City of Winnipeg

Jefferson East Combined Sewer Relief Works (Contract 5) Semple Avenue Trunk Sewer

Geotechnical Data Report

Prepared by:

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Date: November 29, 2019

Project #: 60599385

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Mr. Jurgen Friesen, C.E.T.
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November 29, 2019

Project #
60599385

Dear Mr. Friesen:

Subject: Jefferson East Combined Sewer Relief Works – Contract 5 – Semple Avenue Trunk Sewer - Geotechnical Data Report

AECOM Canada Ltd. (AECOM) is pleased to submit this Geotechnical Data Report for the Jefferson East Combined Sewer Relief Works (Contract 5) to be constructed in Winnipeg, Manitoba. The report provides a summary of the subsurface soil, and groundwater encountered along the alignment of the Semple Avenue Trunk Sewer and the laboratory test results for the soil.

If you have any questions concerning this report, please contact the undersigned at (204) 928-7444.

Sincerely,
AECOM Canada Ltd.

Ryan Harras, B.Sc., EIT
Geotechnical Engineer-in-Training

GR:rz
Encl.

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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 the suitability of 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. The description of the project represents an understanding of the significant aspects of the project relative 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, AECOM Canada Ltd. should be given the opportunity to review the changes and to modify or reaffirm, in writing, the conclusions and recommendations of this report.

The analyses and recommendations represented in this report are based on the data obtained from the test holes drilled 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 on the site are not significantly different from those encountered at the test hole locations. However, variation in the soil conditions between the test holes may exist. 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 different from those encountered in the exploratory borings are observed or encountered during construction, or appear to be present beneath or beyond excavations, AECOM Canada Ltd. should be advised at once so that the conditions can be observed and reviewed and, where necessary, the recommendations reconsidered.

Since it is possible for conditions to vary from those identified at the test hole locations and from those assumed in the analysis and preparation of recommendations, 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, it is recommended that all construction operations dealing with earthwork and the foundations be observed by an experienced geotechnical engineer. In addition, it is recommended that a qualified geotechnical engineer review the plans and specifications that have been prepared to check for substantial conformance with the conclusions and recommendations contained in the report

Quality Information

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1. Introduction

1.1 General

AECOM Canada Ltd. (AECOM) was retained by the City of Winnipeg Water and Waste Department (the City) to provide geotechnical engineering services to support the design and construction of the proposed Semple Avenue Trunk Sewer. AECOM understands that installation of the proposed Semple Avenue Trunk Sewer will be completed using one-pass or two-pass tunneling methods and pipe jacking.

This Geotechnical Data Report (GDR) presents the results of a detailed geotechnical investigation conducted by AECOM along the proposed sewer alignment. The detailed geotechnical investigation was conducted in general accordance with the American Society of Civil Engineers (ASCE) guidelines (*Essex 2007 and ASCE/CI 36-15*).

This report also provides a detailed summary of previous geotechnical investigation programs undertaken at the site and locations close in proximity to the site. The results and factual outcomes of these studies are included within Section 3 of this report.

This GDR should be read in conjunction with the Geotechnical Baseline Report (GBR). The GDR is subject to AECOM's Statement of Qualification and Limitations and General Statement regarding the Normal Variability of the Subsurface Conditions.

1.2 Aims and Objectives

The main objective of the AECOM 2019 geotechnical investigation was to determine the subsurface soil/groundwater conditions and engineering properties of the soil encountered at the test hole locations drilled along the proposed trunk sewer alignment. The primary focus of this report is to present and document the factual findings from this investigation and other relevant geotechnical investigations and laboratory testing programs. The results of AECOM's laboratory testing program and test hole logs are included within **Appendix B, Appendix C,** and **Appendix D** of this report.

The analyses and results presented in this report are based on the data obtained from the test holes drilled at discrete locations along the trunk sewer alignment. This report does not reflect any variations which may occur between the test hole locations. In the performance of subsurface explorations, specific information is obtained at specific locations at specific times. However, it is well known that variations in soil, bedrock, and groundwater conditions exist at most sites between test hole locations. The nature and extent of the variations may not become evident until the course of construction. If variations are then evident, it will be necessary to re-evaluate the findings and results presented in this report after performing on-site observations during the construction period and noting the characteristics of any variations.

This report is subject to the general statement regarding the normal variability of subsurface conditions provided above.

1.3 Project Details

The proposed trunk sewer will be constructed within the Mynarski ward in the northern region of Winnipeg. The proposed trunk sewer alignment extends from the west end of Semple Avenue at McKenzie Street to the east end of Semple Avenue at Scotia Street.

It is understood that the Semple Avenue trunk sewer project is an extension of the Jefferson East Combined Sewer Relief (CSR) Works. The Jefferson East Combined Sewer District was identified as needing upgrade to satisfy five-year level of service (LOS) design criteria. The proposed Semple Avenue Trunk Sewer upgrade involves disconnecting surface runoff from the existing combined sewer system in the northern portion of the Jefferson district, effectively freeing up capacity in the existing Jefferson Combined Sewer trunk and satisfying the five-year LOS design criteria for the remainder of the district. The outfall for this trunk was constructed in 2017 with the trunk temporarily terminating on Scotia Street at the east end of the proposed Semple Avenue Trunk Sewer. This outfall was installed using an open face excavator shield and pipe jacking. To minimize impact to the existing road and adjacent infrastructure at the project site, a trenchless solution is understood to be the preferred method over open-cut installation for the Semple Avenue Trunk Sewer.

Construction of the Semple Avenue Trunk Sewer will be between McKenzie Street on the west, and Scotia Street on the east as shown on **Figure 1** in **Appendix A**. A summary of the Semple Avenue Trunk Sewer lengths, sizes and installation methods are provided in **Table 1-1**.

Table 1-1: Summary of Semple Ave. Trunk Sewer Length, Size, and Proposed Installation Methods

Location	Length (m)	Size (Nominal Internal Diameter) (mm)	Installation Method
Start: McKenzie Street End: Andrews Street	400	1800 - Carrier Pipe	Tunneling with Pipe Jacking
Start: Andrews Street End: Scotia Street (East end of Semple Ave.)	1100	2100 - Carrier Pipe	Tunneling with Pipe Jacking

The proposed Semple Avenue Trunk Sewer alignment will include, at minimum, a launching shaft at the intersection of Semple Avenue and McKenzie Street and a retrieval shaft at the intersection of Semple Avenue and Scotia Street. Based on the selected tunneling method and equipment, the contractor may consider additional shafts at the following intersections: McGregor Street, Andrews Street, Powers Street, Salter Street, Aikins Street, and adjacent to Main Street (outside of the Main Street right of way). Upsizing of the 1800 mm pipe will be permitted.

New manholes will be constructed in shafts. A shaft will be located at the east end of the alignment near the connection to the existing 2100 concrete land drainage sewer (LDS) at Scotia Street. The final location, number, and size of launching and retrieving shafts are dependent on the selected trenchless construction method, as maximum drive lengths vary between each method. Based on current geotechnical information and groundwater depths, dewatering should not be required.

The overburden depth above the pipe crown varies from 3.4 m to 6.3 m along the Semple Avenue Trunk Sewer alignment. Typically, a minimum soil cover of approximately two (2) times the tunnel diameter is

required above the pipe crown. The surficial geology of the site and Semple Avenue Trunk Sewer alignment is shown on **Figure 2** in **Appendix A**.

1.4 Scope of Work

The scope of work for the detailed geotechnical investigation along the Semple Avenue trunk sewer alignment is summarized below:

- Review of geological survey maps and relevant background information.
- Obtain and review geotechnical reports available to AECOM with respect to the subject site. AECOM will also review geotechnical reports available in AECOM's library to collect information on the soil and bedrock within and near to the subject site.
- Prepare a GDR that documents the findings from AECOM's 2019 investigation and from previous geotechnical investigations and laboratory testing.
- Prepare a GBR in accordance with ASCE Guidelines for Preparation of GBR's.

2. Background Information

2.1 General Review of Existing Information

A review of available geotechnical information pertinent to the project was conducted including the geotechnical memo prepared by *AECOM Canada Ltd 2012* (AECOM 2012), a supplementary geotechnical letter prepared by *AECOM Canada Ltd 2015* (AECOM 2015), and an article about historical waterways in the vicinity of the Red River within Winnipeg. The main objective of the review was to obtain and present information specific to the subsurface and groundwater conditions with respect to the Semple Ave. Trunk Sewer alignment and areas adjacent to the site. The available memorandums and reports were also reviewed to prepare a GDR that presents factual information collected from the site investigation and laboratory testing. The following geotechnical documents were obtained and reviewed by the project team:

- AECOM Canada Ltd. (February 2012). Jefferson East Combined Sewer Relief - Sub-Surface Investigation - Geotechnical Memo.
- AECOM Canada Ltd. (October 2015). Jefferson East Combined Sewer Relief – Semple Outfall Supplementary Geotechnical Investigation - Geotechnical Letter.

The location of pertinent exploratory holes from past and existing geotechnical investigations relevant to the site are shown on **Figure 3** in **Appendix A**.

In summary, a review of the background reports indicated the following:

- The soils south of Jefferson Avenue near Scotia Street consist of interlayered sand, silt, and clay underlain by deep silt deposits. (Ref. TH11-01 to TH11-03)
- Soils in other areas consist of interlayered clay fill, silt, and clay underlain by glacio-lacustrine clay soils, glacial till and carbonate bedrock (in descending order).

2.2 Historic Waterways

As part of the review of existing information AECOM reviewed an article about sixteen major streams and twenty small creeks that were present in the Winnipeg area during the time of the first European settlers (*Bernhardt 2018*). Since that time, the waterways are thought to have been drained and either filled, entombed, or re-routed to permit construction of varying infrastructure overtop of them.

Review of this article and the associated maps indicate the presence of a historic waterway named Inkster's Creek that appears to cross the proposed Semple Avenue trunk sewer alignment in a localized area between Main Street and Scotia Street. The presence of Inkster's Creek at the site was validated by an approximately 2.5 m surveyed elevation change across TH19-14 to TH19-17, as well as from topographic contours that follow the shape of a waterway. The maps from this article also suggest that the Inkster's Creek waterway network crossed through the Jefferson East Combined Sewer Relief (CSR) at various other locations, including near previously investigated test hole locations. The presence of the waterway at these previous locations was confirmed through review of topographic information obtained as well as review of observable topographic features from Google Maps Street View.

The presence of Inkster's Creek crossing at the proposed Semple Avenue trunk sewer alignment has implications related to the thickness and nature of overburden soils above the proposed pipe. Near-surface alluvial soil deposits are typical of waterways, and therefore need to be considered in the selection of appropriate tunneling methods. Additionally, the change in ground surface elevation in this localized area and the reduced overburden thickness that results will need to be assessed as part of the design and construction.

2.3 Previous Geotechnical Investigations

AECOM has reviewed the previous geotechnical investigations relevant to the Semple Avenue trunk sewer alignment and adjacent structures near the proposed trunk sewer alignment. The primary objective of the review was to collect information on the subsurface soil/bedrock conditions in the project area.

Table 2-1 summarizes the geotechnical investigations that have been completed at and in near proximity to the site.

Table 2-1: Summary of Previous Geotechnical Investigations Along Proposed Alignment

Organization	Type and Number of Investigation	Drilling Date	Associated Structure	Distance (m) and Relevancy to Semple Ave. Trunk Sewer Alignment	Comments
AECOM	SSA (2 no.)	December 13 to 14, 2011	Jefferson East CSR	Distance: 10 to 20 South of proposed alignment	TH11-11, 12

Notes: SSA- Solid Stem Auger

Geotechnical investigations which have previously been undertaken within the area adjacent to the proposed Semple Avenue trunk sewer alignment are also summarised in **Table 2-2** below.

Table 2-2: Summary of Previous Geotechnical Investigations Offset from Proposed Alignment

Organization	Type and Number of Investigation	Drilling Date	Associated Structure	Distance (m) and Relevancy to NEIS Alignment	Comments
AECOM	SSA (12 no.)	December 12 to 14, 2011	Jefferson East CSR	Distance: 60 to 900 Within Jefferson East CSR General Area	TH11-01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 14, SP11-13
AECOM	SSA/RC (1 no.) SSA (1 no.)	February 24, 2015	Jefferson East CSR - Semple Outfall	Distance: 50 to 80 Southeast of proposed alignment	SI15-01, VW15-02

Notes: SSA- Solid Stem Auger; RC - Rock Core.

The locations of the exploratory holes outlined in **Table 2-1** and **Table 2-2** are shown on **Figure 3** in **Appendix A**. Test hole logs related to previous geotechnical investigations are included as **Appendix B** of this report. The laboratory testing results from the previous geotechnical investigations are provided in **Appendix D** of this report.

2.3.1 AECOM (February 2012) - Jefferson East Combined Sewer Relief - Sub-Surface Investigation - Geotechnical Memo

In support of the City's "Basement Flooding Relief Program", AECOM was engaged to provide geotechnical engineering services for the Jefferson East Combined Sewer District to facilitate the detailed design and contract administration for proposed buried pipes and outfall. As part of the scope of work, AECOM completed a geotechnical drilling investigation and laboratory testing program within the Jefferson East District to characterize sub-surface soil and groundwater conditions, and to provide general recommendations related to pipe installation.

The AECOM 2012 geotechnical investigation consisted of fourteen (14) test holes (TH11-01 to TH11-12, SP11-13, and TH11-14) spread out across the Jefferson East District and drilled to depths ranging from 12.2 m to 19.5 m below ground surface. As part of this investigation, one (1) piezometer was installed in test hole SP11-13 (see Section 3.3 of this report for details). The geotechnical testing program consisted of index classification testing and strength testing of soils. The results of the geotechnical laboratory tests are included within the AECOM 2012 memo. Further information concerning the encountered subsurface soil and groundwater conditions are provided in Section 3 of this report. A summary of the test hole drilling is provided in **Table 2-3**, below. The test hole records for the 2012 investigation are provided in **Appendix B**. The geotechnical material testing results are also provided within **Appendix D** of this report.

Table 2-3: Summary of Jefferson East CSR – Sub-Surface Investigation (AECOM 2012)

Test Hole	Location	Coordinates (UTM 14)	Ground Elevation (m)	Completion Depth (m)	Completion Soil Unit
TH11-01	Scotia St. (between Seven Oaks Blvd. and Jefferson Ave.)	5532753 m N 635380 m E	229.15	12.19	Silt
TH11-02	Scotia St. at Tait Ave.	5532592 m N 635413 m E	229.06	12.19	Silt
TH11-03	Rupertsland Blvd. (West of Scotia St.)	5532453 m N 635415 m E	227.91	12.19	Clay
TH11-04	Mac St. (between Rupertsland Blvd. and Tait Ave.)	5532610 m N 635216 m E	228.68	12.19	Clay
TH11-05	Jones St. at Colleen Rd.	5532614 m N 634999 m E	229.10	12.19	Clay
TH11-06	Seven Oaks Blvd. (between Jones St. and Scotia St.)	5532780 m N 635215 m E	230.77	12.19	Clay
TH11-07	Seven Oaks Blvd. (East of Main St.)	5532903 m N 634952 m E	229.91	12.19	Clay
TH11-08	Jones St. at St. Anthony Avenue	5533006 m N 635170 m E	229.85	12.19	Clay
TH11-09	Jones St. at Hartford Ave.	5533160 m N 635238 m E	228.71	12.19	Clay

Test Hole	Location	Coordinates (UTM 14)	Ground Elevation (m)	Completion Depth (m)	Completion Soil Unit
TH11-10	Scotia St. at Belmont Ave.	5533205 m N 635370 m E	230.67	12.19	Clay
TH11-11	Semple Ave. (East of Main St.)	5533432 m N 635210 m E	230.74	12.19	Clay
TH11-12	Scotia St. at Semple Ave.	5533322 m N 635426 m E	230.89	12.19	Clay
SP11-13	Upper Outfall Area (East of Scotia St.)	5533354 m N 635497 m E	230.58	19.51	Silt (Till)
TH11-14	Lower Outfall Area (East of Scotia St.)	5533346 m N 635514 m E	226.96	15.54	Silt (Till)

The AECOM 2012 memo indicated that the subsurface ground profile within the investigated area generally consisted of (in descending order): topsoil, clay fill, upper complex zone (interlayered clays, silts, and sands), clay, and glacial silt till. No test holes were advanced into bedrock. Carbonate bedrock was encountered underlying the glacial till in all test holes. The AECOM 2012 test holes are presented in **Appendix B** of this report.

Groundwater information collected from the AECOM 2012 geotechnical investigation is summarized in Section 3.3 of this report.

2.3.2 AECOM (October 2015) – Jefferson East Combined Sewer Relief – Semple Outfall Supplementary Geotechnical Investigation - Geotechnical Letter

This letter was produced in support of the Jefferson East District storm relief program waterway application for construction of the proposed chamber and outfall pipe on the west riverbank of the Red River between 405 and 409 Scotia Street. As part of the waterway application, AECOM was engaged to provide riverbank characterization near the proposed infrastructure, complete a pre-construction slope stability analysis, and to provide long term slope monitoring prior to and post-construction. The letter summarizes the findings of the geotechnical investigation, laboratory testing, initial instrumentation monitoring, and provides the results of the completed slope stability analyses.

The AECOM 2015 geotechnical investigation consisted of two (2) test holes (SI15-01 and VW15-02) drilled on either side of the proposed outfall pipe on the west riverbank of the Red River. As part of this investigation, one (1) slope inclinometer was installed in test hole SI15-01 and two (2) vibrating wire piezometers were installed in test hole VW15-02 (see Section 3.3 of this report for details). The geotechnical testing program consisted of index classification testing and strength testing of soils. The results of the geotechnical laboratory tests are included within the AECOM 2015 memo. Further information concerning the encountered subsurface soil and groundwater conditions are provided in Section 3 of this report. A summary of the drilled test holes is provided in **Table 2-4**, below. The test hole records for the 2015 investigation are provided in **Appendix B**. The geotechnical material testing results are also provided within **Appendix D** of this report.

Table 2-4: Summary of Jefferson East CSR – Semple Outfall Supplementary Geotechnical Investigation (AECOM 2015)

Test Hole	Location	*Ground Elevation (m)	Completion Depth (m)	Completion Soil Unit
SI15-01	North of Outfall Pipe 4 m West of Lower Slope	227.00	22.61	Bedrock
VW15-02	South of Outfall Pipe 15 m West of Lower Slope	227.00	12.50	Clay

Notes: * Drilled locations not surveyed. Elevations were inferred.

The AECOM 2015 memo indicated that the subsurface ground profile within the investigated area generally consisted of (in descending order): topsoil, alluvial upper zone (silty clay, silt), lacustrine clay, and glacial silt till. Carbonate bedrock was encountered underlying the glacial till in test hole SI15-01. The AECOM 2015 test holes are presented in **Appendix B** of this report.

Groundwater information collected from the AECOM 2015 geotechnical investigation is summarized in Section 3.3.1 of this report.

A slope stability analysis was performed at the proposed outfall pipe alignment along the riverbank of the Red River. The stability models were developed using SEEP/W, SIGMA/W, and SLOPE/W modules of the GeoStudio 2007 software package. The intent of the stability analyses was to determine the existing stability of the riverbank prior to construction of the outfall pipe for normal summer and normal winter river water levels. The results of the analysis were provided to the City to assist with identifying whether slope stabilizing measures would need to be implemented to satisfy desired post-construction factors of safety.

The slope stability analysis incorporated topographic survey information and subsurface information obtained from the AECOM 2012 and 2015 investigation and material testing programs. The adopted soil strength parameters used within the slope stability analysis are summarised in **Table 2-5** below.

Table 2-5: Soil Properties Used in Stability Modelling (AECOM 2015)

Soil Description	Unit Weight (kN/m^3)	Cohesion (kPa)	Friction Angle (°)	Hydraulic Conductivity (m/s)
Upper Zone (Alluvial)	17	0	25	1×10^{-9}
Lacustrine Clay	17	5	17	1×10^{-9}
Till	20	5	30	1×10^{-5}

2.4 Regional Geology

2.4.1 Bedrock Geology

The shallow bedrock geology of the Winnipeg area generally comprises of carbonate rock of the Selkirk and Fort Garry Members belonging to the Red River Formation. The Red River Formation consists of

alternating layers of limestone and dolomite (with basal shale layers). The proposed Semple Avenue trunk sewer alignment is located near the geological contact between the Selkirk Member and the lower part of the Fort Garry Member of the Red River Formation (*Matile G.L.D 2004*).

The upper surface of the bedrock is generally characterised with poor rock mass characteristics and is highly fractured. Karstic features are also common within the upper zone of the carbonate bedrock. The Karst topography is typically infilled with mixtures of silt, sand and gravel till material. The Winnipeg formation underlies the Red River formation, and typically consists of sandstone and shale units. The basement bedrock geology is comprised of the Pre-Cambrian Basal Granites at depth. The actual bedrock encountered at the site are described in Section 3.0 of this report below.

2.4.2 Surficial Geology

The overlying surficial soils generally comprise of upper complex deposits, glacio-lacustrine clays and glacial till soils of varying thicknesses and compositions. The glacial till soils were laid down by the advancing and retreating glacial ice masses. The glacio-lacustrine soils are a product of fine materials deposited through suspension within the glacial lakes (*Manitoba Energy and Mines 1990*).

The glacio-lacustrine soils are typically 10 m to 12 m thick but vary spatially within the Red River Valley of southern central Manitoba from approximately 1 m to 20 m. The glacio-lacustrine soils are further sub-divided into two (2) distinct sub-units; the Upper and Lower Clay. The transition zone between the two (2) sub-units is typically located between an approximate depth of 4.6 and 7.6 m (*Graham and Shields 1985*).

Glacial till soils underlie the glacio-lacustrine soils, and the soil boundary interface is usually marked by a transition zone containing glacial till inclusions.

2.4.3 Hydrogeology

There are three (3) significant bedrock aquifers beneath the City of Winnipeg. The largest is known as the Upper Carbonate Aquifer which is generally found within the upper 7 m of the carbonate bedrock profile. This aquifer is contained in an extensive network of fractures and Karstic solution cavities formed by the dissolution of the Upper carbonate rocks. Other aquifers include the Lower and Middle Carbonate Aquifers near the base of the carbonate bedrock profile, and the underlying Winnipeg Formation sandstones. In general, these Lower and Middle aquifers are not utilized due either to the presence of saline water or the higher productivity of the Upper Carbonate Aquifer.

Groundwater flow within the Upper Carbonate Aquifer is towards the Red River (the major discharge point for this aquifer), and in particular towards the St. Boniface Industrial Park on the east side of the Red River where consumptive groundwater use occurs. West of the Red River, the water quality varies from brackish to saline, except beneath the northwest part of the city. Therefore, groundwater in this aquifer is mostly used for commercial and industrial heating and cooling. The majority of these systems recycle the water back into the subsurface and there is very little consumptive use.

Prior to the start of development of this aquifer in the late 1800’s, the potentiometric surface was estimated to be approximately 3 to 6 m below ground surface in the central Winnipeg area. Extensive consumptive use of this groundwater resulted in a decline in the potentiometric surface to depths of 21 to 24 m. Consumptive use has declined since the early 1970’s and since that time the potentiometric

surface has been rising. Currently in the downtown area the potentiometric surface is approximately 7 m below grade.

2.5 AECOM 2019 Geotechnical Investigation

The AECOM 2019 geotechnical investigation field program (including laboratory test results) is summarized below. The 2019 AECOM geotechnical investigation was completed to determine the subsurface conditions along the proposed Semple Avenue Trunk Sewer alignment.

2.5.1 Geotechnical Investigation

From June 20 to 21, 2019 a hydro-vac investigation was completed at seventeen (17) proposed test hole locations to a maximum depth of 3.1 m to confirm that the locations were clear of utilities. From June 24 to 27, 2019, 16 test holes (TH19-01 to TH19-08, and TH19-10 to TH19-17) were drilled at the approximate locations shown on **Figure 3** in **Appendix A** and summarized in **Table 2-6** below. One (1) proposed test hole (TH19-09) could not be drilled due to the presence of underground and above ground utilities in the area. A safe work plan was prepared prior to the hydro-vac and drilling investigations, and utility clearance certificates were obtained by AECOM personnel from representatives of ClickBeforeYouDigMB and DigShaw.

Table 2-6: Summary of Jefferson East CSR – Sub-Surface Investigation (AECOM 2019)

Test Hole	Location	Coordinates (UTM 14)	Ground Elevation (m)	Completion Depth (m)	Completion Soil Unit
TH19-01	Sta. 0+197.30	5533995 m N, 634036m E	231.11	231.11	Silt/Sand (Till)
TH19-02	Sta. 0+250.40	5533973 m N, 634084m E	231.28	231.28	Clay
TH19-03	Sta. 0+371.20	5533922 m N, 634193m E	231.52	231.52	Clay
TH19-04	Sta. 0+457.90	5533885 m N, 634272m E	231.54	231.54	Clay
TH19-05	Sta. 0+592.90	5533828 m N, 634394m E	231.32	231.32	Silt/Sand (Till)
TH19-06	Sta. 0+654.10	5533801 m N, 634449m E	231.23	231.23	Clay
TH19-07	Sta. 0+775.20	5533750 m N, 634559m E	231.13	231.13	Clay
TH19-08	Sta. 0+849.90	5533718 m N, 634627m E	230.97	230.97	Silt/Sand (Till)
*TH19-09	Sta. 0+197.30	5533656 m N, 634757 m E	-	-	-
TH19-10	Sta. 1+068.50	5533626 m N, 634825m E	230.73	230.73	Clay
TH19-11	Sta. 1+183.50	5533577 m N, 634929m E	230.89	230.89	Silt/Sand (Till)
TH19-12	Sta. 1+266.00	5533542 m N, 635003m E	230.76	230.76	Clay
TH19-13	Sta. 1+396.00	5533487 m N, 635121m E	230.81	230.81	Clay
TH19-14	Sta. 1+550.80	5533421 m N, 635261m E	230.65	230.65	Silt/Sand (Till)
TH19-15	Sta. 1+591.50	5533404 m N, 635298m E	230.08	230.08	Clay
TH19-16	Sta. 1+656.60	5533376 m N, 635357m E	228.55	228.55	Silt/Sand (Till)
TH19-17	Sta. 1+719.70	5533349 m N, 635414m E	230.54	230.54	Clay

Notes: * TH19-09 not drilled due to presence of underground and above ground utilities in the area

Drilling was completed by Maple Leaf Drilling using the following equipment: track-mounted Acker MP-5 drill rig equipped with 125 mm solid stem augers for test holes TH19-02 to TH19-08 and TH19-12 to TH19-17, and a truck-mounted Canterra CT-250 drill rig equipped with 125 mm solid stem augers for test holes TH19-01, TH19-10, and TH19-11. Subsurface conditions observed during drilling were visually classified and documented by AECOM geotechnical personnel. Other pertinent information such as groundwater and drilling conditions were also recorded during the field investigation.

Disturbed soil samples collected from auger cuttings and split-spoon samplers, as well as relatively undisturbed Shelby Tube samples were obtained at regular intervals. Standard penetration tests (SPTs) were completed at selected intervals in the test holes and blow counts for 300 mm penetration (SPT “N” blow counts) were recorded.

Recovered soil samples were transported to Dyregrov Robinson Inc. materials testing laboratory in Winnipeg for further visual examination and moisture content, undrained shear strength, pocket penetrometer, and bulk unit weight testing. A section of all recovered Shelby Tube samples were waxed to preserve them for further testing. Select samples were taken to H. Manalo Consulting materials testing laboratory in Winnipeg for Atterberg Limits, grain size distribution (hydrometer/sieve methods), and permeability testing. Other samples were taken to Wood Environment & Infrastructure Solutions materials testing laboratory in Winnipeg for Atterberg Limits, grain size distribution (hydrometer/sieve methods), and swell testing. All electrochemical testing was completed by ALS Environmental’s Winnipeg laboratory.

Detailed test hole logs have been prepared for each test hole, and are attached as **Appendix C**. The test hole logs include description and depth of the soil units encountered, sample type, sample location, results of field and laboratory testing, and other pertinent information such as seepage and sloughing.

2.5.2 Laboratory Testing

The laboratory testing program included the determination of moisture contents, grain size distribution (hydrometer method), Atterberg Limits, undrained shear strength (unconfined compressive strength, pocket penetrometer, and torvane tests), bulk unit weight, permeability (hydraulic conductivity test), consolidation (oedometer method), swell (*ASTM D4546-14 one-dimensional swell or collapse test*), and electrochemical properties (pH, sulphate content, resistivity/conductivity). Laboratory test results are included in **Appendix D**, and the type and number of laboratory tests are summarized in **Table 2-7.**

Table 2-7: Summary of Type and Number of Laboratory Tests (AECOM 2019)

Laboratory Test	Number of Tests	Data Location
Moisture Content	157	Test Hole Logs & Appendix D
Atterberg Limits	11	Test Hole Logs & Appendix D
Grain Size Distribution (Hydrometer Method)	11	Test Hole Logs & Appendix D
Undrained Shear Strength (Unconfined Compressive Strength Method)	26	Test Hole Logs & Appendix D
Pocket Penetrometer	29	Test Hole Logs & Appendix D
Torvane	29	Test Hole Logs & Appendix D
Bulk Unit Weight	27	Test Hole Logs & Appendix D
Permeability (Hydraulic Conductivity Method)	2	Appendix D
Free Swell & Swelling Pressure (One-Dimensional Swell or Collapse Method)	5	Appendix D
Electrochemical (pH, Sulphate, Resistivity/Conductivity)	5	Appendix D

The geotechnical testing program undertaken as part of the historic geotechnical investigation programs has been summarized in **Table 2-8**, below.

Table 2-8: Summary of Type and Number of Laboratory Tests (AECOM 2012, AECOM 2015)

Laboratory Test	AECOM (2012) Number of Tests	AECOM (2015) Number of Tests
Moisture Content	131	20
Atterberg Limits	4	3
Grain Size Distribution (Hydrometer Method)	4	2
Undrained Shear Strength (Unconfined Compressive Strength Method)	3	Not Tested
Pocket Penetrometer	34	Not Tested
Torvane	29	13
Bulk Unit Weight	3	Not Tested

3. Subsurface Conditions

3.1 General

The following sections describe the subsurface conditions encountered during the AECOM 2019 geotechnical investigation and information referenced from review of geotechnical investigations previously carried out at the site. The results of the AECOM 2019 investigation are in general agreement with investigations carried out in the past for City owned projects in the site area. It is however prudent to note that subsurface conditions can vary significantly between test holes within the same site. It should also be noted that test holes drilled for the AECOM 2019 investigation were located within the north boulevard of Semple Avenue. As a result, information about the existing roadway pavement structure along the proposed alignment was not collected and has therefore not been discussed or presented within this document. A simplified stratigraphic profile based on the findings of the AECOM 2019 investigation and relevant historic soils data (derived from past geotechnical reports) along the Semple Avenue Trunk Sewer alignment is presented as **Figures 4A to 4E** in **Appendix A**.

Detailed descriptions of the subsurface conditions encountered at the test hole locations as part of the AECOM 2019 investigation are provided on the test hole logs presented in **Appendix C**. A description of the terms and symbols used on the test hole logs are also included in **Appendix C**. A brief description of the subsurface soil/bedrock unit encountered along the trunk sewer alignment and adjacent locations are provided in the following sections.

3.2 Subsurface Profile

Soils encountered during the investigations consisted of the following:

- Topsoil
- Fill
- Upper Complex
    - Clay
    - Silt
    - Sand
- Glacio-Lacustrine Clay
- Glacial Till
- Carbonate Bedrock

Each of these units is described below.

3.2.1 Topsoil

A layer of topsoil was encountered in all test holes drilled as part of the AECOM 2012, AECOM 2015, and AECOM 2019 geotechnical investigations ranging in thickness from 0.1 m to 0.3 m. The topsoil was classified as black, moist, and contained trace to some rootlets.

3.2.2 Fill

Fill was encountered beneath the topsoil in all test holes completed as part of the AECOM 2012 investigation except in test hole TH11-14, and all test holes completed as part of the AECOM 2019 investigation. The fill was classified as clay fill or silt fill and ranged in thickness from 0.3 m to 1.0 m (0.7 m average) when considering only test holes along the proposed trunk sewer alignment from the AECOM 2012 and AECOM 2019 investigations. The fill ranged in thickness from 0.3 m to 3.0 m when considering only test holes offset from the proposed trunk sewer alignment from the AECOM 2012 and AECOM 2015 investigations.

Clay fill was encountered in all AECOM 2012 and AECOM 2019 test holes except in test holes TH11-14, and TH19-03. The clay fill contained some silt to silty, trace to some sand, trace gravel, trace roots, and was brown to dark grey, firm, dry to moist, and of intermediate to high plasticity.

A summary of the laboratory testing results for the clay fill deposits encountered along the proposed alignment as part of the AECOM 2012 and AECOM 2019 investigations are presented in **Table 3-1** below.

Table 3-1: Clay Fill - Summary of Laboratory Testing Along Proposed Alignment (AECOM 2012, AECOM 2019)

Laboratory Test	Clay Fill
Moisture Content (%)	26 to 32 (29)

Notes: (#) - Average Value

A summary of the laboratory testing results for the clay fill deposits encountered offset from the proposed alignment as part of the AECOM 2012 and AECOM 2015 investigations are presented in **Table 3-2** below.

Table 3-2: Clay Fill - Summary of Laboratory Testing Offset from Proposed Alignment (AECOM 2012, AECOM 2015)

Laboratory Test	Clay Fill
Moisture Content (%)	21 to 30 (25)

Notes: (#) - Average Value

Silt fill was encountered in test holes TH19-03 and TH19-14 and was classified as sandy with trace to some clay, light brown, dry to moist, and of low plasticity. No laboratory testing was completed on the encountered silt fill.

3.2.3 Upper Complex

The upper complex is a near ground surface zone common to the Winnipeg area that typically consisting of interlayered clays, silts, sands, and organics near ground surface that are thought to be a mixture of lacustrine and alluvial sediments. Upper complex clays are generally distinguished by a lower range of moisture content when compared to glacio-lacustrine clays, which was evident from the plot of moisture content values on the AECOM 2012 and AECOM 2019 test hole logs along the proposed alignment. Upper complex deposits were encountered beneath the topsoil or fill in all AECOM 2012, AECOM 2015, and AECOM 2019 test holes ranging in total thickness from 0.5 m to 2.2 m for test holes along the proposed alignment and from 0.6 m to 11.6 m for test holes offset from the proposed alignment.

The extent of the upper complex deposit identified from test holes along the proposed trunk sewer alignment from the AECOM 2012 and AECOM 2019 investigations are outlined in **Table 3-3** below.

Table 3-3: Upper Complex - Soil Profile Along Proposed Alignment (AECOM 2012, AECOM 2019)

Location	Profile	Clay	Silt	Sand
Section 1 (Station 0+202 to 0+600)	Elevation at Base (m)		228.3 to 230.0	
	Thickness (m)	0.5 to 1.2	NR to 0.9	NR to 1.0
	*Average Thickness (m)	0.7	0.6	1.0
Section 2 (Station 0+600 to 1+000)	Elevation at Base (m)		228.5 to 229.6	
	Thickness (m)	NR to 0.3	NR to 0.8	NR to 1.1
	*Average Thickness (m)	0.3	0.7	1.1
Section 3 (Station 1+000 to 1+500)	Elevation at Base (m)		228.0 to 229.4	
	Thickness (m)	NR to 0.9	0.8 to 1.2	NR
	*Average Thickness (m)	0.6	1.0	NR
Section 4 (Station 1+500 to 1+742)	Elevation at Base (m)		226.6 to 228.5	
	Thickness (m)	NR to 1.5	NR to 1.1	NR to 0.7
	*Average Thickness (m)	0.9	0.7	0.4

Notes: NR- Not Recorded; * Average thickness from test holes where encountered

The extent of the upper complex deposit identified from test holes offset from the trunk sewer alignment from the AECOM 2012 and AECOM 2015 investigations are outlined in **Table 3-4** below.

Table 3-4: Upper Complex - Soil Profile Offset from Proposed Alignment (AECOM 2012, AECOM 2015)

Location	Profile	Clay	Silt	Sand
Jefferson East CSR (AECOM 2012)	Elevation at Base (m)		216.0 to 227.9	
	Thickness (m)	0.5 to 6.7	0.5 to 10.4	0.9 to 1.5
	*Average Thickness (m)	1.8	2.5	1.2
Outfall Structure (AECOM 2015)	Elevation at Base (m)		225.2 to 225.3	
	Thickness (m)	0.2 to 1.2	0.3 to 0.6	NR
	*Average Thickness (m)	0.6	0.4	NR

Notes: NR- Not Recorded; * Average thickness from test holes where encountered

A summary of the laboratory testing results for the upper complex clay, silt, and sand deposits encountered along the proposed alignment as part of the AECOM 2012 and AECOM 2019 investigations are presented in **Table 3-5** below.

Table 3-5: Upper Complex - Summary of Laboratory Testing Along Proposed Alignment (AECOM 2012, AECOM 2019)

Laboratory Test	Clay	Silt	Sand
Moisture Content (%)	24 to 36 (28)	14 to 28 (22)	12 to 19 (16)
Atterberg - Plastic Limit (%)	23	NP to 16	NT
Atterberg - Liquid Limit (%)	53	NP to 24	NT
Atterberg – Plasticity Index (%)	30	NP to 8	NT
Grain Size - Gravel (%)	0	0	NT
Grain Size - Sand (%)	6	1 to 2 (2)	NT
Grain Size - Silt (%)	39	81 to 87 (84)	NT
Grain Size - Clay (%)	55	11 to 18 (15)	NT
pH	NT	9.1	NT
Resistivity (ohm*cm)	NT	4950	NT
Conductivity (mS/cm)	NT	0.2	NT
Sulphate Content (mg/kg)	NT	46	NT

Notes: NP- Non-Plastic; NT- Not Tested; (#) - Average Value

A summary of the laboratory testing results for the upper complex clay, silt, and sand deposits encountered offset from the proposed alignment as part of the AECOM 2012 and AECOM 2015 investigations are presented in **Table 3-6** below.

Table 3-6: Upper Complex - Summary of Laboratory Testing Offset from Proposed Alignment (AECOM 2012, AECOM 2015)

Laboratory Test	Clay	Silt	Sand
Moisture Content (%)	18 to 38 (29)	8 to 35 (26)	29 to 35 (32)
Atterberg - Plastic Limit (%)	19 to 22 (21)	17	15
Atterberg - Liquid Limit (%)	65 to 71 (68)	34	23
Atterberg – Plasticity Index (%)	47 to 49 (48)	17	8
Grain Size - Gravel (%)	0	1	0
Grain Size - Sand (%)	6 to 7 (6)	5	62
Grain Size - Silt (%)	25 to 30 (27)	70	23
Grain Size - Clay (%)	64 to 69 (66)	25	15
Pocket Penetrometer - Undrained Shear Strength (kPa)	72 to 132 (101)	NT	NT
Torvane - Undrained Shear Strength (kPa)	59 to 79 (71)	NT	NT
Bulk Unit Weight (kN/m^3)	NT	NT	NT

Notes: NT- Not Tested; (#) - Average Value

Plots of moisture content and Atterberg Limits with elevation for the upper complex soil deposits encountered in the AECOM 2012, AECOM 2015, and AECOM 2019 investigations are illustrated in **Figure 3-1** below.

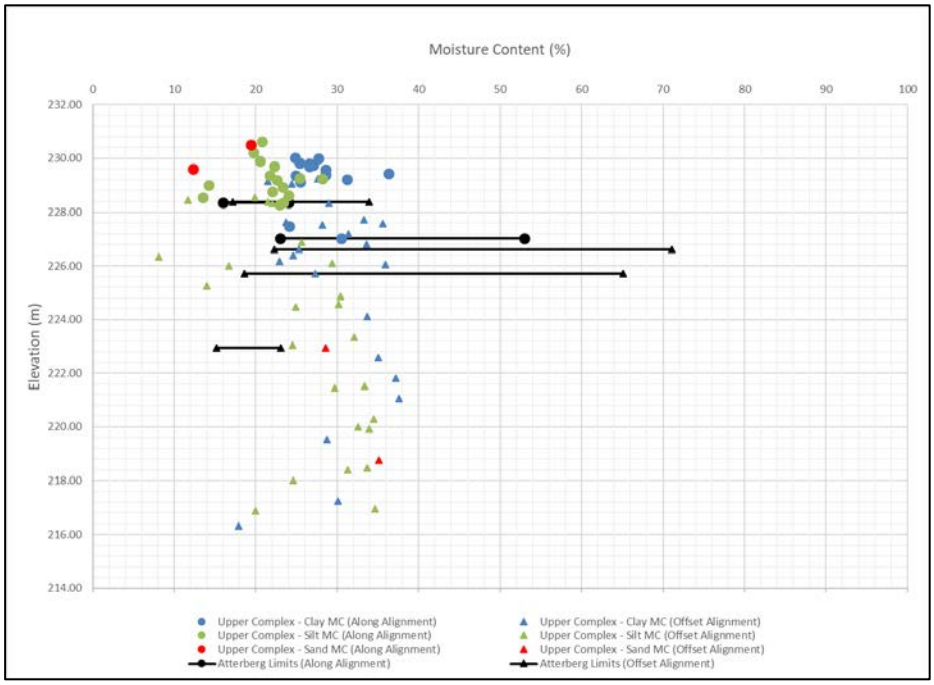

Figure 3-1: Moisture Content & Atterberg Limits with Elevation for Upper Complex (AECOM 2012, AECOM 2016, AECOM 2019)

3.2.3.1 Upper Complex – Clay

The upper complex clay contained trace silt to silty, trace to some sand, and trace to some gravel. The upper complex clay was brown to grey, soft to stiff, moist, and of intermediate to high plasticity. The upper complex clay was classified as clay and silt in test hole TH19-16. Boulder and cobble were not encountered within this layer during the investigations.

3.2.3.2 Upper Complex - Silt

The upper complex silt contained trace clay to clayey, trace sand to sandy, trace to some gravel, and was brown to grey, soft to firm, moist to wet, and ranged from non-plastic to intermediately plastic. Boulder and cobble were not encountered within this layer during the investigations.

3.2.3.3 Upper Complex - Sand

The upper complex sand was silty, contained trace to some clay, and was light brown to brown, and dry to moist. Boulder and cobble were not encountered within this layer during the investigations.

3.2.4 Glacio-Lacustrine Clay

A layer of glacio-lacustrine clay was encountered during the AECOM 2012, AECOM 2015, and AECOM 2019 investigations. These glacio-lacustrine soils are common to the Winnipeg area and have been the subject of prior investigation, research, and testing as part of the Floodway Channel project. The

subsequent sections provide a summary of the glacio-lacustrine clay properties from published literature and technical reports, as well as the results from the AECOM 2012, AECOM 2015, and AECOM 2019 investigations completed in proximity to the proposed trunk sewer alignment site.

3.2.4.1 Reported Geotechnical Properties

Published literature and technical reports were reviewed to obtain data with respect to the subsurface soils and bedrock within the Winnipeg area, specifically along the proposed trunk sewer alignment.

Geotechnical parameters of the Lake Agassiz glacio-lacustrine clay (Upper and Lower Clays) have been referenced from the Floodway Channel Pre-design Floodway Expansion Project (*KGS Group, Acres Engineering and UMA Engineering, 2004*) reports and are presented within **Table 3-7**. The Floodway Channel project is located approximately 10 to 20 km east and southeast of the proposed trunk sewer alignment and involved an extensive study of the glacio-lacustrine soils common to the Winnipeg area.

The glacio-lacustrine clay layer can be further broken down into the Upper Glacio-Lacustrine Clay (Upper Clay) and Lower Glacio-Lacustrine Clay (Lower Clay) layers. The Upper Clay is typically stiff in consistency, highly plastic, fissured, and contains gypsum pockets. The Lower Clay is typically soft to firm in consistency and has an intermediate to high plasticity. Fine to coarse grained gravel and boulders are occasionally found in the Lower Clay near the glacial till interface (*Graham and Shields, 1985*). The clay content was between 67 and 81 percent of the total composition of the Lake Agassiz glacio-lacustrine clay in Winnipeg. The clay size fractions typically consist of up to 75 percent montmorillonite, 10 percent illite, 10 percent kaolinite, and approximately 5 percent quartz mineral.

The typical soil index classification and undrained shear strength compressive strength parameters presented as part of the published literature and technical reports are summarized in **Table 3-7.**

Table 3-7: Glacio-Lacustrine Clay - Published Geotechnical Soil Parameters

Soil Property	Typical Range of Values
Moisture Content (%)	40 to 60- Upper and Lower Clay
Liquid Limit (%)	80 to 110- Upper Clay 65 to 95- Lower Clay
Plasticity Index (%)	60 to 80- Upper Clay 40 to 65- Lower Clay
Undrained Shear Strength (kPa)	70 to 100- Upper Clay 25 to 40- Lower Clay

Notes: Based on *Graham & Shields (1985)*

Effective shear strength parameters of the Upper and Lower Clay obtained from consolidated undrained compression triaxial strength testing on a large number of relatively undisturbed samples yielded intact peak strengths of:

- Upper Clay- c' = 19.6 kPa and ϕ'= 20.5° and
- Lower Clay- c' = 29.8 kPa and ϕ'= 15.8°.

The effective large strain shear strength (fully softened) parameters for the Upper and Lower Clay were reported as follows:

- Upper Clay- c' = 14.5 kPa and ϕ'= 13.3° and

- Lower Clay- c' = 7.7 kPa and ϕ'= 15.7°.

Typical industry accepted effective shear strength parameters used in the Winnipeg area for the glacio-lacustrine clay are summarised in **Table 3-8.**

Table 3-8: Glacio-Lacustrine Clay - Published Effective Shear Strength Parameters

Parameter	Value
Effective Cohesion (c'), kPa	5.0
Effective Friction Angle (ϕ'), degrees	14.0

3.2.4.2 Geotechnical Investigation Findings

A layer of glacio-lacustrine clay was encountered beneath the Upper Complex in all test holes completed as part of the AECOM 2012, AECOM 2015, and AECOM 2019 investigations except for test holes TH11-01 and TH11-02. The glacio-lacustrine clay ranged in thickness from 10.7 m to 15.7 m (13.3 m average) in test holes along the proposed trunk sewer alignment that were advanced through the glacio-lacustrine clay layer into the underlying till. The glacio-lacustrine clay ranged in thickness from 13.1 m to 15.8 m (14.2 m average) in test holes offset from the proposed trunk sewer alignment that were advanced through the glacio-lacustrine clay layer into the underlying till.

The glacio-lacustrine clay generally contained trace silt to silty, trace sand, trace gravel, and was brown to grey, soft to stiff, and of high plasticity. In test hole TH11-14 a 0.9 m silt interlayer with a moisture content of 13% was encountered within the glacio-lacustrine clay layer. In test hole TH19-05 suspected gravel and/or cobble was inferred from the deformed shape of the recovered Shelby Tube pushed at an elevation of 217.6 m.

