

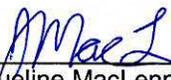


**COCKBURN AND CALROSSIE
COMBINED SEWER RELIEF WORKS
GEOTECHNICAL INVESTIGATION REPORT**

FINAL

KGS Group 11-0107-18
August 2018

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1.0 INTRODUCTION

1.1 GENERAL

KGS Group was retained by the City of Winnipeg Water and Waste Department to perform geotechnical investigations to facilitate the design and construction of the proposed Land Drainage System (LDS) trunk sewer pipe for the Cockburn and Calrossie Sewer Relief Works. This report outlines the geotechnical investigations completed within the alignment of Contracts 6 to 13. KGS Group has previously prepared geotechnical investigation reports for Contracts 1 to 5.

It is our understanding that LDS pipes ranging in size from 250 to 2400 mm will be installed in the Cockburn West and Southeast Jessie District as part of Contracts 6 to 13. The pipe will be installed from Poseidon Bay to Pembina Highway and from Grant Ave. to Taylor Ave.

The purpose of our investigations was to identify the subsurface soil and groundwater conditions along the route of the proposed works. This report contains a description of the geotechnical investigations program performed by KGS Group, our findings and geotechnical design recommendations for the proposed storm sewer.

1.2 PURPOSE OF REPORT AND LIMITATIONS

This report summarizes the geotechnical condition observed within the alignment of Contracts 6 to 13 and provides construction considerations that would form part of the basis of the design for the Work. This report includes:

- Geotechnical data collected at the project site;
- Summary of anticipated subsurface conditions along the pipe alignment; and
- A discussion of design and construction considerations including requirements for excavations, temporary support, groundwater conditions and control, settlement and trenchless tunnel construction.

The results of the geotechnical investigation carried out at the proposed site are presented in this report. This report presents the geotechnical engineer's best judgement of the subsurface and ground conditions anticipated to be encountered at the project site during construction. The soil stratigraphy has been interpolated between the test holes that were drilled along the alignment. While the actual conditions encountered in the field are expected to be within the range of conditions presented and discussed in this document, the spatial variability of actual subsurface and groundwater conditions that would be encountered at the site may vary from the simplified interpretation presented within this report.

2.0 BACKGROUND INFORMATION

2.1 PREVIOUS SITE INVESTIGATIONS

KGS Group has completed separate geotechnical investigations for the previous contracts associated with this work. Summaries of the investigations completed for Contract 4 (Wilton St. from Taylor Ave. to Parker SRB) and Contract 5 (Taylor Ave. from Nathaniel St. to Wentworth St.) are included below.

2.1.1 Contract 4

KGS Group completed a geotechnical investigation for Contract 4 along the Wilton St. alignment from Taylor Ave to the Parker Storm Retention Basin (SBR). The 2016 investigation consisted of drilling nine (9) test holes to investigate the subsurface stratigraphic conditions. Ten (10) pneumatic piezometers were installed in the clay, silt till and bedrock to monitor the groundwater levels.

The stratigraphy observed during the 2016 site investigation generally consisted of a layer of fill over an extensive layer of high plasticity clay and silt till. Silt layers were encountered within the upper 3.0 m. The top of the silt till was encountered at elevations ranging from 219 to 220.8 m±. The test hole logs from the 2016 geotechnical investigation have been included in Appendix A.

A summary of the test hole locations and groundwater monitoring results for the test holes within Contract 6 to 13 pipe alignment are included on Tables 1 and 2, respectively.

2.1.2 Contract 5

KGS Group completed a geotechnical investigation for Contract 5 along the Taylor Ave. alignment from Nathaniel Street to Wentworth Street. The 2017 investigation consisted of drilling 17 test holes to investigate the subsurface stratigraphic conditions. Six (6) vibrating wire piezometers, and nine (9) standpipe piezometers were installed in the clay, silt till and bedrock to monitor the groundwater levels.

The stratigraphy observed during the 2017 site investigation generally consisted of a pavement structure overlying an extensive layer of high plasticity clay, silt till and limestone bedrock. Silt layers were encountered within the upper 3.0 m. The top of the silt till was encountered at elevations ranging from 219 to 220.5 m ±. The test hole logs from the 2017 geotechnical investigation have been included in Appendix B.

A summary of the test hole locations and groundwater monitoring results for the test holes within Contract 6 to 13 pipe alignment are included on Tables 1 and 2, respectively.

2.2 REGIONAL GEOLOGIC SETTING

Winnipeg geology consisted of carbonate sedimentary bedrock overlaying Precambrian era granite and gneiss. The sedimentary rock consists of limestone, dolomite and shale to a lesser extent. Local geological maps indicate karst topography caused from dissolution of the soluble rock, and a heavily fractured upper bedrock layer. The karst topography is typically infilled with mixtures of silt, sand and gravel till material.

During the last glacial advance and retreat, Winnipeg's glacial till was laid down by ice masses. Glaciolacustrine deposits suspended in glacial lakes confined by ice masses settled to overlie the tills. Additional information on the regional geology can be found in Geological Engineering Report for Urban Development of Winnipeg, University of Manitoba (Ref 1).

3.0 SCOPE OF THE 2018 INVESTIGATION PROGRAM

3.1 GENERAL

This section provides a summary of the 2018 field investigation program, and laboratory test results.

3.2 TEST HOLE DRILLING AND SOIL SAMPLING

The test hole drilling and sampling program was completed by KGS Group from April 30 to May 9, 2018. The approximate locations of the test holes drilled within the alignment of Contracts 6 to 13 are shown in Figure 1 and a summary of the locations is presented in Table 1.

The program consisted of drilling 24 test holes to investigate the subsurface stratigraphic conditions. The information obtained from the site investigations will be used to facilitate the design and construction of the various components of the storm sewer line project including the excavation of the launch and reception shafts where trenchless installations methods will be used.

Maple Leaf Drilling Enterprises of Winnipeg, Manitoba provided the drilling services using a track mounted drill rig equipped with 125 mm solid stem augers and NQ coring. Soil samples were collected directly off the auger flights typically at 1.5 m (5 ft.) intervals or at changes in soil strata encountered during drilling. The soil samples were visually inspected for material type and classified according to the Modified Unified Soil Classification System (USCS).

Standard Penetration Tests were completed in the glacial till material to evaluate the in-situ density. Clay samples were tested with a field Torvane to evaluate consistency and estimate undrained shear strengths. Upon completion of drilling, the test holes were examined for indications of sloughing and seepage, and then backfilled. Detailed test hole log records incorporating all field observations, field test results, and laboratory test results are provided in the test hole log records in Appendix C.

3.3 GROUNDWATER MONITORING

A total of four (4) vibrating wire piezometers and four (4) standpipe piezometers were installed in 2018. The vibrating wire piezometers were installed in the clay strata and the standpipe piezometers were installed in the silt till and bedrock. Table 2 summarizes the installation details and the groundwater monitoring to date. The installation details of the 2018 piezometers are shown on the borehole log records provided in Appendix C.

3.4 LABORATORY TESTING

A diagnostic laboratory testing program was performed on representative soil samples to determine the relevant engineering properties of the subsurface soils relative to the trenchless construction method. Diagnostic testing completed included moisture content analyses, Atterberg Limit tests, and grain size analysis. All laboratory testing was completed at a local

laboratory accredited by Standards Council of Canada and testing was performed in accordance with ASTM standards. The results of the laboratory testing are shown on the test hole logs in Appendix A.

Previous geotechnical investigations for Contracts 1 to 5 included unconfined compressive strength testing and XRD testing of the cohesive soils.

TABLE 1
SUMMARY OF TESTHOLE LOCATIONS

Test hole ID	Location	Northing (m)	Easting (m)	Approx. Ground Surface Elevation (m)	Approx. Borehole Depth (m)
TH16-08	Approx. Shaft B	5,524,036	632,399	233.3	16.15
TH16-09	Approx. Shaft C - Taylor Ave. Boulevard East of Wilton	5,524,243	632,294	232.73	15.04
TH17-03	Approximately 140 m west of Wilton St.	5,524,167	632,150	232.32	12.80
TH17-09	West of Harrow St.	5,524,380	632,538	232.12	13.87
TH17-10	East of Harrow St.	5,524,422	632,614	231.76	18.14
TH17-12	West of Stafford St.	5,524,462	632,688	231.98	15.70
TH17-13	East of Stafford St.	5,524,501	632,754	232.10	15.32
TH17-15	Wentworth St.	5,524,580	632,875	231.79	17.98
TH17-16	Approximately 40 m west of Nathaniel St.	5,523,977	631,776	232.14	15.86
TH18-01	Approximately 50 m South of Grant Avenue	5,524,056	631,200	233.00	6.10
TH18-02	Approximately 25 m East of Nathaniel Street	5,523,806	631,337	232.42	9.14
TH18-03	Approximately 650 m East of Cambridge Street	5,523,808	631,450	232.35	10.67
TH18-04	Approximately 230 m West of Wilton Street	5,524,380	631,429	232.28	7.62
TH18-05	Approximately 20 m South of Grant Avenue	5,524,302	631,569		6.10
TH18-06	Approximately 80 m East of Wilton Street	5,524,230	631,751	231.76	9.14
TH18-07	Approximately 35 m East of Wilton Street	5,524,594	631,819	232.13	7.62
TH18-08	Approximately 80 m East of Wilton Street	5,524,353	631,973	231.70	7.62
TH18-09	Approximately 20 m East of Wilton Street	5,524,602	632,069	232.60	14.17
TH18-10	Approximately 25 m South of Grant Avenue	5,524,672	632,206	232.29	6.10
TH18-11	Approximately 40 m West of Harrow Street	5,524,533	632,127	232.31	9.14
TH18-12	Approximately 25 m West of Harrow Street	5,524,531	632,299	232.21	7.62
TH18-13	Approximately 50 m East of Stafford Street	5,524,370	632,183	232.19	10.67
TH18-14	Approximately 25 m East of Wentworth Street	5,524,816	632,341	232.65	7.62
TH18-15	Approximately 25 m East of Lilac Street	5,524,680	632,397	232.55	9.14
TH18-16	Approximately 25 m East of Wentworth Street	5,524,172	632,681	231.98	16.15
TH18-17	Approximately 25 m East of Ebby Avenue	5,524,639	632,672	231.96	7.62
TH18-18	Approximately 40 m East of Stafford Street	5,524,945	632,704	231.72	15.85
TH18-19	Approximately 15 m West of Pembina Highway	5,525,047	632,890	231.93	7.62
TH18-20	Southbound Pembina to Grant Yield Island	5,524,772	632,747		10.67
TH18-21	Approximately 50 m South of Grant Avenue	5,524,807	632,945	231.75	7.62
TH18-22	Approximately 25 m East of Nathaniel Street	5,524,784	632,587	231.97	7.62
TH18-23	Approximately 650 m East of Cambridge Street	5,525,034	633,041	231.80	3.04
TH18-24	Approximately 230 m West of Wilton Street	5,525,256	633,128	232.47	15.85

4.0 SITE STRATIGRAPHY

The site stratigraphy in the section is based on the test holes drilled during the 2018 geotechnical investigation as well as the following test holes from the 2016 and 2017 investigations: TH16-08, TH16-09, TH17-03, TH17-09, TH17-10, TH17-12, TH17-13, TH17-15 and TH17-16.

The stratigraphy at the site consists of pavement with granular fill overlaying clay with thin silt to clayey silt deposit at shallow depths. Beneath the silt deposit is an extensive layer of highly plastic clay overlying glacial silt till and limestone bedrock.

The overburden stratigraphy has been divided into five (5) layers, as follows:

- Pavement structure;
- Fill;
- Silt;
- Clay; and
- Glacial till.

The division of the soil layers is based on visual classification in the field and laboratory testing.

4.1.1 Pavement Structure

The pavement structure at the site generally consists of asphalt overlying concrete and a thin layer of granular base material or concrete overlying a thin layer of granular base. The asphalt and concrete ranged in thickness from 0.2 to 0.3 m. A thin layer of granular base material was observed in test holes TH17-03, TH17-09, TH17-10, TH17-12, TH17-13, TH17-15, TH18-01, TH18-02, TH18-11, TH18-12, TH18-18, TH18-21, and TH18-22.

All of the test holes were drilled on the road surface with exception to test holes TH16-08, TH16-09, TH17-16, and TH18-24.

4.1.2 Clay Fill

A layer of clay fill was encountered in test holes TH17-15, TH18-02, TH18-06 to TH18-10, TH18-13, TH18-15, TH18-17, TH18-18 and TH18-23. The clay fill material ranged in thickness from 0.1 to 1.3 m± and extended to a maximum depth of 1.5 m± below grade at elevation 230.2 m±. The clay fill was black in colour, damp, stiff in consistency, of high plasticity and contained organics.

4.1.3 Silt (ML)

A silt to clayey silt layer approximately 0.1 to 1.2 m± thick was encountered in 23 of the test holes at elevations ranging from 229.0 to 232.2 m±. The silt to clayey silt layer was tan in colour, moist and soft to firm in consistency. Two (2) silt layers were observed in test holes TH18-05, TH18-14, TH18-20, and TH18-21. Seepage is commonly observed within this silt layer. There may be a perched groundwater table within the silt layer. The moisture content of the silt ranges from approximately 20 to 35% and the unit weight is within the range of 18.8 to 20.4 kN/m³ (Ref 1).

4.1.4 Clay (CH)

Underlying the fill and silt is a glaciolacustrine clay deposit. In decreasing occurrence, typically the predominant mineral composition of the lacustrine clay consists of montmorillonite (a member of the smectite family), illite, kaolinite and some mica (Graham and Shields, 1985). An extensive layer of highly plastic clay was encountered at elevations ranging from approximately 229.6 to 232.1 m±. The thickness of the high plasticity clay ranged from 9.6 to 11.9 m±. This deposit will be encountered during the excavation for the shafts and along the proposed pipe alignment and during the excavation. The upper layer of the clay deposit was mottled brown in colour and extended to approximately elevation 224.7 to 227.7 m±. The upper clay deposit was damp to moist, of high plasticity and stiff in consistency. The consistency decreases with depth from stiff to firm. The upper clay is highly fissured with the frequency of fissures decreasing with depth. The lower clay deposit was grey, moist, of high plasticity, and soft to firm in consistency, becoming softer with depth.

The clay deposit contained some silt inclusions and trace to some fine to coarse grained sand, and fine grained gravel. These non-plastic, non-clay materials generally occur throughout the clay deposit as varves, veins, seams, inclusions or pockets that are typically less than a centimeter in diameter. The tendency for horizontal orientation of the varves, veins, and seams introduce a visible macrostructure to the clay and are a contributing cause for the observed anisotropy in horizontal permeability and strength of the deposit. Quigley (1968) offers the explanation that frozen silt lumps were rafted into glacial Lake Agassiz by icebergs and dropped into the clays as frozen lumps. Baracos (1977) provided a more likely explanation, considering the sharply defined boundaries of the inclusions, that they were deposited not frozen but as cemented or lithified material which subsequently disintegrated into silt.

Typical moisture content in the clay ranges from 30 to 60%. Atterberg Limit tests within the brown and grey clay has shown the brown clay is typically more plastic than the underlying grey clay. Liquid Limits in the brown clay typically range from 80 to 110% and the Plastic Index from 60 to 80%. Liquid Limits in the grey clay typically range from 80 to 95% and the Plastic Index ranged from 50 to 75%.

Undrained shear strengths are generally higher within the upper clay zone with strengths decreasing approximately uniformly with increasing depth below 4 to 5 m. The higher undrained shear strength within the upper brown clay and lower shear strengths at depths near the till is caused by weathering near the ground surface and decreasing over consolidation ratios to approximately normally consolidated conditions near the bottom of the deposit. The undrained shear strength, as estimated from the field Torvane, in the upper clay ranged from 30 to 100 kPa with an average of 55 kPa and 20 to 60 kPa with an average of 32 kPa in the lower grey clay. Figure 2 shows variation of undrained shear strength in clay deposit with elevation.

Unconfined compressive strength testing was completed on clay samples taken during the 2016 and 2017 investigations. The measured unconfined compressive strength ranged from 43 to 117 kPa with an average of 82 kPa. Measured values within the upper brown clay are variable due to the fissures.

Liquid and Plastic Limits, Plastic Indices, moisture contents and unconfined compressive strengths are summarized on Table 3. The majority of the laboratory testing results for the clay deposit are within the typical ranges for the Winnipeg area.

XRD analysis was completed on two (2) clay samples from within the proposed LDS alignment. The results of the testing indicated the quartz content of the clay samples ranged from 18.3 to 20.2%, the clinocllore content ranged from 13.3 to 15.7%, the muscovite content ranged from 15.4 to 20.3%, the calcite content ranged from 3.7 to 4.4%, the dolomite content ranged from 6.0 to 9.5%, and the smectite content ranged from 35.9 to 37.1%. High smectite content is often associated with high clogging potential during tunneling.

4.1.5 Glacial Till (ML-CL)

Silt till deposit was encountered below the clay deposit at elevations ranging from 218.9 and 222.4 m±. The silt till deposit ranged in thickness from 0.9 to 3.8m±. A layer of clay till was encountered in test hole TH16-09 below the silt till at an elevation of 218.7 m±. The silt till was found to be tan in colour, damp, loose to very dense and contained some to with fine to coarse grained sand and gravel. Boulders and cobbles are commonly found within the till layer and should be anticipated within the deposit at the project site.

The Standard Penetration Test (SPT) blow counts for 300 mm ranged from 5 to greater than 50 blows. The till was classified as very dense (greater than 50 blows for 300 mm) for five (5) SPT and SPT refusal was encountered during four (4) tests on suspected boulders. A summary of the uncorrected SPT N values recorded in the silt till are presented in Table 4 of this report.

Unconfined compressive strengths ranging from 3.4 to 3.6 MPa have been reported for very dense silt tills with a moisture content of about 5% (Ref 1). Young's moduli typically range from 170 to 240 MPa (Ref 1). The tills are highly variable in terms of thickness, density and boulder content.

4.1.6 Boulders

Cobbles and boulders were not directly observed during the geotechnical investigation. Premature refusal of SPT spoons in the test holes within the till deposit typically indicate the presence of cobbles and boulders in the silt till or at the bedrock surface. Occasional cobbles and boulders were observed within the clay layer during previous tunneling projects within the vicinity of this project. The LDS pipe will be installed within the clay layer, a minimum of 5 m above the silt till interface. The tunneling should not be impacted by the cobbles and boulders within the silt till; however, occasional cobbles may be encountered in the clay layer.

4.2 BEDROCK

The majority of the bedrock encountered at the site was dolomite with dolomite limestone, limestone and interbedded shale and dolomite observed in some of the core holes. The elevation of bedrock varied from El. 215.8 to 219.6 m±. The bedrock will not be encountered during the pipe installation.

4.3 SEEPAGE, SLOUGHING AND GROUND WATER CONDITIONS

Water infiltration was observed in four (4) of the test hole after drilling. The elevation of the water immediately after drilling ranged from 219.6 to 225.4 m±. Some sloughing was observed during the drilling program, test holes TH18-04 and TH18-06 sloughed to elevations 227.7 and 226.6 m± respectively.

As mentioned above, a total of four (4) pneumatic piezometers, eight (8) vibrating wire piezometers and ten (10) standpipe piezometers were installed. The piezometric levels are summarized in Table 2. It should be noted that groundwater levels will fluctuate seasonally and following precipitation events.

In general a slight downwards gradient from the clay into the silt till and bedrock was observed from most of the groundwater monitoring data. The groundwater readings ranged from elevation 224.3 to 231.4 m in the clay, elevations 224.8 to 227.2 m in the silt till and elevations 224.5 to

228.1 m in the bedrock. Details of the piezometer installations are included on the borehole logs.

TABLE 2
GROUNDWATER MEASUREMENTS

Test Hole:	TH16-08		TH16-09		TH17-10			TH17-12		TH17-13	TH17-15		TH17-16		TH18-09		TH18-16		TH18-18		TH18-24	
Ground Elevation (m):	233.30		232.73		231.76	231.76	231.76	231.98	231.98	232.10	231.79	231.79	232.14	232.14	232.60		231.98		231.72		232.47	
Piezometer No.:	36896	36893	36897	36889	1700050	Standpipe	Standpipe	1700049	Standpipe	Standpipe	1700048	Standpipe	1702738	Standpipe	1800934	Standpipe	1800937	Standpipe	1500935	Standpipe	1800932	Standpipe
Tip Elevation (m):	226.0	218.4	224.2	218.1	224.1	218.5	213.6	226.5	216.3	217.5	224.2	213.8	223.9	217.0	225.6	220.0	224.4	216.2	225.6	218.0	225.2	216.8
Monitoring Zone:	Clay	Bedrock	Clay	Bedrock	Clay	Silt Till	Bedrock	Clay	Bedrock	Silt Till	Clay	Bedrock	Clay	Silt Till	Clay	Silt Till	Clay	Bedrock	Clay	Silt Till	Clay	Bedrock
Date																						
25-May-16	230.57	225.22	226.42	225.72																		
17-Jun-16	230.50	224.86	226.42	225.65																		
26-Aug-16			224.32	224.86																		
6-Oct-16			225.62	225.36																		
9-May-17			227.42	227.22	230.31	225.19	226.57	228.78	226.43	226.48	231.37	228.12										
14-Jun-2017			227.42	225.79	229.99	225.66	225.46	228.65	225.21	225.87	230.92	225.67										
25-Sep-2017			227.40	225.29	229.73	225.14	224.65	228.96	224.52	224.75	230.86	225.21										
16-Oct-2017													226.79	225.22								
29-May-2018															227.17	227.19	226.71	225.89	227.45	227.11	227.45	225.05
6-June-2018					228.96	225.21	224.92	228.94	225.71		230.87		227.31	224.99								

5.0 DESIGN AND CONSTRUCTION CONSIDERATIONS

5.1 TRENCHLESS PIPE CONSTRUCTION METHODS

It is our understanding a portion of the work will be large diameter pipe installed by trenchless methods. The two (2) most viable trenchless pipe methods suitable for the proposed work and readily available locally for installing large diameter pipe are Microtunneling and Auger/Thrust Boring.

5.1.1 Microtunneling

Microtunneling is a remotely-controlled, guided, pipe-jacking operation that provides continuous support to the excavation face by applying mechanical or fluid pressure to balance groundwater and earth pressures. Support at the excavation face is a key feature of microtunneling, distinguishing it from traditional open-shield pipe-jacking. Microtunnel Boring Machines (MTBMs) have been used extensively and successfully to install gravity flow sewer lines requiring precise line and grade in weak clay soil deposits

Microtunneling installation technique requires a jacking shaft from which the pipe installation starts and a reception shaft at the opposite end of the pipeline to retrieve the MTBM which would be used to excavate underground along the pipe alignment. The MTBM is pushed into the earth by hydraulic jacks mounted and aligned in the jacking shaft. The jacks are then retracted and the slurry lines and control cables are disconnected. The pipe or casing to be installed is lowered into the shaft and inserted between the jacking frame and the MTBM or previously jacked pipe. Slurry lines and power and control cable connections are made, and the pipe and MTBM are advanced another drive stroke. This process is repeated until the MTBM reaches the reception shaft. Upon drive completion, the MTBM and trailing equipment are retrieved and all equipment removed from the pipeline.

MTBMs have a rotating cutting head to excavate the ground material; the spoil is transported through conveyor or piping system back to the jacking/launching shaft. The cutting head is turned by a hydraulic or electric motor while a pressurized slurry mixing chamber behind the cutter head maintain face stability. MTBMs are capable of independently counter-balancing

earth and hydrostatic pressures. Earth pressure is counter-balanced by careful control of advance rates and excavation rates of spoil materials. Groundwater pressure is counter-balanced by using pressurized slurry in the soil-mixing chamber of the MTBM.

Large diameter sewer line with drive lengths up to 410 m have been successfully completed for Contract 4 of this Work using MTBM.

5.1.2 Auger/Thrust Boring

Auger boring is ideal for installing pipe in relatively soft stable ground conditions such as clay located above the water table. The soil within the pipe is retained during auger boring to reduce the likelihood of ground settlement from excavation, making auger boring a popular installation method for installing utilities under highways, railways and levies where potential settlement is a concern.

The auger boring process uses an auger boring machine to rotate an auger placed within the pipe and fitted to a cutter head at the front of the pipe. The rotating cutter head, which is slightly larger in diameter than the pipe, excavates the soil in front of the pipe. The soil is transported back to the launching where it is removed by hand or machine. The auger boring machine advances along a track, which is aligned to drive the casing pipe on the designed grade. Once the machine reaches the end of the track arrangement, the auger chain is disconnected from the machine and the machine is moved back to the original starting point on the track where a new casing pipe segment and auger chain is connected to the machine and to the existing chain/cutter head. The excavation and thrust process is repeated until the project is completed. The auger chain is then withdrawn from the casing pipe and the pipe is cleaned of all remaining soil and ready to use.

5.2 LAUNCHING AND RECEIVING SHAFTS

For trenchless installation of the pipe launching and receiving shafts are required. The shafts will be constructed primarily within the clay deposit and may extend into the underlying till. General design and construction considerations are outlined below:

- The shaft locations will be used to launch and/or receive the TBM and provide space for construction activities;
- The shaft will be excavated through the clay and shoring may penetrate into the silt till.
- The Contractor is responsible for the design of the shoring and temporary support systems at the shaft locations;
- The temporary support systems must be designed to resist lateral earth pressures, lateral hydrostatic pressures, surcharge of equipment/material stockpiled adjacent to the shaft and control ground movements;
- Groundwater monitoring data is included on Table 2. A base slab capable of resisting buoyance and basal heave is required at the shaft locations unless the Contractor can demonstrate that heave is not a concern and that pressures can be relieved in a controlled manner;
- The design of the shaft complies with Manitoba Workplace Safety and Health Act and Regulation. The Contractor shall be required to submit design details and drawings for their shafts to the City of Winnipeg for approval; and
- All seepage water pumped from the shaft locations will be discharged according to City of Winnipeg requirements.

5.2.1 Base Heave

The base of excavation and shoring should be designed to achieve a minimum factor of safety of 1.5 with respect to basal heave. Installation of groundwater monitoring wells may be required at shaft locations to measure the piezometric elevation in the vicinity of the shaft during construction. Depending on the groundwater conditions at the time of construction, groundwater depressurization may be required to achieve the specified factor of safety against basal heave.

5.2.2 Care and Control of Water

In order to maintain safe working conditions in the excavation and to protect against instability of the excavation base, water will not be allowed to accumulate anywhere within the excavations. Effective drainage and sump pump systems will be required below the base of excavation to maintain a firm, dry working surface. The Contractor shall design the internal drainage system to efficiently collect groundwater seepage and all water inflow draining into the excavation shall be pumped out and treated or use a watertight concrete slab designed to resist uplift. The Contractor will be responsible to prevent surface runoff from entering the excavation.

5.3 TUNNELLING

Trenchless large diameter pipe installation may be required for a portion of the work. General design and construction considerations for the tunnel are outlined below:

- The Contractor must pick suitable equipment to properly handle the excavated material;
- The tunnel will be installed within the clay layer, a minimum of approximately 5.0 m above the glacial silt till deposit;
- The clay layer has a very high swelling potential, mitigation measures such as increasing the size of the overcut may be required depending on the trenchless pipe installation method selected by the Contractor. Furthermore, any activity that may result in a drastic change in the moisture content of the clay (drying or wetting) may aggravate the potential for swelling and should be avoided; and
- The Contractor is required to collect and discharge groundwater flows according with City of Winnipeg requirements.

5.3.1 Stickiness Potential and Clogging Risks

The clay deposit present at the site has a tendency to develop sticky behavior (adhesion of clay material to each other or to a metal surface). This stickiness may result in the clogging and blockage of the cutterhead, tooling, work chamber, screw conveyors (EPBM), muck carts, conveyors, slurry lines or prevent the shield advancement due to excessive friction.

The potential for clogging while tunneling through the clay formation was evaluated using the chart suggested by Hollmann and Thewes (2013). Atterberg limits (Liquid limit, Plastic limit, and natural moisture content) of clay samples tested in the Laboratory and their Plasticity Indices were plotted on Figure 3 to determine the corresponding clogging potential of the clay. It should be noted that the Hollmann and Thewes chart (Figure 3) was developed from data collected from fluid supported shield drives but are assumed to be applicable to other tunneling methods. Based on the Hollmann and Thewes chart the clay deposit at the site has high stickiness and strong clogging potential.

The additional effort that will be required for cleaning clogged components may lead to significant reduction in productivity and increased cost. Therefore, the tunneling system and separation plant (for a slurry supported shield drive) used for this project should be designed to

mitigate this potential clogging problem. Thewes and Burger (2004) suggested the following upgrades to the design of the TBM to mitigate the risk of clogging:

- Enlarge passages and other obstructions in the transport of clay chips from the tunnel face to the slurry line;
- Increase the ratio of suspension flow rate to the volume of excavated soil to prevent accumulation of clay in the chamber (circuit and flushing concepts);
- Avoid clay agglomeration by increasing agitation in areas prone to material settlement; and
- Avoid closed-type cutting wheels.

Other mitigating measures include optimizing the cutting tools' penetration to get a favorable clay chip size, the use chemical additives and provision of high pressure water jets in the cutter head chamber.

5.4 EXCAVATIONS

Temporary excavations will be required to facilitate the construction of the proposed LDS pipe sewer. All excavation work are required to be performed in accordance with the Workplace Safety and Health Act and Part 26 of the Manitoba Workplace Safety and Health Regulation, M.R. 217/2006.

Excavations performed adjacent to the existing roadway or infrastructure, require temporary shoring or bracing. Excavations deeper than 1.5 m are required to be designed and approved prior to construction by an experienced professional engineer with an expertise in geotechnical engineering. The shoring design should account for all applicable surcharge loads. Opening and voids behind shoring lagging or sheet piles will be backfilled with cement grout.

The silt layers are known to be water bearing and are susceptible to strength loss when subjected to mechanical disturbance and sloughing from wetting. All open excavation side slopes will be covered with water proof material to prevent saturation of the soil and all surface runoff will be directed away from the excavations. The Contractor will maintain all surcharge

loads such as stockpiled soil, equipment, etc. a minimum of 10 m away from the edge of excavations.

During the site investigations water infiltration was observed in some of the test holes as discussed in Section 3.7. Temporary pumping may be required as well as potential shoring. Design of the above measures depends on the size, depth and extent of the excavation.

5.4.1 IMPACT ON EXISTING STRUCTURES

Excavation support systems will be designed by the Contractor to control ground movement/subsidence around the perimeter of the excavation. Potential settlement of the ground surface adjacent to temporary shoring system should be recognized and accounted for in the design. Any resulting movement/settlement around the perimeter of the excavation and of utilities, roadways, and buildings must be kept within acceptable limits.

The excavation and shoring system will be designed by a professional engineer with extensive relevant experienced and the works must be inspected and certified by the same professional engineer to verify that the temporary structure has been installed according to the design.

5.4.2 BASE HEAVE

The stability of the bottom of the excavation could be compromised if the high plastic clay is overstressed and allowed to shear. The base of excavation and shoring should be designed to achieve a minimum factor of safety of 1.5 with respect to basal heave.

