MPE Engineering Ltd.

Conway Lift Station
Limited Geotechnical Report

Prepared for:
Mark Baker, P.Eng.
MPE Engineering Ltd.
125 Higgins Ave
Winnipeg, MB
R3B 0B6

Project Number: 0512-011-00

Date: December 18, 2023

TREK GEOTECHNICAL
Quality Engineering | Valued Relationships

December 18, 2023 Our File No. 0512-011-00

Mark Baker, P.Eng.
MPE Engineering Ltd.
125 Higgins Ave
Winnipeg, MB
R3B 0B6

RE: **Conway Lift Station**
Limited Geotechnical Report

TREK Geotechnical Inc. is pleased to submit our final report for the geotechnical investigation for the above noted project.

Please contact the undersigned should you have any questions.

Sincerely,

TREK Geotechnical Inc.
Per:

Michael Van Helden, Ph.D., P.Eng.
Senior Geotechnical Engineer

Encl.

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Revision History

Revision No.	Author	Issue Date	Description
0	JSS	December 15, 2023	Draft Final Report
0	JSS	December 18, 2023	Final Report

Authorization Signatures

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ENGINEERS
GEOSCIENTISTS
MANITOBA
Certificate of Authorization
TREK GEOTECHNICAL INC.
No. 4877

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1.0 Introduction

This report summarizes the results of the geotechnical exploration completed by TREK Geotechnical Inc. (TREK) for the preliminary design of upgrades to the existing Conway Lift Station in Winnipeg, Manitoba for the City of Winnipeg. The terms of reference for the investigation are included in our proposal to MPE Engineering Ltd. (MPE) dated August 25, 2023. The reduced scope of work as per email confirmation dated 18 September 2023 includes a sub-surface investigation, laboratory testing, test hole logs, and this report. This report is limited to provision of factual information obtained in the subsurface investigation, along with parameters and recommendations for excavations and shoring.

2.0 Field Program

2.1 Sub-surface Investigation

The sub-surface investigation was completed on October 12, 2023, under the supervision of TREK personnel to determine the soil stratigraphy and groundwater conditions at site. One deep test hole TH23-01 was drilled and sampled. The test hole location is shown on Figure 01.

The test hole was drilled by Paddock Drilling Ltd. with a track mounted Mobile B57 geotechnical drill rig equipped with 125 mm solid stem augers, 170 mm hollow stem augers and HQ coring equipment. TH23-01 was advanced 0.9 m below the depth of power auger refusal using casing and HQ coring equipment. Sub-surface soils encountered during drilling were visually classified based on the Unified Soil Classification System (USCS). Disturbed (auger cutting and split spoon) samples were taken at regular intervals and relatively undisturbed (Shelby Tube) samples were collected at select depths. Standard Penetration Tests (SPTs) were completed at depths where split spoon samples were taken. Undrained shear strength testing was performed in the field on the grab samples (i.e. auger cuttings / disturbed samples) using Torvane and/or Pocket Penetrometer testing devices, the results are provided on the test hole logs for general information only. A standpipe piezometer was installed in the test hole and the hole was backfilled with bentonite chips, as well as silica sand around the piezometer tip.

All samples retrieved during drilling were transported to TREK's testing laboratory in Winnipeg, Manitoba. Laboratory testing consisted of moisture content determination on all disturbed samples. Bulk unit weight measurements and unconfined compression tests were also completed on Shelby tube and core samples. Atterberg limits and grain size analysis (hydrometer method) tests were also completed on select samples. Laboratory testing results are included in Appendix A.

Test hole coordinates were recorded using a hand held GPS and the elevation was surveyed using a rod and level relative to a temporary benchmark (TBM 1) located at the base of the existing hydro pole. The location of the TBM is also shown on Figure 01. The test hole logs include a description of the soil units encountered and other pertinent information such as groundwater, sloughing conditions, and a summary of the laboratory testing results.

2.2 Soil Stratigraphy

A brief description of the soil units encountered during drilling is 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.

The soil stratigraphy generally consists of near-surface layers of topsoil and clay fill to a depth of 0.9 m. The clay fill is stiff, intermediate to high plastic, mottled black and grey. The fill is underlain by silty clay to a depth of 5.0 m, followed by silt till. The silty clay contains trace sand, is high plastic, and is stiff becoming firm to stiff with depth. A transition layer from silty clay to silt till was encountered between 4.5 to 5.0 m depth. Silt till was encountered at a depth of 5.0 m and it contains trace sand, trace gravel, is moist, non-plastic and compact to dense becoming dense below 9.1 m. In Winnipeg, the silt till typically contains a heterogenous mixture of clay, sand, and gravel within a predominately silt matrix. Although not confirmed during drilling with the augers, cobbles and boulders are commonly present within the silt till. After auger refusal occurred, granitic cobbles were recovered from the core samples taken below a depth of 12.9 m.

Based on geology maps and experience in the area, the depth to bedrock in the area is on the order of 15 m but may vary significantly. The site is located on the boundary between two geologic units at the bedrock surface. The Stony Mountain Formation, Gunn Member appears to be present to the north of the site, while the Red River Formation, Upper Fort Garry member appears to be present south of the site.

2.3 Power Auger Refusal

Power auger refusal was observed at 12.2 m depth on cobbles within the silt till attest hole TH23-01.

2.4 Groundwater and Sloughing Conditions

Groundwater seepage, sloughing and squeezing was observed at the time of the subsurface investigation and is outlined in Table 1 below.

Table 1. Summary of Seepage and Sloughing During Drilling

Test Hole	Depth (m)			
	Observed Seepage	Water Level After Drilling	Observed Sloughing	Test Hole Open to After Drilling
TH23-01	Below 10.7	4.3	Below 4.3 m	4.3

The standpipe installed in TH23-01 was monitored twice in November 2023, as summarized in Table 2.

A hydrograph provided by the Province of Manitoba for provincial well G05MJ087 that is located 1 km west of the site is attached in Appendix B.

Table 2. Summary of Standpipe Water Level Readings

Standpipe	Water Level Depth Below Ground Surface (m)		
	Stratum / Tip Depth Below Ground Surface (m)	Nov. 01, 2023	Nov. 13, 2023
SP23-01	Silt Till / 13.1	8.15	8.38

These observations are short-term and should not be considered reflective of (static) groundwater levels at the site which would require monitoring over an extended period of time to determine. It is important to recognize that groundwater conditions may vary seasonally, annually, or as a result of construction activities.

3.0 Excavations and Shoring

It is understood that an excavation depth of about 11 m is required to construct the new lift station upgrades and that shoring for the excavation will be required. The excavation footprint is not known at this time, but is anticipated to be on the order of 5 m by 5 m.

3.1 Temporary Excavations

Excavations must be carried out in compliance with the current relevant regulations under the Manitoba Workplace Safety and Health Act to suit the planned and expected construction activities and schedule. Excavations greater than 3 m deep must be designed and sealed by a professional engineer. If space is limited or the stability of adjacent structures may be endangered by an excavation, a shoring system may be required to prevent damage to, or movement of, any part of adjacent structures, and the creation of a hazard to workers and the public.

Based on the 11 m excavation depth and the sensitivity of surrounding structures to settlement, conventional shoring will need to be braced. Shoring will need to extend through the clay layer and into the silt till layer. Undrained soil conditions may govern design of the shoring in the short term and effective stress conditions should be considered for the long-term stability. Both undrained and drained soil conditions should be checked and the more conservative condition used to design the shoring.

The earth pressure distribution provided in Figure 02 can be used for braced shoring design, however the shoring designer should refer to the Canadian Foundation Engineering Manual (5th Edition, 2023) and the information provided on the test hole logs for consideration of the layered soil profile in design. The apparent earth pressure distribution shown on Figure 02 can be used for temporary braced shoring design in stiff clay and is not applicable for unsupported shoring. The effect of any surcharge loads must be added to the force on the wall in addition to the calculated earth pressures. The appropriate earth pressure condition should be used to calculate the lateral earth pressure due to surcharge loads. Suggested soil parameters for use in shoring design are provided in Table 3, however it is the Contractor's responsibility to review the test hole logs and confirm the selection of soil parameters for design.

