

CITY OF WINNIPEG

Armstrong Combined Sewer Relief Project

Geotechnical Data Report

Revision:

Final Rev 1

KGS Group Project:

25-0107-002

Date:

March 12, 2026

Client Project:


755-2024

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KGS Group

No. 245

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STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This report has been prepared for City of Winnipeg in accordance with the agreement between KGS Group and City of Winnipeg (the “Agreement”). This report represents KGS Group’s professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read as a whole, and sections or parts should not be read out of context.

This report is based on information made available to KGS Group by City of Winnipeg. Unless stated otherwise, KGS Group has not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this report apply only as they existed at the time of KGS Group’s work.

Third Party Use of Report

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.

Geotechnical Investigation Statement of Limitations

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 boreholes drilled by KGS Group at the site at the time of drilling. If conditions encountered during construction appear to be different from those shown by the boreholes drilled by KGS Group or if the assumptions stated herein are not in keeping with the design, KGS Group should be notified in order that the recommendations can be reviewed and modified if necessary.

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 detailed design and construction of wastewater infrastructure to provide combined sewer separation for the Armstrong Combined Sewer (CS) district in Winnipeg, Manitoba.

The Armstrong Combined Sewer (CS) district encompasses an approximate area of 151 ha, located in the West Kildonan neighbourhood in Winnipeg, will be completely separated via the installation of both new land drainage and wastewater sewers. The Armstrong CS district is bound by McPhillips Street to the west, Kingsbury Avenue to the south, Main Street to the east and the North End Sewage Treatment Plant (NEWPCC) to the north. The district receives land drainage flows from several regional streets in West Kildonan, including McPhillips Street, McGregor Street, Salter Street, Leila Avenue, Partridge Avenue, and Main Street. The district also includes two rail lines: the CPKC Winnipeg Beach Line, which bisects the district, and a spur line along the northern district boundary, just south of NEWPCC. The current sewer system within the Armstrong CS district is a mix of combined sewers and storm relief sewers (SRS). The Armstrong CS district receives land drainage flows from several upstream districts that pass through the 2700 mm CS trunk on Leila Avenue. The combined flows from the Armstrong CS district enter the Leila trunk sewer and are directed to the comminutor station at the intersection of Main Street and Armstrong Avenue, where the flows are redirected to the Main Street Interceptor and ultimately on to NEWPCC.

The Armstrong CS separation work is planned to be phased over multiple construction contracts. The proposed pipe diameter size for the CS district ranges from 250mm to 1050mm and the pipe invert depth varies between 3 m and 12 m below ground surface. All piping will be installed using trenchless methods.

The purpose of our investigation was to identify the subsurface soil and groundwater conditions along the alignments of the proposed works. This factual report contains a description of the historical geotechnical investigations program performed within the project area as well as the geotechnical and hydrogeological investigations performed by KGS Group in 2025 and 2026, and our findings. This GDR should be read in conjunction with the Geotechnical Baseline Report (GBR) prepared by KGS Group for the Project.

1.2 Purpose of Report

This report summarizes the geotechnical conditions observed along the alignments of the proposed pipeline infrastructure within the entire project area and provides geotechnical considerations that would form part of the basis of design for the Work. This report includes geotechnical data collected at the project site and summary of encountered subsurface conditions along the alignments.

1.3 Report Limitations

This report has been prepared for the exclusive use of the City of Winnipeg for the specific application to the proposed Armstrong Combined Sewer Relief project. It has been prepared in accordance with generally accepted geotechnical engineering practice. No other warranty, express or implied, is made.

The geotechnical data presented in this report are based on the observations and test results obtained from field investigation programs completed between 2022 and 2026. The information provided in this report and the contract documents indicate soil and bedrock conditions and water levels only at specific locations and times, and only to the depths penetrated. Subsurface conditions and water levels at other locations may differ from conditions occurring at these explored locations. Also, the passage of time may result in a change in conditions at these locations. KGS Group is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or for reuse of subsurface data, without KGS Group's express written authorization.

2.0 BACKGROUND INFORMATION

2.1 Previous Geotechnical Investigations

A review of available geotechnical information pertinent to the project was conducted and presented in this report, including geotechnical investigations completed by Trek Geotechnical in 2022, 2023 and 2024 to support the preliminary design phases of this project. The boreholes from the previous investigations were considered and incorporated in the development of the site stratigraphy and the associated figures. The results of these geotechnical investigations are summarized below.

2.1.1 2022/2023 GEOTECHNICAL INVESTIGATION

In 2022, Trek Geotechnical conducted a geotechnical investigation for Jacobs Canada Inc. and the City of Winnipeg within the Armstrong CS district as part of the preliminary design phase of this project. The geotechnical investigation was carried out in two phases: in September 2022, and in January 2023. The geotechnical investigation was completed to assess the subsurface stratigraphy and groundwater conditions within the project area.

A total of thirty five (35) boreholes were drilled. Thirty three (33) were located along or near the proposed pipeline alignments, and two (2) were located within the footprint of the proposed bioretention pond site. Fourteen (14) deep boreholes were completed along the main sewer trunk alignment on Leila Avenue, reaching depths between 14.4 and 20.6 m until power auger refusal was encountered. Shallower boreholes were drilled along secondary sewer alignments, with depths ranging from 6.1 to 9.5 m. The two (2) boreholes completed within the proposed bioretention pond site were drilled to 12.2 m depth.

Soil samples collected during drilling were visually classified using the Unified Soil Classification System (USCS). Disturbed grab samples were collected at regular intervals and submitted to the lab for additional material testing. In non-cohesive and till deposits, Standard Penetration Tests (SPTs) were performed, and split spoon samples were retrieved. Shelby tube samples were extracted at depths corresponding to field vane testing and at the proposed bioretention pond location. Laboratory analyses included moisture content determination, Atterberg Limits, particle size analysis, unconfined compressive strength, and hydraulic conductivity of select samples.

The boreholes in Table 2-1 were drilled within the Armstrong project area and were used to develop the soil profiles.

TABLE 2-1: 2022/2023 BOREHOLES IN PROJECT AREA

Borehole ID	Northing (m)	Easting (m)	Approx. Ground Surface Elevation (m)	Approx. Borehole Depth (m)	Approx. Silt Till Contact Elevation (m)
TH22-01	5534839	632749.5	231.57	7.90	
TH22-02	5535069	632961.9	230.92	14.40	217.92
TH22-03	5534970	633163.5	231.31	15.60	216.81
TH22-04	5534875	633359	231.24	15.60	216.74
TH22-05	5534559	633210	231.33	7.90	
TH22-06	5534666	632981.7	231.70	7.90	
TH22-07	5534794	633540.3	231.23	16.70	219.73
TH22-08	5534704	633717.7	231.45	15.20	219.35
TH22-09	5534472	633656.9	230.99	6.30	
TH22-10	5534291	633902.1	231.28	6.20	
TH22-11	5534604	633956.9	230.81	15.20	217.81
TH22-12	5534518	634140.7	230.62	19.30	216.62
TH22-13	5534433	634312.5	231.15	16.50	215.90
TH22-14	5534245	634115.6	231.11	6.30	
TH22-15	5534347	634472	230.54	17.20	214.04
TH22-16	5534284	634592.6	230.57	19.40	213.57
TH22-17	5534180	634813.3	230.58	19.70	212.98
TH22-18	5533994	634706.4	230.42	6.30	
TH22-19	5533995	634905.4	231.14	6.30	
TH22-20	5534186	635026.2	230.59	19.60	211.39
TH22-21	5534092	635201.9	230.37	20.00	211.27
TH22-22	5534077	635464	230.33	20.60	211.83
TH22-23	5534465	634585.5	230.29	6.20	
TH22-24	5534402	634903.8	230.44	6.30	

Borehole ID	Northing (m)	Easting (m)	Approx. Ground Surface Elevation (m)	Approx. Borehole Depth (m)	Approx. Silt Till Contact Elevation (m)
TH22-25	5534704	634755.5	230.48	6.20	
TH22-26	5534642	635004.4	230.35	6.30	
TH22-27	5534510	635176.1	230.51	6.20	
TH22-28	5534793	635099.3	230.56	6.10	
TH22-29	5534642	635341.1	230.66	6.30	
TH22-30	5534689	635682.9	230.65	6.30	
TH22-31	5534445	635557.6	230.84	6.30	
TH22-32	5534386	635550	230.79	9.50	
TH22-33	5534418	635407.3	230.20	6.30	
TH23-01	5534570	634572	230.81	12.20	
TH23-02	5534520	634525	230.89	12.20	

The 2022 and 2023 borehole logs are included in Appendix A. The location of the boreholes within the project area are shown on Figure 1. Laboratory testing results from the 2022/2023 boreholes are included in Appendix B.

A total of five (5) standpipe piezometers were installed along the proposed pipeline alignment along Leila Ave. during the 2022 geotechnical investigation. Four (4) standpipes were installed within the silt till deposit and one (1) standpipe was installed within the silt overburden. A total of two (2) vibrating wire piezometers were installed in the overburden clay during the 2023 geotechnical investigation at the proposed bio-retention pond site. The installation details of the piezometers are shown on the borehole logs in Appendix A. Groundwater monitoring data for the 2022/2023 instrumentation is summarized in Table 2-2.

TABLE 2-2: 2022/2023 GROUNDWATER MONITORING DATA

Borehole ID	TH22-02	TH22-07	TH22-13		TH22-22	TH23-01	TH23-02
Ground Elevation (m)	230.92	231.23	231.15	231.15	230.33	230.81	230.89
Piezometer No.	SP22-02	SP22-07	SP22-13A	SP22-13B	SP22-22	VW23-01	VW23-02
Tip Elevation (m)	217.02	215.03	214.65	228.65	210.53	224.71	224.99
Monitoring Zone	Silt Till	Silt Till	Silt Till	Silt	Silt Till	Clay	Clay

Groundwater Elevation Monitoring Data

Date:							
2022-10-13	-	223.11	222.82	228.71	213.95	226.28	-
2022-11-20	229.84	228.32	225.82	228.71	218.65	-	-
2023-01-19	Frozen to 230.84	229.68	-	-	221.91	-	-
2023-02-02	Frozen to 229.88	229.55	225.36	228.77	222.29	227.85	228.28
2023-03-30	-	-	-	-	-	227.53	227.69
2023-04-27	Frozen to 230.01	Frozen to 230.55	Frozen to 228.79	Frozen to 230.35	225.66	227.53	228.66
2023-06-08	224.59	229.37	226.28	229.14	224.01	227.26	227.70

Notes:

- 1) The field instrumentation installed during the 2022/2023 investigation program was deemed to be inoperable in 2025.

2.1.2 2024 GEOTECHNICAL INVESTIGATION

In February 2024, Trek Geotechnical carried out a geotechnical investigation adjacent to the Canadian Pacific Kansas City (CPKC) Winnipeg Beach Subdivision right-of-way at the intersections of the rail line with Leila Ave. and McGregor St. within the project area. The objective of the investigation was to assess the subsurface stratigraphy and groundwater conditions in support of a new pipeline crossing beneath the CPKC right-of-way at each location as part of the Armstrong CS preliminary design phase.

A total of four (4) boreholes were drilled with two (2) being located on either side of the CPKC right-of-way at the two crossing locations. The boreholes were drilled to depths ranging from 9.1 to 16.8 m.

Soil samples collected during drilling were visually classified in accordance with the Unified Soil Classification System (USCS). The sampling program included both disturbed samples (auger cuttings) and relatively undisturbed samples (Shelby tubes). Laboratory testing included determination of moisture content, measurement of bulk unit weight, Atterberg Limits, particle size analysis of select samples, and estimation of the undrained shear strength on Shelby tube samples using unconfined compression strength tests, pocket penetrometer, and torvane.

The boreholes in Table 2-3 were drilled within the Armstrong project area and were used to develop the soil profiles.

TABLE 2-3: 2024 BOREHOLES IN PROJECT AREA

Borehole ID	Northing (m)	Easting (m)	Approx. Ground Surface Elevation (m)	Approx. Borehole Depth (m)	Approx. Silt Till Contact Elevation (m)
TH24-01	5534390	634384	231.45	16.80	216.25
TH24-02	5534516	634502	230.96	9.80	
TH24-03	5534583	634511	231.11	9.10	
TH24-04	5534419	634320	231.51	16.20	215.72

The 2024 borehole logs are included in Appendix A. The location of the boreholes within the project area is shown on Figure 1. Laboratory testing results from the 2024 boreholes are included in Appendix B.

2.2 Regional Geologic Setting

The geology of Winnipeg generally consists of carbonate sedimentary bedrock overlaying Precambrian era granite and gneiss. The sedimentary rock consists of alternating layers of limestone, and dolomite and to a lesser extent shale. The project area is underlain by the dolomite of the Fort Garry member and dolomitic limestone of the Selkirk member, both within the Red River Formation. The proposed pipelines are not anticipated to encounter the bedrock.

The surface of the bedrock is usually highly fractured and disturbed, often mixed with gravels and sands. Geological maps for Winnipeg 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 soils.

During the last glacial advance and retreat, Winnipeg's glacial till was deposited 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 the Geological Engineering Report for Urban Development of Winnipeg, University of Manitoba (Reference 1).

3.0 SCOPE OF 2025/2026 INVESTIGATION PROGRAM

3.1 General

This section provides a summary of the 2025 and 2026 field investigation programs, instrumentation installation and monitoring, laboratory test results, and hydrogeological studies completed; as well as a description of the subsurface conditions encountered at the project site.

The 2025 and 2026 geotechnical and hydrogeological investigations were completed to determine the subsurface conditions and close geotechnical data gaps along the proposed pipeline alignments. The results of the investigation program are presented in this Geotechnical Data Report.

3.2 Borehole Drilling and Soil Sampling

The borehole drilling and sampling program was completed by KGS Group from May 29 to June 4, 2025. All eight (8) boreholes were advanced to power auger refusal, with one (1) of the boreholes being advanced into bedrock. The boreholes were completed to investigate the subsurface stratigraphic conditions within the project area and evaluate the suitability of the clay for trenchless construction methodologies that are anticipated to be utilized for the various construction contracts and at specific railway crossing locations. The locations of the 2025 boreholes are shown in plan on Figure 1 and a summary of the locations is presented in Table 3-1.

Maple Leaf Drilling of Winnipeg, Manitoba provided the drilling services using a track-mounted drill rig equipped with 125 mm and 200 mm solid stem augers, and triple tube HQ coring. The drilling was completed under the supervision and direction of KGS Group personnel. Soil samples were collected at intervals of 1.5 m (5 ft.) or at any 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 (SPTs) were completed in the glacial till to evaluate the in-situ density. Clay samples were tested with a field Torvane to evaluate the consistency and estimate the undrained shear strengths of cohesive soils. Upon completion of drilling, the boreholes were examined for indications of sloughing and seepage, and then backfilled. Borehole log records incorporating field observations, and field test results are provided in Appendix C. Photographs of select soil samples are included in Appendix D.

TABLE 3-1: SUMMARY OF 2025 BOREHOLE LOCATIONS

Borehole ID	Northing (m)	Easting (m)	Approx. Ground Surface Elevation (m)	Approx. Borehole Depth (m)	Approx. Power Auger Refusal Elevation(m)
TH25-01	5535011	633084	231.02	15.3	215.72
TH25-02	5534751	633638	231.32	17.7	213.62
TH25-03	5534558	634054	230.88	17.1	213.78
TH25-04	5534378	634365	231.79	17.5	214.29
TH25-05	5534125	634946	230.57	18.3	212.27
TH25-06	5534003	635156	230.59	20	210.59
TH25-07	5534174	635234	230.76	23.2	207.56
TH25-08	5534100	635471.1	230.23	21	209.23

Notes:

- 1) Ground surface elevations for boreholes were established using survey grade GPS.

3.3 Groundwater Monitoring

A total of seventeen (17) vibrating wire (VW) piezometers were installed in eight (8) boreholes at the project site. Seven (7) boreholes included two (2) VW piezometers nested within the overburden clay and underlying glacial till deposit. One (1) borehole (TH25-07) included three (3) VW piezometers nested within the overburden clay, glacial till deposit, and limestone bedrock. Table 3-2 summarizes the installation details and the piezometer monitoring completed to date. The installation details of the piezometers are also shown on the 2025 borehole log records provided in Appendix C.

As part of the 2026 hydrogeological investigations, three (3) pumping wells were installed within the project site. Each pumping well was accompanied by two (2) standpipe piezometer monitoring wells. All pumping wells and standpipe monitoring wells were installed to monitor the piezometric conditions in the bedrock. Table 3-3 summarizes the installation details and the static groundwater monitoring readings measured before each of the pump tests. Additional details on the hydrogeological investigations are provided in subsequent sections of this report.

Groundwater levels fluctuate seasonally and contractors should expect the level to rise higher than current measurements during the spring snow melt and after significant rainfall events and/or snowmelts.

TABLE 3-2: GROUNDWATER MONITORING DATA

Borehole ID	TH25-01		TH25-02		TH25-03		TH25-04		TH25-05		TH25-06		TH25-07			TH25-08	
Ground Elevation (m)	231.02		231.32		230.88		231.79		230.57		230.59		230.76			230.23	
Piezometer No.	VW202419	VW202423	VW201353	VW201638	VW201642	VW202426	VW202425	VW202480	VW201637	VW202485	VW201641	VW202218	VW201634	VW201635	VW201644	VW202214	VW202431
Tip Elevation (m)	219.44	216.21	222.13	214.05	218.82	214.24	217.62	214.47	215.92	213.04	215.75	211.18	214.35	210.92	208.03	214.94	209.76
Monitoring Zone	Clay	Till	Clay	Till	Clay	Till	Clay	Till	Clay	Till	Clay	Till	Clay	Till	Bedrock	Clay	Till
Date:	Groundwater Elevation Monitoring Data																
2025-06-16	229.50	229.55	229.26	228.78	228.05	228.05	227.01	225.94	225.04	224.17	226.02	223.70				223.91	222.38
2025-06-25	229.58	229.64	229.36	228.78	228.10	228.11	226.97	225.95	225.10	224.21	226.09	223.68	225.83	223.17	222.91	224.01	222.37
2025-07-30	229.38	229.52	229.16	228.44	227.86	227.87	225.98	225.49	224.90	223.99	225.74	223.67	225.81	223.06	222.49	223.71	222.21
2025-08-28	229.35	229.40	229.04	228.33	227.83	227.79	225.90	225.42	225.11	224.31	226.55	224.47	226.06	223.67	222.95	223.87	222.82
2025-10-15	229.40	229.50	228.87	228.61	227.92	227.89	225.97	225.61	225.59	224.89	227.71	225.62	226.39	224.56	223.83	224.34	223.74
2026-01-16																224.48	224.09
2026-01-28							226.62	226.22									

Notes:

- 1) Additional instrumentation readings are recommended to be collected throughout the year and prior to construction to determine seasonal fluctuations of groundwater.

TABLE 3-3: PUMPING WELL PRE-TEST GROUNDWATER MONITORING DATA

Borehole ID	Eastern Site			Middle Site			Western Site		
Ground Elevation (m)	230.02	229.98	230.52	231.91	231.81	231.26	231.67	231.68	231.78
Piezometer No.	PW26-AM-01	MW26-AM-01	MW26-AM-02	PW26-LM-01	MW26-LM-01	MW26-LM-02	PW26-LJ-01	MW26-LJ-01	MW26-LJ-02
Top of Well Elevation (m)	230.77	229.97	230.51	232.79	231.80	231.25	232.71	231.67	231.77
Tip Elevation (m)	208.07	209.56	209.34	202.95	203.62	203.83	200.58	201.81	202.06
Monitoring Zone	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock
Date:	Groundwater Elevation Monitoring Data								
2026-01-16	224.76	223.89	223.75						
2026-01-28				224.81	224.44	224.36			
2026-02-06							229.91	228.53	228.78

3.4 Laboratory Testing

Laboratory testing was performed on select soil samples for use in the characterization of the subsurface.

Laboratory testing was completed on representative soil samples including:

- Moisture content;
- Particle size distribution; and
- Atterberg Limit.

All laboratory testing was performed at a Canadian Council of Independent Laboratories (CCIL) certified laboratory in general accordance with ASTM International standards.

The 2025 laboratory test results are summarized in Section 4.0 and included in Appendix E.

3.5 Hydrogeological Background Study

KGS Group completed a hydrogeological desktop study to understand the geology of the area and to interpret the existing groundwater conditions and estimate the subsurface conditions that may be encountered during construction of the proposed pipeline and associated deep excavation shafts. The objective of the desktop study was to outline the potential construction risks related to design and execution of deep excavation shafts in proximity to the underlying glacial till deposits, and to estimate the potential requirements for groundwater depressurization at the discrete shaft locations.

The findings of the hydrogeological memo are detailed in Appendix F.

3.6 Hydrogeological Well Pump Testing

KGS Group completed a site-specific hydrogeological investigation program to understand the aquifer conditions and parameters at three (3) key locations within the project area:

- Eastern Site: immediately northeast of the intersection of Armstrong Avenue and Main Street (near the downstream Project tie-in).
- Middle Site: immediately west of the intersection of Leila Avenue and McGregor Street (near the anticipated east shaft location for the CPKC crossing).
- Western Site: immediately north of the intersection of Leila Avenue and Jack Donner Drive (within a zone of the project where the till deposit was observed to be most shallow).

The results of the hydrogeological investigations are intended to be utilized by contractors to assist with the design of excavation/shaft dewatering or depressurization systems throughout the project site to meet the requirements of the Contract Documents.

The drilling scope of work for the investigation program was completed from January 12 to February 4, 2026. At each site one (1) 125 mm diameter steel casing pumping well (PW) and two (2) 50 mm diameter PVC standpipe monitoring wells (MWs) were installed. Drilling services were provided by licensed water well driller Maple Leaf Drilling Ltd., under KGS Group supervision. The wells were completed using a Canterra CT 250 truck-mounted drilling and a Versa 140x truck-mounted drill rig, based on availability. Mud-rotary drilling

techniques were used in the overburden and air rotary was used to drill open-hole within the bedrock. The casing was grouted in place, as per the Provincial water well installation guidelines. The location and stratigraphy encountered in the wells is shown on Figures 01 and 02, and the summary logs are provided in Appendix G.

Two-hour pumping tests were completed at the Eastern, Middle, and Western Sites on January 16, January 28, and February 5, 2026, respectively, to quantify the hydraulic characteristics of the bedrock aquifer at each testing Site. Upon cessation of pumping, the water levels in all wells were allowed to recover to at least 90% of the pre-test static water level conditions or for the same duration as that of pumping, whichever came first.

The hydrogeological investigation and pump testing memorandum is included as Appendix G.

4.0 SUBSURFACE CONDITIONS

The stratigraphy at the site is described in this section and is based on the exploratory boreholes drilled throughout the project site, and our understanding of the site geology. Borehole logs from the 2022 to 2024 geotechnical investigations conducted along the proposed project alignments are provided in Appendix A. The borehole logs from the 2025 geotechnical investigations are provided in Appendix C.

In general, the stratigraphy consists of a top layer of asphalt and concrete or topsoil overlying granular or clay fill, silt, clay, silt till, and bedrock. The following sections describe the soil strata encountered during the geotechnical drilling investigation. A fence line diagram showing soil profiles along the proposed alignment of the Contract 1 wastewater trunk is included as Figure 2.

4.1 Overburden

The overburden deposits encountered at the project site generally consist of fill, clay, and silt, overlying glaciolacustrine clay, glacial silt till deposit, and underlain by the carbonate bedrock. Variable layers of fill consisting of granular material, clay, and silt with different thickness were observed in the boreholes within the Upper Complex Zone.

The Upper Complex Zone in Winnipeg generally consists of stratified clays, and silts with variable amounts of organics, granular and fill material. This zone has high soil variability. The base of the Complex Zone is typically defined by the base of the silt layer. The silt interlayers in the Complex Zones can vary from 100 mm to up to 3 m in thickness and are typically approximately 1 m. Typically the silt is tan in colour, soft in consistency, of no to low plasticity and may have a perched groundwater table. The moisture content of the silt ranges from 20 to 35% and the unit weight is within the range of 18.8 to 20.4 kN/m³ (Reference 1).

Adjacent to the Red River in Winnipeg, alluvial soils consisting of alternating layers of clays, silts, and sands are known to extend below the average depth of the Upper Complex Zone. No alluvial deposits were identified in KGS Group's 2025 geotechnical investigation.

4.1.1 FILL

In the project area, asphalt and concrete pavement, or topsoil, and fill was generally encountered from ground surface. For boreholes drilled on or adjacent to roadways, a layer of granular fill was typically observed.

The granular fill was fine to coarse gravel and was described as brown in colour, dry to damp, loose to compact in density, contained some fine to coarse sand, and trace silt, and trace clay.

4.1.2 UPPER COMPLEX ZONE

The Upper Complex Zone within the project area consists of clay interlayered with variable amounts of silt that results in a modified USCS soil classification of high plasticity clay (CH) to low plasticity clay (CL). The Upper Complex Zone clay was light brown to grey in colour, damp to moist, firm to hard in consistency, low to high plasticity, and contained silt, trace to some fine to coarse gravel, trace to some fine to coarse sand,

some organics, and trace rootlets. The extent of the Upper Complex Zone clay identified in the project area is outlined in Table 4-1 below.

TABLE 4-1: UPPER COMPLEX ZONE CLAY – PROJECT AREA

Location	Profile	Clay
Project Area	Elevation at Top (m)	228.80 to 231.70
	Thickness (m)	0.20 to 4.40 (Avg. 1.80 m)

A summary of the laboratory material testing results on the Upper Complex Zone clay from the KGS Group 2025 geotechnical investigations and the background geotechnical investigations are summarized in Table 4-2.

TABLE 4-2: SUMMARY OF LABORATORY AND FIELD TEST RESULTS FOR UPPER COMPLEX ZONE CLAY

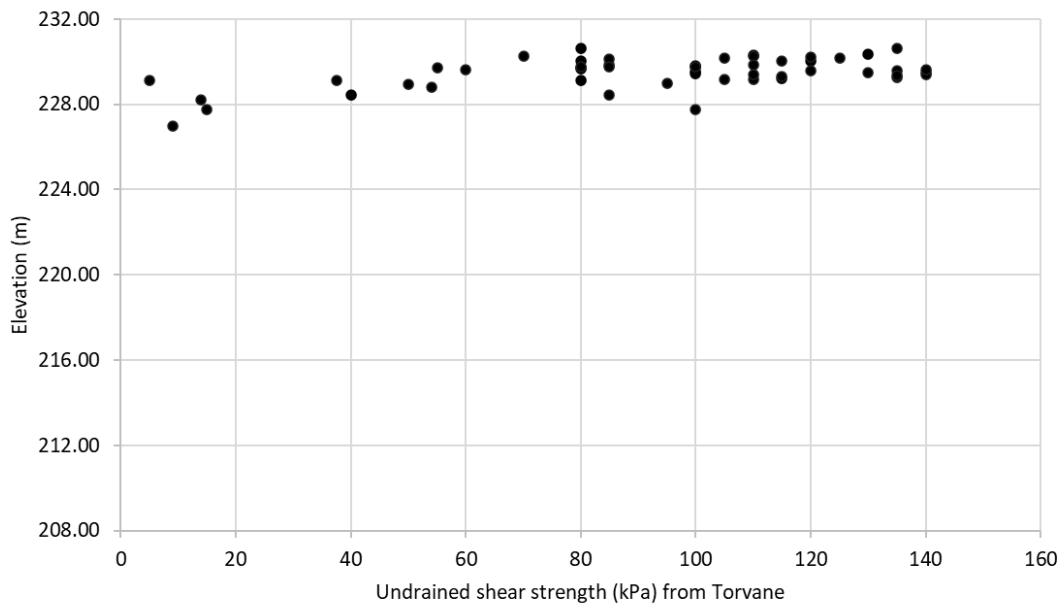
Laboratory Test	Clay
Moisture Content (%), CH Clay	9 to 40 (Avg. 29)
Atterberg – Plastic Limit (%), CH Clay	24
Atterberg – Liquid Limit (%), CH Clay	73
Moisture Content (%), CL Clay	16 to 36 (Avg. 23)
Atterberg – Plastic Limit (%), CL Clay	16 to 18
Atterberg – Liquid Limit (%), CL Clay	29 to 30
Undrained Shear Strength (kPa) – Torvane	5 to 140
Unconfined Compressive Strength (kPa) – Pocket Penetrometer	140 to 350

Notes:

- 1) Atterberg Limits for high plastic clay (CH) was based on one (1) test.

Values of undrained shear strength (S_u) with elevation for the Upper Complex Zone clay as estimated from a field Torvane during the KGS Group 2025 investigation and background geotechnical investigations throughout the project site are summarized in Figure 4-1.

FIGURE 4-1: UNDRAINED SHEAR STRENGTH WITH ELEVATION FOR UPPER COMPLEX ZONE CLAY



4.1.3 GLACIOLACUSTRINE CLAY

The glaciolacustrine clay deposit in the Winnipeg region is typically 9 to 12 m thick. In decreasing occurrence, typically the predominant mineral composition of the lacustrine clay generally consists of montmorillonite (a member of the smectite family), illite, kaolinite and some mica (Graham and Shields 1985). The clay deposit changes from brown to grey (sometimes referred to as blue clay) at depths of approximately 4.6 to 7.6 m. Within this depth range, the brown and grey clays often appear mottled, making it sometimes difficult to observe a discrete contact between the two (2) colours. It is believed the colour change is due to the oxidation of the brown clay (Graham and Shields 1985).

The brown clay is typically stiff in consistency and of a high plasticity. The brown clay is highly fissured with the frequency of fissures decreasing with depth. White gypsum pockets and veins are typically observed within the brown clay, often filling in the fissures. The lower grey clay is firm to stiff in consistency and of intermediate to high plasticity. Fine to coarse grained gravel and boulders are found occasionally in the grey clay, near the till interface.

The glaciolacustrine clay typically contains trace to some silt nodules. 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 introduces 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.

At this site, typical moisture content in the glaciolacustrine clay ranges from 30 to 70%. 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 60 to 95% and the Plastic Index ranges from 40 to 65%. Unconfined compressive strengths usually range from 70 to 100 kPa within the brown clay. Measured values within the upper brown clay are variable due to fissures. Typically, the unconfined compressive strengths generally yield a lower bound to undrained shear strengths (Reference 1).

Undrained shear strengths measured from unconfined compression tests are generally higher within the upper clay zone (~ top 2 to 3 m), typically in the order of 70 to 100 kPa. Below a depth of about 4 to 5 metres, strengths typically decrease approximately uniformly with increasing depth. As the underlying till layer is approached, strengths are typically in the order of 40 kPa but may be as low as 5 kPa. The higher undrained shear strengths with the upper brown clay and lower shear strengths at depth 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. They may also reflect artesian ground water conditions (and therefore low vertical effective stresses).

Effective shear strength parameters of the brown and grey clay obtained from consolidated undrained compression triaxial strength testing of a large number of relatively undisturbed samples yielded intact peak strength of $c' = 19.6$ kPa and $\phi' = 20.5^\circ$ and $c' = 29.8$ kPa and $\phi' = 15.8^\circ$, respectively. While the effective large strain shear strength parameter for the brown and grey clay were $c' = 14.5$ kPa and $\phi' = 13.3^\circ$ and $c' = 7.7$ kPa and $\phi' = 15.7^\circ$, respectively (Reference 1). The effective shear strength parameters typically used by local geotechnical engineers in Winnipeg for slope stability analysis are $c' = 5$ kPa and $\phi' = 14^\circ$ for both clays.

XRD analysis was not completed on the clay deposit as part of the 2025 geotechnical investigations. Testing results from another tunnelling site in Winnipeg indicated that the quartz content of the clay samples ranged from 16.1 to 20.2%, the clinocllore content ranged from 13.3 to 17.0%, the muscovite content ranged from 15.4 to 29.3%, the calcite content ranged from 0.6 to 4.5%, the dolomite content ranged from 4.2 to 9.7%, and the smectite content ranged from 28.6 to 37.1%.

The extent of the glaciolacustrine deposits identified in KGS Group's 2025 geotechnical investigations and the background geotechnical investigations is outlined in Table 4-3 below.

TABLE 4-3: GLACIOLACUSTRINE CLAY – PROJECT AREA

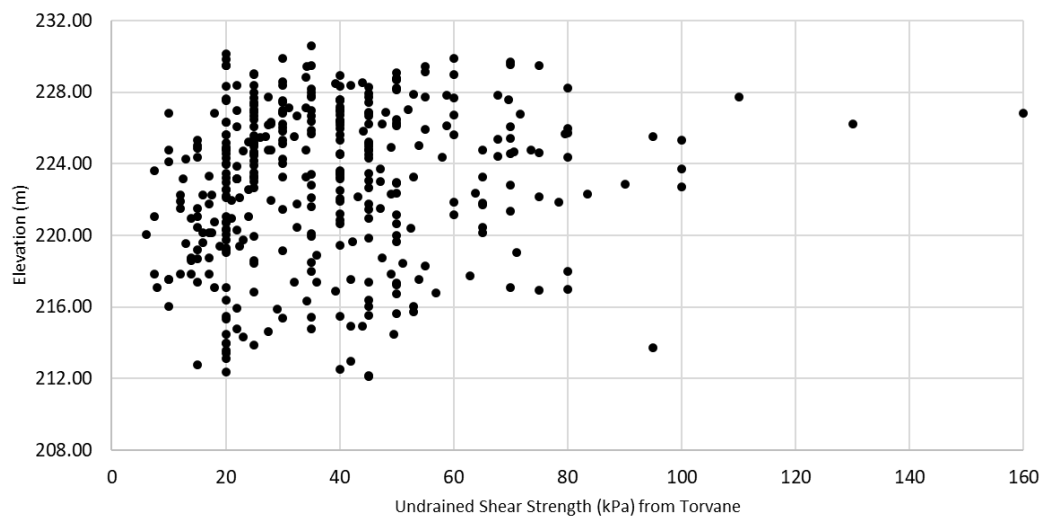
Location	Profile	Glaciolacustrine Clay
Project Area	Elevation at Top (m)	225.50 to 230.80
	Thickness (m)	9.50 to 19.00

A summary of the laboratory material testing results on the glaciolacustrine clay from the KGS Group 2025 geotechnical investigations and the background geotechnical investigations are summarized in Table 4-4.

TABLE 4-4: SUMMARY OF LABORATORY AND FIELD TEST RESULTS FOR GLACIOLACUSTRINE CLAY

Laboratory Test	Glaciolacustrine Clay
Moisture Content (%)	33 to 68 (Avg. 50)
Atterberg – Plastic Limit (%)	19 to 35
Atterberg – Liquid Limit (%)	59 to 107
Plasticity Index (%)	40 to 78
Grain Size – Gravel (%)	0 to 2
Grain Size – Sand (%)	0 to 15
Grain Size – Silt (%)	13 to 41
Grain Size - Clay (%)	44 to 87
Undrained Shear Strength (kPa) – Torvane	6 to 160
Undrained Shear Strength (kPa) – Pocket Penetrometer	5 to 150
Unconfined Compressive Strength (kPa)	67 to 158
Bulk Unit Weight (kN/m ³)	16 to 18

Values of undrained shear strength (S_u) with elevation for the glaciolacustrine clay as estimated from a field Torvane during the KGS Group 2025 investigation and background geotechnical investigations throughout the project site are summarized in Figure 4-2.

FIGURE 4-2: UNDRAINED SHEAR STRENGTH WITH ELEVATION FOR GLACIOLACUSTRINE CLAY

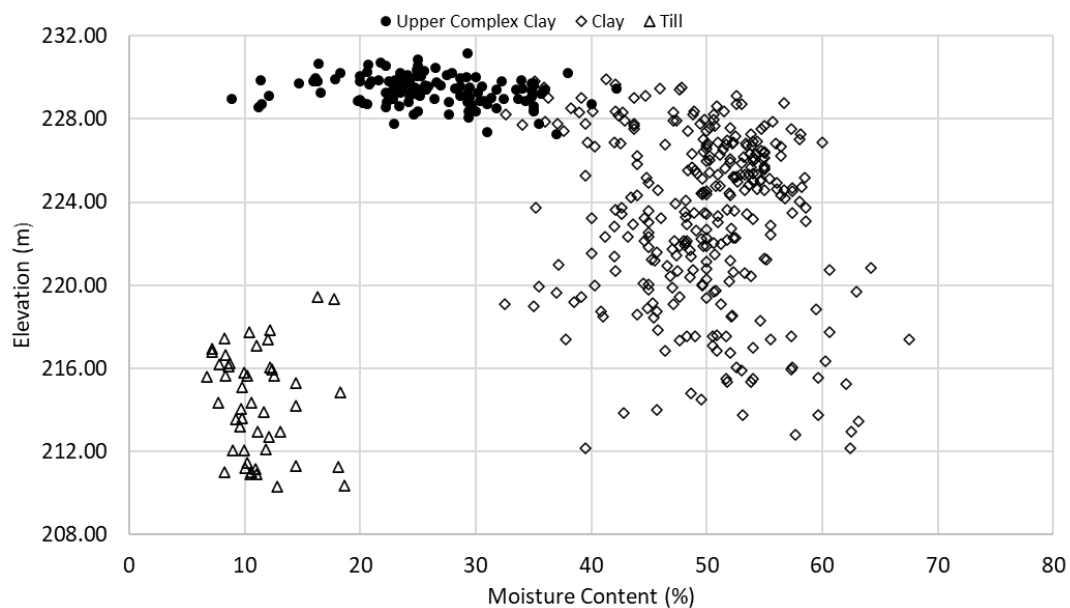
4.1.3.1 Swelling Potential of Clay Deposit

The swelling potential of a clay soil can be categorized based on the plasticity and percentage of clay sized particles (Figure 12.8, Canadian Foundation Engineering Manual, 5th Edition). The swelling potential of clay is highest when a sample has a high percentage of clay size particles and high plasticity index. Clay minerals accounts for between 67 and 81 % of the total composition of the Lake Agassiz clay in Winnipeg. The clays' size fractions typically consist of up to 75 % montmorillonite, 10 % illite, and 10 % kaolinite and approximately 5% quartz mineral. Over-consolidation ratio of the clay is generally less than 2.

The clay in the project area is classified to have a very high potential severity of an expansive soil based on the laboratory testing completed and is subject to considerable volume change with change in moisture content. Volumetric increases are usually in the 2% range with swelling pressure generally less than 75 kPa.

The variability of moisture content in the overburden with elevation in the project area is shown in Figure 4-3.

FIGURE 4-3: MOISTURE CONTENT OF OVERBURDEN WITH ELEVATION



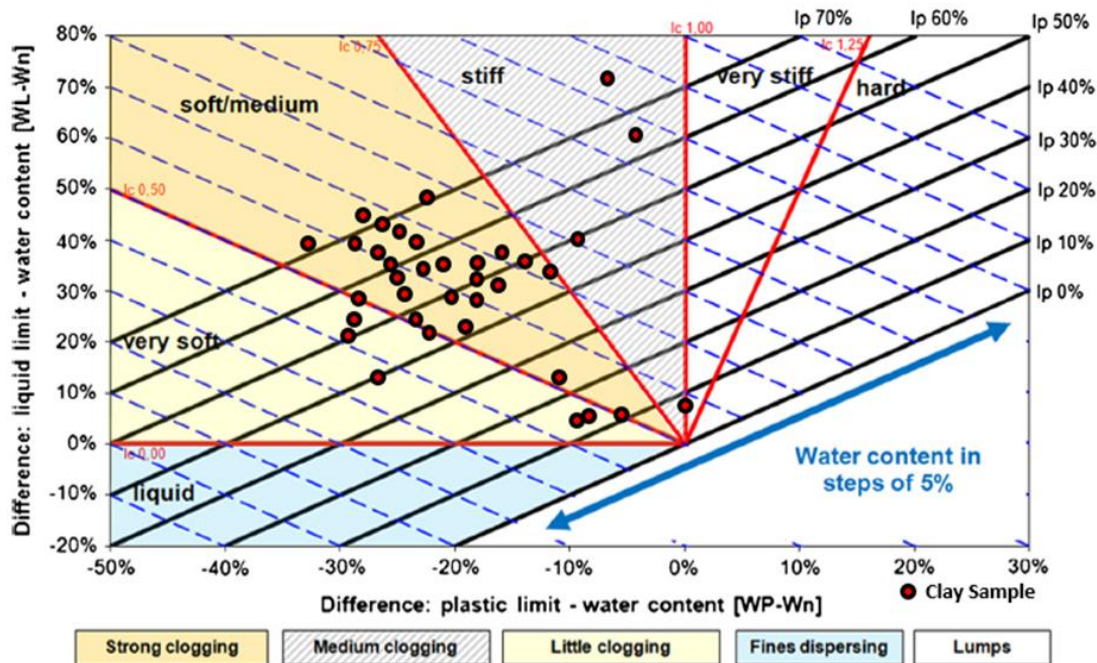
4.1.3.2 Stickiness Potential and Clogging Risks

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

The potential for clogging while tunnelling 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 cohesive samples tested in the Laboratory and their Plasticity Indices were plotted on Figure 4-4 to determine the corresponding clogging potential of the clay. It should be noted that the Hollman and

Thewes chart was developed from data collected from fluid supported trenchless shield drives, but is assumed to be applicable to other tunnelling methods.

FIGURE 4-4: STICKINESS POTENTIAL OF COHESIVE SOIL



4.1.4 GLACIAL TILL DEPOSIT

The glaciolacustrine clays are underlain by glacial silty tills. Based on the borehole drilling, glacial silt till was encountered at elevations ranging from 211.3 to 219.7 m within the project area. The glacial till ranged in thickness from 0.4 to 5.7 m (until power auger refusal was encountered or bedrock was confirmed). The glacial till may include a transition zone of till lenses in clay and clay inclusions in the till. The composition of the till is variable. The till is of varying consistency with the dense to very dense portions of the deposits being a basal till (hardpan). The upper horizon of the till deposit may be frequently loose and considerably softer, and water bearing like an ablation till (putty till). The upper ablation till typically may have water contents ranging from 10 - 15% while the denser basal till will typically have water contents in the range of 7 - 10%. The upper tills contain more clay, and have a slightly higher plasticity than the lower tills with high silt content. Unconfined compressive strengths ranging from 3.4 - 3.6 MPa have been reported for very dense tills with a moisture content of about 5% (Reference 1). Young's moduli typically range from 170 to 240 MPa (Reference 1). The tills are highly variable in terms of thickness, density and cobble/boulder content. Pockets of non-combustible gas, often under pressure are occasionally encountered in the till layer (Reference 2).

The uncorrected Standard Penetration Test blow counts ranged from 12 to greater than 100 blows/0.3 m, classifying the material as compact to very dense throughout the project area.

The extent of the glacial till deposit identified in KGS Group's 2025 geotechnical investigations and the background geotechnical investigation is outlined in Table 4-5 below.

TABLE 4-5: GLACIAL TILL – PROJECT AREA

Location	Profile	Glacial Till
Project Area	Elevation at Top (m)	210.90 to 219.80
	Thickness (m)	0.40 to 18.0

Notes:

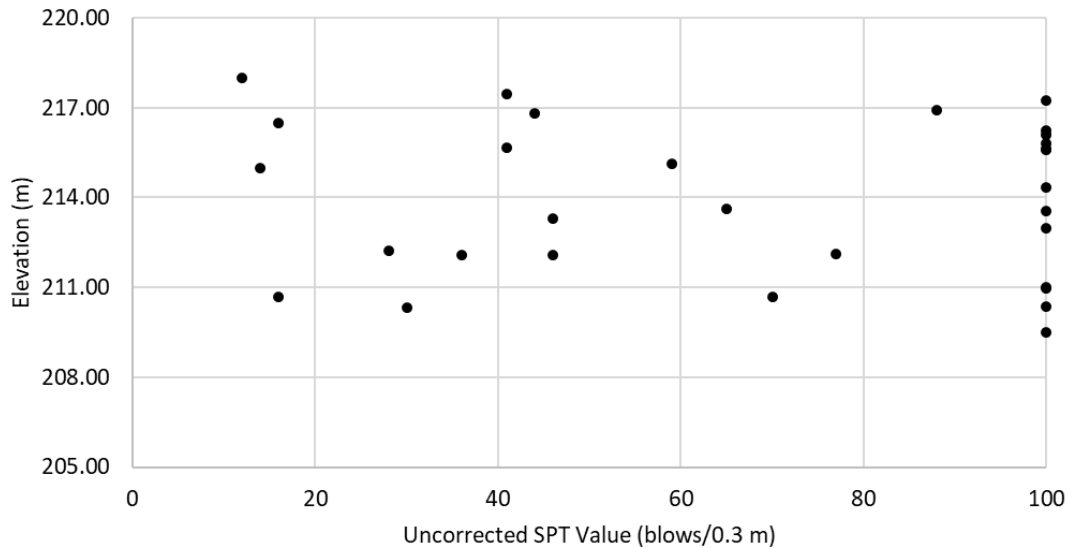
- 1) Thickness is based on boreholes or test well where the bedrock elevation was confirmed.

A summary of the laboratory material testing results on the glacial till deposits from the KGS Group 2025 geotechnical investigations and the background geotechnical investigations are summarized in Table 4-6.

