Golder Associates

TECHNICAL MEMORANDUM

DATE September 29, 2017 **PROJECT No.** 1774389 Phase 2000

TO Mr. Jeff Hamelin
Town of Penetanguishene

CC

FROM Derek Franceschini, EIT
Andrew Hagner, P. Eng.

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ahagner@golder.com

GEOTECHNICAL INVESTIGATION
PROPOSED COLD STORAGE BUILDING AND SALT DOME
TOWNSHIP MUNICIPAL YARD
24 CENTENNIAL DRIVE, PENETANGUISHENE, ON

Golder Associates Ltd. (Golder) has been retained by the Township of Penetanguishene (Township) to provide geotechnical engineering services in support of the design and construction of a cold storage building and salt dome for the Penetanguishene municipal yard at 24 Centennial Drive in Penetanguishene, Ontario. The site location is shown on the attached Key Plan, Figure 1 in Attachment B.

The purpose of this technical memorandum is to obtain information on subsurface soil and groundwater conditions at the site and to provide geotechnical engineering recommendations for the proposed structures.

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.

This technical memorandum should be read in conjunction with “Information and Limitations of this Report”, included in Attachment A. The reader’s attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this memorandum.

Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at this site. Geo-environmental (chemical) and hydrogeological aspects of the project, including 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 not addressed herein.

1.0 PROJECT DESCRIPTION

It is understood that the cold storage unit will have footprint dimensions of approximately 11 m x 14.5 m with a height of about 7.5 m. The proposed structure will have a 1 m tall, 0.6 m thick base wall around its perimeter to support the roof-truss system.

Only preliminary design drawings for the salt dome were available at the time of writing this report. The proposed salt dome will have footprint dimensions of approximately 18 m x 24 m and a height of about 11 m. It is anticipated that the perimeter strip footing width is specified to be no less than 1.8 m.

2.0 FIELD PROCEDURE

A field drilling program was carried out on September 1, 2017 at which time six boreholes (BH17-1 to BH17-6) were drilled to depths ranging from about 3.5 m to 5 m below ground surface. The boreholes were drilled using a steel-track mounted drill rig supplied and operated by Canadian Soil Drilling of Springwater, Ontario. Standard Penetration Testing (SPT) and sampling were carried out at regular intervals of depth in the boreholes using conventional 38 mm internal diameter split spoon sampling equipment driven by an automatic hammer in general accordance with the SPT procedures outlined in ASTM D1586. The results of the in situ field tests (i.e., SPT “N”-values) as presented on the Record of Borehole sheets and in subsequent sections of this report are uncorrected. Groundwater conditions were noted in the open boreholes during drilling; the boreholes were then backfilled upon completion, in accordance with Ontario Regulation 903 (as amended).

Prior to drilling, the borehole locations were laid out by Golder staff in the vicinity of the proposed buildings as shown on the Borehole Location Plan, Figure 2 in Attachment B. The field work for this investigation was monitored by a member of our geotechnical staff, who arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, as well as logged the boreholes. The soil samples obtained during this investigation were identified in the field, placed in appropriate containers, labelled and transported to Golder’s laboratory for further detailed visual examination by the project engineer, water content testing and selective classification analysis.

The locations of the boreholes are summarized in the following Table 1:

Table 1: Summary of Borehole Locations and Elevations

Borehole	UTM	Easting (m)	Northing (m)	Elevation (m)
BH17-1	17T	585663	4959376	240.50
BH17-2	17T	585651	4959359	241.10
BH17-3	17T	585637	4959352	240.80
BH17-4	17T	585623	4959370	240.30
BH17-5	17T	585578	4959273	-
BH17-6	17T	585572	4959258	-

The eastings and northings were read in the field at the borehole locations using a hand held GPS unit. The ground surface elevations at the borehole locations have been read off a Drawing #170821, entitled “Site Plan Preliminary”, which was received on September 5, 2017 from the Township of Penetanguishene.

2.1 Subsurface Conditions

The subsurface soil conditions encountered in the boreholes are shown in detail on the Record of Borehole sheets in Attachment C. Method of Soil Classification, Abbreviations and Terms Used on Records of Boreholes and Test Pits and List of Symbols are also provided in Attachment C to assist in the interpretation of the Record of Borehole sheets. It should be noted that the boundaries between the strata shown on the Borehole Records 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. Subsurface conditions presented may vary significantly between and/or beyond the borehole locations.

Subsurface conditions encountered in the boreholes generally consisted of 0.7 m to 2.1 m of fill materials overlying a native deposit of sand, in which all the boreholes were terminated.

The generally non-cohesive fill materials are comprised of loose to dense sand and gravel, gravelly sand and silty sand to sand. The results of grain size distribution on a single sample of the silty sand fill is presented on Figure D1 in Attachment D.

The underlying native sand deposit was very loose to dense, brown to light brown with trace to some non-plastic fines and was observed to be locally stratified. The results of grain size distribution on a sample of the native sand is presented on Figure D2 in Attachment D.

The results of the SPT testing are shown on the Borehole Records and are summarized in the following Table 2:

Table 2: Summary of SPT Results

Approx. Depth Below Ground Surface (m)	SPT “N”-Values					
	BH17-1	BH17-2	BH17-3	BH17-4	BH17-5	BH17-6
0.0 m to 0.6 m	30 (Fill)	18 (Fill)	20 (Fill)	6 (Fill)	34 (Fill)	7 (Fill)
0.8 m to 1.2 m	37 (Fill)	10 (Fill)	6 (Fill)	10	7	6
1.5 m to 2.0 m	15 (Fill)	35 (Fill)	5 (Fill)	17	3	15
2.3 m to 2.7 m	8	8	9	14	18	21
3.0 m to 3.5 m	10	11	15	16	21	20
3.8 to 4.2 m	32	11	16	18	-	-
4.5 to 5.0 m	26	13	19	21	-	-

SPT “N”-values are measured per 0.3 m of penetration

Groundwater observations carried out during drilling indicated that all boreholes were dry during and upon completion of drilling on September 1, 2017. It should be noted that the groundwater levels are generally expected to fluctuate seasonally. Higher groundwater levels may typically be expected during spring and following periods of increased precipitation.

3.0 GEOTECHNICAL RECOMMENDATION

3.1 Foundation Recommendations

At the time of writing this report, the foundations design concept, founding elevation(s) and grading plans were not available.

