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Associated Engineering Ltd.

Churchill Airport Runway 15-33 and Taxiway A Repairs Geotechnical Information Package

Prepared for:

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Project Number:
0115-034-00

Date:
October 22, 2018

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TREK GEOTECHNICAL

Quality Engineering | Valued Relationships

October 22, 2018

Our File No. 0115-034-00

David Anderson, P.Eng.
Project Manager
Associated Engineering Alberta Ltd.
Suite 500, 9888 Jasper Ave., Edmonton, AB
T5J 5C6

RE: Churchill Airport Runway 15-33 and Taxiway A Repairs
Geotechnical Information Package

TREK Geotechnical Inc. is pleased to submit our Geotechnical Investigation Report for the above noted project located in Churchill, MB.

Please contact Ryan Belbas of our office if you have any questions. Thank you for the opportunity to work with you on this assignment.

Sincerely

TREK Geotechnical Inc.
Per:

Ryan Belbas, M.Sc., P.Eng.
Geotechnical Engineer
Tel: 204.975.9433 ext. 113

Revision History

Revision No.	Author	Issue Date	Description
0	RB	October 22, 2018	Factual Report

Authorization Signature

Prepared By:

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Geotechnical Engineer

Reviewed By:

Kent Bannister, M.Sc., P.Eng.
Senior Geotechnical Engineer

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1.0 Introduction

This factual geotechnical report summarizes the results of the sub-surface investigation and ground temperature monitoring performed by TREK Geotechnical Inc. (TREK) in support of geotechnical design of repairs to Runway 15-33 and Taxiway A at the Churchill Airport in Churchill, MB. Geotechnical design of the repairs will be completed by Englobe Corporation (Englobe).

TREK was retained to complete the following scope of work for preparation of this report:

- Undertake a desktop review of all available existing geotechnical information provided for the site to develop a sub-surface investigation, including a drilling and sampling program to be reviewed and approved of AE and Englobe;
- Coordinate utility line locates and arrange for a drill rig and crew to conduct the field work portion of the sub-surface investigation;
- Conduct a sub-surface investigation to: visually classify soils and frozen soils, record groundwater conditions, conduct *in situ* soils testing, collect soil samples, and install PVC pipes and use thermistor strings to measure ground temperatures;
- Perform laboratory testing and physical soil measurements on select soil samples;
- Prepare a factual geotechnical report that will include a description of the drilling and sampling program, results of laboratory testing and physical soil measurements, test hole logs, and results of ground temperature monitoring.

2.0 Background Information

The Churchill airport services the town and surrounding area of Churchill, MB. Pavement resurfacing was completed at the Churchill Airport in 2010 with a design life expectancy of 15 to 20 years. In 2015, Taxiway A and Runway 15-33 (within approximately 150 m of the threshold) began exhibiting signs of ground movements that have become progressively worse resulting in an uneven pavement surface. As a result, aircraft must reduce speeds to minimize further damage to the taxiway and runway and provide passenger comfort. Rail access to Churchill has not been available since 2016, since that time air transportation has been the primary means of access to the community. As a result, the airport has seen a significant rise in traffic. An asphalt mill-and-fill rehabilitation is planned in the near future as a short-term repair to the runway and taxiway surfaces, and a major rehabilitation is planned to occur in approximately 7 years.

2.1 Existing Information

TREK completed a desktop review of existing geotechnical and ground temperature information provided by Associated Engineering Ltd. (AE) to assist in planning and development of the sub-surface investigation. The information provided includes the following:

1. **Thermocouple Installation and Monitoring Program Taxiway 'A' Churchill Airport (KGS Group, 2007).** The report includes test hole logs, a test hole location plan, and plots of ground temperature versus depth.

One hundred and sixty-seven test hole logs from 8 separate investigations performed at the airport between 1949 and 1996 were also provided by AE and reviewed by TREK.

3.0 Sub-surface Investigation

3.1 Field Program

The sub-surface investigation was completed between September 17 and 19, 2018 under the supervision of TREK personnel to observe the soil stratigraphy and groundwater conditions, and frozen soils within the problem areas of Taxiway A and Runway 15-33. The investigation was intended to include 10 test holes drilled to a maximum depth of 10 m or auger refusal (whichever occurred first). PVC pipe at each test hole location to facilitate use of removable, temporary thermistor strings for ground temperature measurements. However, the intended program could not be completed due to delays associated with airplane traffic (drilling operations were stopped for planes to land and take off) and damage to the drill rig on the third day of drilling (drive head cracked disabling the rig). In this regard, only 3 of the 10 test holes planned were completed with PVC pipe installation.

The test holes (BH1, BH5, BH8, and BH9) were drilled using Transport Canada's CME 75 truck-mounted drill rig equipped with 125 mm diameter solid stem and 200 mm diameter hollow stem augers. Test holes BH5 and BH8 were drilled to auger refusal at depths of 8.8 m and 6.2 m, and BH9 was drilled to 9.6 m below ground surface. Test hole BH1 had been advanced to 1.5 m depth when the drill rig was damaged and could not be completed. A 25 mm diameter PVC pipe was installed to the bottom of BH5, BH8, and BH9 to allow for thermistor string installation. These test holes were backfilled (around the PVC pipes) with auger cuttings and sand. A flush mount casing with a removable cover was set in place with ready-to-use concrete at each location to protect the pipes during operation of the runway and taxiway. Test hole BH1 was backfilled with auger cuttings and topped with 150 mm of ready-to-use concrete.

Sub-surface soils observed during the drilling were visually classified based on the Unified Soil Classification System (USCS). Samples retrieved during drilling included disturbed (auger cutting, split spoon, and split barrel) samples. Standard Penetration Tests were performed where split spoon samples were obtained. Frozen soils observed were classified based on the National Research Council Canada (NRC) Publication No. 7576 Guide to a Field Description of Permafrost for Engineering Purposes. Temperature measurements were taken on all samples retrieved during drilling. A photograph of each sample collected is shown in the Photo Index attached in Appendix A.

Test hole locations on Runway 15-33 (BH1 and BH5) were measured relative to the runway threshold and centerline, and the test hole locations on Taxiway A (BH8 and BH9) were measured relative to the airfield lights. All test hole locations were also recorded by handheld GPS. Test hole logs are provided in Appendix B and include a description of the soil units encountered during drilling and other pertinent information such as groundwater conditions, temperature recordings, and laboratory testing results.

3.2 Laboratory Testing Program

All samples retrieved during drilling were transported to TREK's laboratory in Winnipeg, Manitoba for further visual classification, laboratory testing, and physical soil measurements. The laboratory testing included moisture content determination on all samples, as well as grain size and Atterberg limit determination on select samples. Laboratory and *in situ* test results are included on the test hole logs provided (Appendix B) and TREK's laboratory testing report is attached in Appendix C.

3.3 Soil Stratigraphy

The soil stratigraphy encountered during our investigation is consistent with the findings recorded during the previous investigations at the airport. Brief descriptions of the soil units encountered at the test hole locations are provided below. All interpretations of soil stratigraphy for the purposes of design should refer to the detailed information provided on the attached test hole logs.

3.3.1 Fill

Fill consisting of well-graded, sand and/or gravel was encountered at ground surface in BH8 and BH9 and directly below the asphalt pavement (140 mm thick) in BH1 and BH5. The fill layer extends to depths ranging from 0.5 m to 1.5 m. The fill is generally damp, compact and contains trace amounts of clay and silt. A thin layer of peat (approximately 50 mm thick) was encountered below the fill in BH5 at 1.5 m depth below ground level.

3.3.2 Sand

Poorly-graded sand was encountered in BH8 and BH9 at respective depths of 0.6 m and 0.5 m below the fill and extended to 3.4 and 3.8 m depth. The sand is generally fine to medium-grained and contains trace amounts of coarse-grained sand, clay, silt, clay, gravel, and organics. It is damp to moist, becoming moist to wet below about 2.5 m depth. SPT N-values of 15 and 21 blows per 300 mm were observed in unfrozen sand during Standard Penetration Testing indicating a compact material. N-values of 71 and 79 blows per 300 mm were measured during Standard Penetration Testing in frozen sand.

3.3.3 Clay Till

Clay till was encountered at depths ranging between of 1.6 m and 3.8 m below grade and extended to the depth of exploration in BH5, BH8, and BH9. The clay till is generally silty, sandy with trace amounts of gravel. It is moist, low plastic, and varies in consistency from soft to hard. The high SPT N-values observed during drilling are the result of frozen soil conditions.

3.3.4 Frozen Ground Conditions

Ground temperatures were measured on all samples retrieved during drilling using mechanical and electronic thermometers. Temperatures measured on frozen soil samples ranged from -2.9°C to 0°C. Temperatures greater than 0°C were measured on a few samples retrieved from within the frozen zone. These higher temperatures can likely be attributed to heat gain from the drilling and sampling

techniques, such as excessive turning of the auger in an attempt to advance the test hole at auger refusal and large blow counts during driving of the split spoon sampler during Standard Penetration Testing.

Based on measured ground temperatures and our visual observations during drilling, frozen soils were encountered at depths of 1.6 m below ground surface in BH5 and below 3 m in BH8 and BH9, extending to the depth of exploration in all test holes. The frozen soils consist of non-visible ice at 1.6 m to 2.7 m depth below grade in BH5 and 3.0 m to 4.6 m depth in BH8; frozen soils in BH9 contained entirely non-visible ice. The non-visible ice is poorly bonded in BH5 and well-bonded with excess ice in BH8 and BH9. The visible ice observed in BH5 and BH9 was comprised of varying amount of ice lenses (random and/or stratified), ice coating on soil particles, and ice inclusions.

3.4 Groundwater Conditions

Significant sloughing of the test holes was observed within the fill and/or native sand layers at depths ranging between 0.9 and 1.8 m below ground surface. Hollow stem augers were required to advance the test holes through these layers. No seepage was observed during drilling.

These groundwater measurements should not be considered reflective of (static) long-term groundwater levels, which would require monitoring over an extended period to determine. It is important to recognize that groundwater conditions may change seasonally, annually, or due to construction activities.