TABLE 4-6: SUMMARY OF LABORATORY TEST RESULTS FOR GLACIAL TILL

Laboratory Test	Glacial Till
Moisture Content (%)	7 to 19 (Avg. 11)
Atterberg – Plastic Limit (%)	11 to 12
Atterberg – Liquid Limit (%)	18 to 19
Plasticity Index (%)	7
Grain Size – Gravel (%)	2 to 28
Grain Size – Sand (%)	17 to 44
Grain Size – Silt (%)	35 to 55
Grain Size - Clay (%)	11 to 24
Uncorrected Standard Penetration Test – Blow Count	12 to >100

Uncorrected Standard Penetration Test (SPT) blow count values (blows/0.3 m) with elevation for the glacial till encountered during the KGS Group 2025 investigation and background geotechnical investigations throughout the project site are summarized in Figure 4-5.

FIGURE 4-5: UNCORRECTED SPT VALUES WITH ELEVATION FOR GLACIAL TILL**Notes:**

- 1) Values of 100 indicate early refusal of the split spoon during SPT.

4.2 Bedrock

The carbonate bedrock within the project area belongs to the Selkirk and Fort Garry members of the Red River Formation. The Selkirk and Fort Garry members typically include the medium to highest strength rock in the Winnipeg region, with compressive strengths in the order of 34 to 37 MPa for the Selkirk member and greater than 60 MPa for the Fort Garry member. The Young's modulus (E) generally ranges from 10 to 15 GPa for the stronger rocks in the Winnipeg area, and as low as 4 GPa for the weaker rocks. (Reference 1)

The Selkirk member is primarily a mottled, tan coloured dolomitic limestone with occasional layers high in calcium near the top; this member is typically 40 m thick. The Fort Garry member consists of buff dolomite with thin limestone layers in the upper part and a marker bed or red argillaceous breccia at the top of the lower part; this member is an average of 33 m thick. (Reference 1)

Bedrock was cored in one (1) borehole (TH25-07) during the 2025 KGS Group investigation and was encountered below the silt till deposit at an elevation of El. 210.5 m. The bedrock in TH25-07 was described as dolomitic limestone and was buff in colour, massive, strong to very strong, and contained fossils throughout with trace vug porosity. Mottled red and buff layering was observed in the core recovered.

Bedrock was encountered in all nine (9) wells drilled during the 2026 KGS Group hydrogeological investigations and the elevation of bedrock surface varied from 201.5 m to El. 209.7 m. In general, the bedrock appears to dip down in elevation towards the west.

No unique testing was performed on the bedrock as the Works for the Armstrong Combined Sewer Relief Project are not anticipated to encounter the bedrock.

4.3 Groundwater

Groundwater level monitoring data is presented in Tables 3-2 and 3-3. Based on the piezometric elevations observed in conjunction with the hydrogeological studies in Appendix F and G, depressurization of the underlying glacial till and bedrock strata will be required to facilitate construction of deep excavation shafts depending on the required depth of the shafts. The groundwater monitoring data indicates that the trenchless construction and associated temporary shaft excavations will be performed below the groundwater table.

Site specific hydrogeological data for the bedrock aquifer at three (3) key locations within the project area is presented in the hydrogeological investigation and pump testing memorandum in Appendix G. The bedrock aquifer is highly variable within Winnipeg and contractors should expect a broad range of aquifer conditions to be encountered during construction of the Works. Aquifer conditions are known to vary significantly over short distances.

Groundwater seepage was noted in several boreholes from the 2025 geotechnical investigation and background geotechnical investigations. End of drilling observations are included on the borehole logs in Appendix A and C. Seepage and sloughing observed during or following completion of drilling in the 2025 KGS Group and historical boreholes are summarized in Table 4-7.

TABLE 4-7: SUMMARY OF SEEPAGE AND SLOUGHING OBSERVATIONS DURING BOREHOLE DRILLING

Borehole ID	Ground Elevation (m)	Elevation/Depth (m)	
		Observed Seepage	Observed Sloughing
TH22-01	231.6	230.1/1.5	230.1/1.5
TH22-02	230.9	-	217.0/13.9
TH22-03	231.3	229.9/1.4	229.9/1.4
TH22-08	231.4	218.9/12.5	219.9/11.5
TH22-11	230.8		225.3/5.5
TH22-12	230.6	216.9/13.7	216.9/13.7
TH22-15	230.5	214.7/15.8	215.9/14.6
TH22-16	230.6	215.5/15.1	215.4/15.2
TH22-17	230.6	-	215.7/14.9
TH22-20	230.6	224.5/6.1	224.5/6.1
TH22-21	230.4	210.7/19.7	210.7/19.7
TH22-22	230.3	210.5/19.8	210.5/19.8

Borehole ID	Ground Elevation (m)	Elevation/Depth (m)	
		Observed Seepage	Observed Sloughing
TH23-01	230.8	228.5/2.3	228.5/2.3
TH23-02	230.9	228.0/2.9	228.0/2.9
TH25-01	231.0	-	217.3/13.7
TH25-02	231.3	-	220.9/10.4
TH25-03	230.9	-	
TH25-04	231.8	227.2/4.6	216.9/14.9
TH25-06	230.6	-	218.4/12.2
TH25-07	230.8	227.8/3.0	227.8/3.0
TH25-08	230.2	-	209.8/20.4

Groundwater levels fluctuate seasonally and contractors should expect the water level to rise during the spring snow melt and after significant rainfall events and/or snowmelts. Groundwater levels may also vary as a result of construction activities.

Cobbles, boulders, and/or granular layers are known to exist within till deposits and contractors should expect to encounter these materials. These zones should be expected to be water bearing. The bedrock within the project area is a confined aquifer confined by the overburden layers and seepage from the glacial till deposit and bedrock should be expected during excavation within or near these formations.

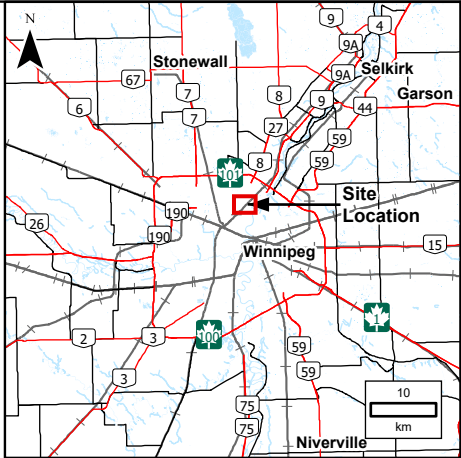
4.4 Well Pump Testing Results

Details of the measured aquifer response based on the site-specific pump testing at three (3) key sites within the project area are provided in the hydrogeological memorandum in Appendix G.

5.0 REFERENCES

1. Department of Geological Engineering, the University of Manitoba, (1983). Geological Engineering Report for Urban Development of Winnipeg.
2. KGS Group, Acres Engineering, UMA Engineering (2004). Appendix B, Floodway Channel Pre-Design, Floodway Expansion Project, Project Definition and Environmental Assessment, Preliminary Engineering Report.
3. Trek Geotechnical (2023). Armstrong Combined Sewer Preliminary Design - Geotechnical Investigation Report.
4. Trek Geotechnical (2024). CP Rail Pipe Crossing Mile 3.05 Winnipeg Beach Subdivision - Geotechnical Investigation Report
5. Trek Geotechnical (2024). CP Rail Pipe Crossing Mile 2.93 Winnipeg Beach Subdivision - Geotechnical Investigation Report.

FIGURES



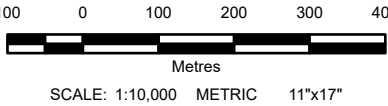
LEGEND:



- KGS Group Test Hole (2026)
- KGS Group Test Well (2026)
- KGS Group Test Hole (2025)
- + Trek Geotechnical Test Hole (2024)
- + Trek Geotechnical Test Hole (2023)
- + Trek Geotechnical Test Hole (2022)
- Proposed Armstrong Design Alignment

NOTES:

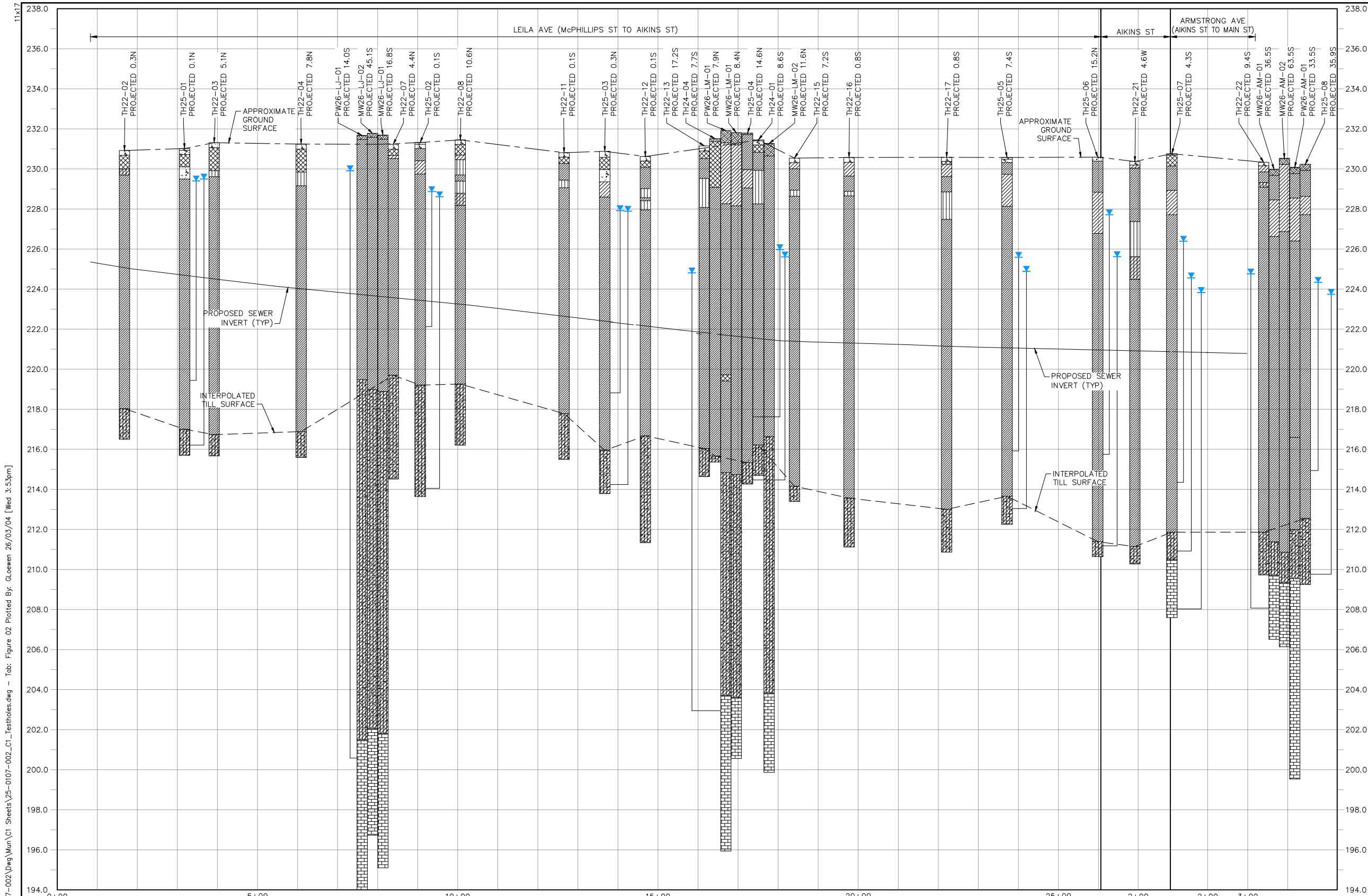
1. All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14.
Elevations are in metres referencing vertical datum (CGVD28).

2. Image Source: ESRI / Maxar (2025).



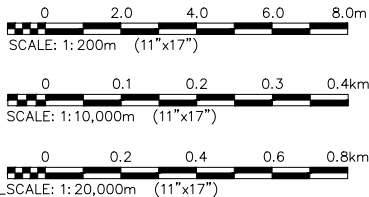
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0	25/10/21	ISSUED WITH FINAL REPORT	KF	JMM
NO.	YY/MM/DD	DESCRIPTION	ISSUED BY	CHECK BY
REVISIONS / ISSUE				
				
ARMSTRONG DETAILED DESIGN AND CONTRACT ADMINISTRATION				
GEOTECHNICAL DATA LOCATION PLAN				
MARCH 2026		FIGURE 01		REV: 1

File Name: \\kgs-file\y-data\Projects\2025\25-0107-002\Drawings\C1 Sheets\25-0107-002_C1_Testholes.dwg - Tab: Figure 02 Plotted By: Gloewen 26/03/04 [Wed 3:53pm]
11"x17" PLOT SCALE: 1:2



- LITHOLOGY GRAPHICS
- TOPSOIL
 - ASPHALT/CONCRETE
 - GRANULAR/CLAY FILL
 - CLAY (CL)
 - CLAY (CH)
 - SILT
 - SILT AND CLAY
 - SILT TILL
 - LIMESTONE

PROFILE
SCALE: 1:10,000H 1:200V





DISCLAIMER:

KGS GROUP IS NOT RESPONSIBLE FOR ANY CLAIMS, DAMAGES, OR LIABILITY ASSOCIATED WITH INTERPRETATION OF SUBSURFACE DATA OR FOR REUSE OF SUBSURFACE DATA.

NOTES:

- ALL UNITS ARE METRIC AND IN METERS UNLESS OTHERWISE NOTED.
- THE GEOTECHNICAL DATA PRESENTED ON THIS DRAWING IS BASED ON OBSERVATIONS AND RESULTS OBTAINED FROM FIELD INVESTIGATION PROGRAMS COMPLETED BETWEEN 2022 AND 2026.
- THE INFORMATION PROVIDED INDICATE SOIL AND BEDROCK CONDITIONS ONLY AT SPECIFIC LOCATIONS AND ONLY TO THE DEPTHS PENETRATED. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THE EXPLORED LOCATIONS. THE TILL SURFACE SHOWN IS BASED ON INTERPOLATION BETWEEN THE BOREHOLES.
- GROUNDWATER READINGS SHOWN AT TH25-01 TO TH25-08 ARE FROM OCTOBER 15, 2025.
- GROUNDWATER READINGS SHOWN AT PW26-AM-01, PW26LM-01 AND PW26-LJ-01 ARE FROM JANUARY 16, JANUARY 28, AND FEBRUARY 6, 2026, RESPECTIVELY.

1	26/03/04	ISSUED WITH FINAL REPORT	KF
0	25/10/21	ISSUED WITH FINAL REPORT	KF
NO.	YY/MM/DD	DESCRIPTION	BY
REVISIONS / ISSUE			
			
ARMSTRONG SEWER RELIEF WORKS CONTRACT 1			
GEOTECHNICAL DATA STRATIGRAPHIC PROFILE CONTRACT 1			
MARCH 12, 2026		FIGURE 02	REV: 1

APPENDIX A

2022 to 2024 Trek Geotechnical Borehole Logs












GENERAL NOTES

- Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
- Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
- When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Major Divisions		USCS Classification	Symbols	Typical Names	Laboratory Classification Criteria		Particle Size		Material	
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than 4.75 mm)	Clean gravel (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3		mm	ASTM Sieve sizes	#10 to #4 #40 to #10 #200 to #40 < #200
			GP		Poorly-graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW				
			GM		Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols			
			GC		Clayey gravels, gravel-sand-silt mixtures	Atterberg limits above "A" line or P.I. greater than 7				
	Sands (More than half of coarse fraction is smaller than 4.75 mm)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3		mm	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425 < 0.075	
			SP		Poorly-graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW				
			SM		Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols			
			SC		Clayey sands, sand-clay mixtures	Atterberg limits above "A" line or P.I. greater than 7				
Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent..... GW, GP, SW, SP More than 12 percent..... GM, GC, SM, SC 6 to 12 percent..... Borderline cases requiring dual symbols*										
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)		Silts and Clays (Liquid limit less than 50)	ML		Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity			Particle Size		Material
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			ASTM Sieve Sizes		
			OL		Organic silts and organic silty clays of low plasticity			mm		
		Silts and Clays (Liquid limit greater than 50)	MH		Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts			> 300		
			CH		Inorganic clays of high plasticity, fat clays			75 to 300		
			OH		Organic clays of medium to high plasticity, organic silts			19 to 75		
		Highly Organic Soils	Pt		Peat and other highly organic soils			4.75 to 19		
			Von Post Classification Limit		Strong colour or odour, and often fibrous texture			Boulders Cobbles Gravel Coarse Fine		

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

	Asphalt		Bedrock (undifferentiated)		Cobbles
	Concrete		Limestone Bedrock		Boulders and Cobbles
	Fill		Cemented Shale		Silt Till
			Non-Cemented Shale		Clay Till

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)	VW - Vibrating Wire Piezometer
PL - Plastic Limit (%)	SI - Slope Inclinator
PI - Plasticity Index (%)	▽ Water Level at Time of Drilling
MC - Moisture Content (%)	▼ Water Level at End of Drilling
SPT - Standard Penetration Test	▼ Water Level After Drilling as Indicated on Test Hole Logs
RQD - Rock Quality Designation	
Qu - Unconfined Compression	
Su - Undrained Shear Strength	

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent
with *	with silt, with sand	> 35 percent

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

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

<u>Descriptive Terms</u>	<u>Undrained Shear Strength (kPa)</u>
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200



Sub-Surface Log

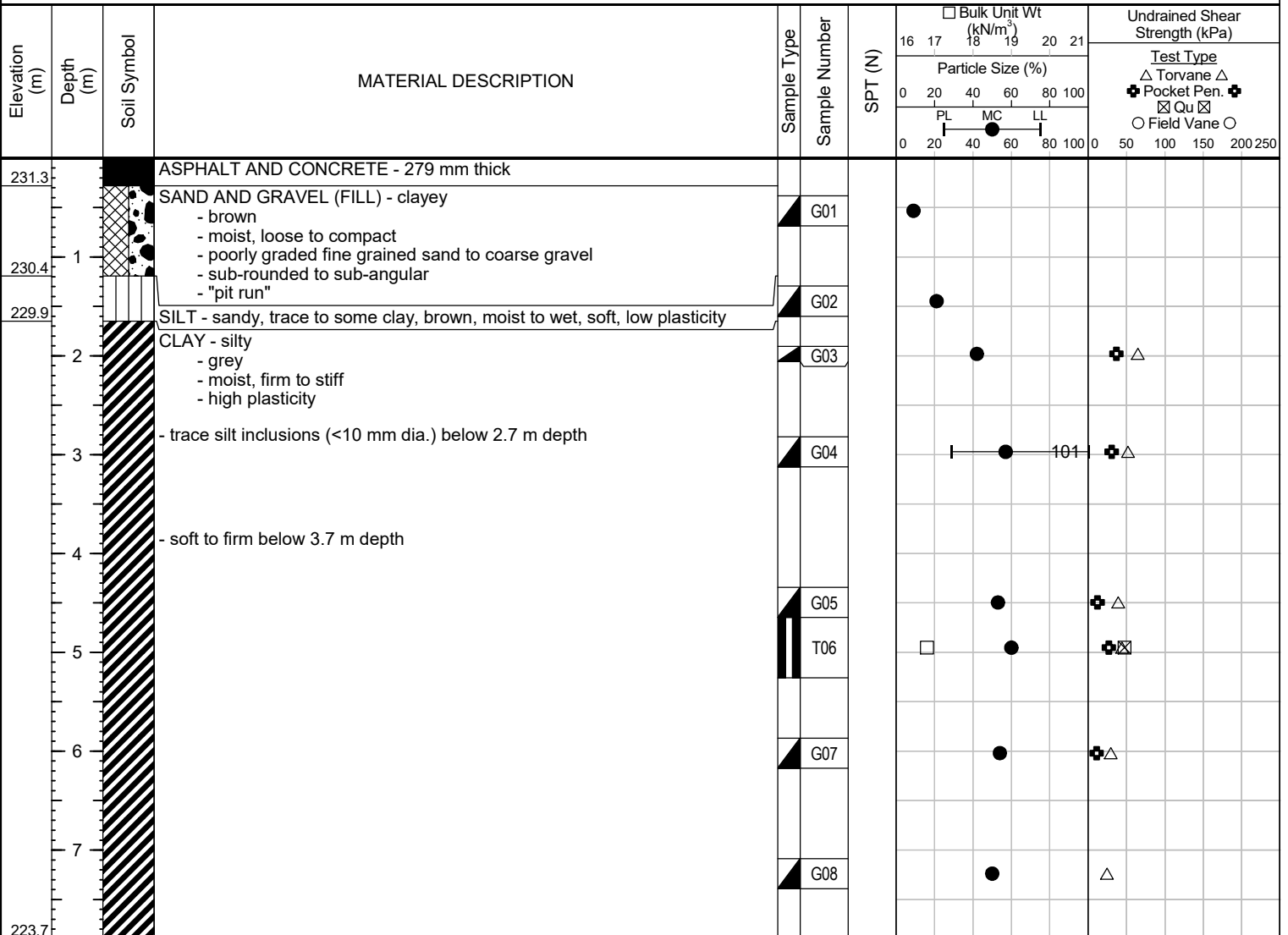
Test Hole TH22-01

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534838.7, E-632749.5
Contractor: Paddock Drilling Ltd. Ground Elevation: 231.57 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 19, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



END TEST HOLE AT 7.9 m IN CLAY

Notes:

- 1) Seepage and sloughing observed between 1.4 m to 1.6 m depth. Squeezing below 3.1 m depth.
- 2) Test hole open to 3.1 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 2211 McPhillips St, 1.8 m East of West median curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira

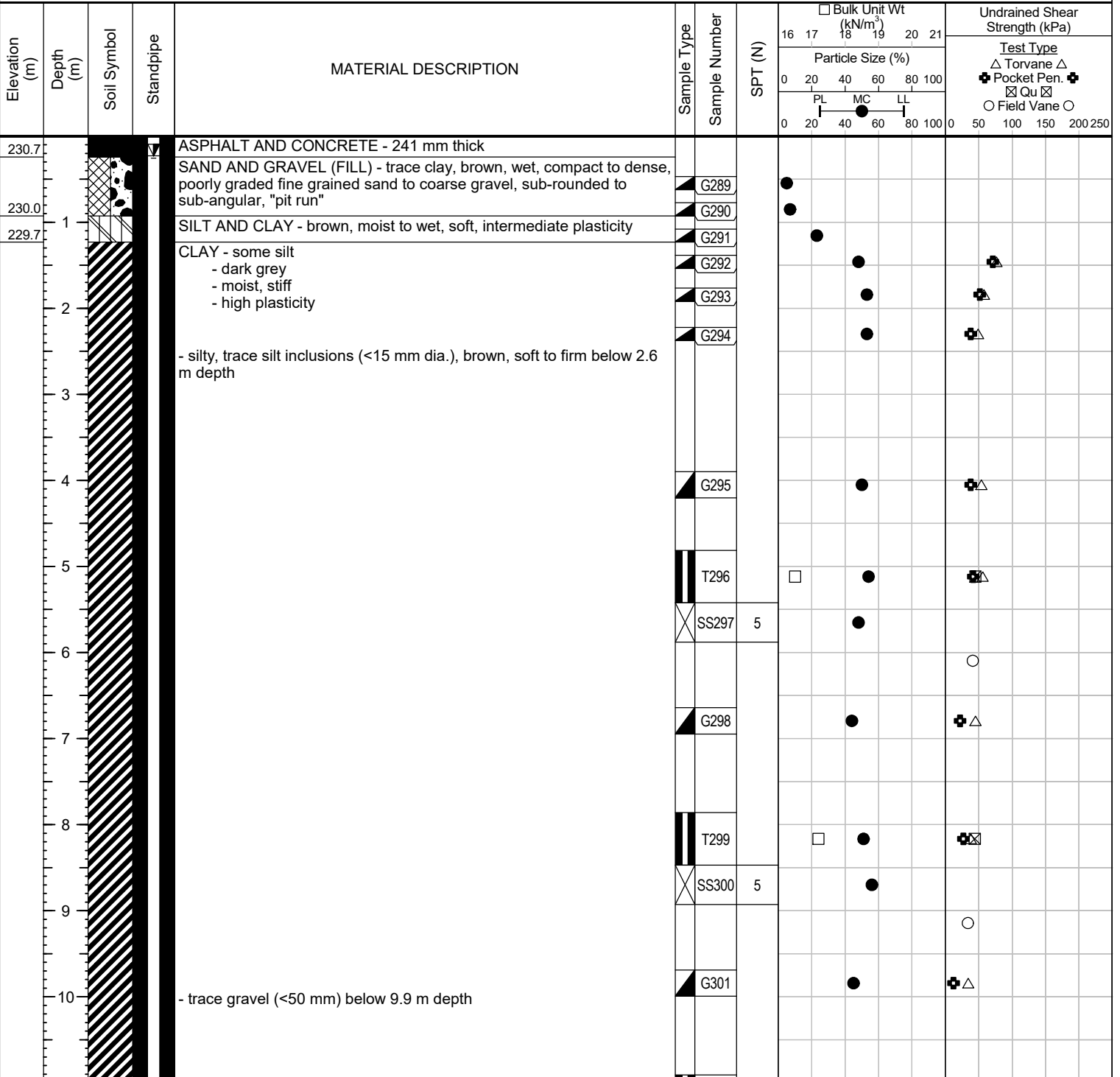
Sub-Surface Log

Test Hole TH22-02

1 of 2

Client: Jacobs Canada Inc. **Project Number:** 0336-003-00
Project Name: Armstrong Combined Sewer **Location:** UTM N-5535069.4, E-632961.9
Contractor: Paddock Drilling Ltd. **Ground Elevation:** 230.92 m Top of Pavement
Method: 150mm Solid Stem Auger, Acker MP8 Truck Mount **Date Drilled:** September 28, 2022

Sample Type: ☒ Grab (G) ☒ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ☐ Core (C)
Particle Size Legend: ☒ Fines ☒ Clay ☒ Silt ☒ Sand ☒ Gravel ☒ Cobbles ☒ Boulders
Backfill Legend: ☒ Bentonite ☒ Cement ☒ Drill Cuttings ☒ Filter Pack Sand ☒ Grout ☒ Slough



Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Nelson Ferreira

- June 8, 2023 - 224.6 m



Sub-Surface Log

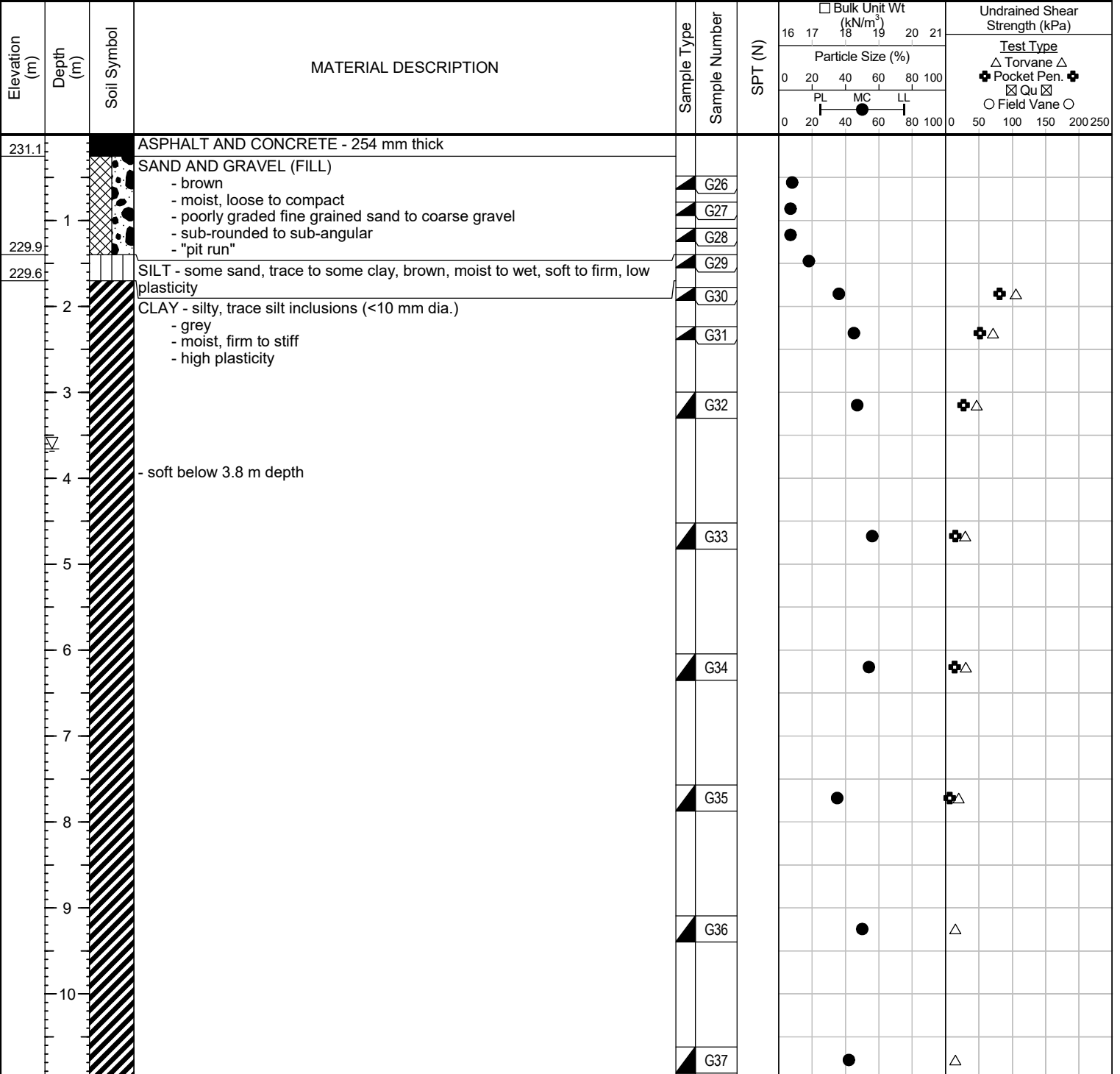
Test Hole TH22-03

1 of 2

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534969.6, E-633163.5
Contractor: Paddock Drilling Ltd. Ground Elevation: 231.31 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 19, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

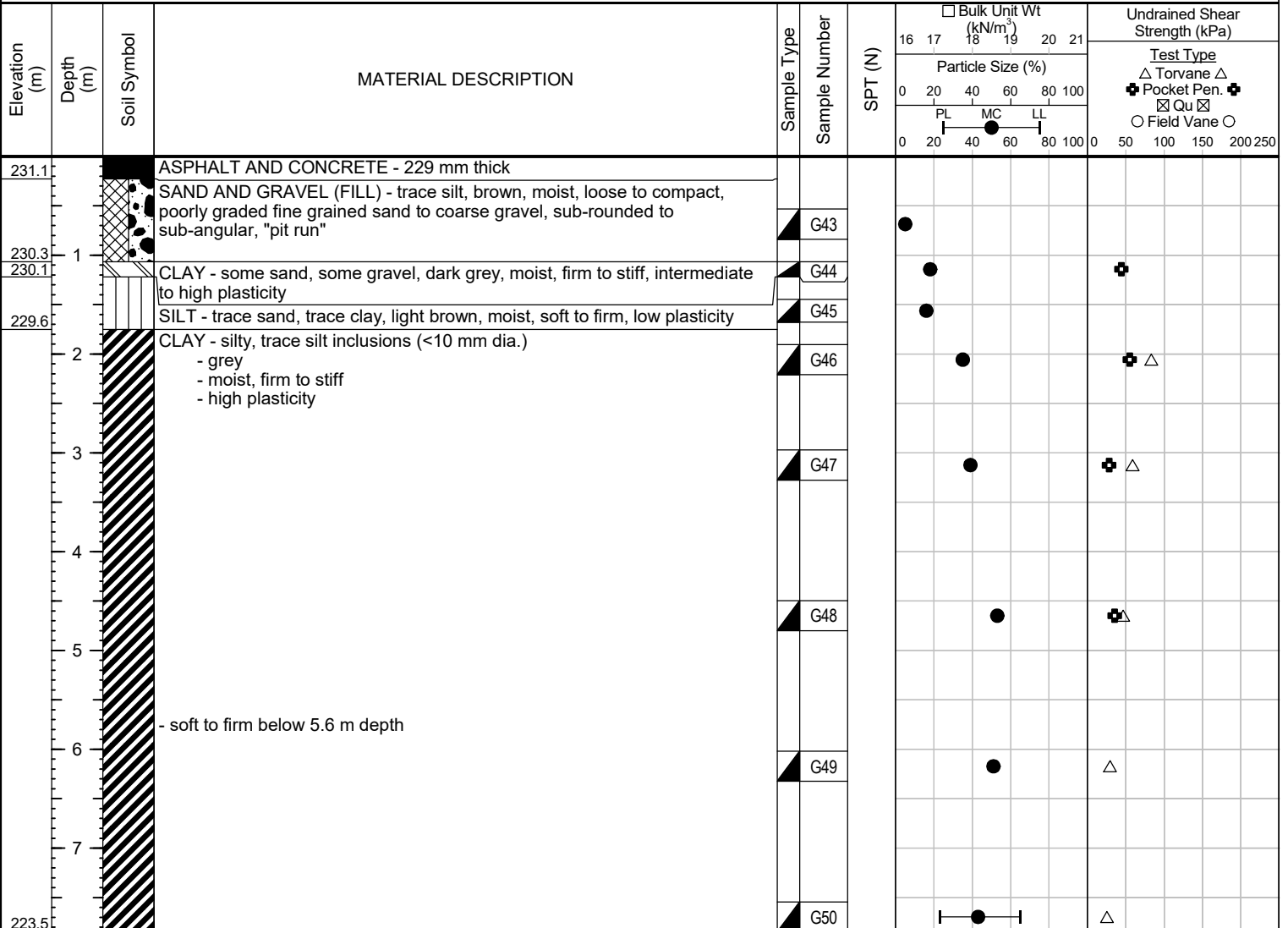
Test Hole TH22-05

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534558.7, E-633210
Contractor: Paddock Drilling Ltd. Ground Elevation: 231.33 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 19, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



END TEST HOLE AT 7.9 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 4.0 m depth.
- 2) Test hole open to 4.0 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 31 Kingsbury Ave, 1.5 m South of North curb.

Logged By: Tyler Chapko

Reviewed By: Kent Bannister

Project Engineer: Nelson Ferreira



Sub-Surface Log

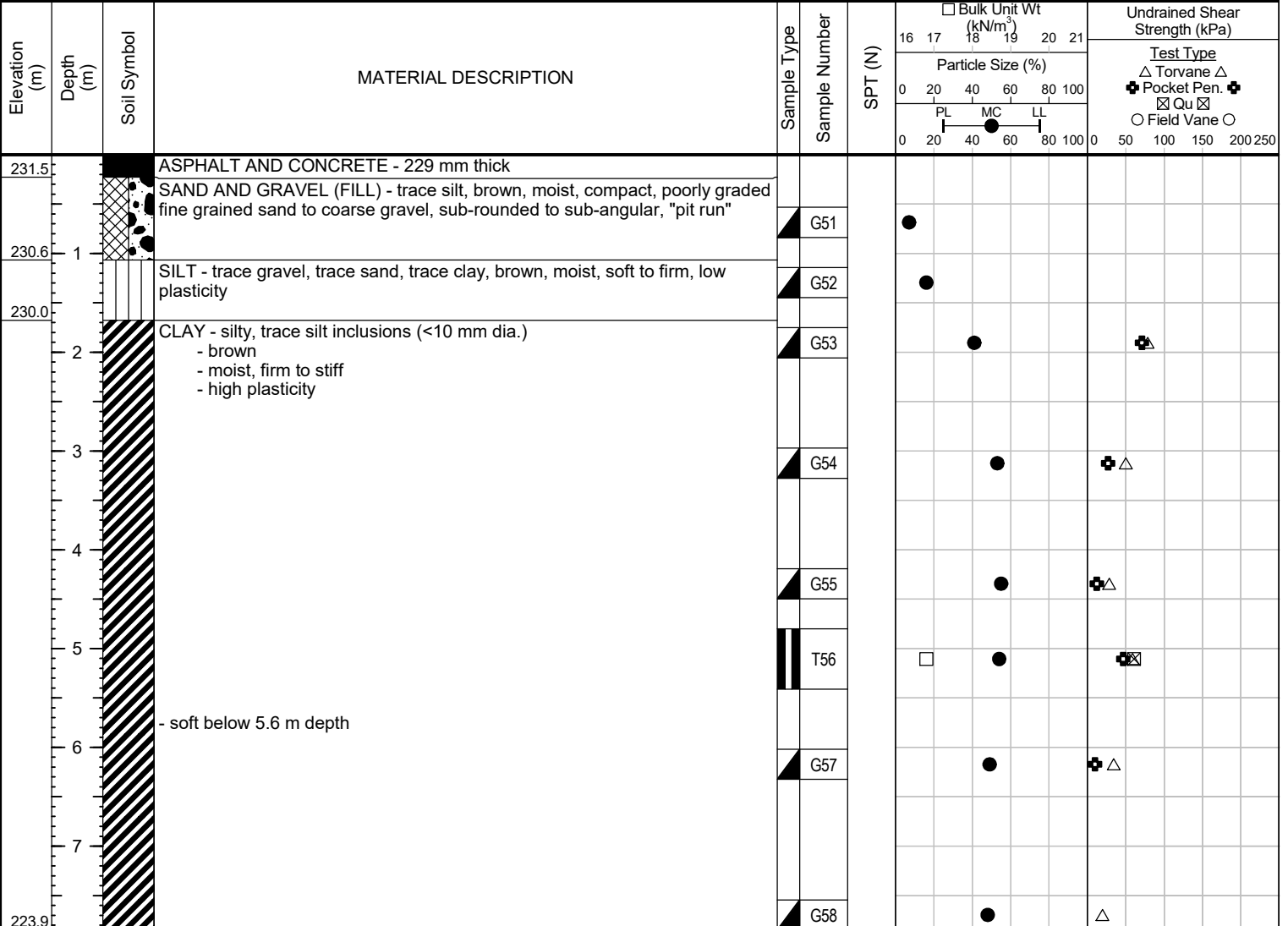
Test Hole TH22-06

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534665.8, E-632981.7
Contractor: Paddock Drilling Ltd. Ground Elevation: 231.70 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 20, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



END TEST HOLE AT 7.9 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 4.8 m depth.
- 2) Test hole open to 4.8 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 97 Kingsbury Ave, 1.5 m South of North curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira

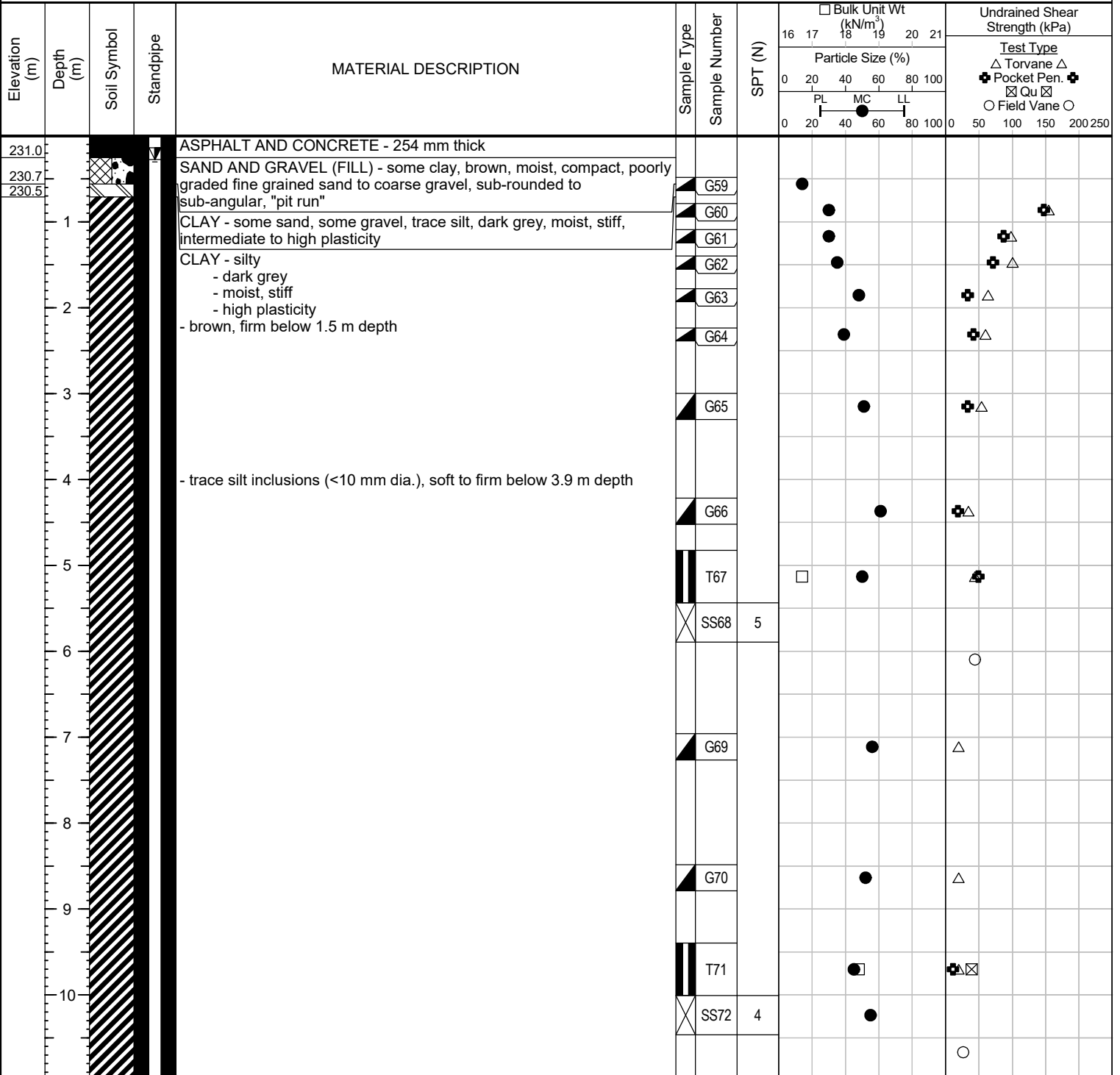
Sub-Surface Log

Test Hole TH22-07

1 of 2

Client: Jacobs Canada Inc. **Project Number:** 0336-003-00
Project Name: Armstrong Combined Sewer **Location:** UTM N-5534793.9, E-633540.3
Contractor: Paddock Drilling Ltd. **Ground Elevation:** 231.23 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount **Date Drilled:** September 20, 2022

Sample Type: ☒ Grab (G) ☒ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ☒ Core (C)
Particle Size Legend: ☒ Fines ☒ Clay ☒ Silt ☒ Sand ☒ Gravel ☒ Cobbles ☒ Boulders
Backfill Legend: ☒ Bentonite ☒ Cement ☒ Drill Cuttings ☒ Filter Pack Sand ☒ Grout ☒ Slough



Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Nelson Ferreira




Sub-Surface Log

Test Hole TH22-07

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	Standpipe	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)					Particle Size (%)					Undrained Shear Strength (kPa)							
								16	17	18	19	20	21	0	20	40	60	80	100	0	50	100	150	200	250
								Test Type																	

219.7				SILT (TILL) - sandy, some clay, some gravel - brownish grey - moist, compact - low plasticity																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			</
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END TEST HOLE AT 16.7 m IN SILT (TILL)

Notes:

- 1) Power Auger Refusal at 16.7 m depth below surface.
- 2) Seepage not observed. Sloughing observed below 13.9 m depth.
- 3) Test hole open to 13.9 m depth below surface immediately after drilling.
- 4) Test hole located in front of 707 Leila Ave, Westbound, 1.9 m North of South median curb.
- 5) Field vane fin dimensions of 63 mm wide and 100 mm long, install depth of 300 mm into clay.
- 6) Standpipe (SP22-07) installed at 16.2 m depth below ground surface.
- 7) Bulk sample obtained between 0.3 m and 2.0 m depth below pavement.
- 8) Standpipe (SP22-07) water elevations recorded per following:
 - October 13, 2022 - 223.1 m
 - November 20, 2022 - 228.3 m
 - January 19, 2023 - 229.7 m
 - February 2, 2023 - 229.5 m
 - April 27, 2023 - 230.5 m
 - June 8, 2023 - 229.4 m



Sub-Surface Log

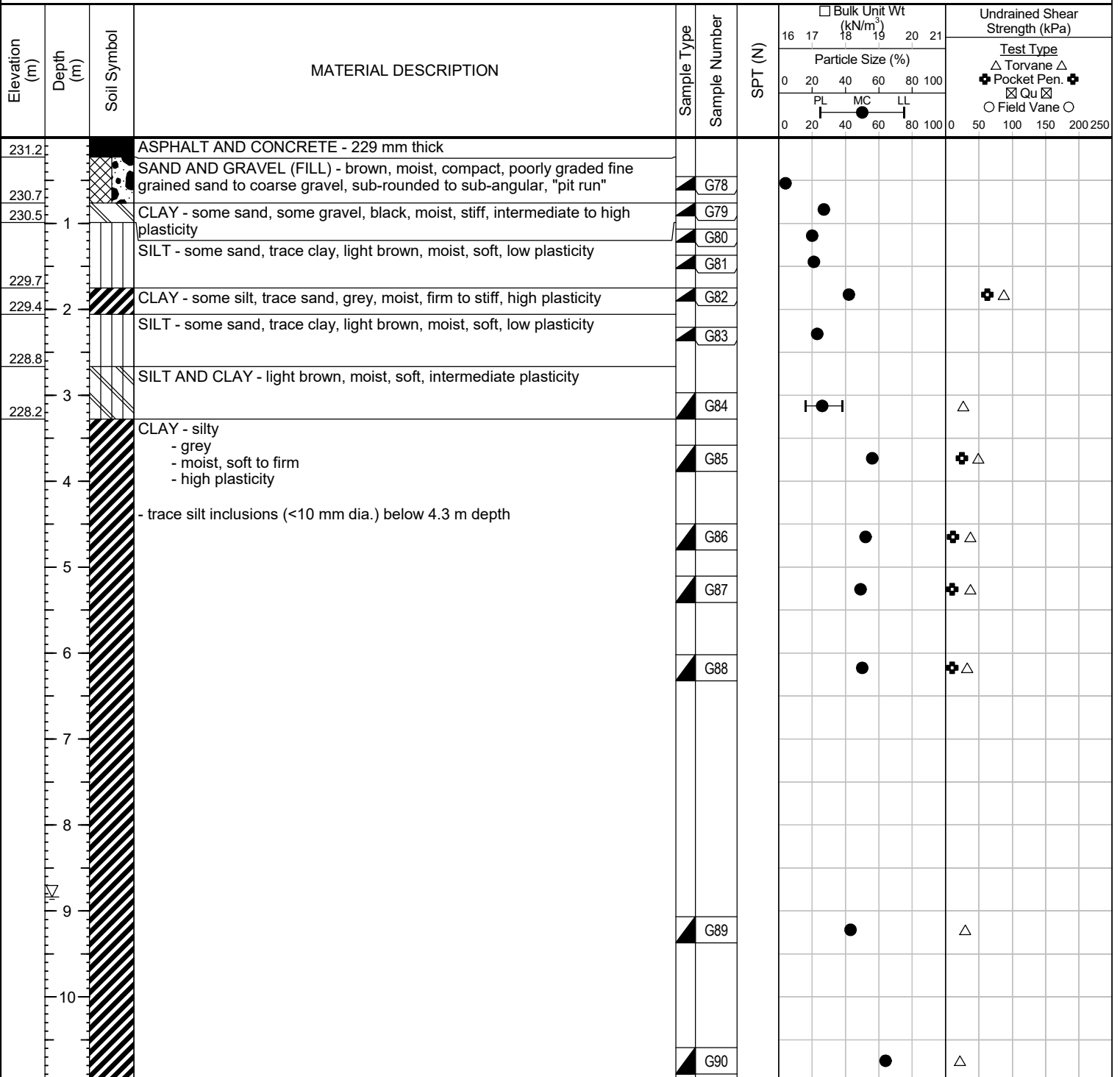
Test Hole TH22-08

1 of 2

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534704, E-633717.7
Contractor: Paddock Drilling Ltd. Ground Elevation: 231.45 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 20, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-08

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)					Undrained Shear Strength (kPa)						
							16	17	18	19	20	21	Test Type					
							Particle Size (%)					△ Torvane △						
							0 20 40 60 80 100					✚ Pocket Pen. ✚						
							PL MC LL					☒ Qu ☒						
0 20 40 60 80 100					○ Field Vane ○													
0 50 100 150 200 250																		
219.3	12		SILT (TILL) - sandy, some clay, some gravel - grey - moist to wet, dense - low plasticity - brown, dry to moist below 13.4 m depth		G91													
	13																	
	14				G92													
					SS93	41												
	15				G94													
216.2					SS95	50 / 76mm												
END TEST HOLE AT 15.2 m IN SILT (TILL)																		
Notes:																		

END TEST HOLE AT 15.2 m IN SILT (TILL)

Notes:

- 1) Power Auger Refusal at 15.2 m depth below surface.
- 2) Seepage observed below 12.5 m depth. Squeezing below 11.5 m depth.
- 3) Test hole open to 11.5 m depth below surface immediately after drilling.
- 4) Water level at 8.9 m depth below surface immediately after drilling.
- 5) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 6) Test hole located in front of 674 Leila Ave, Eastbound lane, 1.7 m South of North median curb.
- 7) Bulk sample obtained between 0.6 m and 2.0 m depth below pavement.