5.4.3 CARE AND CONTROL OF WATER

The base of the excavations may to be below the groundwater level during construction. In order to maintain safe working conditions in the excavation and to protect against instability of the excavation base, the water should not allowed to accumulate anywhere within the excavations or to within 0.5 m below the lowest point within the excavation. Therefore, it will be important to have an effective drainage and sump pump system below the base of excavation,

and to maintain a firm, dry working surface. The drainage system should be designed to efficiently collect groundwater seepage and surface water drainage within the excavation so it can be pumped out and treated. Surface run-off resulting from rainfall should be controlled and prevented from entering into the excavation.

5.5 LATERAL EARTH PRESSURES

For design purposes the soils may be assigned active, at-rest and passive lateral earth pressure coefficients as shown in Table 5.

TABLE 5
LATERAL EARTH PRESSURE COEFFICIENTS

Backfill Material	ϕ'	K_a	K_0	K_p
Till	25°	0.41	0.58	2.46
Native Clay	18°	0.53	0.69	1.89
Well Graded Compacted Granular	35°	0.27	0.43	3.69

5.6 GROUNDWATER MANAGEMENT AND SPOIL DISPOSAL

The Contractor is expected to be familiar with and follow all local spoil disposal regulations including all monitoring, analysis, permits and treatment required by the City of Winnipeg. Transportation and disposal of the spoil material is required to comply with all applicable laws and regulations. The Contractor will be required to obtain all necessary permits/approvals for the discharge of groundwater. Routine monitoring of groundwater discharge quality by the Contractor will be required during construction.

5.7 FROST PENETRATION

The expected depth of frost penetration has been estimated assuming a design freezing index of 2680°C days, taken as the coldest winter over a ten (10) year period. The estimated maximum depth of frost penetration is 2.5 m assuming no insulation cover.

5.8 CORROSION POTENTIAL

The degree of exposure of concrete in contact with soils to sulphate attack is classified in CAN/CSAA23.1-M94 (Concrete Materials and Methods of Concrete Construction) as moderate (S-3), severe (S-2) or very severe (S-1). All concrete utilized in foundation elements should have a minimum specified 28 day compressive strength of 35 MPa and class of exposure of S-1, corresponding to very severe sulphate attack. A maximum water to cement ratio of 0.40 should be specified in accordance with Table 2, CSA A23.1-09 for concrete with very severe sulphate exposure (S-1). Concrete which may be exposed to freezing and thawing should be adequately air entrained to improve freeze-thaw durability in accordance with Table 4, CSA A23.1-09.

6.0 CLOSURE

The geotechnical investigation conducted by KGS Group describes the underlying soil and groundwater conditions along the proposed alignment for Contracts 6 to 13 at the test hole locations. This report presents the geotechnical engineer's best judgment of the subsurface and ground conditions anticipated to be encountered at the project site during construction. In order to develop the design, it was necessary to interpolate between the test holes that were drilled at the site. While the actual conditions encountered in the field are expected to be within the range of conditions discussed in this document, the spatial variability of subsurface and groundwater conditions that would be encountered at the site may be more complex than the simplified interpretation presented in this report.

To facilitate project design, certain assumptions were made with respect to the construction methods and on the level of workmanship that can reasonably be expected for the construction of a large diameter sewer project. It should be noted that the Contractor's selected equipment, means, methods, and workmanship will influence the behaviour and performance of the subsurface soils encountered at the site.

Full time inspection by qualified geotechnical personnel is recommended during construction to ensure that design intent is achieved and to address any issue that may arise due to variability in soils condition.

7.0 REFERENCES

1. Department of Geological Engineering, the University of Manitoba, (1983). Geological Engineering Report for Urban Development of Winnipeg.

8.0 STATEMENT OF LIMITATIONS

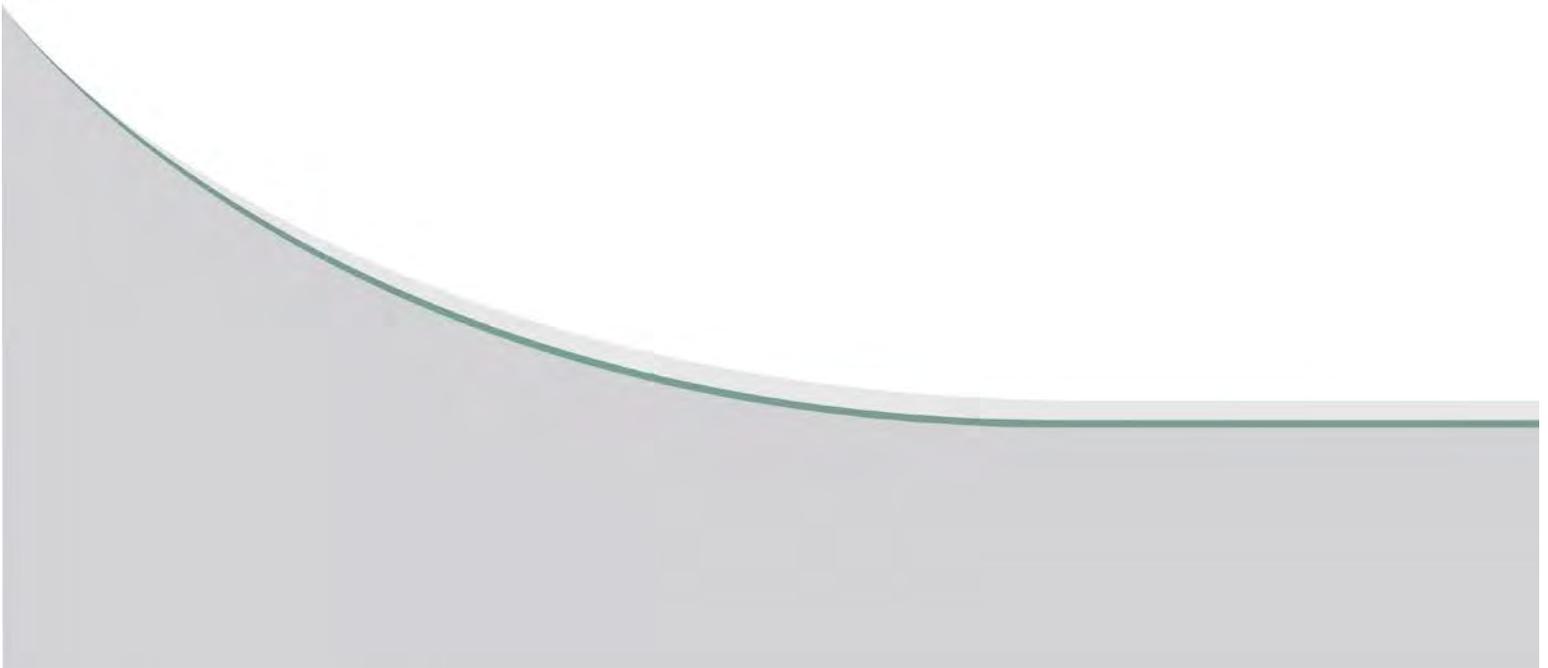
8.1 THIRD PARTY USE OF REPORT

This report has been prepared for the City of Winnipeg to whom this report has been addressed and any use a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report.

8.2 GEOTECHNICAL INVESTIGATION STATEMENT OF LIMITATION

The geotechnical investigation findings and recommendations of this report were prepared in accordance with generally accepted professional engineering principles and practice. The findings and recommendations are based on the results of field and laboratory investigations, combined with an interpolation of soil and groundwater conditions found at and within the depth of the test holes drilled by KGS Group at this site. If conditions encountered during construction appear to be different from those shown by the test holes drilled by KGS Group or if the assumptions stated herein are not in keeping with the design, this office should be notified in order that the recommendations can be reviewed and modified if necessary.

FIGURES



File Name: P:\Projects\2011\11-0107-18\11-0107-18\11-0107-18_Fig01_RevA.mxd
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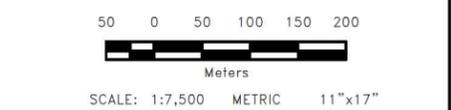


LEGEND:

- ◆ Test Hole
- ◆ Test Hole with Instrument Installation

NOTES:

1. Test holes completed by KGS Group from 2016 to 2018.
2. Imagery: ESRI Base, 2016.



All units are metric and in metres unless otherwise specified.
 Transverse Mercator Projection, NAD 1983, Zone 14
 Elevations are in metres above sea level (MSL)

NO.	YY/MM/DD	DESCRIPTION	ISSUED BY	CHECK BY
A	18/08/21	ISSUED WITH REPORT	JRM	BAT

REVISIONS / ISSUE

C6 - C13 - COCKBURN AND CALROSSIE SEWER RELIEF WORKS

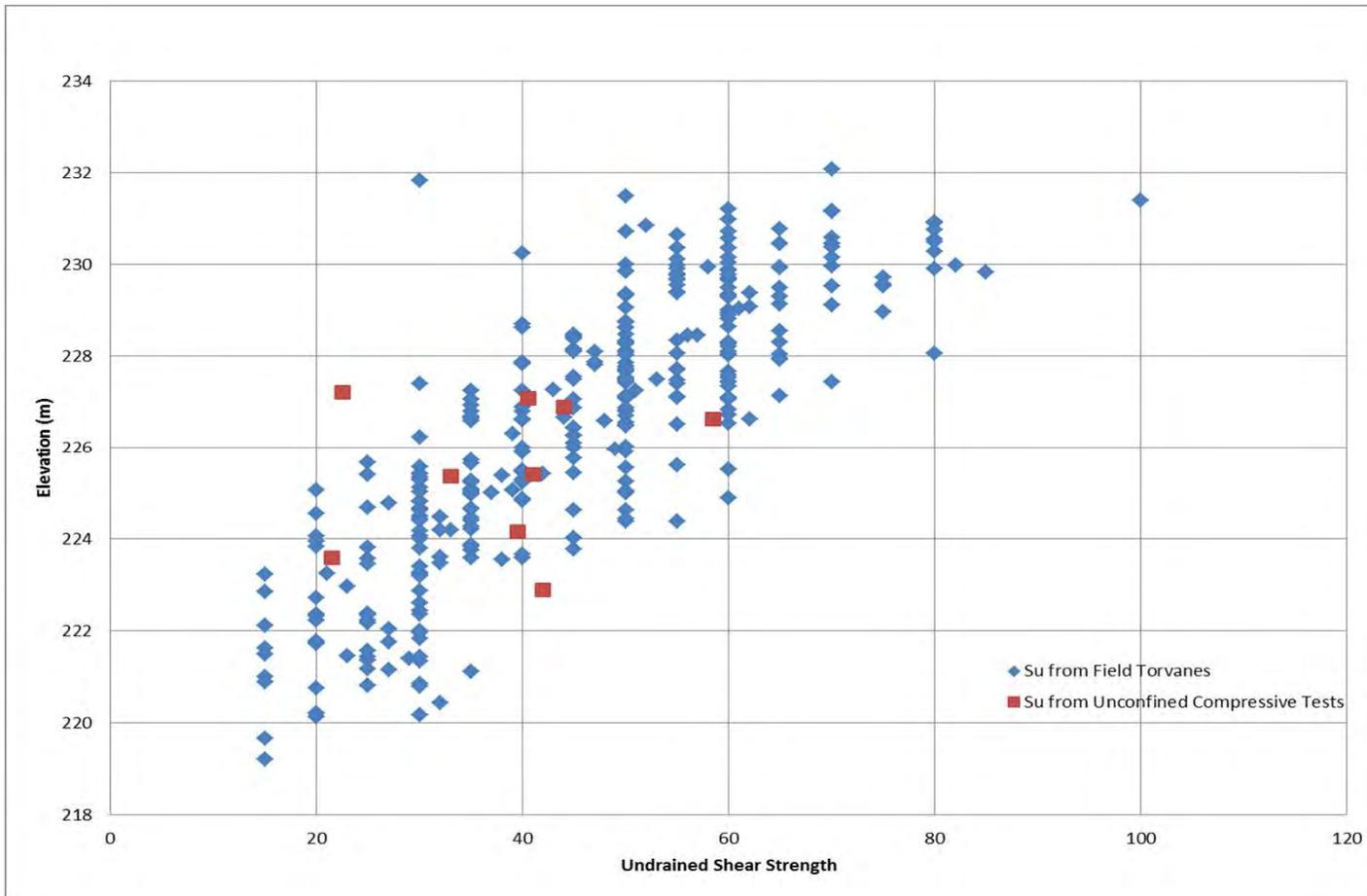
GEOTECHNICAL DRILLING LOCATIONS

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

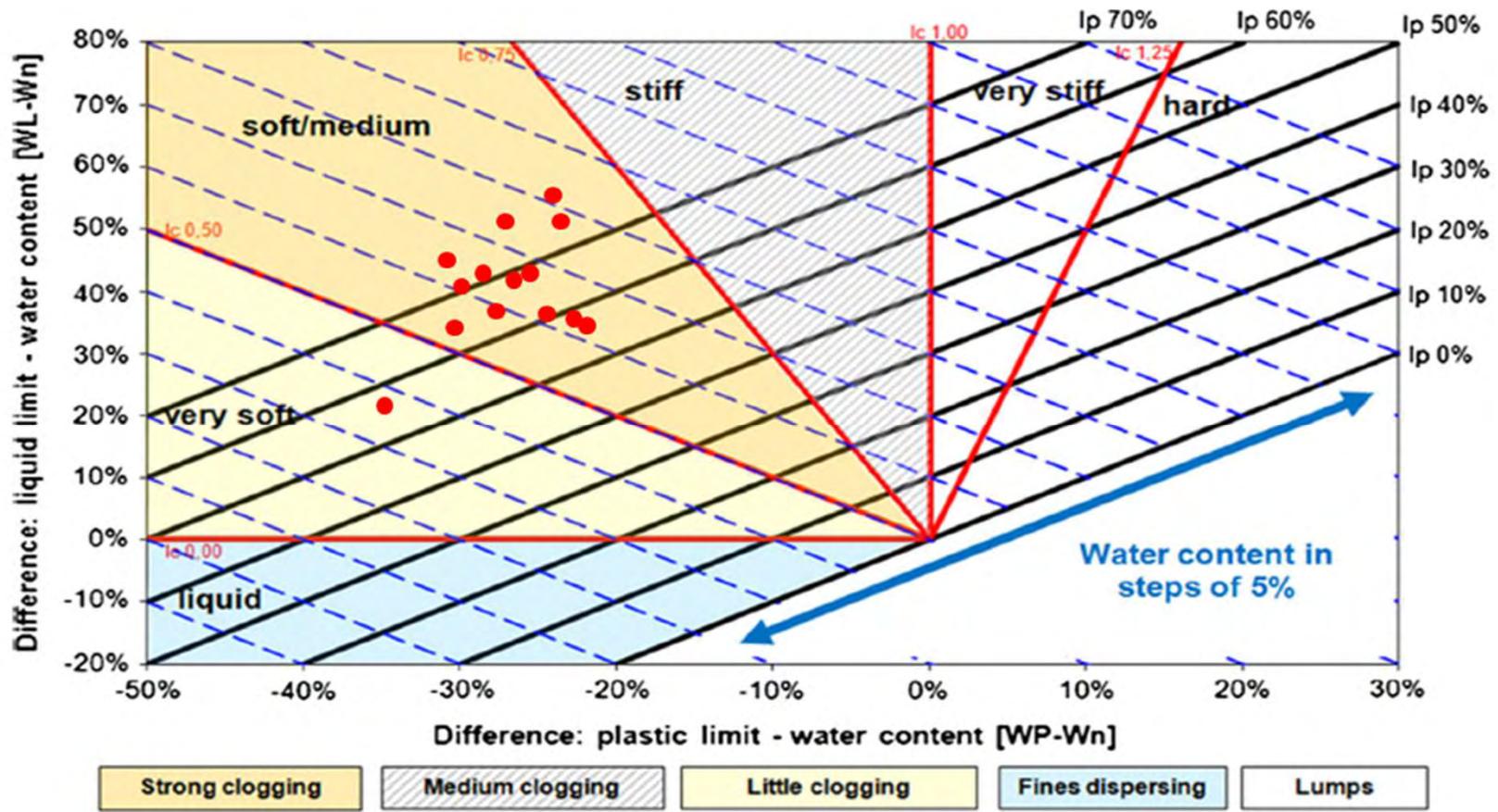
AUGUST 2018	FIGURE 01	REV: A
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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



NOTES:

		
<p>Cockburn/ Calrossie Combined Sewer Relief Project</p>		
<p>Geotechnical Factual Report</p>		
<p>Undrained Shear Strength of Clay Deposit</p>		
<p>August 2018</p>	<p>Figure 2</p>	<p>1 Rev</p>



NOTES:

			
Cockburn/ Calrossie Combined Sewer Relief Project			
Geotechnical Factual Report			
Clogging Potential of the Clay Deposit			
August 2018	Figure 3	1 Rev	

TABLES

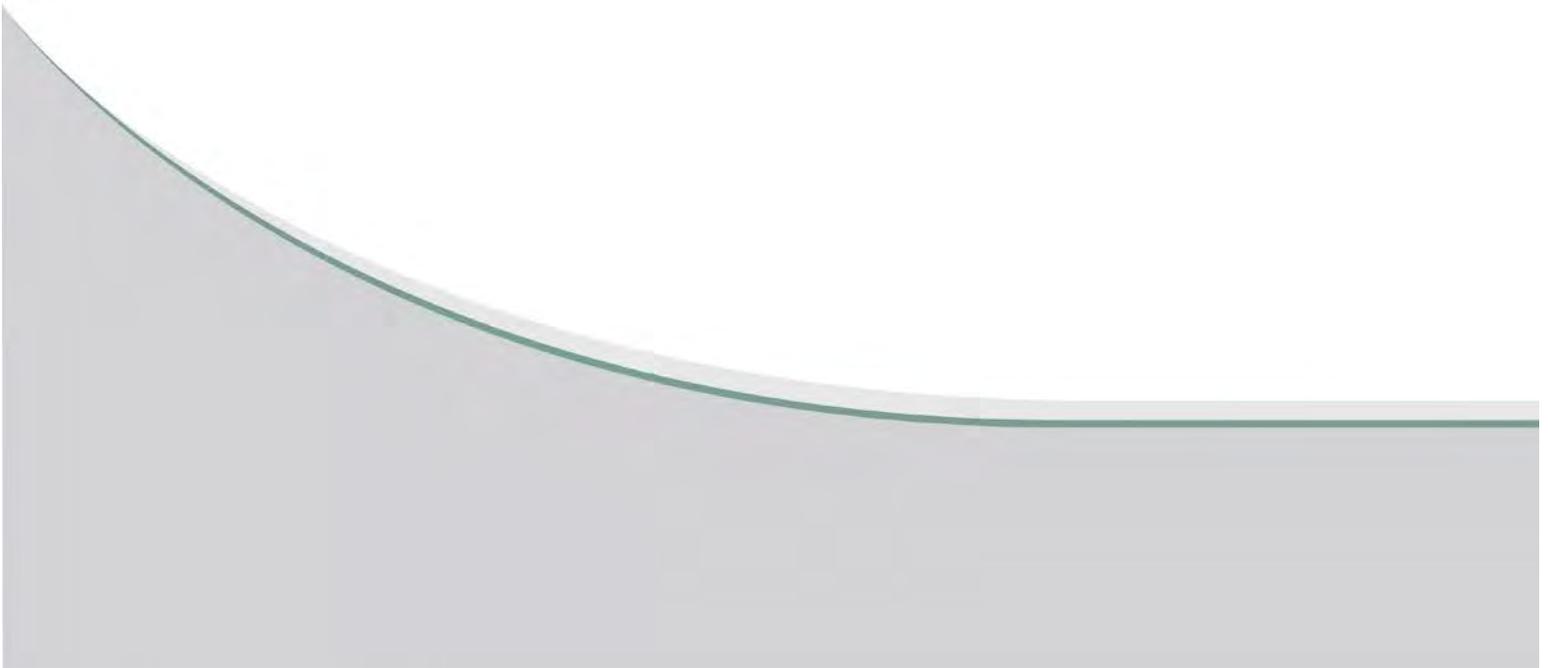


Table 3
Summary of Laboratory Testing Results

Testhole ID	Sample	Sample Depth (m)	Description	Moisture content (%)	Unconfined Compressive Strength (kPa)	Grain Size Analyses						Atterberg Limit		
						Gravel (> 4.75 mm)	Coarse Sand (2-4.75 mm)	Medium Sand (0.425-2 mm)	Fine Sand (0.075-0.425 mm)	Silt (0.002-0.075 mm)	Clay (<0.002 mm)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index
TH16-08	S3	2.0	Silt	24.8										
	S5	3.1	Clay	51										
	S7	5.3	Clay	57.5								100	30	70
	S8	6.1	Clay	52.9	45	0	0	0.1	0.3	18.2	81.4	95	29	66
	S11	9.1	Clay	58.1	79							81	23	58
	S13	12.2	Clay	47.9										
TH16-09	S3	3.7	Clay	52.2										
	S6	6.1	Clay	57.4	117	0	0.1	0.3	0.5	18.2	80.9	98	29	69
	S9	9.1	Clay	46.5	43							85	25	60
	S12	12.2	Silt Till	54.1										
TH17-09	S10	12.8 to 13.1	Silt till	22.8										
	S11	13.4 to 13.7	Silt till	13.1		9.4	6.2	10	14.9	39.2	20.3			
TH17-10	S1	0.9 to 1.2	Silty clay	34.2										
	S3	3.7 to 4.0	Silty clay	54.2								106	31	75
	S6	6.1 to 6.7	Silty clay	47.8	66							86	24	62
	S9	8.2 to 8.5	Silty clay	53.0										
	S11	11.3 to 11.6	Silty clay	48.5								88	24	64
	S12	13.1 to 13.4	Silt till	14.8		3.5	6.4	11.3	14.8	46.9	17.1			
TH17-12	S4	4.6 to 5.2	Silty clay	54.0	81									
	S8	7.6 to 8.2	Silty clay	50.9	84									
TH17-15	S1	1.2 to 1.5	Silty clay	36.0										
	S4	4.6 to 5.2	Silty clay	51.8	88							108	28	80
	S6	6.1 to 6.7	Silty clay	50.4	82							91	26	65
	S12	12.8 to 13.1	Silt till	13.0										
TH18-01	S3	1.2 to 1.5	Clay	34.1										
	S5	3.8 to 4.1	Clay	50.4										
	S6	5.3 to 5.6	Clay	46.9										

TH18-03	S1	0.8 to 1.1	Silt	26.2														
	S3	2.3 to 2.6	Clay	47.9														
	S5	5.3 to 5.6	Clay	10.8														
	S7	8.4 to 8.7	Clay	49.7									96	22	74			
	S9	10.4 to 10.7	Clay	21.7														
TH18-04	S1	0.8 to 1.1	Clay	31.3														
	S3	3.5 to 3.8	Clay	62.1														
	S4	6.4 to 6.7	Clay	53.6														
TH18-06	S3	2.3 to 2.6	Clay	48.6														
	S5	5.5 to 5.8	Clay	47.5														
	S6	7.0 to 7.3	Clay	52.0														
TH18-09	S2	1.2 to 1.5	Clay	36.7														
	S4	3.8 to 4.1	Clay	50.4														
	S5	5.3 to 5.6	Clay	49.8									100	24	76			
	S7	8.4 to 8.7	Clay	43.3														
	S8	9.8 to 10.1	Clay	50.7														
	S11	11.4 to 11.7	Silt Till	16.3			3.8	6.1	11.1	15.7	49.8	13.5						
TH18-13	S3	1.1 to 1.4	Clay	31.9														
	S6	3.8 to 4.1	Clay	47.6														
	S8	7.0 to 7.3	Clay	46.6														
TH18-14	S3	1.5 to 1.8	Clayey silt	23.1														
	S4	2.4 to 2.7	Clay	45.7														
	S6	3.1 to 3.4	Clay	51.3														
	S8	3.8 to 4.1	Clay	54.2														
	S10	7.3 to 7.6	Clay	47.0														
TH18-15	S2	0.9 to 1.2	Clayey Silt	17.2														
	S3	2.3 to 2.6	Clay	45.6														
	S5	3.8 to 4.1	Clay	49.3														
	S6	6.7 to 7.0	Clay	53.1														
TH18-16	S2	2.3 to 2.6	Clay	50.2														
	S4	3.8 to 4.1	Clay	49.3														
	S6	8.4 to 8.7	Clay	49.7									86	29	57			
	S8	11.3 to 11.6	Clay	44.6														

	S9	11.9 to 12.2	Silt Till	25.0										
	S11	13.1 to 13.4	Silt Till	12.9		12.6	6.3	8.1	13.6	42.9	16.5			
TH18-18	S2	0.9 to 1.2	Clay Fill	31.4										
	S3	2.3 to 2.6	Clay	51.9										
	S5	3.8 to 4.1	Clay	56.3								93	26	67
	S7	8.4 to 8.7	Clay	52.9										
	S9	11.3 to 11.6	Clay	51.8										
	S11	12.8 to 13.1	Silt Till	19.2										
	S12	13.4 to 13.7	Silt Till	14.3		8.5	6.1	9.1	13.4	45.0	17.9			
TH18-19	S1	0.3 to 0.6	Clayey silt	29.0										
	S4	2.8 to 3.1	Clay	52.2										
	S6	3.8 to 4.1	Clay	49.4										
TH18-20	S1	0.8 to 1.1	Clay	34.9										
	S2	1.7 to 2.0	Clayey silt	42.4										
	S3	2.5 to 2.8	Clay	48.9										
	S5	4.9 to 5.2	Clay	52.1										
	S7	7.0 to 7.3	Clay	51.5										
	S9	10.0 to 10.3	Clay	54.1										
TH18-24	S2	0.8 to 1.1	Clayey Silt	27.0										
	S5	2.5 to 2.8	Clay	43.5										
	S6	3.8 to 4.1	Clay	53.7										
	S7	5.2 to 5.5	Clay	56.0										

TABLE 4
GLACIAL TILL – SPT SUMMARY

Density	Frequency
Very Loose (0-4 blows/0.3 m)	1
Loose (4-10 blows/0.3 m)	2
Compact (10-30 blows/0.3 m)	4
Dense (30-50 blows/0.3 m)	0
Very Dense (greater than 50 blows/0.3 m)	3
Spoon Refusal (greater than 50 blows for less than 0.3 m)	6

APPENDIX A
2016 TEST HOLE LOGS



PRINCIPAL AND MINOR SOIL COMPONENTS

And	35 – 50%
With	20 – 35%
Some	10 – 20%
Trace	0 – 10%
Occasional	Trace of very local concentration

FIELD MOISTURE CONTENT

Dry	No moisture visible or to touch when fresh exposure is examined
Damp	Slightly wet to touch
Moist	Fresh exposure wet to touch
Wet	A film of water is readily visible around particles of granular soils, cohesive soils can readily be smeared or remolded; water can be squeezed out
Saturated	Water can easily be squeezed out
Free Water	Water completely separated from the soil particles

DEPOSITIONAL STRUCTURE

Massive	Structureless soil
Stratified (Layered)	Different soils or visible variations in soil constituents arranged in layers, generally but not necessarily parallel to one another, and not necessarily in horizontal position, at least 6 mm thick
Varved	Glaciolacustrine deposits with annual pairs of fine and coarser laminae (thin laminae of alternately deposited inorganic silt and clay)
Laminated	Closely spaced, regularly alternating layers of differing soils and/or colours, or shades of similar gradation, relatively consistent in thickness and consisting of sand, silt, or clay
Lens	Inclusions of a different soil within surrounding soils, which thins out horizontally and may not be continuous over any significant distance
Pocket	A different soil type of very limited thickness or lateral extent (a small lens)
Inclusions	Small pockets
Nuggety	A different soil type in the form of small lumps
Parting	Paper thin separation of one type by another

POST DEPOSITIONAL STRUCTURE

Fissured	A soil breaks along definite, pre-existing planes or fracture with little resistance to fracturing
Slickensided	Polished or glossy, sometimes striated surfaces resulting from movement of a material block relative to the adjacent blocks
Blocky/Friable/Platy	Cohesive soil that can be broken down into angular larger fragments (blocky), small fragments (friable), or thin plate-like fragments (platy) which resist further breakdown
Cemented	Soil particles or fragments held together by cemented materials, often chemical precipitants, or deposits within overall soil mass

GRAIN SIZE DISTRIBUTION IN COARSE GRAINED SOIL

Boulders	>200 mm ϕ
Cobbles	75 – 200 mm ϕ
Coarse Grained Gravel	19 – 75 mm ϕ
Fine Grained Gravel	4.75 – 19 mm ϕ
Coarse Grained Sand	2 – 4.75 mm ϕ
Medium Grained Sand	0.425 – 2 mm ϕ
Fine Grained Sand	0.075 – 0.425 mm ϕ

DENSITY OF GRANULAR SOIL

Description	Standard Penetration Test	Relative Density
Very Loose	0 – 4 Blows Per 0.3 m	<15%
Loose	4 – 10 Blows Per 0.3 m	15 – 35%
Compact	10 - 30 Blows Per 0.3 m	35 – 65%
Dense	30 - 50 Blows Per 0.3 m	65 – 85%
Very Dense	>50 Blows Per 0.3 m	>85%

CONSISTENCY OF COHESIVE SOILS

Description	Torvane	Standard Penetration Test
Very Soft	<12 kPa	<2
Soft	12 – 25 kPa	2 – 4
Firm	25 – 50 kPa	4 – 8
Stiff	50 – 100 kPa	8 – 15
Very Stiff	100 – 200 kPa	15 – 30
Hard	>200 kPa	>30

CLIENT CITY OF WINNIPEG
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION 18 m North of CN Tracks
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.00
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/18/2016
UTM (m) N 5,523,861
 E 632,463

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)								PL	MC	LL	PL
232.1	1			SAND & GRAVEL FILL - Brown, wet, loose, some silt.									
232		1		CLAY - Grey, damp, stiff, high plasticity, some silt.									
231.5		5		SILT - Tan, moist, soft, low plasticity, some clay.	S1								
231		2		CLAY - Brown, moist, stiff, high plasticity, some silt.	S2								
230.6		3		CLAY - Brown, moist, stiff, high plasticity, some silt.	S3								
230		10		- Water infiltrating test hole below 3.05 m. - Firm to stiff below 3.36 m. - Some silt nodules, oxidation below 3.66 m.	S4								
229		4		- Firm below 4.57 m.	S5								
228		5		- Grey below 5.18 m. - No silt nodules from 5.18 to 6.10 m.	S6								
227		6		- Mottled grey and brown from 5.80 to 6.10 m.	S7								
226		7			S8								
225		8											
224		9		- Trace to some fine to coarse grained sand below 9.14 m.									

