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Date: September 19, 2022

Project #: 60668984

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Memorandum

Subject: **The City of Winnipeg - Main Street at Murray Avenue Sewer Collapse – Geotechnical Investigation**

1. Introduction

1.1 General

The City of Winnipeg (the City) has retained AECOM Canada Ltd. (AECOM) to provide geotechnical services in response to a sewer collapse that occurred near the intersection of Main Street and Murray Avenue in Winnipeg, Manitoba. This memorandum summarizes the results of the geotechnical investigation completed in June 2022 including test hole information and laboratory test results, and provides geotechnical recommendations in support of the temporary construction works.

1.2 Scope of Work

The geotechnical scope of work included provision of the following services:

- **Geotechnical Investigation** – Drilling one (1) test hole near the collapsed sewer site to auger refusal and converting the test hole to a standpipe piezometer upon completion of the drilling.
- **Laboratory Testing** – Completion of laboratory testing on collected samples, including: moisture content, Atterberg Limits, gradation, unconfined compressive strength, and bulk unit weight.
- **Instrumentation Monitoring** – Completion of two (2) post-installation readings of the standpipe piezometer.
- **Reporting** – Presentation of all geotechnical investigation, laboratory testing, and instrumentation monitoring results, and recommendations related to lateral earth pressure and base heave for the temporary excavation works.

2. Geotechnical Investigation

2.1 General

On June 1, 2022, one (1) test hole (TH22-01) was drilled adjacent to the sewer collapse at Main Street and Murray Ave . A job hazard assessment was prepared prior to the field investigation, and utility clearance certificates were obtained by AECOM personnel from representatives of ClickBeforeYouDigMB and DigShaw.

Drilling was completed by Maple Leaf Drilling Ltd. using a track-mounted Geoprobe 3230DT drill rig equipped with 125 mm Solid Stem Augers (SSA). Disturbed grab and split-spoon samples and relatively undisturbed Shelby Tube samples were retrieved from test holes at select intervals. In-situ standard penetration tests (SPT's) and torvane testing was also completed at regular intervals within the test hole, and the blows required to advance the split-spoon sampler 300 mm were recorded (SPT 'N' values).

Subsurface conditions observed during drilling were documented by AECOM geotechnical personnel according to the Modified Unified Classification System for soils. Other pertinent information such as groundwater and drilling conditions were also recorded. Samples retrieved during the field investigation were tested in the AECOM Materials Testing Laboratory located in Winnipeg, Manitoba.

A test hole log was prepared for the single test hole completed and is attached in **Appendix A**. The log includes descriptions and depths of the soil units encountered, sample type, sample location, results of field and laboratory testing, instrumentation installation and monitoring information, and other pertinent information such as seepage and sloughing conditions encountered during drilling.

2.2 In-situ and Laboratory Testing

In-situ SPT and Torvane testing were completed at select depths during completion of the drilling works. Laboratory testing was completed at select depths and on select soil samples collected during the geotechnical investigation program. The laboratory testing program included the determination of index properties such as moisture content, grain size distribution (sieve analysis/hydrometer method), plasticity (Atterberg Limits), undrained shear strength ("Qu/2" unconfined compressive strength method, "PP" pocket penetrometer method, "TV" Torvane method), and bulk unit weight. The laboratory test results are presented in **Appendix B**. **Table 2-1** summarizes the number of each test completed.

Table 2-1: Summary of In-situ and Laboratory Testing

Test	Number
Moisture Content	12
Atterberg Limits	2
SPT 'N' Blow Count (uncorrected)	4
Grain Size Distribution (Sieve Analysis/Hydrometer Method)	3
Undrained Shear Strength (Qu/2)	2
Undrained Shear Strength (PP)	2
Undrained Shear Strength (TV)	12
Bulk Unit Weight	2

Figure 2-1illustrates specific soil index properties at varying elevations.

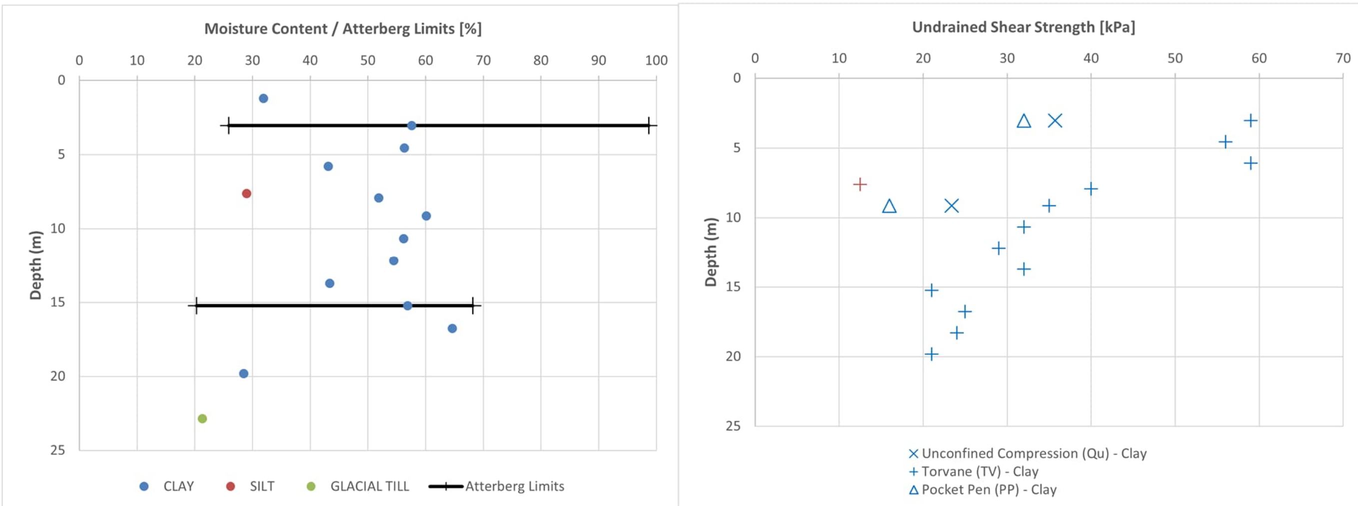

Figure 2-1: Summary of Select Test Results

2.3 Subsurface Conditions

The following sections describe the subsurface conditions encountered during the geotechnical drilling investigation completed by AECOM and the results of laboratory testing.

In descending order from grade, the general soil profile consisted of:

- Concrete
- Gravel Fill
- Upper Complex
    - Clay
    - Silt
- Glacio-lacustrine Clay
- Silt (Till)

Each of these units are described separately below.

<u>Concrete</u>

A layer of concrete 280 mm thick was encountered at ground surface.

<u>Gravel (Fill)</u>

A layer of gravel fill 0.3 m thick was encountered beneath the concrete. The gravel fill contained some sand and was tan and moist.

<u>Upper Complex</u>

The upper complex is a near ground surface zone common to the Winnipeg area that typically consists of interlayered clays, silts, sands, and organics near ground surface that are though to be a mixture of lacustrine and alluvial sediments. Upper complex clays and silts were encountered in test hole TH22-01 and are described individually below.

A layer of upper complex clay was encountered below the gravel fill and had a thickness of 1.7 m. The upper complex clay contained trace sand, trace silt, and was brown, firm, moist, and of high plasticity. A summary of the index properties of the upper complex clay are presented in **Table 2-2**.

Table 2-2: Summary of Index Properties of Upper Complex Clay

Test	Minimum Value	Maximum Value	Number of Tests
Moisture Content (%)	32		1
SPT 'N' Blow Count (uncorrected)	5		1

A layer of upper complex silt was encountered below the upper complex clay and had a thickness of 0.9 m. The upper complex silt contained trace sand, and was light brown, soft, moist, and of low plasticity.

<u>Glacio-lacustrine Clay</u>

A stratum of glacio-lacustrine clay was encountered beneath the upper complex with a thickness of 17.2 m . The glaciolacustrine clay generally contained some silt to silty, trace sand, trace gravel, and was grey, firm to stiff, moist, and of high plasticity. A summary of the index properties of the glacio-lacustrine clay are presented in **Table 2-3**.

Table 2-3: Summary of Index Properties of Glacio-lacustrine Clay

Test	Minimum Value	Maximum Value	Number of Tests
Moisture Content (%)	29	65	11
SPT 'N' Blow Count (uncorrected)	2	6	2
Atterberg – Plastic Limit (%)	20	26	2
Atterberg – Liquid Limit (%)	68	99	2
Grain Size – Gravel (%)	0	3	3
Grain Size – Sand (%)	0	10	3
Grain Size – Silt (%)	11	21	3
Grain Size – Clay (%)	67	89	3
Undrained Shear Strength (Qu/2) (kPa)	23	36	2
Undrained Shear Strength (PP) (kPa)	16	32	2
Undrained Shear Strength (TV) (kPa)	21	59	12
Bulk Unit Weight	16.4		2

A 0.3 m thick silt and clay interlayer was encountered within the glaciolacustrine clay layer at a depth of 7.6 m. The silt and clay layer contained trace sand and was light brown, soft, moist, and of low plasticity. The results of a single moisture content test completed on this layer indicated a moisture content of 29%.

<u>Silt (Till)</u>

The glacio-lacustrine clay stratum was underlain by a silt till layer that extended from 20.4 m to an auger refusal depth of 23.2 m. The silt till was clayey, contained some sand, some gravel, and was brown, moist, and of low plasticity. The results of a single moisture content test completed on this layer indicated a moisture content of 21%.

2.4 Seepage, Sloughing, and Heaving

Sloughing was encountered in test hole TH22-01 at depths below 2.3 m, most likely from the silt layers. Seepage was encountered below 7.6 m during drilling. Detailed information about the nature and location of the sloughing and seepage are provided on the test hole log included in **Appendix A**.

One (1) standpipe piezometer was installed in test hole TH22-01 upon completion of the drilling. Short-term monitoring results of the groundwater level (GWL) from two (2) post-installation readings are provided in **Table 2-4**.

Table 2-4: Piezometer Monitoring Data

Test Hole Number	TH22-01
Tip Depth [m BGS]	23.16
Tip Location	Silt (Till)
Dates	**GWL Depth Below Ground Surface [m]**
June 7, 2022	9.25
July 8, 2022	5.53

It should be noted that groundwater levels, seepage, and sloughing levels in excavations may vary seasonally, annually, or as a result of construction activities.

3. Temporary Excavations

It is understood that the proposed chamber will consist of a 1.8 m diameter precast manhole founded at a depth of approximately 12.9 m below existing grade (elevation of 217.6 m above sea level) which is well below the frost depth in the Winnipeg area.