Sub-Surface Log

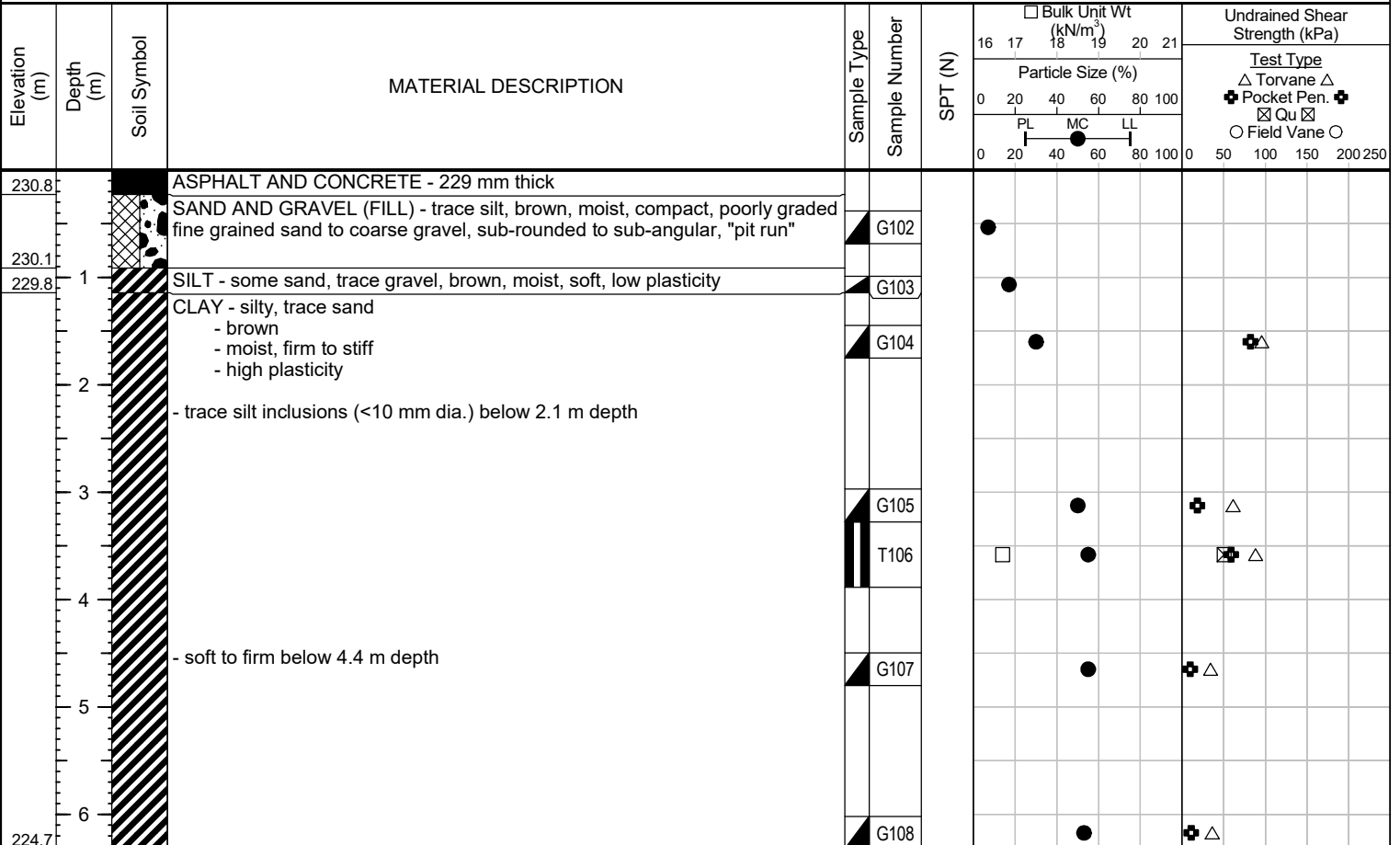
Test Hole TH22-09

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534472.4, E-633656.9
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.99 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 21, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



END TEST HOLE AT 6.3 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 5.3 m depth.
- 2) Test hole open to 5.3 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 1007 Sinclair St, 1.45 m West of East curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-10

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534290.5, E-633902.1
Contractor: Paddock Drilling Ltd. Ground Elevation: 231.28 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 20, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)	
							16	17	18	19	20	21
231.2			ASPHALT AND CONCRETE - 114 mm thick									
230.8			CLAY - gravelly, sandy, dark grey, moist, stiff, intermediate plasticity		G96							
	1		CLAY - silty, trace sand - grey - moist, firm to stiff - high plasticity		G97							
	2		- trace silt inclusions (<10 mm dia.), brown, firm below 1.6 m depth		G98							
	3				G99							
	4		- soft to firm below 4.0 m depth									
	5				G100							
	6				G101							

END TEST HOLE AT 6.2 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 4.7 m depth.
- 2) Test hole open to 4.7 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 51 Laurel Bay, 1.6 m South of North curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

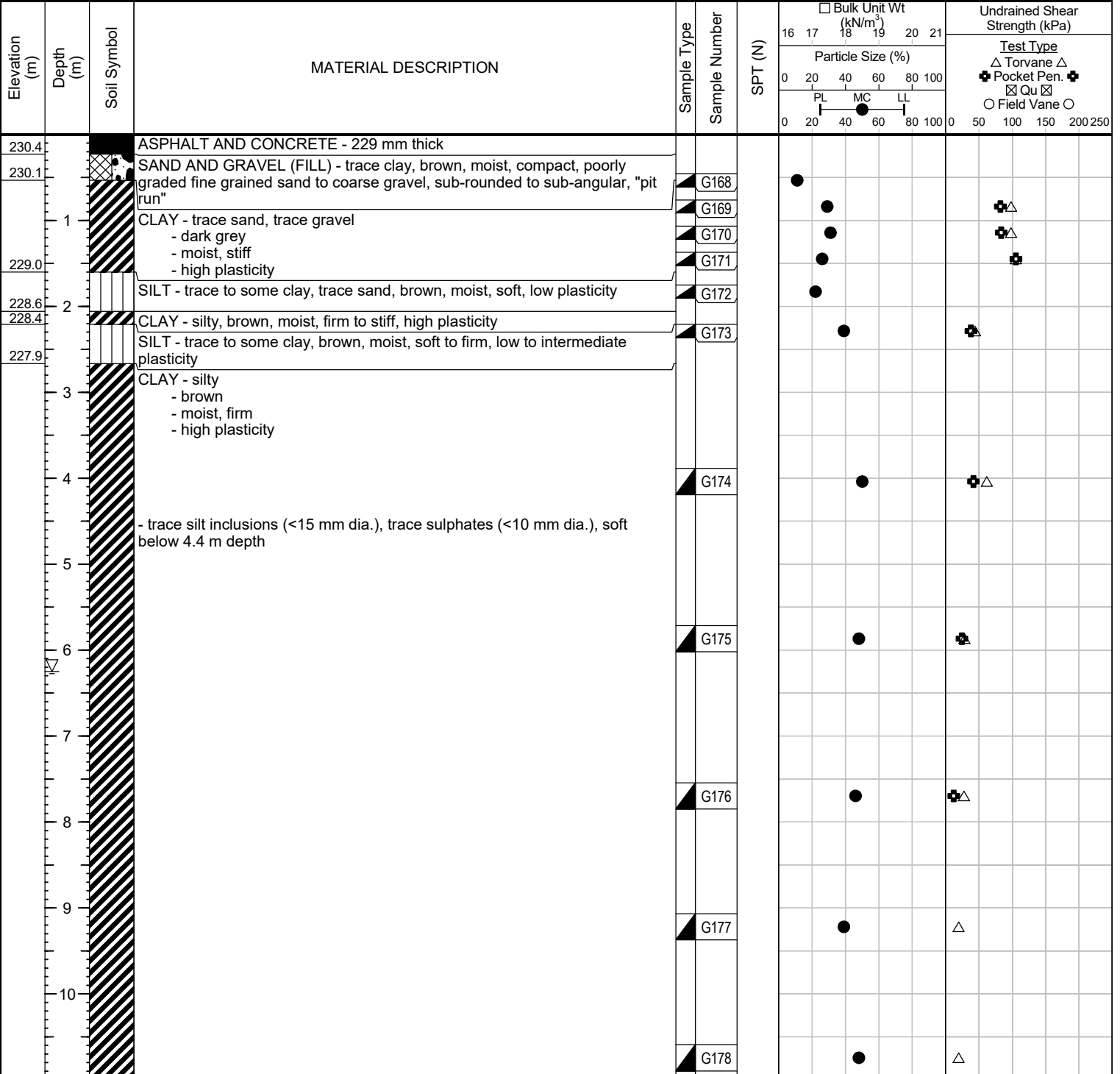
Test Hole TH22-12

1 of 2

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534517.8, E-634140.7
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.62 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 22, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-12

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)					Undrained Shear Strength (kPa)					
							16	17	18	19	20	21	Test Type				
							Particle Size (%)					Torvane					
							0	20	40	60	80	100	0	50	100	150	200
							PL	MC	LL	Pocket Pen.							
							0	20	40	60	80	100	Qu				
							0	20	40	60	80	100	Field Vane				
	12				G179												
217.6	13		- clay to silt (till) transition														
216.7	14		SILT (TILL) - sandy, some clay, trace gravel - brown - moist, very dense - low plasticity		G180												
	15				G181												
	16				SS182	59											
	17				G183												
	18				SS184	65											
	19				G185												
211.3					SS186	77											

END TEST HOLE AT 19.3 m IN SILT (TILL)

Notes:

- 1) Power Auger Refusal at 19.3 m depth below surface.
- 2) Seepage and sloughing observed below 13.7 m depth.
- 3) Test hole open to 15.2 m depth below surface immediately after drilling.
- 4) Water level at 6.3 m depth below surface immediately after drilling.
- 5) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 6) Test hole located in front of 559 Leila Ave, Westbound, 1.45 m South of North curb.
- 7) Bulk sample obtained between 0.6 m and 2.0 m depth below pavement.

Logged By: Tyler Chapko

Reviewed By: Kent Bannister

Project Engineer: Nelson Ferreira

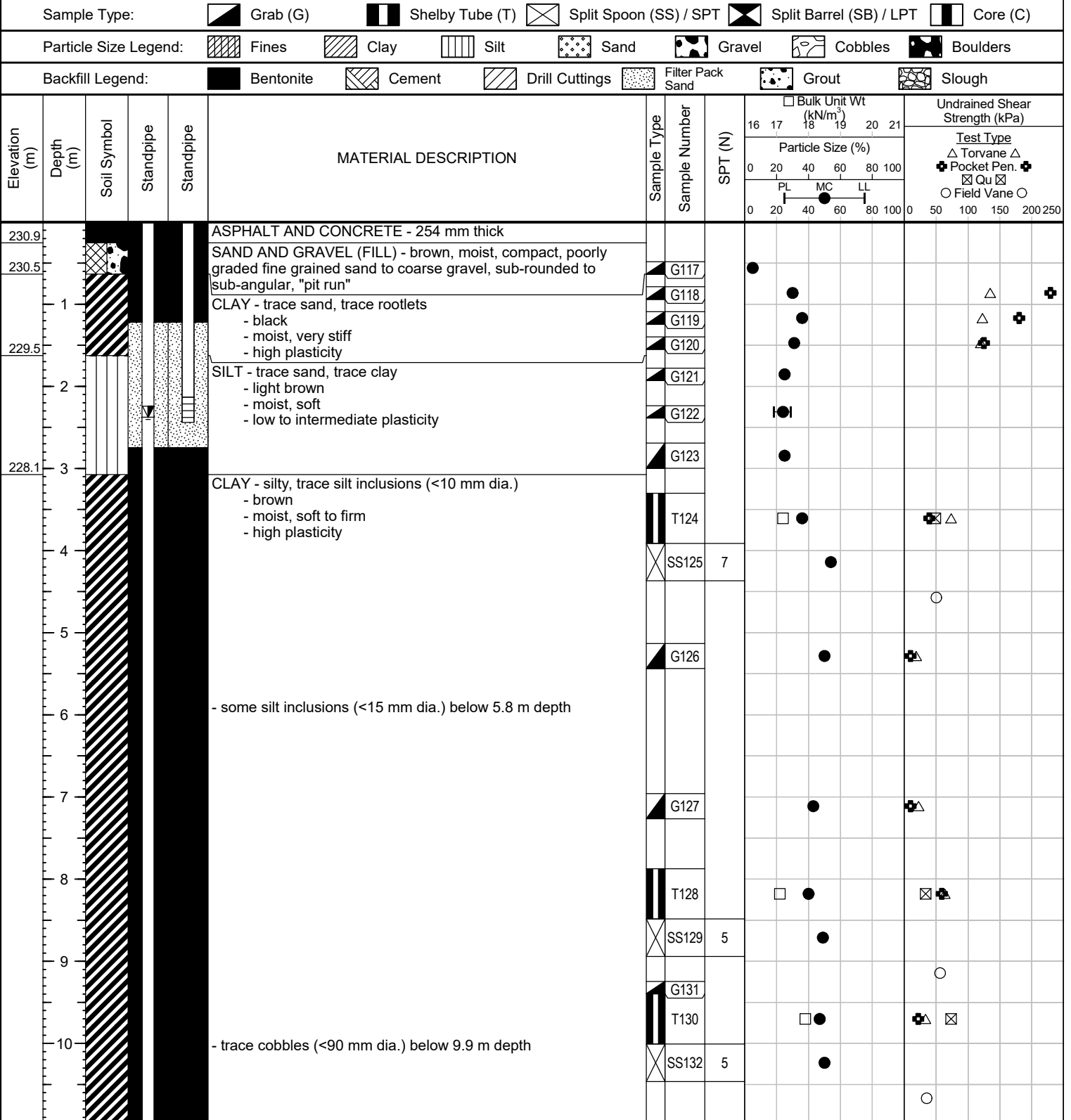


Sub-Surface Log

Test Hole TH22-13

1 of 2

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534432.9, E-634312.5
Contractor: Paddock Drilling Ltd. Ground Elevation: 231.15 m Top of Pavement
Method: 150mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 21, 2022



Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-13

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	Standpipe	Standpipe	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)			
									16	17	18	19	20	21	Test Type	
									0 20 40 60 80 100						△ Torvane △	
									PL MC LL						✦ Pocket Pen. ✦	
0 20 40 60 80 100						0 50 100 150 200 250										

END TEST HOLE AT 16.5 m IN SILT (TILL)

Notes:

- 1) Power Auger Refusal at 16.5 m depth below surface.
- 2) Seepage or sloughing not observed.
- 3) Test hole open to 16.5 m depth below surface immediately after drilling.
- 4) Test hole located in front of 535 Leila Ave, Westbound, 1.7 m South of North curb.
- 5) Field vane fin dimensions of 63 mm wide and 100 mm long, install depth of 300 mm into clay.
- 6) Standpipe (SP22-13A) installed at 16.5 m depth and standpipe (SP22-13B) at 2.5 m depth.
- 7) Bulk sample obtained between 0.3 m and 2.0 m depth below pavement.
- 8) Standpipe (SP22-13A) water elevations recorded per following:
 - October 13, 2022 - 222.8 m
 - November 20, 2022 - 225.8 m
 - February 2, 2023 - 225.4 m
 - April 27, 2023 - 228.8 m
 - June 8, 2023 - 226.3 m
- 9) Standpipe (SP22-13B) water elevations recorded per following:
 - October 13, 2022 - dry
 - November 20, 2022 - dry
 - February 2, 2023 - 228.8 m
 - April 27, 2023 - 230.3 m
 - June 8, 2023 - 229.1 m



Sub-Surface Log

Test Hole TH22-14

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534244.5, E-634115.6
Contractor: Paddock Drilling Ltd. Ground Elevation: 231.11 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 21, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)	
							16	17	18	19	20	21
230.9			ASPHALT AND CONCRETE - 178 mm thick									
230.8			SAND AND GRAVEL (FILL) - brown, moist, compact									
	1		CLAY - trace sand, black, moist, stiff, high plasticity - some silt, grey below 0.5 m depth	G109								
				G110								
229.4												
228.9	2		SILT - trace sand, trace clay, light brown, moist, soft, low to intermediate plasticity	G111								
			CLAY - silty, trace silt inclusions (<10 mm dia.) - brown - moist, soft to firm - high plasticity	G112								
	3			G113								
	4			G114								
	5			T115								
	6			G116								
224.8												

END TEST HOLE AT 6.3 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 5.2 m depth.
- 2) Test hole open to 5.2 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 1032 Diplomat Dr, 1.6 m West of East curb.

Logged By: Tyler Chapko

Reviewed By: Kent Bannister

Project Engineer: Nelson Ferreira



Sub-Surface Log

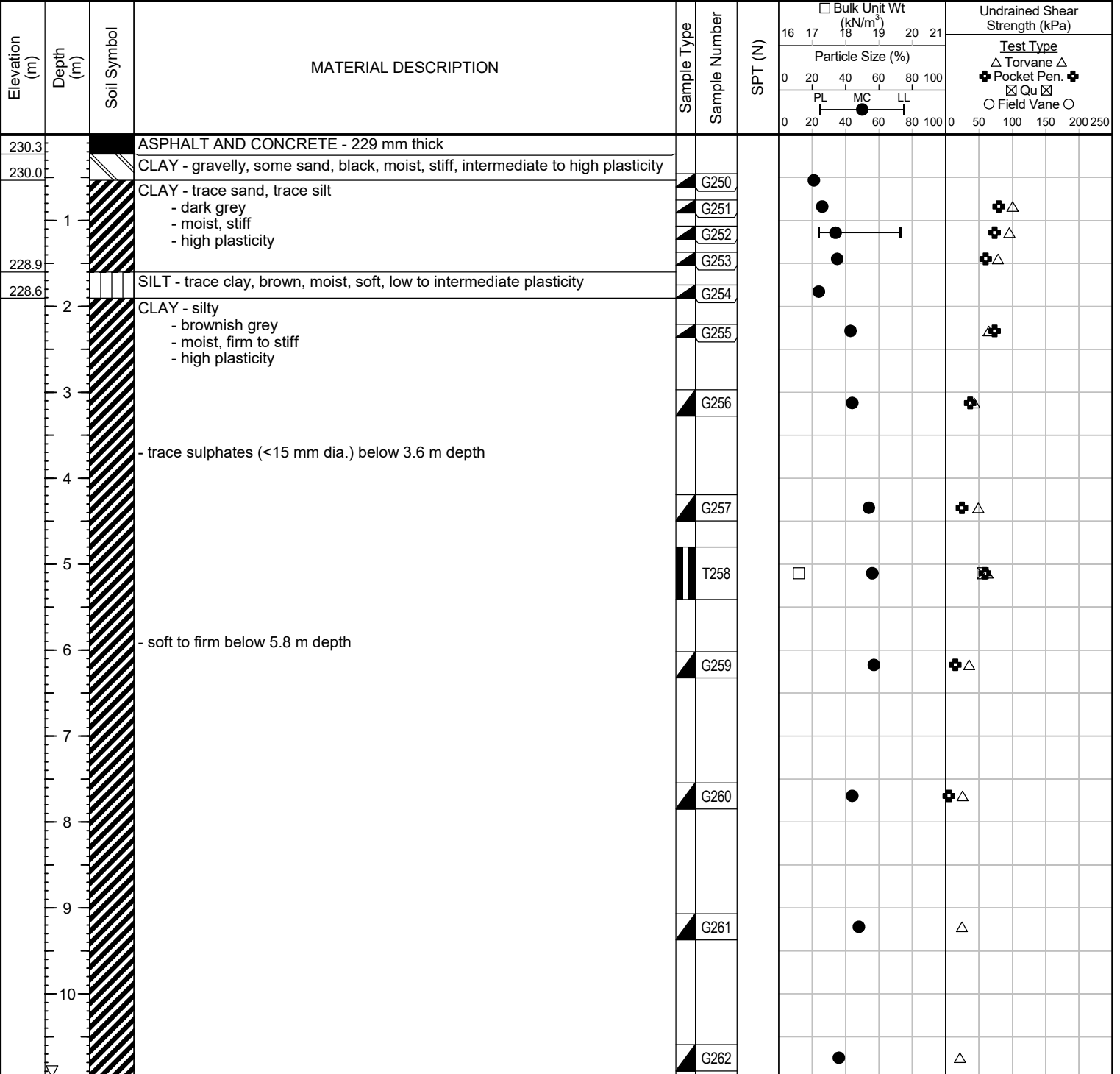
Test Hole TH22-15

1 of 2

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534347.2, E-634472
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.54 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 23, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-15

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)	Particle Size (%)	Undrained Shear Strength (kPa)	
							16 17 18 19 20 21	0 20 40 60 80 100	Test Type △ Torvane △ ✚ Pocket Pen. ✚ ⊠ Qu ⊠ ○ Field Vane ○	
	12				G263					
	13									
	14				G264					
	15									
	16				G265					
214.2										
	17		SILT (TILL) - sandy, some clay, some gravel - brown - moist, very dense - low plasticity		G266					
213.4					SS267	50 / 25mm				

END TEST HOLE AT 17.2 m IN SILT (TILL)

Notes:

- 1) Power Auger Refusal at 17.2 m depth below surface.
- 2) Seepage and sloughing observed below 14.6 m depth.
- 3) Test hole open to 14.6 m depth below surface immediately after drilling.
- 4) Water level at 11.0 m depth below surface immediately after drilling.
- 5) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 6) Test hole located in front of 455 Leila Ave, Westbound, 1.8 m South of North curb.
- 7) Bulk sample obtained between 0.3 m and 2.0 m depth below pavement.



Sub-Surface Log

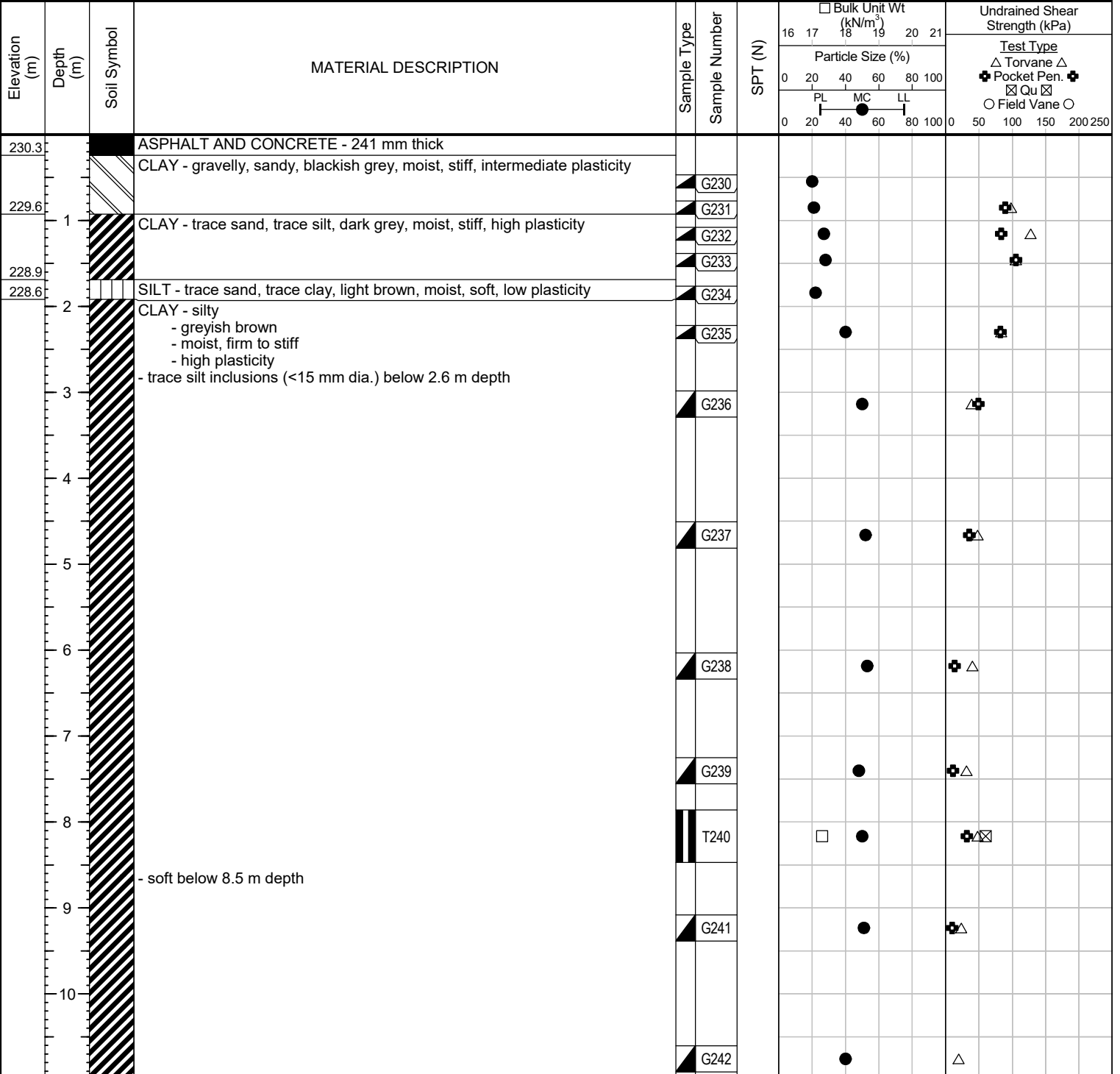
Test Hole TH22-16

1 of 2

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534283.7, E-634592.6
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.57 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 23, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)	Undrained Shear Strength (kPa)	
							16 17 18 19 20 21		
							Particle Size (%)		Test Type
							0 20 40 60 80 100	0 50 100 150 200 250	
							PL MC LL	0 20 40 60 80 100 0 50 100 150 200 250	
	12			G243				△	
	13								
	14			G244				△	
	15								
	16								
	17			G246				△	
	18			G247					
	19			SS248	36				
				G249					

END TEST HOLE AT 19.4 m IN SILT (TILL)

Notes:

- 1) Power Auger Refusal at 19.4 m depth below surface.
- 2) Seepage and sloughing observed below 15.1 m depth.
- 3) Test hole open to 15.2 m depth below surface immediately after drilling.
- 4) Water level at 15.1 m depth below surface immediately after drilling.
- 5) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 6) Test hole located in front of 419 Leila Ave, Westbound, 1.55 m North of South curb.
- 7) Bulk sample obtained between 0.6 m and 2.0 m depth below pavement.



Sub-Surface Log

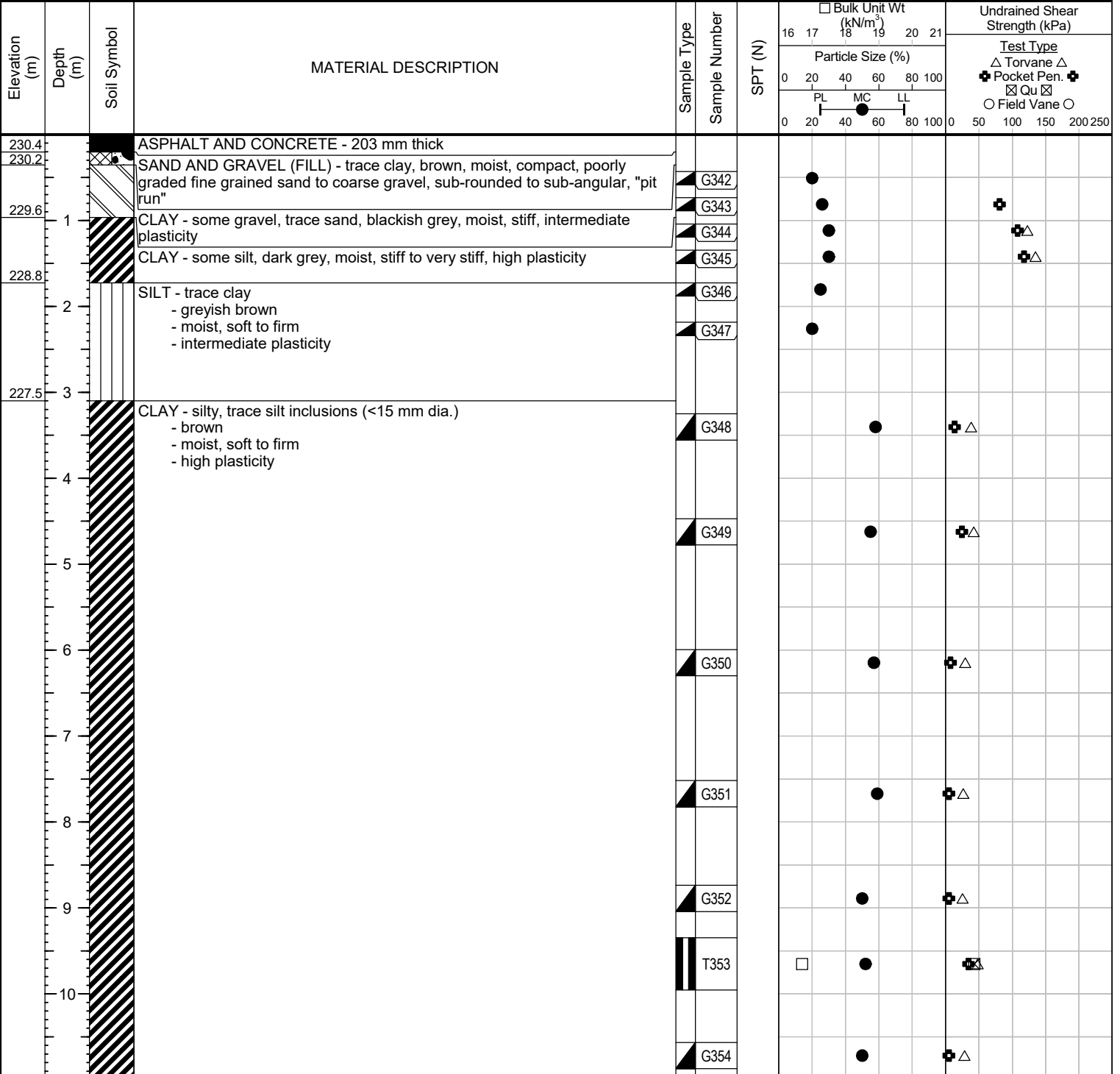
Test Hole TH22-17

1 of 2

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534180.4, E-634813.3
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.58 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 29, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-17

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)					Undrained Shear Strength (kPa)				
							Particle Size (%)					Test Type				
							16 17 18 19 20 21									
							0 20 40 60 80 100									
							PL MC LL									
							0 20 40 60 80 100									
							0 50 100 150 200 250									
	12				G355											
	13															
	14				G356											
	15															
	16				G357											
	17		- trace sand, trace gravel, light grey below 16.3 m depth		G358											
213.0	18		SILT (TILL) - sandy, some clay, some gravel - light brown - moist, dense - low plasticity		G359											
	19				SS360	46										
210.9					G361											

END TEST HOLE AT 19.7 m IN SILT (TILL)

Notes:

- 1) Power Auger Refusal at 19.7 m depth below surface.
- 2) Seepage or sloughing not observed. Squeezing below 14.9 m depth.
- 3) Test hole open to 14.9 m depth below surface immediately after drilling.
- 4) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 5) Test hole located in front of 352 Leila Ave, Westbound, 1.5 m North of South curb.
- 6) Bulk sample obtained between 0.3 m and 2.0 m depth below pavement.

Logged By: Tyler Chapko

Reviewed By: Kent Bannister

Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-18

1 of 1

Client: Jacobs Canada Inc. **Project Number:** 0336-003-00
Project Name: Armstrong Combined Sewer **Location:** UTM N-5533993.6, E-634706.4
Contractor: Paddock Drilling Ltd. **Ground Elevation:** 230.42 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount **Date Drilled:** September 22, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)	Particle Size (%)	Undrained Shear Strength (kPa)
230.2			ASPHALT AND CONCRETE - 241 mm thick						
229.9			SAND AND GRAVEL (FILL) - brown, moist, compact, poorly graded fine grained sand to coarse gravel, sub-rounded to sub-angular, "pit run"		G161				
	1		CLAY - trace gravel, trace sand - dark grey - moist, stiff to very stiff - high plasticity		G162				
229.0			SILT - some clay - brown - moist, soft - low to intermediate plasticity		G163				
228.0	2		SILT AND CLAY - - brown - moist, firm - intermediate plasticity						
227.4	3		CLAY - silty - dark brown - moist, firm to stiff - high plasticity		G164				
	4		- trace silt inclusions (<10 mm dia.) below 4.1 m depth		G165				
	5				T166				
	6				G167				
224.1									

END TEST HOLE AT 6.3 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 5.5 m depth.
- 2) Test hole open to 5.5 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 1035 Powers St, 2.3 m East of West curb.

Logged By: Tyler Chapko

Reviewed By: Kent Bannister

Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-19

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5533994.9, E-634905.4
Contractor: Paddock Drilling Ltd. Ground Elevation: 231.14 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 22, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☒ Silt ☒ Sand ☒ Gravel ☒ Cobbles ☒ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)	Particle Size (%)	Undrained Shear Strength (kPa)
230.9			ASPHALT AND CONCRETE - 203 mm thick						
230.6			SAND AND GRAVEL (FILL) - trace clay, brown, moist, compact, poorly graded fine grained sand to coarse gravel, sub-rounded to sub-angular, "pit run"		G154				
	1		CLAY - some silt, trace gravel, trace sand - dark grey - moist, stiff - high plasticity		G155				
229.4			- silty, brown below 1.1 m depth		G156				
	2		SILT AND CLAY - trace to some sand - brown - moist, soft to firm - intermediate plasticity		G157				
	3								
					G158				
227.3			CLAY - silty, trace silt inclusions (<5 mm dia.) - brown - moist, firm - high plasticity		G159				
	4								
	5		- trace sulphates (<10 mm dia.) below 4.7 m depth						
	6				G160				
224.8									

END TEST HOLE AT 6.3 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 4.0 m depth.
- 2) Test hole open to 4.0 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 1000 Salter St, 2.05 m East of West curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

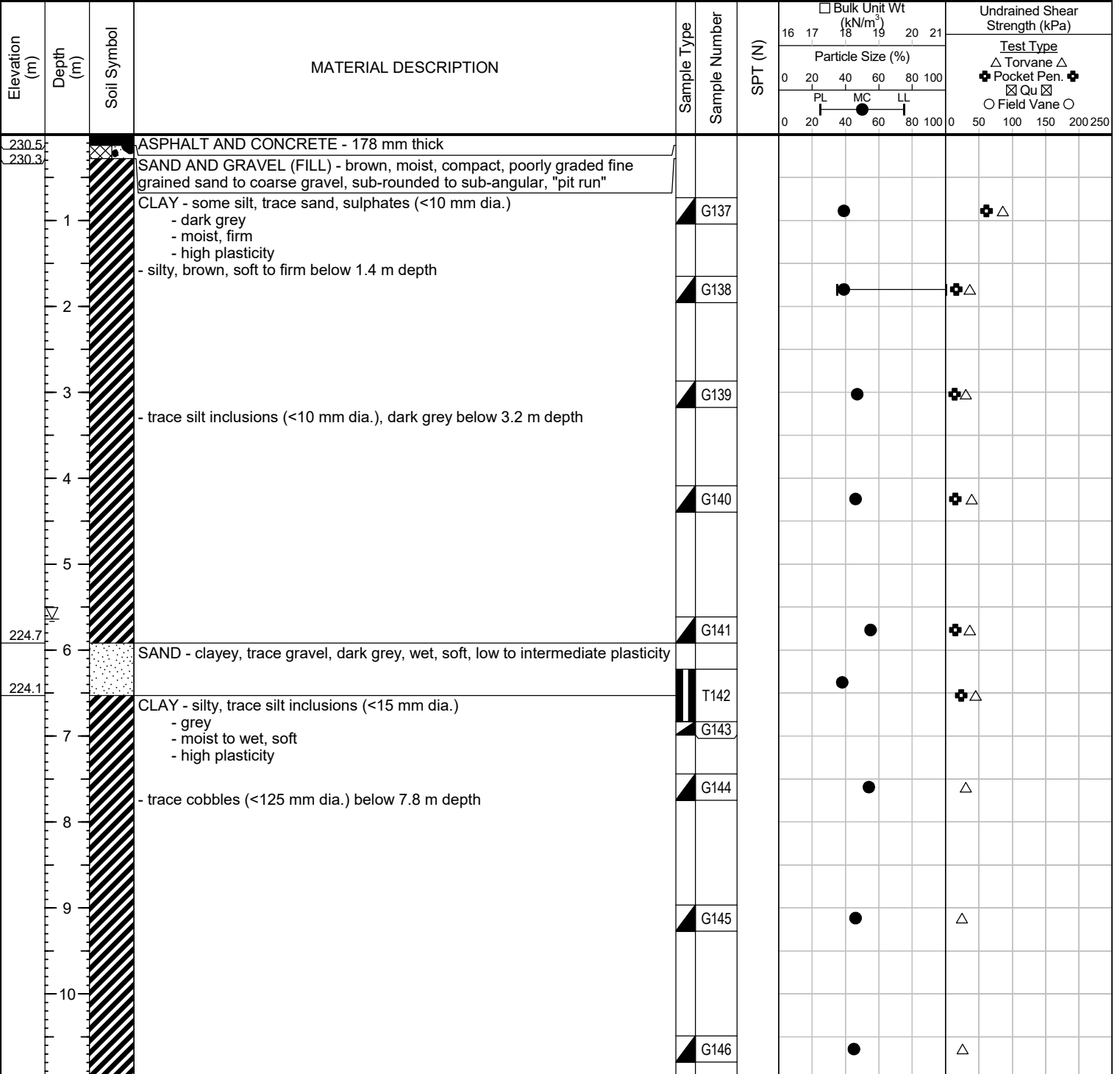
Test Hole TH22-20

1 of 2

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534186.1, E-635026.2
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.59 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 21, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-20

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)													
							16	17	18	19	20	21	Test Type											
													0	20	40	60	80	100	0	50	100	150	200	250
													PL	MC	LL									
	12				G147																			
	13																							
	14				G148																			
	15																							
	16																							
	17				G150																			
	18				G151																			
211.3	19																							
210.9			SILT (TILL) - some sand, some clay, trace gravel, brown, moist, very dense, low plasticity		G152																			

END TEST HOLE AT 19.6 m IN SILT (TILL)

Notes:

- 1) Power Auger Refusal at 19.6 m depth below surface.
- 2) Seepage and sloughing observed below 5.8 m depth.
- 3) Test hole open to 5.8 m depth below surface immediately after drilling.
- 4) Water level at 5.6 m depth below surface immediately after drilling.
- 5) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 6) Test hole located in front of 301 Newton Ave, 1.65 m South of North curb.



Sub-Surface Log

Test Hole TH22-21

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)							
							16	17	18	19	20	21	Test Type					
							0 20 40 60 80 100						△ Torvane △		✦ Pocket Pen. ✦			
							PL MC LL						⊠ Qu ⊠		○ Field Vane ○			
							0	20	40	60	80	100	0	50	100	150	200	250

Sub-Surface Log

Test Hole TH22-22

1 of 2

Client: Jacobs Canada Inc. **Project Number:** 0336-003-00
Project Name: Armstrong Combined Sewer **Location:** UTM N-5534076.8, E-635464
Contractor: Paddock Drilling Ltd. **Ground Elevation:** 230.33 m Top of Pavement
Method: 150mm Solid Stem Auger, Acker MP8 Truck Mount **Date Drilled:** September 28, 2022

Sample Type: ☒ Grab (G) ☒ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ☒ Core (C)
Particle Size Legend: ☒ Fines ☒ Clay ☒ Silt ☒ Sand ☒ Gravel ☒ Cobbles ☒ Boulders
Backfill Legend: ☒ Bentonite ☒ Cement ☒ Drill Cuttings ☒ Filter Pack Sand ☒ Grout ☒ Slough

Elevation (m)	Depth (m)	Soil Symbol	Standpipe	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³) Particle Size (%) Undrained Shear Strength (kPa)
230.2				ASPHALT AND CONCRETE - 178 mm thick				
229.8				CLAY - some gravel, some sand, dark grey, moist, firm, intermediate plasticity	G306			
229.3	1			CLAY - trace silt, dark grey, moist, very stiff, high plasticity	G307			
229.1				SILT AND CLAY - brown, moist, soft to firm, intermediate plasticity	G308			
				CLAY - silty, trace silt inclusions (<15 mm dia.)	G309			
	2			- grey				
				- moist, stiff				
				- high plasticity				
	2			- trace organics (<15 mm dia.), blackish grey from 2.0 m to 3.0 m depth				
	3				G310			
				- brown, soft to firm below 3.2 m depth				
	4							
	5				G311			
	6				G312			
	7				T313			
					SS314	6		
	8							
	9				G315			
	10				G316			

Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Nelson Ferreira



Sub-Surface Log

Test Hole TH22-22

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	Standpipe	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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END TEST HOLE AT 20.6 m IN SILT (TILL)

Notes:

- 1) Power Auger Refusal at 20.6 m depth below surface.
- 2) Seepage and sloughing observed below 19.8 m depth.
- 3) Test hole open to 19.8 m depth below surface immediately after drilling.
- 4) Water level at 7.6 m depth below surface immediately after drilling.
- 5) Test hole located in front of 195 Armstrong Ave, 1.35 m South of North curb.
- 6) Field vane fin dimensions of 2.5" wide and 4" long, install depth of 1 ft into clay.
- 7) Standpipe (SP22-22) installed at 19.8 m depth below ground surface.
- 8) Standpipe (SP22-22) water elevations recorded per following:
 - October 13, 2022 - 213.9 m
 - November 20, 2022 - 218.6 m
 - January 19, 2023 - 221.9 m
 - February 2, 2023 - 222.3 m
 - April 27, 2023 - 225.7 m
 - June 8, 2023 - 224.0 m



Sub-Surface Log

Test Hole TH22-23

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534465.4, E-634585.5
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.29 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 23, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)	
							16	17	18	19	20	21
230.2			CONCRETE - 114 mm thick									
229.6			CLAY - some gravel, some sand, dark grey, moist, stiff, intermediate to high plasticity		G268							
	1		CLAY - silty, trace precipitates (<10 mm dia.) - brown - moist, stiff - high plasticity		G269							
228.7												
	2		SILT - trace clay - light brown - moist, soft - low to intermediate plasticity		G270							
227.7												
227.5			CLAY - silty, brown, moist, stiff, high plasticity		G271							
227.1	3		SILT - some clay, brown, moist, soft to firm, intermediate plasticity		G272							
			CLAY - silty, trace sulphates (<10 mm dia.) - brownish grey - moist, firm to stiff - high plasticity		G273							
	4											
					G274							
	5											
224.1	6				G275							

END TEST HOLE AT 6.2 m DEPTH IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 5.6 m depth.
- 2) Test hole open to 5.6 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 523 Sly Dr, 1.45 m East of West curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-24

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534401.9, E-634903.8
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.44 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 23, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☒ Silt ☒ Sand ☒ Gravel ☒ Cobbles ☒ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)	Particle Size (%)	Undrained Shear Strength (kPa)	Test Type
230.2			ASPHALT AND CONCRETE - 229 mm thick							
229.9			SAND AND GRAVEL (FILL) - light brown, dry to moist, compact, poorly graded fine grained sand to coarse gravel, sub-rounded to sub-angular, "pit run"		G223					
	1		CLAY - gravelly, sandy - brown - moist, firm to stiff - intermediate plasticity		G224					
228.8			SILT - some clay, trace sand, brown, moist, soft, low to intermediate plasticity		G225					
228.1	2		CLAY - silty, trace silt inclusions (<10 mm dia.), trace sulphates (<10 mm dia.) - brownish grey - moist, stiff - high plasticity - firm below 3.0 m depth		G226					
	3				T227					
	4				G228					
	5									
	6				G229					
224.1										

END TEST HOLE AT 6.3 m IN CLAY

Notes:

- 1) Seepage or not sloughing observed. Squeezing below 5.0 m depth.
- 2) Test hole open to 5.0 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 1154 Salter St, 2.0 m West of East curb.

