Appendix B

Geotechnical Data Report (GDR)



City of Winnipeg

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

Prepared by:

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Prepared for:

The City of Winnipeg Water and Waste Department 110 - 1199 Pacific Avenue Winnipeg, MB R3E 3S8

 Date:
 November 29, 2019

 Project #:
 60599385

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November 29, 2019

Project # 60599385

Mr. Jurgen Friesen, C.E.T. Project Coordinator The City of Winnipeg Water and Waste Department 110 - 1199 Pacific Avenue Winnipeg, MB R3E 3S8

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**.

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.

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

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

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
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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.

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

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

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

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.

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

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

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 subdivided 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.

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

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

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**.

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

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

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
 - o Clay
 - o Silt
 - o 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 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.

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	Elevation at Base (m)		228.3 to 230.0	
(Station 0+202 to	Thickness (m)	0.5 to 1.2	NR to 0.9	NR to 1.0
0+600)	*Average Thickness (m)	0.7	0.6	1.0
Section 2	Elevation at Base (m)		228.5 to 229.6	
(Station 0+600 to	Thickness (m)	NR to 0.3	NR to 0.8	NR to 1.1
1+000)	*Average Thickness (m)	0.3	0.7	1.1
Section 3	Elevation at Base (m)		228.0 to 229.4	
(Station 1+000 to	Thickness (m)	NR to 0.9	0.8 to 1.2	NR
1+500)	*Average Thickness (m)	0.6	1.0	NR
Section 4	Elevation at Base (m)		226.6 to 228.5	
(Station 1+500 to	Thickness (m)	NR to 1.5	NR to 1.1	NR to 0.7
1+742)	*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
leffermen Feet CCD	Elevation at Base (m)	216.0 to 227.9		
Jefferson East CSR (AECOM 2012)	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
	Elevation at Base (m)	225.2 to 225.3		
Outfall Structure (AECOM 2015)	Thickness (m)	0.2 to 1.2	0.3 to 0.6	NR
(AECOW 2015)	*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.

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
рН	NT	9.1	NT
Resistivity (ohm*cm)	NT	4950	NT
Conductivity (mS/cm)	NT	0.2	NT
Sulphate Content (mg/kg)	NT	46	NT

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

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.

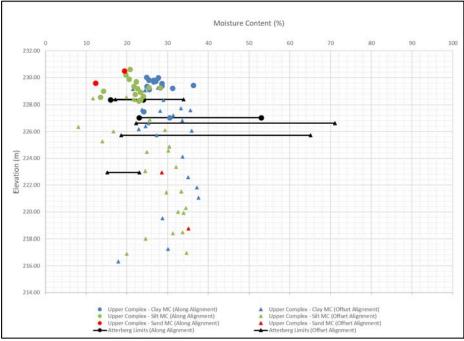


Figure 3-1: Moisture Content & Atterberg Limits with Elevation for Upper Complex (AECOM 2012, AECOM 2016, AECOM 2019)

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**.

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

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

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 glaciolacustrine 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 (¢'), 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.**

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 x 10 ⁻⁸	2.25 x 10 ⁻⁸	2.98 x 10 ⁻⁸
Free Swell (%)	1.9	2.6	3.4
Swelling Pressure (kPa)	35	68	120
рН	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

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

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 glaciolacustrine soil deposits encountered in the AECOM 2012, AECOM 2015, and AECOM 2019 investigations are illustrated in **Figure 3-2** and **Figure 3-3** below

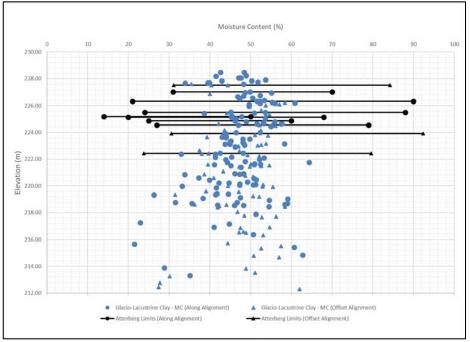


Figure 3-2: Moisture Content & Atterberg Limits with Elevation for Glacio-Lacustrine Clay (AECOM 2012, AECOM 2015, AECOM 2019)

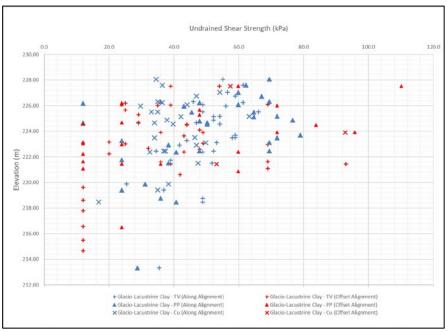


Figure 3-3: Undrained Shear Strength with Elevation for Glacio-Lacustrine Clay (AECOM 2012, AECOM 2015, AECOM 2019

The reported laboratory test results are generally consistent with the published findings for the glaciolacustrine 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**.

Location	Test Hole	Depth (m BGS)	Till Contact Elevation (m)
Section 1	TH19-01	12.5	218.6
(Station 0+202 to 0+600)	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	TH19-14	18.1	212.5
(Station 1+500 to 1+742)	TH19-16	16.0	212.6

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

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	SP11-13	18.6	212.0
(AECOM 2012)	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**.

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		36		
Strength (kPa)		30		
Torvane - Undrained Shear Strength (kPa)		49		

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

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

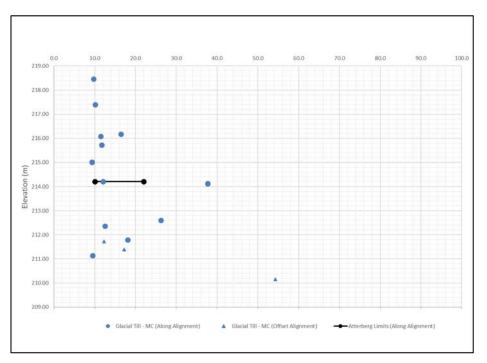


Figure 3-4: Moisture Content & Atterberg Limits with Elevation for Glacial Till (AECOM 2012, AECOM 2015, AECOM 2019)

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.

Location	Test Hole ID	Ground Elev. (m)	Tip Elev. (m)	Soil Unit	Monitoring Date	Depth (m BGS)	GWL Elev. (m)				
				.	Aug-06-2019	4.13	226.98				
	TH19-01	231.11	218.41	Glacial Till	Aug-20-2019	4.21	226.90				
Section 1								1111	Sept-03-2019	4.17	226.94
(Station 0+202 to 0+600)					Aug-06-2019	7.76	223.55				
,	TH19-05	231.32 217.60	231.32	231.32	231.32	231.32 217.60	217.60 Glacial Till	Aug-20-2019	6.55	224.76	
Section 4				.	Aug-06-2019	2.91	225.64				
(Station 1+500	TH19-16	228.55	221.23	Glacio. Clay	Aug-20-2019	2.93	225.63				
to 1+742)				Clay	Sept-03-2019	2.94	225.61				

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

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**.

Location	Test Hole ID	Ground Elev. (m)	Tip Elev. (m)	Soil Unit	Monitoring Date	Depth (m BGS)	GWL Elev. (m)																
					Jan-06-2012	7.80	222.78																
				Mar-13-2015 Glacial May-19-2015	Feb-24-2015	7.50	223.03																
	Jefferson East				Mar-13-2015	7.50	223.03																
Jefferson East		220 50	011.00		May-19-2015	7.40	223.14																
CSR	SP11-13	230.58	211.00		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																

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

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.
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- 5- ASCE/CI 36-15 (2015). Standard Design and Construction Guidelines for Microtunneling. Published by American Society of Civil Engineers.
- 6- Matile, G.L.D. (2004). Surficial Geology, Winnipeg, Manitoba Geoscientific Map MAP2003-7.
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- 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.

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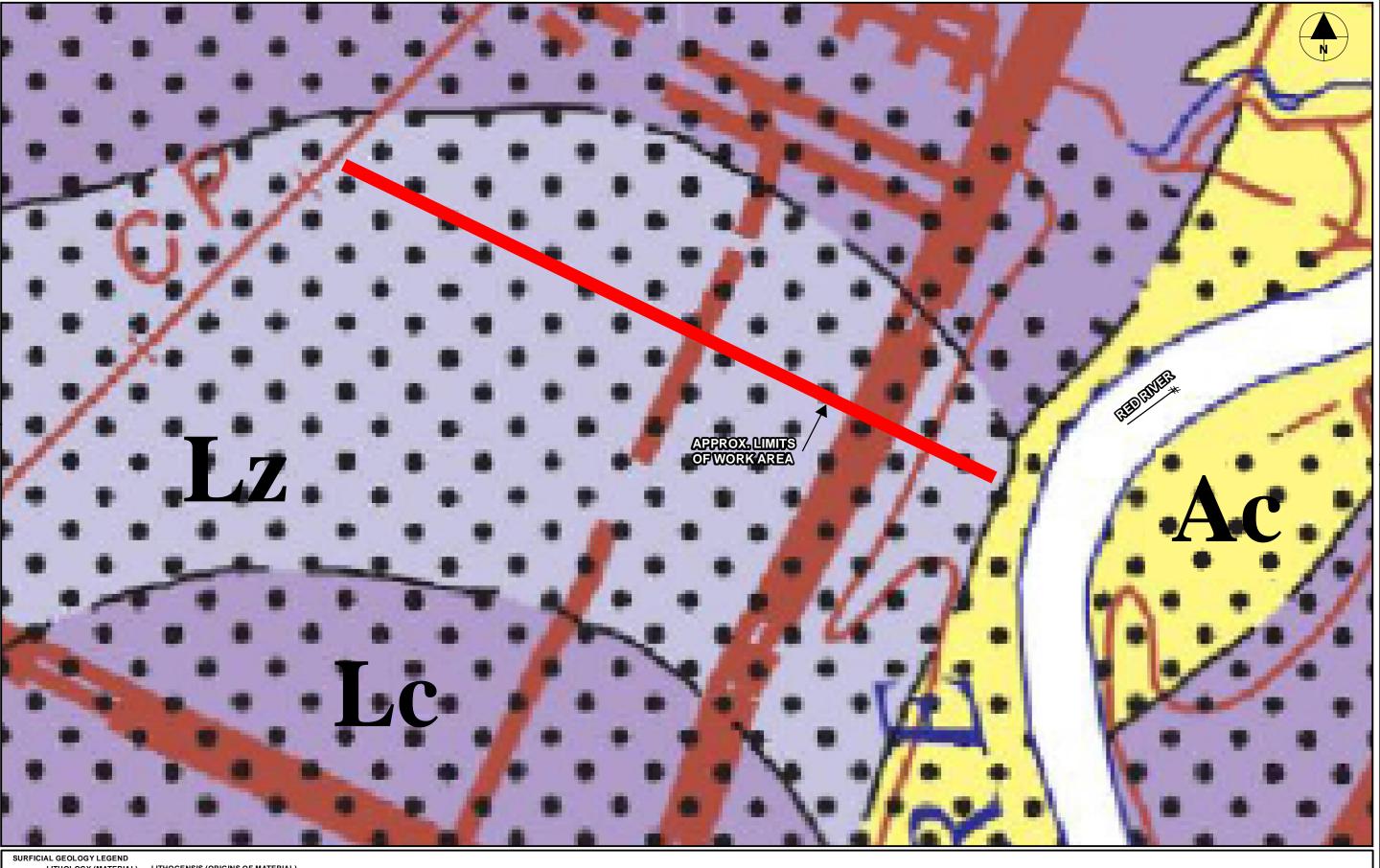
Appendix A

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



FIGURE:



Ac Lc Lz

LITHOLOGY (MATERIAL) LITHOGENSIS (ORIGINS OF MATERIAL)

CHANNEL DEPOSITS ALLUVIAL SEDIMENTS: SAND AND GRAVEL, SAND, SILT, CLAY, ORGANIC DETRITUS; 1-20 m THICK; CHANNEL AND OVERBANK SEDIMENTS; DEPOSITED BY POSTGLACIAL RIVERS.

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. 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.

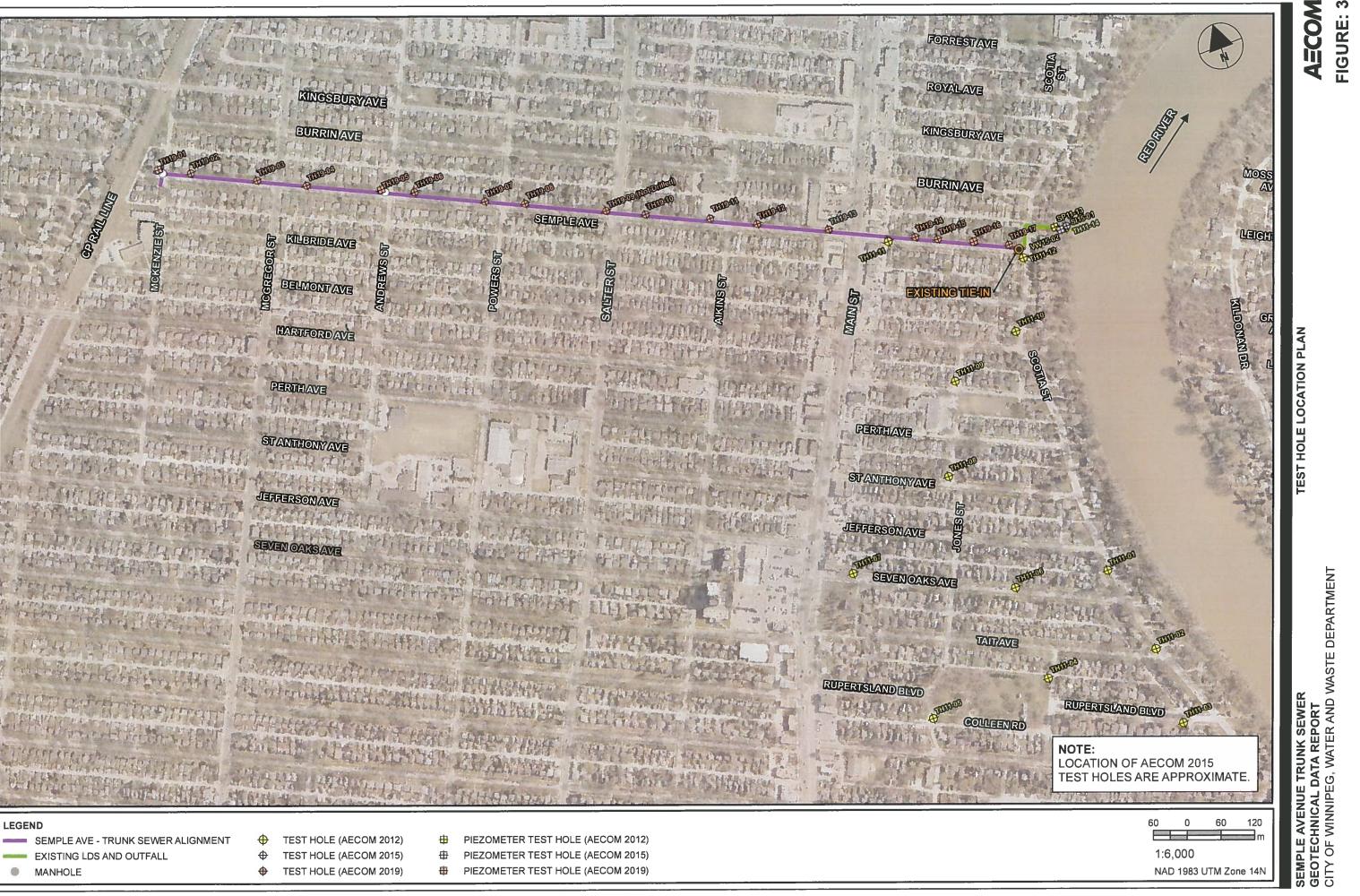
CLAY TO SILTY CLAY CLAYEY TO SANDY SILT

FIGURE: 2 AECOM

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

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

SCALE: NTS





-10-08) ved by: COOPERKL(2019-ne: P:\60599385\900-CAD AECOM 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 TRUNK SEWER



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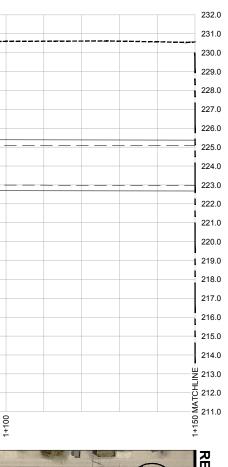
AECOM FIGURE: 4B

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 TRUNK SEWER

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		RE KNOWN ONLY AT THE TEST HOLE LOCATIONS. THE ACTUAL GROUND MATERIALS, CHARACTERISTICS AND VARIABILITY ANTICIPATED WITHIN E	ACH SOIL UNIT ARE PRESENTED IN THE GDR AND GBR. FOR DETAILS OF	THE TEST HOLE LOGS AND GROUNDWATER MEASUREMENTS REFE	R TO GDR.
	NOTE 4: LOCATION OF EXISTING UTILIT	TIES ARE NOT SHOWN. FOR DETAILS ON EXISTING UTILITY LOCATIONS RI	FER TO DRAWINGS/SPECS.		
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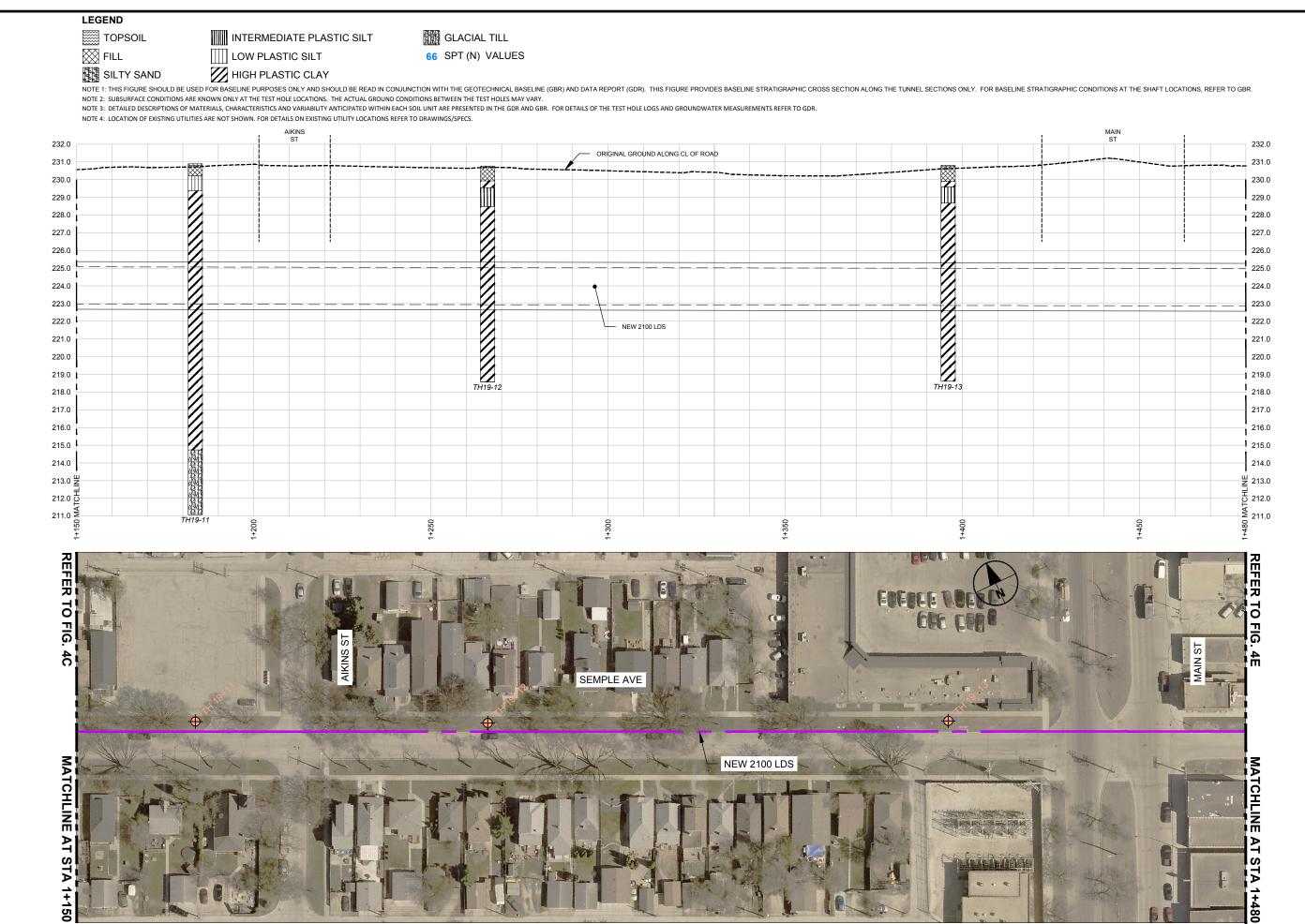




AECOM FIGURE: 4C

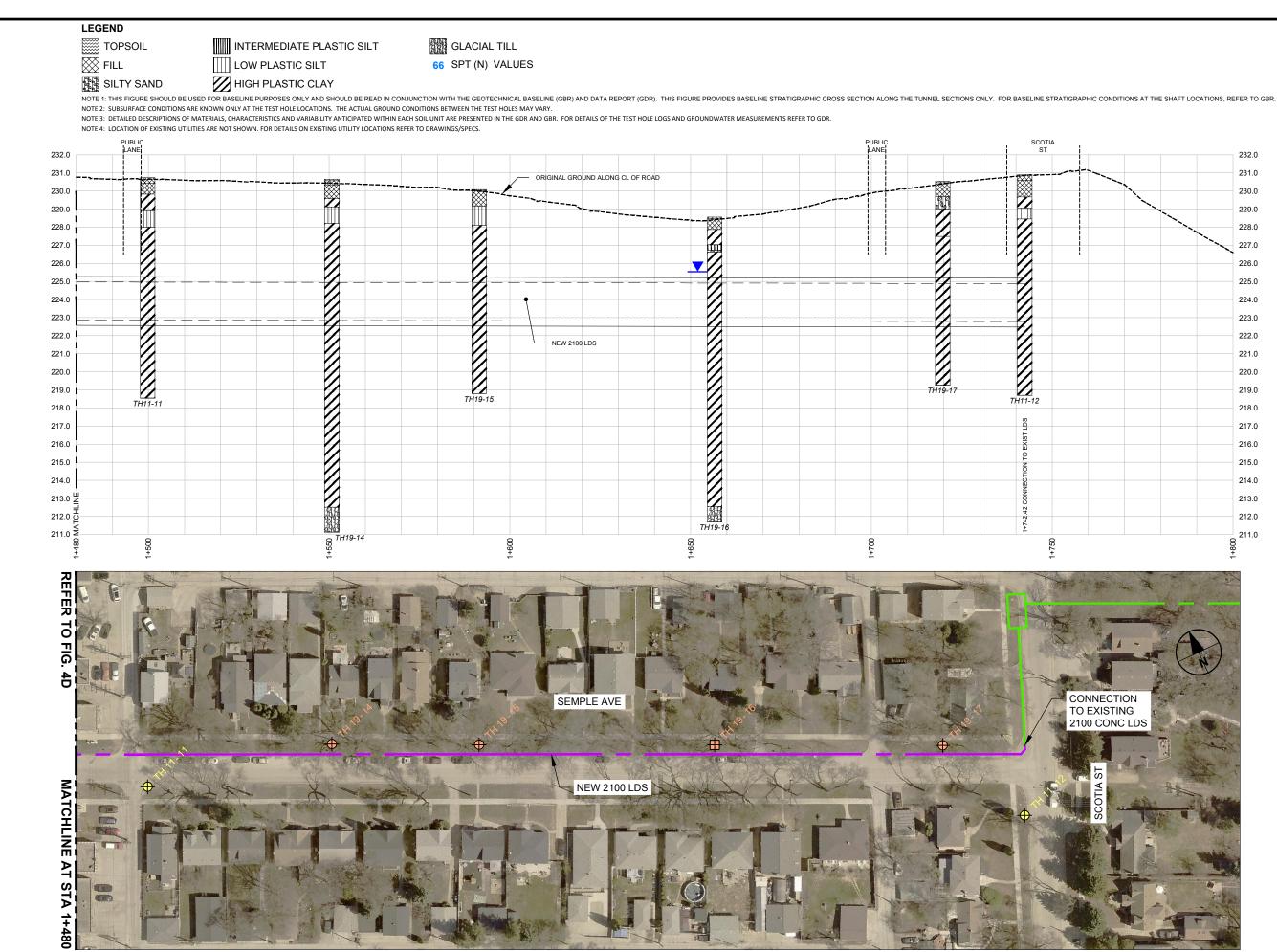
STRATIGRAPHIC SECTION OF SEMPLE AVENUE TRUNK SEWER ALIGNMENT STN 0+830 TO STN 1+150

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



AECOM FIGURE: 4D

SEMPLE AVENUE STRATIGRAPHIC SECTION OF SEMPLI TRUNK SEWER ALIGNMENT STN 1+150 TO STN 1+480 SEMPLE AVENUE TRUNK SEWER GEOTECHNICAL DATA REPORT CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT TRUNK SEWER



AECOM FIGURE: 4E

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

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

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Appendix B

Previous Geotechnical Investigations Test Hole Logs

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

- <u>Standard Penetration Test (SPT) Blow Count</u>. 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.
- SO₄ <u>Water Soluble Sulphate Content</u>. 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 <u>Dry Unit Weight</u>. Usually expressed in kN/m³.
- γ_T <u>Total Unit Weight</u>. Usually expressed in kN/m³.
- Qu <u>Unconfined Compressive Strength</u>. Usually expressed in kPa and may be used in determining allowable bearing capacity of the soil.



- Cu <u>Undrained Shear Strength</u>. 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} <u>Pocket Penetrometer Reading</u>. 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:

Ν	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 1 Cohesive Soils

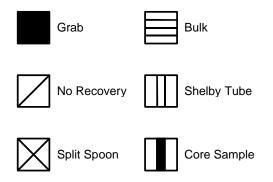
Table 2 Cohesionless Soils

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.

						Performance	e requirements	\$\$,§§
		Water-soluble	Sulphate (SO₄)	Water soluble sulphate (SO ₄) in recycled	Cementing	Maximum er when tested CSA A3004-0 Procedure A	using	Maximum expansion when tested using CSA A3004-C8 Procedure B at 5 °C, % †††
Class of exposure	Degree of exposure	sulphate (SO ₄)† in soil sample, %		aggregate sample, %	materials to be used§††	At 6 months	At 12 months††	At 18 months‡‡
S-1	Very severe	> 2.0	> 10 000	> 2.0	HS** ,HSb, HSLb*** or HSe	0.05	0.10	0.10
S-2	Severe	0.20–2.0	1500-10 000	0.60-2.0	HS**, HSb, HSLb*** or HSe	0.05	0.10	0.10
S-3	Moderate (including seawater exposure*)	0.10-0.20	150–1500	0.20–0.60	MS, MSb, MSe, MSLb***, LH, LHb, HS**, HSb, HSLb*** or HSe	0.10		0.10

Table 3 Requirements for Concrete Subjected to Sulphate Attack*

*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.

++++1f 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.

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

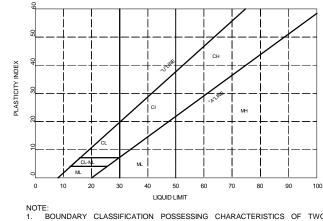
Table 4 Corrosivity Ratings Based on Soil Resistivity

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 ($\mathbf{\nabla}$).



	MAJOR DIVISION		LOG SYMBOLS	UCS	TYPICAL DESCRIPTION	LABORATORY CLA CRITER		
		CLEAN GRAVELS		GW	WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_{u} = \frac{D_{e0}}{D_{10}} > 4 C_{c} = \frac{1}{D_{e0}}$	$\frac{(D_{30})^2}{(10 \times D_{60})^2} = 1 \text{ to } 3$	
VED SOILS COARSE GRAINED SOILS	GRAVELS (MORE THAN HALF COARSE GRAINS	(LITTLE OR NO FINES)		GP	POORLY GRADED GRAVELS AND GRAVEL- SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE	REQUIREMENTS	
o soll	LARGER THAN 4.75 mm)	GRAVELS		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS	ATTERBERG LIMITS BELOW 'A' LINE W _P LESS THAN 4	
AINED		WITH FINES		GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	12%	ATTERBERG LIMITS ABOVE 'A' LINE W _P MORE THAN 7	
E GR/		CLEAN SANDS	0 0 0 0 0 0 0 0 0 0	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_{u} = \frac{D_{60}}{D_{10}} > 6 C_{c} = \frac{D_{c}}{D_{c}}$	$(D_{30})^2 = 1 \text{ to } 3$	
COARSE	SANDS (MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75 mm)	(LITTLE R NO FINES)		SP	POORLY GRADED SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE	REQUIREMENTS	
ö		SANDS		SM	SILTY SANDS, SAND-SILT MIXTURES		ATTERBERG LIMITS BELOW 'A' LINE W _p LESS THAN 4	
		WITH FINES		SC	CLAYEY SANDS, SAND-CLAY MIXTURES	FINES EXCEEDS 12%	ATTERBERG LIMITS ABOVE 'A' LINE W _P MORE THAN 7	
	SILTS (BELOW 'A' LINE	W _L < 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPC PLASTICITY CHART (SEE BELOW)		
ILS	NEGLIGIBLE ORGANIC CONTENT)	W _L > 50		МН	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS			
FINE GRAINED SOILS COARSE GRAINED		W _L < 30		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS			
	CLAYS (ABOVE 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	30 < W _L < 50		CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	WHENEVER THE NATU CONTENT HAS NOT BE IT IS DESIGI BY THE LET	EN DETERMINED, NATED	
9 UE G		$W_L > 50$		СН	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	E.G. SF IS A MIXTURE SILT OR C	OF SAND WITH	
L L	ORGANIC	$W_L < 50$		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY			
	SILTS & CLAYS (BELOW 'A' LINE)	W _L > 50		ОН	ORGANIC CLAYS OF HIGH PLASTICITY			
	HIGHLY ORGANIC S	SOILS		Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR O OFTEN FIBROUS		
	BEDROCK			BR	SEE REPORT DE	SCRIPTION		
	FILL			FILL	SEE REPORT DE	SCRIPTION		



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%

FRACTION		SIEVE S	SIZE (mm)	PERCENTAG	DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS		
		PASSING	RETAINED	PERCENT	IDENTIFIER		
GRAVEL	COARSE	75	19	50.05			
	FINE	19	4.75	50 - 35	AND		
SAND	COARSE	4.75	2.00	05 00	Y SOME		
	MEDIUM	2.00	0.425	35 – 20			
	FINE	0.425	0.080	20 – 10			
SILT (no	n-plastic)			20 - 10			
	or (plastic)	0.	080	10 - 1	TRACE		
		OVERSIZE	MATERIALS				
COBB	DED OR SUB-ROU LES 75 mm TO 200 DULDERS >200 mm) mm		ANGULAR ROCK FRAGMENTS SS > 0.75 m3 IN VOLUME			

MODIFIED UNIFIED SOIL CLASSIFICATION SYSTEM

August 2015

		Jefferson East CSR D&C	CLIEN	IT: C	ity of	Winnipeg				resthole no: TH 11-	
		I: Scotia Street; Between Seven Oaks Boulevard and Jeffe						2.6, 635 379		PROJECT NO.: 602193	
						<u>30, 125 m</u>				ELEVATION (m): 229.1	5
DEPTH (m)	SOIL SYMBOL	YPE GRAB ISHELBY TUBE SOIL DESCRIPTION			● SF 0 2 16 1	PENETRATION * Becker > Dynamic C T (Standard F (Blows/300 0 40 60 Total Unit (kN/m ³) 7 18 19 Plastic MC 0 40 60 0 40 60 1 (Standard F 1 (Standard F 1 (Standard F 1 (Standard F 1 (Standard F) 1 (Standard	I TESTS ** one ◇ Pen Test) ◆ mmi) 0 80 100 Wt ■ 20 21 Liquid	UNDRAINED SHE/ + Torva ∠ QU □ Lab Va △ Pocket I ♥ Field V. (kPa	ne + × ane □ Pen. △ ane •	COMMENTS	
0		TOPSOIL (FILL)				0 40 6	0 80 100				2
·1	Ĭ	CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm intermediate to high plasticity CLAY - silty - brown, moist, firm - intermediate plasticity	ı, /	G 1							2
2		SILT - some clay, trace sand - light brown, moist, soft - low plasticity									2
3 4				G 2							
5		- some sand, trace clay at 4.6 m		G 3		•				· · · · · · · · · · · · · · · · · · ·	
6				G 4		•					
7 8		- some clay, some sand, grey below 6.7 m		G 5		•					
9				G 6					•••••		
10											
11				G 7						· · · · · · · · · · · · · · · · · · ·	:
12		END OF TEST HOLE AT 12.2 m IN SILT Notes: 1. No sloughing observed.		G 8	· · · · · · · · · · · · · · · · · · ·	•				· · · · · · · · · · · · · · · · · · ·	:
13		 No sloughing observed. Seepage observed at 6.4 m below surface. Test hole backfilled with auger cuttings and bentonite pellets. 								· · · · · · · · · · · · ·	
14 15					· · · · · · · · · · · · · · · · · · ·				· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · ·	
										PLETION DEPTH: 12.19 m	ו
		AECOM						aldwin Eymond Toupir		PLETION DATE: 12/12/11 Page	1