GEO-TECHNICAL-SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC4 - 2700 TRUNK SEWER - TAYLOR AVE\LOGS\TRENCHLESS\IDS_LOGS.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)							PL	MC	LL
222	11	35		- Increased fine to coarse grained sand content below 10.67 m.							
221	12	40				S9					
220	13	45		- Soft to firm below 13.12 m.							
219	14	45				S10					
218	15	50		SILT TILL - Tan, moist, loose, low plasticity, some fine to coarse grained sand, trace fine grained gravel.							
217	16	55		- Increased density, with fine to coarse grained sand content below 14.6 m.		S11					
216.7	16.7	56		- Non-plastic from 14.95 to 15.56 m. - Damp, compact below 15.20 m.		S12 56 S13		▲ 4 ▲ 20 ▲ 9			
216	17	55	AUGER REFUSAL AT 16.31 m.								
215	18	60	Notes:								
214	19	65	1. Test hole open to 3.05 m below grade after drilling.								
213	20	65	2. Water level in test hole at 0.91 m below grade after drilling.								
212	21	70	3. Test hole backfilled to grade with bentonite chips and auger cuttings.								

GEO TECHNICAL - SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC4 - 2700 TRUNK SEWER - TAYLOR AVE\LOGS\TRENCHLESS\LOGS.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

CLIENT CITY OF WINNIPEG
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. 45 m Southeast of Shaft B - East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.92
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/18/2016
UTM (m) N 5,523,978
 E 632,433

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							PL	MC	LL	PL
233	1			SANDY SILT - Mottled black and brown, damp, loose to compact, non-plastic, with fine to coarse grained sand, trace fine to coarse grained gravel. - Low plasticity, some clay below 1.07 m.	S1							
232.4	5											
232	2			CLAY - Mottled grey and black, damp, stiff, high plasticity, some fine to coarse grained sand.	S2							
231.8				SILT - Tan, damp to moist, low plasticity, soft, some clay, trace coarse grained sand.								
231	3	10			S3							
230.4												
230	4			CLAY - Brown, moist, stiff, high plasticity, some silt, trace silt nodules. - Mottled grey and brown, trace oxidation below 4.57 m.	S4							
229	5	15										
228	6	20		- Firm below 6.10 m.	S5							
227	7				S6							
226	8	25		- Grey, trace coarse grained sand below 7.62 m.								
225	9	30		- Soft to firm below 8.54 m.	S7							
224												

GEO-TECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC4 - 2700 TRUNK SEWER - TAYLOR AVE\LOGS\TRENCHLESS\LOGS.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR **Maple Leaf Enterprises** INSPECTOR **J. MACLENNAN** APPROVED **DAA** DATE **10/6/16**

CLIENT CITY OF WINNIPEG
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. 65 m Northwest of Shaft B - East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.39
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/19/2016
UTM (m) N 5,524,081
 E 632,378

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)						PL	MC	LL
233	1		[Hatched]	ORGANIC CLAY FILL - Black, damp, stiff, intermediate plasticity, some fine to coarse grained sand, some fine to coarse grained gravel.	S1					
232	5		[Hatched]							
231.3	2		[Dotted]	SILT - Brown, moist, soft, low plasticity, some clay.	S2					
230.8	3		[Diagonal]	CLAY - Brown, moist, stiff, high plasticity, some silt.	S3					
230	10		[Diagonal]	- Trace silt pockets below 3.35 m.	S4					
229	15		[Diagonal]	- Mottled grey and brown below 4.12 m.	S5					
228	20		[Diagonal]	- Firm below 5.18 m.	S6					
227	25		[Diagonal]		S7					
226	30		[Diagonal]	- Grey, increased silt pockets below 8.23 m.	S8					
225			[Diagonal]	- Trace fine to coarse grained sand below 8.54 m.						
224			[Diagonal]							

SAMPLE TYPE [Hatched] Auger Grab [Diagonal] Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

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ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆			
	(m)	(ft)							PL	MC	LL	
223		35		- Soft below 10.37 m.								
222	11					S9						
221	12	40										
220.4	13			SILT TILL - Tan, moist, firm, low plasticity, some fine to coarse grained sand, trace fine grained gravel.								
220		45				S10						
219.4	14			AUGER REFUSAL AT 15.85 m.								
219		50		Notes: 1. Test hole open to 9.45 m below grade after drilling. 2. Water level in test hole at 8.53 m below grade after drilling. 3. Test hole backfilled to grade with bentonite chips and auger cuttings.								
218	16	55										
217	17	60										
216	18	65										
215	19	70										
214	20											
213	21											
212		70										

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

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CLIENT CITY OF WINNIPEG
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. 50 m Southeast of Shaft C - East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.02
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/19/2016
UTM (m) N 5,524,189
 E 632,313

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							PL	MC	LL	PL
232.1	1		[Hatched]	ORGANIC CLAY FILL - Black, moist, firm, intermediate plasticity, trace fine grained gravel, trace fine to coarse grained sand.	S1							
232		5	[Hatched]	CLAY - Brown, damp, stiff, high plasticity, trace fine to coarse grained sand.								
231	2		[Hatched]	CLAY - Brown, damp, stiff, high plasticity, trace fine to coarse grained sand.	S2							
230.7			[Hatched]	SILT - Brown, moist, soft, low plasticity, some clay.	S3							
230.4	3		[Hatched]	CLAY - Brown, damp, stiff, high plasticity, some silt, trace fine to coarse grained sand.								
229.9		10	[Hatched]	SILT - Brown, moist, soft, low plasticity, some clay.								
229.2	4		[Hatched]	CLAY - Brown, moist, stiff, high plasticity, some silt, trace silt pockets.	S4							
229		15	[Hatched]		S5							
228	5		[Hatched]									
227	6		[Hatched]	- Grey below 5.79 m. - Firm below 6.10 m. - Mottled brown and grey from 6.10 to 6.86 m.	S6							
226	7		[Hatched]		S7							
225	8		[Hatched]									
224	9		[Hatched]	- Increased silt pockets from 8.54 m to 9.14 m. - Soft from 9.15 to 10.07 m.								

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

GEO-TECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC4 - 2700 TRUNK SEWER - TAYLOR AVE\LOGS\TRENCHLESS\LOGS.GPJ

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆			
	(m)	(ft)						PL	MC	LL	
222	11	35		SILT TILL - Tan, moist, loose, low plasticity, some to with fine to coarse grained sand, trace fine grained gravel. - Augers wet below 12.19 m. - Compact below 12.81 m.	S8			◆			
221 220.8	12	40						S9		◆	
220 219.7	13	45		AUGER REFUSAL AT 13.29 m.	S10		▲ 50	SPT refusal at 25 mm into 1st set			
219	14	50						S11	100		
218	15	55		Notes: 1. Test hole open to 2.74 m below grade after drilling. 2. Water level in test hole at 2.74 m below grade after drilling. 3. Test hole backfilled to grade with bentonite chips and auger cuttings.							
217	16	60									
216	17	65									
215	18	70									
214	19										
213	20										
212	21										

GEO TECHNICAL - SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC4 - 2700 TRUNK SEWER - TAYLOR AVE\LOGS\TRENCHLESS\LOGS.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

CLIENT CITY OF WINNIPEG
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. 100 m Southeast of Shaft C - East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.15
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/19/2016
UTM (m) N 5,524,144
 E 632,333

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
233				ORGANIC CLAY - Mottled brown and black, moist, stiff, low plasticity, with fine to coarse grained sand, some rootlets. - No rootlets below 0.30 m.								
232.1	1			CLAY - Brown, damp, stiff, high plasticity.			S1					
231.6	5			SILT - Tan, moist, soft, low plasticity, some clay.			S2					
231	2											
230.6				CLAY - Brown, damp, stiff, high plasticity, some silt.								
230.1	3			SILT - Tan, moist, soft, low plasticity, some clay.								
230	10											
229.6				CLAY - Brown, moist, stiff, high plasticity, some silt, trace silt pockets.								
229	4						S3					
	15			- Silt seam from 4.57 to 4.88 m. - Firm below 4.88 m. - Grey below 5.18 m.								
228	5											
227	6						S4					
	20											
226	7						S5					
	25											
225	8			- Soft to firm, silt pockets below 7.92 m.								
	30						S6					
224												

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC4 - 2700 TRUNK SEWER - TAYLOR AVE\LOGS\TRENCHLESS_IDS_LOGS.GPJ

SAMPLE TYPE Auger Grab Split Spoon Core Barrel

CONTRACTOR **Maple Leaf Enterprises** INSPECTOR **J. MACLENNAN** APPROVED **DAA** DATE **10/6/16**

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
223		35										
222	11						S7					
221	12	40		- Auger flights coming up wet below 12.19 m.			S8					
220.0	13											
220				SILT TILL - Grey, damp, loose to compact, low plasticity, some fine to coarse grained sand, trace to some fine to coarse grained gravel.								
219.4	14	45		- Auger refusal, switch to coring at 13.11 m.			S9					
219				LIMESTONE BEDROCK - Light beige, lightly fractured, strong, RQD = 49%.			S10					
218.2	15	50		- Decreased fractures below 14.42 m.			R1	81				
218				END TEST HOLE AT 14.93 m.								
217	16	55		Notes: 1. Installed RST flow - through piezometer PN36898 at 8.53 m below grade and PN36890 at 14.63 m. 2. Backfilled test hole with bentonite - cement grout mixture from 14.93 m to grade. 3. Minor sloughing in test hole from 12.80 m to 13.72 m.								
216	17	60										
215	18	65										
214	19	70										
213	20											
212	21											

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SAMPLE TYPE Auger Grab Split Spoon Core Barrel

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

CLIENT CITY OF WINNIPEG
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. Shaft A
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.27
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/20/2016
UTM (m) N 5,523,883
 E 632,477

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
233				SILTY CLAY FILL - Mottled brown and black, damp, stiff, high plasticity, some fine to coarse grained sand, trace organics. - Increased sand content between 0.61 and 0.91 m. - Trace silt lenses below 0.76 m.								
232.2	1						S1					
232		5		ORGANIC CLAY - Black, damp, stiff, high plasticity, trace fine to coarse grained sand.			S2					
231.3	2						S3					
231				SILT - Tan, moist, soft, low plasticity, trace clay. - Increased clay content below 2.29 m.								
230.1	3	10					S4	100				
230				CLAY - Mottled brown and grey, moist, stiff, high plasticity, some silt, trace silt pockets. - Auger flights coming up wet below 3.05 m.			S5					
229	4						S6					
228		15					S7	100				
227	5						S8					
226						7.2						
225	6	20				7.3						
224							S9					
	7						S10	100				
							S11					
	8											
	9	30										

GEO-TECHNICAL-SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC4 - 2700 TRUNK SEWER - TAYLOR AVE\LOGS\TRENCHLESS_IDS_LOGS.GPJ

SAMPLE TYPE Auger Grab Shelby Tube Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
223		35		- Firm, some silt pockets below 10.67 m.								
222		11					S12					
221		40					S13	100				
220		13										
219.7		45		SILT TILL - Tan, moist, loose, low plasticity, some to with fine to coarse grained sand, trace fine to coarse grained gravel. - Encountered coarse grained gravel and cobbles while drilling below 13.72 m.			S14					
219		15					S15					
218		50		- Increased coarse grained gravel with depth below 15.24 m. - Compact below 15.25 m.		15.1 15.2	S16	83	▲ 9 ▲ 9 ▲ 13			
217.9		55		- Spoon contained angular rock pieces (~30 mm diameter) below 16.32 m.		16.4	S17					
217		55		AUGER REFUSAL AT 16.38 m.			S18	100	▲ 32 ▲ 60			
216		17		Notes: 1. Installed RST flow - through piezometer PN36891 at 15.24 m below grade and PN36895 at 7.32 m. 2. Backfilled test hole with bentonite - cement grout mixture from 16.38 m to grade.								
215		60										
214		19										
213		65										
212		70										

SAMPLE TYPE Auger Grab Shelby Tube Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

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*SPT refusal at 75 mm into 2nd se

CLIENT CITY OF WINNIPEG
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. 45 m Northwest of Shaft A - East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.99
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/20/2016
UTM (m) N 5,523,934
 E 632,451

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆	
	(m)	(ft)								PL	MC
283.9	1			SAND FILL - Brown, dry to damp, loose to compact, well graded, fine to coarse grained, some fine to coarse grained gravel.							
232.5	5			ORGANIC SAND - Black, damp, loose, non plastic, some gravel.							
232	2			ORGANIC CLAY - Black, damp, stiff, high plasticity, some fine to coarse grained sand.							
231.7				SILT - Brown, moist, soft, low plasticity, some clay.							
231	3	10									
230.2	4			CLAY - Mottled brown and grey, moist, stiff, high plasticity, some silt, trace silt pockets.							
230											
229	5	15		- Firm below 6.10 m.							
228	6	20									
227	7										
226	8	25		- Grey below 7.62 m.							
225	9	30									
224											

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SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆			
	(m)	(ft)								PL	MC	LL	
223	11	35		- Soft to firm below 12.19 m.									
222	12	40											
221	13	45											
220	14	50											
219.4	15	55				SILT TILL - Tan, moist, compact to dense, low plasticity, some to with fine to coarse grained sand, trace fine grained gravel.							
219	15	55				- 180 mm sand seam at 15.45 mm.							
218	16	60				- Auger refusal at 15.85 m.							
217.7	16	65				- Spoon contained angular rock pieces (~30 mm diameter) below 16.08 m.							
217	17	70				END TEST HOLE AT 16.31 m.							
216	18	75				Notes: 1. Installed RST flow - through piezometer PN36892 at 15.54 m below grade and PN36894 at 8.84 m. 2. Backfilled test hole with bentonite - cement grout mixture from 16.31 m to grade. 3. Water level in test hole at 5.18 m below grade after drilling.							
215	19	80											
214	20	85											
213	21	90											

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SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

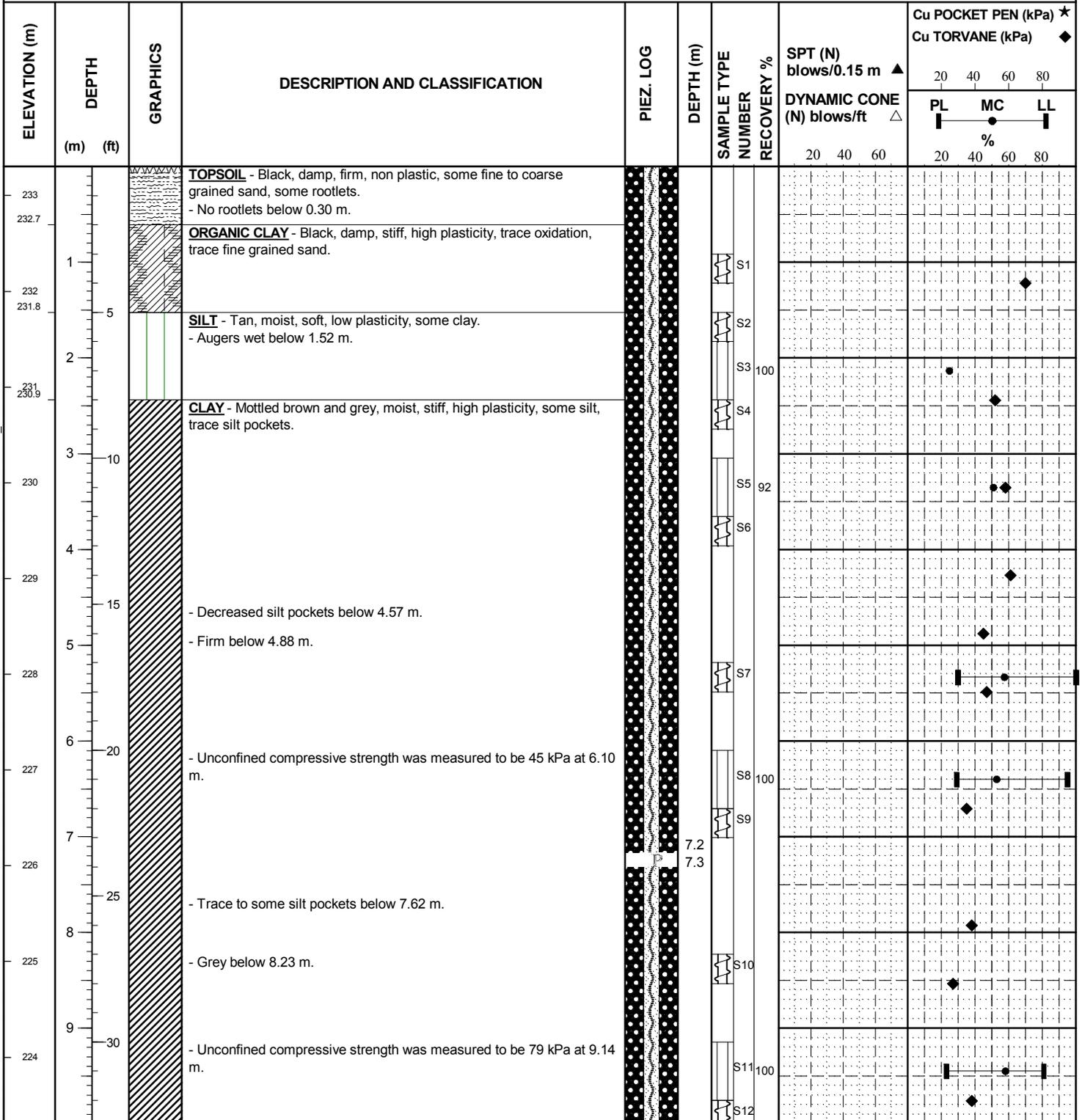
INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/6/16

CLIENT CITY OF WINNIPEG
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. Shaft B
DRILLING METHOD 100 mm ø Solid Stem Auger and NQ coring , B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.30
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/21/2016
UTM (m) N 5,524,036
 E 632,399



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ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
223		35		- Soft below 10.07 m.								
222		11										
221		12										
220		40										
219.9		13										
219.0		45		SILT TILL - Tan, damp, loose to compact, low plasticity, some to with fine to coarse grained sand, trace fine grained gravel.								
		14		- Compact below 14.02 m.								
		14		- Auger refusal, switch to coring at 14.33 m.								
		15		LIMESTONE BEDROCK - Light beige, lightly fractured, RQD = 83%. - Recovery from 14.33 to 16.17 m consisted of limestone gravel, with a maximum diameter of 600 mm.								
218		50		- Loss of return water below 15.25 m.								
217.1		16		- 50 mm thick silt seam at 16.00 m.								
217				END TEST HOLE AT 16.15 m.								
		55		Notes: 1. Installed RST flow - through piezometer PN36896 at 7.32 m below grade and PN36893 at 14.94 m. 2. Backfilled test hole with bentonite - cement grout mixture from 16.15 m to grade. 3. Water level in test hole at 12.19 m below grade after drilling to 14.33 m.								
216		17										
215		60										
214		19										
213		65										
212		70										

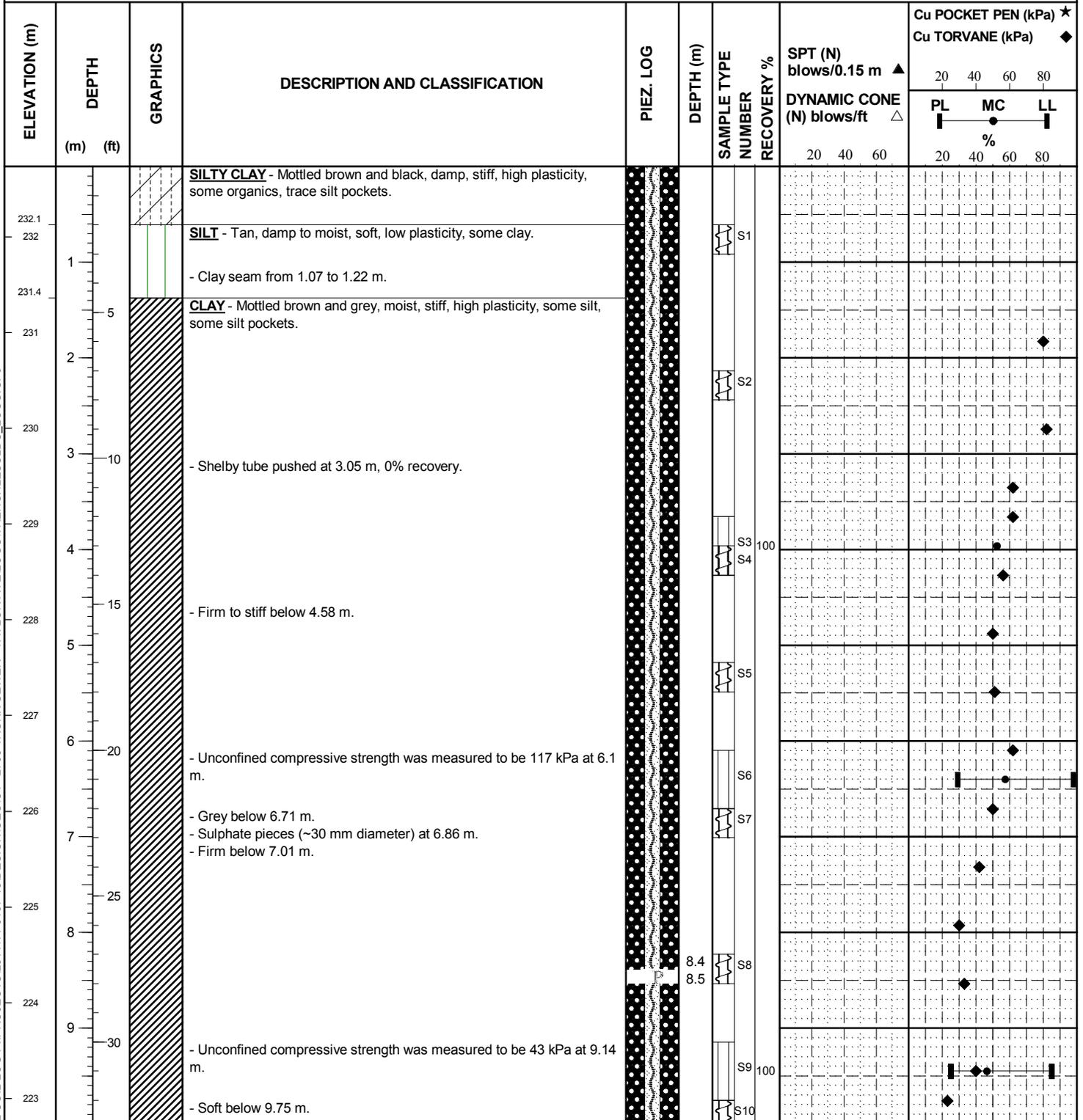
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SAMPLE TYPE Auger Grab Shelby Tube Split Spoon Core Barrel

CONTRACTOR **Maple Leaf Enterprises** INSPECTOR **J. MACLENNAN** APPROVED **DAA** DATE **10/6/16**

CLIENT CITY OF WINNIPEG
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. Shaft C - Taylor Ave. Boulevard East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger and NQ coring , B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 232.73
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/22/2016
UTM (m) N 5,524,243
 E 632,294



GEO TECHNICAL - SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C4 - 2700 TRUNK SEWER - TAYLOR AVE\LOGS\TRENCHLESS\LOGS.GPJ

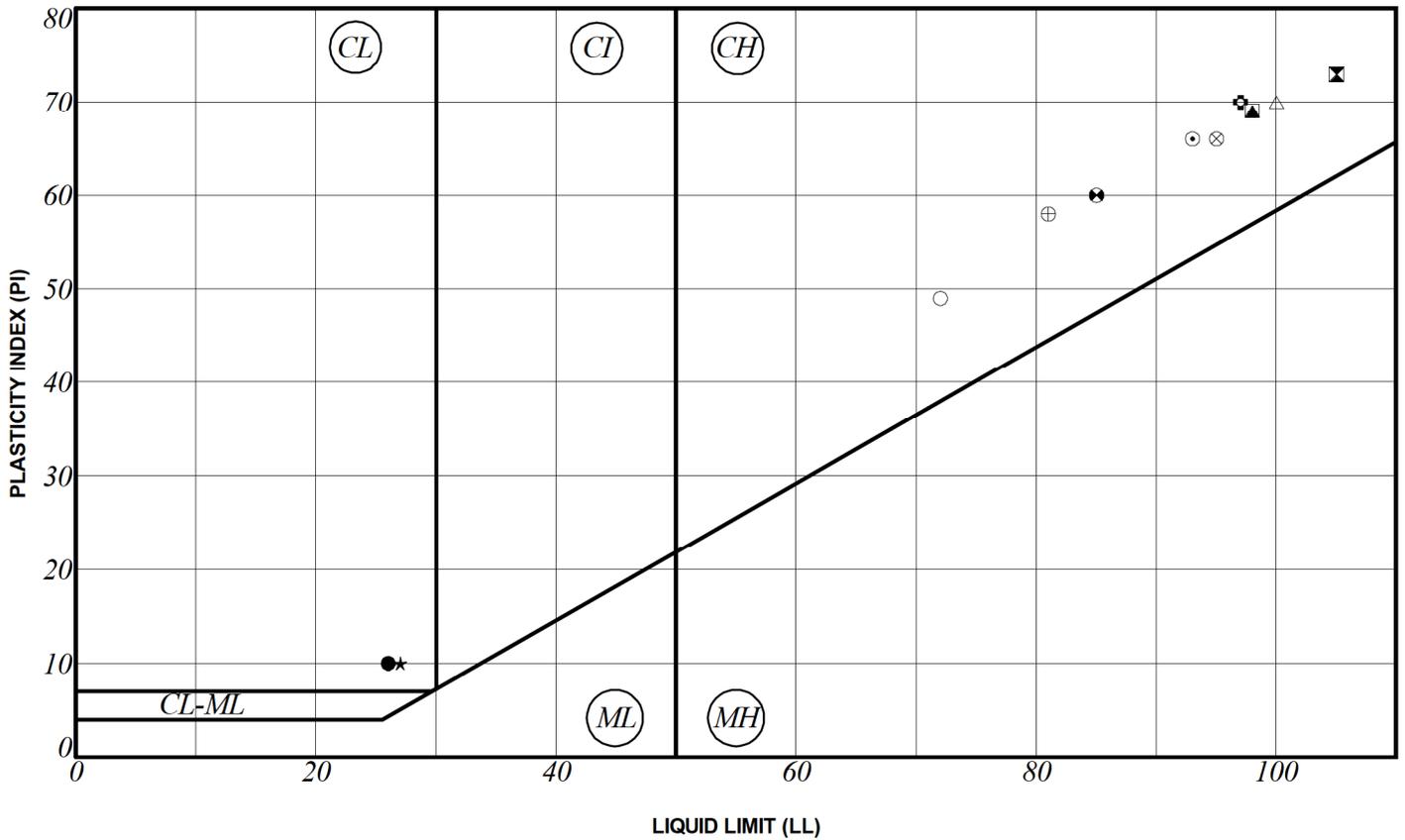
SAMPLE TYPE Auger Grab Shelby Tube Split Spoon Core Barrel

CONTRACTOR **Maple Leaf Enterprises** INSPECTOR **J. MACLENNAN** APPROVED **DAA** DATE **10/6/16**

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
222	11	35	[Hatched]									
221	12	40	[Vertical Lines]	SILT TILL - Tan, damp, loose, low plasticity, some to with fine to coarse grained sand. - Red below 12.80 m.								
220.4	13	45	[Diagonal Lines]	CLAY TILL - Mottled grey, red and green, moist, compact, low plasticity, some fine to coarse grained sand. - Increased density below 13.41 m. - Some fine to coarse grained sand, trace fine grained gravel below 13.72 m. - Auger refusal, switch to coring at 14.02 m.								
219.5	14	45	[Brick Pattern]	LIMESTONE BEDROCK - Light beige, lightly weathered, strong, RQD = 78%.								
218.7	14	45				S11						
218.7	14	45				S12	100					
218.7	14	45				S13						
218.7	14	45				S14						
218.7	14	45				S15						
218.7	14	45				S16	100		▲ 12			
218.7	14	45				S17	100		▲ 50			
218.7	14	45										
218	15	50		END TEST HOLE AT 15.04 m.								
218	15	50				R1	78					
217.7	15	50										
217	16	55		Notes: 1. Installed RST flow - through piezometer PN36897 at 8.53 m below grade and PN36889 at 14.63 m. 2. Backfilled test hole with bentonite - cement grout mixture from 15.04 m to grade.								
216	17	60										
215	18	65										
214	19	70										
213	20	75										
212	21	80										
211	21	80										

GEO/TECHNICAL-SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC4 - 2700 TRUNK SEWER - TAYLOR AVE\LOGS\TRENCHLESS\IDS_LOGS.GPJ

A-LINE PLOT PROJECT: S2011111-10107-18UBESIGNINGE014 - Z00 TRUNK SEWER - 1ATLUR AVE/LOGSITRENUFLESSLUS LUGS.GPJ



SYMBOL	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	% SAND	% SILT	% CLAY	% MC	CLASSIFICATION
●	TH16-02 (I4/5)	2.9	S3	26	16	10				22.9	CL
⊠	TH16-02 (I4/5)	5.6	S5	105	32	73				56.3	CH
▲	TH16-03 (I7)	5.3	S5	98	29	69				53.4	CH
★	TH16-05 (I9)	2.0	S2	27	17	10				25.0	CL
⊙	TH16-05 (I9)	5.6	S4	93	27	66				53.1	CH
⊕	TH16-06 (Shaft A)	6.1	S7	97	27	70	0.5	19.4	80.1	51.8	CH
○	TH16-06 (Shaft A)	9.1	S10	72	23	49				51.5	CH
△	TH16-08 (Shaft B)	5.3	S7	100	30	70				57.5	CH
⊗	TH16-08 (Shaft B)	6.1	S8	95	29	66	0.4	18.2	81.4	52.9	CH
⊕	TH16-08 (Shaft B)	9.1	S11	81	23	58				58.1	CH
□	TH16-09 (Shaft C)	6.1	S6	98	29	69	0.9	18.2	80.9	57.4	CH
⊗	TH16-09 (Shaft C)	9.1	S9	85	25	60				46.5	CH