Based on the results of this investigation, consideration may be given to supporting the proposed buildings on conventional strip footings founded directly in the competent, native and undisturbed sand deposit at the depths summarized in the following Table 3:

Table 3: Recommended Founding Depths for New Foundations

Borehole Location Number	**Recommended Approximate Highest Founding Depths and Elevations**		**Founding Strata**
	Depth (m)	**Elevation (m)**	
BH17-1	3.0	237.50	Compact Sand
BH17-2	3.0	238.10	
BH17-3	3.0	237.80	
BH17-4	1.5	238.80	
BH17-5	2.3	-	
BH17-6	1.5	-	

Alternatively, the footings can be founded on approved engineered fill (see Section 3.3 for recommendations on the placement of engineered fill).

To minimize the potential damage to the footings due to frost action, it is recommended that all footings be given at least 1.5 m soil cover or equivalent thermal insulation.

For preliminary foundation design, the strip footings bearing on the native soils at the approximate elevations listed above or on engineered fill may be designed using geotechnical reaction at Serviceability Limit States (SLS) for 25 mm of settlement and a factored geotechnical resistance at Ultimate Limit States (ULS) values listed below. They are related to various soil embedment depths (i.e. native or engineered fill soil thickness surrounding the footings above their underside elevations):

For 1.5 m embedment: ULS: 250 kPa and SLS: 150 kPa
For 0.6 m embedment: ULS: 190 kPa and SLS: 125 kPa
For 0.3 m embedment: ULS: 140 kPa and SLS: 90 kPa

These bearing resistance values are based on strip footing widths ranging from 0.6 m to 1.8 m.

Stepped strip footings, if required, should be constructed in accordance with the 2012 Ontario Building Code (2012 OBC), Section 9.15.3.9.

Our foundation recommendations are subject to a key assumption that no former excavation, former or existing underground utility or structure is within or intercepts the zone of influence of the proposed footings. The zone of influence of the proposed footings can be defined as any line drawn from the underside edge of the footing down and away at 45^0 angles to the horizontal. Complete removal of any existing or remaining foundations from previous structures or any underground utilities (if present) or lowering the founding elevation (if appropriate) may be required, subject to the inspection by Golder during the time of construction.

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. Due to the presence of fill and localized low 'SPT' N values in sand it will be essential that all founding soils be inspected by Golder's geotechnical engineer prior to pouring concrete for the footings. If the concrete for the footings on native material cannot be poured immediately after excavation and inspection (i.e., within 24 hours of excavation and inspection), it is recommended that a working mat of lean concrete be placed in the excavation to protect the integrity of the bearing stratum. 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 1.5 m of cover after final grading or equivalent thermal insulation, in order to minimize the potential for damage due to frost action (determined from OPSD 3090.101).

To avoid problems with frost adhesion and heaving, the foundation walls should be backfilled with non-frost susceptible sand or sand and gravel conforming to the requirements for OPSS Granular B Type I. In areas where pavement or other hard surfacing will abut the building, differential frost heaving could occur. To reduce the severity of this differential heaving, the backfill adjacent to the wall (especially at the entrances), should be placed to form a frost taper. The frost taper should be brought up to pavement subgrade level from 1.5 m below finished exterior grade at a slope of 3 horizontal to 1 vertical, or flatter, away from the wall. The backfill materials should be placed evenly in lifts not exceeding 200 millimetres loose thickness. The layers should be compacted to at least 98 percent of the materials' SPMDD. Light compaction equipment should be used immediately adjacent to the wall; otherwise compaction stresses on the wall may be greater than that imposed by the backfill material. The upper 0.3 metres of backfill should consist of clayey material to provide a relatively impermeable cap and the exterior grade should also be shaped to slope away from the building.

3.2 Slab-on-Grade Floor for the Salt Dome

Floor slab for the proposed salt dome structure can be designed as a concrete slab-on-grade.

All four boreholes (BH17-1 through BH17-4) encountered variable in composition and compactness fill. The fill is undocumented and, as such is not considered to be suitable to support the proposed slab floor. We recommend that the fill be subexcavated and replaced with engineered fill. Provided that the excavated existing fill materials do not include organic or other deleterious materials, the existing fill may be reused as engineered fill under the slab and under the foundations (if applicable) subject to further testing for frost susceptibility.

Since the building will not be heated, the engineered fill materials within the potential frost penetration of 1.5 m of the top of the floor slab must be non-frost susceptible. The silty sand fill represented on Figure D1 is marginally acceptable for frost susceptibility, subject to further testing. Alternatively, OPSS Granular B Type I type material may be used as engineered fill that conforms to the frost susceptibility criteria. As a second alternative, the existing fill materials may be reused without further testing, but thermal under the slab insulation equivalent to the 1.5 m soil thickness would be required.

Once the engineered fill is in place, the exposed material must be proofrolled in conjunction with an inspection by Golder. Remedial work should be carried out on any softened, disturbed, wet or poorly performing zones as directed by the geotechnical engineer. Any low areas may then be brought up to within at least 200 mm of the underside of the floor slab, as required, using OPSS Granular B, Type I material or other approved material, placed in maximum 200 mm loose lifts and uniformly compacted to at least 100 percent of standard Proctor maximum dry density (SPMDD).

The final lift of granular fill beneath floor slab should consist of a minimum thickness of 200 mm of OPSS Granular A material, uniformly compacted to at least 100 percent of SPMDD. Special care should be taken to ensure adequate compaction adjacent to foundation walls. Any filling operations must be inspected and tested by Golder on a full time basis.

Where the floor slab is at or above the exterior final grade, perimeter drainage at the footing level is generally not required. The floor slabs should be structurally separate from the foundation walls and sawcut control joints are recommended at regular intervals to minimize shrinkage cracking and to allow for any differential settlement of the floor slabs.

3.3 Engineered Fill

Prior to placing engineered fill at the site, all the existing fill materials as well as any organic, disturbed or deleterious materials must be removed from the building envelope. If the proposed foundations are to be founded on engineered fill, at minimum, the excavation around the building envelope for the placement of engineered fill should consist of an area of the actual building envelope plus the depth of the excavated fill plus one metre. The geometry of the excavation should include for safe slopes as dictated by Occupational Health and Safety Act and Regulations for Construction Projects.

The exposed area should then be heavily 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 fill as well as disturbed, loosened, softened, organic and otherwise deleterious materials. Remedial work (i.e., further sub-excavation and replacement) should be carried out as directed by Golder.

Materials for reuse as engineered fill must be approved by Golder prior to placement. In this regard, excavated native soils from the site, free of significant amounts of organics and other deleterious materials, may be reused as engineered fill subject to the conditions indicated in Section 3.2 and provided that the placement water content can be maintained within about 2 percent of optimum water content for compaction. The native subsoils are generally below their optimum moisture content for compaction.

