTES: 1. Water encountered during drilling at a depth of 2.3 m, December 18, 2018 2. Water measured in open borehole at a depth of 3.5 m, December 18, 2018 3. Groundwater measured in monitoring well at a depth of 2.6 m, January 4, 2019									
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872754.70; E 724863.56

RECORD OF BOREHOLE: 18-9

BORING DATE: December 19, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		106.95							
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00 / 106.77							
		FILL - (CL) SILTY CLAY, some sand, some gravel; brown, rootlets to 0.7 m, oxidation staining; cohesive, w~PL, stiff to firm		0.18	1	SS	15				
1					2	SS	5				
				105.25							
		(CL-CI) sandy SILTY CLAY; brown; cohesive, w~PL to w>PL, firm to very stiff		1.70	3	SS	14				
2					4	SS	9			MH	
3					5	SS	17	⊕ +			
				102.91							
4		(CL) Sandy SILTY CLAY, trace gravel; brown, (TILL); cohesive, w~PL to w<PL, very stiff		4.04	6	SS	23				
5											
				101.45							
		(SM) gravelly SILTY SAND; grey, (TILL); non-cohesive, moist, dense to very dense		5.50	7	SS	38				
6											
7											
					8	SS	69				
8				98.87							
		END OF BOREHOLE		8.08							
9		NOTES:									
		1. Borehole caved to a depth of 5.8 m upon completion of drilling, December 19, 2018									
10		2. Water measured in open portion of borehole at a depth of 3.9 m, December 19, 2018									

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DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

PROJECT: 18111688

LOCATION: N 4872761.97; E 724883.87

RECORD OF BOREHOLE: 18-10

BORING DATE: December 20, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		107.02			
0	Track Mount CME55, 150 mm Solid Stem Augers	FILL - Topsoil		0.00	1	SS	7
				106.33			
1		FILL - (CL) sandy SILTY CLAY, some gravel; brown, rootlets, organic inclusions, oxidation staining; cohesive, w~PL, firm to stiff		0.69	2	SS	11
		- Zone of organic at 1.6 m			3	SS	5
2				104.89			
		(CL-CI) SILTY CLAY, some sand; brown, oxidation staining; cohesive, w~PL, stiff to very stiff		2.13	4	SS	8
3					5	SS	18
4				102.98			
		(CL) sandy SILTY CLAY, trace gravel; brown, (TILL); w<PL, very stiff to hard		4.04	6	SS	31
5							
6					7	SS	18
7				99.93			
		(SM) gravelly SILTY SAND; grey, (TILL); non-cohesive, very dense		7.09			
					8	SS	98/ 0.03
8				98.97			
		END OF BOREHOLE		8.05			
9		NOTES:					
		1. Borehole caved to a depth of 6.4 m upon completion of drilling, December 20, 2018					
		2. Water measured in open portion of borehole at a depth of 4.9 m, December 20, 2018					
10							

SOIL PROFILE

SAMPLES

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl (10 20 30 40)

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872713.19; E 724847.59

RECORD OF BOREHOLE: 18-11

BORING DATE: December 17, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		107.11							
0	Track Mount CME55 / 150 mm Solid Stem Augers	FILL - Topsoil		0.00	1	SS	9		○		
				106.70							
		FILL - (CL) SILTY CLAY, some sand; brown and black, rootlets to 0.7 m; cohesive, w~PL, firm to very stiff		0.41							
1					2	SS	12		○		
					3	SS	8		○		
2		- Organic inclusions at 1.8 m		105.01							
		(CL-CI) SILTY CLAY, some sand; brown, oxidation staining; cohesive, w<PL, stiff		2.10				+			
					4	SS	11		○		
3					5	SS	15		○		
4				103.07							
		(SM) gravelly SILTY SAND; brown to grey, (TILL); non-cohesive, moist, very dense		4.04							
					6	SS	50/ 0.13		○		
5		- Becoming grey at 5.6 m									
6					7	SS	50/ 0.13		○		
7											
					8	SS	62		○		
8				99.03							
		END OF BOREHOLE		8.08							
9		NOTES: 1. Water encountered during drilling at a depth of 7.6 m, December 17, 2018 2. Borehole caved to a depth of 7.4 m upon completion of drilling, December 17, 2018 3. Water measured in open portions of borehole at a depth of 7.2 m upon completion of drilling, December 17, 2018									
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872724.40; E 724875.64

RECORD OF BOREHOLE: 18-12

BORING DATE: December 19, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		107.63							
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00							
		FILL - (CL) SILTY CLAY, some sand; brown, organic inclusions, rootlets; cohesive, w~PL, firm to stiff		0.13	1	SS	8		○		
1					2	SS	12		○		
					3	SS	10		○		
2				105.63							
		(CL-CI) SILTY CLAY, some sand, some gravel; brown; cohesive, w~PL, stiff to very stiff		2.00				⊕ +			
					4	SS	17		○		
				104.73							
3		(SM) gravelly SILTY SAND; brown to grey, oxidation staining, (TILL); non-cohesive, moist, very dense		2.90	5	SS	73		○		
4											
					6	SS	50/ 0.05		○		
5		- Becoming grey at 5.4 m									
6					7	SS	50/ 0.13		○		
7		- Oxidation staining to 7.1 m									
				99.71	8	SS	50/ 0.15		○		
8		END OF BOREHOLE		7.92							
		NOTES:									
		1. Borehole open upon completion of drilling, December 19, 2018									
9		2. Borehole dry upon completion of drilling, December 18, 2018									
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872698.55; E 724877.53

RECORD OF BOREHOLE: 18-13

BORING DATE: December 17, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		108.29							
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00	1	SS	11				
				107.60							
1		FILL - (CL) sandy SILTY CLAY, some gravel; brown, oxidation staining; cohesive, w~PL, stiff		0.69	2	SS	14				50 mm Monitoring Well
				106.92							January 4, 2019
2		(SM) gravelly SILTY SAND, some gravel; brown to grey, (TILL); non-cohesive, moist, very dense		1.37	3	SS	50				
					4	SS	92			MH	
3					5	SS	50/ 0.13				Bentonite
4		- Becoming grey at 4.0 m			6	SS	50/ 0.08				
5											
6					7	SS	50/ 0.13				Sand
											Screen
7											
				100.29	8	SS	93/ 0.23				
8		END OF BOREHOLE		8.00							
		NOTES: 1. Borehole dry upon completion of drilling, December 18, 2018 2. Groundwater measured in monitoring well at a depth of 1.4 m, January 4, 2019									
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872859.69; E 724827.39

RECORD OF BOREHOLE: 18-14

BORING DATE: December 20, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		104.24							
0	Track Mount CME55, 150 mm Solid Stem Augers	FILL - Topsoil		0.00 / 103.99							
		FILL - (CL) sandy SILTY CLAY; brown, rootlets, organic inclusions; cohesive, w~PL, stiff		0.25 / 103.55	1	SS	11		○		
1		(CL-CI) SILTY CLAY, some sand; brown to grey, oxidation staining; cohesive, w~PL, stiff to very stiff		0.69	2	SS	11		○		
					3	SS	15		○		
2		- Oxidation staining to 2.1 m			4	SS	22		○		
3		- Becoming grey at 2.9 m			5	SS	11		○		
4											
5				99.21	6	SS	6		○		
		END OF BOREHOLE		5.03							
6		NOTES: 1. Borehole open upon completion of drilling, December 20, 2018 2. Water measured in open borehole/well at a depth of 5.0 m upon completion of drilling, December 20, 2018									
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872867.24; E 724884.56

RECORD OF BOREHOLE: 18-15

BORING DATE: December 21, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		105.02							
	Track Mount CME55 / 150 mm Solid Stem Augers	FILL - Topsoil		0.00							
		FILL - (CL) SILTY CLAY, trace sand; grey, organic inclusions; cohesive, w~PL, firm to stiff		0.15	1	SS	5				
1					2	SS	7				50 mm Monitoring Well
					3	SS	8				Bentonite
2				102.89							
		(CL) SILTY CLAY, some sand; brown, oxidation staining; cohesive, w<PL, stiff		2.13	4	SS	13				
				102.12							Sand ▽ January 4, 2018
3		(CL-CI) SILTY CLAY, trace sand; brown to grey; cohesive, w<PL, stiff to very stiff		2.90	5	SS	22				
											Screen
4		- Becoming grey at 4.0 m									
					6	SS	12				Sand
5				99.99							
		END OF BOREHOLE		5.03							
6		NOTES:									
		1. Water encountered during drilling at a depth of 2.3 m, December 21, 2018									
		2. Borehole open upon completion of drilling, December 21, 2018									
		3. Water measured in well at a depth of 4.5 m upon completion of drilling, December 18, 2018									
7		4. Groundwater measured in monitoring well at a depth of 2.8 m, January 4, 2018									
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872850.59; E 724912.40

RECORD OF BOREHOLE: 18-16

BORING DATE: December 21, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		105.73							
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00 / 105.53							
		FILL - (CL) SILTY CLAY, some sand; brown, rootlets, organic inclusions to 0.7 m; cohesive, w~PL, stiff		0.20	1	SS	9				
1					2	SS	8				
					3	SS	9				
2				103.60							
		(ML) sandy SILT, trace plastic fines; brown, oxidation staining, rootlets; non-cohesive, w~PL, stiff		2.13	4	SS	9				
				102.83							
3		(CL-CI) SILTY CLAY, some sand; brown; cohesive, w~PL, stiff		2.90	5	SS	10				
4				101.69							
		(CL) CLAYEY SAND to SILTY SAND, some sand; brown, (TILL-LIKE); cohesive, w~PL, stiff		4.04	6	SS	13				
5				100.70							
		END OF BOREHOLE		5.03							
6		NOTES: 1. Water encountered during drilling at a depth of 3.1 m, December 21, 2018 2. Water measured in borehole at a depth of 4.8 m upon completion of drilling, December 18, 2018									
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872927.17; E 724993.59

RECORD OF BOREHOLE: 18-17

BORING DATE: December 21, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		104.73							
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00	1	SS	4				
				104.04							
1		(CL-CI) SILTY CLAY, some sand; brown; cohesive, w~PL to w<PL, stiff to very stiff		0.69	2	SS	12				
2					3	SS	12				
					4	SS	16				
3					5	SS	20				
4											
					6	SS	15				
5				99.70							
		END OF BOREHOLE NOTES: 1. Borehole open upon completion of drilling, December 21, 2018 2. Water measured in borehole at a depth of 4.9 m upon completion of drilling, December 18, 2018		5.03							
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872686.51; E 724890.58

RECORD OF BOREHOLE: 18-19

BORING DATE: December 17, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		109.03									
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00	1	SS	6						
				108.34									
1		(CL-CI) SILTY CLAY, some sand; brown; cohesive, w~PL		0.69	2	SS	53						
				107.66									
2		(SM) gravelly SILTY SAND; brown, (TILL); non-cohesive, moist, very dense		1.37	3	SS	86						
					4	SS	95						
3					5	SS	50/ 0.10						
4					6	SS	50/ 0.13						
				104.18									
5		END OF BOREHOLE		4.85									
		NOTES:											
		1. Borehole open and dry upon completion of drilling, December 17, 2018											
6													
7													
8													
9													
10													

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872645.91; E 724879.23

RECORD OF BOREHOLE: 18-20

BORING DATE: December 21, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		109.28							
0	Track Mount CME55, 150 mm Solid Stem Augers	FILL - Topsoil		0.00	1	SS	16				
				108.59							
1		(SM) gravelly SILTY SAND, trace plastic fines; brown, (TILL), oxidation staining; non-cohesive, moist, very dense		0.69	2	SS	57				
2					3	SS	88				
					4	SS	50/ 0.03				
3					5	SS	50/ 0.13				
4					6	SS	50/ 0.13				
				104.43							
5		END OF BOREHOLE NOTES: 1. Borehole open and dry upon completion of drilling, December 21, 2018		4.85							
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872668.29; E 724923.60

RECORD OF BOREHOLE: 18-21

BORING DATE: December 21, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		108.84									
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00	1	SS	5						
				108.15									
1		FILL - (SM) gravelly SILTY SAND; brown, organic inclusions, rootlets; non-cohesive, moist, compact		0.69	2	SS	22						
				107.47									
2		(SM) gravelly SILTY SAND, trace plastic fines; brown, (TILL); non-cohesive, moist, very dense		1.37	3	SS	50/ 0.05						
					4	SS	50/ 0.05						
3					5	SS	50/ 0.08						
4					6	SS	50/ 0.15						
				104.12									
5		END OF BOREHOLE		4.72									
		NOTES: 1. Borehole open and dry upon completion of drilling, December 21, 2018											
6													
7													
8													
9													
10													

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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PROJECT: 18111688

LOCATION: N 4872679.87; E 724952.48

RECORD OF BOREHOLE: 18-22

BORING DATE: December 21, 2018

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp ⊖W WI) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		107.73									
0	Track Mount CME55 150 mm Solid Stem Augers	FILL - Topsoil		0.00	1	SS	15						
				107.04									
		FILL - (SP) SAND, with pockets of silty clay; brown, organic inclusions; non-cohesive, moist, loose		0.69	2	SS	6						50 mm Monitoring Well
1				106.36									Bentonite
		(SM) gravelly SILTY SAND, trace plastic fines; brown, (TILL); non-cohesive, moist, dense to very dense		1.37	3	SS	49						January 4, 2019
2					4	SS	50/ 0.13						
					5	SS	50/ 0.13						Sand
3													
													Screen
4				103.03	6	SS	50/ 0.13						Sand
		END OF BOREHOLE		4.70									
5		NOTES: 1. Borehole open and dry upon completion of drilling, December 21, 2018 2. Ground water measured in monitoring well at a depth of 1.9 m below ground surface, January 4, 2019											
6													
7													
8													
9													
10													

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: MJB

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APPENDIX A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground Water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX B

Cone Penetration Test Results

PRESENTATION OF SITE INVESTIGATION RESULTS

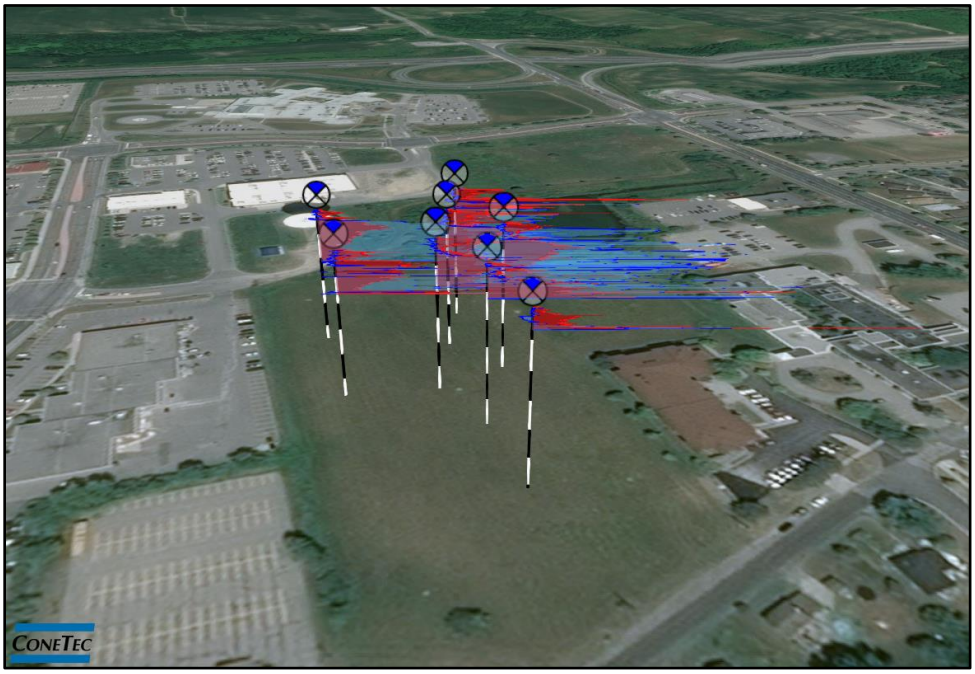
Golden Plough Lodge

Prepared for:

Golder Associates

ConeTec Job No: 19-05024

Project Start Date: 10-Apr-2019
Project End Date: 11-Apr-2019
Report Date: 16-Apr-2019



Prepared by:

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www.conetecdataservices.com

CONETEC

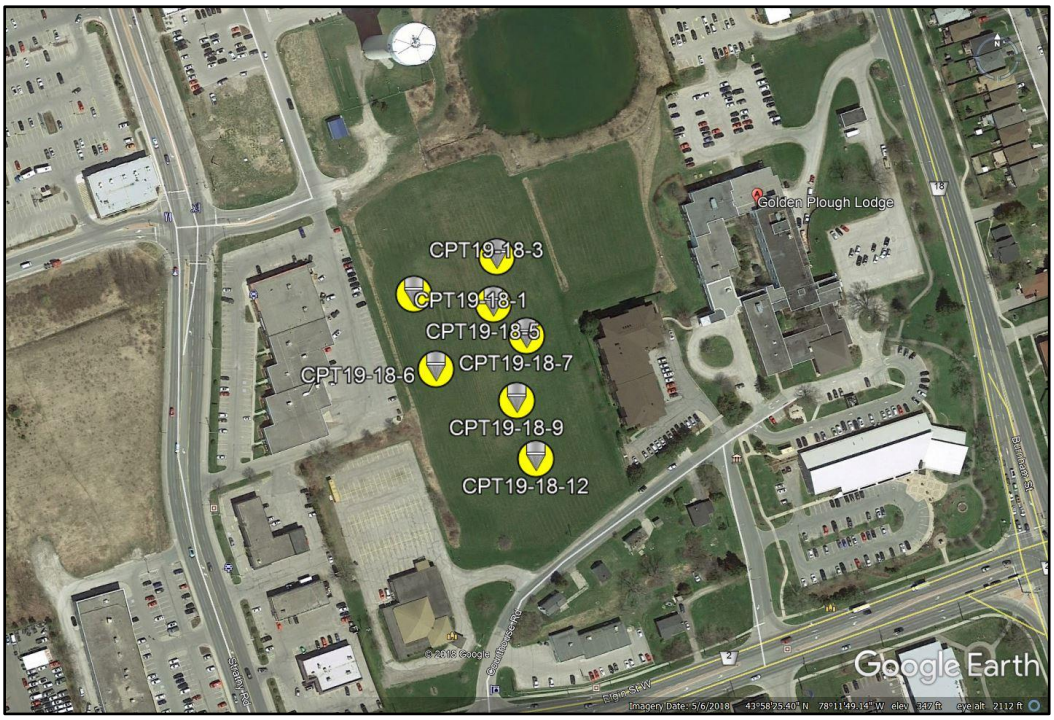
Introduction

The enclosed report presents the results of the site investigation program conducted by ConeTec Investigations Ltd. for Golder Associates at the Golden Plough Lodge, Cobourg, ON. The program consisted of eight cone penetration tests (CPTu).

Project Information

Project	
Client	Golder Associates
Project	Golden Plough Lodge
ConeTec project number	19-05024

An aerial overview from Google Earth including the CPTu test locations is presented below.



Rig Description	Deployment System	Test Type
CPT track rig (M5T)	14 ton rig cylinder	CPT

Coordinates		
Test Type	Collection Method	EPSG Number
CPT	Consumer grade GPS	32617

Cone Penetrometers Used for this Project						
Cone Description	Cone Number	Cross Sectional Area (cm^2)	Sleeve Area (cm^2)	Tip Capacity (bar)	Sleeve Capacity (bar)	Pore Pressure Capacity (psi)
311:T1000F10U500	311	10	150	1000	10	500
Cone 311 was used for all CPT soundings.						

Cone Penetration Test (CPTu)	
Depth reference	Depths are referenced to the existing ground surface at the time of each test.
Tip and sleeve data offset	0.1 meter This has been accounted for in the CPT data files.
Additional plots	Advanced plots with Ic, Su(Nkt), Phi, and N1(60)Ic, as well as Soil Behaviour Type (SBT) scatter plots have been included in the data release package.

Calculated Geotechnical Parameter Tables	
Additional information	The Normalized Soil Behaviour Type Chart based on Q_{tn} (SBT Q_{tn}) (Robertson, 2009) was used to classify the soil for this project. A detailed set of calculated CPTu parameters have been generated and are provided in Excel format files in the release folder. The CPTu parameter calculations are based on values of corrected tip resistance (q_t) sleeve friction (f_s) and pore pressure (u_2). Effective stresses are calculated based on unit weights that have been assigned to the individual soil behaviour type zones and the assumed equilibrium pore pressure profile. Soils were classified as either drained or undrained based on the Q_{tn} Normalized Soil Behaviour Type Chart (Robertson, 2009). Calculations for both drained and undrained parameters were included for materials that classified as silt mixtures – clayey silt to silty clay (zone 4) and sand mixtures – silty sand and sandy silt (zone 5).

Limitations

This report has been prepared for the exclusive use of Golder Associates (Client) for the project titled "Golden Plough Lodge". The report's contents may not be relied upon by any other party without the express written permission of ConeTec Investigations Ltd. (ConeTec). ConeTec has provided site investigation services, prepared the factual data reporting and provided geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

The information presented in the report document and the accompanying data set pertain to the specific project, site conditions and objectives described to ConeTec by the Client. In order to properly understand the factual data, assumptions and calculations, reference must be made to the documents provided and their accompanying data sets, in their entirety.

Cone penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd., a subsidiary of ConeTec.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and a geophone sensor for recording seismic signals. All signals are amplified down hole within the cone body and the analog signals are sent to the surface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in 5 cm^2, 10 cm^2 and 15 cm^2 tip base area configurations in order to maximize signal resolution for various soil conditions. The specific piezocone used for each test is described in the CPT summary table presented in the first appendix. The 15 cm^2 penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm^2 piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 mm diameter over a length of 32 mm with tapered leading and trailing edges) located at a distance of 585 mm above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

All ConeTec piezocones can record pore pressure at various locations. Unless otherwise noted, the pore pressure filter is located directly behind the cone tip in the "u_2" position (ASTM Type 2). The filter is 6 mm thick, made of porous plastic (polyethylene) having an average pore size of 125 microns (90-160 microns). The function of the filter is to allow rapid movements of extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current ASTM D5778 standard. ConeTec's calibration criteria also meets or exceeds those of the current ASTM D5778 standard. An illustration of the piezocone penetrometer is presented in Figure CPTu.

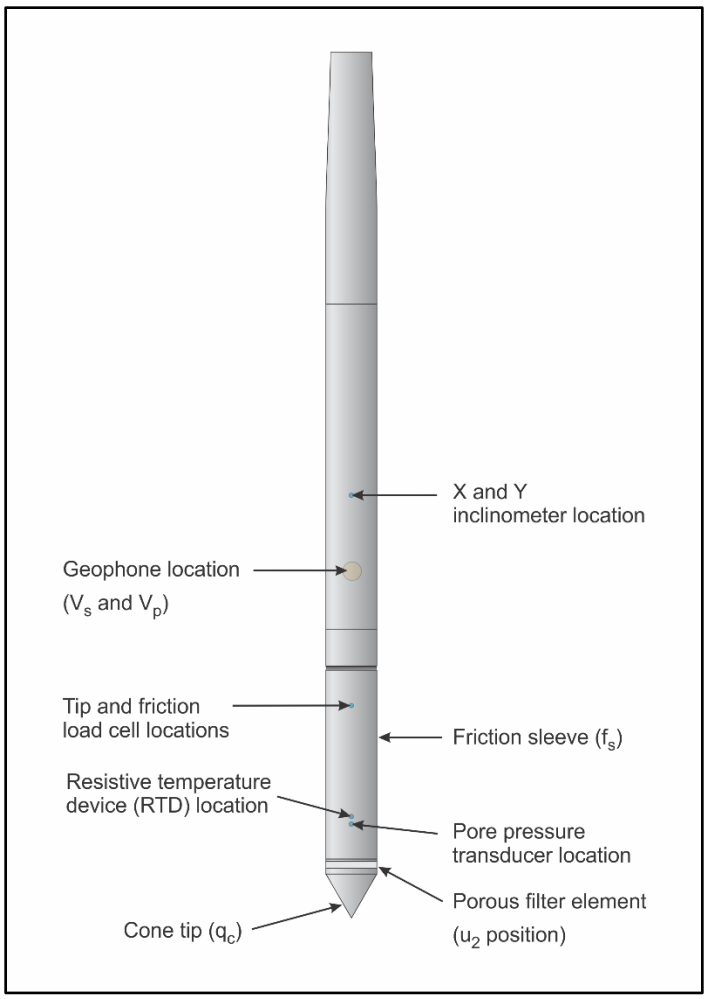


Figure CPTu. Piezocone Penetrometer (15 cm^2)

The ConeTec data acquisition systems consist of a Windows based computer and a signal conditioner and power supply interface box with a 16 bit (or greater) analog to digital (A/D) converter. The data is recorded at fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording interval is 2.5 cm; custom recording intervals are possible.

The system displays the CPTu data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u)
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

All testing is performed in accordance to ConeTec's CPT operating procedures which are in general accordance with the current ASTM D5778 standard.

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with either glycerine or silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position.

The CPTu is conducted at a steady rate of 2 cm/s, within acceptable tolerances. Typically one meter length rods with an outer diameter of 38.1 mm are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Additional information pertaining to ConeTec's cone penetration testing procedures:

- Each filter is saturated in silicone oil under vacuum pressure prior to use
- Recorded baselines are checked with an independent multi-meter
- Baseline readings are compared to previous readings
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs, excessive inclination occurs, equipment damage is likely to take place, or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with ASTM standards

The interpretation of piezocone data for this report is based on the corrected tip resistance (q_t), sleeve friction (f_s) and pore water pressure (u). The interpretation of soil type is based on the correlations developed by Robertson et al. (1986) and Robertson (1990, 2009). It should be noted that it is not always possible to accurately identify a soil behaviour type based on these parameters. In these situations, experience, judgment and an assessment of other parameters may be used to infer soil behaviour type.

The recorded tip resistance (q_c) is the total force acting on the piezocone tip divided by its base area. The tip resistance is corrected for pore pressure effects and termed corrected tip resistance (q_t) according to the following expression presented in Robertson et al. (1986):

$$q_t = q_c + (1\text{-}a) \bullet u_2$$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

The sleeve friction (f_s) is the frictional force on the sleeve divided by its surface area. As all ConeTec piezocones have equal end area friction sleeves, pore pressure corrections to the sleeve data are not required.

The dynamic pore pressure (u) is a measure of the pore pressures generated during cone penetration. To record equilibrium pore pressure, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this occurs is predominantly a function of the permeability of the soil and the diameter of the cone.

The friction ratio (Rf) is a calculated parameter. It is defined as the ratio of sleeve friction to the tip resistance expressed as a percentage. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

A summary of the CPTu soundings along with test details and individual plots are provided in the appendices. A set of files with calculated geotechnical parameters were generated for each sounding based on published correlations and are provided in Excel format in the data release folder. Information regarding the methods used is also included in the data release folder.

For additional information on CPTu interpretations and calculated geotechnical parameters, refer to Robertson et al. (1986), Lunne et al. (1997), Robertson (2009), Mayne (2013, 2014) and Mayne and Peuchen (2012).

The cone penetration test is halted at specific depths to carry out pore pressure dissipation (PPD) tests, shown in Figure PPD-1. For each dissipation test the cone and rods are decoupled from the rig and the data acquisition system measures and records the variation of the pore pressure (u) with time (t).

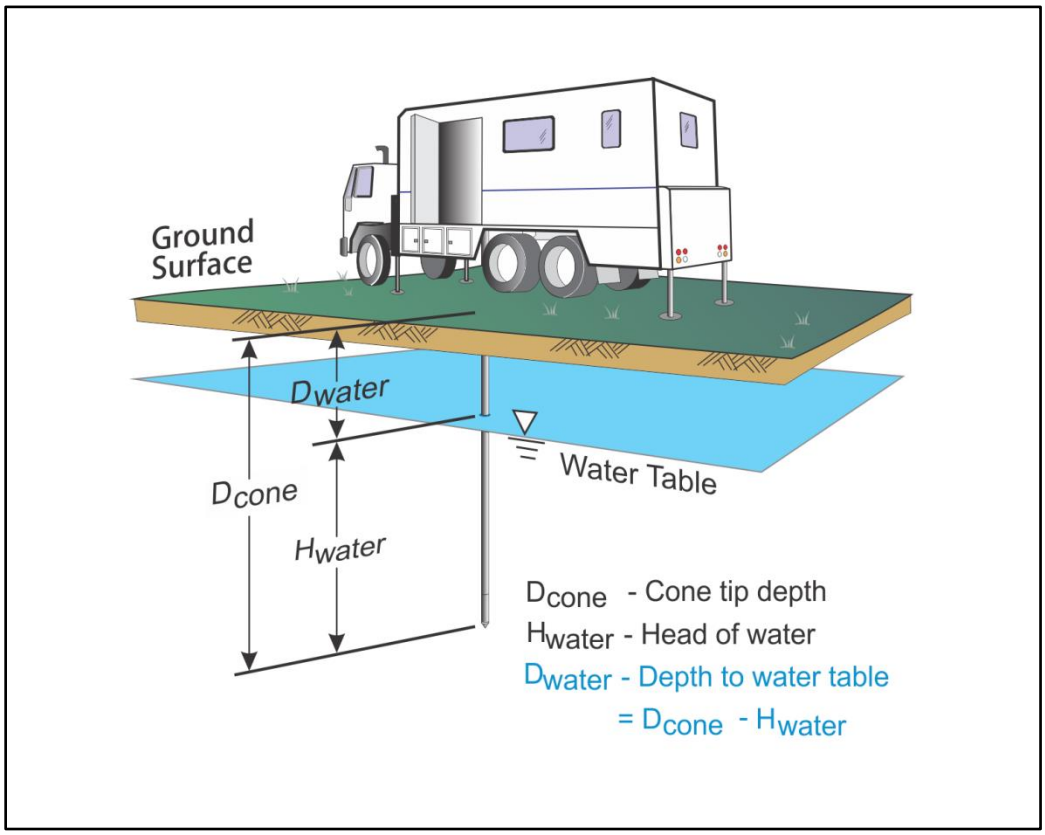


Figure PPD-1. Pore pressure dissipation test setup

Pore pressure dissipation data can be interpreted to provide estimates of ground water conditions, permeability, consolidation characteristics and soil behaviour.

The typical shapes of dissipation curves shown in Figure PPD-2 are very useful in assessing soil type, drainage, in situ pore pressure and soil properties. A flat curve that stabilizes quickly is typical of a freely draining sand. Undrained soils such as clays will typically show positive excess pore pressure and have long dissipation times. Dilative soils will often exhibit dynamic pore pressures below equilibrium that then rise over time. Overconsolidated fine-grained soils will often exhibit an initial dilatory response where there is an initial rise in pore pressure before reaching a peak and dissipating.

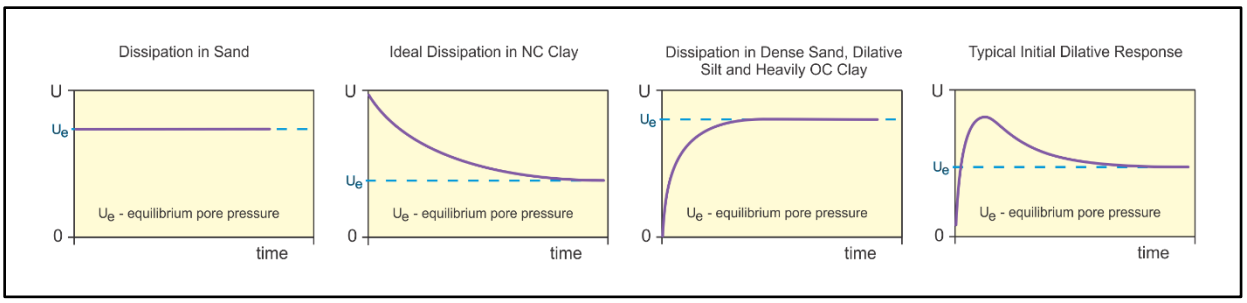


Figure PPD-2. Pore pressure dissipation curve examples

In order to interpret the equilibrium pore pressure (u_{eq}) and the apparent phreatic surface, the pore pressure should be monitored until such time as there is no variation in pore pressure with time as shown for each curve in Figure PPD-2.

In fine grained deposits the point at which 100% of the excess pore pressure has dissipated is known as t_{100}. In some cases this can take an excessive amount of time and it may be impractical to take the dissipation to t_{100}. A theoretical analysis of pore pressure dissipations by Teh and Houlsby (1991) showed that a single curve relating degree of dissipation versus theoretical time factor (T*) may be used to calculate the coefficient of consolidation (c_h) at various degrees of dissipation resulting in the expression for c_h shown below.

$$c_h = \frac{T^* \cdot a^2 \cdot \sqrt{I_r}}{t}$$

Where:

T* is the dimensionless time factor (Table Time Factor)
a is the radius of the cone
I_r is the rigidity index
t is the time at the degree of consolidation

Table Time Factor. T* versus degree of dissipation (Teh and Houlsby (1991))

Degree of Dissipation (%)	20	30	40	50	60	70	80
T* (u_2)	0.038	0.078	0.142	0.245	0.439	0.804	1.60

The coefficient of consolidation is typically analyzed using the time (t_{50}) corresponding to a degree of dissipation of 50% (u_{50}). In order to determine t_{50}, dissipation tests must be taken to a pressure less than u_{50}. The u_{50} value is half way between the initial maximum pore pressure and the equilibrium pore pressure value, known as u_{100}. To estimate u_{50}, both the initial maximum pore pressure and u_{100} must be known or estimated. Other degrees of dissipations may be considered, particularly for extremely long dissipations.

At any specific degree of dissipation the equilibrium pore pressure (u at t_{100}) must be estimated at the depth of interest. The equilibrium value may be determined from one or more sources such as measuring the value directly (u_{100}), estimating it from other dissipations in the same profile, estimating the phreatic surface and assuming hydrostatic conditions, from nearby soundings, from client provided information, from site observations and/or past experience, or from other site instrumentation.

For calculations of c_h (Teh and Houlsby (1991)), t_{50} values are estimated from the corresponding pore pressure dissipation curve and a rigidity index (I_r) is assumed. For curves having an initial dilatory response in which an initial rise in pore pressure occurs before reaching a peak, the relative time from the peak value is used in determining t_{50}. In cases where the time to peak is excessive, t_{50} values are not calculated.

Due to possible inherent uncertainties in estimating I_r, the equilibrium pore pressure and the effect of an initial dilatory response on calculating t_{50}, other methods should be applied to confirm the results for c_h.

Additional published methods for estimating the coefficient of consolidation from a piezocone test are described in Burns and Mayne (1998, 2002), Jones and Van Zyl (1981), Robertson et al. (1992) and Sully et al. (1999).

A summary of the pore pressure dissipation tests and dissipation plots are presented in the relevant appendix.

ASTM D5778-12, 2012, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils", ASTM, West Conshohocken, US.

Burns, S.E. and Mayne, P.W., 1998, "Monotonic and dilatory pore pressure decay during piezocone tests", Canadian Geotechnical Journal 26 (4): 1063-1073.

Burns, S.E. and Mayne, P.W., 2002, "Analytical cavity expansion-critical state model cone dissipation in fine-grained soils", Soils & Foundations, Vol. 42(2): 131-137.

Jones, G.A. and Van Zyl, D.J.A., 1981, "The piezometer probe: a useful investigation tool", Proceedings, 10th International Conference on Soil Mechanics and Foundation Engineering, Vol. 3, Stockholm: 489-495.

Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, "Cone Penetration Testing in Geotechnical Practice", Blackie Academic and Professional.

Mayne, P.W., 2013, "Evaluating yield stress of soils from laboratory consolidation and in-situ cone penetration tests", Sound Geotechnical Research to Practice (Holtz Volume) GSP 230, ASCE, Reston/VA: 406-420.

Mayne, P.W., 2014, "Interpretation of geotechnical parameters from seismic piezocone tests", CPT'14 Keynote Address, Las Vegas, NV, May 2014.

Mayne, P.W. and Peuchen, J., 2012, "Unit weight trends with cone resistance in soft to firm clays", Geotechnical and Geophysical Site Characterization *4,* Vol. 1 (Proc. ISC-4, Pernambuco), CRC Press, London: 903-910.

Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.

Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27: 151-158.