A summary of the laboratory testing results for the glacio-lacustrine clay layers encountered along the proposed alignment as part of the AECOM 2012 and AECOM 2019 investigations are presented in **Table 3-9.**

Table 3-9: Glacio-Lacustrine Clay - Summary of Laboratory Testing Along Proposed Alignment (AECOM 2012, AECOM 2019)

Laboratory Test	Minimum	Average	Maximum
Moisture Content (%)	22	47	64
Atterberg - Plastic Limit (%)	14	23	31
Atterberg - Liquid Limit (%)	50	72	90
Atterberg – Plasticity Index (%)	35	49	69
Grain Size - Gravel (%)	0	0	2
Grain Size - Sand (%)	0	3	19
Grain Size - Silt (%)	12	23	35
Grain Size - Clay (%)	44	74	88
Unconfined Compressive Strength - Undrained Shear Strength (kPa)	17	39	63
Pocket Penetrometer - Undrained Shear Strength (kPa)	12	50	79
Torvane - Undrained Shear Strength (kPa)	25	50	66
Bulk Unit Weight (kN/m^3)	15.6	16.7	18.8
Permeability (cm/s)	1.52×10^{-8}	2.25×10^{-8}	2.98×10^{-8}
Free Swell (%)	1.9	2.6	3.4
Swelling Pressure (kPa)	35	68	120
pH	8.0	8.1	8.3
Resistivity (ohm*cm)	561	1620	3580
Conductivity (mS/cm)	0.3	1.8	1.0
Sulphate Content (mg/kg)	30	590	927

A summary of the laboratory testing results for the glacio-lacustrine clay layers encountered offset from the proposed alignment as part of the AECOM 2012 and AECOM 2015 investigations are presented in Table 3-10.

Table 3-10: Glacio-Lacustrine Clay - Summary of Laboratory Testing Offset from Proposed Alignment (AECOM 2012, AECOM 2015)

Laboratory Test	Minimum	Average	Maximum
Moisture Content (%)	27	48	62
Atterberg - Plastic Limit (%)	24	29	31
Atterberg - Liquid Limit (%)	80	85	92
Atterberg – Plasticity Index (%)	53	57	62
Grain Size - Gravel (%)	0		
Grain Size - Sand (%)	0	1	2
Grain Size - Silt (%)	15	16	17
Grain Size - Clay (%)	81	83	85
Unconfined Compressive Strength - Undrained Shear Strength (kPa)	53	68	93
Pocket Penetrometer - Undrained Shear Strength (kPa)	12	42	110
Torvane - Undrained Shear Strength (kPa)	12	38	93
Bulk Unit Weight (kN/m^3)	17.1	17.2	17.3

Plots of moisture content, Atterberg Limits, and undrained shear strength with elevation for the glacio-lacustrine soil deposits encountered in the AECOM 2012, AECOM 2015, and AECOM 2019 investigations are illustrated in **Figure 3-2** and **Figure 3-3** below

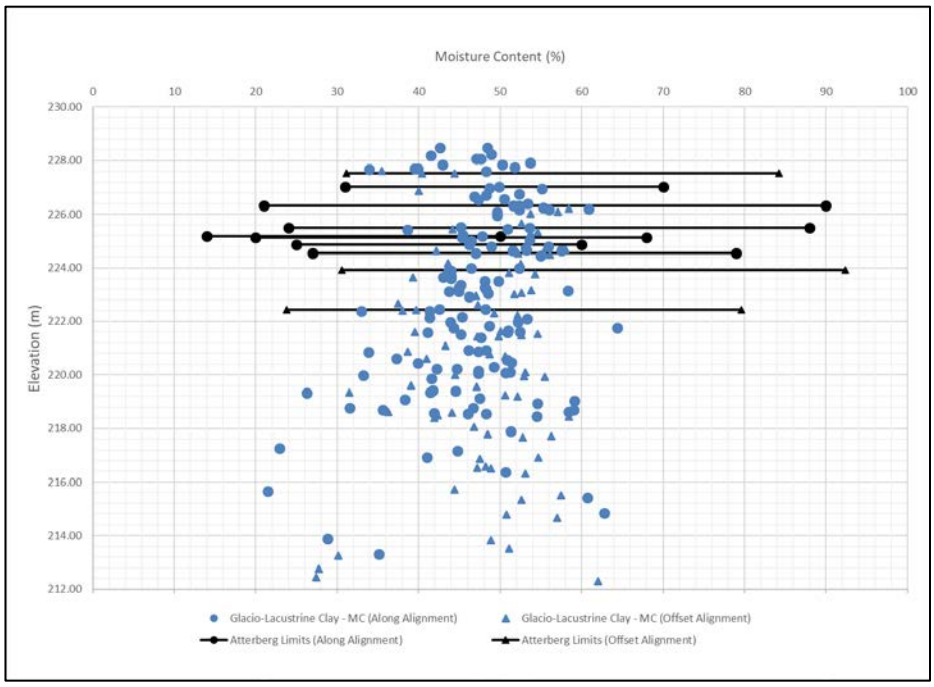

Figure 3-2: Moisture Content & Atterberg Limits with Elevation for Glacio-Lacustrine Clay (AECOM 2012, AECOM 2015, AECOM 2019)

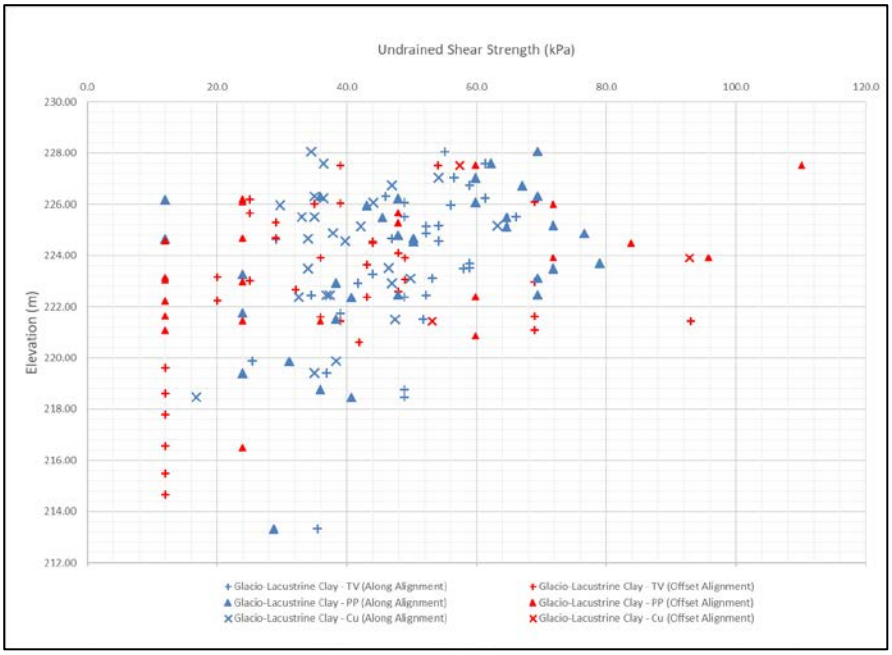

Figure 3-3: Undrained Shear Strength with Elevation for Glacio-Lacustrine Clay (AECOM 2012, AECOM 2015, AECOM 2019

The reported laboratory test results are generally consistent with the published findings for the glacio-lacustrine clay within the Winnipeg area. The trend of the undrained shear strength profile (as shown in Figure 3-3) for the glacio-lacustrine clay showed lower undrained shear strength values closer to the clay/glacial till boundary.

3.2.5 Glacial Till

A glacial till layer was encountered during the AECOM 2012, AECOM 2015, and AECOM 2019 investigations. When considering test holes along the proposed alignment drilled during the AECOM 2019 investigation, the contact elevation of the glacial till layer was noted to be highest at the west end of the proposed alignment and generally decreased in elevation along the alignment towards the river. The glacial till was noted to overlie the carbonate bedrock in test hole SI15-01.

The profile of the glacial till layer encountered as part of the AECOM 2012 and AECOM 2019 investigations along the proposed alignment are outlined in **Table 3-11.**

Table 3-11: Glacial Till - Soil Profile Along Proposed Alignment (AECOM 2012, AECOM 2019)

Location	Test Hole	Depth (m BGS)	Till Contact Elevation (m)
Section 1 (Station 0+202 to 0+600)	TH19-01	12.5	218.6
	TH19-05	14.3	217.0
Section 2 (Station 0+600 to 1+000)	TH19-08	15.1	215.9
Section 3 (Station 1+000 to 1+500)	TH19-11	16.2	214.7
Section 4 (Station 1+500 to 1+742)	TH19-14	18.1	212.5
	TH19-16	16.0	212.6

Notes: BGS – Below Ground Surface

The profile of the glacial till layer encountered as part of the AECOM 2012 and AECOM 2015 investigation offset from the proposed alignment are outlined in **Table 3-12**.

Table 3-12: Glacial Till - Soil Profile Offset from Proposed Alignment (AECOM 2012, AECOM 2015)

Location	Test Hole	Depth (m BGS)	Till Contact Elevation (m)
Jefferson East CSR (AECOM 2012)	SP11-13	18.6	212.0
	TH11-14	14.0	212.9
Outfall Structure (AECOM 2015)	SI15-01	15.5	211.5*

Notes: BGS – Below Ground Surface; * Drilled locations not surveyed. Elevations were inferred.

3.2.5.1 Reported Geotechnical Properties

Within the Winnipeg area, the composition of the glacial till deposit is highly variable and its density varies both with depth and distance. Near the glacio-lacustrine/glacial till interface, the upper zone of the till is typically characterized by a softer sub-unit (locally termed “putty till”) and has a typical moisture content

ranging from 10 and 15 percent. The lower sub-unit has typical in-situ moisture content values of between 7 and 10 percent.

Reported unconfined compressive strength values of the very dense tills (with in-situ moisture contents of 5 percent) range between 3.4 and 3.6 MPa (*Baracos, A.G. Shields, D.H., and Kjartenson, B. 1983*). The elastic modulus of the glacial till soils has also been reported at a range of between 170 and 240 MPa (*Baracos, A.G. Shields, D.H., and Kjartenson, B. 1983*). These parameters are based upon the results of past material testing performed on representative samples of glacial till deposits from within the Winnipeg area.

3.2.5.2 Geotechnical Investigation Findings

The glacial till was generally described as silt and sand containing some clay to clayey, trace to some gravel, and was light brown, compact to very dense, dry to wet, and of low plasticity. The consistency of the glacial till generally increased in strength with depth. Whilst not confirmed during the advancement of the AECOM 2012, AECOM 2015, and AECOM 2019 test holes, the glacial till is suspected to contain cobble and boulder size obstructions.

A summary of the laboratory testing results for the glacial till layer encountered along the proposed alignment as part of the AECOM 2012 and AECOM 2019 investigations are presented in **Table 3-13.**

Table 3-13: Glacial Till - Summary of Laboratory Testing Along Proposed Alignment (AECOM 2012, AECOM 2019)

Laboratory Test	Minimum	Average	Maximum
Moisture Content (%)	9	15	38
SPT ‘N’ Blow Counts (uncorrected)	17	45	≥ 50
Atterberg - Plastic Limit (%)	10		
Atterberg - Liquid Limit (%)	22		
Grain Size - Gravel (%)	0		
Grain Size - Sand (%)	35		
Grain Size - Silt (%)	44		
Grain Size - Clay (%)	21		
Pocket Penetrometer - Undrained Shear Strength (kPa)	36		
Torvane - Undrained Shear Strength (kPa)	49		

A summary of the laboratory testing results for the glacio-lacustrine clay layers encountered offset from the proposed alignment as part of the AECOM 2012 and AECOM 2015 investigations are presented in **Table 3-14.**

Table 3-14: Glacial Till - Summary of Laboratory Testing Offset from Proposed Alignment (AECOM 2012, AECOM 2015)

Laboratory Test	Minimum	Average	Maximum
Moisture Content (%)	12	28	54
Torvane - Undrained Shear Strength (kPa)		12	

Plots of moisture content and Atterberg Limits with elevation for the glacial till encountered in the AECOM 2012, AECOM 2015, and AECOM 2019 investigations are illustrated in **Figure 3-4** below

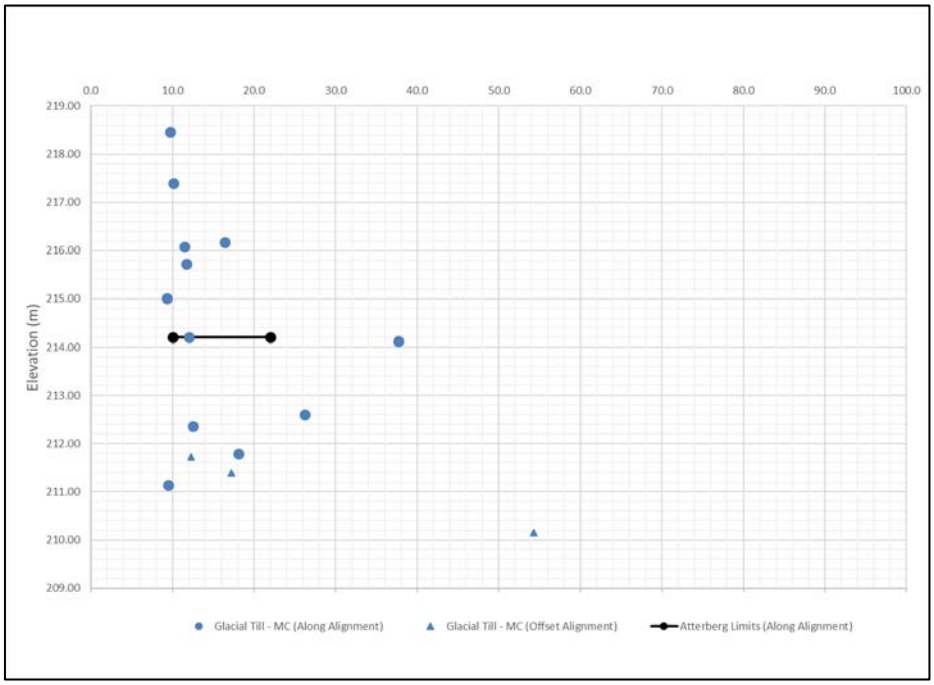

Figure 3-4: Moisture Content & Atterberg Limits with Elevation for Glacial Till (AECOM 2012, AECOM 2015, AECOM 2019)

3.2.6 Carbonate Bedrock

Carbonate bedrock was encountered below the glacial till in one of the AECOM 2015 test holes drilled offset from the proposed alignment. The carbonate bedrock from test hole SI15-01 was encountered at an elevation of 205.2 m and was classified as limestone. These findings are generally consistent with the pre-established bedrock mapping of the area and published literature.

3.3 Groundwater Conditions

Groundwater depths were measured within the monitoring wells installed as part of the AECOM 2019 geotechnical investigation and are summarized in the following section. Groundwater monitoring records from previous geotechnical investigations are also included.

3.3.1 AECOM 2019 Geotechnical Investigation

To assess groundwater levels along the proposed trunk sewer alignment, three (3) standpipe piezometers were installed in test holes TH19-01, TH19-05, and TH19-16 at varying depths and within varying soil units. Short term monitoring results of the groundwater level (GWL) from the instruments installed at the site as part of the AECOM 2019 investigation are provided in **Table 3-15**. Sloughing was observed from the glacial till layer within test holes TH19-01 and TH19-16, and from the Upper Complex silt layer in TH19-05. It should be noted that groundwater levels and subsequently sloughing may change seasonally, annually or as a result of construction activities.

Table 3-15: Summary of GWL Monitoring Results (AECOM 2019)

Location	Test Hole ID	Ground Elev. (m)	Tip Elev. (m)	Soil Unit	Monitoring Date	Depth (m BGS)	GWL Elev. (m)
Section 1 (Station 0+202 to 0+600)	TH19-01	231.11	218.41	Glacial Till	Aug-06-2019	4.13	226.98
					Aug-20-2019	4.21	226.90
					Sept-03-2019	4.17	226.94
	TH19-05	231.32	217.60	Glacial Till	Aug-06-2019	7.76	223.55
					Aug-20-2019	6.55	224.76
					Sept-03-2019	6.11	225.20
Section 4 (Station 1+500 to 1+742)	TH19-16	228.55	221.23	Glacio. Clay	Aug-06-2019	2.91	225.64
					Aug-20-2019	2.93	225.63
					Sept-03-2019	2.94	225.61

Notes: BGS – Below Ground Surface

3.3.2 Previous Geotechnical Investigations

One (1) standpipe piezometer was installed in test hole SP11-13 as part of the AECOM 2012 investigation, and one (1) vibrating wire piezometer was installed as part of the AECOM 2015 investigation.

Results for the vibrating wire piezometers over the reported period indicated nearly constant negative piezometric head (i.e. piezometric elevation is below tip elevation). The development of negative head is likely not credible and may be attributed to instruments malfunction. As a result, the monitoring results of the vibrating wire piezometer have not been presented in this report. The groundwater monitoring results from the AECOM 2012 standpipe piezometer are summarized in **Table 3-16.**

Table 3-16: Summary of GWL Monitoring Results (AECOM 2012)

Location	Test Hole ID	Ground Elev. (m)	Tip Elev. (m)	Soil Unit	Monitoring Date	Depth (m BGS)	GWL Elev. (m)
Jefferson East CSR	SP11-13	230.58	211.08	Glacial Till	Jan-06-2012	7.80	222.78
					Feb-24-2015	7.50	223.03
					Mar-13-2015	7.50	223.03
					May-19-2015	7.40	223.14
					Aug-28-2015	7.50	223.12
					Oct-07-2015	7.70	222.91
					Dec-07-2015	7.70	222.91
					Feb-03-2016	7.70	222.88

Notes: BGS – Below Ground Surface

4. References

1- AECOM Canada Ltd. (2012). City of Winnipeg Jefferson East Sub-Surface Investigation Geotechnical Memo.
2- AECOM Canada Ltd. (2015). City of Winnipeg Construction of Outfall Chamber and Piping Jefferson East CSR – Waterway Application – Supplementary Geotechnical Investigation Letter.
3- Bernhardt, Darren (2018). Ghost creeks: Winnipeg buried many waterways that could have changed city's shape. CBC News.
4- Essex, R.J. (2007). Geotechnical Baseline Reports for Construction, Suggested Guidelines. American Society of Civil Engineers.
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6- Matile, G.L.D. (2004). Surficial Geology, Winnipeg, Manitoba Geoscientific Map MAP2003-7.
7- Manitoba Energy and Mines (1990). Bedrock Geology Compilation Map Series NTS 62H.
8- Graham, J., and Shields, D.H (1985). Influence of geology and geological processes on the geotechnical properties of a plastic clay. Engineering Geology.
9- ASTM D4546-14. Standard Test Methods for One-Dimensional Swell or Collapse of Soils.
10- Baracos, A.G. Shields, D.H., and Kjartenson, B. (1983). Geological Engineering Report for Urban Development of Winnipeg, University of Manitoba- Department of Geological Engineering.

Appendix A

Figures

- Figure 1: Site Location Plan and Semple Avenue Trunk Sewer Alignment
- Figure 2: Surficial Geology
- Figure 3: Test Hole Location Plan
- Figure 4A to 4E: Stratigraphic Section of Semple Avenue Trunk Sewer Alignment

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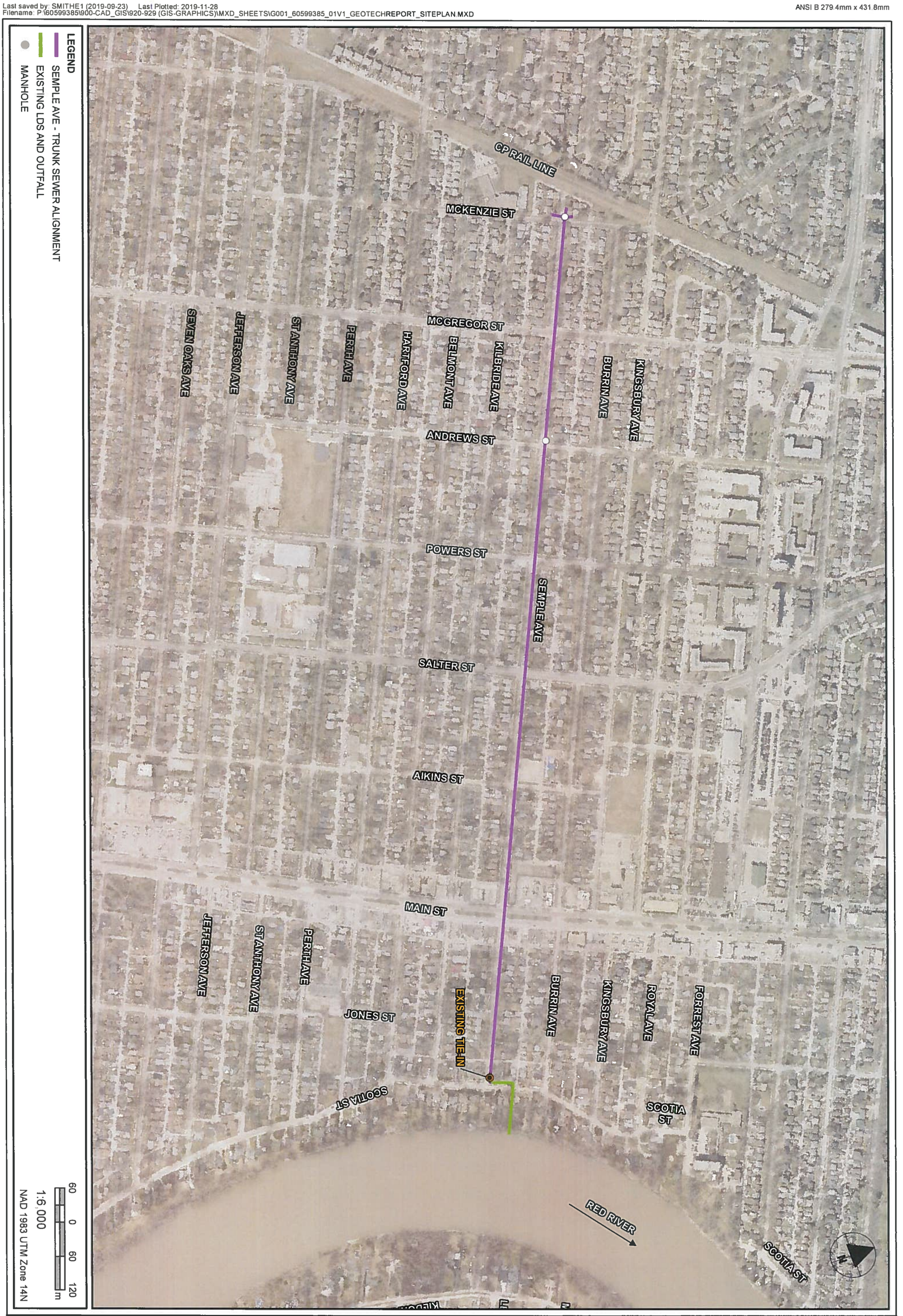


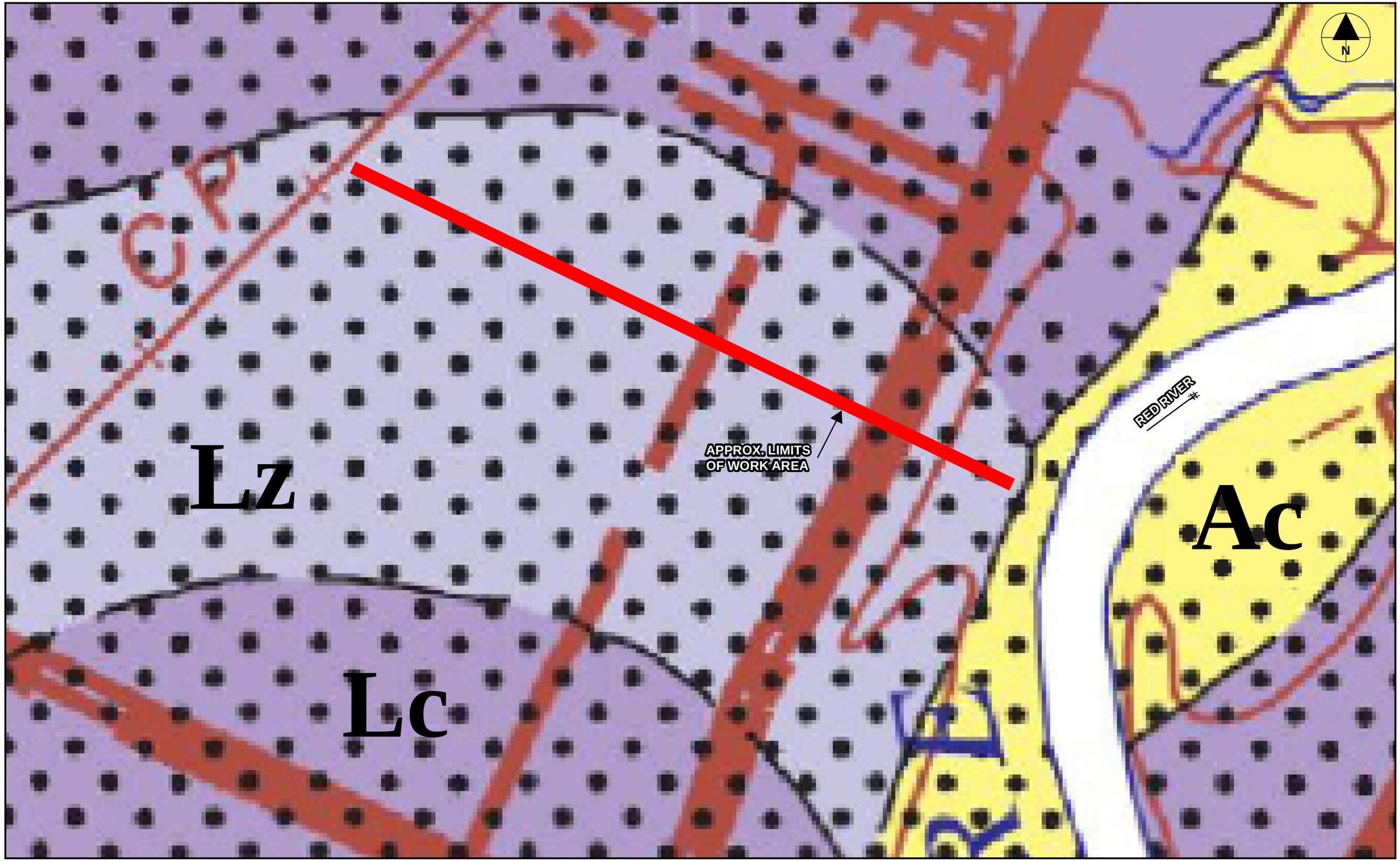
SEMPLE AVENUE TRUNK SEWER
GEOTECHNICAL DATA REPORT
CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT

SITE LOCATION PLAN AND SEMPLE AVENUE TRUNK SEWER ALIGNMENT

AECOM

FIGURE: 1

ANSI B 279.4mm x 431.8mm



SURFICIAL GEOLOGY LEGEND

	LITHOLOGY (MATERIAL)	LITHOGENSIS (ORIGINS OF MATERIAL)
Ac	CHANNEL DEPOSITS	ALLUVIAL SEDIMENTS: SAND AND GRAVEL, SAND, SILT, CLAY, ORGANIC DETRITUS; 1-20 m THICK; CHANNEL AND OVERBANK SEDIMENTS; DEPOSITED BY POSTGLACIAL RIVERS.
Lc	CLAY TO SILTY CLAY	OFFSHORE GLACIOLACUSTRINE SEDIMENTS: CLAY, SILT, MINOR SAND; 1-20 m THICK; VERY LOW RELIEF MASSIVE AND LAMINATED DEPOSITS; DEPOSITED FROM SUSPENSION IN OFFSHORE, DEEP WATER OF GLACIAL LAKE AGASSIZ, COMMONLY SCOURED AND HOMOGENIZED BY ICEBERGS.
Lz	CLAYEY TO SANDY SILT	OFFSHORE GLACIOLACUSTRINE SEDIMENTS: CLAY, SILT, MINOR SAND; 1-20 m THICK; VERY LOW RELIEF MASSIVE AND LAMINATED DEPOSITS; DEPOSITED FROM SUSPENSION IN OFFSHORE, DEEP WATER OF GLACIAL LAKE AGASSIZ, COMMONLY SCOURED AND HOMOGENIZED BY ICEBERGS.

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AECOM

FIGURE: 2

SURFICIAL GEOLOGY
(MATILE, G.L.D. 2004)

SEMPLE AVENUE TRUNK SEWER
GEOTECHNICAL DATA REPORT
CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT

ANSI B 279.4mm x 431.8mm

AECOM

FIGURE: 3

TEST HOLE LOCATION PLAN

SEMPLE AVENUE TRUNK SEWER
GEOTECHNICAL DATA REPORT
CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT

KINGSBURY AVE
BURRIN AVE
SEMPLE AVE
KILBRIDE AVE
BELMONT AVE
HARTFORD AVE
PERTH AVE
ST ANTHONY AVE
JEFFERSON AVE
SEVEN OAKS AVE
TAIT AVE
RUPERTSLAND BLVD
COLLEEN RD
JONES ST
FORREST AVE
ROYAL AVE
SCOTIA ST
REDRIVER
CP RAIL LINE
MCKENZIE ST
MCGREGOR ST
ANDREWS ST
POWERS ST
SALTER ST
AIKINS ST
MAIN ST
KILDONAN DR

TH19-01 TH19-02 TH19-03 TH19-04 TH19-05 TH19-06 TH19-07 TH19-08 TH19-09 (Not Drilled) TH19-10 TH19-11 TH19-12 TH19-13 TH19-14 TH19-15 TH19-16 TH19-17 SP11-13 SH15-01 TH11-14 WW15-02 TH11-12

EXISTING TIE-IN

TH11-11 TH11-10 TH11-09 TH11-08 TH11-07 TH11-06 TH11-01 TH11-02 TH11-04 TH11-05 TH11-03

NOTE:
LOCATION OF AECOM 2015 TEST HOLES ARE APPROXIMATE.

LEGEND

- SEMPLE AVE - TRUNK SEWER ALIGNMENT
- EXISTING LDS AND OUTFALL
- MANHOLE
- TEST HOLE (AECOM 2012)
- TEST HOLE (AECOM 2015)
- TEST HOLE (AECOM 2019)
- PIEZOMETER TEST HOLE (AECOM 2012)
- PIEZOMETER TEST HOLE (AECOM 2015)
- PIEZOMETER TEST HOLE (AECOM 2019)

60 0 60 120 m

1:6,000

NAD 1983 UTM Zone 14N

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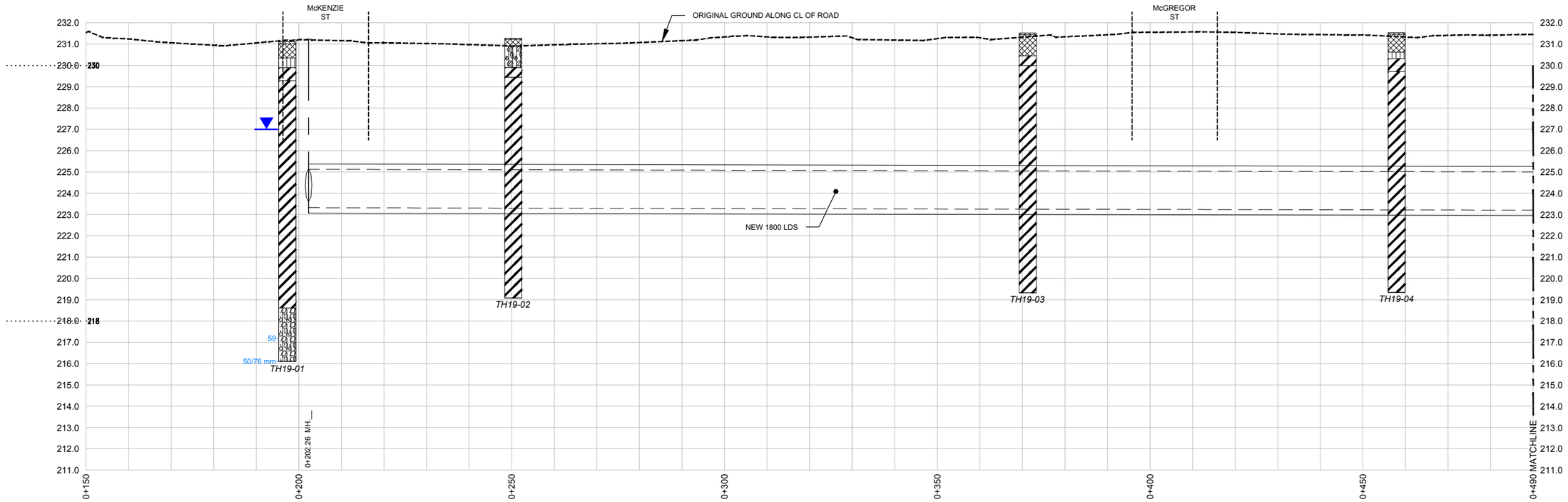
ANSI B 279.4mm x 431.8mm

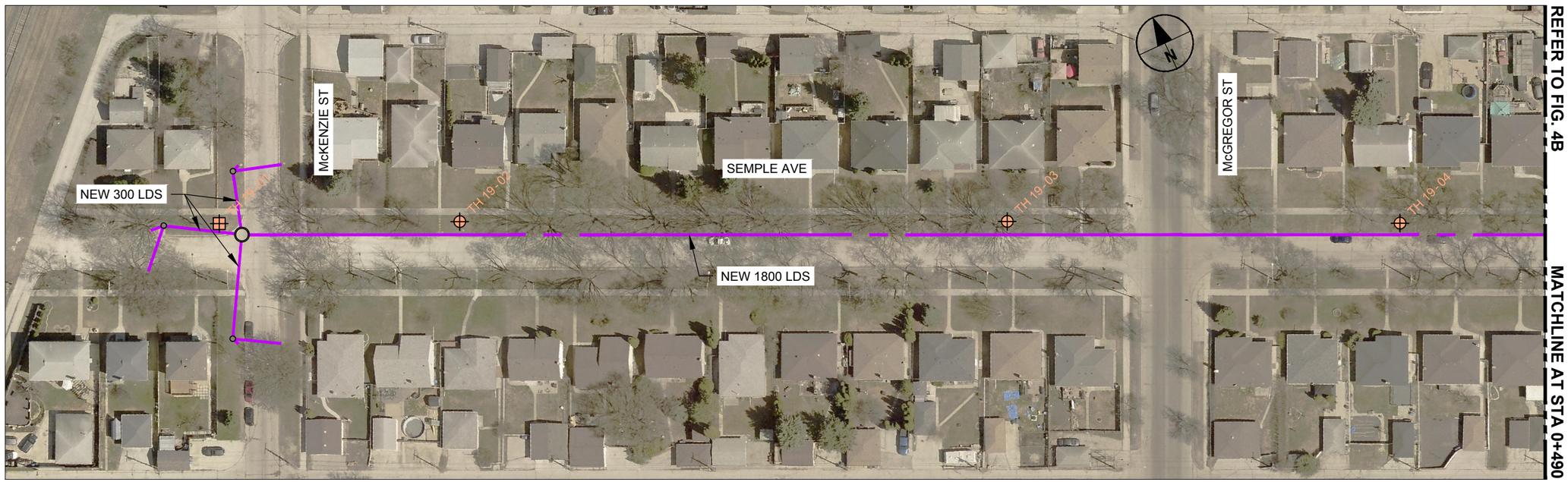
Project Management Initials: Designer: Checked: Approved:

LEGEND

TOPSOIL
FILL
SILTY SAND
INTERMEDIATE PLASTIC SILT
LOW PLASTIC SILT
HIGH PLASTIC CLAY
GLACIAL TILL
66 SPT (N) VALUES

NOTE 1: THIS FIGURE SHOULD BE USED FOR BASELINE PURPOSES ONLY AND SHOULD BE READ IN CONJUNCTION WITH THE GEOTECHNICAL BASELINE (GBR) AND DATA REPORT (GDR). THIS FIGURE PROVIDES BASELINE STRATIGRAPHIC CROSS SECTION ALONG THE TUNNEL SECTIONS ONLY. FOR BASELINE STRATIGRAPHIC CONDITIONS AT THE SHAFT LOCATIONS, REFER TO GBR.
NOTE 2: SUBSURFACE CONDITIONS ARE KNOWN ONLY AT THE TEST HOLE LOCATIONS. THE ACTUAL GROUND CONDITIONS BETWEEN THE TEST HOLES MAY VARY.
NOTE 3: DETAILED DESCRIPTIONS OF MATERIALS, CHARACTERISTICS AND VARIABILITY ANTICIPATED WITHIN EACH SOIL UNIT ARE PRESENTED IN THE GDR AND GBR. FOR DETAILS OF THE TEST HOLE LOGS AND GROUNDWATER MEASUREMENTS REFER TO GDR.
NOTE 4: LOCATION OF EXISTING UTILITIES ARE NOT SHOWN. FOR DETAILS ON EXISTING UTILITY LOCATIONS REFER TO DRAWINGS/SPECS.





REFER TO FIG. 4B

MATCHLINE AT STA 0+490

FIGURE: 4A

STRATIGRAPHIC SECTION OF SEMPLE AVENUE TRUNK SEWER ALIGNMENT STN 0+150 TO STN 0+490

SEMPLE AVENUE TRUNK SEWER
GEOTECHNICAL DATA REPORT
CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT

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Project Management Initials: ____ Designer: ____ Checked: ____ Approved: ____

LEGEND

TOPSOIL
FILL
SILTY SAND
INTERMEDIATE PLASTIC SILT
LOW PLASTIC SILT
HIGH PLASTIC CLAY
GLACIAL TILL
66 SPT (N) VALUES

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AECOM

FIGURE: 4B

STRATIGRAPHIC SECTION OF SEMPLE AVENUE TRUNK SEWER ALIGNMENT STN 0+490 TO STN 0+830

SEMPLE AVENUE TRUNK SEWER
GEOTECHNICAL DATA REPORT
CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT

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ANSI B 279.4mm x 431.8mm

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LEGEND

TOPSOIL
FILL
SILTY SAND
INTERMEDIATE PLASTIC SILT
LOW PLASTIC SILT
HIGH PLASTIC CLAY
GLACIAL TILL
66 SPT (N) VALUES

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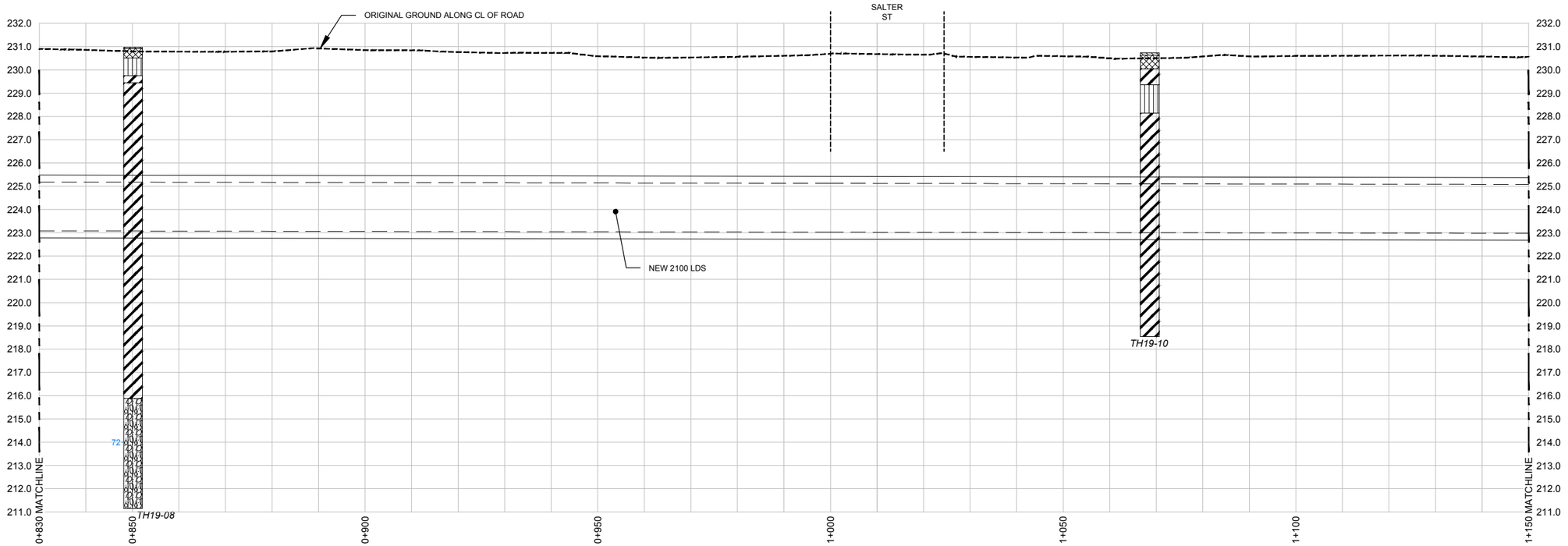

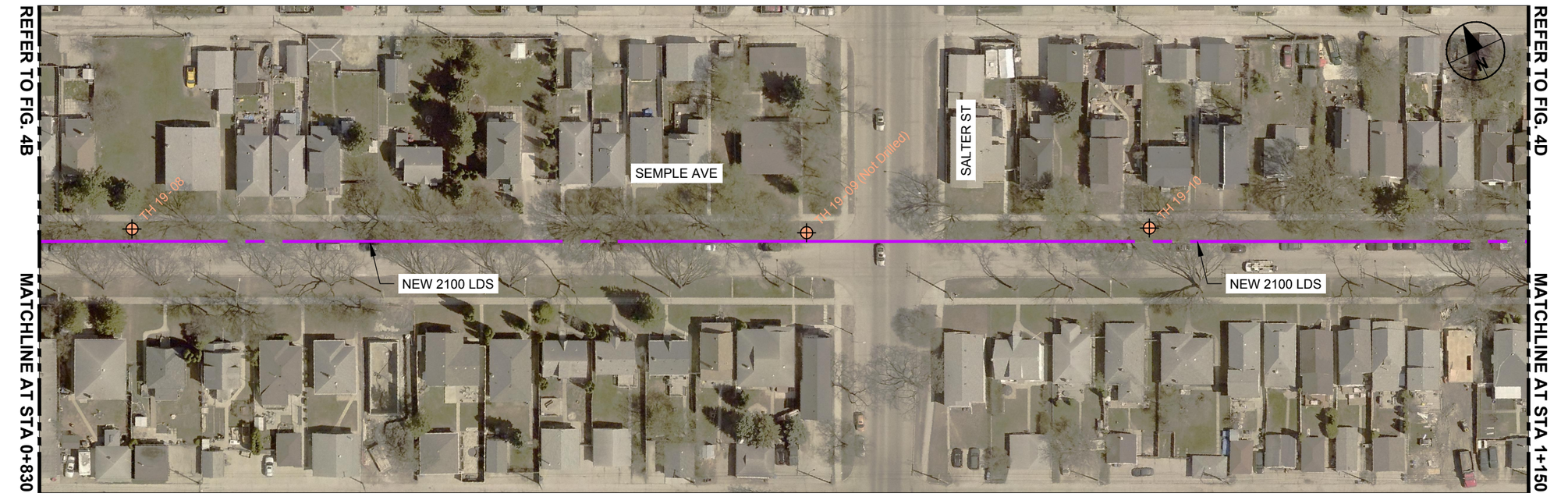

STRATIGRAPHIC SECTION OF SEMPLE AVENUE
TRUNK SEWER ALIGNMENT
STN 0+830 TO STN 1+150

SEMPLE AVENUE TRUNK SEWER
GEOTECHNICAL DATA REPORT
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FIGURE: 4C

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LEGEND

TOPSOIL
FILL
SILTY SAND
INTERMEDIATE PLASTIC SILT
LOW PLASTIC SILT
HIGH PLASTIC CLAY
GLACIAL TILL
66 SPT (N) VALUES

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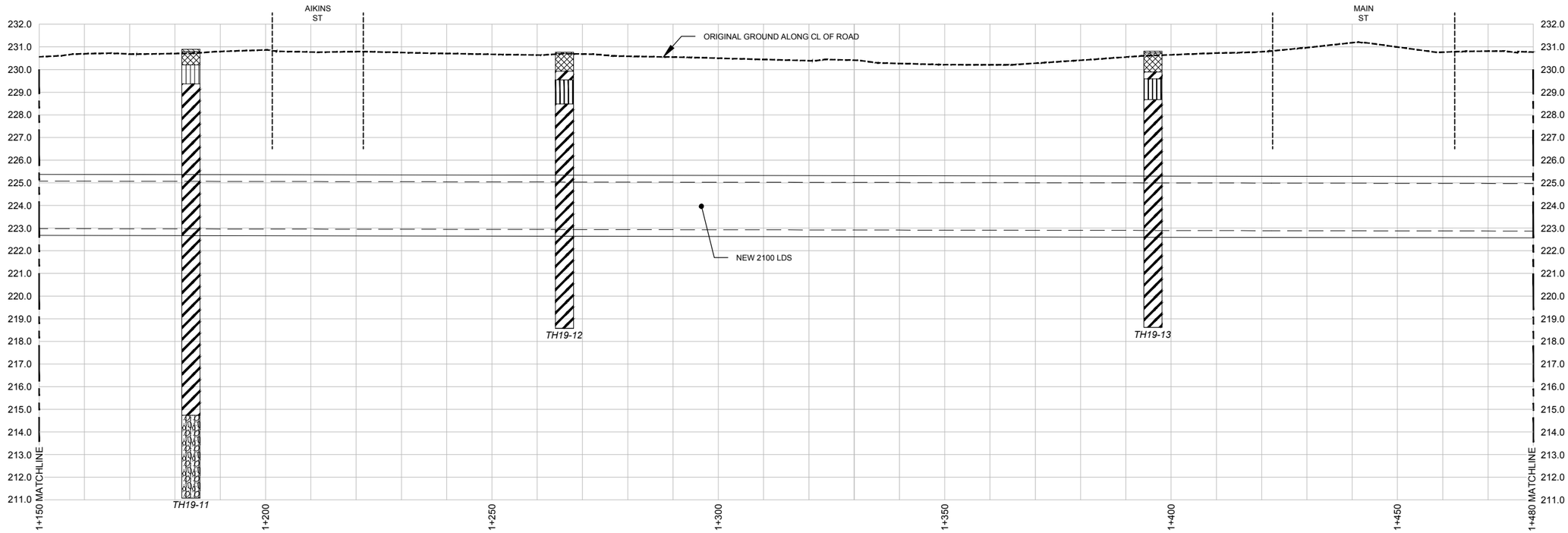

REFER TO FIG. 4C

MATCHLINE AT STA 1+150

REFER TO FIG. 4E

MATCHLINE AT STA 1+480

STRATIGRAPHIC SECTION OF SEMPLE AVENUE
TRUNK SEWER ALIGNMENT
STN 1+150 TO STN 1+480

SEMPLE AVENUE TRUNK SEWER
GEOTECHNICAL DATA REPORT
CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT

AECOM
FIGURE: 4D

ANSI B 279.4mm x 431.8mm
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LEGEND