Logged By: Tyler Chapko

Reviewed By: Kent Bannister

Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-25

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534703.7, E-634755.5
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.48 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 28, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)	
							16	17	18	19	20	21
230.4			CONCRETE - 102 mm thick									
	1		CLAY - some silt, trace sand - grey - moist, firm to stiff - high plasticity		G283							
					G284							
229.0												
	2		SILT - some clay, trace sand, light brown, moist, soft, low to intermediate plasticity		G285							
228.5			CLAY - silty, trace silt inclusions (<10 mm dia.) - brownish grey - moist, firm to stiff - high plasticity									
					G286							
	3											
	4											
	5				G287							
	6				G288							
224.3												

END TEST HOLE AT 6.2 m IN CLAY

Notes:

- 1) Seepage not observed. Sloughing observed between 1.4 m to 1.9 m depth.
- 2) Test hole open to 1.7 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 456 Sly Dr, 2.1 m West of East curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-26

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534642.3, E-635004.4
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.35 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 29, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)	
							16	17	18	19	20	21
230.1			ASPHALT AND CONCRETE - 203 mm thick									
	1		CLAY - gravelly, sandy - dark grey - moist, firm - intermediate plasticity		G382							
					G383							
228.5	2		SILT - some clay - greyish brown - moist, soft to firm - intermediate plasticity		G384							
	3											
227.1			CLAY - silty, trace silt inclusions (<5 mm dia.) - brown - moist, firm to stiff - high plasticity		G385							
	4											
	5				T386							
	6											
224.1					G387							

END TEST HOLE AT 6.3 m IN CLAY

Notes:

- 1) Seepage not observed. Sloughing observed below 2.7 m depth.
- 2) Test hole open to 2.7 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located on Salter St 15 m North of Templeton Ave, 1.6 m East of West curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

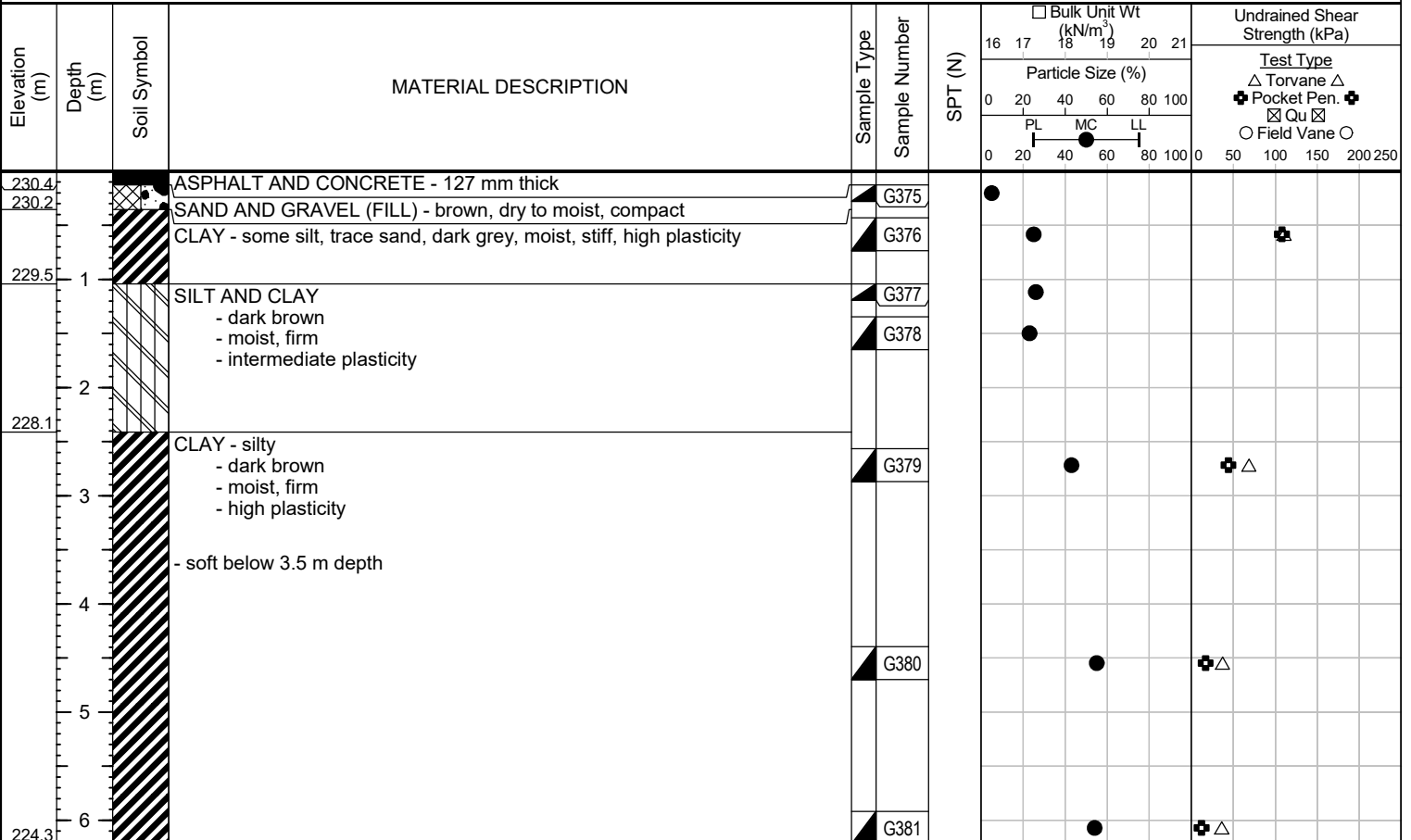
Test Hole TH22-27

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534509.5, E-635176.1
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.51 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 29, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



END TEST HOLE AT 6.2 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 5.8 m depth.
- 2) Test hole open to 5.8 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located on Tanner St 10 m South of Templeton Ave, 1.4 m West of East curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-28

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534792.5, E-635099.3
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.56 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 28, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☒ Silt ☒ Sand ☒ Gravel ☒ Cobbles ☒ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)	
							16	17	18	19	20	21
							0 20 40 60 80 100		0 20 40 60 80 100		0 50 100 150 200 250	
							PL MC LL				Test Type △ Torvane △ ✱ Pocket Pen. ✱ ⊠ Qu ⊠ ○ Field Vane ○	
							0 20 40 60 80 100		0 20 40 60 80 100		0 50 100 150 200 250	
229.3	1		ORGANIC CLAY (TOPSOIL) - trace sand, trace gravel, trace rootlets - black - moist, stiff - intermediate plasticity		G276							
229.0			CLAY - silty, brownish grey, moist, stiff, high plasticity		G277							
	2		SILT - trace clay, light brown, moist, soft, low to intermediate plasticity		G278							
228.2			CLAY - silty - brown - moist, firm - high plasticity - trace silt inclusions (<10 mm dia.) below 3 m depth		G279							
	3				T280							
	4		- firm below 4.1 m depth		G281							
	5											
224.5	6				G282							

END TEST HOLE AT 6.1 m DEPTH IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 4.9 m depth.
- 2) Test hole open to 4.9 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings and bentonite
- 4) Test hole located beside 337 Southall Dr on grass boulevard.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

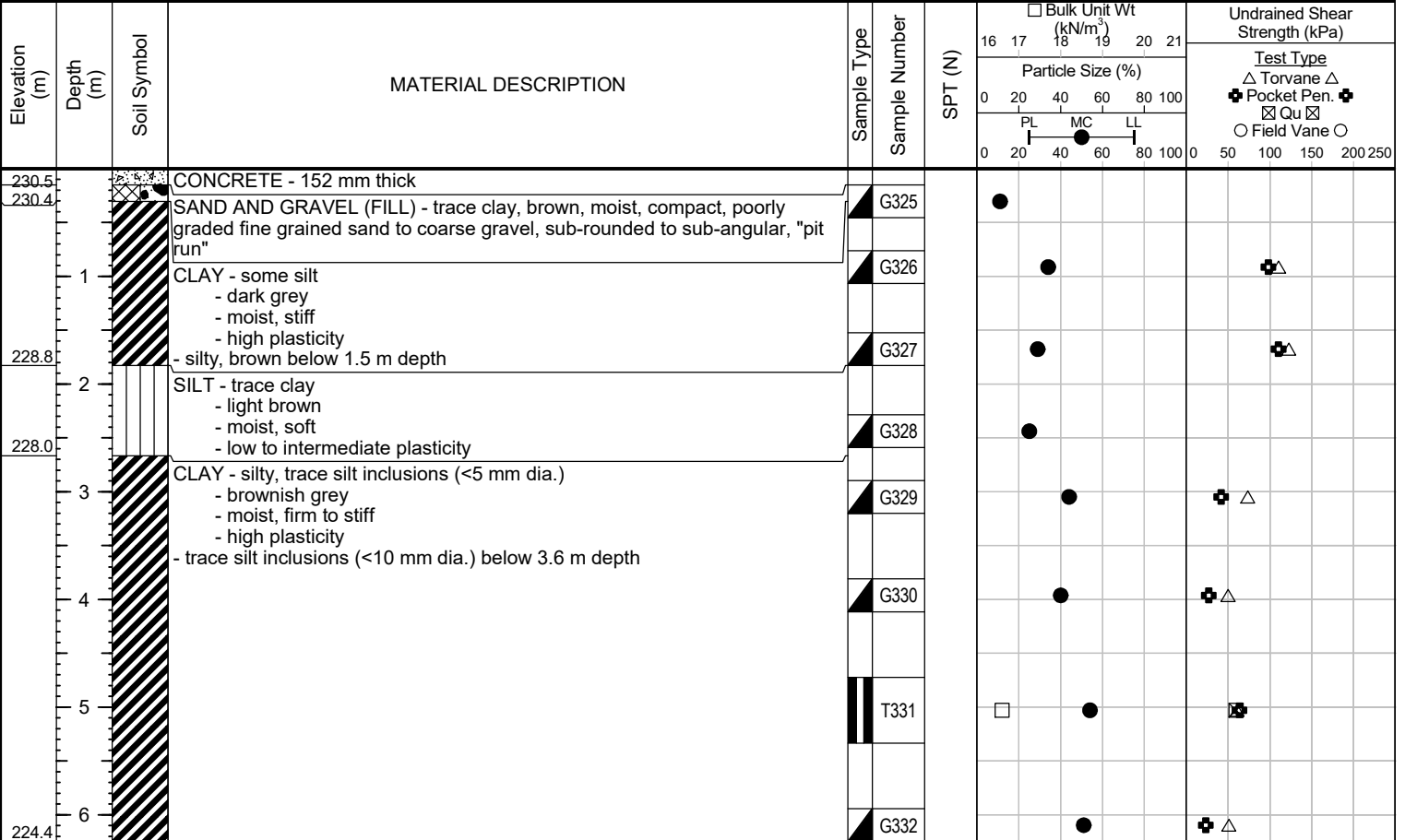
Test Hole TH22-29

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534642.1, E-635341.1
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.66 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 29, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders



END TEST HOLE AT 6.3 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 5.9 m depth.
- 2) Test hole open to 5.9 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located bin front of 275 Southall Dr, 1.7 m South of North curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-30

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534688.6, E-635682.9
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.65 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 29, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)	Particle Size (%)	Undrained Shear Strength (kPa)
230.5			CONCRETE - 152 mm thick						
230.4			SAND AND GRAVEL (FILL) - brown, moist, compact, poorly graded fine grained sand to coarse gravel, sub-rounded to sub-angular, "pit run"		G388				
	1		CLAY - trace silt - blackish grey - moist, stiff - high plasticity						
229.1			SILT - trace clay - light brown - moist, soft - low to intermediate plasticity		G389				
228.1			CLAY - silty, trace silt inclusions (<5 mm dia.) - brown - moist, firm - high plasticity		G390 T391				
	4		- soft below 4.0 m depth		G392				
	5								
224.4	6				G393				

END TEST HOLE AT 6.3 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 5.9 m depth.
- 2) Test hole open to 5.9 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 209 Seaforth Ave, 1.7 m South of North curb.

Logged By: Tyler Chapko

Reviewed By: Kent Bannister

Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-31

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534444.9, E-635557.6
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.84 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 29, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)	
							16	17	18	19	20	21
230.7			ASPHALT AND CONCRETE - 165 mm thick									
230.5			SAND AND GRAVEL (FILL) - trace clay, brown, dry to moist, compact, poorly graded fine grained sand to coarse gravel, sub-rounded to sub-angular, "pit run"		G362							
	1		CLAY - trace silt, trace sand - dark grey - moist, stiff - high plasticity		G363							
229.1												
	2		SILT - some clay, greyish brown, moist to wet, very soft to soft, low to intermediate plasticity		G364							
228.5												
	3		CLAY - silty - brown - moist, firm to stiff - high plasticity		G365							
	4											
	5				G366							
	6				G367							
224.6												

END TEST HOLE AT 6.3 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 5.0 m depth.
- 2) Test hole open to 5.0 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 205 Margaret Ave, 1.5 m South of North curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-32

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534385.9, E-635550
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.79 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 29, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)	
							16	17	18	19	20	21
230.5			ASPHALT, GRANULAR, AND CONCRETE - 318 mm thick									
	1		CLAY - trace silt, trace sand - dark grey - moist, stiff - high plasticity - silty, brown below 1.1 m depth		G333							
					G334							
228.9	2		SILT - some clay - light brown - moist to wet, soft - low to intermediate plasticity		G335							
228.2												
	3		CLAY - silty, trace silt inclusions (<10 mm dia.) - brown - moist, stiff - high plasticity		G336							
	4											
			- soft to firm below 4.3 m depth		G337							
	5											
	6				G338							
	7				G339							
	8				T340							
	9											
221.3					G341							

END TEST HOLE AT 9.5 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 8.5 m depth.
- 2) Test hole open to 8.5 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 2050 Main St, 1.4 m East of West curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



Sub-Surface Log

Test Hole TH22-33

1 of 1

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534417.7, E-635407.3
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.20 m Top of Pavement
Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount Date Drilled: September 29, 2022

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

Particle Size Legend: ☒ Fines ☒ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m ³)	Particle Size (%)	Undrained Shear Strength (kPa)
230.0			ASPHALT AND CONCRETE - 178 mm thick						
229.7			SAND (FILL) - gravelly, trace clay, light brown, dry to moist, loose to compact, poorly graded fine grained sand to coarse gravel, sub-rounded to sub-angular, "pit run"	G368					
	1		CLAY - silty - greyish brown - moist, stiff - high plasticity	G369					
228.6			SILT - some clay - light brown - moist, soft - low to intermediate plasticity	G370					
	2								
	3			G371					
227.0			CLAY - silty, trace silt inclusions (<10 mm dia.) - brown - moist, soft to firm - high plasticity	G372					
	4								
	5			T373					
	6			G374					
223.9									

END TEST HOLE AT 6.3 m IN CLAY

Notes:

- 1) Seepage or sloughing not observed. Squeezing below 5.9 m depth.
- 2) Test hole open to 5.9 m depth below surface immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite, and cold patch asphalt.
- 4) Test hole located in front of 221 Templeton Ave, 1.5 m North of South curb.

Logged By: Tyler Chapko Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira



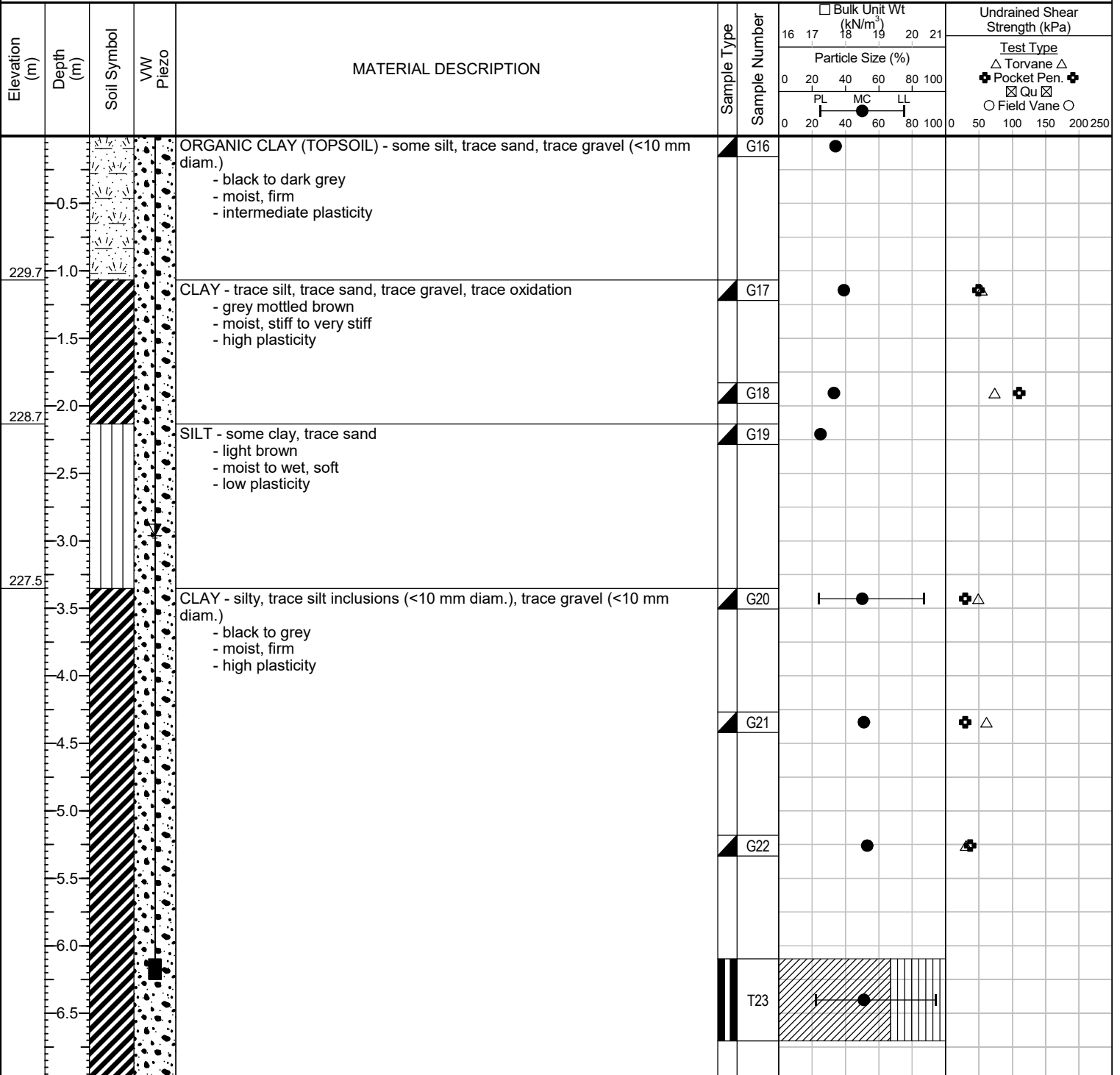
Sub-Surface Log

Test Hole TH23-01

1 of 2

Client: Jacobs Canada Inc. Project Number: 0336-003-00
Project Name: Armstrong Combined Sewer Location: UTM N-5534570, E-634572
Contractor: Paddock Drilling Ltd. Ground Elevation: 230.81 m
Method: 125 mm Solid Stem Auger, Acker SS3 Track Mount Date Drilled: January 20, 2023

Sample Type: ☒ Grab (G) ☒ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ☒ Core (C)
Particle Size Legend: ☒ Fines ☒ Clay ☒ Silt ☒ Sand ☒ Gravel ☒ Cobbles ☒ Boulders
Backfill Legend: ☒ Bentonite ☒ Cement ☒ Drill Cuttings ☒ Filter Pack Sand ☒ Grout ☒ Slough



Logged By: Tyson Roeland Reviewed By: Kent Bannister Project Engineer: Nelson Ferreira

Sub-Surface Log

Test Hole TH23-01

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	VW Piezo	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)					Undrained Shear Strength (kPa)						
							16	17	18	19	20	21	Test Type					
							Particle Size (%)					△ Torvane △						
							0	20	40	60	80	100	✚ Pocket Pen. ✚					
							0	20	40	60	80	100	0	50	100	150	200	250
							0	20	40	60	80	100						
							0	20	40	60	80	100						
							0	20	40	60	80	100						
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				</														

END TEST HOLE AT 12.2 m IN CLAY

Notes:

- 1) Seepage and sloughing observed between 2.3 to 3.4 m depth.
- 2) Test hole open to 12.2 m depth below surface immediately after drilling.
- 3) Vibrating wire piezometer (VW-01) installed at 6.1 m depth.
- 4) Test hole backfilled with grout to surface.
- 5) Vibrating wire piezometer (VW-01) water elevations recorder per following:
 - February 2, 2023 - 227.9 m
 - March 30, 2023 - 227.5 m
 - April 27, 2023 - 227.5 m
 - June 8, 2023 - 227.3 m

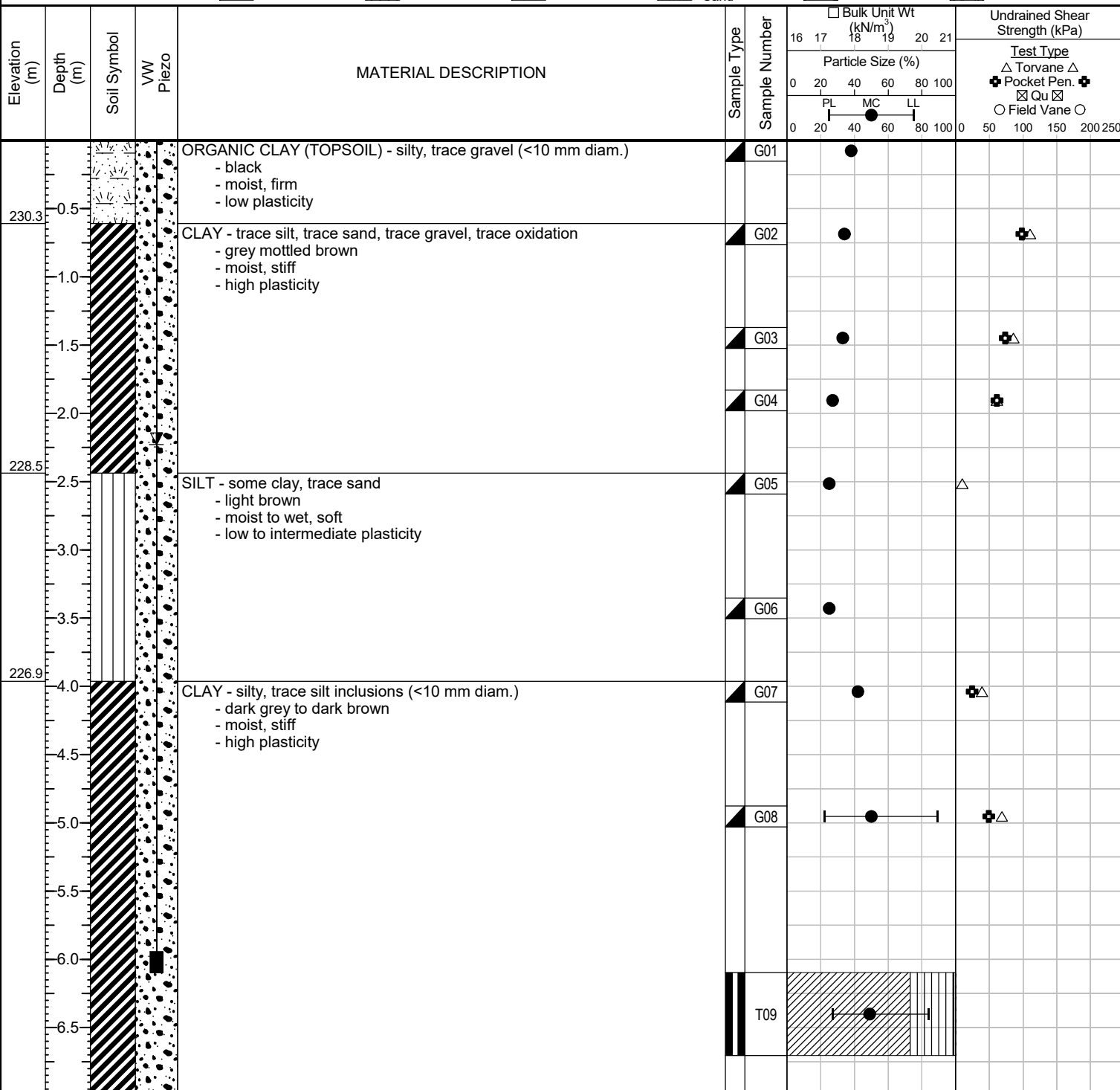
Sub-Surface Log

Test Hole TH23-02

1 of 2

Client: Jacobs Canada Inc. **Project Number:** 0336-003-00
Project Name: Armstrong Combined Sewer **Location:** UTM N-5534520, E-634525
Contractor: Paddock Drilling Ltd. **Ground Elevation:** 230.89 m
Method: 125 mm Solid Stem Auger, Acker SS3 Track Mount **Date Drilled:** January 20, 2023

Sample Type: ☒ Grab (G) ☐ Shelby Tube (T) ☐ Split Spoon (SS) / SPT ☐ Split Barrel (SB) / LPT ☐ Core (C)
Particle Size Legend: ☒ Fines ☐ Clay ☐ Silt ☐ Sand ☐ Gravel ☐ Cobbles ☐ Boulders
Backfill Legend: ☐ Bentonite ☐ Cement ☐ Drill Cuttings ☐ Filter Pack Sand ☐ Grout ☐ Slough





Sub-Surface Log

Test Hole TH24-01

1 of 2

Client: Jacobs Canada Inc.

Project Number: 0336-003-00

Project Name: Armstrong Combined Sewer - Rail Crossings

Location: UTM N-5534390, E-634384

Contractor: Paddock Drilling Ltd.

Ground Elevation: 231.45 m (geodetic)

Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount

Date Drilled: February 1, 2024

Sample Type:

☒ Grab (G)

☐ Shelby Tube (T)

☐ Split Spoon (SS) / SPT

☐ Split Barrel (SB) / LPT

☐ Core (C)

Particle Size Legend:

☒ Fines

☒ Clay

☐ Silt

☐ Sand

☐ Gravel

☐ Cobbles

☐ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m³)					Undrained Shear Strength (kPa)					
						16	17	18	19	20	21	Test Type				
						Particle Size (%)					0 50 100 150 200					
						0	20	40	60	80	100	0	50	100	150	200
												</				

Logged By: Enrico Manimbao

Reviewed By: Matt Klymochko

Project Engineer: Nelson Ferreira



Sub-Surface Log

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)					Undrained Shear Strength (kPa)				
						Particle Size (%)					Test Type				
						0 20 40 60 80 100					△ Torvane △ ✦ Pocket Pen. ✦ ⊠ Qu ⊠ ○ Field Vane ○				
						PL	MC	LL			0	50	100	150	200250
	12				G13		●							✦	
	13														
	14				G14		●							✦	
	15				G15			●						✦	
216.2			SILT (TILL) - some sand, trace gravel, trace clay - light brown - moist, compact - no to low plasticity		G16	●									
	16														
214.7															

END OF TEST HOLE AT 16.8 m IN SILT (TILL)

Notes:

- 1) Power auger refusal at 16.8 m depth.
- 2) Seepage and sloughing observed between 2.4 to 3.2 m depth in SILT.
- 3) Test hole open to 14.2 m depth immediately after drilling.
- 4) Water level at 14.1 m depth immediately after drilling.
- 5) Test hole backfilled with auger cuttings, bentonite, sand, and asphalt cold patch to surface.
- 6) Test hole elevation measured relative to a Temporary Benchmark (BM-2) established by Jacobs as 231.95 m on the top of rail at UTM 14U, N-5534409, E-634361.



Sub-Surface Log

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)		Undrained Shear Strength (kPa)									
						16	17	18	19	20	21						
						Particle Size (%)						Test Type					
						0	20	40	60	80	100	0	50	100	150	200	250
						PL	MC	LL									
						0	20	40	60	80	100	0	50	100	150	200	250

Logged By: Enrico Manimbao **Reviewed By:** Matt Klymochko **Project Engineer:** Nelson Ferreira



Sub-Surface Log

Test Hole TH24-03

1 of 1

Client: Jacobs Canada Inc.

Project Number: 0336-003-00

Project Name: Armstrong Combined Sewer - Rail Crossings

Location: UTM N-5534583, E-634511

Contractor: Paddock Drilling Ltd.

Ground Elevation: 231.11 m (geodetic)

Method: 125mm Solid Stem Auger, Acker MP8 Truck Mount

Date Drilled: February 1, 2024

Sample Type:

☒ Grab (G)

☐ Shelby Tube (T)

☐ Split Spoon (SS) / SPT

☐ Split Barrel (SB) / LPT

☐ Core (C)

Particle Size Legend:

☒ Fines

☐ Clay

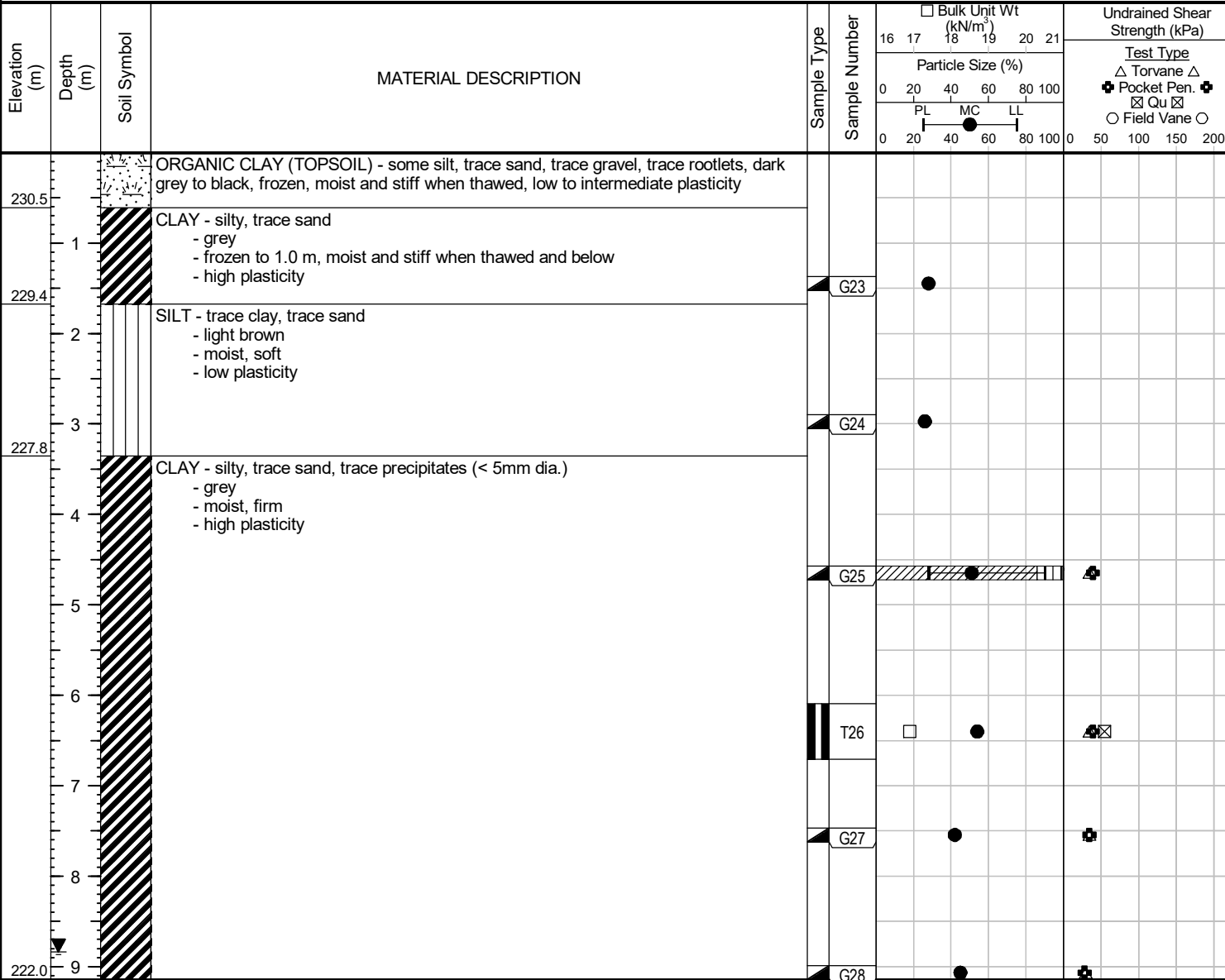
☐ Silt

☐ Sand

☐ Gravel

☐ Cobbles

☐ Boulders



END OF TEST HOLE AT 9.1 m IN CLAY

Notes:

- 1) Seepage and sloughing observed between 2.7 to 3.4 m depth in SILT.
- 2) Test hole open to 8.8 m depth immediately after drilling.
- 3) Water level at 8.8 m depth immediately after drilling.
- 4) Test hole backfilled with auger cuttings and bentonite to surface.
- 5) Test hole elevation measured relative to a Temporary Benchmark (BM-2) established by Jacobs as 231.78 m on the top of rail at UTM 14U, N-5534552, E-634502.

APPENDIX B

2022 to 2024 Trek Geotechnical Laboratory Testing
Results



LABORATORY REQUISITION

CLIENT Jacobs Canada Inc.

PROJECT NO: 0336-003-00

PROJECT NAME Armstrong Combined Sewer

FIELD TECHNICIAN: Tyler Chapko

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILIARY TESTS	water soluble sulphate	Soil Description/Comments
TH22-21	G206	1.6 - 2.6		X								
TH22-21	G207	4.6 - 5.6		X								
TH22-21	G208	8.6 - 9.6		X								
TH22-21	G209	10.1 - 10.6		X								
TH22-21	G210	14.6 - 15.6		X								
TH22-21	G211	16.6 - 17.6		X								
TH22-21	G212	19.6 - 20.6		X								
TH22-21	G213	24.6 - 25.6		X								
TH22-21	G214	29.6 - 30.6		X								
TH22-21	G215	34.6 - 35.6		X								
TH22-21	G216	39.6 - 40.6		X								
TH22-21	G217	44.6 - 45.6		X								
TH22-21	G218	49.6 - 50.6		X								
TH22-21	G219	54.6 - 55.6		X		X						
TH22-21	G220	59.6 - 60.6		X								
TH22-21	G221	62.6 - 63.6		X								
TH22-21	SS222	65.6 - 65.9		X								
TH22-22	G306	0.6 - 1.6		X								
TH22-22	G307	2.1 - 3.1		X								
TH22-22	G308	3.6 - 4.1		X								
TH22-22	G309	4.6 - 5.6		X								
TH22-22	G310	9.6 - 10.6		X		X						
TH22-22	G311	14.6 - 15.6		X								
TH22-22	G312	18.6 - 19.6		X								
TH22-22	T313	20.6 - 22.6		X						X		
TH22-22	SS314	22.6 - 24.1		X								
TH22-22	G315	27.6 - 28.6		X								
TH22-22	G316	32.6 - 33.6		X								
TH22-22	G317	37.6 - 38.6		X								
TH22-22	T318	40.6 - 42.6		X						X		
TH22-22	SS319	42.6 - 44.1		X								
TH22-22	G320	48.6 - 49.6		X								
TH22-22	G321	54.6 - 55.6		X								
TH22-22	G322	59.6 - 60.6		X								
TH22-22	G323	62.6 - 63.6		X		X						

REQUESTED BY: Tyler Chapko

REPORT TO: MVH, TC

REQUISITION DATE: Oct. 17, 2022

DATE REQUIRED: _____

COMMENTS: _____

REQUISITION NO. _____

PAGE 9 OF 12

TREK LABORATORY REQUISITION LOGS 2022-08-23 ARMSTRONG SEWER O.A. TC 0336 003 00 GPJ TREK GEOTECHNICAL GDT 10/17/22



LABORATORY REQUISITION

CLIENT Jacobs Canada Inc.PROJECT NO: 0336-003-00PROJECT NAME Armstrong Combined SewerFIELD TECHNICIAN: Tyler Chapko

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILIARY TESTS	Water Soluble Sulphate	Soil Description/Comments
TH22-22	SS324	65.6 - 67.1		X								
TH22-23	G268	0.4 - 1.4		X								
TH22-23	G269	2.4 - 3.4		X								
TH22-23	G270	5.4 - 6.4		X								
TH22-23	G271	8.4 - 9.4		X								
TH22-23	G272	9.4 - 10.4		X								
TH22-23	G273	11.4 - 12.4		X								
TH22-23	G274	14.4 - 15.4		X								
TH22-23	G275	19.4 - 20.4		X								
TH22-24	G223	0.8 - 1.8		X								
TH22-24	G224	2.8 - 3.8		X								
TH22-24	G225	5.8 - 6.8		X								
TH22-24	G226	8.8 - 9.8		X								
TH22-24	T227	10.8 - 12.8		X					X			
TH22-24	G228	14.8 - 15.8		X								
TH22-24	G229	19.8 - 20.8		X								
TH22-25	G283	0.8 - 1.8		X								
TH22-25	G284	3.3 - 4.3		X								
TH22-25	G285	5.3 - 6.3		X								
TH22-25	G286	8.3 - 9.3		X		X						
TH22-25	G287	14.3 - 15.3		X								
TH22-25	G288	19.3 - 20.3		X								
TH22-26	G382	1.7 - 2.7		X								
TH22-26	G383	4.7 - 5.7		X								
TH22-26	G384	7.7 - 8.7		X								
TH22-26	G385	11.7 - 12.7		X								
TH22-26	T386	15.7 - 17.7		X					X			
TH22-26	G387	19.7 - 20.7		X								
TH22-27	G375	0.4 - 0.9		X								
TH22-27	G376	1.4 - 2.4		X								
TH22-27	G377	3.4 - 3.9		X								
TH22-27	G378	4.4 - 5.4		X								
TH22-27	G379	8.4 - 9.4		X								
TH22-27	G380	14.4 - 15.4		X								
TH22-27	G381	19.4 - 20.4		X								

REQUESTED BY: Tyler ChapkoREPORT TO: MVH, TC

REQUISITION NO.

REQUISITION DATE: OCT. 17, 2022

DATE REQUIRED:

COMMENTS:

PAGE 10 OF 12

TREK LABORATORY REQUISITION LOGS 2022-09-23 ARMSTRONG SEWER 0 A TC 0336 003 00 GP TREK GEOTECHNICAL GDT 10/17/22



LABORATORY REQUISITION

CLIENT Jacobs Canada Inc.PROJECT NO: 0336-003-00PROJECT NAME Armstrong Combined SewerFIELD TECHNICIAN: Tyler Chapko

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILIARY TESTS	Water Soluble Sulphate	Soil Description/Comments
TH22-28	G276	1.0 - 2.0		X								
TH22-28	G277	4.0 - 5.0		X								
TH22-28	G278	5.5 - 6.5		X	X							
TH22-28	G279	8.0 - 9.0		X								
TH22-28	T280	10.0 - 12.0		X					X			
TH22-28	G281	14.0 - 15.0		X								
TH22-28	G282	19.0 - 20.0		X								
TH22-29	G325	0.5 - 1.5		X								
TH22-29	G326	2.5 - 3.5		X								
TH22-29	G327	5.0 - 6.0		X								
TH22-29	G328	7.5 - 8.5		X								
TH22-29	G329	9.5 - 10.5		X								
TH22-29	G330	12.5 - 13.5		X								
TH22-29	T331	15.5 - 17.5		X						/		could not find
TH22-29	G332	19.5 - 20.5		X								
TH22-30	G388	1.5 - 2.5		X								
TH22-30	G389	5.5 - 6.5		X								
TH22-30	G390	9.5 - 10.5		X								
TH22-30	T391	10.5 - 12.5		X					X			
TH22-30	G392	14.5 - 15.5		X								
TH22-30	G393	19.5 - 20.5		X								
TH22-31	G362	0.5 - 1.0		X								
TH22-31	G363	2.5 - 3.5		X								
TH22-31	G364	6.5 - 7.5		X								
TH22-31	G365	9.5 - 10.5		X								
TH22-31	G366	14.5 - 15.5		X								
TH22-31	G367	19.5 - 20.5		X								
TH22-32	G333	2.0 - 3.0		X								
TH22-32	G334	5.0 - 6.0		X								
TH22-32	G335	7.0 - 8.0		X								
TH22-32	G336	10.0 - 11.0		X								
TH22-32	G337	15.0 - 16.0		X								
TH22-32	G338	20.0 - 21.0		X								
TH22-32	G339	24.0 - 25.0		X								
TH22-32	T340	26.0 - 28.0		X					X			

REQUESTED BY: Tyler ChapkoREPORT TO: MVH, TC

REQUISITION NO.

REQUISITION DATE: Oct. 17, 2022

DATE REQUIRED: _____

COMMENTS: _____

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TREK LABORATORY REQUISITION LOGS 2022-08-23 ARMSTRONG SEWER O.A. TC 0336 003 00 GPJ TREK GEOTECHNICAL GDT 10/17/22



LABORATORY REQUISITION

CLIENT Jacobs Canada Inc.PROJECT NO: 0336-003-00PROJECT NAME Armstrong Combined SewerFIELD TECHNICIAN: Tyler Chapko

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILIARY TESTS	Water Soluble Sulphate	Soil Description/Comments
TH22-32	G341	30.0 - 31.0		X								
TH22-33	G368	0.6 - 1.6		X								
TH22-33	G369	2.6 - 3.6		X								
TH22-33	G370	5.6 - 6.6		X								
TH22-33	G371	9.6 - 10.6		X								
TH22-33	G372	11.6 - 12.6		X								
TH22-33	T373	15.6 - 17.6		X						/		Could not find
TH22-33	G374	19.6 - 20.6		X								

TREK LABORATORY REQUISITION LOGS 2022-09-23 ARMSTRONG SEWER 0 A TC 0336 003 00 GPJ TREK GEOTECHNICAL GDT 10/17/22

REQUESTED BY: Tyler ChapkoREPORT TO: MVH, TC

REQUISITION NO.