		: Jefferson East CSR D&C			ty of Winnipeg	TESTHOLE NO: TH 11-	
		N: Scotia Street at Tait Avenue (UTM: 14 N, 5 532 592.2,		,		PROJECT NO .: 602193	
		CTOR: Paddock Drilling Ltd.			RM-30, 125 mm SSA	ELEVATION (m): 229.06	<u>;</u>
SAMP	'LE T			r SPO			1
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPI F TYPF	SAMPLE #	PENETRATION TESTS		
0	X	TOPSOIL (FILL) CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, fir \intermediate to high plasticity	rm,				
-1		CLAY - trace silt - dark brown, moist, firm - high plasticity		G9	•		2:
2		SILT - clayey, some sand - brown, moist, soft to firm - intermediate plasticity					2
3		- trace clay, soft below 3.7 m		G 10			2
4				G11	•		2
5		SAND - silty, some clay					
6	00000	- brown, moist, loose		G12		Gravel: 0.0%, Sand: 61.5%, Silt: 23.1%, Clay: 15.4%	2
7	a Va	SILT - some clay, some sand - grey, moist, soft to firm - intermediate plasticity		G13	•		
8							2
9				G14	•		2
10				G15	•		
11							
12		- some gravel, wet below 11.9 m END OF TEST HOLE AT 12.2 m IN SILT Notes: 1. No sloughing observed.		G16	•		
13		 Seepage observed at 11.9 m below surface. Test hole backfilled with auger cuttings and bentonite pellets. 					
14 15							
			I	1	LOGGED BY: Stephen I	MPLETION DEPTH: 12.19 m	
		AECOM			REVIEWED BY: Jared E	MPLETION DATE: 12/12/11	

		Jefferson East CSR D&C		NT: C	ity o	f Winnipeg		TESTHOLE NO: TH 11-03		
		: Rupertsland Boulevard; West of Scotia Street (UTM: 1- TOR: Paddock Drilling Ltd.						PROJECT NO.: 60219315		
SAMP		-		HOD: LIT SPO		30, 125 mm SSA			/ATION (m): 227.91	1
AIVIP									CORE	T
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION		SAMPLE I YPE SAMPLE #		PENETRATION TESTS	Pocket Fell 2 Pocket Fell 2	2	COMMENTS	
0	\bigotimes	TOPSOIL (FILL) CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, fil	rm.				· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		
1		∖intermediate to high plasticity CLAY - silty, trace to some sand brown, moist, soft intermediate plasticity 		G17		•				2
2										
3		SILT - trace clay, trace sand - brown, moist, soft - low plasticity		G18						
1				G 19		•				
5		CLAY - silty, trace to some sand - grey, moist, firm		G20						
,		SILT - sandy, trace clay - grey, moist, soft - low to intermediate plasticity								
}				G21						:
)	00000	SAND - silty - brown, moist, loose CLAY - silty		G22		•				:
10		- greý, moist, soft - intermediate plasticity		G23						
1		- some gravel below 11.6 m		G 24		D				:
2		CLAY - some silt, trace sand, grey, moist, firm, high plasticity END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed.		G 25		•				
3		 Seepage observed at 5.5 m below surface. Test hole backfilled with auger cuttings and bentonite pellets. 								
14										
		AECOM			RE	GGED BY: Stephen F VIEWED BY: Jared E OJECT ENGINEER:	Baldwin C		ON DEPTH: 12.19 m ON DATE: 12/12/11 Page	

		Jefferson East CSR D&C		ty of Winnipeg	E 016 0)	TESTHOLE NO: TH 11	
		: Mac Steet; Between Rupertsland Boulevard and Tait . TOR: Paddock Drilling Ltd.			o∠10.∠)	PROJECT NO.: 602193	
	PLE T			RM-30, 125 mm SSA		ELEVATION (m): 228.6 COVERY	ŏ
DEPTH (m)	SOIL SYMBOL		- Щ	ENETRATION TESTS	UNDRAINED SHEAR STRE + Torvane + > QU × □ Lab Vane □ △ Pocket Pen. △ ④ Field Vane ④ (kPa)	COMMENTS	
0		TOPSOIL (FILL) CLAY (FILL) - some silty to silty, trace to some sand - brown, moist, firm - high plasticity			0 50 100 150	0 200	2
2			G 51	•			2
3		CLAY - trace to some silt, trace to some sand	 G 52	•			
4		- brown, moist, stiff to firm - high plasticity	G 53	•	+Δ		
5			G 54		Å	· · · · · · · · · · · · · · · · · · ·	
7		- grey below 6.4 m				· · · · · · · · · · · · · · · · · · ·	
3			G 55	•		· · · · · · · · · · · · · · · · · · ·	
9			G 56	•	<u>م</u>		
10 11 12 13 14		SILT - trace clay - light brown, moist to wet, very soft - low plasticity	 G 57	•		· · · · · · · · · · · · · · · · · · ·	
11		CLAY - silty, trace sand - grey, moist, soft - high plasticity				· · · · · · · · · · · · · · · · · · ·	
3		END OF TEST HOLE AT 12.2 m IN CLAY Notes: 1. No sloughing observed. 2. No seepage observed.	G 58			· · · · · · · · · · · · · · · · · · ·	
4		3. Test hole backfilled with auger cuttings and bentonite pellets.				· · · · · · · · · · · · · · · · · · ·	
15					Poteobo		
		AECOM		LOGGED BY: Stephen REVIEWED BY: Jared		OMPLETION DEPTH: 12.19 m OMPLETION DATE: 12/13/11	1

		Jefferson East CSR D&C : Jones Street at Colleen Road (UTM: 14 N, 5 532 613			ity of	Winnipeg		TESTHOLE NO: TH 11-05		
		TOR: Paddock Drilling Ltd.				20 125 mm 004		PROJECT NO.: 60219315 ELEVATION (m): 229.10		
SAMP				PLIT SPO		30, 125 mm SSA BULK	NO RE			0
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION		SAMPLE TYPE SAMPLE #	◆ SI 0 16 1	PENETRATION TESTS	UNDRAINED SHEAR STR + Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ � Field Vane � (kPa)	ENGTH	COMMENTS	
0	\mathbb{Z}	TOPSOIL (FILL) CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, intermediate to high plasticity CLAY - silty, trace sand - dark grey, moist, firm - high plasticity	firm,							2
2		- brown below 1.5 m								
3		- trace silt, firm to soft below 3.7 m		G27	· · · · · · · · · · · · · · · · · · ·		·+4			
5				G28	· · · · · · · · · · · · · · · · · · ·	•	+			
,		- soft below 6.7 m		G29		•		· · · · · · · · · · · · · · · · · · ·		
}				G30		•				
)				G31	· · · · · · · · · · · · · · · · · · ·	•				
0				G 32	· · · · · · · · · · · · · · · · · · ·	•				
12		END OF TEST HOLE AT 12.2 m IN CLAY		G33	· · · · · · · · · · · · · · · · · · ·					
3		Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.								
4 5								· · · · · · · · · · · · · · · · · · ·		
		AECOM			RE	GGED BY: Stephen I /IEWED BY: Jared E DJECT ENGINEER:	Baldwin C		ION DEPTH: 12.19 m ION DATE: 12/12/11 Page	

		Jefferson East CSR D&C : Seven Oaks Boulevard; Betv	veen Jones Street and S	CLIEN	NT: Ci et (UT	<u>ty of N</u> M: 14	Vinnipeg	2 779.6	635 215	.3)		THOLE NO: TH 11	
		TOR: Paddock Drilling Ltd.), 125 m		000 2 10.	.0)		VATION (m): 230.7	
SAMP		•	SHELBY TUBE				<u>, 120 пп</u> ВI			NO RE			
DEPTH (m)	SOIL SYMBOL	SOIL DES	CRIPTION	SAMDI E TVDE	SAMPLE #	♦ SPT 0 20 1 16 17	Total Unit (kN/m ³) 18 19 stic MC		+ 0 ΔP •	D SHEAR STF Torvane + XQU X Lab Vane D Pocket Pen. 2 Field Vane (kPa) 100 1	2	COMMENTS	
0	\bigotimes	TOPSOIL (FILL) CLAY (FILL) - some silt to silty, track intermediate to high plasticity	e to some sand, brown, moist	i, firm,									2
1	$\overset{\otimes}{\mathcal{D}}$	CLAY - silty, trace sand, brown, moi - high plasticity	st, firm		G42								
2		SILT - trace clay, trace sand - light brown, moist, soft			G 43								2
3		- low plasticity CLAY - some silt to silty, trace sand - brown, moist, firm			G43		•		· · · · · · · · · · · · · · · · · · ·	•••••••••••••••••••••••••••••••••••••••			
1		- high plasticity								· · · · · · · · · · · · · · · · · · ·			:
ō					G45				Δ+				:
6					G 46		e		Δ+-	· · · · · · · · · · · · · · · · · · ·			
7		- soft below 6.7 m											
3					G47		٠		∆+-				
9		- grey below 8.2 m			G48				<u>A</u> +	· · · · · · · · · · · · · · · · · · ·			
10													
11					G49								
12		- trace gravel (<12 mm dia.)			G 50					••••••			
3		END OF TEST HOLE AT 12.2 m IN Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cu					•						
4			.										
15										· · · · · · · · · · · · · · · · · · ·	2 · · · · · · · · · · · · · · · · · · ·		
			4					Stephen I				FION DEPTH: 12.19 m	1
		AECON						': Jared E GINEER:			UNIPLE	FION DATE: 12/13/11 Page	<u> </u>

		Jefferson East CSR D&C					Winnipeg					STHOLE NO: TH 11-	
		: Seven Oaks Boulevard; East	or Iviain Street (UTM: 1									ROJECT NO.: 602193	
		TOR: Paddock Drilling Ltd. YPE GRAB	SHELBY TUBE		<u>HOD:</u> LIT SPO		<u>30, 125 m</u>					EVATION (m): 229.97	1
SAIVIP		IPE GRAB	IIII SHEFRA IORE	<u>N</u> SP		1			10000				
DEPTH (m)	SOIL SYMBOL	SOIL DESC	CRIPTION		SAMPLE TYPE SAMPLE #	♦S 0 16 1	PENETRATION	₩ cone <> Pen Test) ◆ mm) 0 80 0 80 0 20 2 20 2 20	0 11	ED SHEAR S + Torvane + × QU × Lab Vane [Pocket Pen. Field Vane (kPa) 100	- 	COMMENTS	
0		TOPSOIL (FILL) CLAY (FILL) - some silt to silty, trace intermediate to high plasticity	to some sand, brown, moist	i, firm,							· · · · · · · · · · · · · · · · · · ·		2
1		SILT - clayey, trace sand, trace grave - brown, moist, soft	:I		— G34		•-1			· · · · · · · · · · · · · · · · · · ·		Gravel: 0.6%, Sand: 4.6%, Silt: 69.9%, Clay:	
2		- intermediate plasticity CLAY - some silt to silty, trace sand									· · · · · · · · · · · · · · · · · · ·	24.9%	
3		- brown, moist, firm - high plasticty			G35		•				•••••••••••••••••••••••••••••••••••••••		
4		- trace silt below 3.7 m						· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·	••••••••		
5		- soft below 4.6 m			G36								
6					G37		•					· · · · ·	
7										· · · · · · · · · · · · · · · · · · ·	•••••••••••••••••••••••••••••••••••••••		
3					G38							· · · ·	
9					G39								
10							•	· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·		
11				-	G 40	 	•						
10									· · · · · · · · · · · · · · · · · · ·	•••••	· · · · · · · · · · · · · · · · · · ·		
12		END OF TEST HOLE AT 12.2 m IN 0 Notes: 1. No sloughing observed.	CLAY		G41			••••••••••••••••••••••••••••••••••••••					
13		 No seepage observed. Test hole backfilled with auger cutt 	ings and bentonite pellets.							· · · · · · · · · · · · · · · · · · ·	•••••••••••••••••••••••••••••••••••••••		
4										· · · · · · · · · · · · · · · · · · ·	•••••••••••••••••••••••••••••••••••••••		
15			_			LO	GGED BY:	Stephen	Petsche	·····	COMPI	: .ETION DEPTH: 12.19 m	2
		AECON					/IEWED B					ETION DATE: 12/12/11	-

		Jefferson East CSR D&C I: Jones Street at St. Anthony	Avenue (LITM· 14 N 5 5				Winnipeg				THOLE NO: TH 11- JECT NO.: 602193	
		TOR: Paddock Drilling Ltd.					, 30, 125 m	m SSA			/ATION (m): 229.8	
SAMP			SHELBY TUBE		PLIT SPO		<u>ві, 120 ін</u>			NO RE		•
DEPTH (m)	SOIL SYMBOL		CRIPTION		SAMPLE TYPE SAMPLE #	♦ SI 0 : 16 1	PENETRATION		+ 	D SHEAR STR Torvane + XQU X Lab Vane □ ocket Pen. △ field Vane � (kPa) 100 15	COMMENTS	
0-1		TOPSOIL (FILL) CLAY (FILL) - some silt to silty, trac intermediate to high plasticity	e to some sand, brown, moist,	, firm,		· · · · · · · · · · · · · · · · · · ·						22
2		CLAY -some silt to silty, trace sand - brown, moist, stiff - high plasticity			G 77							2
3		- trace silt inclusions (<5 mm dia.),	îrm below 3.0 m		G 78		•					2
4					G79		•		+&			
5		- grey, soft to firm below 4.9 m			G80							
7		- soft below 6.7 m										
3					G81							
9 10					G 82							2
11					G 83		•					2
12		END OF TEST HOLE AT 12.2 m IN	CLAY		— G84	· · · · · · · · · · · · · · · · · · ·	•					2
13		Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cr	uttings and bentonite pellets.			· · · · · · · · · · · · · · · · · · ·						2
14 15												
10	1	AECON	1	1	I	RE	GGED BY: /IEWED BY	7: Jared E	Baldwin	C	TON DEPTH: 12.19 m TON DATE: 12/13/11 Page	1

		Jefferson East CSR D&C	CLIE	NT: C	ity of Winnipeg	TESTHOLE NO: TH 11-09	
		: Jones Street at Hartford Avenue (UTM: 14 N, 5 533 159.				PROJECT NO.: 60219315	5
					RM-30, 125 mm SSA	ELEVATION (m): 228.71	
SAMP		YPE GRAB SHELBY TUBE		LIT SPC	ON BULK N PENETRATION TESTS UNDRAINED SHE ※ Becker ※ + Torva ◇ Dynamic Cone ◇ × QU ◆ SPT (Standard Pen Test) ◆	ine +	
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION		SAMPLE IYPE SAMPLE #	0 20 40 60 80 100 0 20 40 60 80 100 ■ Total Unit Wt ■ (KN/m ³) Chocket Total Unit Wt ■ (KN/m ³) Chocket 16 17 18 19 20 21 Plastic MC Liquid Chocket Chocket 20 40 60 80 100 50 100	a)	i
0		TOPSOIL (FILL) CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm intermediate to high plasticity	I,			······	2
2		CLAY - some silt, trace sand, brown, moist, stiff, high plasticity SILT - clayey, trace to some sand, brown, moist, soft, low to intermedia plasticity	ate	G85 G86			2
3		CLAY - some silt, trace sand, trace silt inclusions (<5 mm dia.) - brown, moist, firm - high plasticity		G 87	• <u>A</u> +		2
4						·····	2
5		- firm to soft below 4.3 m		G 88	•		2
6		- grey below 5.5 m		G89	•		2
7		- soft below 6.7 m				·····	2
8				G 90	•		2
9				G 91	•	·····	2
10						·····	2
11				G 92	•		2
2		END OF TEST HOLE AT 12.2 m IN CLAY		G 93	•		2
3		Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.					:
4							:
15					LOGGED BY: Stephen Petsche	COMPLETION DEPTH: 12.19 m	2
		AECOM			REVIEWED BY: Jared Baldwin PROJECT ENGINEER: Eymond Toupir	COMPLETION DATE: 12/13/11	_

		Jefferson East CSR D&C : Scotia Street at Belmont Av	enue (LITM: 14 N 5 533				Vinnipeg						<u>THOLE NO: TH 11</u> JECT NO.: 602193	
		TOR: Paddock Drilling Ltd.), 125 mi	m 66 V					/ATION (m): 230.6	
SAMP			SHELBY TUBE		LIT SPC		<u>J, 12511∥</u> ⊟BL				NO REO			
DEPTH (m)	SOIL SYMBOL		SCRIPTION		SAMPLE TYPE SAMPLE #	 ◆ SP1 0 20 16 17 	ENETRATION * Becker Dynamic Co (Standard P (Blows/3000 40 6(Total Unit (kN/m ³) 18 19 Istic MC	TESTS # pone Pen Test) ◆ mm) 0 80 100 Wt ■ 20 2' Liquid -	1	+ Torv ×Q □ Lab ' △ Pocke � Field (kF	tU X Vane □ et Pen. △ Vane ● Pa)		COMMENTS	Ĩ
0 -1		TOPSOIL (FILL) CLAY (FILL) - some silt to silty, tra intermediate to high plasticity CLAY - some silt to silty, trace san		, firm,		20				50 10	<u>90 15</u> 1	0 200		2
-2		- high plasticity SILT - trace to some clay, trace sa - light brown, moist, soft			G94 G95									2
3		 low plasticity CLAY - trace to some silt, trace sa brown, moist, firm high plasticity 	nd		G96		•			· · · · · · · · · · · · · · · · · · ·				2
4		- grey, soft below 4.0 m				· · · · · · ·				· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·			2
5					G 97		•		-			· · · · · · · ·		
6					G98		•		Δ					:
7						· · · · · ·				· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·		
}					G99									:
)					G100		•			· · · · · · · · · · · · · · · · · · ·				
10														
11					G101							· · · · · · · · ·		
12		END OF TEST HOLE AT 12.2 m II	NCLAY		G102		•			· · · · · · · · · · · · · · · · · · ·				
3		Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger of	uttings and bentonite pellets.			· · · · · · ·)				
4												· · · · · · · · ·		
15										· · · · · · · · · · · · · · · · · · ·				2
							GED BY:						ION DEPTH: 12.19 n	n
		AECON	71				EWED BY					OMPLET	ION DATE: 12/14/11 Page	

		Jefferson East CSR D&C : Semple Avenue; East of Main Street (UTM: 14 N, 5 533				of Winnipeg			HOLE NO: TH 11-	
									ECT NO.: 602193	
SAMP		TOR: Paddock Drilling Ltd.		<u>HOD:</u> PLIT SPC		-30, 125 mm SSA BULK			ATION (m): 230.74	4
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION		SAMPLE TYPE SAMPLE #		PENETRATION TESTS	UNDRAINED SHEAR STR + Torvane + × QU × Lab Vane □ △ Pocket Pen. △ � Field Vane � (kPa)	ENGTH	COMMENTS	
0		TOPSOIL (FILL) CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, firm intermediate to high plasticity	m,				0 50 100 15	0 200		
1	\mathbb{Z}	CLAY - trace to some silt, trace sand - brown, moist, stiff - high plasticity		G68	· · · · · · · · · · · · · · · · · · ·					
2		SILT - some sand, trace clay - light brown, moist, soft - low plasticity		— G69		•				2
3		CLAY - trace silt to some silt, trace sand - brown, moist, firm to stiff - high plasticity		G70		•				
4		- firm to soft below 4.0 m								
5				G71		•	Δ			
6			-	G72		•	<u>A</u> +			
,		- trace silt inclusions (<5 mm dia.), soft below 7.0 m								
3				G73		•				
9			-	G74		•				
10										
11				G75						
2		END OF TEST HOLE AT 12.2 m IN CLAY		G 76						
3		Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.								
4										
15										
		AECOM			R	OGGED BY: Stephen F EVIEWED BY: Jared B ROJECT ENGINEER: I	Baldwin Co		ON DEPTH: 12.19 m ON DATE: 12/13/11 Page	

001		Jefferson East CSR D&C			ty of Winnipeg		TESTHOLE NO: TH 11	
		: Scotia Street at Semple Avenue (UTM: 14 N, 5 533 32 TOR: Paddock Drilling Ltd.			,		PROJECT NO.: 602193	
	I RAC PLE TY				RM-30, 125 mm SSA		ELEVATION (m): 230.8 COVERY	9
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION		Ц Н Н Н Н	PENETRATION TESTS	UNDRAINED SHEAR STRI + Torvane + × QU × □ Lab Vane □ 00 △ Pocket Pen. △ ♥ Field Vane ♥ 21 (kPa)	COMMENTS	
0		TOPSOIL (FILL) CLAY (FILL) - some silt to silty, trace to some sand, brown, moist, fir intermediate to high plasticity	rm,			00 50 100 15	0 200	
1		CLAY - trace to some silt, trace sand, brown, moist, stiff		0.50			· · · · · · · · · · · · · · · · · · ·	2
2		- high plasticity SILT - trace to some clay, trace sand, light brown, moist, soft - low plasticity		G59 G60			· · · · · · · · · · · · · · · · · · ·	2
3		CLAY - trace to some silt, trace sand - brown, moist, stiff - high plasticity		G 61	•			2
4		- firm below 3.7 m						
ō				G62				
6				G 63	•	Å		:
7		- grey, soft below 6.4 m						
3				G 64				:
)				G65	•	Δ+		:
10		- trace sand, trace gravel (<12 mm dia.) below 9.8 m						:
11				G 66				
12		END OF TEST HOLE AT 12.2 m IN CLAY		G 67	•			:
3		Notes: 1. No sloughing observed. 2. No seepage observed. 3. Test hole backfilled with auger cuttings and bentonite pellets.						
4								
15		AECOM			LOGGED BY: Stepher REVIEWED BY: Jared		OMPLETION DEPTH: 12.19 m OMPLETION DATE: 12/13/11	n n

		rson East CSR D&C					of Win					THOLE NO: SP 11-	
		per Outfall Area; East of Sc	otia Street (UTM: 14 N									DJECT NO.: 602193	
		Paddock Drilling Ltd.						<u>25 mm </u>				VATION (m): 230.58	3
	E TYPE	GRAB					N						
BACKF	ILL TYPE	BENTONITE	GRAVEL	SI	LOUG	H		GRO	UT		NGS	SAND	
DEPTH (m)	SOIL SYMBOL	SOIL DES	SCRIPTION		SAMPLE TYPE	SAMPLE	*	otal Unit Wt (kN/m ³) 8 19 MC Li	♦ Test) ♦ 80 100	Proceed Field Vane € Field Vane (kPa)		COMMENTS	
0		TOPSOIL (FILL) CLAY (FILL) - some silt to silty firm, intermediate to high plast CLAY - trace to some silt	, trace to some sand, brown	n, moist,	-								2
2		- brown, moist, firm - high plasticity SILT - some sand, trace to son - light brown, moist, soft	ne clay			115	•						2
3		- low plasticity CLAY - some silt - brown, moist, firm - high plasticity				117		•		Δ+ 		Gravel: 0.0%, Sand: 0.0%, Silt: 14.6%, Clay:	2
4						• •						85.4%	2
5						119				<u></u> ΤΔ			
5					G	120				+ &			
3	Ţ	- grey below 7.3 m			G	121				Δ+			
)						122		•					
10						123							
11		- trace gravel (<12 mm dia.), se	oft below 10.7 m		G	124							
12					G	125		•					
3					G	126		•					
14 15													:
			I					BY: Ste				TION DEPTH: 19.51 m	
		AECOM	l							Baldwin CC	UNPLE	TION DATE: 12/14/11 Page	_

			ast CSR D&C						/innipeg	1			TE	STHOLE NO: SP 11-	.13
		••		otia Street (UTM: 14 N,										ROJECT NO.: 602193	
	LE TYPE		GRAB			<u>i hol</u> Plit s			<u>, 125 m</u> В	<u>m SSA</u> Ulk			EL RECOVE	EVATION (m): 230.58	3
	FILL TYP		BENTONITE	GRAVEL	· · · · ·	LOUG				ROUT				SAND	
DEPTH (m)	SOIL SYMBOL		SOIL DES	SCRIPTION		SAMPLE TYPE	SAMPLI	♦ SPT (20	Blows/300 40 6 Total Unit (kN/m ³) 18 19 tic MC	₩ cone <> Pen Test) ◆ mm) 0 80 0 80 0 20 2 20 Liquid		IED SHEAR S + Torvane	+ n. Δ	COMMENTS	ELEVATION
_ 15						G	6127	20	40 6	0 80 10	0 50	100	150 20	0	
- 															215 -
17						G	5128 ·	· · · · · · · · · · · · · · · · · · ·	•						
-18		∖interm	ediate plasticity	some sand, grey, moist, soft	, /	-	5129				· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		213 -
-19		SILT (- grey, moist, soft, high p Till) - some clay to claye - brown, moist to wet, co	y, some gravel, trace sand		G	5130	· · · · · · · · · · · · · · · · · · ·						• • • •	212 -
		END C	- low plasticity DF TEST HOLE AT 19.5			- G	5131						•••••••••••••••••••••••••••••••••••••••		211-
20 21		2. No s 3. No s 4. Star	ver auger refusal encour sloughing observed. seepage observed. ndpipe piezometer (SP-1	tered at 19.5 m below surfac 1-13) installed with Casagra ground protective casing insi	nde		•••••••••••••••••••••••••••••••••••••••						· · · · · · · · · · · · · · · · · · ·		210
-22		with lo 5. Tes followe 6. On	ck. t hole backfilled with silic ed by bentonite chips to a	a sand to 18.1 m below surfa	ice		•••								209 -
-23		was of	served and recorded.											4 4 4 4 4 4 4	208 -
-24							•••								207 -
25														· · ·	206
26														· · · ·	205 -
											· · · · · · · · · · · · · · · · · · ·		• • • • • • • • • • • • • • • • • • • •		204 -
														- - - - - -	203 -
29													• • • • • • • • • • • • • • • • • • • •	· · · ·	202 -
															201 -
1										Stephen				ETION DEPTH: 19.51 m	
190-			AECOM	l						I Jared E GINEER:		Toupin	COIVIPL	ETION DATE: 12/14/11 Page	2 of 2

		Jefferson East CSR D&C : Lower Outfall Area; East of Scotia Street (UTM: 14 N, 5				Vinnipeg			STHOLE NO: TH 11-	
), 125 mm SSA			ROJECT NO.: 602193 EVATION (m): 226.96	
						$\blacksquare BULK$	NO			0
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION		ц Т Т Т Т Т Т	PE	NETRATION TESTS	UNDRAINED SHEAR + Torvane × QU × □ Lab Vane • A Pocket Per • Field Vane 1 (kPa)	STRENGTH + D	COMMENTS	Ĩ
0		TOPSOIL (FILL)								
1		SILT - trace to some sand, trace clay, light brown, moist, soft - low plasticity CLAY - some silt, trace sand - brown, moist, firm to stiff - high plasticity		G103					· · · · ·	2
2										2
3				G105		-	***		Gravel: 0.0%, Sand: 2.2%, Silt: 16.8%, Clay: 81.0%	2
5		- trace silt inclusions (<5 mm dia.), grey below 4.6 m		G 107		•	+2			
6				G108		•	-+2			:
7		- trace gravel, (<12 mm dia.), soft below 7.0 m	_	G 109		•				
9		SILT - trace sand, trace gravel (<12 mm dia.) - light brown, moist, soft - low plasticity CLAY - trace silt to some silt, trace sand, trace gravel (<12 mm dia.)		G 110						
10		- grey, moist, soft - high plasticity								:
11				G111						
12				— G112		•				
14	9.9	SILT (Till) - some clay to clayey, some gravel (<12 mm dia.), trace sar	nd	— G113		•				
15		 light brown, moist, soft low to intermediate plasticity 	-		LOG	GED BY: Stephen	Petsche	COMPL	ETION DEPTH: 15.54 m	
		AECOM			REVI	EWED BY: Jared E	Baldwin	COMPL	ETION DATE: 12/14/11 Page	

		Jefferson East CSR D&C				<u>f Winnipe</u>	<u>j</u>				HOLE NO: TH 11-	
		I: Lower Outfall Area; East of Scotia Street (UTM: 14									JECT NO.: 602193	
		TOR: Paddock Drilling Ltd.				- <u>30, 125 m</u>			7		ATION (m): 226.96	<u>}</u>
SAMP		YPE GRAB SHELBY TUBE		LIT SPC	DON	B			NO REC		CORE	
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION		SAMPLE TYPE SAMPLE #	◆ : 0 16	Plastic MC	r ₩ Cone ◇ Pen Test) ♦ 0mm) 60 80 10 t Wt ■	× □ La 0 △ Poc • Fie	orvane + QU × b Vane □ ket Pen. △ Id Vane • kPa)	200	COMMENTS	
15			-	G114	4			<u>u su</u>				\square
-16	0.0	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.										2
17		 4. Test hole backfilled with auger cuttings and bentonite pellets 			• • • •					· · · · · · ·		2
18										· · · · · · · · · · · · · · · · · · ·		2
19							2 · · · · 2 · · · · 2 · · · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		2
20												
21												2
22							5 · · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·			2
23										· · · · · ·		2
24												
25												2
26										· · · · · · · · · · · · · · · · · · ·		2
27										· · · · · · · · · · · · · · · · · · ·		
28									· · · · · · · · · · · · · · · · · · ·			.
29												
30						· · · · · · · · · · · · · · · · · · ·						
		AECOM			RE	GGED BY: VIEWED B	Y: Jared I		CO		ION DEPTH: 15.54 m ION DATE: 12/14/11 Page	

LIQCATION: North of the Proposed Outfail Pipe, 4 m West of Lower Slope CONTRACTOR: Maple Leaf Dailing Lid METHOD: MP5 Track Monited: 125mm SSALHO Bare ELEVATION (m): 227.00 Solution SOLUTING: COLOR INC. 6021931 SOLUTING: 237.00 SOLUTING: 237.0			erson East CSR - Semple				City	of W	innipeg						HOLE NO: SI15-01	5
AMPLE TYPE GRAB III SHELEY TUBE SAUT SPOON BULK III CROUVERY III CORE SACKFUL TYPE BENTONTE GRAVEL III SLOUGH GRAVEL III SLOUGH COMMENTEST SAUNCE SHORE SHARE STRUCTURE SAUNCE SHARE SHARE SHARE STRUCTURE SAUNCE SHARE SHA				Pipe, 4 m west of Lov			⊡. ME	05 Tr	ack Mo	untor	1 125m	m 991/				5
BACKFILL TYPE DENTONITE GRAVEL ISLOUGH COUNTINGS SAND Image: Solid DESCRIPTION Image: Soli			· ·									III 33A			. ,	
USE USE SOIL DESCRIPTION USE USE Participation USE USE Description USE								UN	-				<u> </u>			
Unit Solid DESCRIPTION Unit Solid Office Solid DESCRIPTION Unit Solid Office <	SACKI			GRAVEL				1							SAND	-
0 TOPSOL - black, inclusions (<3 mm dia.)	DEPTH (m)	SOIL SYMBOL	SOIL DES	CRIPTION	SAMPLE TYPE	Щ	SPT (N)	◆ SF 0 : 16 1	 ★ Bec > Dynami > C (Standa (Blows/2) 20 40 ■ Total U (KN) 7 18 Plastic 	cker ic Cone ard Pen 300mm <u>60</u> Jnit Wt /m ³) <u>19</u> IC L	e h Test) ♦ h) 80 100 t ■ 20 2 ² iquid	+ @	· Torvane + × QU × Lab Vane [Pocket Pen. Field Vane 4 (kPa)	 &	COMMENTS	
1 - brown motiled grey, stift, motels 1 - G1 Gravel: 0%, Sand: 6.5%, Stift: 25.5%, Clay: 68.8% - G3 Gravel: 0%, Sand: 6.6%, Stift: 29.5%, Clay: 63.9% G3 2 - G1 Gravel: 0%, Sand: 6.6%, Stift: 29.5%, Clay: 63.9% G3 2 - G1 Gravel: 0%, Sand: 6.6%, Stift: 29.5%, Clay: 63.9% G3 4 - G1 Gravel: 0%, Sand: 6.6%, Stift: 29.5%, Clay: 63.9% G3 5 - G1 Gravel: 0%, Sand: 6.6%, Stift: 29.5%, Clay: 63.9% G3 6 - G1 Gravel: 0%, Sand: 6.6%, Stift: 29.5%, Clay: 63.9% G3 7 - G1 Gravel: 0%, Sand: 6.6%, Stift: 29.5%, Clay: 63.9% G3 3 - G1 Gravel: 0%, Sand: 6.6%, Stift: 29.5%, Clay: 63.9% G3 4 - gravel: 0%, Sand: 0%, Stift: 29.5%, Clay: 63.9% G4 5 - gravel: 0%, Sand: 1, stift industors (-5 mm dia.) G4 6 - gravel: 0%, Sand: 1, stift industors (-5 mm dia.) G4 6 - stift pockets (<50 mm dia.) at 4 m	0		TOPSOIL - black, rootlets, froz	zen					20 40							
1 - G3. Gravet: (%, Sant. 6, %, Sit: 29.5%, Clay: 63.9% G3 2 - G1. Gravet: (%, Sant. 6, %, Sit: 29.5%, Clay: 63.9% G5 - light rays, toose motion - G6 - light rays, toose motion - G6 - light rays, toose motion - G7 - bown motid rays (m, motion) - G7 - bown motid rays (m, motion) - G7 - right pasticity - gray below 2.7 m 6 - Silt pockets (-50 mm dia.) at 4 m 5 - Silt pockets (-50 mm dia.) at 4 m 6 - G14 7 - G14 6 - G14			 brown mottled grey, stiff, mo high plasticity 	ist					•	· · · · · · · · · · · · · · · · · · ·	1					
2 2 3 4 5 6 7 8 9 9 1 1 1 1 1 1 1 1	1			, ona 201070, onaji oolo70												2
2 \\ \n is grained CAY (Lacustine) - some silt silt inclusions (<5 mm dia.) - hown motified grey, fim, most - high plasticly - grey below 2.7 m 6			SILT - trace sand, trace grave											· · · · · · · · · · · · · · · · · · ·		
3 - bign pasticity 3 - grey below 2.7 m 4 - silt pockets (<50 mm dia.) at 4 m	2		\- fine grained	silt inclusions (<5 mm dia)		G5		9 			· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·		
3 - silt pockets (<50 mm dia.) at 4 m			 brown mottled grey, firm, mo 	ist		G6			٠							
4 - silt pockets (<50 mm dia.) at 4 m	3		- grey below 2.7 m			G7			•	• • • • • • • •						
						G8			•	· · · · · · · · · · · · · · · · · · ·						
	4		- silt pockets (<50 mm dia.) at	4 m		G10										
										· · · · · · · · · · · · · · · · · · ·		·····		•		
	5					T11			·•							:
$\mathbf{G}_{\mathbf{G}_}\mathbf{G}_{\mathbf{G}_{\mathbf{G}_{\mathbf{G}}_{\mathbf{G}_{\mathbf{G}_{\mathbf{G}_{\mathbf{G}_{\mathbf{G}_{G$						G12			•	•••••••••	•••			·		
	6												· · · · · · · · · · · · · · · · · · ·			:
8 G19 G19						G14			•							
8 G19 G19	7												· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		
G19 G19						G16			•				· · · · · · · · · · · · · · · · · · ·			
G19 G19									·····							
	3					010										
						G19				•••••			· · · · · · · · · · · · · · · · · · ·			
	9		- very soft trace to some silt h	alow 9.1 m		G21					· · · · · · · · · · · · · · · · · · ·					:
			- very sort, indue to sorrie still D	UUUW J. I III		021				••••••••••••••••••••••••••••••••••••••	• • • • • • • • • • • •	<u></u>				
	10															
AECOM LOGGED BY: Mustafa Alkiki COMPLETION DEPTH: 22.61 m REVIEWED BY: Zeyad Shukri COMPLETION DATE: 2/24/15																1