Temporary excavations will be required to facilitate the remediation of the collapsed sewer near the intersection of Main Street and Murray Avenue. It is anticipated that a circular shaft with internal diameter of 3.7 m to 4.9 m will be required for installation of the proposed manhole. For the proposed infrastructure it is understood that temporary shoring will be required during construction, and that the Contractor is responsible for the design and construction of the temporary shoring system. All excavation work will be required to be performed in accordance with the most recent version of the Workplace Safety and Health Act and Part 26 of the Manitoba Workplace Safety and Health Regulation M.R. 217/2006.

3.1 Lateral Earth Pressure

Based on the results of the geotechnical investigation, lateral earth pressure design parameters have been recommended for use by the Contractor in completing the temporary shoring design. The lateral earth pressure distribution will be based on the selected configuration of the shoring system. **Table 3-1** provides a summary of lateral earth pressures for the different soil layers encountered.

Table 3-1: Lateral Earth Pressure Parameters

Soil Type	γ (kN/m^3)	Angle of internal friction, Φ (degrees)	Active Earth Pressure Coefficient, K_a	At-rest Earth Pressure Coefficient, K_o	Passive Earth Pressure Coefficient, K_p
Upper Complex Clay	18	16	0.57	0.72	1.8
Upper Complex Silt	18	24	0.42	0.59	2.4
Glacio-lacustrine Clay	16.5	14	0.61	0.76	1.6
Silt Till	19	32	0.36	0.53	2.8

Temporary shoring systems are required to be designed for lateral earth pressure, lateral hydrostatic pressures below the groundwater level, and surcharge loads of equipment adjacent to the shaft. Buoyant soil unit weight should be considered at depths below the groundwater level. A minimum surcharge of 16 kPa at ground surface is recommended to account for traffic acting adjacent to the wall; however, the actual surcharge of the selected construction equipment should be calculated and accounted for in the design of the shoring system. The temporary shoring design should be capable of controlling ground movement in accordance with the Contract Documents.

The passive earth pressure parameters provided in **Table 3-1** should be reduced by a factor of 1.5 to account for the partial mobilization of passive resistance that generally occurs with small wall displacements under the applied loads. Passive resistance from the soil located in the upper 0.5 m below the excavation level should be ignored.

To attain active earth pressure (K_a) conditions, the displacement at the top of the wall should be at least 0.01 times the height of the wall. In the case of an unyielding wall, the at-rest earth pressure (K_o) should be used in the design.

3.2 Basal Heave

Basal heave recommendations have been prepared for the design of the temporary excavation based on the soil material, excavation geometry, and piezometric conditions within the underlying glacial till. The factor of safety (FS) for basal heave has been calculated using Equation 1 below:

$$FS = \frac{\gamma h + \frac{2c_u h}{B}}{\gamma_w h_w} \qquad \text{[Equation 1]}$$

Where:

γ = unit weight of clay between base of excavation and glacial till interface (taken as 16.4 kN/m^3)
c_u = undrained shear strength of clay at excavation base (taken as 20 kPa)
h = thickness of clay between excavation base and glacial till interface (equal to difference between excavation depth and till depth at 20.4 m)
B = diameter of excavation (assumed as 4.9 m)
h_w = piezometric head in till

The target FS for basal heave should be greater than or equal to 1.3 (FS ≥ 1.3).

Many of the contributing factors to basal heave are fixed, and therefore the piezometric head in the till and the depth of the excavation/clay thickness beneath excavation are considered to be variable design parameters at this time. **Figure 3-1** shows the FS for basal heave based on the parameters identified above (established from the single test hole completed by AECOM) and varying excavation depths and ground water levels (GWL).

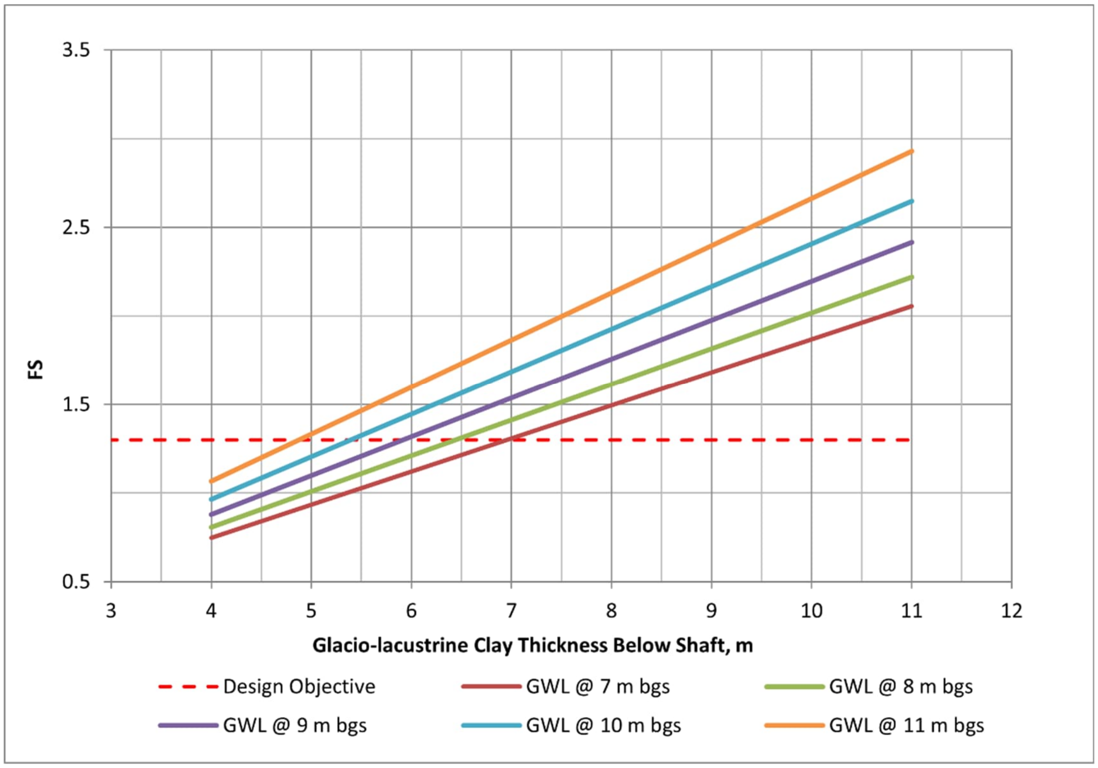

Figure 3-1 - Basal Heave

The base of the shaft should be designed to achieve a minimum FS of 1.3 with respect to basal heave. All shafts are also required to have a concrete base designed to prevent basal heave and prevent the migration of fines from native soils and infiltration of groundwater into the shaft.

Groundwater conditions present at the time of construction and the thickness of glacio-lacustrine clay beneath the proposed shaft may identify the need for groundwater depressurization in order to satisfy required minimum factor of safety design criteria with respect to basal heave.

3.3 Closure

The findings of this memo were based on the results of field and laboratory investigations at a single test hole location. If conditions are encountered that appear to be different from that shown by the test hole at this site and described in this report, or if the assumptions stated herein are not in keeping with the design, this office should be notified in order that the report can be reviewed and adjusted, if necessary.

Soil conditions, by their nature, can be highly variable across a site. The placement of fill and prior construction activities on a site can contribute to the variability especially of near-surface soil conditions. A contingency should be included in the construction budget to allow for the possibility of variation in soil conditions. Such variations may require modifications to the design or construction procedures.

If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,
AECOM Canada Ltd.

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Reviewed by:

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Appendix A

Test Hole Log

AECOM Canada Ltd.

GENERAL STATEMENT

NORMAL VARIABILITY OF SUBSURFACE CONDITIONS

The scope of the investigation presented herein is limited to an investigation of the subsurface conditions as to suitability for the proposed project. This report has been prepared to aid in the evaluation of the site and to assist the engineer in the design of the facilities. Our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of earth work, foundations and similar. In the event of any changes in the basic design or location of the structures as outlined in this report or plan, we should be given the opportunity to review the changes and to modify or reaffirm in writing the conclusions and recommendations of this report.

The analysis and recommendations presented in this report are based on the data obtained from the borings and test pit excavations made at the locations indicated on the site plans and from other information discussed herein. This report is based on the assumption that the subsurface conditions everywhere are not significantly different from those disclosed by the borings and excavations. However, variations in soil conditions may exist between the excavations and, also, general groundwater levels and conditions may fluctuate from time to time. The nature and extent of the variations may not become evident until construction. If subsurface conditions differ from those encountered in the exploratory borings and excavations, are observed or encountered during construction, or appear to be present beneath or beyond excavations, we should be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary.

Since it is possible for conditions to vary from those assumed in the analysis and upon which our conclusions and recommendations are based, a contingency fund should be included in the construction budget to allow for the possibility of variations which may result in modification of the design and construction procedures.

In order to observe compliance with the design concepts, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated, we recommend that all construction operations dealing with earth work and the foundations be observed by an experienced soils engineer. We can be retained to provide these services for you during construction. In addition, we can be retained to review the plans and specifications that have been prepared to check for substantial conformance with the conclusions and recommendations contained in our report.

EXPLANATION OF FIELD & LABORATORY TEST DATA

The field and laboratory test results, as shown for each hole, are described below.

1. NATURAL MOISTURE CONTENT

The relationship between the natural moisture content and depth is significant in determining the subsurface moisture conditions. The Atterberg Limits for a sample should be compared to its natural moisture content and plotted on the Plasticity Chart in order to determine the soil classification.

2. SOIL PROFILE AND DESCRIPTION

Each soil stratum is classified and described noting any special conditions. The Modified Unified Classification System (MUCS) is used. The soil profile refers to the existing ground level at the time the hole was done. Where available, the ground elevation is shown. The soil symbols used are shown in detail on the soil classification chart.

3. TESTS ON SOIL SAMPLES

Laboratory and field tests are identified by the following and are on the logs:

N - Standard Penetration Test (SPT) Blow Count. The SPT is conducted in the field to assess the in-situ consistency of cohesive soils and the relative density of non-cohesive soils. The N value recorded is the number of blows from a 63.5 kg hammer dropped 760 mm which is required to drive a 51 mm split spoon sampler 300 mm into the soil.

SO_4 - Water Soluble Sulphate Content. Expressed in percent. Conducted primarily to determine requirements for the use of sulphate resistant cement. Further details on the water-soluble sulphate content are given in Section 6.