Robertson, P.K., 2009, "Interpretation of cone penetration tests – a unified approach", Canadian Geotechnical Journal, Volume 46: 1337-1355.

Robertson, P.K., Sully, J.P., Woeller, D.J., Lunne, T., Powell, J.J.M. and Gillespie, D.G., 1992, "Estimating coefficient of consolidation from piezocone tests", Canadian Geotechnical Journal, 29(4): 551-557.

Sully, J.P., Robertson, P.K., Campanella, R.G. and Woeller, D.J., 1999, "An approach to evaluation of field CPTU dissipation data in overconsolidated fine-grained soils", Canadian Geotechnical Journal, 36(2): 369-381.

Teh, C.I., and Houlsby, G.T., 1991, "An analytical study of the cone penetration test in clay", Geotechnique, 41(1): 17-34.

The appendices listed below are included in the report:

- Cone Penetration Test Summary and Standard Cone Penetration Test Plots
- Advanced Cone Penetration Test Plots with Ic, Su(Nkt), Phi and N1(60)Ic
- Soil Behaviour Type (SBT) Scatter Plots
- Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Cone Penetration Test Summary and Standard Cone Penetration Test Plots

CONETEC

Job No:	19-05024
Client:	Golder Associates
Project:	Golden Plough Lodge
Start Date:	10-Apr-2019
End Date:	11-Apr-2019

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface[1] (m)	Final Depth (m)	Northing[2] (m)	Easting[2] (m)	Refer to Notation Number
CPT19-16-4	19-05024_CP19-16-4	11-Apr-2019	311:T1000F10U500	2.0	9.200	4872774	724849	
CPT19-18-1	19-05024_CP19-18-1	10-Apr-2019	311:T1000F10U500	2.0	10.775	4872808	724808	
CPT19-18-3	19-05024_CP19-18-3	10-Apr-2019	311:T1000F10U500	2.0	11.850	4872829	724851	
CPT19-18-5	19-05024_CP19-18-5	10-Apr-2019	311:T1000F10U500	2.0	11.650	4872804	724850	
CPT19-18-6	19-05024_CP19-18-6	10-Apr-2019	311:T1000F10U500	2.0	8.125	4872769	724821	
CPT19-18-7	19-05024_CP19-18-7	10-Apr-2019	311:T1000F10U500	2.0	11.450	4872788	724868	
CPT19-18-9	19-05024_CP19-18-9	10-Apr-2019	311:T1000F10U500	2.0	6.100	4872754	724864	
CPT19-18-12	19-05024_CP19-18-12	10-Apr-2019	311:T1000F10U500	2.0	3.350	4872724	724875	

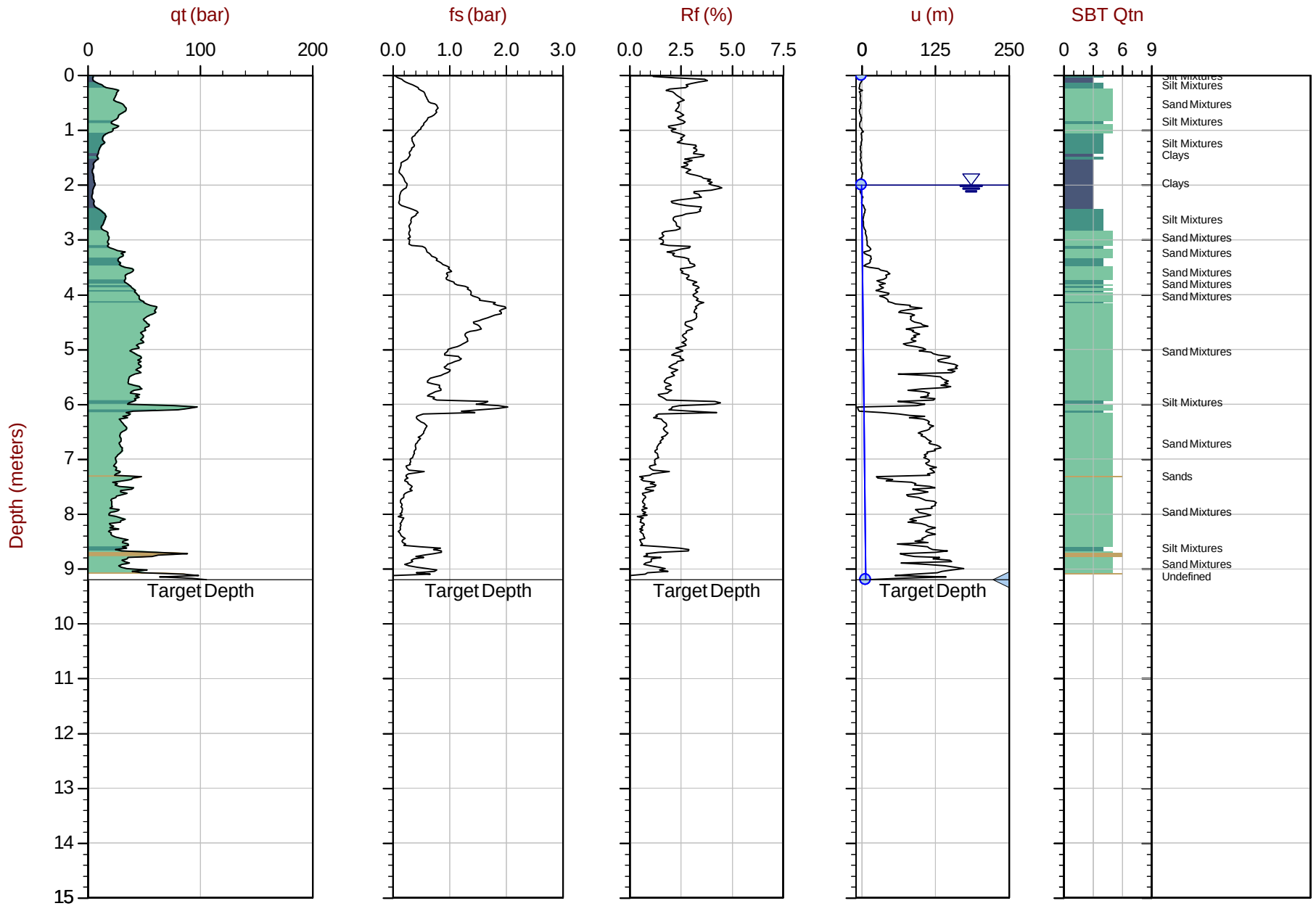
1. The assumed phreatic surface was based on dynamic pore pressure responses, unless otherwise noted. Hydrostatic conditions were assumed for the calculated parameters.
2. The coordinates were acquired using consumer grade GPS equipment in datum: WGS84 / UTM Zone 17 North.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-11 15:21
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-16-4
Cone: 311:T1000F10U500



Max Depth: 9.200 m / 30.18 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-16-4.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872774m E: 724849m
Sheet No: 1 of 1

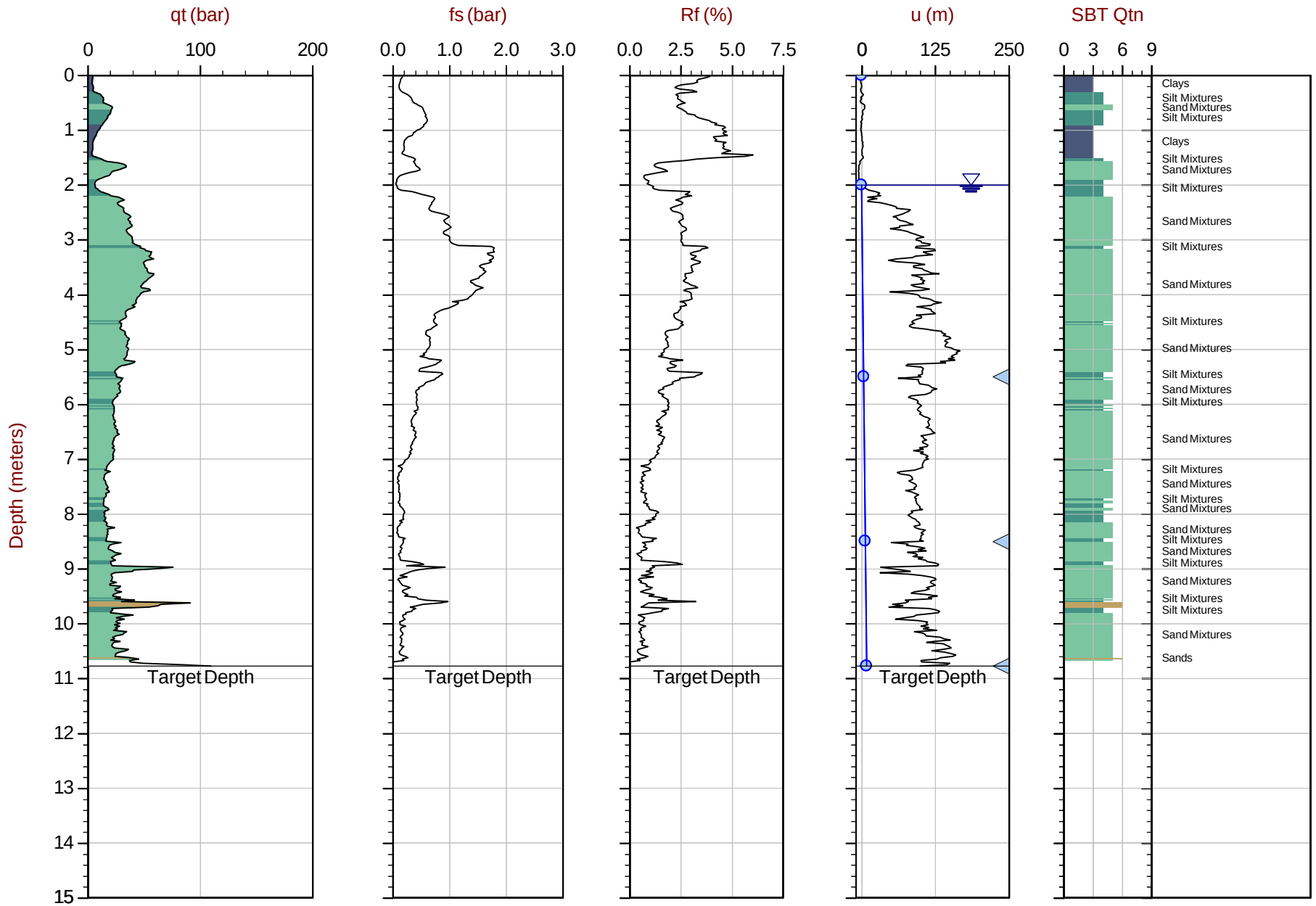
Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 10:47
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-1
Cone: 311:T1000F10U500



Max Depth: 10.775 m / 35.35 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-1.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872808m E: 724808m
Sheet No: 1 of 1

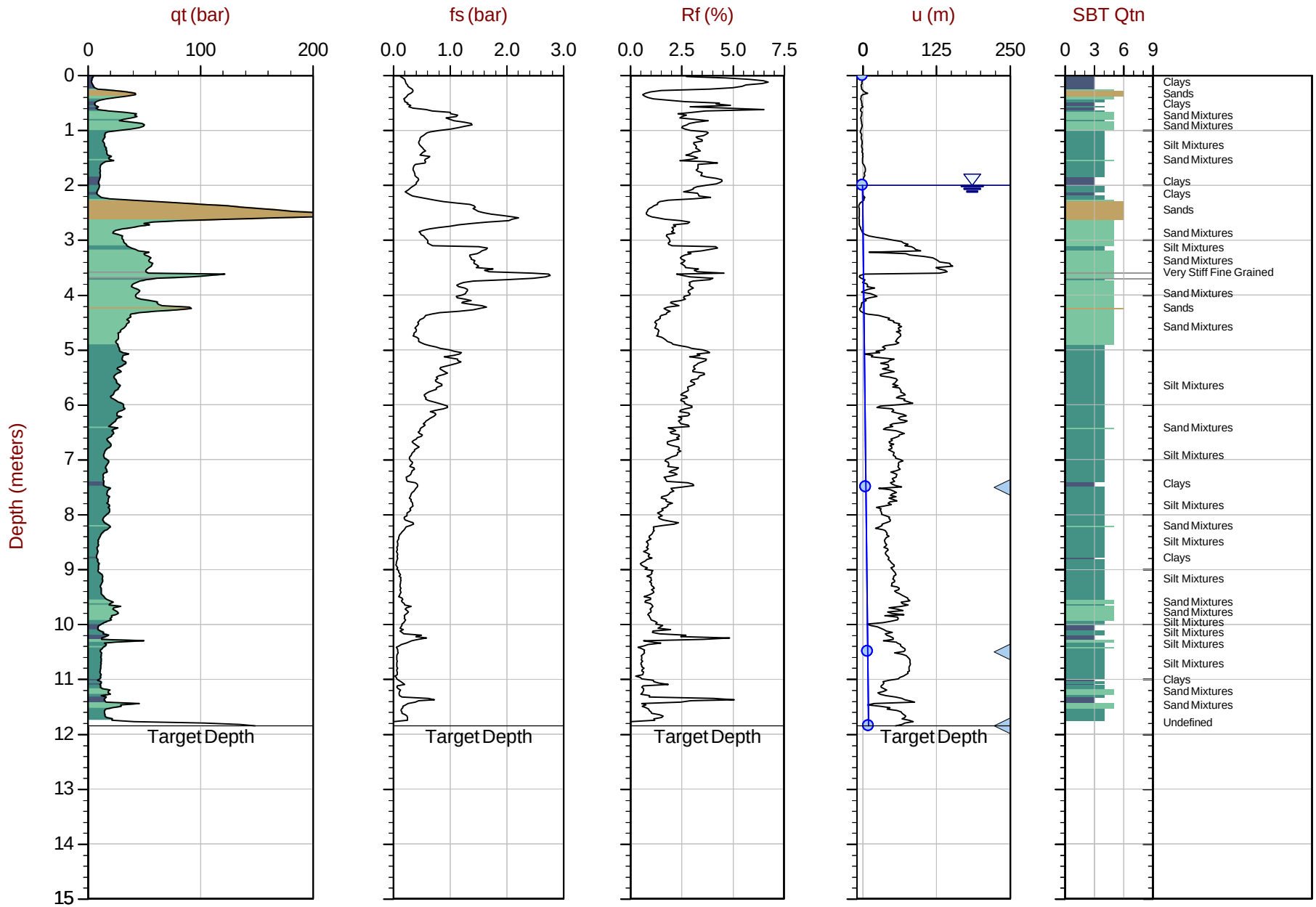
Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 09:30
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-3
Cone: 311:T1000F10U500



Max Depth: 11.850 m / 38.88 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-3.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872829m E: 724851m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

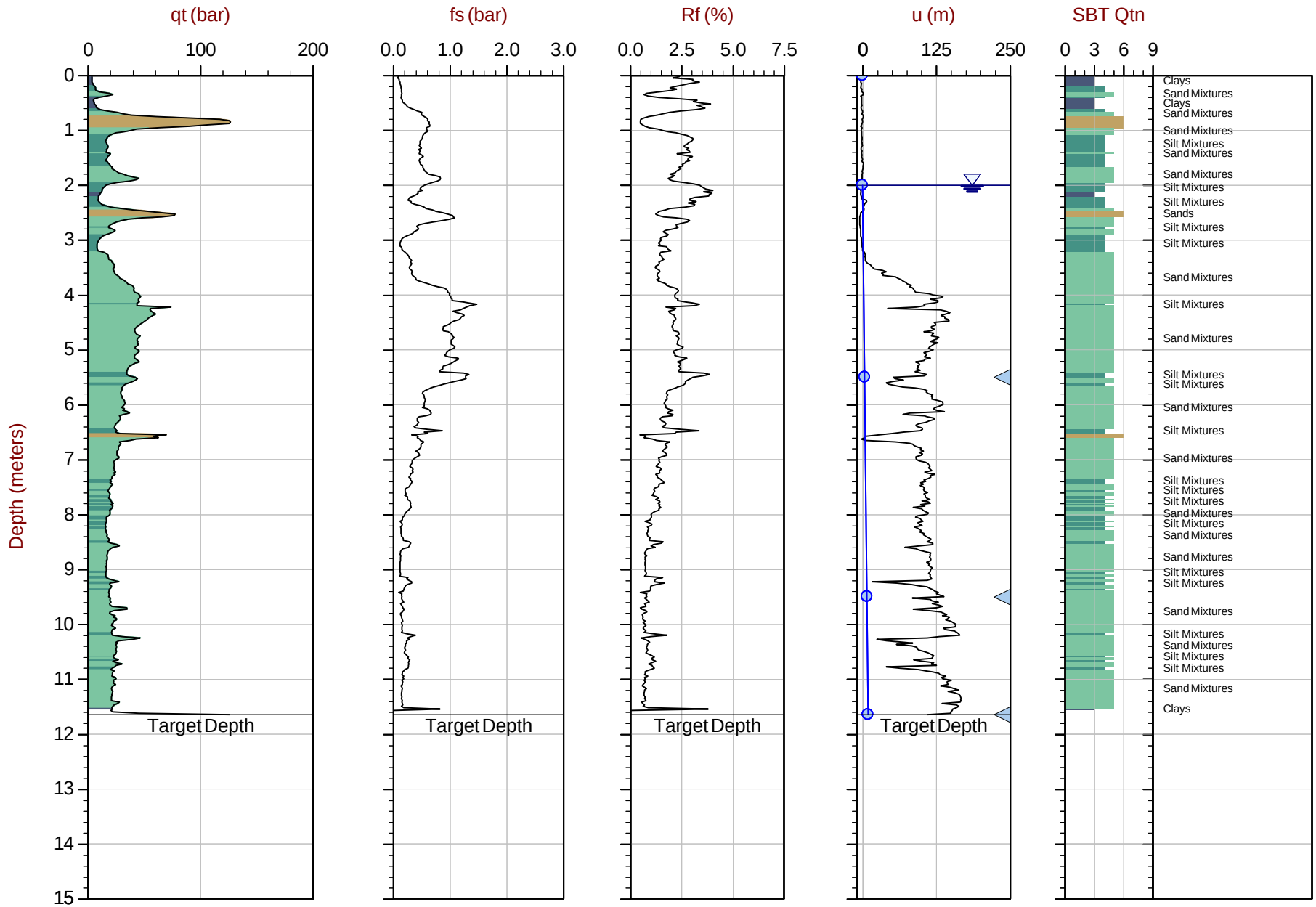
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 11:48
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-5
Cone: 311:T1000F10U500



Max Depth: 11.650 m / 38.22 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-5.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872804m E: 724850m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

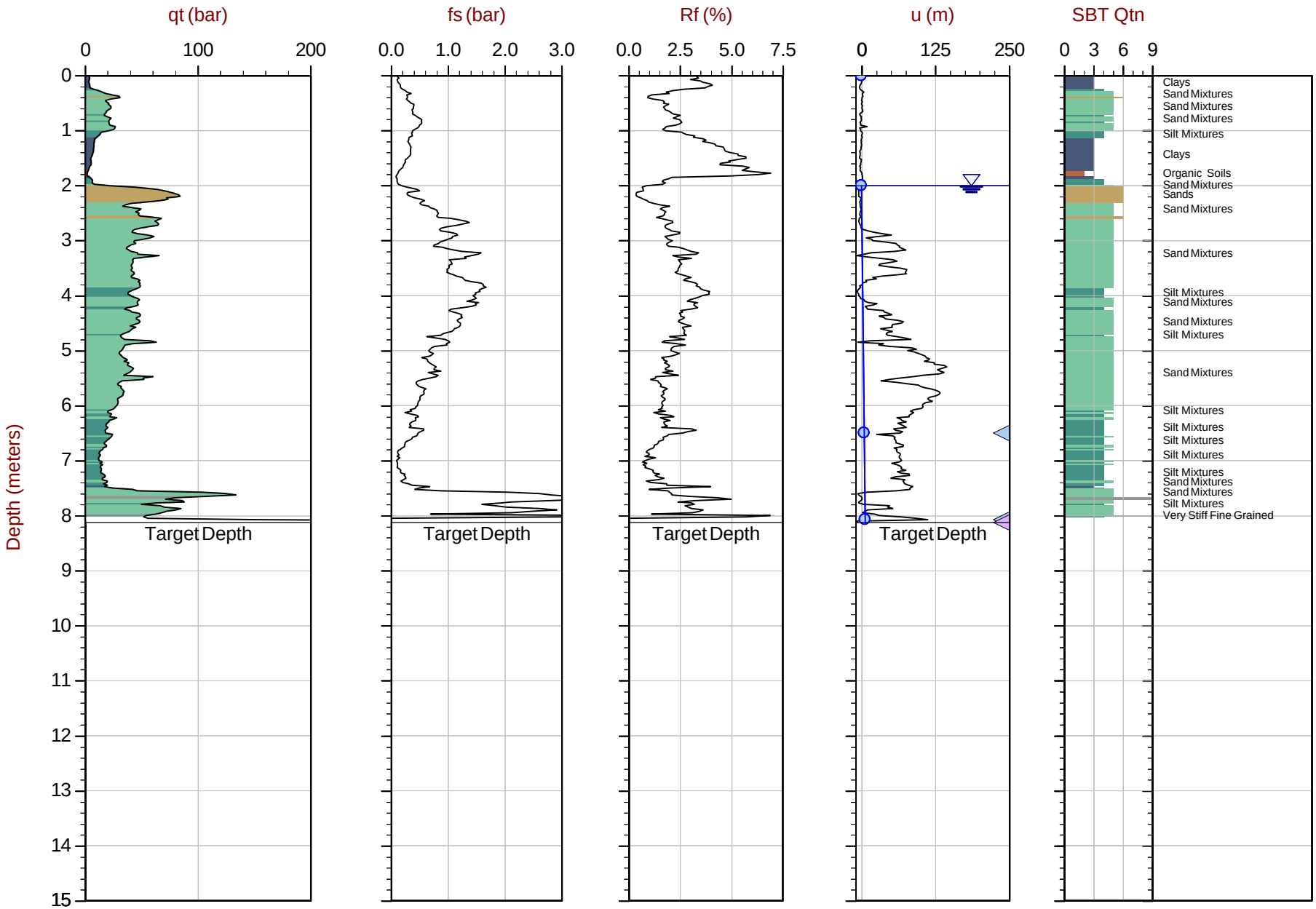
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 12:46
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-6
Cone: 311:T1000F10U500



Max Depth: 8.125 m / 26.66 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-6.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872769m E: 724821m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

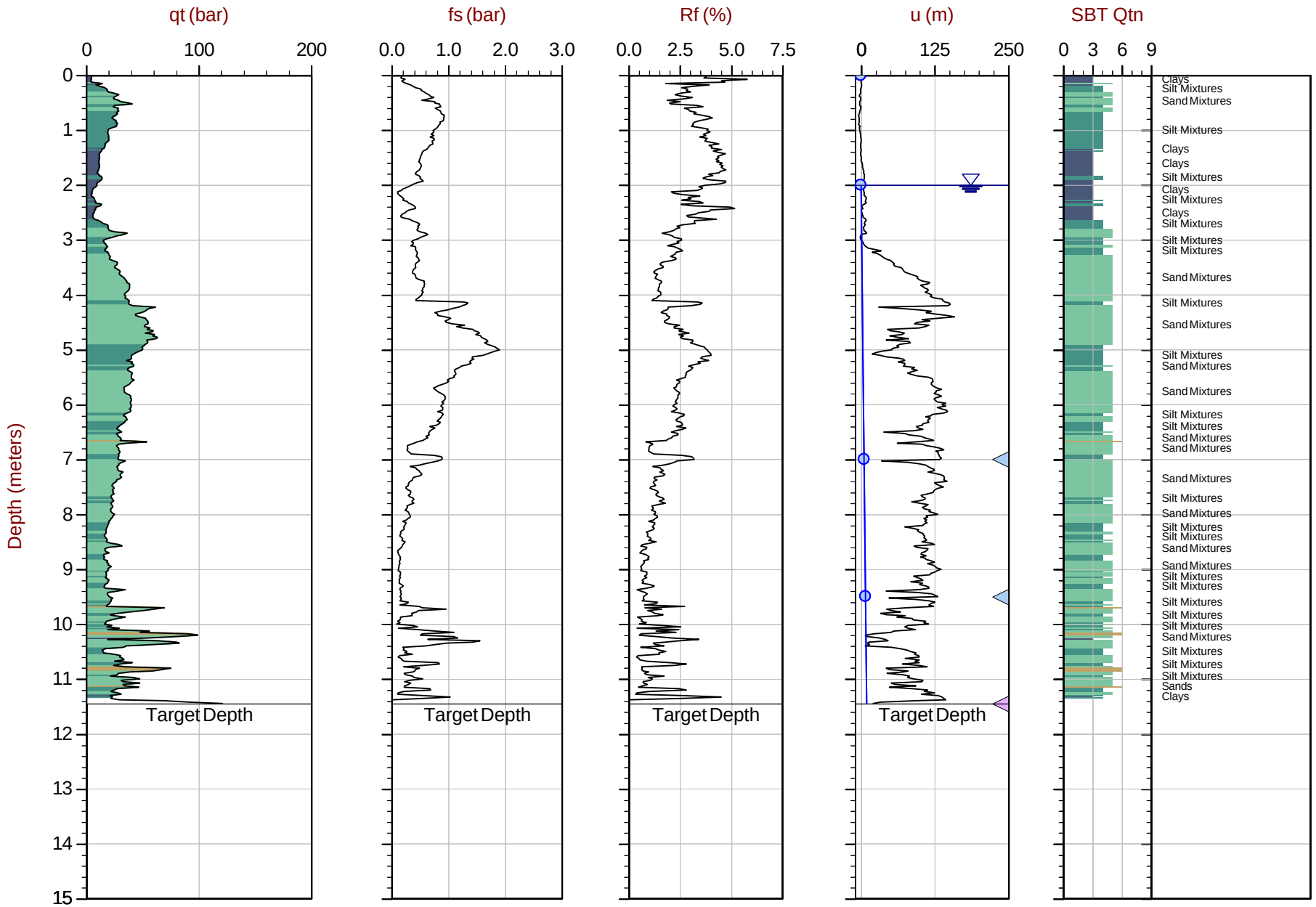
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 13:42
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-7
Cone: 311:T1000F10U500



Max Depth: 11.450 m / 37.57 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-7.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872788m E: 724868m
Sheet No: 1 of 1

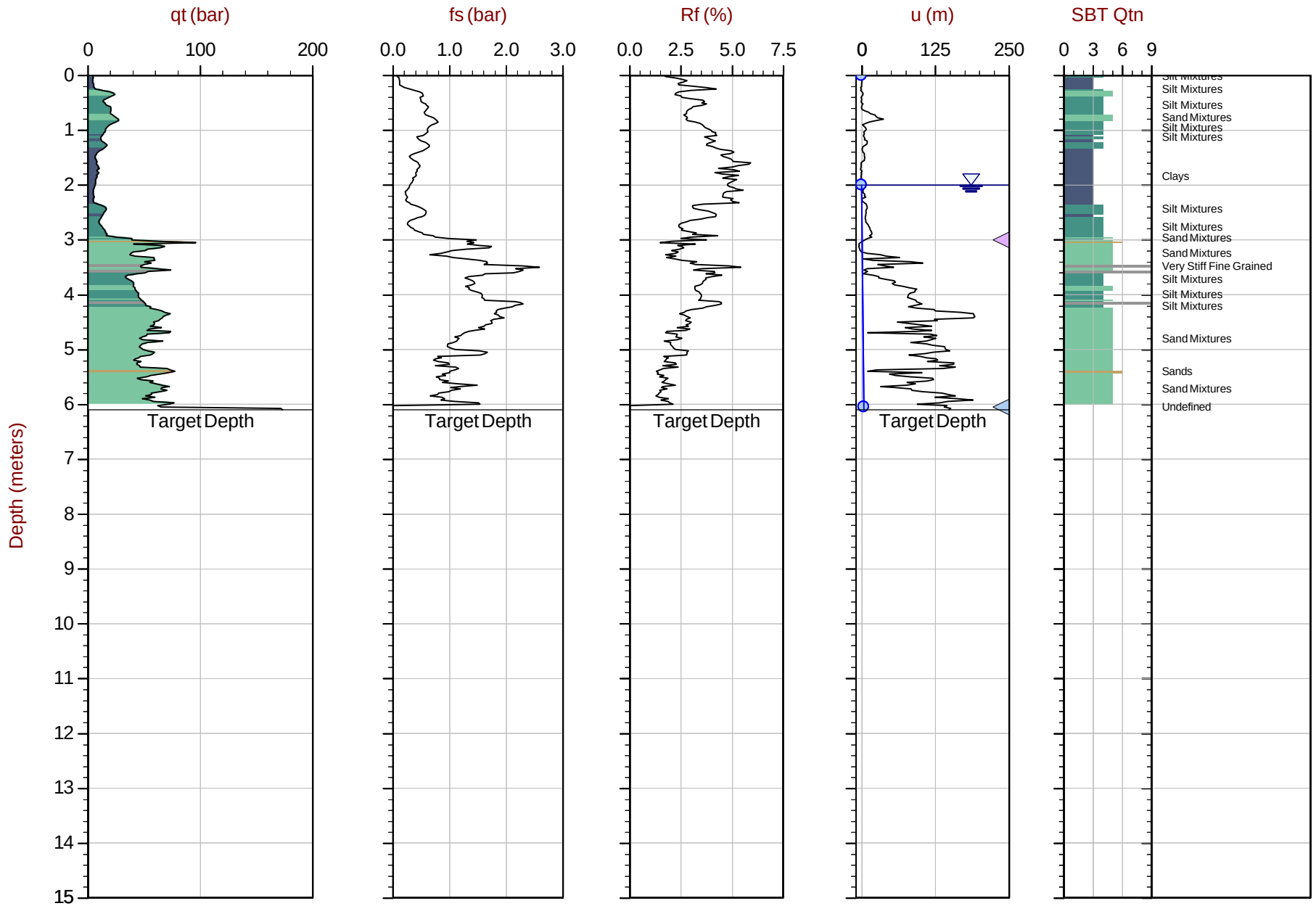
Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 14:45
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-9
Cone: 311:T1000F10U500



Max Depth: 6.100 m / 20.01 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-9.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872754m E: 724864m
Sheet No: 1 of 1

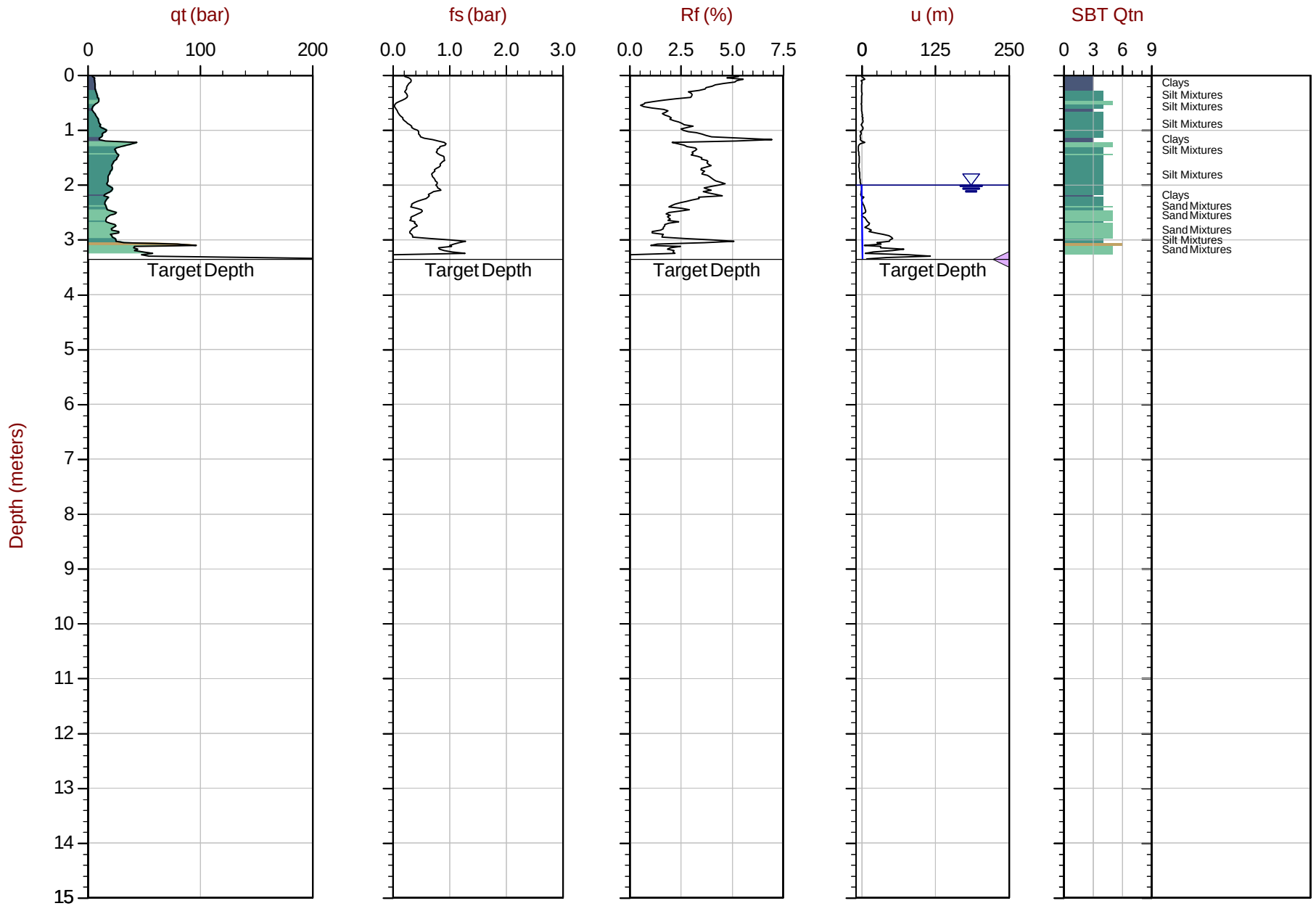
Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 15:49
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-12
Cone: 311:T1000F10U500



Max Depth: 3.350 m / 10.99 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-12.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872724m E: 724875m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

Advanced Cone Penetration Test Plots with Ic, Su(Nkt), Phi and N1(60)Ic

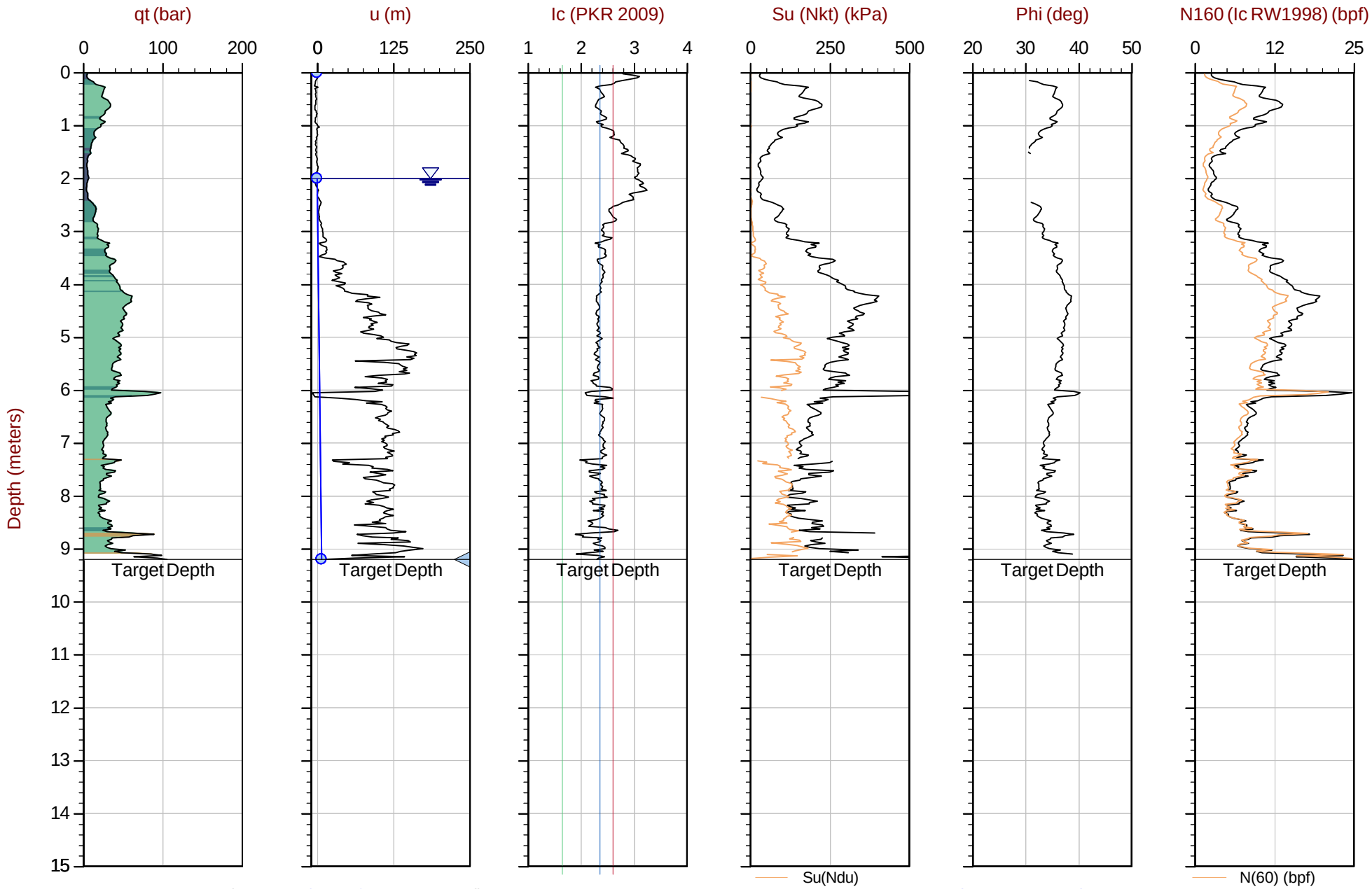
CONETEC

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-11 15:21
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-16-4
Cone: 311:T1000F10U500