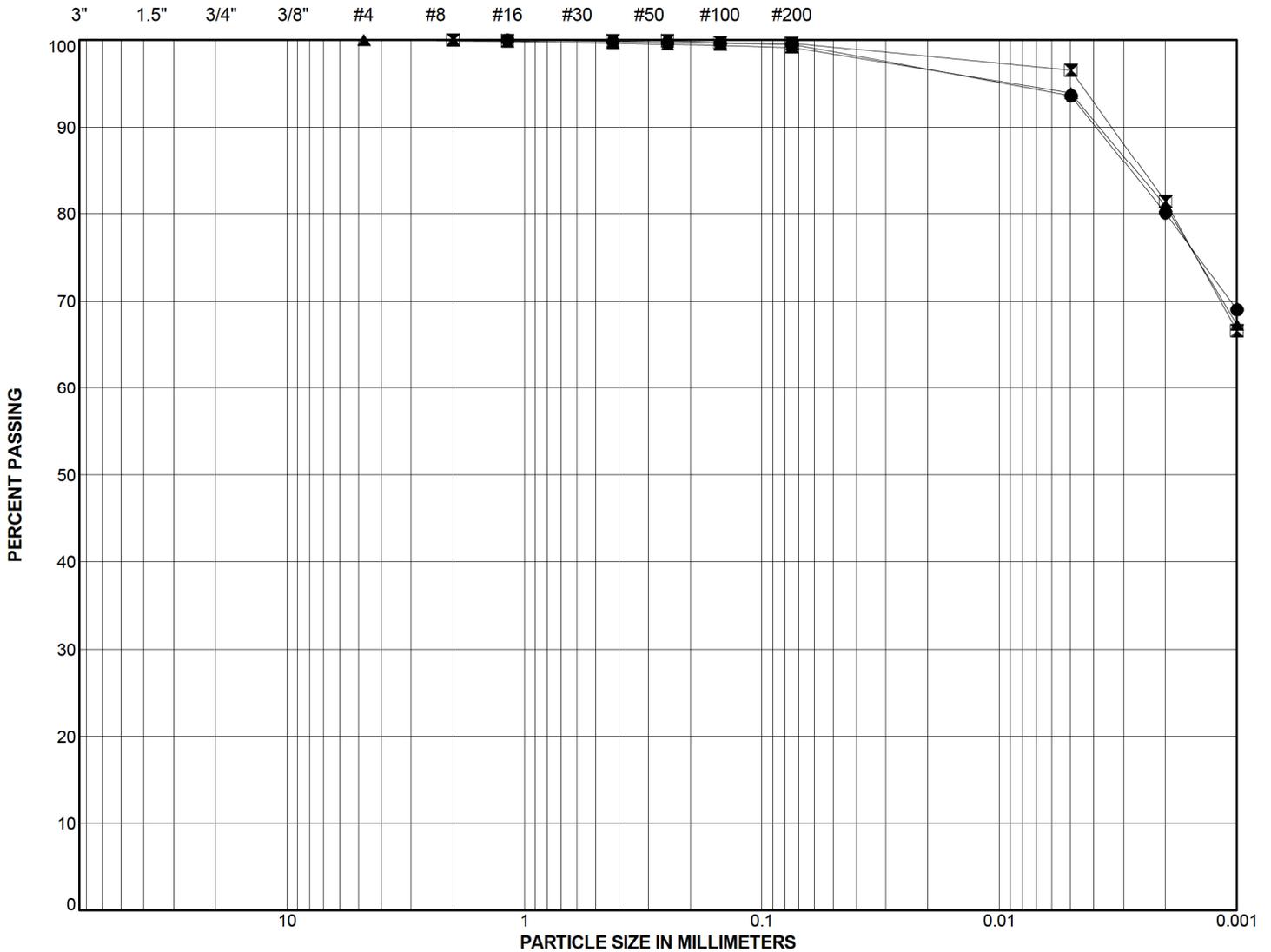
Notes:

- ML - Low Plasticity Silt
- MH - High Plasticity Silt
- CL-ML - Silty Clay
- CL - Low Plasticity Clay
- CI - Intermediate Plasticity Clay
- CH - High Plasticity Clay
- LL - Liquid Limit
- PL - Plastic Limit
- PI - Plasticity Index
- MC - Moisture Content
- NP - Non-Plastic

KGS GROUP	CITY OF WINNIPEG
Cockburn and Calrossie Combined Sewer Relief	
A-LINE PLOT	
October 2016	Page 1 of 1

SIEVE ANALYSIS

HYDROMETER ANALYSIS



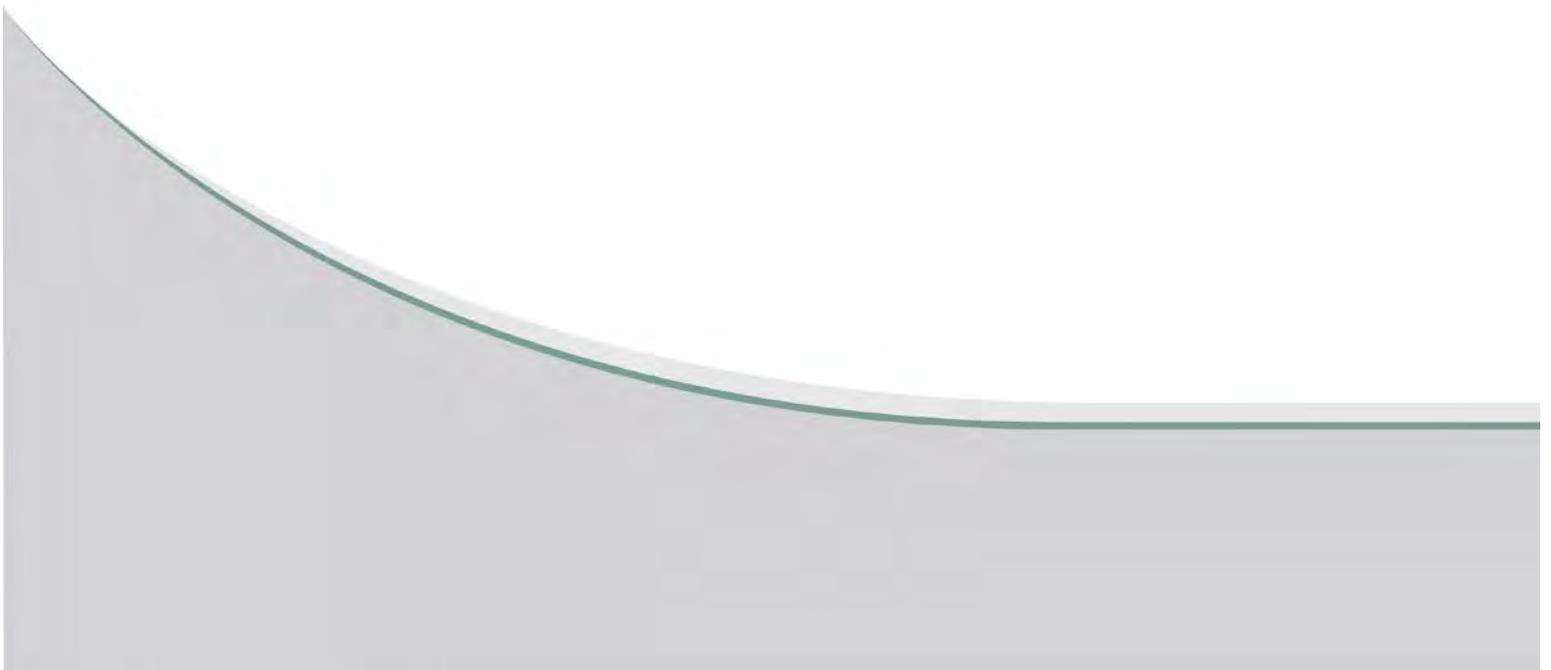
GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

SYMBOL	HOLE	DEPTH (m)	SAMPLE #	% GRAVEL	% SAND	% SILT	% CLAY	% SILT & CLAY	Cu	Cc	CLASSIFICATION
●	TH16-06 (Shaft A)	6.1	S7	0.0	0.5	19.4	80.1	99.5			CH
■	TH16-08 (Shaft B)	6.1	S8	0.0	0.4	18.2	81.4	99.6			CH
▲	TH16-09 (Shaft C)	6.1	S6	0.0	0.9	18.2	80.9	99.1			CH

SIEVE ANALYSIS P:\PROJECTS\201111-0107-18\DESIGN\GEO\C4 - 2700 TRUNK SEWER - TAYLOR AVE\LOGS\TRENCHLESS\LOGS.GPJ

KGS GROUP	CITY OF WINNIPEG	
	Cockburn and Calrossie Combined Sewer Relief	
GRAIN SIZE ANALYSES		
October 2016	Figure A2	Page 1 of 1

APPENDIX B
2017 TEST HOLE LOGS



PRINCIPAL AND MINOR SOIL COMPONENTS

And	35 – 50%
With	20 – 35%
Some	10 – 20%
Trace	0 – 10%
Occasional	Trace of very local concentration

FIELD MOISTURE CONTENT

Dry	No moisture visible or to touch when fresh exposure is examined
Damp	Slightly wet to touch
Moist	Fresh exposure wet to touch
Wet	A film of water is readily visible around particles of granular soils, cohesive soils can readily be smeared or remolded; water can be squeezed out
Saturated	Water can easily be squeezed out
Free Water	Water completely separated from the soil particles

DEPOSITIONAL STRUCTURE

Massive	Structureless soil
Stratified (Layered)	Different soils or visible variations in soil constituents arranged in layers, generally but not necessarily parallel to one another, and not necessarily in horizontal position, at least 6 mm thick
Varved	Glaciolacustrine deposits with annual pairs of fine and coarser laminae (thin laminae of alternately deposited inorganic silt and clay)
Laminated	Closely spaced, regularly alternating layers of differing soils and/or colours, or shades of similar gradation, relatively consistent in thickness and consisting of sand, silt, or clay
Lens	Inclusions of a different soil within surrounding soils, which thins out horizontally and may not be continuous over any significant distance
Pocket	A different soil type of very limited thickness or lateral extent (a small lens)
Inclusions	Small pockets
Nuggety	A different soil type in the form of small lumps
Parting	Paper thin separation of one type by another

POST DEPOSITIONAL STRUCTURE

Fissured	A soil breaks along definite, pre-existing planes or fracture with little resistance to fracturing
Slickensided	Polished or glossy, sometimes striated surfaces resulting from movement of a material block relative to the adjacent blocks
Blocky/Friable/Platy	Cohesive soil that can be broken down into angular larger fragments (blocky), small fragments (friable), or thin plate-like fragments (platy) which resist further breakdown
Cemented	Soil particles or fragments held together by cemented materials, often chemical precipitants, or deposits within overall soil mass

GRAIN SIZE DISTRIBUTION IN COARSE GRAINED SOIL

Boulders	>200 mm ϕ
Cobbles	75 – 200 mm ϕ
Coarse Grained Gravel	19 – 75 mm ϕ
Fine Grained Gravel	4.75 – 19 mm ϕ
Coarse Grained Sand	2 – 4.75 mm ϕ
Medium Grained Sand	0.425 – 2 mm ϕ
Fine Grained Sand	0.075 – 0.425 mm ϕ

DENSITY OF GRANULAR SOIL

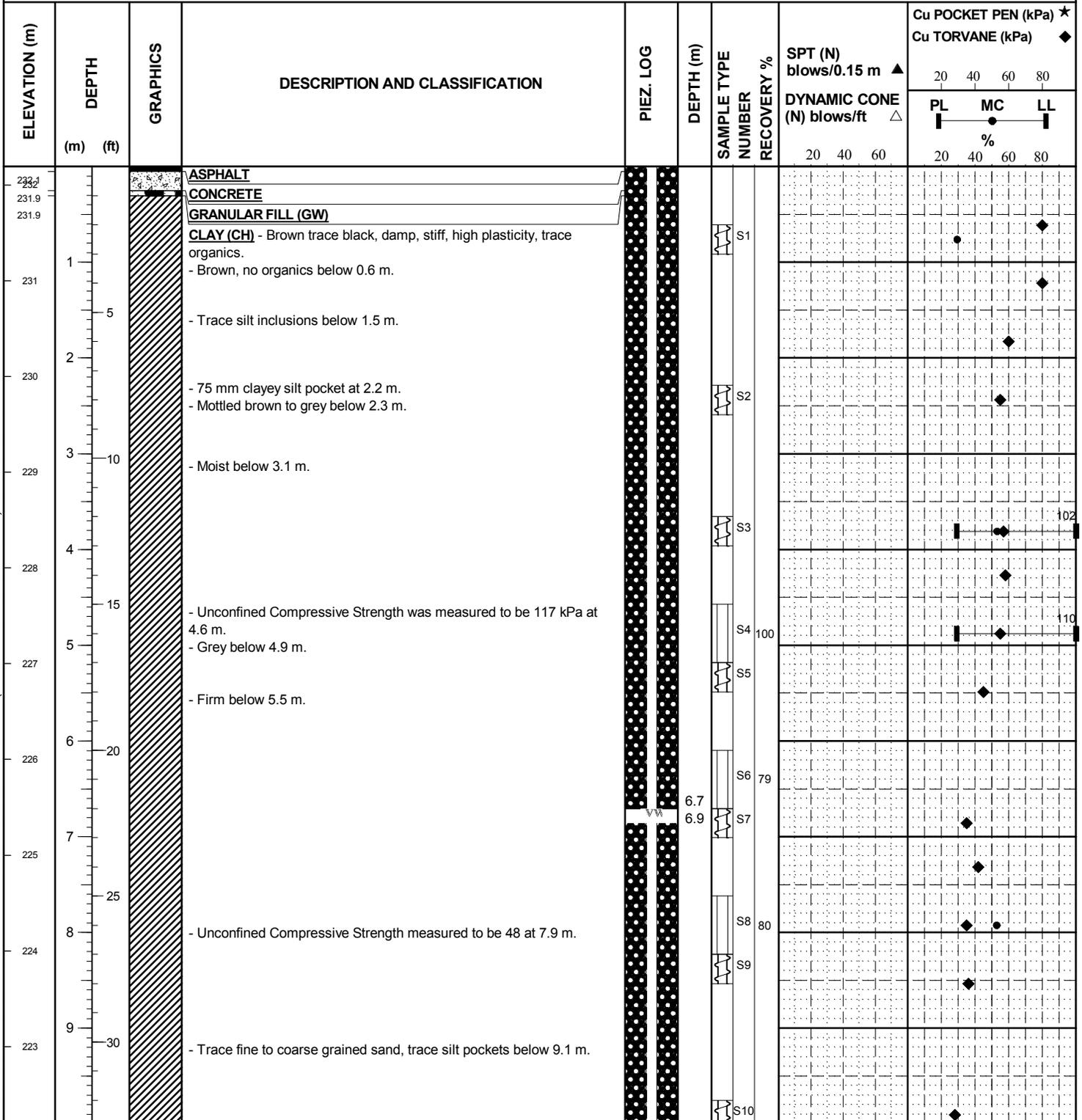
Description	Standard Penetration Test	Relative Density
Very Loose	0 – 4 Blows Per 0.3 m	<15%
Loose	4 – 10 Blows Per 0.3 m	15 – 35%
Compact	10 - 30 Blows Per 0.3 m	35 – 65%
Dense	30 - 50 Blows Per 0.3 m	65 – 85%
Very Dense	>50 Blows Per 0.3 m	>85%

CONSISTENCY OF COHESIVE SOILS

Description	Torvane	Standard Penetration Test
Very Soft	<12 kPa	<2
Soft	12 – 25 kPa	2 – 4
Firm	25 – 50 kPa	4 – 8
Stiff	50 – 100 kPa	8 – 15
Very Stiff	100 – 200 kPa	15 – 30
Hard	>200 kPa	>30

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION Approximately 320 m West of Wilton St.
DRILLING METHOD 125 mm ø Solid Stem Auger, and NQ coring, B54X Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.19
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/3/2017
UTM (m) N 5,524,081
 E 631,992



GEO TECHNICAL - SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Shelby Tube Core Barrel

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
									PL	MC	LL
222	35		- Soft below 10.7 m. - Trace silt pockets below 11.0 m.		11.6	S11			◆		
220	40		SILT TILL (ML) - Tan, damp to moist, compact, low plasticity, some to with fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders.		12.3 12.5 12.8 13.0	S12			◆		
219.1	13		- Auger refusal at 13.0 m, switched to coring.								
219	45		LIMESTONE - Light brown to tan, fractured, poor quality, highly reactive with dilute HCl. - Fine grained with limonite staining along some fractures from 13.1 to 15.10 m. - Run 1: RQD = 32% - Advanced casing to 13.4 m, advanced NQ core barrel below. - Run 2: RQD = 21%			R1	92				
218	14		- Vuggy, broken core zone below 15.1 m.			R2	77				
217	50										
216.8	16		DOLOMITE - Light grey to brown, very fine grained, competent quality. - Run 3: RQD = 69%			R3	90				
216	16		END OF HOLE AT 16.46 m		16.5						
215.7	55		Notes: 1. Installed a standpipe with a slotted screen from 12.80 to 12.50 m, and a vibrating wire piezometer with serial number SN#1700051 at 6.71 m below grade. 2. Backfilled the test hole with bentonite from 16.46 to 12.95, sand from 12.95 to 12.34 m, bentonite from 12.34 to 11.58 m and grout from 11.5 m to grade. 3. Installed a flush mount cover.								
215	17										
214	60										
213	19										
212	65										
211	70										

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Shelby Tube Core Barrel

CONTRACTOR **Maple Leaf Enterprises** INSPECTOR **J. MACLENNAN** APPROVED **DAA** DATE **10/20/17**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION Approximately 265 m West of Wilton St.
DRILLING METHOD 125 mm ø Solid Stem Auger, B54X Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.13
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/3/2017
UTM (m) N 5,524,110
 E 632,046

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							PL	MC	LL	PL
232.2				ASPHALT								
231.8				CONCRETE								
231.8				GRANULAR BASE (GW)								
		1		CLAY (CH) Black, stiff, moist, high plasticity, trace to some organics. - Brown, no organics below 0.6 m.	S1							
		5		- Mottled brown to grey, trace silt inclusions below 1.5 m.								
		2			S2							
		3										
		4			S3							
		5		- Moist below 4.6 m.								
		6			S4							
		7		- Firm to stiff below 6.7 m.								
		8		- Grey, firm below 7.6 m.								
		9		- Soft at 8.5 m.								
				- Trace fine to coarse grained sand below 9.1 m.								
					S7							

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\CS5 - COCKBURN.GPJ

SAMPLE TYPE  Auger Grab  Split Spoon

CONTRACTOR
 Maple Leaf Enterprises

INSPECTOR
 J. MACLENNAN

APPROVED
 DAA

DATE
 10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆						
	(m)	(ft)								PL	MC	LL	PL	MC	LL				
222																			
		35		- Trace silt till pockets below 10.7 m.															
221		11																	
220.4																			
220		40		SILT TILL (ML) - Tan, moist, loose, low plasticity, some fine to coarse grained sand, some clay, trace fine to coarse grained gravel, trace cobbles, trace boulders.	S8			2											
219.3				- Increased water content below 12.5 m.	S9			2											
					S10			2											
219		13		AUGER REFUSAL AT 12.80 m															
				Notes: 1. Test hole open to 12.80 m after the completion of drilling. 2. Water level 12.80 m below grade after the completion of drilling. 3. Test hole backfilled with bentonite and cuttings with a concrete patch at grade.															
219		45																	
218		14																	
218		45																	
217		15																	
217		50																	
216		16																	
216		50																	
215		17																	
215		55																	
214		18																	
214		60																	
213		19																	
213		65																	
212		20																	
212		65																	
211		21																	
211		70																	

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE  Auger Grab  Split Spoon

CONTRACTOR
Maple Leaf Enterprises

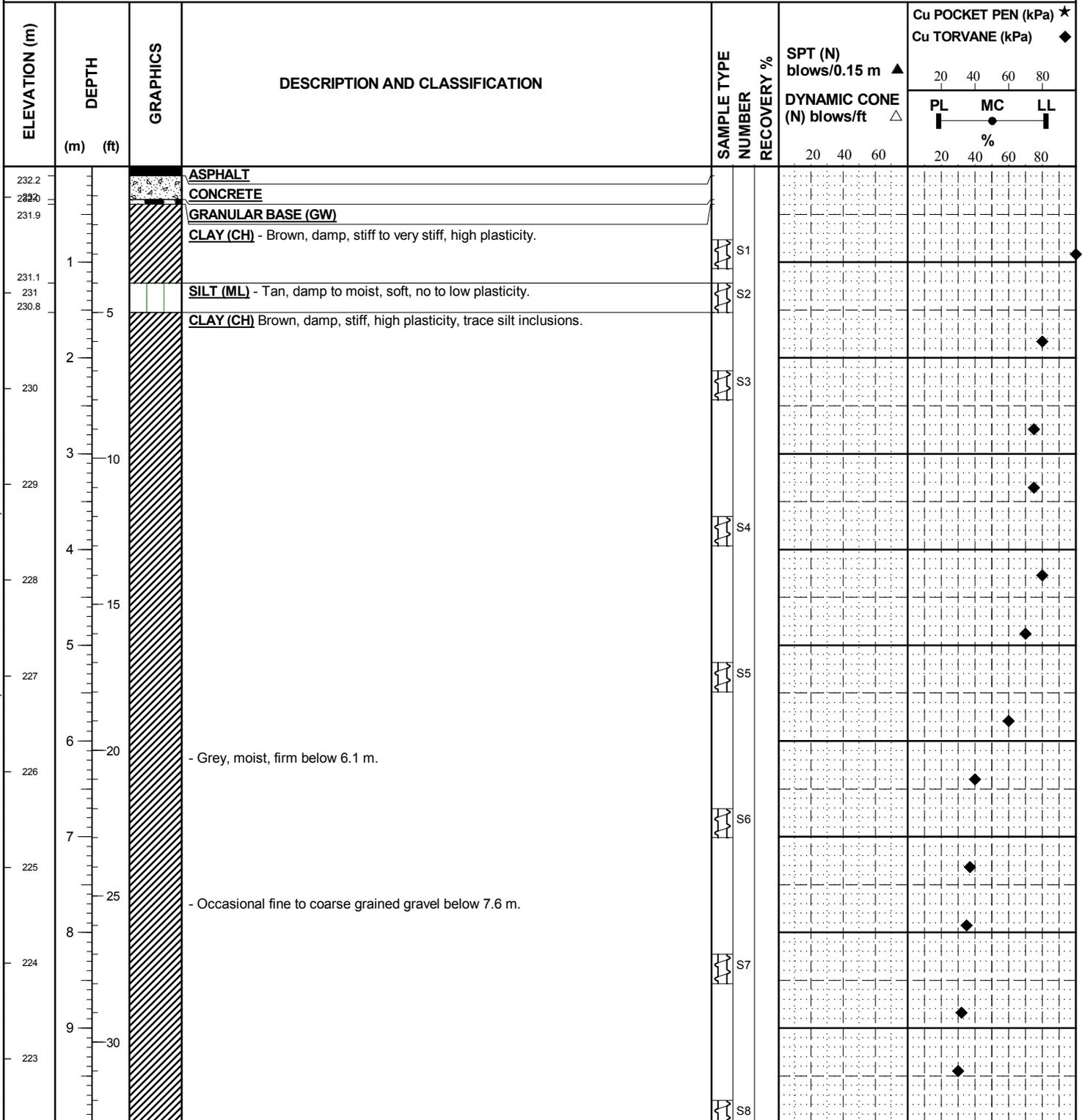
INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION Approximately 140 m West of Wilton St.
DRILLING METHOD 125 mm ø Solid Stem Auger, B54X Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.32
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/4/2017
UTM (m) N 5,524,167
 E 632,150



GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab
 CONTRACTOR **Maple Leaf Enterprises** INSPECTOR **K. HAMILTON** APPROVED **DAA** DATE **10/20/17**

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)						PL	MC	LL
222		35		- Trace silt till pockets below 10.7 m.						
221	11									
220.1		40		SILT TILL (ML) - Tan, moist, low plasticity, compact, some fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders.	S9					
220	12									
219.5				AUGER REFUSAL AT 12.80 m Notes: 1. Test hole open to 12.80 m after the completion of drilling. 2. Test hole dry after the completion of drilling. 3. Test hole backfilled with bentonite and cuttings with a concrete patch at grade.	S10					
219	13									
218	14	45								
217	15	50								
216	16									
215	17	55								
214	18	60								
213	19									
212	20	65								
211	21	70								

SAMPLE TYPE Auger Grab

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
K. HAMILTON

APPROVED
DAA

DATE
10/20/17

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION Approximately 90 m West of Wilton St.
DRILLING METHOD 125 mm ø Solid Stem Auger, B54X Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.58
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/1/2017
UTM (m) N 5,524,195
 E 632,200

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							20	40	60	80
232.5			ASPHALT									
232.3			CONCRETE									
232.2			GRANULAR BASE (GW)									
231.4	1		CLAY (CH) - Black, damp, stiff, high plasticity, trace to some organics. - Brown, no organics below 0.6 m.									
231.1		5	SILT (ML) - Tan, moist, soft, low plasticity.	S1								
231			CLAY (CH) - Brown, damp, stiff, high plasticity.									
230.7		2	SILT (ML) - Tan, moist, soft, low plasticity.	S2								
230.1			CLAY (CH) - Mottled brown to grey, damp, stiff, high plasticity, trace silt inclusions.									
230	3	10										
229				S3								
228	4	15										
227		5	- Grey, moist below 5.2 m. - Firm to stiff below 5.5 m.	S4								
226	6	20										
225		7		S5								
225			- Trace fine grained sand below 7.6 m.									
224	8	25										
224			- Firm, trace fine to coarse grained sand below 8.2 m.	S6								
223	9	30										
				S7								

GEOTECHNICAL-SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

 SAMPLE TYPE Auger Grab Split Spoon

 CONTRACTOR
Maple Leaf Enterprises

 INSPECTOR
J. MACLENNAN

 APPROVED
 DAA

 DATE
 10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	Cu POCKET PEN (kPa) ★
	(m)	(ft)						DYNAMIC CONE (N) blows/ft △	Cu TORVANE (kPa) ◆
								20 40 60 80	20 40 60 80
								20 40 60	PL MC LL % 20 40 60 80
222	35	11		- Trace silt till pockets below 10.7 m.					
221					S8				
220.4	40	12		SILT TILL (ML) - Tan, moist, compact, low plasticity, some fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders.					
220					S9				
219					S10				
218.9	45	13		- Moist to wet, no plasticity, some to with fine to coarse grained sand, trace to some fine to coarse grained gravel below 13.4 m.	S11				
				AUGER REFUSAL AT 13.72 m					
				Notes: 1. Test hole open to 13.56 m after the completion of drilling. 2. Water level 6.10 m below grade after the completion of drilling. 3. Test hole backfilled with bentonite and cuttings with a concrete patch at grade.					
218									
217	50	15							
216									
215	55	17							
214									
213	60	18							
212									
211	65	20							
	70	21							

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION Approximately 80m West of Guelph St.
DRILLING METHOD 125 mm ø Solid Stem Auger, B54X Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.36
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/1/2017
UTM (m) N 5,524,282
 E 632,359

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Soil Properties	
	(m)	(ft)							Cu POCKET PEN (kPa) ★	Cu TORVANE (kPa) ◆
232.3				ASPHALT						
232.2				CONCRETE						
232.0				GRANULAR BASE (GW)						
231.6				CLAY (CH) - Black, damp, stiff, high plasticity, some organics.						
	1			SILT (ML) - Tan, damp, soft, low plasticity. - Moist, some clay below 1.1 m.	A1					
231				CLAY (CH) - Mottled brown to grey, damp, stiff, high plasticity, trace silt inclusions.						
230.8		5								
230					S2					
229										
228					S3					
227										
226					S4					
225										
224					S5					
223										
	7									
	15				S6					
	20									
	25				S7					
	30									

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
 Maple Leaf Enterprises

INSPECTOR
 J. MACLENNAN

APPROVED
 DAA

DATE
 10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆					
	(m)	(ft)								20	40	60	80	20	40	60	80	
222		35																
221		11																
220.3		12		SILT TILL (ML) - Tan, moist, compact, some fine to coarse grained sand, trace fine to coarse grained gravel.		S8												
220		40				S9	0											
219.7				AUGER REFUSAL AT 12.65 m		S10												
219		13		Notes: 1. Test hole open to 12.65 m after the completion of drilling. 2. Water level 12.65 m below grade after the completion of drilling. 3. Test hole backfilled with bentonite and cuttings with a concrete patch at grade.														
218		45																
217		50																
216		55																
215		60																
214		65																
213		70																

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

JOB NO. 11-0107-18

PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief

GROUND ELEV. 232.14

SITE Taylor Ave

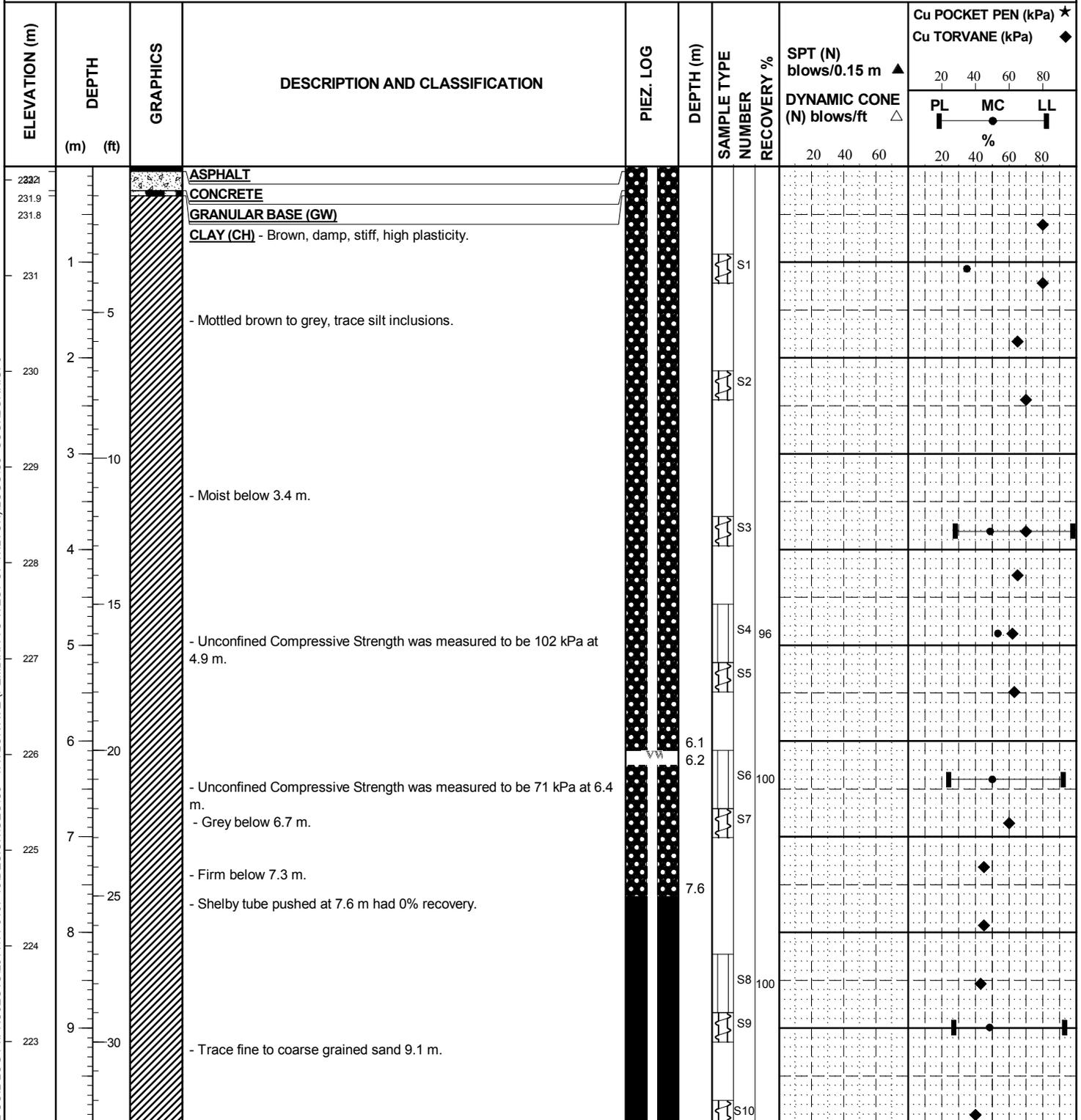
TOP OF PVC ELEV.
LOCATION West of Guelph St.