γ_D - Dry Unit Weight. Usually expressed in kN/m^3.

γ_T - Total Unit Weight. Usually expressed in kN/m^3.

Q_U - Unconfined Compressive Strength. Usually expressed in kPa and may be used in determining allowable bearing capacity of the soil.

C_U - Undrained Shear Strength. Usually expressed in kPa. This value is determined by either a direct shear test or by an unconfined compression test and may also be used in determining the allowable bearing capacity of the soil.

C_{PEN} - Pocket Penetrometer Reading. Usually expressed in kPa. Estimate of the undrained shear strength as determined by a pocket penetrometer.

The following tests may also be performed on selected soil samples and the results are given on separate sheets enclosed with the logs:

- Grain Size Analysis
- Standard or Modified Proctor Compaction Test
- California Bearing Ratio Test
- Direct Shear Test
- Permeability Test
- Consolidation Test
- Triaxial Test

4. SOIL DENSITY AND CONSISTENCY

The SPT test described above may be used to estimate the consistency of cohesive soils and the density of cohesionless soils. These approximate relationships are summarized in the following tables:

Table 1 Cohesive Soils

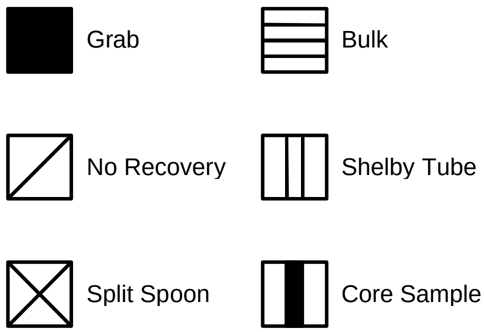
N	Consistency	C_u (kPa) approx.
0 - 1	Very Soft	<10
1 - 4	Soft	10 - 25
4 - 8	Firm	25 - 50
8 - 15	Stiff	50 - 100
15 - 30	Very Stiff	100 - 200
30 - 60	Hard	200 - 300
>60	Very Hard	>300

Table 2 Cohesionless Soils

N	Density
0 - 5	Very Loose
5 - 10	Loose
10 - 30	Compact
30 - 50	Dense
>50	Very Dense

5. SAMPLE CONDITION AND TYPE

The depth, type, and condition of samples are indicated on the logs by the following symbols:



6. WATER SOLUBLE SULPHATE CONCENTRATION

The following table, from CSA Standard A23.1-14, indicates the requirements for concrete subjected to sulphate attack based upon the percentage of water-soluble sulphate as presented on the logs. CSA Standard A23.1-14 should be read in conjunction with the table.

Table 3 Requirements for Concrete Subjected to Sulphate Attack*

						Performance requirements§,§§		
						Maximum expansion when tested using CSA A3004-C8 Procedure A at 23 °C, %		Maximum expansion when tested using CSA A3004-C8 Procedure B at 5 °C, % †††
Class of exposure	Degree of exposure	Water-soluble sulphate (SO_4)† in soil sample, %	Sulphate (SO_4) in groundwater samples, mg/L‡	Water soluble sulphate (SO_4) in recycled aggregate sample, %	Cementing materials to be used§††	At 6 months	At 12 months††	At 18 months‡‡
S-1	Very severe	> 2.0	> 10 000	> 2.0	HS** ,HSb, HSLb*** or HSe	0.05	0.10	0.10
S-2	Severe	0.20–2.0	1500–10 000	0.60–2.0	HS**, HSb, HSLb*** or HSe	0.05	0.10	0.10
S-3	Moderate (including seawater exposure*)	0.10–0.20	150–1500	0.20–0.60	MS, MSb, MSe, MSLb***, LH, LHb, HS**, HSb, HSLb*** or HSe	0.10		0.10

*For sea water exposure, also see Clause 4.1.1.5.
†In accordance with CSA A23.2-3B.
‡In accordance with CSA A23.2-2B.
§Where combinations of supplementary cementing materials and portland or blended hydraulic cements are to be used in the concrete mix design instead of the cementing materials listed, and provided they meet the performance requirements demonstrating equivalent performance against sulphate exposure, they shall be designated as MS equivalent (MSe) or HS equivalent (HSe) in the relevant sulphate exposures (see Clauses 4.1.1.6.2, 4.2.1.1, and 4.2.1.3, and 4.2.1.4).
**Type HS cement shall not be used in reinforced concrete exposed to both chlorides and sulphates, including seawater. See Clause 4.1.1.6.3.

††The requirement for testing at 5 °C does not apply to MS, HS, MSb, HSb, and MSe and HSe combinations made without portland limestone cement.
‡‡ If the increase in expansion between 12 and 18 months exceeds 0.03%, the sulphate expansion at 24 months shall not exceed 0.10% in order for the cement to be deemed to have passed the sulphate resistance requirement.
§§For demonstrating equivalent performance, use the testing frequency in Table 1 of CSA A3004-A1 and see the applicable notes to Table A3 in A3001 with regard to re-establishing compliance if the composition of the cementing materials used to establish compliance changes.
***Where MSLb or HSLb cements are proposed for use, or where MSe or HSe combinations include Portland-limestone cement, they must also contain a minimum of 25% Type F fly ash or 40% slag or 15% metakaolin (meeting Type N pozzolan requirements) or a combination of 5% Type SF silica fume with 25% slag or a combination of 5% Type SF silica fume with 20% Type F fly ash. For some proposed MSLb, HSLb, and MSe or HSe combinations that include Portland-limestone cement, higher SCM replacement levels may be required to meet the A3004-C8 Procedure B expansion limits. Due to the 18-month test period, SCM replacements higher than the identified minimum levels should also be tested. In addition, sulphate resistance testing shall be run on MSLb and HSLb cement and MSe or HSe combinations that include Portland-limestone cement at both 23 °C and 5 °C as specified in the table.
†††If the expansion is greater than 0.05% at 6 months but less than 0.10% at 1 year, the cementing materials combination under test shall be considered to have passed.

7. SOIL CORROSIVITY

The following table, from the Handbook of Corrosion Engineering (Roberge, 1999) indicates the corrosivity rating can be obtained from the soil resistivity, presented on the logs.

Table 4 Corrosivity Ratings Based on Soil Resistivity

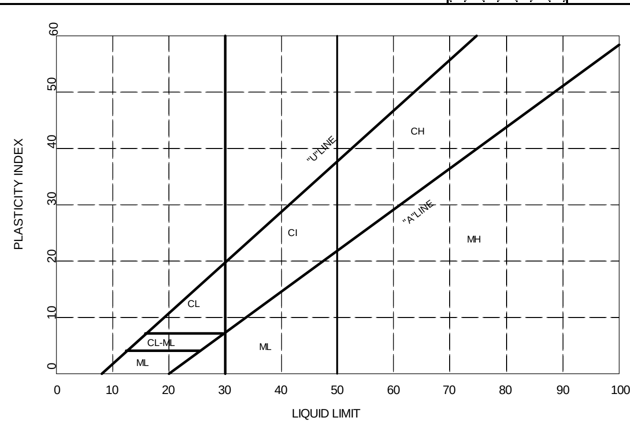
Soil Resistivity (ohm-cm)	Corrosivity Rating
>20,000	Essentially non-corrosive
10,000 – 20,000	Mildly corrosive
5,000 – 10,000	Moderately corrosive
3,000 – 5,000	Corrosive
1,000 – 3,000	Highly corrosive
<1,000	Extremely corrosive

8. GROUNDWATER TABLE

The groundwater table is indicated by the equilibrium level of water in a standpipe installed in a testhole or test pit. This level is generally taken at least 24 hours after installation of the standpipe. The groundwater level is subject to seasonal variations and is usually highest in the spring. The symbol on the logs indicating the groundwater level is an inverted solid triangle (▼).

AECOM

MAJOR DIVISION			LOG SYMBOLS	UCS	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS	GRAVELS (MORE THAN HALF COARSE GRAINS LARGER THAN 4.75 mm)	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4 \quad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
				GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12% — ATTERBERG LIMITS BELOW 'A' LINE W_p LESS THAN 4
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE 'A' LINE W_p MORE THAN 7
	SANDS (MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75 mm)	CLEAN SANDS (LITTLE R NO FINES)		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6 \quad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
				SP	POORLY GRADED SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		SANDS WITH FINES		SM	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12% — ATTERBERG LIMITS BELOW 'A' LINE W_p LESS THAN 4
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE 'A' LINE W_p MORE THAN 7
FINE GRAINED SOILS	SILTS (BELOW 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 50$		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		$W_L > 50$		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS	
	CLAYS (ABOVE 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 30$		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	
		$30 < W_L < 50$		CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	WHENEVER THE NATURE OF THE FINE CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER 'F'. E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY
		$W_L > 50$		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS (BELOW 'A' LINE)	$W_L < 50$		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
		$W_L > 50$		OH	ORGANIC CLAYS OF HIGH PLASTICITY	
HIGHLY ORGANIC SOILS				Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE
BEDROCK				BR	SEE REPORT DESCRIPTION	
FILL				FILL	SEE REPORT DESCRIPTION	



NOTE:

1. BOUNDARY CLASSIFICATION POSSESSING CHARACTERISTICS OF TWO GROUPS ARE GIVEN GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL MIXTURE WITH CLAY BINDER BETWEEN 5% AND 12%

SOIL COMPONENTS

FRACTION		SIEVE SIZE (mm) PASSING	SIEVE SIZE (mm) RETAINED	DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS PERCENT	IDENTIFIER
GRAVEL	COARSE	75	19	50 - 35	AND
	FINE	19	4.75		
SAND	COARSE	4.75	2.00	35 – 20	_____Y
	MEDIUM	2.00	0.425		
	FINE	0.425	0.080	20 – 10	SOME
SILT (non-plastic) or CLAY (plastic)		0.080		10 - 1	TRACE

OVERSIZE MATERIALS	
ROUNDED OR SUB-ROUNDED COBBLES 75 mm TO 200 mm BOULDERS >200 mm	ANGULAR ROCK FRAGMENTS ROCKS > 0.75 m3 IN VOLUME

MODIFIED UNIFIED SOIL CLASSIFICATION SYSTEM

August 2015

PROJECT: Sewer Collapse - Main Street @ Murray Avenue	CLIENT: City of Winnipeg	TESTHOLE NO: TH22-01
LOCATION: UTM 14 - 5535312 m N, 636349 m E		PROJECT NO.: 60680190
CONTRACTOR: Maple Leaf Drilling Ltd.	METHOD: Geoprobe 3230DT - 125 mm SSA	ELEVATION (m):