PROJECT: Jefferson East CSR - Semple Outfall LOCATION: North of the Proposed Outfall Pipe, 4 m West of Lo						, , , ,								HOLE NO: SI15-01 IECT NO.: 6021931			
			Maple Leaf Drilling Ltd.				D: MF	25 Ti	rack N	lounte	ed-125r	nm S	SA/H	Q Barr	el ELEV	ATION (m): 227.00	
						SPL	LIT SPC	ON		BU	LK			NOR	ECOVER	Y CORE	
BACKFILL TYPE BENTONITE GRAVEL				GRAVEL		SLC	DUGH		[GR	OUT				INGS	SAND	
DEPTH (m)	SOIL SYMBOL	SLUFE INCLINOMETER	SOIL DESCRIPTION			SAMPLE #	SPT (N)	♦ S 0 16	PENETRATION TESTS		10 11	□ Lab Vane □ □ △ Pocket Pen. △ ◆ Field Vane ◆ 1 (kPa)		COMMENTS			
10		11							20 40				50	100	150 200		
11						G23	;	· · · · · · · · · · · · · · · · · · ·		•							2
12						G25	;			•							
						G27	,			•							
13						G29				•							:
14																	:
15						G31			•								:
16			SILT (Till) - some clay, some s dia., subangular) - brown, compact, moist to wet - low plasticity												·····		
	00000 00000 00000		ion processi			G33				•					· · · · · · · · · · · · · · · · · · ·		
17	000000 0000000000000000000000000000000		- very dense below 17.4 m														
18	000000 0000000000000000000000000000000														· · · · · · · · · · · · · · · · · · ·		
9																	
20								10	GGFD	BY∙ №	Mustafa	Alkiki				TION DEPTH: 22.61 r	
	AECOM								VIEWE	D BY:	Zeyad	Shukr		(TION DATE: 2/24/15 Page	

PROJECT: Jefferson East CSR - Semple Outfall								City	of Winnipeg		TESTHOLE NO: SI15-01		
	LOCATION: North of the Proposed Outfall Pipe, 4 m West of Low										PROJECT NO.: 60219315		
	CONTRACTOR: Maple Leaf Drilling Ltd.							J: MF			Barrel ELEVATION (m): 227.00		
	MMPLE TYPE GRAB Shelby Tube ACKFILL TYPE BENTONITE GRAVEL				-								
DEPTH (m)		SOIL DESCRIPTION			SAMPLE TYPE SAMPLE # SPT (N)			PENETRATION TESTS	UNDRAINED SHEAR + Torvane × QU × □ Lab Vane △ Pocket Per � Field Vane (kPa)	STRENGTH + 	COMMENTS		
JEFFERSON CSR SEMPLE OUTFALL_TEST HOLE LOGS_REV 02.GPJ UMA WINN.GDT 10/26/15 7			Installed slope inc	E AT 22.61 sal at 17.4 i arrel below erved durin d at 9 and clinometer (m below grade. • 17.4 m. g drilling. 12.8 m below grade.								206 205 204 203 202 201 200 199 198
			A = 0	~ **					LOGGED BY: Mustafa A			ETION DEPTH: 22.61 m	
ð g	AECOM								REVIEWED BY: Zeyad	COMPLETION DATE: 2/24/15			
2									PROJECT ENGINEER:	⊢ymond Toupin		Page	3 of 3

LOCATION: South of the Proposed Outfall Pipe, 15 m West of Lover Stope Image: Contractors. Maple Leaf Drilling Ld. METHOD: MP5 Track Mounted-125mm SSAHDe Barrol BACKFILL TYPE Image: Contractors. Maple Leaf Drilling Ld. Image: Contractors. Maple Leaf Drilling Ld. METHOD: MP5 Track Mounted-125mm SSAHDe Barrol BACKFILL TYPE Image: Contractors. Maple Leaf Drilling Ld. BACKFILL TYPE Image: Contractors. Maple Law Drilling Ld. Image: Contractors. Drilling Ld. SOIL DESCRIPTION Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. TOPSOIL - black. motiets. frozen Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. 1 Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. 2 Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. Image: Contractors. Drilling Ld. 2 Image: Contractors. Driling Ld. Image: Contractors. Drilling Ld. <	TESTHOLE NO: VW15-02 PROJECT NO.: 60219315
SAMPLE TYPE GRAB GRAB SHELPY TUBE SPLIT SPOON BULK ON RECC SACKFILL TYPE BENTONTE CAAVEL CAA	
SACKFILL TYPE DENTONITE GRAVEL Image: Source of the second	. ,
Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description Image: Solid Description<	
0 IOPSOIL - black, rootlets, frozen 1 CLAY - sity, some sand -hoyn plasticity G35 1 SILT - sandy - brown, locke, moist - fine grained - CLAY - sity, some sand, sit inclusions (<5 mm dia.) - G36 2 CLAY - sity, some sand, sit inclusions (<5 mm dia.) - brown moist - brown moist - fine grained - G36 2 CLAY - sity, some sand, sit inclusions (<5 mm dia.) - brown moist - brown moist - brown moist - clay - sit, sit inclusions (<5 mm dia.) 3 - brown moist - brown moist - clay - sit, sit inclusions (<5 mm dia.) 3 - brown moist - brown moist - brown moist - sity plasticity - grey below 2.4 m - brown moist - sity plasticity - grey below 2.4 m - very soft below 7.6 m	COMMENTS
6 7 - very soft below 7.6 m	
7 - very soft below 7.6 m	
	·····
9	
	MPLETION DEPTH: 12.50 m MPLETION DATE: 2/24/15

				East CSR - Semple (of W	innipeg				HOLE NO: VW15-0	
					Pipe, 15 m West of L						405	004/00 5		ECT NO.: 6021931	5
			Mapl	e Leaf Drilling Ltd.							125m			ATION (m): 227.00	
SAMPLE TYPE GRAB SHELBY TUBE								IT SPC	ON				ECOVERY		
SACK		IYPE		BENTONITE	GRAVEL	Ш	∐SLC	DUGH	<u> </u>					SAND	
b DEPTH (m)	SOIL SYMBOL	VW PIEZOMETER	VW PIEZOMETER	SOIL DES	SCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 2 16 1 F	■ Total Unit Wt (kN/m ³) 7 18 19 2 Plastic MC Liqu	⇒ ⁻ est) ◆ 80 100 100 20 21			COMMENTS	
10															
-11 -12															2 [.]
-13				END OF TEST HOLE A (Lacustrine) Notes:											2
·14				 No sloughing observed Seepage observed ay Squeexing below 8.3 Installed VW15-02 an 5.8 and 12 m, respectivil Test hole backfilled w depth). 	[,] 9.6 m below grade. m d VW15-03 in test hole at y.	t									2
15															2
16															2
17															2
18															2
19															2
20												· · · · · · · · · · · · · · · · · · ·			
<u>_</u> V				AECOM		1	1		RE۱	GGED BY: Mus /IEWED BY: Z	eyad S			TION DEPTH: 12.50 n TION DATE: 2/24/15 Page	

ΑΞϹΟΜ

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:

- <u>Standard Penetration Test (SPT) Blow Count</u>. 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.
- SO₄ <u>Water Soluble Sulphate Content</u>. 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 <u>Dry Unit Weight</u>. Usually expressed in kN/m³.
- γ_T <u>Total Unit Weight</u>. Usually expressed in kN/m³.
- Qu <u>Unconfined Compressive Strength</u>. Usually expressed in kPa and may be used in determining allowable bearing capacity of the soil.



- Cu <u>Undrained Shear Strength</u>. 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} <u>Pocket Penetrometer Reading</u>. 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:

Ν	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 1 Cohesive Soils

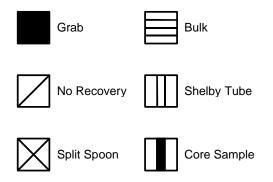
Table 2 Cohesionless Soils

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.

						Performance	e requirements	\$\$,§§
		Water-soluble	Sulphate (SO₄)	Water soluble sulphate (SO ₄) in recycled	Cementing	Maximum er when tested CSA A3004-0 Procedure A	using	Maximum expansion when tested using CSA A3004-C8 Procedure B at 5 °C, % †††
Class of exposure	Degree of exposure	sulphate (SO ₄)† in soil sample, %	in groundwater samples, mg/L‡	aggregate sample, %	materials to be used§††	At 6 months	At 12 months††	At 18 months‡‡
S-1	Very severe	> 2.0	> 10 000	> 2.0	HS** ,HSb, HSLb*** or HSe	0.05	0.10	0.10
S-2	Severe	0.20–2.0	1500-10 000	0.60-2.0	HS**, HSb, HSLb*** or HSe	0.05	0.10	0.10
S-3	Moderate (including seawater exposure*)	0.10-0.20	150–1500	0.20–0.60	MS, MSb, MSe, MSLb***, LH, LHb, HS**, HSb, HSLb*** or HSe	0.10		0.10

Table 3 Requirements for Concrete Subjected to Sulphate Attack*

*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.

++++1f 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.

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

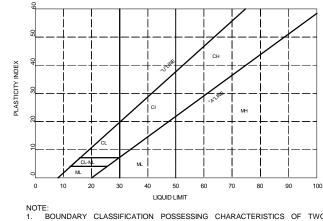
Table 4 Corrosivity Ratings Based on Soil Resistivity

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 ($\mathbf{\nabla}$).



	MAJOR DIVISION		LOG SYMBOLS	UCS	TYPICAL DESCRIPTION	LABORATORY CLA CRITER	
		CLEAN GRAVELS		GW	WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_{u} = \frac{D_{e0}}{D_{10}} > 4 C_{c} = \frac{1}{D_{e0}}$	$\frac{(D_{30})^2}{(10 \times D_{60})^2} = 1 \text{ to } 3$
လု	GRAVELS (MORE THAN HALF COARSE GRAINS	(LITTLE OR NO FINES)		GP	POORLY GRADED GRAVELS AND GRAVEL- SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE	REQUIREMENTS
SOILS	LARGER THAN 4.75 mm)	GRAVELS		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS	ATTERBERG LIMITS BELOW 'A' LINE W _P LESS THAN 4
AINED		WITH FINES		GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	12%	ATTERBERG LIMITS ABOVE 'A' LINE W _P MORE THAN 7
COARSE GRAINED		CLEAN SANDS	0 0 0 0 0 0 0 0 0 0	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_{u} = \frac{D_{60}}{D_{10}} > 6 C_{c} = \frac{D_{c}}{D_{c}}$	$(D_{30})^2 = 1 \text{ to } 3$
DARS	SANDS (MORE THAN HALF	(LITTLE R NO FINES)		SP	POORLY GRADED SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE	REQUIREMENTS
ö	COARSE GRAINS SMALLER THAN 4.75 mm)	SANDS		SM	SILTY SANDS, SAND-SILT MIXTURES		ATTERBERG LIMITS BELOW 'A' LINE W _p LESS THAN 4
		WITH FINES		SC	CLAYEY SANDS, SAND-CLAY MIXTURES	FINES EXCEEDS 12%	ATTERBERG LIMITS ABOVE 'A' LINE W _P MORE THAN 7
	SILTS (BELOW 'A' LINE	W _L < 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS PLASTICITY (SEE BEL	CHART
ILS	NEGLIGIBLE ORGANIC CONTENT)	W _L > 50		МН	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS		
GRAINED SOILS		W _L < 30		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS		
RAINE	CLAYS (ABOVE 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	30 < W _L < 50		CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	WHENEVER THE NATU CONTENT HAS NOT BE IT IS DESIGI BY THE LET	EN DETERMINED, NATED
FINE G		$W_L > 50$		СН	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	E.G. SF IS A MIXTURE SILT OR C	OF SAND WITH
L L	ORGANIC	$W_L < 50$		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
	SILTS & CLAYS (BELOW 'A' LINE)	W _L > 50		ОН	ORGANIC CLAYS OF HIGH PLASTICITY		
	HIGHLY ORGANIC S	SOILS		Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR O OFTEN FIBROUS	
	BEDROCK			BR	SEE REPORT DE	SCRIPTION	
	FILL			FILL	SEE REPORT DE	SCRIPTION	



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%

FRAG	CTION	SIEVE S	SIZE (mm)	DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS					
		PASSING	RETAINED	PERCENT	IDENTIFIER				
GRAVEL	COARSE	75	19	50.05					
	FINE	19	4.75	50 - 35	AND				
SAND	SAND COARSE		2.00	05 00	V				
	MEDIUM	2.00	0.425	35 – 20	SOME				
	FINE	0.425	0.080	20 – 10					
SILT (no	n-plastic)			20 - 10					
	or (plastic)	0.	080	10 - 1	TRACE				
		OVERSIZE	MATERIALS						
COBB	DED OR SUB-ROU LES 75 mm TO 200 DULDERS >200 mm) mm		ANGULAR ROCK FRAGMENTS KS > 0.75 m3 IN VOLUME					

MODIFIED UNIFIED SOIL CLASSIFICATION SYSTEM

August 2015

			erson East CSR Works ((VI 14 - 5533995 m N, 634		C	CLIE	NT: C	City o	f Winni	peg	WWD					ESTHOLE NO: TH19-	
			Maple Leaf Drilling	TUJU III Ľ	N	אביי	יחטר	Cor	torra (יר ד	50 10	5 mm	CC 1			ROJECT NO.: 605993 LEVATION (m): 231.1	
SAMF			GRAB	SHELBY TUBE			<u>10D:</u> .IT SP(terra C	BUI		5 mm	<u>55A</u>	1 _{NO 5}	RECOV		I
		TYPE		GRAVEL	_	_	DUGH	501		GR				_	TINGS	SAND	
DEPTH (m)		SLOTTED PIEZOMETER	SOIL DES		SAMPLE TYPE	E #	SPT (N)	◆ SI 0 16 1	PENETRAT * Be Opnam T (Standa (Blows/ 20 40 Total (kN 7 18	ClON T cker ¥ iic Cor ard Pe 300m 60 Unit W //m ³) 19	ESTS € ne � n Test) ♠ m) <u>80</u> 10	0	INED SH + Tor × Q □ Lab △ Pock ♥ Field	HEAR S rvane RU/2 X Vane [et Pen.	TRENGT - - -		
0	2223		TOPSOIL - black, moist						20 40	60	80 10	0	50 1	100	150 20	00	<u> </u>
1			CLAY (Fill) - silty, some sand - dark grey, firm, moist - high plasticity - light brown below 0.6 m SILT - sandy, some clay - light brown, moist - low plasticity CLAY - silty, some sand	, trace gravel		G1A G1											2
2			 dark brown, firm, moist high plasticity CLAY (Lacustrine) - some sil brown mottled grey, firm to sill plasticity trace silt inclusions (<15 mm) 	stiff, moist													2
3						T2						×	<u>-</u>			Tube Recovery: 100%	2
5						G3						· · · · · · · · · · · · · · · · · · ·					
5			- grey below 6.1 m			G4											:
8						T5						· · · · · · · · · · · · · · · · · · ·	+2			 Tube Recovery: 100%	2
9						G6						· · · · · · · · · · · · · · · · · · ·					2
10			AECON	<u></u>					GGED E VIEWEI				du			2LETION DEPTH: 15.01 2LETION DATE: 6/27/19	m
				71					OJECT						SOIVIP	Page	1 /

			rson East CSR Works (C И 14 - 5533995 m N, 634		C	LIEN	NT: C	city o	f Winr	ipeg	g W\	WD					STHOLE NO: TH19- ROJECT NO.: 605993	
			Maple Leaf Drilling		N	1ETH	HOD:	Can	terra (CT-2	250 -	- 125	mm	SSA			.EVATION (m): 231.1	
SAMP			GRAB	SHELBY TUBE			IT SPC			BL		120			NO R	ECOVE		
		TYPE		GRAVEL		-	UGH				ROU	Г			CUTT		SAND	
DEPTH (m)	SOIL SYMBOL	SLOTTED PIEZOMETER	SOIL DESC	CRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 2 16 1	 ◇ Dynai PT (Stand (Blows) 20 40 ■ Total (k) 7 18 	ecker nic Co lard P s/300r 60	¥ one ≎ Pen Te mm)) 8 Wt ∎ 2(2	est) ♦ 0 100		+ Tor X Q □ Lab △ Pocke ♥ Field (k	vane + U/2 X Vane ⊑ et Pen I Vane € Pa)	Δ	COMMENTS	
10													•••••					2
11			- trace gravel, trace to some s diam.) below 10.7 m	ilt till inclusions (<10 mm		G7											· · · · ·	2
12			SILT and SAND (Till) - clayey - light brown, moist	, trace to some gravel		т8			•				···· 🛆	-			Tube Recovery: 100%	2
13	000000000000000000000000000000000000000		- iigiit brown, inoist			-							· · · · · · · · · · · · · · · · · · ·					2
14	00000000000000000000000000000000000000		- some clay, very dense, dry t	o moist below 13.7 m		S9	59										SPT Blows: [9/30/29], Spoon Recovery: 83%	2
15			END OF TEST HOLE AT 15.0	01 m IN TILL (SPT		S10	50/ 76mm	 				>> (· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	·····	SPT Blows: [50 (76 mm)], Spoon Recovery:	2
16 17			REFUSAL) Notes: 1. Seepage observed below 1 2. Sloughing observed below 4. Test hole open to 13.4 m up 5. Auger refusal at 14.9 m in s 6. Test hole backfilled with sa bentonite from 11.3 m to 10.4 10.4 m to 0.6 m, and sand fro Flush-mount cover installed. 7. Groundwater monitoring: - August 6, 2019 at elev. 22 - August 20, 2019 at elev. 22 - September 3, 2019 at elev.	13.4 m during augering. pon completion of augering. sand (till). nd from 13.4 m to 11.3 m, m, auger cuttings from m 0.6 m to 0.3 m. 26.98 m (4.13 m bgs) 226.90 m (4.21 m bgs)														2
18													· · · · · · · · · · · · · · · · · · ·					2
19 20																		2
				A										41/			ETION DEPTH: 15.01	m
			AECOA	71					/IEWE						(JUIVIPL	ETION DATE: 6/27/19 Page	2

		Jefferson East CSR Works (C		C	CLIEN	NT: C	ity o	f Win	nipe	g W	WD						STHOLE NO: TH19-	
		I: UTM 14 - 5533973 m N, 634	084 m E													PROJECT NO.: 60599385		
		TOR: Maple Leaf Drilling				IOD:					mm	SSA		7			EVATION (m): 231.2	8
SAMF	PLET	YPE GRAB	SHELBY TUBE		SPL	IT SPO			В								RY CORE	
DEPTH (m)	SOIL SYMBOL	SOIL DESCF	RIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 2 16 1 F	 ◇ Dyna ◇ T (Star (Blow ○ 40 Tota (1) 7 18 Plastic 	Becker amic C ndard vs/300 0 6 al Unit kN/m ³	r ¥ Cone < Pen T Imm) i0 { Wt) 9 2 Liqu	> est) ◆ 30 100	1	+ To	HEAR S orvane - QU/2 X b Vane ket Pen Id Vane kPa) 100	+ 	200	COMMENTS	
0		TOPSOIL - black, moist CLAY (Fill) - silty, some sand, trace - dark grey, firm, moist, high plasticit SAND - silty, trace clay - light brown, moist	gravel, trace roots y	Л Л	G16A				· · · · · · · · · · · · · · · · · · ·									2
1	0000	CLAY - silty, some sand - dark brown, firm, moist			G16			•	· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·						2
2		- high plasticity CLAY (Lacustrine) - some silt to silty - brown mottled grey, firm, moist - high plasticity - trace silt inclusions (<15 mm diam.)	, i i i i i i i i i i i i i i i i i i i						· · · · · · · · · · · · · · · · · · ·									
3					G17				•									
4					0.55													
ō		- grey below 4.6 m			G18							· · · · · · · · · · · · · · · · · · ·						
6		- silty, some sand, stiff below 6.1 m							· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·						
7					T19		· · · · H		•				₩∆				Tube Recovery: 100%, (T19) Gravel: 2.0%, Sand: 19.0%, Silt: 35.0%, Clay: 44.0%, Swell: (3.1%, 120 kPa)	
R					G20				•									
,									· · · · · · · · · · · · · · · · · · ·									
)					G21			C										
10								· · · · · ·	· · · · · ·	· · · · ·				· · · · · · · · · · · · · · · · · · ·				
					1	1		GGED									ETION DEPTH: 12.19 r	n
		AECON	Л									Alobai	dv		CO	MPL	ETION DATE: 6/25/19	

CATION: UTM 14 - 5533973 m N, 634084 m E				ty of Winnipeg WWD TESTHOLE NO: 1	
				PROJECT NO.: 6	
NTRACTOR: Maple Leaf Drilling				Acker MP-5 - 125 mm SSA ELEVATION (m):	
MPLE TYPE GRAB SHELBY TUBE		(JSPL T	IT SPC		
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 t(k1/m ³) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100 50 100 150 200 EVENTS UNDRAINED SHEAR STRENGTH + Torvane + × QU/2 × □ Lab Vane □ △ Pocket Pen. △ ♥ Field Vane ♥ (kPa)	S
- trace silt till inclusions (<15 mm diam.) below 10.7 m		G22		•	2
					2
END OF TEST HOLE AT 12.19 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering.		G23			2
 Test hole backfilled with auger cuttings and bentonite upo completion. 	in				2
					2
					2
					2
				LOGGED BY: Ryan Harras COMPLETION DEPTH:	12 19 m
AECOM				REVIEWED BY: Faris Alobaidy COMPLETION DATE: 6/ PROJECT ENGINEER: Jordan T.	

		Jefferson East CSR Works (Contract 5) : UTM 14 - 5533922 m N, 634193 m E	C	LIEN	IT: C	ity o	Winnipe	eg W	WD				ESTHOLE NO: TH19- ROJECT NO.: 605993	
		FOR: Maple Leaf Drilling	Ν/	ГТГ	ים0ו	Ack	n MD F	175	mm	122			LEVATION (m): 231.5	
	PLE T	· · · · · · · · · · · · · · · · · · ·			IOD: IT SPO		<u>r MP-5</u> ₽		111(1)	SSA		RECOV)Z
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	F ◆ SF 0 2 16 1 F	ENETRATIO * Becke Opnamic 1 T (Standard (Blows/30 0 40 Total Uni (kN/m 7 18 1 lastic MC	N TEST er ¥ Cone Pen To 0mm) 60 £ it Wt ∎ 3) [9 2 Liqu	> est) ♦ <u>30 100</u> 0 21	[ED SHEAR + Torvane X QU/2 3 Lab Van Pocket Pe Field Var (kPa)	: STRENG → + × e □ en. Δ ne Đ	COMMENTS	
0		TOPSOIL - black, moist	-				0 40	60 8	80 100	50	100	150 2		
1		SILT (Fill) - sandy, some clay - light brown, moist - low plasticity CLAY - silty, some sand												2
2		- dark brown, firm, moist - high plasticity CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)		G24			•							2
8				G25			•						· · · · · · · · · · · · · · · · · · ·	
		- grey below 4.0 m												
i				G26			¢							
				G27			•							
				G28			•							
0		- trace gravel, firm, trace silt till inclusions (<25 mm diam.) below 9.1 m		T29						**			Tube Recovery: 100%	
		AECOM									,		PLETION DEPTH: 12.19	m
		AELUMI					VIEWED E						PLETION DATE: 6/25/19 Page	1

	Jefferson East CSR Works (Coll : UTM 14 - 5533922 m N, 63419		C	LIEN	IT: C	ity of Winnipeg WWD TESTHOLE NO: TH19- PROJECT NO.: 605993	
	TOR: Maple Leaf Drilling	/J III L	N/	FTH	חח	Acker MP-5 - 125 mm SSA ELEVATION (m): 231.5	
SAMPLE T	· · ·	SHELBY TUBE		SPLI	T SPC		~
DEPTH (m) SolL SYMBOL	SOIL DESCRI	PTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS JNDRAINED SHEAR STRENGTH ★ Becker # + Torvane + ◆ Dynamic Cone ◇ × QU/2 × (Blows/300mm) □ Lab Vane □ 0 20 40 60 80 100 Total Unit Wi ■ △ Pocket Pen. △ ◆ Field Vane ● (kPa) COMMENTS 16 17 18 19 20 21 (kPa)	i
11				G30			2
13	END OF TEST HOLE AT 12.19 m IN C Notes: 1. Seepage not observed during augeri 2. Sloughing not observed during auge 3. Test hole backfilled with auger cuttin completion.	ng. ring.		G31			2
14							
15							
16 17							2
18							2
19							
20		•				LOGGED BY: Ryan Harras COMPLETION DEPTH: 12.19	m 2
	AECOM					REVIEWED BY: Faris AlobaidyCOMPLETION DATE: 6/25/19PROJECT ENGINEER: Jordan T.Page	

		Jefferson East CSR Works (C		С	LIEN	IT: C	ity of	Winni	peg \	NWD				ESTHOLE NO: TH19	
		: UTM 14 - 5533885 m N, 634	272 m E											ROJECT NO.: 60599	
		TOR: Maple Leaf Drilling						r MP-			SSA			LEVATION (m): 231.	54
AMF	PLE T	YPE GRAB	SHELBY TUBE		1 _{Sbr}	IT SPO	1		BULI		1		RECOV		
DEPTH (m)	SOIL SYMBOL	SOIL DESCR	RIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SP ⁻ 0 20 16 17	Dynam (Standa (Blows/ 40 Total (kN 18 astic N	cker X iic Cone ard Pen 300mm 60 Unit Wt //m ³) 19	e ♦ Test) ♦) 80 100	<u>0</u>	NED SHEAR + Torvane X QU/2 : □ Lab Van △ Pocket Pe ◆ Field Var (kPa) 0 100	e + × e □ en. Δ	COMMENTS	
0		TOPSOIL - black, moist CLAY (Fill) - silty, some sand, trace g	aravel trace roots	7								· · · · · · · · · · · · · · · · · · ·			
		 dark grey, firm, moist intermediate to high plasticity 												· · · · · · · · · · · · · · · · · · ·	2
1		SILT - sandy, some clay _ light brown, moist, low plasticity			G32A)						•••	
		CLAY - silty, some sand - dark brown, firm to stiff, moist - high plasticity			G32			•		•••				· · · · · · · · · · · · · · · · · · ·	2
2		CLAY (Lacustrine) - some silt, trace : - brown mottled grey, firm, moist - high plasticity - trace silt inclusions (<15 mm diam.)												· · · · · · · · · · · · · · · · · · ·	
3					G33									· · · · · · · · · · · · · · · · · · ·	4
											· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·	:
1					G34))		· · · · · · · · · · · · · · · · · · ·				
ō														· · · · · · · · · · · · · · · · · · ·	
5					G35				•	•••	•			··· ··· ···	:
		- grey below 6.1 m												· · · · · · · · · · · · · · · · · · ·	:
1											· · · · · · · · · · · · · · · · · · ·			· • · • · •	
3				/	T36				•••••••••••••••••••••••••••••••••••••••					··· ··· ··· Tube Recovery: 0%	
														· · · · · · · · · · · · · · · · · · ·	
)					G37			•						· · · · · · ·	
0									· · · · · · · · · · · · · · · · · · ·					· · · · · · ·	:
<u> </u>				I				GED E					-	PLETION DEPTH: 12.19	
		AECON	Л							Faris / NEER:	Alobaic		COMF	PLETION DATE: 6/25/19 Page)