Table 3. Engineering Properties for Soil

Material	Depth Below Site Grade	Undrained Shear Strength	Effective Cohesion	Effective Friction Angle	Saturated Unit Weight	Effective Unit Weight	Earth Pressure Coefficients (Rankine[1])		
	(m)	(kPa)	(kPa)	(degrees)	(kN/m^3)	(kN/m^3)	Ko	Ka	Kp
Clay	0 – 5	50	5	25	17.5	7.7	0.6	0.4	2.5
Silt Till	5 – 13	n/a	5	32	22.0	12.2	0.47	0.3	3.2
Sand (fill)	-	n/a	0	30	20.0	10.2	0.5	0.3	3.0

Note 1: The effective stress earth pressure coefficients assume the magnitude of wall rotation is sufficient to develop the full earth pressure. The values should be reduced to suit the allowable wall rotation. Refer to Section 20.2.5 of the Canadian Foundation Engineering Manual (5th Edition 2023).

Considerations for the shoring design include:

- Design should be based on local experience with similar shoring systems as well as theoretical and empirical methods,
- Length of time the excavation shoring system will be in service,
- Earth and water pressures,
- Excavation staging,
- Excavation base stability,
- Spoil material from the excavation should not be stockpiled behind the shoring,
- Surcharge loading (q) from construction equipment should be considered in the design. The surcharge loading should be confirmed based on the equipment proposed for use by the contractor,
- Provide positive surface drainage away from the excavation to minimize water infiltration behind the shoring,
- Protection from frost effects are best mitigated by providing free draining backfill behind the shoring. Insulation could also be used to minimize frost penetration into the retained soil,
- Current Manitoba Building Code (MBC 2024) requirements
- Chapter 20 of the Canadian Foundation Engineering Manual (5th Edition 2023)
- Water pressure should be included in the analysis below the water table and/or behind the portion of the shoring that is not drained. The unit weight of water is 9.8 kN/m^3. The groundwater or piezometric level in the clay soil is generally considered to be about 2 m below prairie level (i.e. existing site grade).
- A monitoring program should be established to record the performance of the shoring system from the onset of installation to removal. The monitoring program should include top of pile surveys as a minimum to measure and track lateral movement of the shoring with time. The

vertical profile of soldier piles could be monitored using slope inclinometer casing and measurement of earth pressures acting on the shoring and groundwater pressure measurements could also be considered if deemed important by the shoring designer.

Ground movements behind the shoring and associated settlement are largely unavoidable. The amount of movement cannot be predicted with a high degree of accuracy as it is as much a function of the excavation procedures and workmanship as it is of theoretical considerations. In this regard, good contact between the retaining wall or timber lagging and retained soil should be maintained throughout the construction process. Free-draining sand fill should be used to fill in any voids behind the wall.

It is anticipated that the design of excavation slopes and temporary shoring will be the responsibility of the Contractor. Shoring designs or excavations will need to be designed and sealed by a professional engineer, and shop drawings should be reviewed by TREK prior to construction for review and comment. Shoring design should account for potential base heave and the need for dewatering and/or depressurization of the till or bedrock.

4.0 Closure

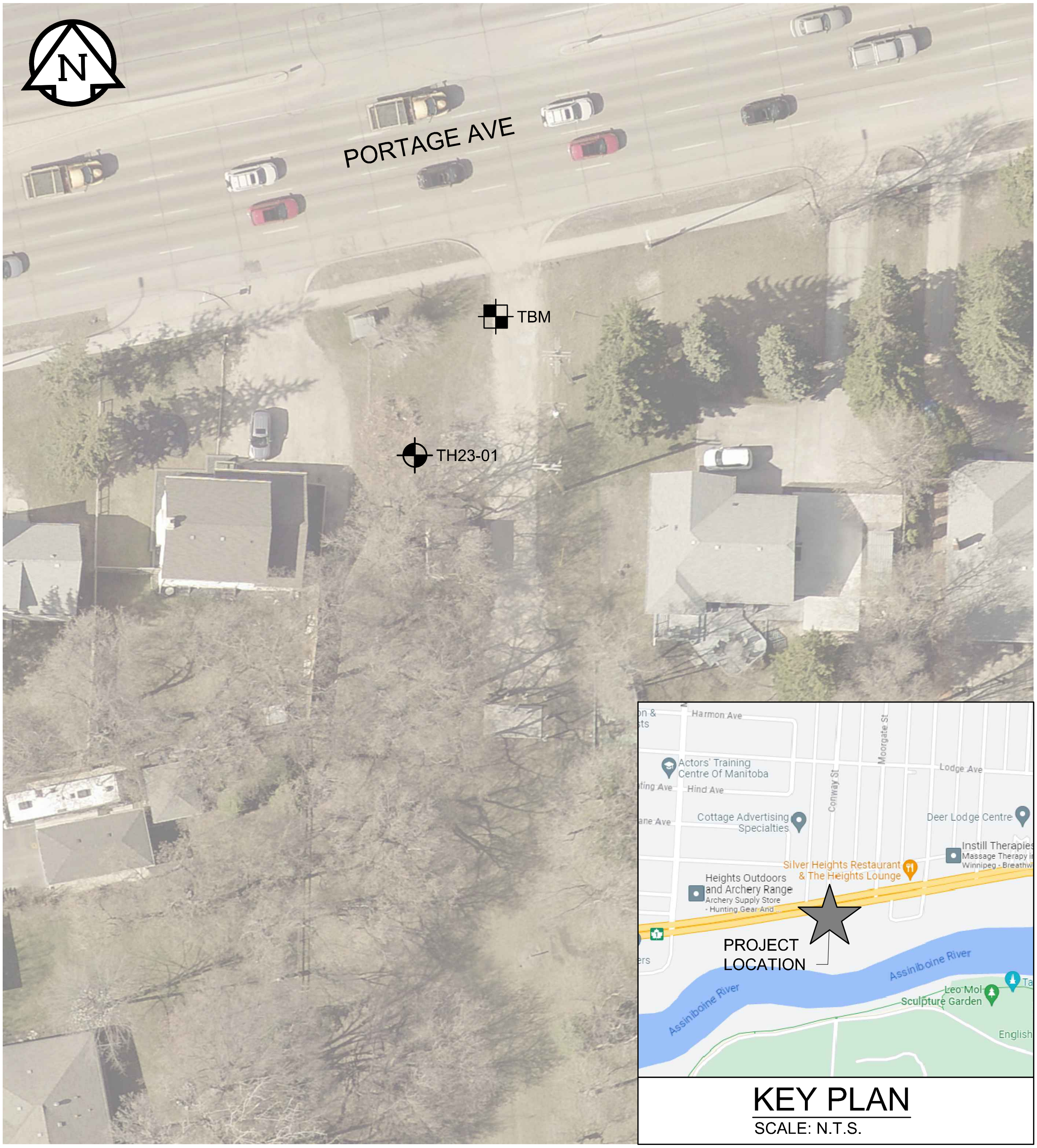
The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation and laboratory testing). Soil conditions are natural deposits that can be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

Figures

0512 011 00
MPE Engineering
Conway Lift Station



LEGEND:

⊕ TEST HOLE (TREK, 2023)

▚ TEMPORARY BENCHMARK

NOTES:

1. AERIAL IMAGERY FROM CITY OF WINNIPEG (2021).
2. TEST HOLE LOCATIONS WERE ESTABLISHED USING A HANDHELD GPS UNIT.
3. TEST HOLE ELEVATIONS WERE SURVEYED RELATIVE TO A TBM (ASSIGNED ELEVATION 100.0 m) LOCATED AT THE BASE OF THE ELECTRICAL POLE (UTM 14U, 5526366 m N, 626385 m E).