WATER ELEV.
DRILLING METHOD 125 mm ø Solid Stem Auger, and NQ coring, B54X Truck Mounted Drill Rig

DATE DRILLED 5/2/2017

UTM (m) N 5,524,316

E 632,420



SAMPLE TYPE Auger Grab Shelby Tube Split Spoon Core Barrel

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
222		35		- Increased sand content, occasional fine to coarse grained gravel below 10.7 m.								
221	11						S11					
220.3		40		SILT TILL (ML) - Tan, moist, compact, low plasticity, some fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders. - Wet, no plasticity, some to with fine to coarse grained sand, some fine to coarse grained gravel below 12.2 m. - Water infiltrating test hole from silt layer below 12.2 m. - Dense, some fine to coarse grained sand, with fine to coarse grained gravel below 12.3 m. Grain Size Distribution: Gravel 45.2%, Sand 16.5%, Silt 21.4%, and Clay 16.9% at 13.0 m. - Auger refusal at 13.4 m, switched to coring.			S12	92	▲4 ▲7 ▲28			
220	12						S13					
219	13											
218.1		45		- Advanced casing to 14.0 m, advanced NQ core barrel below.			R1	71				
218	14			DOLOMITIC LIMESTONE - Yellow and reddish brown, poor quality, vuggy, staining. - Broken core zone from drilling action from 14.02 to 14.4 m. - Run 1: RQD = 0% - Run 2: 92% - Tan, competent, good quality, wide spread joints, joints oriented near perpendicular and parallel to core axis below 14.4 m. - Run 3: RQD = 22%		14.5	R2	100				
217	15											
216.5		50		INTERBEDDED SHALE AND DOLOMITE - Broken core zone from 15.6 to 16.3 m.			R3	90				
216	16			- Red shale with moderately spaced joints below 16.3 m. - Some silt and clay on fracture joints from 16.4 to 16.5 m.								
215.4		55		END OF HOLE AT 16.76 m		16.5						
215	17			Notes: 1. Installed a standpipe with a slotted screen from 16.76 to 16.46 m, and a vibrating wire piezometer with serial number SN#1700053 at 6.10 m below grade. 2. Backfilled the test hole with sand from 16.76 to 14.48 m, bentonite from 14.48 to 7.62 m and grout from 7.62 m to grade. 3. Installed a flush mount cover.		16.8						
214	18											
214	60											
213	19											
212	20											
212	65											
211	21											
211	70											

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION East of Guelph St.
DRILLING METHOD 125 mm ø Solid Stem Auger, B54X Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.18
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/1/2017
UTM (m) N 5,524,328
 E 632,442

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Soil Properties				
	(m)	(ft)								Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆	PL	MC	LL	
232.0				ASPHALT										
231.8				CONCRETE										
231.8				GRANULAR BASE (GW)										
				CLAY (CH) - Brown, damp, stiff, high plasticity.										
231	1	5		- Mottled brown to grey, trace silt inclusions below 1.5 m.			S1							
230	2	10		- Moist below 3.1 m.			S2							
229	3	15		- Firm below 5.2 m.			S3							
228	4	20		- Grey below 6.1 m.			S4							
227	5	25		- Trace fine to coarse grained sand below 7.6 m.			S5							
226	6	30		- Trace silt till pockets below 9.1 m.			S6							
225	7						S7							

GEO-TECHNICAL-SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\5- COCKBURN.GPJ

SAMPLE TYPE Auger Grab

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆			
	(m)	(ft)								PL	MC	LL	
222		35		- Occasional fine to coarse grained gravel below 10.7 m.									
221	11												
220		40		SILT TILL (ML) - Tan, damp, compact, some fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders. - Moist to wet below 12.8 m.									
219.1	12												
219		45		AUGER REFUSAL AT 13.11 m									
		50		Notes: 1. Installed a standpipe with a slotted screen from 13.11 to 12.80 m below grade. 2. Backfilled the test hole with sand from 13.11 to 12.50 m, and bentonite from 14.48 to grade. 3. Installed a flush mount cover.									
218	13												
217	14												
216	15												
215	16												
214	17												
213	18												
212	19												
211	20												
	21	70											

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

JOB NO. 11-0107-18

PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief

GROUND ELEV. 231.86

TOP OF PVC ELEV.
SITE Taylor Ave

WATER ELEV.
LOCATION Approximately 70 m East of Guelph St.

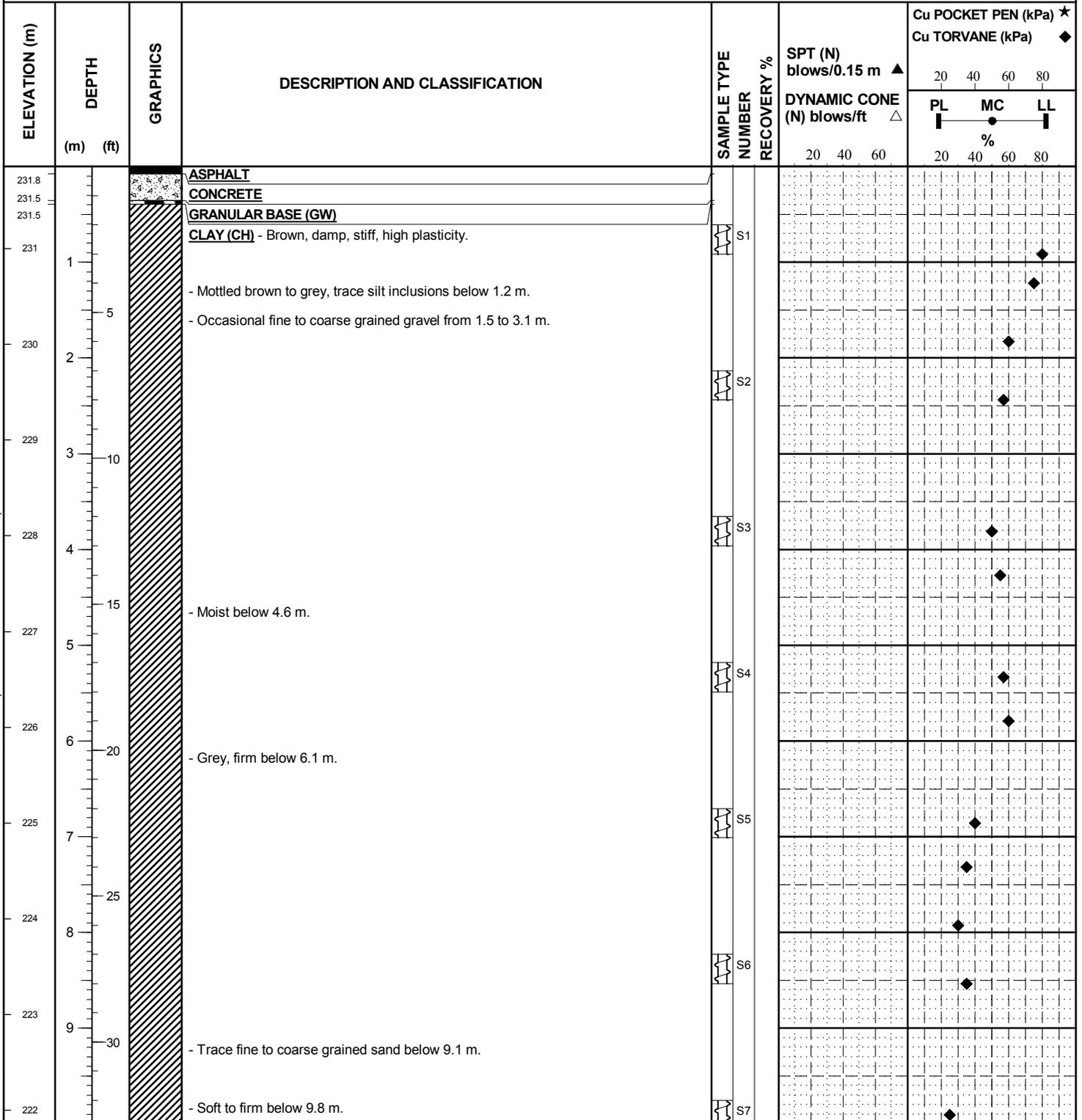
DATE DRILLED 4/28/2017

DRILLING METHOD 125 mm ø Solid Stem Auger, Acker Renegade Track Mounted Rig

UTM (m)

N 5,524,354

E 632,491


 SAMPLE TYPE  Auger Grab

CONTRACTOR
 Maple Leaf Enterprises

INSPECTOR
 J. MACLENNAN

APPROVED
 DAA

DATE
 10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆						
	(m)	(ft)								20	40	60	80	20	40	60	80		
221	11	35		- Trace silt till pockets below 10.7 m.	S8														
220	12	40																	
219.7	13	40		SILT TILL (ML) - Tan, moist, compact, some fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders.	S9														
219	13	40		- Moist to wet, no plasticity, some to with fine to coarse grained sand, some fine to coarse grained gravel below 12.8 m.															
218.8	13	40		AUGER REFUSAL AT 13.11 m															
218	14	45		Notes: 1. Test hole open to 13.11 m after the completion of drilling. 2. Water level 5.79 m below grade after the completion of drilling. 3. Test hole backfilled with bentonite and cuttings with a concrete patch at grade.															
217	15	50																	
216	16	55																	
215	17	60																	
214	18	65																	
213	19	70																	
212	20	75																	
211	21	80																	

SAMPLE TYPE Auger Grab

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\CS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\CS - COCKBURN.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION West of Harrow St.
DRILLING METHOD 125 mm ø Solid Stem Auger, B54X Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.12
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/2/2017
UTM (m) N 5,524,380
 E 632,538

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							20	40	60	80
232.0				ASPHALT								
231.8				CONCRETE								
231.7				GRANULAR BASE (GW)								
231.1	1			CLAY (CH) - Black, moist, high plasticity, stiff, some organics, trace fine to coarse grained sand.	S1							
231				SILT (ML) - Tan, damp, soft, low plasticity.	S2							
230.6	5			CLAY (CH) - Mottled brown to grey, damp, stiff, high plasticity, trace silt inclusions.	S3							
230	2				S4							
229	3	10		- Moist below 3.1 m.	S5							
228	4			- Firm below 4.3 m.	S6							
227	5	15		- Grey below 5.2 m.	S7							
226	6	20			S8							
225	7											
224	8	25		- Trace fine to coarse grained sand, trace silt pockets below 7.6 m.								
223	9	30										

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\5- COCKBURN.GPJ

SAMPLE TYPE  Auger Grab  Split Spoon

CONTRACTOR
 Maple Leaf Enterprises

INSPECTOR
 J. MACLENNAN

APPROVED
 DAA

DATE
 10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆					
	(m)	(ft)								20	40	60	80	20	40	60	80	
222																		
	35																	
221		11			S9													
		12		SILT TILL (ML) - Grey, moist, loose to compact, low plasticity, some fine to coarse grained sand, some to with clay, trace fine to coarse grained gravel, trace cobbles, trace boulders.	S10													
219		13		- Tan, compact, with fine to coarse grained sand, decreased clay below 13.1 m.	S11													
		13.6		Grain Size Distribution: Gravel 9.4%, Sand 31.1%, Silt 39.2%, and Clay 20.3% at 13.6 m.	S12													
218.3		45		AUGER REFUSAL AT 13.87 m														
218		14																
		15		Notes: 1. Test hole open to 13.11 m after the completion of drilling. 2. Water level 12.50 m below grade after the completion of drilling. 3. Test hole backfilled with bentonite and cuttings with a concrete patch at grade.														
217		50																
216		16																
		17																
215		55																
214		18																
		60																
213		19																
		65																
212		20																
		70																

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\5 - COCKBURN.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

JOB NO. 11-0107-18

PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief

GROUND ELEV. 231.76

SITE Taylor Ave

TOP OF PVC ELEV.
LOCATION East of Harrow St.

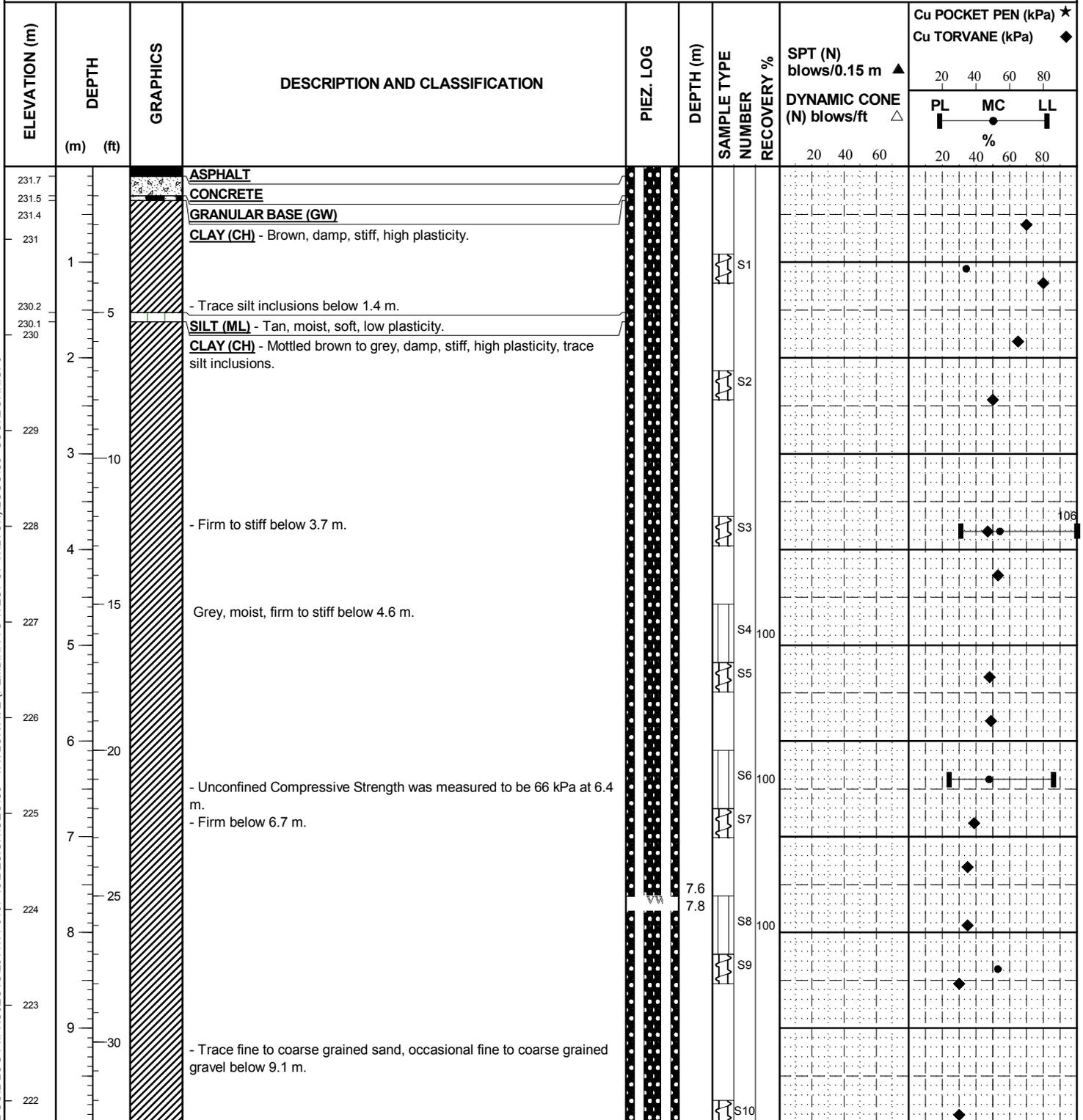
WATER ELEV.
DRILLING METHOD 125 mm ø Solid Stem Auger, and NQ coring, Acker Renegade Track Mounted Rig

DATE DRILLED 4/27/2017

UTM (m) N 5,524,422

E 632,614

GEOTECHNICAL-SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5-COCKBURN.GPJ


 SAMPLE TYPE  Auger Grab  Shelby Tube  Core Barrel

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
221	35	11		<p>SILT TILL (ML) - Tan, moist, loose, no to low plasticity, some to with fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders.</p> <ul style="list-style-type: none"> - Water infiltrating test hole below 12.2 m. - No plasticity, with fine to coarse grained sand below 12.8 m. <p>Grain Size Distribution: Gravel 3.5%, Sand 32.5%, Silt 46.9%, and Clay 17.1% at 13.3 m.</p> <ul style="list-style-type: none"> - Auger refusal at 13.4 m, switched to coring. - Boulder encountered from 13.7 to 14.0 m. - No return water from 14.0 to 14.9 m. 		10.7	S11	-	-	-	-	-
220	40	12										
219.6	40	12		<p>DOLOMITE - Tan, fine grained, moderately spaced joints, competent rock.</p> <ul style="list-style-type: none"> - Broken zone of rock from 14.8 to 15.2 m from drill action on weaker zone at top of hole. - Run 1: RQD = 25% - Advanced casing to 14.9 m, advanced NQ core barrel below. - Vugs at 15.1 m. - Trace shale at 15.2 m. - Run 2: RQD = 77% - Good condition, with few joints below 15.2 m. - Broken core zone from 15.7 to 16.0 m. - Fair condition below 16.0 m. - Run 3: RQD = 71% 		12.8	S12	-	-	-	-	-
219	45	13										
218	45	14		<p>DOLOMITE - Tan, fine grained, moderately spaced joints, competent rock.</p> <ul style="list-style-type: none"> - Broken zone of rock from 14.8 to 15.2 m from drill action on weaker zone at top of hole. - Run 1: RQD = 25% - Advanced casing to 14.9 m, advanced NQ core barrel below. - Vugs at 15.1 m. - Trace shale at 15.2 m. - Run 2: RQD = 77% - Good condition, with few joints below 15.2 m. - Broken core zone from 15.7 to 16.0 m. - Fair condition below 16.0 m. - Run 3: RQD = 71% 		13.0	S12	-	-	-	-	-
218	50	14										
217.9	50	15		<p>DOLOMITE - Tan, fine grained, moderately spaced joints, competent rock.</p> <ul style="list-style-type: none"> - Broken zone of rock from 14.8 to 15.2 m from drill action on weaker zone at top of hole. - Run 1: RQD = 25% - Advanced casing to 14.9 m, advanced NQ core barrel below. - Vugs at 15.1 m. - Trace shale at 15.2 m. - Run 2: RQD = 77% - Good condition, with few joints below 15.2 m. - Broken core zone from 15.7 to 16.0 m. - Fair condition below 16.0 m. - Run 3: RQD = 71% 		14.0	R1	89	-	-	-	-
217	55	15										
216	55	16		<p>DOLOMITE - Tan, fine grained, moderately spaced joints, competent rock.</p> <ul style="list-style-type: none"> - Broken zone of rock from 14.8 to 15.2 m from drill action on weaker zone at top of hole. - Run 1: RQD = 25% - Advanced casing to 14.9 m, advanced NQ core barrel below. - Vugs at 15.1 m. - Trace shale at 15.2 m. - Run 2: RQD = 77% - Good condition, with few joints below 15.2 m. - Broken core zone from 15.7 to 16.0 m. - Fair condition below 16.0 m. - Run 3: RQD = 71% 		17.1	R2	89	-	-	-	-
215	60	16										
215	55	17		<p>DOLOMITE - Tan, fine grained, moderately spaced joints, competent rock.</p> <ul style="list-style-type: none"> - Broken zone of rock from 14.8 to 15.2 m from drill action on weaker zone at top of hole. - Run 1: RQD = 25% - Advanced casing to 14.9 m, advanced NQ core barrel below. - Vugs at 15.1 m. - Trace shale at 15.2 m. - Run 2: RQD = 77% - Good condition, with few joints below 15.2 m. - Broken core zone from 15.7 to 16.0 m. - Fair condition below 16.0 m. - Run 3: RQD = 71% 		17.8	R3	98	-	-	-	-
214	65	17										
213.6	60	18		<p>END OF HOLE AT 18.14 m</p> <p>Notes: 1. Installed a Casagrande standpipe with a screen from 18.14 to 17.83 m, a Casagrande standpipe with a screen from 13.26 to 12.95 m and a vibrating wire piezometer with serial number SN#1700050 at 7.62 m below grade. 2. Backfilled the test hole with sand from 18.14 to 17.07 m, bentonite from 17.07 to 14.02, sand from 14.02 to 12.80 m, bentonite from 12.80 to 10.67 m and grout from 10.67 m to grade. 3. Installed a flush mount cover.</p>		18.1	-	-	-	-	-	-
213	65	18										
212	65	19		<p>END OF HOLE AT 18.14 m</p> <p>Notes: 1. Installed a Casagrande standpipe with a screen from 18.14 to 17.83 m, a Casagrande standpipe with a screen from 13.26 to 12.95 m and a vibrating wire piezometer with serial number SN#1700050 at 7.62 m below grade. 2. Backfilled the test hole with sand from 18.14 to 17.07 m, bentonite from 17.07 to 14.02, sand from 14.02 to 12.80 m, bentonite from 12.80 to 10.67 m and grout from 10.67 m to grade. 3. Installed a flush mount cover.</p>		-	-	-	-	-	-	-
211	70	19										
210	70	20		<p>END OF HOLE AT 18.14 m</p> <p>Notes: 1. Installed a Casagrande standpipe with a screen from 18.14 to 17.83 m, a Casagrande standpipe with a screen from 13.26 to 12.95 m and a vibrating wire piezometer with serial number SN#1700050 at 7.62 m below grade. 2. Backfilled the test hole with sand from 18.14 to 17.07 m, bentonite from 17.07 to 14.02, sand from 14.02 to 12.80 m, bentonite from 12.80 to 10.67 m and grout from 10.67 m to grade. 3. Installed a flush mount cover.</p>		-	-	-	-	-	-	-
210	70	20										

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Shelby Tube Core Barrel

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION Approximately 80 m East of Harrow St.
DRILLING METHOD 125 mm ø Solid Stem Auger, Acker Renegade Track Mounted Rig

JOB NO. 11-0107-18
GROUND ELEV. 231.84
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/28/2017
UTM (m) N 5,524,441
 E 632,650

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							PL	MC	LL	PL
231.6				CONCRETE								
231.3				GRANULAR BASE (GW)								
231	1			CLAY (CH) - Brown, damp, stiff, high plasticity.	S1							
230.2	5			- Mottled brown to grey, trace silt inclusions below 1.5 m.								
230	2			SILT (ML) - Tan, damp, soft, low plasticity.								
229	3	10		CLAY (CH) - Mottled brown to grey, damp, stiff, high plasticity, trace silt inclusions.	S2							
228	4				S3							
227	5	15		- Moist, firm to stiff below 4.6 m.								
226	6	20		- Grey below 6.1 m.	S4							
225	7			- Increased silt inclusions below 6.7 m.	S5							
224	8	25		- Firm below 7.3 m.								
223	9	30										
222				- Firm to soft, trace fine to coarse grained sand, occasional fine to coarse grained	S6							

GEOTECHNICAL SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\EOIC5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
 Maple Leaf Enterprises

INSPECTOR
 J. MACLENNAN

APPROVED
 DAA

DATE
 10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)							PL	MC	LL
				gravel below 9.7 m.							
221	11	35		- Trace silt till pockets below 10.7 m.							
220	12	40			S7						
219.0 219	13			SILT TILL (ML) - Grey, moist, loose, low plasticity, some clay, some fine to coarse grained sand, trace fine to coarse grained gravel.							
218 217.8	14	45		- Compact, no to low plasticity, some to with fine to coarse grained sand, trace clay, trace cobbles, trace boulders below 13.4 m.	S9			▲ 15			
				AUGER REFUSAL AT 14.02 m	S10	25		▲ 50			Spoon refusal in 2nd set
				Notes: 1. Test hole open to 14.02 m after the completion of drilling. 2. Water level 13.41 m below grade after the completion of drilling. 3. Test hole backfilled with bentonite and cuttings with a concrete patch at grade.							
217	15	50									
216	16										
215	17	55									
214	18	60									
213	19										
212	20	65									
211	21	70									

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\5 - COCKBURN.GPJ

SAMPLE TYPE  Auger Grab  Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

JOB NO. 11-0107-18

PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief

GROUND ELEV. 231.98

TOP OF PVC ELEV.
SITE Taylor Ave

WATER ELEV.
LOCATION West of Stafford St.

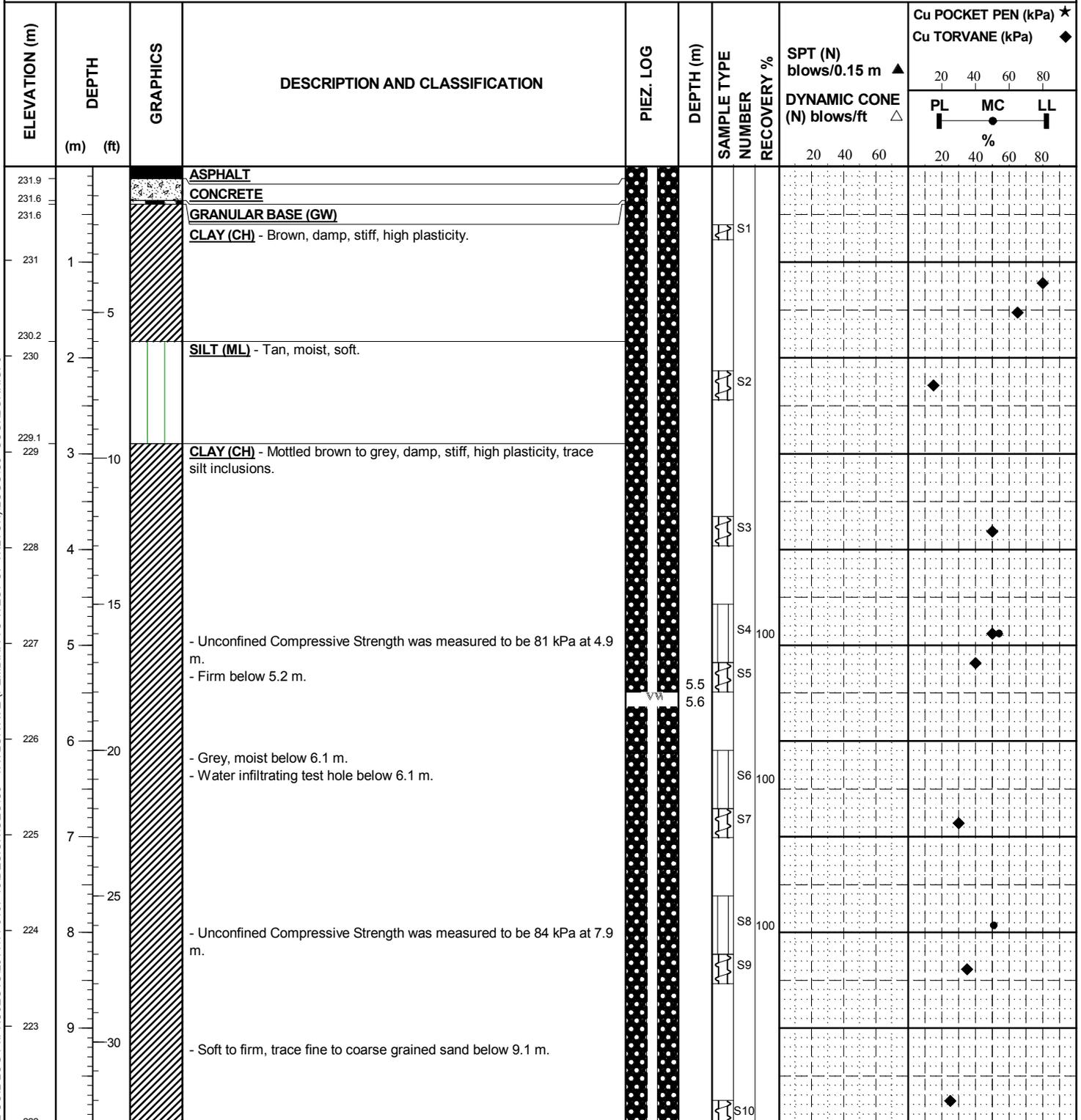
DATE DRILLED 4/26/2017

DRILLING METHOD 125 mm ø Solid Stem Auger, and NQ coring, B40X Truck Mounted Drill Rig

UTM (m)

N 5,524,462

E 632,688



GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Shelby Tube Split Spoon Core Barrel

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
221	11	35	[Hatched]		[Dotted]	10.7						
220	12	40		- Trace cobbles and boulders below 12.2 m			S11					
218.9	13		[Vertical Lines]	SILT TILL (ML) - Grey, moist, firm, low plasticity, some fine to coarse grained sand, trace fine to coarse grained gravel, some clay, trace cobbles and boulders. - Compact below 13.7 m.			S12					
218	14	45	[Vertical Lines]	- Tan, moist, compact to dense, with fine to coarse grained sand, some fine to coarse grained gravel.			S13	▲ 6 ▲ 8 ▲ 13				
217.3	15		[Vertical Lines]	- Auger refusal at 14.6 m, switched to coring. - Advanced casing to 14.9 m, advanced NQ core barrel below.		14.6	S14					
217	15	50	[Hatched]	DOLOMITE - Tan, fine grained, minor limonite staining - Broken zone caused by drill action from 14.6 to 15.4 m., - Run 1: RQD = 0% - Run 2: RQD = 20% - Competent, moderately spaced joints.		15.4	R1	25				
216.3	16		[Hatched]			15.7	R2	45				
216	16			END OF HOLE AT 15.70 m								
215	17	55		Notes: 1. Installed a Casagrande standpipe with a screen from 15.70 to 15.40 m, and a vibrating wire piezometer with serial number SN#1700049 at 5.49 m below grade. 2. Backfilled the test hole with sand from 15.70 to 14.63 m, bentonite from 14.63 to 10.67 m and grout from 10.67 m to grade. 3. Installed a flush mount cover.								
214	18	60										
213	19											
212	20	65										
211	21	70										

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\5 - COCKBURN.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION East of Stafford St.
DRILLING METHOD 125 mm ø Solid Stem Auger, B40X Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.10
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/25/2017
UTM (m) N 5,524,501
 E 632,754

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)									PL	MC	LL	PL
233.9				CONCRETE										
231.9				GRANULAR FILL (GW)										
231.3				CLAY (CH) - Brown, damp, stiff, high plasticity.										
231	1			SILT (ML) - Tan, moist, soft, low plasticity. - Some clay from 0.8 to 1.1 m. - Water infiltrating test hole from granular base material.			S1							
230.3	5													
230	2			CLAY (CH) - Mottled brown to grey, damp, stiff, high plasticity, trace silt inclusions.			S2							
229	3	10		- Moist, firm below 3.1 m.										
228	4						S3							
227	5	15												
226	6	20		- Grey below 6.1 m.			S4							
225	7													
224	8	25		- Increased silt inclusions below 7.6 m.			S5							
223	9	30		- Occasional fine to coarse grained gravel below 9.1 m.										
				- Soft below 9.8 m.			S6							
							S7							