SAMPLE TYPE: GRAB, SHELBY TUBE, SPLIT SPOON, BULK, NO RECOVERY, CORE

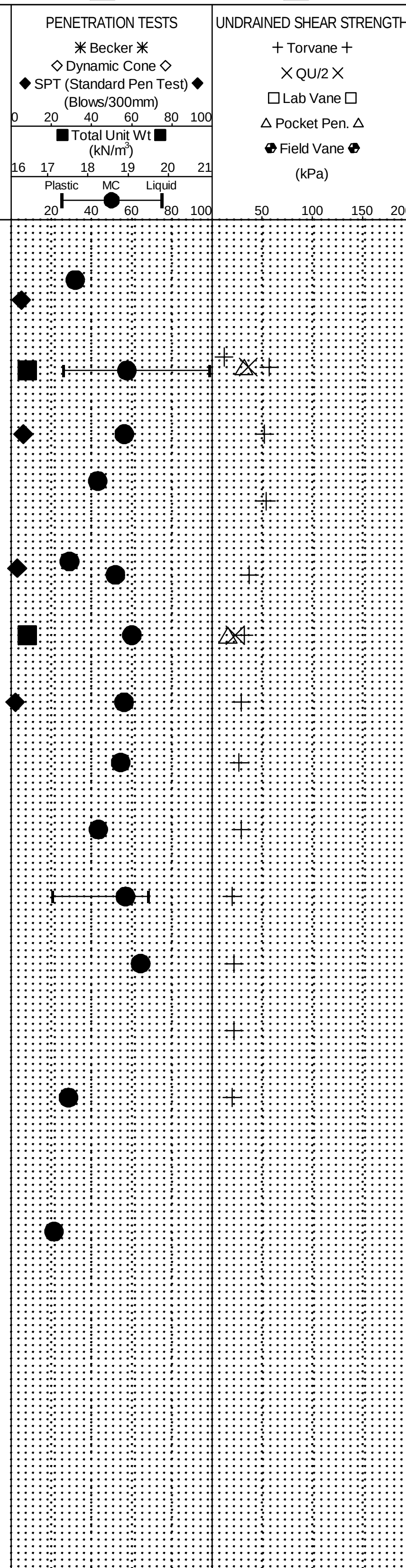
BACKFILL TYPE: BENTONITE, GRAVEL, SLOUGH, GROUT, CUTTINGS, SAND

DEPTH (m)	USC	SOIL DESCRIPTION	SAMPLE #	SPT (N)	COMMENTS
0	CONC	CONCRETE (280 mm)			Drilled through existing road surface
	FILL	GRAVEL (FILL) - some sand - tan, moist	G1		
1–2.7	CH	CLAY - trace sand, trace silt - brown, firm, moist - high plasticity	S2	5	SPT Blows: [2/2/3] Spoon Recovery: 0%
2.7–3	ML	SILT - clayey, trace sand - light brown, soft, moist - low plasticity	T3a T3b		Tube Recovery: 100% - [T3b]: Gravel 0%, Sand 0%, Silt 11.1%, Clay 88.9%
3–7.7	CH	CLAY - some silt - grey, firm to stiff, moist - high plasticity - trace gravel below 5.5 m	S4	6	SPT Blows: [1/3/3] Spoon Recovery: 100%
			G5 T6		Tube Recovery: 0%
7.7–8	ML	SILT - clayey, trace sand - light brown, soft, moist - low plasticity	S7a S7b	3	SPT Blows: [1/1/2] Spoon Recovery: 80%
8–20.4	CH	CLAY - some silt - grey, soft, moist - high plasticity	T8		Tube Recovery: 100% - [T8]: Gravel 0%, Sand 0%, Silt 17.0%, Clay 83.0%
			S9	2	SPT Blows: [1/1/1] Spoon Recovery: 100%
			G10		
			G11		
		- silty, trace sand, trace gravel below 15.2 m	G12		- [G12]: Gravel 2.6%, Sand 9.5%, Silt 21.0%, Clay 66.9%
			G13		
			G14		
		- till inclusions below 19.2 m	G15		
20.4–23.16	TILL	SILT (TILL) - clayey, some sand, some gravel - brown, moist - low plasticity	G16		
			G17		

AUGER REFUSAL AT 23.16 m BELOW GROUND SURFACE (BGS) IN SILT (TILL)

Notes:

1. Seepage observed below 7.6 m BGS during drilling.
2. Sloughing observed from 2.3 m BGS and 7.6 m BGS during drilling.
3. Water to 2.9 m BGS upon completion of drilling.
4. Standpipe piezometer installed with tip at 23.16 m. Test hole backfilled bentonite chips from 18.6 m to 0.3 m, and fast setting concrete from 0.3 m to ground surface. Flush-mount casing installed.
5. Groundwater Monitoring:
- June 7, 2022 at 9.25 m BGS
- July 8, 2022 at 5.53 m BGS



AECOM	LOGGED BY: Alex Baker	COMPLETION DEPTH: 23.16 m
	REVIEWED BY: Ryan Harras	COMPLETION DATE: 1/6/22
	PROJECT ENGINEER: Jordan T.	Page 1 of 1

LOG OF TEST HOLE 60680190 - TEST HOLE LOGS.GPJ UMA WINN.GDT 9/19/22

Appendix B

Laboratory Test Results

AECOM
99 Commerce Drive
Winnipeg, MB, Canada R3P 0Y7
www.aecom.com

204 477 5381 tel
431 800 1210 fax

Memorandum

To	Alex Baker	Page	1
CC			
Subject	Jefferson East Phase 3 – City of Winnipeg –Test Results		
From	Elliott E. Drumright		
Date	June 07, 2022	Project Number	60680190.2.2

Please find attached the following material test result(s) on sample(s) submitted to the Winnipeg Geotechnical Laboratory:

- Twelve (12) Moisture Content Determination Test
- Two (2) Atterberg Limits (3 Points) Test
- Three (3) Grain Size Distribution (Hydrometer Method) Test
- Two (2) Torvane, Pocket Penetrometer, Moisture Content, Bulk Density and Visual Description with Unconfined Compressive Strength on Shelby tube Samples.

If you have any questions, please contact the undersigned.

Sincerely,

Elliott E. Drumright

Elliott E. Drumright, Ph.D.
Associate Geotechnical Engineer

Att.

AECOM Canada Ltd.
Winnipeg Geotechnical Laboratory
99 Commerce Drive
Winnipeg, Manitoba
R3P 0Y7
Phone: 204 477 5381 Fax: 431 800 1210

Project Name:	Jefferson east Ph. 3	Supplier:	AECOM
Project Number:	60680190	Specification:	N/A
Client:	CoW	Field Technician:	ABaker
Sample Location:	Murray and Main	Sample Date:	Varies
Sample Depth:	Varies	Lab Technician:	EManimbao
Sample Number:	Varies	Date Tested:	June 3, 2022

Moisture Content (ASTM D2216-10)

Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Location	Sample	Depth (m)	**Moisture Content (%)**
TH22-01	G1	1.52 - 1.68 m	**31.9%**
	T3	3.05 - 3.66 m	**57.6%**
	S4	4.57 - 2.23 m	**56.3%**
	G6	5.79 - 5.94 m	**43.1%**
	S7a	7.62 - 8.08 m	**29.0%**
	S7b	7.92 - 8.38 m	**51.9%**
	T8	9.14 - 9.75 m	**60.1%**
	S9	10.67 - 2.00 m	**56.2%**
	G10	12.19 - 12.34 m	**54.5%**
	G11	13.72 - 13.87 m	**43.4%**
	G12	15.24 - 1.52 m	**56.9%**
	G13	16.76 - 16.92 m	**64.6%**
	G14	18.29 - 18.44 m	**-**
	G15	19.81 - 19.96 m	**28.5%**
	G16	21.34 - 21.49 m	**-**
	G17	22.86 - 23.01 m	**21.3%**

Location	Sample	Depth (m)	**Moisture Content (%)**

AECOM Canada Ltd.
Winnipeg Geotechnical Laboratory
99 Commerce Drive
Winnipeg, Manitoba
R3P 0Y7
Phone: 204 477 5381 Fax: 204 284 2040

CERTIFIED BY CCIL

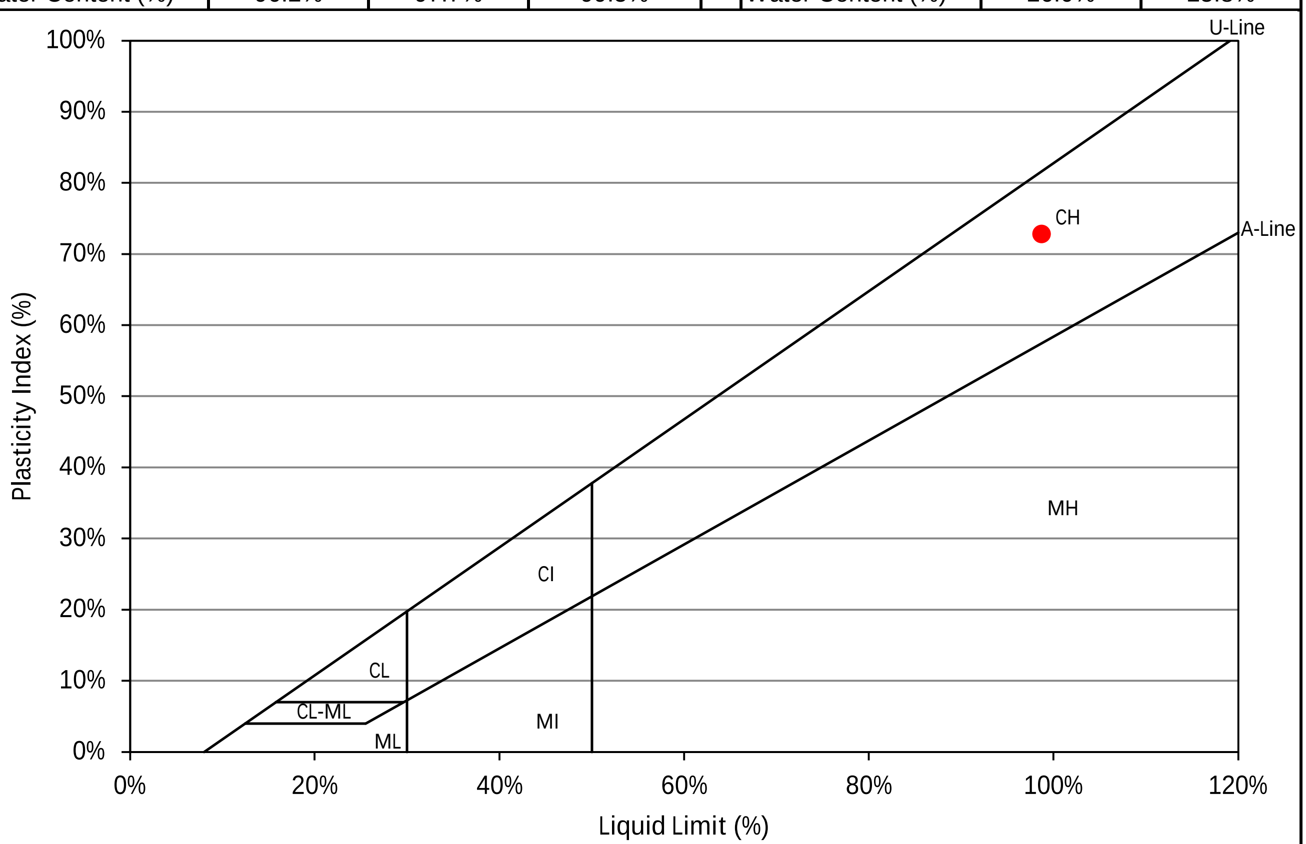
Project Name:	Jefferson East Ph. 3	Supplier:	AECOM
Project Number:	60680190	Specification:	N/A
Client:	CoW	Field Technician:	ABaker
Sample Location:	TH22-01	Sample Date:	June 1, 2022
Sample Depth:	3.05 - 3.66 m	Lab Technician:	EManimbao
Sample Number:	T3	Date Tested:	June 3, 2022

Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	34	29	23
Wet Sample (g)	9.3	7.4	9.2
Dry Sample (g)	4.8	3.7	4.6
Water Content (%)	96.2%	97.7%	99.5%

Plastic Limit		
Trial	1	2
Wet Sample (g)	6.4	6.2
Dry Sample (g)	5.1	4.9
Water Content (%)	26.0%	25.8%



Liquid Limit (%): 98.7%	Plastic Limit (%): 25.9%	Plasticity Index (%): 72.8%

AECOM Canada Ltd.
Winnipeg Geotechnical Laboratory
99 Commerce Drive
Winnipeg, Manitoba
R3P 0Y7
Phone: 204 477 5381 Fax: 204 284 2040

CERTIFIED BY CCIL

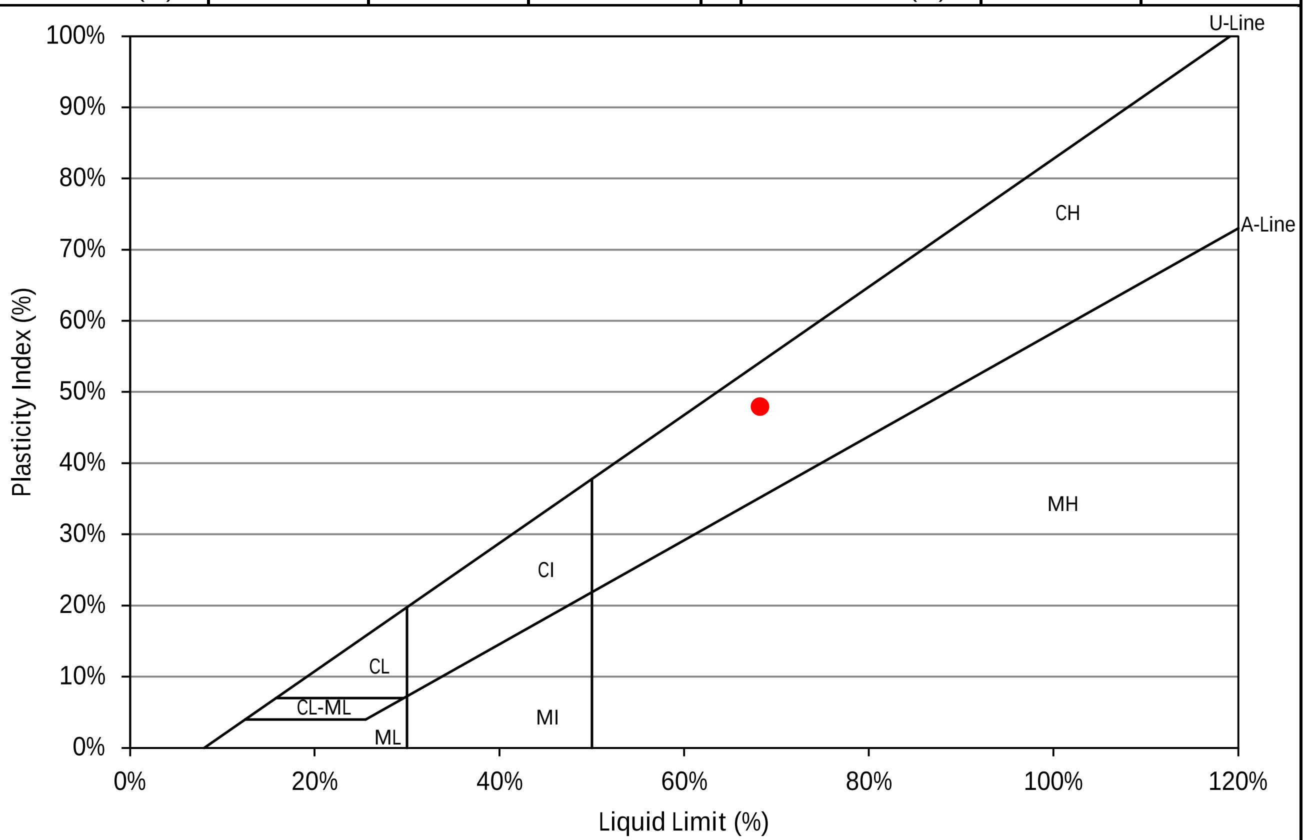
Project Name:	Jefferson East Ph. 3	Supplier:	AECOM
Project Number:	60680190	Specification:	N/A
Client:	CoW	Field Technician:	ABaker
Sample Location:	TH22-01	Sample Date:	June 1, 2022
Sample Depth:	15.24 - 15.39 m	Lab Technician:	EManimbao
Sample Number:	G12	Date Tested:	June 3, 2022

Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	27	21	15
Wet Sample (g)	10.5	8.7	9.7
Dry Sample (g)	6.3	5.2	5.7
Water Content (%)	67.6%	69.4%	71.8%

Plastic Limit		
Trial	1	2
Wet Sample (g)	6.1	6.4
Dry Sample (g)	5.1	5.3
Water Content (%)	20.0%	20.6%



Liquid Limit (%): 68.2%	Plastic Limit (%): 20.3%	Plasticity Index (%): 48.0%

GRAIN SIZE DISTRIBUTION
(ASTM D422-63)

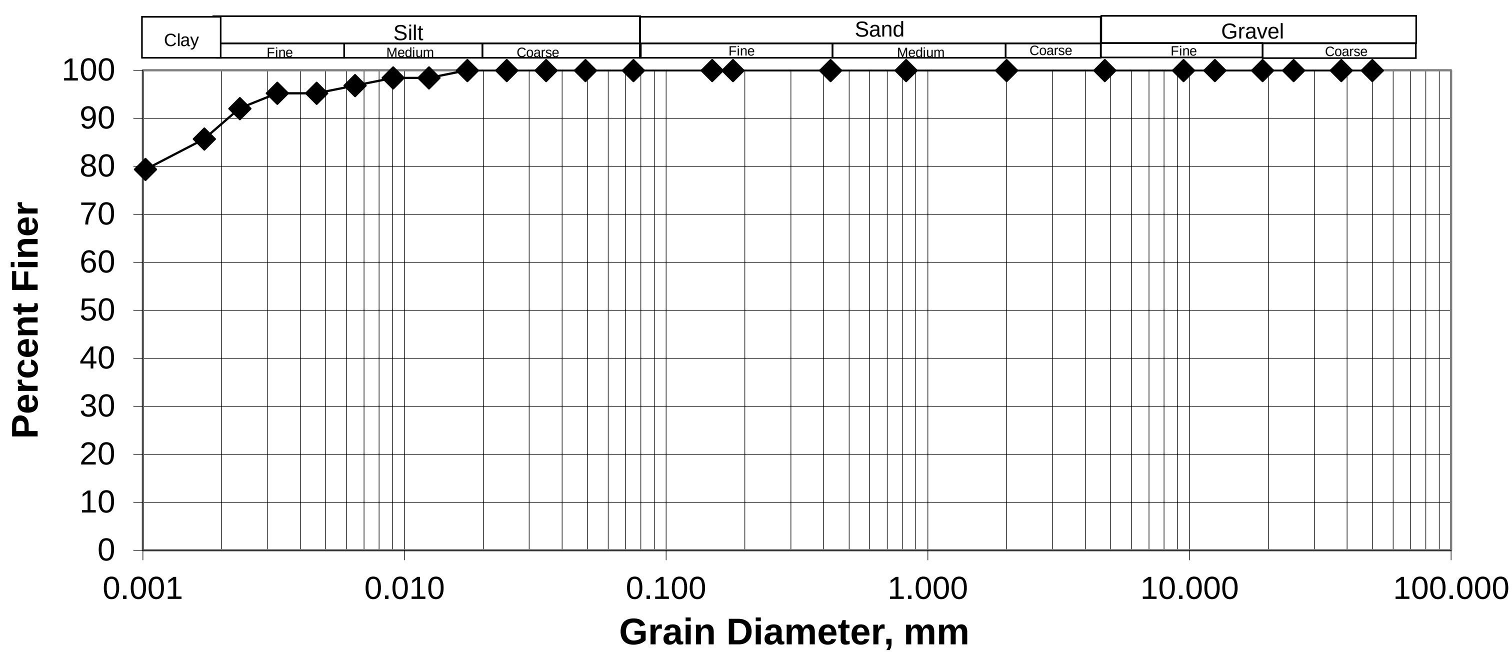
WINNIPEG GEOTECHNICAL LABORATORY
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 **fax** (431) 800-1210

CERTIFIED BY CCIL

Job No.:	60680190	Hole No.:	TH22-01
Client:	City of Winnipeg	Sample No.:	T3
Project :	Jefferson East Phase 3	Depth:	3.05 - 3.66 m
Date Tested:	6-Jun-22	Date Sampled:	Varies
Tested By:	EManimbao	Sampled By:	AECOM