TOPSOIL
FILL
SILTY SAND
INTERMEDIATE PLASTIC SILT
LOW PLASTIC SILT
HIGH PLASTIC CLAY
GLACIAL TILL
66 SPT (N) VALUES

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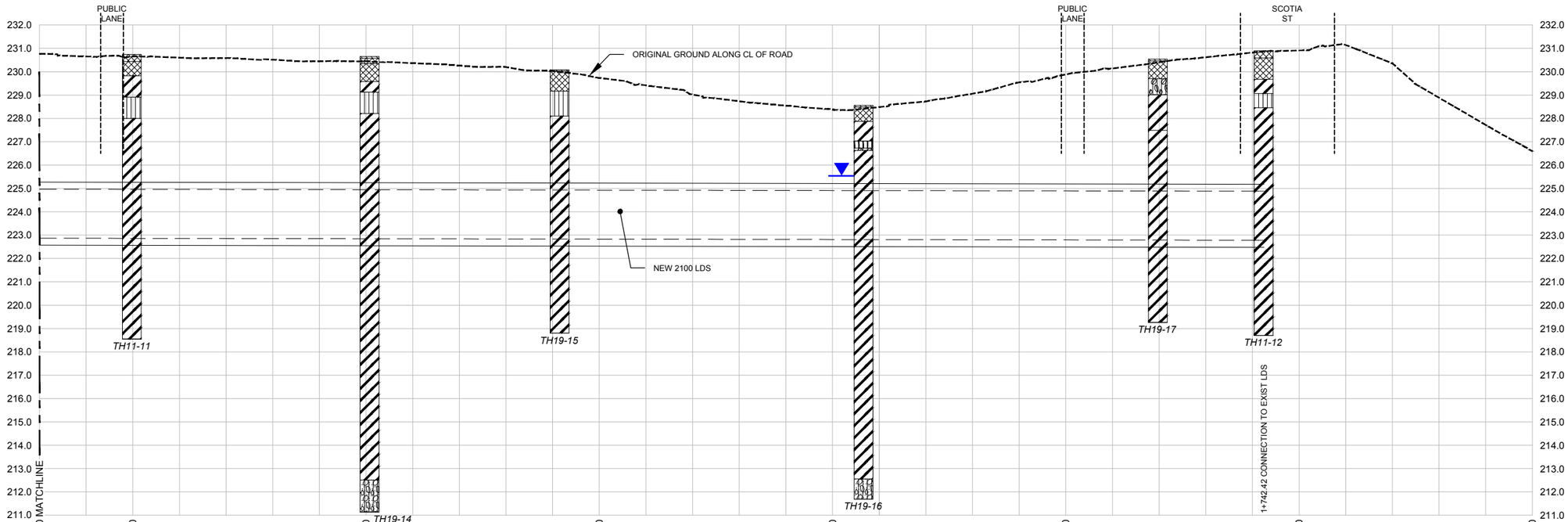

STRATIGRAPHIC SECTION OF SEMPLE AVENUE TRUNK SEWER ALIGNMENT STN 1+480 TO STN 1+800

SEMPLE AVENUE TRUNK SEWER
GEOTECHNICAL DATA REPORT
CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT

AECOM
FIGURE: 4E

ANSI B 279.4mm x 431.8mm
Project Management Initials: Designer: Checked: Approved:
Last saved by: COOPERKL (2019-10-08) Last Plotted: 2019-11-28
Filename: P:\60599385\900-CAD_GIS\910-CAD\25-SKETCHES\B\60599385-FIG-30-0000-B-1004.DWG

Appendix B

Previous Geotechnical Investigations Test Hole Logs

- B-1: AECOM (February 2012) Test Hole Logs
- B-2: AECOM (October 2015) Test Hole Logs

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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

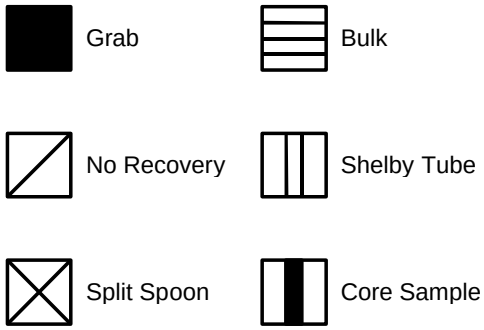
N	Consistency	C_u (kPa) approx.
0 - 1	Very Soft	<10
1 - 4	Soft	10 - 25
4 - 8	Firm	25 - 50
8 - 15	Stiff	50 - 100
15 - 30	Very Stiff	100 - 200
30 - 60	Hard	200 - 300
>60	Very Hard	>300

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*

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§††	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, % †††
						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

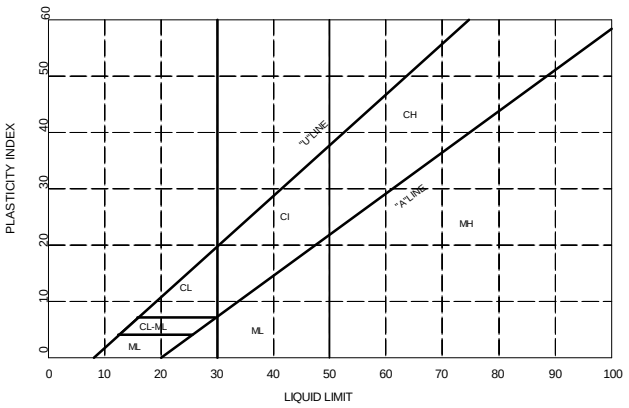
Soil Resistivity (ohm-cm)	Corrosivity Rating
>20,000	Essentially non-corrosive
10,000 – 20,000	Mildly corrosive
5,000 – 10,000	Moderately corrosive
3,000 – 5,000	Corrosive
1,000 – 3,000	Highly corrosive
<1,000	Extremely corrosive

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	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
				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	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
				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	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	
		$30 < W_L < 50$		CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50$		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)		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
		PASSING	RETAINED	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: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-01**
LOCATION: Scotia Street; Between Seven Oaks Boulevard and Jefferson Avenue (UTM: 14 N, 5 532 752.6, 635 379.8)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 229.15

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL (FILL)					229
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity					
1		CLAY - silty - brown, moist, firm - intermediate plasticity		G1			228
2		SILT - some clay, trace sand - light brown, moist, soft - low plasticity					227
3				G2			226
4							225
		- some sand, trace clay at 4.6 m		G3			
5							224
6				G4			223
		- some clay, some sand, grey below 6.7 m					
7							222
				G5			
8							221
9				G6			220
10							219
				G7			
11							218
12				G8			217
		END OF TEST HOLE AT 12.2 m IN SILT Notes: 1. No sloughing observed. 2. Seepage observed at 6.4 m below surface. 3. Test hole backfilled with auger cuttings and bentonite pellets.					
13							216
14							215
15							

PENETRATION TESTS: ✳ Becker ✳ | ◇ Dynamic Cone ◇ | ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU × | ☐ Lab Vane ☐ | △ Pocket Pen. △ | ✤ Field Vane ✤ (kPa) 50 100 150 200

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/12/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-02**
LOCATION: Scotia Street at Tait Avenue (UTM: 14 N, 5 532 592.2, 635 412.6)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 229.06

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

PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane; QU; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	ELEVATION
0		TOPSOIL (FILL)				
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity				
1		CLAY - trace silt - dark brown, moist, firm - high plasticity		G9		228
2		SILT - clayey, some sand - brown, moist, soft to firm - intermediate plasticity				227
3				G10		226
4		- trace clay, soft below 3.7 m				225
				G11		
5						224
		SAND - silty, some clay - brown, moist, loose				
6				G12	Gravel: 0.0%, Sand: 61.5%, Silt: 23.1%, Clay: 15.4%	223
7		SILT - some clay, some sand - grey, moist, soft to firm - intermediate plasticity				222
				G13		
8						221
9				G14		220
10						219
				G15		
11						218
12		- some gravel, wet below 11.9 m		G16		217
		END OF TEST HOLE AT 12.2 m IN SILT Notes: 1. No sloughing observed. 2. Seepage observed at 11.9 m below surface. 3. Test hole backfilled with auger cuttings and bentonite pellets.				
13						216
14						215
15						

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/12/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-03**
LOCATION: Rupertsland Boulevard; West of Scotia Street (UTM: 14 N, 5 532 453.2, 635 414.9)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 227.91

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

PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane; QU; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	ELEVATION
0		TOPSOIL (FILL)				
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity				
1		CLAY - silty, trace to some sand - brown, moist, soft - intermediate plasticity		G17		227
2						226
3		SILT - trace clay, trace sand - brown, moist, soft - low plasticity		G18		225
4						224
				G19		
5						223
6		CLAY - silty, trace to some sand - grey, moist, firm - intermediate to high plasticity		G20		222
7		SILT - sandy, trace clay - grey, moist, soft - low to intermediate plasticity		G21		221
8						220
9		SAND - silty - brown, moist, loose		G22		219
10		CLAY - silty - grey, moist, soft - intermediate plasticity		G23		218
11						217
		- some gravel below 11.6 m		G24		
12		CLAY - some silt, trace sand, grey, moist, firm, high plasticity		G25		216
		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. Seepage observed at 5.5 m below surface. 3. Test hole backfilled with auger cuttings and bentonite pellets.				
13						215
14						214
15						213

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/12/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-04**
LOCATION: Mac Steet; Between Rupertsland Boulevard and Tait Avenue (UTM: 14 N, 5 532 609.5, 635 216.2)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 228.68

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL (FILL)					
		CLAY (FILL) - some silty to silty, trace to some sand - brown, moist, firm - high plasticity		G51			228
1							
2							227
3				G52			226
		CLAY - trace to some silt, trace to some sand - brown, moist, stiff to firm - high plasticity					225
4				G53			224
5							
6				G54			223
		- grey below 6.4 m					222
7							
				G55			221
8							
9				G56			220
							219
10		SILT - trace clay - light brown, moist to wet, very soft - low plasticity		G57			218
11							
		CLAY - silty, trace sand - grey, moist, soft - high plasticity					217
12				G58			216
		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.					
13							215
14							214
15							

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU × ☐ Lab Vane ☐ △ Pocket Pen. △ ⊕ Field Vane ⊕ (kPa) 50 100 150 200

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/13/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-05**
LOCATION: Jones Street at Colleen Road (UTM: 14 N, 5 532 613.7, 634 999.3)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 229.10

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

PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane; QU; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	ELEVATION
0		TOPSOIL (FILL)				229
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity				
1		CLAY - silty, trace sand - dark grey, moist, firm - high plasticity - brown below 1.5 m		G26		228
2						227
3				G27		226
4		- trace silt, firm to soft below 3.7 m				225
				G28		
5						224
6				G29		223
7		- soft below 6.7 m				222
				G30		
8						221
9				G31		220
10						219
				G32		
11						218
12				G33		217
		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.				
13						216
14						215
15						

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/12/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-06**
LOCATION: Seven Oaks Boulevard; Between Jones Street and Scotia Street (UTM: 14 N, 5 532 779.6, 635 215.3)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 230.77

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PENETRATION TESTS: ✳ Becker ✳; ◇ Dynamic Cone ◇; ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH: + Torvane +; × QU ×; □ Lab Vane □; △ Pocket Pen. △; ✣ Field Vane ✣ (kPa) 50 100 150 200	COMMENTS	ELEVATION
0		TOPSOIL (FILL)						
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity						
1								230
		CLAY - silty, trace sand, brown, moist, firm - high plasticity		G42	●			
2		SILT - trace clay, trace sand - light brown, moist, soft - low plasticity		G43	●			229
		CLAY - some silt to silty, trace sand - brown, moist, firm - high plasticity		G44	●			
3								228
4								227
				G45	●	△+		
5								226
6				G46	●	△+		225
		- soft below 6.7 m						
7								224
				G47	●	△+		
8								223
		- grey below 8.2 m						
9				G48	●	△+		222
10								221
				G49	●			
11								220
12		- trace gravel (<12 mm dia.)		G50	●			219
		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.						
13								218
14								217
15								216

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/13/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-07**
LOCATION: Seven Oaks Boulevard; East of Main Street (UTM: 14 N, 5 532 903.1, 634 952.4)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 229.91

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

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ ✣ Field Vane ✣ (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	ELEVATION
0		TOPSOIL (FILL)				
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity				
1						229
		SILT - clayey, trace sand, trace gravel - brown, moist, soft - intermediate plasticity		G34	Gravel: 0.6%, Sand: 4.6%, Silt: 69.9%, Clay: 24.9%	
2						228
		CLAY - some silt to silty, trace sand - brown, moist, firm - high plasticty		G35		
3						227
		- trace silt below 3.7 m				
4						226
		- soft below 4.6 m		G36		
5						225
6				G37		224
7						223
				G38		
8						222
9				G39		221
10						220
				G40		
11						219
12				G41		218
		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.				
13						217
14						216
15						215

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/12/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-08**
LOCATION: Jones Street at St. Anthony Avenue (UTM: 14 N, 5 533 005.7, 635 169.6)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 229.85

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL (FILL)					
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity					
1							229
		CLAY -some silt to silty, trace sand - brown, moist, stiff - high plasticity		G77			
2							228
3		- trace silt inclusions (<5 mm dia.), firm below 3.0 m		G78			227
4							226
				G79			
5		- grey, soft to firm below 4.9 m					225
6				G80			224
7		- soft below 6.7 m					223
				G81			
8							222
9				G82			221
10							220
				G83			
11							219
12				G84			218
		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.					
13							217
14							216
15							215

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU × ☐ Lab Vane ☐ △ Pocket Pen. △ ✣ Field Vane ✣ (kPa) 50 100 150 200

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/13/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-09**
LOCATION: Jones Street at Hartford Avenue (UTM: 14 N, 5 533 159.7, 635 238.0)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 228.71

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL (FILL)					
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity					228
1		CLAY - some silt, trace sand, brown, moist, stiff, high plasticity		G85			
		SILT - clayey, trace to some sand, brown, moist, soft, low to intermediate plasticity		G86			227
2		CLAY - some silt, trace sand, trace silt inclusions (<5 mm dia.) - brown, moist, firm - high plasticity					
3				G87			226
4							225
		- firm to soft below 4.3 m		G88			
5							224
		- grey below 5.5 m					
6				G89			223
		- soft below 6.7 m					
7							222
				G90			
8							221
9				G91			220
10							219
				G92			
11							218
12				G93			217
		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.					216
13							215
14							
15							214

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU × ☐ Lab Vane ☐ △ Pocket Pen. △ ✣ Field Vane ✣ (kPa) 50 100 150 200

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/13/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-10**
LOCATION: Scotia Street at Belmont Avenue (UTM: 14 N, 5 533 204.8, 635 369.7)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 230.67

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

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU × ☐ Lab Vane ☐ △ Pocket Pen. △ ⊕ Field Vane ⊕ (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	ELEVATION
0		TOPSOIL (FILL)			230
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity			
1					229
		CLAY - some silt to silty, trace sand, brown, moist, firm - high plasticity		G94	
2		SILT - trace to some clay, trace sand - light brown, moist, soft - low plasticity		G95	228
3		CLAY - trace to some silt, trace sand - brown, moist, firm - high plasticity		G96	
4		- grey, soft below 4.0 m			227
				G97	
5					226
6				G98	
7					225
				G99	
8					224
9				G100	
10					223
				G101	
11					222
12				G102	
		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.			221
13					220
14					219
15					218
					217
					216

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/14/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-11**
LOCATION: Semple Avenue; East of Main Street (UTM: 14 N, 5 533 432.1, 635 210.0)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 230.74

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL (FILL)					
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity					
1		CLAY - trace to some silt, trace sand - brown, moist, stiff - high plasticity		G68			230
2		SILT - some sand, trace clay - light brown, moist, soft - low plasticity		G69			229
3		CLAY - trace silt to some silt, trace sand - brown, moist, firm to stiff - high plasticity		G70			228
4		- firm to soft below 4.0 m		G71	△		227
5							226
6				G72	△+		225
7		- trace silt inclusions (<5 mm dia.), soft below 7.0 m		G73			224
8							223
9				G74			222
10							221
11				G75			220
12				G76			219
13		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.					218
14							217
15							216

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU × ☐ Lab Vane ☐ △ Pocket Pen. △ ⚉ Field Vane ⚉ (kPa) 50 100 150 200

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/13/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-12**
LOCATION: Scotia Street at Semple Avenue (UTM: 14 N, 5 533 321.9, 635 426.4)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 230.89

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	ELEVATION
0		TOPSOIL (FILL)			
		CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity			
1					230
		CLAY - trace to some silt, trace sand, brown, moist, stiff - high plasticity		G59	
2		SILT - trace to some clay, trace sand, light brown, moist, soft - low plasticity		G60	229
		CLAY - trace to some silt, trace sand - brown, moist, stiff - high plasticity		G61	
3					228
		- firm below 3.7 m			
4					227
				G62	
5					226
6				G63	225
		- grey, soft below 6.4 m			
7					224
				G64	
8					223
9				G65	222
		- trace sand, trace gravel (<12 mm dia.) below 9.8 m			
10					221
				G66	
11					220
12				G67	219
		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.			
13					218
14					217
15					216

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100
■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21
Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ ✣ Field Vane ✣ (kPa) 50 100 150 200

COMMENTS

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/13/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 1

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **SP 11-13**
LOCATION: Upper Outfall Area; East of Scotia Street (UTM: 14 N, 5 533 354.1, 635 496.6)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 230.58

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

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

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	ELEVATION
0	TOPSOIL (FILL)				230
	CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm, intermediate to high plasticity				
1	CLAY - trace to some silt - brown, moist, firm - high plasticity		G115		229
2	SILT - some sand, trace to some clay - light brown, moist, soft - low plasticity		G116		228
3	CLAY - some silt - brown, moist, firm - high plasticity		G117 T118	Gravel: 0.0%, Sand: 0.0%, Silt: 14.6%, Clay: 85.4%	227
4					
			G119		226
5					
					225
6			G120		
					224
7					
	- grey below 7.3 m		G121		223
8					
					222
9			G122 T123		
					221
10					
			G124		220
11	- trace gravel (<12 mm dia.), soft below 10.7 m				
					219
12			G125		
					218
13					
					217
14			G126		
15					216

PENETRATION TESTS: ✳ Becker ✳ | ◇ Dynamic Cone ◇ | ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU × | □ Lab Vane □ | △ Pocket Pen. △ | ✣ Field Vane ✣ (kPa) 50 100 150 200

AECOM	LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 19.51 m
	REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/14/11
	PROJECT ENGINEER: Eymond Toupin	Page 1 of 2

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **SP 11-13**
LOCATION: Upper Outfall Area; East of Scotia Street (UTM: 14 N, 5 533 354.1, 635 496.6)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 230.58

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

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

DEPTH (m)	SOIL SYMBOL	SLOTTED PIEZOMETER	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
15					G127			215
16								
17					G128			214
18			CLAY and SILT - some gravel, some sand, grey, moist, soft, intermediate plasticity		G129			213
			CLAY - grey, moist, soft, high plasticity		G130			212
19			SILT (Till) - some clay to clayey, some gravel, trace sand - brown, moist to wet, compact - low plasticity		G131			211
20			END OF TEST HOLE AT 19.5 m IN SILT (TILL)					210
21			Notes: 1. Power auger refusal encountered at 19.5 m below surface. 2. No sloughing observed. 3. No seepage observed. 4. Standpipe piezometer (SP-11-13) installed with Casagrande tip and 0.99 m stick-up. Above ground protective casing installed with lock. 5. Test hole backfilled with silica sand to 18.1 m below surface followed by bentonite chips to surface. 6. On January 6, 2012, a water level 7.8 m below ground level was observed and recorded.					209
22								208
23								207
24								206
25								205
26								204
27								203
28								202
29								201
30								

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU × ☐ Lab Vane ☐ △ Pocket Pen. △ ✣ Field Vane ✣ (kPa) 50 100 150 200

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 19.51 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/14/11
PROJECT ENGINEER: Eymond Toupin	Page 2 of 2

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-14**
LOCATION: Lower Outfall Area; East of Scotia Street (UTM: 14 N, 5 533 345.7, 635 513.5)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 226.96

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

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	ELEVATION
0		TOPSOIL (FILL)				
		SILT - trace to some sand, trace clay, light brown, moist, soft - low plasticity		G103		
1		CLAY - some silt, trace sand - brown, moist, firm to stiff - high plasticity		G104		226
2						225
3				G105	Gravel: 0.0%, Sand: 2.2%, Silt: 16.8%, Clay: 81.0%	224
				T106		
4						223
		- trace silt inclusions (<5 mm dia.), grey below 4.6 m		G107		
5						222
6				G108		221
7		- trace gravel, (<12 mm dia.), soft below 7.0 m				220
				G109		
8						219
		SILT - trace sand, trace gravel (<12 mm dia.) - light brown, moist, soft - low plasticity				
9				G110		218
		CLAY - trace silt to some silt, trace sand, trace gravel (<12 mm dia.) - grey, moist, soft - high plasticity				
10						217
				G111		
11						216
12				G112		215
13						214
				G113		
14		SILT (Till) - some clay to clayey, some gravel (<12 mm dia.), trace sand - light brown, moist, soft - low to intermediate plasticity				213
15						

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 15.54 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/14/11
PROJECT ENGINEER: Eymond Toupin	Page 1 of 2

PROJECT: Jefferson East CSR D&C	CLIENT: City of Winnipeg	TESTHOLE NO: **TH 11-14**
LOCATION: Lower Outfall Area; East of Scotia Street (UTM: 14 N, 5 533 345.7, 635 513.5)		PROJECT NO.: 60219315
CONTRACTOR: Paddock Drilling Ltd.	METHOD: RM-30, 125 mm SSA	ELEVATION (m): 226.96

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
15				G114			
		END OF TEST HOLE AT 15.5 m IN SILT (TILL) Notes: 1. Power auger refusal encountered at 15.5 m below surface. 2. No sloughing observed. 3. No seepage observed. 4. Test hole backfilled with auger cuttings and bentonite pellets.					
16							211
17							210
18							209
19							208
20							207
21							206
22							205
23							204
24							203
25							202
26							201
27							200
28							199
29							198
30							

PENETRATION TESTS: ✳ Becker ✳ | ◇ Dynamic Cone ◇ | ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU × | ☐ Lab Vane ☐ | △ Pocket Pen. △ | ✣ Field Vane ✣ (kPa) 50 100 150 200

AECOM

LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 15.54 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 12/14/11
PROJECT ENGINEER: Eymond Toupin	Page 2 of 2

LOG OF TEST HOLE JEFFERSON EAST LOGS.GPJ UMA WINN.GDT 1/23/12

PROJECT: Jefferson East CSR - Semple Outfall	CLIENT: City of Winnipeg	TESTHOLE NO: **SI15-01**
LOCATION: North of the Proposed Outfall Pipe, 4 m West of Lower Slope		PROJECT NO.: 60219315
CONTRACTOR: Maple Leaf Drilling Ltd.	METHOD: MP5 Track Mounted-125mm SSA/HQ Barrel	ELEVATION (m): 227.00

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

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

DEPTH (m)	SOIL SYMBOL	SLOPE INCLINOMETER	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH: + Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ ✠ Field Vane ✠ (kPa) 50 100 150 200	COMMENTS	ELEVATION (m)
0			TOPSOIL - black, rootlets, frozen						
			CLAY - silty, trace sand, silt inclusions (<3 mm dia.) - brown mottled grey, stiff, moist - high plasticity - G1: Gravel: 0%, Sand: 5.9%, Silt: 25.3%, Clay: 68.8%		G1				
1					G2				226
			- G3: Gravel: 0%, Sand: 6.6%, Silt: 29.5%, Clay: 63.9%		G3				
			SILT - trace sand, trace gravel - light grey, loose, moist - fine grained		G5				
2			CLAY (Lacustrine) - some silt, silt inclusions (<5 mm dia.) - brown mottled grey, firm, moist - high plasticity		G6				225
			- grey below 2.7 m		G7				
3					G8		△		224
4			- silt pockets (<50 mm dia.) at 4 m		G10		△		223
					T11				
5					G12		△		222
6					G14		△		221
7					G16		△		220
8					G19		△		219
9			- very soft, trace to some silt below 9.1 m		G21		△		218
10									

AECOM

LOGGED BY: Mustafa Alkiki	COMPLETION DEPTH: 22.61 m
REVIEWED BY: Zeyad Shukri	COMPLETION DATE: 2/24/15
PROJECT ENGINEER: Eymond Toupin	Page 1 of 3

LOG OF TEST HOLE JEFFERSON CSR - SEMPLE OUTFALL_TEST HOLE LOGS_REV 02.GPJ UMA WINN.GDT 10/26/15

PROJECT: Jefferson East CSR - Semple Outfall	CLIENT: City of Winnipeg	TESTHOLE NO: **SI15-01**
LOCATION: North of the Proposed Outfall Pipe, 4 m West of Lower Slope		PROJECT NO.: 60219315
CONTRACTOR: Maple Leaf Drilling Ltd.	METHOD: MP5 Track Mounted-125mm SSA/HQ Barrel	ELEVATION (m): 227.00

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

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

DEPTH (m)	SOIL SYMBOL	SLOPE INCLINOMETER	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH: + Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ ☢ Field Vane ☢ (kPa) 50 100 150 200	COMMENTS	ELEVATION (m)
10									
					G23				
11									216
					G25				
12									215
					G27				
13									214
					G29				
14									213
					G31				
15									212
			SILT (Till) - some clay, some sand, trace gravel (<5 mm dia., subangular) - brown, compact, moist to wet - low plasticity						
16									211
					G33				
17			- very dense below 17.4 m						210
18									209
19									208
20									

LOG OF TEST HOLE JEFFERSON CSR - SEMPLE OUTFALL_TEST HOLE LOGS_REV 02.GPJ UMA WINN.GDT 10/26/15

AECOM

LOGGED BY: Mustafa Alkiki	COMPLETION DEPTH: 22.61 m
REVIEWED BY: Zeyad Shukri	COMPLETION DATE: 2/24/15
PROJECT ENGINEER: Eymond Toupin	Page 2 of 3

PROJECT: Jefferson East CSR - Semple Outfall	CLIENT: City of Winnipeg	TESTHOLE NO: **SI15-01**
LOCATION: North of the Proposed Outfall Pipe, 4 m West of Lower Slope		PROJECT NO.: 60219315
CONTRACTOR: Maple Leaf Drilling Ltd.	METHOD: MP5 Track Mounted-125mm SSA/HQ Barrel	ELEVATION (m): 227.00

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

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

DEPTH (m)	SOIL SYMBOL	SLOPE INCLINOMETER	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION (m)
20									
21									206
22			BEDROCK (Limestone)						205
			END OF TEST HOLE AT 22.61 m IN BEDROCK (LIMESTONE)						
23			Notes: 1. Power auger refusal at 17.4 m below grade. 2. Switched to HQ barrel below 17.4 m. 3. No sloughing observed during drilling. 4. Seepage observed at 9 and 12.8 m below grade. 5. Installed slope inclinometer (SI15-01) to 22.6 m. 6. Test hole backfiled with cement/grout to ground surface.						204
24									203
25									202
26									201
27									200
28									199
29									198
30									

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ ☘ Field Vane ☘ (kPa) 50 100 150 200

AECOM

LOGGED BY: Mustafa Alkiki	COMPLETION DEPTH: 22.61 m
REVIEWED BY: Zeyad Shukri	COMPLETION DATE: 2/24/15
PROJECT ENGINEER: Eymond Toupin	Page 3 of 3

LOG OF TEST HOLE JEFFERSON CSR - SEMPLE OUTFALL_TEST HOLE LOGS_REV 02.GPJ UMA WINN.GDT 10/26/15

PROJECT: Jefferson East CSR - Semple Outfall	CLIENT: City of Winnipeg	TESTHOLE NO: **VW15-02**
LOCATION: South of the Proposed Outfall Pipe, 15 m West of Lower Slope		PROJECT NO.: 60219315
CONTRACTOR: Maple Leaf Drilling Ltd.	METHOD: MP5 Track Mounted-125mm SSA/HQ Barrel	ELEVATION (m): 227.00

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

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH: + Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ ✤ Field Vane ✤ (kPa) 50 100 150 200	COMMENTS	ELEVATION (m)
0		TOPSOIL - black, rootlets, frozen							
		CLAY - silty, some sand - brown, stiff, moist - high plasticity		G35					
1		SILT - sandy - brown, loose, moist - fine grained							226
		CLAY - silty, trace sand, silt inclusions (<5 mm dia.) - brown mottled grey, firm, moist - high plasticity		G36					
2		SILT - some sand, trace gravel - light grey, loose, moist							225
		CLAY (Lacustrine) - some silt, silt inclusions (<5 mm dia.) - brown mottled grey, firm, moist - high plasticity - grey below 2.4 m							
3									224
4									223
5									222
6									221
7									220
		- very soft below 7.6 m							
8									219
9									218
10									

AECOM

LOGGED BY: Mustafa Alkiki	COMPLETION DEPTH: 12.50 m
REVIEWED BY: Zeyad Shukri	COMPLETION DATE: 2/24/15
PROJECT ENGINEER: Eymond Toupin	Page 1 of 2

LOG OF TEST HOLE JEFFERSON CSR - SEMPLE OUTFALL_TEST HOLE LOGS_REV 02.GPJ UMA WINN.GDT 10/26/15

PROJECT: Jefferson East CSR - Semple Outfall	CLIENT: City of Winnipeg	TESTHOLE NO: **VW15-02**
LOCATION: South of the Proposed Outfall Pipe, 15 m West of Lower Slope		PROJECT NO.: 60219315
CONTRACTOR: Maple Leaf Drilling Ltd.	METHOD: MP5 Track Mounted-125mm SSA/HQ Barrel	ELEVATION (m): 227.00

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

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

DEPTH (m)	SOIL SYMBOL	VW PIEZOMETER	VW PIEZOMETER	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH: + Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ ☘ Field Vane ☘ (kPa) 50 100 150 200	COMMENTS	ELEVATION (m)
10										
11										216
12										215
13				**END OF TEST HOLE AT 12.50 m IN CLAY (Lacustrine)**						214
14				Notes: 1. No sloughing observed during drilling. 2. Seepage observed ay 9.6 m below grade. 3. Squeexing below 8.3 m 4. Installed VW15-02 and VW15-03 in test hole at 5.8 and 12 m, respectivly. 5. Test hole backfilled with cement/grout (full depth).						213
15										212
16										211
17										210
18										209
19										208
20										

LOG OF TEST HOLE JEFFERSON CSR - SEMPLE OUTFALL_TEST HOLE LOGS_REV 02.GPJ UMA WINN.GDT 10/26/15

AECOM

LOGGED BY: Mustafa Alkiki	COMPLETION DEPTH: 12.50 m
REVIEWED BY: Zeyad Shukri	COMPLETION DATE: 2/24/15
PROJECT ENGINEER: Eymond Toupin	Page 2 of 2

Appendix C

AECOM (June 2019) Geotechnical Investigation Test Hole Logs

- AECOM (June 2019) Geotechnical Investigation Test Hole Logs

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

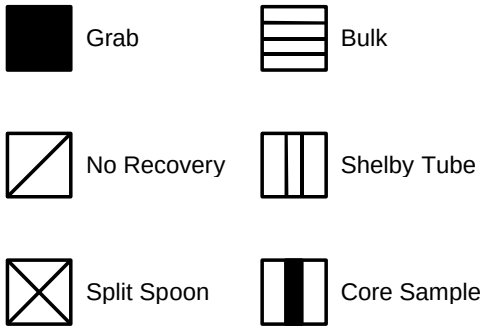
N	Consistency	C_u (kPa) approx.
0 - 1	Very Soft	<10
1 - 4	Soft	10 - 25
4 - 8	Firm	25 - 50
8 - 15	Stiff	50 - 100
15 - 30	Very Stiff	100 - 200
30 - 60	Hard	200 - 300
>60	Very Hard	>300

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*

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§††	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, % †††
						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

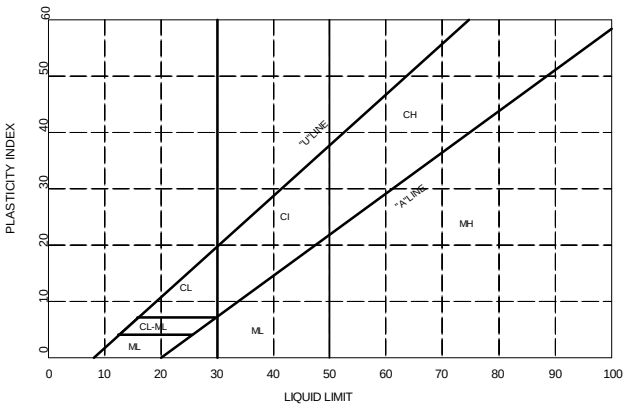
Soil Resistivity (ohm-cm)	Corrosivity Rating
>20,000	Essentially non-corrosive
10,000 – 20,000	Mildly corrosive
5,000 – 10,000	Moderately corrosive
3,000 – 5,000	Corrosive
1,000 – 3,000	Highly corrosive
<1,000	Extremely corrosive

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	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
				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	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
				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	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	
		$30 < W_L < 50$		CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50$		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)		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
		PASSING	RETAINED	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: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-01
LOCATION: UTM 14 - 5533995 m N, 634036 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Canterra CT-250 - 125 mm SSA	ELEVATION (m): 231.11

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

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

DEPTH (m)	SOIL SYMBOL	SLOTTED PIEZOMETER	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0			TOPSOIL - black, moist					231
			CLAY (Fill) - silty, some sand, trace gravel - dark grey, firm, moist - high plasticity - light brown below 0.6 m					
1			SILT - sandy, some clay - light brown, moist - low plasticity		G1A			230
			CLAY - silty, some sand - dark brown, firm, moist - high plasticity		G1			
2			CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)					229
3								228
					T2		Tube Recovery: 100%	
4								227
					G3			
5								226
6					G4			225
			- grey below 6.1 m					
7								224
8					T5		Tube Recovery: 100%	223
9					G6			222
10								

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 15.01 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/27/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-01
LOCATION: UTM 14 - 5533995 m N, 634036 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Canterra CT-250 - 125 mm SSA	ELEVATION (m): 231.11

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

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

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
10						221
	- trace gravel, trace to some silt till inclusions (<10 mm diam.) below 10.7 m		G7			
11						220
12						219
	SILT and SAND (Till) - clayey, trace to some gravel - light brown, moist		T8		Tube Recovery: 100%	
13						218
	- some clay, very dense, dry to moist below 13.7 m		S9	59	SPT Blows: [9/30/29], Spoon Recovery: 83%	
14						217
15			S10	50/ 76mm	SPT Blows: [50 (76 mm)], Spoon Recovery: 17%	216
	END OF TEST HOLE AT 15.01 m IN TILL (SPT REFUSAL)					
16						215
17						214
18						213
19						212
20						

Notes:
1. Seepage observed below 13.7 m during augering.
2. Sloughing observed below 13.4 m during augering.
4. Test hole open to 13.4 m upon completion of augering.
5. Auger refusal at 14.9 m in sand (till).
6. Test hole backfilled with sand from 13.4 m to 11.3 m, bentonite from 11.3 m to 10.4 m, auger cuttings from 10.4 m to 0.6 m, and sand from 0.6 m to 0.3 m. Flush-mount cover installed.
7. Groundwater monitoring:
   - August 6, 2019 at elev. 226.98 m (4.13 m bgs)
   - August 20, 2019 at elev. 226.90 m (4.21 m bgs)
   - September 3, 2019 at elev. 226.94 m (4.17 m bgs)

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 15.01 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/27/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-02
LOCATION: UTM 14 - 5533973 m N, 634084 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.28

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL - black, moist						231
		CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark grey, firm, moist, high plasticity						
1		SAND - silty, trace clay - light brown, moist		G16A				230
		CLAY - silty, some sand - dark brown, firm, moist - high plasticity		G16				
2		CLAY (Lacustrine) - some silt to silty, trace sand, trace gravel - brown mottled grey, firm, moist - high plasticity - trace silt inclusions (<15 mm diam.)						229
3				G17				228
4								227
				G18				
		- grey below 4.6 m						
5								226
6		- silty, some sand, stiff below 6.1 m						225
				T19			Tube Recovery: 100%, (T19) Gravel: 2.0%, Sand: 19.0%, Silt: 35.0%, Clay: 44.0%, Swell: (3.1%, 120 kPa)	
7								224
				G20				
8								223
9				G21				
								222
10								

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-02
LOCATION: UTM 14 - 5533973 m N, 634084 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.28

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
10								221
		- trace silt till inclusions (<15 mm diam.) below 10.7 m		G22				
11								220
12				G23				219
		END OF TEST HOLE AT 12.19 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.						
13								218
14								217
15								216
16								215
17								214
18								213
19								212
20								

PENETRATION TESTS: ✳ Becker ✳ | ◇ Dynamic Cone ◇ | ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU/2 × | ☐ Lab Vane ☐ | △ Pocket Pen. △ | ⚉ Field Vane ⚉ (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-03
LOCATION: UTM 14 - 5533922 m N, 634193 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.52

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ▩ SPLIT SPOON ▤ BULK ▨ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL - black, moist						231
		SILT (Fill) - sandy, some clay - light brown, moist - low plasticity						
1		CLAY - silty, some sand - dark brown, firm, moist - high plasticity	■	G24				230
		CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)						
2								229
3			■	G25				
								228
4		- grey below 4.0 m						
			■	G26				227
5								
								226
6			■	G27				
								225
7								
			■	G28				224
8								
								223
9		- trace gravel, firm, trace silt till inclusions (<25 mm diam.) below 9.1 m	▥	T29			Tube Recovery: 100%	
								222
10								

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m³) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU/2 × ☐ Lab Vane ☐ △ Pocket Pen. △ ⬘ Field Vane ⬘ (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-03
LOCATION: UTM 14 - 5533922 m N, 634193 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.52

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

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
10							221
11				G30			220
12							
		END OF TEST HOLE AT 12.19 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.		G31			219
13							218
14							217
15							216
16							215
17							214
18							213
19							212
20							

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-04
LOCATION: UTM 14 - 5533885 m N, 634272 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.54

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL - black, moist						231
		CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark grey, firm, moist - intermediate to high plasticity						
1		SILT - sandy, some clay - light brown, moist, low plasticity		G32A				
		CLAY - silty, some sand - dark brown, firm to stiff, moist - high plasticity		G32				230
2		CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm, moist - high plasticity - trace silt inclusions (<15 mm diam.)						229
3				G33				
								228
4								
				G34				227
5								
								226
6		- grey below 6.1 m		G35				
								225
7								
								224
8				T36			Tube Recovery: 0%	
								223
9				G37				
								222
10								

PENETRATION TESTS: Becker ✳ | Dynamic Cone ◇ | SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt ■ (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU/2 × | □ Lab Vane □ | △ Pocket Pen. △ | Field Vane (kPa) 50 100 150 200

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-04
LOCATION: UTM 14 - 5533885 m N, 634272 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.54

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
10								221
11				G38				220
12								219
13		END OF TEST HOLE AT 12.19 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.		G39				218
14								217
15								216
16								215
17								214
18								213
19								212
20								

PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane; QU/2; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-05
LOCATION: UTM 14 - 5533828 m N, 634394 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.32

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

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

DEPTH (m)	SOIL SYMBOL	SLOTTED PIEZOMETER	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0			TOPSOIL - black, moist					231
			CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark grey mottled brown, firm, moist - high plasticity		G40A			
1			CLAY - silty, some sand - dark brown, firm, moist - high plasticity		G40			230
2			SILT - some clay, trace sand - light brown, moist to wet - non-plastic					229
3			CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)		G41		(G41) Gravel: 0.0%, Sand: 2.4%, Silt: 86.6%, Clay: 11.0%	228
4								227
5					T42		Tube Recovery: 100%	226
6			- grey below 6.1 m		G43			225
7								224
8					T44		Tube Recovery: 33%	223
9					G45			222
10								

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 16.56 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/26/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-05
LOCATION: UTM 14 - 5533828 m N, 634394 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.32

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

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

DEPTH (m)	SOIL SYMBOL	SLOTTED PIEZOMETER	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
10									221
11					T46			Tube Recovery: 0%	220
12			- trace gravel, soft to firm below 11.6 m		G47				219
13									218
14			- trace silt till inclusions (< 20 mm diam.) below 13.7 m - suspected cobble/gravel encountered while pushing Shelby Tube at 13.7 m		T48			Tube Recovery: 0%	217
15			SILT and SAND (Till) - some clay to clayey, trace to some gravel - light brown, compact, moist		S49	17		SPT Blows: [8/8/9], Spoon Recovery: 75%	216
16					S50	50/ 102mm		SPT Blows: [30/50 (102 mm)], Spoon Recovery: 33%	215
17			END OF TEST HOLE AT 16.56 m IN TILL (SPT REFUSAL) Notes: 1. Seepage observed from silt layer during augering. 2. Water to 3.1 m below ground surface upon completion of augering. 3. Sloughing observed from silt layer during augering. 4. Test hole open to 14.6 m upon completion of augering. 5. Auger refusal at 16.3 m on suspected cobble/boulder. 6. Test hole backfilled with sand from 14.6 m to 10.4 m, bentonite from 10.4 m to 7.3 m, auger cuttings from 7.3 m to 0.6 m, and sand from 0.6 m to 0.3 m. Flush-mount cover installed. 7. Groundwater monitoring: - August 6, 2019 at elev. 223.55 m (7.76 m bgs) - August 20, 2019 at elev. 224.76 m (6.55 m bgs) - September 3, 2019 at elev. 225.20 m (6.11 m bgs)					214
18									213
19									212
20									

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 16.56 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/26/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-06
LOCATION: UTM 14 - 5533801 m N, 634449 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.23

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL - black, moist						231
		CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark brown, firm, moist - high plasticity						
1		SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity		G55				230
		CLAY - silty, some sand - dark brown, firm, moist, high plasticity		G56A				
2		SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity		G56B				229
3		CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)		G56				228
4		- grey below 4.0 m						227
				G57				
5								226
6		- silty below 6.1 m						225
				T58			Tube Recovery: 100%, (T58) Gravel: 0.0%, Sand: 2.0%, Silt: 30.0%, Clay: 68.0%, Swell: (1.9%, 57 kPa)	
7				G59				224
8		- trace gravel below 7.9 m						223
9				G60				222
10								

PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane; QU/2; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/26/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-06
LOCATION: UTM 14 - 5533801 m N, 634449 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.23

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH: Torvane; QU/2; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200	COMMENTS	ELEVATION
10									221
		- trace silt till inclusions (<25 mm diam.) below 10.7 m		G61					
11									220
12				G62					219
		END OF TEST HOLE AT 12.19 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.							
13									218
14									217
15									216
16									215
17									214
18									213
19									212
20									

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/26/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-07
LOCATION: UTM 14 - 5533750 m N, 634559 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.13

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ▩ SPLIT SPOON ▤ BULK ▨ NO RECOVERY ▧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL - black, moist						231
		CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark grey mottled brown, firm, moist - high plasticity						
1		SAND - silty, trace clay - light brown, moist	■	G63		●		230
2		CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)						229
3			■	G64		●		228
4								227
			■	G65		●		
5								226
		- grey below 5.5 m						
6			■	G66		●		225
7		- trace gravel below 7.0 m						224
			▥	T67		■ ● ⊗ △	Tube Recovery: 100%	
8								223
9			■	G68		●		222
10								

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU/2 × ☐ Lab Vane ☐ △ Pocket Pen. △ ⊕ Field Vane ⊕ (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/26/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-07
LOCATION: UTM 14 - 5533750 m N, 634559 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.13

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH: Torvane; QU/2; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200	COMMENTS	ELEVATION
10									221
				G69					
11									220
12				G70					219
		END OF TEST HOLE AT 12.19 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.							
13									218
14									217
15									216
16									215
17									214
18									213
19									212
20									

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/26/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-08
LOCATION: UTM 14 - 5533718 m N, 634627 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.97

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

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0	TOPSOIL - black, moist					
	CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark brown, firm, moist, high plasticity					
	SILT - sandy, some clay - light brown, moist - low plasticity		G71A			
1						230
	CLAY - silty, some sand - brown, firm to stiff, moist, high plasticity		G71			
	CLAY (Lacustrine) - some silt, trace sand - brown, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)					
2						229
3			G72			228
4						227
			G73			
	- grey below 4.6 m					
5						226
6						225
	- silty below 6.1 m		T74		Tube Recovery: 100%, (T74) Gravel: 0.0%, Sand: 1.0%, Silt: 35.0%, Clay: 64.0%, Ks = 1.52 x 10^{-8} cm/s	
7						224
			G75			
8						223
9			G76			222
	- trace gravel, trace silt till inclusions below 9.1 m - firm from 9.1 m to 13.6 m					
10						221
			G77			
11						220
12						

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 19.81 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/26/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-08
LOCATION: UTM 14 - 5533718 m N, 634627 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.97

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
12				G78				
13								218
		- soft to firm below 13.6 m		G79				
14								217
15								216
		SILT and SAND (Till) - clayey, trace gravel - light brown, loose, moist - low plasticity		G80				
16								215
17		- very dense below 16.8 m		S81	72		SPT Blows: [12/30/42], Spoon Recovery: 100%, (S81) Gravel: 0.0%, Sand: 35.2%, Silt: 43.8%, Clay: 21.0%	214
18								213
19								212
20		END OF TEST HOLE AT 19.81 m IN TILL. Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.						211
21								210
22								209
23								208
24								

PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane; QU/2; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 19.81 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/26/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-10
LOCATION: UTM 14 - 5533626 m N, 634825 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Canterra CT-250 - 125 mm SSA	ELEVATION (m): 230.73

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ▨ SPLIT SPOON ▤ BULK ▨ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL - black, moist						230
		CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark grey, firm, moist - brown below 0.4 m - high plasticity						
1		CLAY - silty, some sand - dark brown, firm, moist - high plasticity	■	G91A				
		SILT - sandy, some clay - light brown, moist - low plasticity	■	G91				229
2								
		CLAY (Lacustrine) - some silt to silty, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.) - some silt below 3.1 m						228
3			■	G92				
								227
4								
			■	G93				226
5		- grey below 4.9 m						
								225
6			■	G94				
								224
7								
			▥	T95			Tube Recovery: 100%	223
8								
								222
9			■	G96				
								221
10								

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m³) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU/2 × ☐ Lab Vane ☐ △ Pocket Pen. △ ⬘ Field Vane ⬘ (kPa) 50 100 150 200

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/27/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

AECOM

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-10
LOCATION: UTM 14 - 5533626 m N, 634825 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Canterra CT-250 - 125 mm SSA	ELEVATION (m): 230.73

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ⊠ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m³) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH + Torvane + × QU/2 × ☐ Lab Vane ☐ △ Pocket Pen. △ ⚉ Field Vane ⚉ (kPa) 50 100 150 200	COMMENTS	ELEVATION
10								220
11								219
12			■	G97				218
			■	G98				
13		END OF TEST HOLE AT 12.19 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.						217
14								216
15								215
16								214
17								213
18								212
19								211
20								

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/27/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-11
LOCATION: UTM 14 - 5533577 m N, 634929 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Canterra CT-250 - 125 mm SSA	ELEVATION (m): 230.89

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL - black, moist						230
		CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark brown mottled grey, firm, moist - high plasticity		G99A				
1		SILT - sandy, some clay - light brown, moist - low plasticity		G99				229
2		CLAY (Lacustrine) - some silt to silty - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.) - some silt below 2.1 m						
3				G100				228
4								227
5				T101			Tube Recovery: 100%, (T101) Gravel: 0.0%, Sand: 0.0%, Silt: 12.0%, Clay: 88.0%, Swell: (2.1%, 58 kPa)	226
		- grey below 5.5 m						
6				G102				225
7								224
				G103				
8								223
9				G104				222
		- trace silt till inclusions (<15 mm diam.) from 9.1 m to 12.2 m						
10								221
				G105				
11								220
12								219

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 19.81 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/27/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-11
LOCATION: UTM 14 - 5533577 m N, 634929 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Canterra CT-250 - 125 mm SSA	ELEVATION (m): 230.89

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
12		- trace gravel, trace silt till inclusions (<50 mm diam.) below 12.2 m		G106				
13								218
				G107				
14								217
15		- soft to firm below 15.1 m		G108				216
16								215
		SILT and SAND (Till) - some clay to clayey, trace to some gravel - light brown, loose, moist		G109				
17								214
18		- compact below 19.8 m		G110				213
19								212
20		END OF TEST HOLE AT 19.81 m IN TILL Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.						211
21								210
22								209
23								208
24								207

PENETRATION TESTS: ✳ Becker ✳ | ◇ Dynamic Cone ◇ | ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU/2 × | ☐ Lab Vane ☐ | △ Pocket Pen. △ | ⚉ Field Vane ⚉ (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 19.81 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/27/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-12
LOCATION: UTM 14 - 5533542 m N, 635003 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.76

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL - black, moist						
		CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark grey, firm, moist - high plasticity						
1		CLAY - silty, some sand - brown, firm, moist - high plasticity		G111A				230
		SILT - clayey, some sand - light brown, soft to firm, moist - intermediate plasticity		G111				
2								229
		CLAY (Lacustrine) - some silt, trace sand - brown, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)						
3				G112				228
		- brown mottled grey from 3.1 m to 4.3 m						
4								227
		- grey, firm below 4.3 m						
				G113				226
5								
6				T114			Tube Recovery: 100%	225
								224
7								
				G115				223
8								
								222
9				G116				
								221
10								

PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane; QU/2; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-12
LOCATION: UTM 14 - 5533542 m N, 635003 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.76

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

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
10							220
11							219
12				G117			218
13				G118			217
14							216
15							215
16							214
17							213
18							212
19							211
20							

END OF TEST HOLE AT 12.19 m IN CLAY

Notes:
1. Seepage not observed during augering.
2. Sloughing not observed during augering.
3. Test hole backfilled with auger cuttings and bentonite upon completion.