The approved materials for engineered fill should be placed in maximum 300 mm loose lifts and uniformly compacted to at least 100 percent of SPMDD throughout. The placement of engineered fill must be monitored by Golder on a full-time basis.

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. During periods of freezing weather, additional soil cover should be placed above final subgrade to provide for frost protection. Prior to placing additional engineered fill, the surface of the existing engineered fill must be re-inspected by Golder.

3.4 Granular Floor for the Cold Storage Structure

Based on the results of boreholes BH17-5 and BH17-6, only approximately 0.7 m fill thickness was encountered. Depending upon the final site grading and the required granular floor base thickness, the existing fill should be subexcavated, as required, and the remainder heavily proofrolled in conjunction with inspection by our engineer. Remedial work should be carried out as required, based on our comments in the above Section 3.2. Prior to construction, Golder should review the design of the granular base floor to confirm its long term performance consistent with the proposed loading.

3.5 Foundation Excavations

Based on the preliminary information provided by the client it is anticipated that excavations for foundations and/or the construction of engineered fill will require excavations up to approximately 3 m in depth. It is anticipated that excavations can be accomplished using conventional hydraulic excavating equipment using conventional temporary open cuts. However, depending upon the construction procedures adopted by the contractor, actual groundwater seepage conditions, the success of the contractor's groundwater control methods and weather conditions at the time of construction, some flattening and/or blanketing of the slopes may be required. 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 and sloped according to the guideline in the regulations. Based on the Occupational Health and Safety Regulations for Construction Projects, the fill and underlying native subsoils are generally classified as Type 3 soils and all excavations through these soils should be sloped no steeper than 1.5 horizontal to 1 vertical, subject to inspection by Golder at the time of construction. Where space restrictions dictate, the excavation sides have to be fully braced to resist lateral earth pressure.

Careful assessment will be required prior to excavation to ensure that all underground utilities are properly supported prior to excavating. In addition, excavations should not encroach within the zone of influence of the foundations of the existing salt dome or other adjacent infrastructure.

3.6 Site Classification for Seismic Site Response

Seismic hazard is defined in the 2012 Ontario Building Code (OBC 2012) by uniform hazard spectra (UHS) at spectral coordinates of 0.2 second, 0.5 second, 1.0 second and 2.0 seconds and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g. shear wave velocity, Standard Penetration Test (SPT) resistance, undrained soil shear strength, etc.) in the 30 m below the foundation level. There are 6 site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote 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 F_a and F_v, respectively, used to modify the UHS to account for the effects of site-specific soil conditions in design.

Based on the results of the borehole investigation, for footings founded at the depths recommended in Section 3.1, **Site class D** may be used for design.

It may be possible to upgrade the site class if geophysical investigation is carried out at the site. The need for geophysical testing should be discussed with the structural engineer.

4.0 CLOSURE

The findings of this technical memorandum are based upon the results of field and laboratory investigations carried out by Golder. If conditions encountered at the surface or at depth during construction are different than indicated in the report, or if the stated assumptions are not consistent with design, this office should be notified for review and adjustment of recommendations, if necessary.

Soil conditions are, by their nature, highly variable across a construction site. The placement of fill and prior construction activities can contribute to variables in the near-surface conditions. A contingency should be included in any construction budget to allow for the possibility of variation of soil conditions that may result in modification of design and construction procedures.

We trust this report is sufficient for your immediate requirements. Should you have any comments or questions, please do not hesitate to contact us.

Yours truly,

GOLDER ASSOCIATES LTD.

Derek Franceschini, EIT
Engineer-In-Training

Andrew J. Hagner, P. Eng.
Associate, Senior Geotechnical Engineer

LICENSED PROFESSIONAL ENGINEER
AJH
A. J. HAGNER
Sept 29, 2017
PROVINCE OF ONTARIO

DF/RA/AJH/

Attachments:

Attachment A
Important Information and Limitations of This Report

Attachment B
Figure 1 – Key Plan
Figure 2 – Borehole Location Plan

Attachment C
Method of Soil Classification
Abbreviations and Terms Used on Records of Boreholes and Test Pits
List of Symbols
Record of Borehole Sheets: BH17-1 to BH17-6

Attachment D
Figure D1
Figure D2

https://golderassociates.sharepoint.com/sites/13115g/shared documents/phase 2000 - salt dome + cold storage/report/1774389_twp_of_penetang_municipal_yard_investigation_mem_2017'9'29.docx

Attachment 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 can not 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 Groundwater 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.

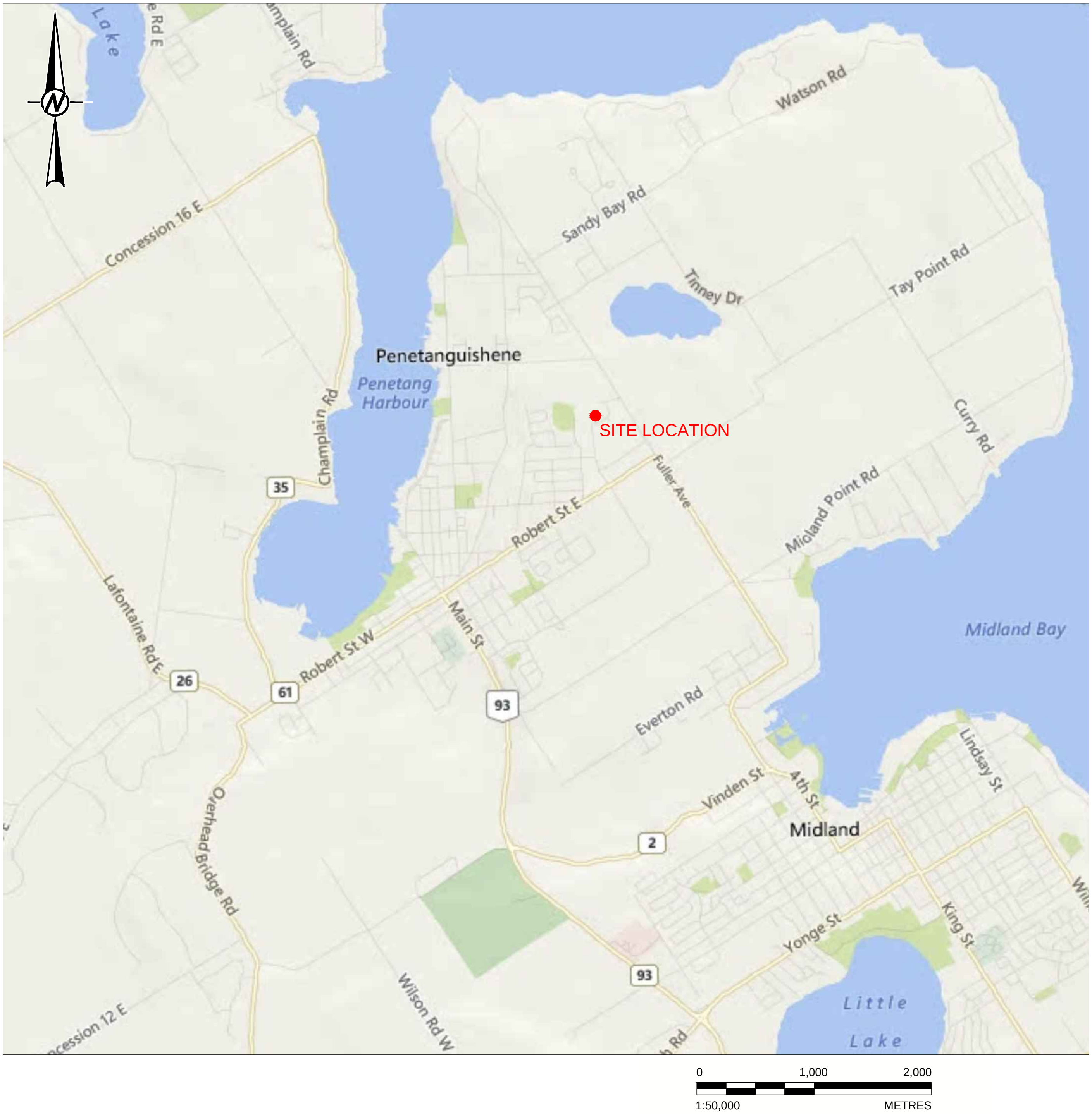
During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and 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.