Max Depth: 9.200 m / 30.18 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-16-4.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872774m E: 724849m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

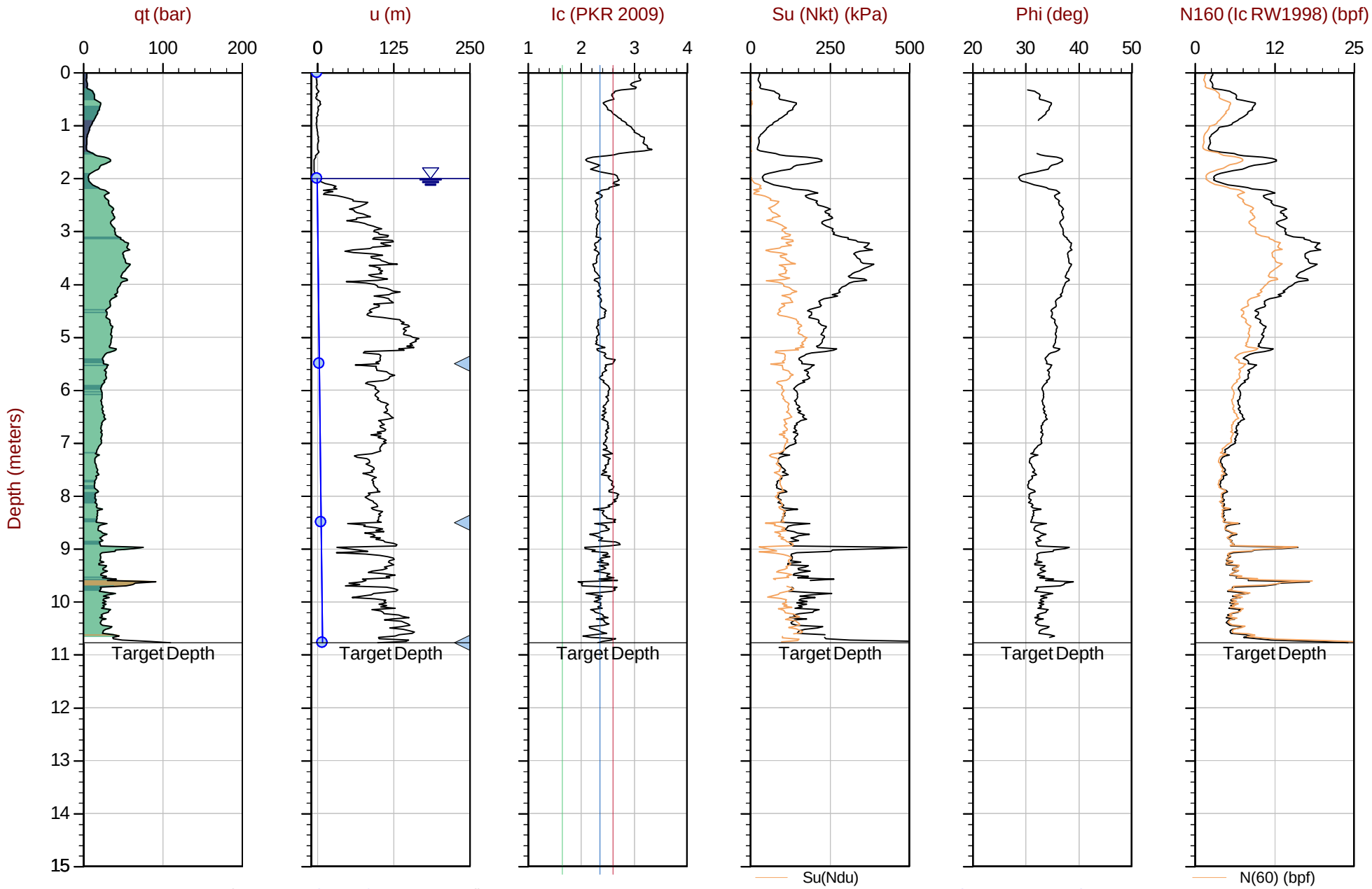
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 10:47
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-1
Cone: 311:T1000F10U500



Max Depth: 10.775 m / 35.35 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-1.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872808m E: 724808m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

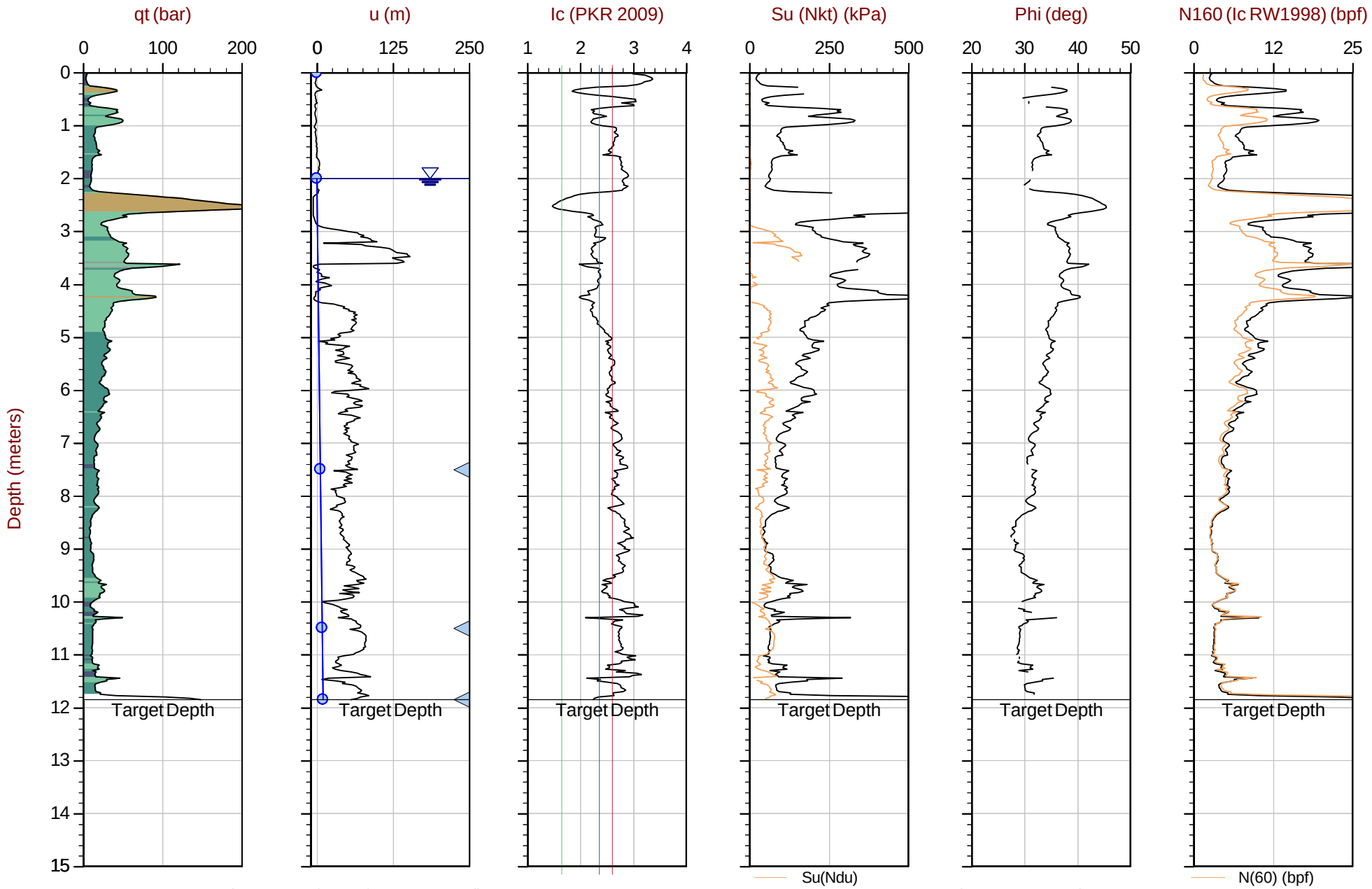
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 09:30
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-3
Cone: 311:T1000F10U500



Max Depth: 11.850 m / 38.88 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-3.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872829m E: 724851m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

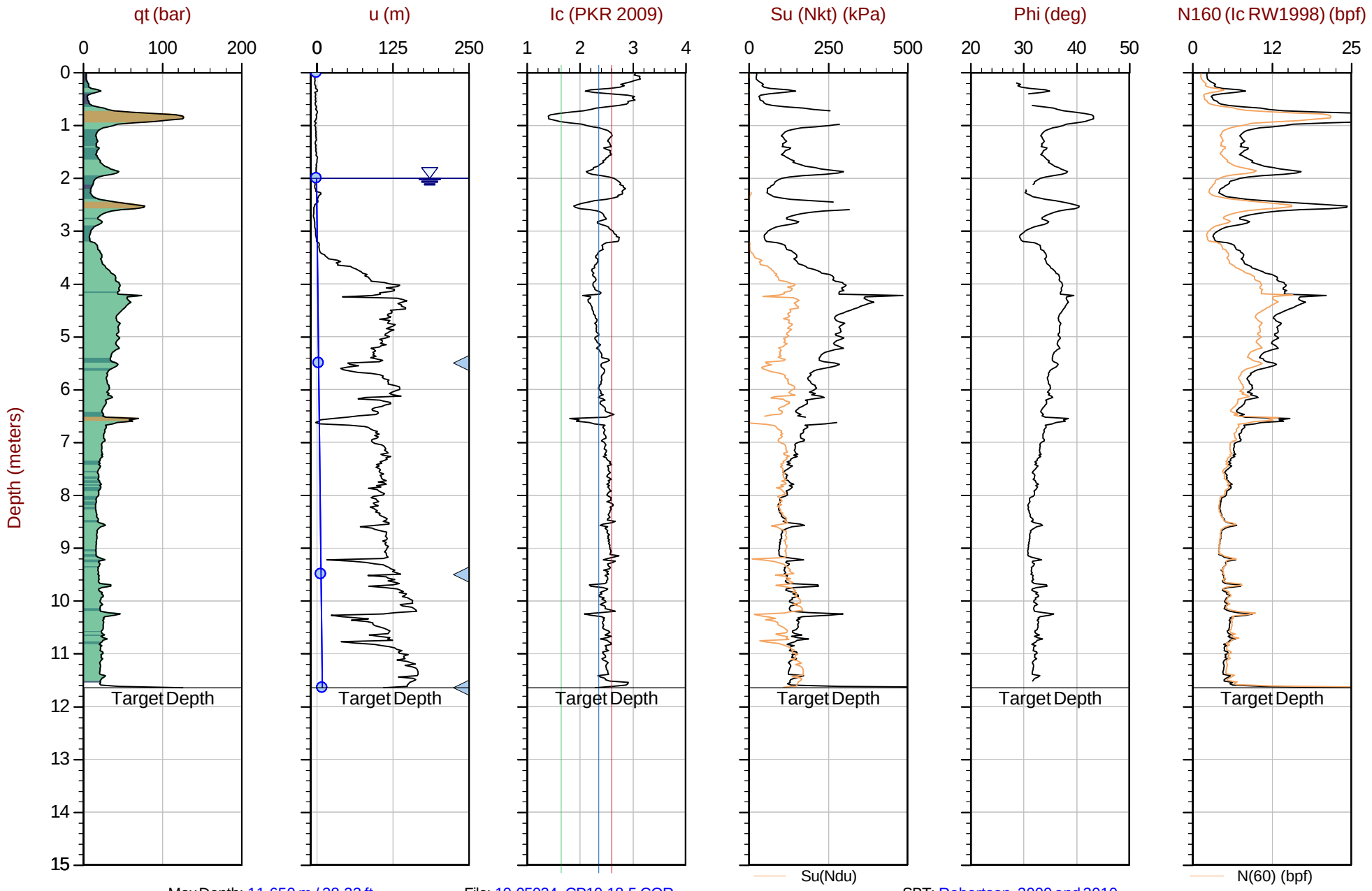
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 11:48
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-5
Cone: 311:T1000F10U500



Max Depth: 11.650 m / 38.22 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-5.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872804m E: 724850m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

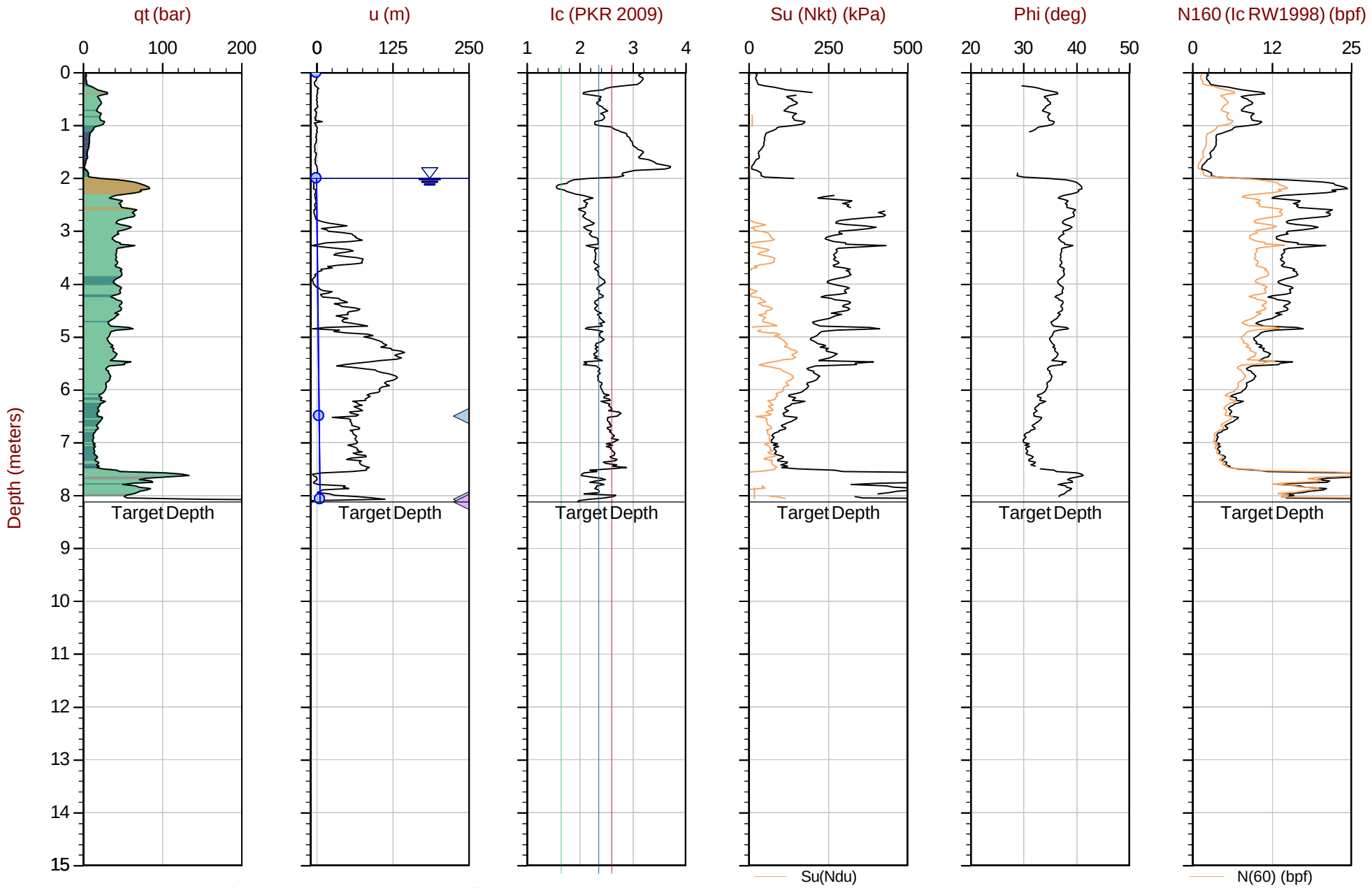
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 12:46
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-6
Cone: 311:T1000F10U500



Max Depth: 8.125 m / 26.66 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-6.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872769m E: 724821m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

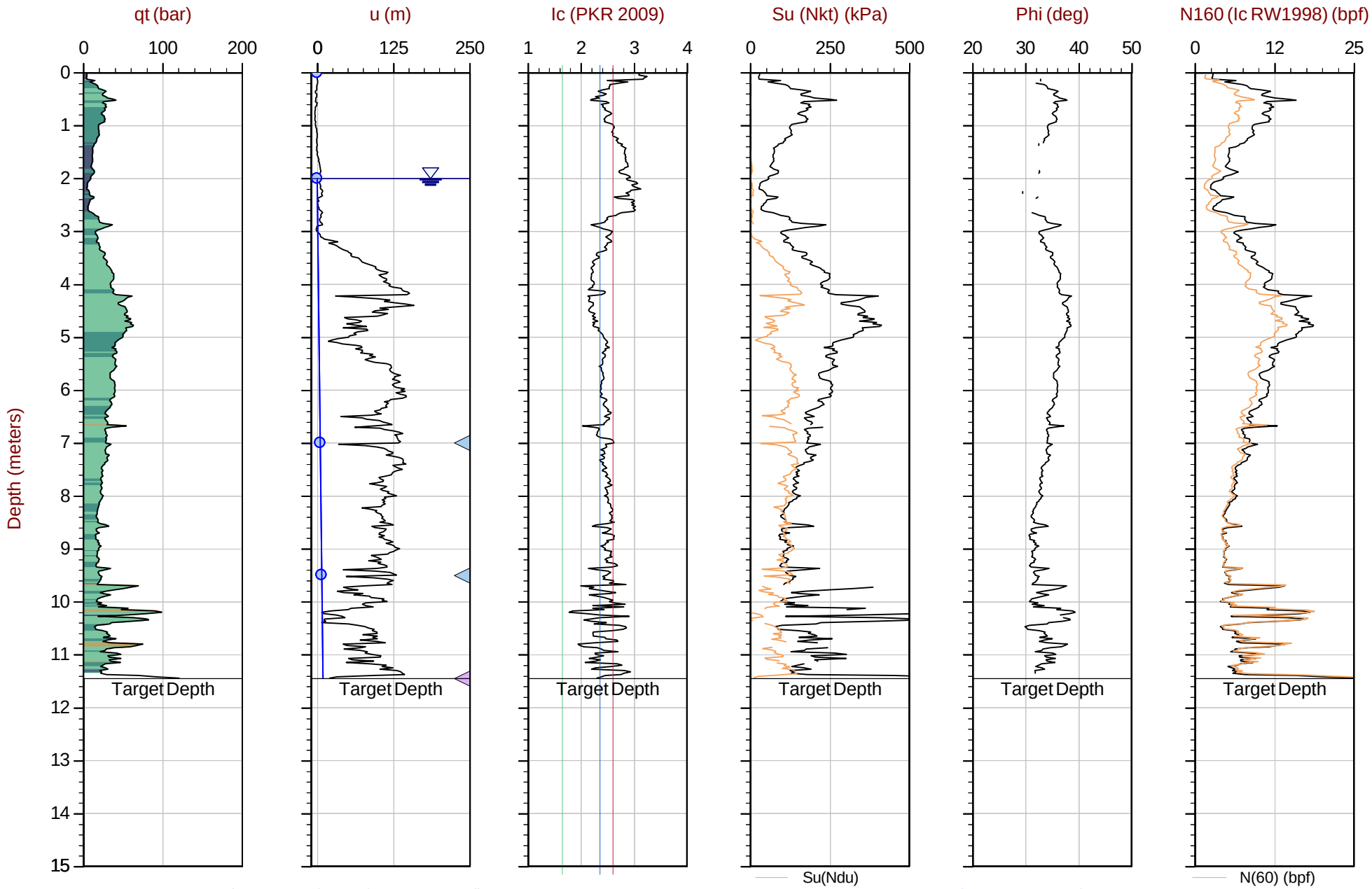
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 13:42
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-7
Cone: 311:T1000F10U500



Max Depth: 11.450 m / 37.57 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-7.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872788m E: 724868m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

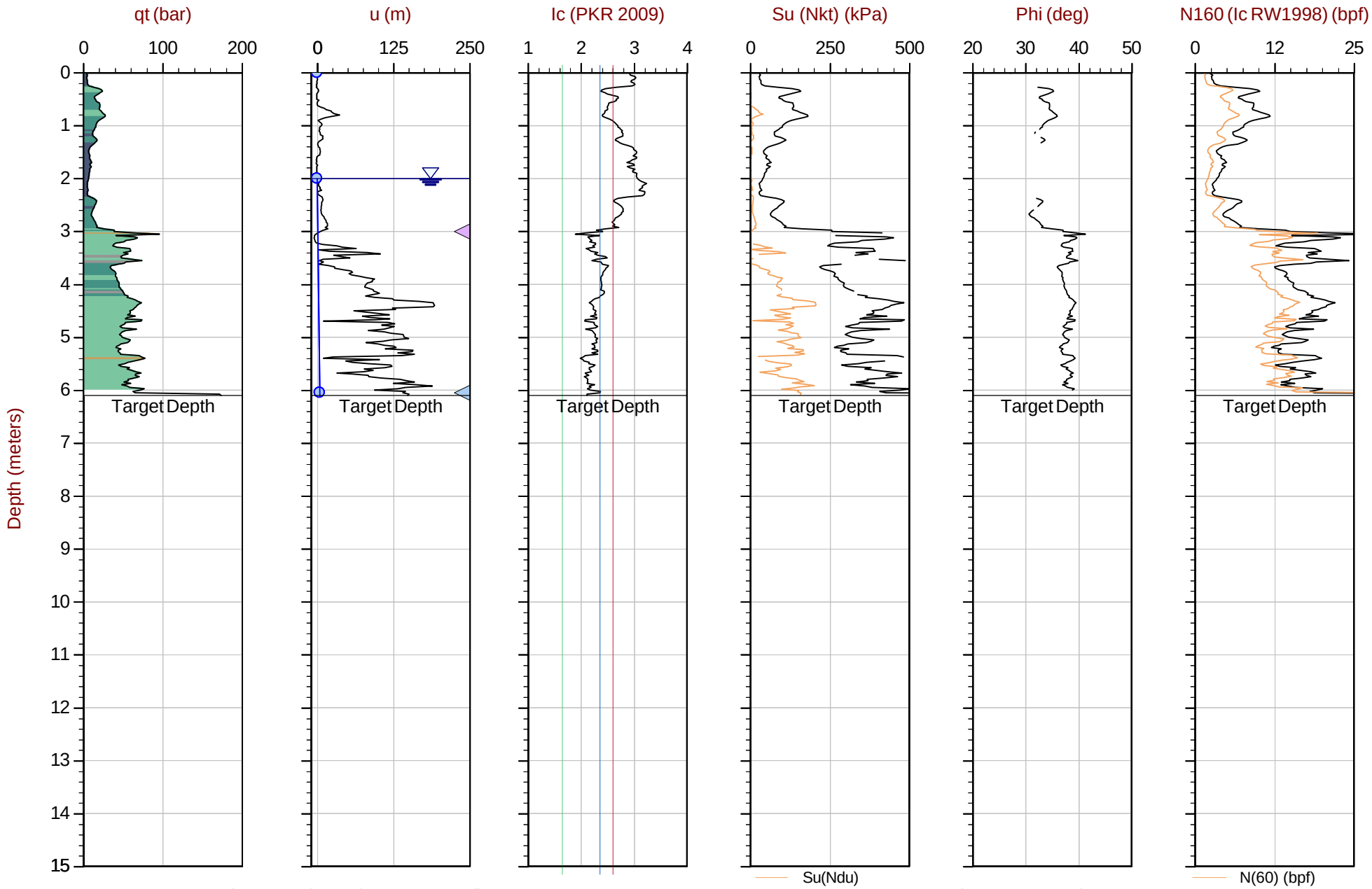
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 14:45
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-9
Cone: 311:T1000F10U500



Max Depth: 6.100 m / 20.01 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-9.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872754m E: 724864m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

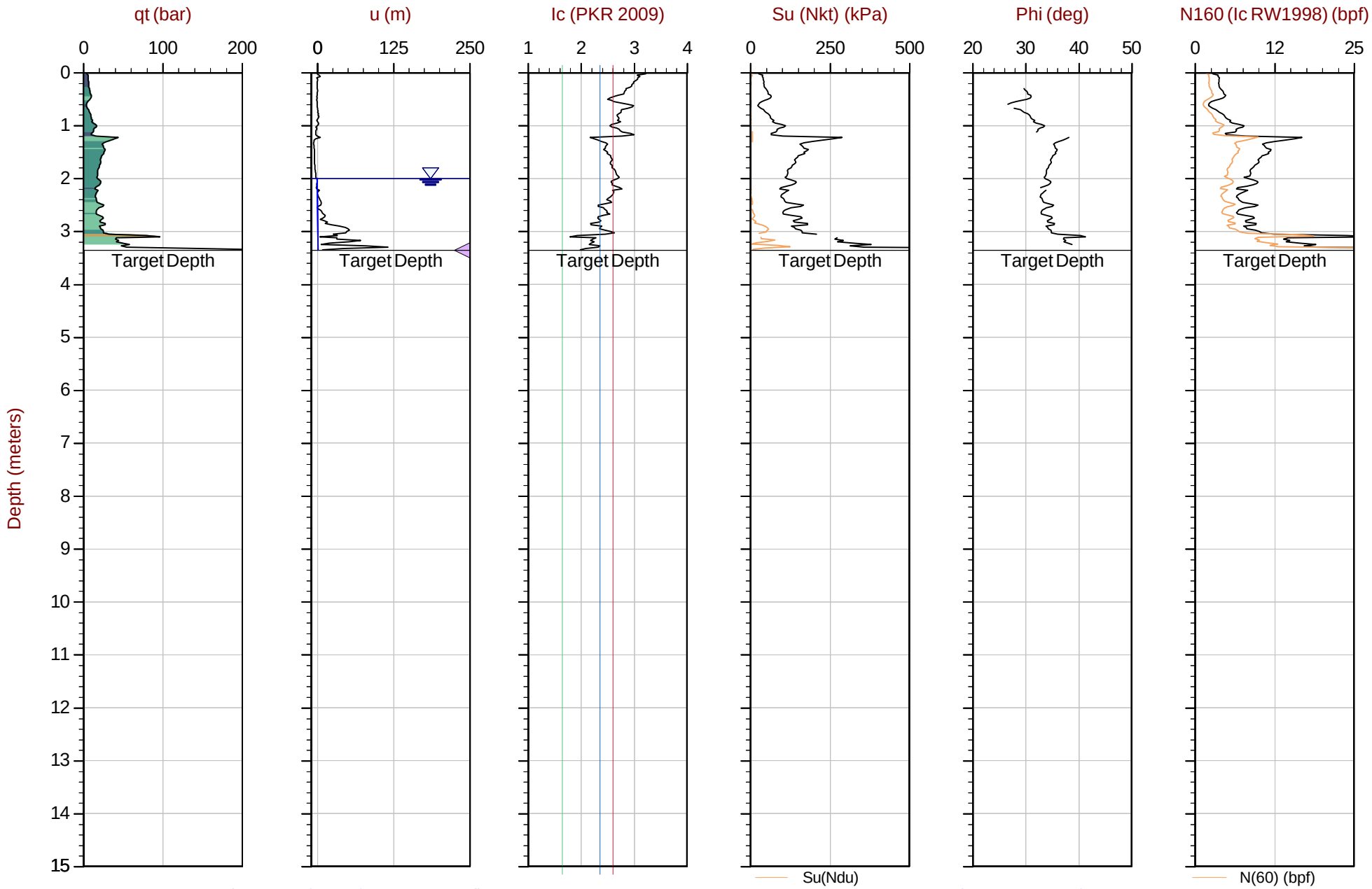
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Golder

Job No: 19-05024
Date: 2019-04-10 15:49
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-12
Cone: 311:T1000F10U500



Max Depth: 3.350 m / 10.99 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-05024_CP19-18-12.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4872724m E: 724875m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Soil Behaviour Type (SBT) Scatter Plots

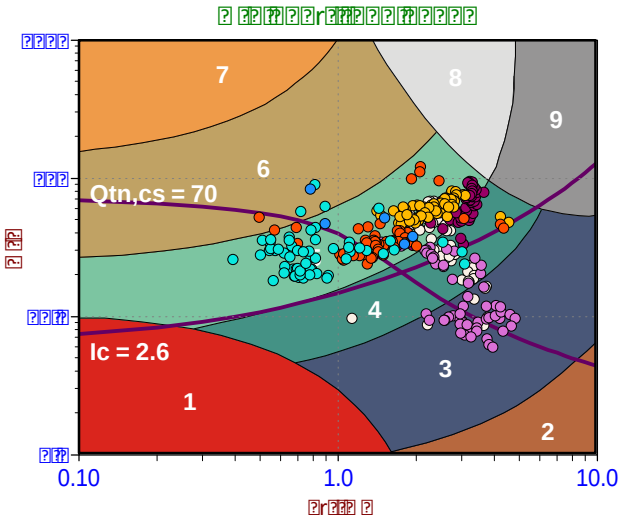
CONETEC

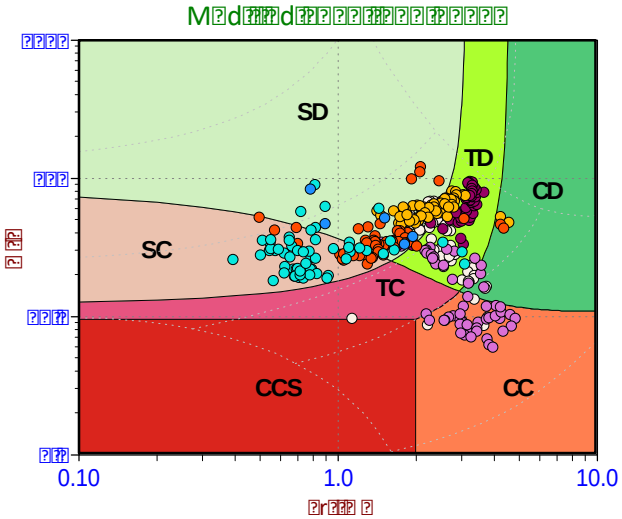
CONETEC

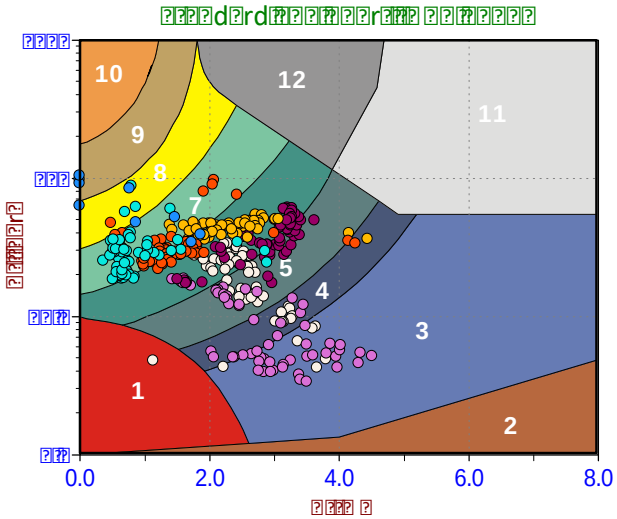
Golder

Job No: 19-05024
Date: 2019-04-11 15:21
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-16-4
Cone: 311:T1000F10U500







Depth Ranges

- >0.0 to 1.5 m
- >1.5 to 3.0 m
- >3.0 to 4.5 m
- >4.5 to 6.0 m
- >6.0 to 7.5 m
- >7.5 to 9.0 m
- >9.0 to 10.5 m
- >10.5 to 12.0 m
- >12.0 to 13.5 m
- >13.5 to 15.0 m
- >15.0 m

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

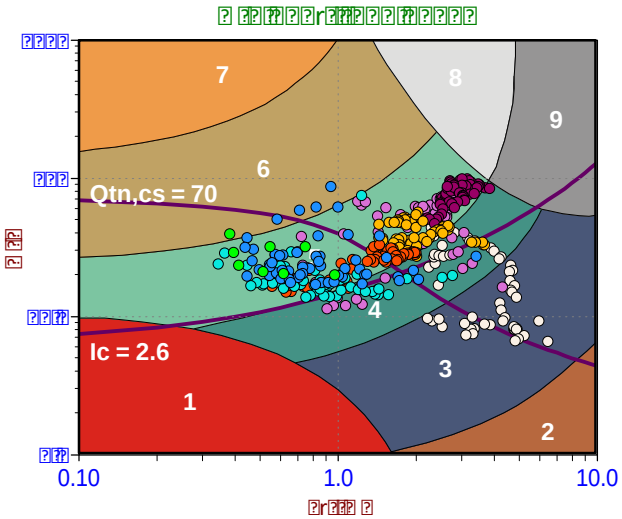
- Fines
- Fines
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

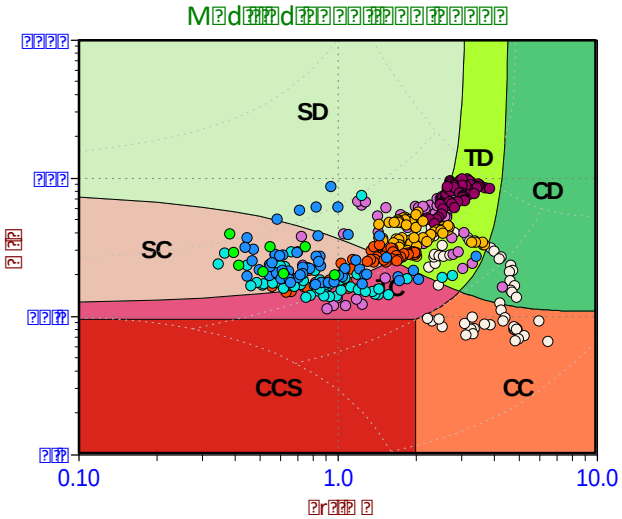
CONETEC

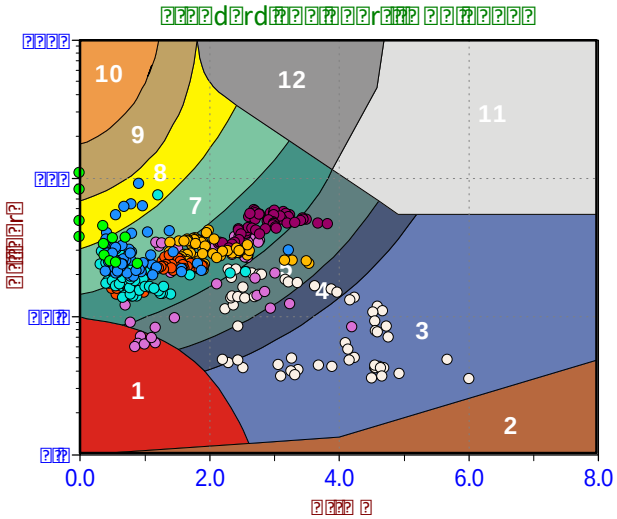
Golder

Job No: 19-05024
Date: 2019-04-10 10:47
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-1
Cone: 311:T1000F10U500