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	4.75	100.0	0.0750	100.0
38.0	100.0	2.00	100.0	0.0491	100.0
25.0	100.0	0.825	100.0	0.0347	100.0
19.0	100.0	0.425	100.0	0.0246	100.0
12.5	100.0	0.18	100.0	0.0174	100.0
9.5	100.0	0.15	100.0	0.0124	98.4
4.75	100.0	0.075	100.0	0.0091	98.4
				0.0065	96.8
				0.0046	95.2
				0.0033	95.2
				0.0023	92.1
				0.0017	85.7
				0.0010	79.3

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.0%**	**Silt**	**11.1%**
Sand	**0.0%**	**Clay**	**88.9%**

GRAIN SIZE DISTRIBUTION
(ASTM D422-63)

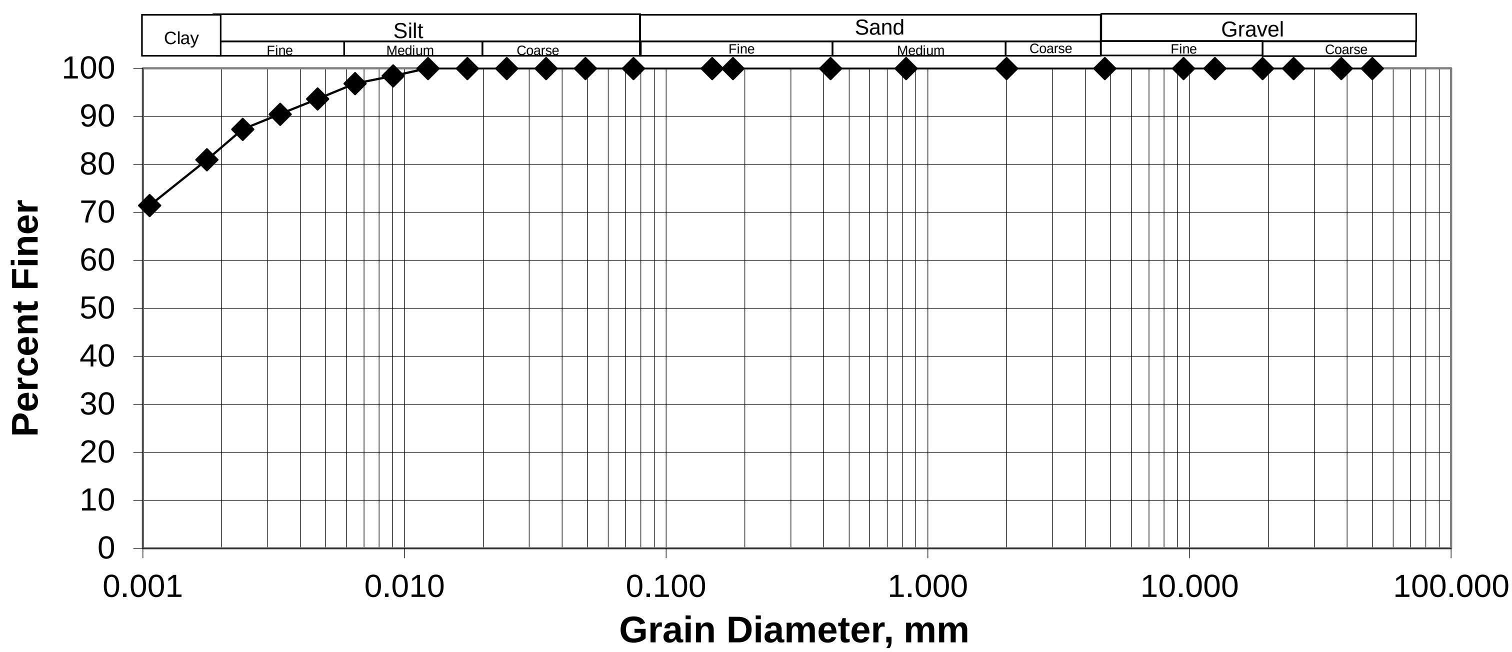
WINNIPEG GEOTECHNICAL LABORATORY
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 **fax** (431) 800-1210

CERTIFIED BY

Job No.:	60680190	Hole No.:	TH22-01
Client:	City of Winnipeg	Sample No.:	T8
Project :	Jefferson East Phase 3	Depth:	9.14 - 9.75 m
Date Tested:	6-Jun-22	Date Sampled:	Varies
Tested By:	EManimbao	Sampled By:	AECOM

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	4.75	100.0	0.0750	100.0
38.0	100.0	2.00	100.0	0.0491	100.0
25.0	100.0	0.825	100.0	0.0347	100.0
19.0	100.0	0.425	100.0	0.0246	100.0
12.5	100.0	0.18	100.0	0.0174	100.0
9.5	100.0	0.15	100.0	0.0123	100.0
4.75	100.0	0.075	100.0	0.0091	98.4
				0.0065	96.8
				0.0047	93.6
				0.0033	90.5
				0.0024	87.3
				0.0018	80.9
				0.0011	71.4

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.0%**	**Silt**	**17.0%**
Sand	**0.0%**	**Clay**	**83.0%**

GRAIN SIZE DISTRIBUTION
(ASTM D422-63)

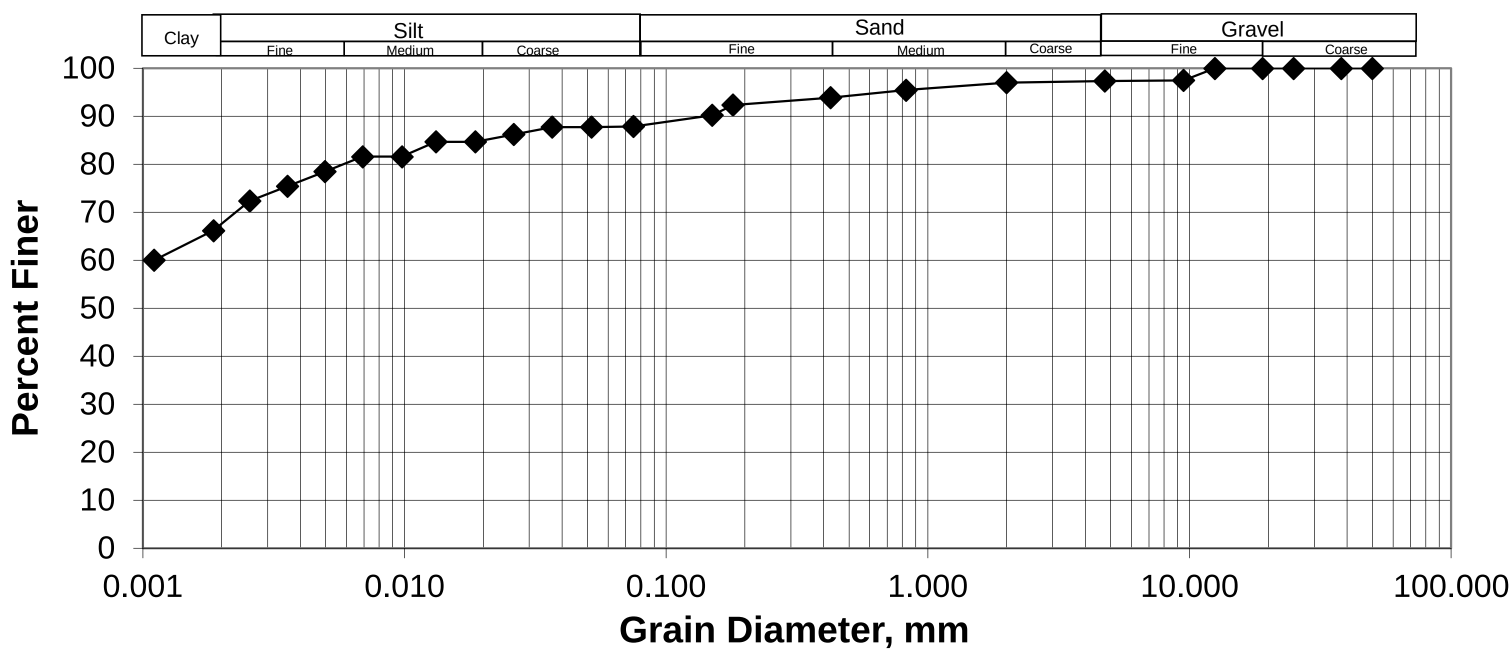
AECOM
WINNIPEG GEOTECHNICAL LABORATORY
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 **fax** (431) 800-1210

CERTIFIED BY CCIL

Job No.:	60680190	Hole No.:	TH22-01
Client:	City of Winnipeg	Sample No.:	G12
Project :	Jefferson East Phase 3	Depth:	15.24 - 15.39 m
Date Tested:	6-Jun-22	Date Sampled:	Varies
Tested By:	EManimbao	Sampled By:	AECOM

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	4.75	97.4	0.0750	87.9
38.0	100.0	2.00	97.0	0.0518	87.8
25.0	100.0	0.825	95.5	0.0367	87.8
19.0	100.0	0.425	93.9	0.0261	86.2
12.5	100.0	0.18	92.4	0.0186	84.7
9.5	97.5	0.15	90.2	0.0132	84.7
4.75	97.4	0.075	87.9	0.0098	81.6
				0.0069	81.6
				0.0050	78.5
				0.0036	75.4
				0.0026	72.4
				0.0019	66.2
				0.0011	60.0

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**2.6%**	**Silt**	**21.0%**
Sand	**9.5%**	**Clay**	**66.9%**