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-13
LOCATION: UTM 14 - 5533487 m N, 635121 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.81

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

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0		TOPSOIL - black, moist					
		CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark grey, firm, moist - high plasticity		G119A			230
1		CLAY - silty, some sand - brown, firm, moist, high plasticity					
		SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity		G119			229
2		CLAY (Lacustrine) - some silt, trace sand - brown, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)					
3		- brown mottled grey from 3.1 m to 4.0 m		G120			228
4		- grey below 4.0 m					227
5				T121		Tube Recovery: 100%	226
6				G122			225
7							224
		- firm below 7.6 m		G123			
8							223
9				G124			222
10							221

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-13
LOCATION: UTM 14 - 5533487 m N, 635121 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.81

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH: Torvane; QU/2; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200	COMMENTS	ELEVATION
10									
11									220
12			G125						219
13		END OF TEST HOLE AT 12.19 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.	G126						218
14									217
15									216
16									215
17									214
18									213
19									212
20									211

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-14
LOCATION: UTM 14 - 5533421 m N, 635261 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.65

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

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0		TOPSOIL - black, moist					230
		SILT (Fill) - sandy, trace to some clay - light brown, dry to moist					
1		CLAY (Fill) - silty, some sand, trace roots - dark brown, firm, moist - high plasticity					
		CLAY - silty, some sand - brown, firm, moist - high plasticity		G127			229
2		SILT - some clay, trace sand - light brown, moist - low plasticity		G127A		(G127A) Gravel: 0.0%, Sand: 1.4%, Silt: 80.6%, Clay: 18.0%	
		CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)					228
3				T128		Tube Recovery: 100%	
4							227
		- grey below 4.6 m					226
5				T129		Tube Recovery: 100%	
6							225
				T130		Tube Recovery: 100%, (T130) Gravel: 0.0%, Sand: 1.0%, Silt: 13.0%, Clay: 87.0%, (Swell: 2.6%, 72 kPa)	224
7				G131			223
8							
9							222
		- trace gravel, trace silt till inclusions (<30 mm diam.) below 9.1 m		T132		Tube Recovery: 100%	221
10							
				G133			220
11							
12							219

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 19.51 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-14
LOCATION: UTM 14 - 5533421 m N, 635261 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.65

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH + Torvane + × QU/2 × ☐ Lab Vane ☐ △ Pocket Pen. △ ⚉ Field Vane ⚉ (kPa) 50 100 150 200	COMMENTS	ELEVATION
12		- soft to firm from 12.2 m to 16.6 m		T134				Tube Recovery: 100%
13								
				G135				
14								
15				G136				
16								
		- soft below 16.6 m		G137				
17								
18								
		SILT and SAND (Till) - some clay to clayey, trace gravel - light brown, loose to compact, moist		G138				
19								
				S139				SPT Blows: [50 (0 mm)], Spoon Recovery: 100%
		END OF TEST HOLE AT 19.51 m IN TILL (AUGER REFUSAL) Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Auger refusal at 19.5 m on suspected cobble/boulder. 4. Test hole backfilled with auger cuttings and bentonite upon completion.						
20								
21								
22								
23								
24								

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 19.51 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/25/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-15
LOCATION: UTM 14 - 5533404 m N, 635298 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.08

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

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0		TOPSOIL - black, moist					230
		CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark brown, firm, dry to moist - high plasticity					
1		SILT - sandy, some clay - light brown, dry to moist - low plasticity					229
				T139		Tube Recovery: 75%	
2		CLAY (Lacustrine) - some silt to silty - brown, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)					228
3		- brown mottled grey from 3.1 m to 4.6 m					227
				T140	15.9	Tube Recovery: 100%, (T140) Gravel: 0.0%, Sand: 0.0%, Silt: 20.0%, Clay: 80.0%, Ks = 2.98 x 10^{-8} cm/s	
4							226
		- grey below 4.6 m					
5				T141	15.9	Tube Recovery: 100%	225
6				G142			224
7							223
		- trace gravel, firm below 7.6 m					
8				T143		Tube Recovery: 100%	222
9				G144			221
10							

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 11.28 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/24/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-15
LOCATION: UTM 14 - 5533404 m N, 635298 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.08

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
10								220
11				T145			Tube Recovery: 54%	219
		END OF TEST HOLE AT 11.28 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.						
12								218
13								217
14								216
15								215
16								214
17								213
18								212
19								211
20								

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU/2 × ☐ Lab Vane ☐ △ Pocket Pen. △ ⬘ Field Vane ⬘ (kPa) 50 100 150 200

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 11.28 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/24/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-16
LOCATION: UTM 14 - 5533376 m N, 635357 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 228.55

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

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

DEPTH (m)	SOIL SYMBOL	SLOTTED PIEZOMETER	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0			TOPSOIL - black, moist					228
			CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark grey, firm, moist - high plasticity					
1			CLAY and SILT - trace sand - dark brown, firm, moist - high plasticity					
					G146		(G146) Gravel: 0.0%, Sand: 6.0%, Silt: 39.0%, Clay: 55.0%	227
			SILT - clayey, some sand - brown, soft, moist, intermediate plasticity					
2			SAND - silty, trace clay - light brown, moist					
			CLAY (Lacustrine) - some silt - brown, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)					226
3			- brown mottled grey from 3.1 m to 4.3 m					
					T147		Tube Recovery: 100%, (T147) Gravel: 0.0%, Sand: 0.0%, Silt: 14.0%, Clay: 85.0%, Swell: (3.4%, 35 kPa)	225
4								
								224
			- grey from 4.7 m to 5.2 m					
5					T148-2		Tube Recovery: 100%	
			- brown mottled grey from 5.2 m to 7.6 m					223
6								
					T149		Tube Recovery: 100%	222
7								
					G150			221
8								
								220
9								
			- trace gravel, trace silt till inclusions (<25 mm diam.) below 9.1 m		T151		Tube Recovery: 100%	219
10								

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 16.86 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/24/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-16
LOCATION: UTM 14 - 5533376 m N, 635357 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 228.55

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

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

DEPTH (m)	SOIL SYMBOL	SLOTTED PIEZOMETER	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100; Total Unit Wt (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH: Torvane; QU/2; Lab Vane; Pocket Pen.; Field Vane (kPa) 50 100 150 200	COMMENTS	ELEVATION
10										218
11										217
12					G152					216
13					G153					215
14					T154				Tube Recovery: 100%	214
15					T155				Tube Recovery: 100%	213
16			SILT and SAND (Till) - some clay to clayey, trace gravel - light brown, moist to wet		G156					212
17			END OF TEST HOLE AT 16.86 m IN TILL (AUGER REFUSAL)							211
18										210
19										209
20										

Notes:
1. Seepage observed below 15.2 m during augering.
2. Water to 8.5 m below ground surface upon completion of augering.
3. Test hole open to 16.0 m upon completion of augering.
4. Auger refusal at 16.9 m on suspected cobble/boulder.
5. Test hole backfilled with bentonite from 16.0 m to 14.5 m, auger cuttings from 14.5 m to 10.1 m, bentonite from 10.1 m to 7.6 m, sand from 7.6 m to 6.1 m, bentonite from 6.1 m to 0.9 m, and sand from 0.9 m to 0.3 m. Flush-mount cover installed.
6. Groundwater monitoring:
   - August 6, 2019 at elev. 225.64 m (2.91 m bgs)
   - August 20, 2019 at elev. 225.63 m (2.93 m bgs)
   - September 3, 2019 at elev. 225.61 m (2.94 m bgs)

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 16.86 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/24/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-17
LOCATION: UTM 14 - 5533349 m N, 635414 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.54

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ⊠ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
0		TOPSOIL - black, moist						230
		CLAY (Fill) - silty, some sand, trace roots - dark grey, firm, moist - high plasticity	■	G158A				
1		SAND - silty, trace clay - light brown, loose, dry to moist	■	G158				229
2		CLAY - silty, some sand - brown, firm, moist - high plasticity						228
3		CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm, moist - high plasticity - trace silt inclusions (<15 mm diam.)	■	G159				227
4								226
5			▥	T160	15.6		Tube Recovery: 100%	225
6			■	G161				224
7		- grey below 6.7 m						223
8		- trace gravel, trace silt till inclusions below 7.6 m	▥	T162			Tube Recovery: 100%	222
9			■	G163				221
10								

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU/2 × ☐ Lab Vane ☐ △ Pocket Pen. △ ⬘ Field Vane ⬘ (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 11.28 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/24/19
PROJECT ENGINEER: Jordan T.	Page 1 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

PROJECT: Jefferson East CSR Works (Contract 5)	CLIENT: City of Winnipeg WWD	TESTHOLE NO: TH19-17
LOCATION: UTM 14 - 5533349 m N, 635414 m E		PROJECT NO.: 60599385
CONTRACTOR: Maple Leaf Drilling	METHOD: Acker MP-5 - 125 mm SSA	ELEVATION (m): 230.54

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ▤ BULK ⊘ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION
10								220
11				T164			Tube Recovery: 100%	219
12		END OF TEST HOLE AT 11.28 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.						218
13								217
14								216
15								215
16								214
17								213
18								212
19								211
20								

PENETRATION TESTS: ✳ Becker ✳ ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + × QU/2 × ☐ Lab Vane ☐ △ Pocket Pen. △ ⚉ Field Vane ⚉ (kPa) 50 100 150 200

AECOM

LOGGED BY: Ryan Harras	COMPLETION DEPTH: 11.28 m
REVIEWED BY: Faris Alobaidy	COMPLETION DATE: 6/24/19
PROJECT ENGINEER: Jordan T.	Page 2 of 2

LOG OF TEST HOLE 60599385 - TEST HOLE LOGS - ALL COMBINED.GPJ UMA WINN.GDT 11/28/19

AECOM

Appendix D

Laboratory Testing Reports

- D-1: AECOM (February 2012) Laboratory Testing Results
- D-2: AECOM (October 2015) Laboratory Testing Results
- D-3: AECOM (June 2019) Laboratory Testing Results

MOISTURE CONTENT

JOB No.: 60219315
CLIENT: City of Winnipeg
PROJECT: Jefferson East CSR

DATE: December 2011 - January 2012

HOLE NO.	TH11-01	-	-	-	-	-
SAMPLE NO.	G1	G2	G3	G4	G5	G6
DEPTH (FT)	5.0	10.0	15.0	20.0	25.0	30.0
MOISTURE CONTENT %	23.7	29.4	30.2	24.5	33.4	32.6

HOLE NO.	TH11-01	-	TH11-02	-	-	-
SAMPLE NO.	G7	G8	G9	G10	G11	G12
DEPTH (FT)	35.0	40.0	5.0	10.0	15.0	20.0
MOISTURE CONTENT %	33.7	34.6	28.2	16.7	24.9	28.6

HOLE NO.	TH11-02	-	-	-	TH11-03	-
SAMPLE NO.	G13	G14	G15	G16	G17	G18
DEPTH (FT)	25.0	30.0	35.0	40.0	5.0	10.0
MOISTURE CONTENT %	29.7	33.9	31.3	20.0	24.6	30.4

HOLE NO.	TH11-03	-	-	-	-	-
SAMPLE NO.	G19	G20	G21	G22	G23	G24
DEPTH (FT)	15.0	20.0	25.0	30.0	35.0	38.0
MOISTURE CONTENT %	32.1	37.2	34.5	35.1	30.1	17.9

NOTES:

AECOM

MATERIALS LABORATORY
AECOM
99 Commerce Drive, Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 **fax** (204) 284-2040

MOISTURE CONTENT

JOB No.: 60219315
CLIENT: City of Winnipeg
PROJECT: Jefferson East CSR

DATE: December 2011 - January 2012

HOLE NO.	TH11-03	TH11-05	-	-	-	-
SAMPLE NO.	G25	G26	G27	G28	G29	G30
DEPTH (FT)	40.0	5.0	10.0	15.0	20.0	25.0
MOISTURE CONTENT %	44.4	35.6	35.9	52.2	51.7	52.6

HOLE NO.	TH11-05	-	-	TH11-07	-	-
SAMPLE NO.	G31	G32	G33	G34	G35	G36
DEPTH (FT)	30.0	35.0	40.0	5.0	10.0	15.0
MOISTURE CONTENT %	52.9	58.4	54.7	21.5	40.0	54.6

HOLE NO.	TH11-07	-	-	-	-	TH11-06
SAMPLE NO.	G37	G38	G39	G40	G41	G42
DEPTH (FT)	20.0	25.0	30.0	35.0	40.0	5.0
MOISTURE CONTENT %	51.1	49.3	48.7	50.6	56.3	27.6

HOLE NO.	TH11-06	-	-	-	-	-
SAMPLE NO.	G43	G44	G45	G46	G47	G48
DEPTH (FT)	8.0	10.0	15.0	20.0	25.0	30.0
MOISTURE CONTENT %	22.0	33.3	58.4	58.0	53.8	50.1

NOTES:

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tel (204) 477-5381 **fax** (204) 284-2040

MOISTURE CONTENT

JOB No.: 60219315
CLIENT: City of Winnipeg
PROJECT: Jefferson East CSR

DATE: December 2011 - January 2012

HOLE NO.	TH11-06	-	TH11-04	-	-	-
SAMPLE NO.	G49	G50	G51	G52	G53	G54
DEPTH (FT)	35.0	40.0	5.0	10.0	15.0	20.0
MOISTURE CONTENT %	53.1	44.1	20.9	29.5	33.7	35.0

HOLE NO.	TH11-04	-	-	-	TH11-12	-
SAMPLE NO.	G55	G56	G57	G58	G59	G60
DEPTH (FT)	25.0	30.0	35.0	40.0	5.0	7.0
MOISTURE CONTENT %	37.6	28.7	24.6	48.9	24.9	22.0

HOLE NO.	TH11-12	-	-	-	-	-
SAMPLE NO.	G61	G62	G63	G64	G65	G66
DEPTH (FT)	10.0	15.0	20.0	25.0	30.0	35.0
MOISTURE CONTENT %	42.9	52.3	55.9	44.9	44.3	44.70

HOLE NO.	TH11-12	TH11-11	-	-	-	-
SAMPLE NO.	G67	G68	G69	G70	G71	G72
DEPTH (FT)	40.0	5.0	7.0	10.0	15.0	20.0
MOISTURE CONTENT %	35.6	31.2	24.0	39.5	56.0	57.5

NOTES:

AECOM

MATERIALS LABORATORY
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99 Commerce Drive, Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 **fax** (204) 284-2040

MOISTURE CONTENT

JOB No.: 60219315
CLIENT: City of Winnipeg
PROJECT: Jefferson East CSR

DATE: December 2011 - January 2012

HOLE NO.	TH11-11	-	-	-	TH11-08	-
SAMPLE NO.	G73	G74	G75	G76	G77	G78
DEPTH (FT)	25.0	30.0	35.0	40.0	5.0	10.0
MOISTURE CONTENT %	43.7	50.9	50.7	46.0	29.0	33.6

HOLE NO.	TH11-08	-	-	-	-	-
SAMPLE NO.	G79	G80	G81	G82	G83	G84
DEPTH (FT)	15.0	20.0	25.0	30.0	35.0	40.0
MOISTURE CONTENT %	53.7	54.3	52.1	50.6	52.1	52.8

HOLE NO.	TH11-09	-	-	-	-	-
SAMPLE NO.	G85	G86	G87	G88	G89	G90
DEPTH (FT)	5.0	6.0	10.0	15.0	20.0	25.0
MOISTURE CONTENT %	31.4	25.6	52.6	52.5	47.3	43.3

HOLE NO.	TH11-09	-	-	TH11-10	-	-
SAMPLE NO.	G91	G92	G93	G94	G95	G96
DEPTH (FT)	30.0	35.0	40.0	1.0	7.0	10.0
MOISTURE CONTENT %	47.1	46.8	47.2	21.5	19.9	35.5

NOTES:

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MOISTURE CONTENT

JOB No.: 60219315
CLIENT: City of Winnipeg
PROJECT: Jefferson East CSR

DATE: December 2011 - January 2012

HOLE NO.	TH11-10	-	-	-	-	-
SAMPLE NO.	G97	G98	G99	G100	G101	G102
DEPTH (FT)	15.0	20.0	25.0	30.0	35.0	40.0
MOISTURE CONTENT %	57.1	55.3	52.6	54.6	44.5	42.3
HOLE NO.	TH11-14	-	-	-	-	-
SAMPLE NO.	G103	G104	G105	G107	G108	G109
DEPTH (FT)	2.0	5.0	10.0	15.0	20.0	25.0
MOISTURE CONTENT %	8.1	44.2	43.8	38.0	38.7	31.5
HOLE NO.	TH11-14	-	-	-	-	TH11-13
SAMPLE NO.	G110	G111	G112	G113	G114	G115
DEPTH (FT)	30.0	35.0	40.0	45.0	50.0	5.0
MOISTURE CONTENT %	13.1	53.1	50.8	30.1	12.3	24.4
HOLE NO.	TH11-13	-	-	-	-	-
SAMPLE NO.	G116	G117	G119	G120	G121	G122
DEPTH (FT)	7.0	10.0	15.0	20.0	25.0	30.0
MOISTURE CONTENT %	11.7	40.4	53.7	56.1	47.0	49.8

NOTES:

AECOM

MATERIALS LABORATORY
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tel (204) 477-5381 **fax** (204) 284-2040

MOISTURE CONTENT

JOB No.: 60219315
CLIENT: City of Winnipeg
PROJECT: Jefferson East CSR

DATE: December 2011 - January 2012

HOLE NO.	TH11-13	-	-	-	-	-
SAMPLE NO.	G124	G125	G126	G127	G128	G129
DEPTH (FT)	35.0	40.0	45.0	50.0	55.0	58.5
MOISTURE CONTENT %	55.5	41.9	47.5	52.6	48.9	27.7

HOLE NO.	TH11-13	-				
SAMPLE NO.	G130	G131				
DEPTH (FT)	60.0	63.0				
MOISTURE CONTENT %	62.0	17.2				

HOLE NO.						
SAMPLE NO.						
DEPTH (FT)						
MOISTURE CONTENT %						

HOLE NO.						
SAMPLE NO.						
DEPTH (FT)						
MOISTURE CONTENT %						

NOTES:

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MATERIALS LABORATORY
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ATTERBERG
(ASTM D4318-98)

MATERIALS LABORATORY
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tel (204) 477-5381 **fax** (204) 284-2040

JOB No.:	60219315	DATE:	4-Jan-12
CLIENT:	City of Winnipeg	TEST HOLE:	TH11-02
PROJECT:	Jefferson East CSR	SAMPLE:	G12
LOCATION:		DEPTH:	20.0'
		TECH.:	AL

Liquid Limit

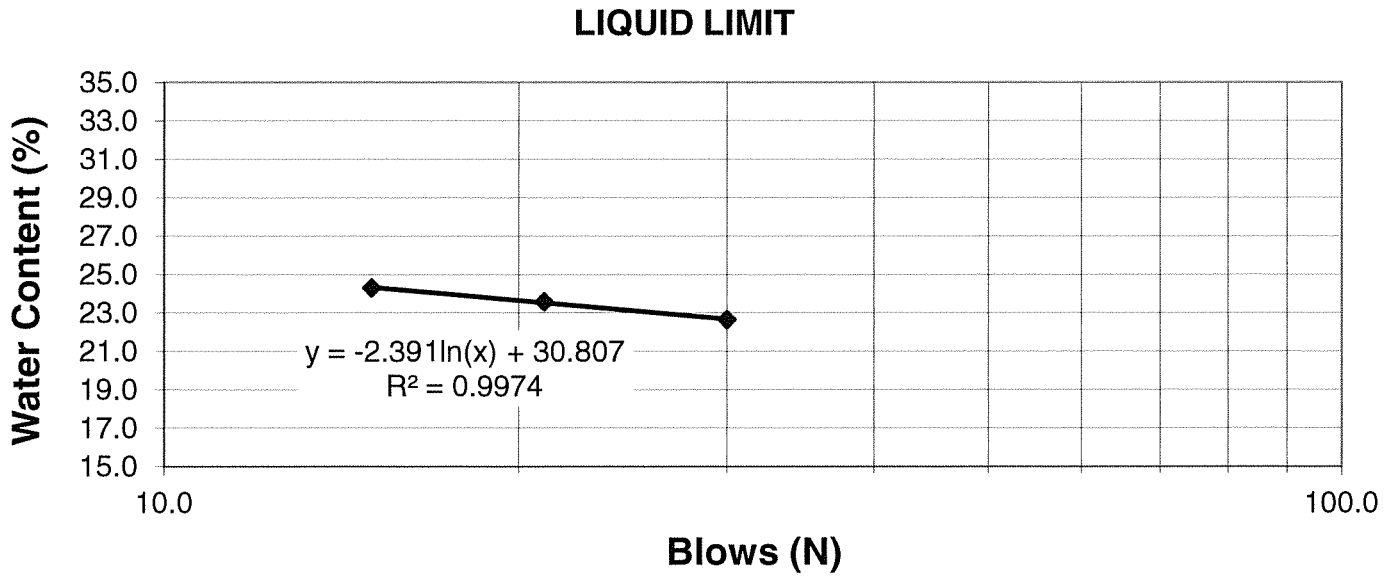
WATER CONTENT

Blows	30	21	15		
WT. SAMPLE WET + TARE (gr)	104.020	105.633	108.950		
WT. SAMPLE DRY + TARE (gr)	99.491	101.590	104.305		
WT. TARE (gr)	79.496	84.441	85.195		
WT. WATER (gr)	4.529	4.043	4.645		
WT. DRY SOIL (gr)	19.995	17.149	19.110		
MOISTURE CONTENT (%)	22.651	23.576	24.307		

Plastic Limit

WATER CONTENT

WT. SAMPLE WET + TARE (gr)	92.370	86.663			
WT. SAMPLE DRY + TARE (gr)	91.580	85.797			
WT. TARE (gr)	86.387	80.119			
WT. WATER (gr)	0.790	0.866			
WT. DRY SOIL (gr)	5.193	5.678			
MOISTURE CONTENT (%)	15.213	15.252			



Liquid Limit =	23.1	Plastic Limit =	15.2	Plasticity Index =	7.9

ATTERBERG
(ASTM D4318-98)

MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 **fax** (204) 284-2040

JOB No.:	60219315	DATE:	4-Jan-12
CLIENT:	City of Winnipeg	TEST HOLE:	TH11-07
PROJECT:	Jefferson East CSR	SAMPLE:	G34
LOCATION:		DEPTH:	5.0'
		TECH.:	AL

Liquid Limit

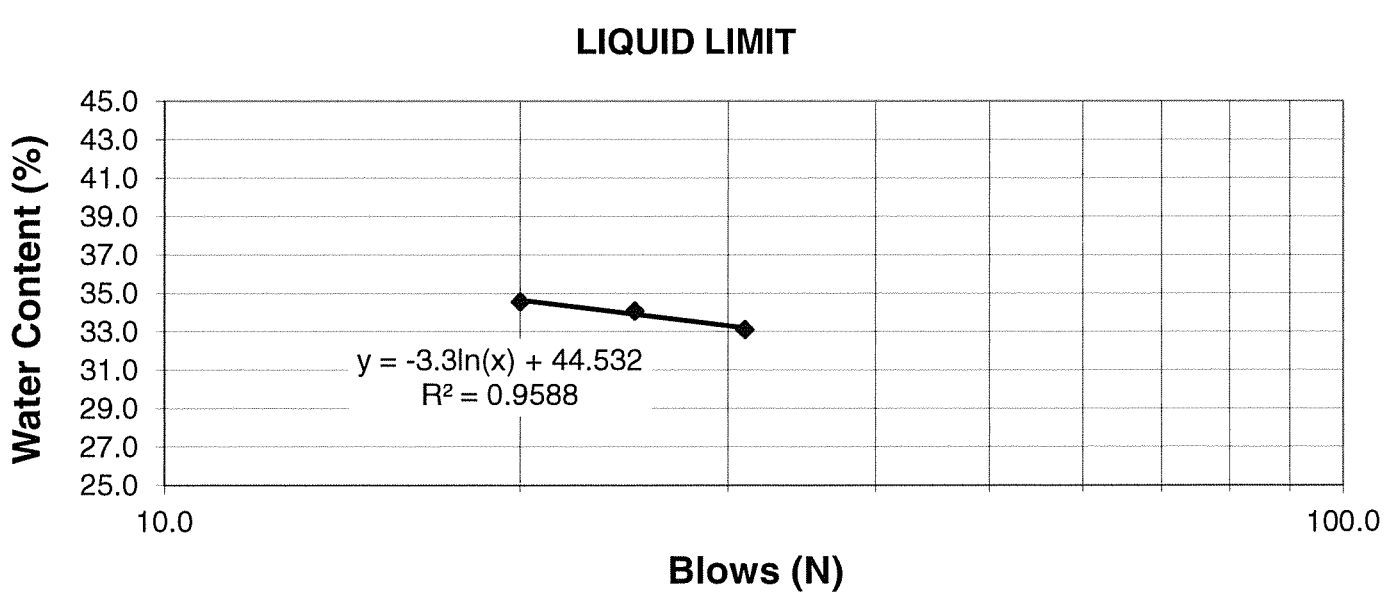
WATER CONTENT

Blows	31	25	20		
WT. SAMPLE WET + TARE (gr)	99.544	98.151	92.131		
WT. SAMPLE DRY + TARE (gr)	96.267	94.541	89.127		
WT. TARE (gr)	86.370	83.949	80.435		
WT. WATER (gr)	3.277	3.610	3.004		
WT. DRY SOIL (gr)	9.897	10.592	8.692		
MOISTURE CONTENT (%)	33.111	34.082	34.561		

Plastic Limit

WATER CONTENT

WT. SAMPLE WET + TARE (gr)	92.603	92.822			
WT. SAMPLE DRY + TARE (gr)	91.608	91.874			
WT. TARE (gr)	85.821	86.365			
WT. WATER (gr)	0.995	0.948			
WT. DRY SOIL (gr)	5.787	5.509			
MOISTURE CONTENT (%)	17.194	17.208			



Liquid Limit =	33.9	Plastic Limit =	17.2	Plasticity Index =	16.7

ATTERBERG
(ASTM D4318-98)

MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 **fax** (204) 284-2040

JOB No.:	60219315	DATE:	4-Jan-12
CLIENT:	City of Winnipeg	TEST HOLE:	TH11-13
PROJECT:	Jefferson East CSR	SAMPLE:	T118
LOCATION:		DEPTH:	10.0 - 12.0'
		TECH.:	AL

Liquid Limit

WATER CONTENT

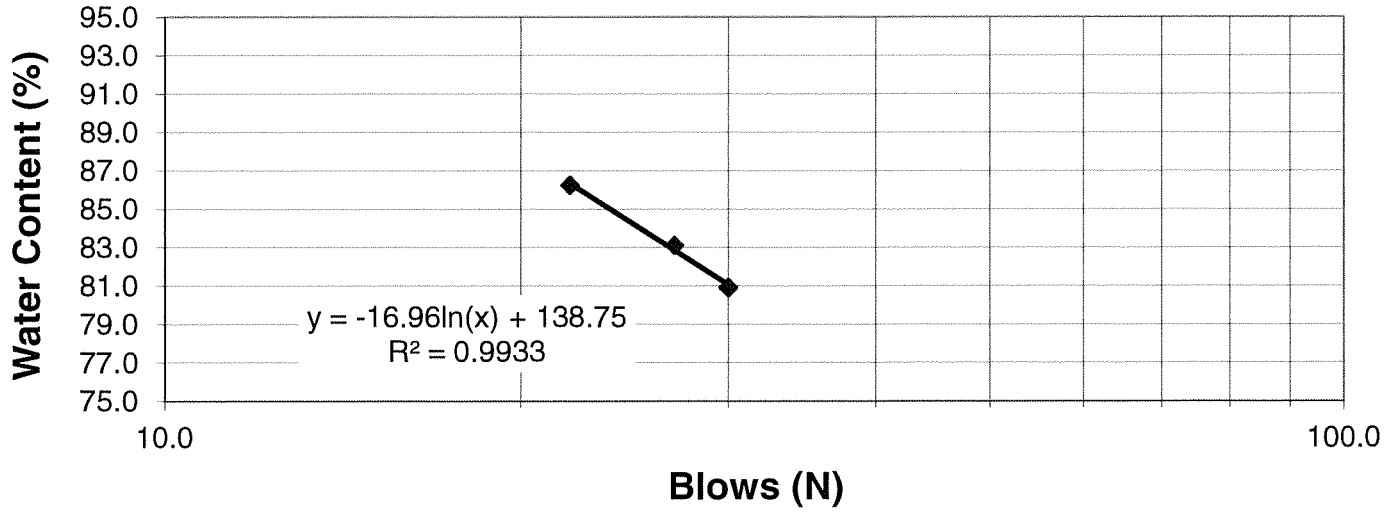
Blows	30	27	22		
WT. SAMPLE WET + TARE (gr)	93.527	92.186	93.261		
WT. SAMPLE DRY + TARE (gr)	88.267	86.724	88.061		
WT. TARE (gr)	81.766	80.152	82.032		
WT. WATER (gr)	5.260	5.462	5.200		
WT. DRY SOIL (gr)	6.501	6.572	6.029		
MOISTURE CONTENT (%)	80.911	83.110	86.250		

Plastic Limit

WATER CONTENT

WT. SAMPLE WET + TARE (gr)	84.944	83.483			
WT. SAMPLE DRY + TARE (gr)	83.829	82.010			
WT. TARE (gr)	80.237	77.286			
WT. WATER (gr)	1.115	1.473			
WT. DRY SOIL (gr)	3.592	4.724			
MOISTURE CONTENT (%)	31.041	31.181			

LIQUID LIMIT



Liquid Limit =	84.2	Plastic Limit =	31.1	Plasticity Index =	53.0

ATTERBERG
(ASTM D4318-98)

MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 **fax** (204) 284-2040

JOB No.:	60219315	DATE:	4-Jan-12
CLIENT:	City of Winnipeg	TEST HOLE:	TH11-14
PROJECT:	Jefferson East CSR	SAMPLE:	T106
LOCATION:		DEPTH:	10.0 - 12.0'
		TECH.:	AL

Liquid Limit

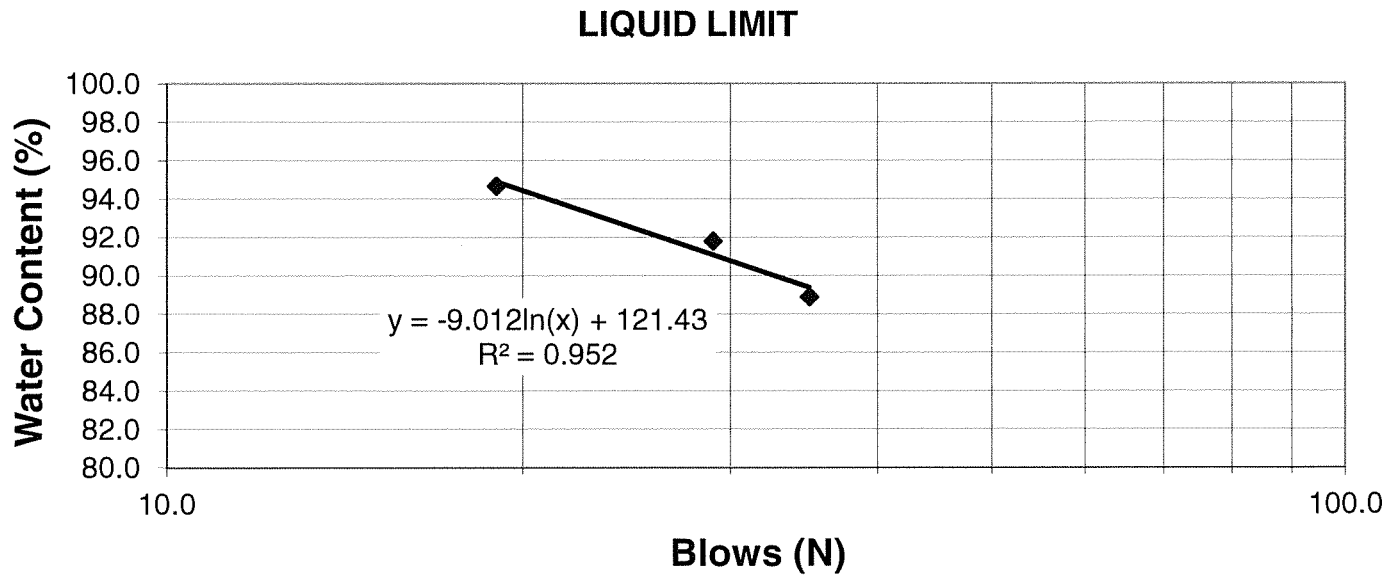
WATER CONTENT

Blows	35	29	19		
WT. SAMPLE WET + TARE (gr)	91.139	91.936	92.988		
WT. SAMPLE DRY + TARE (gr)	86.440	86.284	87.441		
WT. TARE (gr)	81.154	80.127	81.582		
WT. WATER (gr)	4.699	5.652	5.547		
WT. DRY SOIL (gr)	5.286	6.157	5.859		
MOISTURE CONTENT (%)	88.895	91.798	94.675		

Plastic Limit

WATER CONTENT

WT. SAMPLE WET + TARE (gr)	88.930	91.154			
WT. SAMPLE DRY + TARE (gr)	87.957	89.995			
WT. TARE (gr)	84.775	86.208			
WT. WATER (gr)	0.973	1.159			
WT. DRY SOIL (gr)	3.182	3.787			
MOISTURE CONTENT (%)	30.578	30.605			



Liquid Limit =	92.4	Plastic Limit =	30.6	Plasticity Index =	61.8

GRAIN SIZE DISTRIBUTION

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MATERIALS LABORATORY
AECOM
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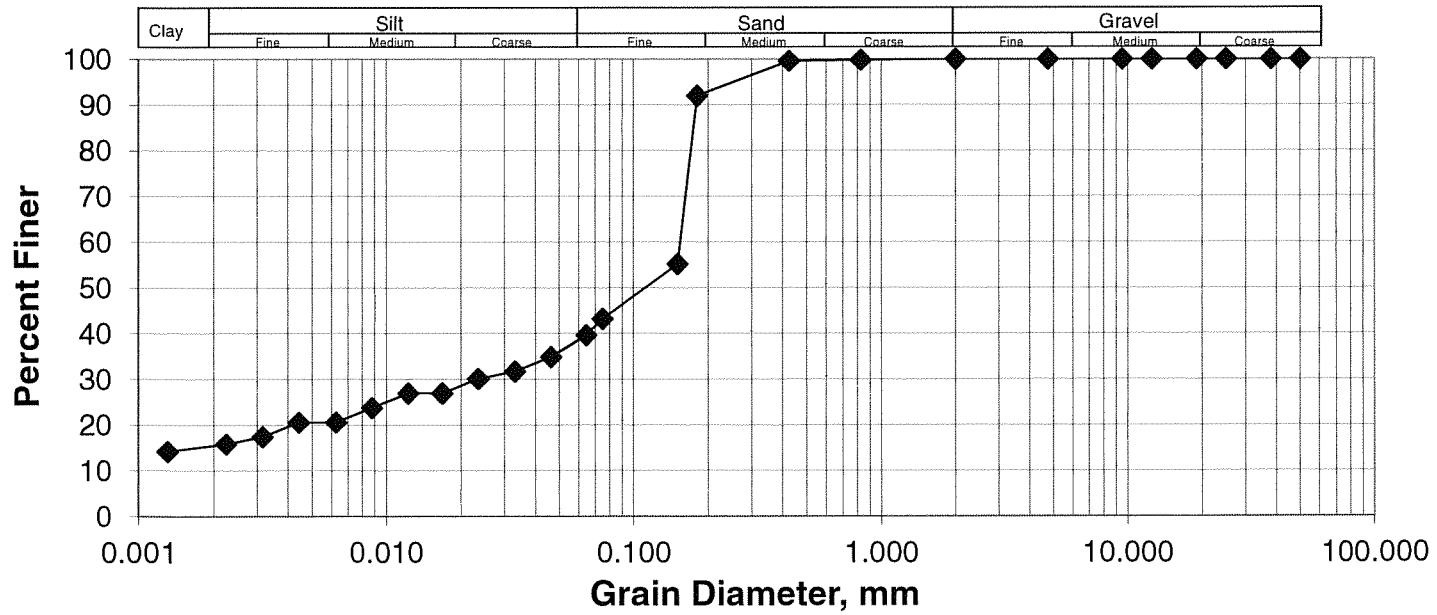
Job No.:	60219315	Hole No.:	TH11-02
Client:	City of Winnipeg	Sample No.:	G12
Project :	Jefferson East CSR	Depth:	20.0'
Date Tested:	4-Jan-12	Date Sampled:	
Tested By:		Sampled By:	

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	2.00	100.0	0.0750	43.2
38.0	100.0	0.83	99.8	0.0644	39.6
25.0	100.0	0.43	99.6	0.0463	34.9
19.0	100.0	0.18	92.0	0.0331	31.7
12.5	100.0	0.15	55.2	0.0235	30.1
9.5	100.0	0.075	43.2	0.0168	26.9
4.75	100.0			0.0123	26.9
2.00	100.0			0.0088	23.8
				0.0063	20.6
				0.0044	20.6
				0.0032	17.4
				0.0022	15.8
				0.0013	14.2

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.0%**	**Silt**	**23.1%**
Sand	**61.5%**	**Clay**	**15.4%**

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

MATERIALS LABORATORY
AECOM
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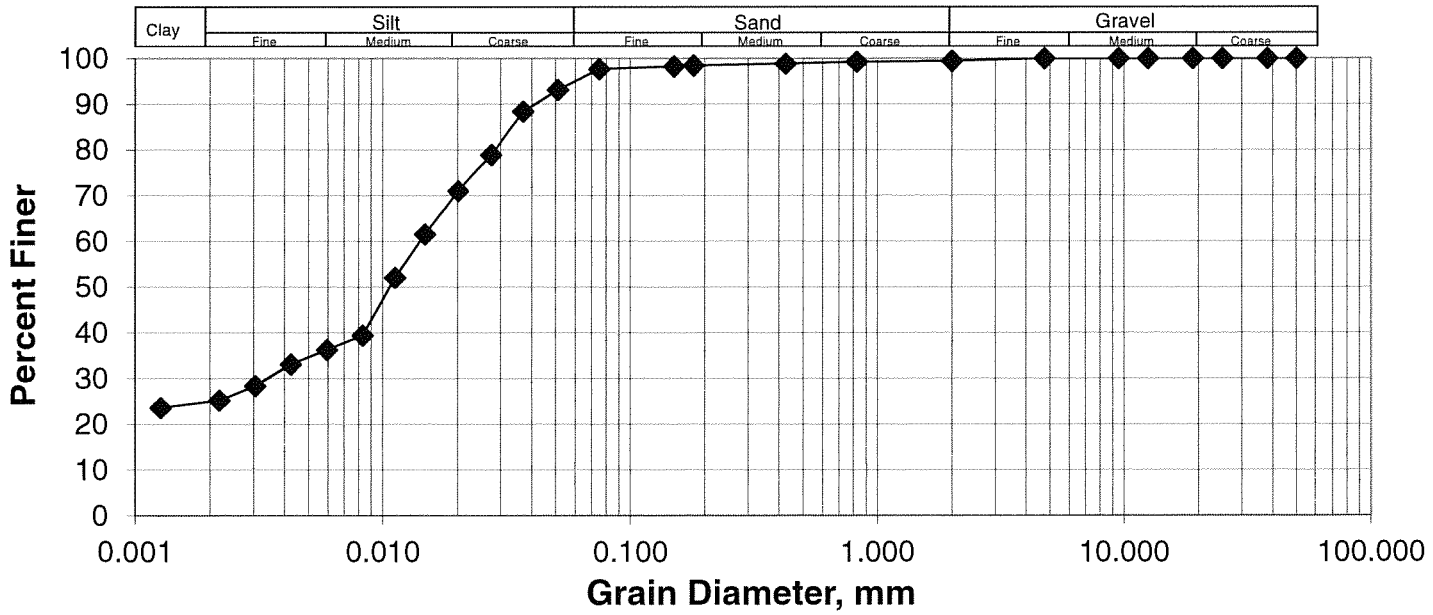
Job No.:	60219315	Hole No.:	TH11-07
Client:	City of Winnipeg	Sample No.:	G34
Project :	Jefferson East CSR	Depth:	5.0'
Date Tested:	4-Jan-12	Date Sampled:	
Tested By:		Sampled By:	

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	2.00	99.4	0.0750	97.7
38.0	100.0	0.83	99.2	0.0510	93.1
25.0	100.0	0.43	98.8	0.0370	88.4
19.0	100.0	0.18	98.4	0.0274	78.9
12.5	100.0	0.15	98.2	0.0201	71.0
9.5	100.0	0.075	97.7	0.0148	61.5
4.75	100.0			0.0112	52.1
2.00	99.4			0.0083	39.4
				0.0059	36.3
				0.0042	33.1
				0.0030	28.4
				0.0022	25.2
				0.0013	23.6

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.6%**	**Silt**	**69.9%**
Sand	**4.6%**	**Clay**	**24.9%**

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

MATERIALS LABORATORY
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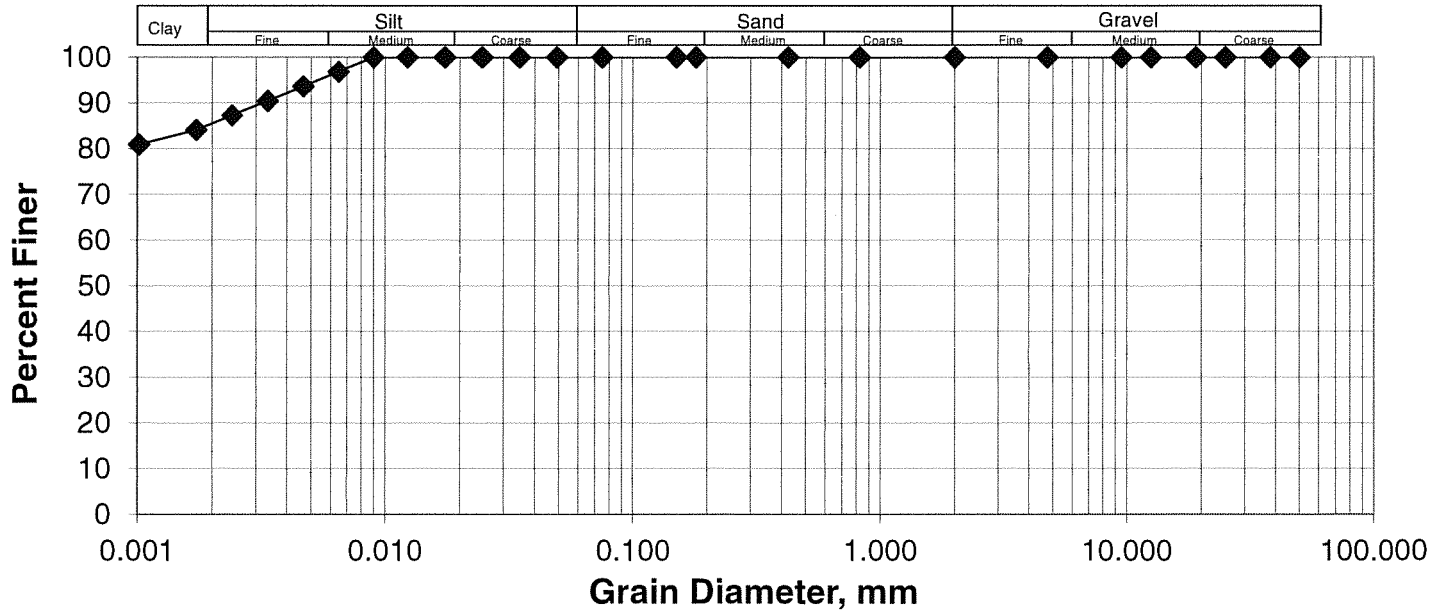
tel (204) 477-5381 **fax** (204) 284-2040

Job No.:	60219315	Hole No.:	TH11-13
Client:	City of Winnipeg	Sample No.:	T118
Project :	Jefferson East CSR	Depth:	10.0 - 12.0'
Date Tested:	4-Jan-12	Date Sampled:	
Tested By:		Sampled By:	

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	2.00	100.0	0.0750	100.0
38.0	100.0	0.83	100.0	0.0491	100.0
25.0	100.0	0.43	100.0	0.0347	100.0
19.0	100.0	0.18	100.0	0.0246	100.0
12.5	100.0	0.15	100.0	0.0174	100.0
9.5	100.0	0.075	100.0	0.0123	100.0
4.75	100.0			0.0090	100.0
2.00	100.0			0.0065	96.8
				0.0047	93.6
				0.0033	90.5
				0.0024	87.3
				0.0017	84.1
				0.0010	80.9

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.0%**	**Silt**	**14.6%**
Sand	**0.0%**	**Clay**	**85.4%**