Depth Ranges

- >0.0 to 1.5 m
- >1.5 to 3.0 m
- >3.0 to 4.5 m
- >4.5 to 6.0 m
- >6.0 to 7.5 m
- >7.5 to 9.0 m
- >9.0 to 10.5 m
- >10.5 to 12.0 m
- >12.0 to 13.5 m
- >13.5 to 15.0 m
- >15.0 m

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

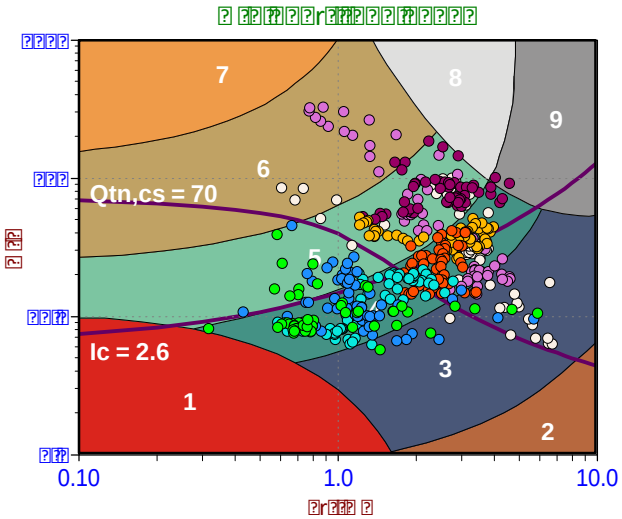
- Fines
- Fines
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

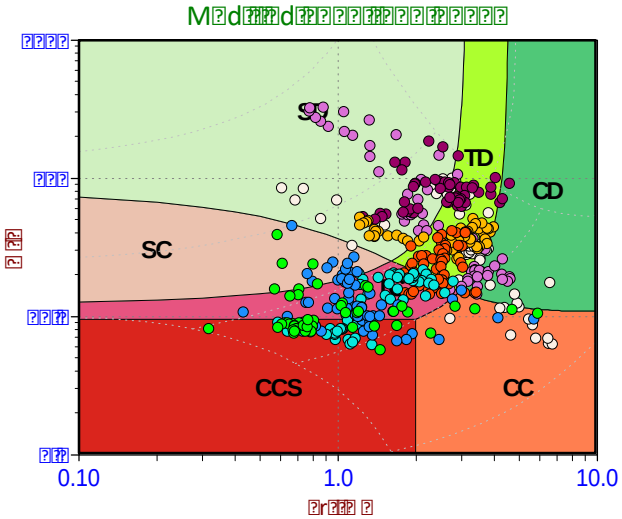
CONETEC

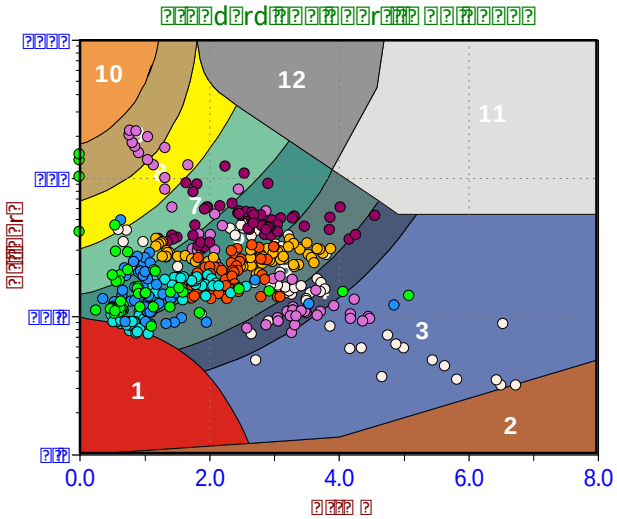
Golder

Job No: 19-05024
Date: 2019-04-10 09:30
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-3
Cone: 311:T1000F10U500







Depth Ranges

- >0.0 to 1.5 m
- >1.5 to 3.0 m
- >3.0 to 4.5 m
- >4.5 to 6.0 m
- >6.0 to 7.5 m
- >7.5 to 9.0 m
- >9.0 to 10.5 m
- >10.5 to 12.0 m
- >12.0 to 13.5 m
- >13.5 to 15.0 m
- >15.0 m

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

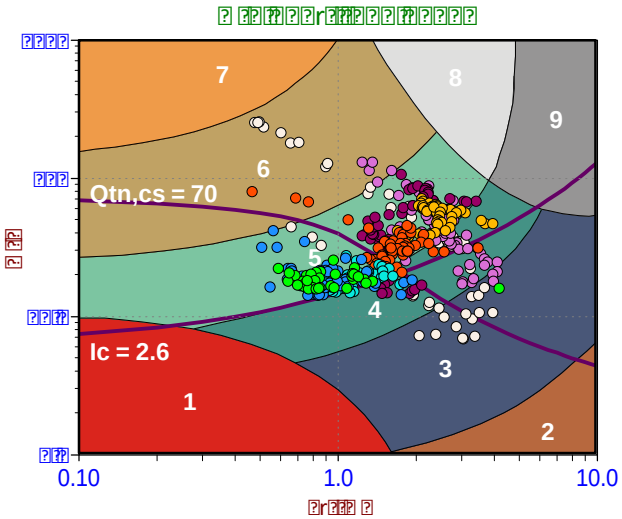
- Fines
- Fines
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

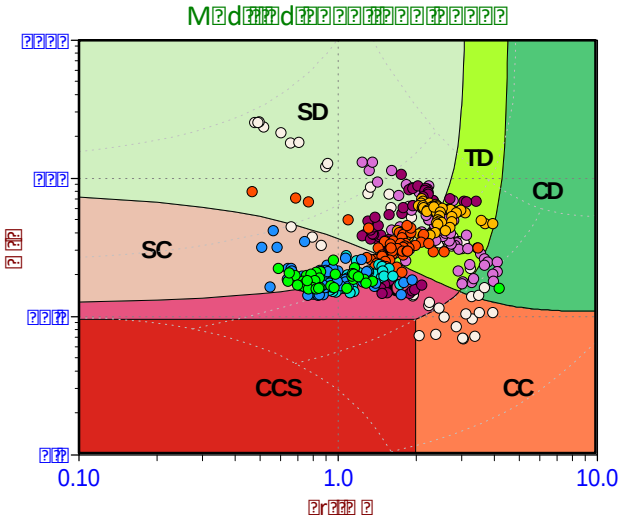
CONETEC

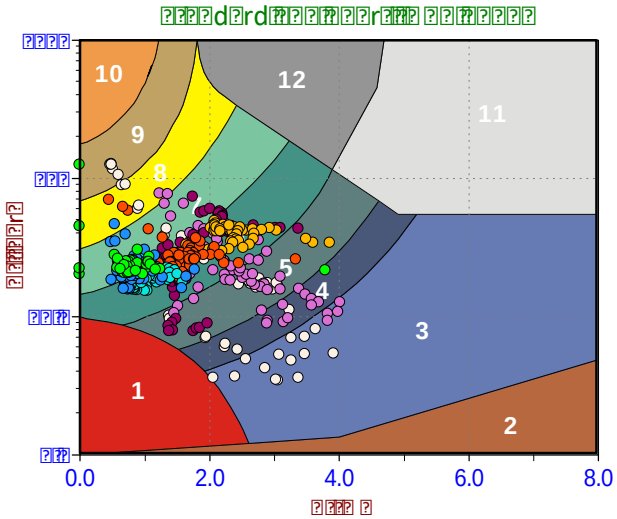
Golder

Job No: 19-05024
Date: 2019-04-10 11:48
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-5
Cone: 311:T1000F10U500







Depth Ranges

- >0.0 to 1.5 m
- >1.5 to 3.0 m
- >3.0 to 4.5 m
- >4.5 to 6.0 m
- >6.0 to 7.5 m
- >7.5 to 9.0 m
- >9.0 to 10.5 m
- >10.5 to 12.0 m
- >12.0 to 13.5 m
- >13.5 to 15.0 m
- >15.0 m

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

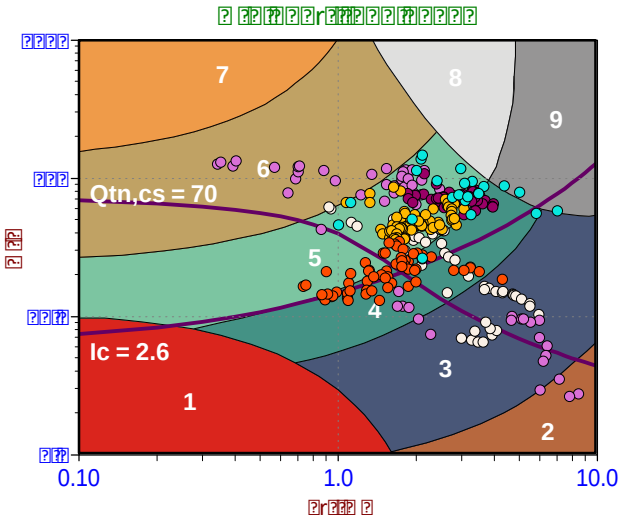
- Fines
- Fines
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

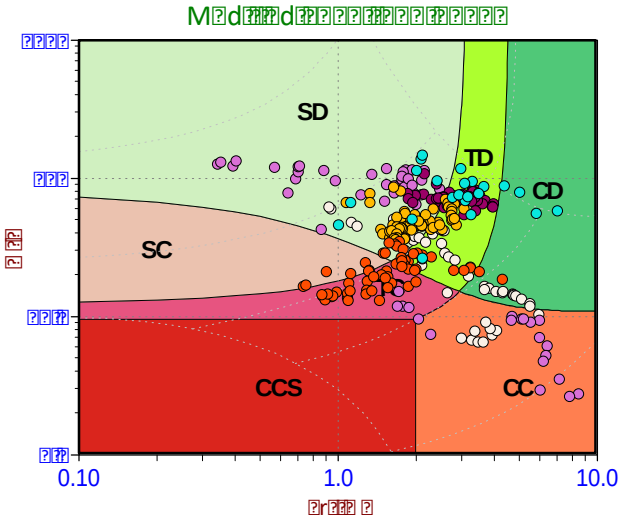
CONETEC

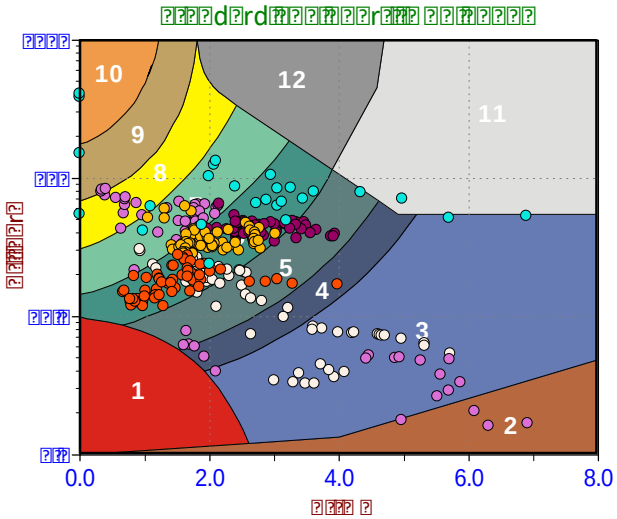
Golder

Job No: 19-05024
Date: 2019-04-10 12:46
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-6
Cone: 311:T1000F10U500







Depth Ranges

- >0.0 to 1.5 m
- >1.5 to 3.0 m
- >3.0 to 4.5 m
- >4.5 to 6.0 m
- >6.0 to 7.5 m
- >7.5 to 9.0 m
- >9.0 to 10.5 m
- >10.5 to 12.0 m
- >12.0 to 13.5 m
- >13.5 to 15.0 m
- >15.0 m

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

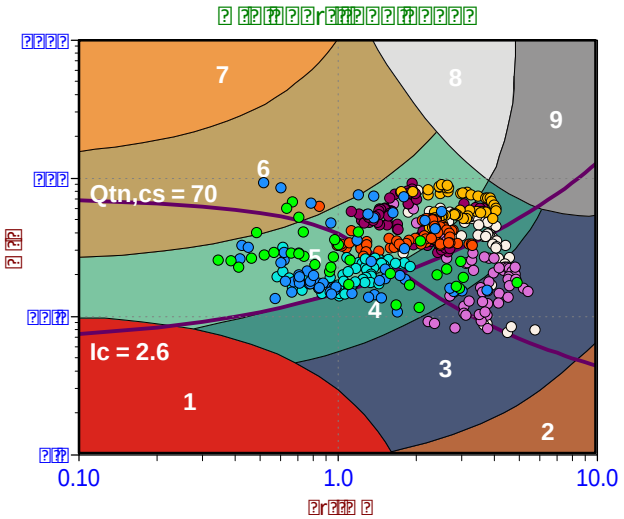
- Fines
- Fines
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

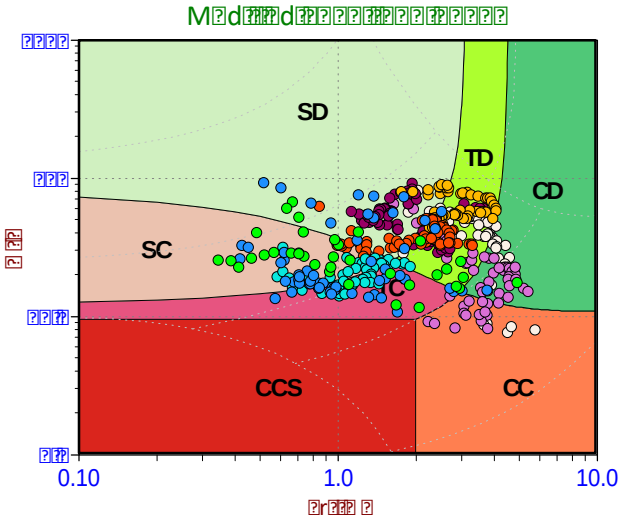
CONETEC

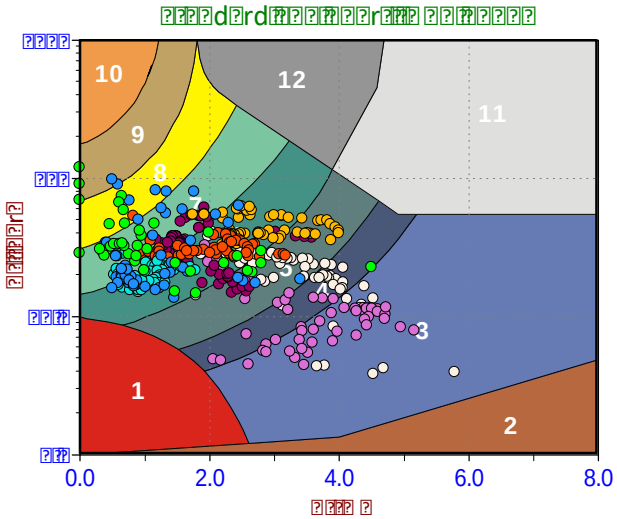
Golder

Job No: 19-05024
Date: 2019-04-10 13:42
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-7
Cone: 311:T1000F10U500







Depth Ranges

- >0.0 to 1.5 m
- >1.5 to 3.0 m
- >3.0 to 4.5 m
- >4.5 to 6.0 m
- >6.0 to 7.5 m
- >7.5 to 9.0 m
- >9.0 to 10.5 m
- >10.5 to 12.0 m
- >12.0 to 13.5 m
- >13.5 to 15.0 m
- >15.0 m

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

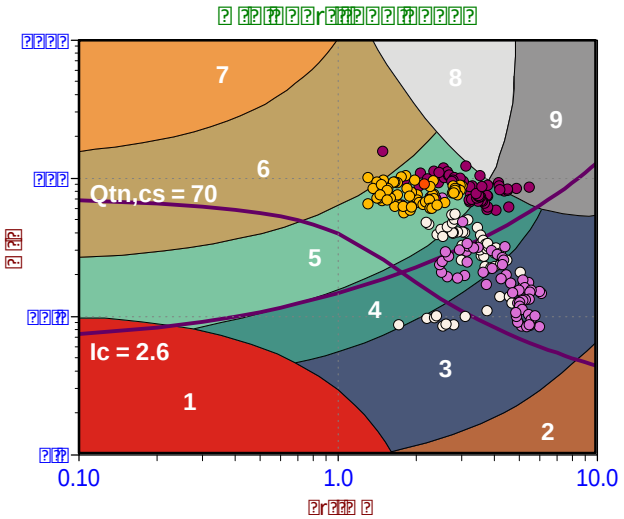
- Fines
- Fines
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

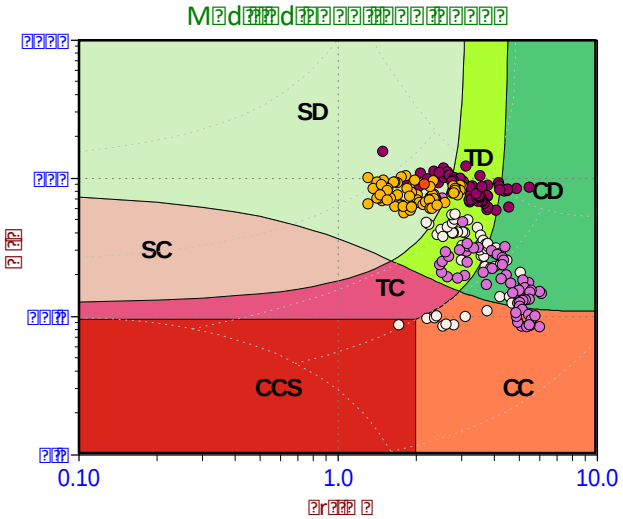
CONETEC

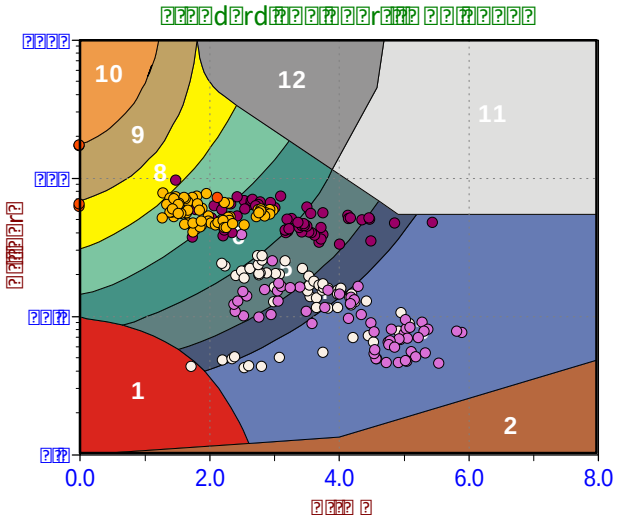
Golder

Job No: 19-05024
Date: 2019-04-10 14:45
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-9
Cone: 311:T1000F10U500







Depth Ranges

- >0.0 to 1.5 m
- >1.5 to 3.0 m
- >3.0 to 4.5 m
- >4.5 to 6.0 m
- >6.0 to 7.5 m
- >7.5 to 9.0 m
- >9.0 to 10.5 m
- >10.5 to 12.0 m
- >12.0 to 13.5 m
- >13.5 to 15.0 m
- >15.0 m

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

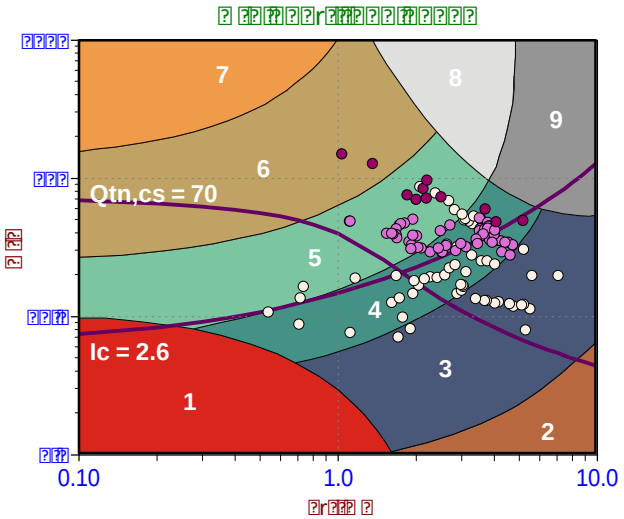
- Fines
- Fines
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

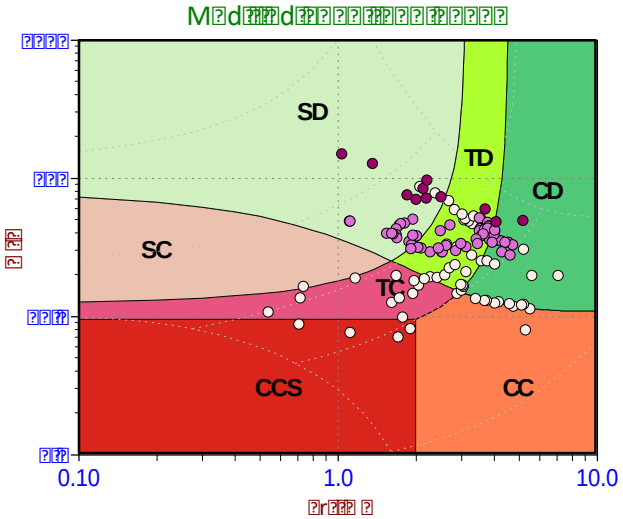
CONETEC

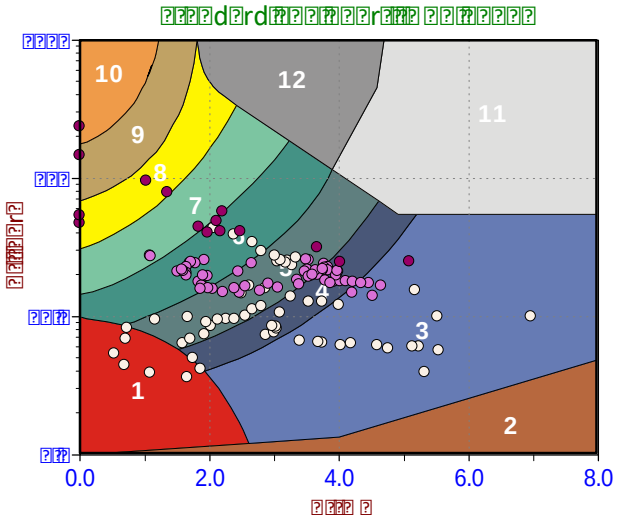
Golder

Job No: 19-05024
Date: 2019-04-10 15:49
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-12
Cone: 311:T1000F10U500







Depth Ranges

- >0.0 to 1.5 m
- >1.5 to 3.0 m
- >3.0 to 4.5 m
- >4.5 to 6.0 m
- >6.0 to 7.5 m
- >7.5 to 9.0 m
- >9.0 to 10.5 m
- >10.5 to 12.0 m
- >12.0 to 13.5 m
- >13.5 to 15.0 m
- >15.0 m

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

- Fines
- Fines
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Job No:	19-05024
Client:	Golder Associates
Project:	Golden Plough Lodge
Start Date:	10-Apr-2019
End Date:	11-Apr-2019

CPTu PORE PRESSURE DISSIPATION SUMMARY

Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (m)	Equilibrium Pore Pressure U_{eq} (m)	Estimated Equilibrium Pore Pressure U_{eq} (m)	Calculated Phreatic Surface (m)	Estimated Phreatic Surface (m)	t_{50} [a] (s)	Assumed Rigidity Index (I_r)	c_h [b] (cm^2/min)
CPT19-16-4	19-05024_CP19-16-4	10	350	9.200	Not Achieved	7.2		2.0	172	100	2.7
CPT19-18-1	19-05024_CP19-18-1	10	600	5.500	Not Achieved	3.5		2.0	528	100	0.9
CPT19-18-1	19-05024_CP19-18-1	10	365	8.500	Not Achieved	6.5		2.0	219	100	2.1
CPT19-18-1	19-05024_CP19-18-1	10	300	10.775	Not Achieved	8.8		2.0	69	100	6.7
CPT19-18-3	19-05024_CP19-18-3	10	505	7.500	Not Achieved	5.5		2.0	313	100	1.5
CPT19-18-3	19-05024_CP19-18-3	10	405	10.500	Not Achieved	8.5		2.0	210	100	2.2
CPT19-18-3	19-05024_CP19-18-3	10	300	11.850	Not Achieved	9.9		2.0	160	100	2.9
CPT19-18-5	19-05024_CP19-18-5	10	450	5.500	Not Achieved	3.5		2.0	327	100	1.4
CPT19-18-5	19-05024_CP19-18-5	10	300	9.500	Not Achieved	7.5		2.0	90	100	5.2
CPT19-18-5	19-05024_CP19-18-5	10	300	11.650	Not Achieved	9.7		2.0	179	100	2.6
CPT19-18-6	19-05024_CP19-18-6	10	305	6.500	Not Achieved	4.5		2.0	100	100	4.7
CPT19-18-6	19-05024_CP19-18-6	10	335	8.075	Not Achieved	6.1		2.0	157	100	3.0
CPT19-18-6	19-05024_CP19-18-6	10	235	8.125	Not Achieved						
CPT19-18-7	19-05024_CP19-18-7	10	300	7.000	Not Achieved	5.0		2.0	115	100	4.1
CPT19-18-7	19-05024_CP19-18-7	10	315	9.500	Not Achieved	7.5		2.0	49	100	9.5
CPT19-18-7	19-05024_CP19-18-7	10	300	11.450	Not Achieved						
CPT19-18-9	19-05024_CP19-18-9	10	300	3.000	Not Achieved						
CPT19-18-9	19-05024_CP19-18-9	10	600	6.050	Not Achieved	4.1		2.0	352	100	1.3
CPT19-18-12	19-05024_CP19-18-12	10	300	3.350	Not Achieved						

a. Time is relative to where umax occurred.

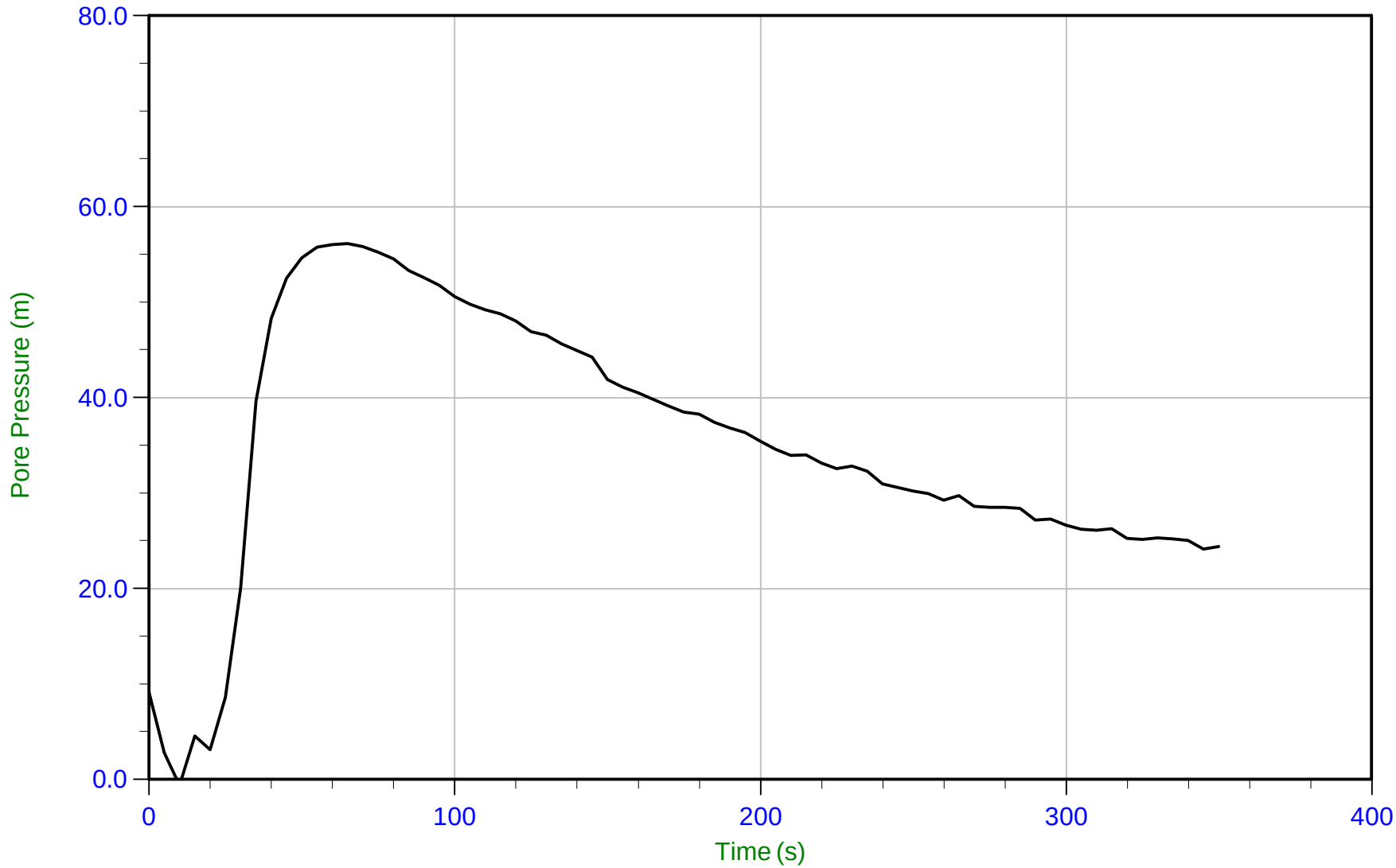
b. Houlsby and Teh, 1991.

CONETEC

Golder

Job No: 19-05024
Date: 04/11/2019 15:21
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-16-4
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-16-4.PPF
Depth: 9.200 m / 30.183 ft
Duration: 350.0 s

u Min: -0.7 m
u Max: 56.1 m
u Final: 24.4 m

WT: 2.000 m / 6.562 ft
Ueq: 7.2 m
U(50): 31.66 m

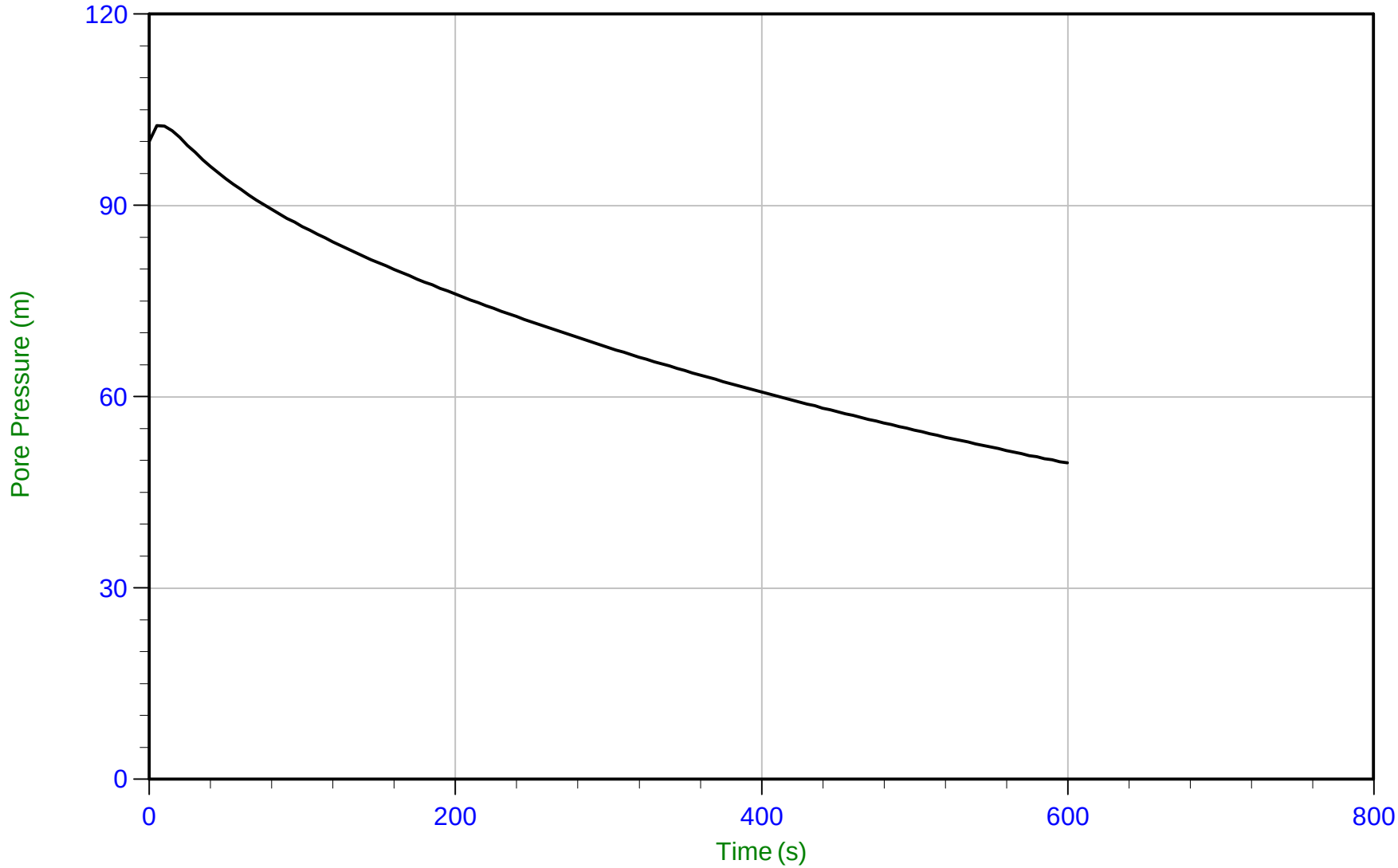
T(50): 172.4 s
Ir: 100
Ch: 2.7 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 10:47
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-1
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-1.PPF
Depth: 5.500 m / 18.044 ft
Duration: 600.0 s