3.5 Thermistor String Measurements

Ground temperature monitoring was performed by TREK personnel while present on-site (September 17 to 19) and continued weekly thereafter by Transport Canada personnel by alternating 2 thermistor strings amongst the 3 test hole locations. The strings are lowered into the PVC pipes, left in place for approximately 1 week to allow for temperatures to stabilize, and then read prior to removal and transportation to the next test hole. Table 01 below provides a summary of the thermistor measurements to date at each test hole location. Plots of ground temperature versus depth are provided in Appendix D.

Table 01. Summary of Ground Temperatures

Test Hole	Depth Below Grade to Thermistor Tip (m)	Approx. Depth Below Grade to Frozen Ground (m)	Approx. Temperature at Tip (°C)
BH5	8.6	2.1	-3.6
BH8	6.1	1.8	-2.4
BH9	9.5	3.6	-2.3

4.0 Closure

The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation and laboratory testing). Soil conditions are natural deposits that can be

highly variable across a site. If sub-surface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

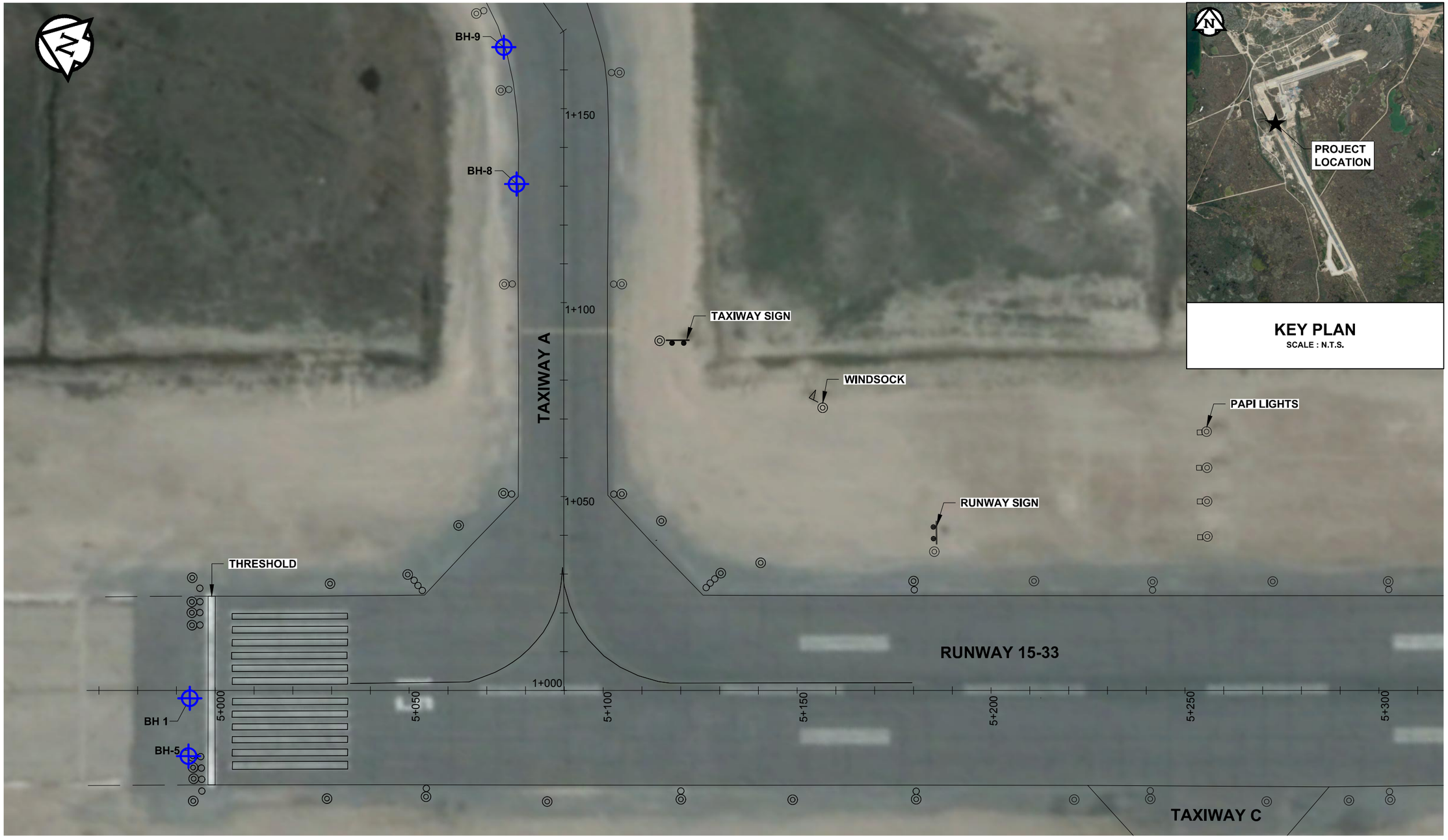
All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work or standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of the Associated Engineering Ltd. (the Client) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be used or relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.

Test Hole Location Plan

TREK GEOTECHNICAL

0115 034 00
Associated Engineering Ltd.
Churchill Airport Runway Repair



KEY PLAN
SCALE : N.T.S.

0 10 20 30 40 50 m
SCALE = 1 : 1 000 (279 mm x 432 mm)

LEGEND:
- TEST HOLE (TREK, 2018)
- AIRFIELD LIGHTING

NOTES:
1. FIGURE BASED ON DRAWING PROVIDED BY ASSOCIATED ENGINEERING

Figure 01
TEST HOLE LOCATION PLAN

Z:\Projects\0115 Associated Engineering\0115 034 00 Churchill Airport Runaway Repair\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\Fig 01 2018-10-11 Churchill Airport Runway Repair 0_A_DW 0115 034 00 dwg

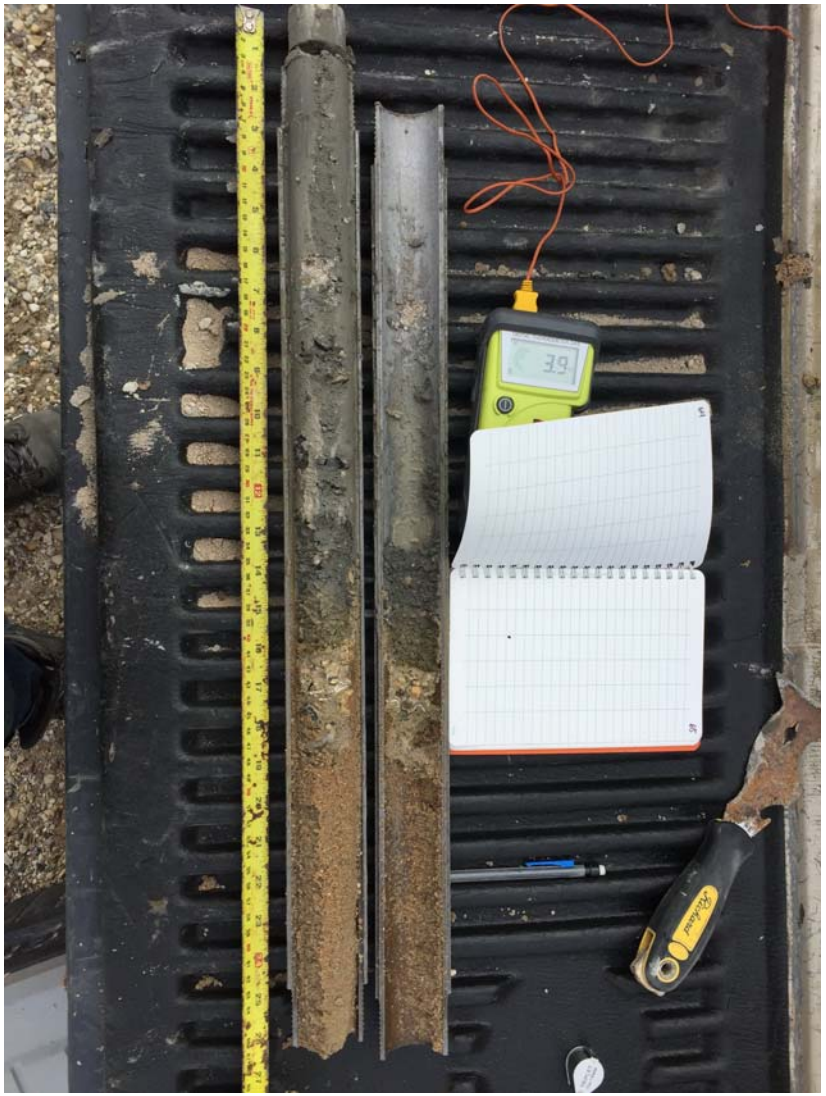
Appendix A – Photographs of Soil Samples

File Name	Description
IMG_7272	S06
IMG_7273	S07
IMG_7274	S08
IMG_7275	S09
IMG_7276	S09
IMG_7278	S10
IMG_7279	S11
IMG_7280	S12
IMG_7281	S13
IMG_7282	S13
IMG_7283	S14
IMG_7284	S18
IMG_7285	S18
IMG_7286	S19
IMG_7287	S19
IMG_7288	S20
IMG_7289	S21
IMG_7290	S22
IMG_7292	S23
IMG_7293	S24
IMG_7328	B29
IMG_7329	B29
IMG_7330	B30
IMG_7331	B30
IMG_7332	B30 - closeup of Vc and Vx around gravel
IMG_7333	B31
IMG_7334	B32
IMG_7335	B32
IMG_7336	B32 - granulated ice lense from sample
IMG_7337	B32 - granulated ice lense from sample
IMG_7338	B33
IMG_7339	B33
IMG_7340	B34A
IMG_7341	B34A - gravel from bottom of sample that pushed some sample away
IMG_7342	B34A - gravel from bottom of sample that pushed some sample away
IMG_7343	B34B
IMG_7344	B35
IMG_7345	B36
IMG_7346	B37A
IMG_7347	B37B
IMG_7348	B37B - granulated ice lense from sample
IMG_7349	B38