Attachment B

Figure 1 – Key Plan
Figure 2 – Borehole Location Plan



LEGEND

● APPROXIMATE SITE LOCATION

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2017

BASE IMAGERY - © 2017 DIGITALGLOBE IMAGE COURTESY OF USGS EARTHSTAR GEOGRAPHICS SIO © 2017 MICROSOFT CORPORATION

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PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
TOWN OF PENETANGUISHENE

PROJECT
GEOTECHNICAL INVESTIGATION
PROPOSED COLD STORAGE BUILDING AND SALT STORAGE DOME, 24 CENTENNIAL DRIVE, PENETANGUISHENE, ONTARIO

TITLE
KEY PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-09-14
DESIGNED	STB
PREPARED	STB
REVIEWED	DF
APPROVED	AJH

PROJECT NO.	CONTROL	REV.	FIGURE
1774389	0001	A	1

LEGEND

⊕ BOREHOLE LOCATION

0 20 40

1:800 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

BASE DATA - TOWN OF PENETANGUISHENE, DRAWING FILE: 170821_SITE_PLAN_PRELIMINARY.DWG, OBTAINED SEPTEMBER 5, 2017

BASE IMAGERY - © THE CORPORATION OF THE COUNTY OF SIMCOE, 2017

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PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

TOWN OF PENETANGUISHENE

PROJECT

GEOTECHNICAL INVESTIGATION
PROPOSED COLD STORAGE BUILDING AND SALT STORAGE DOME, 24 CENTENNIAL DRIVE, PENETANGUISHENE, ONTARIO

TITLE

BOREHOLE LOCATION PLAN

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-09-28
DESIGNED	STB
PREPARED	STB
REVIEWED	DF
APPROVED	AJH

PROJECT NO.	CONTROL	REV.	FIGURE
1774389	0001	A	2

25 mm

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Attachment C

Method of Soil Classification

Abbreviations and Terms Used on Records of Boreholes and Test Pits

List of Symbols

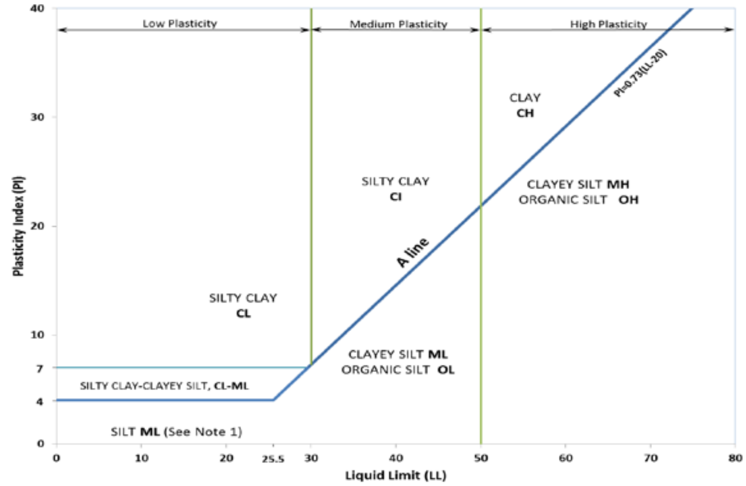
Record of Borehole Sheets: BH17-1 to BH17-6

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	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10}xD_{60}}$	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, SAND and CLAY)
> 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 which are 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 descriptions based on SPT 'N' ranges from Terzaghi and Peck (1967) and correspond to typical average N_{60} values.