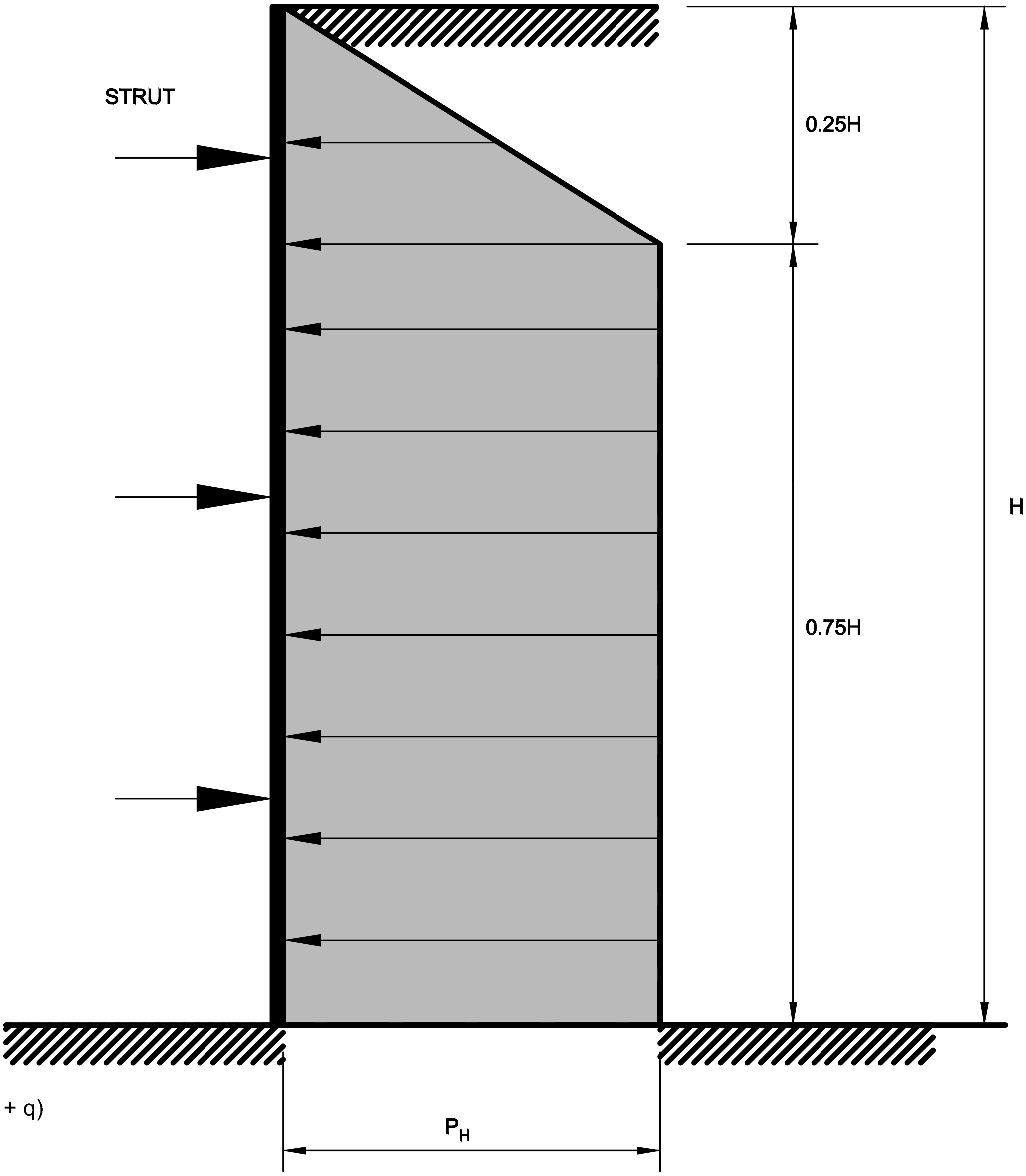
Z:\Projects\0512 MPE Engineering\0512 011 00 Conway Lift Station\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\Fig 2023-11-02 Conway Lift Station 0_A 0512-011-00.dwg, 2023-11-02 3:03:41 PM

0 5 10 15 20 25 m

SCALE = 1 : 500 (216 mm x 279 mm)

Figure 01
Test Hole Location Plan

0512 011 00
MPE Engineering
Conway Lift Station



$P_H = 0.4\ (\gamma\ H + q)$

WHERE:
P_H = LATERAL EARTH PRESSURE (kPa)
H = DEPTH OF EXCAVATION (m)
γ = BULK SOIL UNIT WEIGHT (17.0 kN/m³)
q = SURFACE SURCHARGE LOAD (kPa)

Figure 02
Apparent Temporary Lateral Earth Pressure Distribution
Braced Excavation in Stiff Clay

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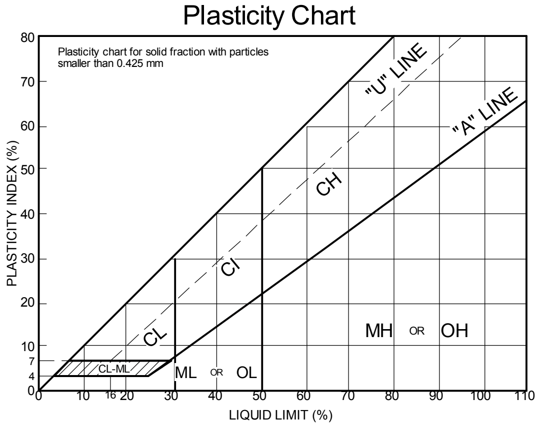
Sub-Surface Logs

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 Classi-fication	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*	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	○	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	▥	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			GC	▨	Clayey gravels, gravel-sand-silt mixtures		Atterberg limits above "A" line or P.I. greater than 7	
	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	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			SC	▨	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
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	

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

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

* 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
with *	with silt, with sand	> 35 percent

* Used when the material is classified based on behaviour as a cohesive material

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

Sub-Surface Log

Test Hole TH23-01

1 of 2

Client: MPE Engineering

Project Name: Conway Lift Station-Winnipeg, MB

Contractor: Paddock Drilling Ltd.

Method: 125mm Solid Stem Augers / HQ Coring, B57 Track Rig

Project Number: 0512-011-00

Location: UTM N-5526354, E-626378

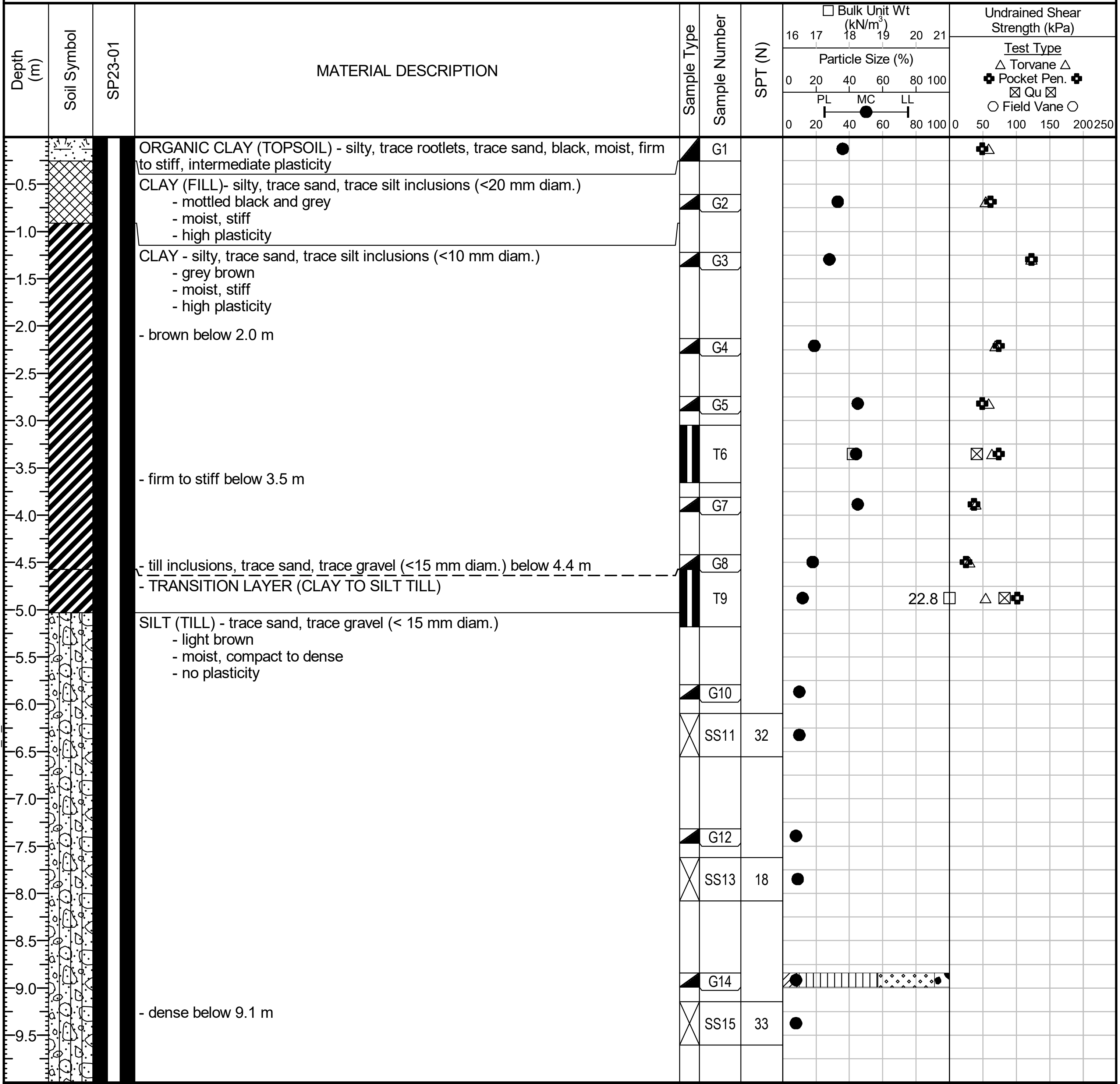
Ground Elevation: 99.895 m m (local datum)