0115 034 00 - Churchill Airport Runway Repairs Photo Contact Sheet

IMG_7272

IMG_7273



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IMG_7274

IMG_7275

0115 034 00 - Churchill Airport Runway Repairs Photo Contact Sheet

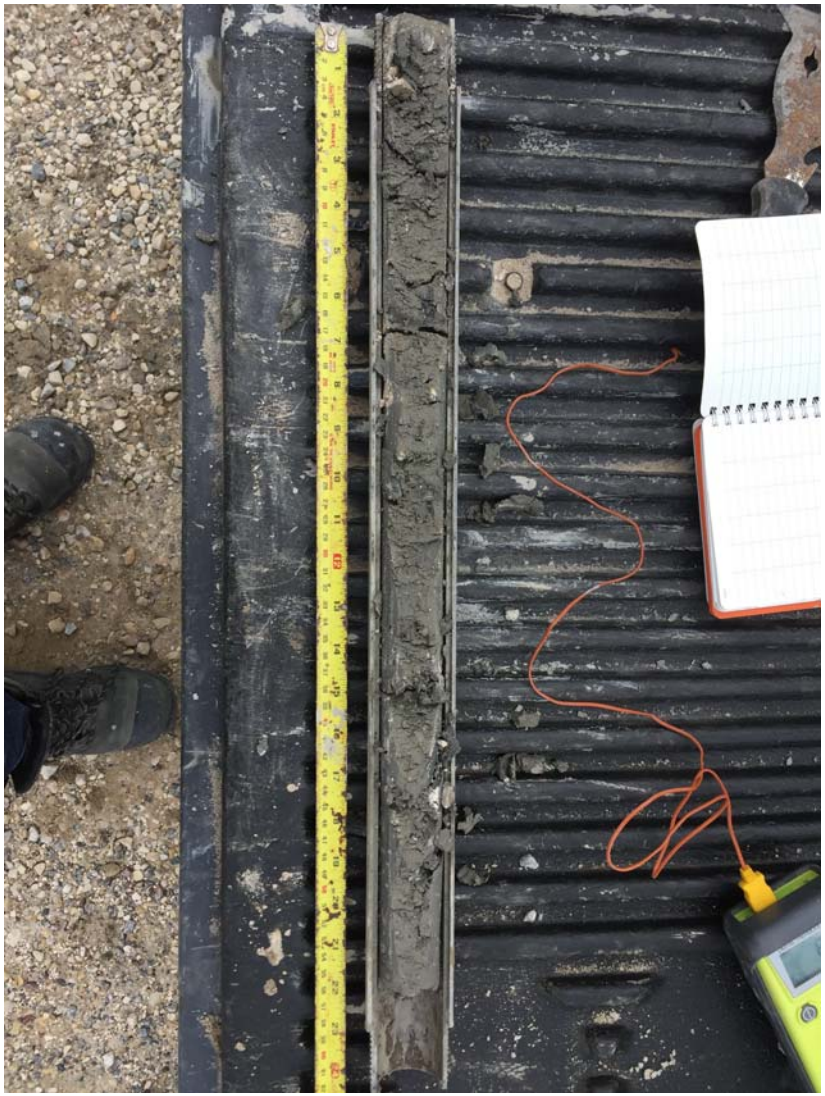
IMG_7276

IMG_7278

0115 034 00 - Churchill Airport Runway Repairs Photo Contact Sheet

IMG_7279

IMG_7280



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IMG_7281

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0115 034 00 - Churchill Airport Runway Repairs Photo Contact Sheet

IMG_7348

IMG_7349

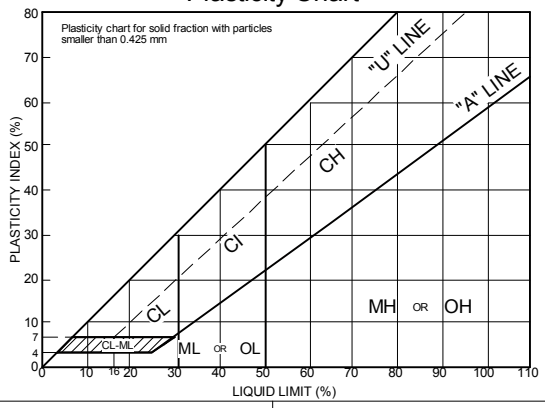
Appendix B – Test Hole Logs

EXPLANATION OF FIELD AND LABORATORY TESTING

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Major Divisions			USCS Classification	Symbols	Typical Names	Laboratory Classification Criteria
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than 4.75 mm)	Clean gravel (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent..... GW, GP, SW, SP; More than 12 percent..... GM, GC, SM, SC; 6 to 12 percent..... Borderline case4s requiring dual symbols*
			GP		Poorly-graded gravels, gravel-sand mixtures, little or no fines	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
		Gravel with fines (Appreciable amount of fines)	GM		Silty gravels, gravel-sand-silt mixtures	Not meeting all gradation requirements for GW
			GC		Clayey gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line or P.I. greater than 7 / Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
	Sands (More than half of coarse fraction is smaller than 4.75 mm)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP		Poorly-graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM		Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line or P.I. greater than 7 / Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
			SC		Clayey sands, sand-clay mixtures	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	Plasticity Chart
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL		Organic silts and organic silty clays of low plasticity	
	Silts and Clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts	
			CH		Inorganic clays of high plasticity, fat clays	
			OH		Organic clays of medium to high plasticity, organic silts	
	Highly Organic Soils		Pt		Peat and other highly organic soils	Von Post Classification Limit: Strong colour or odour, and often fibrous texture



Particle Size	Material	ASTM Sieve sizes	mm
	Sand		
	Coarse	#10 to #4	2.00 to 4.75
	Medium	#40 to #10	0.425 to 2.00
	Fine	#200 to #40	0.075 to 0.425
	Silt or Clay	< #200	< 0.075

Particle Size	Material	ASTM Sieve Sizes	mm
	Boulders	> 12 in.	> 300
	Cobbles	3 in. to 12 in.	75 to 300
	Gravel		
	Coarse	3/4 in. to 3 in.	19 to 75
	Fine	#4 to 3/4 in.	4.75 to 19

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

	Asphalt		Bedrock (undifferentiated)		Cobbles
	Concrete		Limestone Bedrock		Boulders and Cobbles
	Fill		Cemented Shale		Silt Till
			Non-Cemented Shale		Clay Till

EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD - Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength
VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling

▼ Water Level at End of Drilling

▼ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	Undrained Shear Strength (kPa)
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200

TABLE I

ICE DESCRIPTIONS

A. ICE NOT VISIBLE[a]

Group Symbol	Subgroup			Field Identification
	Description	Symbol		
N	Poorly bonded or friable	Nf		Identify by visual examination. To determine presence of excess ice, use procedure under note[b] and hand magnifying lens as necessary. For soils not fully saturated, estimate degree of ice saturation: medium, low. Note presence of crystals or of ice coatings around larger particles.
	No excess ice Well-bonded	Nb	Nbn	
	Excess ice		Nbe	

[a] *Frozen soils in the N group may, on close examination, indicate presence of ice within the voids of the material by crystalline reflections or by a sheen on fractured or trimmed surfaces. The impression received by the unaided eye, however, is that none of the frozen water occupies space in excess of the original voids in the soil. The opposite is true of frozen soils in the V group* (see p. 14).

[b] *When visual methods may be inadequate, a simple field test to aid evaluation of volume of excess ice can be made by placing some frozen soil in a small jar, allowing it to melt, and observing the quantity of supernatant water as a percentage of total volume.*

FIG A. ICE NOT VISIBLE

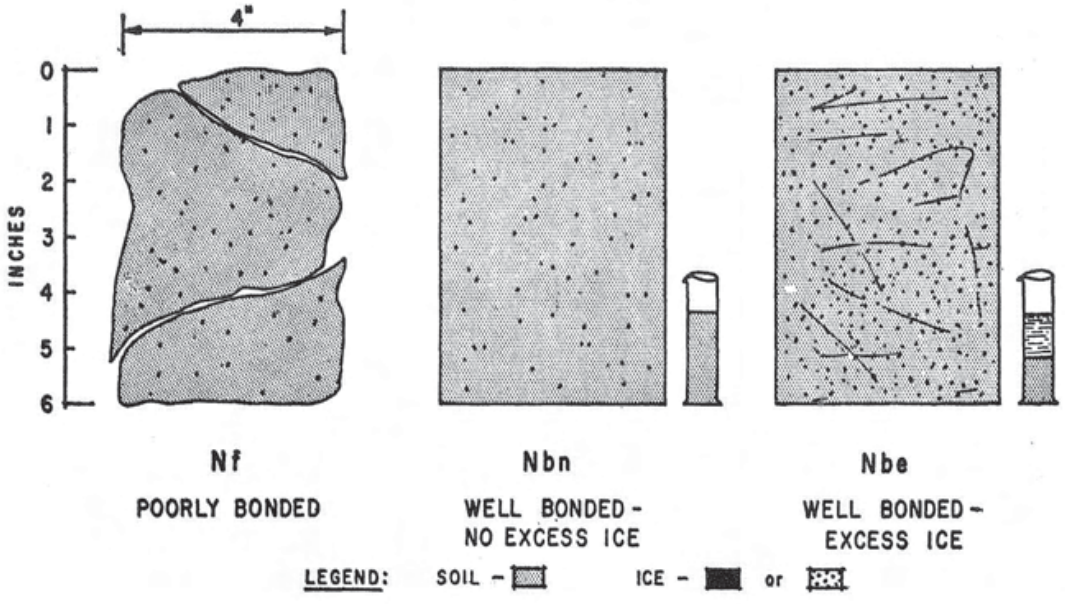


TABLE I (cont'd)

ICE DESCRIPTIONS

B. VISIBLE ICE—LESS THAN 1 INCH THICK[a]

Group Symbol	Subgroup		Field Identification
	Description	Symbol	
V	Individual ice crystal or inclusions	Vx	For ice phase, record the following when applicable: Location, Size, Orientation, Shape, Thickness, Pattern of arrangement, Length, Spacing, Hardness, Structure, Colour } per Group C (see p. 16) Estimate volume of visible segregated ice present as percentage of total sample volume.
	Ice coatings on particles	Vc	
	Random or irregularly oriented ice formations	Vr	
	Stratified or distinctly oriented ice formations	Vs	