REQUISITION DATE: Oct. 17, 2022

DATE REQUIRED: _____

COMMENTS: _____

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1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

Moisture Content Report ASTM D2216-10

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

Sample Date 28-Sep-22
Test Date 10-Nov-22
Technician JC

Test Hole	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01
Depth (m)	0.4 - 0.7	1.3 - 1.6	1.9 - 2.1	2.8 - 3.1	4.4 - 4.7	5.9 - 6.2
Sample #	G01	G02	G03	G04	G05	G07
Tare ID	Z139	N09	A126	F6	AA20	AC09
Mass of tare	8.6	8.8	8.5	8.7	6.7	6.9
Mass wet + tare	302.7	280.7	256.2	373.6	271.6	255.6
Mass dry + tare	278.0	234.2	182.8	241.6	180.4	168.6
Mass water	24.7	46.5	73.4	132.0	91.2	87.0
Mass dry soil	269.4	225.4	174.3	232.9	173.7	161.7
Moisture %	9.2%	20.6%	42.1%	56.7%	52.5%	53.8%

Test Hole	TH22-01	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02
Depth (m)	7.1 - 7.4	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9
Sample #	G08	G289	G290	G291	G292	G293
Tare ID	W42	F128	DATE	AB11	H50	Z10
Mass of tare	8.6	8.6	310.8	7.0	8.8	9.2
Mass wet + tare	260.8	280.9	692.3	264.3	264.6	273.5
Mass dry + tare	177.1	267.9	666.6	216.0	181.9	182.4
Mass water	83.7	13.0	25.7	48.3	82.7	91.1
Mass dry soil	168.5	259.3	355.8	209.0	173.1	173.2
Moisture %	49.7%	5.0%	7.2%	23.1%	47.8%	52.6%

Test Hole	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02
Depth (m)	2.2 - 2.4	3.9 - 4.2	5.4 - 5.9	6.6 - 6.9	8.5 - 8.9	9.7 - 10.0
Sample #	G294	G295	SS297	G298	SS300	G301
Tare ID	W54	E120	F120	K9	F57	D5
Mass of tare	8.5	8.5	8.8	8.5	8.6	8.2
Mass wet + tare	256.2	281.9	280.9	306.3	291.4	290.4
Mass dry + tare	170.4	191.1	192.2	215.3	190.5	202.5
Mass water	85.8	90.8	88.7	91.0	100.9	87.9
Mass dry soil	161.9	182.6	183.4	206.8	181.9	194.3
Moisture %	53.0%	49.7%	48.4%	44.0%	55.5%	45.2%



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Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

Sample Date 28-Sep-22
Test Date 10-Nov-22
Technician JC

Test Hole	TH22-02	TH22-02	TH22-02	TH22-03	TH22-03	TH22-03
Depth (m)	11.5 - 12.0	13.0 - 13.4	14.0 - 14.4	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2
Sample #	SS303	G304	SS305	G26	G27	G28
Tare ID	Z105	H55	D24	AB88	F102	F11
Mass of tare	8.4	8.7	8.7	6.9	8.9	8.7
Mass wet + tare	284.7	319.6	342.9	289.9	313.9	310.2
Mass dry + tare	207.0	254.4	320.4	270.2	294.5	290.6
Mass water	77.7	65.2	22.5	19.7	19.4	19.6
Mass dry soil	198.6	245.7	311.7	263.3	285.6	281.9
Moisture %	39.1%	26.5%	7.2%	7.5%	6.8%	7.0%

Test Hole	TH22-03	TH22-03	TH22-03	TH22-03	TH22-03	TH22-03
Depth (m)	1.4 - 1.6	1.8 - 1.9	2.2 - 2.4	3.0 - 3.3	4.5 - 4.8	6.0 - 6.3
Sample #	G29	G30	G31	G32	G33	G34
Tare ID	P22	W19	E62	Z109	H11	AB19
Mass of tare	8.8	9.5	8.6	8.8	8.6	6.7
Mass wet + tare	291.4	266.2	263.3	261.3	266.8	285.0
Mass dry + tare	248.8	198.4	184.6	180.4	174.1	187.0
Mass water	42.6	67.8	78.7	80.9	92.7	98.0
Mass dry soil	240.0	188.9	176.0	171.6	165.5	180.3
Moisture %	17.8%	35.9%	44.7%	47.1%	56.0%	54.4%

Test Hole	TH22-03	TH22-03	TH22-03	TH22-03	TH22-03	TH22-03
Depth (m)	7.6 - 7.9	9.1 - 9.4	10.6 - 10.9	12.1 - 12.4	13.7 - 14.0	14.6 - 14.9
Sample #	G35	G36	G37	G38	G39	G40
Tare ID	W97	E134	K14	AB18	AA19	W32
Mass of tare	8.5	8.3	8.6	6.8	6.8	8.6
Mass wet + tare	250.7	267.2	271.8	272.4	245.6	291.4
Mass dry + tare	187.6	181.5	193.8	198.6	165.0	228.9
Mass water	63.1	85.7	78.0	73.8	80.6	62.5
Mass dry soil	179.1	173.2	185.2	191.8	158.2	220.3
Moisture %	35.2%	49.5%	42.1%	38.5%	50.9%	28.4%



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Test Hole	TH22-03	TH22-03	TH22-04	TH22-04	TH22-04	TH22-04
Depth (m)	15.2 - 15.5	15.5 - 15.6	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.6
Sample #	G41	SS42	G09	G10	G11	G12
Tare ID	D29	E35	AB08/	AB08	N04	W92
Mass of tare	8.4	8.6	6.9	6.9	8.7	8.5
Mass wet + tare	360.8	212.5	231.9	234.7	248.7	227.5
Mass dry + tare	220.6	194.2	215.0	219.1	233.6	196.8
Mass water	140.2	18.3	16.9	15.6	15.1	30.7
Mass dry soil	212.2	185.6	208.1	212.2	224.9	188.3
Moisture %	66.1%	9.9%	8.1%	7.4%	6.7%	16.3%

Test Hole	TH22-04	TH22-04	TH22-04	TH22-04	TH22-04	TH22-04
Depth (m)	1.8 - 1.9	2.2 - 2.4	3.0 - 3.3	4.5 - 4.8	6.0 - 6.3	7.3 - 7.6
Sample #	G15	G14	G13	G16	G17	G18
Tare ID	C19	D12	F52	G03	AB05	C8
Mass of tare	8.4	8.4	8.5	8.6	6.8	8.5
Mass wet + tare	371.4	213.3	224.1	241.5	225.9	219.9
Mass dry + tare	243.2	158.7	171.1	159.9	150.7	152.0
Mass water	128.2	54.6	53.0	81.6	75.2	67.9
Mass dry soil	234.8	150.3	162.6	151.3	143.9	143.5
Moisture %	54.6%	36.3%	32.6%	53.9%	52.3%	47.3%

Test Hole	TH22-04	TH22-04	TH22-04	TH22-04	TH22-04	TH22-04
Depth (m)	9.1 - 9.4	10.6 - 10.9	12.1 - 12.4	13.7 - 14.0	14.6 - 14.9	15.6 - 15.6
Sample #	G23	G22	G21	G20	G24	SS25
Tare ID	Z132	A17	AB90	E108	Z63	E4
Mass of tare	8.5	8.6	6.8	8.6	8.5	8.5
Mass wet + tare	241.2	229.3	253.3	223.2	275.1	180.0
Mass dry + tare	162.5	153.5	176.4	153.3	254.6	164.1
Mass water	78.7	75.8	76.9	69.9	20.5	15.9
Mass dry soil	154.0	144.9	169.6	144.7	246.1	155.6
Moisture %	51.1%	52.3%	45.3%	48.3%	8.3%	10.2%



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Test Hole	TH22-05	TH22-05	TH22-05	TH22-05	TH22-05	TH22-05
Depth (m)	0.5 - 0.9	1.1 - 1.2	1.5 - 1.7	1.9 - 2.2	3.0 - 3.3	4.5 - 4.8
Sample #	G43	G44	G45	G46	G47	G48
Tare ID	N12	N58	E8	W111	AC03	AB23
Mass of tare	8.7	8.5	8.5	8.6	6.9	6.7
Mass wet + tare	245.7	219.4	218.2	208.4	214.7	220.7
Mass dry + tare	233.8	186.8	189.5	156.4	156.4	146.2
Mass water	11.9	32.6	28.7	52.0	58.3	74.5
Mass dry soil	225.1	178.3	181.0	147.8	149.5	139.5
Moisture %	5.3%	18.3%	15.9%	35.2%	39.0%	53.4%

Test Hole	TH22-05	TH22-05	TH22-06	TH22-06	TH22-06	TH22-06
Depth (m)	6.0 - 6.3	7.6 - 7.9	0.5 - 0.9	1.2 - 1.5	1.8 - 2.1	3.0 - 3.3
Sample #	G49	G50	G51	G52	G53	G54
Tare ID	W07	P34	AB33	F31	A167	F133
Mass of tare	8.6	8.4	7.2	8.5	8.6	8.4
Mass wet + tare	233.7	361.0	226.3	235.3	224.9	213.5
Mass dry + tare	157.7	255.7	211.7	203.4	161.7	142.8
Mass water	76.0	105.3	14.6	31.9	63.2	70.7
Mass dry soil	149.1	247.3	204.5	194.9	153.1	134.4
Moisture %	51.0%	42.6%	7.1%	16.4%	41.3%	52.6%

Test Hole	TH22-06	TH22-06	TH22-06	TH22-07	TH22-07	TH22-07
Depth (m)	4.2 - 4.5	6.0 - 6.3	7.6 - 7.9	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2
Sample #	G55	G57	G58	G59	G60	G61
Tare ID	E22	Z29	F42	K2	N47	C6
Mass of tare	8.7	8.6	8.4	8.3	8.5	8.5
Mass wet + tare	230.5	243.0	223.4	193.3	237.3	240.4
Mass dry + tare	152.1	166.2	153.5	171.0	184.6	187.2
Mass water	78.4	76.8	69.9	22.3	52.7	53.2
Mass dry soil	143.4	157.6	145.1	162.7	176.1	178.7
Moisture %	54.7%	48.7%	48.2%	13.7%	29.9%	29.8%



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Test Hole	TH22-07	TH22-07	TH22-07	TH22-07	TH22-07	TH22-07
Depth (m)	1.4 - 1.6	1.8 - 1.9	2.2 - 2.4	3.0 - 3.3	4.2 - 4.5	5.4 - 5.9
Sample #	G62	G63	G64	G65	G66	SS68
Tare ID	E25	AA13	W80	F124	N35	NO1
Mass of tare	8.9	6.6	8.5	8.6	8.6	8.6
Mass wet + tare	206.8	209.3	239.4	263.5	258.9	208.1
Mass dry + tare	155.4	143.9	174.5	177.9	142.4	173.8
Mass water	51.4	65.4	64.9	85.6	116.5	34.3
Mass dry soil	146.5	137.3	166.0	169.3	133.8	165.2
Moisture %	35.1%	47.6%	39.1%	50.6%	87.1%	20.8%

Test Hole	TH22-07	TH22-07	TH22-07	TH22-07	TH22-07	TH22-07
Depth (m)	6.9 - 7.3	8.5 - 8.8	10.0 - 10.5	11.8 - 12.1	13.4 - 13.7	15.2 - 15.5
Sample #	G69	G70	SS72	G73	G74	G76
Tare ID	W102	Z40	E87	Z02	Z01	W22
Mass of tare	8.6	8.5	8.7	8.6	8.5	8.6
Mass wet + tare	249.0	238.3	235.7	348.1	280.2	267.2
Mass dry + tare	162.3	159.6	155.0	300.4	250.6	239.1
Mass water	86.7	78.7	80.7	47.7	29.6	28.1
Mass dry soil	153.7	151.1	146.3	291.8	242.1	230.5
Moisture %	56.4%	52.1%	55.2%	16.3%	12.2%	12.2%

Test Hole	TH22-07	TH22-08	TH22-08	TH22-08	TH22-08	TH22-08
Depth (m)	16.4 - 16.7	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9
Sample #	G77	G78	G79	G80	G81	G82
Tare ID	AC37	D42	E99	H60	F110	W189
Mass of tare	6.8	8.8	8.7	8.7	8.2	8.6
Mass wet + tare	290.6	248.3	209.9	216.7	215.8	207.7
Mass dry + tare	246.7	238.5	167.8	182.1	180.1	148.6
Mass water	43.9	9.8	42.1	34.6	35.7	59.1
Mass dry soil	239.9	229.7	159.1	173.4	171.9	140.0
Moisture %	18.3%	4.3%	26.5%	20.0%	20.8%	42.2%



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Test Hole	TH22-08	TH22-08	TH22-08	TH22-08	TH22-08	TH22-08
Depth (m)	2.2 - 2.4	3.0 - 3.3	3.6 - 3.9	4.5 - 4.8	5.1 - 5.4	6.0 - 6.3
Sample #	G83	G84	G85	G86	G87	G88
Tare ID	F129	H73	N75	E106	W20	F146
Mass of tare	8.6	8.5	8.8	8.6	8.5	8.3
Mass wet + tare	246.4	368.4	226.3	230.4	234.4	237.4
Mass dry + tare	202.4	293.5	148.5	154.7	160.4	160.8
Mass water	44.0	74.9	77.8	75.7	74.0	76.6
Mass dry soil	193.8	285.0	139.7	146.1	151.9	152.5
Moisture %	22.7%	26.3%	55.7%	51.8%	48.7%	50.2%

Test Hole	TH22-08	TH22-08	TH22-08	TH22-08	TH22-08	TH22-08
Depth (m)	9.1 - 9.4	10.6 - 10.9	12.1 - 12.4	13.7 - 14.0	14.0 - 14.4	14.9 - 15.2
Sample #	G89	G90	G91	G92	SS93	G94
Tare ID	Z39	Z91	C11	N40	H41	W30
Mass of tare	8.5	8.6	8.3	8.5	8.7	8.6
Mass wet + tare	248.5	241.9	241.9	267.8	241.2	226.0
Mass dry + tare	176.1	150.7	206.8	243.3	223.5	185.1
Mass water	72.4	91.2	35.1	24.5	17.7	40.9
Mass dry soil	167.6	142.1	198.5	234.8	214.8	176.5
Moisture %	43.2%	64.2%	17.7%	10.4%	8.2%	23.2%

Test Hole	TH22-08	TH22-09	TH22-09	TH22-09	TH22-09	TH22-09
Depth (m)	15.2 - 15.2	0.4 - 0.7	1.0 - 1.2	1.5 - 1.8	3.0 - 3.3	4.5 - 4.8
Sample #	SS95	G102	G103	G104	G105	G107
Tare ID	N39	W25	AB04	Z90	N16	Z80
Mass of tare	8.5	8.6	6.7	8.4	8.5	8.4
Mass wet + tare	222.3	235.5	261.4	218.3	238.4	248.7
Mass dry + tare	205.2	220.7	225.1	169.7	162	163.7
Mass water	17.1	14.8	36.3	48.6	76.4	85.0
Mass dry soil	196.7	212.1	218.4	161.3	153.5	155.3
Moisture %	8.7%	7.0%	16.6%	30.1%	49.8%	54.7%

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Test Hole	TH22-09	TH22-10	TH22-10	TH22-10	TH22-10	TH22-10
Depth (m)	6.0 - 6.3	0.1 - 0.4	0.7 - 1.0	1.8 - 2.1	2.9 - 3.2	4.4 - 4.7
Sample #	G108	G96	G97	G98	G99	G100
Tare ID	Z93	N53	AA19	Z101	W79	E470
Mass of tare	8.3	8.5	6.7	8.3	8.6	8.6
Mass wet + tare	232.3	214.1	225.4	221.3	220.7	247.7
Mass dry + tare	155.0	168.3	176.0	154.3	148.6	165.6
Mass water	77.3	45.8	49.4	67.0	72.1	82.1
Mass dry soil	146.7	159.8	169.3	146.0	140.0	157.0
Moisture %	52.7%	28.7%	29.2%	45.9%	51.5%	52.3%

Test Hole	TH22-10	TH22-11	TH22-11	TH22-11	TH22-11	TH22-11
Depth (m)	5.9 - 6.2	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9
Sample #	G101	G187	G188	G189	G190	G191
Tare ID	F141	P05	G29	P21	W94	F79
Mass of tare	8.6	8.7	8.7	8.5	8.5	8.7
Mass wet + tare	248.5	204.4	242.5	224.7	249.7	216.3
Mass dry + tare	169.4	184.3	189.5	175.8	203.5	153.2
Mass water	79.1	20.1	53.0	48.9	46.2	63.1
Mass dry soil	160.8	175.6	180.8	167.3	195.0	144.5
Moisture %	49.2%	11.4%	29.3%	29.2%	23.7%	43.7%

Test Hole	TH22-11	TH22-11	TH22-11	TH22-11	TH22-11	TH22-11
Depth (m)	2.2 - 2.4	3.3 - 3.6	4.5 - 4.8	6.0 - 6.3	7.6 - 7.9	8.5 - 8.8
Sample #	G192	G193	G194	G195	G196	G197
Tare ID	W15	P14	N72	F34	W103	F56
Mass of tare	8.4	8.5	8.9	9	8.7	8.6
Mass wet + tare	245.1	386.7	244.5	238.1	229.7	230.2
Mass dry + tare	165.3	248.9	162.2	158.2	161.5	165.5
Mass water	79.8	137.8	82.3	79.9	68.2	64.7
Mass dry soil	156.9	240.4	153.3	149.2	152.8	156.9
Moisture %	50.9%	57.3%	53.7%	53.6%	44.6%	41.2%



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Test Hole	TH22-11	TH22-11	TH22-11	TH22-11	TH22-11	TH22-11
Depth (m)	10.6 - 10.9	12.1 - 12.4	13.7 - 14.0	14.0 - 14.4	14.6 - 14.9	15.2 - 15.3
Sample #	G199	G200	G201	SS202	G203	SS204
Tare ID	W77	E38	AB60	AC15	N79	AB38
Mass of tare	8.7	8.5	6.9	7	8.6	6.8
Mass wet + tare	223.9	211.1	263.4	203.2	306.2	209.7
Mass dry + tare	150.4	180.5	238	190.1	284.7	196.9
Mass water	73.5	30.6	25.4	13.1	21.5	12.8
Mass dry soil	141.7	172.0	231.1	183.1	276.1	190.1
Moisture %	51.9%	17.8%	11.0%	7.2%	7.8%	6.7%

Test Hole	TH22-12	TH22-12	TH22-12	TH22-12	TH22-12	TH22-12
Depth (m)	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.2 - 2.4
Sample #	G168	G169	G170	G171	G172	G173
Tare ID	AB57	W01	AB68	Z44	R92	W95
Mass of tare	6.8	8.6	6.8	8.6	8.5	8.5
Mass wet + tare	219.5	218.4	222.7	212.1	247.3	232.8
Mass dry + tare	199.3	171.5	171.1	169.6	204	170.5
Mass water	20.2	46.9	51.6	42.5	43.3	62.3
Mass dry soil	192.5	162.9	164.3	161.0	195.5	162.0
Moisture %	10.5%	28.8%	31.4%	26.4%	22.1%	38.5%

Test Hole	TH22-12	TH22-12	TH22-12	TH22-12	TH22-12	TH22-12
Depth (m)	3.9 - 4.2	5.7 - 6.0	7.6 - 7.9	9.1 - 9.4	10.6 - 10.9	12.1 - 12.4
Sample #	G174	G176	G175	G177	G178	G179
Tare ID	Z114	Z121	W45	K26	A27	Z65
Mass of tare	8.3	8.9	8.6	8.7	8.5	8.5
Mass wet + tare	247.4	236.2	272.2	258.6	223.9	351.1
Mass dry + tare	167.9	164.5	187	188.3	153.7	233.6
Mass water	79.5	71.7	85.2	70.3	70.2	117.5
Mass dry soil	159.6	155.6	178.4	179.6	145.2	225.1
Moisture %	49.8%	46.1%	47.8%	39.1%	48.3%	52.2%



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Test Hole	TH22-12	TH22-12	TH22-12	TH22-12	TH22-12	TH22-12
Depth (m)	13.7 - 14.0	15.2 - 15.5	15.5 - 16.1	16.4 - 16.7	17.0 - 17.5	59.8 - 17.9
Sample #	G180	G181	SS182	G183	SS184	G185
Tare ID	C7	F89	AA14	A109	C4	AA21
Mass of tare	8.6	8.6	6.9	9	8.5	6.9
Mass wet + tare	253.6	282.2	248.8	227	242.2	211.1
Mass dry + tare	206.9	253	227.3	199.6	221.4	193.2
Mass water	46.7	29.2	21.5	27.4	20.8	17.9
Mass dry soil	198.3	244.4	220.4	190.6	212.9	186.3
Moisture %	23.6%	11.9%	9.8%	14.4%	9.8%	9.6%

Test Hole	TH22-12	TH22-13	TH22-13	TH22-13	TH22-13	TH22-13
Depth (m)	18.5 - 19.0	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.6	1.8 - 1.9
Sample #	SS186	G117	G118	G119	G120	G121
Tare ID	AB12	F17	P06	P85	N32	Z99
Mass of tare	7	8.6	8.7	8.6	8.5	8.6
Mass wet + tare	238.7	249.8	251.9	227.4	223.4	224.9
Mass dry + tare	214.3	238.2	196.5	170	172.2	181.8
Mass water	24.4	11.6	55.4	57.4	51.2	43.1
Mass dry soil	207.3	229.6	187.8	161.4	163.7	173.2
Moisture %	11.8%	5.1%	29.5%	35.6%	31.3%	24.9%

Test Hole	TH22-13	TH22-13	TH22-13	TH22-13	TH22-13	TH22-13
Depth (m)	2.2 - 2.4	2.7 - 3.0	3.9 - 4.4	5.1 - 5.4	6.9 - 7.3	8.5 - 8.9
Sample #	G122	G123	SS125	G126	G127	SS129
Tare ID	F131	N84	F66	F50	AB95	N16
Mass of tare	8.4	8.6	8.6	8.6	6.7	8.9
Mass wet + tare	358.3	242.5	229.3	221.5	262.4	244.8
Mass dry + tare	291.8	196.2	152.1	150.3	185	167.1
Mass water	66.5	46.3	77.2	71.2	77.4	77.7
Mass dry soil	283.4	187.6	143.5	141.7	178.3	158.2
Moisture %	23.5%	24.7%	53.8%	50.2%	43.4%	49.1%

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Test Hole	TH22-13	TH22-13	TH22-13	TH22-13	TH22-13	TH22-14
Depth (m)	10.0 - 10.5	11.5 - 11.8	13.4 - 13.7	15.2 - 15.5	15.5 - 15.9	0.5 - 0.8
Sample #	SS132	G133	G134	G135	SS136	G109
Tare ID	F105	D34	AC28	N41	H80	Z15
Mass of tare	8.5	8.8	6.3	8.6	8.9	8.5
Mass wet + tare	205.7	284.2	406.3	210.5	236	262.6
Mass dry + tare	140	209.8	255.3	188.3	218.6	205.9
Mass water	65.7	74.4	151.0	22.2	17.4	56.7
Mass dry soil	131.5	201.0	249.0	179.7	209.7	197.4
Moisture %	50.0%	37.0%	60.6%	12.4%	8.3%	28.7%

Test Hole	TH22-14	TH22-14	TH22-14	TH22-14	TH22-14	TH22-14
Depth (m)	0.8 - 1.1	1.7 - 2.0	2.4 - 2.6	2.9 - 3.2	4.1 - 4.5	6.0 - 6.3
Sample #	G110	G111	G112	G113	G114	G116
Tare ID	C26	AC27	H48	H35	F75	F61
Mass of tare	8.5	6.9	8.5	8.5	8.7	8.6
Mass wet + tare	287.1	301.2	262.8	251.2	239	270.4
Mass dry + tare	215.2	246.5	208.5	171.6	154.5	183.6
Mass water	71.9	54.7	54.3	79.6	84.5	86.8
Mass dry soil	206.7	239.6	200.0	163.1	145.8	175.0
Moisture %	34.8%	22.8%	27.2%	48.8%	58.0%	49.6%

Test Hole	TH22-15	TH22-15	TH22-15	TH22-15	TH22-15	TH22-15
Depth (m)	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.2 - 2.4
Sample #	G250	G251	G252	G253	G254	G255
Tare ID	D20	W90	AC17	H56	E136	A6
Mass of tare	8.7	8.6	6.7	8.5	8.4	8.2
Mass wet + tare	281.7	323.5	351.1	299.5	312	260.3
Mass dry + tare	234.9	259.6	264.7	224.3	252.7	184.9
Mass water	46.8	63.9	86.4	75.2	59.3	75.4
Mass dry soil	226.2	251.0	258.0	215.8	244.3	176.7
Moisture %	20.7%	25.5%	33.5%	34.8%	24.3%	42.7%

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Test Hole	TH22-15	TH22-15	TH22-15	TH22-15	TH22-15	TH22-15
Depth (m)	3.0 - 3.3	4.2 - 4.5	6.0 - 6.3	7.6 - 7.9	9.1 - 9.4	10.6 - 10.9
Sample #	G256	G257	G259	G260	G261	G262
Tare ID	N52	D27	F131	P36	A8	N22
Mass of tare	8.8	8.4	8.5	8.9	8	8.6
Mass wet + tare	283.5	250.1	281.2	322.6	280	317
Mass dry + tare	200	165	181.7	227.3	192.5	236.2
Mass water	83.5	85.1	99.5	95.3	87.5	80.8
Mass dry soil	191.2	156.6	173.2	218.4	184.5	227.6
Moisture %	43.7%	54.3%	57.4%	43.6%	47.4%	35.5%

Test Hole	TH22-15	TH22-15	TH22-15	TH22-15	TH22-15	TH22-16
Depth (m)	12.1 - 12.4	13.7 - 14.0	15.2 - 15.5	16.5 - 17.0	17.0 -	0.5 - 0.6
Sample #	G263	G264	G265	G266	SS267	G230
Tare ID	AA05	AA18	Z134	D49	E56	N93
Mass of tare	6.8	6.8	8.8	8.6	8.2	8.5
Mass wet + tare	282.5	297.9	252.8	415.2	240.8	299
Mass dry + tare	196.4	199.7	169.5	379.3	221.3	250.5
Mass water	86.1	98.2	83.3	35.9	19.5	48.5
Mass dry soil	189.6	192.9	160.7	370.7	213.1	242.0
Moisture %	45.4%	50.9%	51.8%	9.7%	9.2%	20.0%

Test Hole	TH22-16	TH22-16	TH22-16	TH22-16	TH22-16	TH22-16
Depth (m)	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.2 - 2.4	3.0 - 3.3
Sample #	G231	G232	G233	G234	G235	G236
Tare ID	N91	F44	AB27	W24	D9	D39
Mass of tare	8.6	8.4	6.8	8.4	8.6	8.7
Mass wet + tare	323	307.2	256.5	371.5	246.8	253.9
Mass dry + tare	269.4	244.4	201.6	305.4	178.6	172
Mass water	53.6	62.8	54.9	66.1	68.2	81.9
Mass dry soil	260.8	236.0	194.8	297.0	170.0	163.3
Moisture %	20.6%	26.6%	28.2%	22.3%	40.1%	50.2%



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Test Hole	TH22-16	TH22-16	TH22-16	TH22-16	TH22-16	TH22-16
Depth (m)	4.5 - 4.8	6.0 - 6.3	7.3 - 7.6	9.1 - 9.4	10.6 - 10.9	12.1 - 12.4
Sample #	G237	G238	G239	G241	G242	G243
Tare ID	E72	A101	D32	K34	Z68	W27
Mass of tare	8.5	8.7	8.6	8.6	8.5	8.4
Mass wet + tare	257.5	230.8	263	244.9	225.5	272.3
Mass dry + tare	172.3	153.6	180.3	165.4	163.2	195.5
Mass water	85.2	77.2	82.7	79.5	62.3	76.8
Mass dry soil	163.8	144.9	171.7	156.8	154.7	187.1
Moisture %	52.0%	53.3%	48.2%	50.7%	40.3%	41.0%

Test Hole	TH22-16	TH22-16	TH22-16	TH22-16	TH22-16	TH22-16
Depth (m)	13.7 - 14.0	15.2 - 15.5	16.7 - 17.0	17.6 - 17.9	18.5 - 19.0	19.1 - 19.4
Sample #	G244	G245	G246	G247	SS248	G249
Tare ID	C13	Z21	N02	AB71	H21	K20
Mass of tare	8.4	8.6	8.6	6.7	9.4	8.5
Mass wet + tare	272.9	223.1	245.2	304.5	233.8	196.7
Mass dry + tare	189.1	148.1	174.3	274.7	215.3	179.3
Mass water	83.8	75.0	70.9	29.8	18.5	17.4
Mass dry soil	180.7	139.5	165.7	268.0	205.9	170.8
Moisture %	46.4%	53.8%	42.8%	11.1%	9.0%	10.2%

Test Hole	TH22-17	TH22-17	TH22-17	TH22-17	TH22-17	TH22-17
Depth (m)	0.4 - 0.6	0.7 - 0.9	1.0 - 1.2	1.3 - 1.5	1.7 - 1.9	2.2 - 2.3
Sample #	G342	G343	G344	G345	G346	G347
Tare ID	F37	Z59	N28	AA15	K19	W96
Mass of tare	8.7	8.7	8.5	6.9	8.7	8.7
Mass wet + tare	235	240.4	220.4	218.4	258.9	217.1
Mass dry + tare	197	192.7	171.2	169.1	208.9	182.4
Mass water	38.0	47.7	49.2	49.3	50.0	34.7
Mass dry soil	188.3	184.0	162.7	162.2	200.2	173.7
Moisture %	20.2%	25.9%	30.2%	30.4%	25.0%	20.0%



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Test Hole	TH22-17	TH22-17	TH22-17	TH22-17	TH22-17	TH22-17
Depth (m)	3.3 - 3.6	4.5 - 4.8	6.0 - 6.3	7.5 - 7.8	8.7 - 9.1	10.6 - 10.9
Sample #	G348	G349	G350	G351	G352	G354
Tare ID	A51	H13	H49	AC38	Z102	F137
Mass of tare	8.6	8.5	8.5	6.8	8.6	8.8
Mass wet + tare	242.3	230	214.9	223	251.1	232.1
Mass dry + tare	156.4	151.6	140.2	143.1	170.6	158.1
Mass water	85.9	78.4	74.7	79.9	80.5	74.0
Mass dry soil	147.8	143.1	131.7	136.3	162.0	149.3
Moisture %	58.1%	54.8%	56.7%	58.6%	49.7%	49.6%

Test Hole	TH22-17	TH22-17	TH22-17	TH22-17	TH22-17	TH22-17
Depth (m)	12.1 - 12.4	13.6 - 13.9	15.1 - 15.5	16.7 - 17.0	17.9 - 18.2	18.5 - 19.0
Sample #	G355	G356	G357	G358	G359	SS360
Tare ID	W98	Z56	N105	H50	Z75	A103
Mass of tare	8.7	8.5	8.9	8.6	8.6	8.8
Mass wet + tare	245.9	352.1	273.4	289.2	315.8	236.4
Mass dry + tare	164.6	231.6	183.2	244.6	282.6	215.9
Mass water	81.3	120.5	90.2	44.6	33.2	20.5
Mass dry soil	155.9	223.1	174.3	236.0	274.0	207.1
Moisture %	52.1%	54.0%	51.7%	18.9%	12.1%	9.9%

Test Hole	TH22-17	TH22-18	TH22-18	TH22-18	TH22-18	TH22-18
Depth (m)	19.4 - 19.7	0.2 - 0.5	0.9 - 1.2	1.5 - 1.8	3.0 - 3.3	4.2 - 4.5
Sample #	G361	G161	G162	G163	G164	G165
Tare ID	N97	F17	H43	AB74	K32	A105
Mass of tare	8.5	8.6	8.7	6.9	8.5	8.7
Mass wet + tare	253.6	204.4	211.6	229.4	234.1	220
Mass dry + tare	229.6	188.6	165.4	188.1	160.5	149.4
Mass water	24.0	15.8	46.2	41.3	73.6	70.6
Mass dry soil	221.1	180.0	156.7	181.2	152.0	140.7
Moisture %	10.9%	8.8%	29.5%	22.8%	48.4%	50.2%



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Test Hole	TH22-18	TH22-19	TH22-19	TH22-19	TH22-19	TH22-19
Depth (m)	6.0 - 6.3	0.2 - 0.5	0.8 - 1.1	1.4 - 1.7	2.0 - 2.3	3.4 - 3.7
Sample #	G167	G154	G155	G156	G157	G158
Tare ID	Z57	A160	Z85	Z61	F13	Z104
Mass of tare	8.6	8.6	8.4	8.6	8.5	8.6
Mass wet + tare	259.3	201.7	222.2	245	354.7	255.6
Mass dry + tare	176.3	188.5	170.6	197.4	284.8	174.7
Mass water	83.0	13.2	51.6	47.6	69.9	80.9
Mass dry soil	167.7	179.9	162.2	188.8	276.3	166.1
Moisture %	49.5%	7.3%	31.8%	25.2%	25.3%	48.7%

Test Hole	TH22-19	TH22-19	TH22-20	TH22-20	TH22-20	TH22-20
Depth (m)	4.2 - 4.5	6.0 - 6.3	0.7 - 1.0	1.6 - 2.0	2.9 - 3.2	4.1 - 4.4
Sample #	G159	G160	G137	G138	G139	G140
Tare ID	AC08	Z97	E133	E121	F16	E40
Mass of tare	6.9	8.7	8.4	8.4	8.6	8.8
Mass wet + tare	209.9	252.6	245.2	325.6	258.4	231.8
Mass dry + tare	138.4	165.7	178.5	236.7	178.6	161.9
Mass water	71.5	86.9	66.7	88.9	79.8	69.9
Mass dry soil	131.5	157.0	170.1	228.3	170.0	153.1
Moisture %	54.4%	55.4%	39.2%	38.9%	46.9%	45.7%

Test Hole	TH22-20	TH22-20	TH22-20	TH22-20	TH22-20	TH22-20
Depth (m)	5.6 - 5.9	6.8 - 7.0	7.4 - 7.7	9.0 - 9.3	10.5 - 10.8	12.0 - 12.3
Sample #	G141	G143	G144	G145	G146	G147
Tare ID	Z67	H38	AB13	K20	E102	W101
Mass of tare	8.8	8.6	6.8	8.4	8.6	8.4
Mass wet + tare	253.6	251.2	251.4	245.2	231	242.6
Mass dry + tare	166.6	184.2	165.6	170.9	162.5	171
Mass water	87.0	67.0	85.8	74.3	68.5	71.6
Mass dry soil	157.8	175.6	158.8	162.5	153.9	162.6
Moisture %	55.1%	38.2%	54.0%	45.7%	44.5%	44.0%



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Test Hole	TH22-20	TH22-20	TH22-20	TH22-20	TH22-20	TH22-20
Depth (m)	13.5 - 13.8	15.1 - 15.4	16.6 - 16.9	17.8 - 18.1	19.3 - 19.6	19.6 - 19.7
Sample #	G148	G149	G150	G151	G152	SS153
Tare ID	F69	H34	N61	A23	W47	F97
Mass of tare	8.6	8.6	8.4	8.6	8.4	8.6
Mass wet + tare	223	225.8	226.6	245.4	307.8	185.8
Mass dry + tare	151.1	149.5	158.2	158.8	270.2	172.4
Mass water	71.9	76.3	68.4	86.6	37.6	13.4
Mass dry soil	142.5	140.9	149.8	150.2	261.8	163.8
Moisture %	50.5%	54.2%	45.7%	57.7%	14.4%	8.2%

Test Hole	TH22-21	TH22-21	TH22-21	TH22-21	TH22-21	TH22-21
Depth (m)	0.2 - 0.3	0.5 - 0.8	1.4 - 1.7	2.6 - 2.9	3.1 - 3.2	4.5 - 4.8
Sample #	G205	G206	G207	G208	G209	G210
Tare ID	F10	F81	P31	E16	F48	C22
Mass of tare	8.7	8.6	8.4	8.8	8.6	8.6
Mass wet + tare	218.7	220.5	218	217.9	221	217.6
Mass dry + tare	165.5	165	168.4	161.4	175.2	179.2
Mass water	53.2	55.5	49.6	56.5	45.8	38.4
Mass dry soil	156.8	156.4	160.0	152.6	166.6	170.6
Moisture %	33.9%	35.5%	31.0%	37.0%	27.5%	22.5%

Test Hole	TH22-21	TH22-21	TH22-21	TH22-21	TH22-21	TH22-21
Depth (m)	5.1 - 5.4	6.0 - 6.3	7.5 - 7.8	9.0 - 9.3	10.5 - 10.9	12.1 - 12.4
Sample #	G211	G212	G213	G214	G215	G216
Tare ID	K22	E115	Z25	W76	Z71	N93
Mass of tare	8.6	8.8	8.3	8.6	8.6	8.6
Mass wet + tare	225.1	218.6	226.4	227.4	230	229
Mass dry + tare	163.8	149	148.6	155.8	159.2	151.2
Mass water	61.3	69.6	77.8	71.6	70.8	77.8
Mass dry soil	155.2	140.2	140.3	147.2	150.6	142.6
Moisture %	39.5%	49.6%	55.5%	48.6%	47.0%	54.6%



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Test Hole	TH22-21	TH22-21	TH22-21	TH22-21	TH22-21	TH22-21
Depth (m)	13.6 - 13.9	15.1 - 15.4	16.6 - 16.9	18.2 - 18.5	19.1 - 19.4	20.0 - 20.1
Sample #	G217	G218	G219	G220	G221	SS222
Tare ID	K39	E59	H27	N110	Z05	Z73
Mass of tare	8.5	8.5	8.3	8.5	8.5	8.5
Mass wet + tare	226.9	220.8	361.7	248.8	266.4	123.7
Mass dry + tare	152.2	139.5	229.7	180.7	226.8	105.6
Mass water	74.7	81.3	132.0	68.1	39.6	18.1
Mass dry soil	143.7	131.0	221.4	172.2	218.3	97.1
Moisture %	52.0%	62.1%	59.6%	39.5%	18.1%	18.6%

Test Hole	TH22-22	TH22-22	TH22-22	TH22-22	TH22-22	TH22-22
Depth (m)	0.2 - 0.5	0.6 - 0.9	1.1 - 1.2	1.4 - 1.7	2.9 - 3.2	4.5 - 4.8
Sample #	G306	G307	G308	G309	G310	G311
Tare ID	A106	AB35	W67	AC34	F54	F54
Mass of tare	8.3	6.8	8.4	6.8	8.4	8.7
Mass wet + tare	300.9	333.4	300	288.7	399.7	273.6
Mass dry + tare	263.5	259.4	238	224.9	292.8	192.7
Mass water	37.4	74.0	62.0	63.8	106.9	80.9
Mass dry soil	255.2	252.6	229.6	218.1	284.4	184.0
Moisture %	14.7%	29.3%	27.0%	29.3%	37.6%	44.0%

Test Hole	TH22-22	TH22-22	TH22-22	TH22-22	TH22-22	TH22-22
Depth (m)	5.7 - 6.0	6.9 - 7.3	8.4 - 8.7	9.9 - 10.2	11.5 - 11.8	13.0 - 13.4
Sample #	G312	SS314	G315	G316	G317	SS319
Tare ID	E85	P29	N83	AB51	K7	E125
Mass of tare	8.7	8.5	8.7	6.7	8.7	8.4
Mass wet + tare	258.8	233.7	267.8	303.9	270.6	251.7
Mass dry + tare	168.9	155.2	183.6	200	172.9	173.2
Mass water	89.9	78.5	84.2	103.9	97.7	78.5
Mass dry soil	160.2	146.7	174.9	193.3	164.2	164.8
Moisture %	56.1%	53.5%	48.1%	53.8%	59.5%	47.6%



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Test Hole	TH22-22	TH22-22	TH22-22	TH22-22	TH22-22	TH22-23
Depth (m)	14.8 - 15.1	16.6 - 16.9	18.2 - 18.5	19.1 - 19.4	20.0 - 20.5	0.1 - 0.4
Sample #	G320	G321	G322	G323	SS324	G268
Tare ID	F76	Z114	Z70	D10	Z04	AA10
Mass of tare	8.8	8.7	8.7	8.4	8.8	6.9
Mass wet + tare	257.4	309.2	273.2	414.3	73.1	209.8
Mass dry + tare	164.6	205	171.6	377.3	65.8	162.4
Mass water	92.8	104.2	101.6	37.0	7.3	47.4
Mass dry soil	155.8	196.3	162.9	368.9	57.0	155.5
Moisture %	59.6%	53.1%	62.4%	10.0%	12.8%	30.5%

Test Hole	TH22-23	TH22-23	TH22-23	TH22-23	TH22-23	TH22-23
Depth (m)	0.7 - 1.0	1.6 - 2.0	2.6 - 2.9	2.9 - 3.2	3.5 - 3.8	4.4 - 4.7
Sample #	G269	G270	G271	G272	G273	G274
Tare ID	AA10	AB06	Z115	AB67	F86	Z137
Mass of tare	8.5	6.9	8.6	6.7	8.8	8.5
Mass wet + tare	263.9	315	263.6	315.4	253.3	265.1
Mass dry + tare	201.7	256.1	186.1	256.1	175.8	176.2
Mass water	62.2	58.9	77.5	59.3	77.5	88.9
Mass dry soil	193.2	249.2	177.5	249.4	167.0	167.7
Moisture %	32.2%	23.6%	43.7%	23.8%	46.4%	53.0%

Test Hole	TH22-23	TH22-24	TH22-24	TH22-24	TH22-24	TH22-24
Depth (m)	5.9 - 6.2	0.2 - 0.5	0.9 - 1.2	1.8 - 2.1	2.7 - 3.0	4.5 - 4.8
Sample #	G275	G223	G224	G225	G226	G228
Tare ID	H59	W59	AA22	F154	Z74	W65
Mass of tare	8.9	8.7	6.9	8.5	8.6	8.5
Mass wet + tare	282.3	226	218.9	238	252.8	213
Mass dry + tare	191.2	210.5	197	194.4	190.8	143
Mass water	91.1	15.5	21.9	43.6	62.0	70.0
Mass dry soil	182.3	201.8	190.1	185.9	182.2	134.5
Moisture %	50.0%	7.7%	11.5%	23.5%	34.0%	52.0%

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

Sample Date 28-Sep-22
Test Date 10-Nov-22
Technician JC

Test Hole	TH22-24	TH22-25	TH22-25	TH22-25	TH22-25	TH22-25
Depth (m)	6.0 - 6.3	0.2 - 0.5	1.0 - 1.3	1.6 - 1.9	2.5 - 2.8	4.4 - 4.7
Sample #	G229	G283	G284	G285	G286	G287
Tare ID	F114	Z94	P34	E42	Z51	A20
Mass of tare	8.4	9.3	8.7	8.6	8.4	8.8
Mass wet + tare	252.6	208.8	248	277	354.1	246.1
Mass dry + tare	169.2	156.9	198	229.3	237.9	162.7
Mass water	83.4	51.9	50.0	47.7	116.2	83.4
Mass dry soil	160.8	147.6	189.3	220.7	229.5	153.9
Moisture %	51.9%	35.2%	26.4%	21.6%	50.6%	54.2%

Test Hole	TH22-25	TH22-26	TH22-26	TH22-26	TH22-26	TH22-26
Depth (m)	5.9 - 6.2	0.5 - 0.8	1.4 - 1.7	2.3 - 2.7	3.6 - 3.9	6.0 - 6.3
Sample #	G288	G382	G383	G384	G385	G387
Tare ID	AB87	N48	H12	D11	P13	AB26
Mass of tare	6.8	8.6	8.6	9	8.5	6.8
Mass wet + tare	251.5	235.7	203.6	305.3	217.6	210.5
Mass dry + tare	174.6	217.2	184	247.7	146.3	140.8
Mass water	76.9	18.5	19.6	57.6	71.3	69.7
Mass dry soil	167.8	208.6	175.4	238.7	137.8	134.0
Moisture %	45.8%	8.9%	11.2%	24.1%	51.7%	52.0%

Test Hole	TH22-27	TH22-27	TH22-27	TH22-27	TH22-27	TH22-27
Depth (m)	0.1 - 0.3	0.4 - 0.7	1.0 - 1.2	1.3 - 1.6	2.6 - 2.9	4.4 - 4.7
Sample #	G375	G376	G377	G378	G379	G380
Tare ID	AB22	Z72	AB47	AB40	P03	K37
Mass of tare	6.7	8.9	6.9	6.9	8.8	8.6
Mass wet + tare	236	206.7	214.6	230.3	251.5	246
Mass dry + tare	224.3	167.5	172.2	188.8	178.6	161.8
Mass water	11.7	39.2	42.4	41.5	72.9	84.2
Mass dry soil	217.6	158.6	165.3	181.9	169.8	153.2
Moisture %	5.4%	24.7%	25.7%	22.8%	42.9%	55.0%

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

Sample Date 28-Sep-22
Test Date 10-Nov-22
Technician JC

Test Hole	TH22-27	TH22-28	TH22-28	TH22-28	TH22-28	TH22-28
Depth (m)	5.9 - 6.2	0.3 - 0.6	1.2 - 1.5	1.7 - 2.0	2.4 - 2.7	4.3 - 4.6
Sample #	G381	G276	G277	G278	G279	G281
Tare ID	AB64	D38	F116	N43	F153	P28
Mass of tare	6.7	8.4	8.4	8.5	8.5	8.7
Mass wet + tare	261.7	239.7	247.5	358.1	239	217
Mass dry + tare	171.9	180	191.4	288.5	170.4	146.6
Mass water	89.8	59.7	56.1	69.6	68.6	70.4
Mass dry soil	165.2	171.6	183.0	280.0	161.9	137.9
Moisture %	54.4%	34.8%	30.7%	24.9%	42.4%	51.1%