AECOM - SOILS LABORATORY
SHEAR STRENGTH, MOISTURE CONTENT & DENSITY CALCULATIONS

AECOM

CLIENT: City of Winnipeg
PROJECT: Jefferson East Pase 3
JOB NO.: 60680190

TEST HOLE NO.:	**TH22-01**
SAMPLE NO.:	**T3**
SAMPLE DEPTH:	3.05 - 3.66 m
DATE TESTED:	3-Jun-22
SHEAR STRENGTH TESTS	
TORVANE	
Reading	0.60
Vane Size (S, M, L)	M
Undrained Shear Strength (kPa)	**58.8**
Undrained Shear Strength (ksf)	1.23
POCKET PENETROMETER	
Reading - Qu (tsf)	0.50
Undrained Shear Strength (kPa)	**23.9**
Reading - Qu (tsf)	0.75
Undrained Shear Strength (kPa)	**35.9**
Reading - Qu (tsf)	0.75
Undrained Shear Strength (kPa)	**35.9**
UNCONFINED COMPRESSIVE STRENGTH TEST	
Unconfined compressive strength (kPa)	**71.5**
Unconfined compressive strength (ksf)	**1.5**
Undrained Shear Strength (kPa)	**35.7**
Undrained Shear Strength (ksf)	**0.746**
MOISTURE CONTENT	
Tare Number	J10
Wt. Sample wet + tare (g)	550.3
Wt. Sample dry + tare (g)	352.3
Wt. Tare (g)	8.3
Moisture Content %	**57.6**
BULK DENSITY	
Sample Wt. (g)	1058.5
Diameter 1 (cm)	7.20
Diameter 2 (cm)	7.30
Diameter 3 (cm)	7.20
Avg. Diameter (cm)	**7.23**
Length 1 (cm)	15.30
Length 2 (cm)	15.40
Length 3 (cm)	15.40
Avg. Length (cm)	**15.37**
Volume (cm^3)	631.5
Moisture content (%)	57.6
Bulk Density (g/cm^3)	1.676
Bulk Unit Weight (kN/m^3)	**16.4**
Bulk Unit Weight (pcf)	**104.7**
Dry Unit Weight (kN/m^3)	**10.43**

AECOM - SOILS LABORATORY
UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS (ASTM D2166)

AECOM

CLIENT:	City of Winnipeg
PROJECT:	Jefferson East Pase 3
JOB NO.:	60680190

TEST HOLE NO.:	TH22-01
SAMPLE NO.:	T3
SAMPLE DEPTH:	3.05 - 3.66 m
SAMPLE DATE:	
TEST DATE:	3-Jun-22

SOIL DESCRIPTION:	
CLAY - trace silt, trace sand, trace gravel, moist, firm,	
dark grey, high plasticity	
MOISTURE CONTENT:	57.6

SAMPLE DIAM.(Do):	72.33	(mm)	INITIAL AREA, Ao:	4109.3	(mm^2)
SAMPLE LENGTH, (Lo):	153.67	(mm)	PISTON RATE:	0.0602	(inches / minute)
L / D RATIO:	2.12	(2 < L/D < 2.5)	AXIAL STRAIN RATE, R:	1.00	(0.5<R<2 % / minute)

FAILURE SKETCH

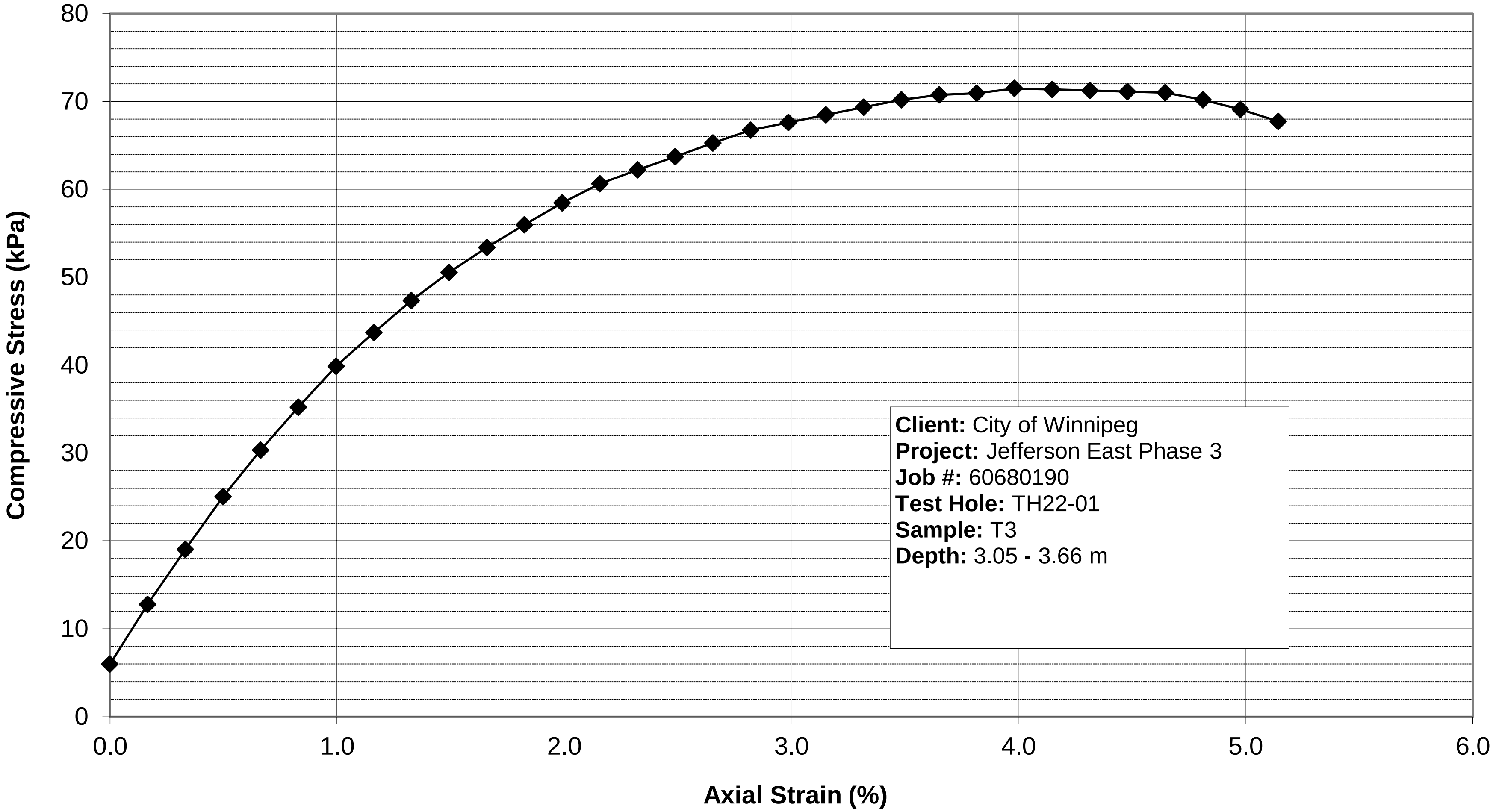
TEST DATA - DIAL READINGS							
AXIAL COMPRESSION	PROVING RING	TOTAL AXIAL STRAIN, E_1	AVERAGE CROSS-SECTIONAL AREA, A	APPLIED AXIAL LOAD, P	COMPRESSIVE STRESS, σ_C		
(inches)	(inches)	(%)	(inches2)	(lbs)	(psi)	(ksf)	(kPa)
0.01	0.0006	0.00	6.37	5.53	0.87	0.125	6.0
0.02	0.0013	0.17	6.38	11.81	1.85	0.266	12.8
0.03	0.0019	0.33	6.39	17.62	2.76	0.397	19.0
0.04	0.0025	0.50	6.40	23.24	3.63	0.523	25.0
0.05	0.0030	0.66	6.41	28.20	4.40	0.633	30.3
0.06	0.0035	0.83	6.42	32.80	5.11	0.735	35.2
0.07	0.0040	1.00	6.43	37.20	5.78	0.833	39.9
0.08	0.0044	1.16	6.44	40.85	6.34	0.913	43.7
0.09	0.0047	1.33	6.46	44.32	6.87	0.989	47.3
0.10	0.0051	1.49	6.47	47.41	7.33	1.056	50.6
0.11	0.0054	1.66	6.48	50.13	7.74	1.115	53.4
0.12	0.0056	1.83	6.49	52.66	8.12	1.169	56.0
0.13	0.0059	1.99	6.50	55.10	8.48	1.221	58.5
0.14	0.0061	2.16	6.51	57.25	8.79	1.266	60.6
0.15	0.0063	2.32	6.52	58.84	9.02	1.299	62.2
0.16	0.0064	2.49	6.53	60.34	9.24	1.330	63.7
0.17	0.0066	2.66	6.54	61.94	9.47	1.363	65.3
0.18	0.0068	2.82	6.55	63.43	9.68	1.394	66.7
0.19	0.0069	2.99	6.57	64.37	9.80	1.412	67.6
0.20	0.0070	3.15	6.58	65.31	9.93	1.430	68.5
0.21	0.0071	3.32	6.59	66.25	10.06	1.448	69.3
0.22	0.0072	3.48	6.60	67.18	10.18	1.466	70.2
0.23	0.0072	3.65	6.61	67.84	10.26	1.478	70.8
0.24	0.0073	3.82	6.62	68.12	10.29	1.481	70.9
0.25	0.0073	3.98	6.63	68.78	10.37	1.493	71.5
0.26	0.0073	4.15	6.65	68.78	10.35	1.490	71.4
0.27	0.0073	4.31	6.66	68.78	10.33	1.488	71.2
0.28	0.0073	4.48	6.67	68.78	10.31	1.485	71.1
0.29	0.0073	4.65	6.68	68.78	10.30	1.483	71.0
0.30	0.0073	4.81	6.69	68.12	10.18	1.466	70.2
0.31	0.0072	4.98	6.70	67.18	10.02	1.443	69.1
0.32	0.0070	5.14	6.71	65.96	9.82	1.415	67.7

UNCONFINED COMPRESSIVE STRENGTH, q_u:	71.48	kPa
(based on maximum q_u value)	1.493	ksf
UNDRAINED SHEAR STRENGTH, S_u:	35.74	kPa
(based on maximum q_u value)	0.746	ksf

NOTES:

AECOM
UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS
(ASTM D2166)

AECOM




BEFORE


AFTER

AECOM - SOILS LABORATORY
SHEAR STRENGTH, MOISTURE CONTENT & DENSITY CALCULATIONS

CLIENT: City of Winnipeg
PROJECT: Jefferson East Pase 3
JOB NO.: 60680190

TEST HOLE NO.:	**TH22-01**
SAMPLE NO.:	**T8**
SAMPLE DEPTH:	9.14 - 9.75 m
DATE TESTED:	3-Jun-22
SHEAR STRENGTH TESTS	
TORVANE	
Reading	0.40
Vane Size (S, M, L)	M
Undrained Shear Strength (kPa)	**39.2**
Undrained Shear Strength (ksf)	0.82
POCKET PENETROMETER	
Reading - Qu (tsf)	0.25
Undrained Shear Strength (kPa)	**12.0**
Reading - Qu (tsf)	0.25
Undrained Shear Strength (kPa)	**12.0**
Reading - Qu (tsf)	0.50
Undrained Shear Strength (kPa)	**23.9**
UNCONFINED COMPRESSIVE STRENGTH TEST	
Unconfined compressive strength (kPa)	**46.8**
Unconfined compressive strength (ksf)	**1.0**
Undrained Shear Strength (kPa)	**23.4**
Undrained Shear Strength (ksf)	**0.489**
MOISTURE CONTENT	
Tare Number	DRAKE
Wt. Sample wet + tare (g)	592.1
Wt. Sample dry + tare (g)	373.0
Wt. Tare (g)	8.2
Moisture Content %	**60.1**
BULK DENSITY	
Sample Wt. (g)	1053.3
Diameter 1 (cm)	7.20
Diameter 2 (cm)	7.20
Diameter 3 (cm)	7.30
Avg. Diameter (cm)	**7.23**
Length 1 (cm)	15.40
Length 2 (cm)	15.40
Length 3 (cm)	15.30
Avg. Length (cm)	**15.37**
Volume (cm^3)	631.5
Moisture content (%)	60.1
Bulk Density (g/cm^3)	1.668
Bulk Unit Weight (kN/m^3)	**16.4**
Bulk Unit Weight (pcf)	**104.1**
Dry Unit Weight (kN/m^3)	**10.22**