[a] *Frozen soils in the N group may, on close examination, indicate presence of ice within the voids of the material by crystalline reflections or by a sheen on fractured or trimmed surfaces. The impression received by the unaided eye, however, is that none of the frozen water occupies space in excess of the original voids in the soil. The opposite is true of frozen soils in the V group.*

FIG B. VISIBLE ICE LESS THAN ONE INCH THICK

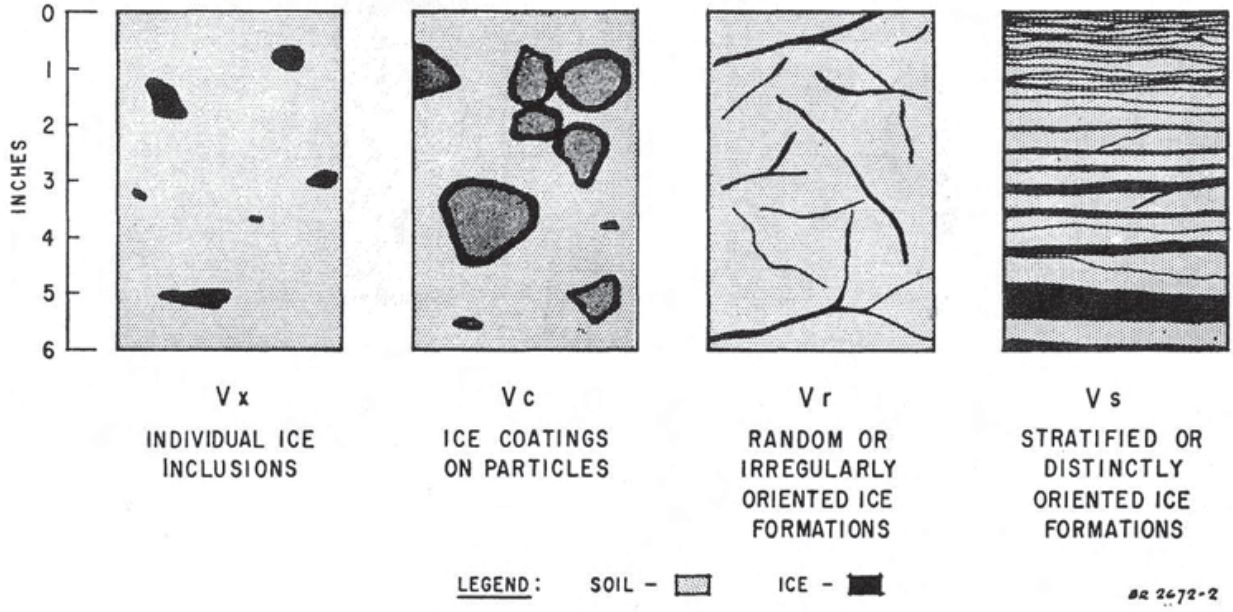


TABLE I (cont'd)

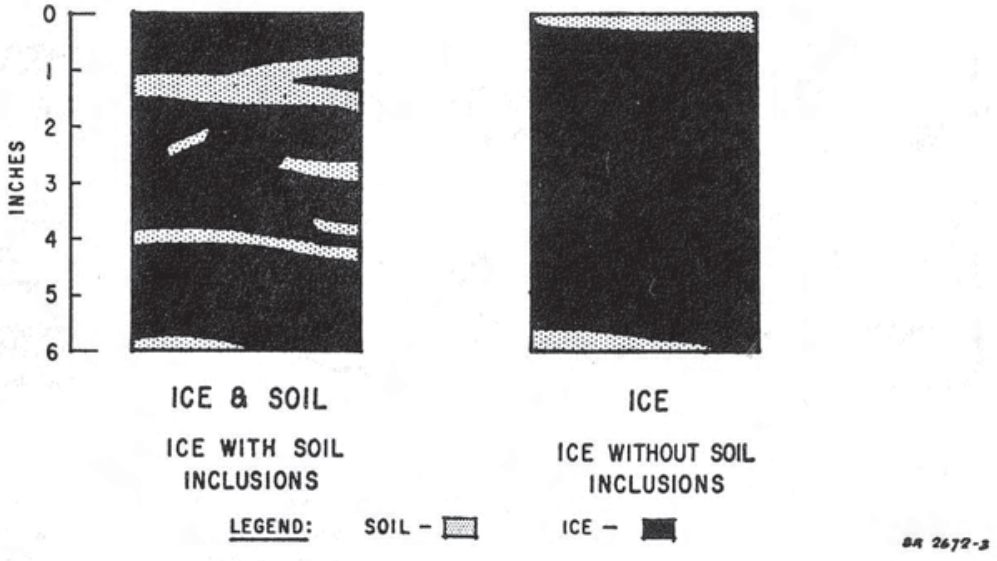
ICE DESCRIPTIONS

C. VISIBLE ICE—GREATER THAN 1 INCH THICK

Group Symbol	Subgroup		Field Identification
	Description	Symbol	
ICE	Ice with soil inclusions	ICE + soil type	Designate material as ICE[a] and use descriptive terms as follows, usually one item from each group, when applicable:
	Ice without soil inclusions	ICE	Hardness: HARD; SOFT (of mass, not individual crystals). Structure[b]: CLEAR, CLOUDY, POROUS, CANDLED, GRANULAR, STRATIFIED. Colour (Examples): COLOURLESS, GRAY, BLUE. Admixtures (Examples): CONTAINS FEW THIN SILT INCLUSIONS

[a] *Where special forms of ice such as hoarfrost can be distinguished, more explicit description should be given.*
[b] *Observer should be careful to avoid being misled by surface scratches or frost coating on the ice.*

FIG C. VISIBLE ICE GREATER THAN ONE INCH THICK



Sub-Surface Log

Test Hole BH1

Client:	Associated Engineering Ltd.	**Project Number:**	0115 034 00
Project Name:	Churchill Airport Runway 15-33 and Taxiway A Repairs	**Location:**	UTM: Zone 14U, 5529239 N, 589271 E
Contractor:	Richard Stolar	**Ground Elevation:**	Existing Ground
Method:	125 mm Solid Stem Auger, 200 mm Hollow Stem Auger, CME-75 Truck Mount	**Date Drilled:**	18 September 2018

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Temperature (°C)	Bulk Unit Wt (kN/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL	Undrained Shear Strength (kPa) Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
		ASPHALT (140 mm thick)						
		SAND (FILL) - gravelly, trace clay, trace silt - light brown, dry to damp, compact, well-graded, fine-grained sand to fine-grained gravel		G39			●	
1				G40			●	
		SAND AND GRAVEL (FILL) - trace clay, trace silt - brown, damp, compact - well graded, fine-grained sand to coarse-grained gravel		G41			●	

END OF TEST HOLE AT 1.5 m IN SAND AND GRAVEL (FILL)

Notes:
1. Test hole terminated due to drill rig breakdown.
2. No seepage observed.
3. Sloughing observed in fill layer below 0.9 m depth.
4. Drilling method switched from 125 mm solid stem augers to 200 mm hollow stem augers at 1.5 m depth.
5. Test hole backfilled with auger cuttings and 150 mm of ready-to-use concrete to ground surface.

Logged By: Reinhardt Van Rensburg **Reviewed By:** Kent Bannister **Project Engineer:** Ryan Belbas

Sub-Surface Log

Test Hole BH5
1 of 1

Client:	Associated Engineering Ltd.	**Project Number:**	0115 034 00
Project Name:	Churchill Airport Runway 15-33 and Taxiway A Repairs	**Location:**	UTM: Zone 14U, 5529226 N, 589268 E
Contractor:	Richard Stolar	**Ground Elevation:**	Existing Ground
Method:	125 mm Solid Stem Auger, 200 mm Hollow Stem Auger, CME-75 Truck Mount	**Date Drilled:**	18 September 2018

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Backfill Legend: Bentonite | Cement | Drill Cuttings | Filter Pack Sand | Grout | Slough

Depth (m)	Material Description	Sample Type	Sample Number	SPT (N)	Temperature (°C)
0	ASPHALT (140 mm thick)				
	SAND AND GRAVEL (FILL) - trace clay, trace silt, light brown, dry to damp, compact, well-graded, fine-grained sand to fine-grained gravel		G25		
1	- brown, damp, fine-grained sand to coarse-grained gravel below 0.3 m		G26		
			G27		
	PEAT (51 mm thick)		S28A	1 / 51mm	
2	CLAY (TILL) - silty, sandy, trace gravel - grey, moist, stiff (when thawed), low plasticity - frozen - non-visible ice, poorly bonded (Nf)		S28B B29	9 / 254mm	5.6
3	- visible ice inclusions (Vx, <20 mm diam. inclusions) below 2.4 m - soft (when thawed) at 2.7 m - visible ice coating on particles (Vc, <5 mm thick ice) at 2.7 m - firm (when thawed) below 3.0 m		B30		-0.9
			B31		-1.3
4			B32		-0.2
	- firm to stiff (when thawed) below 4.6 m - visible ice lenses (Vr, <5 mm thick lenses) below 4.6 m - visible ice inclusions (Vx, <5 mm diam. inclusions) below 4.6 m		B33		-1.4
5			B34A		-0.9
			B34B		-1.5
6			B35		-2.2
			B36		-2.9
7	- visible ice inclusions (Vx, <8 mm diam. inclusions) below 7.8 m		B37A		-0.8
	- visible stratified ice lenses (Vs, <15 mm thick) at 8.2 m		B37B		-1.7
8	- visible stratified ice lense (Vs, <25 mm thick, clear, hard) at 8.7 m		B38		2.1

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa) — Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○: 0 50 100 150 200 250

END OF TEST HOLE AT 8.8 m IN CLAY (TILL)

Notes:
1. Power auger refusal at 8.8 m depth.
2. No seepage observed.
3. Sloughing observed in fill layer below 0.9 m depth.
4. Drilling method switched from 125 mm solid stem augers to 200 mm hollow stem augers at 1.5 m depth.
5. High temperature measured on sample B38 attributed to excessive turning of auger to advance the test hole.
6. 25 mm diameter PVC pipe installed to 8.8 m depth for temporary thermistor string installation.
7. Test hole backfilled around PVC pipe with auger cuttings and topped with sand.