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

GRAIN SIZE DISTRIBUTION

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MATERIALS LABORATORY
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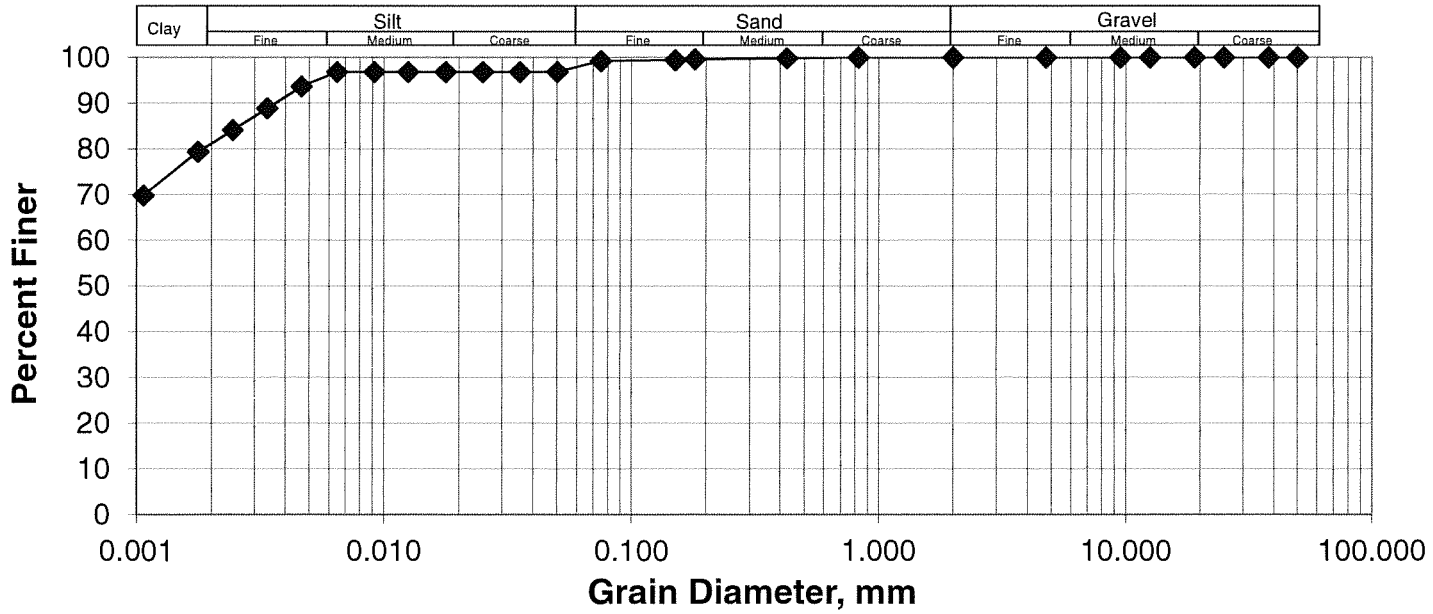
Job No.:	60219315	Hole No.:	TH11-14
Client:	City of Winnipeg	Sample No.:	T106
Project :	Jefferson East CSR	Depth:	10.0 - 12.0'
Date Tested:	4-Jan-12	Date Sampled:	
Tested By:		Sampled By:	

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	2.00	100.0	0.0750	99.2
38.0	100.0	0.83	100.0	0.0500	96.8
25.0	100.0	0.43	99.8	0.0354	96.8
19.0	100.0	0.18	99.6	0.0250	96.8
12.5	100.0	0.15	99.4	0.0177	96.8
9.5	100.0	0.075	99.2	0.0125	96.8
4.75	100.0			0.0091	96.8
2.00	100.0			0.0065	96.8
				0.0047	93.6
				0.0034	88.9
				0.0024	84.1
				0.0018	79.3
				0.0011	69.8

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.0%**	**Silt**	**16.8%**
Sand	**2.2%**	**Clay**	**81.0%**

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

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

AECOM

CLIENT: City of Winnipeg
PROJECT: Jefferson East CSR
JOB NO.: 60219315

TEST HOLE NO.:	**TH11-13**		
SAMPLE NO.:	**T118**		
SAMPLE DEPTH:	10.0 - 12.0'		
DATE TESTED:	2-Jan-12		
SHEAR STRENGTH TESTS			
LAB VANE	**Su 1**		
Reading			
Spring Number	4		
Undrained Shear Strength (kPa) =	**0.0**		
Undrained Shear Strength (ksf) =	0.00		
TORVANE			
Reading	0.70		
Vane Size (S, M, L)	m		
Undrained Shear Strength (kPa) =	**68.7**		
Undrained Shear Strength (ksf) =	1.43		
POCKET PENETROMETER			
Reading - Qu (tsf)	2.25		
Undrained Shear Strength (kPa) =	**107.7**		
Reading - Qu (tsf)	2.25		
Undrained Shear Strength (kPa) =	**107.7**		
Reading - Qu (tsf)	2.50		
Undrained Shear Strength (kPa) =	**119.7**		
UNCONFINED COMPRESSIVE STRENGTH TEST			
Unconfined compressive strength (kPa) =	**114.8**		
Unconfined compressive strength (ksf) =	**2.4**		
Undrained Shear Strength (kPa) =	**57.4**		
Undrained Shear Strength (ksf) =	**1.199**		
	Density -Su1		
MOISTURE CONTENT			
Tare Number	A19		
Wt. Sample wet + tare (g)	375.0		
Wt. Sample dry + tare (g)	262.3		
Wt. Tare (g)	8.2		
Moisture Content, w% =	**44.4**		
BULK DENSITY			
Sample Wt. (g)	1040.6		
Diameter 1 (cm)	7.25		
Diameter 2 (cm)	7.18		
Diameter 3 (cm)	7.21		
Avg. Diameter (cm)	**7.21**		
Length 1 (cm)	14.48		
Length 2 (cm)	14.45		
Length 3 (cm)	14.42		
Avg. Length (cm)	**14.45**		
Volume (cm3)	590.5		
Moisture content (%)	44.4		
Bulk Density (g/cm^3)	1.762		
Bulk Density (kN/m^3)	**17.3**		
Bulk Density (pcf)	**110.0**		
Dry Density (kN/m^3)	**11.97**		

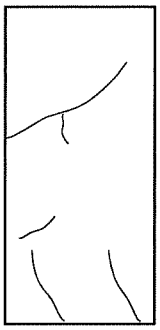
AECOM - SOILS LABORATORY
UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS (ASTM D2166)

AECOM

CLIENT:	City of Winnipeg
PROJECT:	Jefferson East CSR
JOB NO.:	60219315

TEST HOLE NO.:	TH11-13
SAMPLE NO.:	T118
SAMPLE DEPTH:	10.0 - 12.0'
SAMPLE DATE:	14-Dec-11
TEST DATE:	2-Jan-12

SOIL DESCRIPTION:	
CLAY; trace silt, light brown, moist, firm, high plasticity, blocky	
MOISTURE CONTENT:	44.4



FAILURE SKETCH

SAMPLE DIAM.(Do):	72.13	(mm)	INITIAL AREA, Ao:	4086.6	(mm^2)
SAMPLE LENGTH, (Lo):	144.50	(mm)	PISTON RATE:	0.051	(inches / minute)
L / D RATIO:	2.0	(2 < L/D < 2.5)	AXIAL STRAIN RATE, R:	0.90	(0.5<R<2 % / minute)

TEST DATA - DIAL READINGS

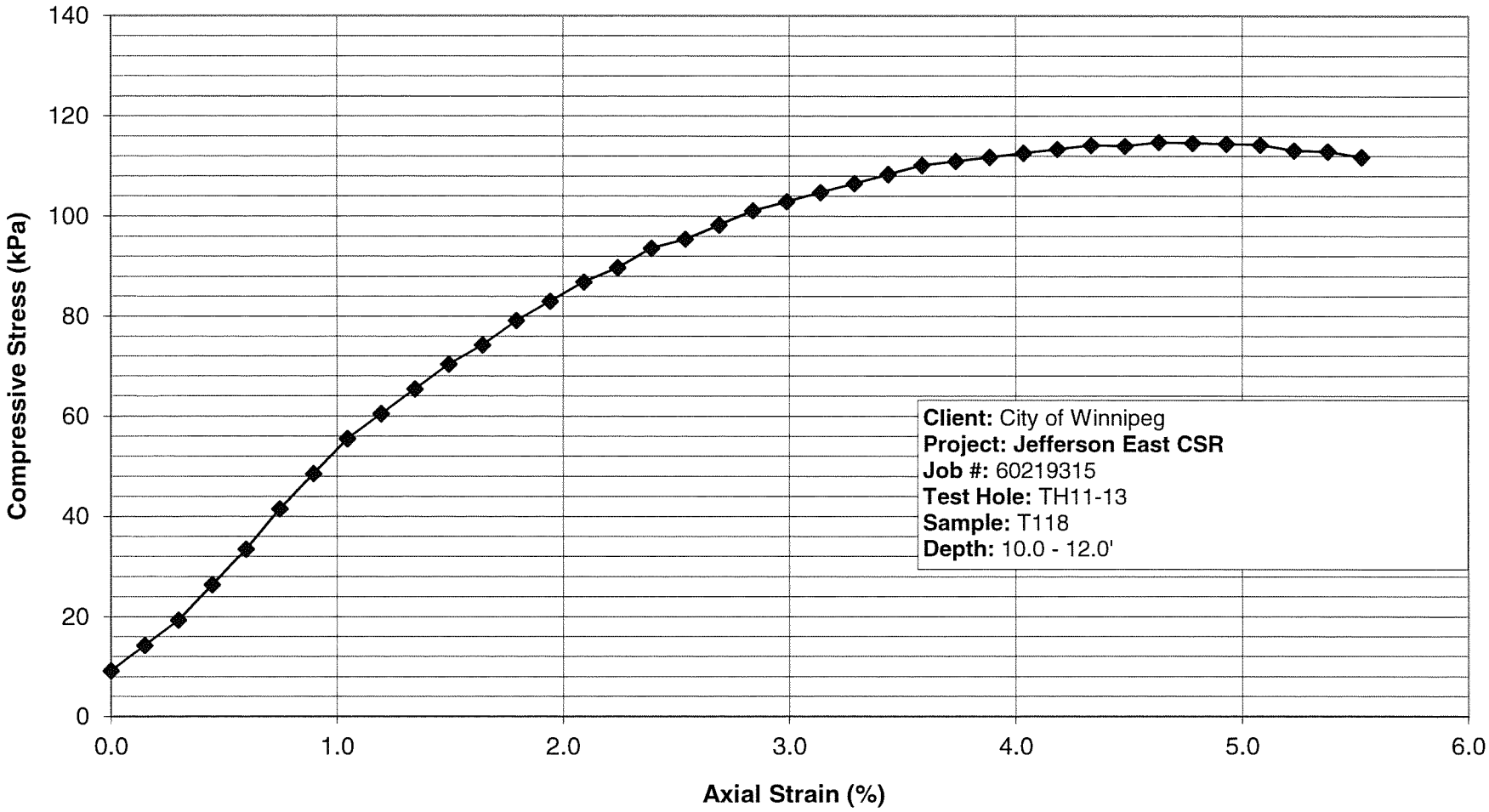
AXIAL COMPRESSION	PROVING RING	TOTAL AXIAL STRAIN, E_1	AVERAGE CROSS-SECTIONAL AREA, A	APPLIED AXIAL LOAD, P	COMPRESSIVE STRESS, σ_c		
(inches)	(inches)	(%)	(inches2)	(lbs)	(psi)	(ksf)	(kPa)
0.01	0.0009	0.00	6.33	8.43	1.33	0.192	9.2
0.02	0.0014	0.15	6.34	13.12	2.07	0.298	14.3
0.03	0.0019	0.30	6.35	17.80	2.80	0.404	19.3
0.03	0.0026	0.45	6.36	24.36	3.83	0.551	26.4
0.04	0.0033	0.60	6.37	30.92	4.85	0.699	33.5
0.05	0.0041	0.75	6.38	38.42	6.02	0.867	41.5
0.06	0.0048	0.90	6.39	44.98	7.04	1.013	48.5
0.07	0.0055	1.05	6.40	51.54	8.05	1.159	55.5
0.08	0.0060	1.20	6.41	56.22	8.77	1.263	60.5
0.09	0.0065	1.34	6.42	60.91	9.49	1.366	65.4
0.09	0.0070	1.49	6.43	65.59	10.20	1.469	70.3
0.10	0.0074	1.64	6.44	69.34	10.77	1.550	74.2
0.11	0.0079	1.79	6.45	74.02	11.48	1.653	79.1
0.12	0.0083	1.94	6.46	77.77	12.04	1.734	83.0
0.13	0.0087	2.09	6.47	81.52	12.60	1.814	86.9
0.14	0.0090	2.24	6.48	84.33	13.01	1.874	89.7
0.14	0.0094	2.39	6.49	88.08	13.57	1.954	93.6
0.15	0.0096	2.54	6.50	89.95	13.84	1.993	95.4
0.16	0.0099	2.69	6.51	92.76	14.25	2.052	98.3
0.17	0.0102	2.84	6.52	95.57	14.66	2.111	101.1
0.18	0.0104	2.99	6.53	97.45	14.92	2.149	102.9
0.19	0.0106	3.14	6.54	99.32	15.19	2.187	104.7
0.20	0.0108	3.29	6.55	101.20	15.45	2.225	106.5
0.20	0.0110	3.44	6.56	103.07	15.71	2.263	108.3
0.21	0.0112	3.59	6.57	104.94	15.97	2.300	110.1
0.22	0.0113	3.74	6.58	105.88	16.09	2.317	110.9
0.23	0.0114	3.88	6.59	106.82	16.21	2.334	111.8
0.24	0.0115	4.03	6.60	107.76	16.33	2.351	112.6
0.25	0.0116	4.18	6.61	108.69	16.44	2.368	113.4
0.26	0.0117	4.33	6.62	109.63	16.56	2.384	114.2
0.26	0.0117	4.48	6.63	109.63	16.53	2.381	114.0
0.27	0.0118	4.63	6.64	110.57	16.65	2.397	114.8
0.28	0.0118	4.78	6.65	110.57	16.62	2.393	114.6
0.29	0.0118	4.93	6.66	110.57	16.59	2.390	114.4
0.30	0.0118	5.08	6.67	110.57	16.57	2.386	114.2
0.31	0.0117	5.23	6.68	109.63	16.40	2.362	113.1
0.31	0.0117	5.38	6.69	109.63	16.38	2.358	112.9
0.32	0.0116	5.53	6.70	108.69	16.21	2.334	111.8

UNCONFINED COMPRESSIVE STRENGTH, q_u:	114.78	kPa
(based on maximum q_u value)	2.397	ksf
UNDRAINED SHEAR STRENGTH, S_u:	57.39	kPa
(based on maximum q_u value)	1.199	ksf

NOTES:

REMARKS:

AECOM
UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS
(ASTM D2166)



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

AECOM

CLIENT: City of Winnipeg
PROJECT: Jefferson East CSR
JOB NO.: 60219315

TEST HOLE NO.:	**TH11-13**		
SAMPLE NO.:	**T123**		
SAMPLE DEPTH:	30.0 32.0'		
DATE TESTED:	2-Jan-12		
SHEAR STRENGTH TESTS			
LAB VANE	**Su 1**		
Reading			
Spring Number	4		
Undrained Shear Strength (kPa) =	**0.0**		
Undrained Shear Strength (ksf) =	0.00		
TORVANE			
Reading	0.45		
Vane Size (S, M, L)	m		
Undrained Shear Strength (kPa) =	**44.1**		
Undrained Shear Strength (ksf) =	0.92		
POCKET PENETROMETER			
Reading - Qu (tsf)	0.75		
Undrained Shear Strength (kPa) =	**35.9**		
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) =	**106.3**		
Unconfined compressive strength (ksf) =	**2.2**		
Undrained Shear Strength (kPa) =	**53.1**		
Undrained Shear Strength (ksf) =	**1.110**		
	Density -Su1		
MOISTURE CONTENT			
Tare Number	75		
Wt. Sample wet + tare (g)	327.4		
Wt. Sample dry + tare (g)	225.1		
Wt. Tare (g)	8.3		
Moisture Content, w% =	**47.2**		
BULK DENSITY			
Sample Wt. (g)	1095.0		
Diameter 1 (cm)	7.22		
Diameter 2 (cm)	7.22		
Diameter 3 (cm)	7.24		
Avg. Diameter (cm)	**7.23**		
Length 1 (cm)	15.32		
Length 2 (cm)	15.35		
Length 3 (cm)	15.32		
Avg. Length (cm)	**15.33**		
Volume (cm3)	628.8		
Moisture content (%)	47.2		
Bulk Density (g/cm^3)	1.741		
Bulk Density (kN/m^3)	**17.1**		
Bulk Density (pcf)	**108.7**		
Dry Density (kN/m^3)	**11.60**		

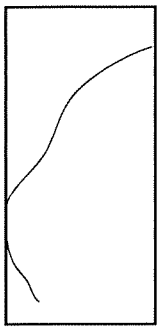
AECOM - SOILS LABORATORY
UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS (ASTM D2166)

AECOM

CLIENT:	City of Winnipeg
PROJECT:	Jefferson East CSR
JOB NO.:	60219315

TEST HOLE NO.:	TH11-13
SAMPLE NO.:	T123
SAMPLE DEPTH:	30.0 32.0'
SAMPLE DATE:	14-Dec-11
TEST DATE:	2-Jan-12

SOIL DESCRIPTION:	
CLAY; some silt inclusions (< 5mm), grey, moist, firm, high plasticity, slickensided	
MOISTURE CONTENT:	47.2



FAILURE SKETCH

SAMPLE DIAM.(Do):	72.27	(mm)	INITIAL AREA, Ao:	4101.7	(mm^2)
SAMPLE LENGTH, (Lo):	153.30	(mm)	PISTON RATE:	0.051	(inches / minute)
L / D RATIO:	2.1	(2 < L/D < 2.5)	AXIAL STRAIN RATE, R:	0.85	(0.5<R<2 % / minute)

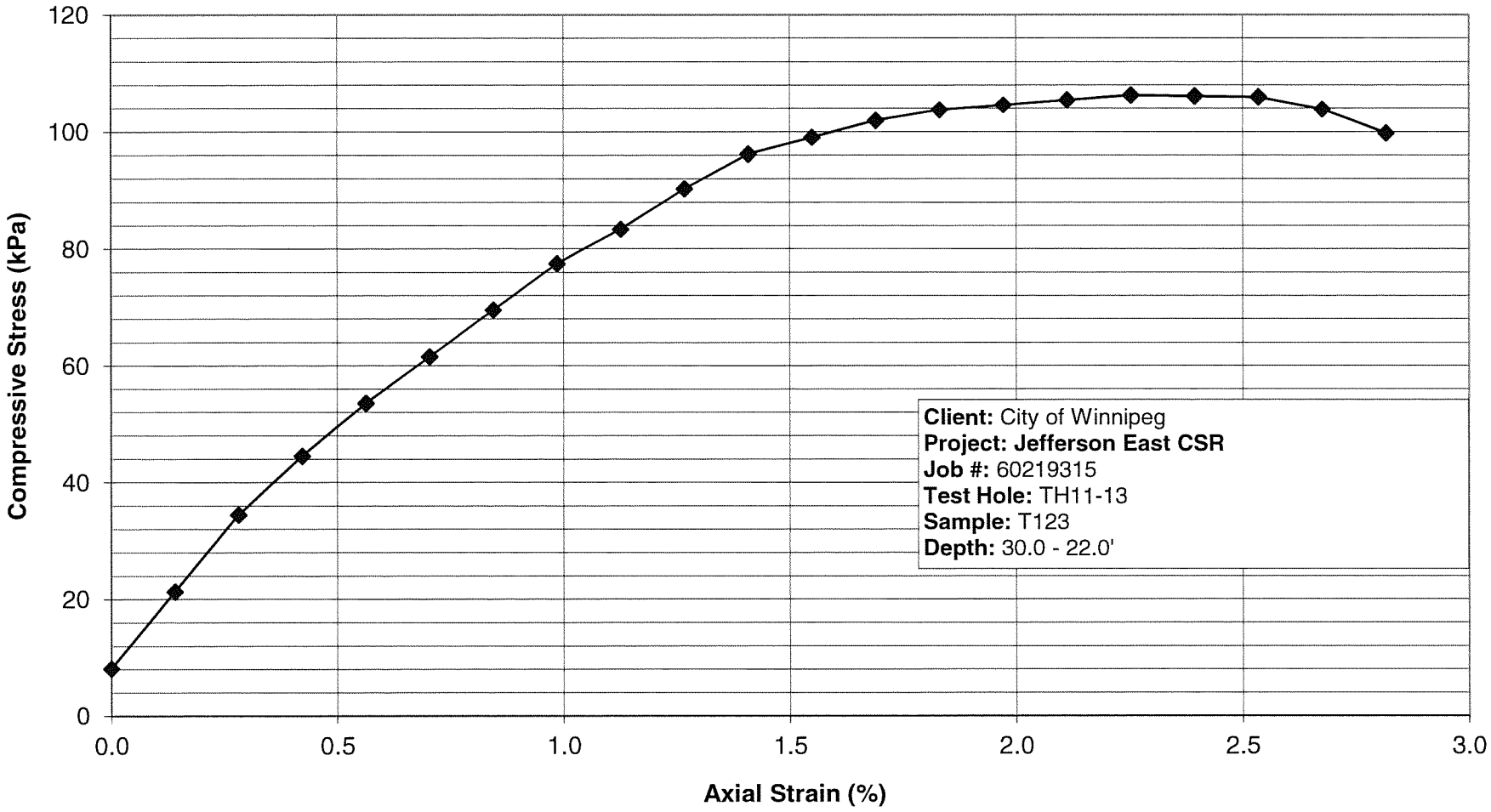
TEST DATA - DIAL READINGS							
AXIAL COMPRESSION	PROVING RING	TOTAL AXIAL STRAIN, E_1	AVERAGE CROSS-SECTIONAL AREA, A	APPLIED AXIAL LOAD, P	COMPRESSIVE STRESS, σ_c		
(inches)	(inches)	(%)	(inches2)	(lbs)	(psi)	(ksf)	(kPa)
0.01	0.0008	0.00	6.36	7.50	1.18	0.170	8.1
0.02	0.0021	0.14	6.37	19.68	3.09	0.445	21.3
0.03	0.0034	0.28	6.38	31.86	5.00	0.720	34.5
0.03	0.0044	0.42	6.38	41.23	6.46	0.930	44.5
0.04	0.0053	0.56	6.39	49.66	7.77	1.118	53.6
0.05	0.0061	0.70	6.40	57.16	8.93	1.285	61.5
0.06	0.0069	0.85	6.41	64.65	10.08	1.452	69.5
0.07	0.0077	0.99	6.42	72.15	11.24	1.618	77.5
0.08	0.0083	1.13	6.43	77.77	12.09	1.742	83.4
0.09	0.0090	1.27	6.44	84.33	13.10	1.886	90.3
0.09	0.0096	1.41	6.45	89.95	13.95	2.009	96.2
0.10	0.0099	1.55	6.46	92.76	14.36	2.069	99.0
0.11	0.0102	1.69	6.47	95.57	14.78	2.128	101.9
0.12	0.0104	1.83	6.48	97.45	15.05	2.167	103.7
0.13	0.0105	1.97	6.49	98.39	15.17	2.184	104.6
0.14	0.0106	2.11	6.49	99.32	15.29	2.202	105.4
0.14	0.0107	2.25	6.50	100.26	15.41	2.220	106.3
0.15	0.0107	2.39	6.51	100.26	15.39	2.216	106.1
0.16	0.0107	2.54	6.52	100.26	15.37	2.213	106.0
0.17	0.0105	2.68	6.53	98.39	15.06	2.169	103.8
0.18	0.0101	2.82	6.54	94.64	14.47	2.083	99.7

UNCONFINED COMPRESSIVE STRENGTH, q_u:	106.28	kPa
(based on maximum q_u value)	2.220	ksf
UNDRAINED SHEAR STRENGTH, S_u:	53.14	kPa
(based on maximum q_u value)	1.110	ksf

NOTES:

REMARKS:

AECOM
UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS
(ASTM D2166)



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

AECOM

CLIENT: City of Winnipeg
PROJECT: Jefferson East CSR
JOB NO.: 60219315

TEST HOLE NO.:	**TH11-14**		
SAMPLE NO.:	**T106**		
SAMPLE DEPTH:	10.0 - 12.0'		
DATE TESTED:	2-Jan-12		
SHEAR STRENGTH TESTS			
LAB VANE	**Su 1**		
Reading			
Spring Number	4		
Undrained Shear Strength (kPa) =	**0.0**		
Undrained Shear Strength (ksf) =	0.00		
TORVANE			
Reading	0.95		
Vane Size (S, M, L)	m		
Undrained Shear Strength (kPa) =	**93.2**		
Undrained Shear Strength (ksf) =	1.95		
POCKET PENETROMETER			
Reading - Qu (tsf)	2.00		
Undrained Shear Strength (kPa) =	**95.8**		
Reading - Qu (tsf)	2.00		
Undrained Shear Strength (kPa) =	**95.8**		
Reading - Qu (tsf)	2.00		
Undrained Shear Strength (kPa) =	**95.8**		
UNCONFINED COMPRESSIVE STRENGTH TEST			
Unconfined compressive strength (kPa) =	**185.6**		
Unconfined compressive strength (ksf) =	**3.9**		
Undrained Shear Strength (kPa) =	**92.8**		
Undrained Shear Strength (ksf) =	**1.938**		
	Density -Su1		
MOISTURE CONTENT			
Tare Number	14		
Wt. Sample wet + tare (g)	375.3		
Wt. Sample dry + tare (g)	264.1		
Wt. Tare (g)	8.1		
Moisture Content, w% =	**43.4**		
BULK DENSITY			
Sample Wt. (g)	1099		
Diameter 1 (cm)	7.24		
Diameter 2 (cm)	7.20		
Diameter 3 (cm)	7.23		
Avg. Diameter (cm)	**7.22**		
Length 1 (cm)	15.36		
Length 2 (cm)	15.36		
Length 3 (cm)	15.30		
Avg. Length (cm)	**15.34**		
Volume (cm3)	628.6		
Moisture content (%)	43.4		
Bulk Density (g/cm^3)	1.748		
Bulk Density (kN/m^3)	**17.1**		
Bulk Density (pcf)	**109.1**		
Dry Density (kN/m^3)	**11.95**		

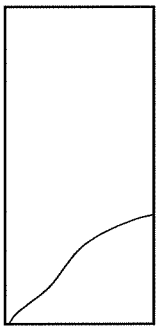
AECOM - SOILS LABORATORY
UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS (ASTM D2166)

AECOM

CLIENT:	City of Winnipeg
PROJECT:	Jefferson East CSR
JOB NO.:	60219315

TEST HOLE NO.:	TH11-14
SAMPLE NO.:	T106
SAMPLE DEPTH:	10.0 - 12.0'
SAMPLE DATE:	14-Dec-11
TEST DATE:	2-Jan-12

SOIL DESCRIPTION:	
CLAY; trace silt inclusions (<5mm), light brown, moist, firm, intermediate to high plasticity, slickensided	
MOISTURE CONTENT:	43.4



FAILURE SKETCH

SAMPLE DIAM.(Do):	72.23	(mm)	INITIAL AREA, Ao:	4097.9	(mm^2)
SAMPLE LENGTH, (Lo):	153.40	(mm)	PISTON RATE:	0.051	(inches / minute)
L / D RATIO:	2.1	(2 < L/D < 2.5)	AXIAL STRAIN RATE, R:	0.84	(0.5<R<2 % / minute)

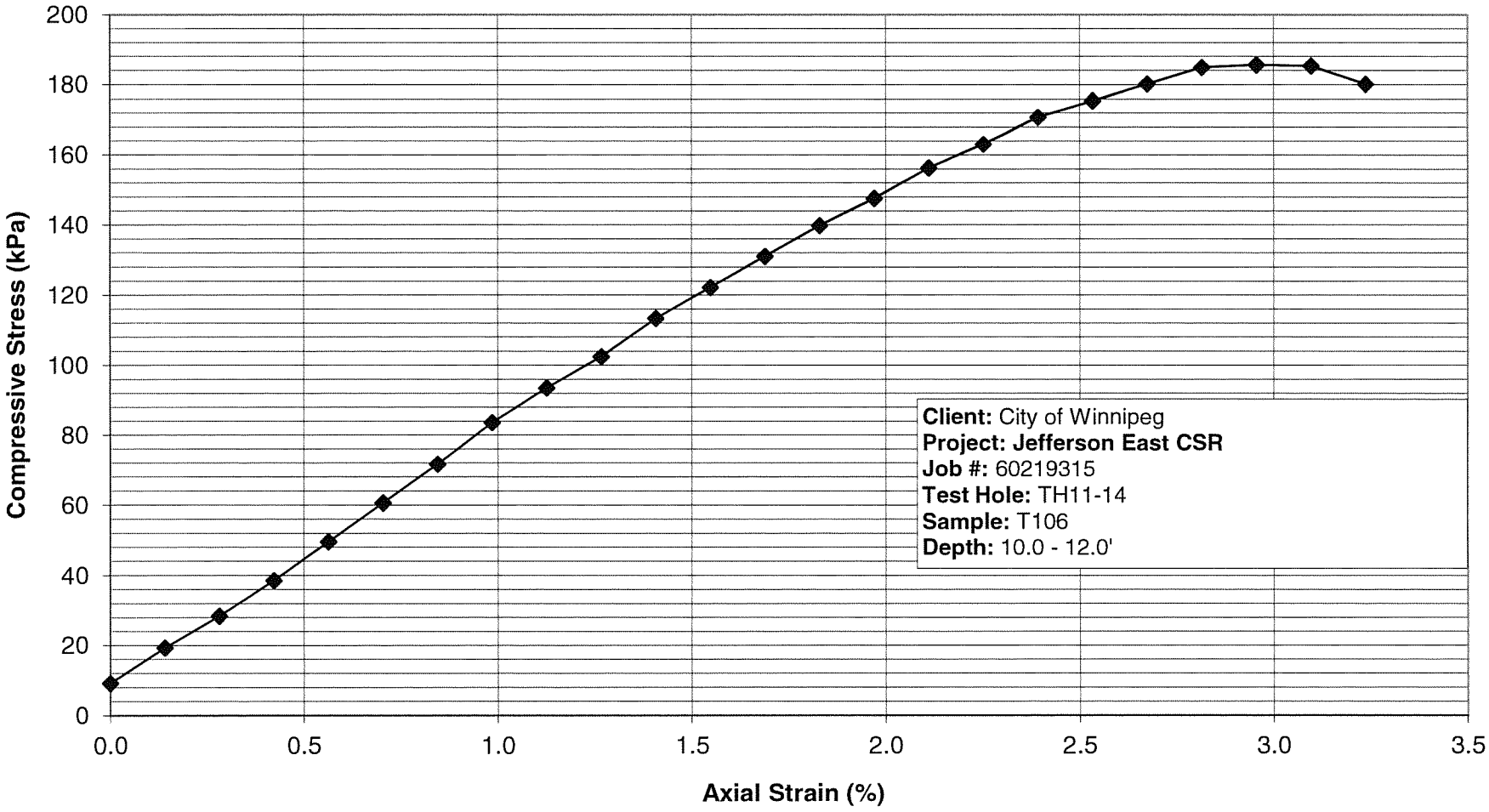
TEST DATA - DIAL READINGS							
AXIAL COMPRESSION	PROVING RING	TOTAL AXIAL STRAIN, E_1	AVERAGE CROSS-SECTIONAL AREA, A	APPLIED AXIAL LOAD, P	COMPRESSIVE STRESS, σ_c		
(inches)	(inches)	(%)	(inches2)	(lbs)	(psi)	(ksf)	(kPa)
0.01	0.0009	0.00	6.35	8.43	1.33	0.191	9.2
0.02	0.0019	0.14	6.36	17.80	2.80	0.403	19.3
0.03	0.0028	0.28	6.37	26.24	4.12	0.593	28.4
0.03	0.0038	0.42	6.38	35.61	5.58	0.804	38.5
0.04	0.0049	0.56	6.39	45.91	7.19	1.035	49.6
0.05	0.0060	0.70	6.40	56.22	8.79	1.266	60.6
0.06	0.0071	0.84	6.41	66.53	10.39	1.495	71.6
0.07	0.0083	0.99	6.42	77.77	12.12	1.746	83.6
0.08	0.0093	1.13	6.42	87.14	13.56	1.953	93.5
0.09	0.0102	1.27	6.43	95.57	14.86	2.139	102.4
0.09	0.0113	1.41	6.44	105.88	16.43	2.367	113.3
0.10	0.0122	1.55	6.45	114.31	17.72	2.551	122.2
0.11	0.0131	1.69	6.46	122.75	19.00	2.736	131.0
0.12	0.0140	1.83	6.47	131.18	20.27	2.920	139.8
0.13	0.0148	1.97	6.48	138.68	21.40	3.082	147.6
0.14	0.0157	2.11	6.49	147.11	22.67	3.265	156.3
0.14	0.0164	2.25	6.50	153.67	23.65	3.405	163.0
0.15	0.0172	2.39	6.51	161.16	24.77	3.566	170.8
0.16	0.0177	2.53	6.52	165.85	25.45	3.665	175.5
0.17	0.0182	2.67	6.53	170.53	26.13	3.763	180.2
0.18	0.0187	2.81	6.54	175.22	26.81	3.861	184.8
0.19	0.0188	2.96	6.55	176.16	26.91	3.876	185.6
0.20	0.0188	3.10	6.55	176.16	26.87	3.870	185.3
0.20	0.0183	3.24	6.56	171.47	26.12	3.762	180.1

UNCONFINED COMPRESSIVE STRENGTH, q_u:	185.56	kPa
(based on maximum q_u value)	3.876	ksf
UNDRAINED SHEAR STRENGTH, S_u:	92.78	kPa
(based on maximum q_u value)	1.938	ksf

NOTES:

REMARKS:

AECOM
UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS
(ASTM D2166)



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

Project Name:	Jefferson East CSR	Supplier:	N/A
Project Number:	60219315	Specification:	N/A
Client:	City of Winnipeg	Field Technician:	MAlkiki
Sample Location:	Varies	Sample Date:	February 24, 2015
Sample Depth:	Varies	Lab Technician:	EManimbao
Sample Number:	Varies	Date Tested:	March 25, 2014

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 (%)
TH15-01	G1	0.30 - 0.46 m	**25.3**
	G2	0.76 - 0.91 m	**22.9**
	G3	1.22 - 1.37 m	**27.3**
	G5	1.68 - 1.83 m	**14.0**
	G6	2.29 - 2.44 m	**42.2**
	G7	2.74 - 2.90 m	**43.6**
	G8	3.05 - 3.20 m	**39.3**
	G10	4.27 - 4.42 m	**37.5**
	T11	4.57 - 5.18 m	**39.7**
	G12	5.33 - 5.49 m	**39.5**
	G14	6.10 - 6.25 m	**41.0**
	G16	7.32 - 7.47 m	**39.1**
	G19	8.38 - 8.53 m	**36.3**
	G21	9.14 - 9.30 m	**48.5**
	G23	10.36 - 10.52 m	**48.2**
	G25	11.43 - 11.58 m	**57.5**
	G27	12.19 - 12.34 m	**57.0**
	G29	13.41 - 13.56 m	**51.1**
	G31	14.48 - 14.63 m	**27.4**
	G33	16.76 - 16.92 m	**54.3**

Location	Sample	Depth (m)	Moisture Content (%)

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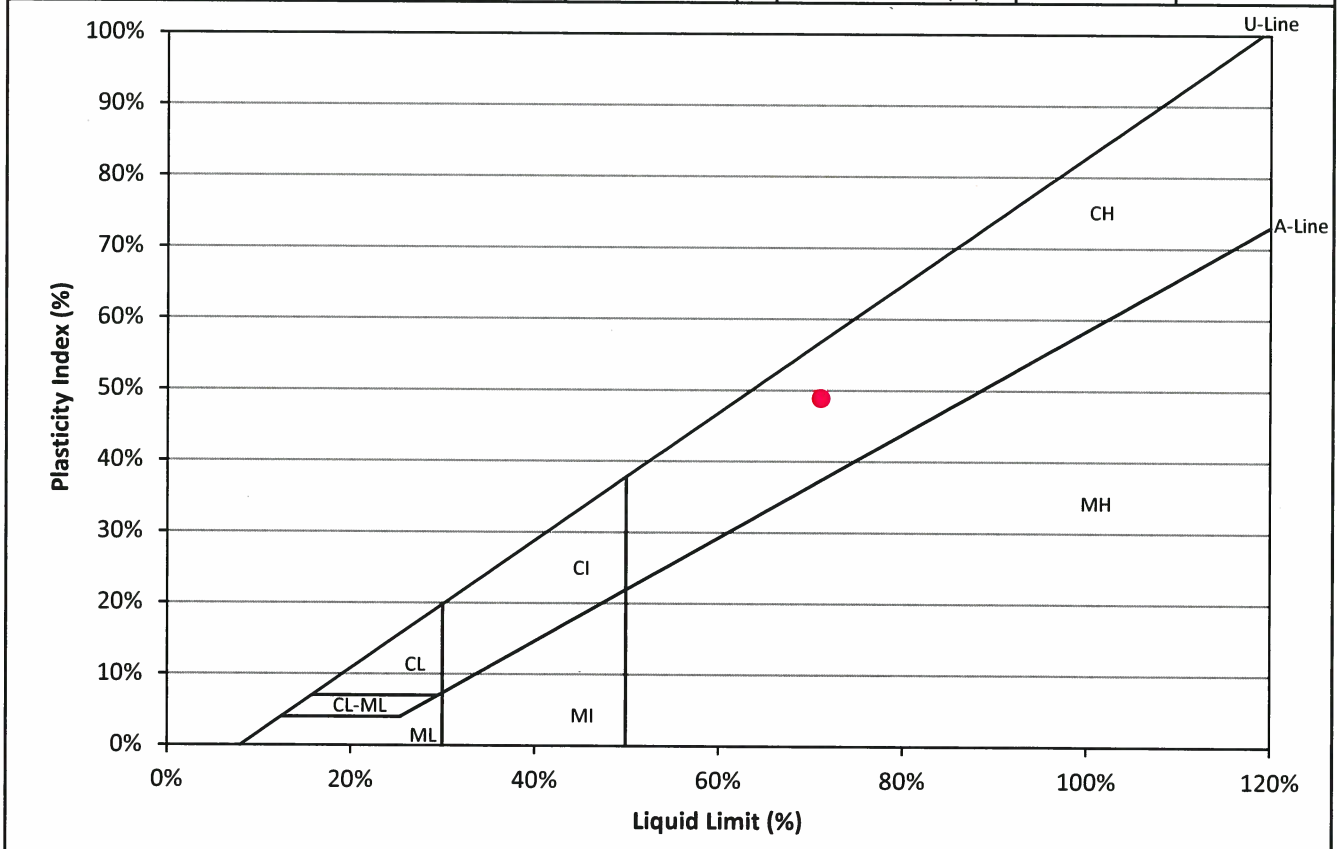
Project Name:	Jefferson East CSR	Supplier:	AECOM
Project Number:	60219315	Specification:	N/A
Client:	City of Winnipeg	Field Technician:	MAlkiki
Sample Location:	TH15-01	Sample Date:	February 24, 2015
Sample Depth:	0.30 - 0.46 m	Lab Technician:	EManimbao
Sample Number:	G1	Date Tested:	April 1, 2015

Atterberg Limits

ASTM D4318: Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	35	23	18
Wet Sample (g)	7.5	7.9	9.5
Dry Sample (g)	4.5	4.6	5.5
Water Content (%)	69.1%	71.8%	72.8%

Plastic Limit		
Trial	1	2
Wet Sample (g)	8.1	9.4
Dry Sample (g)	6.7	7.7
Water Content (%)	21.8%	22.7%



Liquid Limit (%): 71.1%	Plastic Limit (%): 22.3%	Plasticity Index (%): 48.9%

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99 Commerce Drive
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Phone: 204 477 5381 Fax: 204 284 2040

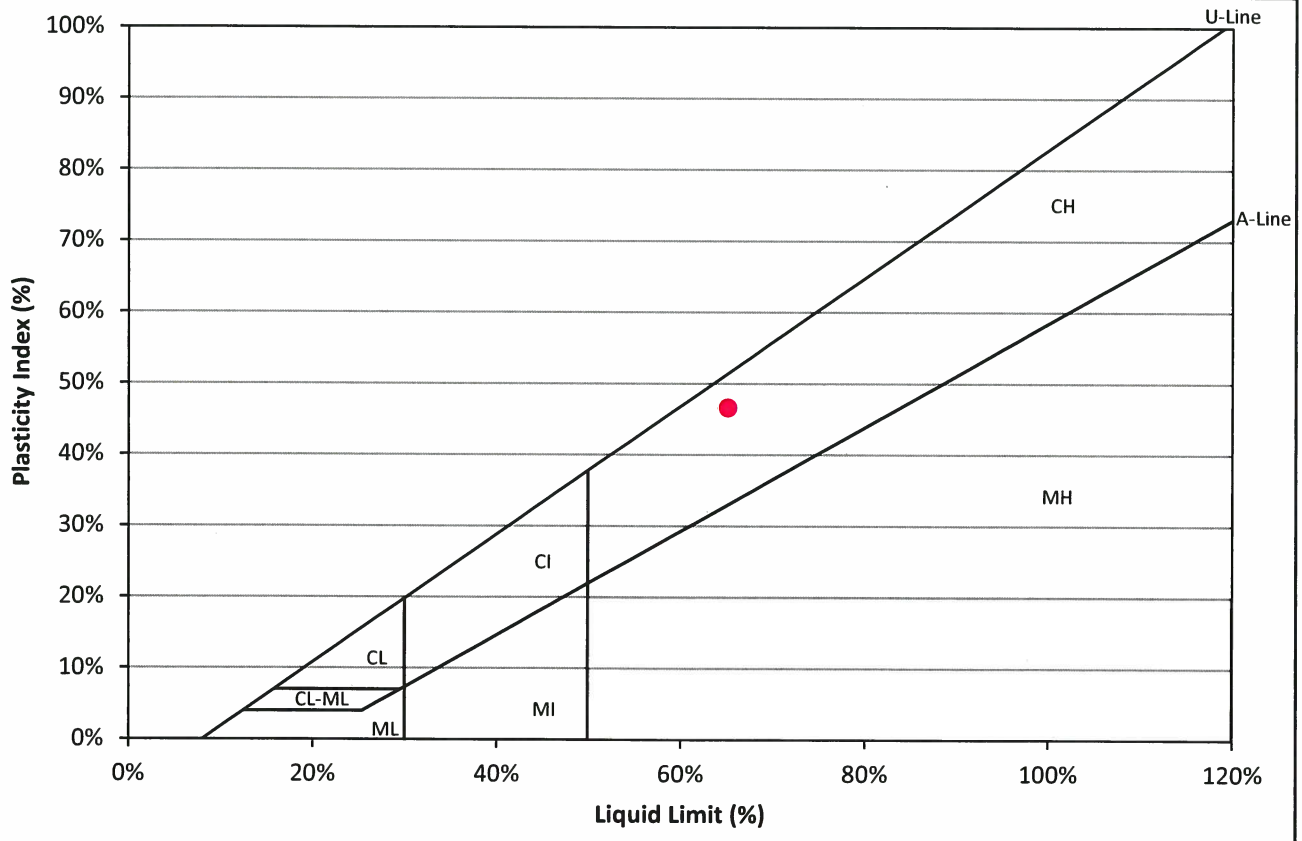
Project Name:	Jefferson East CSR	Supplier:	AECOM
Project Number:	60219315	Specification:	N/A
Client:	City of Winnipeg	Field Technician:	MAlkiki
Sample Location:	TH15-01	Sample Date:	February 24, 2015
Sample Depth:	1.22 - 1.37 m	Lab Technician:	EManimbao
Sample Number:	G3	Date Tested:	April 1, 2015

Atterberg Limits

ASTM D4318: Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	35	26	21
Wet Sample (g)	8.4	8.0	7.5
Dry Sample (g)	5.2	4.8	4.5
Water Content (%)	62.0%	65.3%	66.5%

Plastic Limit		
Trial	1	2
Wet Sample (g)	9.9	9.7
Dry Sample (g)	8.4	8.1
Water Content (%)	18.5%	18.7%



Liquid Limit (%): 65.1%	Plastic Limit (%): 18.6%	Plasticity Index (%): 46.6%

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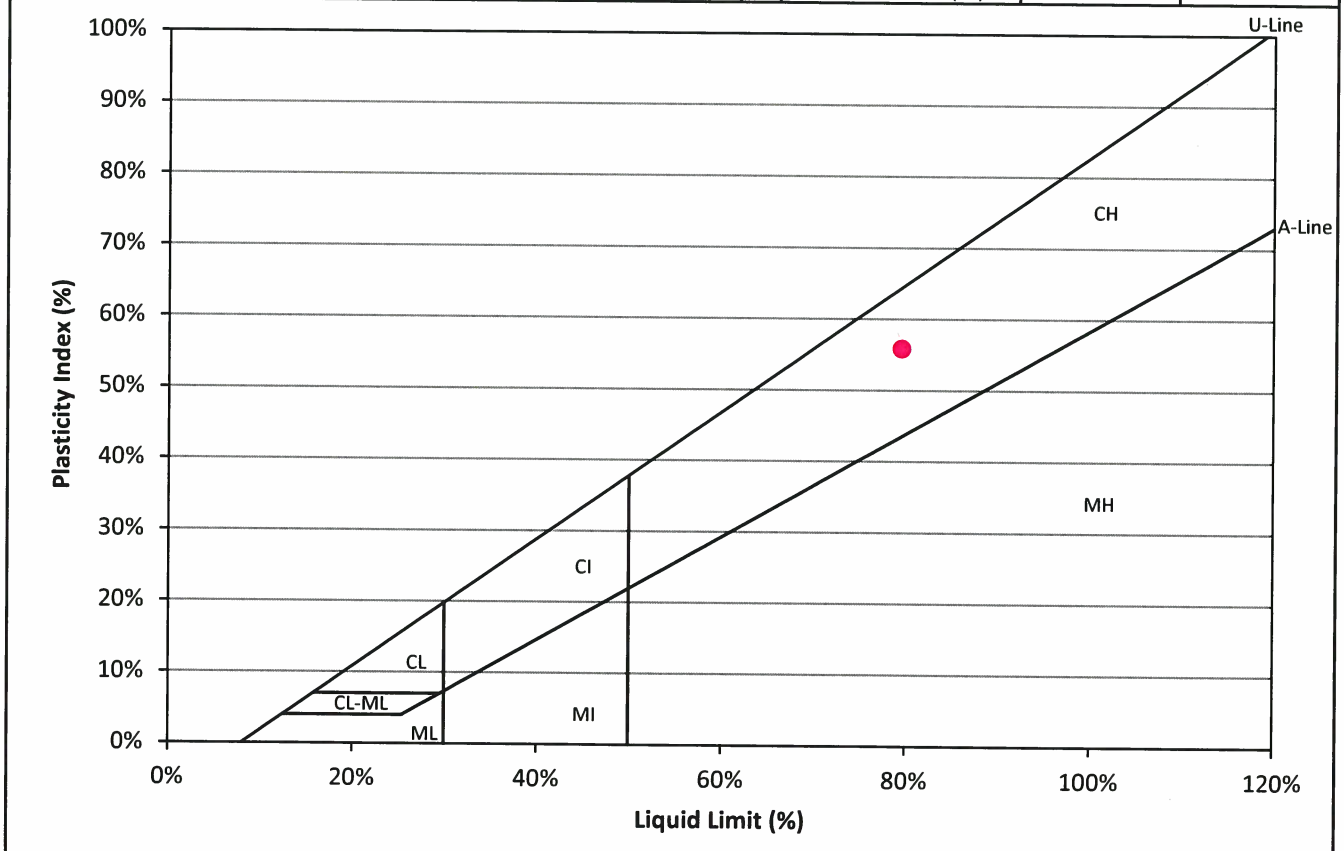
Project Name:	Jefferson East CSR	Supplier:	AECOM
Project Number:	60219315	Specification:	N/A
Client:	City of Winnipeg	Field Technician:	MAlkiki
Sample Location:	TH15-01	Sample Date:	February 24, 2015
Sample Depth:	4.57 - 5.18 m	Lab Technician:	EManimbao
Sample Number:	T11	Date Tested:	April 2, 2015

Atterberg Limits

ASTM D4318: Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	17	26	35
Wet Sample (g)	11.6	11.7	9.9
Dry Sample (g)	6.4	6.5	5.6
Water Content (%)	82.1%	79.4%	77.0%

Plastic Limit		
Trial	1	2
Wet Sample (g)	6.9	6.8
Dry Sample (g)	5.6	5.5
Water Content (%)	23.8%	23.7%