Date Drilled: October 12, 2023

Sample Type: ◢ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧓ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders

Backfill Legend: ■ Bentonite ▩ Cement ▨ Drill Cuttings ▒ Filter Pack Sand ⁘ Grout ▩ Slough



MATERIAL DESCRIPTION

ORGANIC CLAY (TOPSOIL) - silty, trace rootlets, trace sand, black, moist, firm to stiff, intermediate plasticity

CLAY (FILL)- silty, trace sand, trace silt inclusions (<20 mm diam.)
- mottled black and grey
- moist, stiff
- high plasticity

CLAY - silty, trace sand, trace silt inclusions (<10 mm diam.)
- grey brown
- moist, stiff
- high plasticity

- brown below 2.0 m

- firm to stiff below 3.5 m

- till inclusions, trace sand, trace gravel (<15 mm diam.) below 4.4 m

- TRANSITION LAYER (CLAY TO SILT TILL)

SILT (TILL) - trace sand, trace gravel (< 15 mm diam.)
- light brown
- moist, compact to dense
- no plasticity

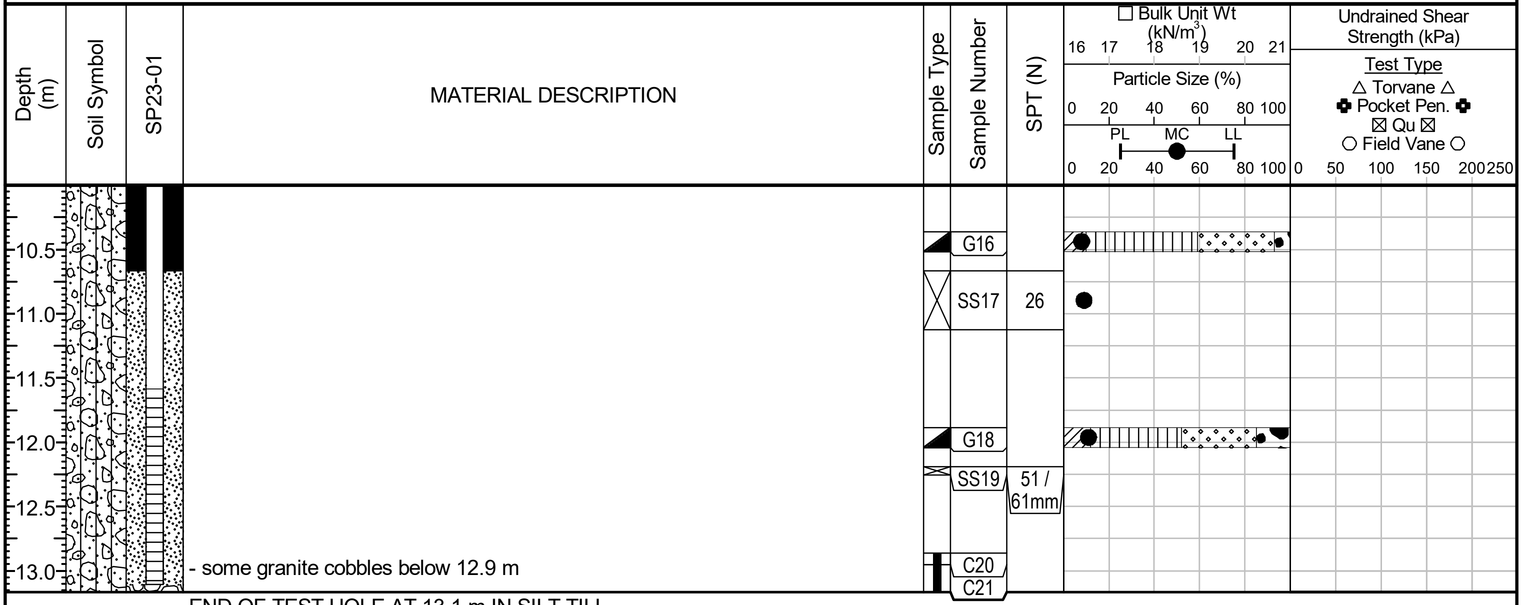
- dense below 9.1 m

Sample Type	Sample Number	SPT (N)
◢	G1	
◢	G2	
◢	G3	
◢	G4	
◢	G5	
▮	T6	
◢	G7	
◢	G8	
▮	T9	
◢	G10	
☒	SS11	32
◢	G12	
☒	SS13	18
◢	G14	
☒	SS15	33

Logged By: Thanveer Doorga **Reviewed By:** Gil Robinson **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH23-01



- some granite cobbles below 12.9 m

END OF TEST HOLE AT 13.1 m IN SILT TILL

Notes:

1. Power auger refusal observed at 12.2 m depth and drill method switched to HQ coring.
2. Seepage observed at 10.7 m depth.
3. Sloughing observed at 4.3 m depth from transition layer.
4. Test hole open to 4.3 m depth immediately after drilling.
5. 50 mm diameter PVC standpipe piezometer (SP23-01) fitted with slotted pipe installed at 13.1 m depth.
6. Water level in standpipe at 8.15 m below ground surface on November 1, 2023, and at 8.38 m below ground surface on November 13, 2023
7. Test hole elevation surveyed relative to TBM 1 (hydro pole on north west corner of property) with assumed datum elevation of 100.000 m.

Logged By: Thanveer Doorga **Reviewed By:** Gil Robinson **Project Engineer:** Michael Van Helden

Appendix A

Laboratory Testing

GEOTECHNICAL Quality Engineering | Valued Relationships

MEMORANDUM

Date	November 8, 2023
To	Thanveer Doorga, TREK Geotechnical
From	Angela Fidler-Kliewer, TREK Geotechnical
Project No.	0512-011-00
Project	Conway Lift Station – Winnipeg, MB
Subject	Laboratory Testing Results – Lab Req. R23-514
Distribution	Michael Van Helden

Attached are the laboratory testing results for the above noted project. The testing included moisture content determinations, particle size distribution (Hydrometer method) and Shelby Tube visual classification and related testing.

Regards,

Angela Fidler-Kliewer, C.Tech.

Attach.