Logged By: Reinhardt Van Rensburg **Reviewed By:** Kent Bannister **Project Engineer:** Ryan Belbas

SUB-SURFACE LOG LOGS 2018-09-20 CHURCHILL AIRPORT 0_A_RVR 0115-034-00.GPJ TREK GEOTECHNICAL.GDT 22/10/18

Sub-Surface Log

Test Hole BH8
1 of 1

TREK GEOTECHNICAL

Client:	Associated Engineering Ltd.	**Project Number:**	0115 034 00
Project Name:	Churchill Airport Runway 15-33 and Taxiway A Repairs	**Location:**	UTM: Zone 14U, 5529225 N, 589292 E
Contractor:	Richard Stolar	**Ground Elevation:**	Existing Ground
Method:	125 mm Solid Stem Auger, 200 mm Hollow Stem Auger, CME-75 Truck Mount	**Date Drilled:**	17 September 2018

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Backfill Legend: Bentonite | Cement | Drill Cuttings | Filter Pack Sand | Grout | Slough

Depth (m)	Soil Symbol	Moitoring Well	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Temperature (°C)
0			SAND AND GRAVEL (FILL) - trace clay, trace silt - brown, damp, compact, well-graded, fine-grained sand to coarse-grained gravel		G15		
1			SAND - trace clay, trace silt, trace gravel - light brown to brown - damp to moist, compact - poorly graded, medium-grained sand		G16		6.5
					G17		6.3
2					S18	15	5.6
			- trace cobbles, brown, moist below 2.3 m		S19	3 / 101mm	0.5
3			- frozen, non-visible ice, well bonded, excess water (Nbe) below 3.0 m - gravelly, till inclusions, frozen, visible ice inclusions (Vx, <15 mm diam.) below 3.2 m		S20A	71	0
					S20B	35	-0.4
4			CLAY (TILL) - silty, sandy, trace gravel - grey - moist, stiff (when thawed) - low plasticity - frozen - non-visible ice, poorly bonded (Nf)		S21	42	-1
5			- firm (when thawed) below 4.6 m - visible ice lenses (Vr, <5 mm thick lenses) below 4.6 m - visible ice coating on particles (Vc, <5 mm thick ice) below 4.6 m		S22	43	-1.2
					S23	111 / 253mm	-0.9
6			- soft (when thawed) below 6.1 m		S24	100 / 128mm	
			END OF TEST HOLE AT 6.2 m IN CLAY (TILL)				

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

Notes:
1. Auger refusal at 6.2 m depth.
2. No seepage observed.
3. Sloughing observed in sand layer below 1.2 m depth.
4. Drilling method switched from 125 mm solid stem augers to 200 mm hollow stem augers at 1.5 m depth.
5. 25 mm diameter PVC pipe installed to 6.1 m depth for temporary thermistor strinig installation.
6. Test hole backfilled around PVC pipe with auger cuttings and topped with sand.

Logged By: Reinhardt Van Rensburg **Reviewed By:** Kent Bannister **Project Engineer:** Ryan Belbas

SUB-SURFACE LOG LOGS 2018-09-20 CHURCHILL AIRPORT 0_A_RVR 0115-034-00.GPJ TREK GEOTECHNICAL.GDT 22/10/18

Sub-Surface Log

Test Hole BH9
1 of 1

Client:	Associated Engineering Ltd.	**Project Number:**	0115 034 00
Project Name:	Churchill Airport Runway 15-33 and Taxiway A Repairs	**Location:**	UTM: Zone 14U, 5529235 N, 589294 E
Contractor:	Richard Stolar	**Ground Elevation:**	Existing Ground
Method:	125 mm Solid Stem Auger, 200 mm Hollow Stem Auger, CME-75 Truck Mount	**Date Drilled:**	17 September 2018

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Backfill Legend: Bentonite | Cement | Drill Cuttings | Filter Pack Sand | Grout | Slough

Depth (m)	Soil Symbol	Moitoring Well	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Temperature (°C)
0			SAND AND GRAVEL (FILL) - trace clay, trace silt, brown, damp, compact, well-graded, fine-grained sand to coarse-grained gravel		G01		
			SAND - trace clay, trace silt, trace gravel - light brown to brown - damp to moist, compact - poorly graded, fine to medium-grained sand		G02		
1					G03		6.5
					S04	21	7.6
2					G05		0.3
			- moist to wet below 2.6 m - some silt below 2.9 m - trace organics (peat, H4, <10 mm diam. inclusions) at 2.9 to 3.0 m - frozen below 3.0 m - non-visible ice, well bonded, excess water (Nbe) below 3.0 m		S06	79	0
3							
4			CLAY (TILL) - silty, sandy, trace gravel - grey - moist, stiff (when thawed) - low plasticity - frozen - non-visible ice, well bonded, no excess water (Nbn)		S07	87	-0.4
					S08	71	-0.5
5					S09	60	-0.3
6					S10	50	-1.1
7					S11	49	-1
			- very stiff (when thawed) below 7.6 m		S12	41	-1.3
8					S13	82	4.4
9			- hard (when thawed) below 9.1 m		S14	62	4

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 9.6 m IN CLAY (TILL)

Notes:
1. No seepage observed.
2. Minor sloughing in sand layer below 1.8 m depth.
3. Drilling method switched from 125 mm solid stem augers to 200 mm hollow stem augers at 3.0 m depth.
4. High temperature measured on samples S13 and S14 attributed to hard driving with split spoon sampler.
5. PVC pipe installed to 9.5 m depth in test hole for temporary thermistor installation.
6. Test hole backfilled around PVC pipe with auger cuttings and sand.

Logged By: Reinhardt Van Rensburg **Reviewed By:** Kent Bannister **Project Engineer:** Ryan Belbas

SUB-SURFACE LOG LOGS 2018-09-20 CHURCHILL AIRPORT 0_A_RVR 0115-034-00.GPJ TREK GEOTECHNICAL.GDT 22/10/18

Appendix C – Laboratory Testing Results

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Moisture Content Report
ASTM D2216-10

Project No. 0115-034-00
Client Associated Engineering
Project Churchill Airport Runway Repairs

Sample Date 17-Sep-18
Test Date 1-Oct-18
Technician KM

Test Pit	TH18-01	TH18-01	TH18-01	TH18-01	TH18-01	TH18-01
Depth (m)	0.2 - 0.3	0.6 - 0.8	1.2 - 1.4	1.5 - 2.0	2.3 - 2.4	3.0 - 3.5
Sample #	G01	G02	G03	S04	G05	S06
Tare ID	N35	AB06	F99	Z47	AA05	E22
Mass of tare	8.6	6.6	8.6	8.4	6.8	8.8
Mass wet + tare	180.0	169.2	160.8	298.6	228.8	171.8
Mass dry + tare	173.2	162.4	154.8	273.0	195.6	140.0
Mass water	6.8	6.8	6.0	25.6	33.2	31.8
Mass dry soil	164.6	155.8	146.2	264.6	188.8	131.2
Moisture %	4.1%	4.4%	4.1%	9.7%	17.6%	24.2%

Test Pit	TH18-01	TH18-01	TH18-01	TH18-01	TH18-01	TH18-01
Depth (m)	3.8 - 4.3	4.6 - 5.0	5.3 - 5.8	6.1 - 6.6	6.9 - 7.3	7.6 - 8.1
Sample #	S07	S08	S09	S10	S11	S12
Tare ID	AB81	E81	P85	C11	K30	AB40
Mass of tare	6.8	8.8	8.6	8.2	8.6	6.6
Mass wet + tare	182	183.8	179	400.8	198	179
Mass dry + tare	163.6	164.8	163.0	358.4	181.9	163.6
Mass water	18.4	19.0	16.0	42.4	16.2	15.4
Mass dry soil	156.8	156.0	154.4	350.2	173.3	157.0
Moisture %	11.7%	12.2%	10.4%	12.1%	9.3%	9.8%

Test Pit	TH18-01	TH18-01	TH18-02	TH18-02	TH18-02	TH18-02
Depth (m)	8.4 - 8.8	9.1 - 9.6	0.2 - 0.3	0.8 - 0.9	1.4 - 1.5	1.5 - 2.0
Sample #	S13	S14	G15	G16	G17	S18
Tare ID	H12	A103	AB09	Z33	N48	P15
Mass of tare	8.6	8.8	6.6	8.6	9.0	8.4
Mass wet + tare	179.0	148.0	200.6	179.4	199.6	188.4
Mass dry + tare	166.2	138.4	191.8	170.6	187.4	161.4
Mass water	12.8	9.6	8.8	8.8	12.2	27.0
Mass dry soil	157.6	129.6	185.2	162.0	178.4	153.0
Moisture %	8.1%	7.4%	4.8%	5.4%	6.8%	17.6%

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Moisture Content Report
ASTM D2216-10

Project No. 0115-034-00
Client Associated Engineering
Project Churchill Airport Runway Repairs

Sample Date 17-Sep-18
Test Date 1-Oct-18
Technician KM

Test Pit	TH18-02	TH18-02	TH18-02	TH18-02	TH18-02	TH18-02
Depth (m)	2.3 - 2.5	3.0 - 3.2	3.2 - 3.5	3.8 - 4.3	4.6 - 5.0	5.3 - 5.7
Sample #	S19	S20 A	S20 B	S21	S22	S23
Tare ID	Z109	F52	E13	K11	N73	N03
Mass of tare	8.6	8.6	9.0	8.8	8.4	8.6
Mass wet + tare	180.2	172.0	170.4	190.6	177.0	184.8
Mass dry + tare	152.6	161.0	153.4	171.6	160.8	167.0
Mass water	27.6	11.0	17.0	19.0	16.2	17.8
Mass dry soil	144.0	152.4	144.4	162.8	152.4	158.4
Moisture %	19.2%	7.2%	11.8%	11.7%	10.6%	11.2%