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
 Maple Leaf Enterprises

INSPECTOR
 J. MACLENNAN

APPROVED
 DAA

DATE
 10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
222		35										
221	11						S8					
220	12	40										
219.8												
219	13			SILT TILL (ML) - Tan, damp, compact, low plasticity, some fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders.			S9					
218	14	45		- Moist, with fine to coarse grained sand, with fine to coarse grained gravel below 13.7 m.								
218				Grain Size Distribution: Gravel 46.5%, Sand 40.3%, Silt 9.8%, and Clay 3.4% at 14.5 m.			S10	50	▲ 16 ▲ 5 ▲ 6			
217	15	50					S11					
216.8				AUGER REFUSAL AT 15.32 m								
216	16			Notes: 1. Installed a Casagrande standpipe with a screen from 14.63 to 14.33 m below grade. 2. Backfilled the test hole with sand from 14.63 to 13.32 m, and bentonite from 14.02 to grade. 3. Test hole open to 14.63 m after the completion of drilling. 4. Water level 6.71 m below grade after the completion of drilling. 5. Installed a flush mount cover.								
215	17	55										
214	18	60										
213	19											
212	20	65										
211	21	70										

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE  Auger Grab  Split Spoon

CONTRACTOR
Maple Leaf Enterprises

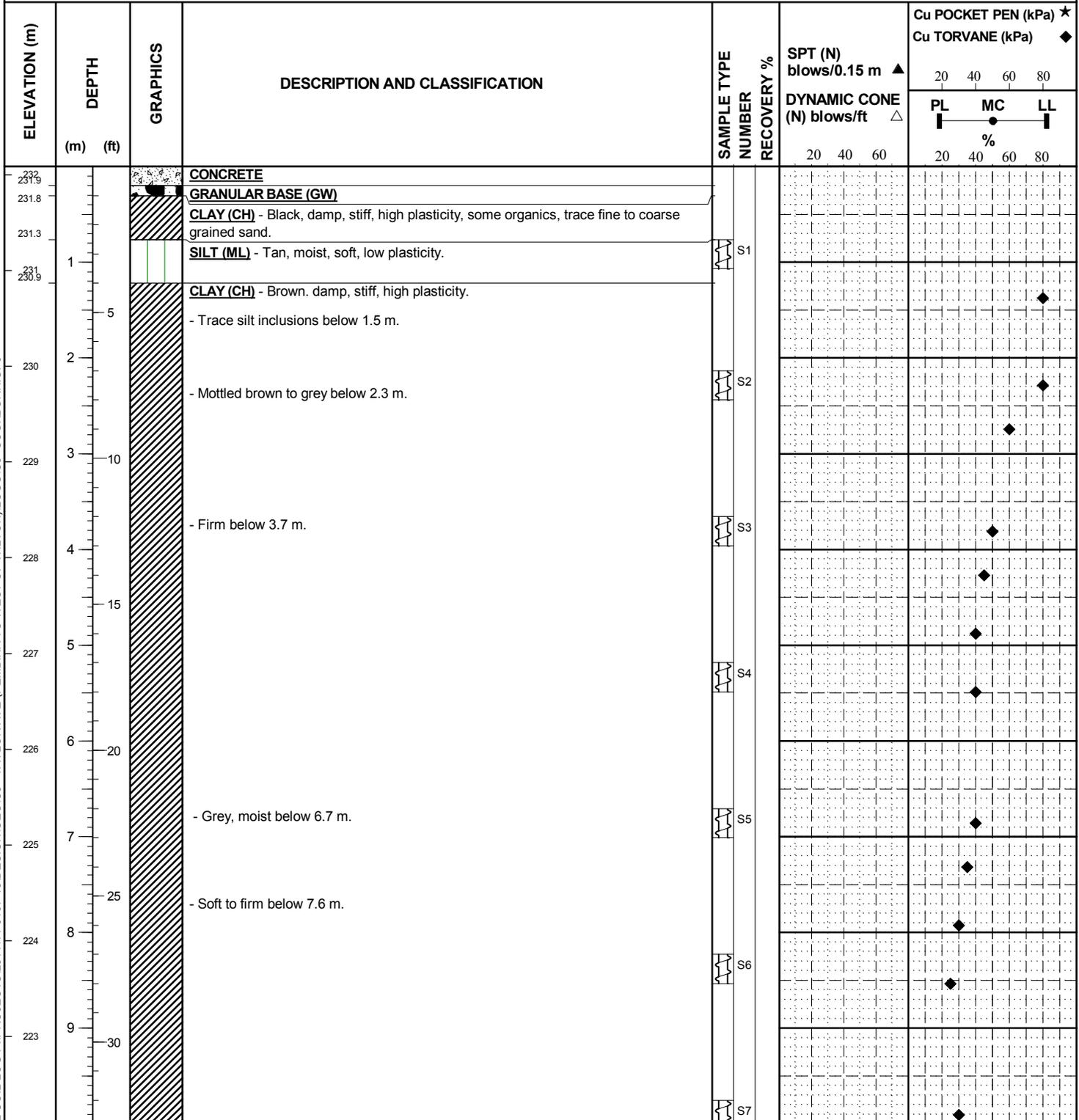
INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION Approximately 85 m East of Stafford St.
DRILLING METHOD 125 mm ø Solid Stem Auger, B40X Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.09
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/25/2017
UTM (m) N 5,524,528
 E 632,806



GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\CS5 - COCKBURN.GPJ

SAMPLE TYPE  Auger Grab  Split Spoon

CONTRACTOR
 Maple Leaf Enterprises

INSPECTOR
 J. MACLENNAN

APPROVED
 DAA

DATE
 10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆						
	(m)	(ft)								20	40	60	80	PL	MC	LL	20	40	60
222				- Soft, trace fine to coarse grained sand below 10.4 m.															
		35			- Trace silt till inclusions below 10.7 m.														
221		11			S8														
220		12																	
219.6		40		SILT TILL (ML) - Tan, moist, loose, no to low plasticity, some to with fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders.															
219		13			- Compact below 13.1 m.	S9													
218		45																	
		14			S10			▲ 6											
		14			S11			▲ 11											
		14			S11			▲ 16											
217.2		15		AUGER REFUSAL AT 14.94 m	S12														
217		50		Notes: 1. Test hole open to 14.33 m after the completion of drilling. 2. Water level 6.10 m below grade after the completion of drilling. 3. Test hole backfilled with bentonite and cuttings with a concrete patch at grade.															
216		16																	
		55																	
215		17																	
		60																	
214		18																	
		65																	
213		19																	
		70																	
212		20																	
211		21																	

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

JOB NO. 11-0107-18

PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief

GROUND ELEV. 231.79

SITE Taylor Ave

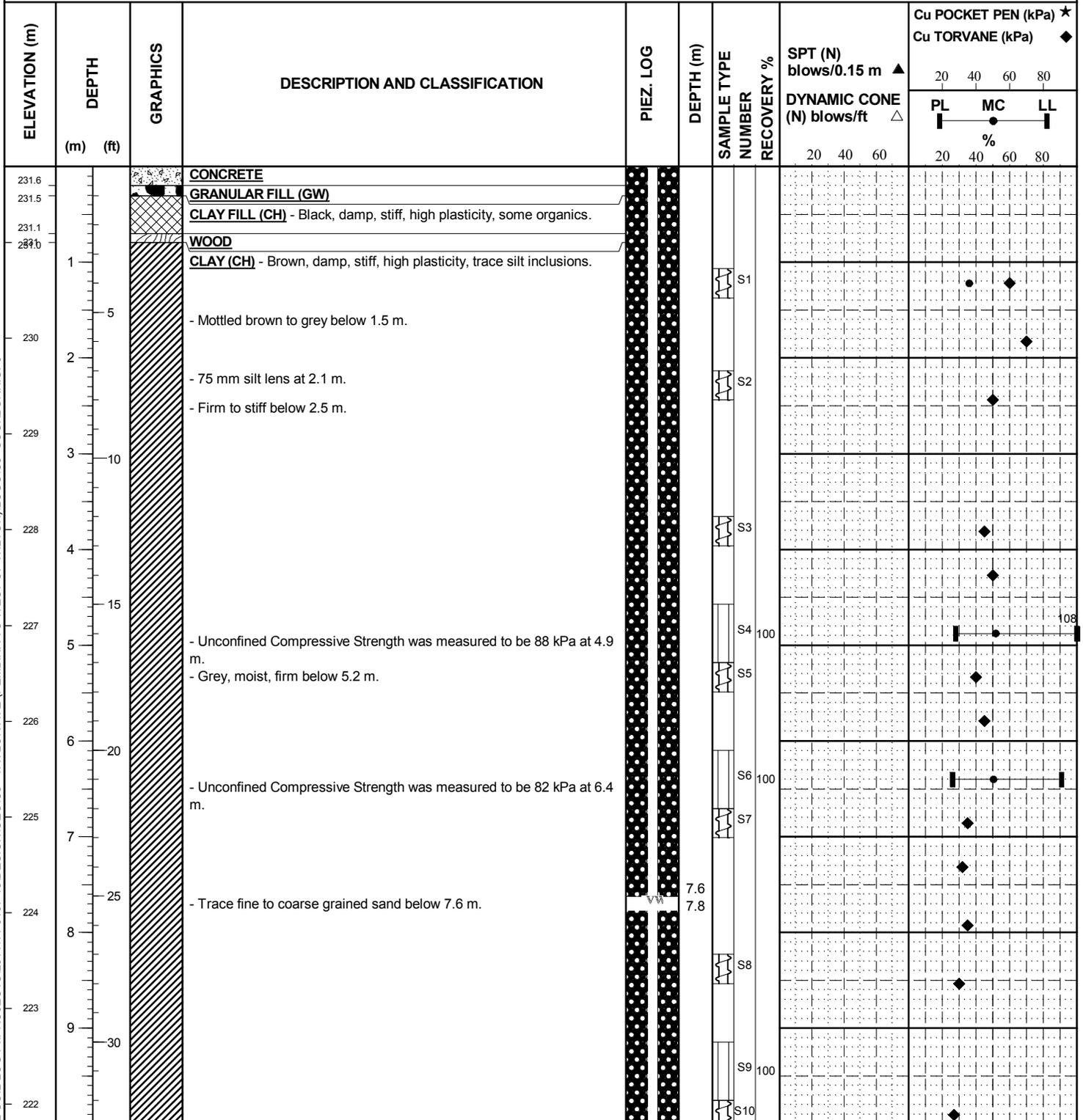
TOP OF PVC ELEV.
LOCATION Wentworth St.

WATER ELEV.
DRILLING METHOD 125 mm ø Solid Stem Auger, and NQ coring, B40X Truck Mounted Drill Rig

DATE DRILLED 4/24/2017

UTM (m) N 5,524,580

E 632,875



GEOTECHNICAL-SOIL LOG LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Shelby Tube Split Spoon Core Barrel

CONTRACTOR
Maple Leaf Enterprises

INSPECTOR
J. MACLENNAN

APPROVED
DAA

DATE
10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
221	35	11		- Soft, trace fine to coarse grained sand below 10.7 m.								
220							S11					
219.6	40	12		SILT TILL (ML) - Tan, damp, compact, low plasticity, some fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders.								
219							S12					
218	45	13		- Some to with fine to coarse grained sand below 13.4 m.								
217							S13	67	▲ 50 ▲ 50			
216	50	14		- Auger refusal at 14.0 m, switched to coring.								
215.8							R1	14				
215.5	55	15		- Advanced casing to 15.2 m, advanced NQ core barrel below. - Granite boulder and rubby bedrock encountered from 15.1 to 16.0 m. - Run 1: RQD = 14%		15.2						
215.2							R2	81				
215				DOLOMITE - Light brown to grey brown, slightly mottled texture. - Run 2: RQD = 81%								
214				SHALE - Red and grey, good quality, mottled texture.								
213.8	60	16		DOLOMITE - Light brown, competent, good quality, wide spaced fractures, weak to very weak reaction with dilute HCl. - Run 3: RQD = 90%								
213							R3	100				
212	65	17		- Badly broken by fracture that runs parallel to core axis from 17.9 to 18.1 m.		16.9						
211												
210	70	18		END OF HOLE AT 18.14 m		17.7						
						18.0						
						18.1						
				Notes: 1. Installed a Casagrande standpipe with a screen from 17.98 to 17.68 m, and a vibrating wire piezometer with serial number SN#1700048 at 7.62 m below grade. 2. Backfilled the test hole with sand from 18.14 to 16.92 m, bentonite from 16.92 to 15.24 m and grout from 15.24 m to grade. 3. Installed a flush mount cover.								

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION Approximately 40 m West of Nathaniel St.
DRILLING METHOD 125 mm ø Solid Stem Auger, CT-250 Truck mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.14
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 10/5/2017
UTM (m) N 5,523,977
 E 631,776

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆	
	(m)	(ft)								PL	MC
232				TOPSOIL - Black, damp, firm, trace roots, trace fine to coarse grained sand.							
231.8				SILT (ML) - Tan, moist, soft, low plasticity.							
231.4	1			CLAY (CH) - Brown, damp, stiff, high plasticity, trace silt inclusions.							
231		5		- Mottled brown to grey, moist, trace silt inclusions below 1.5 m.							
230		10		- Firm below 3.7 m.							
229	3										
228		15		- Grey below 5.2 m.							
227		20									
226	6										
225		25		- Silt till pocket, approximately 100 mm thick at 7.6 m. - Trace fine grained gravel below 7.6 m.							
224	8										
223		30		- Trace silt till pockets below 9.1 m. - Soft below 9.8 m.							

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\CS5 - COCKBURN.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR **Paddock Drilling Ltd.**

INSPECTOR **J. MACLENNAN**

APPROVED

DATE 10/20/17

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\5 - COCKBURN.GPJ

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								PL	MC	LL
222		35										
221	11											
220	12											
219	13			SILT TILL (ML) - Grey, moist, loose, low plasticity, some fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders.		13.1	S9					
218	14			- Brown, very dense below 13.7 m.								
217	15			- Wet below 14.95 m. - Limestone fragments observed in spoon at 15.3 m.		14.5	S10	100	▲ 2 ▲ 1 ▲ 4			
216.3	15.8					14.9	S11					
216	16			AUGER REFUSAL AT 15.86 m		15.2	S12	100	▲ 2 ▲ 22 ▲ 33			
215	17			Notes: 1. Installed a Casagrande standpipe with a screen from 15.25 to 14.95 m and a vibrating wire piezometer with serial number SN#1702738 at 8.24 m below grade. 2. Backfilled the test hole with sand from 15.86 to 14.49 m, bentonite from 14.02 to 13.12 m and grout from 13.12 m to grade. 3. Test hole open to 15.86 m after the completion of drilling. 4. Water level 11.90 m below grade after the completion of drilling. 5. Installed a flush mount cover.		15.8	S13					
214	18											
213	19											
212	20											
211	21											
		70										

SAMPLE TYPE  Auger Grab  Split Spoon

CONTRACTOR
Paddock Drilling Ltd.

INSPECTOR
J. MACLENNAN

APPROVED

DATE
10/20/17

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Contract 5 - Cockburn and Calrossie Sewer Relief
SITE Taylor Ave
LOCATION Approximately 90 m East of Nathaniel St.
DRILLING METHOD 125 mm ø Solid Stem Auger, CT-250 Truck mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.27
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 10/5/2017
UTM (m) N 5,524,030
 E 631,900

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							PL	MC	LL	PL
232.0				CONCRETE								
231.9				GRANULAR BASE (GW)								
		1		CLAY (CH) - Brown, damp, stiff, high plasticity.	S1							
231.1				SILT (ML) - Tan, moist, soft, low plasticity.								
230.8		5		CLAY (CH) - Mottled brown to grey, damp, stiff, high plasticity. - Trace silt pockets from 1.5 to 3.1 m.	S2							
230					S3							
229		10		- Moist below 3.1 m.	S4							
228					S5							
227		15			S6							
226		20		- Grey, trace silt inclusions below 6.1 m.	S7							
225				- Firm below 6.7 m.								
224		25		- Trace fine grained gravel below 7.6 m.								
223		30										

GEOTECHNICAL-SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

SAMPLE TYPE  Auger Grab  Split Spoon

CONTRACTOR
 Paddock Drilling Ltd.

INSPECTOR
 J. MACLENNAN

APPROVED

DATE
 10/20/17

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	Cu POCKET PEN (kPa) ★
	(m)	(ft)						DYNAMIC CONE (N) blows/ft △	Cu TORVANE (kPa) ◆
								20 40 60 80	20 40 60 80
								20 40 60	PL MC LL % 20 40 60 80
222		35							
221	11								
220.5				SILT TILL (ML) - Tan, moist, loose, no to low plasticity, some to with fine to coarse grained sand, trace fine to coarse grained gravel, trace cobbles, trace boulders.	S8				
220		40							
					S9	100	▲ 2 ▲ 2 ▲ 2		
219	13			- Compact below 13.1 m.					
218.6		45			S10				
				AUGER REFUSAL AT 13.73 m			▲ 50		
218	14			Notes: 1. Test hole open to 13.67 m after the completion of drilling. 2. Water level 12.81 m below grade after the completion of drilling. 3. Test hole backfilled with bentonite and cuttings with a concrete patch at grade.					
217	15	50							
216	16								
215	17	55							
214	18	60							
213	19								
212	20	65							
211	21	70							

GEO-TECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOICS5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5-COCKBURN.GPJ

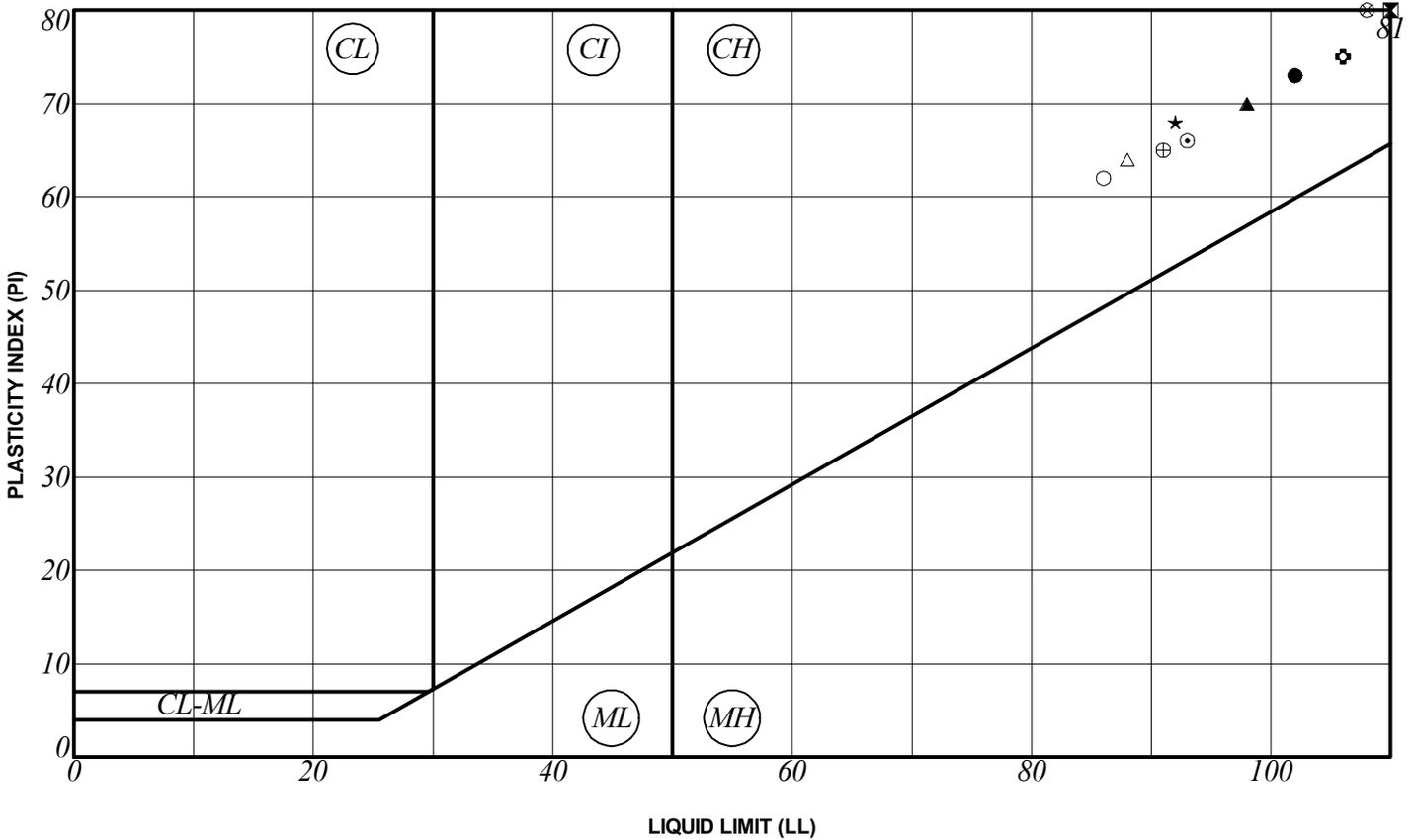
SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR
Paddock Drilling Ltd.

INSPECTOR
J. MACLENNAN

APPROVED

DATE
10/20/17



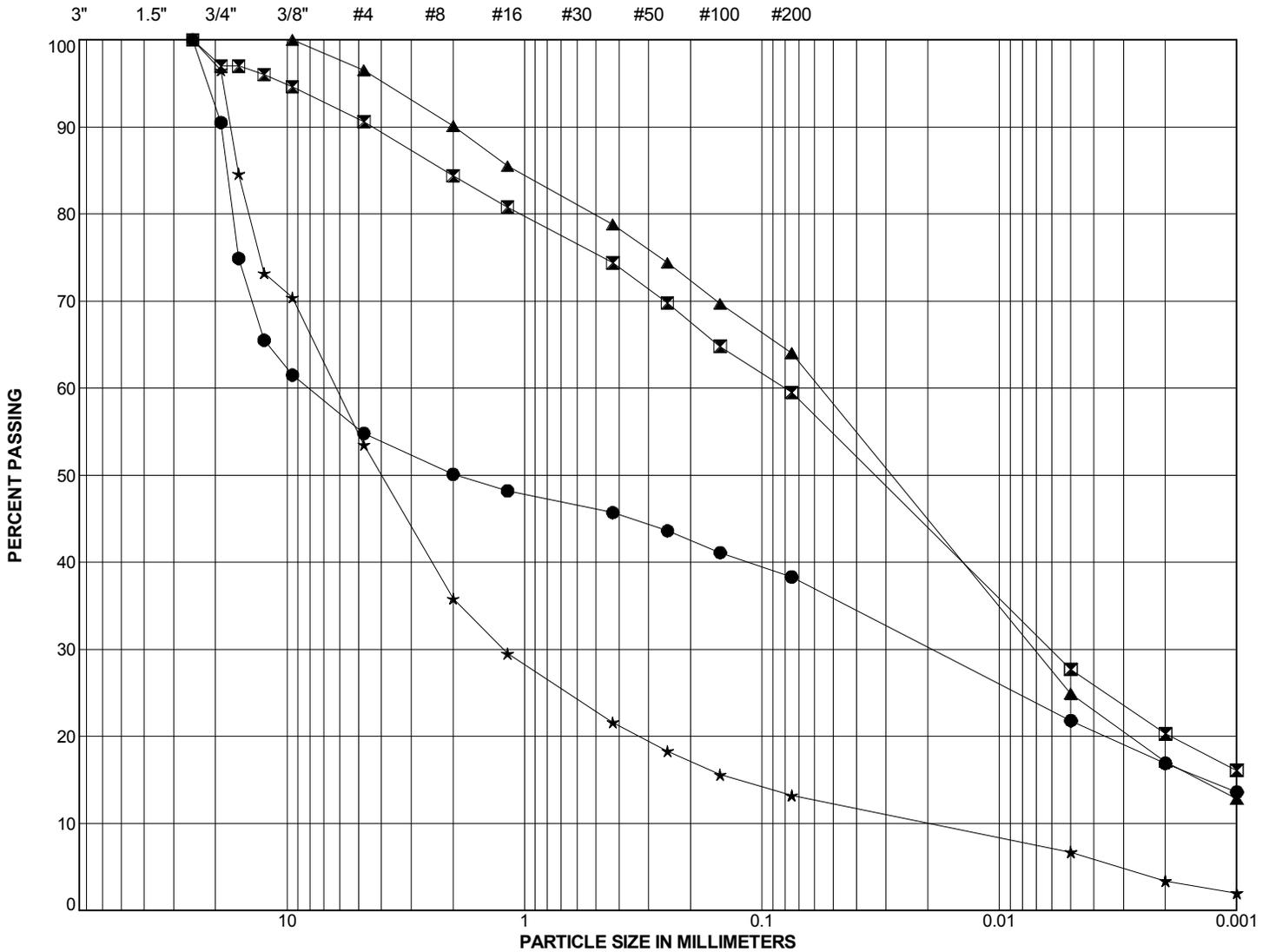
SYMBOL	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	% SAND	% SILT	% CLAY	% MC	CLASSIFICATION
●	TH17-01	3.8	S3	102	29	73				53.1	CH
⊠	TH17-01	4.9	S4	110	29	81				55.4	CH
▲	TH17-06	3.8	S3	98	28	70				48.7	CH
★	TH17-06	6.4	S6	92	24	68				50.0	CH
⊙	TH17-06	9.0	S9	93	27	66				48.4	CH
⊕	TH17-10	3.8	S2	106	31	75				54.2	CH
○	TH17-10	6.4	S6	86	24	62				47.8	CH
△	TH17-10	11.4	S11	88	24	64				48.5	CH
⊗	TH17-15	4.9	S4	108	28	80				51.8	CH
⊕	TH17-15	6.4	S6	91	26	65				50.4	CH

Notes:
 ML - Low Plasticity Silt
 MH - High Plasticity Silt
 CL-ML - Silty Clay
 CL - Low Plasticity Clay
 CI - Intermediate Plasticity Clay
 CH - High Plasticity Clay
 LL - Liquid Limit
 PL - Plastic Limit
 PI - Plasticity Index
 MC - Moisture Content
 NP - Non-Plastic

KGS GROUP	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	
	Contract 5 - Cockburn and Calrossie Sewer Relief	
A-LINE PLOT		
October 2017	Figure B01	Page 1 of 1

SIEVE ANALYSIS

HYDROMETER ANALYSIS



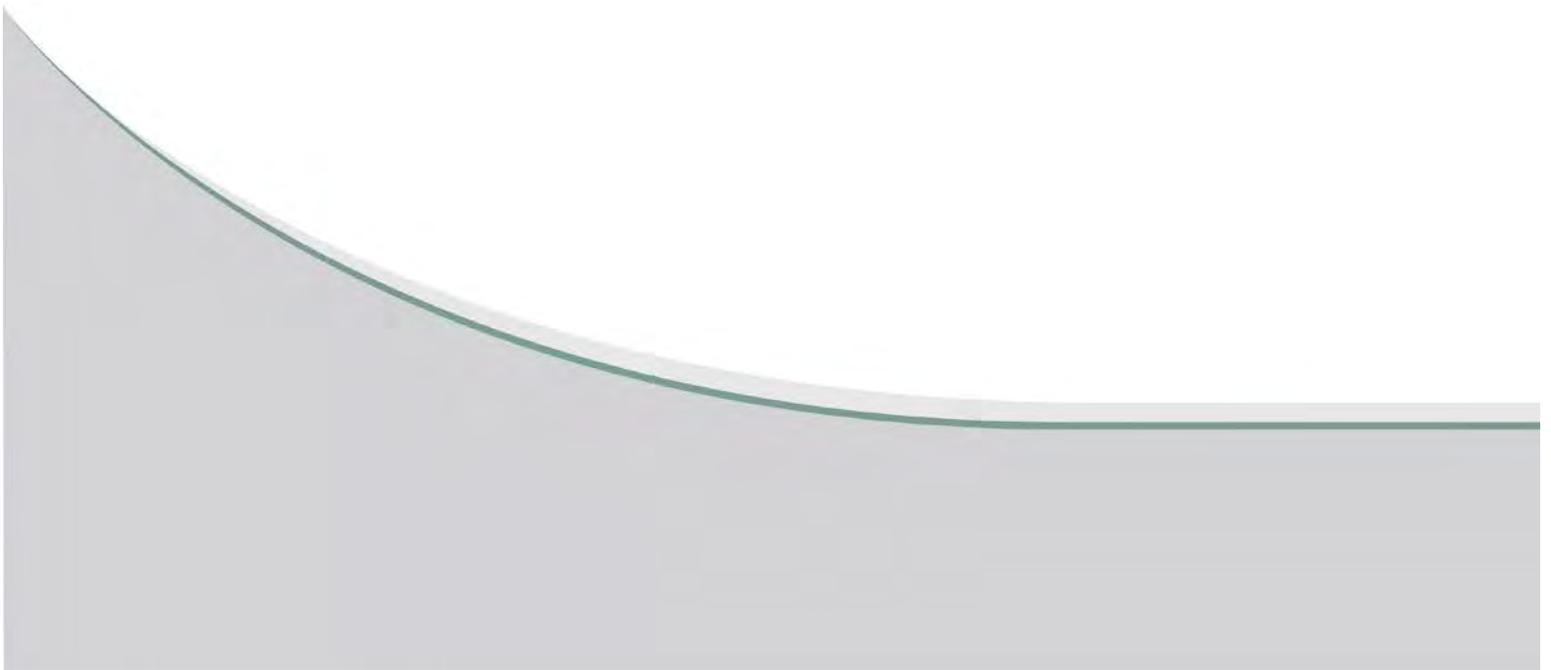
GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

SYMBOL	HOLE	DEPTH (m)	SAMPLE #	% GRAVEL	% SAND	% SILT	% CLAY	% SILT & CLAY	Cu	Cc	CLASSIFICATION
●	TH17-06	13.0	S13	45.2	16.5	21.4	16.9	38.3			
■	TH17-09	13.6	S11	9.4	31.1	39.2	20.3	59.5			
▲	TH17-10	13.3	S12	3.5	32.5	46.9	17.1	64.0			
★	TH17-13	14.5	S11	46.5	40.3	9.8	3.4	13.2	313.6	12.3	

SIEVE ANALYSIS P:\PROJECTS\201111-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\C5 - COCKBURN.GPJ

	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	
	Contract 5 - Cockburn and Calrossie Sewer Relief	
<h2>GRAIN SIZE ANALYSES</h2>		
October 2017	Figure B2	Page 1 of 1

APPENDIX C
2018 TEST HOLE LOGS



PRINCIPAL AND MINOR SOIL COMPONENTS

And	35 – 50%
With	20 – 35%
Some	10 – 20%
Trace	0 – 10%
Occasional	Trace of very local concentration

FIELD MOISTURE CONTENT

Dry	No moisture visible or to touch when fresh exposure is examined
Damp	Slightly wet to touch
Moist	Fresh exposure wet to touch
Wet	A film of water is readily visible around particles of granular soils, cohesive soils can readily be smeared or remolded; water can be squeezed out
Saturated	Water can easily be squeezed out
Free Water	Water completely separated from the soil particles