Review Control:

Prepared By: AFK	*Reviewed By:* AFK	*Checked By:* NJF

TREK GEOTECHNICAL

LABORATORY REQUISITION

CLIENT MPE Engineering

PROJECT NAME Conway Lift Station-Winnipeg, MB

PROJECT NO: 0512-011-00

FIELD TECHNICIAN: Thanveer Doorga

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILIARY TESTS					Soil Description/Comments
TH23-01	G1	0.0 - 0.8		X											CLAY TOPSOIL
TH23-01	G2	2.0 - 2.5		X											CLAY (Fill)
TH23-01	G3	4.0 - 4.5		X											CLAY
TH23-01	G4	7.0 - 7.5		X											
TH23-01	G5	9.0 - 9.5		X											
TH23-01	T6	10.0 - 12.0		X						X					
TH23-01	G7	12.5 - 13.0		X											
TH23-01	G8	14.5 - 15.0		X											
TH23-01	T9	15.0 - 17.0		X						X					possible transition from clay to silt ti
TH23-01	G10	19.0 - 19.5		X											Silt till.
TH23-01	SS11	20.0 - 21.5		X											
TH23-01	G12	24.0 - 24.5		X											
TH23-01	SS13	25.0 - 26.5		X											
TH23-01	G14	29.0 - 29.5		X			X								
TH23-01	SS15	30.0 - 31.5		X											
TH23-01	G16	34.0 - 34.5		X			X								
TH23-01	SS17	35.0 - 36.5		X											
TH23-01	G18	39.0 - 39.5		X			X								
TH23-01	SS19	40.0 - 40.2													No recovery
TH23-01	C20	42.2 - 42.5													Cobbles from Till possib
TH23-01	C21	42.5 - 43.2													Boulder / Bedrock

Samples collected in sample bags.

- couldn't find SS19

REQUESTED BY: Thanveer Doorga

REQUISITION DATE: 12 oct 2023

COMMENTS:

REPORT TO: M.V.H / T.D

DATE REQUIRED: ASAP

REQUISITION NO. R23-514

PAGE 1 OF 1

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Moisture Content Report
ASTM D2216-98

Project No. 0512-011-00
Client MPE Engineering
Project Conway Lift Station - Winnipeg, MB

Sample Date 11-Oct-23
Test Date 29-Oct-23
Technician DS

Test Hole	TH23-01	TH23-01	TH23-01	TH23-01	TH23-01	TH23-01
Depth (m)	0.0 - 0.2	0.6 - 0.8	1.2 - 1.4	2.1 - 2.3	2.7 - 2.9	3.8 - 4.0
Sample #	G1	G2	G3	G4	G5	G7
Tare ID	N18	E63	M67	AC33	I58	F128
Mass of tare	9.0	7.0	6.7	6.8	7.0	8.5
Mass wet + tare	235.4	248.7	218.2	279.5	211.7	242.6
Mass dry + tare	175.6	188.8	171.4	236.4	147.8	169.8
Mass water	59.8	59.9	46.8	43.1	63.9	72.8
Mass dry soil	166.6	181.9	164.7	229.6	140.8	161.3
Moisture %	35.9%	32.9%	28.4%	18.8%	45.4%	45.1%

Test Hole	TH23-01	TH23-01	TH23-01	TH23-01	TH23-01	TH23-01
Depth (m)	4.4 - 4.6	5.8 - 5.9	6.1 - 6.6	7.3 - 7.5	7.6 - 8.1	8.8 - 9.0
Sample #	G8	G10	SS11	G12	SS13	G14
Tare ID	W07	C12	AC14	P07	E93	M00
Mass of tare	8.7	8.5	7.1	8.6	8.6	6.8
Mass wet + tare	235.3	229.6	223.1	225.3	251.8	268.8
Mass dry + tare	200.4	208.8	204.4	208.8	232.6	250.0
Mass water	34.9	20.8	18.7	16.5	19.2	18.8
Mass dry soil	191.7	200.3	197.3	200.2	224.0	243.2
Moisture %	18.2%	10.4%	9.5%	8.3%	8.6%	7.7%

Test Hole	TH23-01	TH23-01	TH23-01	TH23-01		
Depth (m)	9.1 - 9.6	10.4 - 10.5	10.7 - 11.1	11.9 - 12.0		
Sample #	SS15	G16	SS17	G18		
Tare ID	E49	W47	W28	N76		
Mass of tare	6.8	8.6	8.6	8.8		
Mass wet + tare	262.3	390.6	244.9	401.8		
Mass dry + tare	243.4	363.2	226.2	361.6		
Mass water	18.9	27.4	18.7	40.2		
Mass dry soil	236.6	354.6	217.6	352.8		
Moisture %	8.0%	7.7%	8.6%	11.4%		

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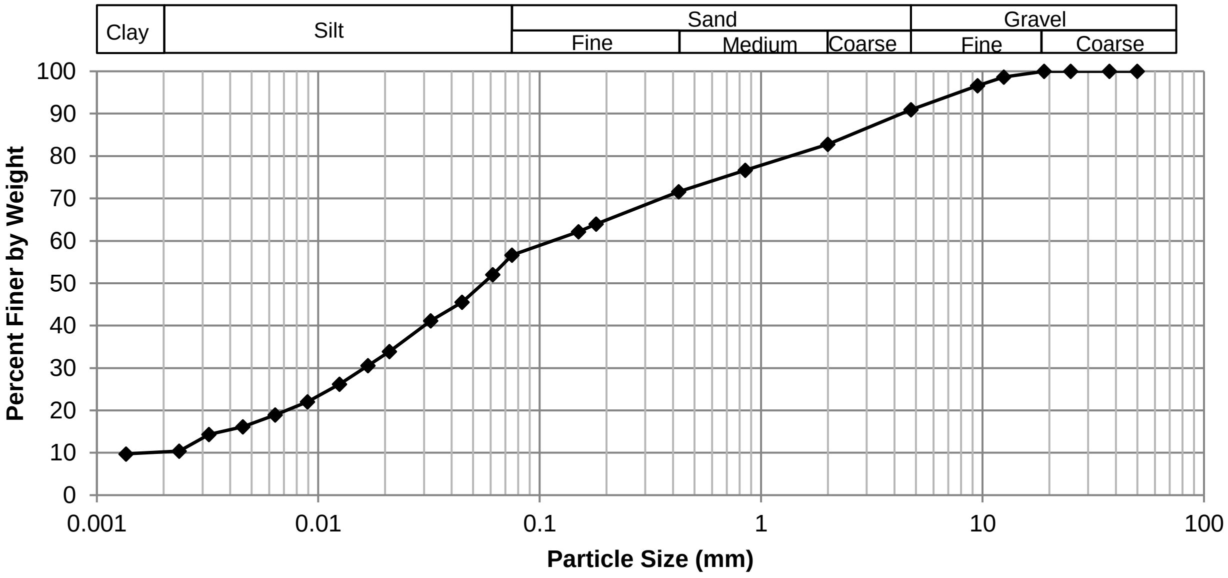
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

CERTIFIED BY CCIL
Canadian Council of Independent Laboratories
For specific tests as listed on www.ccil.com

Project No.	0512-011-00
Client	MPE Engineering
Project	Conway Lift Station- Winnipeg, MB
Test Hole	TH23-01
Sample #	G14
Depth (m)	8.8 - 9.0
Sample Date	11-Oct-23
Test Date	03-Nov-23
Technician	DS

Gravel	9.1%
Sand	34.3%
Silt	46.5%
Clay	10.2%

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	90.94	0.0750	56.64
37.5	100.00	2.00	82.78	0.0614	52.03
25.0	100.00	0.850	76.63	0.0447	45.56
19.0	100.00	0.425	71.59	0.0322	41.17
12.5	98.68	0.180	63.97	0.0210	33.92
9.50	96.62	0.150	62.16	0.0168	30.56
4.75	90.94	0.075	56.64	0.0125	26.16
				0.0090	22.02
				0.0064	18.95
				0.0046	16.10
				0.0032	14.35
				0.0024	10.39
				0.0014	9.75