Test Pit	TH18-02	TH18-03	TH18-03	TH18-03	TH18-03	TH18-03
Depth (m)	6.1 - 6.2	0.2 - 0.3	0.8 - 0.9	1.4 - 1.5	1.5 - 1.6	1.6 - 2.0
Sample #	S24	G25	G26	G27	S28 A	S28 B
Tare ID	AB58	P08	P25	K31	F66	D42
Mass of tare	6.6	8.6	8.4	8.4	8.4	8.6
Mass wet + tare	166.6	188.8	222.4	226.0	87.6	173.8
Mass dry + tare	156.8	181.8	205.4	209.0	70.4	126.0
Mass water	9.8	7.0	17.0	17.0	17.2	47.8
Mass dry soil	150.2	173.2	197.0	200.6	62.0	117.4
Moisture %	6.5%	4.0%	8.6%	8.5%	27.7%	40.7%

Test Pit	TH18-03	TH18-03	TH18-03	TH18-03	TH18-03	TH18-03
Depth (m)	2.3 - 2.7	3.0 - 3.5	3.8 - 4.3	4.6 - 5.0	5.5 - 5.6	6.1 - 6.6
Sample #	B30	B31	B32	B33	B34	B35
Tare ID	AB67	E83	H11	E43	C30	F89
Mass of tare	7.0	8.8	8.6	8.6	8.2	8.6
Mass wet + tare	219.4	171.2	187.4	406.0	171.2	215.4
Mass dry + tare	189.6	152.2	170.4	360.2	153.4	195.2
Mass water	29.8	19.0	17.0	45.8	17.8	20.2
Mass dry soil	182.6	143.4	161.8	351.6	145.2	186.6
Moisture %	16.3%	13.2%	10.5%	13.0%	12.3%	10.8%

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Moisture Content Report
ASTM D2216-10

Project No. 0115-034-00
Client Associated Engineering
Project Churchill Airport Runway Repairs

Sample Date 17-Sep-18
Test Date 1-Oct-18
Technician KM

Test Pit	TH18-03	TH18-03	TH18-03	TH18-03	TH18-04	TH18-04
Depth (m)	6.9 - 7.3	7.6 - 7.9	7.9 - 8.4	8.4 - 8.8	0.2 - 0.3	0.8 - 0.9
Sample #	B36	B37 A	B37 B	B38	G39	G40
Tare ID	N54	E46	AB48	C17	Z114	F62
Mass of tare	8.4	8.4	6.8	8.8	8.4	8.4
Mass wet + tare	193.8	173.4	199.8	191.2	179.0	198.2
Mass dry + tare	175.4	156.4	171.8	175.2	170.0	184.4
Mass water	18.4	17.0	28.0	16.0	9.0	13.8
Mass dry soil	167.0	148.0	165.0	166.4	161.6	176.0
Moisture %	11.0%	11.5%	17.0%	9.6%	5.6%	7.8%

Test Pit	TH18-04					
Depth (m)	1.4 - 1.5					
Sample #	G41					
Tare ID	Z19					
Mass of tare	8.6					
Mass wet + tare	181.8					
Mass dry + tare	163.4					
Mass water	18.4					
Mass dry soil	154.8					
Moisture %	11.9%					

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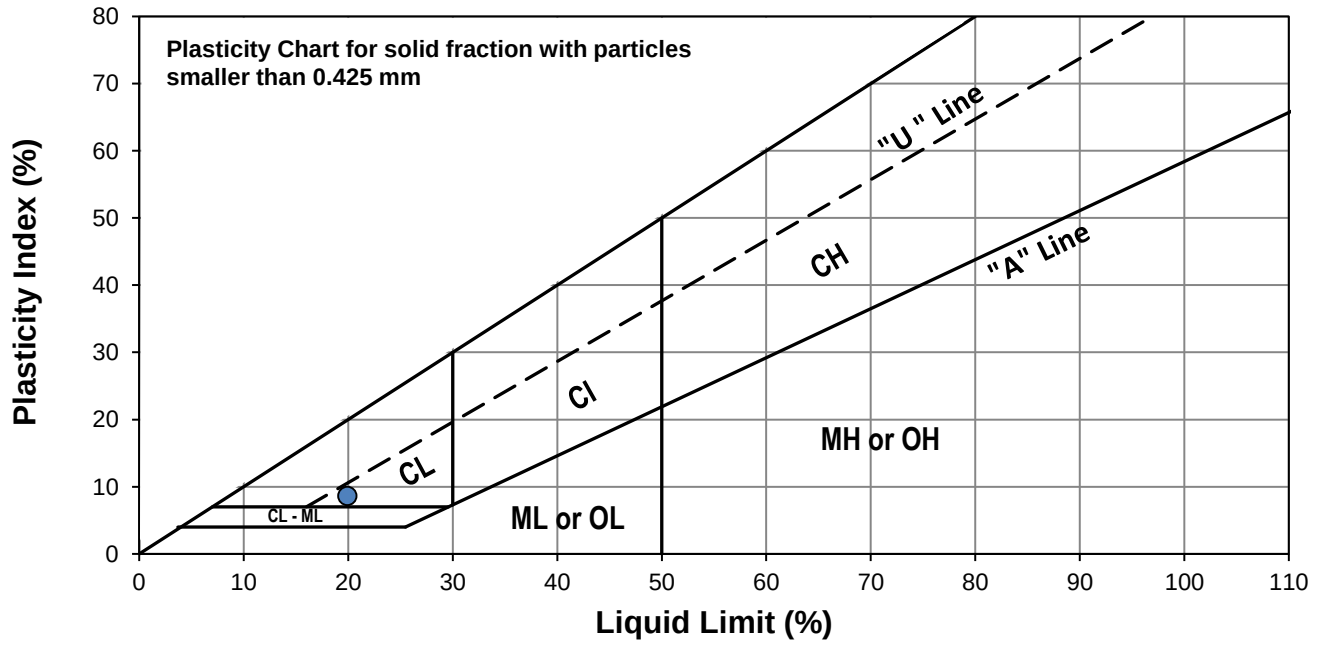
Atterberg Limits
ASTM D4318-10e1

Project No.	0115-034-00
Client	Associated Engineering
Project	Churchill Airport Runway Repairs
Test Hole	TH18-03 (BH5)
Sample #	B33
Depth (m)	4.6 - 5.0
Sample Date	17-Sep-18
Test Date	4-Oct-18
Technician	BH

Liquid Limit	20
Plastic Limit	11
Plasticity Index	9

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	15	26	34		
Mass Wet Soil + Tare (g)	26.480	25.523	25.552		
Mass Dry Soil + Tare (g)	24.294	23.682	23.730		
Mass Tare (g)	14.094	14.277	14.234		
Mass Water (g)	2.186	1.841	1.822		
Mass Dry Soil (g)	10.200	9.405	9.496		
Moisture Content (%)	21.431	19.575	19.187		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	25.137	24.774			
Mass Wet Soil + Tare (g)	24.025	23.720			
Mass Dry Soil + Tare (g)	14.249	14.297			
Mass Water (g)	1.112	1.054			
Mass Dry Soil (g)	9.776	9.423			
Moisture Content (%)	11.375	11.185			

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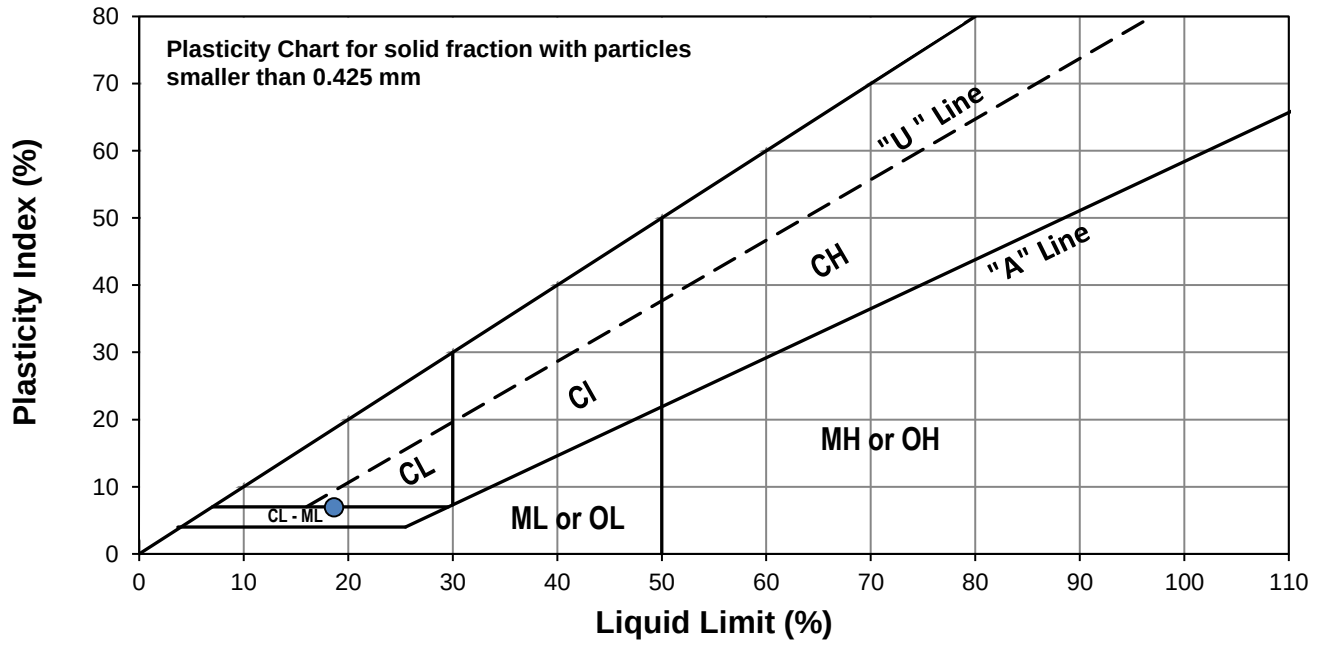
Atterberg Limits
ASTM D4318-10e1