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: 1774389

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH17-1

BORING DATE: September 1, 2017

SHEET 1 OF 1

DATUM: Geodetic

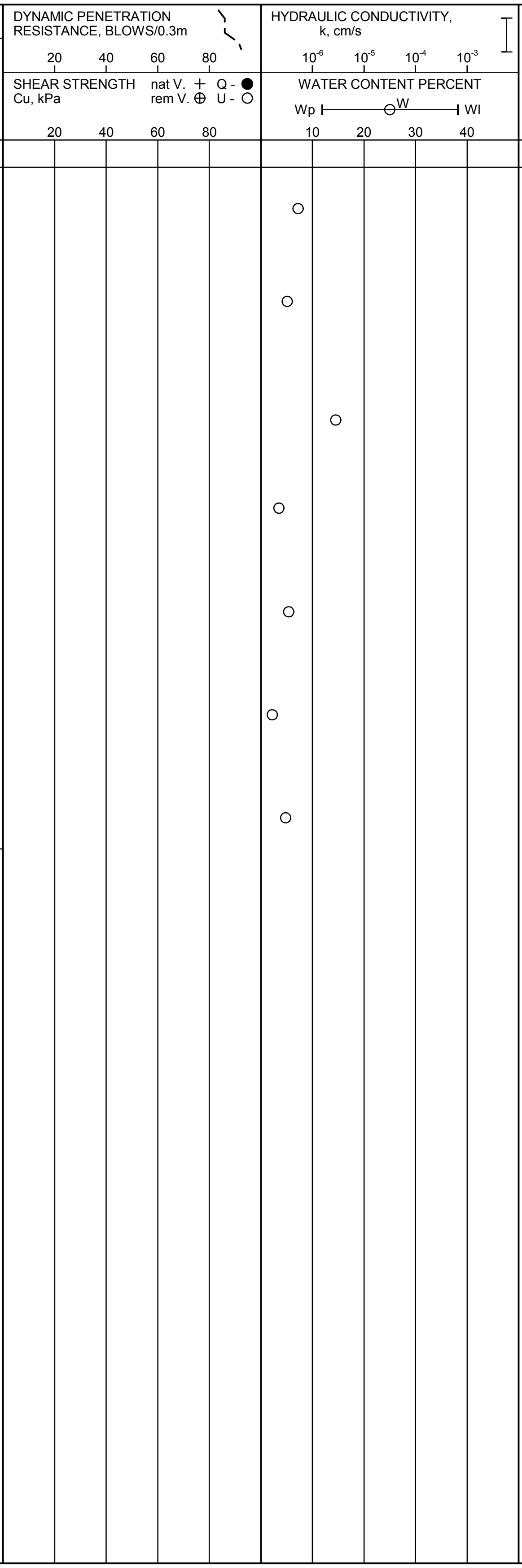
SPT/DCPT HAMMER: MASS, 64kg; DROP, 762mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		240.50					
0	POWER AUGER CME 55 TRACK MOUNT Solid Stem Augers	FILL - (SP/GP) SAND and GRAVEL, some non-plastic fines; brown, mottled; non-cohesive, moist, dense	▩	0.00	1	SS	30		
1					2	SS	37		
		FILL - (SM) SILTY SAND, trace gravel; brown; non-cohesive, dry to moist, compact	▩	239.13 1.37	3A 3B	SS	15	M	
2		(SP) SAND, trace non-plastic fines; brown to light brown, laminated silty sand inclusions; non-cohesive, dry to moist, loose to dense		238.37 2.13	4	SS	8		
3					5	SS	10		
4					6	SS	32		
					7	SS	26		
5		END OF BOREHOLE		235.47 5.03					
6									
7									
8									
9									
10									

NOTES:

1. Borehole dry upon completion of drilling.



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DF

CHECKED: RA

PROJECT: 1774389

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH17-2

BORING DATE: September 1, 2017

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 762mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m
		GROUND SURFACE		241.10			
0	POWER AUGER CME 55 TRACK MOUNT Solid Stem Augers	FILL - (SP/GP) SAND and GRAVEL, some non-plastic fines; brown; non-cohesive, dry to moist, compact	▨	0.00	1A	SS	18
		FILL - (SM) SILTY SAND, some gravel; brown to light brown; non-cohesive, moist, compact to dense	▨	240.80 0.30	1B		
1					2	SS	10
					3	SS	35
2		(SP) SAND, trace to some non-plastic fines; brown; non-cohesive, dry to moist, loose to compact		238.97 2.13	4	SS	8
3					5	SS	11
4					6	SS	11
					7	SS	13
5		END OF BOREHOLE		236.07 5.03			
6							
7							
8							
9							
10							

NOTES:

1. Borehole dry upon completion of drilling.

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

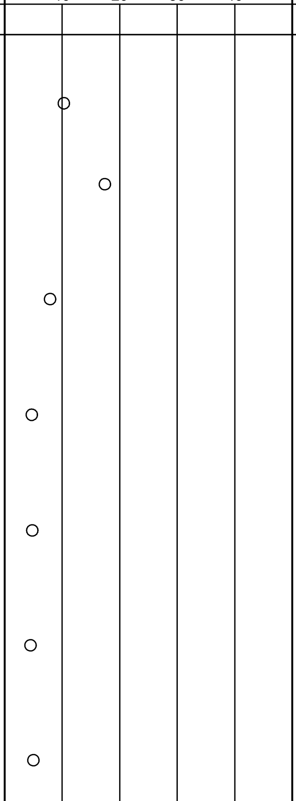
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

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 Associates

LOGGED: DF

CHECKED: RA

PROJECT: 1774389

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH17-3

SHEET 1 OF 1

DATUM: Geodetic

BORING DATE: September 1, 2017

SPT/DCPT HAMMER: MASS, 64kg; DROP, 762mm

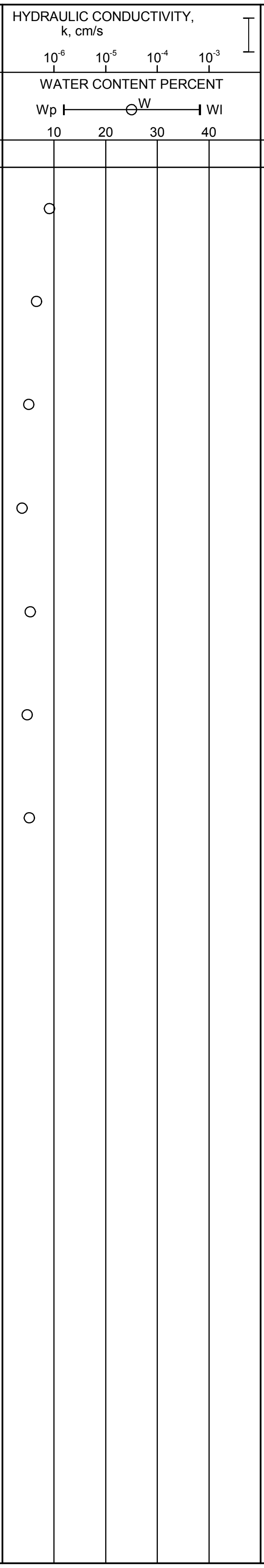
HAMMER TYPE: AUTOMATIC

BORING METHOD: POWER AUGER CME 55 TRACK MOUNT, Solid Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE		240.80			
0	FILL - (SP/GP) SAND and GRAVEL, trace non-plastic fines; brown to black; non-cohesive, moist, compact	▨	0.00	1	SS	20
	FILL - (SP) SAND, trace non-plastic fines; light brown; non-cohesive, dry to moist, loose	▨	240.11 0.69	2	SS	6
				3	SS	5
2	(SP) SAND, trace non-plastic fines; light brown; non-cohesive, dry to moist, loose to compact		238.67 2.13	4	SS	9
				5	SS	15
				6	SS	16
				7	SS	19
5	END OF BOREHOLE		235.77 5.03			

NOTES:

1. Borehole dry upon completion of drilling.



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DF

CHECKED: RA

PROJECT: 1774389

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH17-4

BORING DATE: September 1, 2017

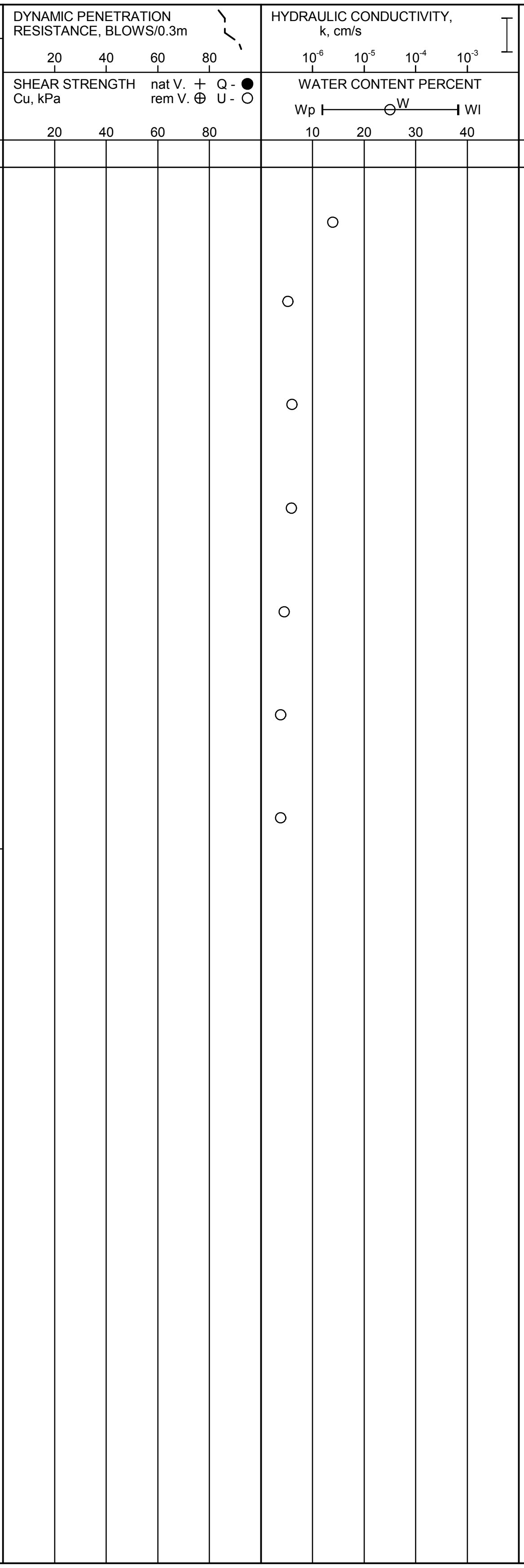
SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 762mm

HAMMER TYPE: AUTOMATIC

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 / SHEAR STRENGTH Cu, kPa	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		240.30							
0	POWER AUGER CME 55 TRACK MOUNT Solid Stem Augers	FILL - (SW) gravelly SAND, some non-plastic fines; brown; non-cohesive, moist, loose	▩	0.00 240.10 0.20	1A						
		FILL - (SM) SILTY SAND; brown, rootlets; non-cohesive, moist, loose	▩		1B	SS	6				
		(SP) SAND, trace non-plastic fines; brown to light brown; non-cohesive, moist, loose to compact		239.61 0.69							
1					2	SS	10				
					3	SS	17				
2											
					4	SS	14				
3					5	SS	16				
4					6	SS	18				
					7	SS	21				
5		END OF BOREHOLE		235.27 5.03							
6											
7											
8											
9											
10											



NOTES:

1. Borehole dry upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DF

CHECKED: RA

PROJECT: 1774389

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH17-5

BORING DATE: September 1, 2017

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 762mm

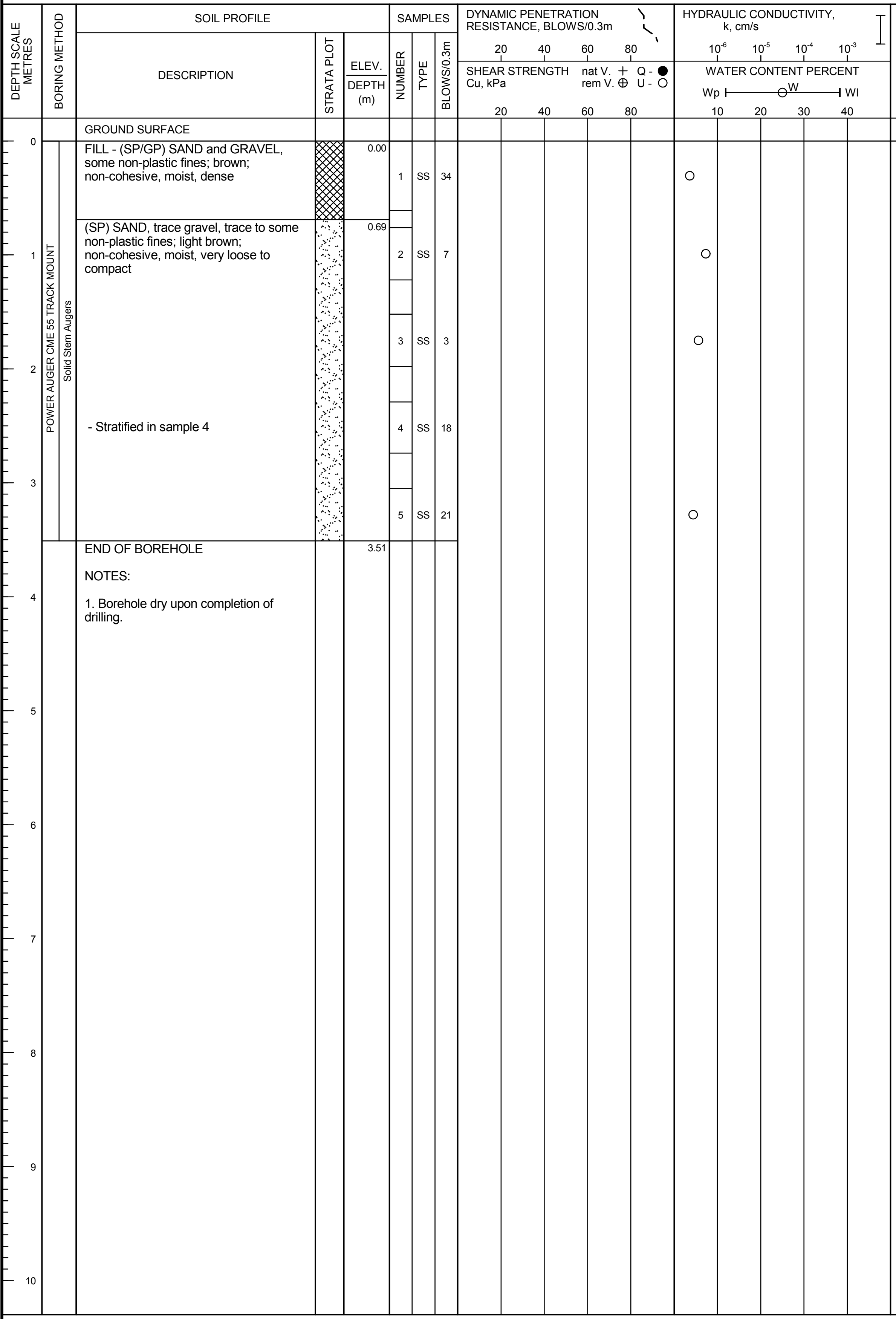
HAMMER TYPE: AUTOMATIC

BORING METHOD: POWER AUGER CME 55 TRACK MOUNT – Solid Stem Augers

DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE					
FILL - (SP/GP) SAND and GRAVEL, some non-plastic fines; brown; non-cohesive, moist, dense	▨	0.00	1	SS	34
(SP) SAND, trace gravel, trace to some non-plastic fines; light brown; non-cohesive, moist, very loose to compact		0.69	2	SS	7
			3	SS	3
- Stratified in sample 4			4	SS	18
			5	SS	21
END OF BOREHOLE		3.51			

NOTES:

1. Borehole dry upon completion of drilling.



DEPTH SCALE

1 : 50

LOGGED: DF

CHECKED: RA

PROJECT: 1774389

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH17-6

BORING DATE: September 1, 2017

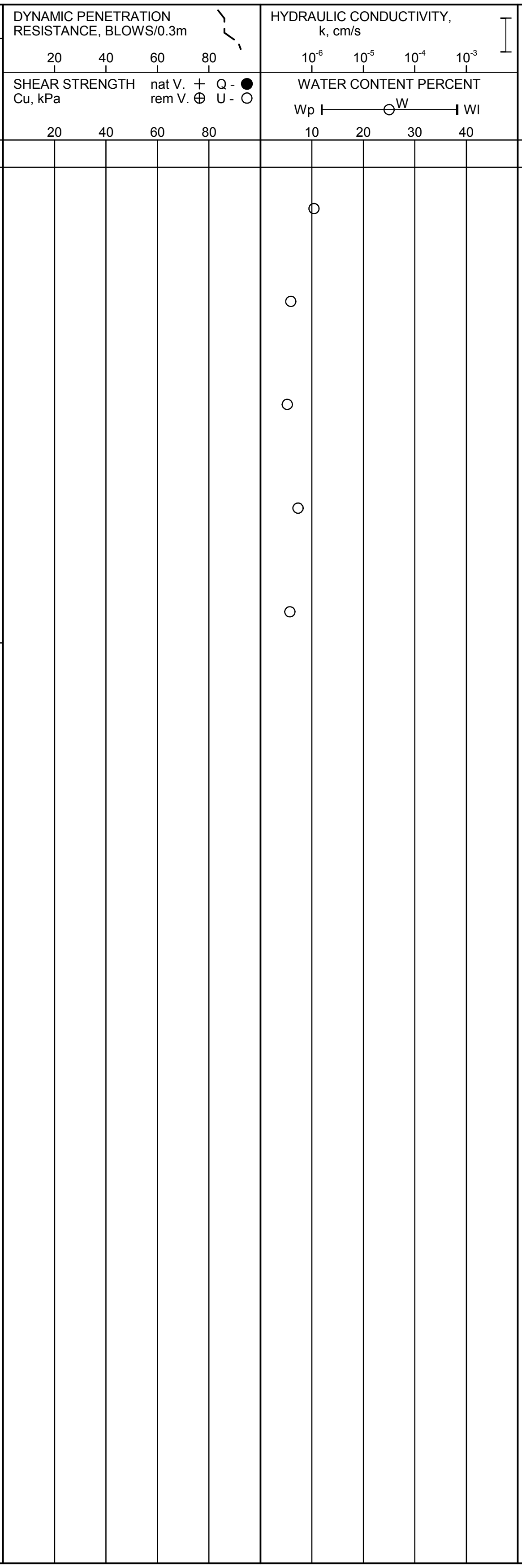
SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 762mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE							
0	POWER AUGER CME 55 TRACK MOUNT Solid Stem Augers	FILL - (SM) SILTY SAND, some gravel; brown, cobble fragments; non-cohesive, moist, loose	▩	0.00	1	SS	7		
1		(SP) SAND, trace non-plastic fines; brown to light brown; non-cohesive, dry to moist, loose to compact	⁙	0.69	2	SS	6		
2					3	SS	15	M	
					4	SS	21		
3					5	SS	20		
		END OF BOREHOLE NOTES: 1. Borehole dry upon completion of drilling.		3.51					
4									
5									
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DF