DONTEACTOR: Magic Let/Dilling Internetion Let/DOI: Let/DIII Let/DI		Jefferson East CSR Works (Contract 5) UTM 14 - 5533885 m N, 634272 m E	C	LIEN	IT: C	ity of Winnipeg WWD	TESTHOLE NO: TH19-04 PROJECT NO.: 60599385
SAMPLE TYPE ORAS OSPLIT SPOON ■ULL ØNDALLE MURDLING DORSE OVER DORSE OVE			N		ים0ו	Acker MP-5 - 125 mm SSA	
Solid Solid Description Description <thdescription< th=""> <thdescription< th=""> <thdescript< td=""><td></td><td>· · · ·</td><td>\square</td><td>]SPL</td><td>IT SPC</td><td></td><td></td></thdescript<></thdescription<></thdescription<>		· · · ·	\square]SPL	IT SPC		
11 C38 C38 C38 12 END OF TEST HOLE AT 12.19 m IN CLAY C39 13 1. Sepage not deserved during augering. 2. Stophing not deserved during augering. 13 1. Sepage not deserved during augering. 14 15 16 16 17 18 18 19 20 10.0000 mm local with auger cullings and bentomle upon completion.		SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	★ Becker ¥ + Torvane + ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (KN/m ³) △ Pocket Pen. △ ➢ Field Vane ④ 16 17 18 19 20 21 Plastic MC Liquid (kPa)	COMMENTS
END OF TEST HOLE AT 12.19 m IN CLAY 1.5 Sepage not observed during augering. 2. Studying not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upon completion.	-11						2
	10	Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering. 3. Test hole backfilled with auger cuttings and bentonite upor	1	639			······
							· · · · · · · · · · · · · · · · · · ·
	16						······
	17						·····
	18						······
	19						· · · · · · · · · · · · · · · · · · ·
LOGGED BY: Ryan Harras COMPLETION DEPTH: 12.19 m	20						
		AECOM					OMPLETION DEPTH: 12.19 m OMPLETION DATE: 6/25/19

			rson East CSR Works (C		С	LIEN	NT: C	City o	f Winnip	eg WW	D				STHOLE NO: TH19-	
			/ 14 - 5533828 m N, 634 Maple Leaf Drilling	374 III Ľ		AC		A . I		105		^			OJECT NO.: 605993	
							<u>iod:</u> It spo		er MP-5	<u>- 125 m</u> BULK	im 55		IO REC		EVATION (m): 231.3 RY CORE	Z
			GRAB			JSPL SLO		JUN								
SACK		TYPE	BENTONITE	GRAVEL	Щ	IJSLO T	UGH			GROUT			CUTTIN			
DEPTH (m)	SOIL SYMBOL	SLOTTED PIEZOMETER	SOIL DESC	CRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SI 0 16 1	Plastic MC	xer ¥ : Cone ◇ d Pen Test) 00mm) <u>60 80</u> nit Wt ■ n ³) 19 20	100 21	RAINED SHE + Torva × QU. □ Lab V △ Pocket ♣ Field \ (kP: 50 10	ane + /2 × ane □ Pen. △ /ane ⊕ a)	ENGTH	COMMENTS	Ĩ
0	\bigotimes	- 7	TOPSOIL - black, moist CLAY (Fill) - silty, some sand,	trace gravel trace roots	_				÷							
			- dark grey mottled brown, firr	n, moist					÷	· · · · · · · · · · · · · · · · · · ·				 		2
			- high plasticity			G40A			•	· · · · · · · · · · · · · · · · · · ·		·······		 		
1	\bowtie	10	CLAY - silty, some sand		_											
		20	 dark brown, firm, moist high plasticity 						÷							
		30	- night plasticity			G40			•	· · · · · · · · · · · · · · · · · · ·		······································		 		·
		10							÷…÷…	•		··	·····			
2		38							·····					 		
		10	SILT - some clay, trace sand							·		···;····;		 		
		10	 light brown, moist to wet non-plastic 						÷	• • • • • • • •		•				
		30	- F						÷	•						
3		10				G41			•					 	(G41) Gravel: 0.0%,	
		20	CLAY (Lacustrine) - some silt - brown mottled grey, firm to s	, trace sand .tiff, moist					÷						Sand: 2.4%, Silt: 86.6%, Clay: 11.0%	
		30	 high plasticity trace silt inclusions (<15 mm 						÷•••••	• • • • • • • • • • •		•••••••••••••••••••••••••••••••••••••••				
		10		ruiam.)					÷••••	• • • • • • • • • • • • • •		······································		 		
1		20														
		40							÷							
		20							÷••••	· · · · · · · · · · · · · · · · · · ·		···;·····; ···;·····;	· · · · · · · · · · · · · · · · · · ·	 		
		30				T42									Tube Recovery: 100%	
5		10				142									Tube Recovery. 10076	
		20				1			÷					· · · · · · ·		
		40								·		••••••••••		 		
		20														
ò			- grey below 6.1 m			G43				•				 		
		10	- grey below 6.1 m						÷	· · · · · · · · · · · · · · · · · · ·		···;····;		 		
		30							÷	•						
		10							÷•••••	•••••••		•••••••••••••••••••••••••••••••••••••••				
1		38												 		
									÷	·						
						-			÷	• • • • • • • • • •						
						T44			.	· · · · · · · · · · · · · · · · · · ·		···+^··		 	Tube Recovery: 33%	
5									<u>.</u>							
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•						G45						···:	·····			
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0	\square								÷	· · · · · · · · · · ·		···	····.			
				A								aldu			ETION DEPTH: 16.56 r	n
			AECON	71					VIEWED OJECT E					ννιγί	ETION DATE: 6/26/19 Page	1

	-	TOD		394 m E													ROJECT NO.: 605993	
			Maple Leaf Drilling				HOD:					mm	SSA		1		LEVATION (m): 231.3	32
SAMP BACK			GRAB BENTONITE	GRAVEL		_	IT SPC	DON		BI G		т			-	RECOV TINGS	ERY CORE	
DEPTH (m)		PIEZOMETER	SOIL DES		SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 2 16 1	PENETI ★ Dyn PT (Sta (Blo 20 4 ■ To 7 1 Plastic	RATION Becker namic C Indard I ws/300 to 6 tal Unit (kN/m ³) 8 19 MC 40 6	N TEST T ¥ Cone Pen Te mm) 0 8 Wt ■ 2 Liqu	TS > est) ♦ 30 100		INED SH + Tor X Q □ Lab Δ Pock ● Field (k	HEAR S rvane - QU/2 X Vane et Pen d Vane Vane kPa)	STRENGT ⊢ □ . △	COMMENTS	
-11 -12			- trace gravel, soft to firm belo	w 11.6 m		T46				•							Tube Recovery: 0%	22
-13			 trace silt till inclusions (< 20 suspected cobble/gravel end Shelby Tube at 13.7 m SILT and SAND (Till) - some some gravel light brown, compact, moist 	countered while pushing	/	T48											Tube Recovery: 0%	2 2 2
-15						S49	50/										 SPT Blows: [8/8/9], Spoon Recovery: 75%	2
-17 -18	<u></u>		END OF TEST HOLE AT 16. REFUSAL) Notes: 1. Seepage observed from sil 2. Water to 3.1 m below groun of augering. 3. Sloughing observed from s 4. Test hole open to 14.6 m u 5. Auger refusal at 16.3 m on 6. Test hole beneficied with co	t layer during augering. nd surface upon completion ilt layer during augering. pon completion of augering. suspected cobble/boulder.		4	102mn										mm)], Spoon Recovery: 	2'
-19			 6. Test hole backfilled with sa bentonite from 10.4 m to 7.3 r m to 0.6 m, and sand from 0.6 cover installed. 7. Groundwater monitoring: August 6, 2019 at elev. 22 August 20, 2019 at elev. 13 September 3, 2019 at elev. 	n, auger cuttings from 7.3 5 m to 0.3 m. Flush-mount 23.55 m (7.76 m bgs) 224.76 m (6.55 m bgs)														2.
20									<u></u>			<u></u>		<u></u>	· · · · · · · · · · · · · · · · · · ·	<u></u>		
			AECOM	A						DBY:			rras Alobai	4.,			LETION DEPTH: 16.56 LETION DATE: 6/26/19	m

	V: UTM 14 - 5533801 m N, 634449 m E CTOR: Maple Leaf Drilling TYPE GRAB GRAB GRAB GRAB GRAB GRAB GRAB GRAB			OD:T SPO	ON	PENETI ★ Dyn PT (Sta (Blov 0 4 ■ Tot 7 1. Plastic	RATIO Becke andard ws/300 40 (tal Uni (kN/m 8 1	ULK N TES r X Pen T Omm) 50 t Wt 3) 9 2 Liqu	TS > rest) ♦ 80 100 1 20 21	UNDRA	INED SH + Tor × Q □ Lab △ Pock ♥ Fielc (k	HEAR S rvane H U/2 X Vane [et Pen. d Vane SPa)	E RECOV STRENG	COMMENTS	
DEPTH (m) DEPTH (m) Soll SYMBOL	GRAB SHELBY TUBE SOIL DESCRIPTION TOPSOIL - black, moist CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark brown, firm, moist - high plasticity SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity CLAY - silty, some sand - dark brown, firm, moist, high plasticity SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity CLAY - silty, some sand - light brown, soft, moist - intermediate plasticity SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)	TYPE X	SPLI # 37000000000000000000000000000000000000	T SPO (N)	ON	PENETI ★ Dyn PT (Sta (Blov 0 4 ■ Tot 7 1. Plastic	RATIO Becke andard ws/300 40 (kN/m 8 1 MC	ULK N TES r X Pen T Omm) 50 t Wt 3) 9 2 Liqu	TS ⇒ iest) ♦ 80 100 1 20 21 uid	UNDRA	INED SH + Tor × Q □ Lab △ Pock ♥ Fielc (k	HEAR S rvane H U/2 X Vane [et Pen. d Vane SPa)	RECOV STRENG [™] ⊢ □ . △		2: 2:
DEPTH (m)	SOIL DESCRIPTION TOPSOIL - black, moist CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark brown, firm, moist - high plasticity SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity CLAY - silty, some sand - dark brown, firm, moist, high plasticity SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity CLAY - silty, some sand - light brown, soft, moist - intermediate plasticity SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)	TYPE	# 374000000000000000000000000000000000000	SPT (N)	P ♦ SP 0 2 16 11	PENETI	RATIO Becken andard ws/300 40 0 tal Uni (kN/m 8 1 MC	N TES or ★ Pen T Dmm) 50 t Wt ∎ 3) 9 2 Liqu	> est) ♦ 80 100 1 20 21		INED SH + Tor X Q □ Lab Δ Pock € Fielc (k	HEAR S rvane H U/2 X Vane [et Pen. d Vane SPa)	GTRENG ⁻ ⊢ . △ €	COMMENTS	2
	CLAY (Fill) - silty, some sand, trace gravel, trace roots - dark brown, firm, moist - high plasticity SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity CLAY - silty, some sand - dark brown, firm, moist, high plasticity SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)		G56A G56B			•									2
			G57				•								2
	- silty below 6.1 m		T58 G59				•			~~~>	\$∧			Tube Recovery: 100%, (T58) Gravel: 0.0%, Sand: 2.0%, Silt: 30.0%, Clay: 68.0%, Swell: (1.9%, 57 kPa)	2
	- trace gravel below 7.9 m		G60						an Ha Faris <i>F</i>						: : :

COJECT: Jefferson East CSR Works (Contract 5)	С	LIEN	IT: C	ity of Winnipeg WWD	TESTHOLE NO: TH19-06
CATION: UTM 14 - 5533801 m N, 634449 m E					PROJECT NO.: 60599385
DNTRACTOR: Maple Leaf Drilling				Acker MP-5 - 125 mm SSA	ELEVATION (m): 231.23
MPLE TYPE GRAB SHELBY TUBE		JSPL	IT SPC		
SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS UNDRAINED SHEAR ST ★ Becker ★ + Torvane + ◆ Dynamic Cone ◆ + Torvane + ◆ SPT (Standard Pen Test) □ Lab Vane □ 20 40 60 80 100 ■ Total Unit WT ■ Call Unit WT □ Lab Vane □ △ Pocket Pen. ■ Total Unit WT ■ Field Vane ④ ○ (kPa) ○ (kPa)	COMMENTS
- trace silt till inclusions (<25 mm diam.) below 10.7 m		G61			
2 END OF TEST HOLE AT 12.19 m IN CLAY Notes: 1. Seepage not observed during augering. 2. Sloughing not observed during augering.		G62			
 Test hole backfilled with auger cuttings and bentonite upo completion. 	n				
					······
,					
3					
				LOGGED BY: Ryan Harras	COMPLETION DEPTH: 12.19 m
AECOM					COMPLETION DATE: 6/26/19

		lefferson East CSR Works (Co		С	LIEN	IT: C	ity of	Winnipeg WWD			STHOLE NO: TH19-	
		UTM 14 - 5533750 m N, 6345	59 M E	-							OJECT NO.: 605993	
		DR: Maple Leaf Drilling						er MP-5 - 125 mn			EVATION (m): 231.1	3
	LE TYF	GRAB GRAB	SHELBY TUBE		JSPL	IT SPO	1	BULK		RECOVE	RY CORE	-
DEPTH (m)	SOIL SYMBOL	SOIL DESCR	IPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 2 16 1 F	ENETRATION TESTS ★ Becker ★ ◊ Dynamic Cone ◊ (Blows/300mm) 0 40 60 80 10 Total Unit Wt ■ (kN/m ³) 7 18 19 20 2 Tastic Mc Liquid 0 40 60 80 10	□ Lab Vane △ Pocket Per ④ Field Vane 21 (kPa)	+ 	COMMENTS	
		FOPSOIL - black, moist CLAY (Fill) - silty, some sand, trace gi	ravel trace roots	Λ								
1 1 2		dark grey mottled brown, firm, moist high plasticity SAND - silty, trace clay light brown, moist		<u>ر</u>	G63		•					2
2		CLAY (Lacustrine) - some silt, trace s brown mottled grey, firm to stiff, mois high plasticity trace silt inclusions (<15 mm diam.)	and st									
3					G64							
5					G65			•				
		grey below 5.5 m			G66			•				
7		trace gravel below 7.0 m			-							
					T67				XIA		Tube Recovery: 100%	
					G68			•				
10		AECON	-		1		LOC	GED BY: Ryan H	arras	COMPL	ETION DEPTH: 12.19 r	n m

	son East CSR Works (С	LIEN	IT: C	ity of	Winnip	eg W	WD			STHOLE NO: TH1	
	1 14 - 5533750 m N, 63	4559 m E										OJECT NO.: 6059	
	Maple Leaf Drilling						er MP-5		mm			EVATION (m): 231	.13
SAMPLE TYPE	GRAB	SHELBY TUBE		SPL	IT SPC	1		BULK			RECOVE	RY CORE	
DEPTH (m) SOIL SYMBOL	SOIL DESC	RIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SP 0 2 16 1; F	ENETRATI * Becl Dynamic T (Standar (Blows/3 0 40 Total U (kN/r 7 18 lastic MC 0 40	ker ₩ c Cone ≎ rd Pen Te 00mm) 60 8 nit Wt ■ m ³) 19 2(Liqui	> est) ♦ 80 100 0 21	JNDRAINED SHEAR + Torvane × QU/2 × □ Lab Vane △ Pocket Per � Field Vane (kPa) 50 100	+ 	COMMENTS	
10													2
11				G69			C) 					
													2
Notes:)F TEST HOLE AT 12.19 m page not observed during au			G70			(2
2. Slou	ighing not observed during a t hole backfilled with auger c	ugering.											
14								· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·			
15													
16													
17										· · · · · · · · · · · · · · · · · · ·			2
18													:
9								· · · · · · · · · · · · · · · · · · ·					
20						LOC	GED B	Y: Rva	in Har	ras	COMPL	ETION DEPTH: 12.1	 9 m
	AECO/	M								lobaidy		ETION DATE: 6/26/1	

	ECT: Jefferson Ea			С	LIEN	IT: C	ity of	Winnip	eg W	'WD					THOLE NO: TH19-	
	FION: UTM 14 - 5		627 m E												JECT NO.: 605993	
	RACTOR: Maple	GRAB	SHELBY TUBE			<u>OD:</u> T SPO		er MP-5	<u>- 125</u> BULK	<u>mm</u>	SSA) RECO		VATION (m): 230.9 Y П CORE	97
DEPTH (m)	ABOL			SAMPLE TYPE	SAMPLE #	SPT (N)	F ♦ SF 0 2 16 1	ENETRATI	ON TES ker ¥ c Cone < rd Pen T 00mm) 60 nit Wt m ³) 19 2	> est) ◆ 80 100] ک	ED SHEAI + Torvan × QU/2 Lab Var Pocket P Field Va (kPa)	R STREN e + × ne □ en. △	-	COMMENTS	
0	- dark brown, f SILT - sandy, s - light brown, n - low plasticity CLAY - silty, su - brown, firm tc CLAY (Lacustr - brown, firm tc - high plasticity	Ity, some sand, trace (rm, moist, high plastic some clay noist ome sand stiff, moist, high plas ine) - some silt, trace stiff, moist	ity icity sand		G71A G71					80 100	50	100	150	200		2 2 2 2 2
4 5 6	- grey below 4.				G73											2
7					T74			•							Tube Recovery: 100%, T74) Gravel: 0.0%, Sand: 1.0%, Silt: 35.0%, Clay: 64.0%, Ks = 1.52 < 10 ⁸ cm/s	
9 10	- trace gravel, - firm from 9.1	race silt till inclusions m to 13.6 m	below 9.1 m		G76									· · · · · · · · · · · · · · · · · · ·		
11					G77				· · · · · · · · · · · · · · · · · · ·							2
	Λ	=	A					GED B							TION DEPTH: 19.81	m
	A	ECOV	/1					/IEWED DJECT E						NPLE	TION DATE: 6/26/19 Page	1

	Jefferson East CSR Works (Contr : UTM 14 - 5533718 m N, 634627		С	LIEN	IT: C	ity of Wi	nnipeg WWD			<u>STHOLE NO: TH19-</u> OJECT NO.: 605993	
	TOR: Maple Leaf Drilling		N	ורדוו		A alcor M	ID E 10E mm			EVATION (m): 230.9	
SAMPLE T		SHELBY TUBE			<u>UD:</u> T SPO		IP-5 - 125 mm BULK		RECOVE		7
SAIVIPLE I	IPE GRAB			JSPLI							1
DEPTH (m) SOIL SYMBOL	SOIL DESCRIP	TION	SAMPLE TYPE	SAMPLE #	SPT (N)	¥ ♦ Dy ♦ SPT (St (Bl 0 20	IRATION TESTS & Bocker ★ namic Cone ◇ andard Pen Test) ◆ avdard Pen Test) ◆ obal Unit Wt ■ (kN/m³) 18 19 20 2 MC Liquid 80 10	□ Lab Vane △ Pocket Per ④ Field Vane 1 (kPa)	+ 	COMMENTS	
12 13 14	- soft to firm below 13.6 m			G78							2
15 000 000 000 000 000 000 000 0	SILT and SAND (Till) - clayey, trace grave - light brown, loose, moist - low plasticity			G80		•					2
17 000 000 000 000 000 000 18 000 000 000 000 000 000	- very dense below 16.8 m		X	S81	72	•	•			SPT Blows: [12/30/42], Spoon Recovery: 100%, (S81) Gravel: 0.0%, Sand: 35.2%, Silt: 43.8%, Clay: 21.0%	
19 0 0 0 0 0 0 0 0 0 0 0 0 0	END OF TEST HOLE AT 19.81 m IN TILL Notes:										
21	 Seepage not observed during augering Sloughing not observed during augering Test hole backfilled with auger cuttings completion. 	g. and bentonite upon									
22											
24	ΑΞϹΟΜ					LOGGE	D BY: Ryan Ha VED BY: Faris	arras		.ETION DEPTH: 19.81 r .ETION DATE: 6/26/19	 m

		Jefferson East CSR Work		C	LIEN	IT: C	ity o	f Win	nipe	g W	WD					STHOLE NO: TH19-	
		I: UTM 14 - 5533626 m N,	634825 m E													ROJECT NO.: 605993	
		TOR: Maple Leaf Drilling				IOD:					- 125	5 mm				EVATION (m): 230.7	13
SAMP	LE T	YPE GRAB	SHELBY TUBE		SPL	IT SPO	ON		В	ULK		1	\angle	NO R	ECOVI		
DEPTH (m)	SOIL SYMBOL	SOIL DES	CRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 2 16 1 F	♦ Dyn PT (Star (Blov 20 4 ■ Tot (7 18 Plastic	Becke amic C ndard vs/300 0 6 al Unit kN/m ³ 3 1	r ¥ Cone < Pen T () () () () () () () () () () () () ()	> est) ✦ 30 100	0	+ Tor X Qi □ Lab △ Pocke ● Field (k	vane + U/2 X Vane E et Pen. Vane (Pa)	נ ב	COMMENTS	
0		- TOPSOIL - black, moist		7													
1		CLAY (Fill) - silty, some sand, t - dark grey, firm, moist - brown below 0.4 m - high plasticity CLAY - silty, some sand - dark brown, firm, moist - high plasticity	ace gravel, trace roots	<u></u>	G91A			•								· · · ·	2
2		SILT - sandy, some clay - light brown, moist - low plasticity			G91											· · · ·	
3		CLAY (Lacustrine) - some silt to - brown mottled grey, firm to sti - high plasticity - trace silt inclusions (<15 mm o - some silt below 3.1 m	f, moist		G92			۲				· · · · · · · · · · · · · · · · · · ·				· · · ·	
1					G93								· · · · · · · · · · · · · · · · · · ·				
5		- grey below 4.9 m			675											· · · ·	
5					G94				٠								
7																	
}					T95				•			· · · · · · · · · · · · · · · · · · ·	¥∠.			Tube Recovery: 100%	:
)					G96											· · · ·	
10													· · · · · · · · · · · · · · · · · · ·				
								GGED								LETION DEPTH: 12.19	m
		AECO					RE	/IEW	ED B	SY: F	aris /	Alobai	dy	(COMP	LETION DATE: 6/27/19	

		Jefferson East CSR		C	CLIEN	IT: C	ity o	f Wir	nnipe	g W\	ND				TES	THOLE NO: TH	19-10
		I: UTM 14 - 5533626													PRO	JECT NO.: 605	99385
		TOR: Maple Leaf Dri	-			OD:					125	i mm				VATION (m): 23	30.73
SAMP	PLE T	YPE GRAB	SHELBY TUBE		SPL	T SPO	ON		В	ULK			\square]NO RE	ECOVER	r Core	
DEPTH (m)	SOIL SYMBOL	SOIL [DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 2 16 1 F	₩ > Dyn PT (Sta (Blo 20 ■ To 7 7 Plastic	Becken amic C ndard ws/300 0 6 tal Unit (kN/m ³ 8 19 MC	Cone Pen Te mm) 0 8 Wt ■) 2 20 Liquid	est) ♦ 0 100 0 21		+ Tor × Q □ Lab △ Pock ♥ Field (k	HEAR ST vane + U/2 × Vane □ et Pen. 2 d Vane € Pa)	۵ ۲	COMMENTS	EI EVATION
10 11 12 13 14 15 16 17 18 19 20		END OF TEST HOLE AT Notes: 1. Seepage not observed 2. Sloughing not observe 3. Test hole backfilled wit completion.	during augering.		G97 G98												224 214 214 214 214 214 214 214 214 214
19																	21.
20									אַ פּע	Duo	n Hor	rrac				TION DEPTH: 12	10 m
		AEC	M O							Rya Y: Fa		rras Nobaio	lv			TION DEPTH: 12 TION DATE: 6/27	
												Jorda		\dashv	2.711 LL		age 2 o

		Jefferson East CSR Works (C : UTM 14 - 5533577 m N, 634		CI	LIEN	IT: C	ity of	Winnip	eg W\	WD					STHOLE NO: TH19- OJECT NO.: 605993	
		TOR: Maple Leaf Drilling	727 III L	NA	сти		Cont	erra CT	. 250	125	mm	CC V			EVATION (m): 230.8	
	PLE T		SHELBY TUBE			<u>UD:</u> T SPO			<u>-250 -</u> BULK	- 125	mm		NO RE			9
SAIVIE						1310				c I			EAR STR			
DEPTH (m)	SOIL SYMBOL	SOIL DESCR	RIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SP1 0 20 16 17 Pi	¥ Beck > Dynamic (Standard (Blows/30) 40 ■ Total Ur (kN/n	er ¥ Cone ◇ d Pen Te 00mm) 60 8 nit Wt ■ 19 20 Liqui	est) ♦ 0 100		+ Ton X Ql □ Lab △ Pocke 伊 Field (kl	vane + J/2 X Vane □ t Pen. △ Vane ⊕ Pa)	7	COMMENTS	
0		TOPSOIL - black, moist CLAY (Fill) - silty, some sand, trace g	ravel trace roots	-/												
		- dark brown mottled grey, firm, mois	t		G99A			•								
1		 high plasticity SILT - sandy, some clay 		-17							•••••					2
I		 light brown, moist low plasticity 														
		CLAY (Lacustrine) - some silt to silty			G99)	• • • • • • • •							
•		- brown mottled grey, firm to stiff, mo	ist													2
2		 high plasticity trace silt inclusions (<15 mm diam.) 														
		- some silt below 2.1 m														
3				ľ	G100) <u>.</u>							'
1																
				H												
5					T101)		\cdots	-·∆· · ·		 	Tube Recovery: 100%, (T101) Gravel: 0.0%,	2
											•••••				Sand: 0.0%, Silt: 12.0%,	
		- grey below 5.5 m							• • • • • • • •						Clay: 88.0%, Swell: (2.1%, 58 kPa)	
5					G102				• • • • • • •							
					0102											
7																
/																
					G103			•								
_																
ว่																
9		- trace silt till inclusions (<15 mm diar	(n) from 0.1 m to 10.0 m		G104				•							'
		- יי מניד אוו נוו ווונוטאטוזא (< דא דוווו Ulal	n., nom 7. i in to iz.z m								· · · · · · · ·					
							÷				•••••					.
0											•••••					:
															1	
				ľ	G105			•								
1	\square															:
2																
		AECON	A					GED BY				N.			ETION DEPTH: 19.81 r	m
		AELUN	71					IEWED						UIVIPL	ETION DATE: 6/27/19 Page	1

		Jefferson East CSR Works (Contract 5)	C	CLIEN	IT: C	city o	of Winnipeg WWD			STHOLE NO: TH19	
		: UTM 14 - 5533577 m N, 634929 m E								OJECT NO.: 60599	
		TOR: Maple Leaf Drilling					nterra CT-250 - 125			EVATION (m): 230.8	89
SAMP	LEI	YPE GRAB SHELBY TUBE		JSPL T	IT SPC	1	BULK		ECOVER	RY CORE	<u> </u>
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)		Plastic MC Liquid		- &	COMMENTS	
12		- trace gravel, trace silt till inclusions (<50 mm diam.) below 12.2 m		G106				0 50 100	150 200		
13						· · · · · · · · · · · · · · · · · · ·					2
14				G107							2
15		- soft to firm below 15.1 m		G108			•				:
16	00	SILT and SAND (Till) - some clay to clayey, trace to some	_								:
17		gravel - light brown, loose, moist		G109		· · · · · · · · · · · · · · · · · · ·	•				:
18	00000000000000000000000000000000000000	- compact below 19.8 m		G110			•				:
19											:
20	<u>.4</u> .2	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 cutlings and bentonite upon									
21		completion.									
22						· · · · · · · · · · · · · · · · · · ·					
23											
24							÷····				
							GGED BY: Ryan Ha			ETION DEPTH: 19.81	
		AECOM					VIEWED BY: Faris A OJECT ENGINEER:		COMPLE	ETION DATE: 6/27/19 Page	

1 CLAY - sity, some sand - high plasticity 2 Image plasticity 3 - epit trown, soil of firm, most - high plasticity G111 3 - CLAY (Laustime) - some sill, trace sand - brown, firm to sill, most - high plasticity G112 4 - grey, lim below 4.3 m G113 5 G114 - grey, lim below 4.3 m 6			Jefferson East CSR Works (Co		С	LIEN	IT: C	ity o	f Winr	ipeg	WWD					ESTHOLE NO: TH19-	
SAMPLE TYPE CRAB Construction Constructi				03 m E													
Image: Solution of the second seco			· · · · ·									<u>i SSA</u>					6
000000000000000000000000000000000000	SAMP	LE T	YPE GRAB	SHELBY TUBE		SPL	T SPO	ON		BUL	K						
0 CIAP Folk, molds - ark gray, fin, mids - ark gray, fin, mids - ark gray, fin, mids - ark gray, fin, mids - ark gray, fin, mids - ark gray, fin, mids - ark gray, fin, mids - ark gray, fin, mids - ark gray, fin, mids - ark gray, fin, mids - bray, mask soft to finr, mids - ark gray, fin, mids - bray, soft to finr, mids - ark gray, finr, mids - bray, mins - ark gray, finr, mids - bray, mins - ark gray, finr, arks - ark gray, finr, arks - ark gray, finr, arks - ark gray, finr, arks - ark gray, finr, arks - ark gray, finr, arks - ark gray, finr, arks - ark gray, finr, arks - ark gray, finr, arks - ark gray, finr, arks - ark gray, finr, arks - bray, noticit gray, finra, ark - ark gray, finra, ark - ark gray, finra, bray, ark - ark - gray, firm below 4.3 m - ark - gray, firm below 4.3 m - ark - gray, firm below 4.3 m - ark - ark - ark - ark - ark - ark - ark - ark -	DEPTH (m)	SOIL SYMBOL	SOIL DESCR	IPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 2 16 1 F	 ★ Bi ◆ Dynar T (Stand (Blows) 20 40 ▲ Total (k 7 18 Plastic 	ecker * mic Cor dard Pe s/300mr 60 Unit W N/m ³) 19 MC	n Test) ♦ m) 80 10 t ■ 20 2 Liquid	0 1	+ Torv X QL □ Lab ^V △ Pocke ④ Field (kF	vane J/2 X Vane [et Pen. Vane ⊃a)	+ . △ ₽	COMMENTS	
 - Woorn, Irim, mold - Store, Sith Trace sand - Intermediate plasticity - CLAY (Lacustrine) - some sith, Trace sand - orrey, firm bolow 4.3 m - orrey firm bolow 4.3 m <l< td=""><td>0</td><td></td><td>CLAY (Fill) - silty, some sand, trace gr - dark grey, firm, moist - high plasticity</td><td>avel, trace roots</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>· · · · · · · · · · · · · · · · · · ·</td><td></td><td></td><td></td><td></td><td>2</td></l<>	0		CLAY (Fill) - silty, some sand, trace gr - dark grey, firm, moist - high plasticity	avel, trace roots								· · · · · · · · · · · · · · · · · · ·					2
3 CLAY (Lacustrine) - some sill, trace sand - brown, firm bolff, moist - brown motiled grey from 3.1 m to 4.3 m 4 - grey, firm below 4.3 m 5 G113 6 T114 7 G115 6 G116 7 G116 6 G116	1		- brown, firm, moist - high plasticity SILT - clayey, some sand - light brown, soft to firm, moist						•					· · · · · · · · · · · · · · · · · · ·			2
4 - grey, firm below 4.3 m 5 5 6 113 6 114 • • 7 • 8 • 9 6113 • •			- brown, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)			G112			•			· · · · · · · · · · · · · · · · · · ·					
	ŀ		- grey, firm below 4.3 m									· · · · · · · · · · · · · · · · · · ·					
	5					G113											
	5					T114				•		· · · ×	Å			Tube Recovery: 100%	
	7					G115											
	3											· · · · · · · · · · · · · · · · · · ·					
	,					G116						· · · · · · · · · · · · · · · · · · ·					
LOCCED BY: Dyon Horroc COMDI ETION DEDTH: 12.10 m	10								· · · · · · ·								
	10			_				LO	GGED	BY: F	Ryan Ha	arras			COMP	LETION DEPTH: 12.19	n m
			AECON										dy			LETION DATE: 6/25/19	

	Jefferson East CSR Works (C	LIEN	IT: C	ity of	Winnip	eg WV	VD			STHOLE NO: THIS	
	UTM 14 - 5533542 m N, 63	5003 M E				A . I .		105		<u> </u>		DJECT NO.: 60599	
SAMPLE TY	OR: Maple Leaf Drilling	SHELBY TUBE			I <u>OD:</u> T SPC		r MP-5	<u>- 125 </u> BULK	mm		LLE RECOVER	VATION (m): 230	/0
DEPTH (m) SOIL SYMBOL	SOIL DESCI		SAMPLE TYPE	SAMPLE #	SPT (N)	P ◆ SP 0 2 16 17 P	ENETRATIO * Beck Dynamic T (Standar (Blows/30 0 40 Total Un (kN/r 18 lastic MC	DN TESTS er ₩ cone ◇ d Pen Tes 00mm) 60 80 nit Wt ■ n ³) 19 20	st) ♦ 0_100 1	JNDRAINED SHEAR + Torvane - × QU/2 × Lab Vane & Pield Vane (kPa) 50 100	STRENGTH + A	COMMENTS	
10 11 12				G117			C)	· · · · · · · · · · · · · · · · · · ·				2
10	END OF TEST HOLE AT 12.19 m I Notes: 1. Seepage not observed during au 2. Sloughing not observed during au 3. Test hole backfilled with auger cu completion.	gering. Jaerina.		G118									2
14													2
16									· · · · · · · · · · · · · · · · · · ·				2
17													2
18									· · · · · · ·				2
19									· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·		2
20						LOC	GED B	/:_Ryar	n <u>H</u> ar	ras	COMPLE	TION DEPTH: 12.19	2 9 m
	AECO/	M				REV	'IEWED	BY: Fa	aris A		COMPLE	TION DATE: 6/25/19) e 2 (

		Jefferson East CSR Works (C		С	LIEN	IT: C	ity of	Winnipeg WWD			STHOLE NO: TH19	
		: UTM 14 - 5533487 m N, 635	IZIME			a -					ROJECT NO.: 60599	
		TOR: Maple Leaf Drilling						<u>r MP-5 - 125 mm</u>			EVATION (m): 230.8	31
SAMP	PLE T	YPE GRAB	SHELBY TUBE		SPLI	T SPO	ON	BULK		RECOVE	ERY CORE	
DEPTH (m)	SOIL SYMBOL	SOIL DESCR	RIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SP 0 20 16 17 Pl	Total Unit Wt (kN/m ³)	→ Focket Fen	+ □ . △	COMMENTS	
0 ·1 ·2		TOPSOIL - black, moist CLAY (Fill) - silty, some sand, trace of - dark grey, firm, moist - high plasticity CLAY - silty, some sand - brown, firm, moist, high plasticity SILT - clayey, some sand - light brown, soft, moist - intermediate plasticity CLAY (Lacustrine) - some silt, trace site			G119A G119			•			 . .<	2
3		 brown, firm to stiff, moist high plasticity trace silt inclusions (<15 mm diam.) brown mottled grey from 3.1 m to 4 			G120			•			· · · ·	2
4		- grey below 4.0 m			T121			•	×s+		Tube Recovery: 100%	
5					G122			•				
7					G123			•				
}		- firm below 7.6 m										
9					G124			•			· · · ·	
10			_					GED RV Duon Lla	rras		· LETION DEPTH:12.19	
		AECON	Λ					GED BY: Ryan Ha IEWED BY: Faris A			LETION DEPTH: 12.19 LETION DATE: 6/25/19	
			7 🖬					JECT ENGINEER:			Page	

	fferson East CSR Works (TM 14 - 5533487 m N, 63		CI	LIEN	IT: C	ity of Winnipeg WW)		THOLE NO: TH19- DJECT NO.: 60599	
	R: Maple Leaf Drilling		М	FTH	ΩD·	Acker MP-5 - 125 m	m SSΔ		VATION (m): 230.8	
SAMPLE TYPE		SHELBY TUBE			T SPC			RECOVER		
DEPTH (m) SOIL SYMBOL	SOIL DESCI	RIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS ★ Becker ★ ◆ Dynamic Cone ◆ ◆ SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 ■ Total Unit Wt ■ (KN/m ³) 16 17 18 19 20 Plastic MC Liquid 20 40 60 80	Lab Vane	+ 	COMMENTS	
10				G125						2
No 1. S 2. S 3. T	D OF TEST HOLE AT 12.19 m I tes: Seepage not observed during au Sloughing not observed during au Test hole backfilled with auger cu mpletion.	gering. Jaerina.		G126						2
14										
16										
17										2
18										2
19										2
20	AECO	A				LOGGED BY: Ryan REVIEWED BY: Fari			TION DEPTH: 12.19 TION DATE: 6/25/19	m 2