DEPOSITIONAL STRUCTURE

Massive	Structureless soil
Stratified (Layered)	Different soils or visible variations in soil constituents arranged in layers, generally but not necessarily parallel to one another, and not necessarily in horizontal position, at least 6 mm thick
Varved	Glaciolacustrine deposits with annual pairs of fine and coarser laminae (thin laminae of alternately deposited inorganic silt and clay)
Laminated	Closely spaced, regularly alternating layers of differing soils and/or colours, or shades of similar gradation, relatively consistent in thickness and consisting of sand, silt, or clay
Lens	Inclusions of a different soil within surrounding soils, which thins out horizontally and may not be continuous over any significant distance
Pocket	A different soil type of very limited thickness or lateral extent (a small lens)
Inclusions	Small pockets
Nuggety	A different soil type in the form of small lumps
Parting	Paper thin separation of one type by another

POST DEPOSITIONAL STRUCTURE

Fissured	A soil breaks along definite, pre-existing planes or fracture with little resistance to fracturing
Slickensided	Polished or glossy, sometimes striated surfaces resulting from movement of a material block relative to the adjacent blocks
Blocky/Friable/Platy	Cohesive soil that can be broken down into angular larger fragments (blocky), small fragments (friable), or thin plate-like fragments (platy) which resist further breakdown
Cemented	Soil particles or fragments held together by cemented materials, often chemical precipitants, or deposits within overall soil mass

GRAIN SIZE DISTRIBUTION IN COARSE GRAINED SOIL

Boulders	>200 mm ϕ
Cobbles	75 – 200 mm ϕ
Coarse Grained Gravel	19 – 75 mm ϕ
Fine Grained Gravel	4.75 – 19 mm ϕ
Coarse Grained Sand	2 – 4.75 mm ϕ
Medium Grained Sand	0.425 – 2 mm ϕ
Fine Grained Sand	0.075 – 0.425 mm ϕ

DENSITY OF GRANULAR SOIL

Description	Standard Penetration Test	Relative Density
Very Loose	0 – 4 Blows Per 0.3 m	<15%
Loose	4 – 10 Blows Per 0.3 m	15 – 35%
Compact	10 - 30 Blows Per 0.3 m	35 – 65%
Dense	30 - 50 Blows Per 0.3 m	65 – 85%
Very Dense	>50 Blows Per 0.3 m	>85%

CONSISTENCY OF COHESIVE SOILS

Description	Torvane	Standard Penetration Test
Very Soft	<12 kPa	<2
Soft	12 – 25 kPa	2 – 4
Firm	25 – 50 kPa	4 – 8
Stiff	50 – 100 kPa	8 – 15
Very Stiff	100 – 200 kPa	15 – 30
Hard	>200 kPa	>30

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Poseidon Bay - East Lane
LOCATION Approximately 25 m North of Taylor Avenue
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 233.00
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/2/2018
UTM (m) N 5,524,056
 E 631,200

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆		
	(m)	(ft)							20	40	60	80	20	40
232.9				ASPHALT										
232.8				CONCRETE	S1									
232.6				GRANULAR FILL - Tan, moist compact to dense.	S2									
232.1	1			TOPSOIL - Black, frozen, trace fine to coarse grained gravel, trace oxidation.										
232		5		CLAY - Mottled brown to grey, frozen, high plasticity, trace silt inclusions, trace oxidation.	S3									
231	2			- Moist, stiff below 1.8 m.	S4									
230	3	10			S5									
229	4	15			S6									
228	5	20												
228.7	6			END OF HOLE AT 6.10 m										
226	7			Notes: 1. Test hole open to 6.10 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.										
225	8													
224	9	30												
223	10	35												
222	11	40												
221	12													

SAMPLE TYPE Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED

DATE 8/7/18

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Poseidon Bay - East Lane
LOCATION Approximately 250 m North of Taylor Avenue
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.42
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/3/2018
UTM (m) N 5,523,806
 E 631,338

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆		
	(m)	(ft)							20	40	60	80	20	40
232.2				ASPHALT										
232.2				CONCRETE										
232.1				GRANULAR FILL - Tan, moist, compact to dense.	S1									
231.7	1			CLAY FILL - Grey, frozen, high plasticity, trace silt inclusions.	S2									
231.0		5		CLAYEY SILT - Light brown, frozen, low to intermediate plasticity, trace oxidation.	S3									
231				CLAY - Mottled brown to grey, frozen, high plasticity, trace silt inclusions, trace oxidation. - Moist, stiff below 1.8 m.	S4									
230					S5									
229	3	10												
228				- Firm below 4.3 m.	S6									
228	4	15												
227				- Grey, trace fine grained gravel below 5.5 m.	S7									
226				- No oxidation below 6.1 m.	S8									
226	6	20												
225				- Increased trace silt inclusions below 7.0 m.										
225	7	25												
224	8	30												
223.3	9	30		END OF HOLE AT 9.14 m										
223				Notes: 1. Test hole open to 8.84 m below existing grade. 2. Test hole dry immediately after drilling. 3. Water seeping from silt layer. 4. Test hole backfilled with cuttings and bentonite chips with concrete patch.										
222	10	35												
221	11	40												
220	12	40												

SAMPLE TYPE  Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED

DATE **8/7/18**

GEO-TECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Taylor Avenue - North Curb Lane
LOCATION Approximately 230 m East of Poseidon Bay
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.35
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/3/2018
UTM (m) N 5,523,809
 E 631,450

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆		
	(m)	(ft)							PL	MC	LL	PL	MC	LL
232.3				ASPHALT										
232				CONCRETE										
232.1				SILT - Light brown, moist, firm, low to intermediate plasticity, with clay, trace oxidation.	S1									
	1			- Frozen below 1.2 m.	S2									
233.0		5		CLAY - Mottled brown to grey, frozen, high plasticity, trace silt inclusions, trace oxidation.	S3									
	2			- Trace fine grained gravel below 1.5 m.										
230				- Moist, stiff below 1.8 m.	S4									
	3	10												
229														
	4			- Trace gypsum nodules, no fine grained gravel below 4.0 m.	S5									
228		15												
	5													
227														
	6	20		- Grey, firm below 6.1 m.	S6									
226														
	7													
225				- Trace to some silt inclusions below 7.2 m.	S7									
	8	25												
224														
	9	30												
223														
	10			- Trace to some fine to coarse grained gravel below 9.8 m.	S8									
222														
221.7		35		END OF HOLE AT 10.67 m	S9									
	11													
221				Notes: 1. Test hole open to 10.36 m below existing grade. 2. Test hole dry immediately after drilling. 3. Water seeping from silt layer. 4. Test hole backfilled with cuttings and bentonite chips with concrete patch.										
	12	40												
220														

 SAMPLE TYPE  Auger Grab

 CONTRACTOR **Maple Leaf Drilling Ltd.**

 INSPECTOR **M. ALFARO**

APPROVED

 DATE **8/7/18**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Grant Avenue - North Service Road
LOCATION Approximately 115 m East of Cambridge Street
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.28
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/3/2018
UTM (m) N 5,524,380
 E 631,430

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆			
	(m)	(ft)							PL	MC	LL	PL	MC	LL	
232.2				ASPHALT											
232.2				CONCRETE											
232.1				CLAY - Mottled brown to grey, frozen, high plasticity, trace silt inclusions. - Trace fine grained gravel between 0.6 m and 0.9 m.	S1										
231	1	5		- Moist, stiff below 1.4 m. - Trace oxidation below 1.7 m.	S2										
230	2	10			S3										
229	3	15			S4										
228	4	20			S5										
228	5	25		- Grey, firm, no oxidation below 7.0 m.											
226	6			END OF HOLE AT 7.62 m											
225	7			Notes: 1. Test hole open to 4.57 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.											
224.7	8														
224	9	30													
223	10	35													
222	11	40													
221	12														
220															

SAMPLE TYPE  Auger Grab

CONTRACTOR Maple Leaf Drilling Ltd.
INSPECTOR M. ALFARO

APPROVED

DATE
 8/7/18

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Nathaniel Street - West Lane
LOCATION Approximately 50 m South of Grant Avenue
DRILLING METHOD 125 mm ø Solid Stem Auger B40 Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.03
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/7/2018
UTM (m) N 5,524,302
 E 631,569

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆		
	(m)	(ft)							20	40	60	80	20	40
232.0				ASPHALT										
231.7				CONCRETE										
231.1	1	3.3		SILT - Light brown, frozen, low to intermediate plasticity, trace fine to coarse grained sand, trace oxidation.	S1									
229.6	5	16.7		SANDY SILT - Tan, moist, trace clay, trace oxidation.	S2									
230				SILT - Light brown, moist, firm, low to intermediate plasticity, trace oxidation.	S3									
229.6	2	6.7		- Moist to wet below 1.4 m.	S4A									
229				CLAY - Mottled brown to grey, moist, firm to stiff, high plasticity, trace silt inclusions, trace oxidation.	S4B									
229	3	10		- Grey below 3.4 m.	S5									
228	4	13.3			S6									
227	5	16.7												
225.0	6	20		END OF HOLE AT 6.10 m										
225	7	23.3		Notes: 1. Test hole open to 6.10 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.										
224	8	26.7												
223	9	30												
222	10	33.3												
221	11	36.7												
220	12	40												

SAMPLE TYPE  Auger Grab

CONTRACTOR Maple Leaf Drilling Ltd.
INSPECTOR M. ALFARO

APPROVED
 JRM

DATE
 8/7/18

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Hector Avenue - North Lane
LOCATION Approximately 25 m East of Nathaniel Street
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 231.76
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/3/2018
UTM (m) N 5,524,231
 E 631,751

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆					
	(m)	(ft)							20	40	60	80	PL	MC	LL	20	40
231.7				ASPHALT													
231.5				CONCRETE													
231.0	1	3.3		CLAY FILL - Black, frozen, intermediate plasticity, trace fine to coarse grained gravel, trace organics, trace silt inclusions.	S1												
231.0	5	16.4		CLAY - Mottled brown to grey, frozen, high plasticity, trace silt inclusions.	S2												
230	2	6.6		- Moist, stiff, trace oxidation below 1.5 m.													
229	3	9.9			S3												
228	4	13.1		- Firm below 3.7 m.	S4												
227	5	16.4															
226	6	19.7		- Trace fine to coarse grained gravel below 5.2 m. - Grey below 5.5 m.	S5												
225	7	22.9		- Soft, increasing trace silt inclusions below 7.0 m.	S6												
224	8	26.2		- Trace to some fine to coarse grained gravel below 8.0 m.	S7												
223	9	29.5															
222.6	9	29.5		END OF HOLE AT 9.14 m													
222	10	32.8		Notes: 1. Test hole open to 5.18 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.													
221	11	36.1															
220	12	39.4															
219																	

SAMPLE TYPE  Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.**

INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Grant Avenue - North Service Road
LOCATION Approximately 650 m East of Cambridge Street
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.13
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/3/2018
UTM (m) N 5,524,594
 E 631,820

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							20	40	60	80
232.2			[Hatched]	ASPHALT								
231.9			[Cross-hatched]	CONCRETE								
231.4	1	3	[Dotted]	CLAY FILL - Grey, frozen, high plasticity, trace fine to coarse grained sand, trace fine to coarse grained gravel.	S1							
231	5	10	[Dotted]	SILT - Light brown, frozen, with clayey silt, trace oxidation, trace fine to coarse grained gravel.	S2							
230.1	2	4	[Dotted]	CLAY - Mottled brown to grey, moist, stiff, high plasticity, trace silt inclusions, trace oxidation.	S3							
230												
229	3	10	[Dotted]	- Firm below 4.3 m.	S4							
228	4	15	[Dotted]									
227	5	20	[Dotted]	- Grey below 6.1 m.	S5							
226	6	25	[Dotted]									
225	7	30	[Dotted]	- Trace to some silt inclusions below 7.0 m.	S6							
224.5	8	35		END OF HOLE AT 7.62 m								
224	9	40		Notes: 1. Test hole open to 7.16 m below existing ground surface immediately after drilling. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.								
223	10											
222	11											
221	12											
220												

SAMPLE TYPE [Icon] Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC66 - C:\3\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Hector Avenue - North Lane
LOCATION Approximately 230 m West of Wilton Street
DRILLING METHOD 125 mm ø Solid Stem Auger B40 Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 231.70
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/7/2018
UTM (m) N 5,524,353
 E 631,974

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆		
	(m)	(ft)							PL	MC	LL	PL	MC
231.5				CONCRETE									
231	1			CLAY FILL - Black, frozen, intermediate plasticity, trace silt inclusions, trace fine grained gravel. - Trace organics from 0.2 m to 1.1 m. - Brown below 1.1 m.	S1								
230.3	5			SILT - Light brown, frozen, intermediate plasticity, trace oxidation.	S2								
229.9	2			CLAY - Mottled brown to grey, moist, stiff, high plasticity, trace rootlets, trace silt inclusions, trace oxidation.	S3								
229	3	10		- Grey below 4.9 m.									
228	4	15			S4								
227	5	20			S5								
226	6	25			S6								
225	7												
224.1	8												
224													
				END OF HOLE AT 7.62 m									
				Notes: 1. Test hole open to 7.62 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.									
223	9	30											
222	10												
221	11	35											
220	12	40											
219													

SAMPLE TYPE Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**

GEO-TECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C:\3\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

JOB NO. 11-0107-18

PROJECT Cockburn and Calrossie Sewer Relief

GROUND ELEV. 232.60

SITE Wilton Street - West Lane

TOP OF PVC ELEV.

LOCATION Approximately 20 m South of Grant Avenue

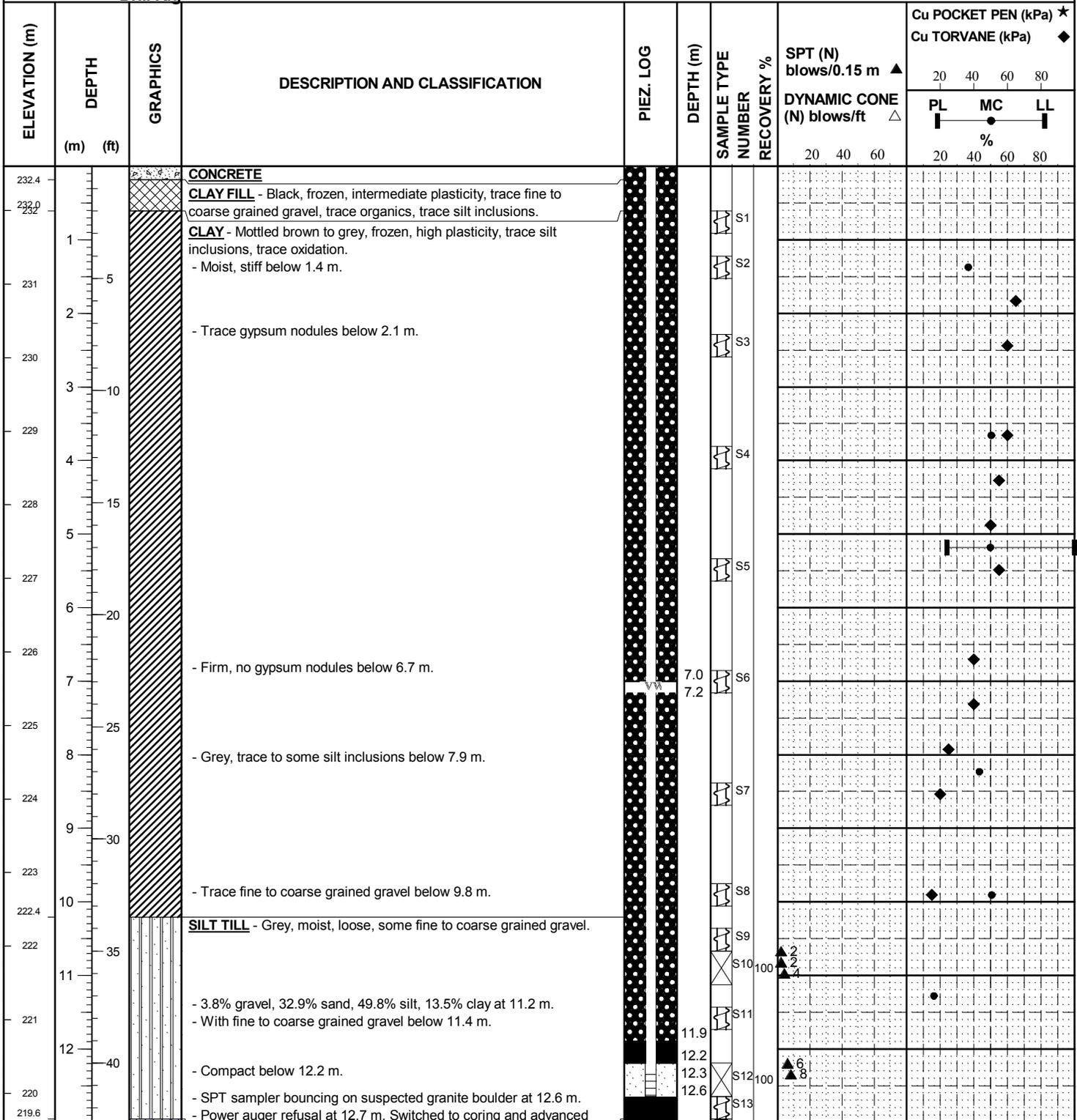
WATER ELEV.

DRILLING METHOD 125 mm ø Solid Stem Auger, and Triple Tube Coring, B54X Mobile Track Mounted Drill Rig

DATE DRILLED 5/4/2018

UTM (m) N 5,524,602

E 632,070



GEO TECHNICAL SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

SAMPLE TYPE Auger Grab Split Spoon Core Barrel

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆		
	(m)	(ft)								20	40	60
219	14	45		casing to 13.0 m. BEDROCK - Pink to white, poor quality, highly weathered. - Run 1: RQD = 31% - Yellowish white below 13.4 m. - Increased quality below 13.4 m. - Vuggy below 13.7 m.		14.2	R1					
218.4				END OF HOLE AT 14.17 m								
218	15	50		Notes: 1. Installed a standpipe with a slotted screen from 12.3 m to 12.6 m, and a vibrating wire piezometer (SN#1800934) 7.0 m below grade. 2. Test hole backfilled with sand from 12.6 m to 12.3 m, bentonite pellets from 12.3 m to 11.9 m, and grout from 11.9 m to grade. 3. Installed a flush mount cover.								
217	16	55										
216	17	60										
215	18	65										
214	19	70										
213	20	75										
212	21	80										
211	22	85										
210	23	90										
209	24											
208	25											
207	26											
206	27											
205	28											

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

SAMPLE TYPE  Auger Grab  Split Spoon  Core Barrel

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO** APPROVED **JRM** DATE **8/7/18**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Weatherdon Avenue -
LOCATION Approximately 80 m East of Wilton Street
DRILLING METHOD 125 mm ø Solid Stem Auger B40 Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.29
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/8/2018
UTM (m) N 5,524,672
 E 632,207

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							20	40	60	80
232.1				CONCRETE								
232				CLAY FILL - Black, frozen, intermediate plasticity, trace fine to coarse grained gravel, trace organics, trace silt inclusions.	S1							
231.7				CLAY - Mottled brown and grey, frozen, high plasticity, trace silt inclusions, trace oxidation.	S2							
230.9		5		CLAYEY SILT - Light brown, moist, firm, low to intermediate plasticity, trace oxidation, trace silt inclusions.	S3							
230.8				CLAY - Mottled brown to grey, moist, firm to stiff, high plasticity, trace silt inclusions, trace oxidation.	S4							
230		2										
229		3										
228		4		- Trace gypsum pocket (25 mm) at 4.0 m.	S5							
228		5										
227		6			S6							
226.2		20		END OF HOLE AT 6.10 m								
226				Notes: 1. Test hole open to 6.10 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.								
225		7										
225		25										
224		8										
224		30										
223		9										
223		35										
222		10										
222		35										
221		11										
221		40										
220		12										

SAMPLE TYPE  Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**

GEO-TECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Carter Avenue - North Lane
LOCATION Approximately 35 m East of Wilton Street
DRILLING METHOD 125 mm ø Solid Stem Auger B40 Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.31
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/7/2018
UTM (m) N 5,524,534
 E 632,128

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							PL	MC	LL	PL
232.1				CONCRETE								
232.0				GRANULAR FILL - Tan, moist, compact to dense, trace fine to coarse grained sand.	S1							
	1	5		CLAY - Mottled brown to grey, frozen, high plasticity, trace oxidation, trace silt inclusions. - Trace rootlets between 0.3 m and 0.9 m.	S2							
	2	10		- Moist, stiff below 1.8 m.								
	3	15		- Gypsum pocket (10.2 cm - 15.2 cm diameter) at 3.0 m.	S3							
	4	20			S4							
	5	25		- Trace fine grained gravel at 5.0 m.	S5							
	6	30			S6							
	7	35		- Grey, some silt inclusions below 7.5 m. - Trace fine to coarse grained gravel below 7.8 m.	S7							
	8	40		- Firm below 8.5 m.								
	9			END OF HOLE AT 9.14 m								
	10			Notes: 1. Test hole open to 9.14 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.								

SAMPLE TYPE  Auger Grab

CONTRACTOR Maple Leaf Drilling Ltd.
INSPECTOR M. ALFARO

APPROVED
 JRM

DATE
 8/7/18

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Hector Avenue - West Lane
LOCATION Approximately 80 m East of Wilton Street
DRILLING METHOD 125 mm ø Solid Stem Auger B40 Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.21
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/7/2018
UTM (m) N 5,524,532
 E 632,299

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							PL	MC	LL	PL
232.2				CONCRETE								
231.7				GRANULAR FILL - Tan, dry to damp, compact to dense, with fine to coarse grained gravel.	S1							
231	1	5		CLAY - Mottled brown to grey, moist, stiff, high plasticity, trace silt inclusions, trace oxidation.	S2							
230	2	10			S3							
229	3	15			S4							
228	4	20			S5							
227	5	25			S6							
226	6	30		- Grey, trace to some silt inclusions, trace fine to coarse grained gravel below 6.2 m.								
225	7	35										
224.6	8	40		END OF HOLE AT 7.62 m								
224	9			Notes: 1. Test hole open to 7.62 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.								
223	10											
222	11											
221	12											
220												

SAMPLE TYPE  Auger Grab

CONTRACTOR Maple Leaf Drilling Ltd.
INSPECTOR M. ALFARO

APPROVED
 JRM

DATE
 8/7/18

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Ebby Avenue - West Lane
LOCATION Approximately 20 m East of Wilton Street
DRILLING METHOD 125 mm ø Solid Stem Auger B40 Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.19
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/7/2018
UTM (m) N 5,524,370
 E 632,183

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆		
	(m)	(ft)							20	40	60	80	20	40
232.0				CONCRETE										
231.8				CLAY FILL - Black, frozen, intermediate plasticity, trace fine to coarse grained gravel, trace organics, trace silt inclusions.	S1									
231	1			CLAY - Brown, frozen, intermediate to high plasticity, trace silt inclusions, trace rootlets, trace oxidation.	S2									
		5		- Mottled brown to grey, moist, stiff, high plasticity below 1.4 m.	S3									
					S4									
230	2				S5									
229	3	10		- Trace gypsum nodules below 3.7 m.	S6									
228	4	15			S7									
227	5	20		- Firm, no gypsum nodules below 6.1 m.	S8									
				- Grey below 6.4 m.										
226	6	25			S9									
225	7	30												
224	8	35												
223	9													
222	10													
221.5	11			END OF HOLE AT 10.67 m										
221	12			Notes: 1. Test hole open to 10.67 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.										
220														

SAMPLE TYPE  Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

JOB NO. 11-0107-18

PROJECT Cockburn and Calrossie Sewer Relief

GROUND ELEV. 232.65

SITE Harrow Avenue - South Back Lane

TOP OF PVC ELEV.

LOCATION Approximately 25 m South of Grant Avenue

WATER ELEV.

DRILLING METHOD 125 mm ø Solid Stem Auger B40 Truck Mounted Drill Rig

DATE DRILLED 5/8/2018

UTM (m) N 5,524,816

E 632,342

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							PL	MC	LL	PL
232.5				CONCRETE								
232.0				TOPSOIL - Black, frozen, trace fine to coarse grained gravel, trace rootlets, trace oxidation.	S1							
231.3	1			CLAY - Mottled brown to grey, frozen, intermediate to high plasticity, trace organics, trace rootlets, trace to some silt inclusions.	S2							
231.0		5		SILT - Light brown, moist, low to intermediate plasticity, trace oxidation.	S3							
230.5	2			CLAY - Mottled brown to grey, moist, stiff, high plasticity, trace silt inclusions, trace oxidation.	S4							
229.9				SILT - Light brown, moist, low to intermediate plasticity, trace oxidation.	S5							
229.6	3			CLAY - Mottled brown to grey, moist, stiff, high plasticity, trace silt inclusions.	S6							
229.0		10		CLAY - Mottled brown to grey, moist, stiff, high plasticity, trace silt inclusions.	S7							
228.5	4			- Trace gypsum nodules between 3.8 m and 5.0 m. - Firm to stiff below 4.3 m.	S8							
228.0		15			S9							
227.5	5				S10							
227.0		20										
226.5	6											
226.0		25		- Trace fine to coarse grained gravel below 7.0 m. - Grey below 7.3 m.								
225.0	7											
225.0		25		END OF HOLE AT 7.62 m								
224.5	8			Notes: 1. Test hole open to 7.62 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite with concrete patch.								
224.0												
223.5	9											
223.0		30										
222.5	10											
222.0												
221.5	11											
221.0		35										
220.5	12											
220.0		40										

SAMPLE TYPE Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.**

INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**

GEO-TECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Carter Avenue - East Lane
LOCATION Approximately 40 m West of Harrow Street
DRILLING METHOD 125 mm ø Solid Stem Auger B40 Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.55
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/8/2018
UTM (m) N 5,524,681
 E 632,397

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆		
	(m)	(ft)							20	40	60	80	20	40
232.4			[Concrete Pattern]	CONCRETE										
232.3			[Asphalt Pattern]	ASPHALT										
231.8			[Clay Fill Pattern]	CLAY FILL - Black, moist, soft, trace fine to coarse grained gravel.	S1									
	1		[Clayey Silt Pattern]	CLAYEY SILT - Light brown, frozen, low to intermediate plasticity, trace oxidation. - Moist below 1.2 m.	S2									
231.0		5	[Clay Pattern]	CLAY - Mottled brown to grey, moist, firm to stiff, high plasticity, trace silt inclusions, trace oxidation. - 50 mm silt pocket at 2.0 m.										
231					S3									
230														
229														
228					S4									
228		15												
227					S5									
227														
226														
226		20			S6									
225														
225														
224					S7									
224														
223.4		30		END OF HOLE AT 9.14 m										
223				Notes: 1. Test hole open to 9.14 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.										
222														
222		35												
221														
221														
220														
220		40												

SAMPLE TYPE [Auger Grab Icon] Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

JOB NO. 11-0107-18

PROJECT Cockburn and Calrossie Sewer Relief

GROUND ELEV. 231.98

TOP OF PVC ELEV.
SITE Sparring Avenue - East Lane

WATER ELEV.
LOCATION Approximately 25 m West of Harrow Street

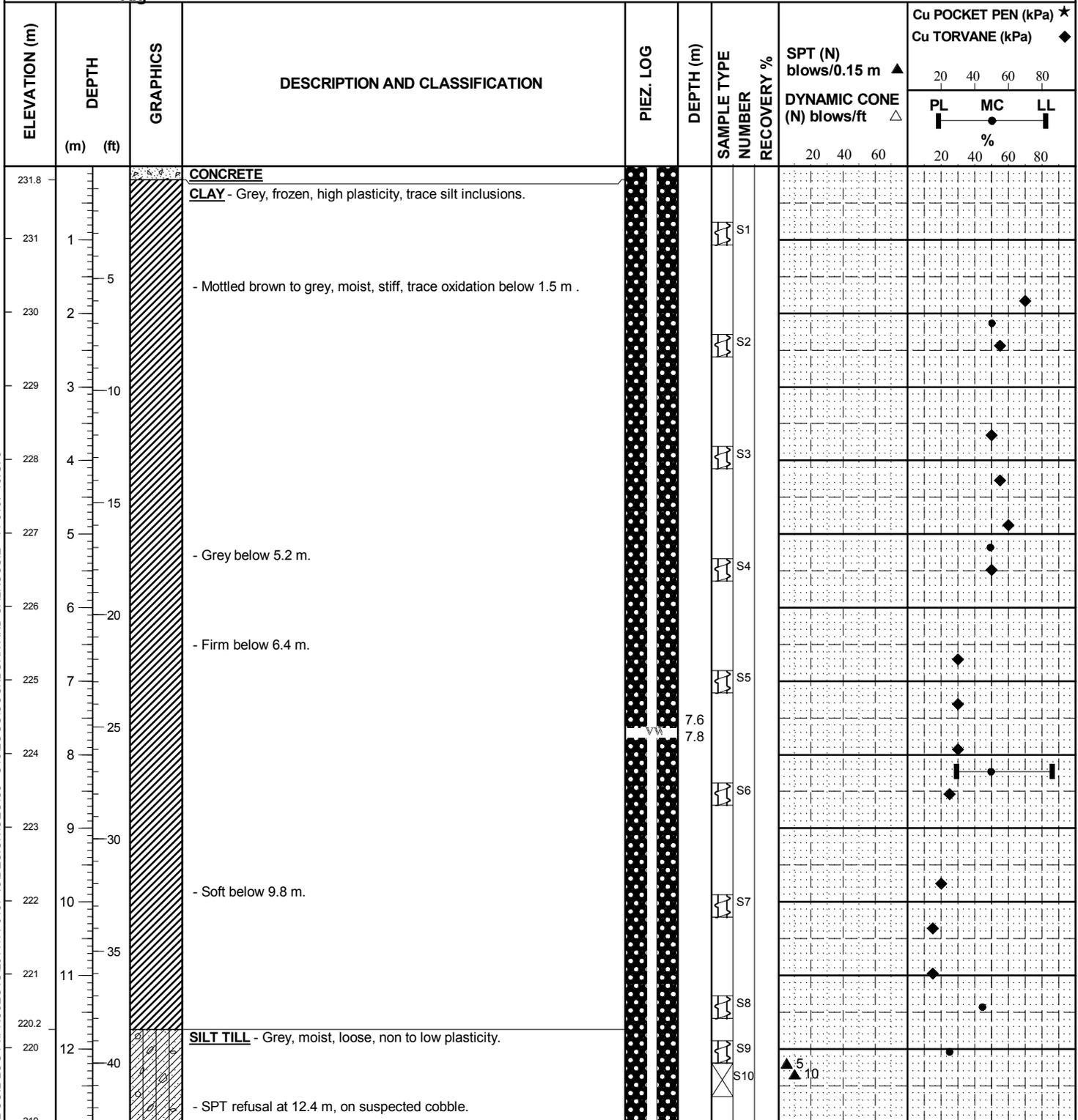
DATE DRILLED 4/30/2018

DRILLING METHOD 125 mm ø Solid Stem Auger, and Triple Tube Coring B54X Mobile Track Mounted Drill Rig