Test Hole	TH22-28	TH22-29	TH22-29	TH22-29	TH22-29	TH22-29
Depth (m)	5.8 - 6.1	0.2 - 0.5	0.8 - 1.1	1.5 - 1.8	2.3 - 2.6	2.9 - 3.2
Sample #	G282	G325	G326	G327	G328	G329
Tare ID	W70	AB46	AB43	N21	D3	Z77
Mass of tare	8.4	6.8	6.8	9	8.4	8.6
Mass wet + tare	284.2	172.3	204.5	222	275.1	217.9
Mass dry + tare	191.3	155.4	154	173.6	221.7	154.3
Mass water	92.9	16.9	50.5	48.4	53.4	63.6
Mass dry soil	182.9	148.6	147.2	164.6	213.3	145.7
Moisture %	50.8%	11.4%	34.3%	29.4%	25.0%	43.7%

Test Hole	TH22-29	TH22-29	TH22-30	TH22-30	TH22-30	TH22-30
Depth (m)	3.8 - 4.1	5.9 - 6.2	0.5 - 0.8	1.7 - 2.0	2.9 - 3.2	4.4 - 4.7
Sample #	G330	G332	G388	G389	G390	G392
Tare ID	E55	Z58	AC30	Z116	K4	N54
Mass of tare	8.7	8.6	6.9	8.5	8.6	9.3
Mass wet + tare	219.4	245.5	222.5	225.2	241.5	254.2
Mass dry + tare	159.5	165.4	168.2	184	175.5	165.9
Mass water	59.9	80.1	54.3	41.2	66.0	88.3
Mass dry soil	150.8	156.8	161.3	175.5	166.9	156.6
Moisture %	39.7%	51.1%	33.7%	23.5%	39.5%	56.4%

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Project Armstrong Combined Sewer

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Test Date 10-Nov-22
Technician JC

Test Hole	TH22-30	TH22-31	TH22-31	TH22-31	TH22-31	TH22-31
Depth (m)	5.9 - 6.2	0.2 - 0.3	0.8 - 1.1	2.0 - 2.3	2.9 - 3.2	4.4 - 4.7
Sample #	G393	G362	G363	G364	G365	G366
Tare ID	N07	Z66	AB98	P24	N73	Z47
Mass of tare	9.2	8.4	6.8	8.8	8.8	8.6
Mass wet + tare	255.1	174	237	302.5	250.2	219.3
Mass dry + tare	164.6	156.1	184.9	249.2	172.9	144.5
Mass water	90.5	17.9	52.1	53.3	77.3	74.8
Mass dry soil	155.4	147.7	178.1	240.4	164.1	135.9
Moisture %	58.2%	12.1%	29.3%	22.2%	47.1%	55.0%

Test Hole	TH22-31	TH22-32	TH22-32	TH22-32	TH22-32	TH22-32
Depth (m)	5.9 - 6.2	0.6 - 0.9	1.5 - 1.8	2.1 - 2.4	3.0 - 3.4	4.6 - 4.9
Sample #	G367	G333	G334	G335	G336	G337
Tare ID	W53	E27	N06	Z73	H72	A39
Mass of tare	8.7	8.7	8.7	8.4	9.1	8.3
Mass wet + tare	231.1	240.2	222.6	343.1	267.8	237.5
Mass dry + tare	151.2	183.6	173.7	279.6	182.3	157.9
Mass water	79.9	56.6	48.9	63.5	85.5	79.6
Mass dry soil	142.5	174.9	165.0	271.2	173.2	149.6
Moisture %	56.1%	32.4%	29.6%	23.4%	49.4%	53.2%

Test Hole	TH22-32	TH22-32	TH22-32	TH22-33	TH22-33	TH22-33
Depth (m)	6.1 - 6.4	7.3 - 7.6	9.1 - 9.4	0.2 - 0.5	0.8 - 1.1	1.7 - 2.0
Sample #	G338	G339	G341	G368	G369	G370
Tare ID	W34	W34	N76	AC01	E94	N111
Mass of tare	8.4	8.4	8.6	6.7	8.6	8.7
Mass wet + tare	216.3	216.3	210.8	250.9	248.8	319.9
Mass dry + tare	140.5	140.5	144.8	239.3	190.8	264.3
Mass water	75.8	75.8	66.0	11.6	58.0	55.6
Mass dry soil	132.1	132.1	136.2	232.6	182.2	255.6
Moisture %	57.4%	57.4%	48.5%	5.0%	31.8%	21.8%



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Moisture Content Report ASTM D2216-10

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

Sample Date 28-Sep-22
Test Date 10-Nov-22
Technician JC

Test Hole	TH22-33	TH22-33	TH22-33			
Depth (m)	2.9 - 3.2	3.5 - 3.8	6.0 - 6.3			
Sample #	G371	G372	G374			
Tare ID	N99	C2	F108			
Mass of tare	8.4	8.5	8.4			
Mass wet + tare	264.7	249.8	237.9			
Mass dry + tare	214.6	165.7	154.8			
Mass water	50.1	84.1	83.1			
Mass dry soil	206.2	157.2	146.4			
Moisture %	24.3%	53.5%	56.8%			



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Atterberg Limits ASTM D4318-10e1

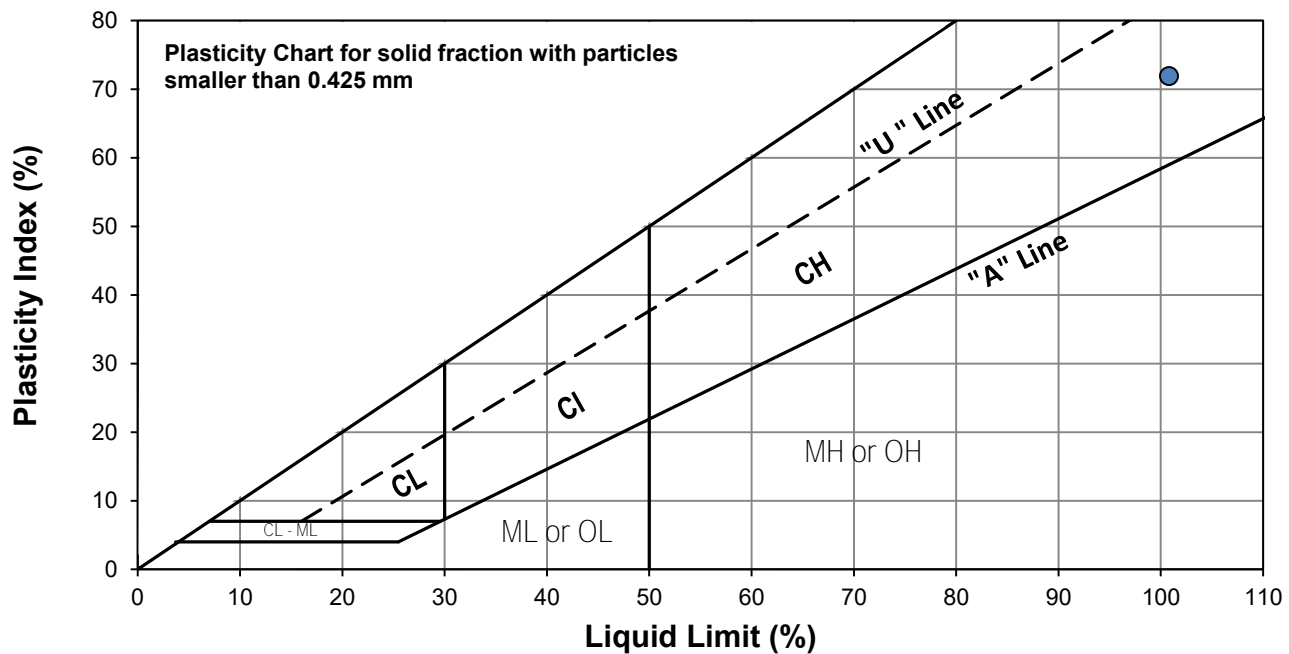
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong combined Sewer
Test Hole TH22-01
Sample # G04
Depth (m) 2.8 - 3.1
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician TN



Liquid Limit	101
Plastic Limit	29
Plasticity Index	72

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	15	24	29		
Mass Tare (g)	14.089	14.149	4.610		
Mass Wet Soil + Tare (g)	29.273	27.757	20.268		
Mass Dry Soil + Tare (g)	21.332	20.884	12.525		
Mass Water (g)	7.941	6.873	7.743		
Mass Dry Soil (g)	7.243	6.735	7.915		
Moisture Content (%)	109.637	102.049	97.827		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.192	13.878			
Mass Wet Soil + Tare (g)	22.939	23.776			
Mass Dry Soil + Tare (g)	20.960	21.575			
Mass Water (g)	1.979	2.201			
Mass Dry Soil (g)	6.768	7.697			
Moisture Content (%)	29.241	28.596			

Note: Additional information recorded/measured for this test is available upon request.

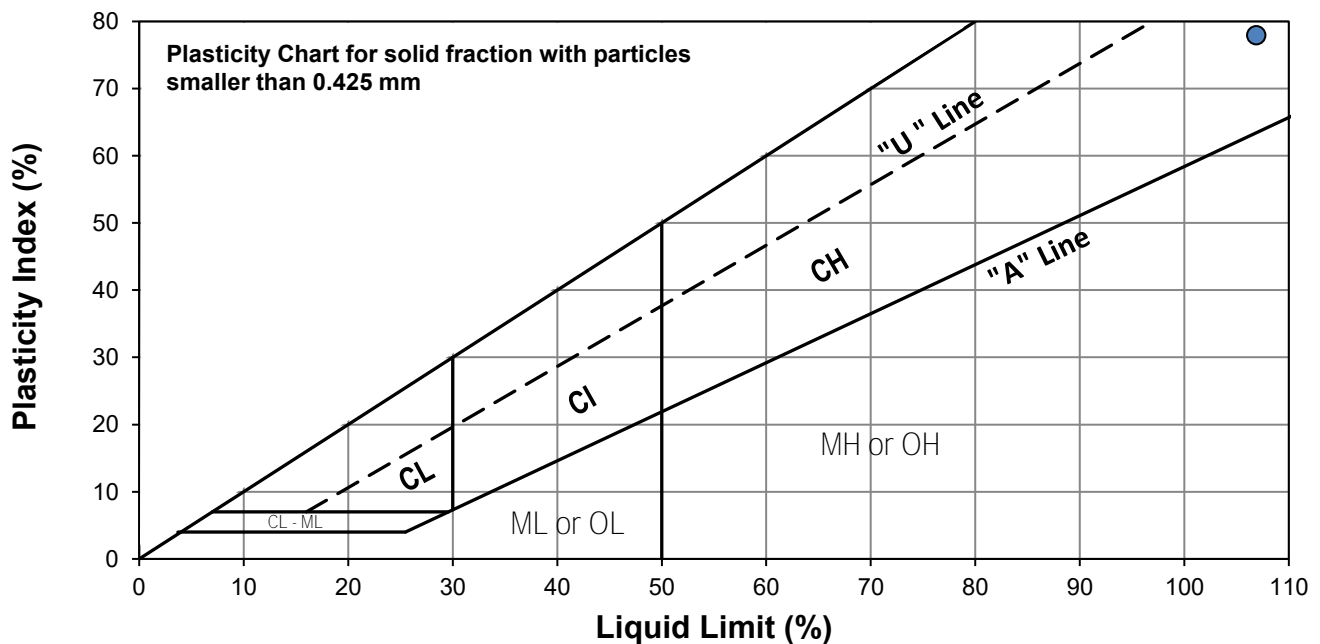
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer
Test Hole TH22-04
Sample # G15
Depth (m) 1.8 - 1.9
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician TN



Liquid Limit 107
Plastic Limit 29
Plasticity Index 78

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	18	29	35		
Mass Tare (g)	14.046	14.083	14.110		
Mass Wet Soil + Tare (g)	26.207	28.706	28.394		
Mass Dry Soil + Tare (g)	19.861	21.171	21.111		
Mass Water (g)	6.346	7.535	7.283		
Mass Dry Soil (g)	5.815	7.088	7.001		
Moisture Content (%)	109.132	106.306	104.028		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.192	13.878			
Mass Wet Soil + Tare (g)	22.939	23.776			
Mass Dry Soil + Tare (g)	20.960	21.575			
Mass Water (g)	1.979	2.201			
Mass Dry Soil (g)	6.768	7.697			
Moisture Content (%)	29.241	28.596			

Note: Additional information recorded/measured for this test is available upon request.

Project No. 0336-003-00
Client Jacobs Canada Inc
Project Armstrong Combined Sewer

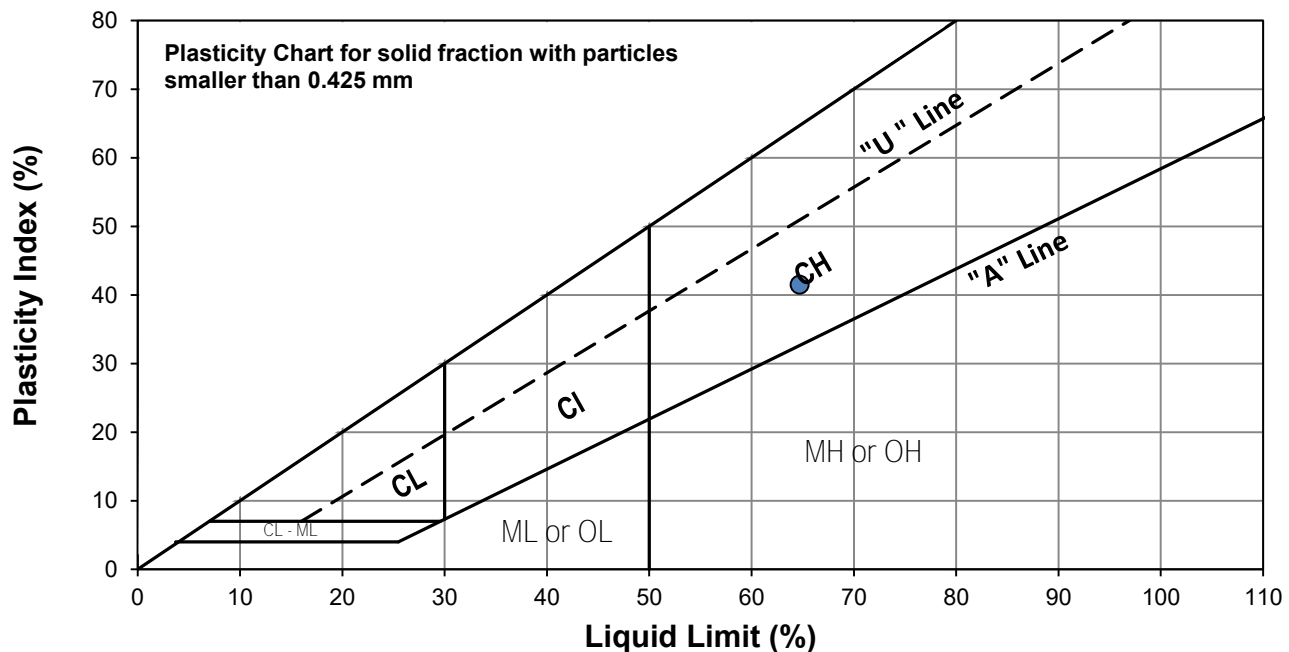
Test Hole TH22-05
Sample # G50
Depth (m) 7.6 - 7.9
Sample Date 17-Oct-22
Test Date 01-Nov-22
Technician TN



Liquid Limit	65
Plastic Limit	23
Plasticity Index	41

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	15	20	32		
Mass Tare (g)	14.328	14.215	14.123		
Mass Wet Soil + Tare (g)	31.242	27.701	26.990		
Mass Dry Soil + Tare (g)	24.412	22.350	22.000		
Mass Water (g)	6.830	5.351	4.990		
Mass Dry Soil (g)	10.084	8.135	7.877		
Moisture Content (%)	67.731	65.778	63.349		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.235	14.072			
Mass Wet Soil + Tare (g)	22.866	22.226			
Mass Dry Soil + Tare (g)	21.253	20.678			
Mass Water (g)	1.613	1.548			
Mass Dry Soil (g)	7.018	6.606			
Moisture Content (%)	22.984	23.433			

Note: Additional information recorded/measured for this test is available upon request.

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Client Jacobs Canada Inc
Project Armstrong Combined Sewer

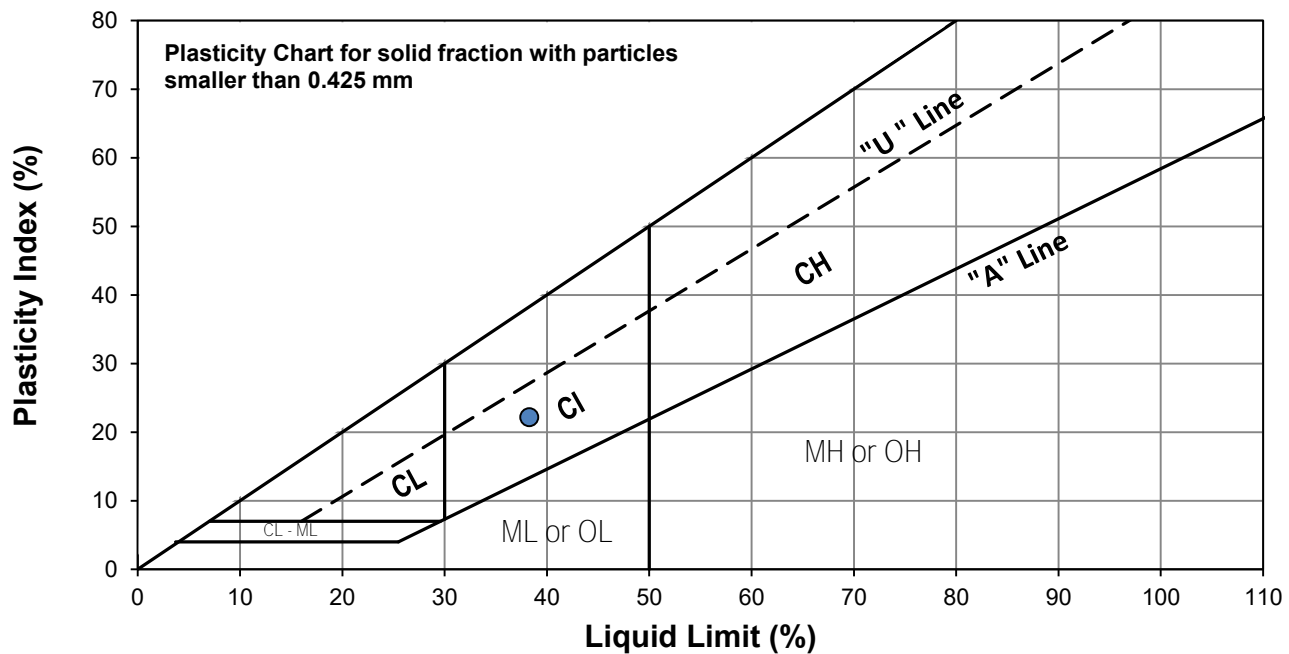
Test Hole TH22-08
Sample # G84
Depth (m) 3.0 - 3.3
Sample Date 17-Oct-22
Test Date 01-Nov-22
Technician TN



Liquid Limit	38
Plastic Limit	16
Plasticity Index	22

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	23	28		
Mass Tare (g)	14.059	13.960	14.094		
Mass Wet Soil + Tare (g)	29.765	35.000	32.190		
Mass Dry Soil + Tare (g)	25.292	29.140	27.222		
Mass Water (g)	4.473	5.860	4.968		
Mass Dry Soil (g)	11.233	15.180	13.128		
Moisture Content (%)	39.820	38.603	37.843		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.857	14.304			
Mass Wet Soil + Tare (g)	23.234	26.887			
Mass Dry Soil + Tare (g)	21.921	25.150			
Mass Water (g)	1.313	1.737			
Mass Dry Soil (g)	8.064	10.846			
Moisture Content (%)	16.282	16.015			

Note: Additional information recorded/measured for this test is available upon request.

Project No. 0336-003-00
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Project Armstrong Combined Sewer

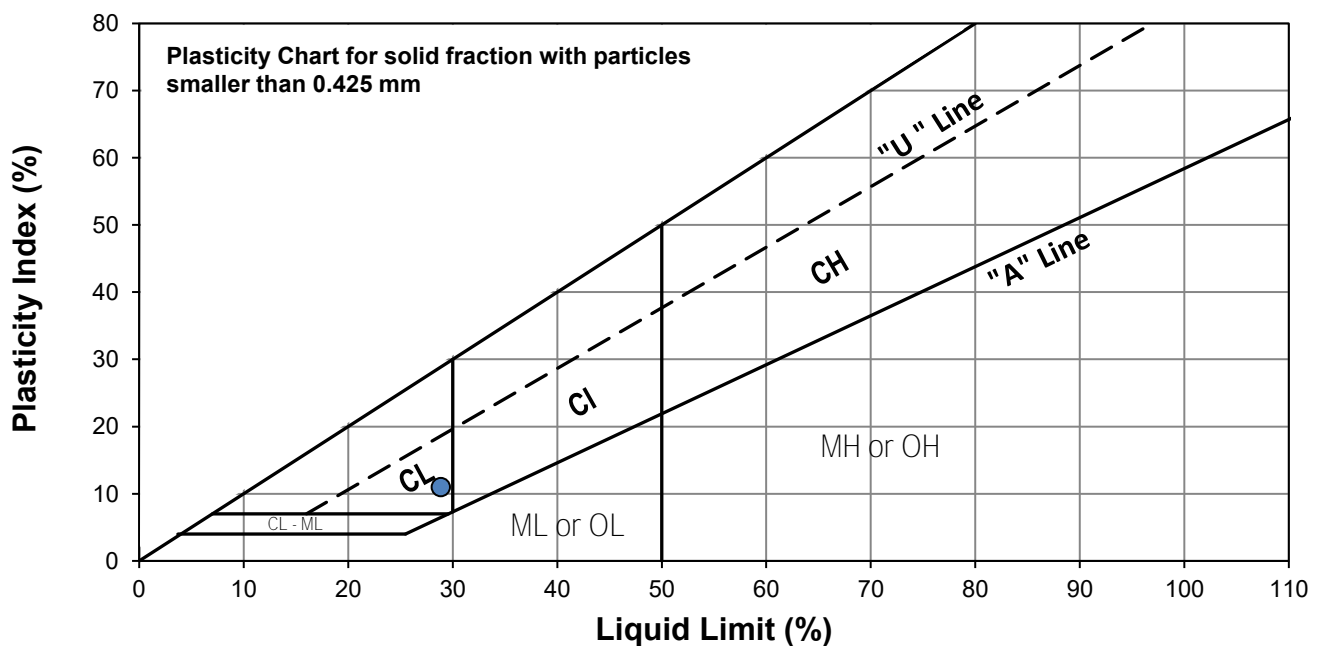
Test Hole TH22-13
Sample # G122
Depth (m) 2.3 - 2.4
Sample Date 2022-
Test Date 02-Nov-22
Technician TN



Liquid Limit	29
Plastic Limit	18
Plasticity Index	11

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	18	30	35		
Mass Tare (g)	13.802	13.889	13.928		
Mass Wet Soil + Tare (g)	24.791	23.133	24.731		
Mass Dry Soil + Tare (g)	22.268	21.099	22.364		
Mass Water (g)	2.523	2.034	2.367		
Mass Dry Soil (g)	8.466	7.210	8.436		
Moisture Content (%)	29.802	28.211	28.058		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.025	13.962			
Mass Wet Soil + Tare (g)	25.755	26.428			
Mass Dry Soil + Tare (g)	23.976	24.534			
Mass Water (g)	1.779	1.894			
Mass Dry Soil (g)	9.951	10.572			
Moisture Content (%)	17.878	17.915			

Note: Additional information recorded/measured for this test is available upon request.

Project No. 0336-003-00
Client Jacobs Canada Inc
Project Armstrong Combined Sewer

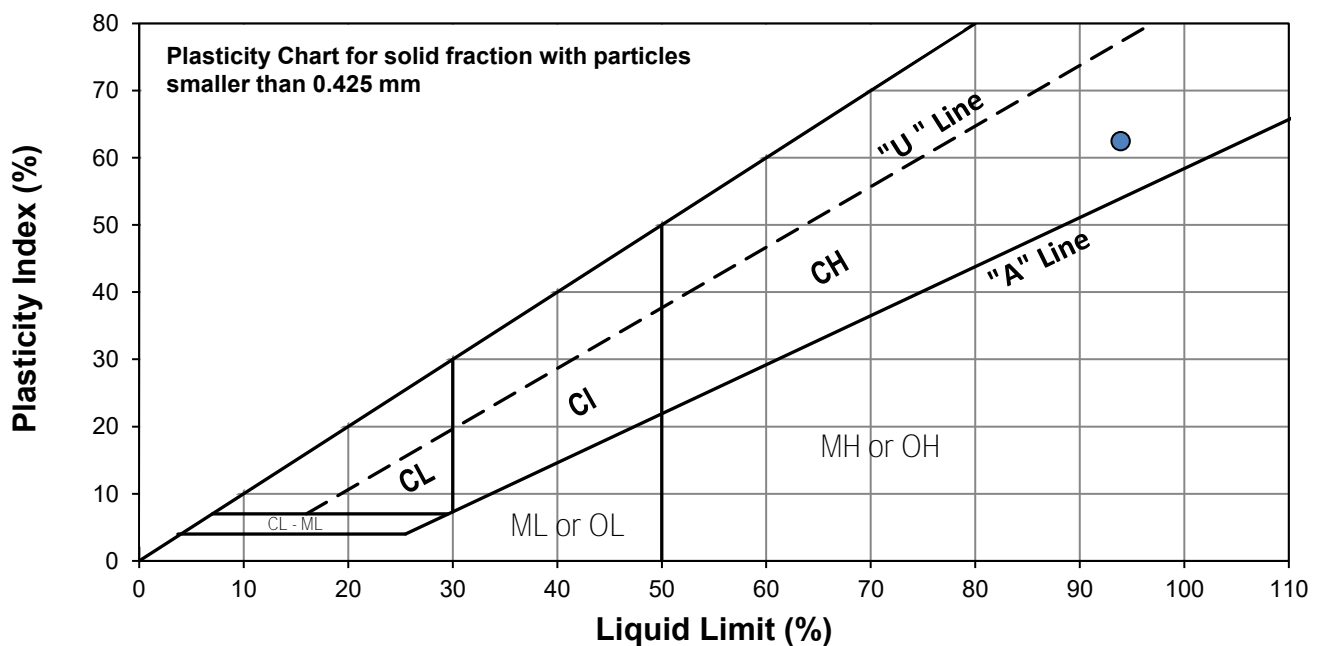
Test Hole TH22-13
Sample # G134
Depth (m) 2.0 - 2.3
Sample Date 2022-
Test Date 02-Nov-22
Technician TN



Liquid Limit 94
Plastic Limit 31
Plasticity Index 62

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	18	28	34		
Mass Tare (g)	14.115	14.201	14.160		
Mass Wet Soil + Tare (g)	23.826	21.613	22.501		
Mass Dry Soil + Tare (g)	19.035	18.047	18.535		
Mass Water (g)	4.791	3.566	3.966		
Mass Dry Soil (g)	4.920	3.846	4.375		
Moisture Content (%)	97.378	92.720	90.651		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.935	14.052			
Mass Wet Soil + Tare (g)	23.920	22.195			
Mass Dry Soil + Tare (g)	21.524	20.255			
Mass Water (g)	2.396	1.940			
Mass Dry Soil (g)	7.589	6.203			
Moisture Content (%)	31.572	31.275			

Note: Additional information recorded/measured for this test is available upon request.

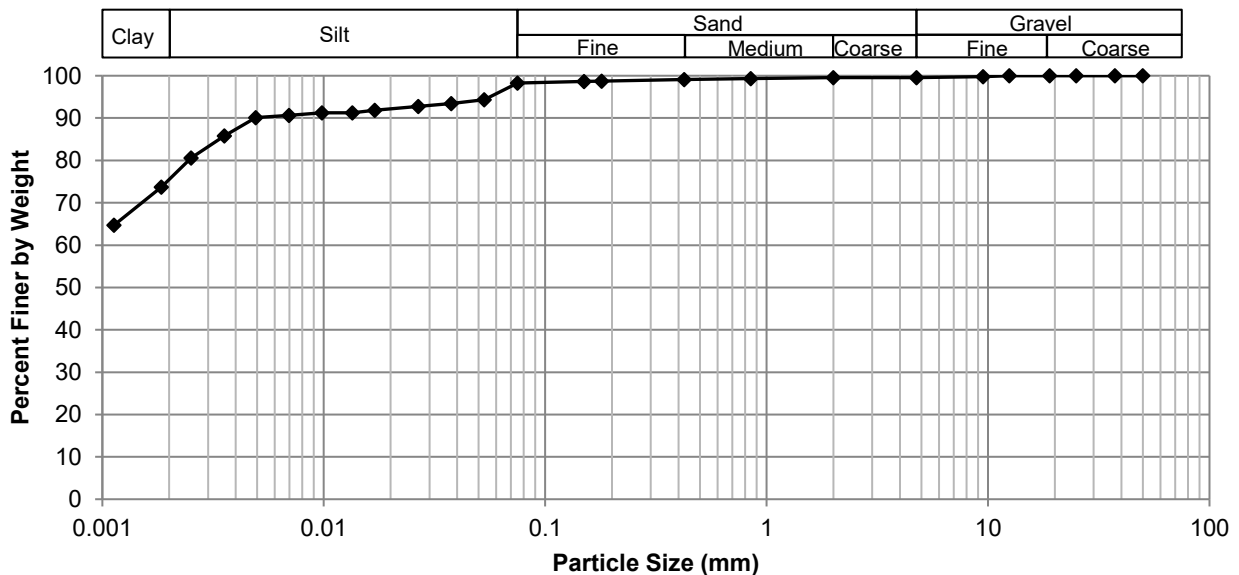
Project No. 0336-003-00
Client Jacobs Canada
Project Armstrong Combined Sewer



Test Hole TH22-13
Sample # G134
Depth (m) 13.4 - 13.7
Sample Date 19-Sep-22
Test Date 2-Nov-22
Technician AFK

Gravel	0.5%
Sand	1.2%
Silt	23.0%
Clay	75.3%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	99.53	0.0750	98.29
37.5	100.00	2.00	99.53	0.0530	94.34
25.0	100.00	0.850	99.31	0.0377	93.41
19.0	100.00	0.425	99.13	0.0267	92.78
12.5	100.00	0.180	98.74	0.0170	91.85
9.50	99.80	0.150	98.63	0.0135	91.23
4.75	99.53	0.075	98.29	0.0098	91.23
				0.0070	90.65
				0.0049	90.07
				0.0036	85.77
				0.0025	80.61
				0.0018	73.68
				0.0011	64.73

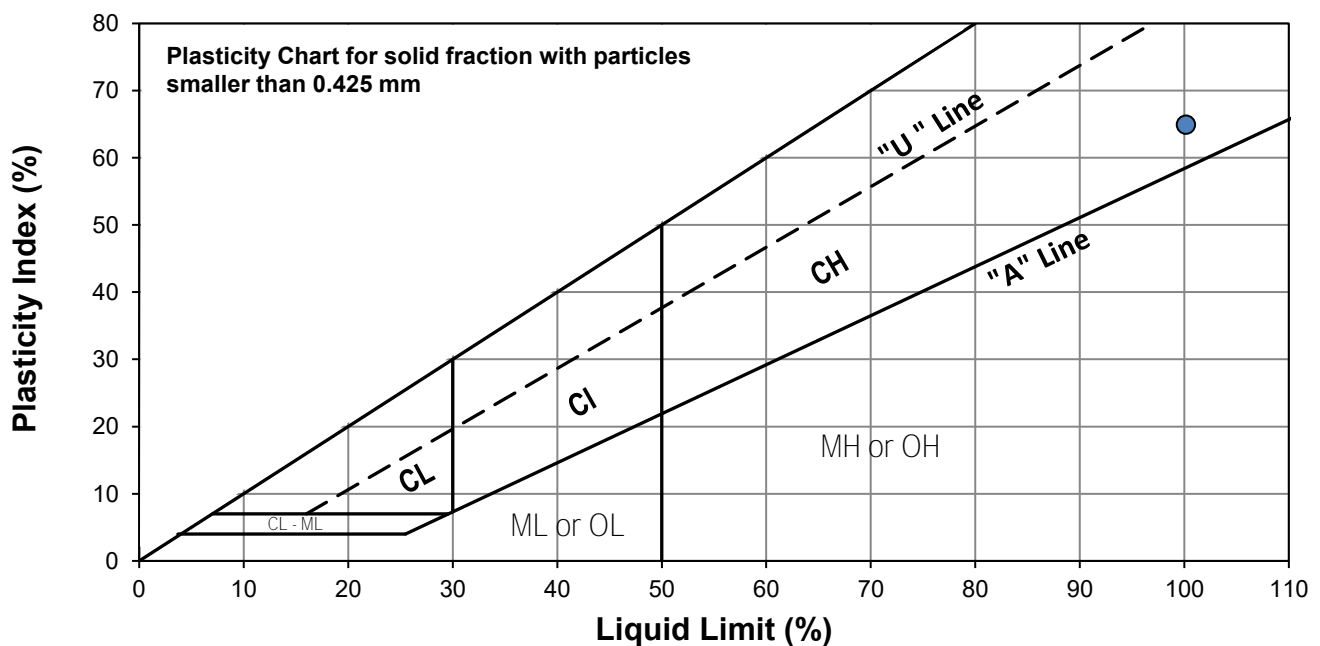
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer
Test Hole TH22-20
Sample # G138
Depth (m) 1.6 - 2.0
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician TN



Liquid Limit 100
Plastic Limit 35
Plasticity Index 65

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	18	24	33		
Mass Tare (g)	14.050	14.163	13.929		
Mass Wet Soil + Tare (g)	23.264	22.472	23.110		
Mass Dry Soil + Tare (g)	18.580	18.302	18.583		
Mass Water (g)	4.684	4.170	4.527		
Mass Dry Soil (g)	4.530	4.139	4.654		
Moisture Content (%)	103.400	100.749	97.271		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.112	14.079			
Mass Wet Soil + Tare (g)	25.779	27.441			
Mass Dry Soil + Tare (g)	22.742	23.954			
Mass Water (g)	3.037	3.487			
Mass Dry Soil (g)	8.630	9.875			
Moisture Content (%)	35.191	35.311			

Note: Additional information recorded/measured for this test is available upon request.

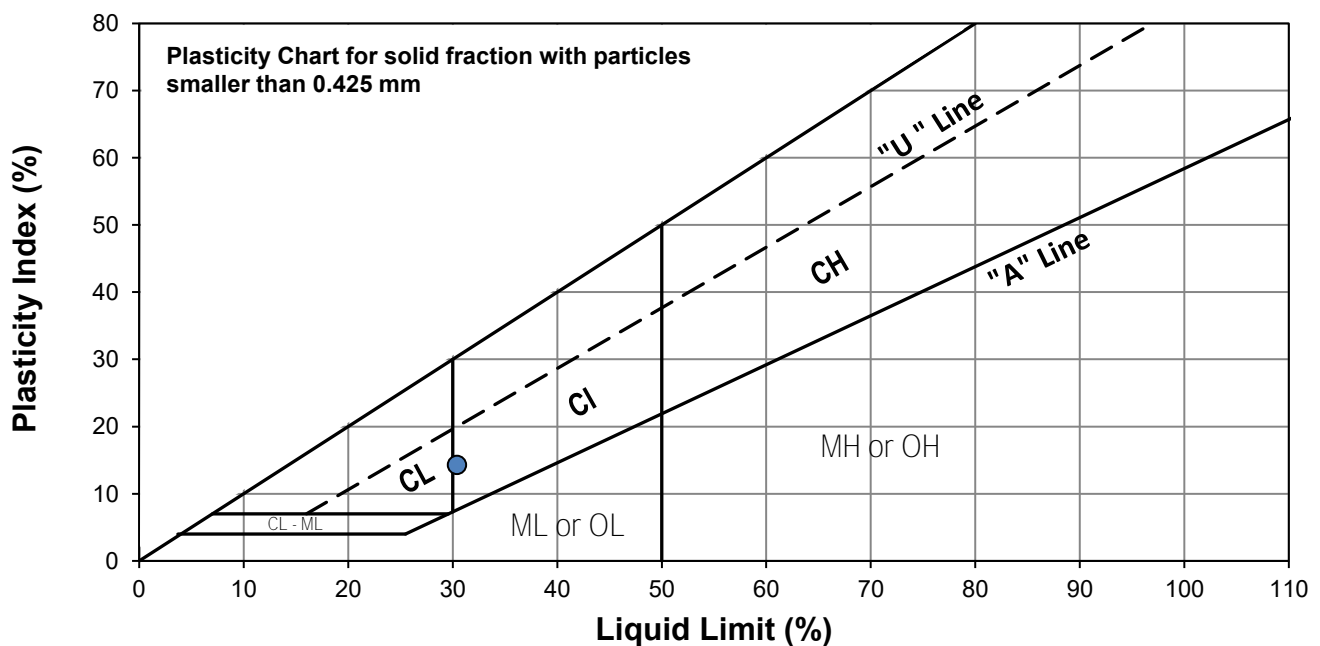
Project No. 0336-003-00
Client Jacobs Canada Inc
Project Armstrong Combined Sewer
Test Hole TH22-19
Sample # G157
Depth (m) 2.0 - 2.3
Sample Date 2022-
Test Date 02-Nov-22
Technician TN



Liquid Limit 30
Plastic Limit 16
Plasticity Index 14

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	16	26	34		
Mass Tare (g)	14.083	13.607	14.060		
Mass Wet Soil + Tare (g)	26.202	25.744	24.335		
Mass Dry Soil + Tare (g)	23.276	22.927	21.996		
Mass Water (g)	2.926	2.817	2.339		
Mass Dry Soil (g)	9.193	9.320	7.936		
Moisture Content (%)	31.829	30.225	29.473		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.026	14.218			
Mass Wet Soil + Tare (g)	24.399	28.877			
Mass Dry Soil + Tare (g)	22.945	26.862			
Mass Water (g)	1.454	2.015			
Mass Dry Soil (g)	8.919	12.644			
Moisture Content (%)	16.302	15.936			

Note: Additional information recorded/measured for this test is available upon request.

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

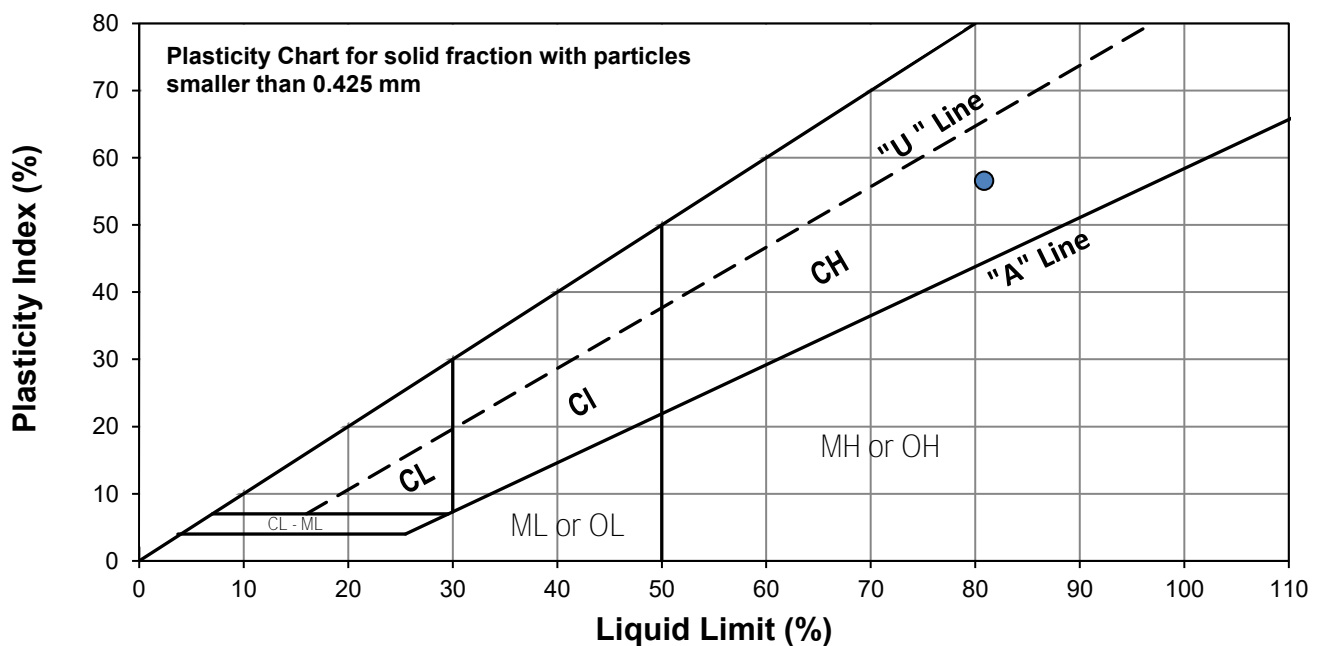
Test Hole TH22-12
Sample # G179
Depth (m) 12.1 - 12.4
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician TN



Liquid Limit 81
Plastic Limit 24
Plasticity Index 57

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	15	24	30		
Mass Tare (g)	13.846	13.948	14.121		
Mass Wet Soil + Tare (g)	19.838	28.800	28.890		
Mass Dry Soil + Tare (g)	17.073	22.155	22.356		
Mass Water (g)	2.765	6.645	6.534		
Mass Dry Soil (g)	3.227	8.207	8.235		
Moisture Content (%)	85.683	80.967	79.344		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.830	14.068			
Mass Wet Soil + Tare (g)	27.004	27.284			
Mass Dry Soil + Tare (g)	24.440	24.694			
Mass Water (g)	2.564	2.590			
Mass Dry Soil (g)	10.610	10.626			
Moisture Content (%)	24.166	24.374			

Note: Additional information recorded/measured for this test is available upon request.

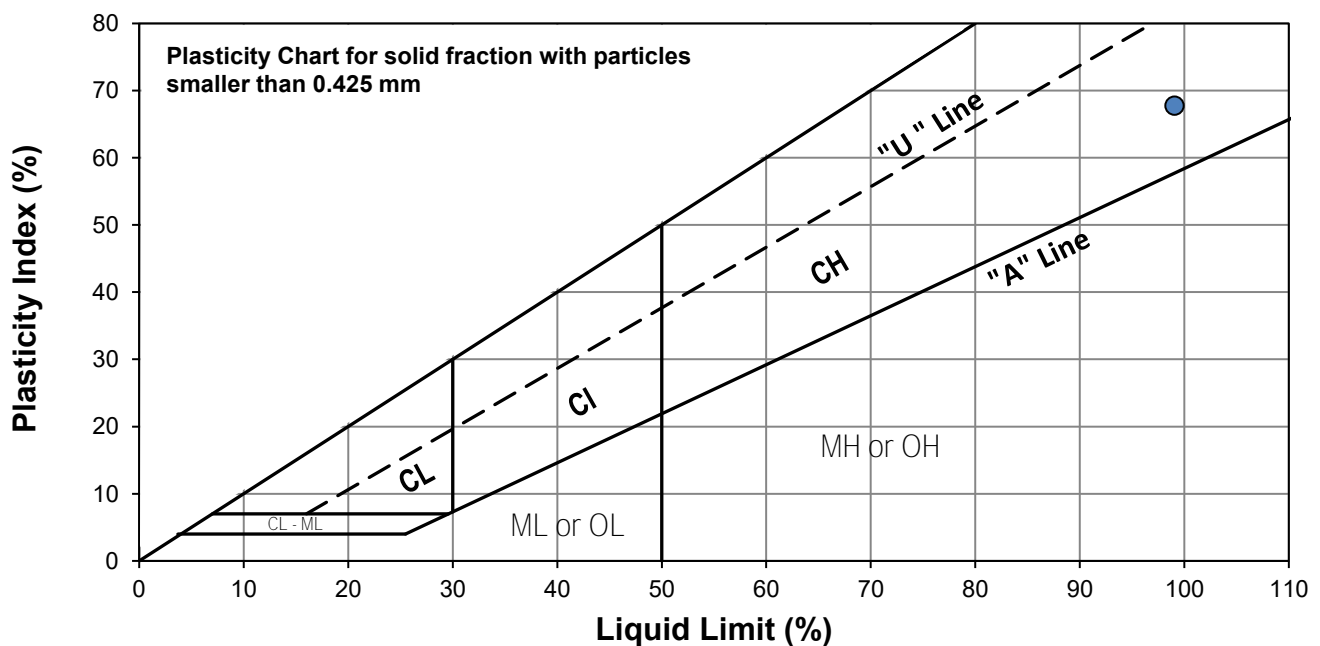
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer
Test Hole TH22-11
Sample # G193
Depth (m) 3.3 - 3.6
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician SL



Liquid Limit 99
Plastic Limit 31
Plasticity Index 68

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	20	29		
Mass Tare (g)	13.606	14.013	13.950		
Mass Wet Soil + Tare (g)	19.088	19.760	22.819		
Mass Dry Soil + Tare (g)	16.292	16.845	18.458		
Mass Water (g)	2.796	2.915	4.361		
Mass Dry Soil (g)	2.686	2.832	4.508		
Moisture Content (%)	104.095	102.931	96.739		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.117	14.181			
Mass Wet Soil + Tare (g)	20.480	20.592			
Mass Dry Soil + Tare (g)	18.979	19.048			
Mass Water (g)	1.501	1.544			
Mass Dry Soil (g)	4.862	4.867			
Moisture Content (%)	30.872	31.724			

Note: Additional information recorded/measured for this test is available upon request.