u Min: 49.6 m
u Max: 102.5 m
u Final: 49.6 m

WT: 2.000 m / 6.562 ft
Ueq: 3.5 m
U(50): 53.00 m

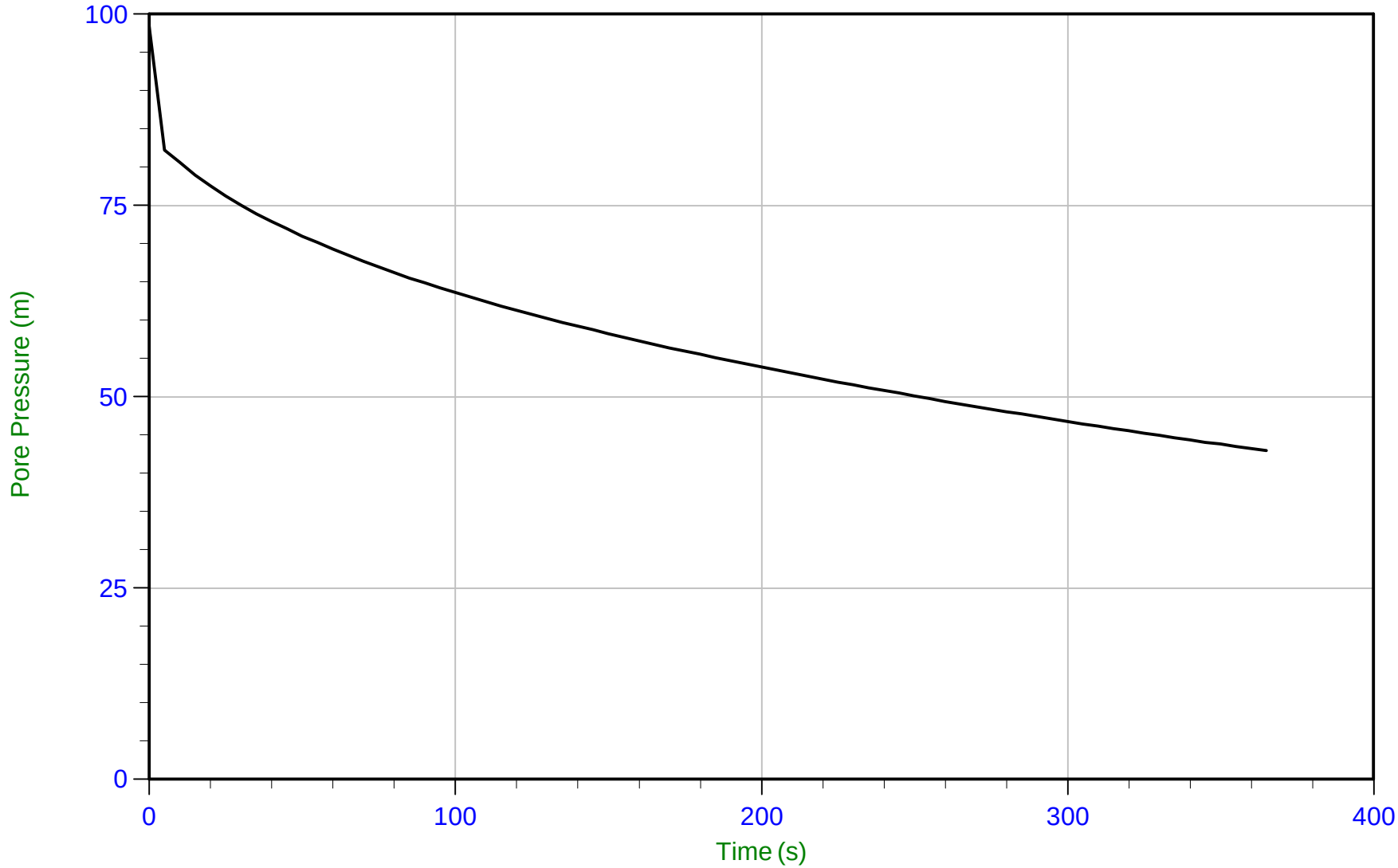
T(50): 527.8 s
Ir: 100
Ch: 0.9 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 10:47
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-1
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-1.PPF
Depth: 8.500 m / 27.887 ft
Duration: 365.0 s

u Min: 43.0 m
u Max: 98.4 m
u Final: 43.0 m

WT: 2.000 m / 6.562 ft
Ueq: 6.5 m
U(50): 52.43 m

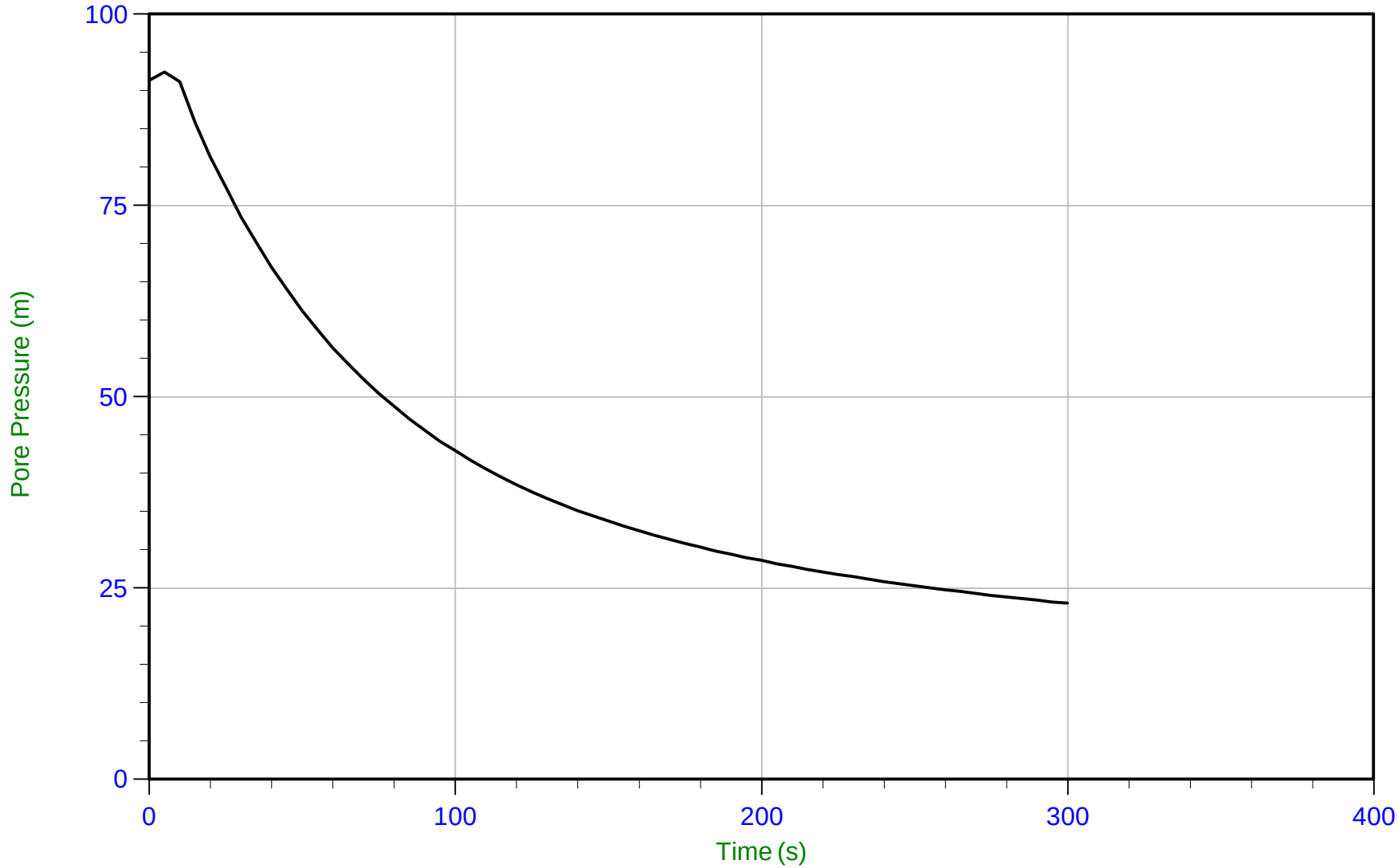
T(50): 218.6 s
Ir: 100
Ch: 2.1 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 10:47
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-1
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-1.PPF
Depth: 10.775 m / 35.351 ft
Duration: 300.0 s

u Min: 23.0 m
u Max: 92.4 m
u Final: 23.0 m

WT: 2.000 m / 6.562 ft
Ueq: 8.8 m
U(50): 50.60 m

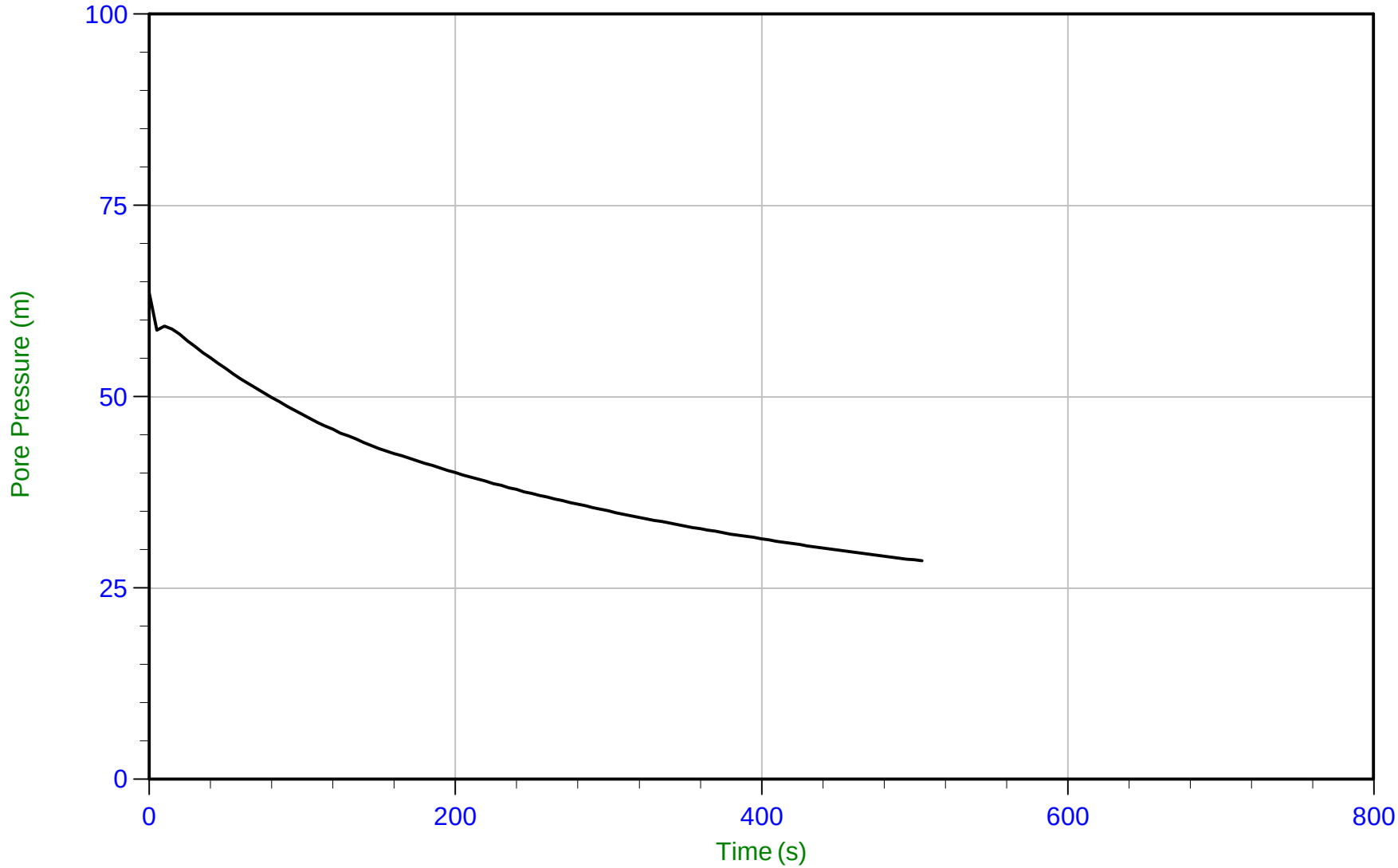
T(50): 69.5 s
Ir: 100
Ch: 6.7 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 09:30
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-3
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-3.PPF
Depth: 7.500 m / 24.606 ft
Duration: 505.0 s

u Min: 28.5 m
u Max: 63.6 m
u Final: 28.5 m

WT: 2.000 m / 6.562 ft
Ueq: 5.5 m
U(50): 34.54 m

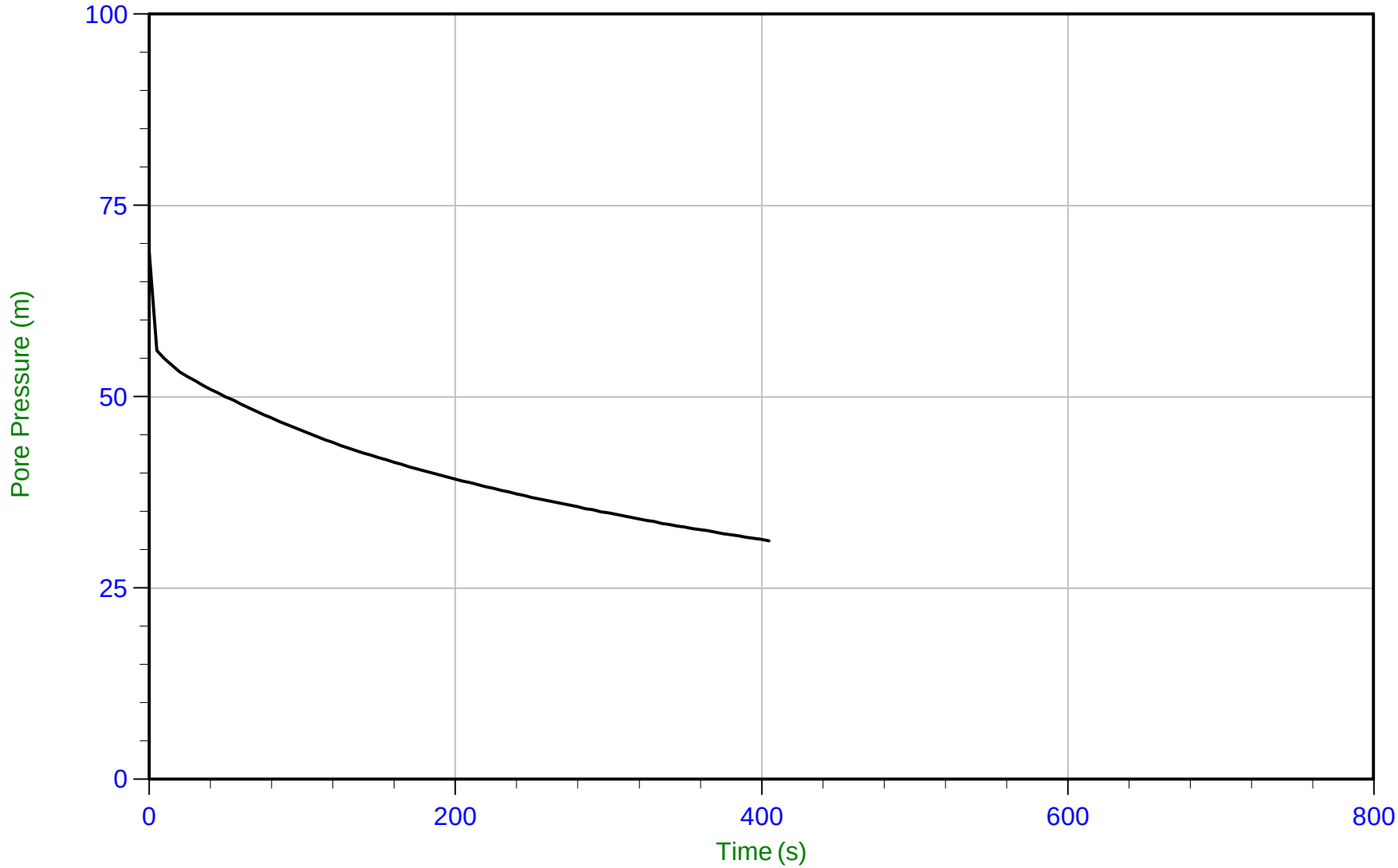
T(50): 312.8 s
Ir: 100
Ch: 1.5 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 09:30
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-3
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-3.PPF
Depth: 10.500 m / 34.448 ft
Duration: 405.0 s

u Min: 31.2 m
u Max: 69.0 m
u Final: 31.2 m

WT: 2.000 m / 6.562 ft
Ueq: 8.5 m
U(50): 38.75 m

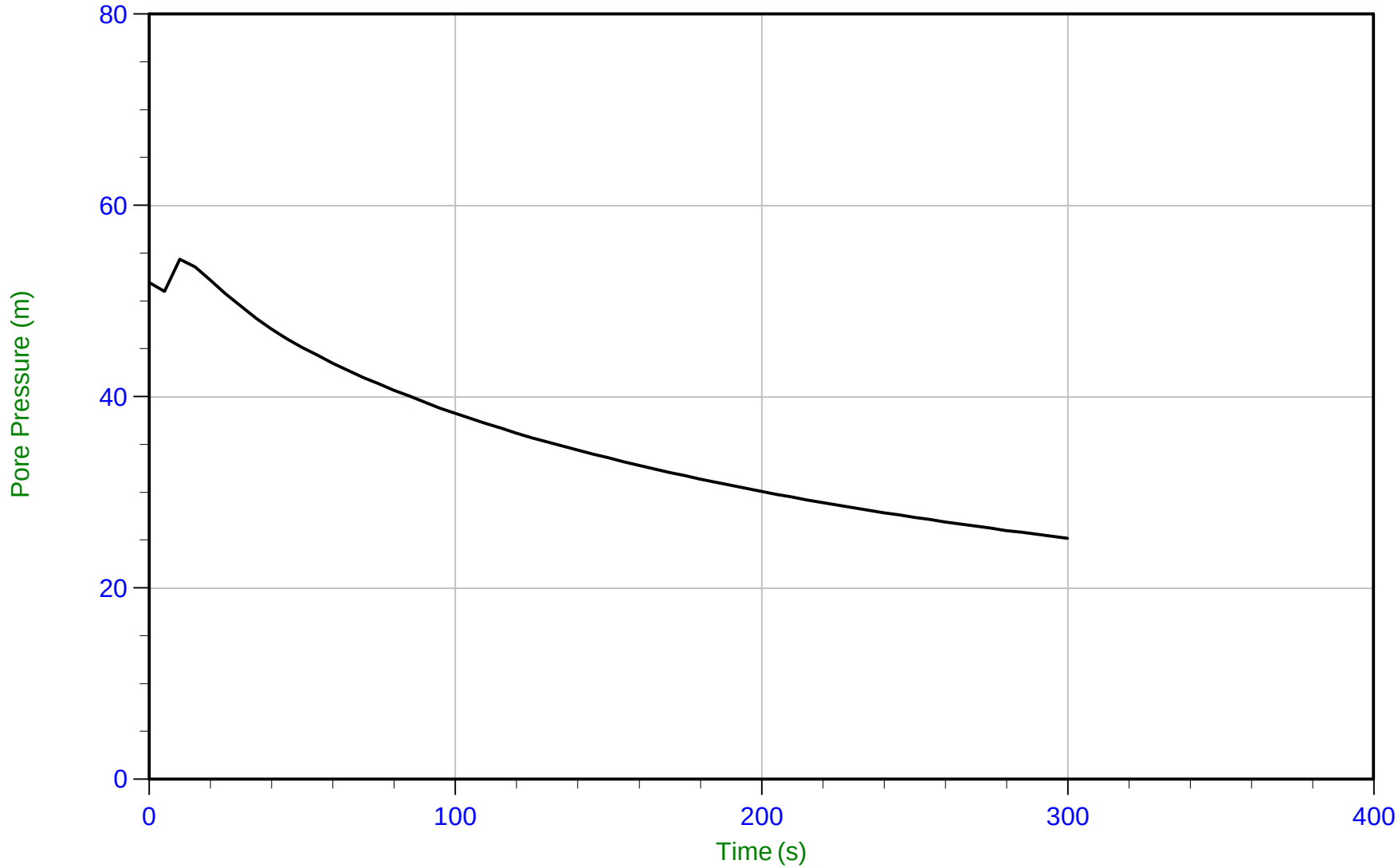
T(50): 209.8 s
Ir: 100
Ch: 2.2 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 09:30
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-3
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-3.PPF
Depth: 11.850 m / 38.877 ft
Duration: 300.0 s

u Min: 25.2 m
u Max: 54.4 m
u Final: 25.2 m

WT: 2.000 m / 6.562 ft
Ueq: 9.8 m
U(50): 32.12 m

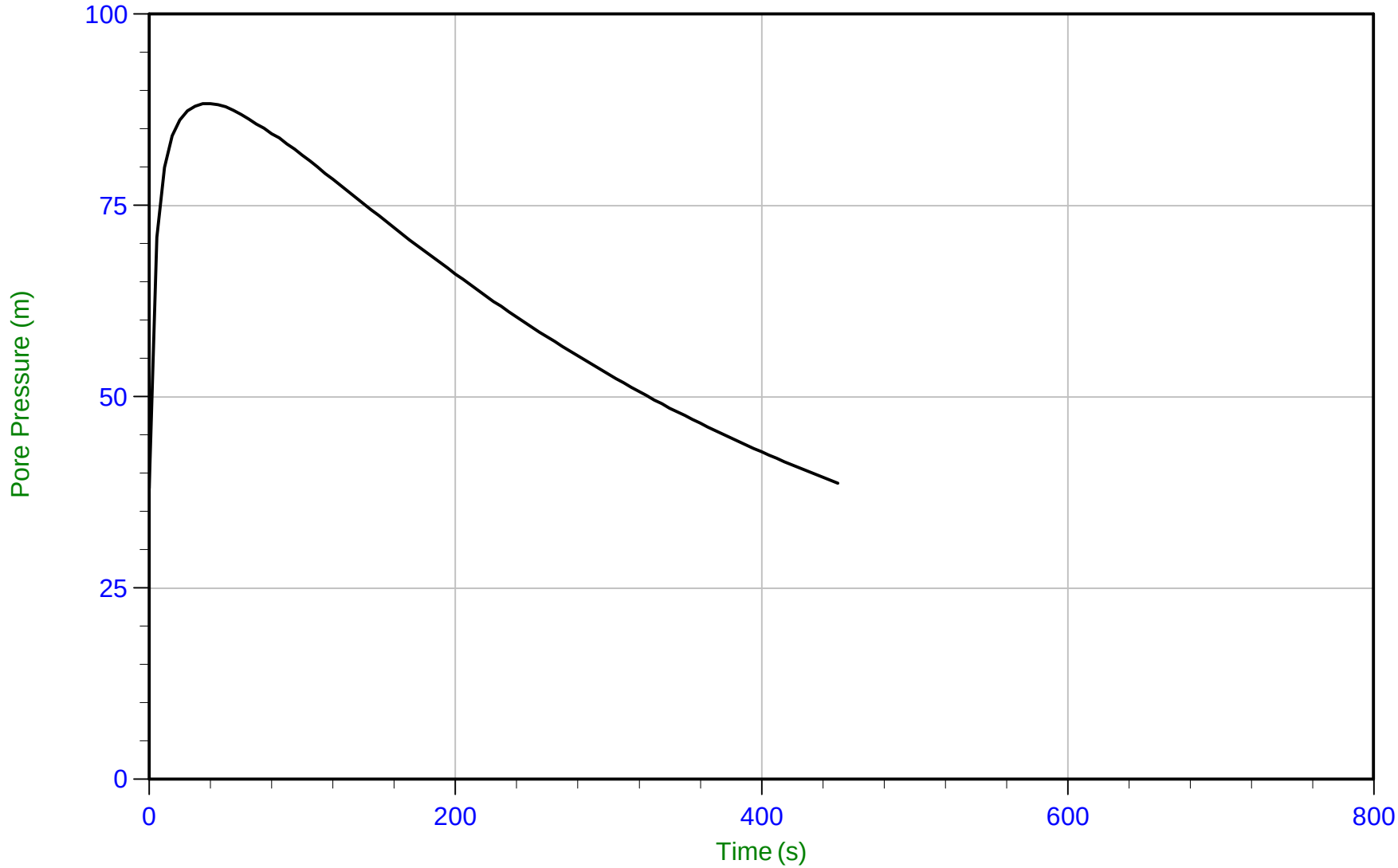
T(50): 159.5 s
Ir: 100
Ch: 2.9 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 11:48
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-5
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-5.PPF
Depth: 5.500 m / 18.044 ft
Duration: 450.0 s

u Min: 38.0 m
u Max: 88.3 m
u Final: 38.7 m

WT: 2.000 m / 6.562 ft
Ueq: 3.5 m
U(50): 45.91 m

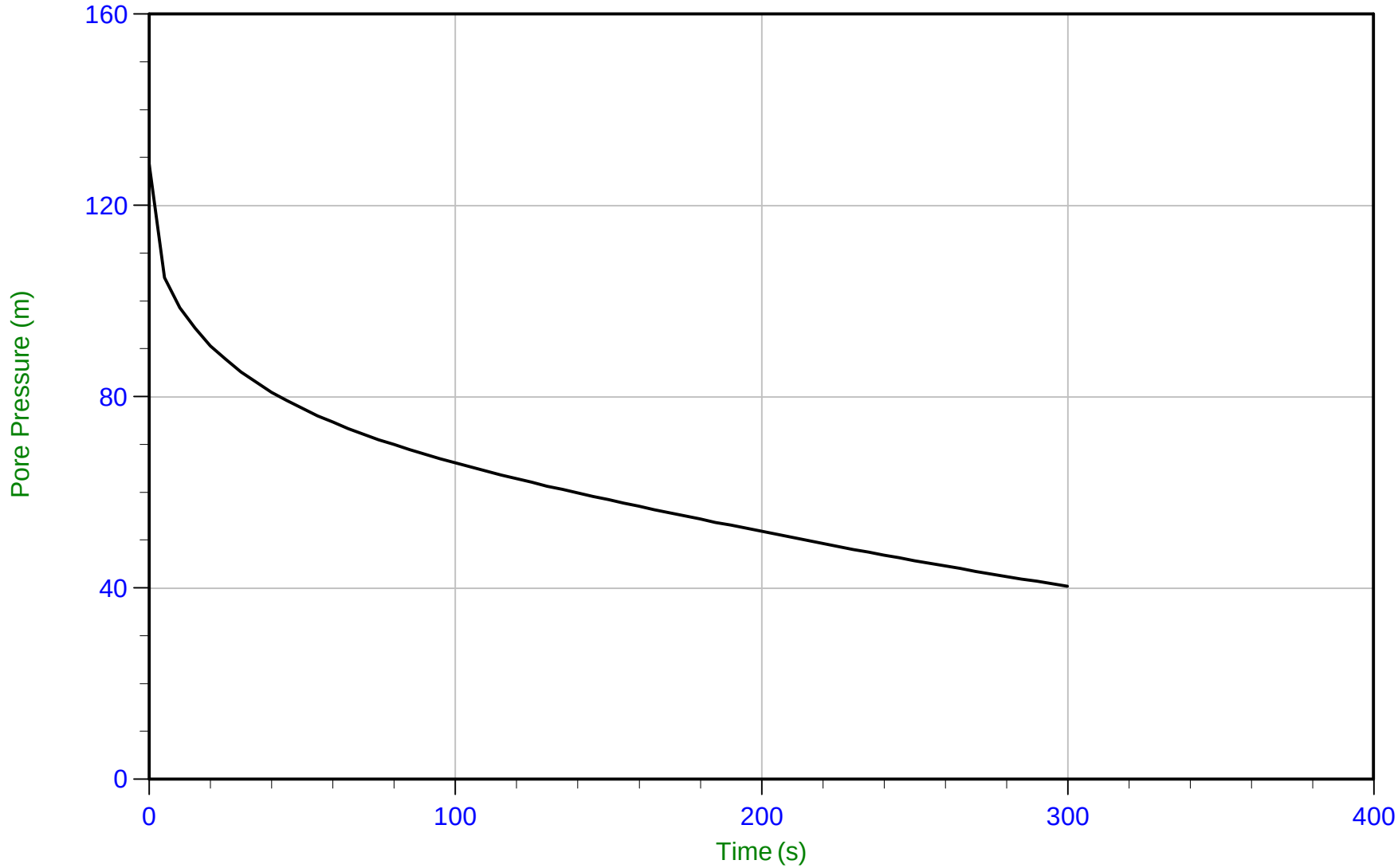
T(50): 326.5 s
Ir: 100
Ch: 1.4 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 11:48
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-5
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-5.PPF
Depth: 9.500 m / 31.168 ft
Duration: 300.0 s

u Min: 40.4 m
u Max: 128.6 m
u Final: 40.4 m

WT: 2.000 m / 6.562 ft
Ueq: 7.5 m
U(50): 68.05 m

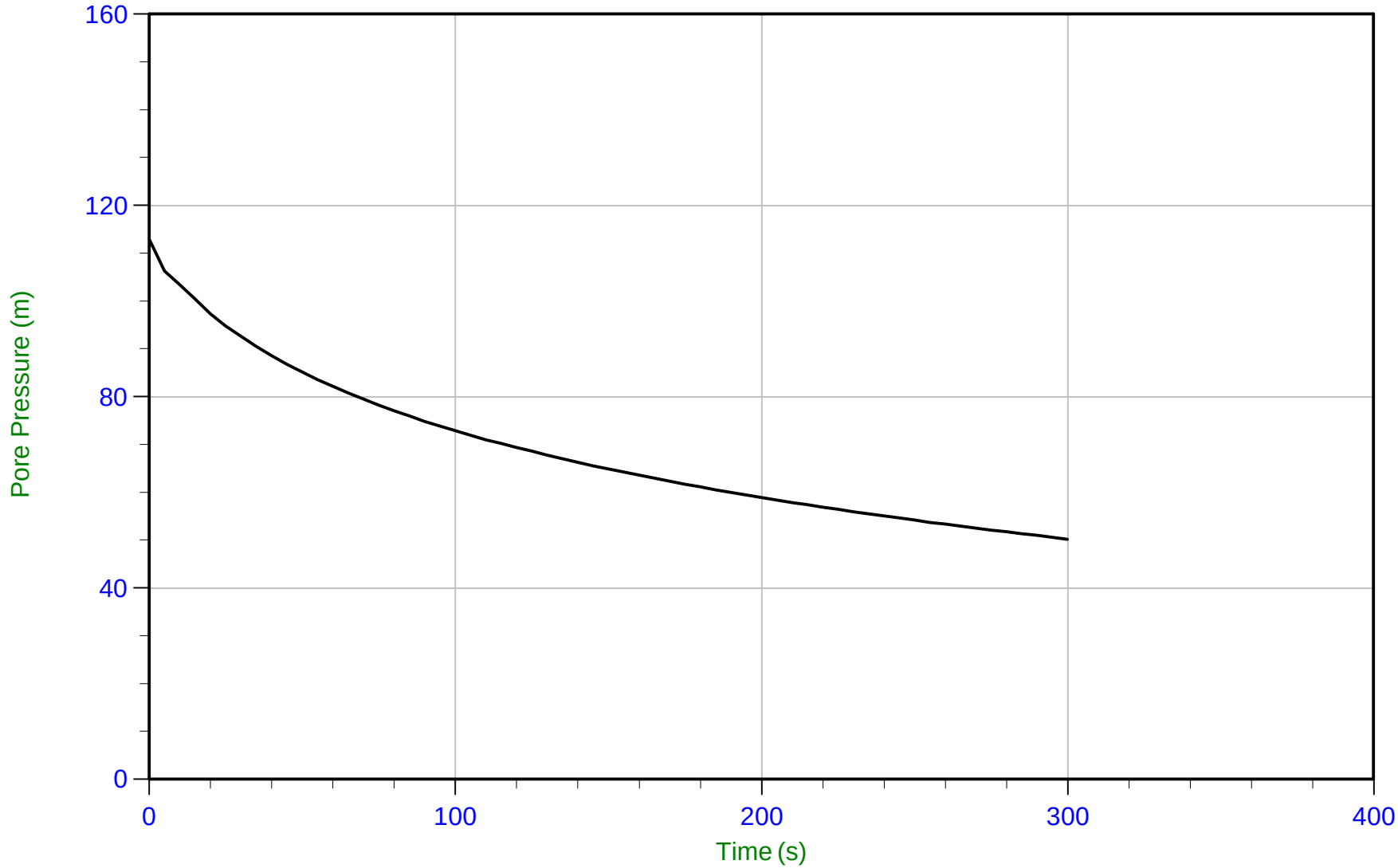
T(50): 89.8 s
Ir: 100
Ch: 5.2 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 11:48
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-5
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-5.PPF
Depth: 11.650 m / 38.221 ft
Duration: 300.0 s

u Min: 50.2 m
u Max: 113.0 m
u Final: 50.2 m

WT: 2.000 m / 6.562 ft
Ueq: 9.7 m
U(50): 61.30 m

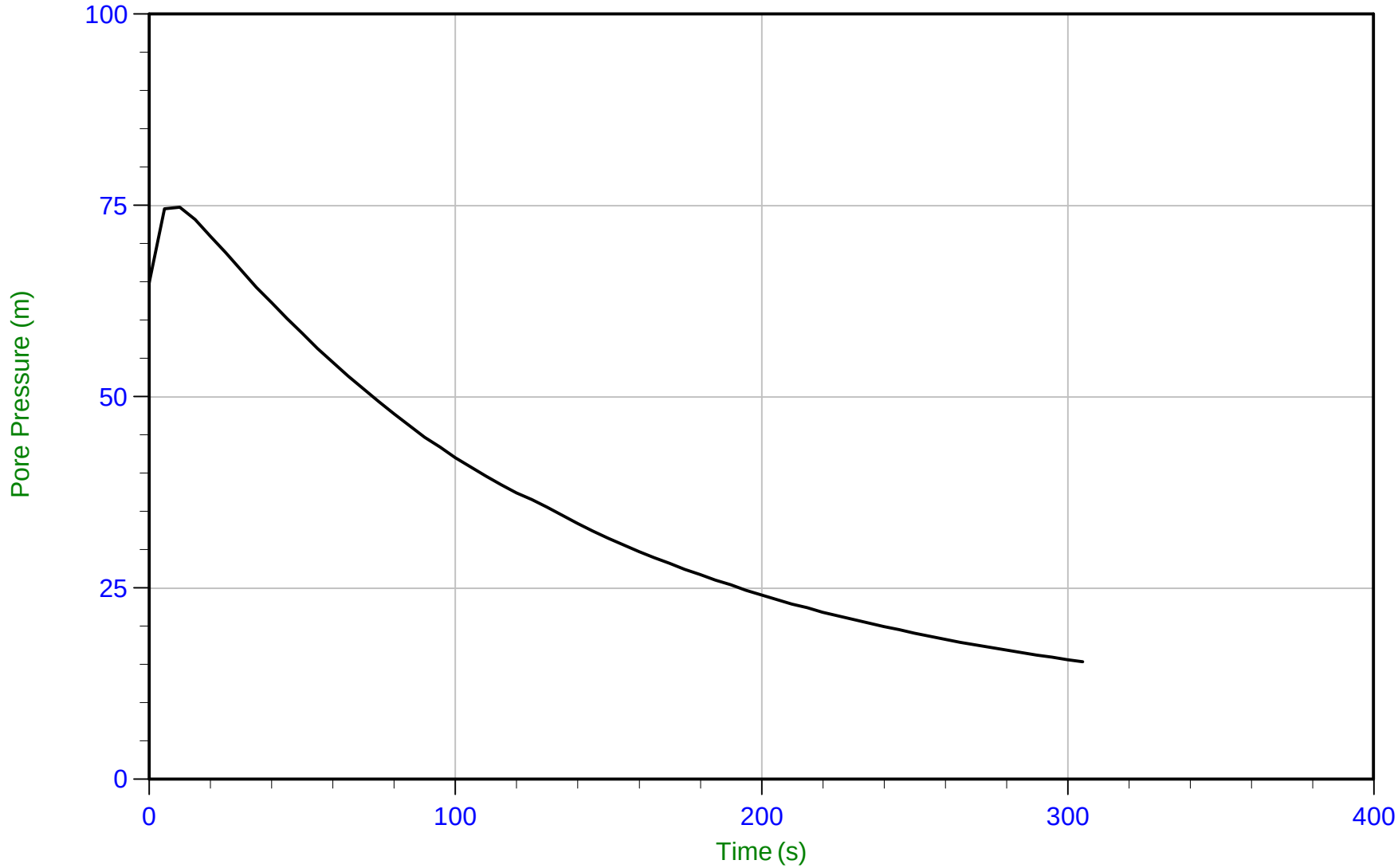
T(50): 178.7 s
Ir: 100
Ch: 2.6 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 4/10/2019 12:46
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-6
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-6.PPF
Depth: 6.500 m / 21.325 ft
Duration: 305.0 s