		Jefferson East CSR Works (Contract 5)	С	LIEN	IT: C	ity o	f Winnipeg WWD			STHOLE NO: TH19-	
		: UTM 14 - 5533421 m N, 635261 m E	-	45.7.		<u>.</u> .				ROJECT NO.: 605993	
		TOR: Maple Leaf Drilling					er MP-5 - 125 mn		RECOVE	EVATION (m): 230.6	5
SAIVIE		YPE GRAB SHELBY TUBE		JSPL	IT SPO		BULK				
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 : 16 1	PENETRATION TESTS ★ Becker ★ ♦ Dynamic Cone ♦ T (Standard Pen Test) ◀ (Blows/300mm) 20 40 60 80 10 Total Unit WI ■ (kN/m ³) 7 18 19 20 2 Plastic M Liquid 20 40 €0 80 10	□ Lab Van □ Δ Pocket Pe	e + ≺ e □ en. ∆	COMMENTS	
0		TOPSOIL - black, moist SILT (Fill) - sandy, trace to some clay - light brown, dry to moist CLAY (Fill) - silty, some sand, trace roots - dark brown, firm, moist - high plasticity				· · · · · · · · · · · · · · · · · · ·				· · · ·	23
2		CLAY - silty, some sand - brown, firm, moist - high plasticity SILT - some clay, trace sand - light brown, moist	/	G127			•				2
3		 low plasticity CLAY (Lacustrine) - some silt, trace sand brown mottled grey, firm to stiff, moist high plasticity trace silt inclusions (<15 mm diam.) 		G127/						(G127A) Gravel: 0.0%, Sand: 1.4%, Silt: 80.6%, Clay: 18.0%	2
4				T128				**		Tube Recovery: 100%	2
5		- grey below 4.6 m		T129			•	*		Tube Recovery: 100%	2
6 7				T130			I	×4		Tube Recovery: 100%, (T130) Gravel: 0.0%, Sand: 1.0%, Silt: 13.0%, Clay: 87.0%, (Swell: 2.6%, 72 kPa)	2
3				G131						2.070, 12 NF 0J	2
9		- trace gravel, trace silt till inclusions (<30 mm diam.) below 9.1 m		T132			•	∆ X.		Tube Recovery: 100%	2
10				G133			•				
11											
12									•		L
							GGED BY: Ryan H		-	LETION DEPTH: 19.51 r	n
		AECOM					VIEWED BY: Faris OJECT ENGINEER	*		LETION DATE: 6/25/19 Page	1

	T: Jefferson East C DN: UTM 14 - 55334			CL	LIEN	T: C	ity of	Winr	nipeg V	VWD					STHOLE NO: TH19- ROJECT NO.: 605993	
	ACTOR: Maple Leaf			1.4	ΓТИ	ח∩	Ack		-5 - 12	5 mm	٨ 22				EVATION (m): 230.6	
SAMPLE	· · · · · · · · · · · · · · · · · · ·	-	SHELBY TUBE			UD: T SPO					JSA					J
						. 510						ě				1
DEPTH (m) SOIL SVMBOL	SOI	L DESCRIF	PTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 2 16 1 F		ecker ¥ mic Cone dard Pen s/300mm) 60 I Unit Wt I N/m ³) 19 MC Lic	♦ Test) ♦ 80 100	1	+ Tor X Q □ Lab △ Pock ● Field (k	vane + ∪/2 × Vane ⊑ et Pen d Vane € :Pa)) Δ	COMMENTS	
12 13	- soft to firm from 12	2 m to 16.6 m			T134	I			•		ׯ	4			Tube Recovery: 100%	2
14					G135			¢)						· · · ·	2
15					G136				•							2
16	- soft below 16.6 m				G137			•								
17 18	SILT and SAND (Till) - some clay to clay	rey, trace gravel		G138											
19 00 00	 Iight brown, loose to Iight brown, loose to 															2
20	Notes: 1. Seepage not obse 2. Sloughing not obs 3. Auger refusal at 1 4. Test hole backfille	rved during augerir erved during augeri	L (AUGER REFUSAL) g. ng. cobble/boulder. s and bentonite upon		S139										SPT Blows: [50 (0 mm)], Spoon Recovery: 100%	
21	completion.						· · · · · · · · · · · · · · · · · · ·								- - - - - -	
22														•	· · · ·	
23																
24									BY: Ry			<u></u>	·	: COMDI	. LETION DEPTH: 19.51 r	 m
	ΔΞ	COM							D BY:			dv			LETION DATE: 6/25/19	11
			l						ENGI				+		Page	2

		Jefferson East CSR Works (Contract 5)	С	LIEN	IT: C	ty of Winnipeg WWD TESTHOLE NO: TH	
		I: UTM 14 - 5533404 m N, 635298 m E				PROJECT NO.: 605	
		TOR: Maple Leaf Drilling				Acker MP-5 - 125 mm SSA ELEVATION (m): 23	3.08
SAMF	PLET	YPE GRAB SHELBY TUBE		SPL	IT SPO		
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS ★ Bocker ★ ◆ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) 0 20 40 60 80 100 ■ Total Unit WT 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100 ■ Total Unit WT Plastic MC Liquid 20 40 60 80 100 50 100 150 200 Eliquid 50 100 150 200	
0		TOPSOIL - black, moist CLAY (Fill) - silty, some sand, trace gravel, trace roots					2
·1		- dark brown, firm, dry to moist - high plasticity SILT - sandy, some clay - light brown, dry to moist - low plasticity					2
2		CLAY (Lacustrine) - some silt to silty - brown, firm to stiff, moist - high plasticity - trace silt inclusions (<15 mm diam.)		T139		Tube Recovery: 75%	2
3		- brown mottled grey from 3.1 m to 4.6 m		T140	1!	, Tube Recovery: 1009 (T140) Gravel: 0.0%, Sand: 0.0%, Silt: 20.0	%,
4		- grey below 4.6 m		T141	1.	Clay: 80.0%, Ks = 2.9 x 10 ⁸ cm/s Tube Recovery: 1009	
6				G142			
7		- trace gravel, firm below 7.6 m		-			:
3		-		T143		Tube Recovery: 1009	
9 10				G144			2
						LOGGED BY: Ryan Harras COMPLETION DEPTH: 11.	
		AECOM				REVIEWED BY: Faris Alobaidy COMPLETION DATE: 6/24/	19

10 <		Jefferson East CSR Works (Contract 5)	С	LIEN	IT: C	ity o	f Winnipeg WWD			STHOLE NO: TH19	
SAMPLE TYPE CRAR Solution Solution Solution Consecutive Consecutive <thconsecutive< th="" thcosecutive<=""></thconsecutive<>											
Bit Hold		· · · ·									08
Open Description	SAMPLE T	YPE GRAB UUSHELBY TUBE		JSPLI	i SPO						
11 Tube Recovery 54% 12 END OF TEST HOLE AT 1128 m IN CLAY Mote: 1. Seepage and to benefind using augeing. 2. Stacking not observed during augeing. 3. Itest hole backlind with suger cultings and bentomle upon completion. Tube Recovery 54% 13		SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SI 0 16 1	¥ Becker ¥ ◇ Dynamic Cone ◇ YT (Standard Pen Test) ◆ (Blows/300mm) 20 40 60 80 100 T Otal Unit Wt (kN/m ³) 7 18 19 20 21 Plastic MC Liquid Liquid 10	+ Torvane - X QU/2 × □ Lab Vane △ Pocket Pen � Field Vane (kPa)	+ □ n. Δ	COMMENTS	E C E
1. Seepage not observed during augering. 2. Subjection to beserved during augering. 3. Test hole backfilled with auger cuttings and benonite upon completion. 13 14 15 16 17 18 19	-11			T145			•			Tube Recovery: 54%	2
	12	 Seepage not observed during augering. Sloughing not observed during augering. Test hole backfilled with auger cuttings and bentonite upon 								· · · ·	2
						· · · · · · · · · · · · · · · · · · ·				· · · ·	2
										· · · ·	2
	16										2
19	17										2
	18					· · · · · ·					2
20	19					· · · · · ·				· · · ·	2
AECOM LOGGED BY: Ryan Harras COMPLETION DEPTH: 11.28 m REVIEWED BY: Faris Alobaidy COMPLETION DATE: 6/24/19	20										

		rson East CSR Works (C / 14 - 5533376 m N, 635		0	CLIENT: City of Winnipeg WWD TESTHOLE NO: TH1 PROJECT NO.: 6059								STHOLE NO: TH19- OJECT NO.: 605993			
		Maple Leaf Drilling		N	1FTH	IUD.	Ack	≏r MP-	5.1	125 mn					EVATION (m): 228.5	
SAMF		GRAB	SHELBY TUBE			IT SPC			BU		133A		NO RE			5
	TYPE	BENTONITE	GRAVEL	<u> </u>		UGH			_	OUT					SAND	
DEPTH (m)	SLOTTED PIEZOMETER	SOIL DESC		SAMPLE TYPE	LE #	SPT (N)	◆ SI 0 16 1	PENETRA	TION ⁻ cker ic Co ard Pe /300m 60 Unit V V/m ³) 19 MC	TESTS ★ en Test) 100 100 100 100 100 100 100 10	<u>10</u> .	NED SHE + Torv X QU □ Lab \ △ Pockel ♥ Field \ (kP 0 10	EAR STR ane + I/2 X /ane □ t Pen. ∆ Vane ⊕ Pa)	ENGTH	COMMENTS	
0 -1 -2		TOPSOIL - black, moist CLAY (Fill) - silty, some sand, - dark grey, firm, moist - high plasticity CLAY and SILT - trace sand - dark brown, firm, moist - high plasticity SILT - clayey, some sand - brown, soft, moist, intermedia SAND - silty, trace clay - light brown, moist CLAY (Lacustrine) - some silt - brown, firm to stiff, moist			G146	,			T						(G146) Gravel: 0.0%, Sand: 6.0%, Silt: 39.0%, Clay: 55.0%	2
3	Ţ	 high plasticity trace silt inclusions (<15 mm) brown mottled grey from 3.1 			T147				•		×-	A			Tube Recovery: 100%, (T147) Gravel: 0.0%, Sand: 0.0%, Silt: 14.0%, Clay: 85.0%, Swell: (3.4%, 35 kPa)	2
·5		- grey from 4.7 m to 5.2 m - brown mottled grey from 5.2	m to 7.6 m		- T148- -	2									Tube Recovery: 100%	2
7		- grey, soft to firm below 7.6 m			T149 G150						× ×	⊢ ∆∙			Tube Recovery: 100%	
3		 grey, solt to firm below 7.6 m trace gravel, trace silt till inclu 			-		· · · · · · · · · · · · · · · · · · ·				 					
10		below 9.1 m			T151		 	GGED F	₩	Ryan H				OMPI	Tube Recovery: 100%	n 2
		AECOA	1							': Faris		v			ETION DATE: 6/24/19	
			″∎							GINEER		•	+		Page	1

			rson East CSR Works (0 M 14 - 5533376 m N, 635				<u>vi.</u> C	<u>ny o</u>	f Winnip	icy n						STHOLE NO: TH19- OJECT NO.: 60599	
CONT	FRAC	TOR:	Maple Leaf Drilling		Ν	1ETF	HOD:	Ack	er MP-5	- 12	5 mm	SSA			EL	EVATION (m): 228.5	55
SAMF	PLE T	YPE	GRAB	SHELBY TUBE	\geq	SPL	IT SPC	DON		BULK			\square	NO RE	COVE	RY CORE	
ЗАСК	FILL	TYPE	BENTONITE	GRAVEL	Π]SLC	UGH			GROI	JT		\square	CUTTI	NGS	SAND	
DEPTH (m)	SOIL SYMBOL	SLOTTED PIEZOMETER	SOIL DES	CRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 : 16 1	Total U (kN/r	ker ¥ c Cone d Pen ⁻ 00mm) 60 nit Wt n ³) 19 Liq	♦ Test) ♦ 80 100 80 20		NED SH + Torv ∠ QL □ Lab ¹ △ Pocke ♥ Field (kF	vane + J/2 X Vane □ tr Pen. Δ Vane @ Pa)	2	COMMENTS	
-11 -11 -12						G152											2 2 2 2 2
-15						T154			•••			- <u>A</u> -				Tube Recovery: 100%	2
·16	00000000000000000000000000000000000000		SILT and SAND (Till) - some - light brown, moist to wet			G156											2
-17 -18 -19			END OF TEST HOLE AT 16. REFUSAL) Notes: 1. Seepage observed below 7 2. Water to 8.5 m below group of augering. 3. Test hole open to 16.0 m u 4. Auger refusal at 16.9 m on 5. Test hole backfilled with be m, auger cuttings from 14.5 m 10.1 m to 7.6 m, sand from 7. from 6.1 m to 0.9 m, and sand Flush-mount cover installed. 6. Groundwater monitoring: - August 6, 2019 at elev. 22	15.2 m during augering. nd surface upon completion pon completion of augering. suspected cobble/boulder. entonite from 16.0 m to 14.5 n to 10.1 m, bentonite from .6 m to 6.1 m, bentonite d from 0.9 m to 0.3 m. 25.64 m (2.91 m bqs)													2
20			- August 20, 2019 at elev. : - September 3, 2019 at ele	225.63 m (2.93 m bgs)													2
			AECOA						GGED BY				łv			ETION DEPTH: 16.86 ETION DATE: 6/24/19	
				71					DJECT E						UNIPL	Page	

	CT: Jefferson East CSR Works (Contract 5)		CLIENT: City of Winnipeg WWD TESTHOLE NO: TH19-1							
	ION: UTM 14 - 5533349 m N, 635414 m E					T NO.: 60599385				
						ION (m): 230.54				
AIVIPL	E TYPE GRAB SHELBY 1		N2PL	IT SPO						
DEPTH (m)	SOIL DESCRIPTION	SAMDI E TVDE	SAMPLE # FIE	SPT (N)	PENETRATION TESTS UNDRAINED SHEAR STRENGTH ★ Becker ★ + Torvane + ◆ Dynamic Cone ◇ + Torvane + ◆ SPT (Standard Pen Test) □ Lab Vane □ 0 20 40 60 80 100 ■ Total Unit WT (kl/m²) □ Lab Vane □ △ Pocket Pen. △ 16 17 18 19 20 21 (kPa) Plastic MC Liquid 50 100 50 200 200	OMMENTS				
	TOPSOIL - black, moist CLAY (Fill) - silty, some sand, trace roots	/			·····					
	 - dark grey, firm, moist - high plasticity 		G158	A	•	2				
	SAND - silty, trace clay - light brown, loose, dry to moist		G15	3	•	2				
2	CLAY - silty, some sand - brown, firm, moist - high plasticity									
						2				
	CLAY (Lacustrine) - some silt, trace sand - brown mottled grey, firm, moist - high plasticity - trace silt inclusions (<15 mm diam.)		G15	3		2				
4		Ţ	T160		15δ. Tube I	Recovery: 100%				
5						2				
5			G16 ⁻	1						
,	- grey below 6.7 m					2				
	- trace gravel, trace silt till inclusions below 7.6 m	T	T162		Tube I	2 Recovery: 100%				
						:				
			G16	3						
10					LOGGED BY: Ryan Harras COMPLETION	2 I DEPTH: 11.28 m				
	AECOM					I DATE: 6/24/19				
					PROJECT ENGINEER: Jordan T.	Page 1 o				

		n East CSR Works (С	LIEN	IT: C	ity o	f Winnip	eg WV	ND			STHOLE NO: TH19	
		4 - 5533349 m N, 63	5414 M E	<u> </u>			<u>.</u> .		40-		004		ROJECT NO.: 60599	
		aple Leaf Drilling	SHELBY TUBE			IOD: IT SPC	: Acker MP-5 - 125 mm SSA 200N ⊟BULK ☑NO RI						EVATION (m): 230.5	04
SAMPLE		GKAB	MO2HETRA IORE		1 _{2hri}	ii SPC T	1							
DEPTH (m) SOIL SYMBOI		SOIL DESCI	RIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SF 0 2 16 1	Plastic MC	er ¥ Cone ◇ d Pen Te 00mm) <u>60 8(</u> nit Wt ■ n ³) 19 20	est) ♦ 0 100 0 21	UNDRAINED SHEAR + Torvane × QU/2 × □ Lab Vane △ Pocket Per ✔ Field Vana (kPa) 50 100	+ n	COMMENTS	
10	END OF	TEST HOLE AT 11.28 m I	N CLAY		T164						-#X		Tube Recovery: 100%	2:
12	2. Slough	ge not observed during au ing not observed during at le backfilled with auger cu n.	gering. Igering. Ittings and bentonite upon											2
13										· · · · · · · · · · · · · · · · · · ·			· · · ·	2
14										· · · · · · · · · · · · · · · · · · ·			· · · ·	2
16										· · · · · · · · · · · · · · · · · · ·			· · · ·	2
17										· · · · · · · · · · · · · · · · · · ·			· · · ·	2
18										· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·			2
19										· · · · · · · · · · · · · · · · · · ·				2
											·····.			
20							LO(GED BY	: Ryaı	n Har	ras	COMPL	. _ETION DEPTH: 11.28	m
		AECO/	N				RE	/IEWED	BY: Fa	aris A			ETION DATE: 6/24/19 Page	

ΑΞϹΟΜ

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

JOB No.: 60219315 CLIENT: City of Winnipeg PROJECT: Jefferson East CSR DATE: December 2011 - January 2012

HOLE NO.	TH11-01	-	-	-		-
SAMPLE NO.	<u>G1</u>	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
	32.1	37.2	34.5	35.1	30.1	17.9





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

MATERIALS LABORATORY



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
		31.2	24.0	39.5	56.0	57.5

MATERIALS LABORATORY



JOB No.: 60219315 CLIENT: City of Winnipeg PROJECT: Jefferson East CSR DATE: December 2011 - January 2012

HOLE NO. SAMPLE NO. DEPTH (FT) MOISTURE CONTENT %	TH11-11 G73 25.0	- G74 30.0	- G75 35.0	- G76	TH11-08 G77	- G78
	25.0	30.0	35.0			40.0
MOISTURE CONTENT %			00.0	40.0	5.0	10.0
	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
	0.0	0.0	10.0	10.0	20.0	20.0
MOISTURE CONTENT %	31.4	25.6	52.6	52.5	47.3	43.3
	711111000			T 1111 10		
HOLE NO.	TH11-09	-	- G93	TH11-10 G94	-	- G96
SAMPLE NO. DEPTH (FT)	G91 30.0	G92 35.0	40.0	1.0	G95 7.0	10.0
	30.0	33.0	40.0	1.0	1.0	10.0
MOISTURE CONTENT %	47.1	46.8	47.2	21.5	19.9	35.5

MATERIALS LABORATORY



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. SAMPLE NO.	TH11-14 G110	- G111	- G112	- G113	- G114	TH11-13 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
	TU14 40					
HOLE NO. SAMPLE NO.	TH11-13 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
MOISTOILE CONTEINT /	11.7	ד.טד	55.7	50.1	U. 1	-5.0
NOTES:						

MATERIALS LABORATORY



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:		<u></u>		L		L
AEC	сом		ABORATORY ive, Winnipeg, ME 31 fax (204) 284		da	

MATERIALS LABORATORY



AECOM

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

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

4-Jan-12
TH11-02
G12
20.0'
AL

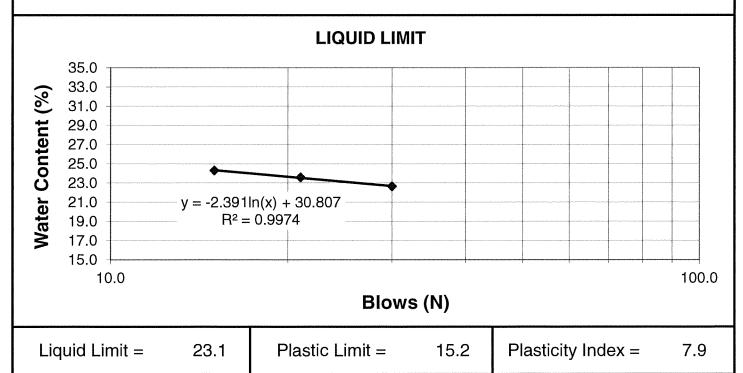
Liquid Limit

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

92.370	86.663			
91.580	85.797			
86.387	80.119			
0.790	0.866			
5.193	5.678			
15.213	15.252			
	91.580 86.387 0.790 5.193	91.580 85.797 86.387 80.119 0.790 0.866 5.193 5.678	91.580 85.797 86.387 80.119 0.790 0.866 5.193 5.678	91.580 85.797 86.387 80.119 0.790 0.866 5.193 5.678



MATERIALS LABORATORY



AECOM

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

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

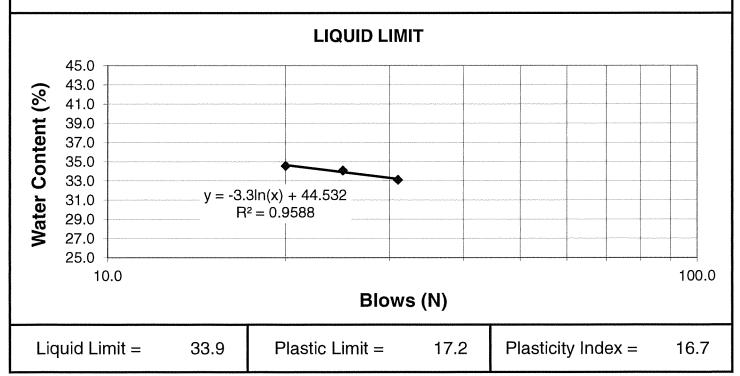
DATE:	4-Jan-12
TEST HOLE:	TH11-07
SAMPLE:	G34
DEPTH:	5.0'
TECH.:	AL

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	



MATERIALS LABORATORY



AECOM

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

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

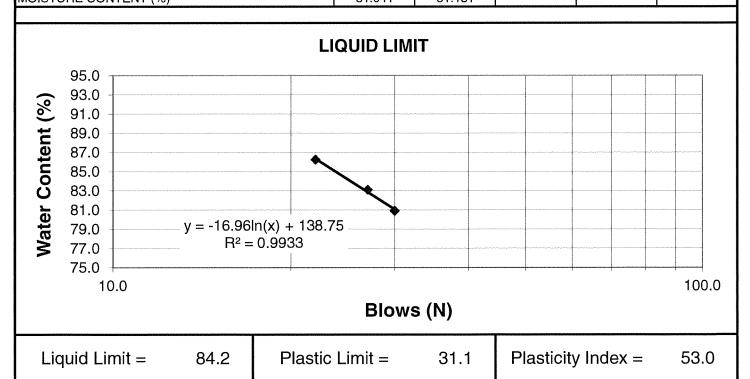
DATE:	4-Jan-12	
TEST HOLE:	TH11-13	
SAMPLE:	T118	
DEPTH:	10.0 - 12.0'	
TECH.:	AL	

Liquid Limit

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		



MATERIALS LABORATORY



AECOM

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

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

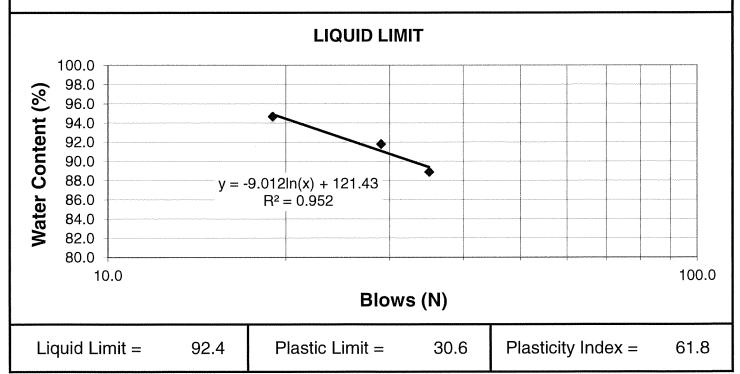
DATE:	4-Jan-12
TEST HOLE:	TH11-14
SAMPLE:	T106
DEPTH:	10.0 - 12.0'
TECH.:	AL

Liquid Limit

35	29	19		
91.139	91.936	92.988		
86.440	86.284	87.441		
81.154	80.127	81.582		
4.699	5.652	5.547		
5.286	6.157	5.859		
88.895	91.798	94.675		
	91.139 86.440 81.154 4.699 5.286	91.139 91.936 86.440 86.284 81.154 80.127 4.699 5.652 5.286 6.157	91.139 91.936 92.988 86.440 86.284 87.441 81.154 80.127 81.582 4.699 5.652 5.547 5.286 6.157 5.859	91.139 91.936 92.988 86.440 86.284 87.441 81.154 80.127 81.582 4.699 5.652 5.547 5.286 6.157 5.859

Plastic Limit

88.930	91.154			
87.957	89.995			
84.775	86.208			
0.973	1.159			
3.182	3.787			
30.578	30.605			
	87.957 84.775 0.973 3.182	87.957 89.995 84.775 86.208 0.973 1.159 3.182 3.787	87.957 89.995 84.775 86.208 0.973 1.159 3.182 3.787	87.957 89.995 84.775 86.208 0.973 1.159 3.182 3.787





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

Job No.: Client: Project : Date Tested: Tested By:

60219315 City of Winnipeg Jefferson East CSR 4-Jan-12

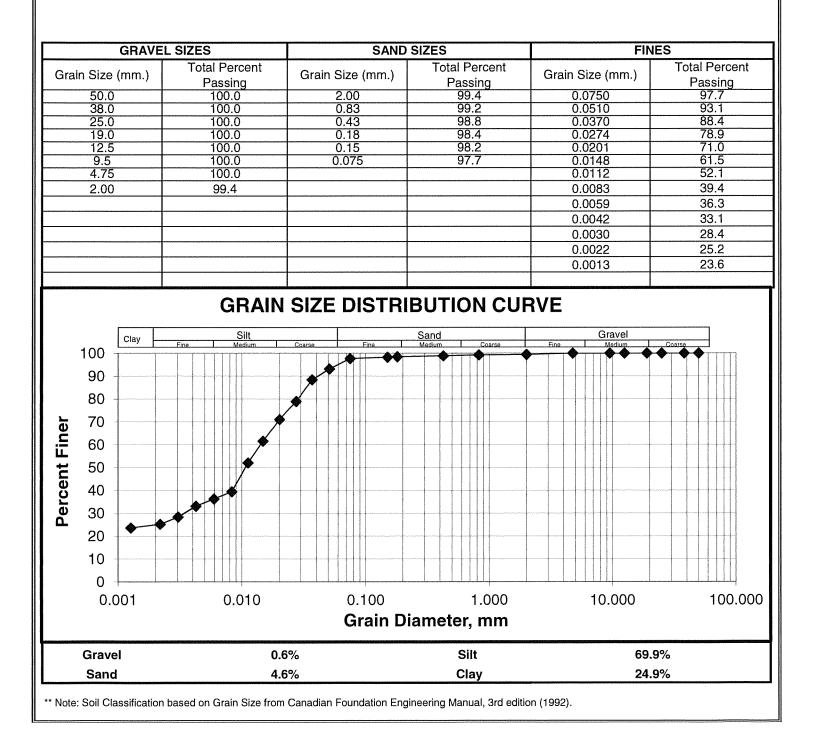
Hole No.:	TH11-02	
Sample No.:	G12	
Depth:	20.0'	
Date Sampled:		
Sampled By:		

	GRAVE	L SIZES	SAND		FIN	
Ornir	n Size (mm.)	Total Percent	Grain Size (mm.)	Total Percent	Grain Size (mm.)	Total Percent
Grai		Passing		Passing		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
	100 90 80	Silt Fine Medium 1	Coarse Fine	Sand Medium Coarse	Gravel	
Percent Finer	70 60 50 40 30					
D .	20 10 0					
	0.001	0.010	0.100	1.000	10.000	100.00
			Grain Di	ameter, mm		
	Gravel	0.0)%	Silt	23. ⁻	1%
	Sand	61.		Clay	15.4	
	17/11/1U	01.	J / D		10.4	T /U



MATERIALS LABORATORY AECOM

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

Job No.: Client: Project : Date Tested: Tested By: 60219315 City of Winnipeg Jefferson East CSR 4-Jan-12 



MATERIALS LABORATORY

Job No.: Client: Project : Date Tested: Tested By:

60219315	
City of Winnipeg	
Jefferson East CSR	
4-Jan-12	

Hole No.: Sample No.: Depth: Sampled By:

TH11-13 T118 10.0 - 12.0' Date Sampled: _____

	GRAVE	L SIZES	SAND	SIZES	FIN	ES
Gra	ain Size (mm.)	Total Percent	Grain Size (mm.)	Total Percent	Grain Size (mm.)	Total Percent
Gia	· ·	Passing	· ,	Passing		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	100.0 100.0
	12.5 9.5	100.0 100.0	0.15	100.0 100.0	0.0174	100.0
	4.75	100.0	0.075	100.0	0.0090	100.0
						96.8
	2.00	100.0			0.0065	
					0.0047	93.6
		- · - ·			0.0033	90.5
					0.0024	87.3
					0.0017	84.1
					0.0010	80.9
L	100 90 80 70					
ne	60					
Ţ	50					
en D	00					
π.	40					
erc	40					
Perc	30					
Perc	30 20					
Perc	30 20 10					
Perc	30 20 10 0	0.010	0.100	1.000	10.000	100-00
Perc	30 20 10	0.010	0.100 Grain D	1.000 iameter, mm	10.000	100.00
Percent Finer	30 20 10 0				10.000	

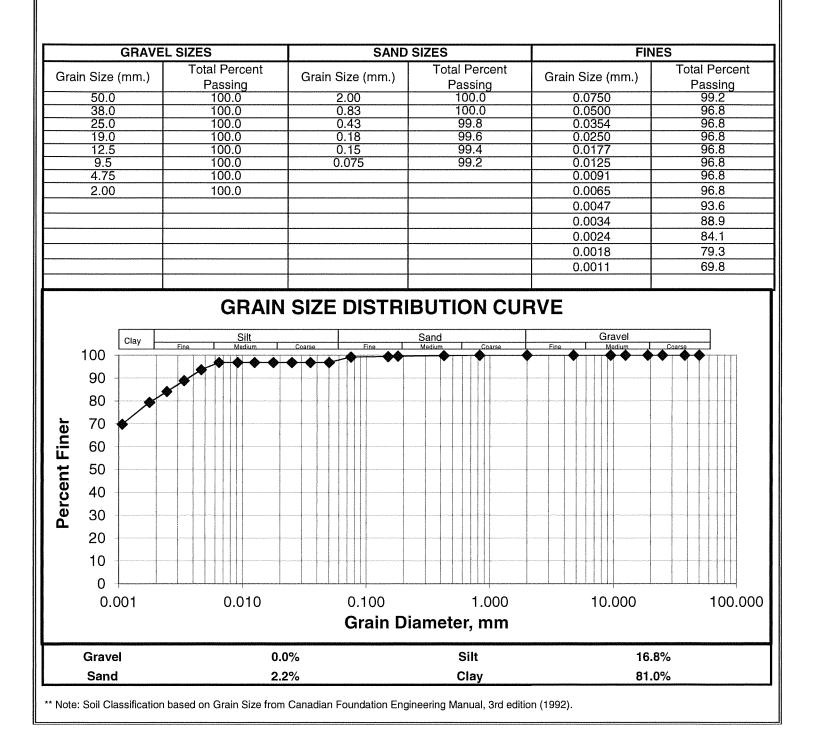


MATERIALS LABORATORY AECOM

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

Job No.: Client: Project : Date Tested: Tested By:

60219315
City of Winnipeg
Jefferson East CSR
4-Jan-12



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



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	
DATE TESTED.		
SHEAR STRENGTH TESTS		
LAB VANE	Su 1	
Reading		
Spring Number	4	
Undrained Shear Strength (kPa) =	0.0	
Undrained Shear Strength (ksf) =	0.00	
	0.000	
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 57.4	
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 7.21 14.48	
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 (a/cm ³)	1.762	
Bulk Density (kN/m³)	17.3	
Bulk Density (pcf)	110.0	
Drv Densitv (kN/m ³)	11.97	I