Project No.	0115-034-00
Client	Associated Engineering
Project	Churchill Airport Runway Repairs
Test Hole	TH18-01 (BH9)
Sample #	S10
Depth (m)	6.1 - 6.6
Sample Date	17-Sep-18
Test Date	4-Oct-18
Technician	BH

Liquid Limit	19
Plastic Limit	12
Plasticity Index	7

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	20	32		
Mass Wet Soil + Tare (g)	26.132	25.173	26.630		
Mass Dry Soil + Tare (g)	24.203	23.432	24.683		
Mass Tare (g)	14.212	14.269	14.005		
Mass Water (g)	1.929	1.741	1.947		
Mass Dry Soil (g)	9.991	9.163	10.678		
Moisture Content (%)	19.307	19.000	18.234		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	23.505	23.610			
Mass Wet Soil + Tare (g)	22.507	22.614			
Mass Dry Soil + Tare (g)	14.021	14.093			
Mass Water (g)	0.998	0.996			
Mass Dry Soil (g)	8.486	8.521			
Moisture Content (%)	11.761	11.689			

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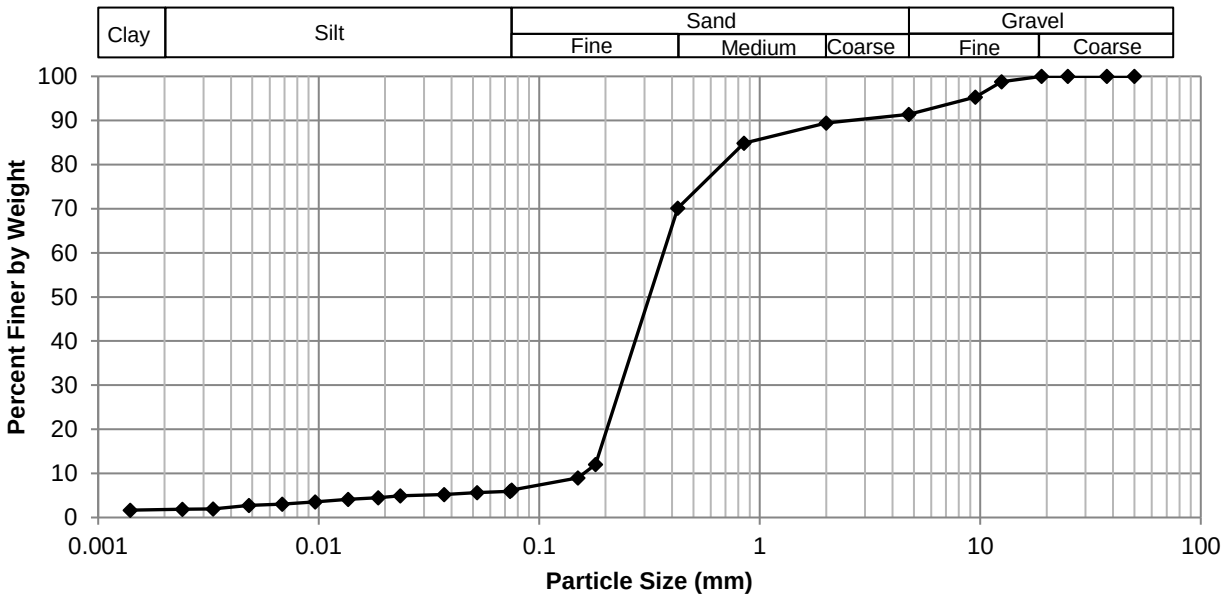
Grain Size Analysis (Hydrometer Method)
ASTM D422

Project No.	0115-034-00
Client	Associated Engineering
Project	Churchill Airport Runway Repair
Test Hole	TH18-01 (BH9)
Sample #	S04
Depth (m)	1.5 - 2.0
Sample Date	17-Sep-18
Test Date	4-Oct-18
Technician	KM

Gravel	8.6%
Sand	85.2%
Silt	4.4%
Clay	1.8%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	91.39	0.0750	6.19
37.5	100.00	2.00	89.40	0.0738	5.91
25.0	100.00	0.850	84.87	0.0523	5.63
19.0	100.00	0.425	70.10	0.0371	5.21
12.5	98.80	0.180	12.00	0.0235	4.93
9.50	95.27	0.150	8.98	0.0186	4.51
4.75	91.39	0.075	6.19	0.0136	4.12
				0.0097	3.56
				0.0068	3.03
				0.0048	2.73
				0.0033	1.92
				0.0024	1.89
				0.0014	1.67

www.trekgeotechnical.ca
1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

Grain Size Analysis (Hydrometer Method)
ASTM D422

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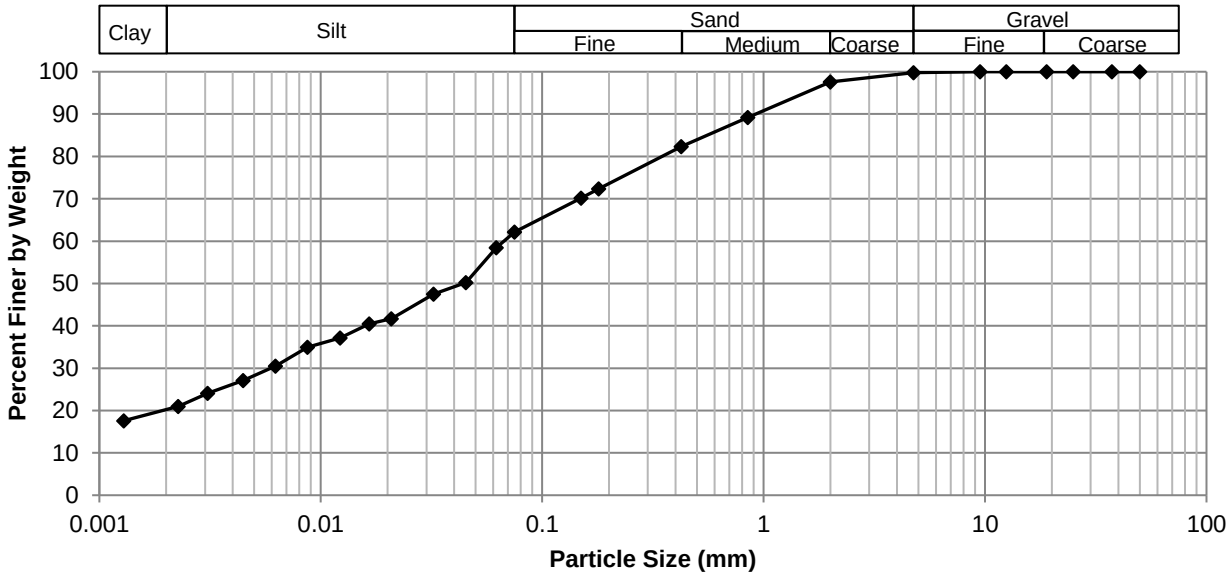
Project No.	0115-034-00
Client	Associated Engineering
Project	Churchill Airport Runway Repair
Test Hole	TH18-03 (BH5)
Sample #	B33
Depth (m)	4.6 - 5.0
Sample Date	18-Sep-18
Test Date	12-Oct-18
Technician	DS

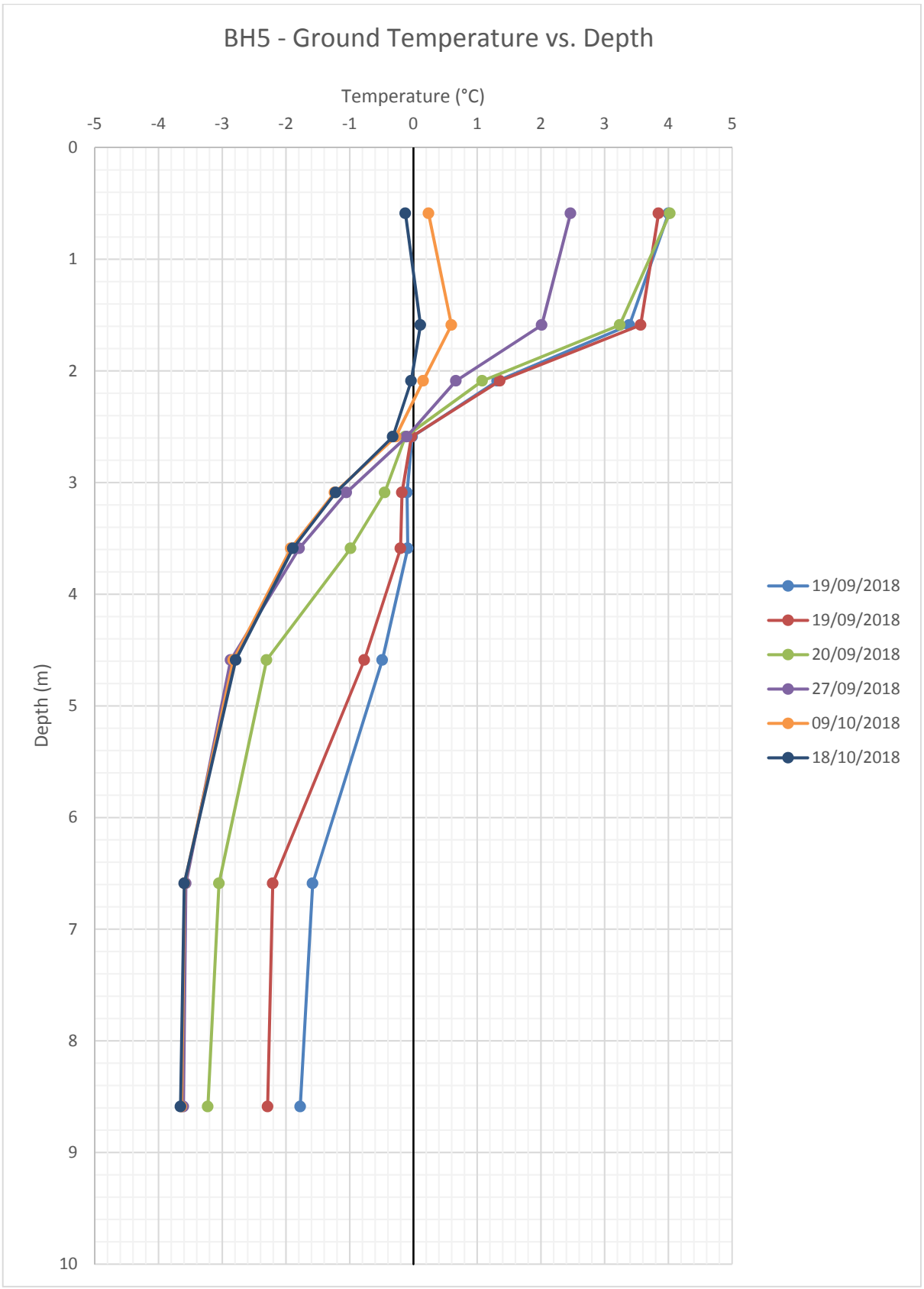
Gravel	0.2%
Sand	37.6%
Silt	44.4%
Clay	17.8%