Liquid Limit (%): 79.6%	Plastic Limit (%): 23.8%	Plasticity Index (%): 55.9%

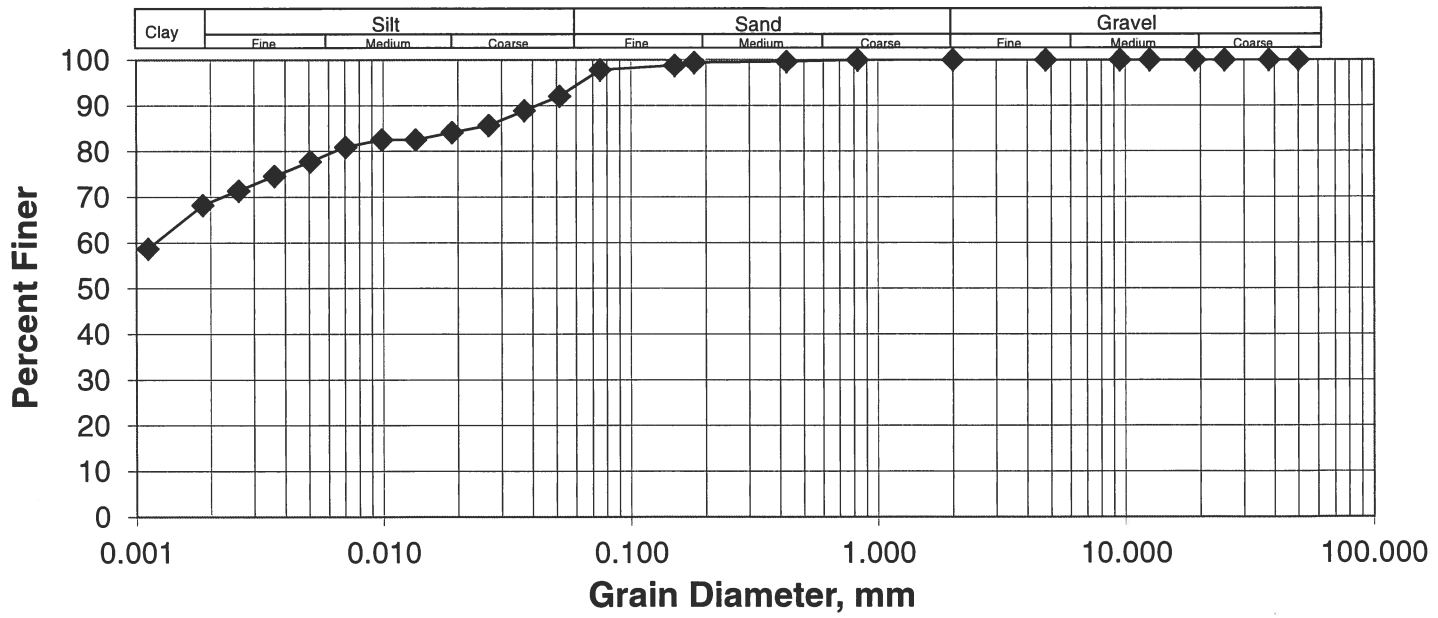
GRAIN SIZE DISTRIBUTION
(ASTM D422-63)

AECOM
MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 **fax** (204) 284-2040

Job No.:	60219315	Hole No.:	TH15-01
Client:	City of Winnipeg	Sample No.:	G1
Project :	Jefferson East CSR	Depth:	0.30 - 0.46 m
Date Tested:	2-Apr-15	Date Sampled:	24-Feb-15
Tested By:	MLotecki	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	2.00	100.0	0.0750	97.8
38.0	100.0	0.83	100.0	0.0514	92.1
25.0	100.0	0.43	99.6	0.0370	88.9
19.0	100.0	0.18	99.4	0.0266	85.7
12.5	100.0	0.15	98.8	0.0189	84.1
9.5	100.0	0.075	97.8	0.0135	82.5
4.75	100.0			0.0099	82.5
2.00	100.0			0.0070	80.9
				0.0050	77.8
				0.0036	74.6
				0.0026	71.4
				0.0019	68.2
				0.0011	58.7

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.0%**	**Silt**	**25.3%**
Sand	**5.9%**	**Clay**	**68.8%**

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

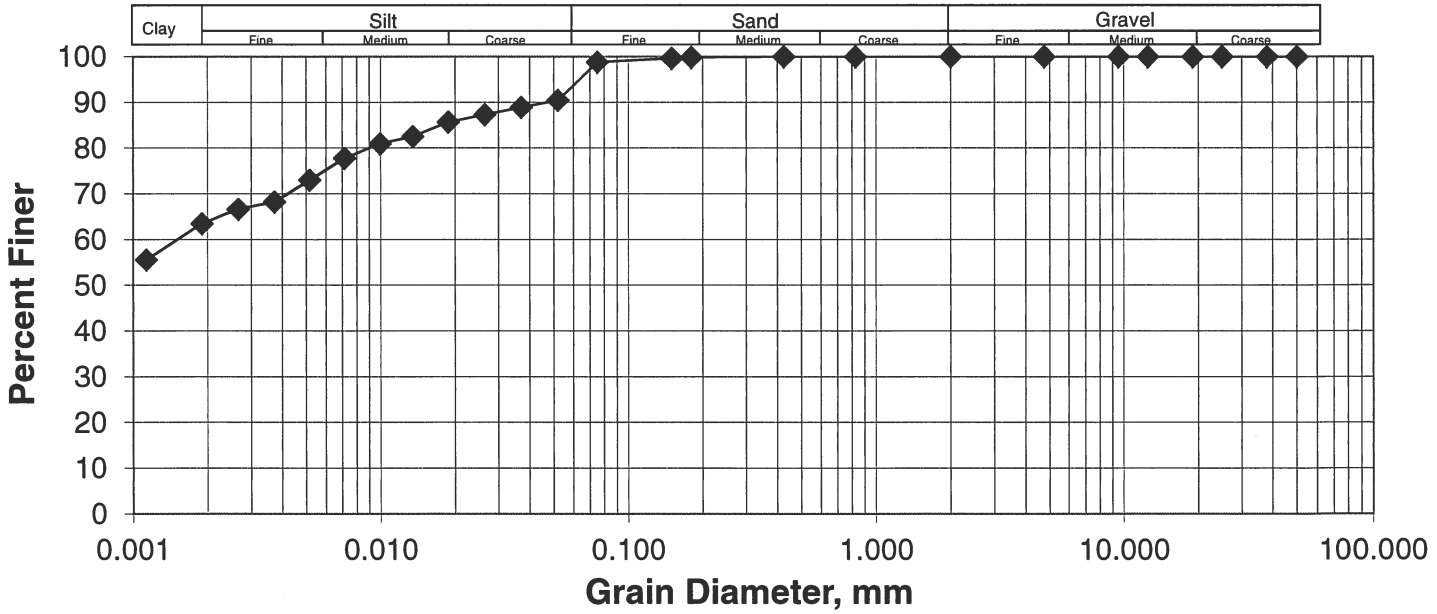
GRAIN SIZE DISTRIBUTION
(ASTM D422-63)

AECOM
MATERIALS LABORATORY
AECOM
99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada
tel (204) 477-5381 **fax** (204) 284-2040

Job No.:	60219315	Hole No.:	TH15-01
Client:	City of Winnipeg	Sample No.:	G3
Project :	Jefferson East CSR	Depth:	1.22 - 1.37 m
Date Tested:	2-Apr-15	Date Sampled:	24-Feb-15
Tested By:	MLotecki	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	2.00	100.0	0.0750	98.8
38.0	100.0	0.83	100.0	0.0518	90.5
25.0	100.0	0.43	100.0	0.0370	88.9
19.0	100.0	0.18	99.8	0.0264	87.3
12.5	100.0	0.15	99.6	0.0188	85.7
9.5	100.0	0.075	98.8	0.0135	82.5
4.75	100.0			0.0099	80.9
2.00	100.0			0.0071	77.8
				0.0052	73.0
				0.0037	68.2
				0.0026	66.6
				0.0019	63.5
				0.0011	55.5

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.0%**	**Silt**	**29.5%**
Sand	**6.6%**	**Clay**	**63.9%**

** Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

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Project Name:	Jefferson East CSR (Phase 2)	Supplier:	AECOM
Project Number:	60599385	Specification:	N/A
Client:	City of Winnipeg	Field Technician:	RHarras
Sample Location:	Varies	Sample Date:	Varies
Sample Depth:	Varies	Lab Technician:	RHarras
Sample Number:	Varies	Date Tested:	June 24 - 27, 2019

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 (%)
TH19-01	G1A	1.07 - 1.22 m	**20.5%**
	G1	1.37 - 1.52 m	**28.6%**
	G3	4.42 - 4.57 m	**47.3%**
	G4	5.94 - 6.10 m	**46.4%**
	G6	8.99 - 9.14 m	**43.9%**
	G7	10.52 - 10.67 m	**39.9%**
	S9	13.72 - 14.17 m	**10.1%**
	S10	14.94 - 15.01 m	**16.4%**
TH19-02	G16A	0.69 - 0.84 m	**19.4%**
	G16	1.37 - 1.52 m	**27.1%**
	G17	2.90 - 3.05 m	**48.9%**
	G18	4.42 - 4.57 m	**48.3%**
	G20	7.47 - 7.62 m	**43.0%**
	G21	8.99 - 9.14 m	**41.3%**
	G22	10.52 - 10.67 m	**37.3%**
	G23	12.04 - 12.19 m	**38.3%**
TH19-03	G24	1.37 - 1.52 m	**27.7%**
	G25	2.90 - 3.05 m	**42.6%**
	G26	4.42 - 4.57 m	**55.1%**
	G27	5.94 - 6.10 m	**38.6%**
	G28	7.47 - 7.62 m	**44.0%**
	G30	10.52 - 10.67 m	**33.8%**
	G31	12.04 - 12.19 m	**26.3%**
TH19-04	G32A	0.91 - 1.07 m	**20.8%**
	G32	1.37 - 1.52 m	**24.8%**
	G33	2.90 - 3.05 m	**48.4%**
	G34	4.42 - 4.57 m	**48.7%**
	G35	5.94 - 6.10 m	**50.9%**
	G37	8.99 - 9.14 m	**41.3%**
	G38	10.52 - 10.67 m	**47.3%**
	G39	12.04 - 12.19 m	**41.4%**
TH19-05	G40A	0.61 - 0.76 m	**25.9%**
	G40	1.37 - 1.52 m	**26.6%**
	G41	2.90 - 3.05 m	**22.9%**
	G43	5.94 - 6.10 m	**45.4%**
	G45	8.99 - 9.14 m	**45.3%**
	G47	12.04 - 12.19 m	**47.5%**
	S49	15.24 - 15.70 m	**11.5%**

Location	Sample	Depth (m)	Moisture Content (%)
	S50	16.31 - 16.56 m	**9.3%**
TH19-06	G55	1.37 - 1.52 m	**22.3%**
	G56A	1.75 - 1.91 m	**28.6%**
	G56B	2.21 - 2.36 m	**23.3%**
	G56	2.90 - 3.05 m	**41.5%**
	G57	4.42 - 4.57 m	**46.8%**
	G59	7.47 - 7.62 m	**44.0%**
	G60	8.99 - 9.14 m	**53.3%**
	G61	10.52 - 10.67 m	**50.8%**
	G62	12.04 - 12.19 m	**59.1%**
TH19-07	G63	1.37 - 1.52 m	**12.3%**
	G64	2.90 - 3.05 m	**47.1%**
	G65	4.42 - 4.57 m	**50.5%**
	G66	5.94 - 6.10 m	**53.6%**
	G68	8.99 - 9.14 m	**52.2%**
	G69	10.52 - 10.67 m	**51.4%**
	G70	12.04 - 12.19 m	**54.6%**
TH19-08	G71A	0.69 - 0.84 m	**19.7%**
	G71	1.37 - 1.52 m	**36.3%**
	G72	2.90 - 3.05 m	**53.7%**
	G73	4.42 - 4.57 m	**53.4%**
	G75	7.47 - 7.62 m	**45.2%**
	G76	8.99 - 9.14 m	**48.7%**
	G77	10.52 - 10.67 m	**49.2%**
	G78	12.04 - 12.19 m	**46.7%**
	G79	13.56 - 13.72 m	**22.9%**
	G80	15.09 - 15.24 m	**11.7%**
	S81	16.76 - 17.22 m	**12.0%**
TH19-10	G91A	0.84 - 0.99 m	**25.4%**
	G91	1.37 - 1.52 m	**22.6%**
	G92	2.90 - 3.05 m	**33.9%**
	G93	4.42 - 4.57 m	**52.3%**
	G94	5.94 - 6.10 m	**51.5%**
	G96	8.99 - 9.14 m	**41.1%**
	G97	10.52 - 10.67 m	**47.3%**
	G98	12.04 - 12.19 m	**48.3%**
TH19-11	G99A	0.53 - 0.69 m	**31.4%**
	G99	1.37 - 1.52 m	**21.7%**

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Winnipeg Geotechnical Laboratory
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Winnipeg, Manitoba
R3P 0Y7
Phone: 204 477 5381 Fax: 204 284 2040

Project Name:	Jefferson East CSR (Phase 2)	Supplier:	AECOM
Project Number:	60599385	Specification:	N/A
Client:	City of Winnipeg	Field Technician:	RHarras
Sample Location:	Varies	Sample Date:	Varies
Sample Depth:	Varies	Lab Technician:	RHarras
Sample Number:	Varies	Date Tested:	June 24 - 27, 2019

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 (%)
	G100	2.90 - 3.05 m	**50.3%**
	G102	5.94 - 6.10 m	**48.9%**
	G103	7.47 - 7.62 m	**48.1%**
	G104	8.99 - 9.14 m	**64.3%**
	G105	10.52 - 10.67 m	**42.2%**
	G106	12.04 - 12.19 m	**59.0%**
	G107	13.56 - 13.72 m	**44.8%**
	G108	15.09 - 15.24 m	**21.5%**
	G109	16.61 - 16.76 m	**37.7%**
	G110	18.14 - 18.29 m	**26.2%**
TH19-12	G111A	0.99 - 1.14 m	**26.6%**
	G111	1.37 - 1.52 m	**28.2%**
	G112	2.90 - 3.05 m	**39.9%**
	G113	4.42 - 4.57 m	**60.9%**
	G115	7.47 - 7.62 m	**58.3%**
	G116	8.99 - 9.14 m	**52.4%**
	G117	10.52 - 10.67 m	**51.2%**
	G118	12.04 - 12.19 m	**41.9%**
TH19-13	G119A	0.69 - 0.84 m	**31.5%**
	G119	1.37 - 1.52 m	**25.4%**
	G120	2.90 - 3.05 m	**51.8%**
	G122	5.94 - 6.10 m	**53.1%**
	G123	7.47 - 7.62 m	**48.3%**
	G124	8.99 - 9.14 m	**51.0%**
	G125	10.52 - 10.67 m	**47.3%**
	G126	12.04 - 12.19 m	**58.4%**
TH19-14	G127	1.37 - 1.52 m	**25.5%**
	G127A	2.21 - 2.36 m	**23.4%**
	G131	7.47 - 7.62 m	**48.5%**
	G133	10.52 - 10.67 m	**33.2%**
	G135	13.56 - 13.72 m	**41.0%**
	G136	15.09 - 15.24 m	**60.7%**
	G137	16.61 - 16.76 m	**28.8%**
	G138	18.14 - 18.29 m	**12.5%**
	S139	19.51 - 19.51 m	**9.5%**
TH19-15	G142	5.94 - 6.10 m	**52.3%**
	G144	8.99 - 9.14 m	**46.1%**
TH19-16	G146	1.37 - 1.52 m	**30.5%**

Location	Sample	Depth (m)	Moisture Content (%)
	G150	7.47 - 7.62 m	**48.3%**
	G152	10.52 - 10.67 m	**51.3%**
	G153	12.04 - 12.19 m	**50.7%**
	G156	16.61 - 16.76 m	**18.1%**
TH19-17	G158A	0.69 - 0.84 m	**27.0%**
	G158	1.37 - 1.52 m	**14.2%**
	G159	2.90 - 3.05 m	**24.1%**
	G161	5.94 - 6.10 m	**55.0%**
	G163	8.99 - 9.14 m	**47.6%**

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MOISTURE CONTENT OF SOIL (ASTM D2216)

CLIENT:	AECOM	TEST NO:	19- 001	PROJECT NO:	112-1909
PROJECT:	Jefferson East CSR (Phase 2)	DATE SAMPLED:	26-Jul-2019	SAMPLED BY:	Client
PROJECT CONTACT:	Ryan Harras	DATE TESTED:	29-Jul-2019	TESTED BY:	Navpreet Singh
TEST LOCATION:	Winnipeg Manitoba				

Description	TH 19 - 16	TH 19 - 16			
Sample	T148-2	T154			
Wt Wet Sample + Tare	127.40	201.70			
Wt Dry Sample + Tare	88.40	125.50			
Wt Water	39.00	76.20			
Wt Tare	4.30	4.20			
Wt Dry Sample	84.10	121.30			
Moisture Content (%)	**46.4**	**62.8**			
Description					
Sample					
Wt Wet Sample + Tare					
Wt Dry Sample + Tare					
Wt Water					
Wt Tare					
Wt Dry Sample					
Moisture Content (%)					
Description					
Sample					
Wt Wet Sample + Tare					
Wt Dry Sample + Tare					
Wt Water					
Wt Tare					
Wt Dry Sample					
Moisture Content (%)					
Description					
Sample					
Wt Wet Sample + Tare					
Wt Dry Sample + Tare					
Wt Water					
Wt Tare					
Wt Dry Sample					
Moisture Content (%)					

MTR/Disptach No: MTR 1331

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CLIENT: AECOM
99 Commerce Drive,
Winnipeg, MB R3P 0Y7
ATTENTION: Ryan Harras
PROJECT: Jefferson East CSR (Phase 2)

PROJECT NO.: 112-1909

Summary of Particle Size Analysis and Atterberg Limits

Hole No	Sample No.	% Clay	% Silt	% Sand	Liquid Limit	Plastic Limit	Plasticity Index
TH 19-05	G41	11	86.6	2.4	Non plastic		
TH 19-08	T74	64	35	1.0	60	25	35
TH 19-08	S81	21	43.8	35.2	22	10	12
TH 19-14	G127A	18	80.6	1.4	24	16	8
TH 19-15	T140	80	20	0	70	31	39
TH 19-16	G146	55	39	6.0	53	23	30

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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

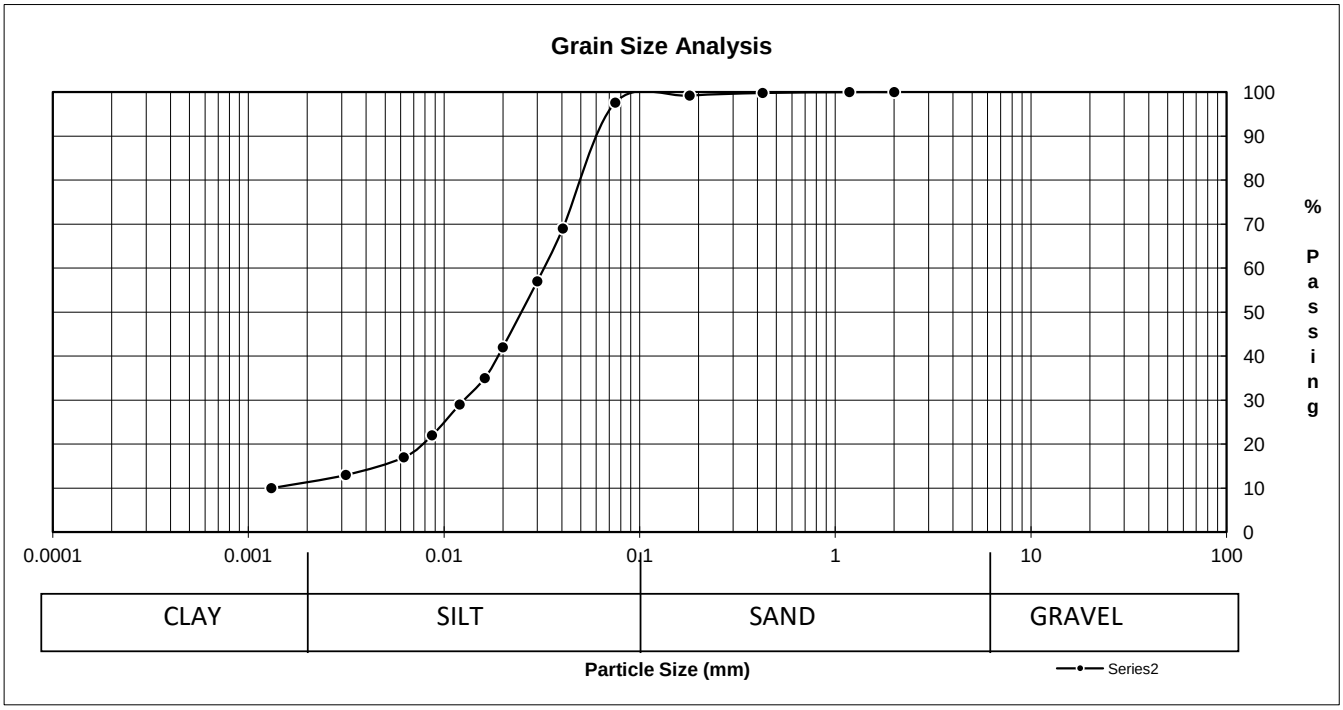
CLIENT:	AECOM	PROJECT NO.	112-1909
	99 Commerce Drive,	Test No:	1
	Winnipeg, MB R3P 0Y7	Lab No:	HM 314
ATTENTION:	Ryan Harras		
PROJECT:	Jefferson East CSR (Phase 2)		
	Winnipeg, Manitoba		

Date Sampled:	6/24-27/2019	Date Received:	27-Jul-19
Sampled By:	Client	Date Tested:	1-Aug-19

Material Identification

B.H./T.H. No.	TH 19-05
Sample No.	G41
Sample depth	10'
Specific Gravity of Material:	2.65

Sieve Analysis		Hydrometer Analysis	
Sieve (mm)	% Passing	Diameter	% Finer
50.00	100.0		
37.50	100.0		
25.00	100.0		
19.00	100.0		
16.00	100.0		
12.50	100.0	0.0405	69.0
9.50	100.0	0.0300	57.0
4.75	100.0	0.0200	42.0
2.00	100.0	0.0162	35.0
1.18	100.0	0.0120	29.0
0.425	99.8	0.0087	22.0
0.180	99.2	0.0062	17.0
0.075	97.6	0.0031	13.0



SOIL DESCRIPTION	% Composition			
		Gravel	D10	0.00130
	2.4	Sand	D30	0.01205
	86.6	Silt	D60	0.03245
	11.0	Clay	Cu	24.96
			Cc	3.44

Remarks: Test Method: ASTM D422, D2216, D4318

Technician: Navi

P. Bevel

Reviewed by: Paul Bevel

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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

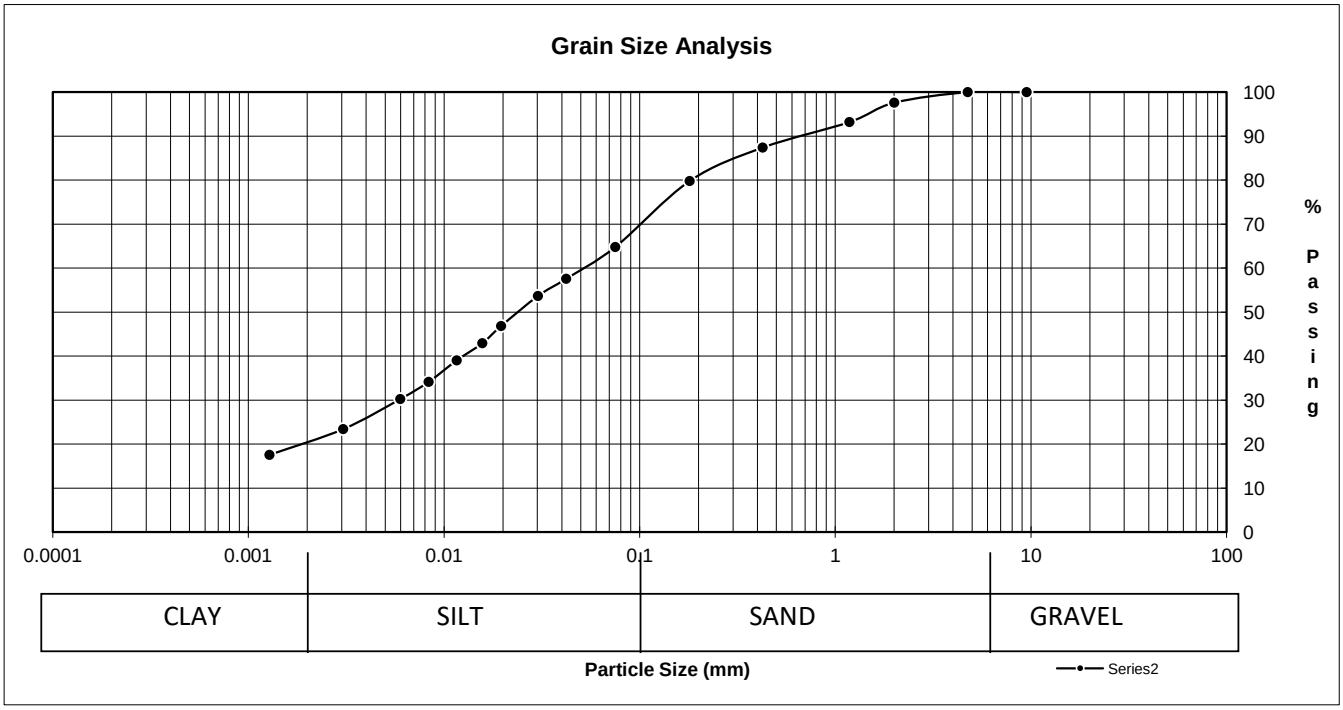
CLIENT:	AECOM	PROJECT NO.	112-1909
	99 Commerce Drive,	Test No:	2
	Winnipeg, MB R3P 0Y7	Lab No:	HM 314
ATTENTION:	Ryan Harras		
PROJECT:	Jefferson East CSR (Phase 2)		
	Winnipeg, Manitoba		

Date Sampled:	6/24-27/2019	Date Received:	27-Jul-19
Sampled By:	Client	Date Tested:	1-Aug-19

Material Identification

B.H./T.H. No.	TH 19-08
Sample No.	S81
Sample depth	55'
Specific Gravity of Material:	2.65

Sieve Analysis		Hydrometer Analysis	
Sieve (mm)	% Passing	Diameter	% Finer
50.00	100.0		
37.50	100.0		
25.00	100.0		
19.00	100.0		
16.00	100.0		
12.50	100.0	0.0421	57.6
9.50	100.0	0.0302	53.7
4.75	100.0	0.0196	46.8
2.00	97.6	0.0157	42.9
1.18	93.2	0.0116	39.0
0.425	87.4	0.0083	34.2
0.180	79.8	0.0060	30.3
0.075	64.8	0.0030	23.4



SOIL DESCRIPTION	% Composition		D10	
		Gravel	D30	0.00590
	35.2	Sand	D60	0.00184
	43.8	Silt	Cu	#DIV/0!
	21.0	Clay	Cc	#DIV/0!

Remarks: Test Method: ASTM D422, D2216, D4318

Technician: Navi

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Reviewed by: Paul Bevel

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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

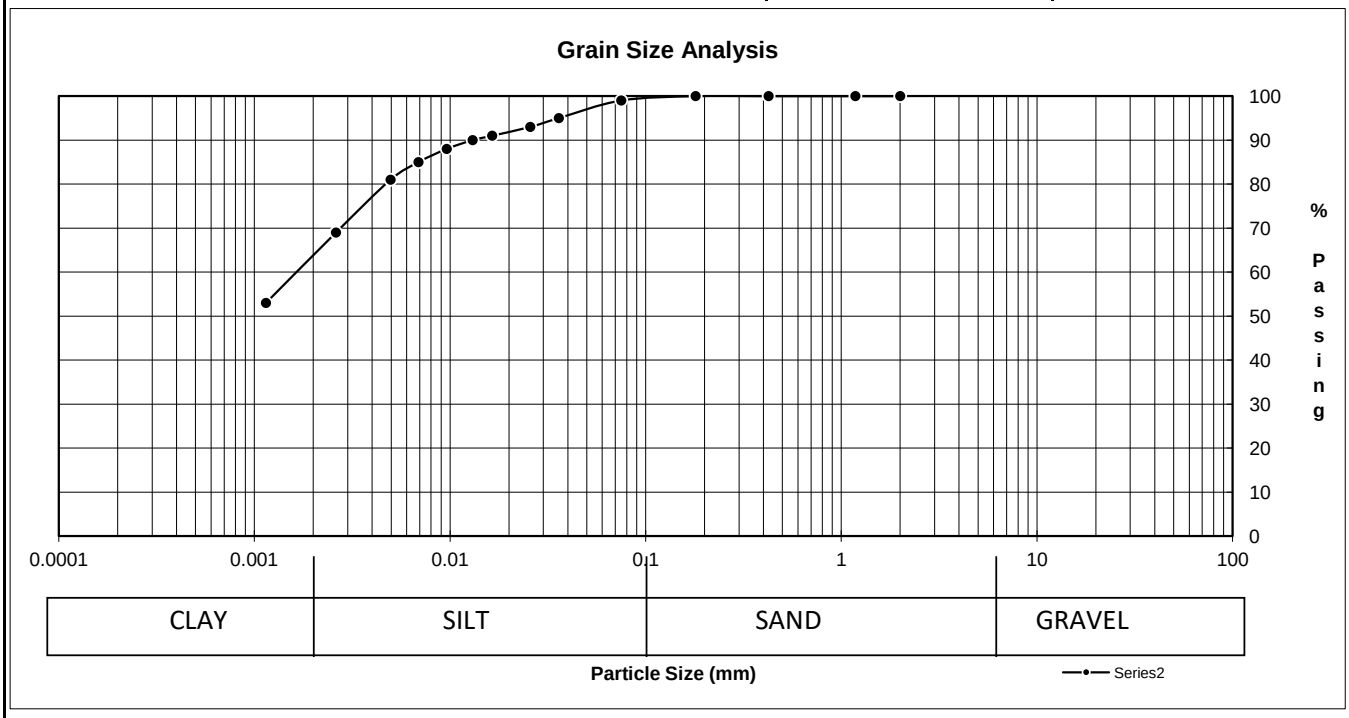
CLIENT:	AECOM	PROJECT NO.	112-1909
	99 Commerce Drive,	Test No:	3
	Winnipeg, MB R3P 0Y7	Lab No:	HM 314
ATTENTION:	Ryan Harras		
PROJECT:	Jefferson East CSR (Phase 2)		
	Winnipeg, Manitoba		

Date Sampled:	6/24-27/2019	Date Received:	27-Jul-19
Sampled By:	Client	Date Tested:	1-Aug-19

Material Identification

B.H./T.H. No.	TH 19-08
Sample No.	T74
Sample depth	20'
Specific Gravity of Material:	2.65

Sieve Analysis		Hydrometer Analysis	
Sieve (mm)	% Passing	Diameter	% Finer
50.00	100.0		
37.50	100.0		
25.00	100.0		
19.00	100.0		
16.00	100.0		
12.50	100.0	0.0360	95.0
9.50	100.0	0.0257	93.0
4.75	100.0	0.0164	91.0
2.00	100.0	0.0130	90.0
1.18	100.0	0.0096	88.0
0.425	100.0	0.0069	85.0
0.180	100.0	0.0050	81.0
0.075	99.0	0.0026	69.0



SOIL DESCRIPTION	% Composition		D10	
		Gravel	D30	
	1.0	Sand	D60	0.00184
	35.0	Silt	Cu	#DIV/0!
	64.0	Clay	Cc	#DIV/0!

Remarks: Test Method: ASTM D422, D2216, D4318

Technician: Navi

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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

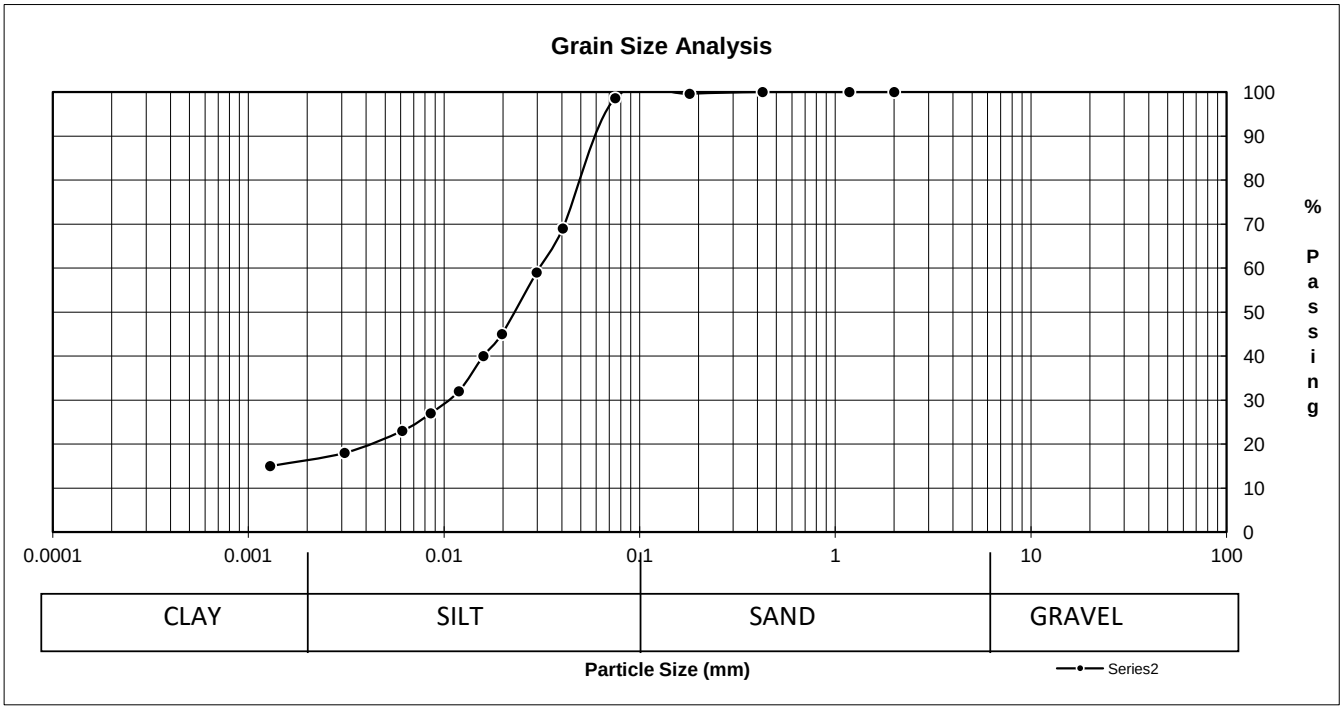
CLIENT:	AECOM	PROJECT NO.	112-1909
	99 Commerce Drive,	Test No:	4
	Winnipeg, MB R3P 0Y7	Lab No:	HM 314
ATTENTION:	Ryan Harras		
PROJECT:	Jefferson East CSR (Phase 2)		
	Winnipeg, Manitoba		

Date Sampled:	6/24-27/2019	Date Received:	27-Jul-19
Sampled By:	Client	Date Tested:	1-Aug-19

Material Identification

B.H./T.H. No.	TH 19-14
Sample No.	G127A
Sample depth	7.5'
Specific Gravity of Material:	2.65

Sieve Analysis		Hydrometer Analysis	
Sieve (mm)	% Passing	Diameter	% Finer
50.00	100.0		
37.50	100.0		
25.00	100.0		
19.00	100.0		
16.00	100.0		
12.50	100.0	0.0405	69.0
9.50	100.0	0.0297	59.0
4.75	100.0	0.0198	45.0
2.00	100.0	0.0159	40.0
1.18	100.0	0.0119	32.0
0.425	100.0	0.0085	27.0
0.180	99.6	0.0061	23.0
0.075	98.6	0.0031	18.0



SOIL DESCRIPTION	% Composition		D10	
		Gravel	D30	0.01268
	1.4	Sand	D60	0.02970
	80.6	Silt	Cu	#DIV/0!
	18.0	Clay	Cc	#DIV/0!

Remarks: Test Method: ASTM D422, D2216, D4318

Technician: Navi

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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

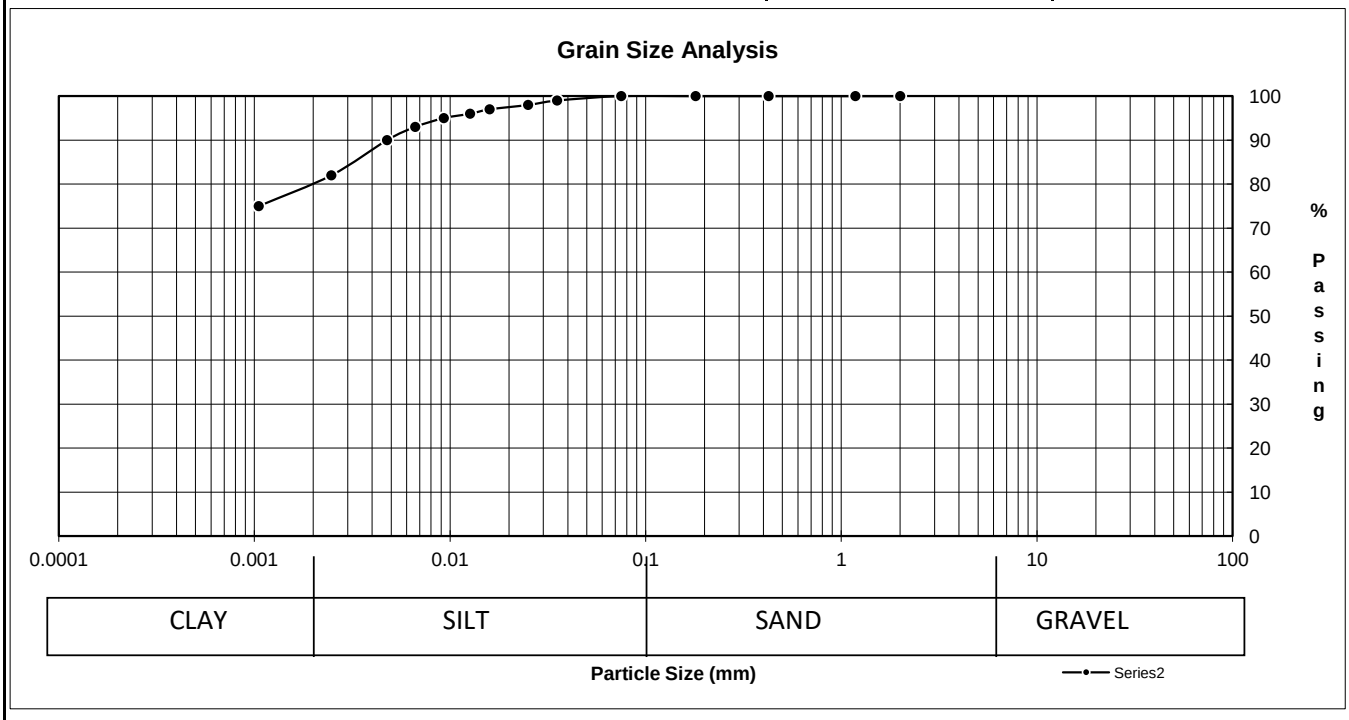
CLIENT:	AECOM	PROJECT NO.	112-1909
	99 Commerce Drive,	Test No:	5
	Winnipeg, MB R3P 0Y7	Lab No:	HM 314
ATTENTION:	Ryan Harras		
PROJECT:	Jefferson East CSR (Phase 2)		
	Winnipeg, Manitoba		

Date Sampled:	6/24-27/2019	Date Received:	27-Jul-19
Sampled By:	Client	Date Tested:	1-Aug-19

Material Identification

B.H./T.H. No.	TH 19-15
Sample No.	T140
Sample depth	10'
Specific Gravity of Material:	2.65

Sieve Analysis		Hydrometer Analysis	
Sieve (mm)	% Passing	Diameter	% Finer
50.00	100.0		
37.50	100.0		
25.00	100.0		
19.00	100.0		
16.00	100.0		
12.50	100.0	0.0353	99.0
9.50	100.0	0.0251	98.0
4.75	100.0	0.0159	97.0
2.00	100.0	0.0127	96.0
1.18	100.0	0.0093	95.0
0.425	100.0	0.0066	93.0
0.180	100.0	0.0048	90.0
0.075	100.0	0.0025	82.0



SOIL DESCRIPTION	% Composition		D10	
		Gravel	D30	
		Sand	D60	
	20.0	Silt	Cu	#DIV/0!
	80.0	Clay	Cc	#DIV/0!

Remarks: Test Method: ASTM D422, D2216, D4318

Technician: Navi

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Reviewed by: Paul Bevel

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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT

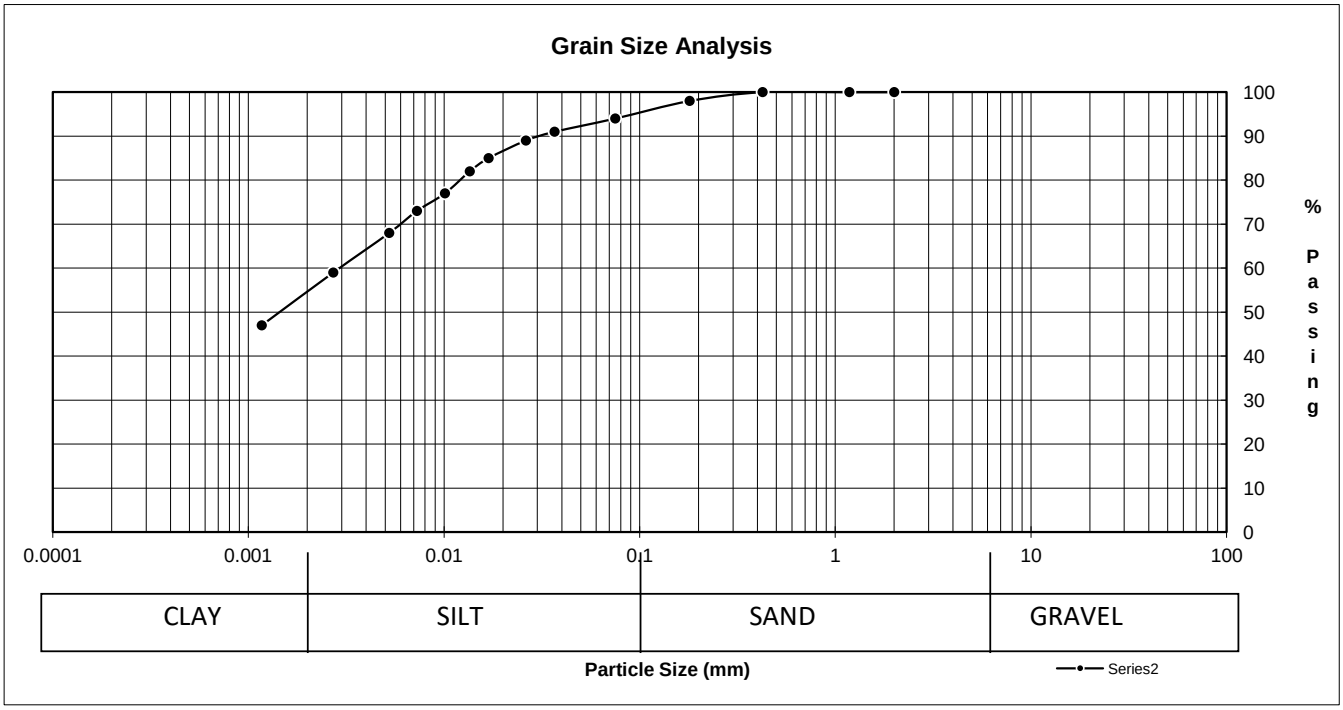
CLIENT:	AECOM	PROJECT NO.	112-1909
	99 Commerce Drive,	Test No:	6
	Winnipeg, MB R3P 0Y7	Lab No:	HM 314
ATTENTION:	Ryan Harras		
PROJECT:	Jefferson East CSR (Phase 2)		
	Winnipeg, Manitoba		

Date Sampled:	6/24-27/2019	Date Received:	27-Jul-19
Sampled By:	Client	Date Tested:	1-Aug-19

Material Identification

B.H./T.H. No.	TH 19-15
Sample No.	T146
Sample depth	5'
Specific Gravity of Material:	2.65

Sieve Analysis		Hydrometer Analysis	
Sieve (mm)	% Passing	Diameter	% Finer
50.00	100.0		
37.50	100.0		
25.00	100.0		
19.00	100.0		
16.00	100.0		
12.50	100.0	0.0367	91.0
9.50	100.0	0.0262	89.0
4.75	100.0	0.0169	85.0
2.00	100.0	0.0135	82.0
1.18	100.0	0.0101	77.0
0.425	100.0	0.0073	73.0
0.180	98.0	0.0052	68.0
0.075	94.0	0.0027	59.0



SOIL DESCRIPTION	% Composition		D10	
		Gravel	D30	
	6.0	Sand	D60	0.00272
	39.0	Silt	Cu	#DIV/0!
	55.0	Clay	Cc	#DIV/0!

Remarks: Test Method: ASTM D422, D2216, D4318

Technician: Navi

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Reviewed by: Paul Bevel

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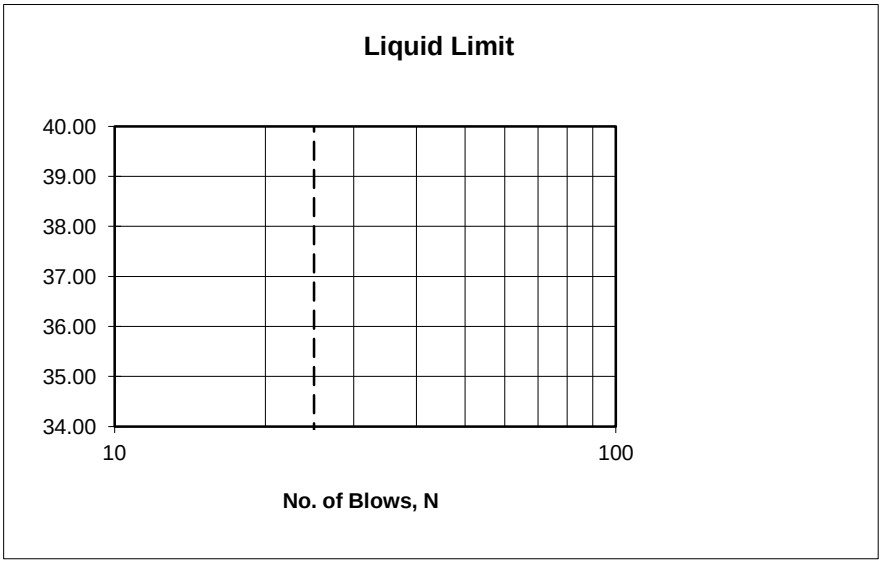
Atterberg Limits (ASTM D4318)

Client:	AECOM	Project No.:	112-1909
	99 Commerce Drive	Test No.:	1
	Winnipeg, MB R3P 0Y7	Lab No.:	HM 314
Attention:	Ryan Harras	Date Received:	27-Jul-19
Project:	Jefferson East CSR (Phase 2)	Date Tested / By:	2-Aug-19 / NS

Liquid Limit Determination

Dish No.:	1	2	3		Liquid Limit 25 Blows
Wet Soil + Dish:					
Dry Soil + Dish:					
Moisture:					
Dish:					
Dry Soil:	**Liquid Limit could not be determined** (See Remarks)				
% Moisture:					
No. of Blows:					
Liquid Limits:					



Material Identification:

T.H./B.H. No. TH 19-05, G41

Depth: 10 ft

Liquid Limit, %: n/a
Plastic Limit, %: n/a
Plasticity Index: n/a
(LL-PL)

Plastic Limit Determination

Dish No.:					
Wet Soil + Dish:					
Dry Soil + Dish:					
Moisture:					
Dish:					
Dry Soil:	**Non-Plastic**				
% Moisture:					
Average:					

Test Method : ASTM: D4318, D2216

Remarks: ASTM D4318 - Section 12.5: When successive trials have been made where the number of drops required to close the groove is always less than 25, record that the Liquid Limit could not be determined and report the soil as Non-Plastic.