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



CLIENT:	City of Winnipe	<u>,</u>			
PROJECT:	Jefferson East (CSR			
JOB NO.:	60219315				
TEST HOLE NO .:	TH11-13		SOIL	L DESCRIPTION	:
SAMPLE NO.:	T118		CLAY; trace silt, light brown, moist	t, firm, high plast	icity, blocky
SAMPLE DEPTH:	10.0 - 12.0'				
SAMPLE DATE:	14-Dec-11				
TEST DATE:	2-Jan-12		MOISTURE CONTENT:	44.4	
SAMPLE DIAM.(Do):	72.13	(mm)	INITIAL AREA, Ao:	4086. 6	(mm²)
SAMPLE LENGTH, (Lo):	144.50	(mm)	PISTON RATE:	0.051	(inches / minute)

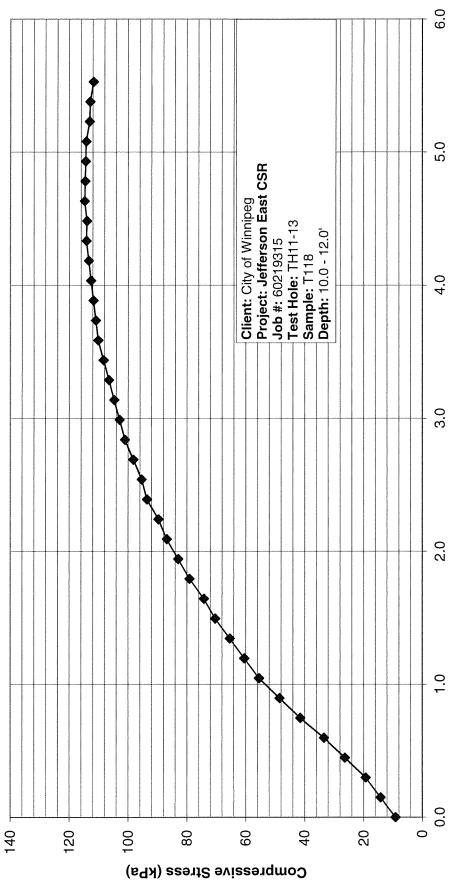


SAMPLE DIAM.(Do):	72.13	(mm)	INITIAL AREA, Ao:	4086. 6	(mm²)
SAMPLE LENGTH, (Lo):		(mm)	PISTON RATE:	0.001	(inches / minute)
L / D RATIO:	2.0	(2 < L/D < 2.5)	AXIAL STRAIN RATE, R:		(0.5 <r<2 %="" minute)<="" td=""></r<2>

		TOTAL			1			
AXIAL COMPRESSION	PROVING RING	AXIAL STRAIN, E ₁	AVERAGE CROSS-SECTIONAL AREA, A	APPLIED AXIAL LOAD, P	СОМР	DMPRESSIVE 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.	
0.05	0.0041	0.75	6.38	38.42	6.02	0.867	41.	
0.06	0.0048	0.90	6.39	44.98	7.04	1.013	48.	
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.	
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.	
0.12	0.0083	1.94	6.46	77.77	12.04	1.734	83.(
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.	
0.14	0.0094	2.39	6.49	88.08	13.57	1.954	93.0	
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.	
0.17	0.0102	2.84	6.52	95.57	14.66	2.111	101	
0.18	0.0104	2.99	6.53	97.45	14.92	2.149	102	
0.19	0.0106	3.14	6.54	99.32	15.19	2,187	104	
0.20	0.0108	3.29	6.55	101.20	15.45	2.225	106	
0.20	0.0110	3.44	6.56	103.07	15.71	2.263	108	
0.21	0.0112	3.59	6.57	104.94	15.97	2.300	110	
0.22	0.0113	3.74	6.58	105.88	16.09	2.317	110	
0.23	0.0114	3.88	6.59	106.82	16.21	2.334	111	
0.24	0.0115	4.03	6.60	107.76	16.33	2.351	112	
0.25	0.0116	4.18	6.61	108.69	16.44	2.368	113	
0.26	0.0117	4.33	6.62	109.63	16.56	2.384	114	
0.26	0.0117	4.48	6.63	109.63	16.53	2.381	114.	
0.27	0.0118	4.63	6.64	110.57	16.65	2.397	114	
0.28	0.0118	4.78	6.65	110.57	16.62	2.393		
0.29	0.0118	4.93	6.66	110.57	16.59	2.390	114	
0.30	0.0118	5.08	6.67	110.57	16.57	2.386		
0.31	0.0117	5.23	6.68	109.63	16.40	2.362	113	
0.31	0.0117	5.38	6.69	109.63	16.38	2.358	112	
0.32	0.0116	5.53	6.70	108.69	16.21	2.334		
							·····	
	+	<u> </u>			•			
	.							
	·····						•••••	
	+	<u> </u>			+			
	.							
	1				1			
	+							
	1	L			1			
NFINED COMPRESSI	VE STRENGTH, qu:		kPa		NOTES:			
(based on maximum	n q, value) EAR STRENGTH, S,:		ksf KPa					
	n q., value)	1,199		1				

REMARKS:

AECOM UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS (ASTM D2166)



Axial Strain (%)

A=COM



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

CLIENT: City of Winnipeg PROJECT: Jefferson East CSR JOB NO.: <u>60219315</u>

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		
Undrained Shear Strength (kPa) =	4 0.0	
Undrained Shear Strength (kra) =	0.00	
Ondrained Onear Strength (KSI) =	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	100.0	
Unconfined compressive strength (kPa) =	106.3 2.2	
Unconfined compressive strength (ksf) =		
Undrained Shear Strength (kPa) =	53.1 1.110	
Undrained Shear Strength (ksf) =		
MOISTURE CONTENT	Density -Su1	
Tare Number	75	
Wt. Sample wet + tare (g)	75 327.4	
Wt. Sample dry + tare (g) 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	I
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 (a/cm ³)	1.741 17.1	
Bulk Density (kN/m ³)		
Bulk Density (pcf)	108.7	
Drv Density (kN/m ³)	11.60	

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

PISTON RATE:

AXIAL STRAIN RATE, R

0.051

0.85

(inches / minute)

(0.5<R<2 % / minute)

AECOM

CLIENT:	City of Winnipeg]					
	Jefferson East C	erson East CSR					
JOB NO.:	60219315						
TEST HOLE NO.:	TH11-13		SO	IL DESCRIPTION	:		
SAMPLE NO.:	T123		CLAY; some silt inclusions (< 5m	m), grey, moist, fi	rm, high plasticity,		
SAMPLE DEPTH:	30.0 32.0'		slickensided				
SAMPLE DATE:	14-Dec-11						
TEST DATE:	2-Jan-12		MOISTURE CONTENT:	47.2			
		_					
SAMPLE DIAM.(Do):	72.27	(mm)	INITIAL AREA, Ao:	4101.7	(mm²)		
SAMPLE DIAM.(Do):	72.27	(mm)	INITIAL AREA, Ao:	4101.7	(mm²)		

153.30

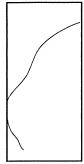
2.1

(mm)

(2 < L/D < 2.5)

SAMPLE LENGTH, (Lo):

L / D RATIO:



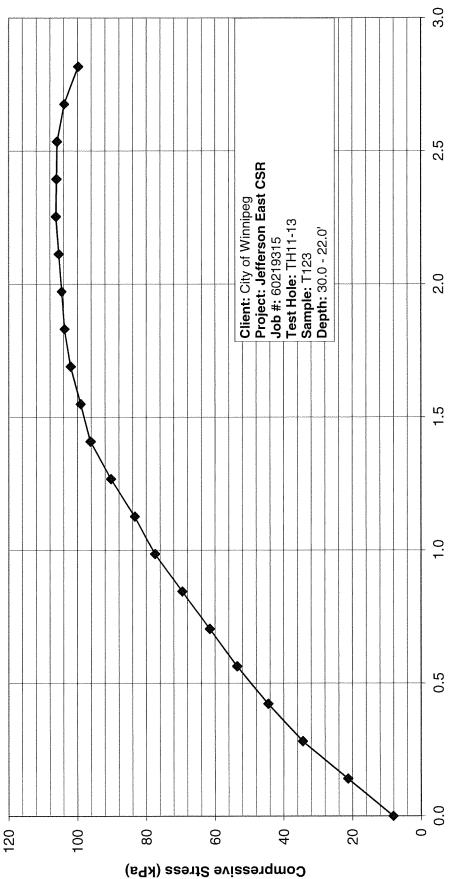
FAILURE SKETCH

AXIAL COMPRESSION	PROVING RING	TOTAL AXIAL STRAIN, E ₁	AVERAGE CROSS-SECTIONAL AREA, A	APPLIED AXIAL LOAD, P	COMPRI	ESSIVE STRESS, Ø	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
0.02 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
0.04	0.0061	0.70	6.40	57.16	8.93	1.285	61.5
0.05	0.0069	0.85	6.41	64.65	10.08	1.452	69.5
0.07	0.0003	0.85	6.42	72.15	11.24	1.618	77.5
		1.13	6.43	77.77	12.09	1.742	83.4
0.08 0.09	0.0083	1.13	6.44	84.33	13.10	1.886	90.3
	0.0090						96.2
0.09	0.0096	1.41	6.45	89.95	13.95	2.009	
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
ONFINED COMPRESSI (based on maximur	n q., value)	2.220	kPa ksf		NOTES:		
	AR STRENGTH, S		kPa				

REMARKS:

AECOM UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS (ASTM D2166)

AICOM



Axial Strain (%)



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

CLIENT: City of Winnipeg PROJECT: Jefferson East CSR JOB NO.: <u>60219315</u>

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	185.6	
Unconfined compressive strength (kPa) = Unconfined compressive strength (ksf) =	3.9	
Undrained Shear Strength (kPa) =	92.8	
Undrained Shear Strength (kr a) =	1.938	
Ondrained Onear Ottength (Kely =	Density -Su1	
MOISTURE CONTENT	Deneny eur	
Tare Number		
Wt. Sample wet + tare (g)	14 375.3	
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 15.34	
Avg. Length (cm)	***************************************	
Volume (cm3) Moisture content (%)	<u>628.6</u> 43.4	
	1.748	
Bulk Density (a/cm ³)	17.1	
Bulk Density (kN/m³) Bulk Density (pcf)	109.1	
Dry Density (kN/m ³)	11.95	

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

PISTON RATE:

AXIAL STRAIN RATE, R:

0.051

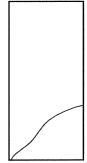
0.84

(inches / minute)

(0.5<R<2 % / minute)

AECOM

CLIENT:	City of Winnipeg				
PROJECT:	Jefferson East C	SR			
JOB NO.:	60219315				
		_			
TEST HOLE NO.:	TH11-14		SO	IL DESCRIPTION	:
SAMPLE NO.:	T106		CLAY; trace silt inclusions (<5mn	n), light brown, mo	oist, firm, intermediate
SAMPLE DEPTH:	10.0 - 12.0'		to high plasticity, slickensided		
SAMPLE DATE:	14-Dec-11				
TEST DATE:	2-Jan-12		MOISTURE CONTENT:	43.4	
		-			
SAMPLE DIAM.(Do):	72.23	(mm)	INITIAL AREA, Ao:	4097.9	(mm²)



FAILURE SKETCH

TEST DATA - DIAL	READINGS						
AXIAL COMPRESSION	PROVING RING	TOTAL AXIAL STRAIN, E ₁	AVERAGE CROSS-SECTIONAL AREA, A	APPLIED AXIAL LOAD, P	COMPF	ESSIVE STRESS, C	5 _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	0.30	6.40	56.22	8.79	1.266	60.6
0.05	0.0071	0.70	6.41	66.53	10.39	1.495	71.6
0.07		0.99	6.42	77,77	12.12	1.746	83.6
0.07	0.0083	1.13	6.42		13.56	1.953	93.5
	0.0093			87.14 95.57	14.86	2.139	
0.09	0.0102	1.27	6.43		14.80		102.4
0.09	0.0113	1.41	6.44	105.88		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 2.39	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
		3.24		171.47	26.12	3.762	180.1
0.20	0.0183	3.24	6.56	1/1.4/	20.12	0.702	100.1
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				-			
NCONFINED COMPRESSI	VE STRENGTH, q.:		kPa	1	NOTES:		
(based on maximun	n q _u value)		ksf				
LINIDRAINED SHE	AR STRENGTH, S.	92.78	kPa	1			
		1.938	ksf				

REMARKS:

SAMPLE LENGTH, (Lo):

L / D RATIO:

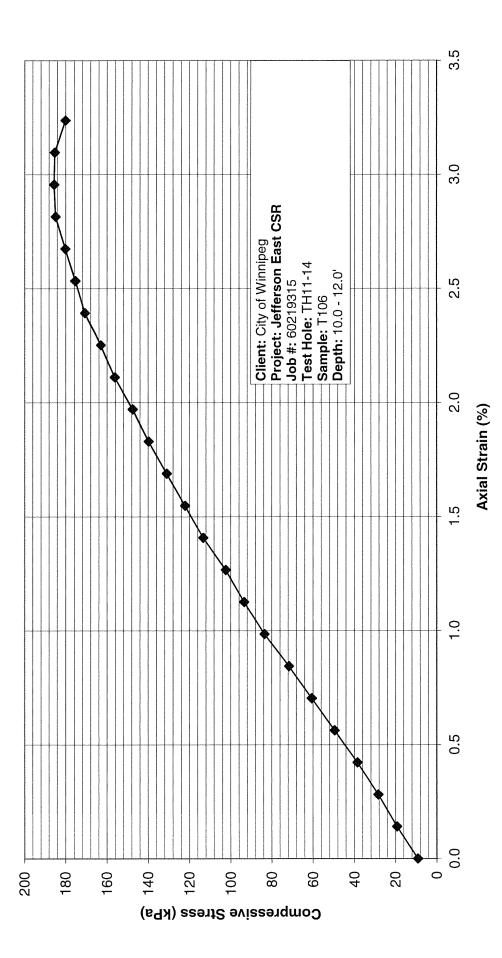
153.40

2.1

(mm)

(2 < L/D < 2.5)

AECOM UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS (ASTM D2166)



AICOM



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	Location	Sample	Depth (m)	Moisture
THE			Content (%)		· · ·	,	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	-			1
	G6	2.29 - 2.44 m	42.2		ļ.		
	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				
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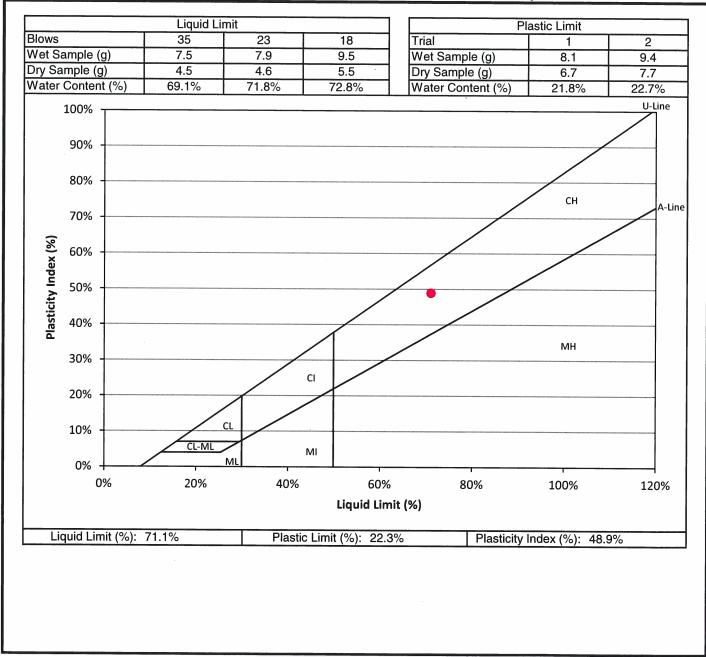


Fax: 204 284 2040

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:	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



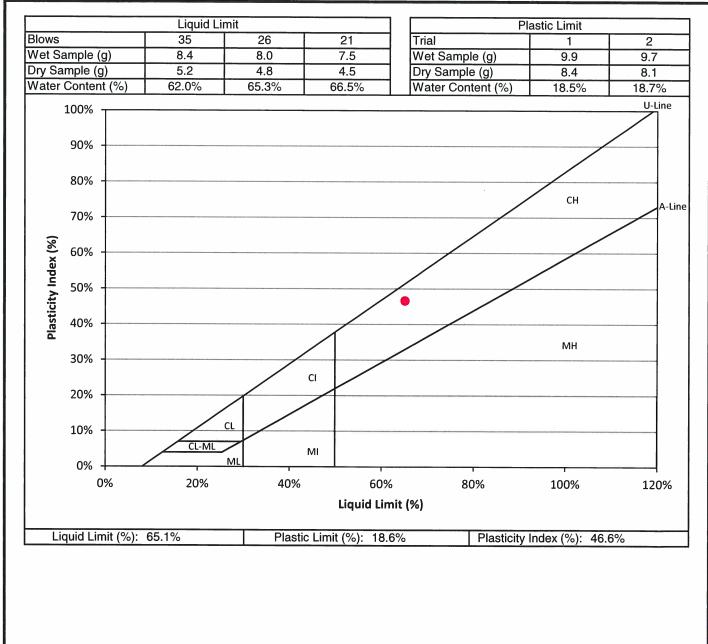


Fax: 204 284 2040

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



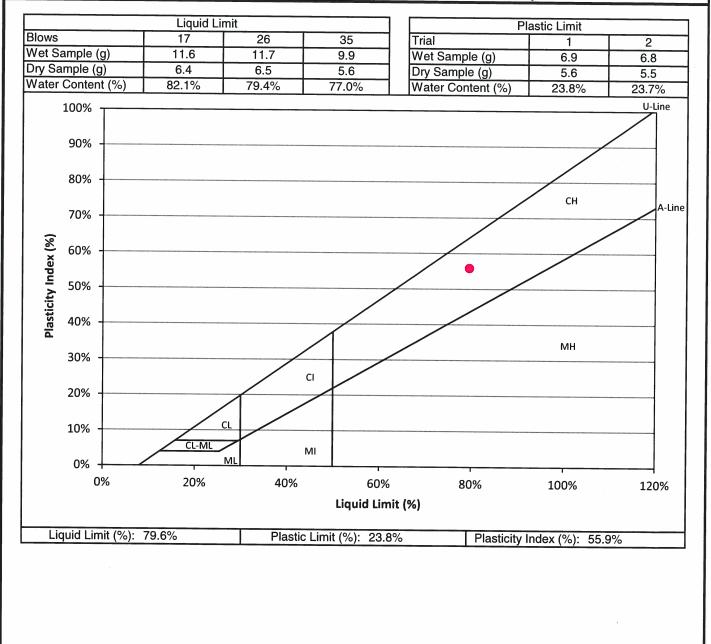


Fax: 204 284 2040

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:	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



(ASTM D422-63)



MATERIALS LABORATORY

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

Job No.: Client: Project : Date Tested: Tested By:

60219315
City of Winnipeg
Jefferson East CSR
2-Apr-15
MLotecki

Hole No.: Sample No.: Depth: Date Sampled: 24-Feb-15 Sampled By:

TH15-01 G1 0.30 - 0.46 m AECOM

GRAVEL SIZES			SANE	O SIZES	FINES		
Grai	n 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	
	100 Clay	Silt Fine Medium	Coarse Fine	Sand Medium Coarse	Gravel		
	90						
	90						
	80			┝━━━┼━╍┼╾┽┽┽╡┽┼┼╴╴╴╴┼			
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Percent Finer	•						
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	20						
	10						
	10						
	10						
	10	0.010	0.100	1.000	10.000	100.00	
	10	0.010		1.000 Diameter, mm	10.000	100.00	
	10				10.000	100.0C	

GRAIN SIZE DISTRIBUTION (ASTM D422-63)



MATERIALS LABORATORY

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

Job No.: Client: Project : Date Tested: Tested By:

60219315	
City of Winnipeg	
Jefferson East CSR	
2-Apr-15	
MLotecki	

Hole No.:	TH15-01
Sample No.:	G3
Depth:	1.22 - 1.37 m
Date Sampled:	24-Feb-15
Sampled By:	AECOM

GRAVEL SIZES			SAN	SAND SIZES FINES			
Grain S	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	
		Notes			0.0037	68.2	
		·····			0.0026	66.6	
					0.0019	63.5	
					0.0013	55.5	
					0.0011	55.5	
	·····		I SIZE DISTR	IBUTION CUR			
	Clay	Silt	Coarse Fine	Sand	Gravel	Coarse	
1(00			<u> </u>	─────� ───		
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	70						
e	70						
<u>، ⊇.</u>	60						
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	10 +						
	0 +						
	0.001	0.010	0.100	1.000	10.000	100.00	
				Diameter, mm			
		-		•			
	aravel	0.	0%	Silt	29.5%		
G	alavei		6%		63.9		



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 (%)	Location	Sample	Depth (m)	Moisture Content (%)
TH19-01	G1A	1.07 - 1.22 m	20.5%		S50	16.31 - 16.56 m	9.3%
	G1	1.37 - 1.52 m	28.6%	TH19-06	G55	1.37 - 1.52 m	22.3%
	G3	4.42 - 4.57 m	47.3%		G56A	1.75 - 1.91 m	28.6%
	G4	5.94 - 6.10 m	46.4%		G56B	2.21 - 2.36 m	23.3%
	G6	8.99 - 9.14 m	43.9%		G56	2.90 - 3.05 m	41.5%
	G7	10.52 - 10.67 m	39.9%		G57	4.42 - 4.57 m	46.8%
	S9	13.72 - 14.17 m	10.1%		G59	7.47 - 7.62 m	44.0%
	S10	14.94 - 15.01 m	16.4%		G60	8.99 - 9.14 m	53.3%
TH19-02	G16A	0.69 - 0.84 m	19.4%		G61	10.52 - 10.67 m	50.8%
	G16	1.37 - 1.52 m	27.1%		G62	12.04 - 12.19 m	59.1%
	G17	2.90 - 3.05 m	48.9%	TH19-07	G63	1.37 - 1.52 m	12.3%
	G18	4.42 - 4.57 m	48.3%		G64	2.90 - 3.05 m	47.1%
	G20	7.47 - 7.62 m	43.0%		G65	4.42 - 4.57 m	50.5%
	G21	8.99 - 9.14 m	41.3%		G66	5.94 - 6.10 m	53.6%
	G22	10.52 - 10.67 m	37.3%		G68	8.99 - 9.14 m	52.2%
	G23	12.04 - 12.19 m	38.3%		G69	10.52 - 10.67 m	51.4%
TH19-03	G24	1.37 - 1.52 m	27.7%		G70	12.04 - 12.19 m	54.6%
	G25	2.90 - 3.05 m	42.6%	TH19-08	G71A	0.69 - 0.84 m	19.7%
	G26	4.42 - 4.57 m	55.1%		G71	1.37 - 1.52 m	36.3%
	G27	5.94 - 6.10 m	38.6%		G72	2.90 - 3.05 m	53.7%
	G28	7.47 - 7.62 m	44.0%		G73	4.42 - 4.57 m	53.4%
	G30	10.52 - 10.67 m	33.8%		G75	7.47 - 7.62 m	45.2%
	G31	12.04 - 12.19 m	26.3%		G76	8.99 - 9.14 m	48.7%
TH19-04	G32A	0.91 - 1.07 m	20.8%		G77	10.52 - 10.67 m	49.2%
	G32	1.37 - 1.52 m	24.8%		G78	12.04 - 12.19 m	46.7%
	G33	2.90 - 3.05 m	48.4%		G79	13.56 - 13.72 m	22.9%
	G34	4.42 - 4.57 m	48.7%		G80	15.09 - 15.24 m	11.7%
	G35	5.94 - 6.10 m	50.9%		S81	16.76 - 17.22 m	12.0%
	G37	8.99 - 9.14 m	41.3%	TH19-10	G91A	0.84 - 0.99 m	25.4%
	G38	10.52 - 10.67 m	47.3%		G91	1.37 - 1.52 m	22.6%
	G39	12.04 - 12.19 m	41.4%		G92	2.90 - 3.05 m	33.9%
TH19-05	G40A	0.61 - 0.76 m	25.9%		G93	4.42 - 4.57 m	52.3%
	G40	1.37 - 1.52 m	26.6%		G94	5.94 - 6.10 m	51.5%
	G41	2.90 - 3.05 m	22.9%		G96	8.99 - 9.14 m	41.1%
	G43	5.94 - 6.10 m	45.4%		G97	10.52 - 10.67 m	47.3%
	G45	8.99 - 9.14 m	45.3%		G98	12.04 - 12.19 m	48.3%
	G47	12.04 - 12.19 m	47.5%	TH19-11	G99A	0.53 - 0.69 m	31.4%
	S49	15.24 - 15.70 m	11.5%		G99	1.37 - 1.52 m	21.7%



AECOM Canada Ltd. Winnipeg Geotechnical Laboratory 99 Commerce Drive Winnipeg, Manitoba R3P 0Y7 Phone: 204 477 5381 Fax: 2

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	Location	Sample	Depth (m)	Moisture
			Content (%)			,	Content (%)
	G100	2.90 - 3.05 m	50.3%		G150	7.47 - 7.62 m	48.3%
	G102	5.94 - 6.10 m	48.9%		G152	10.52 - 10.67 m	51.3%
	G103	7.47 - 7.62 m	48.1%		G153	12.04 - 12.19 m	50.7%
	G104	8.99 - 9.14 m	64.3%		G156	16.61 - 16.76 m	18.1%
	G105	10.52 - 10.67 m	42.2%	TH19-17	G158A	0.69 - 0.84 m	27.0%
	G106	12.04 - 12.19 m	59.0%		G158	1.37 - 1.52 m	14.2%
	G107	13.56 - 13.72 m	44.8%		G159	2.90 - 3.05 m	24.1%
	G108	15.09 - 15.24 m	21.5%		G161	5.94 - 6.10 m	55.0%
	G109	16.61 - 16.76 m	37.7%		G163	8.99 - 9.14 m	47.6%
	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%		<u> </u>		
TH19-15	G142	5.94 - 6.10 m	52.3%				
1110-10	G144	8.99 - 9.14 m	46.1%				
TH19-16	G146	1.37 - 1.52 m	30.5%		<u> </u>		



MOISTURE CONTENT OF SOIL (ASTM D2216)

CLIENT: AECOM		TEST NO:	19- 001	PROJECT NO:	112-1909
PROJECT: Jefferson Eas	t 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



PROJECT NO.: 112-1909

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

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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	45001/				440 4000	
CLIENT:	AECOM			JECT NO.	112-1909 1	
	99 Commerce Winnipeg, MB			est No: .ab No:	1 HM 314	
ATTENTION:		RSP 017	L	ad No.		
PROJECT:	Ryan Harras	t CSR (Phase 2)				
FROJECT.	Winnipeg, Ma	. ,				
Date Sampled:		Date Received: 27-Jul-19	Sieve An	alvsis	Hydromete	er Analysis
Sampled By:	Client	Date Tested: 1-Aug-19	Sieve (mm) %	-	Diameter	% Finer
			50.00	100.0		
			37.50	100.0		
			25.00	100.0		
			19.00	100.0		
			16.00	100.0		
Material Identific	cation		12.50	100.0	0.0405	69.0
B.H./T.H. No.		TH 19-05	9.50	100.0	0.0300	57.0
Sample No.		G41	4.75	100.0	0.0200	42.0
Sample depth		10'	2.00	100.0	0.0162	35.0
Specific Gravity c	of Material:	2.65	1.18	100.0	0.0120	29.0
			0.425 0.180	99.8 99.2	0.0087 0.0062	22.0 17.0
			0.180	99.2 97.6	0.0082	17.0
			•	-		
		Grain Size Analy	SIS			n 100
						90
						- 80 %
		+++++ + + <u>+</u> +++++++ + +				70 70
						60 P
						50 s
						s
						-40 i n
						³⁰ g
						20
	•					- 10
						0
0.0001	0.001	0.01 0,1	1	10	1	100
CLA	Y	SILT	SAND	GI	RAVEL	
	I	Particle Size (mn	1)	Į	Series2	
			% Compo	sition	D10	0.00130
	SOIL DESC	RIPTION		Gravel	D30	0.00130
			2.4 S	and	D60	0.03245
				Silt	Cu	24.96
			<mark>11.0</mark> 0	Clay	Сс	3.44

P. Bevel



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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT PROJECT NO. CLIENT: AECOM 112-1909 2 99 Commerce Drive, Test No: Winnipeg, MB R3P 0Y7 HM 314 Lab No: ATTENTION: Ryan Harras PROJECT: Jefferson East CSR (Phase 2) Winnipeg, Manitoba 6/24-27/2019 Date Received: 27-Jul-19 Hydrometer Analysis Date Sampled: Sieve Analysis Date Tested: Sieve (mm) % Passing Diameter % Finer Sampled By: Client 1-Aug-19 50.00 100.0 37.50 100.0 25.00 100.0 19.00 100.0 16.00 100.0 Material Identification 12.50 100.0 0.0421 57.6 TH 19-08 53.7 B.H./T.H. No. 9.50 100.0 0.0302 Sample No. S81 4.75 100.0 0.0196 46.8 Sample depth 55' 42.9 2.00 97.6 0.0157 Specific Gravity of Material: 1.18 0.0116 39.0 2.65 93.2 0.425 0.0083 34.2 87.4 0.180 79.8 0.0060 30.3 0.0030 23.4 0.075 64.8 **Grain Size Analysis** 100 90 80 % 70 Р 60 а s 50 s 40 i n 30 g 20 10 0 0.0001 0.001 0.01 0,1 10 100 1 SAND CLAY SILT GRAVEL Particle Size (mm) % Composition D10 SOIL DESCRIPTION Gravel D30 0.00590 35.2 Sand D60 0.00184 43.8 Silt Cu #DIV/0! 21.0 Clay Сс #DIV/0! Remarks: Test Method: ASTM D422, D2216, D4318

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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT PROJECT NO. 112-1909 CLIENT: AECOM 99 Commerce Drive, Test No: 3 Winnipeg, MB R3P 0Y7 HM 314 Lab No: ATTENTION: Ryan Harras PROJECT: Jefferson East CSR (Phase 2) Winnipeg, Manitoba 6/24-27/2019 Date Received: 27-Jul-19 Hydrometer Analysis Date Sampled: Sieve Analysis Date Tested: Sieve (mm) % Passing Diameter % Finer Sampled By: Client 1-Aug-19 50.00 100.0 37.50 100.0 25.00 100.0 19.00 100.0 16.00 100.0 Material Identification 12.50 100.0 0.0360 95.0 TH 19-08 93.0 B.H./T.H. No. 9.50 100.0 0.0257 Sample No. T74 4.75 100.0 0.0164 91.0 Sample depth 20' 100.0 90.0 2.00 0.0130 Specific Gravity of Material: 1.18 100.0 88.0 2.65 0.0096 0.425 100.0 0.0069 85.0 0.180 100.0 0.0050 81.0 0.075 99.0 0.0026 69.0 **Grain Size Analysis** 100 90 80 % 70 Р 60 а s 50 s 40 i n 30 g 20 10 0 0.0001 0.001 0.01 0,1 10 100 1 SAND CLAY SILT GRAVEL Particle Size (mm) % Composition D10 SOIL DESCRIPTION Gravel D30 1.0 Sand D60 0.00184 35.0 Silt Cu #DIV/0! 64.0 Clay Сс #DIV/0! Remarks: Test Method: ASTM D422, D2216, D4318

P. Bevel



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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT PROJECT NO. 112-1909 CLIENT: AECOM 99 Commerce Drive, Test No: 4 Winnipeg, MB R3P 0Y7 HM 314 Lab No: ATTENTION: Ryan Harras PROJECT: Jefferson East CSR (Phase 2) Winnipeg, Manitoba 6/24-27/2019 Date Received: 27-Jul-19 Hydrometer Analysis Date Sampled: Sieve Analysis Date Tested: Sieve (mm) % Passing Diameter % Finer Sampled By: Client 1-Aug-19 50.00 100.0 37.50 100.0 25.00 100.0 19.00 100.0 16.00 100.0 Material Identification 12.50 100.0 0.0405 69.0 TH 19-14 59.0 B.H./T.H. No. 9.50 100.0 0.0297 Sample No. G127A 4.75 100.0 0.0198 45.0 Sample depth 7.5' 100.0 40.0 2.00 0.0159 Specific Gravity of Material: 0.0119 1.18 100.0 32.0 2.65 0.425 100.0 0.0085 27.0 0.180 99.6 0.0061 23.0 0.0031 0.075 98.6 18.0 **Grain Size Analysis** 100 90 80 % 70 Р 60 а s 50 s 40 i n 30 g 20 10 0 0.0001 0.001 0.01 0,1 10 100 1 SAND CLAY SILT GRAVEL Particle Size (mm) % Composition D10 SOIL DESCRIPTION Gravel D30 0.01268 1.4 Sand D60 0.02970 80.6 Silt Cu #DIV/0! 18.0 Clay Сс #DIV/0! Remarks: Test Method: ASTM D422, D2216, D4318