AECOM - SOILS LABORATORY
UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS (ASTM D2166)

AECOM

CLIENT:	City of Winnipeg
PROJECT:	Jefferson East Pase 3
JOB NO.:	60680190

TEST HOLE NO.:	TH22-01	**SOIL DESCRIPTION:**	
SAMPLE NO.:	T8	CLAY - trace silt, trace sand, trace gravel, moist, firm,	
SAMPLE DEPTH:	9.14 - 9.75 m	dark grey, high plasticity	
SAMPLE DATE:			
TEST DATE:	3-Jun-22	**MOISTURE CONTENT:**	60.1

SAMPLE DIAM.(Do):	72.33	**(mm)**	**INITIAL AREA, Ao:**	4109.3	**(mm^2)**
SAMPLE LENGTH, (Lo):	153.67	**(mm)**	**PISTON RATE:**	0.0602	**(inches / minute)**
L / D RATIO:	2.12	**(2 < L/D < 2.5)**	**AXIAL STRAIN RATE, R:**	1.00	**(0.5<R<2 % / minute)**

FAILURE SKETCH

TEST DATA - DIAL READINGS							
AXIAL COMPRESSION	**PROVING RING**	**TOTAL AXIAL STRAIN, E_1**	**AVERAGE CROSS-SECTIONAL AREA, A**	**APPLIED AXIAL LOAD, P**	**COMPRESSIVE STRESS, σ_C**		
(inches)	(inches)	(%)	(inches2)	(lbs)	(psi)	(ksf)	(kPa)
0.01	0.0003	0.00	6.37	3.00	0.47	0.068	3.2
0.02	0.0007	0.17	6.38	6.18	0.97	0.140	6.7
0.03	0.0009	0.33	6.39	8.71	1.36	0.196	9.4
0.04	0.0012	0.50	6.40	11.43	1.79	0.257	12.3
0.05	0.0015	0.66	6.41	13.59	2.12	0.305	14.6
0.06	0.0017	0.83	6.42	16.12	2.51	0.361	17.3
0.07	0.0019	1.00	6.43	17.99	2.80	0.403	19.3
0.08	0.0022	1.16	6.44	20.15	3.13	0.450	21.6
0.09	0.0024	1.33	6.46	22.02	3.41	0.491	23.5
0.10	0.0025	1.49	6.47	23.52	3.64	0.524	25.1
0.11	0.0027	1.66	6.48	25.11	3.88	0.558	26.7
0.12	0.0028	1.83	6.49	26.61	4.10	0.591	28.3
0.13	0.0030	1.99	6.50	28.20	4.34	0.625	29.9
0.14	0.0031	2.16	6.51	29.42	4.52	0.651	31.2
0.15	0.0033	2.32	6.52	30.64	4.70	0.677	32.4
0.16	0.0034	2.49	6.53	31.86	4.88	0.702	33.6
0.17	0.0035	2.66	6.54	33.17	5.07	0.730	35.0
0.18	0.0036	2.82	6.55	34.01	5.19	0.747	35.8
0.19	0.0037	2.99	6.57	34.95	5.32	0.767	36.7
0.20	0.0038	3.15	6.58	35.89	5.46	0.786	37.6
0.21	0.0039	3.32	6.59	36.82	5.59	0.805	38.5
0.22	0.0040	3.48	6.60	37.76	5.72	0.824	39.5
0.23	0.0041	3.65	6.61	38.70	5.85	0.843	40.4
0.24	0.0042	3.82	6.62	39.35	5.94	0.856	41.0
0.25	0.0043	3.98	6.63	39.92	6.02	0.866	41.5
0.26	0.0044	4.15	6.65	40.85	6.15	0.885	42.4
0.27	0.0044	4.31	6.66	41.51	6.24	0.898	43.0
0.28	0.0045	4.48	6.67	42.07	6.31	0.909	43.5
0.29	0.0046	4.65	6.68	42.73	6.40	0.921	44.1
0.30	0.0046	4.81	6.69	43.38	6.48	0.934	44.7
0.31	0.0047	4.98	6.70	43.66	6.51	0.938	44.9
0.32	0.0047	5.14	6.71	44.32	6.60	0.950	45.5
0.33	0.0048	5.31	6.73	44.60	6.63	0.955	45.7
0.34	0.0048	5.48	6.74	45.16	6.70	0.965	46.2
0.35	0.0049	5.64	6.75	45.54	6.75	0.971	46.5
0.36	0.0049	5.81	6.76	45.82	6.78	0.976	46.7
0.37	0.0049	5.97	6.77	45.82	6.76	0.974	46.6
0.38	0.0049	6.14	6.79	46.10	6.79	0.978	46.8
0.39	0.0049	6.31	6.80	46.10	6.78	0.977	46.8
0.40	0.0049	6.47	6.81	45.82	6.73	0.969	46.4
0.41	0.0049	6.64	6.82	45.54	6.67	0.961	46.0
0.42	0.0048	6.80	6.83	44.60	6.53	0.940	45.0
0.43	0.0047	6.97	6.85	43.66	6.38	0.918	44.0

UNCONFINED COMPRESSIVE STRENGTH, q_u:	46.84	kPa
(based on maximum q_u value)	0.978	ksf
UNDRAINED SHEAR STRENGTH, S_u:	23.42	kPa
(based on maximum q_u value)	0.489	ksf

NOTES:
Tested the lower portion of sample (11' 1" to 12') for UCS

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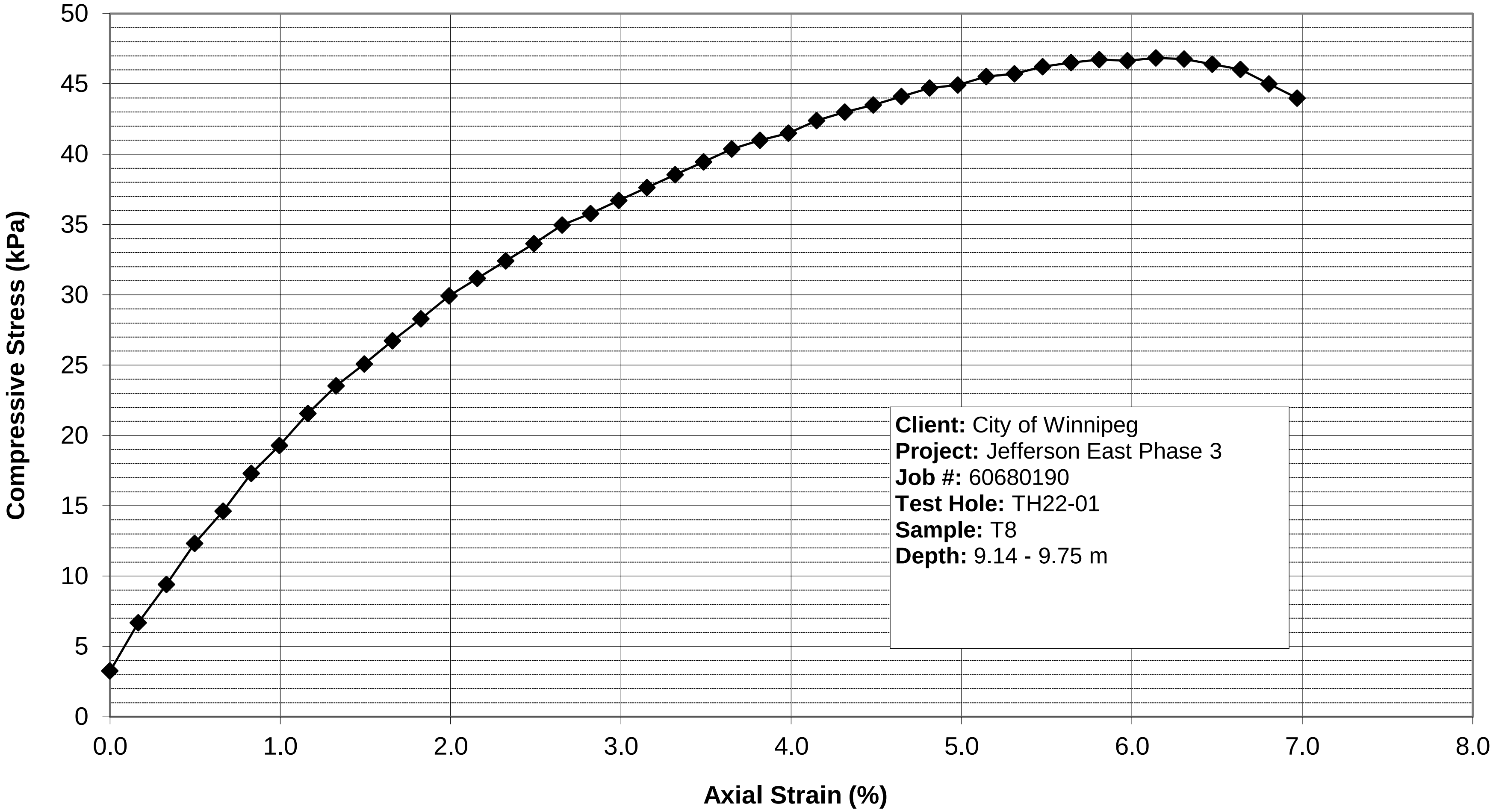
(ASTM D2166)



Client: City of Winnipeg
Project: Jefferson East Phase 3
Job #: 60680190
Test Hole: TH22-01
Sample: T8
Depth: 9.14 - 9.75 m


BEFORE


AFTER