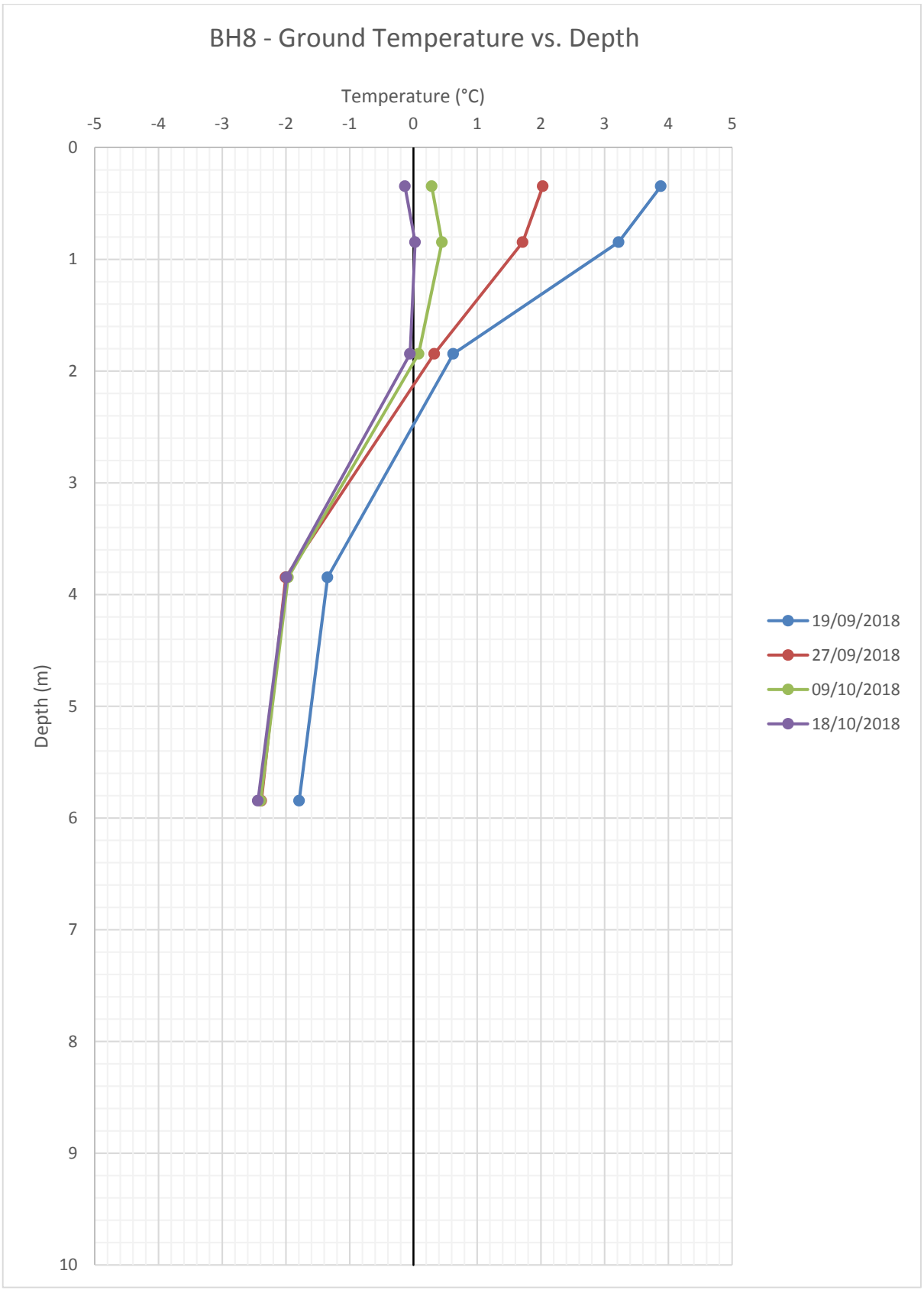
Particle Size Distribution Curve

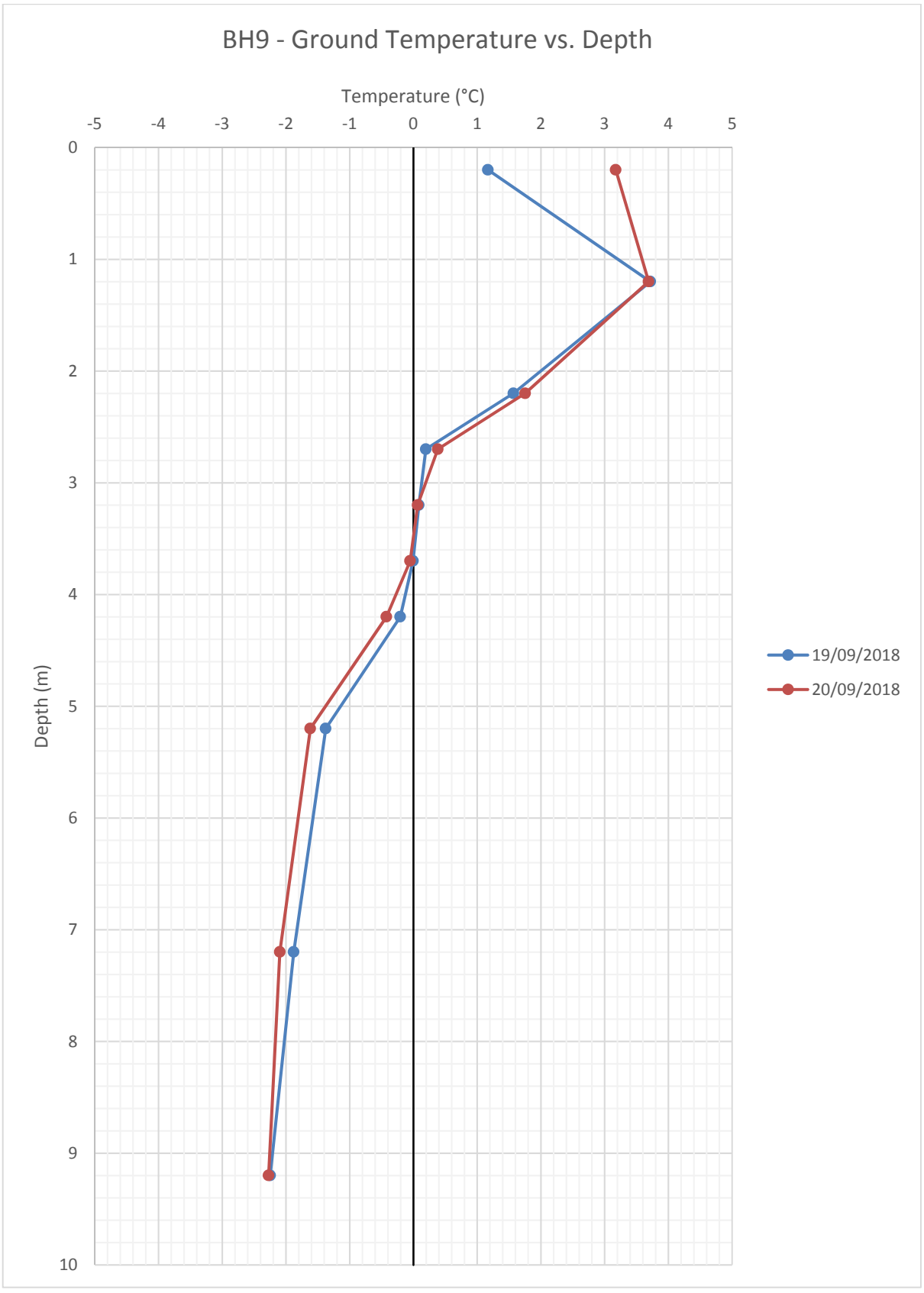


Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	99.79	0.0750	62.17
37.5	100.00	2.00	97.62	0.0621	58.49
25.0	100.00	0.850	89.18	0.0453	50.25
19.0	100.00	0.425	82.33	0.0323	47.50
12.5	100.00	0.180	72.32	0.0209	41.70
9.50	100.00	0.150	70.20	0.0166	40.48
4.75	99.79	0.075	62.17	0.0122	37.12
				0.0087	34.99
				0.0062	30.46
				0.0045	27.10
				0.0031	24.05
				0.0023	20.95
				0.0013	17.59

Appendix D – Ground Temperature versus Depth Plots


BH5 - Ground Temperature vs. Depth
Temperature (°C)
-5
-4
-3
-2
-1
0
1
2
3
4
5
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
19/09/2018
19/09/2018
20/09/2018
27/09/2018
09/10/2018
18/10/2018


BH8 - Ground Temperature vs. Depth
Temperature (°C)
-5
-4
-3
-2
-1
0
1
2
3
4
5
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
19/09/2018
27/09/2018
09/10/2018
18/10/2018


BH9 - Ground Temperature vs. Depth
Temperature (°C)
-5
-4
-3
-2
-1
0
1
2
3
4
5
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
19/09/2018
20/09/2018