u Min: 15.4 m
u Max: 74.8 m
u Final: 15.4 m

WT: 2.000 m / 6.562 ft
Ueq: 4.5 m
U(50): 39.63 m

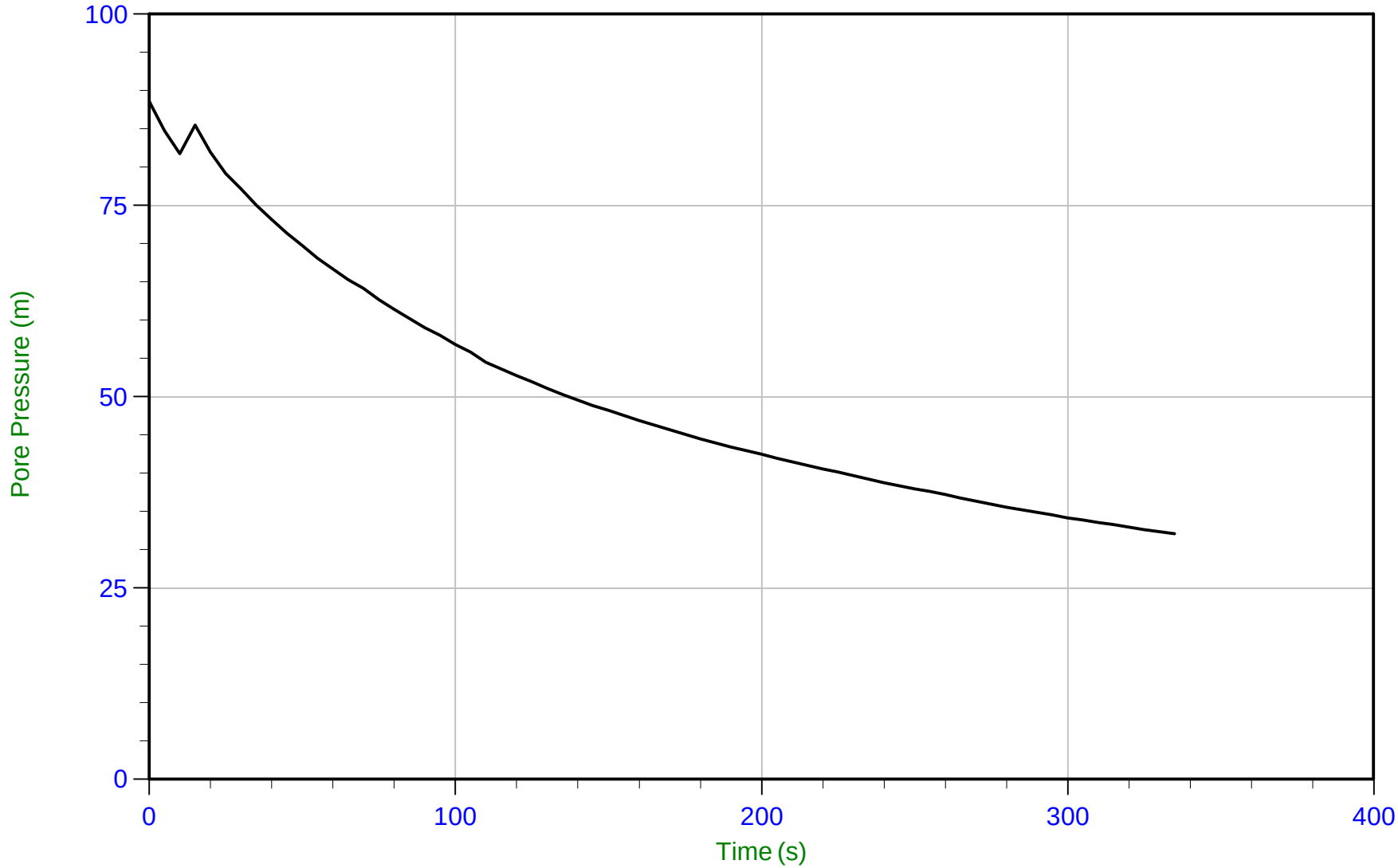
T(50): 99.9 s
Ir: 100
Ch: 4.7 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 4/10/2019 12:46
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-6
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-6.PPF
Depth: 8.075 m / 26.492 ft
Duration: 335.0 s

u Min: 32.1 m
u Max: 88.6 m
u Final: 32.1 m

WT: 2.000 m / 6.562 ft
Ueq: 6.1 m
U(50): 47.34 m

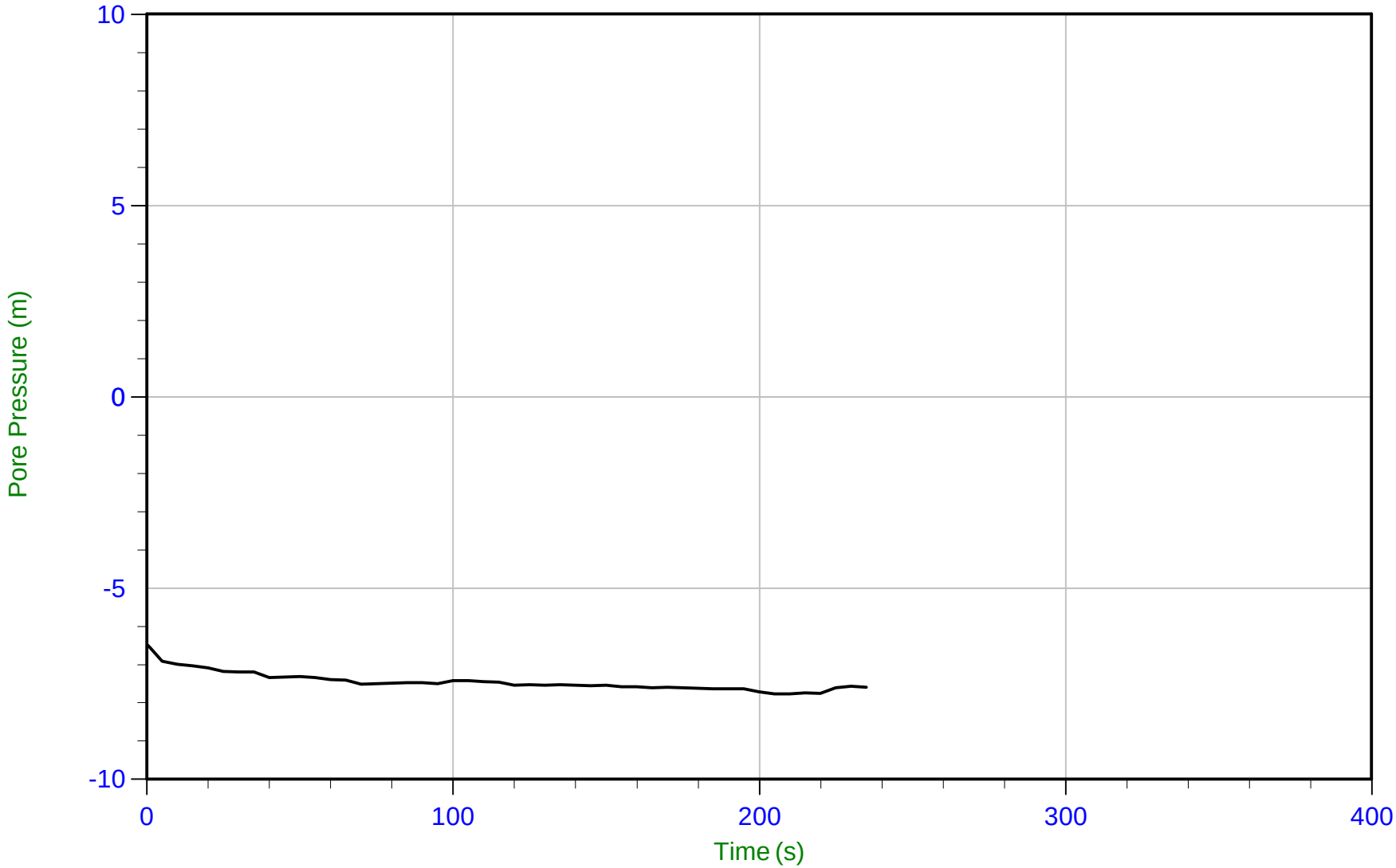
T(50): 156.7 s
Ir: 100
Ch: 3.0 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 4/10/2019 12:46
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-6
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-6.PPF
Depth: 8.125 m / 26.657 ft
Duration: 235.0 s

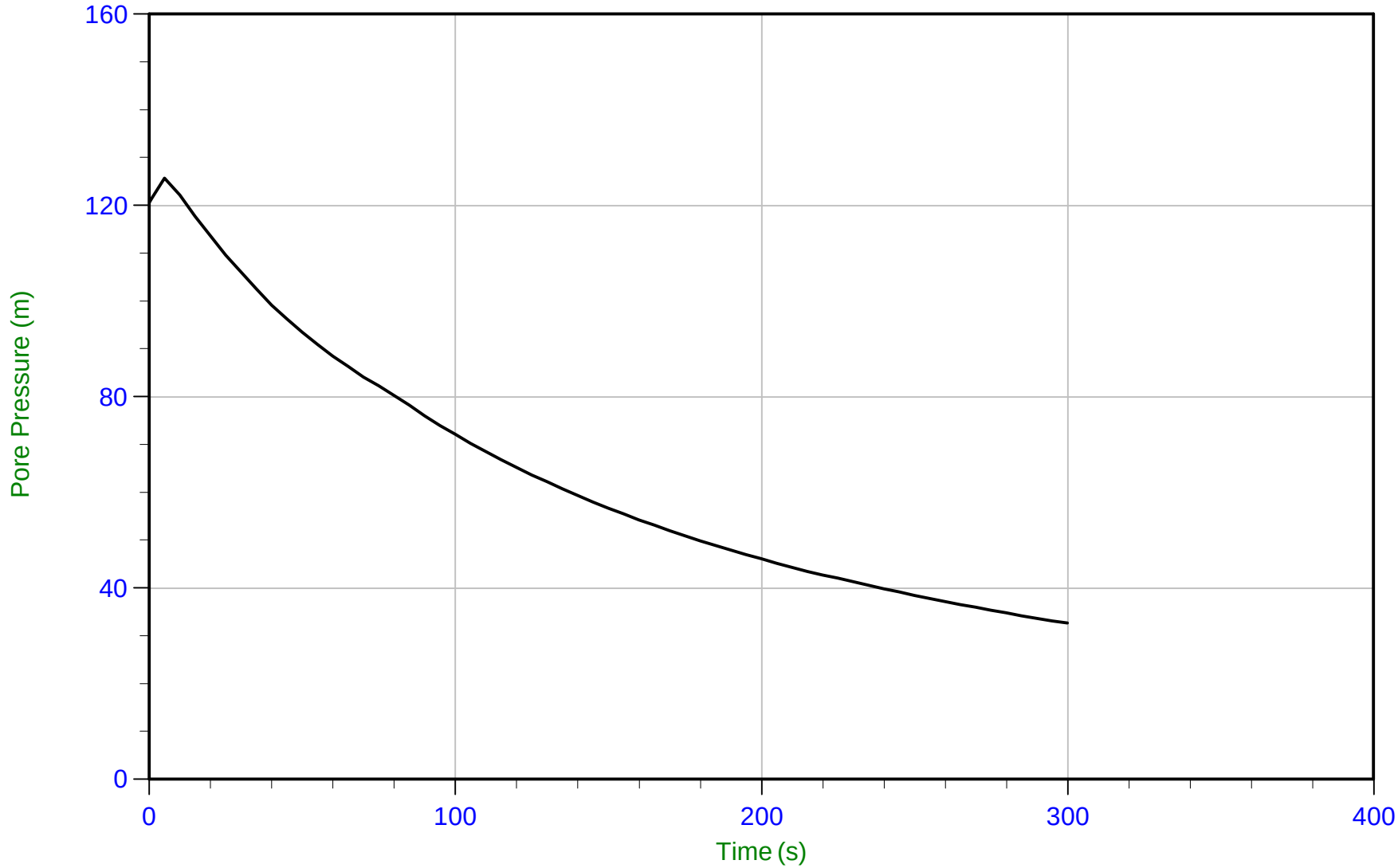
u Min: -7.8 m
u Max: -6.5 m
u Final: -7.6 m

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 13:42
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-7
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-7.PPF
Depth: 7.000 m / 22.966 ft
Duration: 300.0 s

u Min: 32.7 m
u Max: 125.7 m
u Final: 32.7 m

WT: 2.000 m / 6.562 ft
Ueq: 5.0 m
U(50): 65.34 m

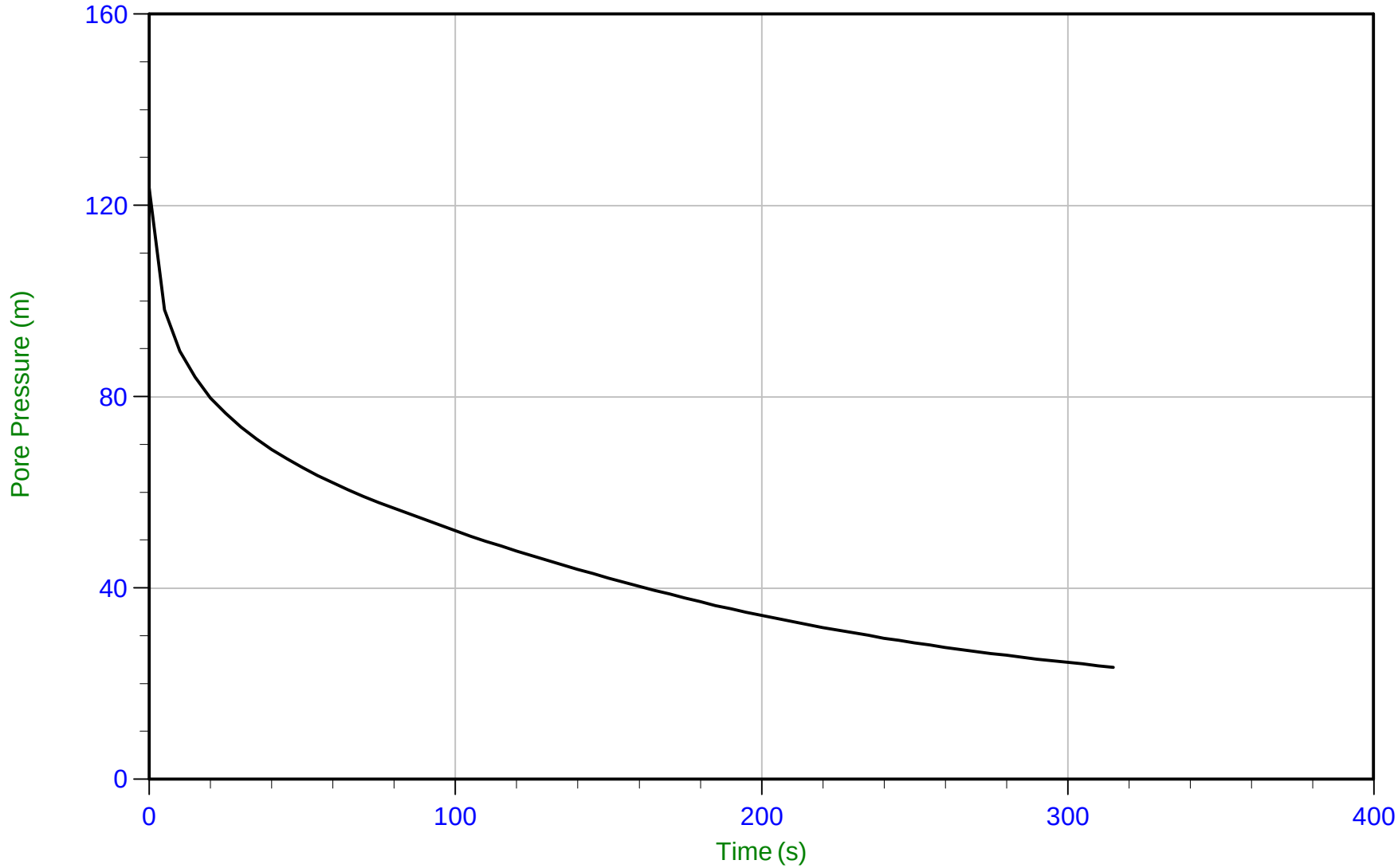
T(50): 114.6 s
Ir: 100
Ch: 4.1 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 13:42
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-7
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-7.PPF
Depth: 9.500 m / 31.168 ft
Duration: 315.0 s

u Min: 23.4 m
u Max: 123.6 m
u Final: 23.4 m

WT: 2.000 m / 6.562 ft
Ueq: 7.5 m
U(50): 65.54 m

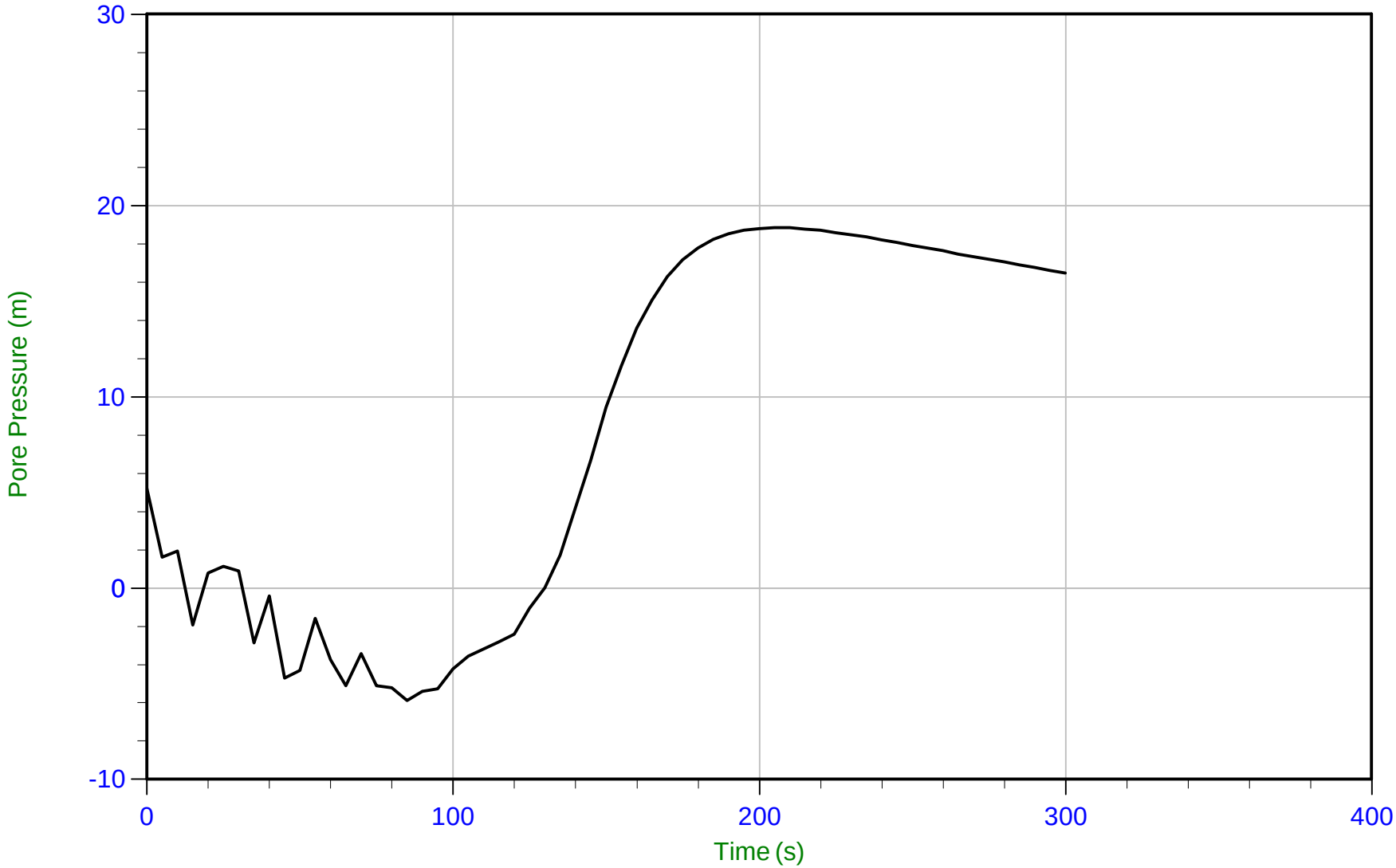
T(50): 49.0 s
Ir: 100
Ch: 9.5 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 13:42
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-7
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-7.PPF
Depth: 11.450 m / 37.565 ft
Duration: 300.0 s

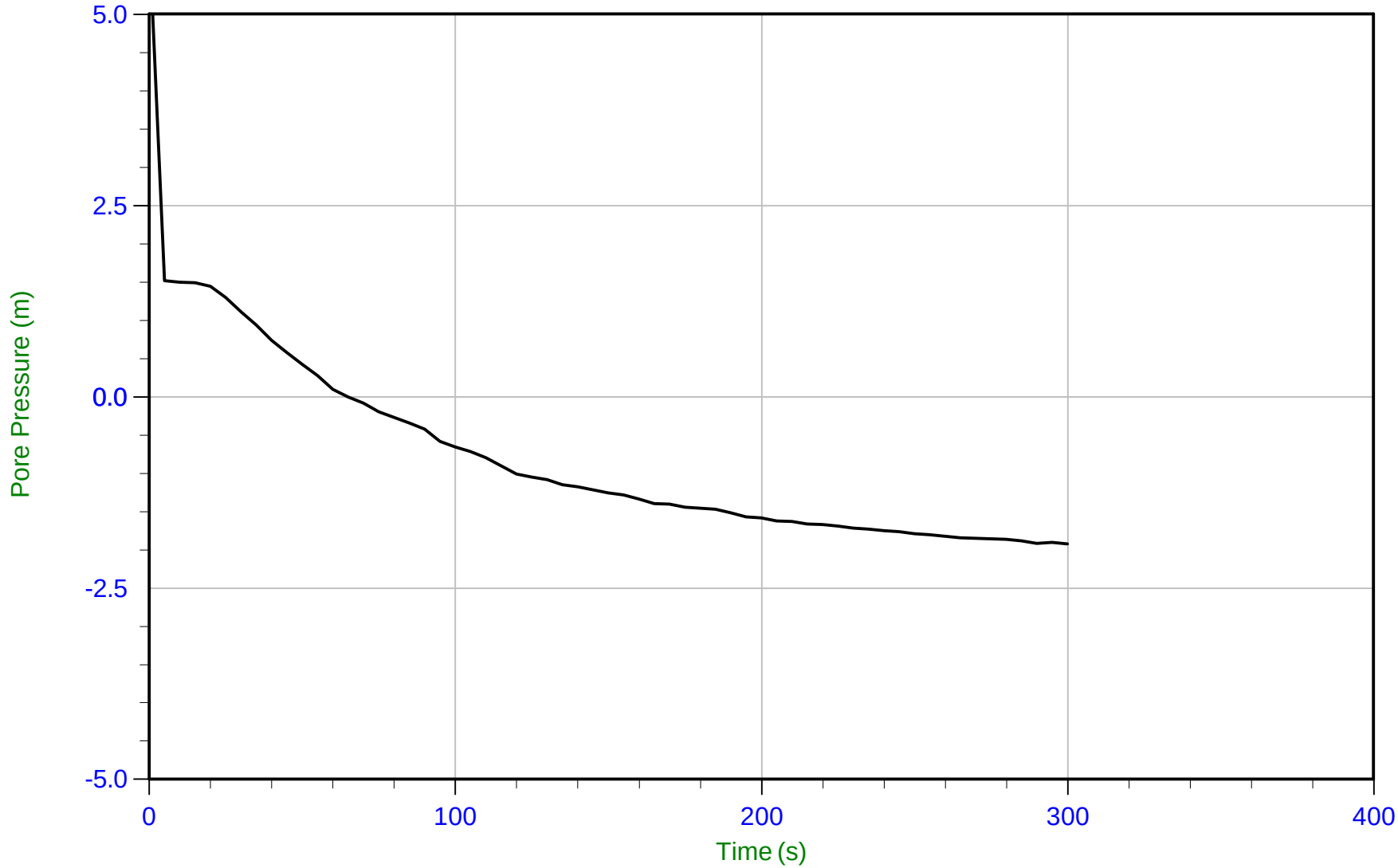
u Min: -5.9 m
u Max: 18.8 m
u Final: 16.5 m

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 14:45
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-9
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-9.PPF
Depth: 3.000 m / 9.842 ft
Duration: 300.0 s

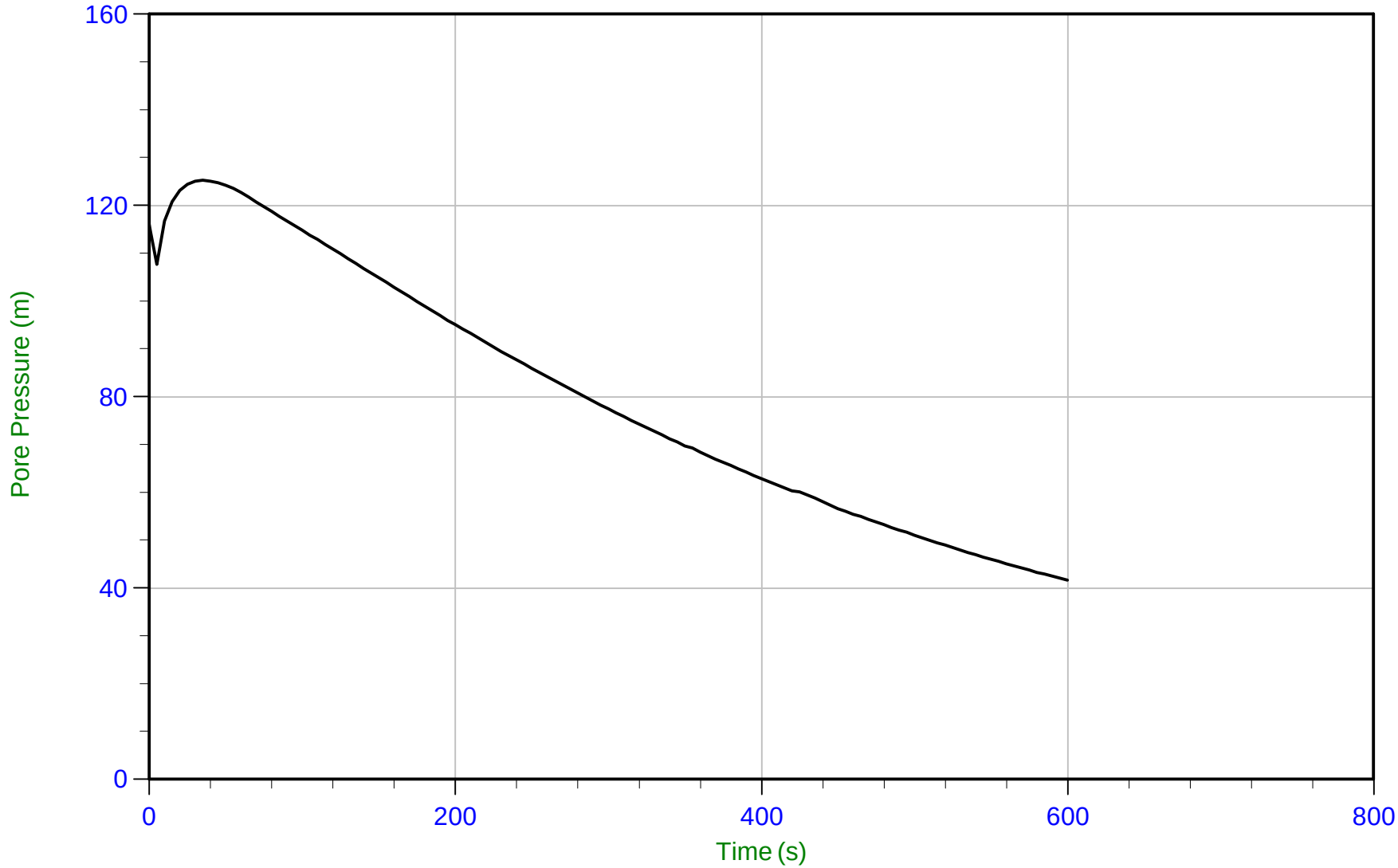
u Min: -1.9 m
u Max: 6.0 m
u Final: -1.9 m

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 14:45
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-9
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-9.PPF
Depth: 6.050 m / 19.849 ft
Duration: 600.0 s

u Min: 41.6 m
u Max: 125.2 m
u Final: 41.6 m

WT: 2.000 m / 6.562 ft
Ueq: 4.0 m
U(50): 64.65 m

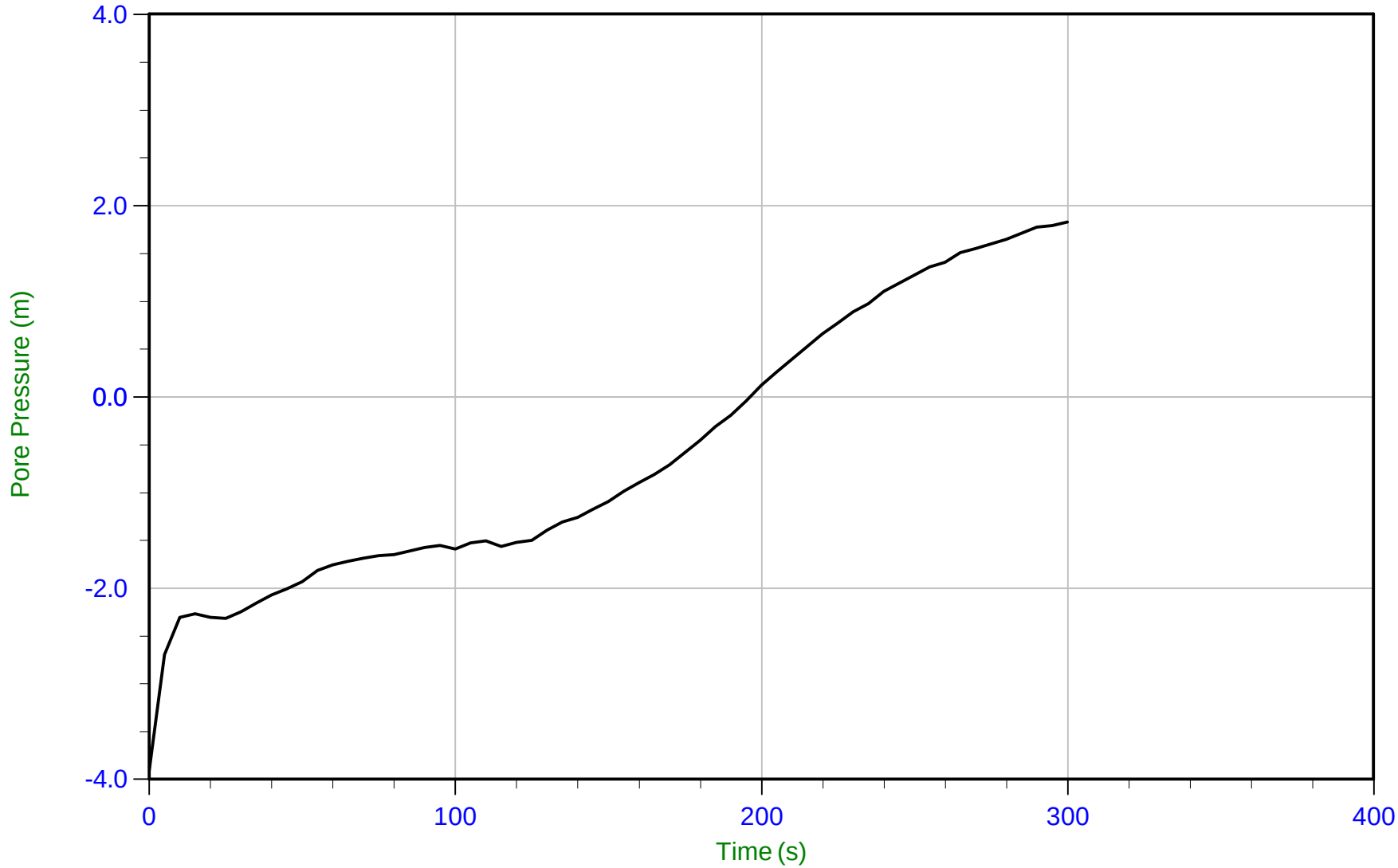
T(50): 352.0 s
Ir: 100
Ch: 1.3 cm²/min

CONETEC

Golder

Job No: 19-05024
Date: 04/10/2019 15:49
Site: Golden Plough Lodge, Cobourg, ON

Sounding: CPT19-18-12
Cone: 311:T1000F10U500 Area=10 cm²



Trace Summary:

Filename: 19-05024_CP19-18-12.PPF
Depth: 3.350 m / 10.991 ft
Duration: 300.0 s

u Min: -3.9 m
u Max: 1.8 m
u Final: 1.8 m

APPENDIX C

Analytical Laboratory Testing

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: GOLDER ASSOCIATES LTD.
100 SCOTIA COURT
WHITBY, ON L1N8Y6
(905) 723-2727

ATTENTION TO: m battley

PROJECT: 18111688

AGAT WORK ORDER: 18T423686

SOIL ANALYSIS REVIEWED BY: Yris Verastegui, Report Reviewer

DATE REPORTED: Jan 04, 2019

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18T423686

PROJECT: 18111688

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: m battley

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2018-12-24

DATE REPORTED: 2019-01-04

		SAMPLE DESCRIPTION:		BH18-1 Sa2	BH18-3 Sa1	BH18-10 Sa2	BH18-10 Sa5	BH18-11 Sa4	BH18-13 Sa1	BH18-13 Sa3	BH18-20 Sa1
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2018-12-18	2018-12-20	2018-12-20	2018-12-20	2018-12-17	2018-12-17	2018-12-17	2018-12-21
Parameter	Unit	G / S	RDL	9809141	9809143	9809144	9809145	9809146	9809147	9809148	9809149
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	2	2	2	2	2	2	2	5
Barium	µg/g	220	2	90	97	163	106	105	158	34	56
Beryllium	µg/g	2.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5
Boron	µg/g	36	5	<5	<5	6	6	6	5	<5	6
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.15	0.18	<0.10	<0.10	<0.10	<0.10	<0.10	0.32
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	2	19	19	29	20	20	28	7	11
Cobalt	µg/g	21	0.5	5.5	5.7	9.4	7.2	7.2	8.8	2.5	3.7
Copper	µg/g	92	1	9	15	21	14	15	18	5	10
Lead	µg/g	120	1	6	9	6	5	5	6	2	43
Molybdenum	µg/g	2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	µg/g	82	1	10	11	18	14	14	18	5	7
Selenium	µg/g	1.5	0.4	<0.4	1.1	<0.4	<0.4	<0.4	1.0	<0.4	0.6
Silver	µg/g	0.5	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	0.6	0.7	0.6	<0.5	0.5	0.6	<0.5	<0.5
Vanadium	µg/g	86	1	33	32	46	33	34	46	14	20
Zinc	µg/g	290	5	34	47	61	45	44	56	15	52
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.11
Electrical Conductivity	mS/cm	0.57	0.005	0.161	0.175	0.139	0.140	0.147	0.131	0.093	0.168
Sodium Adsorption Ratio	NA	2.4	NA	0.377	0.240	0.240	0.479	0.643	0.133	0.376	0.118
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.46	7.52	7.63	7.66	7.41	7.46	7.81	7.47

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9809141-9809149 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: Iris Verástegui

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T423686

PROJECT: 18111688

ATTENTION TO: m battley

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Jan 04, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	9809141	9809141	<0.8	<0.8	NA	< 0.8	110%	70%	130%	89%	80%	120%	102%	70%	130%
Arsenic	9809141	9809141	2	2	NA	< 1	104%	70%	130%	100%	80%	120%	100%	70%	130%
Barium	9809141	9809141	90	93	2.8%	< 2	96%	70%	130%	102%	80%	120%	90%	70%	130%
Beryllium	9809141	9809141	<0.5	<0.5	NA	< 0.5	97%	70%	130%	100%	80%	120%	90%	70%	130%
Boron	9809141	9809141	<5	<5	NA	< 5	114%	70%	130%	96%	80%	120%	76%	70%	130%
Boron (Hot Water Soluble)	9809141	9809141	0.15	0.13	NA	< 0.10	103%	60%	140%	95%	70%	130%	89%	60%	140%
Cadmium	9809141	9809141	<0.5	<0.5	NA	< 0.5	97%	70%	130%	101%	80%	120%	100%	70%	130%
Chromium	9809141	9809141	19	19	0.1%	< 2	86%	70%	130%	99%	80%	120%	102%	70%	130%
Cobalt	9809141	9809141	5.5	5.6	2.2%	< 0.5	88%	70%	130%	97%	80%	120%	93%	70%	130%
Copper	9809141	9809141	9	10	4.3%	< 1	92%	70%	130%	111%	80%	120%	102%	70%	130%
Lead	9809141	9809141	6	6	1.6%	< 1	97%	70%	130%	107%	80%	120%	104%	70%	130%
Molybdenum	9809141	9809141	<0.5	<0.5	NA	< 0.5	96%	70%	130%	108%	80%	120%	105%	70%	130%
Nickel	9809141	9809141	10	11	2.2%	< 1	93%	70%	130%	100%	80%	120%	94%	70%	130%
Selenium	9809141	9809141	<0.4	<0.4	NA	< 0.4	101%	70%	130%	100%	80%	120%	100%	70%	130%
Silver	9809141	9809141	<0.2	<0.2	NA	< 0.2	92%	70%	130%	104%	80%	120%	97%	70%	130%
Thallium	9809141	9809141	<0.4	<0.4	NA	< 0.4	98%	70%	130%	98%	80%	120%	97%	70%	130%
Uranium	9809141	9809141	0.6	0.6	NA	< 0.5	107%	70%	130%	110%	80%	120%	107%	70%	130%
Vanadium	9809141	9809141	33	34	2.5%	< 1	91%	70%	130%	101%	80%	120%	96%	70%	130%
Zinc	9809141	9809141	34	36	4.3%	< 5	96%	70%	130%	106%	80%	120%	104%	70%	130%
Chromium VI	9808888		<0.2	<0.2	NA	< 0.2	104%	70%	130%	109%	80%	120%	115%	70%	130%
Cyanide	9809252		<0.040	<0.040	NA	< 0.040	100%	70%	130%	91%	80%	120%	105%	70%	130%
Mercury	9809141	9809141	<0.10	<0.10	NA	< 0.10	99%	70%	130%	92%	80%	120%	103%	70%	130%
Electrical Conductivity	9809141	9809141	0.161	0.168	4.3%	< 0.005	93%	90%	110%	NA			NA		
Sodium Adsorption Ratio	9809141	9809141	0.377	0.364	3.4%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	9807492		7.81	7.79	0.3%	NA	101%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL

Certified By: Iris Verástegui

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T423686

PROJECT: 18111688

ATTENTION TO: m battley

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010C	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 18T423686

Cooler Quantity: 1 Bottle (ice)

Arrival Temperatures: 6.0 16.5 16.8

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: Golder Associates

Contact:

Address: 100 Scotia Crt
Whitby ON L1N 8Y6

Phone: 905-723-2727 Fax: 905-723-2182

Reports to be sent to:

1. Email: mibentley@golder.com
2. Email: eric-wolinsky@golder.com

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☒ Regulation 153/04
Table 1 *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☒ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm

Region _____ *Indicate One*

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other

_____ *Indicate One*

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

_____

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 18111688

Site Location:

Sampled By: Yusuf Solimanig

AGAT Quote #: _____ PO: _____

Please note: If quotation number is not provided, client will be billed full price for analysis.