Reviewed by: _____
Gladys Paciente, P.Eng

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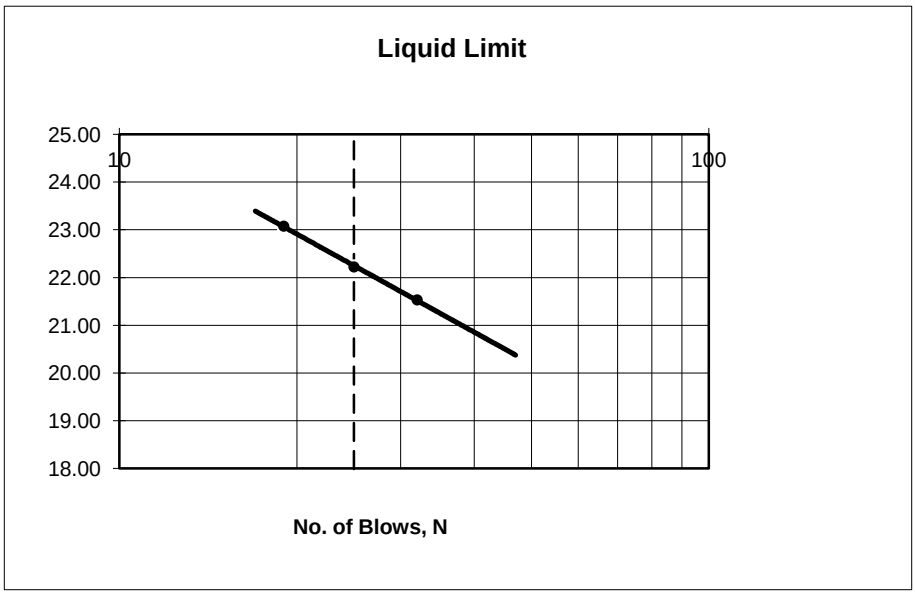
Atterberg Limits (ASTM D4318)

Client:	AECOM	Project No.:	112-1909
	99 Commerce Drive	Test No.	2
	Winnipeg, MB R3P 0Y7	Lab No.:	HM 314
Attention.:	Ryan Harras	Date Received:	27-Jul-19
Project:	Jefferson East CSR (Phase 2)	Date Tested / By:	2-Aug-19 / NS

Liquid Limit Determination

Dish No.:	1	2	3		Liquid Limit 25 Blows
Wet Soil + Dish:	13	15.4	13.9		
Dry Soil + Dish:	12.1	13.40	12.1		
Moisture:	0.9	2	1.8		
Dish:	4.4	4.4	4.3		
Dry Soil:	4.18	9	7.8		
% Moisture:	21.53	22.22	23.08		
No. of Blows:	32	25	19		
Liquid Limits:	22.18	22.22	22.32		**22**



Material Identification:

T.H./B.H. No. **TH 19-08, S81**

Depth: **55ft**

Liquid Limit, %: **22**
Plastic Limit, %: **10**
Plasticity Index: **12**
(LL-PL)

Plastic Limit Determination

Dish No.:	1	2	3		
Wet Soil + Dish:	12.5	12.35	12.14		
Dry Soil + Dish:	11.8	11.62	11.49		
Moisture:	0.7	0.73	0.65		
Dish:	4.53	4.28	4.43		
Dry Soil:	7.27	7.34	7.06		
% Moisture:	9.63	9.95	9.21		
Average:					**10**

Test Method : ASTM: D4318, D2216

P. Bevel

Reviewed by: Paul Bevel

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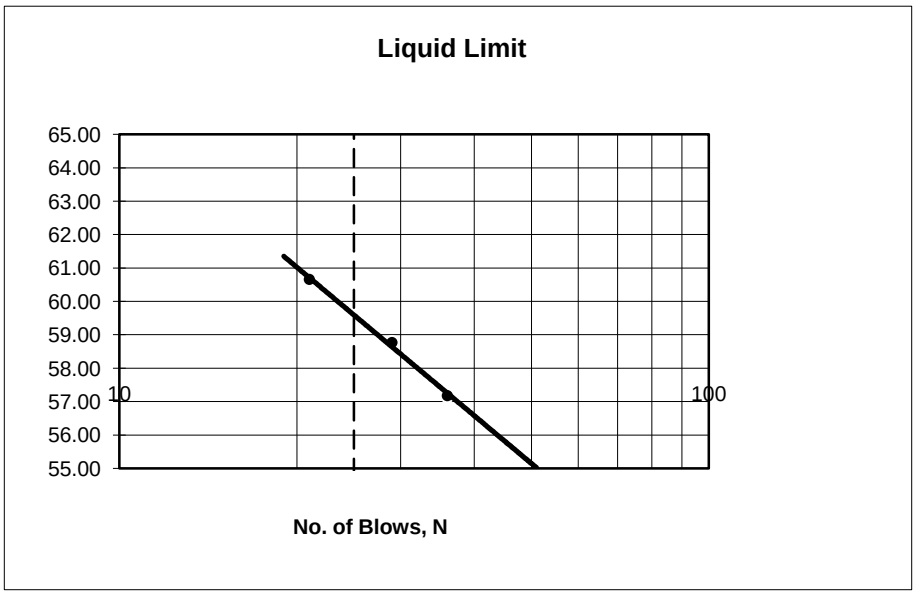
Atterberg Limits (ASTM D4318)

Client:	AECOM	Project No.:	112-1909
	99 Commerce Drive	Test No.	3
	Winnipeg, MB R3P 0Y7	Lab No.:	HM 314
Attention.:	Ryan Harras	Date Received:	27-Jul-19
Project:	Jefferson East CSR (Phase 2)	Date Tested / By:	2-Aug-19 / NS

Liquid Limit Determination

Dish No.:	1	2	3		Liquid Limit 25 Blows
Wet Soil + Dish:	11.51	12.73	11.54		
Dry Soil + Dish:	9.12	9.58	8.78		
Moisture:	2.39	3.15	2.76		
Dish:	4.45	4.22	4.23		
Dry Soil:	4.18	5.36	4.55		
% Moisture:	57.18	58.77	60.66		
No. of Blows:	36	29	21		
Liquid Limits:	59.76	59.83	59.39		**60**



Material Identification:

T.H./B.H. No. **TH 19-08, T74**

Depth: **20ft**

Liquid Limit, %: **60**
Plastic Limit, %: **25**
Plasticity Index: **35**
(LL-PL)

Plastic Limit Determination

Dish No.:	1	2	3		
Wet Soil + Dish:	9.8	9.69	9.42		
Dry Soil + Dish:	8.68	8.6	8.38		
Moisture:	1.12	1.09	1.04		
Dish:	4.25	4.28	4.29		
Dry Soil:	4.43	4.32	4.09		
% Moisture:	25.28	25.23	25.43		
Average:					**25**

Test Method : ASTM: D4318, D2216

P. Bevel

Reviewed by: Paul Bevel

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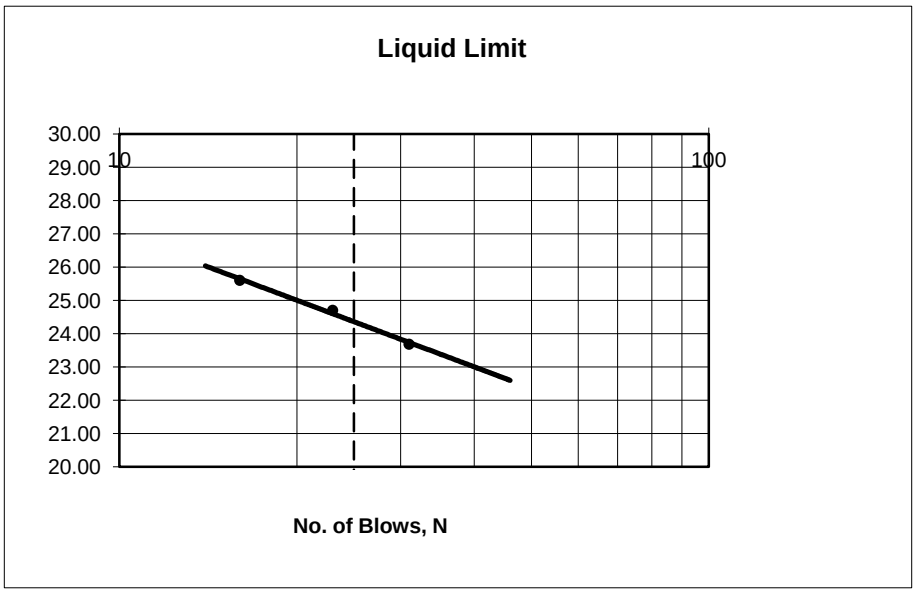
Atterberg Limits (ASTM D4318)

Client:	AECOM	Project No.:	112-1909
	99 Commerce Drive	Test No.	4
	Winnipeg, MB R3P 0Y7	Lab No.:	HM 314
Attention.:	Ryan Harras	Date Received:	27-Jul-19
Project:	Jefferson East CSR (Phase 2)	Date Tested / By:	2-Aug-19 / NS

Liquid Limit Determination

Dish No.:	1	2	3		Liquid Limit 25 Blows
Wet Soil + Dish:	12.4	14.7	14.8		
Dry Soil + Dish:	11.41	12.62	12.68		
Moisture:	0.99	2.08	2.12		
Dish:	4.2	4.2	4.4		
Dry Soil:	4.18	8.42	8.28		
% Moisture:	23.68	24.70	25.60		
No. of Blows:	31	23	16		
Liquid Limits:	24.31	24.46	24.26		**24**



Material Identification:

T.H No **TH 19-14, G127 A**

Depth: **7.5ft**

Liquid Limit, %: **24**
Plastic Limit, %: **16**
Plasticity Index: **8**
(LL-PL)

Plastic Limit Determination

Dish No.:	1	2	3		
Wet Soil + Dish:	12.1	11.8	12.2		
Dry Soil + Dish:	11	10.72	11.1		
Moisture:	1.1	1.08	1.1		
Dish:	4.2	4.1	4.3		
Dry Soil:	6.8	6.62	6.8		
% Moisture:	16.18	16.31	16.18		
Average:					**16**

Test Method : ASTM: D4318, D2216

P. Bevel

Reviewed by: Paul Bevel

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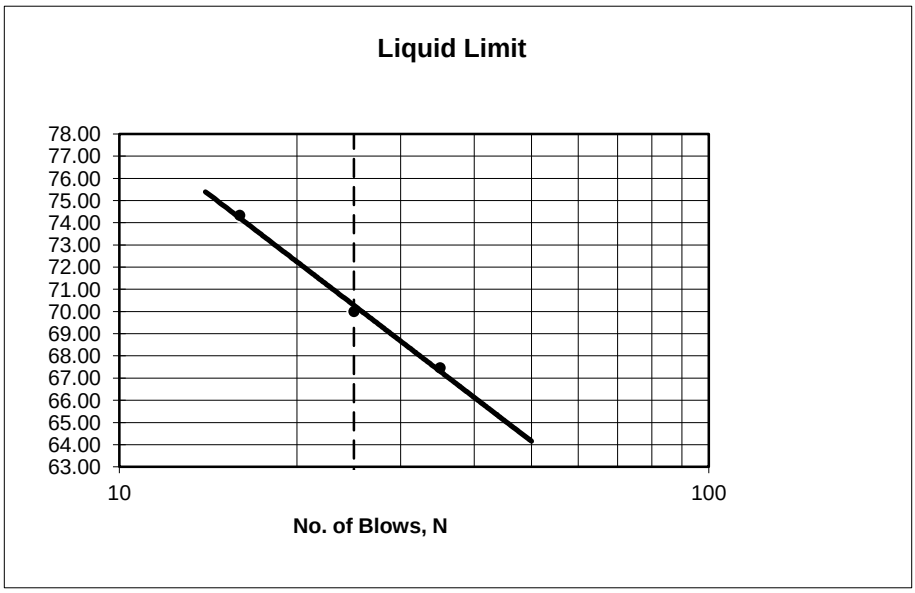
Atterberg Limits (ASTM D4318)

Client:	AECOM	Project No.:	112-1909
	99 Commerce Drive	Test No.	5
	Winnipeg, MB R3P 0Y7	Lab No.:	HM 314
Attention.:	Ryan Harras	Date Received:	27-Jul-19
Project:	Jefferson East CSR (Phase 2)	Date Tested / By:	2-Aug-19 / Navi

Liquid Limit Determination

Dish No.:	1	2	3		Liquid Limit 25 Blows
Wet Soil + Dish:	12.75	13.02	12.07		
Dry Soil + Dish:	9.93	9.38	8.71		
Moisture:	2.82	3.64	3.36		
Dish:	4.17	4.18	4.19		
Dry Soil:	4.18	5.2	4.52		
% Moisture:	67.46	70.00	74.34		
No. of Blows:	35	25	16		
Liquid Limits:	70.27	70.00	70.43		**70**



Material Identification:

T.H No **TH 19-14, G127 A**

Depth: **7.5ft**

Liquid Limit, %: **70**
Plastic Limit, %: **31**
Plasticity Index: **39**
(LL-PL)

Plastic Limit Determination

Dish No.:	1	2	3		
Wet Soil + Dish:	10.04	9.9	10.62		
Dry Soil + Dish:	8.65	8.58	9.1		
Moisture:	1.39	1.32	1.52		
Dish:	4.22	4.21	4.28		
Dry Soil:	4.43	4.37	4.82		
% Moisture:	31.38	30.21	31.54		
Average:					**31**

Test Method : ASTM: D4318, D2216

P. Bevel

Reviewed by: Paul Bevel

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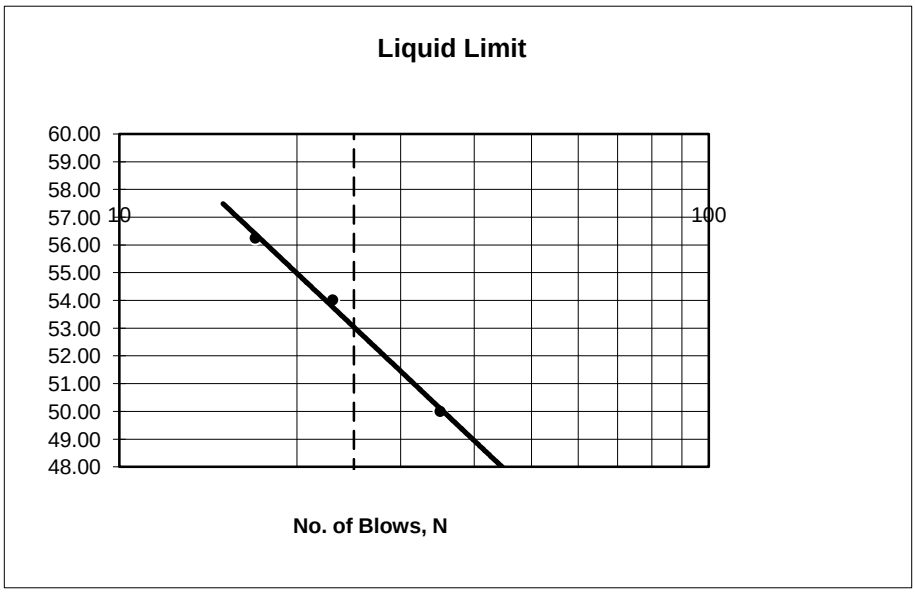
Atterberg Limits (ASTM D4318)

Client:	AECOM	Project No.:	112-1909
	99 Commerce Drive	Test No.	6
	Winnipeg, MB R3P 0Y7	Lab No.:	HM 314
Attention.:	Ryan Harras	Date Received:	27-Jul-19
Project:	Jefferson East CSR (Phase 2)	Date Tested / By:	2-Aug-19 / NS

Liquid Limit Determination

Dish No.:	1	2	3		Liquid Limit 25 Blows
Wet Soil + Dish:	13.6	11.12	13.24		
Dry Soil + Dish:	11.51	8.70	10		
Moisture:	2.09	2.42	3.24		
Dish:	4.19	4.22	4.24		
Dry Soil:	4.18	4.48	5.76		
% Moisture:	50.00	54.02	56.25		
No. of Blows:	35	23	17		
Liquid Limits:	52.08	53.48	53.69		**53**



Material Identification:

T.H No **TH 19-16, G126**

Depth: **5ft**

Liquid Limit, %: **53**
Plastic Limit, %: **23**
Plasticity Index: **30**
(LL-PL)

Plastic Limit Determination

Dish No.:	1	2	3		
Wet Soil + Dish:	10.26	10.13	10.03		
Dry Soil + Dish:	9.15	9	8.95		
Moisture:	1.11	1.13	1.08		
Dish:	4.43	4.18	4.31		
Dry Soil:	4.72	4.82	4.64		
% Moisture:	23.52	23.44	23.28		
Average:					**23**

Test Method : ASTM: D4318, D2216

P. Bevel

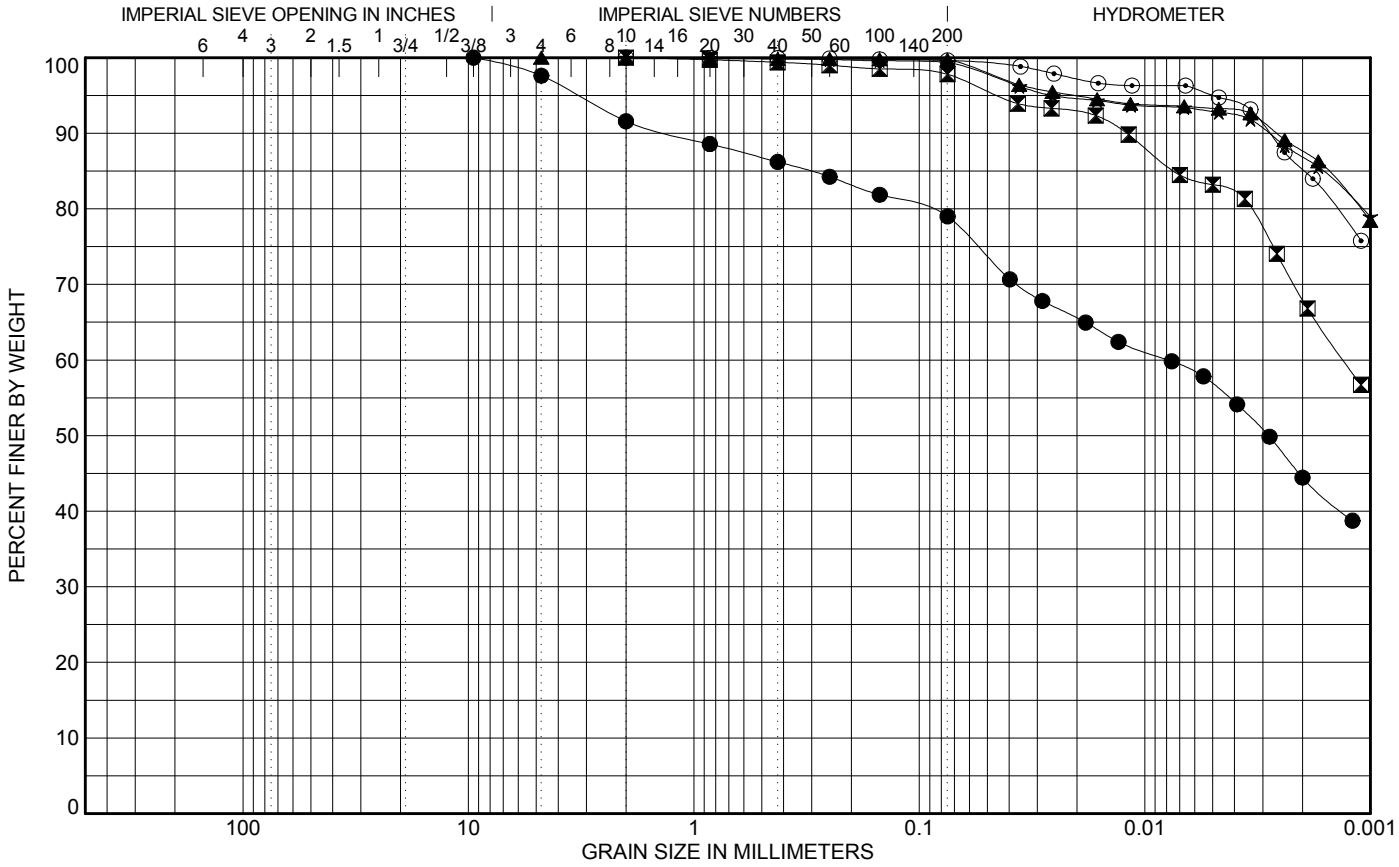
Reviewed by: Paul Bevel

PARTICLE SIZE ANALYSIS

Report Date: 20 September 2019

Client		**Project**	
Name:	AECOM C/O Dyregrov Robinson Inc.	**Name:**	Jefferson East CSR (Phase 2)
Address:	1692 Dublin Avenue, Winnipeg, MB	**Address:**	Jefferson Avenue, Winnipeg MB
Attention:	Gil Robinson	**Project No.:**	WX11735
PO Number:		**Manager:**	JW

Gradation Specification:



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample ID	mUSCS	MC	D100	D60	D30	D10	LL	PL	% Gravel	% Sand	% Fines
●	TH19-02, 6.1 m	CH		9.5	0			50	14	2	19	35 (Silt) : 44 (Clay)
⊠	TH19-06, 6.1 m	CH		2	0			68	20	0	2	30 (Silt) : 68 (Clay)
▲	TH19-11, 4.6 m	CH		4.8				90	21	0	0	12 (Silt) : 88 (Clay)
★	TH19-14, 6.1 m	CH		2				79	27	0	1	13 (Silt) : 87 (Clay)
⊙	TH19-16, 3 m	CH		2				88	24	0	0	14 (Silt) : 85 (Clay)

WX11735 - DYREGROV ROBINSON - JEFFERSON EAST GEOTECHNICAL TESTING.GPJ 19/09/20 03:22 PM (WOOD - PSA MULTI RESULT WITH ATTERBERG)

Reporting of these results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request.

DYREGROV ROBINSON INC. — *UNCONFINED COMPRESSION TEST*

PROJECT: Jefferson East CSR — ***DATE:*** July 2019

AECOM PROJECT No.: 60599385

Test Hole	19-01		Depth	10	feet
			Sample No.	T2	
Wet + Tare Wt.	209.02	g	Length	176	mm
Dry + Tare Wt.	151.52	g	Diameter	71	mm
Tare Wt.	30.73	g	Area	3959	mm²
Wt. Water	57.50	g	Weight	1178.15	g
Dry Wt.	120.79	g	Strain	5.82	%
Moisture Cont.	**47.6**	**%**	Avg. Area	4204	mm²
Wet Density	**105.55**	lb/ft³	***16.58***	*kN/m³*	
Pocket Pen: Rdg	1.45	tsf	**Torvane:** Rdg	0.56	tsf
Su	**1.45**	**ksf**	Std vane Su	**1.15**	**ksf**
Su	*69.4*	*kPa*	Su	*54.9*	*kPa*
Qu: Displacement	10.25	mm	**GeoPen:** Rdg		kg
Load Cell	0.288	kN	**10 mm tip Su**		**ksf**
Su	*34.3*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.72**	**ksf**			

Test Hole	19-01		Depth	25	feet
			Sample No.	T5	
Wet + Tare Wt.	231.83	g	Length	170	mm
Dry + Tare Wt.	165.20	g	Diameter	71	mm
Tare Wt.	31.28	g	Area	3959	mm²
Wt. Water	66.63	g	Weight	1215.96	g
Dry Wt.	133.92	g	Strain	4.26	%
Moisture Cont.	**49.8**	**%**	Avg. Area	4136	mm²
Wet Density	**112.78**	lb/ft³	***17.72***	*kN/m³*	
Pocket Pen: Rdg	1.50	tsf	**Torvane:** Rdg	0.59	tsf
Su	**1.50**	**ksf**	Std vane Su	**1.21**	**ksf**
Su	*71.8*	*kPa*	Su	*57.9*	*kPa*
Qu: Displacemen	7.25	mm	**GeoPen:** Rdg		kg
Load Cell	0.282	kN	**10 mm tip Su**		**ksf**
Su	*34.1*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.71**	**ksf**			

Test Hole	19-01		Depth	40	feet
			Sample No.	T8	
Wet + Tare Wt.	243.69	g	Length		mm
Dry + Tare Wt.	192.72	g	Diameter		mm
Tare Wt.	31.10	g	Area		mm²
Wt. Water	50.97	g	Weight		g
Dry Wt.	161.62	g	Strain		%
Moisture Cont.	**31.5**	**%**	Avg. Area		mm²
Wet Density		lb/ft³		*kN/m³*	
Pocket Pen: Rdg	0.75	tsf	**Torvane:** Rdg	0.50	tsf
Su	**0.75**	**ksf**	Std vane Su	**1.02**	**ksf**
Su	*35.9*	*kPa*	Su	*49.0*	*kPa*
Qu: Displacement		mm	**GeoPen:** Rdg		kg
Load Cell		kN	**10 mm tip Su**		**ksf**
Su		*kPa*	*10 mm tip Su*		*kPa*
Su		**ksf**			

Test Hole	19-02		Depth	20	feet
			Sample No.	T19	
Wet + Tare Wt.	208.56	g	Length	171	mm
Dry + Tare Wt.	151.18	g	Diameter	72	mm
Tare Wt.	31.16	g	Area	4072	mm²
Wt. Water	57.38	g	Weight	1204.54	g
Dry Wt.	120.02	g	Strain	7.16	%
Moisture Cont.	**47.8**	**%**	Avg. Area	4386	mm²
Wet Density	**108.01**	lb/ft³	***16.97***	*kN/m³*	
Pocket Pen: Rdg	1.50	tsf	**Torvane:** Rdg	0.55	tsf
Su	**1.50**	**ksf**	Std vane Su	**1.13**	**ksf**
Su	*71.8*	*kPa*	Su	*53.9*	*kPa*
Qu: Displacemen	12.25	mm	**GeoPen:** Rdg		kg
Load Cell	0.554	kN	**10 mm tip Su**		**ksf**
Su	*63.2*	*kPa*	*10 mm tip Su*		*kPa*
Su	**1.32**	**ksf**			

Test Hole	19-03		Depth	30	feet
			Sample No.	T29	
Wet + Tare Wt.	222.10	g	Length	170	mm
Dry + Tare Wt.	174.56	g	Diameter	71	mm
Tare Wt.	30.54	g	Area	3959	mm²
Wt. Water	47.54	g	Weight	1236.40	g
Dry Wt.	144.02	g	Strain	6.62	%
Moisture Cont.	**33.0**	**%**	Avg. Area	4240	mm²
Wet Density	**114.68**	lb/ft³	***18.01***	*kN/m³*	
Pocket Pen: Rdg	0.85	tsf	**Torvane:** Rdg	0.50	tsf
Su	**0.85**	**ksf**	Std vane Su	**1.02**	**ksf**
Su	*40.7*	*kPa*	Su	*49.0*	*kPa*
Qu: Displacement	11.25	mm	**GeoPen:** Rdg		kg
Load Cell	0.278	kN	**10 mm tip Su**		**ksf**
Su	*32.8*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.68**	**ksf**			

Test Hole	19-05		Depth	15	feet
			Sample No.	T42	
Wet + Tare Wt.	314.81	g	Length	176	mm
Dry + Tare Wt.	217.20	g	Diameter	70	mm
Tare Wt.	30.56	g	Area	3848	mm²
Wt. Water	97.61	g	Weight	1193.74	g
Dry Wt.	186.64	g	Strain	4.55	%
Moisture Cont.	**52.3**	**%**	Avg. Area	4032	mm²
Wet Density	**110.02**	lb/ft³	***17.28***	*kN/m³*	
Pocket Pen: Rdg	1.40	tsf	**Torvane:** Rdg	0.60	tsf
Su	**1.40**	**ksf**	Std vane Su	**1.23**	**ksf**
Su	*67.0*	*kPa*	Su	*58.8*	*kPa*
Qu: Displacemen	8.00	mm	**GeoPen:** Rdg		kg
Load Cell	0.380	kN	**10 mm tip Su**		**ksf**
Su	*47.1*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.98**	**ksf**			

DYREGROV ROBINSON INC. *UNCONFINED COMPRESSION TEST*

PROJECT: Jefferson East CSR ***DATE:*** July 2019

AECOM PROJECT No.: 60599385

Test Hole	**19-05**		**Depth**	**25**	**feet**
			Sample No.	**T44**	
Wet + Tare Wt.	223.96	g	Length		mm
Dry + Tare Wt.	164.88	g	Diameter		mm
Tare Wt.	30.67	g	Area		mm²
Wt. Water	59.08	g	Weight		g
Dry Wt.	134.21	g	Strain		%
Moisture Cont.	**44.0**	**%**	Avg. Area		mm²
Wet Density		lb/ft³	*kN/m³*		
Pocket Pen: Rdg	1.65	tsf	**Torvane:** Rdg	0.60	tsf
Su	**1.65**	**ksf**	Std vane Su	**1.23**	**ksf**
Su	*79.0*	*kPa*	Su	*58.8*	*kPa*
Qu: Displacement		mm	**GeoPen:** Rdg		kg
Load Cell		kN	**10 mm tip Su**	**0.00**	**ksf**
Su		*kPa*	*10 mm tip Su*	*0.0*	*kPa*
Su		**ksf**			

Test Hole	**19-06**		**Depth**	**20**	**feet**
			Sample No.	**T58**	
Wet + Tare Wt.	199.52	g	Length	172	mm
Dry + Tare Wt.	146.96	g	Diameter	72	mm
Tare Wt.	30.89	g	Area	4072	mm²
Wt. Water	52.56	g	Weight	1217.33	g
Dry Wt.	116.07	g	Strain	5.23	%
Moisture Cont.	**45.3**	**%**	Avg. Area	4296	mm²
Wet Density	**108.52**	lb/ft³	***17.05***	*kN/m³*	
Pocket Pen: Rdg	1.35	tsf	**Torvane:** Rdg	0.53	tsf
Su	**1.35**	**ksf**	Std vane Su	**1.09**	**ksf**
Su	*64.6*	*kPa*	Su	*52.0*	*kPa*
Qu: Displacemen	9.00	mm	**GeoPen:** Rdg		kg
Load Cell	0.364	kN	**10 mm tip Su**		**ksf**
Su	*42.4*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.88**	**ksf**			

Test Hole	**19-07**		**Depth**	**25**	**feet**
			Sample No.	**T67**	
Wet + Tare Wt.	199.34	g	Length	175	mm
Dry + Tare Wt.	144.83	g	Diameter	71	mm
Tare Wt.	31.48	g	Area	3959	mm²
Wt. Water	54.51	g	Weight	1214.45	g
Dry Wt.	113.35	g	Strain	5.29	%
Moisture Cont.	**48.1**	**%**	Avg. Area	4180	mm²
Wet Density	**109.42**	lb/ft³	***17.19***	*kN/m³*	
Pocket Pen: Rdg	1.50	tsf	**Torvane:** Rdg	0.60	tsf
Su	**1.50**	**ksf**	Std vane Su	**1.23**	**ksf**
Su	*71.8*	*kPa*	Su	*58.8*	*kPa*
Qu: Displacement	9.25	mm	**GeoPen:** Rdg		kg
Load Cell	0.388	kN	**10 mm tip Su**		**ksf**
Su	*46.4*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.97**	**ksf**			

Test Hole	**19-08**		**Depth**	**20**	**feet**
			Sample No.	**T74**	
Wet + Tare Wt.	205.36	g	Length	174	mm
Dry + Tare Wt.	150.29	g	Diameter	71	mm
Tare Wt.	31.05	g	Area	3959	mm²
Wt. Water	55.07	g	Weight	1191.08	g
Dry Wt.	119.24	g	Strain	5.60	%
Moisture Cont.	**46.2**	**%**	Avg. Area	4194	mm²
Wet Density	**107.94**	lb/ft³	***16.96***	*kN/m³*	
Pocket Pen: Rdg	1.60	tsf	**Torvane:** Rdg	0.53	tsf
Su	**1.60**	**ksf**	Std vane Su	**1.09**	**ksf**
Su	*76.6*	*kPa*	Su	*52.0*	*kPa*
Qu: Displacemen	9.75	mm	**GeoPen:** Rdg		kg
Load Cell	0.316	kN	**10 mm tip Su**		**ksf**
Su	*37.7*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.79**	**ksf**			

Test Hole	**19-10**		**Depth**	**25**	**feet**
			Sample No.	**T95**	
Wet + Tare Wt.	214.95	g	Length	170	mm
Dry + Tare Wt.	157.80	g	Diameter	72	mm
Tare Wt.	30.59	g	Area	4072	mm²
Wt. Water	57.15	g	Weight	1170.50	g
Dry Wt.	127.21	g	Strain	5.44	%
Moisture Cont.	**44.9**	**%**	Avg. Area	4306	mm²
Wet Density	**105.57**	lb/ft³	***16.58***	*kN/m³*	
Pocket Pen: Rdg	1.45	tsf	**Torvane:** Rdg	0.54	tsf
Su	**1.45**	**ksf**	Std vane Su	**1.11**	**ksf**
Su	*69.4*	*kPa*	Su	*53.0*	*kPa*
Qu: Displacement	9.25	mm	**GeoPen:** Rdg		kg
Load Cell	0.427	kN	**10 mm tip Su**		**ksf**
Su	*49.6*	*kPa*	*10 mm tip Su*		*kPa*
Su	**1.04**	**ksf**			

Test Hole	**19-11**		**Depth**	**15**	**feet**
			Sample No.	**T101**	
Wet + Tare Wt.	215.72	g	Length	172	mm
Dry + Tare Wt.	152.69	g	Diameter	72	mm
Tare Wt.	30.56	g	Area	4072	mm²
Wt. Water	63.03	g	Weight	1162.57	g
Dry Wt.	122.13	g	Strain	4.51	%
Moisture Cont.	**51.6**	**%**	Avg. Area	4264	mm²
Wet Density	**103.64**	lb/ft³	***16.28***	*kN/m³*	
Pocket Pen: Rdg	1.45	tsf	**Torvane:** Rdg	0.47	tsf
Su	**1.45**	**ksf**	Std vane Su	**0.96**	**ksf**
Su	*69.4*	*kPa*	Su	*46.1*	*kPa*
Qu: Displacemen	7.75	mm	**GeoPen:** Rdg		kg
Load Cell	0.300	kN	**10 mm tip Su**		**ksf**
Su	*35.2*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.73**	**ksf**			

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Test Hole	19-12		Depth	20	feet
			Sample No.	T114	
Wet + Tare Wt.	212.23	g	Length	177	mm
Dry + Tare Wt.	149.10	g	Diameter	71	mm
Tare Wt.	30.44	g	Area	3959	mm²
Wt. Water	63.13	g	Weight	1160.97	g
Dry Wt.	118.66	g	Strain	5.65	%
Moisture Cont.	**53.2**	**%**	Avg. Area	4196	mm²
Wet Density	**103.42**	lb/ft³	***16.25***	*kN/m³*	
Pocket Pen: Rdg	1.05	tsf	**Torvane:** Rdg	0.48	tsf
Su	**1.05**	**ksf**	Std vane Su	**0.98**	**ksf**
Su	*50.3*	*kPa*	Su	*47.1*	*kPa*
Qu: Displacement	10.00	mm	**GeoPen:** Rdg		kg
Load Cell	0.287	kN	**10 mm tip Su**		**ksf**
Su	*34.2*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.71**	**ksf**			

Test Hole	19-13		Depth	15	feet
			Sample No.	T121	
Wet + Tare Wt.	221.59	g	Length	171	mm
Dry + Tare Wt.	153.91	g	Diameter	71	mm
Tare Wt.	31.42	g	Area	3959	mm²
Wt. Water	67.68	g	Weight	1142.30	g
Dry Wt.	122.49	g	Strain	5.12	%
Moisture Cont.	**55.3**	**%**	Avg. Area	4173	mm²
Wet Density	**105.33**	lb/ft³	***16.55***	*kN/m³*	
Pocket Pen: Rdg	1.00	tsf	**Torvane:** Rdg	0.63	tsf
Su	**1.00**	**ksf**	Std vane Su	**1.28**	**ksf**
Su	*47.9*	*kPa*	Su	*61.3*	*kPa*
Qu: Displacemen	8.75	mm	**GeoPen:** Rdg		kg
Load Cell	0.304	kN	**10 mm tip Su**		**ksf**
Su	*36.4*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.76**	**ksf**			

Test Hole	19-14		Depth	10	feet
			Sample No.	T128	
Wet + Tare Wt.	246.30	g	Length	175	mm
Dry + Tare Wt.	176.16	g	Diameter	72	mm
Tare Wt.	30.90	g	Area	4072	mm²
Wt. Water	70.14	g	Weight	1179.65	g
Dry Wt.	145.26	g	Strain	6.14	%
Moisture Cont.	**48.3**	**%**	Avg. Area	4338	mm²
Wet Density	**103.36**	lb/ft³	***16.24***	*kN/m³*	
Pocket Pen: Rdg	1.30	tsf	**Torvane:** Rdg	0.63	tsf
Su	**1.30**	**ksf**	Std vane Su	**1.28**	**ksf**
Su	*62.2*	*kPa*	Su	*61.3*	*kPa*
Qu: Displacement	10.75	mm	**GeoPen:** Rdg		kg
Load Cell	0.314	kN	**10 mm tip Su**		**ksf**
Su	*36.2*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.76**	**ksf**			

Test Hole	19-14		Depth	15	feet
			Sample No.	T129	
Wet + Tare Wt.	184.35	g	Length	176	mm
Dry + Tare Wt.	133.37	g	Diameter	72	mm
Tare Wt.	30.52	g	Area	4072	mm²
Wt. Water	50.98	g	Weight	1183.22	g
Dry Wt.	102.85	g	Strain	6.11	%
Moisture Cont.	**49.6**	**%**	Avg. Area	4336	mm²
Wet Density	**103.08**	lb/ft³	***16.19***	*kN/m³*	
Pocket Pen: Rdg	1.25	tsf	**Torvane:** Rdg	0.50	tsf
Su	**1.25**	**ksf**	Std vane Su	**1.02**	**ksf**
Su	*59.9*	*kPa*	Su	*49.0*	*kPa*
Qu: Displacemen	10.75	mm	**GeoPen:** Rdg		kg
Load Cell	0.380	kN	**10 mm tip Su**		**ksf**
Su	*43.8*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.92**	**ksf**			

Test Hole	19-14		Depth	20	feet
			Sample No.	T130	
Wet + Tare Wt.	323.84	g	Length	176	mm
Dry + Tare Wt.	230.29	g	Diameter	72	mm
Tare Wt.	31.11	g	Area	4072	mm²
Wt. Water	93.55	g	Weight	1171.11	g
Dry Wt.	199.18	g	Strain	4.40	%
Moisture Cont.	**47.0**	**%**	Avg. Area	4259	mm²
Wet Density	**102.03**	lb/ft³	***16.03***	*kN/m³*	
Pocket Pen: Rdg	1.05	tsf	**Torvane:** Rdg	0.55	tsf
Su	**1.05**	**ksf**	Std vane Su	**1.13**	**ksf**
Su	*50.3*	*kPa*	Su	*53.9*	*kPa*
Qu: Displacement	7.75	mm	**GeoPen:** Rdg		kg
Load Cell	0.338	kN	**10 mm tip Su**		**ksf**
Su	*39.7*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.83**	**ksf**			

Test Hole	19-14		Depth	30	feet
			Sample No.	T132	
Wet + Tare Wt.	208.64	g	Length	158	mm
Dry + Tare Wt.	153.44	g	Diameter	73	mm
Tare Wt.	31.30	g	Area	4185	mm²
Wt. Water	55.20	g	Weight	1084.67	g
Dry Wt.	122.14	g	Strain	4.91	%
Moisture Cont.	**45.2**	**%**	Avg. Area	4401	mm²
Wet Density	**102.40**	lb/ft³	***16.09***	*kN/m³*	
Pocket Pen: Rdg	0.80	tsf	**Torvane:** Rdg	0.53	tsf
Su	**0.80**	**ksf**	Std vane Su	**1.08**	**ksf**
Su	*38.3*	*kPa*	Su	*51.5*	*kPa*
Qu: Displacemen	7.75	mm	**GeoPen:** Rdg		kg
Load Cell	0.417	kN	**10 mm tip Su**		**ksf**
Su	*47.4*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.99**	**ksf**			

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Test Hole	19-14		Depth	40	feet
			Sample No.	T134	
Wet + Tare Wt.	287.03	g	Length	161	mm
Dry + Tare Wt.	196.75	g	Diameter	72	mm
Tare Wt.	31.21	g	Area	4072	mm²
Wt. Water	90.28	g	Weight	1079.26	g
Dry Wt.	165.54	g	Strain	2.02	%
Moisture Cont.	**54.5**	**%**	Avg. Area	4155	mm²
Wet Density	**102.78**	lb/ft³	***16.15***	*kN/m³*	
Pocket Pen: Rdg	0.85	tsf	**Torvane:** Rdg	0.50	tsf
Su	**0.85**	**ksf**	Std vane Su	**1.02**	**ksf**
Su	*40.7*	*kPa*	Su	*49.0*	*kPa*
Qu: Displacement	3.25	mm	**GeoPen:** Rdg		kg
Load Cell	0.140	kN	**10 mm tip Su**		**ksf**
Su	*16.8*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.35**	**ksf**			

Test Hole	19-15		Depth	5	feet
			Sample No.	T139	
Wet + Tare Wt.	217.25	g	Length		mm
Dry + Tare Wt.	195.20	g	Diameter		mm
Tare Wt.	31.49	g	Area		mm²
Wt. Water	22.05	g	Weight		g
Dry Wt.	163.71	g	Strain		%
Moisture Cont.	**13.5**	**%**	Avg. Area		mm²
Wet Density		lb/ft³		*kN/m³*	
Pocket Pen: Rdg		tsf	**Torvane:** Rdg		tsf
Su		**ksf**	Std vane Su		**ksf**
Su		*kPa*	Su		*kPa*
Qu: Displacement		mm	**GeoPen:** Rdg		kg
Load Cell		kN	**10 mm tip Su**		**ksf**
Su		*kPa*	*10 mm tip Su*		*kPa*
Su		**ksf**			

Test Hole	19-15		Depth	10	feet
			Sample No.	T140	
Wet + Tare Wt.	166.50	g	Length	176	mm
Dry + Tare Wt.	121.39	g	Diameter	72	mm
Tare Wt.	31.07	g	Area	4072	mm²
Wt. Water	45.11	g	Weight	1164.05	g
Dry Wt.	90.32	g	Strain	7.39	%
Moisture Cont.	**49.9**	**%**	Avg. Area	4396	mm²
Wet Density	**101.41**	lb/ft³	***15.93***	*kN/m³*	
Pocket Pen: Rdg	1.25	tsf	**Torvane:** Rdg	0.58	tsf
Su	**1.25**	**ksf**	Std vane Su	**1.18**	**ksf**
Su	*59.9*	*kPa*	Su	*56.4*	*kPa*
Qu: Displacement	13.00	mm	**GeoPen:** Rdg		kg
Load Cell	0.477	kN	**10 mm tip Su**		**ksf**
Su	*54.3*	*kPa*	*10 mm tip Su*		*kPa*
Su	**1.13**	**ksf**			

Test Hole	19-15		Depth	15	feet
			Sample No.	T141	
Wet + Tare Wt.	244.03	g	Length	176	mm
Dry + Tare Wt.	177.53	g	Diameter	72	mm
Tare Wt.	30.55	g	Area	4072	mm²
Wt. Water	66.50	g	Weight	1162.97	g
Dry Wt.	146.98	g	Strain	5.82	%
Moisture Cont.	**45.2**	**%**	Avg. Area	4323	mm²
Wet Density	**101.32**	lb/ft³	***15.92***	*kN/m³*	
Pocket Pen: Rdg	0.95	tsf	**Torvane:** Rdg	0.68	tsf
Su	**0.95**	**ksf**	Std vane Su	**1.38**	**ksf**
Su	*45.5*	*kPa*	Su	*66.2*	*kPa*
Qu: Displacemen	10.25	mm	**GeoPen:** Rdg		kg
Load Cell	0.302	kN	**10 mm tip Su**		**ksf**
Su	*34.9*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.73**	**ksf**			

Test Hole	19-15		Depth	25	feet
			Sample No.	T143	
Wet + Tare Wt.	222.36	g	Length	171	mm
Dry + Tare Wt.	160.00	g	Diameter	71	mm
Tare Wt.	30.67	g	Area	3959	mm²
Wt. Water	62.36	g	Weight	1158.32	g
Dry Wt.	129.33	g	Strain	3.65	%
Moisture Cont.	**48.2**	**%**	Avg. Area	4109	mm²
Wet Density	**106.81**	lb/ft³	***16.78***	*kN/m³*	
Pocket Pen: Rdg	1.00	tsf	**Torvane:** Rdg	0.35	tsf
Su	**1.00**	**ksf**	Std vane Su	**0.72**	**ksf**
Su	*47.9*	*kPa*	Su	*34.3*	*kPa*
Qu: Displacement	6.25	mm	**GeoPen:** Rdg		kg
Load Cell	0.306	kN	**10 mm tip Su**		**ksf**
Su	*37.2*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.78**	**ksf**			

Test Hole	19-15		Depth	35	feet
			Sample No.	T145	
Wet + Tare Wt.	266.96	g	Length		mm
Dry + Tare Wt.	197.42	g	Diameter		mm
Tare Wt.	30.60	g	Area		mm²
Wt. Water	69.54	g	Weight		g
Dry Wt.	166.82	g	Strain		%
Moisture Cont.	**41.7**	**%**	Avg. Area		mm²
Wet Density		lb/ft³		*kN/m³*	
Pocket Pen: Rdg		tsf	**Torvane:** Rdg		tsf
Su	**0.00**	**ksf**	Std vane Su	**0.00**	**ksf**
Su	*0.0*	*kPa*	Su	*0.0*	*kPa*
Qu: Displacement		mm	**GeoPen:** Rdg		kg
Load Cell		kN	**10 mm tip Su**		**ksf**
Su		*kPa*	*10 mm tip Su*		*kPa*
Su		**ksf**			

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Test Hole	19-16		Depth	10	feet
			Sample No.	T147	
Wet + Tare Wt.	173.98	g	Length	172	mm
Dry + Tare Wt.	123.97	g	Diameter	71	mm
Tare Wt.	30.71	g	Area	3959	mm²
Wt. Water	50.01	g	Weight	1130.22	g
Dry Wt.	93.26	g	Strain	7.27	%
Moisture Cont.	**53.6**	**%**	Avg. Area	4269	mm²
Wet Density	**103.61**	lb/ft³	***16.28***	*kN/m³*	
Pocket Pen: Rdg	1.35	tsf	**Torvane:** Rdg	0.50	tsf
Su	**1.35**	**ksf**	Std vane Su	**1.02**	**ksf**
Su	*64.6*	*kPa*	Su	*49.0*	*kPa*
Qu: Displacement	12.50	mm	**GeoPen:** Rdg		kg
Load Cell	0.284	kN	**10 mm tip Su**		**ksf**
Su	*33.3*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.69**	**ksf**			