CHECKED: RA

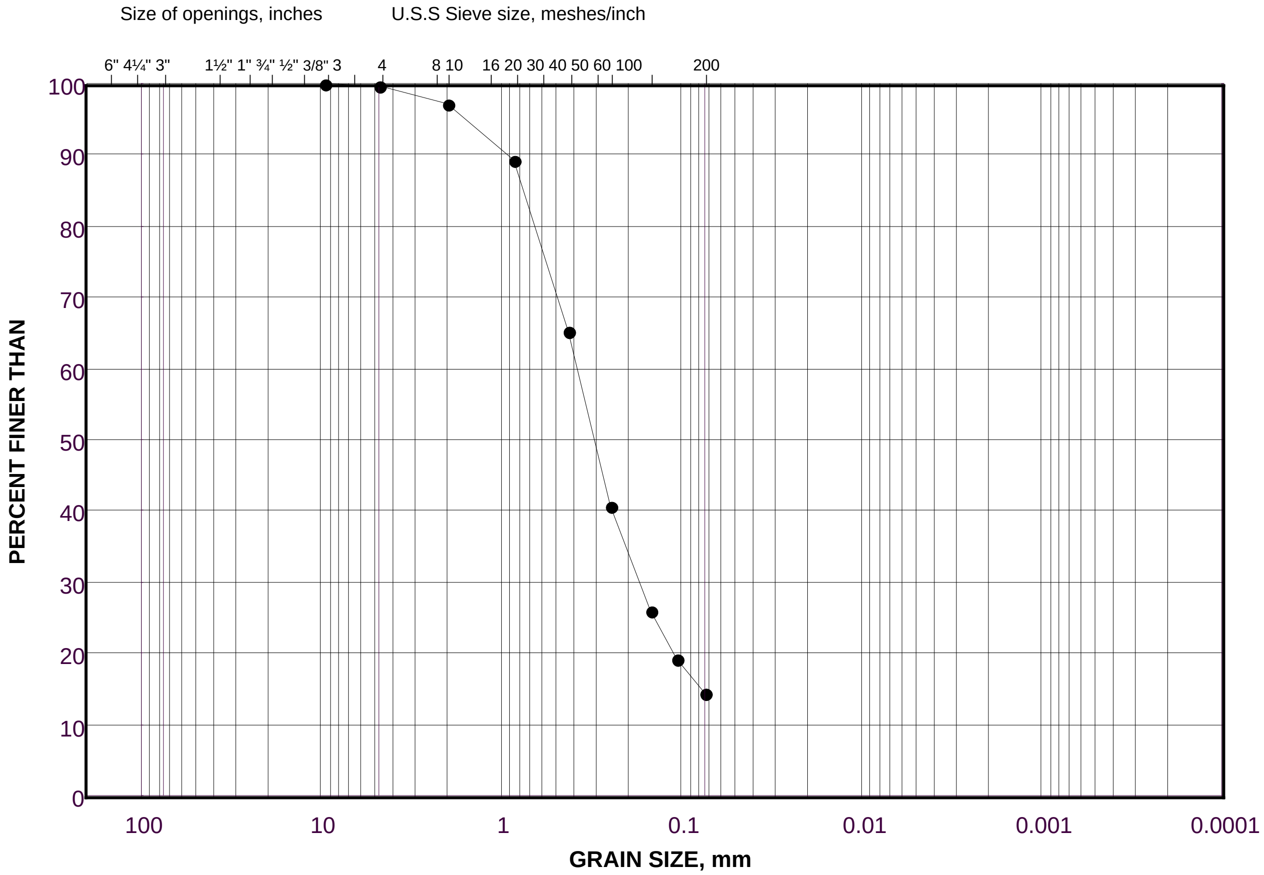
Attachment D

Lab Figure D1

Lab Figure D2

GRAIN SIZE DISTRIBUTION
(SM) SILTY SAND (FILL)
ASTM D6913

FIGURE D1



COBBLE	COARSE	FINE	COARS	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
l	BH17-1	SA 3B	1.75 - 1.98

Project Number: 1774389

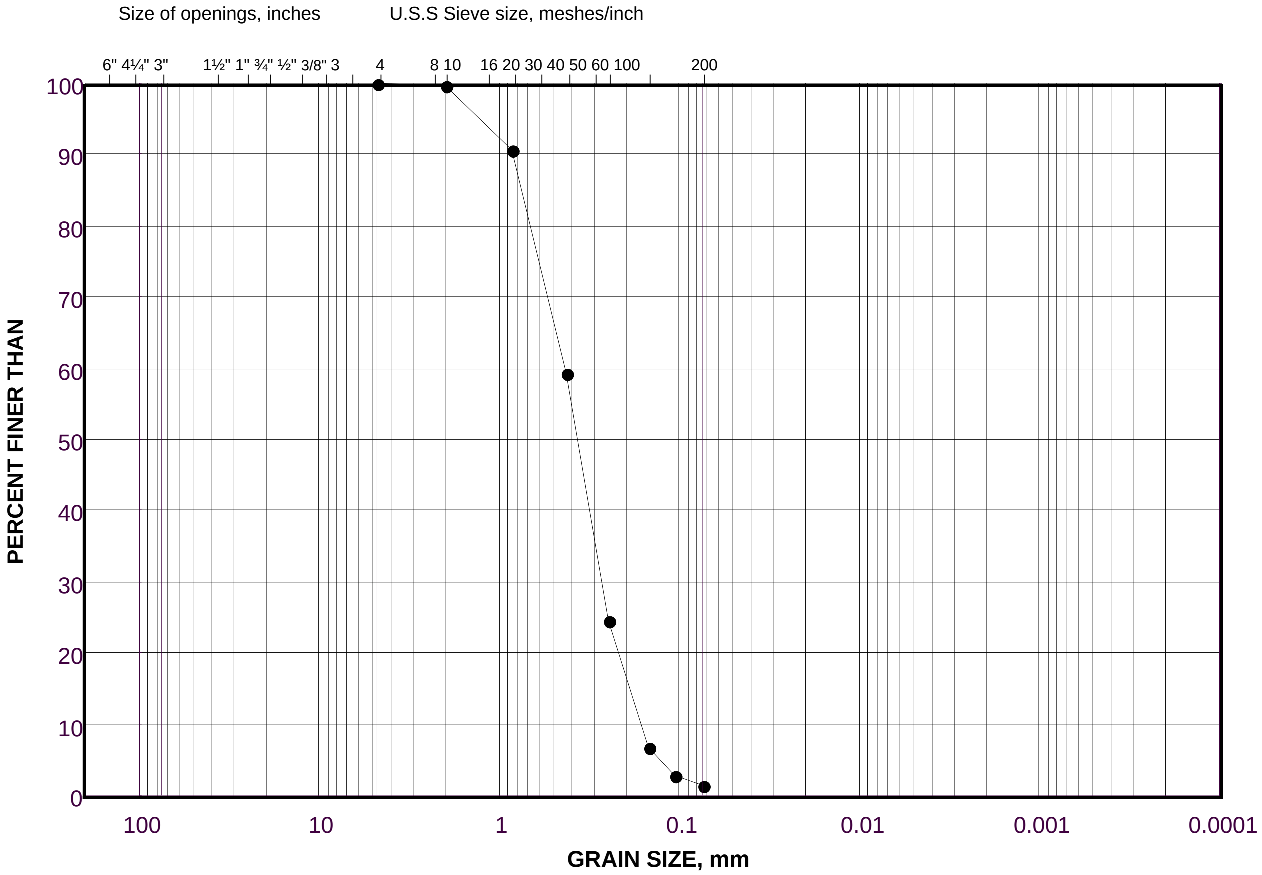
Checked By: DF

Golder Associates

Date: 22-Sep-17

GRAIN SIZE DISTRIBUTION
(SP) SAND
ASTM D6913

FIGURE D2



COBBLE	COARSE	FINE	COARS	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	BH17-6	SA 3	1.52 - 1.98

Project Number: 1774389

Checked By: DF

Golder Associates

Date: 22-Sep-17