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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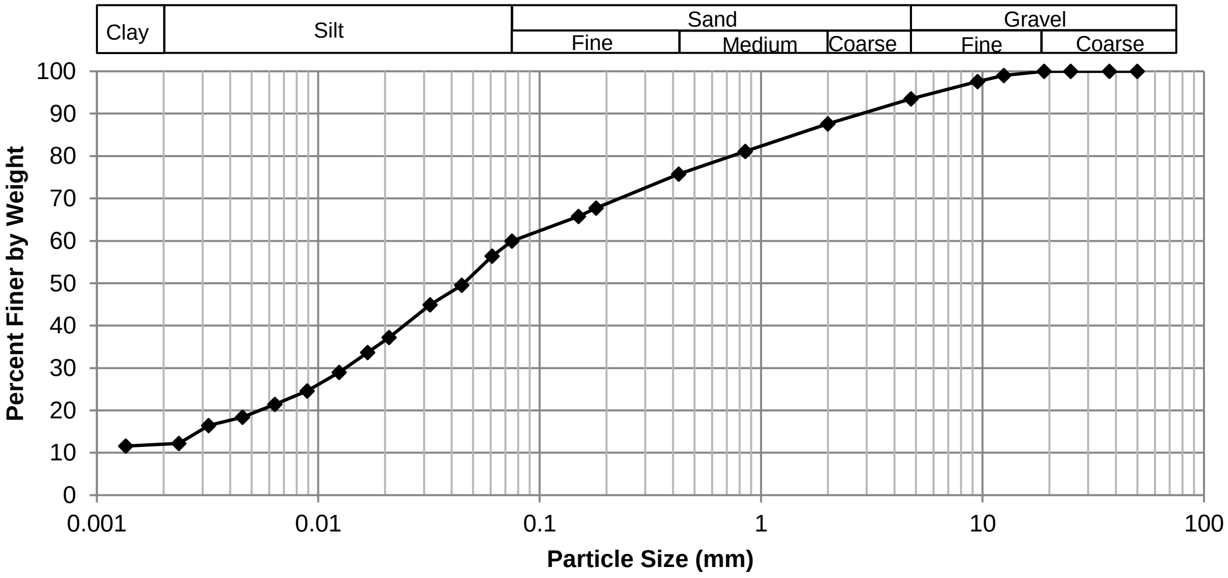
Project No.	0512-011-00
Client	MPE Engineering
Project	Conway Lift Station- Winnipeg, MB
Test Hole	TH23-01
Sample #	G16
Depth (m)	10.4 - 10.5
Sample Date	11-Oct-23
Test Date	03-Nov-23
Technician	DS

Gravel	6.5%
Sand	33.5%
Silt	48.6%
Clay	11.3%

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	93.48	0.0750	59.95
37.5	100.00	2.00	87.62	0.0610	56.39
25.0	100.00	0.850	81.10	0.0444	49.55
19.0	100.00	0.425	75.77	0.0320	44.89
12.5	99.05	0.180	67.71	0.0209	37.23
9.50	97.57	0.150	65.79	0.0167	33.67
4.75	93.48	0.075	59.95	0.0124	29.01
				0.0089	24.63
				0.0064	21.39
				0.0046	18.38
				0.0032	16.42
				0.0024	12.17
				0.0014	11.58

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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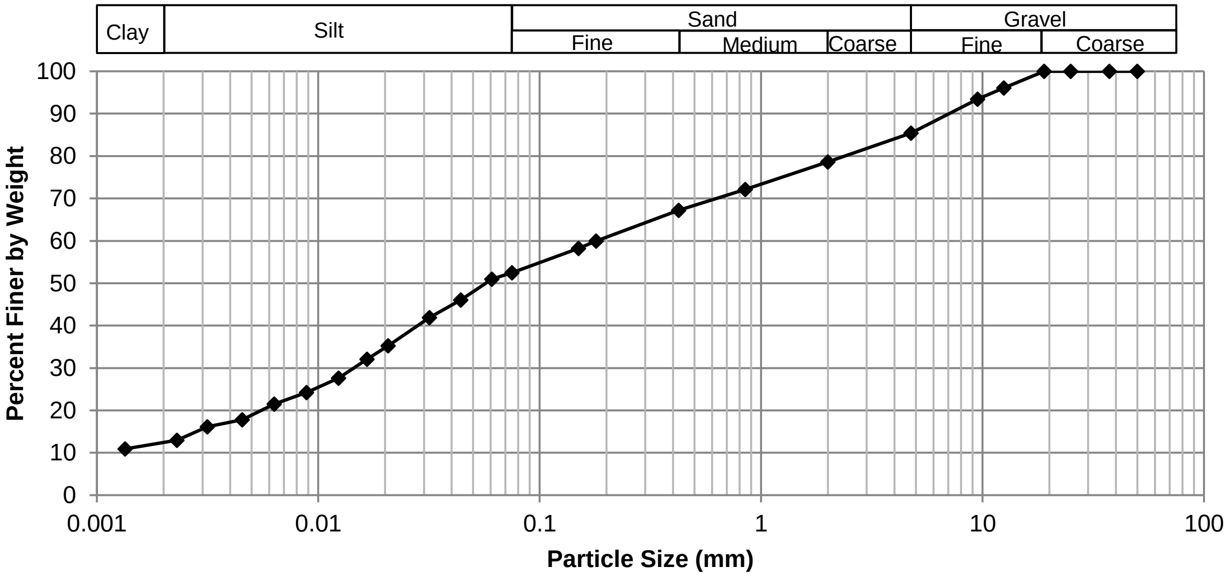
Project No.	0512-011-00
Client	MPE Engineering
Project	Conway Lift Station- Winnipeg, MB
Test Hole	TH23-01
Sample #	G18
Depth (m)	11.9 - 12.0
Sample Date	11-Oct-23
Test Date	03-Nov-23
Technician	DS

Gravel	14.5%
Sand	33.0%
Silt	40.3%
Clay	12.1%

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	85.45	0.0750	52.46
37.5	100.00	2.00	78.60	0.0609	50.99
25.0	100.00	0.850	72.15	0.0441	46.08
19.0	100.00	0.425	67.22	0.0318	41.90
12.5	96.08	0.180	59.99	0.0207	35.27
9.50	93.41	0.150	58.25	0.0166	32.07
4.75	85.45	0.075	52.46	0.0123	27.65
				0.0088	24.21
				0.0063	21.51
				0.0045	17.83
				0.0032	16.11
				0.0023	12.95
				0.0013	10.92

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Shelby Tube Visual

Project No.	0512-011-00
Client	MPE Engineering
Project	Conway Lift Station - Winnipeg, MB
Test Hole	TH23-01
Sample #	T06
Depth (m)	3.0 - 3.7
Sample Date	11-Oct-23
Test Date	26-Oct-23
Technician	AD

Tube Extraction

Recovery (mm) 470

Bottom - 3.52 m	3.42 m	3.25 m	3.08 m	**Top - 3.05 m**

Moisture Content PP/TV Visual	Keep	Qu Bulk	Slough
100 mm	170 mm	170 mm	30 mm

Visual Classification

Material	CLAY
Composition	silty

trace sand
trace silt till inclusions (<10 mm diam.)
trace oxidation

Color	light brown
Moisture	moist
Consistency	firm to stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.65
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	63.8

Pocket Penetrometer

Reading	**1**	1.40
	2	1.60
	3	1.50
	Average	1.50
Undrained Shear Strength (kPa)		73.6

Moisture Content

Tare ID	H35
Mass tare (g)	8.4
Mass wet + tare (g)	308.6
Mass dry + tare (g)	217.4
Moisture %	43.6%

Unit Weight

Bulk Weight (g)		1171.8
Length (mm)	**1**	152.00
	2	151.76
	3	152.02
	4	151.86
Average Length (m)		0.152
Diam. (mm)	**1**	73.05
	2	72.74
	3	72.91
	4	72.73
Average Diameter (m)		0.073
Volume (m^3)		6.33E-04
Bulk Unit Weight (kN/m^3)		18.1
Bulk Unit Weight (pcf)		115.5
Dry Unit Weight (kN/m^3)		12.6
Dry Unit Weight (pcf)		80.4

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Unconfined Compressive Strength

ASTM D2166

Project No.	0512-013-00
Client	MPE Engineering
Project	Renfrew Outfall Gate Chamber Upgrades

Test Hole	TH23-01
Sample #	T06
Depth (m)	3.0 - 3.7
Sample Date	2023-10-11
Test Date	2023-10-26
Technician	AD

Unconfined Strength

	kPa	**ksf**
Max q_u	81.5	1.7
Max S_u	40.8	0.9

Specimen Data

Description CLAY - silty, trace sand, trace silt till inclusions (<10 mm diam.), trace oxidation, light brown, moist, firm to stiff, high plasticity