P. Bevel



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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT PROJECT NO. 112-1909 CLIENT: AECOM 99 Commerce Drive, Test No: 5 Winnipeg, MB R3P 0Y7 HM 314 Lab No: ATTENTION: Ryan Harras PROJECT: Jefferson East CSR (Phase 2) Winnipeg, Manitoba 6/24-27/2019 Date Received: 27-Jul-19 Hydrometer Analysis Date Sampled: Sieve Analysis Date Tested: Sieve (mm) % Passing Diameter % Finer Sampled By: Client 1-Aug-19 50.00 100.0 37.50 100.0 25.00 100.0 19.00 100.0 16.00 100.0 Material Identification 12.50 100.0 0.0353 99.0 TH 19-15 98.0 B.H./T.H. No. 9.50 100.0 0.0251 Sample No. T140 4.75 100.0 0.0159 97.0 Sample depth 10' 100.0 96.0 2.00 0.0127 Specific Gravity of Material: 1.18 100.0 95.0 2.65 0.0093 0.425 100.0 0.0066 93.0 0.180 100.0 0.0048 90.0 0.075 100.0 0.0025 82.0 **Grain Size Analysis** 100 90 80 % 70 Р 60 а s 50 s 40 i n 30 g 20 10 0 0.0001 0.001 0.01 0,1 10 100 1 SAND CLAY SILT GRAVEL Particle Size (mm) % Composition D10 SOIL DESCRIPTION Gravel D30 Sand D60 20.0 Silt Cu #DIV/0! 80.0 Clay Сс #DIV/0! Remarks: Test Method: ASTM D422, D2216, D4318

P. Bevel



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PARTICLE SIZE ANALYSIS OF SOILS TEST REPORT PROJECT NO. 112-1909 CLIENT: AECOM 99 Commerce Drive, Test No: 6 Winnipeg, MB R3P 0Y7 HM 314 Lab No: ATTENTION: Ryan Harras PROJECT: Jefferson East CSR (Phase 2) Winnipeg, Manitoba 6/24-27/2019 Date Received: 27-Jul-19 Hydrometer Analysis Date Sampled: Sieve Analysis Client Date Tested: Sieve (mm) % Passing Diameter % Finer Sampled By: 1-Aug-19 50.00 100.0 37.50 100.0 25.00 100.0 19.00 100.0 16.00 100.0 Material Identification 12.50 100.0 0.0367 91.0 B.H./T.H. No. TH 19-15 89.0 9.50 100.0 0.0262 Sample No. T146 4.75 100.0 0.0169 85.0 Sample depth 5' 100.0 82.0 2.00 0.0135 Specific Gravity of Material: 2.65 1.18 100.0 77.0 0.0101 0.425 100.0 0.0073 73.0 0.180 98.0 0.0052 68.0 0.075 94.0 0.0027 59.0 **Grain Size Analysis** 100 90 80 % 70 Р 60 а s 50 s 40 i n 30 g 20 10 0 0.0001 0.001 0.01 0,1 10 100 1 SAND CLAY SILT GRAVEL Particle Size (mm) % Composition D10 SOIL DESCRIPTION Gravel D30 6.0 Sand D60 0.00272 39.0 Silt Cu #DIV/0! 55.0 Clay Сс #DIV/0! Remarks: Test Method: ASTM D422, D2216, D4318

P. Bevel



						nmanalo@mts.net
		Atterbe	erg Limits ((ASTM D4	318)	
Client:	AECOM		-	Project No	,	
	99 Commerc	e Drive		Test No.:	1	
	Winnipeg, M			Lab No.:	HM 314	
Attention:	Ryan Harras			Date Rece	-	
Project:	•	st CSR (Phase	2)			/ NS
	Jenerson La				Ju / Dy. 2-Aug-19	/ 110
Dish No.:		1	Liquid Limit De 2	3		Liquid Limit
Wet Soil + D	ich:	1	2	3		25 Blows
Dry Soil + Di						23 DI0W3
Moisture:	511.					,
Dish:						
Dry Soil:			hit could not b	e determined	(See Remarks)	,
% Moisture:						
No. of Blows	•					,
Liquid Limits						
_		•		•		
		Liquid Limit			Material Identification	on:
40.00 -						
39.00					T.H./B.H. No.	TH 19-05, G41
38.00					Depth:	10 ft
37.00	 					
36.00					Liquid Limit, %:	
35.00					Plastic Limit, %:	
35.00					Plasticity Index:	n/a
34.00					(LL-PL)	
10			100			
	No. d	of Blows, N				
		Plastic L	imit Determinatio	n		
Dish No.:						
Wet Soil + D						
Dry Soil + Di	sh:					
Moisture:						
Dish:						
Dry Soil:				Non-Plas	stic	
				Non-Plas	stic	

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:

Infant

Gladys Paciente, P.Eng



				<u>hmanalo@mts.net</u>	
	Atterberg	g Limits (A	STM D43	318)	
Client: AECOM			Project N	lo.: 112-1909	
99 Commerc	e Drive		Test No.	2	
Winnipeg, M	B R3P 0Y7		Lab No.:	HM 314	
Attention.: Ryan Harras			Date Rec	ceived: 27-Jul-19	
Project: Jefferson Ea	st CSR (Phase			ted / By: 2-Aug-19	/ NS
	Lic	uid Limit Deter	mination		
Dish No.:	1	2	3		Liquid Limit
Wet Soil + Dish:	13	15.4	13.9		25 Blows
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
25.00 24.00 23.00 22.00 21.00 20.00 19.00 18.00 No. of E	Blows, N			Material Identifica T.H./B.H. No. Depth: Liquid Limit, %: Plastic Limit, %: Plasticity Index: (LL-PL)	TH 19-08, S81 55ft 22 10 12
	1	it Determinatio			
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

P. Bevel



h				hmanalo@mts.net	
	Atterberg	g Limits (A	STM D431	18)	
Client: AECOM			Project No	.: 112-1909	
99 Commerc			Test No.	3	
Winnipeg, M	B R3P 0Y7		Lab No.:	HM 314	
Attention.: Ryan Harras			Date Rece	eived: 27-Jul-19	
Project: Jefferson Ea	st CSR (Phase			ed / By: 2-Aug-19	/ NS
	Lic	luid Limit Deter	mination		
Dish No.:	1	2	3		Liquid Limit
Wet Soil + Dish:	11.51	12.73	11.54		25 Blows
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
65.00 64.00 63.00 62.00 61.00 60.00 59.00 58.00 57.00 55.00 No. of I	Blows, N			Material Identifica T.H./B.H. No. Depth: Liquid Limit, %: Plastic Limit, %: Plasticity Index: (LL-PL)	TH 19-08, T74 20ft 60 25
	Plastic Lim	it Determination	۱		
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

P. Bevel



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	Atterberg	g Limits (A	STM D43	18)	
Client: AECOM		•	Project N		
99 Commerc			Test No.	4	
Winnipeg, M	B R3P 0Y7		Lab No.:	HM 314	
Attention.: Ryan Harras			Date Rec	eived: 27-Jul-19	
Project: Jefferson Ea	st CSR (Phase			ted / By: 2-Aug-19	/ NS
	Lic	uid Limit Deter	mination		
Dish No.:	1	2	3		Liquid Limit
Wet Soil + Dish:	12.4	14.7	14.8		25 Blows
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
30.00 29.00 28.00 27.00 26.00 24.00 23.00 21.00 20.00 No. of E	Blows, N			Material Identifica T.H No TH 19- Depth: Liquid Limit, %: Plastic Limit, %: Plasticity Index: (LL-PL)	14, G127 A 7.5ft 24 16
	Plastic Lim	it Determination	n		
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

P. Bevel



			-	hmanalo@mts.net	
	Atterberg	g Limits (A	STM D43	18)	
Client: AECOM			Project No	o.: 112-1909	
99 Commerc	e Drive		Test No.	5	
Winnipeg, M	B R3P 0Y7		Lab No.:	HM 314	
Attention.: Ryan Harras			Date Rec	eived: 27-Jul-19	
Project: Jefferson Ea	st CSR (Phase			ed / By: 2-Aug-19	/ Navi
	Liq	uid Limit Deter	mination		-
Dish No.:	1	2	3		Liquid Limit
Wet Soil + Dish:	12.75	13.02	12.07		25 Blows
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
78.00 77.00 76.00 75.00 74.00 73.00 71.00 70.00 69.00 68.00 66.00 65.00 63.00 10 No. of E	Blows, N	100		Material Identifica T.H No TH 19- Depth: Liquid Limit, %: Plastic Limit, %: Plasticity Index: (LL-PL)	14, G127 A 7.5ft 70 31
	Plastic Lim	it Determination	n		
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

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	NS Liquid Limit 25 Blows
99 Commerce Drive Winnipeg, MB R3P 0Y7Test No.6 Lab No.:Attention.:Ryan HarrasDate Received:27-Jul-19Project:Jefferson East CSR (Phase 2)Date Tested / By:2-Aug-19 / NLiquid Limit DeterminationDish No.:123Liquid Limit DeterminationWet Soil + Dish:13.611.1213.242Dry Soil + Dish:11.518.701010	Liquid Limit
Winnipeg, MB R3P 0Y7Lab No.:HM 314Attention.:Ryan HarrasDate Received:27-Jul-19Project:Jefferson East CSR (Phase 2)Date Tested / By:2-Aug-19 / NLiquid Limit DeterminationDish No.:123Liquid Limit DeterminationWet Soil + Dish:13.611.1213.242Dry Soil + Dish:11.518.701010	Liquid Limit
Attention.:Ryan HarrasDate Received:27-Jul-19Project:Jefferson East CSR (Phase 2)Date Tested / By:2-Aug-19 / NLiquid Limit DeterminationDish No.:123Liquid Limit DeterminationWet Soil + Dish:13.611.1213.242Dry Soil + Dish:11.518.701010	Liquid Limit
Project: Jefferson East CSR (Phase 2) Date Tested / By: 2-Aug-19 / N Liquid Limit Determination Liquid Limit Determination <td>Liquid Limit</td>	Liquid Limit
Liquid Limit Determination Dish No.: 1 2 3 Liquid Limit Determination Wet Soil + Dish: 13.6 11.12 13.24 2 Dry Soil + Dish: 11.51 8.70 10 2	Liquid Limit
Dish No.: 1 2 3 Lie Wet Soil + Dish: 13.6 11.12 13.24 2 Dry Soil + Dish: 11.51 8.70 10 2	•
Wet Soil + Dish: 13.6 11.12 13.24 2 Dry Soil + Dish: 11.51 8.70 10 2	•
Dry Soil + Dish: 11.51 8.70 10	25 Blows
Moisture: 2.00 2.42 2.24	
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
Liquid Limit 60.00 59.00 50.00 57.00 56.00 55.00 54.00 52.00 51.00 50.00 48.00 No. of Blows, N Material Identification T.H No TH 19-16, Depth: Liquid Limit, %: Plastic Limit, %: Plasticity Index: (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

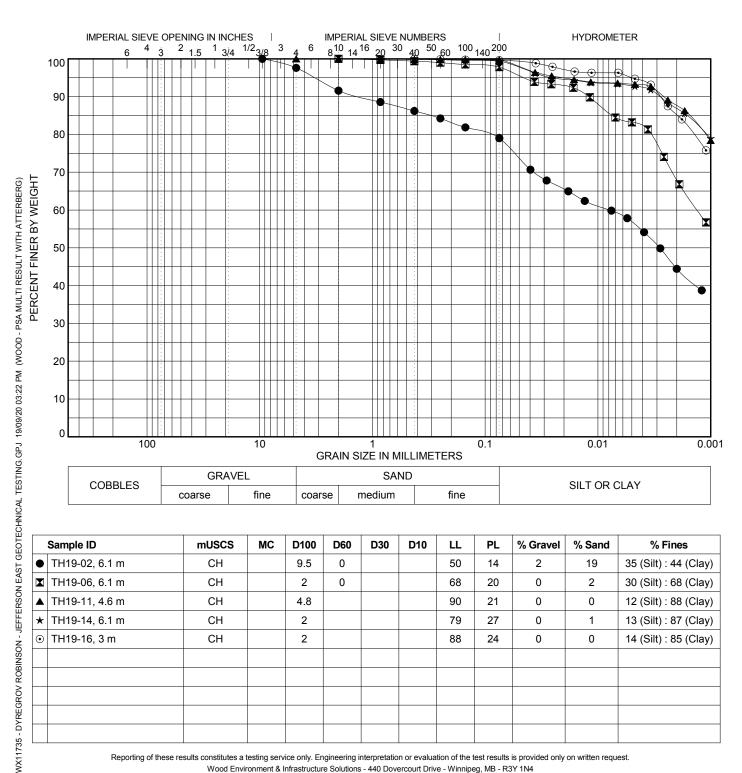
P. Bevel

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:



Reporting of these results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request. Wood Environment & Infrastructure Solutions - 440 Dovercourt Drive - Winnipeg, MB - R3Y 1N4

UNCONFINED COMPRESSION TEST

PROJECT:	Jefferson East CSR
AECOM PROJECT No.:	60599385

Test Hole	19-01	<u>Depth</u>	10	feet	Test Hole	19-01	Depth	25	feet
_		Sample No.	T2	-	_		Sample No.	Т5	
Wet + Tare Wt.	209.02 g	Length	176	mm	Wet + Tare Wt.	231.83 g	Length	170	mm
Dry + Tare Wt.	151.52 g	Diameter	71	mm	Dry + Tare Wt.	165.20 g	Diameter	71	mm
Tare Wt.	30.73 g	Area	3959	mm²	Tare Wt.	31.28 g	Area	3959	mm²
Wt. Water	57.50 g	Weight	1178.15	g	Wt. Water	66.63 g	Weight	1215.96	g
Dry Wt.	120.79 g	Strain	5.82	%	Dry Wt.	133.92 g	Strain	4.26	%
Moisture Cont.	47.6 %	Avg. Area	4204	mm²	Moisture Cont.	49.8 %	Avg. Area	4136	mm²
Wet Density	105.55 lb/ft3	16.58	kN/m³		Wet Density	112.78 lb/ft3	17.72	kN/m³	
Pocket Pen: Rdg	1.45 tsf	Torvane: Rdg	0.56	tsf	Pocket Pen: Rdg	1.50 tsf	Torvane: Rdg	0.59	tsf
Su	1.45 ksf	Std vane Su	1.15	ksf	Su	1.50 ksf	Std vane Su	1.21	ksf
Su	69.4 kPa	Su	54.9	kPa	Su	71.8 kPa	Su	57.9	kPa
Qu: Displacement	10.25 mm	GeoPen: Rdg		kg	Qu: Displacemen	7.25 mm	GeoPen: Rdg		kg
Load Cell	0.288 kN	10 mm tip Su		ksf	Load Cell	0.282 kN	10 mm tip Su		ksf
Su	34.3 kPa	10 mm tip Su		kPa	Su	34.1 kPa	10 mm tip Su		kPa
Su	0.72 ksf				Su	0.71 ksf			
Test Hole	19-01	Depth	40	feet	Test Hole	19-02	Depth	20	feet
		Sample No.	Т8	-			Sample No.	T19	
Wet + Tare Wt.	243.69 g	Length		mm	Wet + Tare Wt.	208.56 g	Length	171	mm
Dry + Tare Wt.	192.72 g	Diameter		mm	Dry + Tare Wt.	151.18 g	Diameter	72	mm
Tare Wt.	31.10 g	Area		mm²	Tare Wt.	31.16 g	Area	4072	mm²
Wt. Water	50.97 g	Weight		g	Wt. Water	57.38 g	Weight	1204.54	
Dry Wt.	161.62 g	Strain		9 %	Dry Wt.	120.02 g	Strain	7.16	0
Moisture Cont.	31.5 %	Avg. Area		mm²	Moisture Cont.	47.8 %	Avg. Area	4386	
Wet Density	lb/ft ³		kN/m³	-	Wet Density	108.01 lb/ft ³	16.97		
Pocket Pen: Rdg	0.75 tsf	Torvane: Rdg	0.50	tsf	Pocket Pen: Rdg	1.50 tsf	Torvane: Rdg	0.55	tsf
Su	0.75 ksf	Std vane Su	1.02	ksf	Su	1.50 ksf	Std vane Su	1.13	
Su	35.9 kPa	Su	49.0	kPa	Su	71.8 kPa	Su	53.9	
Qu: Displacement	mm	GeoPen: Rdg		kg	Qu: Displacemen	12.25 mm	GeoPen: Rdg	••••••	kg
Load Cell	kN	10 mm tip Su		ksf	Load Cell	0.554 kN	10 mm tip Su		ksf
Su	kPa	10 mm tip Su		kPa	Su	63.2 kPa	10 mm tip Su		kPa
Su	ksf	.			Su	1.32 ksf	i		
Test Hole	19-03	<u>Depth</u>	30	feet	Test Hole	19-05	<u>Depth</u>	15	feet
		Sample No.	T29	-			Sample No.	T42	-
Wet + Tare Wt.	222.10 g	Length		mm	Wet + Tare Wt.	314.81 g	Length		mm
Dry + Tare Wt.	174.56 g	Diameter		mm	Dry + Tare Wt.	217.20 g	Diameter		mm
Tare Wt.	30.54 g	Area	3959		Tare Wt.	30.56 g	Area	3848	
Wt. Water	47.54 g	-	1236.40	-	Wt. Water	97.61 g	Weight	1193.74	-
Dry Wt.	144.02 g	Strain	6.62		Dry Wt.	186.64 g	Strain	4.55	
Moisture Cont.	33.0 %	Avg. Area	4240	mm²	Moisture Cont.	52.3 %	Avg. Area	4032	mm²
Wet Density	114.68 lb/ft ³	18.01		·	Wet Density	110.02 lb/ft ³	17.28		1.6
Pocket Pen: Rdg	0.85 tsf	Torvane: Rdg	0.50		Pocket Pen: Rdg	1.40 tsf	Torvane: Rdg	0.60	
Su	0.85 ksf	Std vane Su	1.02		Su	1.40 ksf	Std vane Su	1.23	
Su	40.7 kPa	Su	49.0		Su	67.0 kPa	Su	58.8	
Qu: Displacement	11.25 mm	GeoPen: Rdg		kg	Qu: Displacemen	8.00 mm	GeoPen: Rdg		kg
Load Cell	0.278 kN	10 mm tip Su		ksf	Load Cell	0.380 kN	10 mm tip Su		ksf
Su	32.8 kPa	10 mm tip Su		kPa	Su	47.1 kPa	10 mm tip Su		kPa
Su	0.68 ksf				Su	0.98 ksf			

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Test Hole	19-05	<u>Depth</u>	25	feet		Test Hole	19-06	Depth	20	feet
		Sample No.	T44					Sample No.	T58	
Wet + Tare Wt.	223.96 g	Length		mm		Wet + Tare Wt.	199.52 g	Length	172	mm
Dry + Tare Wt.	164.88 g	Diameter		mm		Dry + Tare Wt.	146.96 g	Diameter	72	mm
Tare Wt.	30.67 g	Area		mm²		Tare Wt.	30.89 g	Area	4072	mm²
Wt. Water	59.08 g	Weight		g		Wt. Water	52.56 g	Weight	1217.33	g
Dry Wt.	134.21 g	Strain		%		Dry Wt.	116.07 g	Strain	5.23	%
Moisture Cont.	44.0 %	Avg. Area		mm²		Moisture Cont.	45.3 %	Avg. Area	4296	mm²
Wet Density	lb/ft ³		kN/m³			Wet Density	108.52 lb/ft3	17.05	⟨N/m³	
Pocket Pen: Rdg	1.65 tsf	Torvane: Rdg	0.60	tsf		Pocket Pen: Rdg	1.35 tsf	Torvane: Rdg	0.53	tsf
Su	1.65 ksf	Std vane Su	1.23	ksf		Su	1.35 ksf	Std vane Su	1.09	ksf
Su	79.0 kPa	Su	58.8	kPa		Su	64.6 kPa	Su	52.0	kPa
Qu: Displacement	mm	GeoPen: Rdg		kg		Qu: Displacemen	9.00 mm	GeoPen: Rdg		kg
Load Cell	kN	10 mm tip Su	0.00	ksf		Load Cell	0.364 kN	10 mm tip Su		ksf
Su	kPa	10 mm tip Su	0.0	kPa		Su	42.4 kPa	10 mm tip Su		kPa
Su	ksf					Su	0.88 ksf			
Test Hole	19-07	Depth	25	feet		Test Hole	19-08	Depth	20	feet
		Sample No.	 T67					Sample No.	 T74	
Wet + Tare Wt.	199.34 g	Length	175	mm		Wet + Tare Wt.	205.36 g	Length	174	mm
Dry + Tare Wt.	144.83 g	Diameter		mm		Dry + Tare Wt.	150.29 g	Diameter		mm
Tare Wt.	31.48 g	Area	3959			Tare Wt.	31.05 g	Area	3959	
Wt. Water	54.51 g		1214.45			Wt. Water	55.07 g	Weight	1191.08	
Dry Wt.	113.35 g	Strain	5.29	-		Dry Wt.	119.24 g	Strain	5.60	-
Moisture Cont.	48.1 %	Avg. Area	4180			Moisture Cont.	46.2 %	Avg. Area	4194	
Wet Density	109.42 lb/ft ³	17.19			•	Wet Density	107.94 lb/ft ³	16.96		
Pocket Pen: Rdg	1.50 tsf	Torvane: Rdg	0.60	tsf		Pocket Pen: Rdg	1.60 tsf	Torvane: Rdg	0.53	tsf
Su	1.50 ksf	Std vane Su	1.23	ksf		Su	1.60 ksf	Std vane Su	1.09	ksf
Su	71.8 kPa	Su	58.8	kPa		Su	76.6 kPa	Su	52.0	
Qu: Displacement	9.25 mm	GeoPen: Rdg		kg		Qu: Displacemen	9.75 mm	GeoPen: Rdg		kg
Load Cell	0.388 kN	10 mm tip Su		ksf		Load Cell	0.316 kN	10 mm tip Su		ksf
Su	46.4 kPa	10 mm tip Su		kPa		Su	37.7 kPa	10 mm tip Su		kPa
Su	0.97 ksf	••••••				Su	0.79 ksf	••••••		
Test Hole	19-10	<u>Depth</u>	25	feet		Test Hole	19-11	<u>Depth</u>		feet
		Sample No.	T95	•				Sample No.	T101	
Wet + Tare Wt.	214.95 g	Length	170			Wet + Tare Wt.	215.72 g	Length	172	
Dry + Tare Wt.	157.80 g	Diameter		mm		Dry + Tare Wt.	152.69 g	Diameter		mm
Tare Wt.	30.59 g	Area	4072			Tare Wt.	30.56 g	Area	4072	
Wt. Water	57.15 g	-	1170.50	-		Wt. Water	63.03 g	Weight	1162.57	-
Dry Wt.	127.21 g	Strain	5.44			Dry Wt.	122.13 g	Strain	4.51	
Moisture Cont.	44.9 %	Avg. Area	4306	mm-	-	Moisture Cont.	51.6 %	Avg. Area	4264	mm-
Wet Density	105.57 lb/ft ³ 1.45 tsf	16.58		tof		Wet Density	103.64 lb/ft ³	16.28 /		tof
Pocket Pen: Rdg	1.45 tsi 1.45 ksf	Torvane: Rdg	0.54			Pocket Pen: Rdg	1.45 tsf 1.45 ksf	Torvane: Rdg	0.47	
Su Su	69.4 kPa	Std vane Su	1.11			Su Su	69.4 kPa	Std vane Su	0.96	
	9.25 mm	Su Goo Pon: Edg	53.0				7.75 mm	Su GooPon: Pdg	46.1	
Qu: Displacement Load Cell	9.25 mm 0.427 kN	GeoPen: Rdg 10 mm tip Su		kg ksf		Qu: Displacemen Load Cell	0.300 kN	GeoPen: Rdg 10 mm tip Su		kg ksf
Su	49.6 kPa	10 mm tip Su		kPa		Load Cell Su	35.2 kPa	10 mm tip Su		kSi kPa
		io min up Su		лга				10 11111 up Su		лга
Su	1.04 ksf					Su	0.73 ksf			

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Test Hole	19-12	Depth	20	feet	Test Hole	19-13	<u>Depth</u>	15	feet
_		Sample No.	T114	•	_		Sample No.	T121	· I
Wet + Tare Wt.	212.23 g	Length	177	mm	Wet + Tare Wt.	221.59 g	Length	171	mm
Dry + Tare Wt.	149.10 g	Diameter	71	mm	Dry + Tare Wt.	153.91 g	Diameter	71	mm
Tare Wt.	30.44 g	Area	3959	mm²	Tare Wt.	31.42 g	Area	3959	mm²
Wt. Water	63.13 g	Weight	1160.97	g	Wt. Water	67.68 g	Weight	1142.30	g
Dry Wt.	118.66 g	Strain	5.65	%	Dry Wt.	122.49 g	Strain	5.12	%
Moisture Cont.	53.2 %	Avg. Area	4196	mm²	Moisture Cont.	55.3 %	Avg. Area	4173	mm²
Wet Density	103.42 lb/ft3	16.25	kN/m³		Wet Density	105.33 lb/ft3	16.55	kN/m³	
Pocket Pen: Rdg	1.05 tsf	Torvane: Rdg	0.48	tsf	Pocket Pen: Rdg	1.00 tsf	Torvane: Rdg	0.63	tsf
Su	1.05 ksf	Std vane Su	0.98	ksf	Su	1.00 ksf	Std vane Su	1.28	ksf
Su	50.3 kPa	Su	47.1	kPa	Su	47.9 kPa	Su	61.3	kPa
Qu: Displacement	10.00 mm	GeoPen: Rdg		kg	Qu: Displacemen	8.75 mm	GeoPen: Rdg		kg
Load Cell	0.287 kN	10 mm tip Su		ksf	Load Cell	0.304 kN	10 mm tip Su		ksf
Su	34.2 kPa	10 mm tip Su		kPa	Su	36.4 kPa	10 mm tip Su		kPa
Su	0.71 ksf				Su	0.76 ksf			
Test Hole	19-14	Depth	10	feet	Test Hole	19-14	Depth	15	feet
		Sample No.	T128	•			Sample No.	T129	
Wet + Tare Wt.	246.30 g	Length	175	mm	Wet + Tare Wt.	184.35 g	Length	176	mm
Dry + Tare Wt.	176.16 g	Diameter		mm	Dry + Tare Wt.	133.37 g	Diameter		mm
Tare Wt.	30.90 g	Area	4072		Tare Wt.	30.52 g	Area	4072	
Wt. Water	70.14 g		1179.65		Wt. Water	50.98 g	Weight	1183.22	
Dry Wt.	145.26 g	Strain	6.14	-	Dry Wt.	102.85 g	Strain	6.11	°
Moisture Cont.	48.3 %	Avg. Area	4338		Moisture Cont.	49.6 %	Avg. Area	4336	
Wet Density	103.36 lb/ft ³	16.24			Wet Density	103.08 lb/ft ³	16.19		
Pocket Pen: Rdg	1.30 tsf	Torvane: Rdg	0.63	tsf	Pocket Pen: Rdg	1.25 tsf	Torvane: Rdg	0.50	tsf
Su	1.30 ksf	Std vane Su	1.28		Su	1.25 ksf	Std vane Su	1.02	
Su	62.2 kPa	Su	61.3		Su	59.9 kPa	Su	49.0	
Qu: Displacement	10.75 mm	GeoPen: Rdg		kg	Qu: Displacemen	10.75 mm	GeoPen: Rdg		kg
Load Cell	0.314 kN	10 mm tip Su		ksf	Load Cell	0.380 kN	10 mm tip Su		ksf
Su	36.2 kPa	10 mm tip Su		kPa	Su	43.8 kPa	10 mm tip Su		kPa
Su	0.76 ksf	10			Su	0.92 ksf	, , , , , , , , , , , , , , , , , , ,		
Test Hole	19-14	Depth	20	feet	Test Hole	19-14	<u>Depth</u>		feet
		Sample No.	T130	-			Sample No.	T132	-
Wet + Tare Wt.	323.84 g	Length	176		Wet + Tare Wt.	208.64 g	Length	158	
Dry + Tare Wt.	230.29 g	Diameter		mm	Dry + Tare Wt.	153.44 g	Diameter		mm
Tare Wt.	31.11 g	Area	4072		Tare Wt.	31.30 g	Area	4185	
Wt. Water	93.55 g	-	1171.11	-	Wt. Water	55.20 g	Weight	1084.67	-
Dry Wt.	199.18 g	Strain	4.40		Dry Wt.	122.14 g	Strain	4.91	
Moisture Cont.	47.0 %	Avg. Area	4259	mm²	Moisture Cont.	45.2 %	Avg. Area	4401	mm²
Wet Density	102.03 lb/ft ³	16.03			Wet Density	102.40 lb/ft ³	16.09		
Pocket Pen: Rdg	1.05 tsf	Torvane: Rdg	0.55		Pocket Pen: Rdg	0.80 tsf	Torvane: Rdg	0.53	
Su	1.05 ksf	Std vane Su	1.13		Su	0.80 ksf	Std vane Su	1.08	
Su	50.3 kPa	Su	53.9	••••••	Su	38.3 kPa	Su	51.5	
Qu: Displacement	7.75 mm	GeoPen: Rdg		kg	Qu: Displacemen	7.75 mm	GeoPen: Rdg		kg
Load Cell	0.338 kN	10 mm tip Su		ksf	Load Cell	0.417 kN	10 mm tip Su		ksf
Su	39.7 kPa	10 mm tip Su		kPa	Su	47.4 kPa	10 mm tip Su		kPa
Su	0.83 ksf				Su	0.99 ksf			

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Test Hole	19-14	Depth	40	feet	Test Hole	19-15		<u>Depth</u>	5	feet
_		Sample No.	T134					Sample No.	T139	
Wet + Tare Wt.	287.03 g	Length	161	mm	Wet + Tare Wt.	217.25 g		Length		mm
Dry + Tare Wt.	196.75 g	Diameter	72	mm	Dry + Tare Wt.	195.20 g		Diameter		mm
Tare Wt.	31.21 g	Area	4072	mm²	Tare Wt.	31.49 g		Area		mm²
Wt. Water	90.28 g	Weight	1079.26	g	Wt. Water	22.05 g		Weight		g
Dry Wt.	165.54 g	Strain	2.02	%	Dry Wt.	163.71 g		Strain		%
Moisture Cont.	54.5 %	Avg. Area	4155	mm²	Moisture Cont.	13.5 %	5	Avg. Area		mm²
Wet Density	102.78 lb/ft3	16.15			Wet Density		/ft³		⟨N/m³	
Pocket Pen: Rdg	0.85 tsf	Torvane: Rdg	0.50	tsf	Pocket Pen: Rdg	ts		Torvane: Rdg		tsf
Su	0.85 ksf	Std vane Su	1.02	ksf	Su	ks		Std vane Su		ksf
Su	40.7 kPa	Su	49.0	kPa	Su	kF	Pa	Su		kPa
Qu: Displacement	3.25 mm	GeoPen: Rdg		kg	Qu: Displacement		m	GeoPen: Rdg		kg
Load Cell	0.140 kN	10 mm tip Su		ksf	Load Cell	k١		10 mm tip Su		ksf
Su	16.8 kPa	10 mm tip Su		kPa	Su	kF	Pa	10 mm tip Su		kPa
Su	0.35 ksf				Su	ks	sf			
Test Hole	19-15	Depth	10	feet	Test Hole	19-15		Depth	15	feet
		Sample No.	T140	-		<u> </u>		Sample No.	T141	-
Wet + Tare Wt.	166.50 g	Length	176	mm	Wet + Tare Wt.	244.03 g		Length	176	mm
Dry + Tare Wt.	121.39 g	Diameter	72	mm	Dry + Tare Wt.	177.53 g		Diameter	72	mm
Tare Wt.	31.07 g	Area	4072	mm²	Tare Wt.	30.55 g		Area	4072	mm²
Wt. Water	45.11 g	Weight	1164.05	g	Wt. Water	66.50 g		Weight	1162.97	g
Dry Wt.	90.32 g	Strain	7.39	%	Dry Wt.	146.98 g		Strain	5.82	%
Moisture Cont.	49.9 %	Avg. Area	4396	mm²	Moisture Cont.	45.2 %	5	Avg. Area	4323	mm²
Wet Density	101.41 lb/ft3	15.93	kN/m³		Wet Density	101.32 lb	∕ft³	15.92	kN/m³	
Pocket Pen: Rdg	1.25 tsf	Torvane: Rdg	0.58	tsf	Pocket Pen: Rdg	0.95 ts	f	Torvane: Rdg	0.68	tsf
Su	1.25 ksf	Std vane Su	1.18	ksf	Su	0.95 ks	sf	Std vane Su	1.38	ksf
Su	59.9 kPa	Su	56.4	kPa	Su	45.5 kF	Pa	Su	66.2	kPa
Qu: Displacement	13.00 mm	GeoPen: Rdg		kg	Qu: Displacemen	10.25 m	m	GeoPen: Rdg		kg
Load Cell	0.477 kN	10 mm tip Su		ksf	Load Cell	0.302 kN	N	10 mm tip Su		ksf
Su	54.3 kPa	10 mm tip Su		kPa	Su	34.9 kF	Pa	10 mm tip Su		kPa
Su	1.13 ksf				Su	0.73 ks	sf			
Test Hole	19-15	Depth	25	feet	Test Hole	19-15		Depth	35	feet
		Sample No.	T143	1001				Sample No.	T145	1001
Wet + Tare Wt.	222.36 g	Length		mm	Wet + Tare Wt.	266.96 g		Length		mm
Dry + Tare Wt.	160.00 g	Diameter		mm	Dry + Tare Wt.	197.42 g		Diameter		mm
Tare Wt.	30.67 g	Area	3959		Tare Wt.	30.60 g		Area		mm²
Wt. Water	62.36 g		1158.32		Wt. Water	69.54 g		Weight		g
Dry Wt.	129.33 g	Strain	3.65	-	Dry Wt.	166.82 g		Strain		%
Moisture Cont.	48.2 %	Avg. Area	4109		Moisture Cont.	41.7 %	5	Avg. Area		mm²
Wet Density	106.81 lb/ft ³	16.78			Wet Density		/ft³	¥	⟨N/m³	
Pocket Pen: Rdg	1.00 tsf	Torvane: Rdg	0.35	tsf	Pocket Pen: Rdg	ts	f	Torvane: Rdg		tsf
Su	1.00 ksf	Std vane Su	0.72	ksf	Su	0.00 ks	sf	Std vane Su	0.00	ksf
Su	47.9 kPa	Su	34.3		Su	0.0 kF	Pa	Su		kPa
Qu: Displacement	6.25 mm	GeoPen: Rdg		kg	Qu: Displacement	m	m	GeoPen: Rdg		kg
Load Cell	0.306 kN	10 mm tip Su		ksf	Load Cell	k١	N	10 mm tip Su		ksf
Su	37.2 kPa	10 mm tip Su		kPa	Su	kF	Pa	10 mm tip Su		kPa
Su	0.78 ksf				Su	ks	sf			