UTM (m)

N 5,524,172

E 632,682



GEOTECHNICAL-SOIL LOG.P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

SAMPLE TYPE		Auger Grab		Split Spoon		Core Barrel
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CONTRACTOR	INSPECTOR
Maple Leaf Drilling Ltd.	M. ALFARO

APPROVED
JRM

DATE
8/7/18

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	Cu POCKET PEN (kPa) ★
								DYNAMIC CONE (N) blows/ft △	Cu TORVANE (kPa) ◆
								20 40 60	20 40 60 80
								20 40 60	PL MC LL % 20 40 60 80
214.0	14		<ul style="list-style-type: none"> - Boulders and cobbles between 12.5 and 13.4 m. - Tan below 13.0 m. - 12.6% gravel, 28.0% sand, 42.9% silt, 16.5% clay at 13.1 m. - Power auger refusal at 13.4 m, switched to coring. 			S11			●
217	15		<p>BEDROCK</p> <ul style="list-style-type: none"> - Pink to white, highly fractured. - Run 1: Boulder and 50 mm of bedrock, RQD = 0%. - Run 2: RQD = 0%, 150 mm of bedrock. 		14.9	R1			
215.8	16		<ul style="list-style-type: none"> - Rubble at 15.1 m. - Run 3: RQD = 12% 		15.5	R2			
			<p>END OF HOLE AT 16.15 m</p>		15.8	R3			
			<p>Notes:</p> <ol style="list-style-type: none"> 1. Installed a standpipe with a slotted screen from 16.2 m to 15.8 m, and a vibrating wire piezometer (SN#1800937) 7.6 m below grade. 2. Test hole backfilled with sand from 15.8 m to 15.5 m, bentonite pellets from 15.5 m to 14.9 m, and grout from 14.9 m to grade. 3. Installed a flush mount cover. 		16.2				
215	17								
214	18								
213	19								
212	20								
211	21								
210	22								
209	23								
208	24								
207	25								
206	26								
205	27								
204	28								

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

SAMPLE TYPE Auger Grab Split Spoon Core Barrel

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO** APPROVED **JRM** DATE **8/7/18**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Ebby Avenue - West Lane
LOCATION Approximately 50 m East of Stafford Street
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 231.96
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/2/2018
UTM (m) N 5,524,640
 E 632,673

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							20	40	60	80
231.9				ASPHALT								
231.7				CONCRETE								
231.3				CLAY FILL - Grey to brown, moist, firm to stiff, high plasticity.								
230.9	1	3		SILT - Tan, moist, soft, low plasticity, trace to some clay, trace fine grained gravel.	S1							
230	2	6		CLAY - Mottled brown to grey, frozen, high plasticity, trace silt inclusions, trace organics, trace oxidation. - Increased silt inclusions between 1.4m and 1.5 m. - Moist, stiff, no organics below 1.5 m.	S2 S3							
229	3	10			S4							
228	4	13			S5							
227	5	15		- Firm to stiff below 14.3 m.								
226	6	20			S6							
225	7	23		- Grey, firm, no oxidation below 7.0 m.	S7							
224.3	7.62	25		END OF HOLE AT 7.62 m	S8							
224	8	26		Notes: 1. Test hole open to 7.32 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chip with concrete patch.								
223	9	30										
222	10	33										
221	11	35										
220	12	40										
219												

 SAMPLE TYPE  Auger Grab

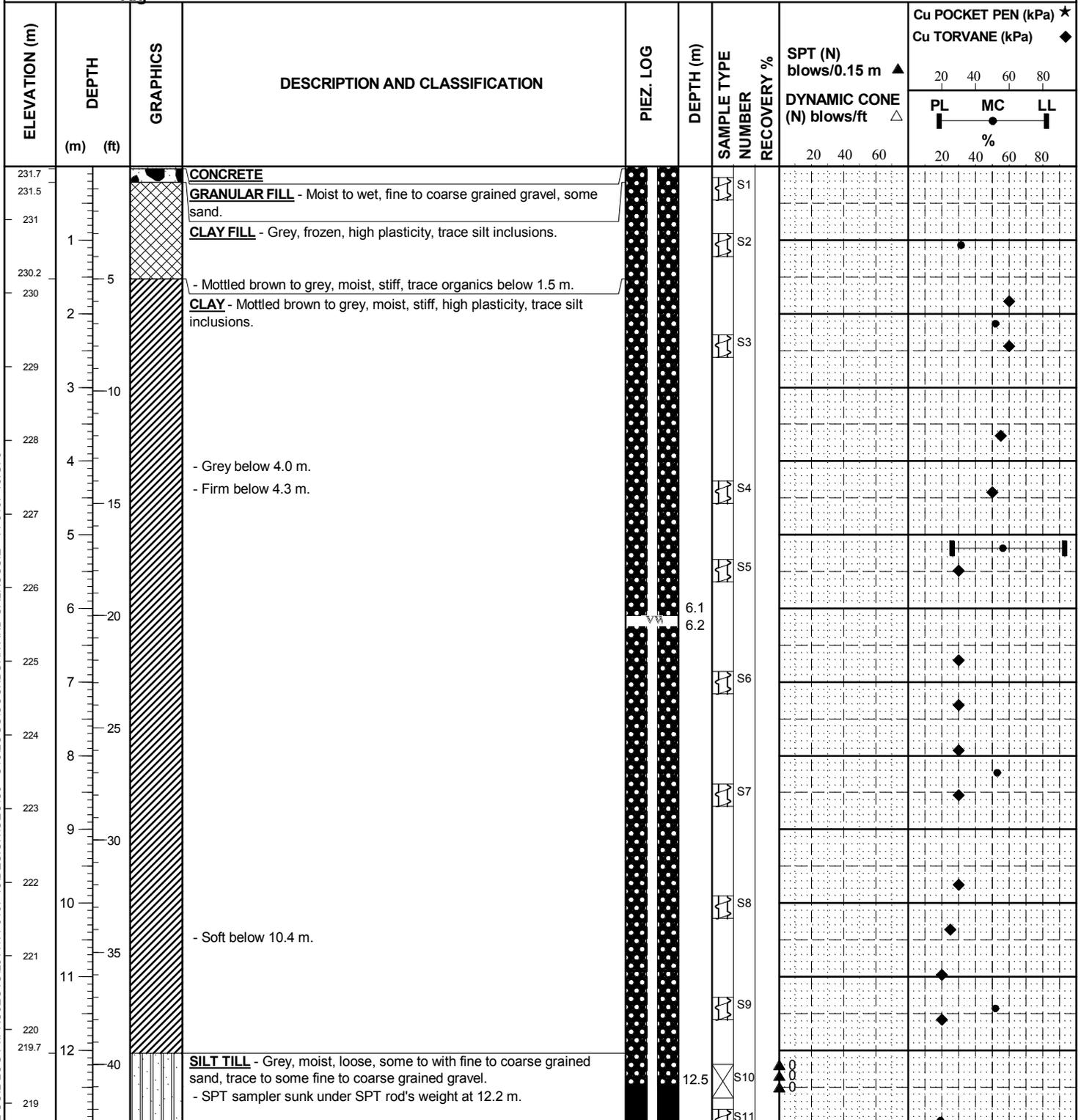
 CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

 APPROVED **JRM**

 DATE **8/7/18**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Weatherdon Avenue - West Lane
LOCATION Approximately 25 m East of Wentworth Street
DRILLING METHOD 125 mm ø Solid Stem Auger, and Triple Tube Coring B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 231.72
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/1/2018
UTM (m) N 5,524,945
 E 632,705



GEOTECHNICAL SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

SAMPLE TYPE  Auger Grab  Split Spoon  Core Barrel

CONTRACTOR Maple Leaf Drilling Ltd. **INSPECTOR** M. ALFARO

APPROVED JRM

DATE 8/7/18

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	Cu POCKET PEN (kPa) ★
								DYNAMIC CONE (N) blows/ft △	Cu TORVANE (kPa) ◆
								20 40 60 80	20 40 60 80
								PL MC LL %	
218	45		- Tan, moist to wet, with fine to coarse grained sand below 13.1 m. - 8.5% gravel, 28.6% sand, 45.0% silt, 17.9% clay at 13.4 m.		13.1	S12		▲ 22	◆
217.1	45		- SPT refusal at 14.1 m 100 mm into third set. - Power auger refusal at 14.3 m, switched to coring and casing advanced to 14.6 m.		13.4	S13		▲ 48	
217	50		BEDROCK - Pink to white. - Run 1: RQD = 32% - White to grey below 15.2 m		13.7	S14		▲ 50	
216	50		END OF HOLE AT 15.85 m		15.8	R1			
215	55		Notes: 1. Installed a standpipe with a slotted screen from 13.7 m to 13.7 m, and a vibrating wire piezometer (SN#1800935) at 6.1 m below grade. 2. Test hole backfilled with bentonite pellets from 15.8 m to 13.7 m, sand from 13.7 m to 13.1 m, bentonite pellets from 13.1 m to 12.5 m, and grout from 12.5 m to grade. 3. Installed a flush mount cover.						

G:\TECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

SAMPLE TYPE Auger Grab Split Spoon Core Barrel

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO** APPROVED **JRM** DATE **8/7/18**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Weatherdon Avenue - West Lane
LOCATION Approximately 25 m East of Lilac Street
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 231.93
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/2/2018
UTM (m) N 5,525,048
 E 632,891

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							20	40	60	80
231.8				CONCRETE								
231.3				SILT - Light brown, frozen, low plasticity, trace to some clay, trace oxidation.	S1							
231	1			CLAY - Mottled brown and grey, frozen, high plasticity, trace silt inclusions, trace oxidation.	S2							
230	2			- Moist, stiff below 1.8 m.	S3							
229	3				S4							
228	4			- Firm below 3.7 m.	S5							
227	5				S6							
226	6				S7							
225	7			- Grey, no oxidation below 6.7 m.								
224.3	25			END OF HOLE AT 7.62 m								
224	8			Notes: 1. Test hole open to 7.46 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chip with concrete patch.								
223	9											
222	10											
221	11											
220	12											
219												

SAMPLE TYPE Auger Grab

CONTRACTOR Maple Leaf Drilling Ltd.
INSPECTOR M. ALFARO

APPROVED JRM

DATE 8/7/18

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Hector Avenue - West Lane
LOCATION Approximately 25 m East of Wentworth Street
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 231.63
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/2/2018
UTM (m) N 5,524,773
 E 632,748

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆		
	(m)	(ft)							20	40	60	80	20	40
231.4				CONCRETE										
231	1	3.2		CLAY - Mottled grey to brown, frozen, high plasticity, trace silt inclusions, trace oxidation.	S1									
229.0	5	6.2		- Moist, firm below 1.2 m.										
229.8	2	3.8		- Brown below 1.5 m.	S2									
229	3	4.2		CLAYEY SILT - Light brown, moist, firm, trace oxidation.	S3									
228	4	4.6		CLAY - Mottled brown to grey, moist, stiff, high plasticity, trace silt inclusions, trace oxidation below 1.8 m.	S4									
227	5	5.0		- Firm below 4.9 m.	S5									
226	6	5.4		- No oxidation below 5.5 m.	S6									
225	7	5.8			S7									
224	8	6.2			S8									
223	9	6.6			S9									
222	10	7.0												
221.0	11	7.4		END OF HOLE AT 10.67 m										
220	12	7.8		Notes: 1. Test hole open to 2.44 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.										
219														

SAMPLE TYPE  Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**

GEO TECHNICAL - SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEOIC6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Lilac Street - South Lane
LOCATION Approximately 25 m East of Ebby Avenue
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 231.75
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/2/2018
UTM (m) N 5,524,808
 E 632,946

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★			Cu TORVANE (kPa) ◆		
	(m)	(ft)							20	40	60	80	20	40
231.7				ASPHALT	S1									
231.5				GRANULAR FILL - Tan, moist, compact to dense.	S2									
231.2				SILT - Grey, frozen, low plasticity, trace oxidation.										
229.9	1	5		CLAY - Mottled brown to grey, frozen, high plasticity, trace silt inclusions, trace fine to coarse grained gravel. - Brown, moist, stiff, trace oxidation below 1.5 m.	S3									
229.6	2			SILT - Light brown, moist, soft, trace oxidation.	S4									
229	3	10		CLAY - Mottled brown and grey, moist, stiff, high plasticity, trace silt inclusions, trace oxidation.	S5									
228	4				S6									
227	5	15		- Firm to stiff below 4.3 m.										
226	6	20		- No oxidation below 5.5 m. - Grey below 5.8 m.	S7									
225	7				S8									
224.1	8	25		END OF HOLE AT 7.62 m										
224				Notes: 1. Test hole open to 7.32 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.										
223	9	30												
222	10													
221	11	35												
220	12	40												
219														

SAMPLE TYPE  Auger Grab

CONTRACTOR Maple Leaf Drilling Ltd. **INSPECTOR** M. ALFARO

APPROVED JRM

DATE 8/7/18

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Carter Street - West Lane
LOCATION Approximately 40 m East of Stafford Street
DRILLING METHOD 125 mm ø Solid Stem Auger B54X Mobile Track Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 231.97
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/2/2018
UTM (m) N 5,524,785
 E 632,587

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲	DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★		Cu TORVANE (kPa) ◆	
	(m)	(ft)							PL	MC	LL	PL
231.8				CONCRETE								
231.4				GRANULAR FILL - Tan, moist, compact to dense, with clay.								
231	1			SILT - Light brown, frozen, low to intermediate plasticity, trace oxidation.	S1							
230.6	5			CLAY - Mottled brown to grey, frozen, high plasticity, trace silt inclusions, trace oxidation.	S2							
230	2			- Moist, stiff below 2.1 m.	S3							
229	3	10			S4							
228	4			- Firm below 4.3 m.	S5							
227	5	15			S6							
226	6	20		- Grey below 6.4 m.	S7							
225	7				S8							
224.4	25			END OF HOLE AT 7.62 m								
224	8			Notes: 1. Test hole open to 7.46 m below existing grade. 2. Test hole dry immediately after drilling. 3. Test hole backfilled with cuttings and bentonite chips with concrete patch.								
223	9	30										
222	10											
221	11	35										
220	12	40										
219												

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CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Sewer Relief
SITE Lilac Street - West Lane
LOCATION Approximately 15 m West of Pembina Highway
DRILLING METHOD 125 mm ø Solid Stem Auger B40 Truck Mounted Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 231.80
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5/8/2018
UTM (m) N 5,525,034
 E 633,042

ELEVATION (m)	DEPTH		GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆	
	(m)	(ft)						PL	MC
231.6				CONCRETE	S1				
231.3				CLAY FILL - Black, frozen, intermediate plasticity, trace fine to coarse grained gravel, trace organics, trace silt inclusions.	S2				
231.0				CLAYEY SILT - Tan to light brown, frozen, low to intermediate plasticity, trace to some clay.	S3				
231	1	3		CLAY - Mottled brown to grey, frozen, high plasticity. - Moist, stiff, trace silt inclusions, trace oxidation below 1.5 m.					
230	2	5							
229					S4				
228.8	3	10		END OF HOLE AT 3.04 m					
228	4	13		Notes: 1. Drilling hit an abandoned water line at approximately 2.44 m - 2.74 m. 2. Water observed to be flowing out of the test hole due to the damaged water line. 3. Test hole was abandoned for pipe repair.					
227	5	15							
226	6	20							
225	7	25							
224	8	30							
223	9	35							
222	10	40							
221	11								
220	12								
219									

SAMPLE TYPE Auger Grab

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

JOB NO. 11-0107-18

PROJECT Cockburn and Calrossie Sewer Relief

GROUND ELEV. 232.47

TOP OF PVC ELEV.
SITE Grant Avenue and Pembina Highway

WATER ELEV.
LOCATION Southbound Pembina to Grant Yield Island

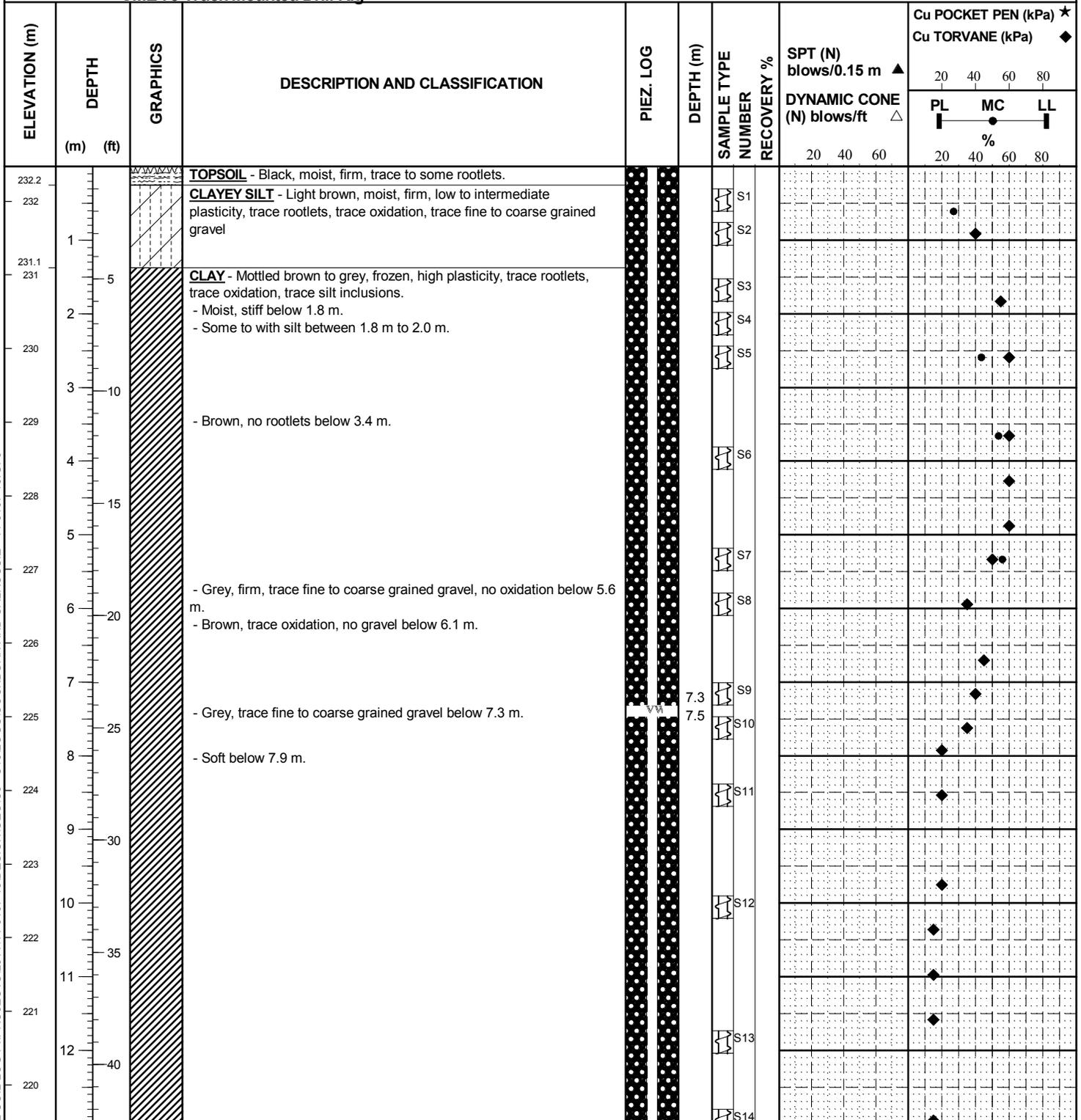
DATE DRILLED 5/9/2018

DRILLING METHOD Portable Concrete Core Drill; 125 mm ø Solid Stem Auger, and Triple Tube Coring
CME 75 Truck Mounted Drill Rig

UTM (m)

N 5,525,257

E 633,129



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SAMPLE TYPE Auger Grab Split Spoon Core Barrel

 CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

 APPROVED **JRM**

 DATE **8/7/18**

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆			
									PL	MC	LL	
219.2												
219	45		SILT TILL - Tan, moist, compact, some to with fine to coarse grained sand, some fine to coarse grained gravel.		13.9	S15		▲ 55				
218			- Test hole sloughed in at 14.3 m. Started coring at 14.3 m.									
217.7	15		- Boulders/cobbles between 14.3 m and 14.5 m. - SPT sampler at 14.6 m advanced to 0.3 m and refused 102 mm into second set. - Power auger refusal at 14.9 m, switched to coring.		15.1	S16		▲ 38				
217	50		BEDROCK - Grey to white, very weathered.		15.4	S17		▲ 50				
216.6	16		- Run 1: RQD = 22.9%		15.7	S19A						
216			- Rubble from 14.8 m to 15 m.		15.8	S19B						
216	55		- SPT refusal at 14.9 m									
215	17		- Fracture at 15.1 m.									
214	60		- Pink to white from 15.2 m to 15.5 m.									
214			- Fracture at 15.5 m.									
213	65		END OF HOLE AT 15.85 m									
212	70		Notes:									
211	75		1. Test hole dry immediately after drilling.									
210	80		2. Installed a standpipe with a slotted screen from 15.7 m to 15.4 m, and a vibrating wire piezometer (SN#1800932) at 7.3 m below grade.									
209	85		3. Test hole backfilled with sand from 15.8 m to 15.1 m, bentonite pellets from 15.1 m to 13.9 m, and grout from 13.9 m to grade.									
208	90		4. Installed a flush mount cover.									
207												
206												
205												
205	90											
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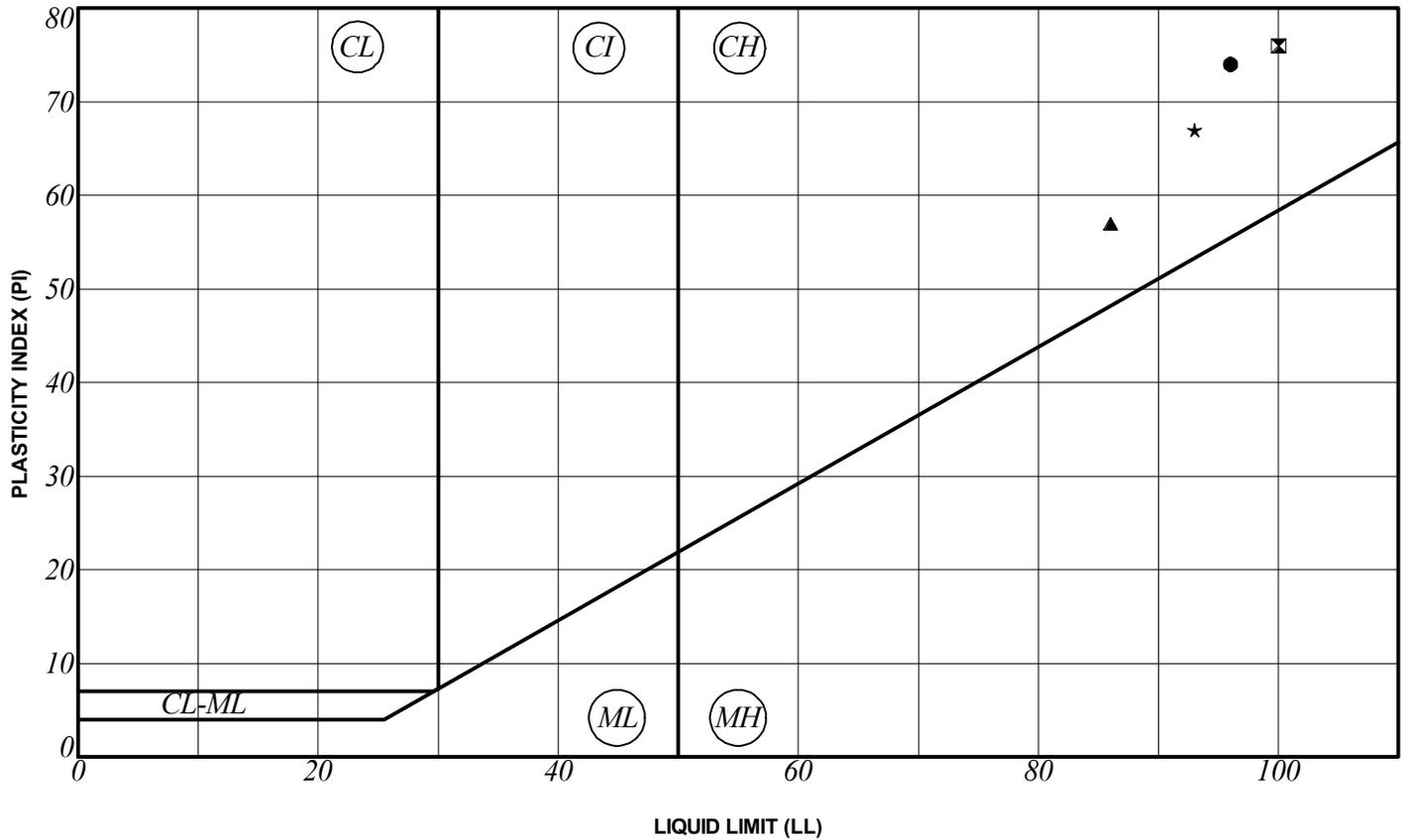
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SAMPLE TYPE Auger Grab Split Spoon Core Barrel

CONTRACTOR **Maple Leaf Drilling Ltd.** INSPECTOR **M. ALFARO**

APPROVED **JRM**

DATE **8/7/18**



SYMBOL	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	% SAND	% SILT	% CLAY	% MC	CLASSIFICATION
●	TH18-03	8.2	S7	96	22	74				49.7	CH
◻	TH18-09	5.2	S5	100	24	76				49.8	CH
▲	TH18-16	8.2	S6	86	29	57				49.7	CH
★	TH18-18	5.2	S5	93	26	67				56.3	CH

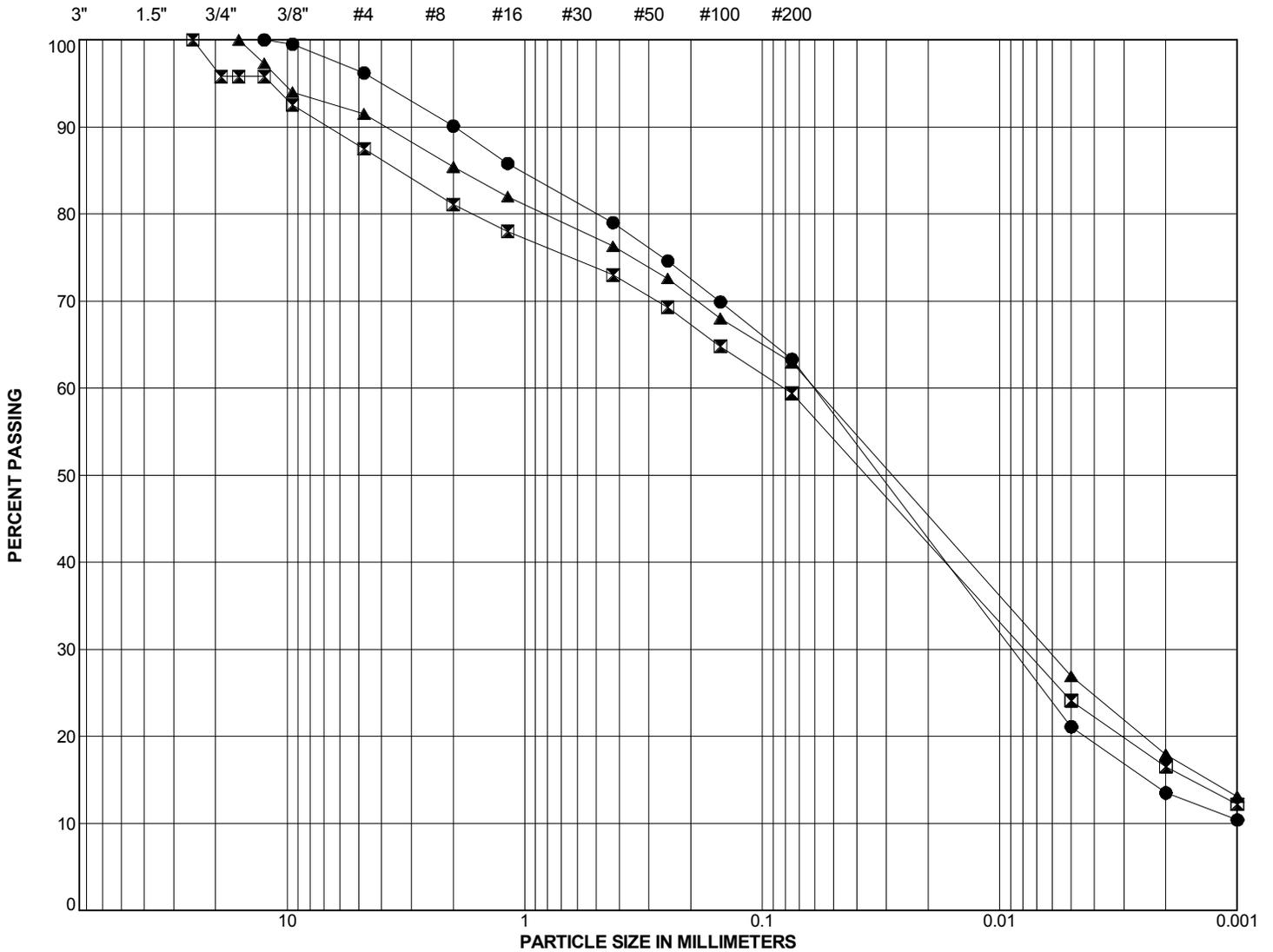
Notes:

- ML - Low Plasticity Silt
- MH - High Plasticity Silt
- CL-ML - Silty Clay
- CL - Low Plasticity Clay
- CI - Intermediate Plasticity Clay
- CH - High Plasticity Clay
- LL - Liquid Limit
- PL - Plastic Limit
- PI - Plasticity Index
- MC - Moisture Content
- NP - Non-Plastic

KGS GROUP	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
Cockburn and Calrossie Sewer Relief	
A-LINE PLOT	
August 2018	Figure C1
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SIEVE ANALYSIS

HYDROMETER ANALYSIS



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

SYMBOL	HOLE	DEPTH (m)	SAMPLE #	% GRAVEL	% SAND	% SILT	% CLAY	% SILT & CLAY	Cu	Cc	CLASSIFICATION
●	TH18-09	11.3	S11	3.8	32.9	49.8	13.5	63.3			
⊠	TH18-16	13.1	S11	12.5	28.1	42.9	16.5	59.4			
▲	TH18-18	13.4	S12	8.5	28.6	45.0	17.9	62.9			

SIEVE ANALYSIS P:\PROJECTS\201111-0107-18\DESIGN\GEO\C6 - C13\LOGS\COCKBURN AND CALROSSIE - 11-0107-18.GPJ

	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	
	Cockburn and Calrossie Sewer Relief	
<h2>GRAIN SIZE ANALYSES</h2>		
August 2018	Figure C2	Page 1 of 1