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on *Certificate of Analysis* ☒ Yes ☐ No

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:

Contact:

Address:

Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics	All Metals ☐ 153 Metals (excl. Hydrides)	Hydride Metals	ORPs: ☐ B-HWS ☐ Cl ☐ CN	☐ Cr^{6+} ☐ EC ☐ FOC ☐ Hg	☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN	☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use
BH 18-1 Sa2	Dec/18/18	2:14pm	1	Soil			X																	
BH 18-3 Sa1	Dec 20/18	1:02pm	1	Soil			X																	
BH 18-10 Sa2	Dec 20/18	8:08am	1	Soil			X																	
BH 18-10 Sa5	Dec 20/18	8:42am	1	Soil			X																	
BH 18-11 Sa4	Dec 17/18	4:03pm	1	Soil			X																	
BH ~~18-13~~ 18-13 Sa1	Dec 17/18	1:07pm	1	Soil			X																	
BH 18-13 Sa3	Dec 17/18	1:22pm	1	Soil			X																	
BH 18-20 Sa1	Dec 21/18	1:45pm	1	Soil			X																	

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
M BENTLEY	Dec 24/18		Neil Ramnarain	Dec. 24/18	9:52 AM
					Page 1 of 1
					N°: T 040181

Document ID: DIV-78-1511_013

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

Date Issued: September 20, 2016

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: GOLDER ASSOCIATES LTD.
100 SCOTIA COURT
WHITBY, ON L1N8Y6
(905) 723-2727

ATTENTION TO: Michael Beatley

PROJECT: 18111688

AGAT WORK ORDER: 19T426856

SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

DATE REPORTED: Jan 17, 2019

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 19T426856

PROJECT: 18111688

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Michael Beatley

SAMPLING SITE:

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2019-01-10

DATE REPORTED: 2019-01-17

				SAMPLE DESCRIPTION:	18-3 Sa4	18-13 Sa3
				SAMPLE TYPE:	Soil	Soil
				DATE SAMPLED:	2018-12-20	2018-12-20
Parameter	Unit	G / S	RDL		9825768	9825769
Sulfide (S2-)	%		0.05		<0.05	<0.05
Chloride (2:1)	µg/g	NA	2		8	4
Sulphate (2:1)	µg/g		2		9	7
pH (2:1)	pH Units		NA		8.18	8.40
Electrical Conductivity (2:1)	mS/cm	0.57	0.005		0.139	0.093
Resistivity (2:1)	ohm.cm		1		7190	10800
Redox Potential (2:1)	mV		5		194	181

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9825768-9825769 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).
*Sulphide analyzed at AGAT 5623 McAdam
PI note: Redox Potential is not an accredited parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: Divine Basily

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 19T426856

PROJECT: 18111688

ATTENTION TO: Michael Beatley

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Jan 17, 2019			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Sulfide (S2-)	9825768	9825768	<0.05	<0.05	NA	< 0.05	98%	80%	120%						
Chloride (2:1)	9825768	9825768	8	8	NA	< 2	106%	80%	120%	108%	80%	120%	104%	70%	130%
Sulphate (2:1)	9825768	9825768	9	10	NA	< 2	106%	80%	120%	103%	80%	120%	95%	70%	130%
pH (2:1)	9825768	9825768	8.18	8.15	0.4%	NA	100%	90%	110%						
Electrical Conductivity (2:1)	9825768	9825768	0.139	0.133	4.4%	< 0.005	97%	90%	110%						
Redox Potential (2:1)	9825768	9825768	194	192	1.0%	< 5	105%	70%	130%						

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Nivine Basily

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 19T426856

PROJECT: 18111688

ATTENTION TO: Michael Beatley

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S2-)	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2580 B	REDOX POTENTIAL ELECTRODE

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 19T426856

Cooler Quantity: Small

Arrival Temperatures: 3.7 | 3.5 | 8.3 | 8.1

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: Golder Associates
Contact: Michael Bentley
Address: 100 Scotia Court
Whitby ON L1N 8Y6
Phone: 905-723-2737 Fax: 905-723-2182
Reports to be sent to:
1. Email: mibentley@golder.com
2. Email: Alan_Mohammad@golder.com

Regulatory Requirements:

☐ No Regulatory Requirement
(Please check all applicable boxes)

☒ Regulation 153/04
Table 1 *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture *(Check One)*
☒ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region _____ *Indicate One*

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
_____ *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply): _____

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 1811168
Site Location: Cobourg
Sampled By: Yusuf Solimani
AGAT Quote #: _____ PO: _____
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI Y/N	O. Reg 153: Metals and Inorganics (☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals)	O. Reg 153: ORPs: ☐ B-HWS ☐ Cl⁻ ☐ CN ☐ Cr⁶⁺ ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	Filtered
18-3 S41	2018-12-20	13:05	1	Soil																✓
18-13 S43	2018-12-17	13:08	1	Soil																✓

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
M BENTLEY	2019-01-09	10:10		Jan 10/19	11:57
	Jan 10/19	12:48			

Page 1 of 1

Nº: T 040184

APPENDIX D

Figures D1 to D4 – Oedometer Test Results

CONSOLIDATION TEST SUMMARY

ASTM D2435/D2435M

FIGURE D1

SAMPLE IDENTIFICATION

Project Number	18111688	Sample Number	TW
Borehole Number	18-1	Sample Depth, m	7.01-7.47

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	3		
Date Started	04/23/2019		
Date Completed	05/09/2019		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.53	Unit Weight, kN/m^3	21.24
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	18.00
Area, cm^2	31.48	Specific Gravity, measured	2.74
Volume, cm^3	79.74	Solids Height, cm	1.697
Water Content, %	17.99	Volume of Solids, cm^3	53.41
Wet Mass, g	172.68	Volume of Voids, cm^3	26.33
Dry Mass, g	146.35	Degree of Saturation, %	100.0

TEST COMPUTATIONS

Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	2.533	0.493	2.533				
5.91	2.529	0.491	2.531	113	1.20E-02	2.47E-04	2.91E-07
10.70	2.525	0.488	2.527	279	4.85E-03	3.30E-04	1.57E-07
20.58	2.516	0.483	2.521	231	5.83E-03	3.68E-04	2.10E-07
40.05	2.505	0.477	2.511	230	5.81E-03	2.21E-04	1.26E-07
79.03	2.491	0.468	2.498	214	6.18E-03	1.44E-04	8.71E-08
40.10	2.491	0.468	2.491				
10.70	2.493	0.469	2.492				
40.29	2.491	0.468	2.492	47	2.80E-02	1.87E-05	5.13E-08
79.15	2.488	0.467	2.490	74	1.78E-02	3.05E-05	5.30E-08
156.86	2.471	0.457	2.480	113	1.15E-02	8.59E-05	9.71E-08
312.17	2.444	0.440	2.458	240	5.33E-03	7.07E-05	3.69E-08
623.03	2.411	0.421	2.427	360	3.47E-03	4.11E-05	1.40E-08
1245.20	2.370	0.397	2.391	208	5.82E-03	2.61E-05	1.49E-08
2487.60	2.324	0.370	2.347	240	4.87E-03	1.47E-05	7.00E-09
623.03	2.330	0.373	2.327				
156.86	2.336	0.377	2.333				
40.10	2.344	0.381	2.340				
10.77	2.351	0.386	2.347				

Note:
Consolidation loading and unloading schedule assigned by the client.
cv and k are approximate only based on t_{90} estimated from Square Root of Time Method (ASTMD2435/2435M)

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.35	Unit Weight, kN/m^3	22.20
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	19.39
Area, cm^2	31.48	Specific Gravity, measured	2.74
Volume, cm^3	74.02	Solids Height, cm	1.697
Water Content, %	14.51	Volume of Solids, cm^3	53.41
Wet Mass, g	167.59	Volume of Voids, cm^3	20.61
Dry Mass, g	146.35		

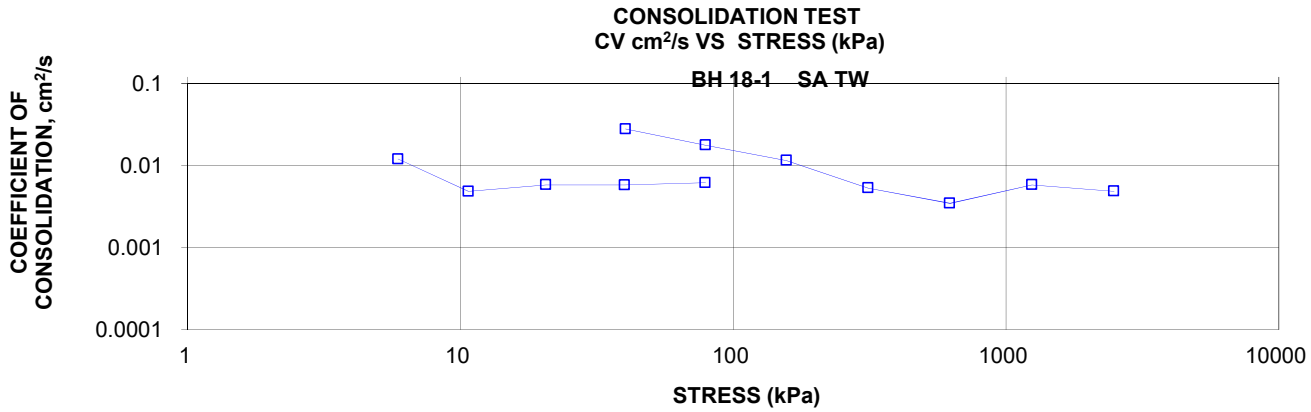
Prepared By: LH

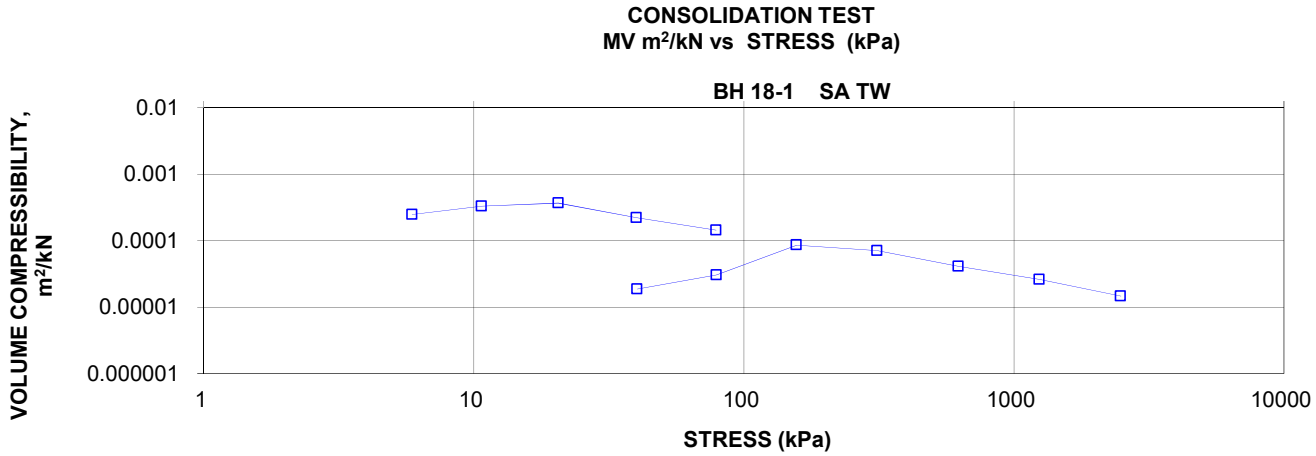
Golder Associates

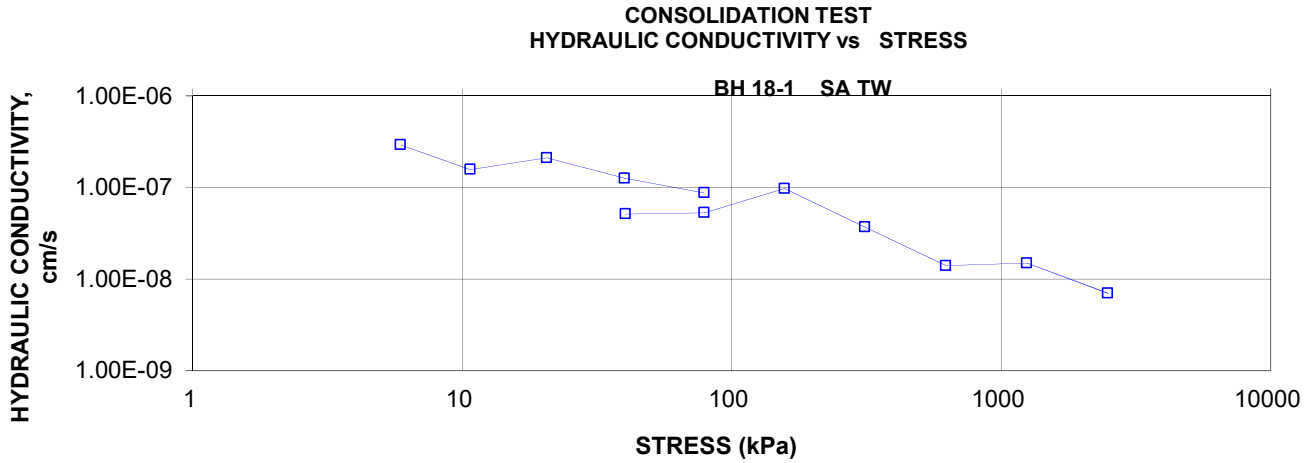
Checked By: AM

CONSOLIDATION TEST SUMMARY

FIGURE D1
2 of 4







Project No. 18111688

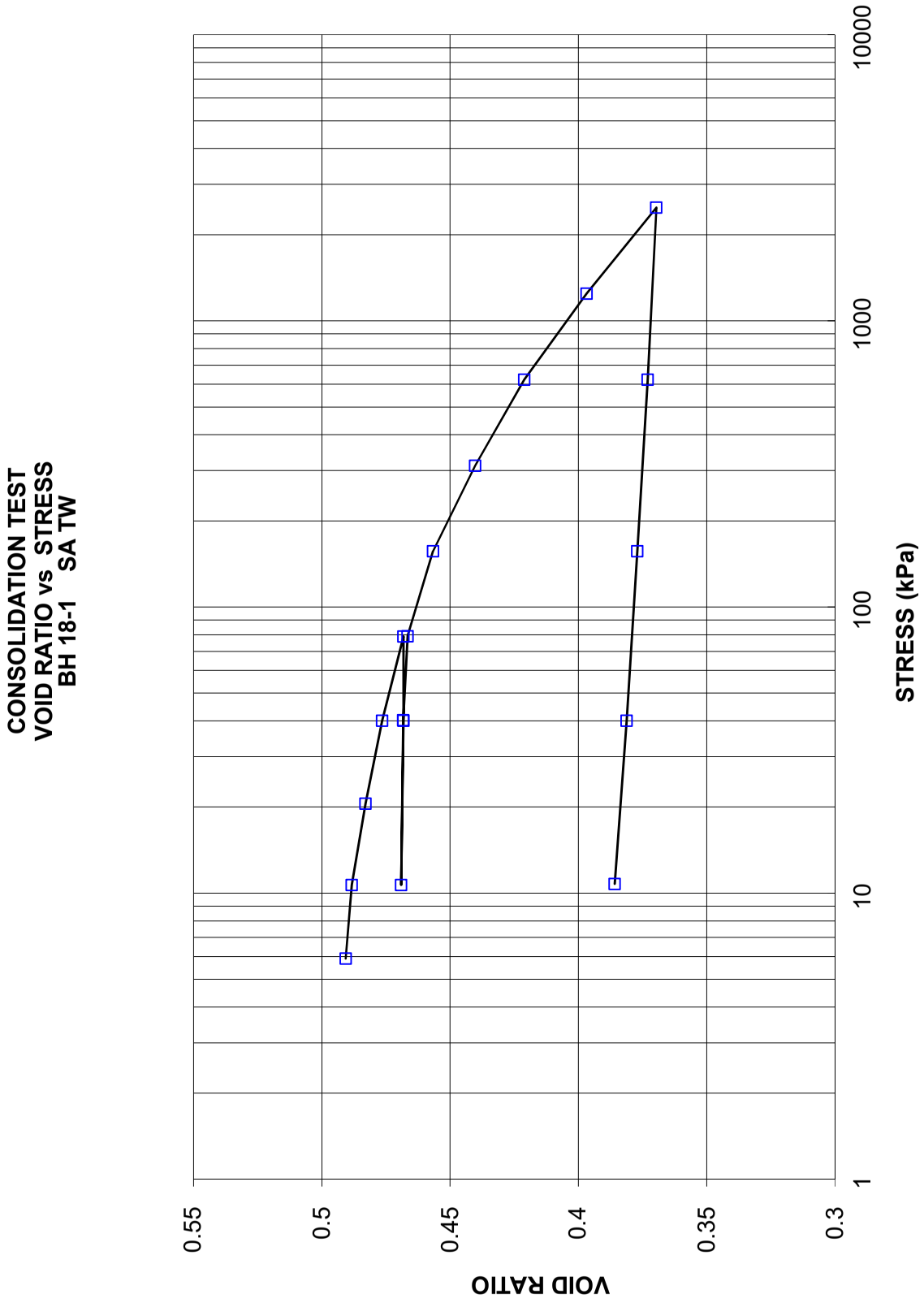
Prepared By: SJ

Golder Associates

Checked By: AM

CONSOLIDATION TEST
VOID RATIO VS LOG STRESS

FIGURE D1
3 of 4



Project No. 18111688

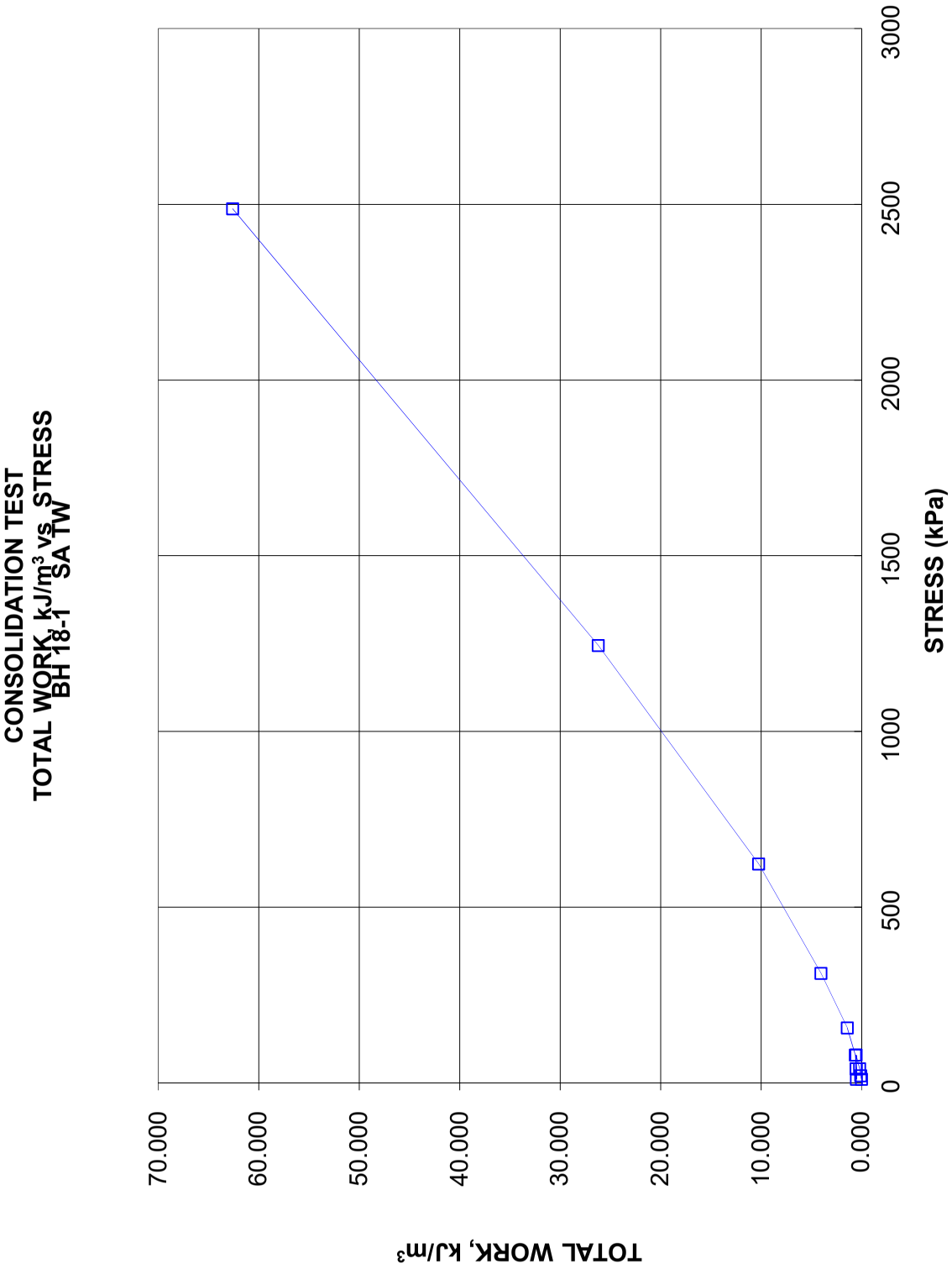
Prepared By: SJ

Golder Associates

Checked By: AM

CONSOLIDATION TEST
TOTAL WORK VS STRESS

FIGURE D1
4 of 4



Project No. 18111688

Golder Associates

Prepared By: SJ

Checked By: AM

CONSOLIDATION TEST SUMMARY

ASTM D2435/D2435M

FIGURE D2

SAMPLE IDENTIFICATION

Project Number	18111688	Sample Number	TW
Borehole Number	18-3	Sample Depth, m	10.36-10.82

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	2		
Date Started	04/23/2019		
Date Completed	05/09/2019		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m^3	22.25
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	19.67
Area, cm^2	31.65	Specific Gravity, measured	2.72
Volume, cm^3	80.29	Solids Height, cm	1.871
Water Content, %	13.14	Volume of Solids, cm^3	59.20
Wet Mass, g	182.19	Volume of Voids, cm^3	21.09
Dry Mass, g	161.03	Degree of Saturation, %	100.3

TEST COMPUTATIONS

Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	2.537	0.356	2.537				
6.03	2.499	0.336	2.518	2589	5.19E-04	2.48E-03	1.26E-07
10.69	2.490	0.331	2.494	1500	8.79E-04	7.87E-04	6.78E-08
20.45	2.472	0.321	2.481	1500	8.70E-04	7.23E-04	6.16E-08
40.08	2.447	0.308	2.459	1168	1.10E-03	4.98E-04	5.36E-08
78.65	2.418	0.292	2.432	712	1.76E-03	2.99E-04	5.17E-08
40.08	2.418	0.293	2.418				
10.72	2.420	0.294	2.419				
39.89	2.419	0.293	2.420	83	1.50E-02	2.16E-05	3.17E-08
78.62	2.415	0.291	2.417	113	1.10E-02	4.17E-05	4.48E-08
155.86	2.383	0.274	2.399	790	1.54E-03	1.62E-04	2.46E-08
311.23	2.341	0.252	2.362	501	2.36E-03	1.06E-04	2.44E-08
620.65	2.306	0.233	2.324	390	2.94E-03	4.45E-05	1.28E-08
1239.20	2.268	0.213	2.287	187	5.93E-03	2.43E-05	1.41E-08
2475.11	2.229	0.192	2.249	189	5.67E-03	1.25E-05	6.95E-09
620.65	2.233	0.194	2.231				
155.86	2.238	0.196	2.235				
40.08	2.244	0.200	2.241				
10.64	2.249	0.202	2.246				

Note:
Consolidation loading and unloading schedule assigned by the client.
cv and k are approximate only based on t_{90} estimated from Square Root of Time Method (ASTMD2435/2435M)

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.25	Unit Weight, kN/m^3	24.11
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	22.19
Area, cm^2	31.65	Specific Gravity, measured	2.72
Volume, cm^3	71.16	Solids Height, cm	1.871
Water Content, %	8.66	Volume of Solids, cm^3	59.20
Wet Mass, g	174.98	Volume of Voids, cm^3	11.96
Dry Mass, g	161.03		

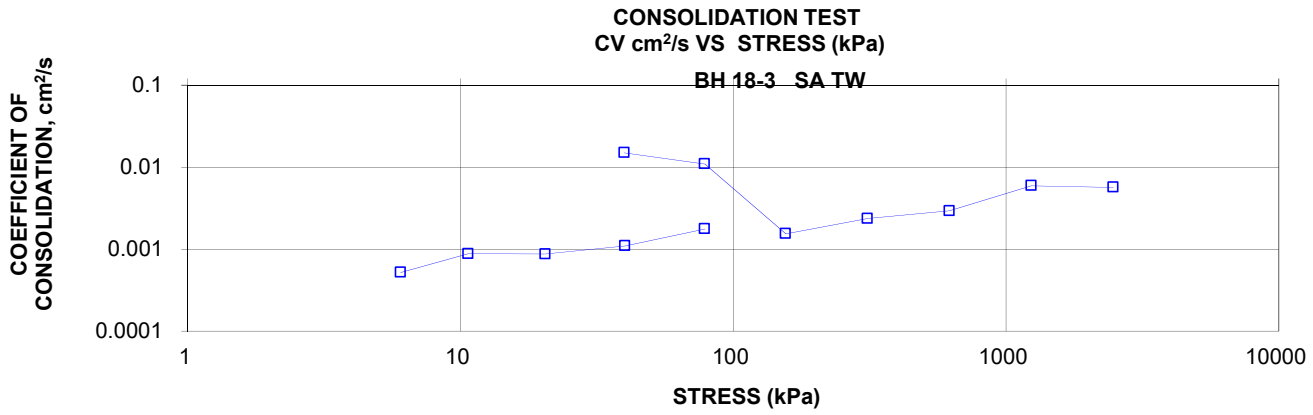
Prepared By: LH

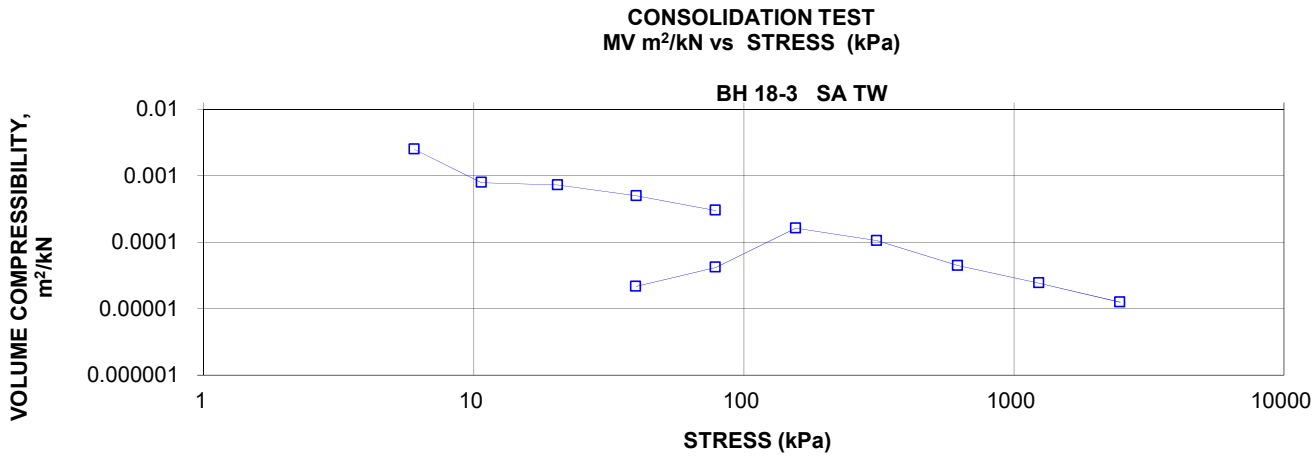
Golder Associates

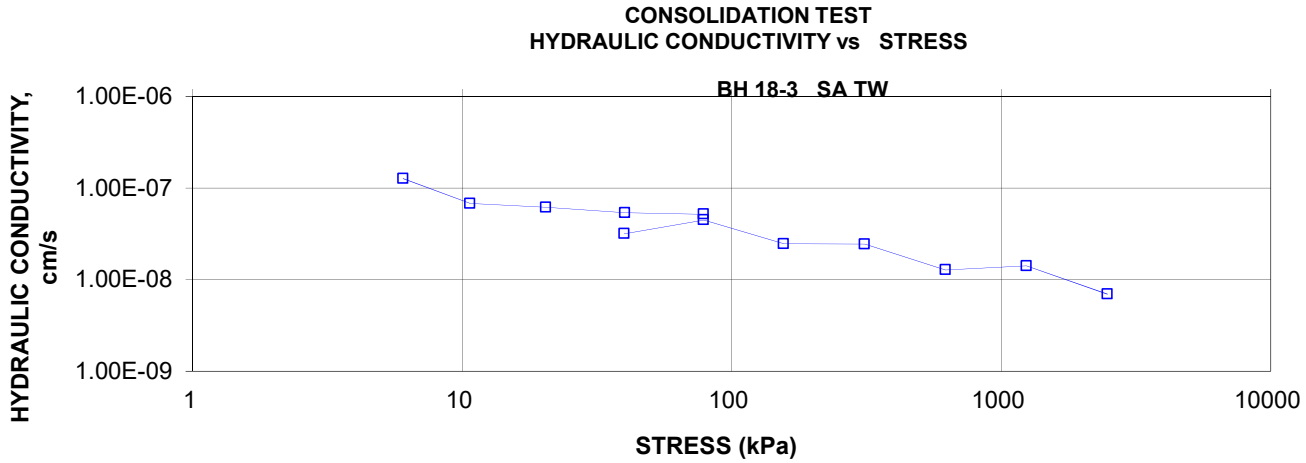
Checked By: AM

CONSOLIDATION TEST SUMMARY

FIGURE D2
2 of 4







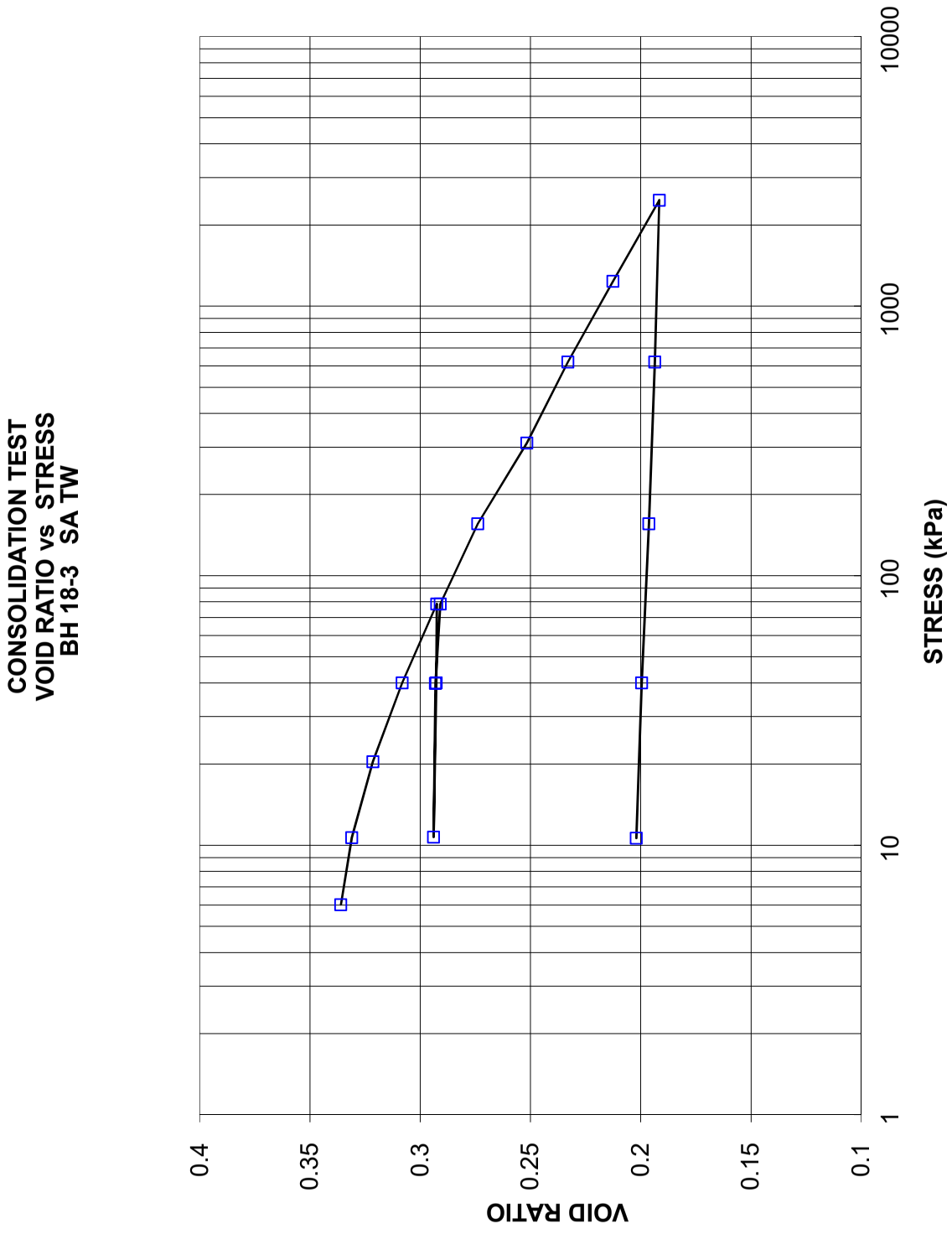
Project No. 18111688

Prepared By: SJ

Golder Associates

Checked By: AM

CONSOLIDATION TEST VOID RATIO VS LOG STRESS	FIGURE D2 3 of 4



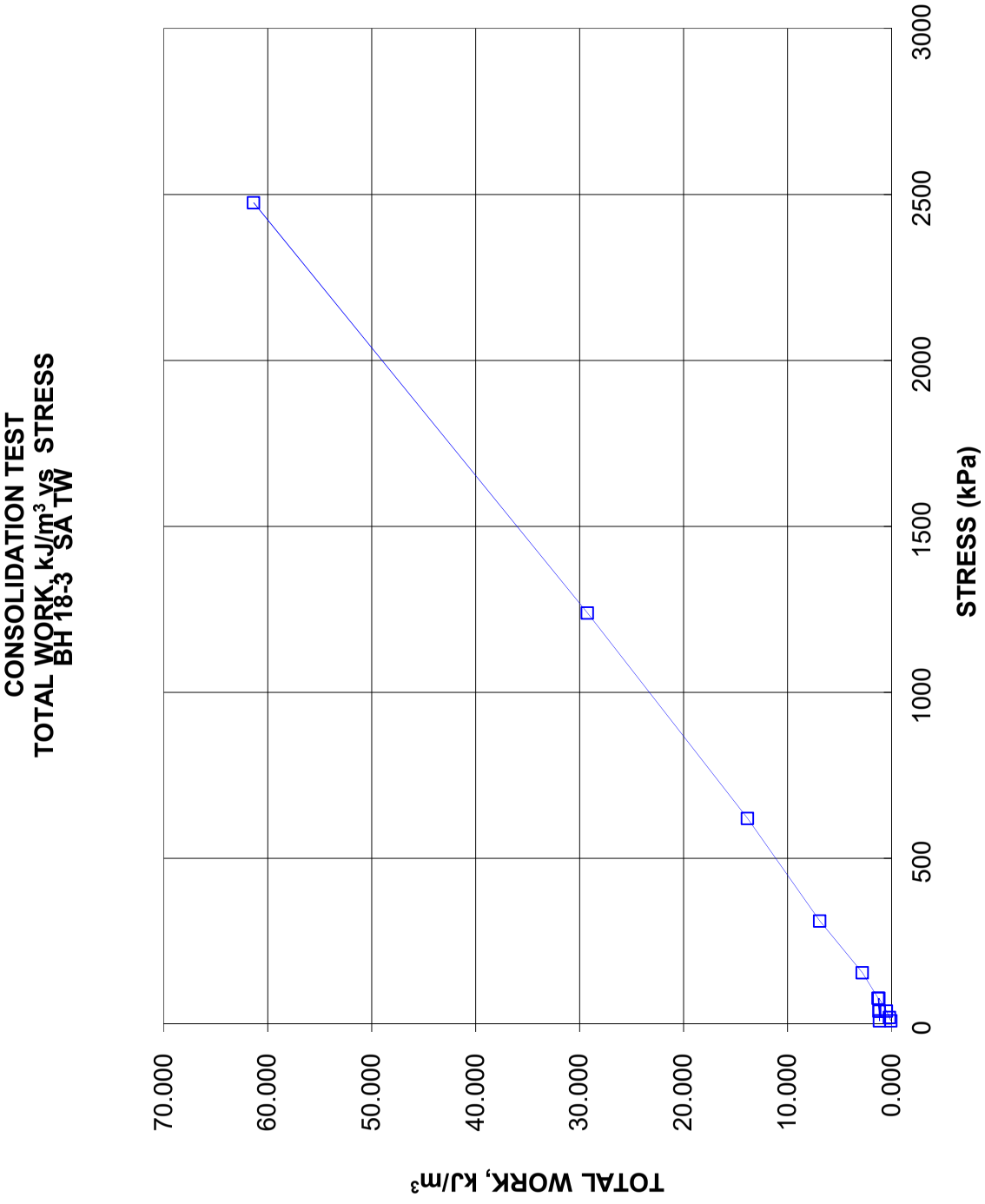
Project No. 18111688

Prepared By: SJ

Golder Associates

Checked By: AM

CONSOLIDATION TEST TOTAL WORK VS STRESS	FIGURE D2 4 of 4



Project No. 18111688

Prepared By: SJ

Golder Associates

Checked By: AM

CONSOLIDATION TEST SUMMARY

ASTM D2435/D2435M

FIGURE D3

SAMPLE IDENTIFICATION

Project Number	18111688	Sample Number	TW
Borehole Number	18-6	Sample Depth, m	10.36-10.82