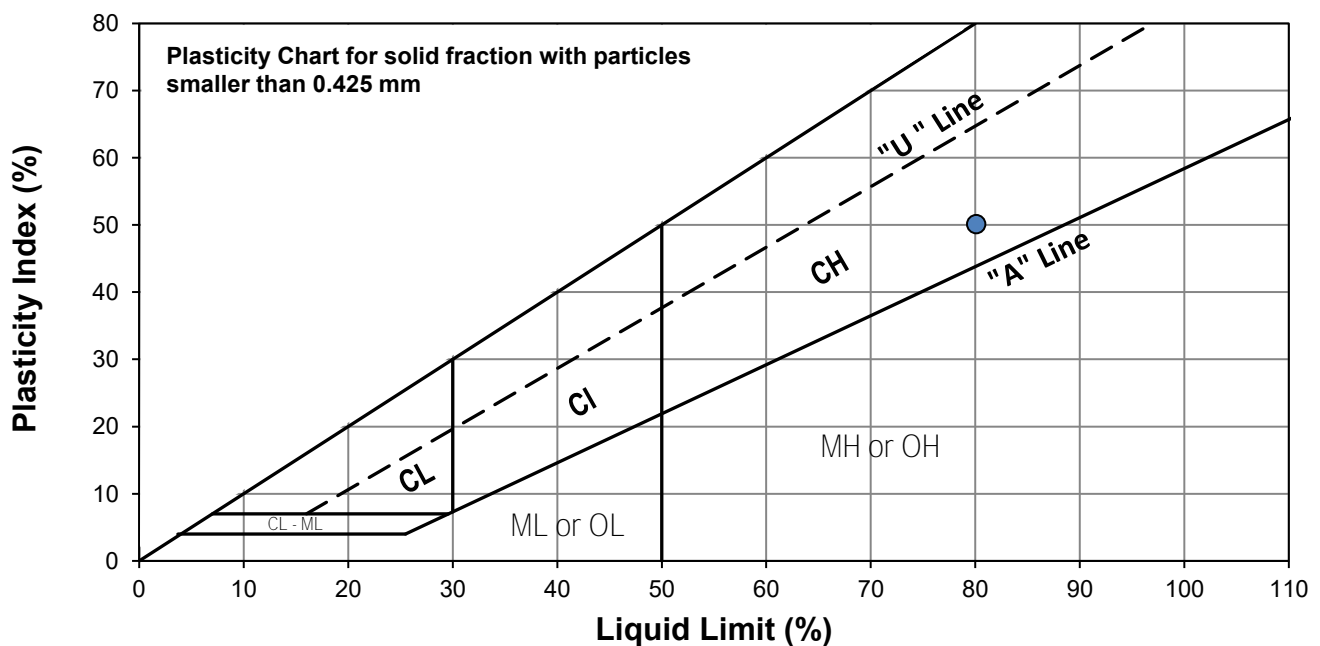
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer
Test Hole TH22-21
Sample # G219
Depth (m) 16.6 - 16.9
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician KF



Liquid Limit 80
Plastic Limit 30
Plasticity Index 50

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	18	23	35		
Mass Tare (g)	13.610	14.059	14.103		
Mass Wet Soil + Tare (g)	21.748	25.267	25.509		
Mass Dry Soil + Tare (g)	18.055	20.242	20.560		
Mass Water (g)	3.693	5.025	4.949		
Mass Dry Soil (g)	4.445	6.183	6.457		
Moisture Content (%)	83.082	81.271	76.646		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.952	14.143			
Mass Wet Soil + Tare (g)	26.954	20.073			
Mass Dry Soil + Tare (g)	23.960	18.704			
Mass Water (g)	2.994	1.369			
Mass Dry Soil (g)	10.008	4.561			
Moisture Content (%)	29.916	30.015			

Note: Additional information recorded/measured for this test is available upon request.

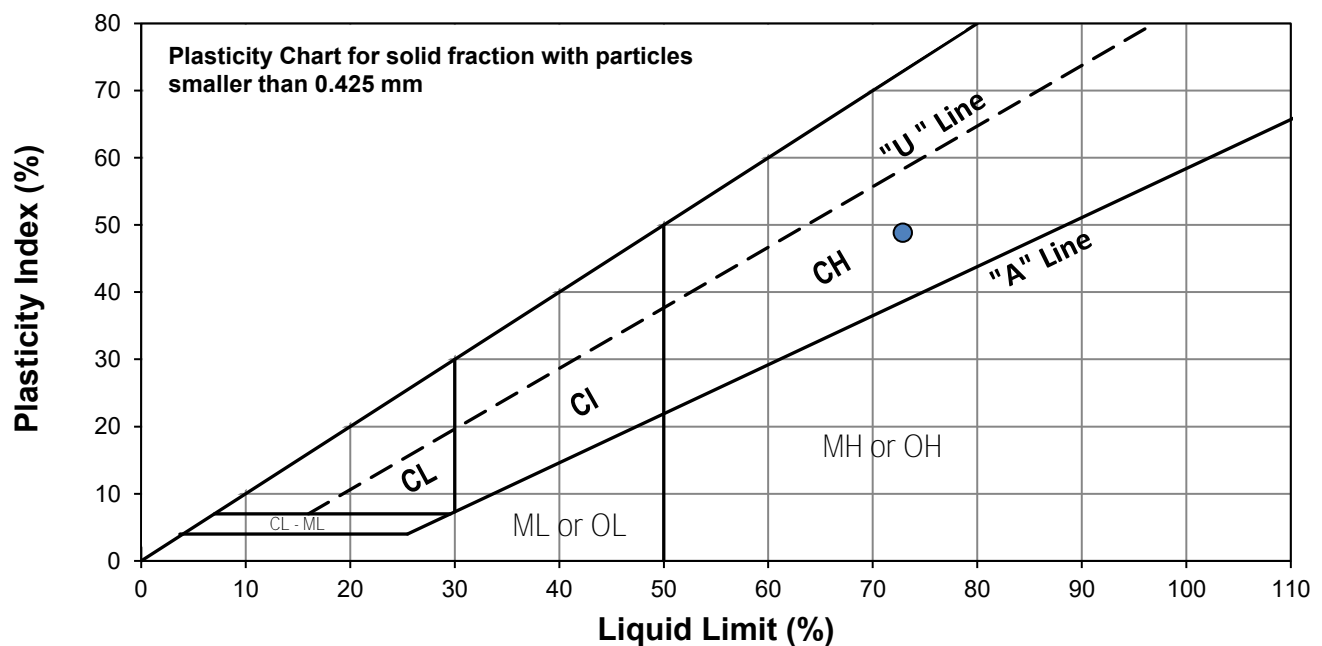
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer
Test Hole TH22-15
Sample # G252
Depth (m) 1.1 - 1.2
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician TN



Liquid Limit 73
Plastic Limit 24
Plasticity Index 49

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	16	25	31		
Mass Tare (g)	13.950	13.859	13.915		
Mass Wet Soil + Tare (g)	30.258	28.605	26.962		
Mass Dry Soil + Tare (g)	23.297	22.390	21.495		
Mass Water (g)	6.961	6.215	5.467		
Mass Dry Soil (g)	9.347	8.531	7.580		
Moisture Content (%)	74.473	72.852	72.124		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.018	14.240			
Mass Wet Soil + Tare (g)	26.430	32.163			
Mass Dry Soil + Tare (g)	24.015	28.707			
Mass Water (g)	2.415	3.456			
Mass Dry Soil (g)	9.997	14.467			
Moisture Content (%)	24.157	23.889			

Note: Additional information recorded/measured for this test is available upon request.

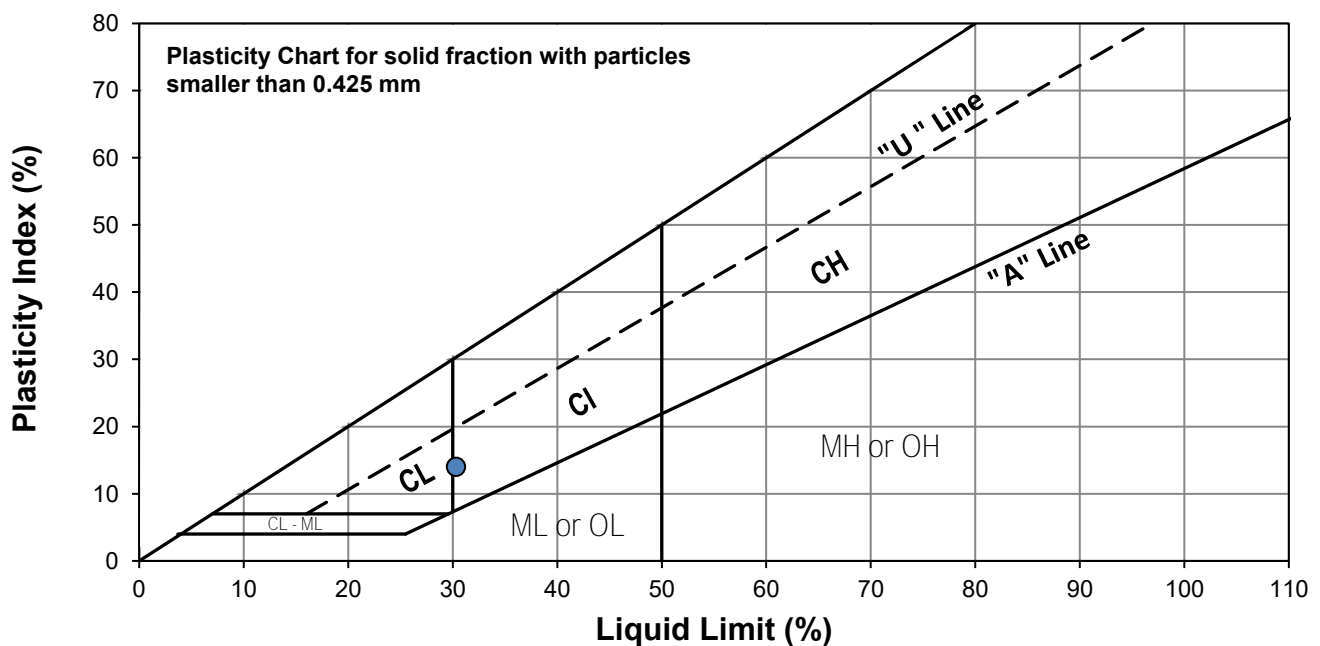
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer
Test Hole TH22-28
Sample # G278
Depth (m) 1.7 - 2.0
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician SL



Liquid Limit 30
Plastic Limit 16
Plasticity Index 14

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	20	24	32		
Mass Tare (g)	14.099	14.048	14.321		
Mass Wet Soil + Tare (g)	26.626	24.406	26.055		
Mass Dry Soil + Tare (g)	23.683	21.998	23.348		
Mass Water (g)	2.943	2.408	2.707		
Mass Dry Soil (g)	9.584	7.950	9.027		
Moisture Content (%)	30.707	30.289	29.988		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.208	14.091			
Mass Wet Soil + Tare (g)	28.956	28.696			
Mass Dry Soil + Tare (g)	26.880	26.650			
Mass Water (g)	2.076	2.046			
Mass Dry Soil (g)	12.672	12.559			
Moisture Content (%)	16.383	16.291			

Note: Additional information recorded/measured for this test is available upon request.

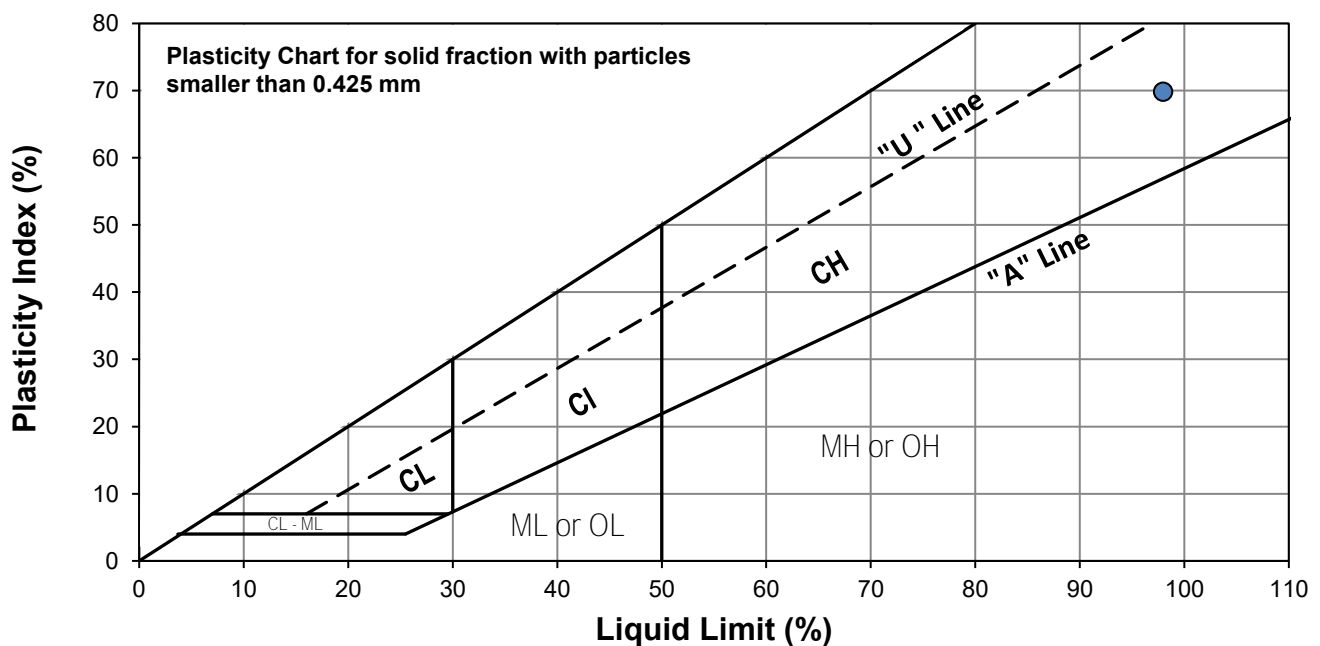
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer
Test Hole TH22-25
Sample # G286
Depth (m) 2.5 - 2.8
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician KF



Liquid Limit 98
Plastic Limit 28
Plasticity Index 70

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	20	25	31		
Mass Tare (g)	14.183	14.007	13.958		
Mass Wet Soil + Tare (g)	22.487	22.991	26.109		
Mass Dry Soil + Tare (g)	18.315	18.550	20.181		
Mass Water (g)	4.172	4.441	5.928		
Mass Dry Soil (g)	4.132	4.543	6.223		
Moisture Content (%)	100.968	97.755	95.260		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.900	13.849			
Mass Wet Soil + Tare (g)	20.023	19.999			
Mass Dry Soil + Tare (g)	18.663	18.664			
Mass Water (g)	1.360	1.335			
Mass Dry Soil (g)	4.763	4.815			
Moisture Content (%)	28.553	27.726			

Note: Additional information recorded/measured for this test is available upon request.

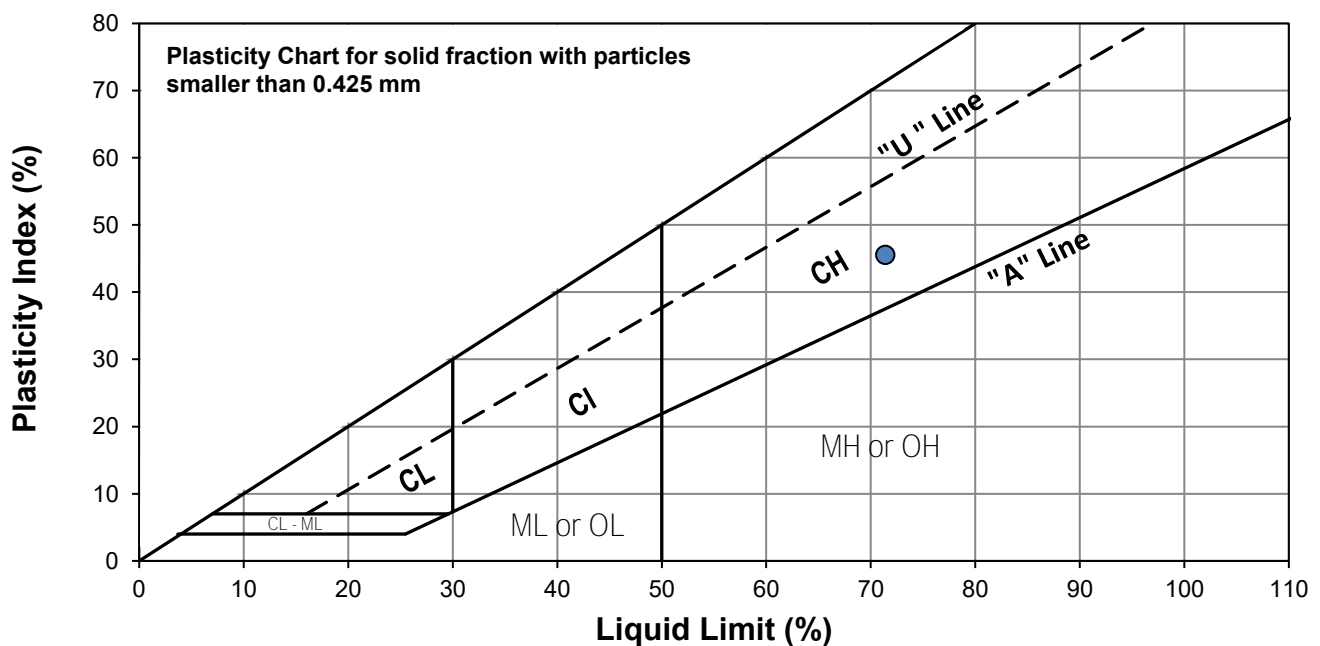
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer
Test Hole TH22-21
Sample # G310
Depth (m) 2.9 - 3.2
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician SL



Liquid Limit 71
Plastic Limit 26
Plasticity Index 46

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	16	23	35		
Mass Tare (g)	14.204	14.046	13.948		
Mass Wet Soil + Tare (g)	32.920	30.108	31.718		
Mass Dry Soil + Tare (g)	25.002	23.382	24.418		
Mass Water (g)	7.918	6.726	7.300		
Mass Dry Soil (g)	10.798	9.336	10.470		
Moisture Content (%)	73.328	72.044	69.723		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.220	4.533			
Mass Wet Soil + Tare (g)	27.891	14.254			
Mass Dry Soil + Tare (g)	25.058	12.276			
Mass Water (g)	2.833	1.978			
Mass Dry Soil (g)	10.838	7.743			
Moisture Content (%)	26.140	25.546			

Note: Additional information recorded/measured for this test is available upon request.

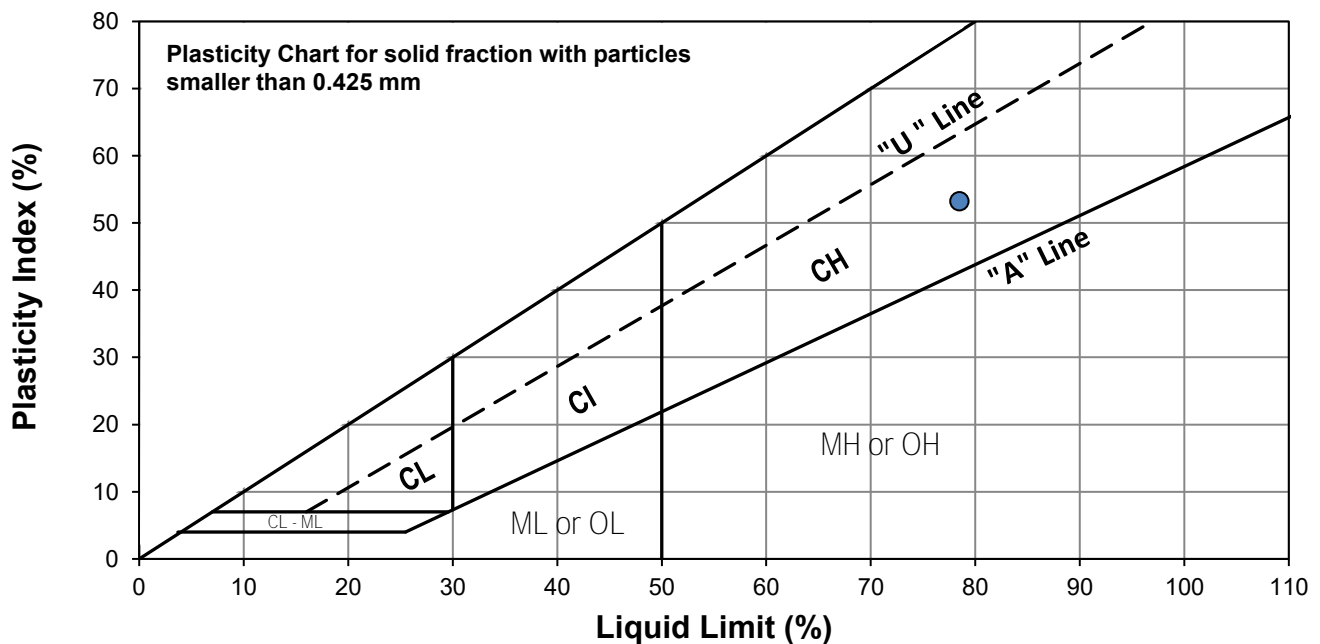
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer
Test Hole TH22-17
Sample # G356
Depth (m) 13.6 - 13.9
Sample Date 19-Sep-22
Test Date 03-Nov-22
Technician SL



Liquid Limit 78
Plastic Limit 25
Plasticity Index 53

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	15	22	30		
Mass Tare (g)	14.185	14.050	14.102		
Mass Wet Soil + Tare (g)	20.212	19.197	19.732		
Mass Dry Soil + Tare (g)	17.480	16.925	17.278		
Mass Water (g)	2.732	2.272	2.454		
Mass Dry Soil (g)	3.295	2.875	3.176		
Moisture Content (%)	82.914	79.026	77.267		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.145	14.233			
Mass Wet Soil + Tare (g)	20.228	20.480			
Mass Dry Soil + Tare (g)	19.009	19.211			
Mass Water (g)	1.219	1.269			
Mass Dry Soil (g)	4.864	4.978			
Moisture Content (%)	25.062	25.492			

Note: Additional information recorded/measured for this test is available upon request.

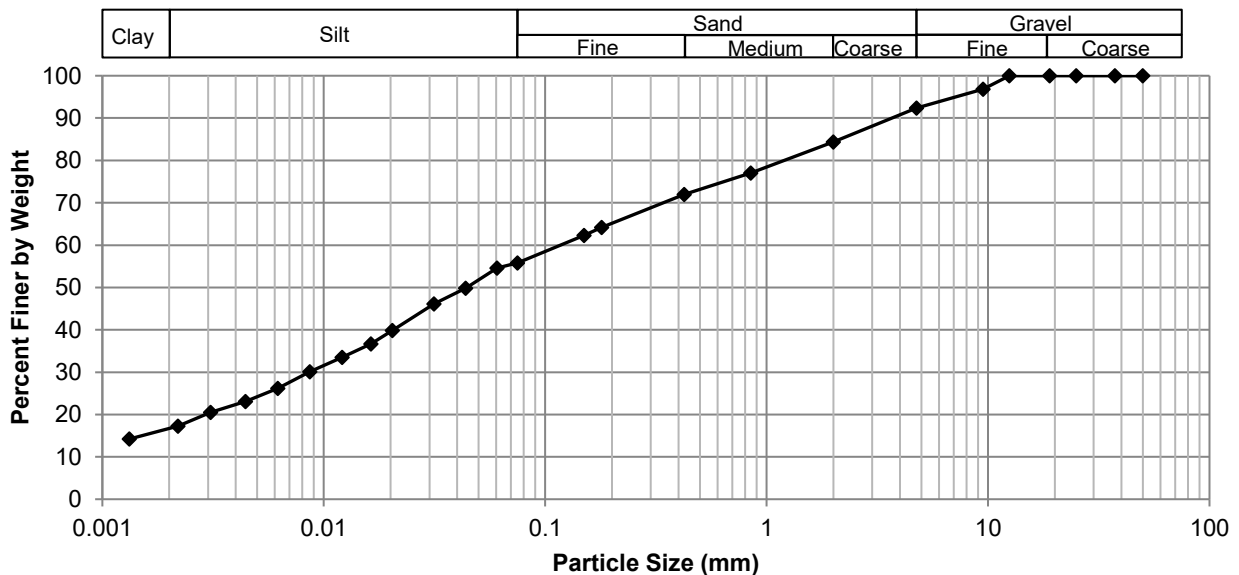
Project No. 0336-003-00
Client Jacobs Canada
Project Armstrong Combined Sewer



Test Hole TH22-03
Sample # G41
Depth (m) 15.2 - 15.5
Sample Date 19-Sep-22
Test Date 2-Nov-22
Technician AFK

Gravel	7.6%
Sand	36.6%
Silt	39.3%
Clay	16.6%

Particle Size Distribution Curve



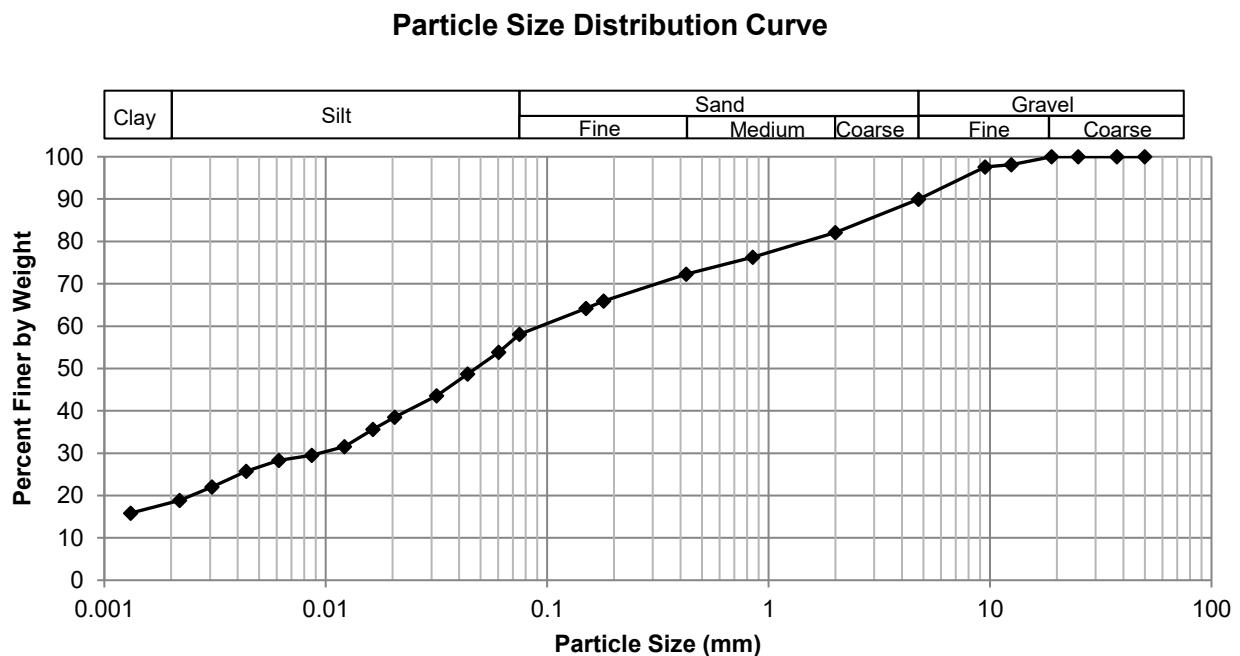
Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	92.41	0.0750	55.84
37.5	100.00	2.00	84.36	0.0606	54.61
25.0	100.00	0.850	77.07	0.0438	49.86
19.0	100.00	0.425	71.95	0.0315	46.17
12.5	100.00	0.180	64.22	0.0204	39.84
9.50	96.87	0.150	62.30	0.0164	36.68
4.75	92.41	0.075	55.84	0.0121	33.51
				0.0087	30.12
				0.0062	26.19
				0.0044	23.07
				0.0031	20.53
				0.0022	17.28
				0.0013	14.22

Project No.	0336-003-00
Client	Jacobs Canada
Project	Armstrong Combined Sewer



Test Hole	TH22-07
Sample #	G73
Depth (m)	11.8 - 12.1
Sample Date	19-Sep-22
Test Date	2-Nov-22
Technician	AFK

Gravel	10.1%
Sand	31.9%
Silt	39.9%
Clay	18.2%



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	89.94	0.0750	58.05
37.5	100.00	2.00	82.07	0.0604	53.86
25.0	100.00	0.850	76.28	0.0438	48.73
19.0	100.00	0.425	72.27	0.0317	43.60
12.5	98.15	0.180	65.95	0.0205	38.47
9.50	97.60	0.150	64.23	0.0164	35.65
4.75	89.94	0.075	58.05	0.0122	31.54
				0.0087	29.52
				0.0061	28.28
				0.0044	25.75
				0.0031	22.00
				0.0022	18.85
				0.0013	15.85

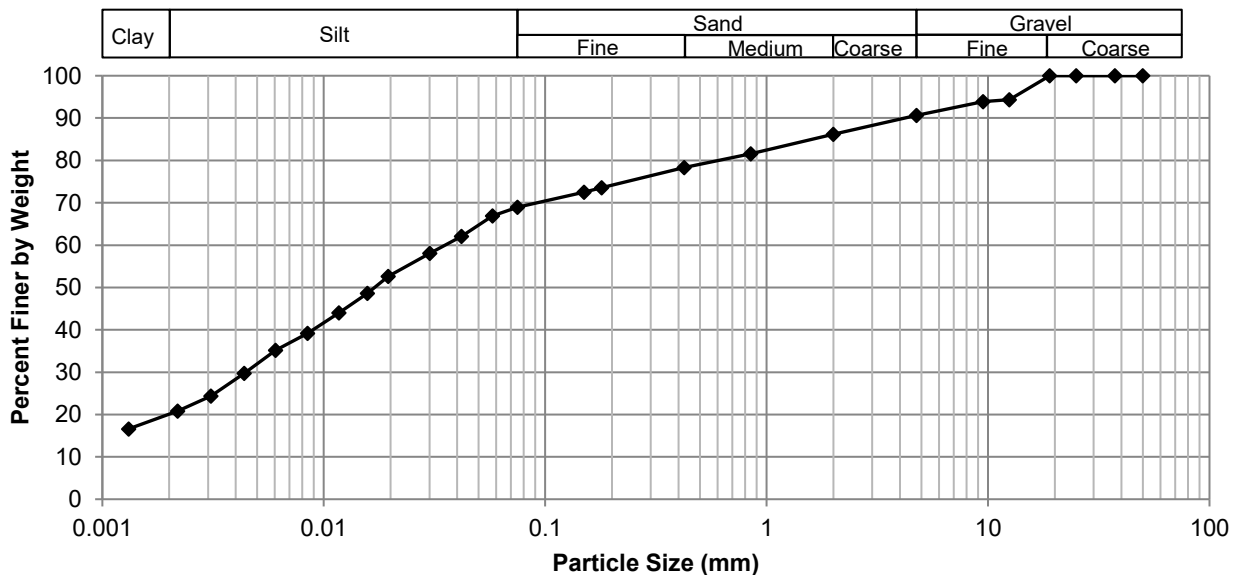
Project No. 0336-003-00
Client Jacobs Canada
Project Armstrong Combined Sewer



Test Hole TH22-20
Sample # G152
Depth (m) 19.3 - 19.6
Sample Date 19-Sep-22
Test Date 7-Nov-22
Technician AFK

Gravel	9.3%
Sand	21.7%
Silt	49.1%
Clay	19.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	90.67	0.0750	68.99
37.5	100.00	2.00	86.16	0.0578	66.94
25.0	100.00	0.850	81.60	0.0419	62.09
19.0	100.00	0.425	78.33	0.0302	58.05
12.5	94.34	0.180	73.59	0.0196	52.67
9.50	93.88	0.150	72.50	0.0157	48.62
4.75	90.67	0.075	68.99	0.0117	44.04
				0.0084	39.20
				0.0061	35.15
				0.0044	29.77
				0.0031	24.38
				0.0022	20.78
				0.0013	16.62

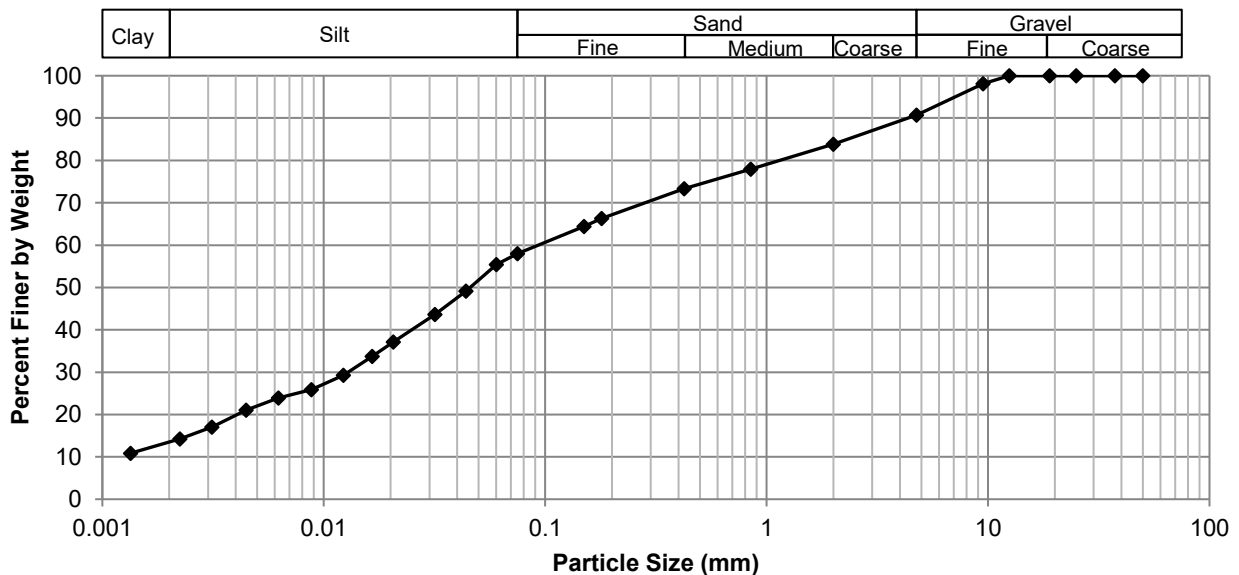
Project No. 0336-003-00
Client Jacobs Canada
Project Armstrong Combined Sewer



Test Hole TH22-11
Sample # G203
Depth (m) 14.6 - 14.9
Sample Date 19-Sep-22
Test Date 2-Nov-22
Technician AFK

Gravel	9.3%
Sand	32.7%
Silt	44.7%
Clay	13.3%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	90.69	0.0750	58.03
37.5	100.00	2.00	83.80	0.0603	55.47
25.0	100.00	0.850	77.98	0.0439	49.18
19.0	100.00	0.425	73.32	0.0318	43.67
12.5	100.00	0.180	66.27	0.0206	37.12
9.50	98.12	0.150	64.45	0.0165	33.72
4.75	90.69	0.075	58.03	0.0123	29.26
				0.0088	25.92
				0.0063	23.88
				0.0045	21.07
				0.0031	17.06
				0.0022	14.22
				0.0013	10.86

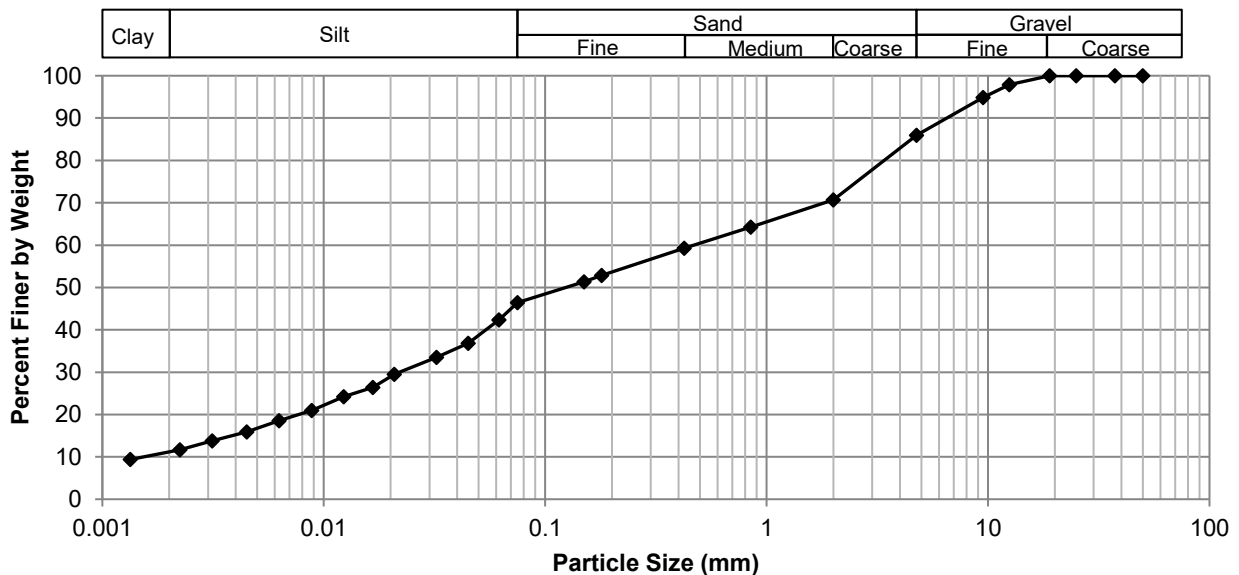
Project No. 0336-003-00
Client Jacobs Canada
Project Armstrong Combined Sewer



Test Hole TH22-16
Sample # G247
Depth (m) 17.6 - 17.9
Sample Date 19-Sep-22
Test Date 2-Nov-22
Technician AFK

Gravel	14.0%
Sand	39.5%
Silt	35.4%
Clay	11.1%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	85.96	0.0750	46.43
37.5	100.00	2.00	70.73	0.0618	42.36
25.0	100.00	0.850	64.27	0.0449	36.83
19.0	100.00	0.425	59.30	0.0323	33.52
12.5	97.88	0.180	52.85	0.0208	29.54
9.50	94.84	0.150	51.37	0.0167	26.44
4.75	85.96	0.075	46.43	0.0123	24.23
				0.0088	20.94
				0.0063	18.53
				0.0045	15.90
				0.0031	13.76
				0.0022	11.67
				0.0013	9.39

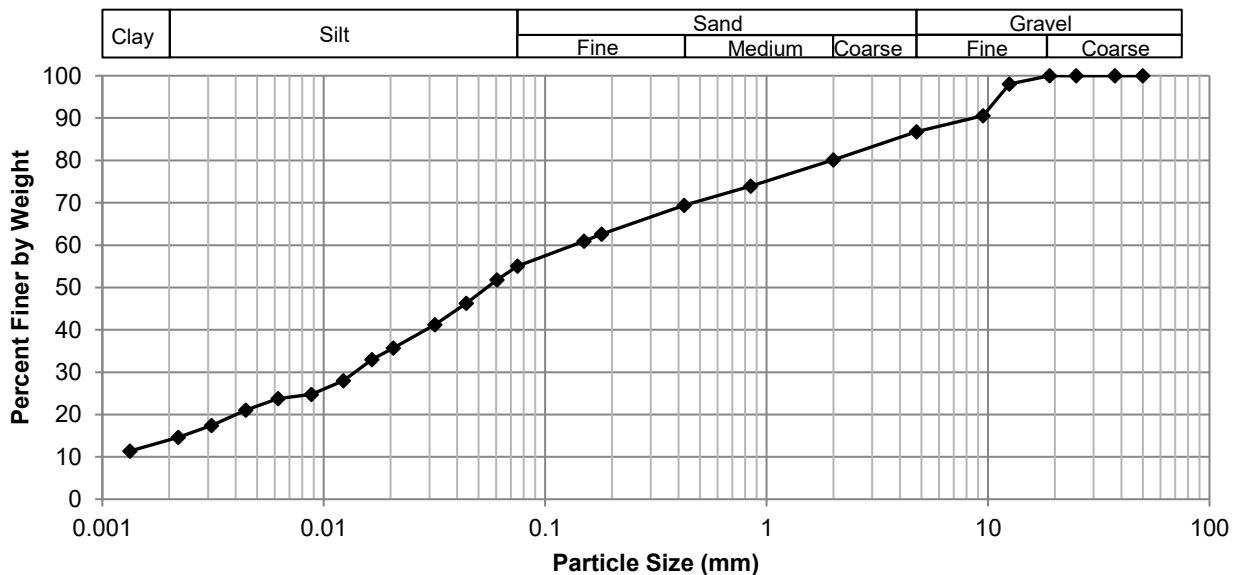
Project No. 0336-003-00
Client Jacobs Canada
Project Armstrong Combined Sewer



Test Hole TH22-02
Sample # G304
Depth (m) 13.0 - 13.4
Sample Date 19-Sep-22
Test Date 2-Nov-22
Technician AFK

Gravel	13.2%
Sand	31.8%
Silt	41.2%
Clay	13.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	86.81	0.0750	55.03
37.5	100.00	2.00	80.13	0.0607	51.77
25.0	100.00	0.850	73.97	0.0440	46.26
19.0	100.00	0.425	69.38	0.0318	41.24
12.5	98.04	0.180	62.62	0.0206	35.73
9.50	90.56	0.150	60.92	0.0165	32.98
4.75	86.81	0.075	55.03	0.0123	27.97
				0.0088	24.75
				0.0062	23.79
				0.0044	21.08
				0.0031	17.44
				0.0022	14.65
				0.0013	11.39

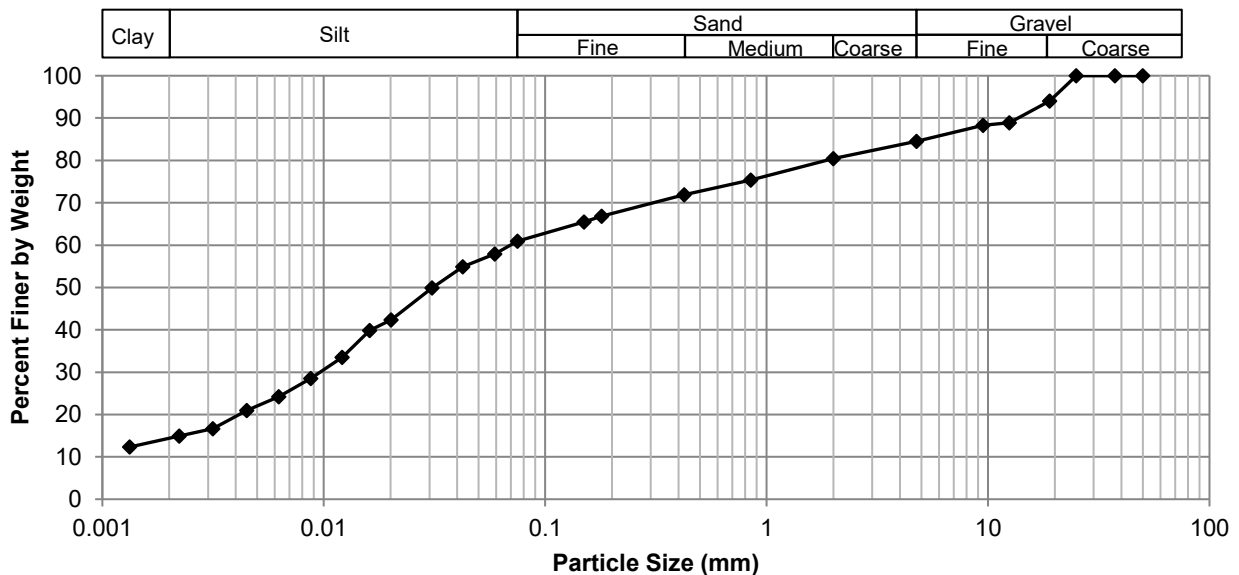
Project No. 0336-003-00
Client Jacobs Canada
Project Armstrong Combined Sewer



Test Hole TH22-22
Sample # G323
Depth (m) 19.1 - 19.4
Sample Date 19-Sep-22
Test Date 7-Nov-22
Technician AFK

Gravel	15.5%
Sand	23.6%
Silt	46.7%
Clay	14.3%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	84.52	0.0750	60.94
37.5	100.00	2.00	80.45	0.0592	57.95
25.0	100.00	0.850	75.40	0.0425	54.93
19.0	94.02	0.425	71.91	0.0308	49.90
12.5	88.92	0.180	66.82	0.0202	42.35
9.50	88.27	0.150	65.46	0.0161	39.84
4.75	84.52	0.075	60.94	0.0121	33.55
				0.0087	28.52
				0.0063	24.24
				0.0045	20.97
				0.0032	16.70
				0.0022	14.92
				0.0013	12.34



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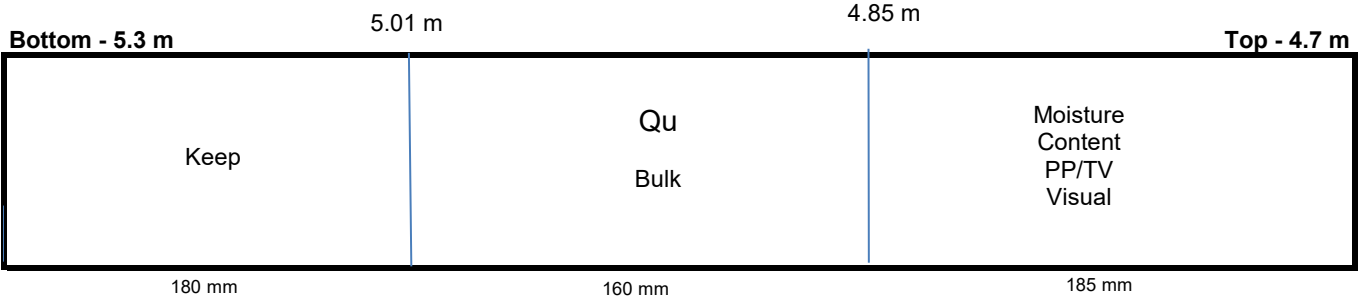
Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-01
Sample # T06
Depth (m) 4.7 - 5.3
Sample Date 19-Sep-22
Test Date 09-Nov-22
Technician DS

Tube Extraction

Recovery (mm) 525



Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<10mm diam.)	
trace silt inclusions (<10mm diam.)	