Length	151.9	(mm)	**Moisture %**	44%	
Diameter	72.9	(mm)	**Bulk Unit Wt.**	18.1	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	12.6	(kN/m^3)
Initial Area	0.00417	(m^2)	**Liquid Limit**		
Load Rate	1.00	(%/min)	**Plastic Limit**		
			Plasticity Index		

Undrained Shear Strength Tests

Torvane

trace silt inclu	**Undrained Shear Strength**	
trace precipitat	**kPa**	**ksf**
trace oxidation	63.8	1.33
Vane Size		
m		

Pocket Penetrometer

	Reading	**Undrained Shear Strength**	
	tsf	**kPa**	**ksf**
	1.40	68.7	1.43
	1.60	78.5	1.64
	1.50	73.6	1.54
Average	**1.50**	**73.6**	**1.54**

Failure Geometry

Sketch:

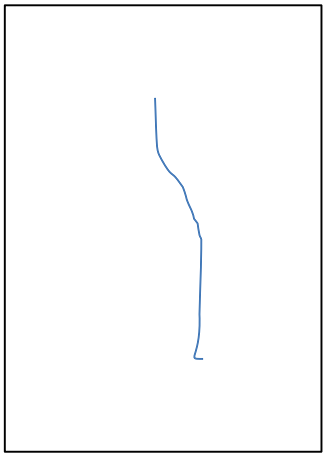


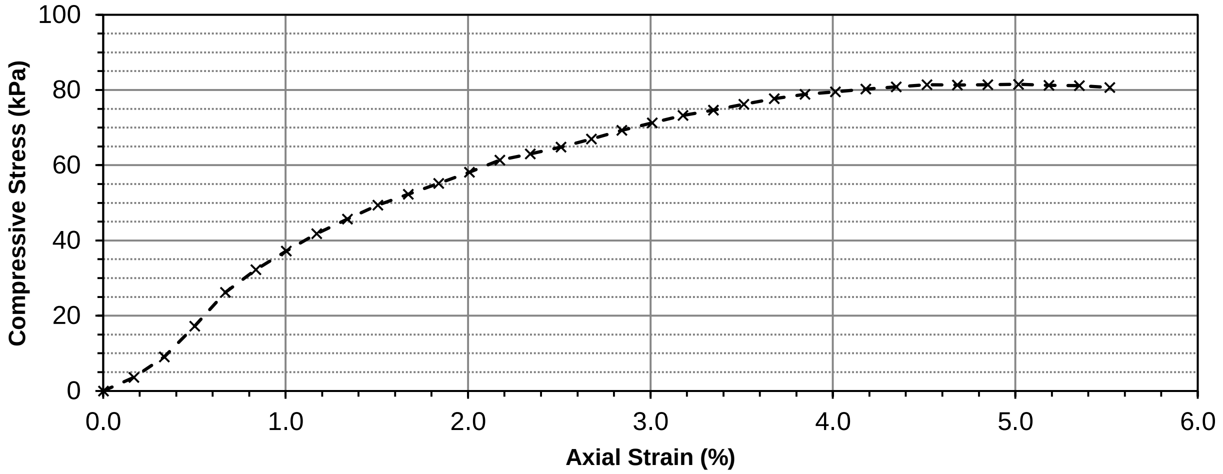
Photo:

Unconfined Compressive Strength

ASTM D2166

Project No. 0512-013-00
Client MPE Engineering
Project Renfrew Outfall Gate Chamber Upgrades

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.70	0.0000	0.00	0.004169	0.0	0.00	0.00
10	1.00	0.2540	0.17	0.004176	15.1	3.62	1.81
20	1.45	0.5080	0.33	0.004183	37.8	9.04	4.52
30	2.13	0.7620	0.50	0.004190	72.1	17.20	8.60
40	2.88	1.0160	0.67	0.004197	109.9	26.18	13.09
50	3.39	1.2700	0.84	0.004204	135.6	32.25	16.12
60	3.81	1.5240	1.00	0.004211	156.8	37.22	18.61
70	4.20	1.7780	1.17	0.004218	176.4	41.82	20.91
80	4.53	2.0320	1.34	0.004226	193.0	45.68	22.84
90	4.85	2.2860	1.50	0.004233	209.2	49.42	24.71
100	5.10	2.5400	1.67	0.004240	221.8	52.31	26.15
110	5.35	2.7940	1.84	0.004247	234.4	55.18	27.59
120	5.61	3.0480	2.01	0.004254	247.5	58.17	29.08
130	5.89	3.3020	2.17	0.004262	261.6	61.38	30.69
140	6.04	3.5560	2.34	0.004269	269.2	63.05	31.52
150	6.20	3.8100	2.51	0.004276	277.2	64.83	32.41
160	6.39	4.0640	2.68	0.004284	286.8	66.95	33.48
170	6.60	4.3180	2.84	0.004291	297.4	69.30	34.65
180	6.78	4.5720	3.01	0.004298	306.5	71.29	35.65
190	6.96	4.8260	3.18	0.004306	315.5	73.28	36.64
200	7.09	5.0800	3.34	0.004313	322.1	74.67	37.34
210	7.23	5.3340	3.51	0.004321	329.1	76.17	38.09
220	7.37	5.5880	3.68	0.004328	336.2	77.67	38.84
230	7.48	5.8420	3.85	0.004336	341.7	78.82	39.41

Unconfined Compressive Strength

ASTM D2166

Project No. 0512-013-00
Client MPE Engineering
Project Renfrew Outfall Gate Chamber Upgrades

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	7.55	6.0960	4.01	0.004343	345.3	79.49	39.75
250	7.63	6.3500	4.18	0.004351	349.3	80.28	40.14
260	7.69	6.6040	4.35	0.004359	352.3	80.83	40.42
270	7.75	6.8580	4.51	0.004366	355.3	81.39	40.69
280	7.76	7.1120	4.68	0.004374	355.8	81.36	40.68
290	7.78	7.3660	4.85	0.004382	356.9	81.45	40.72
300	7.80	7.6200	5.02	0.004389	357.9	81.53	40.77
310	7.79	7.8740	5.18	0.004397	357.4	81.27	40.64
320	7.79	8.1280	5.35	0.004405	357.4	81.13	40.57
330	7.76	8.3820	5.52	0.004413	355.8	80.64	40.32

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Shelby Tube Visual

Project No.	0512-011-00
Client	MPE Engineering
Project	Conway Lift Station - Winnipeg, MB
Test Hole	TH23-01
Sample #	T09
Depth (m)	4.6 - 5.2
Sample Date	11-Oct-23
Test Date	26-Oct-23
Technician	AD

Tube Extraction

Recovery (mm) 420

Bottom - 4.99 m	4.82 m	4.65 m **Top - 4.57 m**
Bulk Keep	Keep	Moisture Content PP/TV Visual/
170 mm	170 mm	80 mm

Visual Classification

Material	CLAY (TILL)
Composition	silty
trace sand	
trace gravel (< 25mm diam.)	
trace to some silt till inclusions (<50 mm diam.)	
Color	light brown
Moisture	moist
Consistency	very stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.55
Vane Size (s,m,l)	s
Undrained Shear Strength (kPa)	134.8

Pocket Penetrometer

Reading	**1**	1.90
	2	2.20
	3	2.10
	Average	2.07
Undrained Shear Strength (kPa)		101.3

Moisture Content

Tare ID	E01
Mass tare (g)	8.4
Mass wet + tare (g)	295.4
Mass dry + tare (g)	264.8
Moisture %	11.9%

Unit Weight

Bulk Weight (g)		1458.0
Length (mm)	**1**	151.62
	2	151.18
	3	151.36
	4	151.56
Average Length (m)		0.151
Diam. (mm)	**1**	72.06
	2	73.78
	3	71.73
	4	72.84
Average Diameter (m)		0.073
Volume (m^3)		6.27E-04
Bulk Unit Weight (kN/m^3)		22.8
Bulk Unit Weight (pcf)		145.2
Dry Unit Weight (kN/m^3)		20.4
Dry Unit Weight (pcf)		129.7