Test Hole	19-16		Depth	20	feet
			Sample No.	T149	
Wet + Tare Wt.	219.86	g	Length	177	mm
Dry + Tare Wt.	163.55	g	Diameter	72	mm
Tare Wt.	30.96	g	Area	4072	mm²
Wt. Water	56.31	g	Weight	1216.82	g
Dry Wt.	132.59	g	Strain	4.24	%
Moisture Cont.	**42.5**	**%**	Avg. Area	4252	mm²
Wet Density	**105.41**	lb/ft³	***16.56***	*kN/m³*	
Pocket Pen: Rdg	1.45	tsf	**Torvane:** Rdg	0.53	tsf
Su	**1.45**	**ksf**	Std vane Su	**1.09**	**ksf**
Su	*69.4*	*kPa*	Su	*52.0*	*kPa*
Qu: Displacemen	7.50	mm	**GeoPen:** Rdg		kg
Load Cell	0.314	kN	**10 mm tip Su**		**ksf**
Su	*36.9*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.77**	**ksf**			

Test Hole	19-16		Depth	30	feet
			Sample No.	T151	
Wet + Tare Wt.	310.11	g	Length	174	mm
Dry + Tare Wt.	224.24	g	Diameter	70	mm
Tare Wt.	31.32	g	Area	3848	mm²
Wt. Water	85.87	g	Weight	1285.00	g
Dry Wt.	192.92	g	Strain	7.33	%
Moisture Cont.	**44.5**	**%**	Avg. Area	4153	mm²
Wet Density	**119.80**	lb/ft³	***18.82***	*kN/m³*	
Pocket Pen: Rdg	0.50	tsf	**Torvane:** Rdg	0.38	tsf
Su	**0.50**	**ksf**	Std vane Su	**0.77**	**ksf**
Su	*23.9*	*kPa*	Su	*36.8*	*kPa*
Qu: Displacement	12.75	mm	**GeoPen:** Rdg		kg
Load Cell	0.290	kN	**10 mm tip Su**		**ksf**
Su	*34.9*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.73**	**ksf**			

Test Hole	19-16		Depth	50	feet
			Sample No.	T155	
Wet + Tare Wt.	263.47	g	Length	148	mm
Dry + Tare Wt.	203.21	g	Diameter	71	mm
Tare Wt.	31.44	g	Area	3959	mm²
Wt. Water	60.26	g	Weight	993.55	g
Dry Wt.	171.77	g	Strain	0.00	%
Moisture Cont.	**35.1**	**%**	Avg. Area	3959	mm²
Wet Density	**105.85**	lb/ft³	***16.63***	*kN/m³*	
Pocket Pen: Rdg	0.60	tsf	**Torvane:** Rdg	0.36	tsf
Su	**0.60**	**ksf**	Std vane Su	**0.74**	**ksf**
Su	*28.7*	*kPa*	Su	*35.3*	*kPa*
Qu: Displacement		mm	**GeoPen:** Rdg		kg
Load Cell		kN	**10 mm tip Su**		**ksf**
Su		*kPa*	*10 mm tip Su*		*kPa*
Su		**ksf**			

Test Hole	19-17		Depth	15	feet
			Sample No.	T160	
Wet + Tare Wt.	286.57	g	Length	149	mm
Dry + Tare Wt.	201.89	g	Diameter	72	mm
Tare Wt.	31.14	g	Area	4072	mm²
Wt. Water	84.68	g	Weight	962.80	g
Dry Wt.	170.75	g	Strain	3.86	%
Moisture Cont.	**49.6**	**%**	Avg. Area	4235	mm²
Wet Density	**99.08**	lb/ft³	***15.56***	*kN/m³*	
Pocket Pen: Rdg	0.90	tsf	**Torvane:** Rdg	0.57	tsf
Su	**0.90**	**ksf**	Std vane Su	**1.17**	**ksf**
Su	*43.1*	*kPa*	Su	*55.9*	*kPa*
Qu: Displacement	5.75	mm	**GeoPen:** Rdg		kg
Load Cell	0.253	kN	**10 mm tip Su**		**ksf**
Su	*29.9*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.62**	**ksf**			

Test Hole	19-17		Depth	25	feet
			Sample No.	T162	
Wet + Tare Wt.	249.61	g	Length	161	mm
Dry + Tare Wt.	180.67	g	Diameter	72	mm
Tare Wt.	31.33	g	Area	4072	mm²
Wt. Water	68.94	g	Weight	1135.74	g
Dry Wt.	149.34	g	Strain	8.39	%
Moisture Cont.	**46.2**	**%**	Avg. Area	4444	mm²
Wet Density	**108.16**	lb/ft³	***16.99***	*kN/m³*	
Pocket Pen: Rdg	0.80	tsf	**Torvane:** Rdg	0.43	tsf
Su	**0.80**	**ksf**	Std vane Su	**0.87**	**ksf**
Su	*38.3*	*kPa*	Su	*41.7*	*kPa*
Qu: Displacemen	13.50	mm	**GeoPen:** Rdg		kg
Load Cell	0.416	kN	**10 mm tip Su**		**ksf**
Su	*46.8*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.98**	**ksf**			

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Test Hole	**19-17**		**Depth**	**35**	**feet**
			Sample No.	**T164**	
Wet + Tare Wt.	320.44	g	Length	176	mm
Dry + Tare Wt.	235.45	g	Diameter	71	mm
Tare Wt.	31.27	g	Area	3959	mm²
Wt. Water	84.99	g	Weight	1246.37	g
Dry Wt.	204.18	g	Strain	5.97	%
Moisture Cont.	**41.6**	**%**	Avg. Area	4210	mm²
Wet Density	**111.66**	lb/ft³	***17.54***	*kN/m³*	
Pocket Pen: Rdg	0.65	tsf	**Torvane:** Rdg	0.26	tsf
Su	**0.65**	**ksf**	Std vane Su	**0.53**	**ksf**
Su	*31.1*	*kPa*	Su	*25.5*	*kPa*
Qu: Displacement	10.50	mm	**GeoPen:** Rdg		kg
Load Cell	0.322	kN	**10 mm tip Su**		**ksf**
Su	*38.2*	*kPa*	*10 mm tip Su*		*kPa*
Su	**0.80**	**ksf**			

Test Hole			**Depth**		**feet**
			Sample No.		
Wet + Tare Wt.		g	Length		mm
Dry + Tare Wt.		g	Diameter		mm
Tare Wt.		g	Area		mm²
Wt. Water		g	Weight		g
Dry Wt.		g	Strain		%
Moisture Cont.		**%**	Avg. Area		mm²
Wet Density		lb/ft³		*kN/m³*	
Pocket Pen: Rdg		tsf	**Torvane:** Rdg		tsf
Su		**ksf**	Std vane Su		**ksf**
Su		*kPa*	Su		*kPa*
Qu: Displacement		mm	**GeoPen:** Rdg		kg
Load Cell		kN	**10 mm tip Su**		**ksf**
Su		*kPa*	*10 mm tip Su*		*kPa*
Su		**ksf**			

Test Hole			**Depth**		**feet**
			Sample No.		
Wet + Tare Wt.		g	Length		mm
Dry + Tare Wt.		g	Diameter		mm
Tare Wt.		g	Area		mm²
Wt. Water		g	Weight		g
Dry Wt.		g	Strain		%
Moisture Cont.		**%**	Avg. Area		mm²
Wet Density		lb/ft³	***0.00***		
Pocket Pen: Rdg		tsf	**Torvane:** Rdg		tsf
Su		**ksf**	Std vane Su		**ksf**
Su		*kPa*	Su		*kPa*
Qu: Displacement		mm	**GeoPen:** Rdg		kg
Load Cell		kN	**10 mm tip Su**		**ksf**
Su		*kPa*	*10 mm tip Su*		*kPa*
Su		**ksf**			

Test Hole			**Depth**		**feet**
			Sample No.		
Wet + Tare Wt.		g	Length		mm
Dry + Tare Wt.		g	Diameter		mm
Tare Wt.		g	Area		mm²
Wt. Water		g	Weight		g
Dry Wt.		g	Strain		%
Moisture Cont.		**%**	Avg. Area		mm²
Wet Density		lb/ft³	***0.00***		
Pocket Pen: Rdg		tsf	**Torvane:** Rdg		tsf
Su		**ksf**	Std vane Su		**ksf**
Su		*kPa*	Su		*kPa*
Qu: Displacement		mm	**GeoPen:** Rdg		kg
Load Cell		kN	**10 mm tip Su**		**ksf**
Su		*kPa*	*10 mm tip Su*		*kPa*
Su		**ksf**			

Test Hole			**Depth**		**feet**
			Sample No.		
Wet + Tare Wt.		g	Length		mm
Dry + Tare Wt.		g	Diameter		mm
Tare Wt.		g	Area		mm²
Wt. Water		g	Weight		g
Dry Wt.		g	Strain		%
Moisture Cont.		**%**	Avg. Area		mm²
Wet Density		lb/ft³	***0.00***		
Pocket Pen: Rdg		tsf	**Torvane:** Rdg		tsf
Su		**ksf**	Std vane Su		**ksf**
Su		*kPa*	Su		*kPa*
Qu: Displacement		mm	**GeoPen:** Rdg		kg
Load Cell		kN	**10 mm tip Su**		**ksf**
Su		*kPa*	*10 mm tip Su*		*kPa*
Su		**ksf**			

Test Hole			**Depth**		**feet**
			Sample No.		
Wet + Tare Wt.		g	Length		mm
Dry + Tare Wt.		g	Diameter		mm
Tare Wt.		g	Area		mm²
Wt. Water		g	Weight		g
Dry Wt.		g	Strain		%
Moisture Cont.		**%**	Avg. Area		mm²
Wet Density		lb/ft³	***0.00***		
Pocket Pen: Rdg		tsf	**Torvane:** Rdg		tsf
Su		**ksf**	Std vane Su		**ksf**
Su		*kPa*	Su		*kPa*
Qu: Displacement		mm	**GeoPen:** Rdg		kg
Load Cell		kN	**10 mm tip Su**		**ksf**
Su		*kPa*	*10 mm tip Su*		*kPa*
Su		**ksf**			

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hmanalo@mts.net

HYDRAULIC CONDUCTIVITY TEST REPORT

CLIENT: Aecom
99 Comerce Drive
Winnipeg, MB R3P 0Y7
ATTENTION: Ryan Harras
PROJECT: Jefferson East CSR (Phase 2)

PROJECT NO. 112-1909

Date Sampled: 24-27-Jun-19 Date Received: 26-Jul-19 Sampled By: Client
Test Started: 26-Jul-19 Test Ended: 15-Aug-19 Sample ID: TH 19-08, T74

Test Result

Corrected Saturated Hydraulic Conductivity, Ks (cm/sec) 1.52 x 10 $^{-8}$

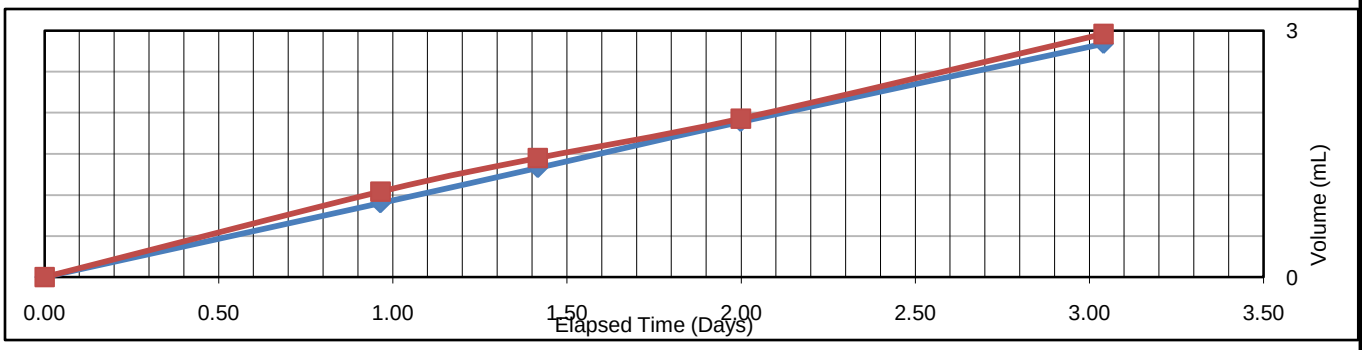
Consolidation Data

	Avg. Height (m)	Avg. Diameter (m)	Moisture Content %	Degree of Saturation %	Cell Pressure kPa	Back Pressure kPa
Initial	0.058	0.072	50.6	95.1	120.0	100.0
Final	0.059	0.072	53.8	99.2	120.0	100.0

Permeation Data

Time Increment (Days)	Elapsed Time (Days)	Q (ml)		In/Out Ratio	Average Flow (ml)	Temperature Correction	Corrected Conductivity, Ks (m/s)
		In	Out				
0.96	0.96	0.90	1.04	0.865	0.97	0.95	1.62E-10
0.45	1.42	0.43	0.41	1.049	0.42	0.95	1.50E-10
0.58	2.00	0.56	0.48	1.167	0.52	0.95	1.44E-10
1.04	3.04	0.95	1.03	0.922	0.99	0.95	1.53E-10

Permeant: De-aired tap water
Hydraulic Gradient: 17.30



Comments
Specific gravity of soil was assumed to be 2.75

Remarks: Test Method: ASTM D5084 (Constant Head)
Technician: NS

P. Bevel

Reviewed by: Paul Bevel

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Phone: 204 697 3854 Cell: 204 997-1355
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HYDRAULIC CONDUCTIVITY TEST REPORT

CLIENT: Aecom
99 Comerce Drive
Winnipeg, MB R3P 0Y7
ATTENTION: Ryan Harras
PROJECT: Jefferson East CSR (Phase 2)

PROJECT NO. 112-1909

Date Sampled: 24-27-Jun-19 Date Received: 26-Jul-19 Sampled By: Client
Test Started: 26-Jul-19 Test Ended: 15-Aug-19 Sample ID: TH 19-08, T74

Test Result

Corrected Saturated Hydraulic Conductivity, Ks (cm/sec) 1.52 x 10 $^{-8}$

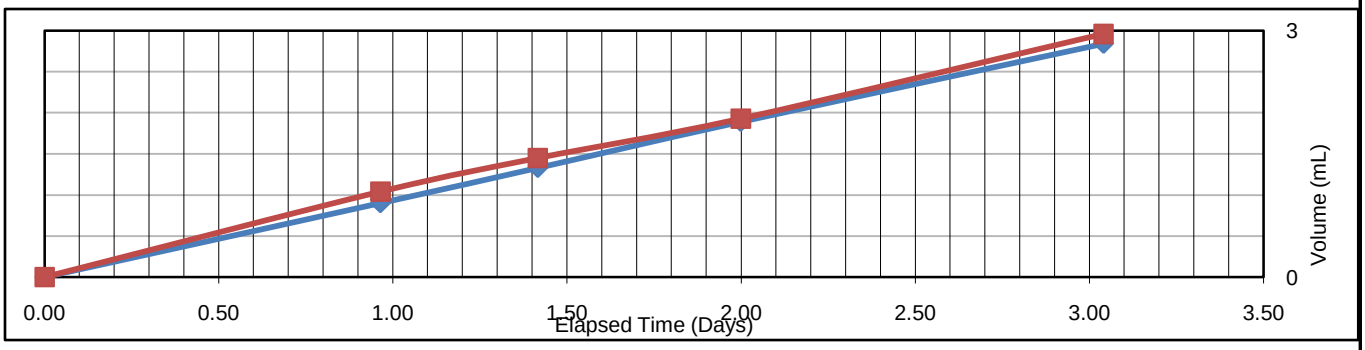
Consolidation Data

	Avg. Height (m)	Avg. Diameter (m)	Moisture Content %	Degree of Saturation %	Cell Pressure kPa	Back Pressure kPa
Initial	0.058	0.072	50.6	95.1	120.0	100.0
Final	0.059	0.072	53.8	99.2	120.0	100.0

Permeation Data

Time Increment (Days)	Elapsed Time (Days)	Q (ml)		In/Out Ratio	Average Flow (ml)	Temperature Correction	Corrected Conductivity, Ks (m/s)
		In	Out				
0.96	0.96	0.90	1.04	0.865	0.97	0.95	1.62E-10
0.45	1.42	0.43	0.41	1.049	0.42	0.95	1.50E-10
0.58	2.00	0.56	0.48	1.167	0.52	0.95	1.44E-10
1.04	3.04	0.95	1.03	0.922	0.99	0.95	1.53E-10

Permeant: De-aired tap water
Hydraulic Gradient: 17.30



Comments
Specific gravity of soil was assumed to be 2.75

Remarks: Test Method: ASTM D5084 (Constant Head)
Technician: NS

P. Bevel

Reviewed by: Paul Bevel

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HYDRAULIC CONDUCTIVITY TEST REPORT

CLIENT: Aecom
99 Comerce Drive
Winnipeg, MB R3P 0Y4
ATTENTION: Ryan Harras
PROJECT: Jefferson East CSR (Phase 2)

PROJECT NO. 112-1909

Date Sampled: June 24-27 Date Received: 26-Jul-19 Sampled By: Client
Test Started: 05-Aug-19 Test Ended: 26-Aug-19 Sample ID: TH 19-15 (T140)

Test Result

Corrected Saturated Hydraulic Conductivity, Ks (cm/sec) 2.98×10^{-8}

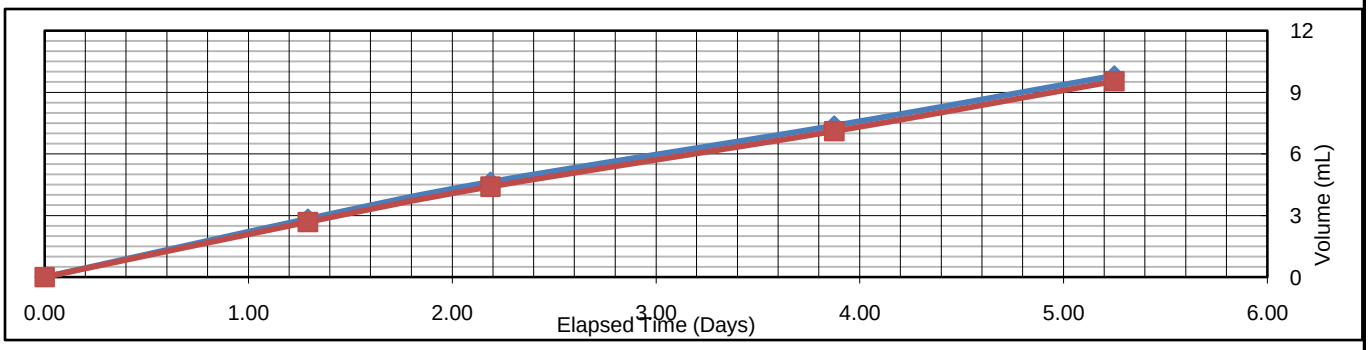
Consolidation Data

	Avg. Height (m)	Avg. Diameter (m)	Moisture Content %	Degree of Saturation %	Cell Pressure kPa	Back Pressure kPa
Initial	0.086	0.070	50.8	92.8	130.0	100.0
Final	0.087	0.071	58.8	99.1	130.0	100.0

Permeation Data

Time Increment (Days)	Elapsed Time (Days)	Q (ml)		In/Out Ratio	Average Flow (ml)	Temperature Correction	Corrected Conductivity, Ks (m/s)
		In	Out				
1.29	1.29	2.84	2.68	1.060	2.76	0.95	3.40E-10
0.90	2.19	1.80	1.72	1.047	1.76	0.95	3.13E-10
1.69	3.88	2.74	2.70	1.015	2.72	0.95	2.57E-10
1.38	5.25	2.44	2.43	1.004	2.44	0.95	2.82E-10

Permeant: De-aired tap water
Hydraulic Gradient: 17.54



Comments
Specific gravity of soil was assumed to be 2.75

Remarks: Test Method: ASTM D5084 (Constant Head)
Technician: NS

P. Bevel

Reviewed by: Paul Bevel

SWELL TEST REPORT

ASTM D4546-14 TEST METHOD A

Client	AECOM C/O Dyregrov Robinson Inc.	Test Hole	TH19-02	Test Start:	5-Sep-19
Project	Jefferson East CST (Phase 2)	Sample	T19	Tested By:	NM
Project No.	WX11735	Depth	20 ft		

Before Test

Consolidation ring no.	(new) #4	
Mass of ring	110.17	*g*
Inside diameter of the ring	6.367	*cm*
Height of the specimen, H_o	2.474	*cm*
Area of the specimen	31.839	*cm2*
Mass (specimen + ring)	246.23	*g*
Mass of wet sample	136.1	*g*
Initial Moisture Content	39.3%	

After Test

Mass(sample$_{wet}$+ring+tare)	360.87	*g*
Mass of tare	114.46	*g*
Mass (wet soil + ring)	246.41	*g*
Mass of wet sample	136.24	*g*
Mass (dry soil+ring+can)	322.27	*g*
Mass of dry specimen	97.64	*g*
Final MC of specimen	39.5%	
Specific gravity of Solids	2.7	
Seating pressure	1	kPa

Soil Properties

Mass of solids	97.64	*g*
Mass of water in specimen before test	38.42	*g*
Mass of water in specimen after test	38.60	*g*
Height of Solids	1.1358	*cm*
Height of water before test	1.2067	*cm*
Height of water after test	1.2123	*cm*
Change in height of specimen after test	0.0259	*cm*
Height of specimen after test	2.4481	*cm*
Void ratio before test	1.178	
Void ratio after test	1.155	
Degree of saturation before test	90.17%	
Degree of saturation after test	92.38%	
Dry Density before test	1.240	g/cm3

Visual Description of Soil

Clay (CH) - silty, trace sand, high plastic, moist, dark greyish brown

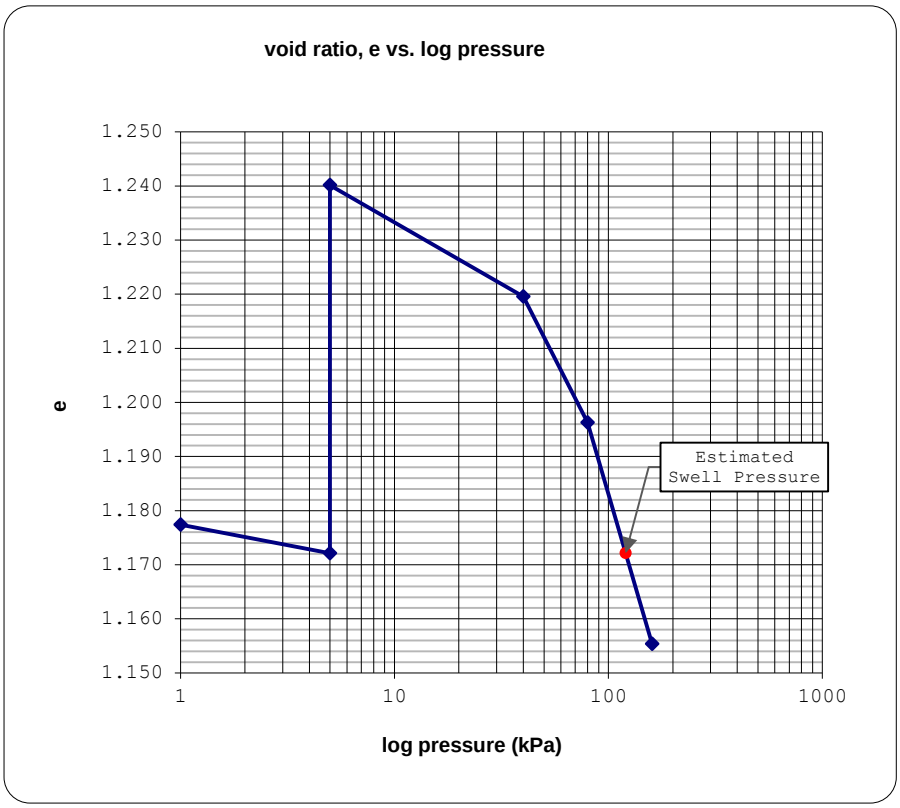


TABLE 1: Test Summary

Load No.	Pressure	Void Ratio
Seating	1	1.177
1	5	1.172
2	5	1.240
3	40	1.220
4	80	1.196
5	160	1.155

Final Results:

Swell (+) / Collpase (-) Strain	=	3.1%	Swell
Estimated Swell Pressure	=	120	kPa

SWELL TEST REPORT

ASTM D4546-14 TEST METHOD B

Client	AECOM C/O Dyregrov Robinson Inc.	Test Hole	TH19-06	Test Start:	6-Sep-19
Project	Jefferson East CST (Phase 2)	Sample	T19	Tested By:	NM
Project No.	WX11735	Depth	20 ft		

Before Test

Consolidation ring no.	#12	
Mass of ring	90.64	g
Inside diameter of the ring	6.494	cm
Height of the specimen, H_o	2.324	cm
Area of the specimen	33.122	cm2
Mass (specimen + ring)	224.19	g
Mass of wet sample	133.6	g
Initial Moisture Content	42.0%	

After Test

Mass(sample$_{wet}$+ring+tare)	340.60	g
Mass of tare	114.74	g
Mass (wet soil + ring)	225.86	g
Mass of wet sample	135.22	g
Mass (dry soil+ring+can)	299.44	g
Mass of dry specimen	94.06	g
Final MC of specimen	43.8%	
Specific gravity of Solids	2.7	
Seating pressure	1	kPa

Soil Properties

Mass of solids	94.06	g
Mass of water in specimen before test	39.49	g
Mass of water in specimen after test	41.16	g
Height of Solids	1.0518	cm
Height of water before test	1.1923	cm
Height of water after test	1.2427	cm
Change in height of specimen after test	0.0216	cm
Height of specimen after test	2.3024	cm
Void ratio before test	1.210	
Void ratio after test	1.189	
Degree of saturation before test	93.72%	
Degree of saturation after test	99.37%	
Dry Density before test	1.222	g/cm3

Visual Description of Soil

Clay (CH) - silty, trace sand, high plastic, moist, dark greyish brown

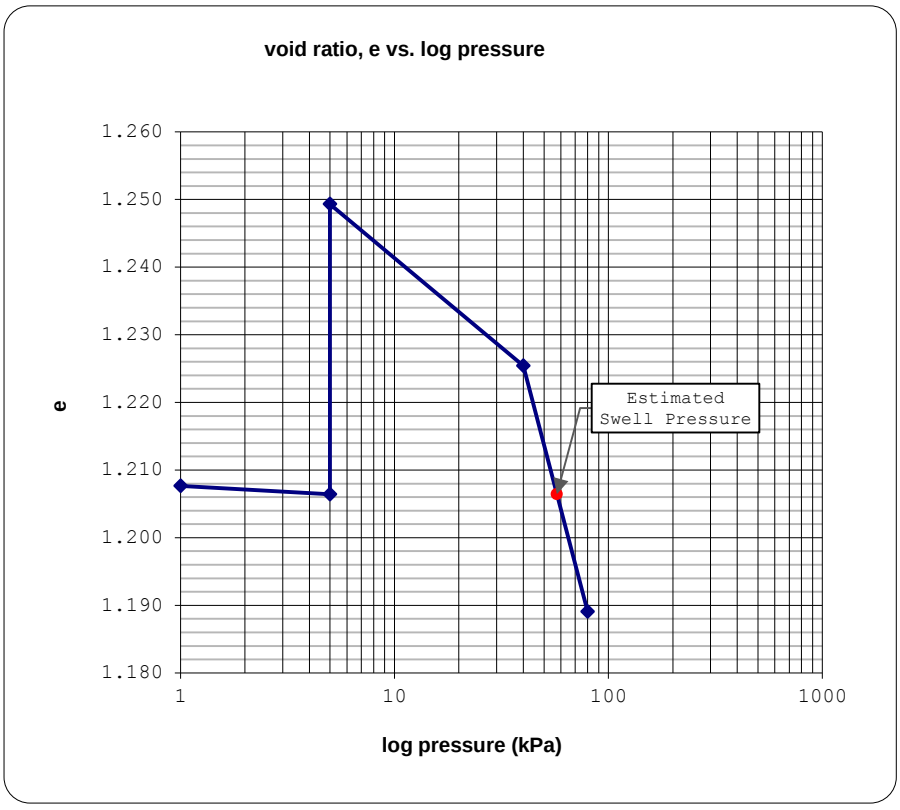


TABLE 1: Test Summary

Load No.	Pressure	Void Ratio
Seating	1	1.208
1	5	1.206
2	5	1.249
3	40	1.225
4	80	1.189

Final Results:

Swell (+) / Collpase (-) Strain	=	1.9%	Swell
Estimated Swell Pressure	=	57	kPa

SWELL TEST REPORT

ASTM D4546-14 TEST METHOD B

Client	AECOM C/O Dyregrov Robinson Inc.	Test Hole	TH19-11	Test Start:	13-Sep-19
Project	Jefferson East CST (Phase 2)	Sample	T101	Tested By:	NM
Project No.	WX11735	Depth	15 ft		

Before Test

Consolidation ring no.	#12	
Mass of ring	90.64	*g*
Inside diameter of the ring	6.494	*cm*
Height of the specimen, H_o	2.386	*cm*
Area of the specimen	33.122	*cm2*
Mass (specimen + ring)	224.85	*g*
Mass of wet sample	134.2	*g*
Initial Moisture Content	34.3%	

After Test

Mass(sample$_{wet}$+ring+tare)	341.47	*g*
Mass of tare	114.74	*g*
Mass (wet soil + ring)	226.73	*g*
Mass of wet sample	136.09	*g*
Mass (dry soil+ring+can)	305.35	*g*
Mass of dry specimen	99.97	*g*
Final MC of specimen	36.1%	
Specific gravity of Solids	2.7	
Seating pressure	1	kPa

Soil Properties

Mass of solids	99.97	*g*
Mass of water in specimen before test	34.24	*g*
Mass of water in specimen after test	36.12	*g*
Height of Solids	1.1179	*cm*
Height of water before test	1.0338	*cm*
Height of water after test	1.0905	*cm*
Change in height of specimen after test	0.0244	*cm*
Height of specimen after test	2.3616	*cm*
Void ratio before test	1.134	
Void ratio after test	1.113	
Degree of sat	81.52%	
Degree of saturation after test	87.68%	
Dry Density before test	1.265	g/cm3

Visual Description of Soil

Clay (CH) - silty, trace sand, high plastic, moist, dark greyish brown

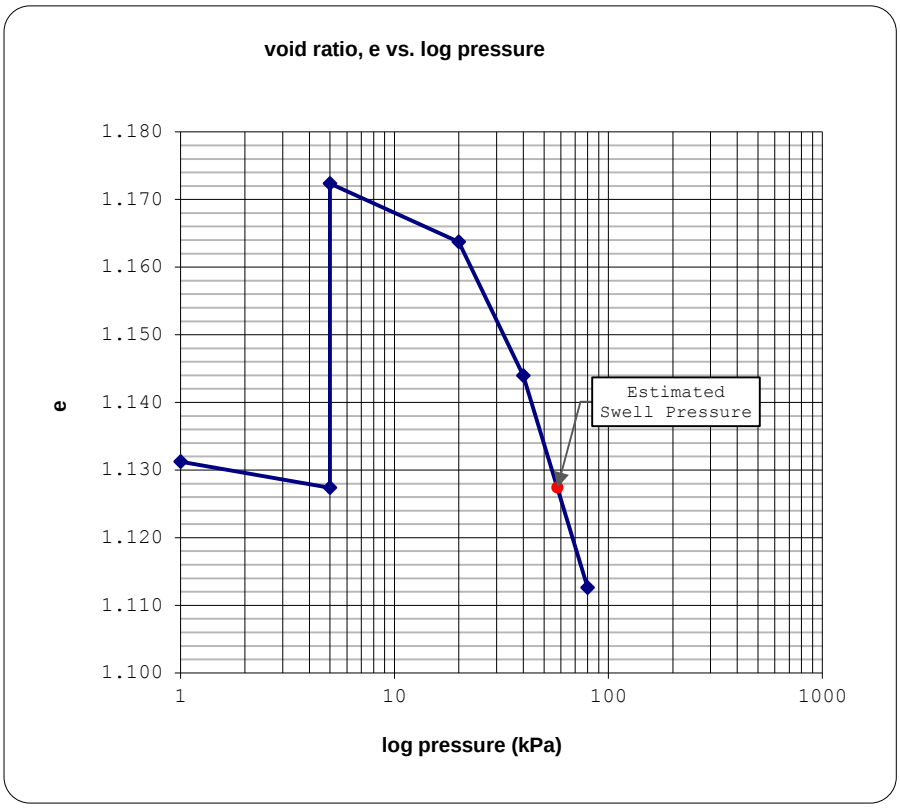


TABLE 1: Test Summary

Load No.	Pressure	Void Ratio
Seating	1	1.131
1	5	1.127
2	5	1.172
3	20	1.164
4	40	1.144
5	80	1.113

Final Results:

Swell (+) / Collpase (-) Strain	=	2.1%	Swell
Estimated Swell Pressure	=	58	kPa

SWELL TEST REPORT

ASTM D4546-14 TEST METHOD A

Client	AECOM C/O Dyregrov Robinson Inc.	Test Hole	TH19-14	Test Start:	13-Sep-19
Project	Jefferson East CST (Phase 2)	Sample	T130	Tested By:	NM
Project No.	WX11735	Depth	20 ft		

Before Test

Consolidation ring no.	(new) #4	
Mass of ring	110.17	*g*
Inside diameter of the ring	6.366	*cm*
Height of the specimen, H_o	2.449	*cm*
Area of the specimen	31.829	*cm2*
Mass (specimen + ring)	238.47	*g*
Mass of wet sample	128.3	*g*
Initial Moisture Content	56.2%	

After Test

Mass(sample$_{wet}$+ring+tare)	353.94	*g*
Mass of tare	114.23	*g*
Mass (wet soil + ring)	239.71	*g*
Mass of wet sample	129.54	*g*
Mass (dry soil+ring+can)	306.54	*g*
Mass of dry specimen	82.14	*g*
Final MC of specimen	57.7%	
Specific gravity of Solids	2.7	
Seating pressure	1	kPa

Soil Properties

Mass of solids	82.14	*g*
Mass of water in specimen before test	46.16	*g*
Mass of water in specimen after test	47.40	*g*
Height of Solids	0.9558	*cm*
Height of water before test	1.4502	*cm*
Height of water after test	1.4892	*cm*
Change in height of specimen after test		*cm*
Height of specimen after test	2.4490	*cm*
Void ratio before test	1.562	
Void ratio after test	1.562	
Degree of saturation before test	97.12%	
Degree of saturation after test	99.73%	
Dry Density before test	1.054	g/cm3

Visual Description of Soil

Clay (CH) - silty, trace sand, high plastic, moist, dark greyish brown

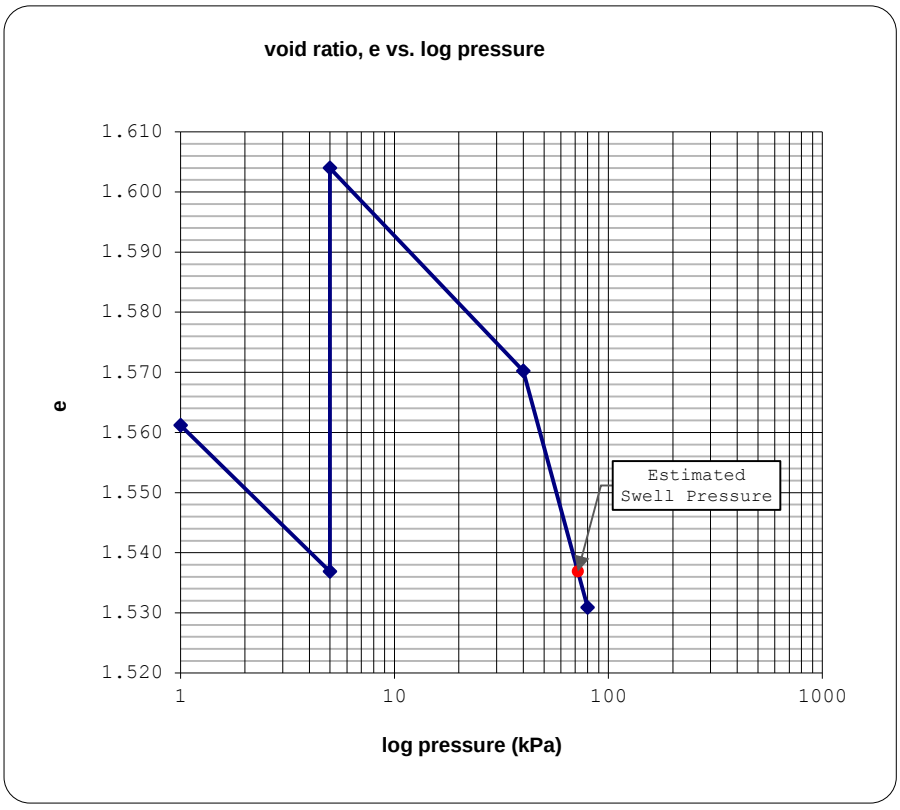


TABLE 1: Test Summary

Load No.	Pressure	Void Ratio
Seating	1	1.561
1	5	1.537
2	5	1.604
3	40	1.570
4	80	1.531

Final Results:

Swell (+) / Collpase (-) Strain	=	2.6%	Swell
Estimated Swell Pressure	=	72	kPa

SWELL TEST REPORT

ASTM D4546-14 TEST METHOD B

Client	AECOM C/O Dyregrov Robinson Inc.	Test Hole	TH19-16	Test Start:	13-Sep-19
Project	Jefferson East CST (Phase 2)	Sample	T147	Tested By:	NM
Project No.	WX11735	Depth	10 ft		

Before Test

Consolidation ring no.	#12	
Mass of ring	110.19	*g*
Inside diameter of the ring	6.367	*cm*
Height of the specimen, H_o	2.438	*cm*
Area of the specimen	31.839	*cm2*
Mass (specimen + ring)	239.18	*g*
Mass of wet sample	129.0	*g*
Initial Moisture Content	48.6%	

After Test

Mass(sample$_{wet}$+ring+tare)	353.80	*g*
Mass of tare	114.30	*g*
Mass (wet soil + ring)	239.50	*g*
Mass of wet sample	129.31	*g*
Mass (dry soil+ring+can)	311.27	*g*
Mass of dry specimen	86.78	*g*
Final MC of specimen	49.0%	
Specific gravity of Solids	2.7	
Seating pressure	1	kPa

Soil Properties

Mass of solids	86.78	*g*
Mass of water in specimen before test	42.21	*g*
Mass of water in specimen after test	42.53	*g*
Height of Solids	1.0095	*cm*
Height of water before test	1.3257	*cm*
Height of water after test	1.3358	*cm*
Change in height of specimen after test	0.0433	*cm*
Height of specimen after test	2.3947	*cm*
Void ratio before test	1.415	
Void ratio after test	1.372	
Degree of sat	92.80%	
Degree of saturation after test	96.43%	
Dry Density before test	1.118	g/cm3

Visual Description of Soil

Clay (CH) - silty, trace sand, high plastic, moist, dark greyish brown

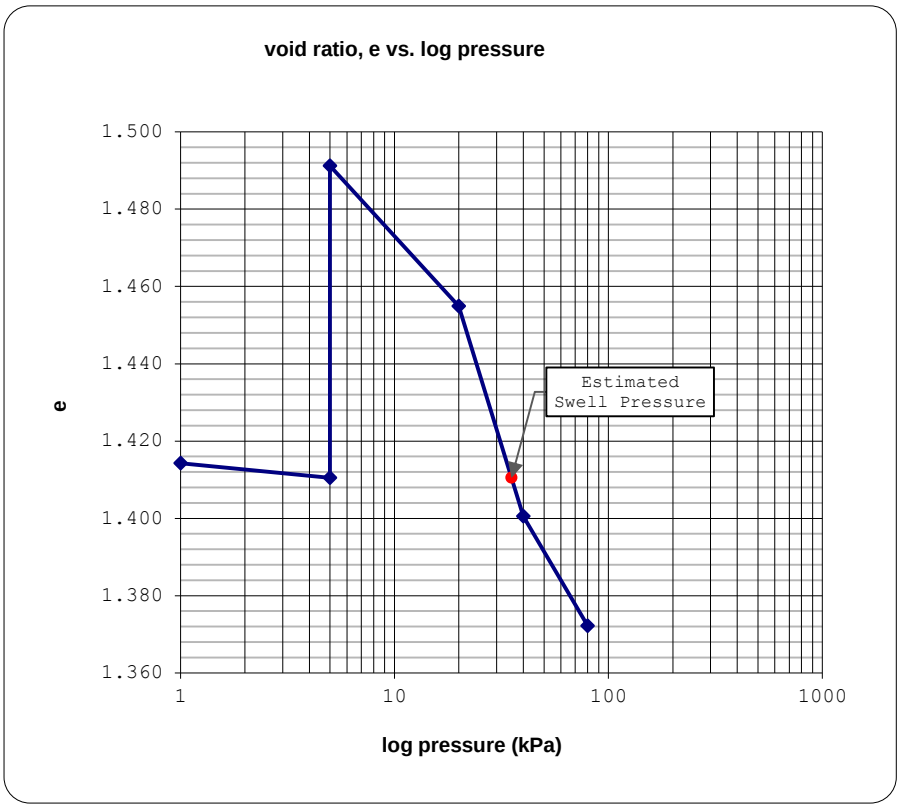


TABLE 1: Test Summary

Load No.	Pressure	Void Ratio
Seating	1	1.414
1	5	1.410
2	5	1.491
3	20	1.455
4	40	1.401
5	80	1.372

Final Results:

Swell (+) / Collpase (-) Strain	=	3.4%	Swell
Estimated Swell Pressure	=	35	kPa

AECOM Canada Ltd.
ATTN: RYAN HARRAS
99 Commerce Drive
Winnipeg MB R3P 0Y7

Date Received: 29-JUL-19
Report Date: 08-AUG-19 14:00 (MT)
Version: FINAL

Client Phone: 204-928-7444

Certificate of Analysis

Lab Work Order #: L2318801

Project P.O. #: 60599385
Job Reference: 60599385
C of C Numbers:
Legal Site Desc:

Hua Wo
Chemistry Laboratory Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2318801-1 TH19-01; G3 @ 15'							
Sampled By: CLIENT on 24-JUL-19							
Matrix: SOIL							
Miscellaneous Parameters							
% Moisture	31.8		0.10	%	01-AUG-19	02-AUG-19	R4737126
Resistivity	561		1.0	ohm*cm		08-AUG-19	
Sulphate	927		20	mg/kg	02-AUG-19	06-AUG-19	R4742614
pH (1:2 soil:water)	7.96		0.10	pH	07-AUG-19	07-AUG-19	R4740588
Conductivity	1.78		0.0040	mS/cm		08-AUG-19	R4743353
L2318801-2 TH19-05; G43 @ 20'							
Sampled By: CLIENT on 24-JUL-19							
Matrix: SOIL							
Miscellaneous Parameters							
% Moisture	31.7		0.10	%	01-AUG-19	02-AUG-19	R4737126
Resistivity	1400		1.0	ohm*cm		08-AUG-19	
Sulphate	511		20	mg/kg	02-AUG-19	06-AUG-19	R4742614
pH (1:2 soil:water)	8.12		0.10	pH	07-AUG-19	07-AUG-19	R4740588
Conductivity	0.713		0.0040	mS/cm		08-AUG-19	R4743353
L2318801-3 TH19-10; G91 @ 5'							
Sampled By: CLIENT on 24-JUL-19							
Matrix: SOIL							
Miscellaneous Parameters							
% Moisture	16.8		0.10	%	01-AUG-19	02-AUG-19	R4737126
Resistivity	4950		1.0	ohm*cm		08-AUG-19	
Sulphate	46		20	mg/kg	02-AUG-19	06-AUG-19	R4742614
pH (1:2 soil:water)	9.13		0.10	pH	07-AUG-19	07-AUG-19	R4740588
Conductivity	0.202		0.0040	mS/cm		08-AUG-19	R4743353
L2318801-4 TH19-13; G120 @ 10'							
Sampled By: CLIENT on 24-JUL-19							
Matrix: SOIL							
Miscellaneous Parameters							
% Moisture	34.9		0.10	%	01-AUG-19	02-AUG-19	R4737126
Resistivity	3580		1.0	ohm*cm		08-AUG-19	
Sulphate	30		20	mg/kg	02-AUG-19	06-AUG-19	R4742614
pH (1:2 soil:water)	8.18		0.10	pH	07-AUG-19	07-AUG-19	R4740588
Conductivity	0.279		0.0040	mS/cm		08-AUG-19	R4743353
L2318801-5 TH19-15; G142 @ 20'							
Sampled By: CLIENT on 24-JUL-19							
Matrix: SOIL							
Miscellaneous Parameters							
% Moisture	35.0		0.10	%	01-AUG-19	02-AUG-19	R4737126
Resistivity	940		1.0	ohm*cm		08-AUG-19	
Sulphate	890		20	mg/kg	02-AUG-19	06-AUG-19	R4742614
pH (1:2 soil:water)	8.28		0.10	pH	07-AUG-19	07-AUG-19	R4740588
Conductivity	1.06		0.0040	mS/cm		08-AUG-19	R4743353

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
EC-WT	Soil	Conductivity (EC)	MOEE E3138
A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.			
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).			
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-1:2-SK	Soil	pH (1:2 Soil:Water Extraction)	AB Ag (1988) p.7
1 part dry soil and 2 parts de-ionized water (by volume) is mixed. The slurry is allowed to stand with occasional stirring for 30 - 60 minutes. After equilibration, pH of the slurry is measured using a pH meter.			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138
Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.			
SO4-WT	Soil	Sulphate	EPA 300.0
5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: AECOM Canada Ltd.
99 Commerce Drive
Winnipeg MB R3P 0Y7
Contact: RYAN HARRAS

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-WT	**Soil**							
Batch R4743353								
WG3126300-2 IRM		**WT SAR3**						
Conductivity			86.4		%		70-130	08-AUG-19
WG3126843-1 LCS								
Conductivity			97.5		%		90-110	08-AUG-19
WG3126300-1 MB								
Conductivity			<0.0040		mS/cm		0.004	08-AUG-19
MOISTURE-WT	**Soil**							
Batch R4737126								
WG3122283-2 LCS								
% Moisture			100.8		%		90-110	02-AUG-19
WG3122283-1 MB								
% Moisture			<0.10		%		0.1	02-AUG-19
PH-1:2-SK	**Soil**							
Batch R4740588								
WG3121916-2 IRM		**SAL814**						
pH (1:2 soil:water)			7.90		pH		7.65-8.25	07-AUG-19
WG3121916-3 LCS								
pH (1:2 soil:water)			6.88		pH		6.66-7.06	07-AUG-19
SO4-WT	**Soil**							
Batch R4742614								
WG3123166-4 CRM		**AN-CRM-WT**						
Sulphate			96.2		%		60-140	06-AUG-19
WG3123166-2 LCS								
Sulphate			103.3		%		80-120	06-AUG-19
WG3123166-1 MB								
Sulphate			<20		mg/kg		20	06-AUG-19

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.