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Test Hole	19-16	<u>Depth</u>	10	feet		Test Hole	19-16		<u>Depth</u>	20	feet
_		Sample No.	T147	•		_			Sample No.	T149	
Wet + Tare Wt.	173.98 g	Length	172	mm		Wet + Tare Wt.	219.86 g	9	Length	177	mm
Dry + Tare Wt.	123.97 g	Diameter	71	mm		Dry + Tare Wt.	163.55 g)	Diameter	72	mm
Tare Wt.	30.71 g	Area	3959	mm²		Tare Wt.	30.96 g)	Area	4072	mm²
Wt. Water	50.01 g	Weight	1130.22	g		Wt. Water	56.31 g)	Weight	1216.82	g
Dry Wt.	93.26 g	Strain	7.27	%		Dry Wt.	132.59 g)	Strain	4.24	%
Moisture Cont.	53.6 %	Avg. Area	4269	mm²		Moisture Cont.	42.5 %	6	Avg. Area	4252	mm²
Wet Density	103.61 lb/ft3	16.28	kN/m³			Wet Density	105.41 lt	b/ft³	16.56	kN/m³	
Pocket Pen: Rdg	1.35 tsf	Torvane: Rdg	0.50	tsf		Pocket Pen: Rdg	1.45 ts	sf	Torvane: Rdg	0.53	tsf
Su	1.35 ksf	Std vane Su	1.02	ksf		Su	1.45 k	sf	Std vane Su	1.09	ksf
Su	64.6 kPa	Su	49.0	kPa		Su	69.4 k	(Pa	Su	52.0	kPa
Qu: Displacement	12.50 mm	GeoPen: Rdg		kg		Qu: Displacemen	7.50 n	nm	GeoPen: Rdg		kg
Load Cell	0.284 kN	10 mm tip Su		ksf		Load Cell	0.314 k	٢N	10 mm tip Su		ksf
Su	33.3 kPa	10 mm tip Su		kPa		Su	36.9 k	(Pa	10 mm tip Su		kPa
Su	0.69 ksf					Su	0.77 k	sf			
Test Hole	19-16	Depth	30	feet	-	Test Hole	19-16		Depth	50	feet
		Sample No.	T151	•			<u> </u>		Sample No.	T155	
Wet + Tare Wt.	310.11 g	Length	174	mm		Wet + Tare Wt.	263.47 g	1	Length	148	mm
Dry + Tare Wt.	224.24 g	Diameter	70	mm		Dry + Tare Wt.	203.21 g	3	Diameter	71	mm
Tare Wt.	31.32 g	Area	3848	mm²		Tare Wt.	31.44 g		Area	3959	mm²
Wt. Water	85.87 g	Weight	1285.00	g		Wt. Water	60.26 g	1	Weight	993.55	g
Dry Wt.	192.92 g	Strain	7.33	-		Dry Wt.	171.77 g	1	Strain	0.00	%
Moisture Cont.	44.5 %	Avg. Area	4153	mm²		Moisture Cont.	35.1 %	6	Avg. Area	3959	mm²
Wet Density	119.80 lb/ft3	18.82	kN/m³		1	Wet Density	105.85 lt	b/ft³	16.63	kN/m³	
Pocket Pen: Rdg	0.50 tsf	Torvane: Rdg	0.38	tsf	1	Pocket Pen: Rdg	0.60 ts	sf	Torvane: Rdg	0.36	tsf
Su	0.50 ksf	Std vane Su	0.77	ksf		Su	0.60 k	sf	Std vane Su	0.74	ksf
Su	23.9 kPa	Su	36.8	kPa		Su	28.7 k	(Pa	Su	35.3	kPa
Qu: Displacement	12.75 mm	GeoPen: Rdg		kg		Qu: Displacement	n	nm	GeoPen: Rdg		kg
Load Cell	0.290 kN	10 mm tip Su		ksf		Load Cell	k	٢N	10 mm tip Su		ksf
Su	34.9 kPa	10 mm tip Su		kPa		Su	k	(Pa	10 mm tip Su		kPa
Su	0.73 ksf					Su	k	sf			
Test Hole	19-17	Depth	15	feet	1	Test Hole	19-17		Depth	25	feet
	13-17	Sample No.	T160	leet			19-17		Sample No.	T162	ieet
Wet + Tare Wt.	286.57 g	Length		mm		Wet + Tare Wt.	249.61 g	r	Length	161	mm
Dry + Tare Wt.	200.37 g 201.89 g	Diameter		mm		Dry + Tare Wt.	180.67 g	•	Diameter		mm
Tare Wt.	31.14 g	Area	4072			Tare Wt.	31.33 g	-	Area	4072	
Wt. Water	84.68 g	Weight	962.80			Wt. Water	68.94 g	-	Weight	1135.74	
Dry Wt.	170.75 g	Strain	3.86	-		Dry Wt.	149.34 g		Strain	8.39	-
Moisture Cont.	49.6 %	Avg. Area	4235			Moisture Cont.	46.2 %		Avg. Area	4444	
Wet Density	99.08 lb/ft ³	15.56				Wet Density	108.16		16.99		
Pocket Pen: Rdg	0.90 tsf	Torvane: Rdg	0.57	tsf	1	Pocket Pen: Rdg	0.80 ts		Torvane: Rdg	0.43	tsf
Su	0.90 ksf	Std vane Su	1.17			Su	0.80 k		Std vane Su	0.87	
Su	43.1 kPa	Sta valle Su Su	55.9			Su	38.3 k		Sta vane Su Su	41.7	
Qu: Displacement	5.75 mm	<u>GeoPen:</u> Rdg	55.9	kg		Qu: Displacemen	13.50 n	•••••	GeoPen: Rdg		kg
Load Cell	0.253 kN	10 mm tip Su		ksf		Load Cell	0.416 k		10 mm tip Su		ksf
Su	29.9 kPa	10 mm tip Su		kPa		Su	46.8 k		10 mm tip Su		kPa
Su	0.62 ksf					Su	0.98 k				
Ju					-	<u> </u>	0.00 M				

UNCONFINED COMPRESSION TEST

PROJECT:	Jefferson East CSR
AECOM PROJECT No.:	60599385

<u></u>					-				
Test Hole	19-17	Depth		eet		Test Hole		Depth	feet
		Sample No.	T164					Sample No.	
Wet + Tare Wt.	320.44 g	Length	176 m	nm		Wet + Tare Wt.	g	Length	mm
Dry + Tare Wt.	235.45 g	Diameter	71 m	nm		Dry + Tare Wt.	g	Diameter	mm
Tare Wt.	31.27 g	Area	3959 m	۱m²		Tare Wt.	g	Area	mm²
Wt. Water	84.99 g	Weight	1246.37 g			Wt. Water	g	Weight	g
Dry Wt.	204.18 g	Strain	5.97 %	, 0		Dry Wt.	g	Strain	%
Moisture Cont.	41.6 %	Avg. Area	4210 m	۱m²		Moisture Cont.	%	Avg. Area	mm²
Wet Density	111.66 lb/ft3	17.54	kN/m³			Wet Density	lb/ft³		kN/m³
Pocket Pen: Rdg	0.65 tsf	Torvane: Rdg	0.26 ts	sf		Pocket Pen: Rdg	tsf	Torvane: Rdg	tsf
Su	0.65 ksf	Std vane Su	0.53 ks			Su	ksf	Std vane Su	ksf
Su	31.1 kPa	Su	25.5 kł	Pa		Su	kPa	Su	kPa
Qu: Displacement	10.50 mm	GeoPen: Rdg	kç	g		Qu: Displacement	mm	GeoPen: Rdg	kg
Load Cell	0.322 kN	10 mm tip Su	ks	sf		Load Cell	kN	10 mm tip Su	ksf
Su	38.2 kPa	10 mm tip Su	kł	Pa		Su	kPa	10 mm tip Su	kPa
Su	0.80 ksf					Su	ksf		
Teat Hala		Donth	f		-	Teet Hele		Danth	faat
Test Hole		<u>Depth</u>	Te	et		Test Hole		<u>Depth</u>	feet
\A/at . Taua \A/t		Sample No.				14/at 1 Tama 14/4	-	Sample No.	
Wet + Tare Wt.	g	Length		1m		Wet + Tare Wt.	g	Length	mm
Dry + Tare Wt.	g	Diameter		nm		Dry + Tare Wt.	g	Diameter	mm
Tare Wt.	g	Area		۱m²		Tare Wt.	g	Area	mm²
Wt. Water	g	Weight	g			Wt. Water	g	Weight	g
Dry Wt.	g	Strain	%			Dry Wt.	g	Strain	%
Moisture Cont.	%	Avg. Area	m	זm²	_	Moisture Cont.	%	Avg. Area	mm²
Wet Density	lb/ft ³	0.00			4	Wet Density	lb/ft ³	0.00	
Pocket Pen: Rdg	tsf	Torvane: Rdg	ts			Pocket Pen: Rdg	tsf	Torvane: Rdg	tsf
Su	ksf	Std vane Su		sf		Su	ksf	Std vane Su	ksf
Su	kPa	Su		Pa		Su	kPa	Su	kPa
Qu: Displacement	mm	GeoPen: Rdg	kç	-		Qu: Displacement	mm	GeoPen: Rdg	kg
Load Cell	kN	10 mm tip Su		sf		Load Cell	kN	10 mm tip Su	ksf
Su	kPa	10 mm tip Su	kl	Pa		Su	kPa	10 mm tip Su	kPa
Su	ksf				_	Su	ksf		
Test Hole		Depth	fe	et	-	Test Hole		Depth	feet
		Sample No.						Sample No.	
Wet + Tare Wt.	g	Length	m	nm		Wet + Tare Wt.	g	Length	mm
Dry + Tare Wt.	g	Diameter		nm		Dry + Tare Wt.	g	Diameter	mm
Tare Wt.	g	Area		יייי וm²		Tare Wt.	g	Area	mm²
Wt. Water	g	Weight	g			Wt. Water	9 g	Weight	g
Dry Wt.	g	Strain	9%			Dry Wt.	9 g	Strain	9 %
Moisture Cont.	9 %	Avg. Area		້ າm²		Moisture Cont.	9 %	Avg. Area	mm²
Wet Density	lb/ft ³	0.00				Wet Density	lb/ft ³	0.00	
Pocket Pen: Rdg	tsf	Torvane: Rdg	ts	sf		Pocket Pen: Rdg	tsf	Torvane: Rdg	tsf
Su	ksf	Std vane Su		sf		Su	ksf	Std vane Su	ksf
Su	kPa	Su		Pa		Su	kPa	Su	kPa
Qu: Displacement	mm	GeoPen: Rdg				Qu: Displacement	mm	GeoPen: Rdg	kg
Load Cell	kN	10 mm tip Su		⁹ sf		Load Cell	kN	10 mm tip Su	ksf
Su	kPa	10 mm tip Su		Pa		Su	kPa	10 mm tip Su	kPa
Su	ksf					Su	ksf		u
54									



H. MANALO CONSULTING LTD.

1402 Notre Dame Ave., Winnipeg, MB R3E Phone: 204 697 3854 Cell: 204 997-1355 hmanalo@mts.net

HYDRAULIC CONDUCTIVITY TEST REPORT

CLIENT:	Aecom	PROJECT NO.	112-1909
	99 Comerce Drive Winnipeg, MB R3P 0Y7		
ATTENTION: PROJECT:			
Date Sampled:	24-27-Jun-19 Date Received: 26-Jul-19	Sampled By:	Client

				1 /	
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

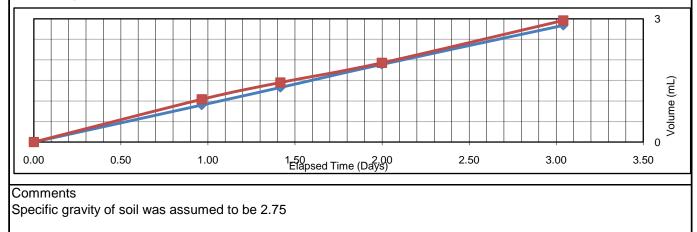
Consolidation Data

	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	Elapsed Time	Q (ml)		Average Flow Temperatu	Temperature	Corrected
(Days)	(Days)	In	Out	In/Out Ratio	(ml)	Correction	Conductivity, Ks (m/s)
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



Remarks: Test Method: ASTM D5084 (Constant Head) Technician: NS

P. Bevel



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1402 Notre Dame Ave., Winnipeg, MB R3E Phone: 204 697 3854 Cell: 204 997-1355 hmanalo@mts.net

HYDRAULIC CONDUCTIVITY TEST REPORT

CLIENT:	Aecom	PROJECT NO.	112-1909
	99 Comerce Drive Winnipeg, MB R3P 0Y7		
ATTENTION: PROJECT:			
Date Sampled:	24-27-Jun-19 Date Received: 26-Jul-19	Sampled By:	Client

				1 /	
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

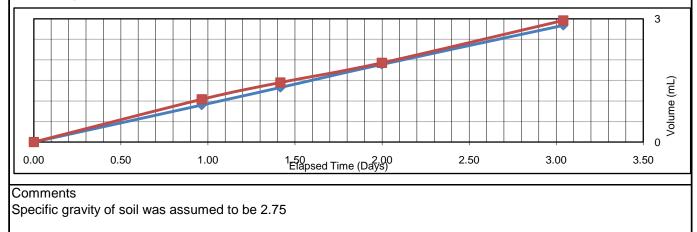
Consolidation Data

	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	Elapsed Time	Q (ml)		Average Flow Temperatu	Temperature	Corrected
(Days)	(Days)	In	Out	In/Out Ratio	(ml)	Correction	Conductivity, Ks (m/s)
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



Remarks: Test Method: ASTM D5084 (Constant Head) Technician: NS

P. Bevel



H. MANALO CONSULTING LTD.

1402 Notre Dame Ave., Winnipeg, MB R3E 3 Phone: 204 697 3854 Cell: 204 997-1355 hmanalo@mts.net

HYDRAULIC CONDUCTIVITY TEST REPORT

CLIENT:	Aecom		PROJECT NO.	112-1909				
	99 Comerce Drive							
	Winnipeg, MB R3P 0Y4							
ATTENTION:	Ryan Harras							
PROJECT:	Jefferson East CSR (Phase 2)							
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)				

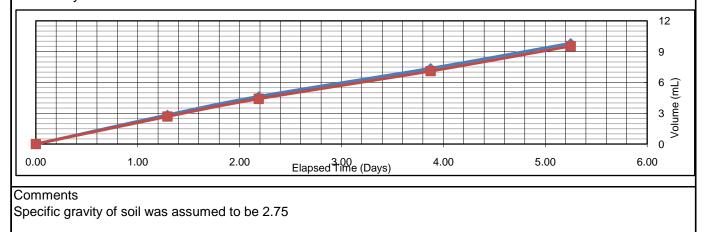
Consolidation Data

	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	Elapsed Time	Q (ml)		Average Flow	Temperature	Corrected
(Days)	(Days)	In	Out	In/Out Ratio	In/Out (ml)		Conductivity, Ks (m/s)
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



Remarks: Test Method: ASTM D5084 (Constant Head) Technician: NS

P. Bevel

ASTM D4546-14 TEST METHOD A

Client AECOM C/O Dyregrov Robinson Inc. Project Jefferson East CST (Phase 2) Project No. WX11735			Test Hole Sample Depth	TH19-02 T19 20 ft	Test Start: Tested By:	5-Sep- NM	19
Before Test		After Test		Soil Properties			
Consolidation ring no.	(new) #4	Mass(samplewet+ring+tare)	360.87 g	Mass of solids		97.64	g
Mass of ring	110.17 g	Mass of tare	114.46 g	Mass of water in specimen	before test	38.42	g
Inside diameter of the ring	6.367 cm	Mass (wet soil + ring)	246.41 g	Mass of water in specimen	after test	38.60	g
Height of the specimen, H_o	2.474 cm	Mass of wet sample	136.24 g	Height of Solids		1.1358	ст
Area of the specimen	31.839 cm2	Mass (dry soil+ring+can)	322.27 g	Height of water before test		1.2067	ст

97.64 g

2.7

1 kPa

39.5%

Height of water after test

Void ratio before test

Void ratio after test

Height of specimen after test

Degree of saturation before test

Degree of saturation after test Dry Density before test

Change in height of specimen after test

Visual Description of Soil

Mass (specimen + ring)

Initial Moisture Content

Mass of wet sample

Clay (CH) - silty, trace sand, high plastic, moist, dark greyish brown

Mass of dry specimen

Final MC of specimen

Seating pressure

Specific gravity of Solids

246.23 g

136.1 g

39.3%

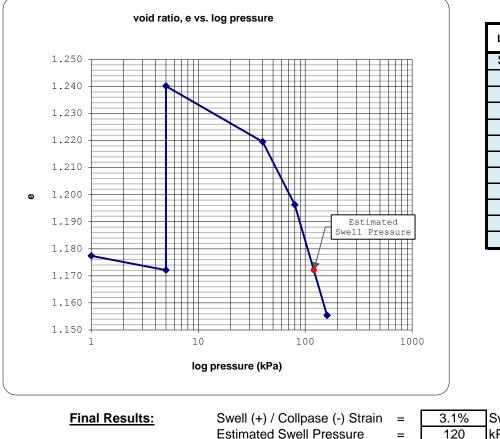


TABLE 1: Test Summary

1.2123 cm

0.0259 cm

2.4481 cm

1.178

1.155

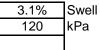
90.17%

92.38%

1.240 g/cm3

		,, ,
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

Estimated Swell Pressure



ASTM D4546-14 TEST METHOD B

Client AECOM C/O Dyregrov Robinson Inc. Project Jefferson East CST (Phase 2) Project No. WX11735			Test Hole Sample Depth	TH19-06 T19 20 ft	Test Start: Tested By:	6-Sep-19 NM
Before Test		After Test		Soil Properties		
Consolidation ring no.	#12	Mass(samplewet+ring+tare)	340.60 g	Mass of solids		94.06 g
Mass of ring	90.64 g	Mass of tare	114.74 g	Mass of water in specimen	before test	39.49 g
Inside diameter of the ring	6.494 cm	Mass (wet soil + ring)	225.86 g	Mass of water in specimen	after test	41.16 g
Height of the specimen, H_{o}	2.324 cm	Mass of wet sample	135.22 g	Height of Solids		1.0518 cm
Area of the specimen	33.122 cm2	Mass (dry soil+ring+can)	299.44 g	Height of water before test		1.1923 cm

Area of the specimen Mass (specimen + ring) Mass of wet sample Initial Moisture Content

		Alter Test
#12		Mass(samplewet+ring+
90.64	g	Mass of tare
6.494	ст	Mass (wet soil + ring)
2.324	ст	Mass of wet sample
33.122	cm2	Mass (dry soil+ring+ca
224.19	g	Mass of dry specimen
133.6	g	Final MC of specimen
42.0%		Specific gravity of Solid
		Seating pressure

e)	340.60	g	Mass of solids
	114.74	g	Mass of water in spec
	225.86	g	Mass of water in spec
	135.22	g	Height of Solids
	299.44	g	Height of water before
	94.06	g	Height of water after t
	43.8%		Change in height of s
	2.7		Height of specimen a
	1	kPa	Void ratio before test

Solids

Height of water after test

Void ratio after test

Height of specimen after test

Degree of saturation before test

Degree of saturation after test Dry Density before test

Change in height of specimen after test

Visual Description of Soil

Clay (CH) - silty, trace sand, high plastic, moist, dark greyish brown

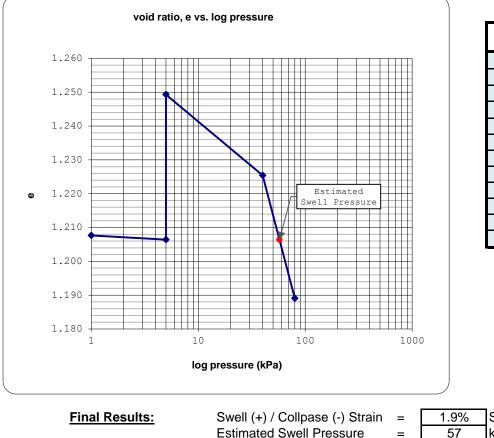


TABLE 1: Test Summary

1.2427 cm

0.0216 cm

2.3024 cm

1.210

1.189

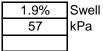
93.72%

99.37%

1.222 g/cm3

TABLE 1. TOSt Outliniary				
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		

Estimated Swell Pressure



ASTM D4546-14 TEST METHOD B

Client AECOM C/O Dyregrov Robinson Inc. Project Jefferson East CST (Phase 2) Project No. WX11735			Test Hole Sample Depth	TH19-11 T101 15 ft	Test Start: Tested By:	13-Sep-19 NM
Before Test		After Test		Soil Properties		
Consolidation ring no.	#12	Mass(samplewet+ring+tare)	341.47 g	Mass of solids		99.97 g
Mass of ring	90.64 g	Mass of tare	114.74 g	Mass of water in specimen	before test	34.24 g
Inside diameter of the ring	6.494 cm	Mass (wet soil + ring)	226.73 g	Mass of water in specimen	after test	36.12 g
Height of the specimen, H_{o}	2.386 cm	Mass of wet sample	136.09 g	Height of Solids		1.1179 cm

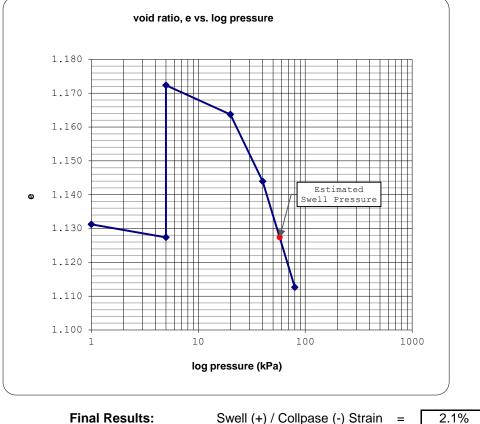
Area of the specimen Mass (specimen + ring) Mass of wet sample Initial Moisture Content

#12		Mass(samplewet+ring+tar
90.64	g	Mass of tare
6.494	ст	Mass (wet soil + ring)
2.386	ст	Mass of wet sample
33.122	cm2	Mass (dry soil+ring+can)
224.85	g	Mass of dry specimen
134.2	g	Final MC of specimen
34.3%		Specific gravity of Solids
		Seating pressure

e)	341.47	g
	114.74	g
	226.73	g
	136.09	g
	305.35	g
	99.97	g
	36.1%	
	2.7	
	1	kF

Visual Description of Soil

Clay (CH) - silty, trace sand, high plastic, moist, dark greyish brown



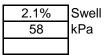
)	Mass of solids	99.97	g
9	Mass of water in specimen before test	34.24	g
7	Mass of water in specimen after test	36.12	g
7	Height of Solids	1.1179	ст
7	Height of water before test	1.0338	ст
7	Height of water after test	1.0905	ст
	Change in height of specimen after test	0.0244	ст
	Height of specimen after test	2.3616	ст
Pa	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

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 **Estimated Swell Pressure**



=

ASTM D4546-14 TEST METHOD A

Client AECOM C/O Dyregrov Robinson Inc. Project Jefferson East CST (Phase 2) Project No. WX11735			Test Hole Sample Depth	TH19-14 T130 20 ft	Test Start: Tested By:	13-Sep- NM	19
Before Test		After Test		Soil Properties			
Consolidation ring no.	(new) #4	Mass(samplewet+ring+tare)	353.94 g	Mass of solids		82.14 g	9
Mass of ring	110.17 g	Mass of tare	114.23 g	Mass of water in specimen	before test	46.16 g	7
Inside diameter of the ring	6.366 cm	Mass (wet soil + ring)	239.71 g	Mass of water in specimen	after test	47.40 g	9
Height of the specimen, H_o	2.449 cm	Mass of wet sample	129.54 g	Height of Solids		0.9558 d	cm
Area of the specimen	31.829 cm2	Mass (dry soil+ring+can)	306.54 g	Height of water before test		1.4502 c	cm

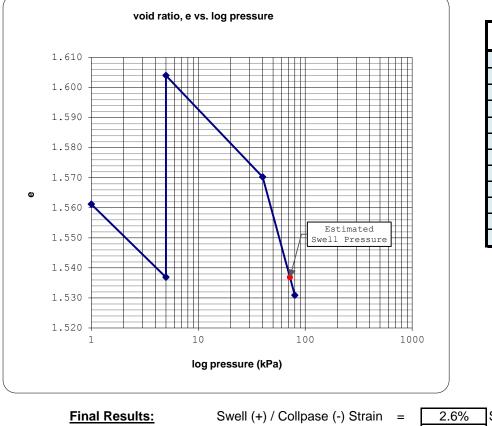
Mass (specimen + ring) Mass of wet sample Initial Moisture Content

Mass (dry soil+ring+can) **238.47** g Mass of dry specimen Final MC of specimen **128.3** g 56.2% Specific gravity of Solids Seating pressure

e)	353.94	g	Mass of solids
	114.23	g	Mass of water in spec
	239.71	g	Mass of water in spec
	129.54	g	Height of Solids
	306.54	g	Height of water before
	82.14	g	Height of water after t
	57.7%		Change in height of s
	2.7		Height of specimen a
	1	kPa	Void ratio before test

Visual Description of Soil

Clay (CH) - silty, trace sand, high plastic, moist, dark greyish brown



Height of water before test Height of water after test

Change in height of specimen after test

Height of specimen after test

Degree of saturation before test

Degree of saturation after test

Void ratio after test

1.4892 cm

2.4490 cm

1.562

1.562

97.12%

99.73%

ст

Dry Density	1.054	g/cm3		
	mmary	_		
	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	

Estimated Swell Pressure =



ASTM D4546-14 TEST METHOD B

	D Dyregrov R ast CST (Pha	Robinson Inc. ase 2)	Test Hole Sample Depth	TH19-16 T147 10 ft	Test Start: Tested By:	13-Sep- NM	19
Before Test	After Test		Soil Properties				
Consolidation ring no.	#12	Mass(samplewet+ring+tare)	353.80 g	Mass of solids		86.78	9
Mass of ring	110.19 g	Mass of tare	114.30 g	Mass of water in specimen	before test	42.21	9
Inside diameter of the ring	6.367 cm	Mass (wet soil + ring)	239.50 g	Mass of water in specimen	after test	42.53	9
Height of the specimen, H_{o}	2.438 cm	Mass of wet sample	129.31 g	Height of Solids		1.0095	ст
Area of the specimen	31.839 cm2	Mass (dry soil+ring+can)	311.27 g	Height of water before test		1.3257	ст

Mass (specimen + ring) 239 Mass of wet sample Initial Moisture Content

#12		Mass(samplewet+ring+
110.19	g	Mass of tare
6.367	ст	Mass (wet soil + ring)
2.438	ст	Mass of wet sample
31.839	cm2	Mass (dry soil+ring+ca
239.18	g	Mass of dry specimen
129.0	g	Final MC of specimen
48.6%		Specific gravity of Solid
		Seating pressure

e)	353.80	g	Mass of solids
	114.30	g	Mass of water in spec
	239.50	g	Mass of water in spec
	129.31	g	Height of Solids
	311.27	g	Height of water before
	86.78	g	Height of water after t
	49.0%		Change in height of s
	2.7		Height of specimen a
	1	kPa	Void ratio before test

Solids

Height of water after test

Void ratio after test

Degree of sat

Height of specimen after test

Degree of saturation after test

Swell

kPa

Dry Density before test

Change in height of specimen after test

Visual Description of Soil

Clay (CH) - silty, trace sand, high plastic, moist, dark greyish brown

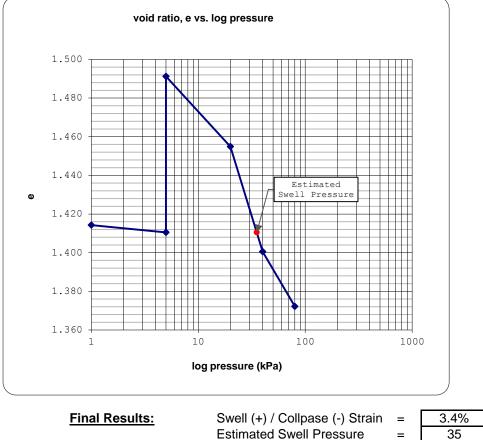


TABLE 1: Test Summary

1.3358 cm

0.0433 cm

2.3947 cm

1.415

1.372

92.80%

96.43% 1.118 g/cm3

	11 1001 04	, initial y	
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	



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	pН	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	рН	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	рН	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	рН	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 subsamp conductivity meter.	le is tumble	d with de-ionized (DI) water. The ratio of water t	o soil is 2:1 v/w. After tumbling the sample is then analyzed by a
Analysis conducted in acc Protection Act (July 1, 201		n the Protocol for Analytical Methods Used in th	e Assessment of Properties under Part XV.1 of the Environmenta
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 equilibration, pH of the slu			to stand with occasional stirring for 30 - 60 minutes. After
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
Resistivity are calculated b	based on the	e conductivity using APHA 2510B where Condu	ctivity is the inverse of Resistivity.
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138
Resistivity are calculated b	based on the	e conductivity using APHA 2510B where Condu	ctivity is the inverse of Resistivity.
SO4-WT	Soil	Sulphate	EPA 300.0
5 grams of soil is mixed w	ith 50 mL of	distilled water for a minimum of 30 minutes. The	ne extract is filtered and analyzed by ion chromatography.

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

			Workorder:	L2318801		Report Date:	08-AUG-19	Pag	e 1 of 2
Client: Contact:	99 Comm	Canada Ltd. herce Drive MB R3P 0Y7							
Test		Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-WT		Soil							
Batch F WG3126300-2 Conductivity	R4743353 RM		WT SAR3	86.4		%		70-130	08-AUG-19
WG3126843-1 Conductivity	LCS			97.5		%		90-110	08-AUG-19
WG3126300-1 Conductivity	MB			<0.0040		mS/cm		0.004	08-AUG-19
MOISTURE-WT		Soil							
Batch F WG3122283-2 % Moisture	R4737126 LCS			100.8		%		90-110	02-AUG-19
WG3122283-1 % Moisture	MB			<0.10		%		0.1	02-AUG-19
PH-1:2-SK		Soil							
Batch F	R4740588								
WG3121916-2 pH (1:2 soil:w			SAL814	7.90		рН		7.65-8.25	07-AUG-19
WG3121916-3 pH (1:2 soil:w				6.88		рН		6.66-7.06	07-AUG-19
SO4-WT		Soil							
	R4742614								
WG3123166-4 Sulphate	CRM		AN-CRM-WT	96.2		%		60-140	06-AUG-19
WG3123166-2 Sulphate	LCS			103.3		%		80-120	06-AUG-19
WG3123166-1 Sulphate	MB			<20		mg/kg		20	06-AUG-19

Quality Control Report

Workorder: L2318801

Report Date: 08-AUG-19

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 predetermined 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.

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