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	1		
Date Started	04/23/2019		
Date Completed	05/07/2019		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.56	Unit Weight, kN/m^3	19.45
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	15.58
Area, cm^2	31.67	Specific Gravity, measured	2.74
Volume, cm^3	80.91	Solids Height, cm	1.481
Water Content, %	24.84	Volume of Solids, cm^3	46.91
Wet Mass, g	160.46	Volume of Voids, cm^3	34.01
Dry Mass, g	128.53	Degree of Saturation, %	93.9

TEST COMPUTATIONS

Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	2.555	0.725	2.555				
5.09	2.557	0.726	2.556				
10.63	2.558	0.727	2.557				
20.45	2.557	0.726	2.558	28	4.95E-02	5.18E-05	2.51E-07
40.05	2.553	0.723	2.555	83	1.67E-02	8.39E-05	1.37E-07
78.56	2.542	0.716	2.547	97	1.42E-02	1.10E-04	1.53E-07
40.12	2.544	0.717	2.543				
10.63	2.546	0.719	2.545				
40.05	2.545	0.718	2.545	106	1.30E-02	1.60E-05	2.03E-08
78.67	2.541	0.716	2.543	83	1.65E-02	3.55E-05	5.74E-08
155.76	2.528	0.706	2.534	113	1.21E-02	6.96E-05	8.21E-08
310.37	2.505	0.691	2.516	97	1.38E-02	5.67E-05	7.69E-08
619.62	2.472	0.669	2.489	208	6.31E-03	4.15E-05	2.57E-08
1237.71	2.416	0.631	2.444	240	5.28E-03	3.60E-05	1.86E-08
2473.73	2.329	0.572	2.372	208	5.74E-03	2.74E-05	1.54E-08
619.62	2.344	0.583	2.337				
155.76	2.372	0.601	2.358				
39.80	2.402	0.622	2.387				
10.63	2.418	0.633	2.410				

Note:
Consolidation loading and unloading schedule assigned by the client.
cv and k are approximate only based on t_{90} estimated from Square Root of Time Method (ASTMD2435/2435M)
specimen swelled under 20.45kPa

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.42	Unit Weight, kN/m^3	20.26
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	16.46
Area, cm^2	31.67	Specific Gravity, measured	2.74
Volume, cm^3	76.59	Solids Height, cm	1.481
Water Content, %	23.13	Volume of Solids, cm^3	46.91
Wet Mass, g	158.26	Volume of Voids, cm^3	29.68
Dry Mass, g	128.53		

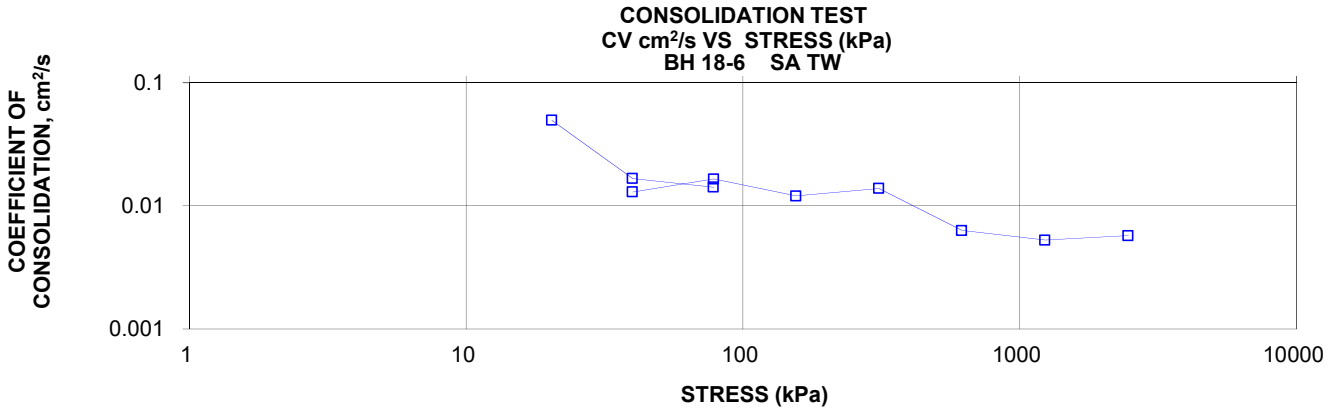
Prepared By: LH

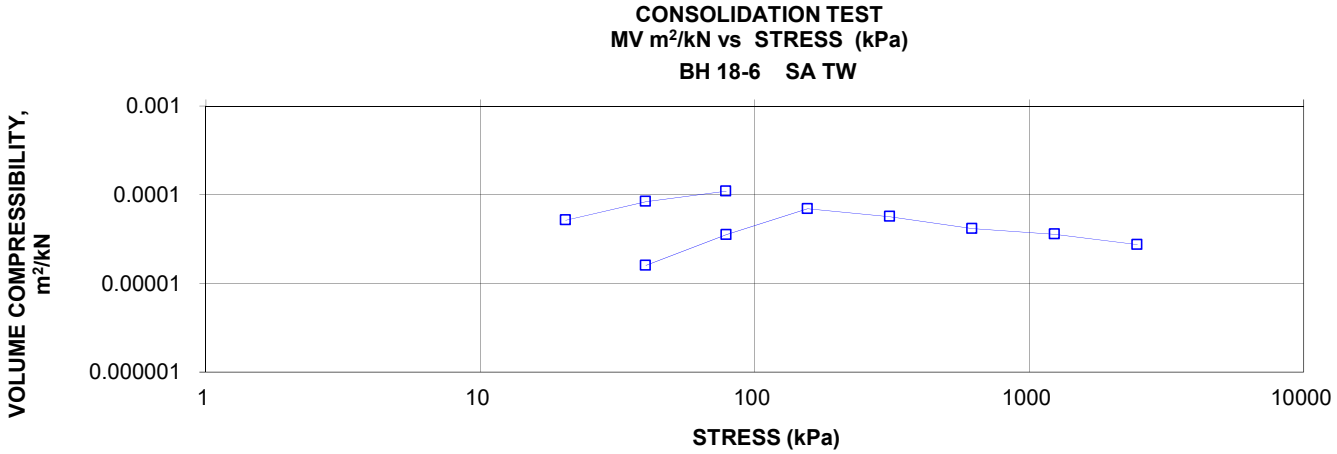
Golder Associates

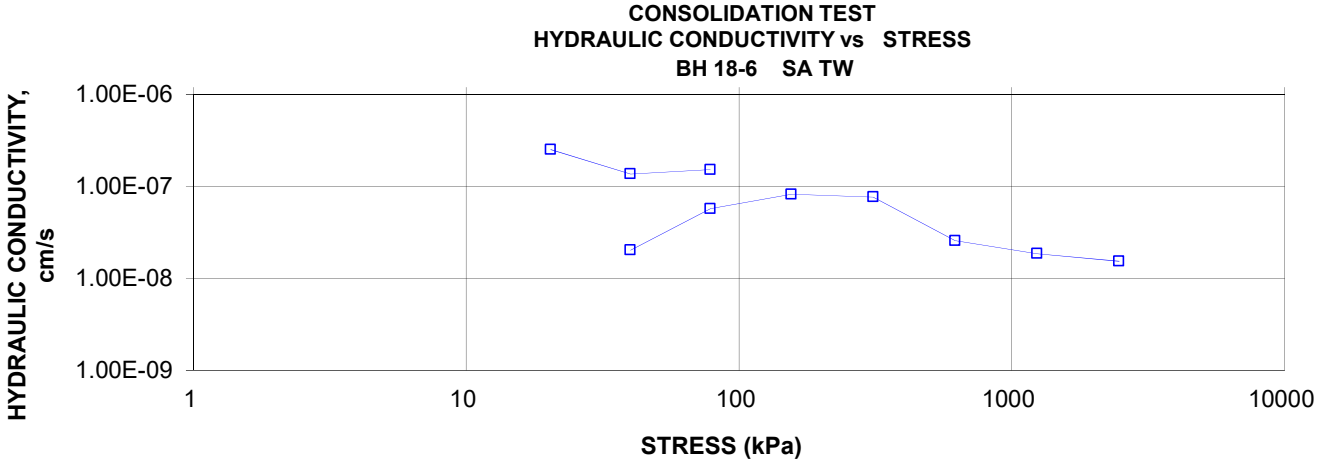
Checked By: AM

CONSOLIDATION TEST SUMMARY

FIGURE D3
2 of 4







Project No. 18111688

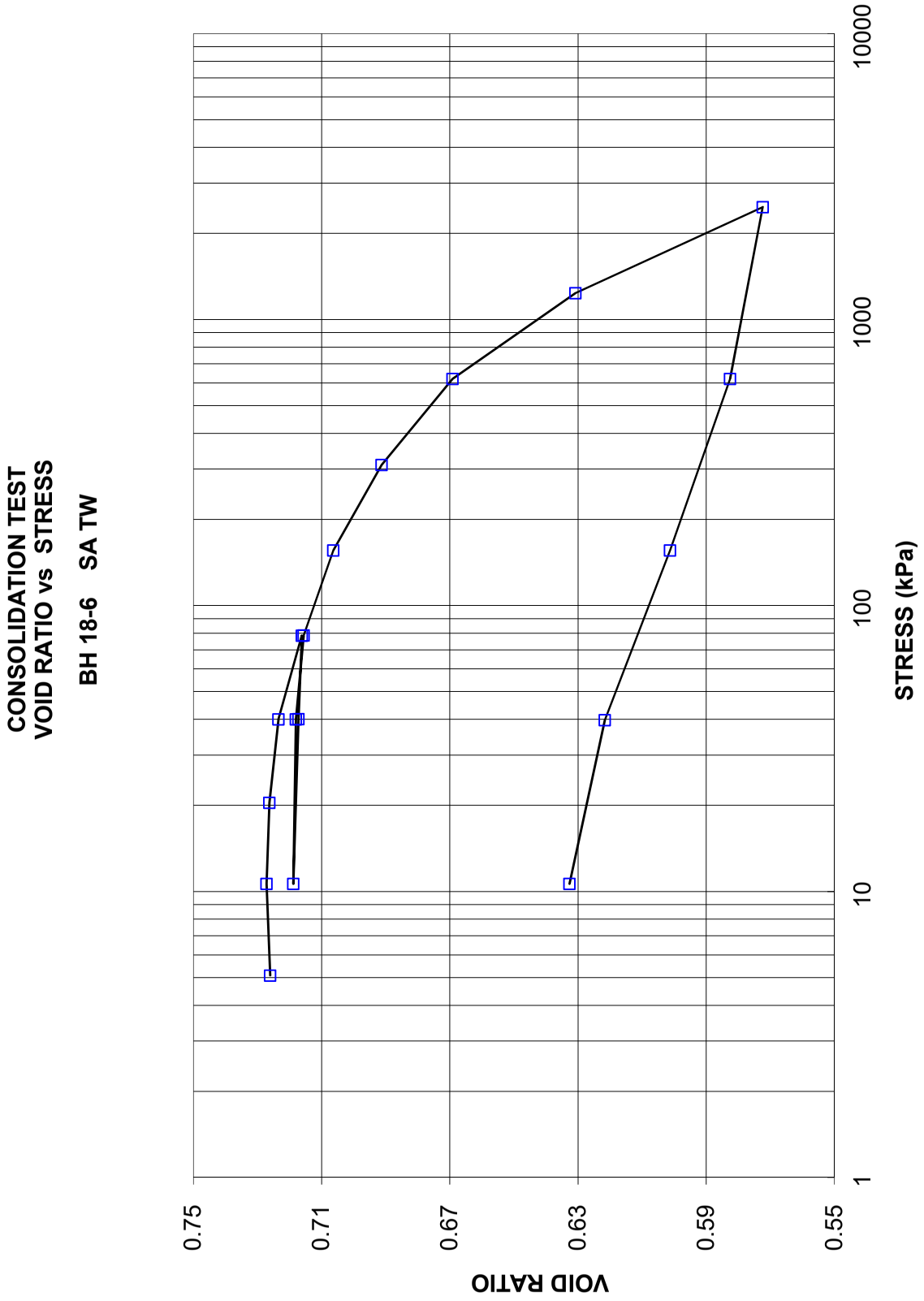
Prepared By: SJ

Golder Associates

Checked By: AM

CONSOLIDATION TEST
VOID RATIO VS LOG STRESS

FIGURE D3
3 of 4



Project No. 18111688

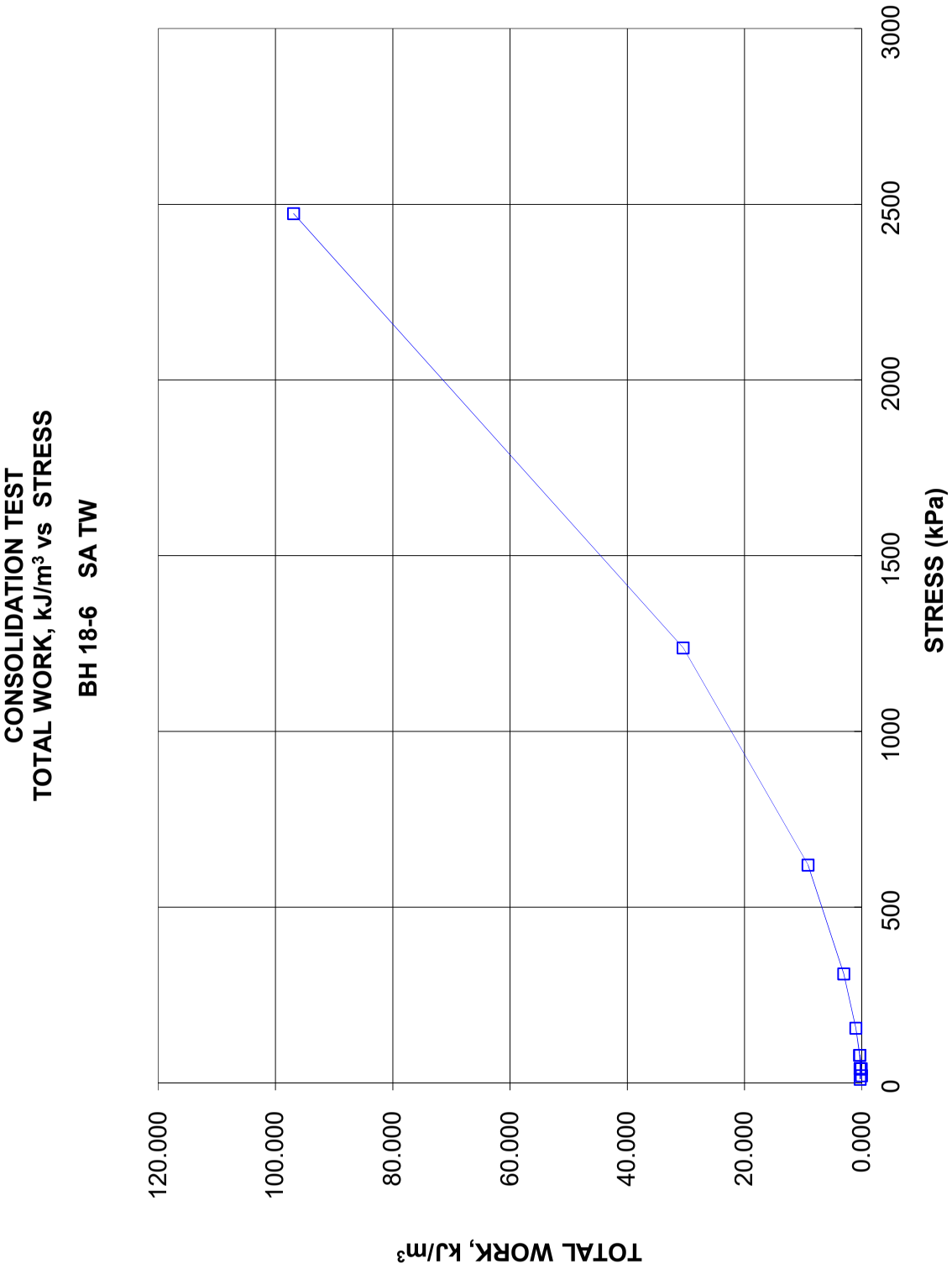
Prepared By: SJ

Golder Associates

Checked By: AM

CONSOLIDATION TEST
TOTAL WORK VS STRESS

FIGURE D3
4 of 4



Project No. 18111688

Golder Associates

Prepared By: SJ

Checked By: AM

CONSOLIDATION TEST SUMMARY

ASTM D2435/D2435M

FIGURE D4

SAMPLE IDENTIFICATION

Project Number	18111688	Sample Number	TW
Borehole Number	18-7	Sample Depth, m	7.47-7.92

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	5		
Date Started	04/23/2019		
Date Completed	05/06/2019		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m^3	20.27
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	16.54
Area, cm^2	31.46	Specific Gravity, measured	2.74
Volume, cm^3	59.84	Solids Height, cm	1.171
Water Content, %	22.55	Volume of Solids, cm^3	36.84
Wet Mass, g	123.69	Volume of Voids, cm^3	23.00
Dry Mass, g	100.93	Degree of Saturation, %	99.0

TEST COMPUTATIONS

Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	1.902	0.624	1.902				
6.10	1.904	0.626	1.903				
10.94	1.903	0.626	1.904	332	2.31E-03	1.10E-04	2.49E-08
20.76	1.903	0.625	1.903	187	4.11E-03	4.23E-05	1.70E-08
40.32	1.900	0.623	1.901	113	6.78E-03	5.99E-05	3.98E-08
79.27	1.895	0.619	1.898	187	4.08E-03	6.64E-05	2.66E-08
40.51	1.896	0.619	1.896				
10.94	1.896	0.620	1.896				
40.26	1.896	0.619	1.896	185	4.12E-03	1.22E-05	4.92E-09
79.27	1.895	0.618	1.895	148	5.14E-03	1.52E-05	7.68E-09
157.15	1.890	0.614	1.892	231	3.29E-03	3.09E-05	9.94E-09
312.61	1.883	0.608	1.886	145	5.20E-03	2.45E-05	1.25E-08
623.84	1.870	0.597	1.877	113	6.61E-03	2.09E-05	1.35E-08
1246.03	1.833	0.565	1.852	146	4.98E-03	3.20E-05	1.56E-08
2490.90	1.783	0.523	1.808	148	4.68E-03	2.09E-05	9.59E-09
623.84	1.786	0.526	1.785				
157.03	1.796	0.533	1.791				
40.51	1.806	0.542	1.801				
10.97	1.815	0.550	1.810				

Note:
Consolidation loading and unloading schedule assigned by the client.
cv and k are approximate only based on t_{90} estimated from Square Root of Time Method (ASTMD2435/2435M)
specimen swelled under 10.94kPa

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.81	Unit Weight, kN/m^3	20.93
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	17.34
Area, cm^2	31.46	Specific Gravity, measured	2.74
Volume, cm^3	57.09	Solids Height, cm	1.171
Water Content, %	20.72	Volume of Solids, cm^3	36.84
Wet Mass, g	121.84	Volume of Voids, cm^3	20.26
Dry Mass, g	100.93		

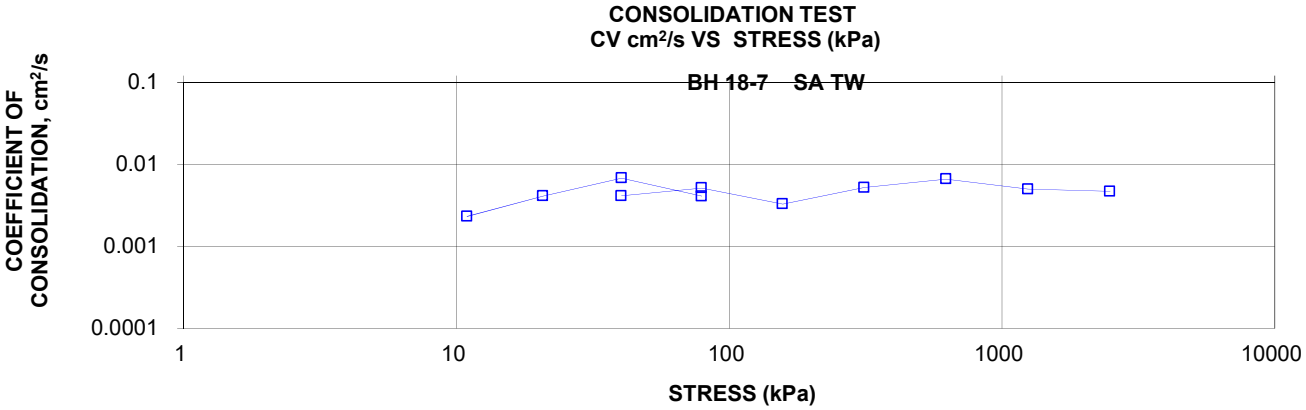
Prepared By: LH

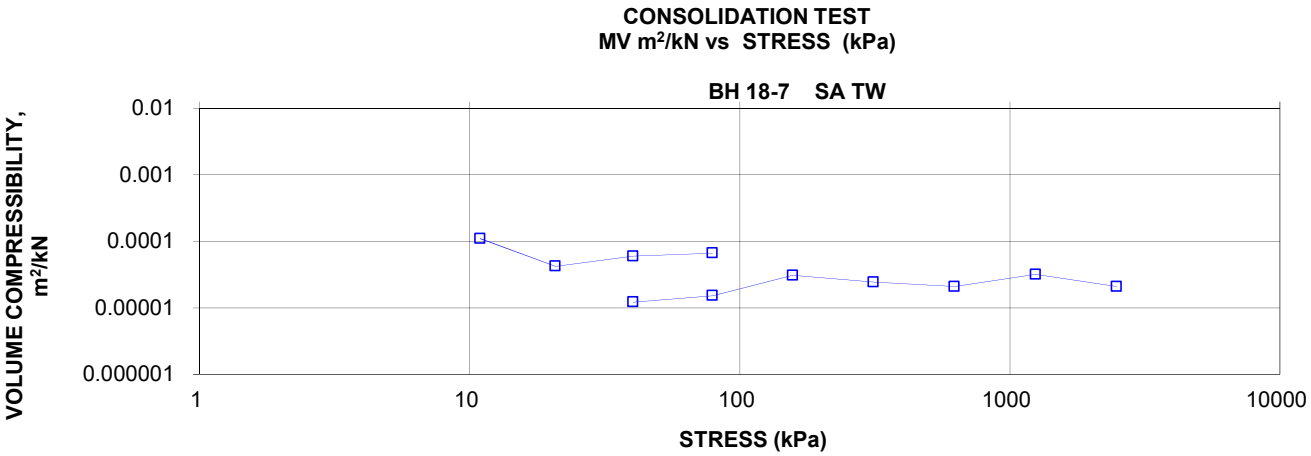
Golder Associates

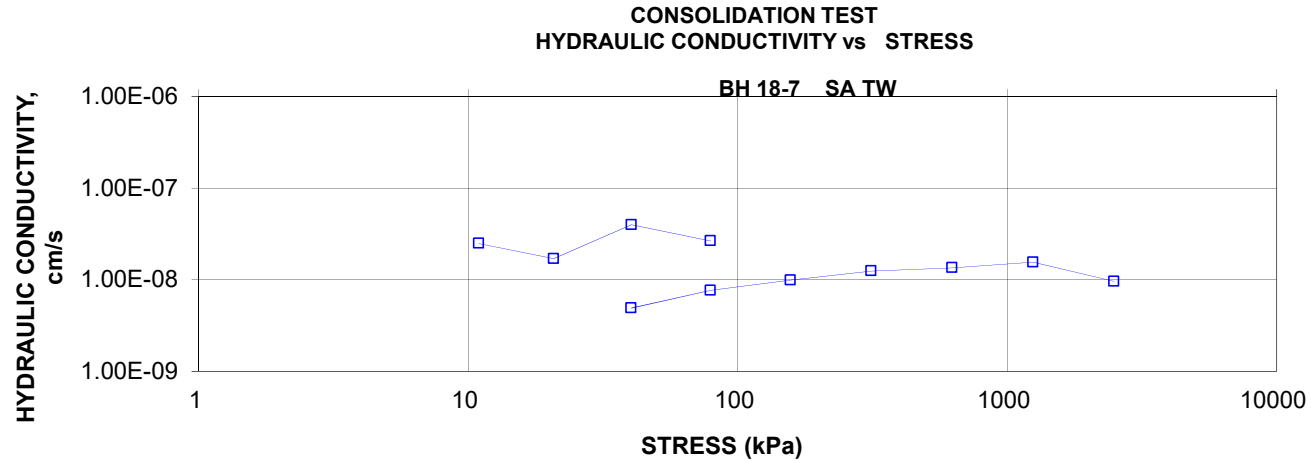
Checked By: AM

CONSOLIDATION TEST SUMMARY

FIGURE D4
2 of 4







Project No. 18111688

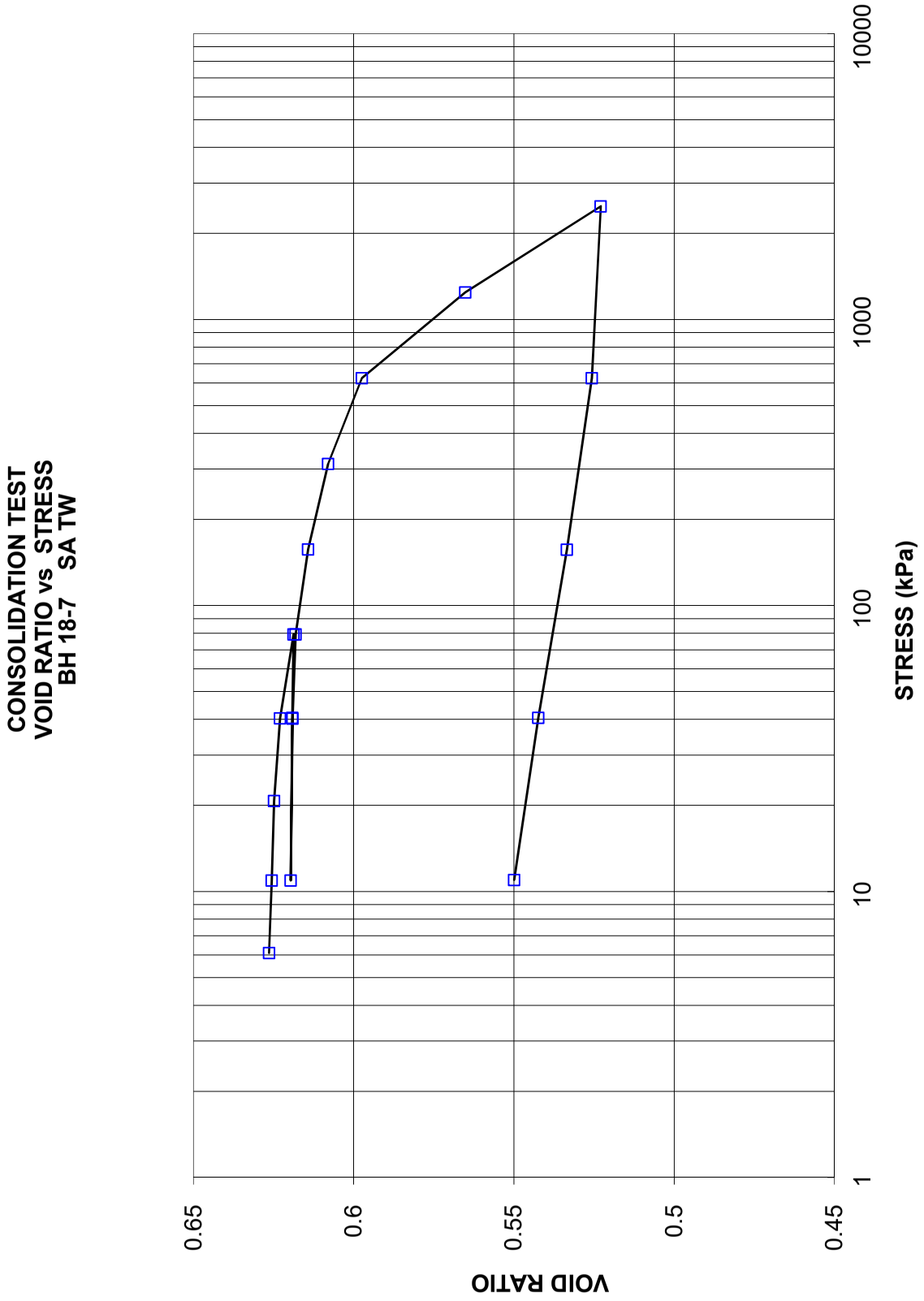
Prepared By: SJ

Golder Associates

Checked By: AM

CONSOLIDATION TEST
VOID RATIO VS LOG STRESS

FIGURE D4
3 of 4



Project No. 18111688

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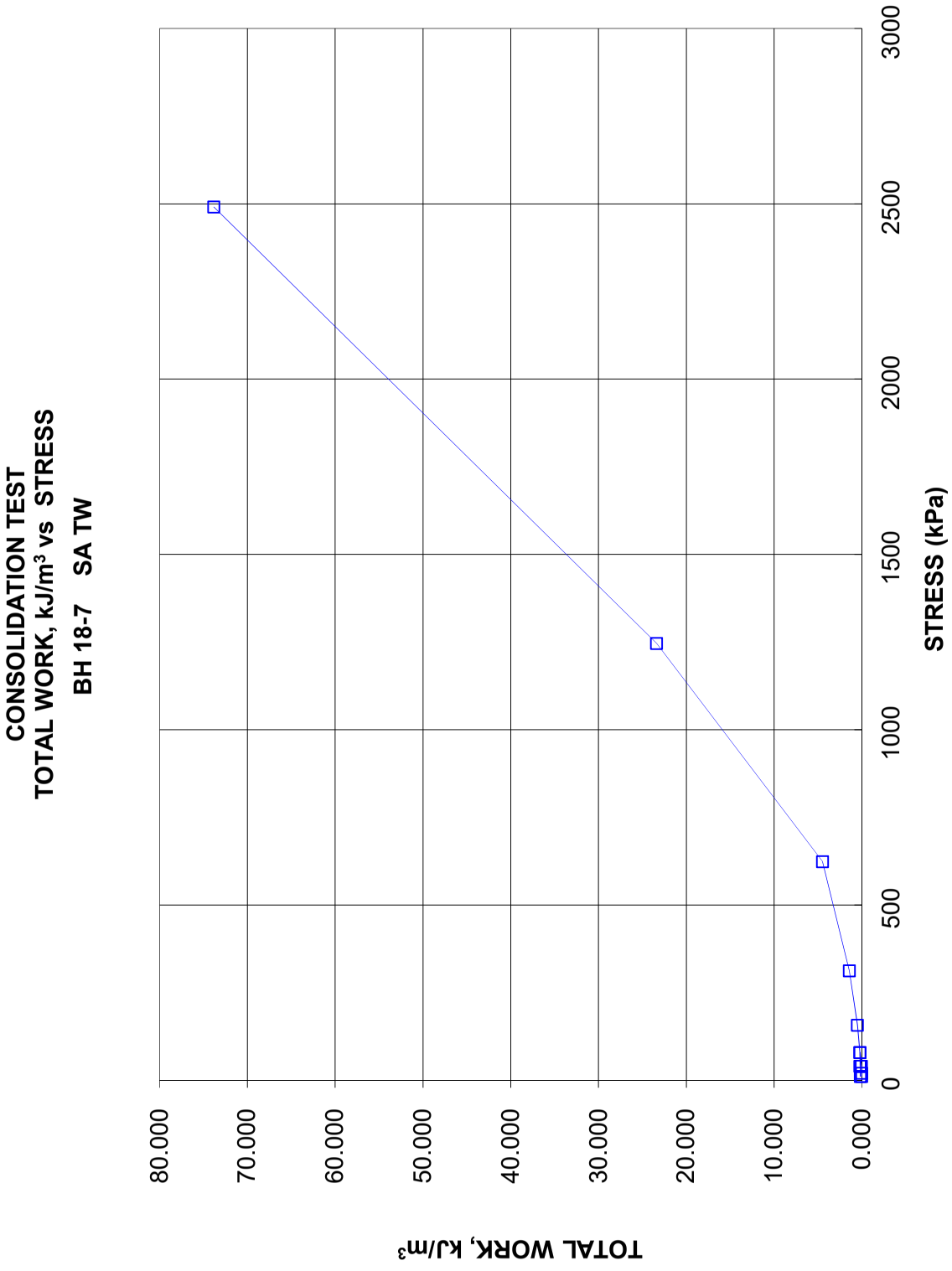
CONSOLIDATION TEST
TOTAL WORK VS STRESS

FIGURE D4
4 of 4



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