Unconfined Compressive Strength

ASTM D2166

Project No.	0512-013-00
Client	MPE Engineering
Project	Renfrew Outfall Gate Chamber Upgrades

Test Hole	TH23-01
Sample #	T09
Depth (m)	4.6 - 5.2
Sample Date	2023-10-11
Test Date	2023-10-26
Technician	AD

Unconfined Strength

	kPa	**ksf**
Max q_u	165.5	3.5
Max S_u	82.7	1.7

Specimen Data

Description CLAY (TILL) - silty, trace sand, trace gravel (< 25mm diam.), trace to some silt till inclusions (<50 mm diam.), light brown, moist, very stiff, high plasticity

Length	151.4	(mm)
Diameter	72.6	(mm)
L/D Ratio	2.1	
Initial Area	0.00414	(m^2)
Load Rate	1.00	(%/min)

Moisture %	12%	
Bulk Unit Wt.	22.8	(kN/m^3)
Dry Unit Wt.	20.4	(kN/m^3)
Liquid Limit	94	
Plastic Limit	27	
Plasticity Index	67	

Undrained Shear Strength Tests

Torvane

trace silt inclu	**Undrained Shear Strength**	
trace precipitat	**kPa**	**ksf**
trace oxidation	134.8	2.82
Vane Size		
s		

Pocket Penetrometer

	Reading	**Undrained Shear Strength**	
	tsf	**kPa**	**ksf**
	1.90	93.2	1.95
	2.20	107.9	2.25
	2.10	103.0	2.15
Average	**2.07**	**101.4**	**2.12**

Failure Geometry

Sketch:

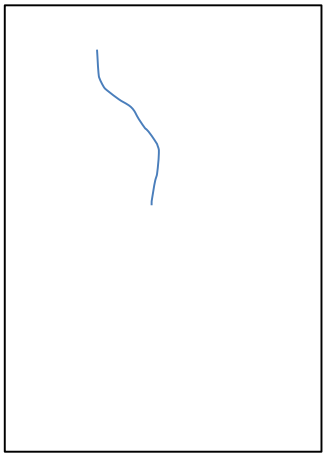


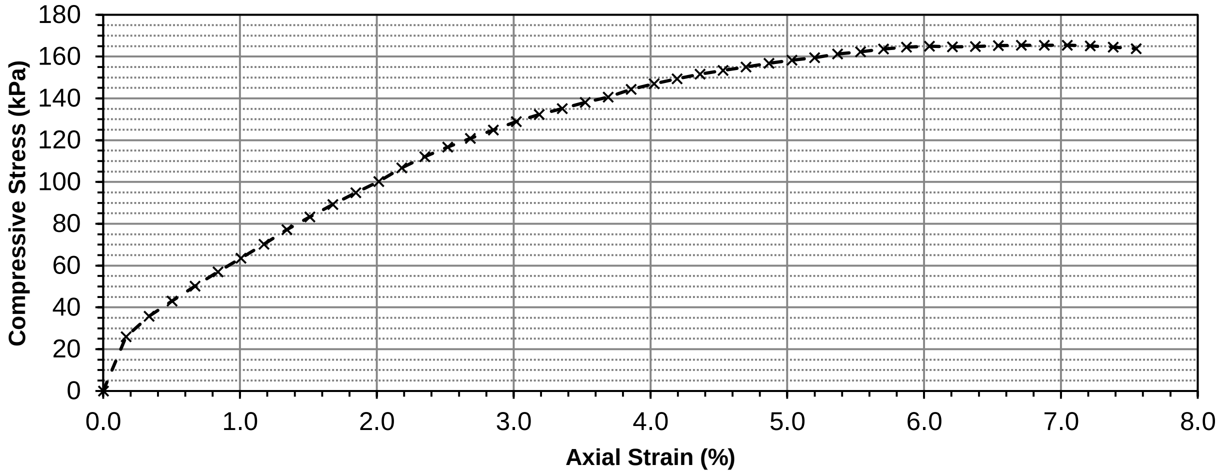
Photo:

Unconfined Compressive Strength

ASTM D2166

Project No. 0512-013-00
Client MPE Engineering
Project Renfrew Outfall Gate Chamber Upgrades

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.74	0.0000	0.00	0.004140	0.0	0.00	0.00
10	2.87	0.2540	0.17	0.004147	107.4	25.89	12.94
20	3.69	0.5080	0.34	0.004154	148.7	35.80	17.90
30	4.29	0.7620	0.50	0.004161	178.9	43.00	21.50
40	4.89	1.0160	0.67	0.004168	209.2	50.19	25.09
50	5.46	1.2700	0.84	0.004175	237.9	56.98	28.49
60	6.01	1.5240	1.01	0.004182	265.6	63.52	31.76
70	6.58	1.7780	1.17	0.004189	294.4	70.27	35.13
80	7.17	2.0320	1.34	0.004196	324.1	77.23	38.62
90	7.69	2.2860	1.51	0.004203	350.3	83.34	41.67
100	8.19	2.5400	1.68	0.004211	375.5	89.18	44.59
110	8.68	2.7940	1.85	0.004218	400.2	94.88	47.44
120	9.14	3.0480	2.01	0.004225	423.4	100.21	50.11
130	9.70	3.3020	2.18	0.004232	451.6	106.71	53.35
140	10.17	3.5560	2.35	0.004239	475.3	112.11	56.06
150	10.57	3.8100	2.52	0.004247	495.5	116.67	58.33
160	10.94	4.0640	2.68	0.004254	514.1	120.85	60.43
170	11.30	4.3180	2.85	0.004261	532.3	124.90	62.45
180	11.66	4.5720	3.02	0.004269	550.4	128.94	64.47
190	11.96	4.8260	3.19	0.004276	565.5	132.25	66.12
200	12.22	5.0800	3.35	0.004284	578.6	135.08	67.54
210	12.50	5.3340	3.52	0.004291	592.7	138.13	69.07
220	12.73	5.5880	3.69	0.004299	604.3	140.59	70.29
230	13.07	5.8420	3.86	0.004306	621.5	144.32	72.16

Unconfined Compressive Strength

ASTM D2166

Project No. 0512-013-00
Client MPE Engineering
Project Renfrew Outfall Gate Chamber Upgrades

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	13.32	6.0960	4.03	0.004314	634.1	146.99	73.50
250	13.54	6.3500	4.19	0.004321	645.2	149.30	74.65
260	13.76	6.6040	4.36	0.004329	656.2	151.60	75.80
270	13.93	6.8580	4.53	0.004336	664.8	153.31	76.66
280	14.10	7.1120	4.70	0.004344	673.4	155.02	77.51
290	14.27	7.3660	4.86	0.004352	682.0	156.71	78.36
300	14.43	7.6200	5.03	0.004359	690.0	158.29	79.14
310	14.56	7.8740	5.20	0.004367	696.6	159.51	79.75
320	14.73	8.1280	5.37	0.004375	705.1	161.18	80.59
330	14.85	8.3820	5.54	0.004383	711.2	162.28	81.14
340	14.99	8.6360	5.70	0.004390	718.2	163.60	81.80
350	15.09	8.8900	5.87	0.004398	723.3	164.45	82.23
360	15.16	9.1440	6.04	0.004406	726.8	164.96	82.48
370	15.16	9.3980	6.21	0.004414	726.8	164.67	82.33
380	15.20	9.6520	6.37	0.004422	728.8	164.83	82.41
390	15.26	9.9060	6.54	0.004430	731.9	165.21	82.61
400	15.30	10.1600	6.71	0.004438	733.9	165.37	82.69
410	15.33	10.4140	6.88	0.004446	735.4	165.42	82.71
420	15.36	10.6680	7.04	0.004454	736.9	165.46	82.73
430	15.36	10.9220	7.21	0.004462	736.9	165.16	82.58
440	15.33	11.1760	7.38	0.004470	735.4	164.52	82.26
450	15.29	11.4300	7.55	0.004478	733.4	163.77	81.89

Appendix B

Provincial Well Hydrograph

G05MJ087 GF8 - OLIVE RL 13 ST.JAMES

GROUND LEVEL ELEVATION 236.528 METRES (776.01 FEET)