Color	dark brown
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	stratified (clay and silt, <10mm thick)
Gradation	-

Torvane

Reading	0.49
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	48.1

Pocket Penetrometer

Reading	1	0.80
	2	0.80
	3	0.90
	Average	0.83
Undrained Shear Strength (kPa)		40.9

Moisture Content

Tare ID	E48
Mass tare (g)	8.8
Mass wet + tare (g)	233.4
Mass dry + tare (g)	149.6
Moisture %	59.5%

Unit Weight

Bulk Weight (g)	1051.6
------------------------	--------

Length (mm)	1	149.99
	2	149.61
	3	149.80
	4	149.94

Average Length (m)	0.150
---------------------------	-------

Diam. (mm)	1	71.89
	2	72.27
	3	72.31
	4	72.20

Average Diameter (m)	0.072
-----------------------------	-------

Volume (m³)	6.13E-04
Bulk Unit Weight (kN/m³)	16.8
Bulk Unit Weight (pcf)	107.1
Dry Unit Weight (kN/m³)	10.5
Dry Unit Weight (pcf)	67.2

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-01
Sample # T06
Depth (m) 4.7 - 5.3
Sample Date 19-Sep-22
Test Date 9-Nov-22
Technician DS

Unconfined Strength

	kPa	ksf
Max q_u	94.6	2.0
Max S_u	47.3	1.0

Specimen Data

Description CLAY - silty, trace sand, trace gravel (<10mm diam.), trace silt inclusions (<10mm diam.), dark brown, moist, firm, high plasticity, stratified (clay and silt, <10mm thick)

Length 149.8 (mm)
Diameter 72.2 (mm)
L/D Ratio 2.1
Initial Area 0.00409 (m²)
Load Rate 1.00 (%/min)

Moisture % 60%
Bulk Unit Wt. 16.8 (kN/m³)
Dry Unit Wt. 10.5 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
	kPa	ksf
tsf		
0.49	48.1	1.00
Vane Size		
m		

Pocket Penetrometer

Reading	Undrained Shear Strength	
	kPa	ksf
tsf		
0.80	39.2	0.82
0.80	39.2	0.82
0.90	44.1	0.92
Average	0.83	40.9
		0.85

Failure Geometry

Sketch:

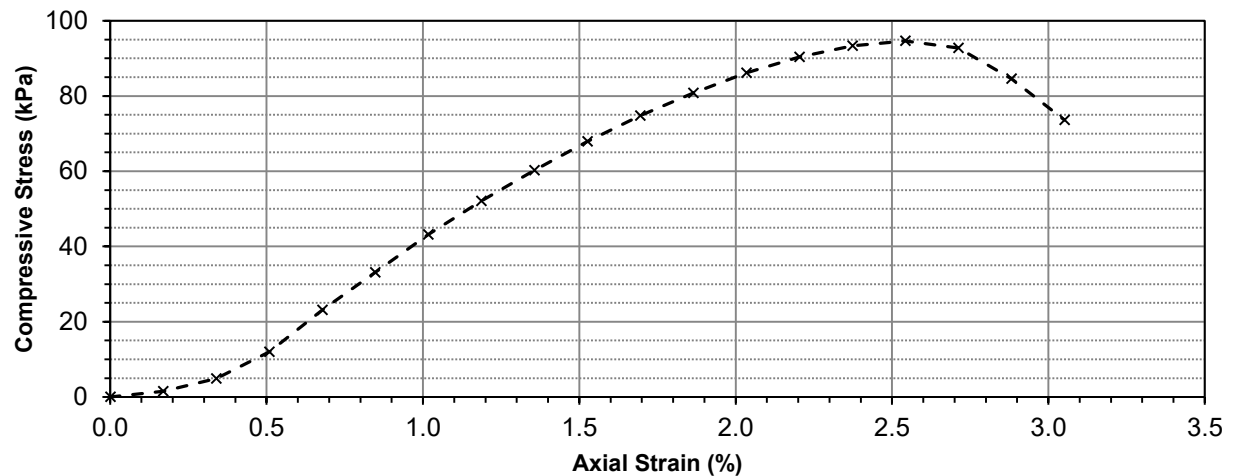


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004090	0.0	0.00	0.00
10	0.46	0.2540	0.17	0.004097	6.0	1.48	0.74
20	0.74	0.5080	0.34	0.004104	20.2	4.91	2.46
30	1.32	0.7620	0.51	0.004111	49.4	12.01	6.01
40	2.23	1.0160	0.68	0.004118	95.3	23.13	11.57
50	3.05	1.2700	0.85	0.004125	136.6	33.11	16.55
60	3.88	1.5240	1.02	0.004133	178.4	43.18	21.59
70	4.62	1.7780	1.19	0.004140	215.7	52.11	26.06
80	5.30	2.0320	1.36	0.004147	250.0	60.29	30.14
90	5.94	2.2860	1.53	0.004154	282.3	67.95	33.98
100	6.51	2.5400	1.70	0.004161	311.0	74.74	37.37
110	7.02	2.7940	1.86	0.004168	336.7	80.78	40.39
120	7.48	3.0480	2.03	0.004175	359.9	86.19	43.09
130	7.84	3.3020	2.20	0.004183	378.0	90.38	45.19
140	8.10	3.5560	2.37	0.004190	391.1	93.35	46.67
150	8.22	3.8100	2.54	0.004197	397.2	94.63	47.31
160	8.08	4.0640	2.71	0.004205	390.1	92.79	46.39
170	7.41	4.3180	2.88	0.004212	356.3	84.61	42.30
180	6.50	4.5720	3.05	0.004219	310.5	73.59	36.79



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-04
Sample # T19
Depth (m) 7.9 - 8.5
Sample Date 19-Sep-22
Test Date 07-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 550

8.43 m		8.26 m		8.10 m		7.90 m	
Bottom - 8.5 m						Top - 7.9 m	
Toss	Moisture Content PP/TV Visual	Qu Bulk		Keep		Toss	
50 mm	100 mm	160 mm		170 mm		70 mm	

Visual Classification

Material	CLAY
Composition	silty
trace gravel (<10 mm diam)	
trace silt inclusions (<20 mm diam.)	
trace oxidation	

Color	dark grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.48
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	47.1

Pocket Penetrometer

Reading	1	1.00
	2	1.10
	3	0.90
	Average	1.00
Undrained Shear Strength (kPa)		49.0

Moisture Content

Tare ID	AH18
Mass tare (g)	8.7
Mass wet + tare (g)	292.3
Mass dry + tare (g)	196
Moisture %	51.4%

Unit Weight

Bulk Weight (g)	1090.0
------------------------	--------

Length (mm)	1	150.40
	2	150.33
	3	150.20
	4	150.90

Average Length (m)	0.150
---------------------------	-------

Diam. (mm)	1	72.68
	2	72.40
	3	72.42
	4	72.91

Average Diameter (m)	0.073
-----------------------------	-------

Volume (m³)	6.23E-04
Bulk Unit Weight (kN/m³)	17.2
Bulk Unit Weight (pcf)	109.2
Dry Unit Weight (kN/m³)	11.3
Dry Unit Weight (pcf)	72.2

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-04
Sample # T19
Depth (m) 7.9 - 8.5
Sample Date 19-Sep-22
Test Date 7-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	98.8	2.1
Max S_u	49.4	1.0

Specimen Data

Description CLAY - silty, trace gravel (<10 mm diam), trace silt inclusions (<20 mm diam.), trace oxidation, dark grey, moist, firm, high plasticity

Length 150.5 (mm)
Diameter 72.6 (mm)
L/D Ratio 2.1
Initial Area 0.00414 (m²)
Load Rate 1.00 (%/min)

Moisture % 51%
Bulk Unit Wt. 17.2 (kN/m³)
Dry Unit Wt. 11.3 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength
tsf	kPa ksf
0.48	47.1 0.98

Vane Size
m

Pocket Penetrometer

Reading	Undrained Shear Strength
tsf	kPa ksf
1.00	49.1 1.02
1.10	54.0 1.13
0.90	44.1 0.92
Average	1.00 49.1 1.02

Failure Geometry

Sketch:

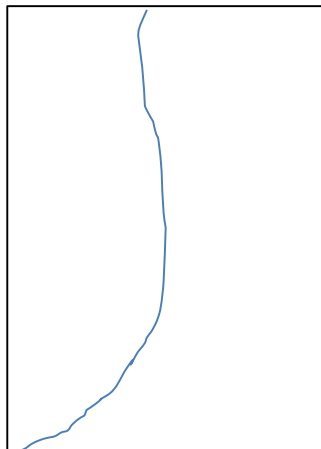
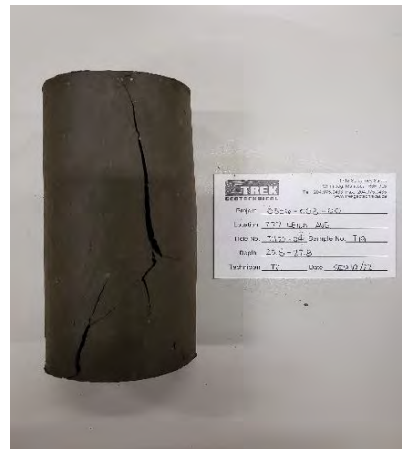
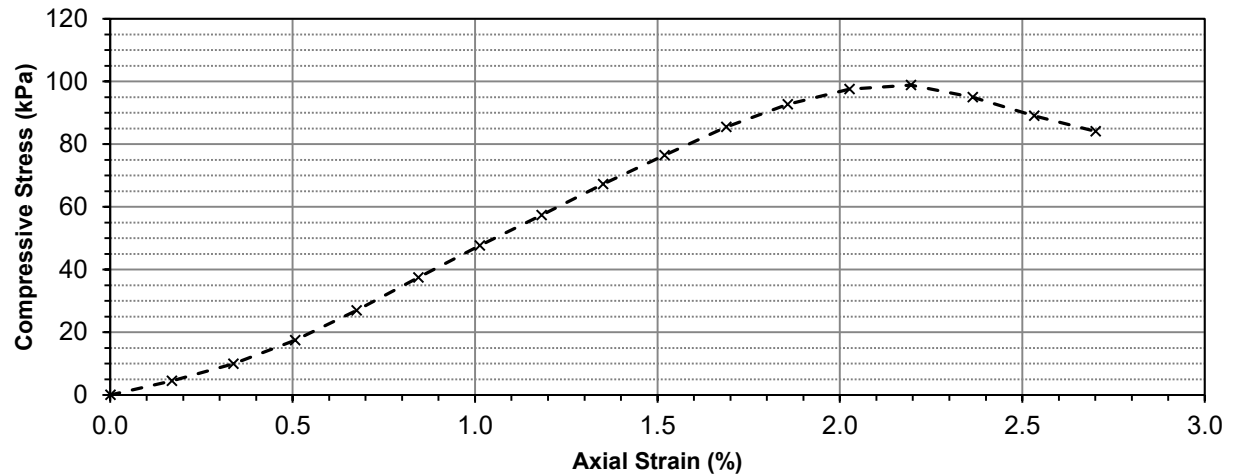


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004140	0.0	0.00	0.00
10	0.71	0.2540	0.17	0.004147	18.6	4.50	2.25
20	1.16	0.5080	0.34	0.004154	41.3	9.95	4.97
30	1.78	0.7620	0.51	0.004161	72.6	17.44	8.72
40	2.57	1.0160	0.68	0.004168	112.4	26.97	13.48
50	3.44	1.2700	0.84	0.004175	156.2	37.42	18.71
60	4.29	1.5240	1.01	0.004182	199.1	47.60	23.80
70	5.11	1.7780	1.18	0.004189	240.4	57.39	28.69
80	5.94	2.0320	1.35	0.004197	282.3	67.26	33.63
90	6.72	2.2860	1.52	0.004204	321.6	76.50	38.25
100	7.48	2.5400	1.69	0.004211	359.9	85.46	42.73
110	8.10	2.7940	1.86	0.004218	391.1	92.72	46.36
120	8.52	3.0480	2.03	0.004226	412.3	97.57	48.79
130	8.64	3.3020	2.19	0.004233	418.3	98.83	49.42
140	8.33	3.5560	2.36	0.004240	402.7	94.98	47.49
150	7.84	3.8100	2.53	0.004247	378.0	89.00	44.50
160	7.44	4.0640	2.70	0.004255	357.9	84.11	42.05



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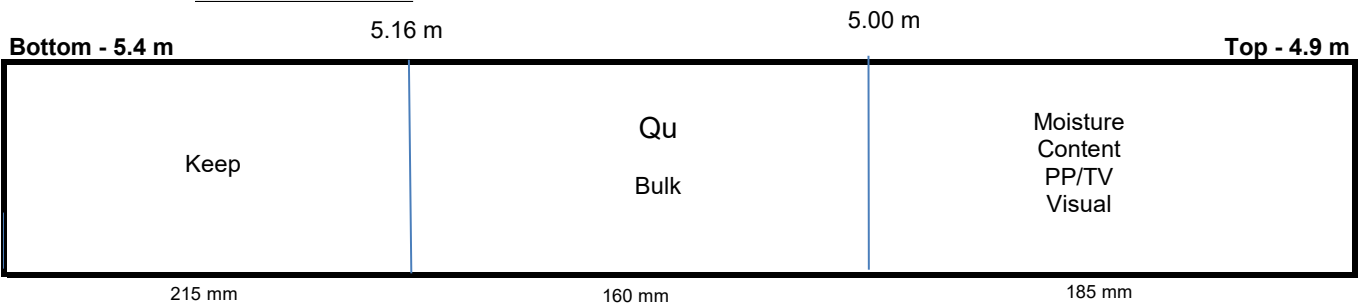
Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-06
Sample # T56
Depth (m) 4.8 - 5.4
Sample Date 20-Sep-22
Test Date 09-Nov-22
Technician DS

Tube Extraction

Recovery (mm) 560



Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<10mm diam.)	
trace silt inclusions (<10mm diam.)	

Color	dark grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane	
Reading	0.55
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	53.9

Pocket Penetrometer	
Reading	1 1.20
	2 1.30
	3 1.20
	Average 1.23
Undrained Shear Strength (kPa)	60.5

Moisture Content

Tare ID	N88
Mass tare (g)	8.4
Mass wet + tare (g)	300
Mass dry + tare (g)	198
Moisture %	53.8%

Unit Weight

Bulk Weight (g)	1041.8
Length (mm)	1 149.59
	2 149.46
	3 149.66
	4 149.44
Average Length (m)	0.150
Diam. (mm)	1 71.95
	2 71.96
	3 72.31
	4 71.87
Average Diameter (m)	0.072

Volume (m³)	6.09E-04
Bulk Unit Weight (kN/m³)	16.8
Bulk Unit Weight (pcf)	106.8
Dry Unit Weight (kN/m³)	10.9
Dry Unit Weight (pcf)	69.4

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-06
Sample # T56
Depth (m) 4.8 - 5.4
Sample Date 20-Sep-22
Test Date 9-Nov-22
Technician DS

Unconfined Strength

	kPa	ksf
Max q_u	121.7	2.5
Max S_u	60.9	1.3

Specimen Data

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

Length 149.5 (mm)
Diameter 72.0 (mm)
L/D Ratio 2.1
Initial Area 0.00407 (m²)
Load Rate 1.00 (%/min)

Moisture % 54%
Bulk Unit Wt. 16.8 (kN/m³)
Dry Unit Wt. 10.9 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.55	53.9	1.13
Vane Size		
m		

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.20	58.9	1.23
1.30	63.8	1.33
1.20	58.9	1.23
Average	1.23	60.5
		1.26

Failure Geometry

Sketch:

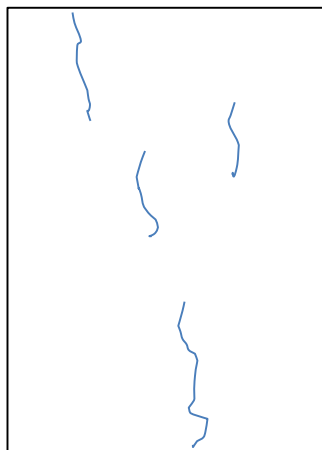
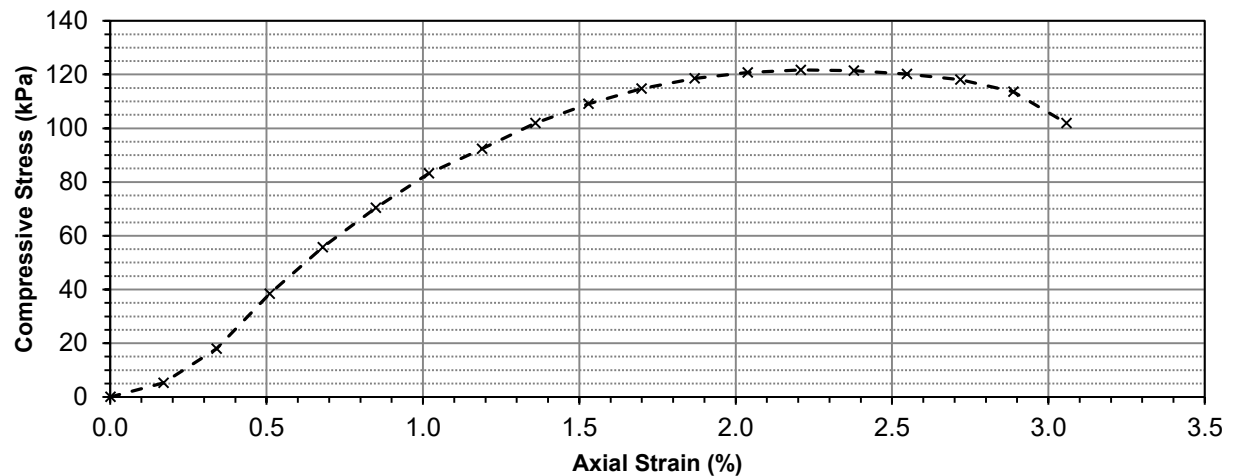


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004074	0.0	0.00	0.00
10	0.76	0.2540	0.17	0.004081	21.2	5.19	2.59
20	1.79	0.5080	0.34	0.004088	73.1	17.88	8.94
30	3.46	0.7620	0.51	0.004095	157.3	38.40	19.20
40	4.87	1.0160	0.68	0.004102	228.3	55.66	27.83
50	6.08	1.2700	0.85	0.004109	289.3	70.41	35.21
60	7.13	1.5240	1.02	0.004116	342.2	83.15	41.57
70	7.89	1.7780	1.19	0.004123	380.5	92.30	46.15
80	8.69	2.0320	1.36	0.004130	420.9	101.90	50.95
90	9.29	2.2860	1.53	0.004137	451.1	109.03	54.52
100	9.77	2.5400	1.70	0.004144	475.3	114.68	57.34
110	10.10	2.7940	1.87	0.004152	491.9	118.49	59.25
120	10.30	3.0480	2.04	0.004159	502.0	120.71	60.36
130	10.40	3.3020	2.21	0.004166	507.1	121.71	60.86
140	10.39	3.5560	2.38	0.004173	506.6	121.38	60.69
150	10.31	3.8100	2.55	0.004181	502.5	120.20	60.10
160	10.15	4.0640	2.72	0.004188	494.5	118.07	59.03
170	9.79	4.3180	2.89	0.004195	476.3	113.54	56.77
180	8.84	4.5720	3.06	0.004203	428.4	101.94	50.97



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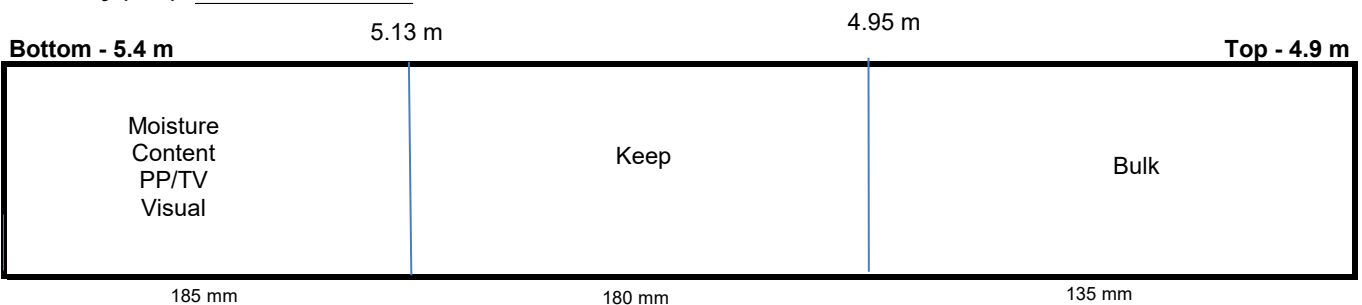
Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-07
Sample # T67
Depth (m) 4.8 - 5.4
Sample Date 19-Sep-22
Test Date 09-Nov-22
Technician DS

Tube Extraction

Recovery (mm) 525



Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<10mm diam.)	
trace silt inclusions (<15mm diam.)	

Color	brown
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	friable
Gradation	-

Torvane

Reading	0.80
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	78.5

Pocket Penetrometer

Reading	1	1.50
	2	1.50
	3	1.60
	Average	1.53
Undrained Shear Strength (kPa)		75.2

Moisture Content

Tare ID	F152
Mass tare (g)	8.4
Mass wet + tare (g)	298.2
Mass dry + tare (g)	202
Moisture %	49.7%

Unit Weight

Bulk Weight (g)	669.6
------------------------	-------

Length (mm)	1	99.42
	2	99.19
	3	99.18
	4	99.50

Average Length (m)	0.099
---------------------------	-------

Diam. (mm)	1	70.55
	2	72.21
	3	71.12
	4	70.01

Average Diameter (m)	0.071
-----------------------------	-------

Volume (m³)	3.93E-04
Bulk Unit Weight (kN/m³)	16.7
Bulk Unit Weight (pcf)	106.4
Dry Unit Weight (kN/m³)	11.2
Dry Unit Weight (pcf)	71.1



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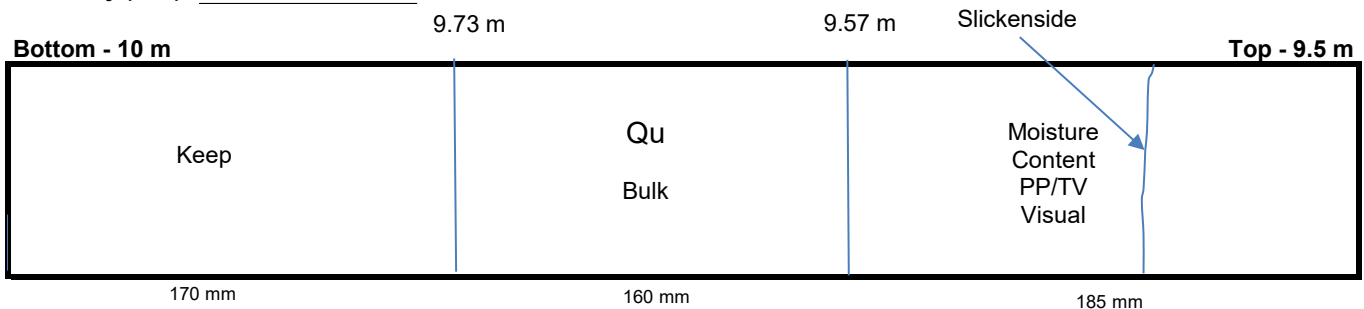
Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-07
Sample # T71
Depth (m) 9.4 - 10.0
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Tube Extraction

Recovery (mm) 515



Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<15mm diam.)	
trace silt inclusions (<15 mm diam.)	

Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	slickensides
Gradation	-

Torvane

Reading	0.35
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	34.3

Pocket Penetrometer

Reading	1	0.70
	2	0.70
	3	0.80
Average		0.73
Undrained Shear Strength (kPa)		36.0

Moisture Content

Tare ID	W44
Mass tare (g)	8.4
Mass wet + tare (g)	246.6
Mass dry + tare (g)	172.8
Moisture %	44.9%

Unit Weight

Bulk Weight (g)	1147.2
------------------------	--------

Length (mm)	1	150.16
	2	150.14
	3	150.21
	4	150.37

Average Length (m)	0.150
---------------------------	-------

Diam. (mm)	1	71.39
	2	72.04
	3	72.22
	4	72.12

Average Diameter (m)	0.072
-----------------------------	-------

Volume (m³)	6.11E-04
Bulk Unit Weight (kN/m³)	18.4
Bulk Unit Weight (pcf)	117.3
Dry Unit Weight (kN/m³)	12.7
Dry Unit Weight (pcf)	80.9

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-07
Sample # T71
Depth (m) 9.4 - 10.0
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Unconfined Strength

	kPa	ksf
Max q_u	78.2	1.6
Max S_u	39.1	0.8

Specimen Data

Description CLAY - silty, trace sand, trace gravel (<15mm diam.), trace silt inclusions (<15 mm diam.), grey, moist, firm, high plasticity, slickensides

Length 150.2 (mm)
Diameter 71.9 (mm)
L/D Ratio 2.1
Initial Area 0.00407 (m²)
Load Rate 1.00 (%/min)

Moisture % 45%
Bulk Unit Wt. 18.4 (kN/m³)
Dry Unit Wt. 12.7 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.35	34.3	0.72
Vane Size		
m		

Pocket Penetrometer

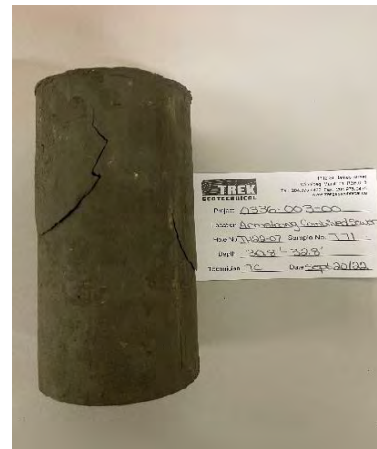
Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.70	34.3	0.72
0.70	34.3	0.72
0.80	39.2	0.82
Average	0.73	0.75

Failure Geometry

Sketch:

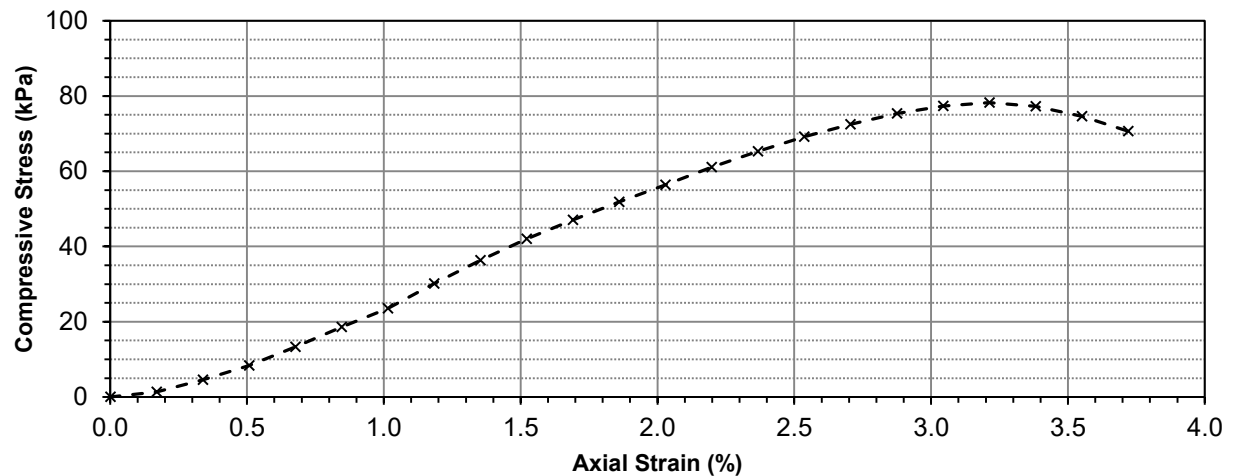


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004065	0.0	0.00	0.00
10	0.45	0.2540	0.17	0.004072	5.5	1.36	0.68
20	0.71	0.5080	0.34	0.004079	18.6	4.57	2.29
30	1.02	0.7620	0.51	0.004086	34.3	8.39	4.19
40	1.42	1.0160	0.68	0.004093	54.4	13.30	6.65
50	1.85	1.2700	0.85	0.004100	76.1	18.56	9.28
60	2.26	1.5240	1.01	0.004107	96.8	23.57	11.78
70	2.80	1.7780	1.18	0.004114	124.0	30.14	15.07
80	3.31	2.0320	1.35	0.004121	149.7	36.33	18.16
90	3.78	2.2860	1.52	0.004128	173.4	42.00	21.00
100	4.20	2.5400	1.69	0.004135	194.6	47.05	23.53
110	4.60	2.7940	1.86	0.004142	214.7	51.84	25.92
120	4.98	3.0480	2.03	0.004149	233.9	56.37	28.18
130	5.38	3.3020	2.20	0.004156	254.0	61.12	30.56
140	5.73	3.5560	2.37	0.004164	271.7	65.25	32.62
150	6.06	3.8100	2.54	0.004171	288.3	69.12	34.56
160	6.35	4.0640	2.71	0.004178	302.9	72.50	36.25
170	6.60	4.3180	2.87	0.004185	315.5	75.39	37.69
180	6.77	4.5720	3.04	0.004193	324.1	77.30	38.65
190	6.86	4.8260	3.21	0.004200	328.6	78.25	39.12

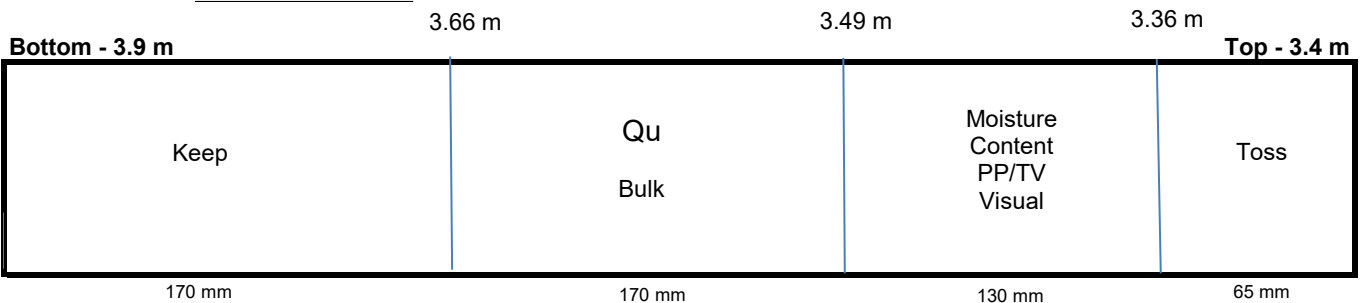


Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-09
Sample # T106
Depth (m) 3.3 - 3.9
Sample Date 19-Sep-22
Test Date 07-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 550



Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10 mm diam.)	
trace organics	
trace oxidation	

Color	brownish grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	laminated clay (<5mm diam.)
Gradation	-

Torvane

Reading	0.69
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	67.7

Pocket Penetrometer

Reading	1	1.40
	2	1.40
	3	1.50
	Average	1.43
Undrained Shear Strength (kPa)		70.3

Moisture Content

Tare ID	AH18
Mass tare (g)	8.6
Mass wet + tare (g)	337.8
Mass dry + tare (g)	220.8
Moisture %	55.1%

Unit Weight

Bulk Weight (g)	1044.8
------------------------	--------

Length (mm)	1	149.90
	2	150.60
	3	150.05
	4	150.16

Average Length (m)	0.150
---------------------------	-------

Diam. (mm)	1	71.84
	2	72.33
	3	72.63
	4	72.00

Average Diameter (m)	0.072
-----------------------------	-------

Volume (m³)	6.15E-04
Bulk Unit Weight (kN/m³)	16.7
Bulk Unit Weight (pcf)	106.1
Dry Unit Weight (kN/m³)	10.7
Dry Unit Weight (pcf)	68.4

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-09
Sample # T106
Depth (m) 3.3 - 3.9
Sample Date 19-Sep-22
Test Date 7-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	101.4	2.1
Max S_u	50.7	1.1

Specimen Data

Description CLAY - silty, trace silt inclusions (<10 mm diam.), trace organics, trace oxidation, brownish grey, moist, stiff, high plasticity, laminated clay (<5mm diam.)

Length 150.2 (mm)
Diameter 72.2 (mm)
L/D Ratio 2.1
Initial Area 0.00409 (m²)
Load Rate 1.00 (%/min)

Moisture % 55%
Bulk Unit Wt. 16.7 (kN/m³)
Dry Unit Wt. 10.7 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading
tsf
0.69
Vane Size
m

Undrained Shear Strength
kPa
67.7
ksf
1.41

Pocket Penetrometer

Reading
tsf
1.40
1.40
1.50
Average **1.43**

Undrained Shear Strength
kPa
68.7
68.7
73.6
70.3
ksf
1.43
1.43
1.54
1.47

Failure Geometry

Sketch:

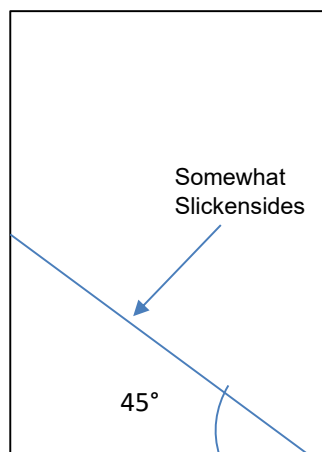
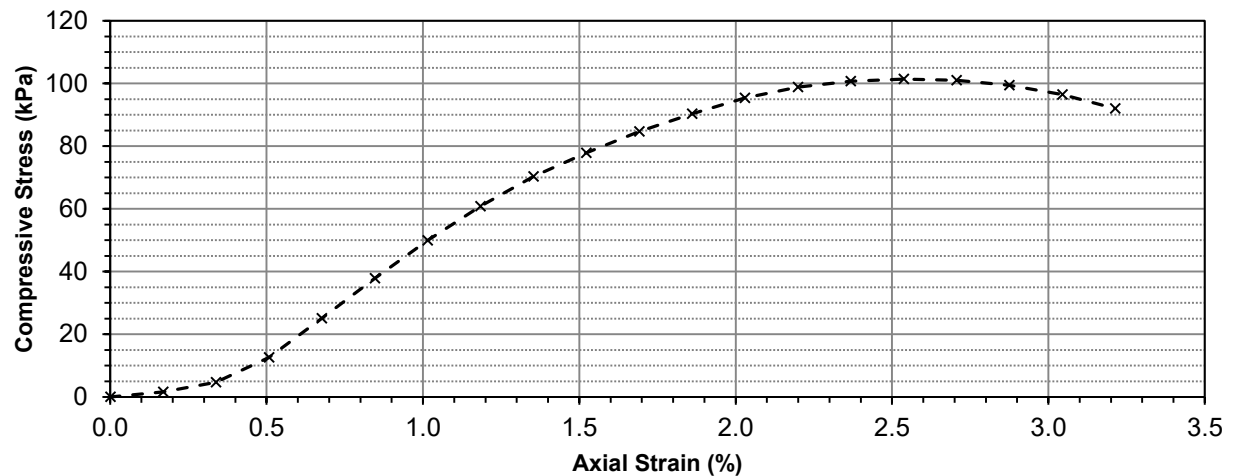


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.32	0.0000	0.00	0.004094	0.0	0.00	0.00
10	0.45	0.2540	0.17	0.004101	6.6	1.60	0.80
20	0.70	0.5080	0.34	0.004108	19.2	4.66	2.33
30	1.35	0.7620	0.51	0.004115	51.9	12.62	6.31
40	2.37	1.0160	0.68	0.004122	103.3	25.07	12.53
50	3.42	1.2700	0.85	0.004129	156.2	37.84	18.92
60	4.42	1.5240	1.01	0.004136	206.7	49.96	24.98
70	5.32	1.7780	1.18	0.004143	252.0	60.83	30.41
80	6.11	2.0320	1.35	0.004150	291.8	70.32	35.16
90	6.74	2.2860	1.52	0.004157	323.6	77.83	38.92
100	7.32	2.5400	1.69	0.004165	352.8	84.72	42.36
110	7.80	2.7940	1.86	0.004172	377.0	90.37	45.19
120	8.23	3.0480	2.03	0.004179	398.7	95.40	47.70
130	8.53	3.3020	2.20	0.004186	413.8	98.85	49.43
140	8.70	3.5560	2.37	0.004193	422.4	100.72	50.36
150	8.77	3.8100	2.54	0.004201	425.9	101.39	50.69
160	8.75	4.0640	2.71	0.004208	424.9	100.97	50.49
170	8.64	4.3180	2.88	0.004215	419.4	99.48	49.74
180	8.40	4.5720	3.04	0.004223	407.3	96.44	48.22
190	8.04	4.8260	3.21	0.004230	389.1	91.99	45.99



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-14
Sample # T115
Depth (m) 7.9 - 8.5
Sample Date 21-Sep-22
Test Date 07-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 590

8.23 m		8.05 m	7.97 m	
Bottom - 8.5 m				Top - 7.9 m
Keep	Qu Bulk	Moisture Content PP/TV Visual	Toss	
220 mm	180 mm	80 mm	110 mm	

Visual Classification

Material	CLAY
Composition	silty
trace gravel (<20mm diam.)	
trace silt inclusions (<25mm diam.)	
Color	grey
Moisture	moist
Consistency	firm to stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.44
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	43.2

Pocket Penetrometer

Reading	1	1.10
	2	0.90
	3	1.10
	Average	1.03
Undrained Shear Strength (kPa)		50.7

Moisture Content

Tare ID	W136
Mass tare (g)	8.8
Mass wet + tare (g)	331.2
Mass dry + tare (g)	229.9
Moisture %	45.8%

Unit Weight

Bulk Weight (g)		1070.0
Length (mm)	1	149.58
	2	149.21
	3	149.60
	4	149.45
Average Length (m)		0.149
Diam. (mm)	1	72.34
	2	71.94
	3	72.36
	4	72.33
Average Diameter (m)		0.072

Volume (m³)	6.13E-04
Bulk Unit Weight (kN/m³)	17.1
Bulk Unit Weight (pcf)	109.0
Dry Unit Weight (kN/m³)	11.7
Dry Unit Weight (pcf)	74.8

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-14
Sample # T115
Depth (m) 7.9 - 8.5
Sample Date 21-Sep-22
Test Date 7-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	137.4	2.9
Max S_u	68.7	1.4

Specimen Data

Description CLAY - silty, trace gravel (<20mm diam.), trace silt inclusions (<25mm diam.), grey, moist, firm to stiff, high plasticity

Length 149.5 (mm)
Diameter 72.2 (mm)
L/D Ratio 2.1
Initial Area 0.00410 (m²)
Load Rate 1.00 (%/min)

Moisture % 46%
Bulk Unit Wt. 17.1 (kN/m³)
Dry Unit Wt. 11.7 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.44	43.2	0.90
Vane Size		
m		

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.10	54.0	1.13
0.90	44.1	0.92
1.10	54.0	1.13
Average	1.03	50.7
		1.06

Failure Geometry

Sketch:

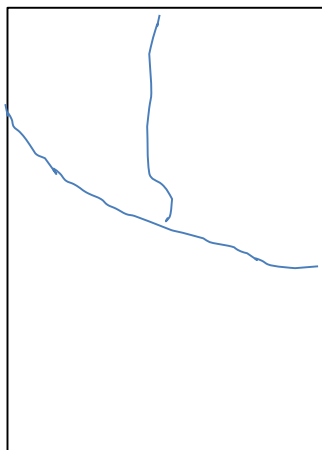
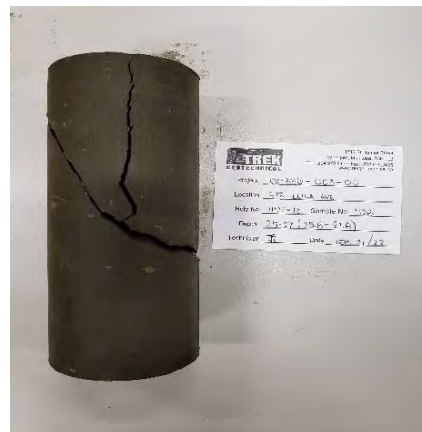
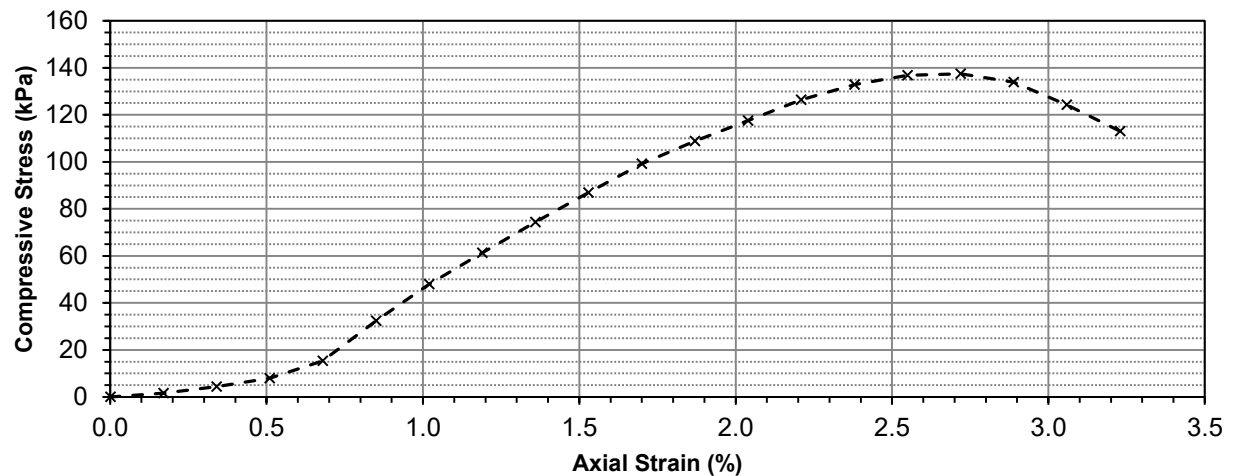


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004099	0.0	0.00	0.00
10	0.47	0.2540	0.17	0.004106	6.6	1.60	0.80
20	0.70	0.5080	0.34	0.004113	18.1	4.41	2.21
30	0.99	0.7620	0.51	0.004120	32.8	7.95	3.98
40	1.60	1.0160	0.68	0.004127	63.5	15.39	7.69
50	3.00	1.2700	0.85	0.004134	134.1	32.43	16.22
60	4.28	1.5240	1.02	0.004141	198.6	47.95	23.98
70	5.38	1.7780	1.19	0.004148	254.0	61.24	30.62
80	6.47	2.0320	1.36	0.004155	309.0	74.35	37.18
90	7.52	2.2860	1.53	0.004163	361.9	86.94	43.47
100	8.55	2.5400	1.70	0.004170	413.8	99.24	49.62
110	9.36	2.7940	1.87	0.004177	454.6	108.84	54.42
120	10.10	3.0480	2.04	0.004184	491.9	117.57	58.78
130	10.85	3.3020	2.21	0.004192	529.7	126.38	63.19
140	11.41	3.5560	2.38	0.004199	558.0	132.88	66.44
150	11.76	3.8100	2.55	0.004206	575.6	136.85	68.42
160	11.83	4.0640	2.72	0.004214	579.1	137.44	68.72
170	11.55	4.3180	2.89	0.004221	565.0	133.86	66.93
180	10.76	4.5720	3.06	0.004228	525.2	124.21	62.10
190	9.84	4.8260	3.23	0.004236	478.8	113.04	56.52



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-13
Sample # T124
Depth (m) 3.3 - 3.9
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Tube Extraction

Recovery (mm) 430

3.56 m

3.40 m

Bottom - 3.9 m

Top - 3.5 m

Keep	Qu Bulk	Moisture Content PP/TV Visual
160 mm	160 mm	110 mm

Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<10mm diam.)	
trace silt inclusions (<30mm diam)	
trace oxidation	
Color	brown
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	grey clay lenses (<15mm thick)
Gradation	-

Torvane

Reading	0.85
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	83.4

Pocket Penetrometer

Reading	1	1.70
	2	1.70
	3	1.80
	Average	1.73
Undrained Shear Strength (kPa)		85.0

Moisture Content

Tare ID	H31
Mass tare (g)	8.6
Mass wet + tare (g)	303
Mass dry + tare (g)	224.4
Moisture %	36.4%

Unit Weight

Bulk Weight (g)		1047.6
Length (mm)	1	146.43
	2	146.76
	3	147.18
	4	146.41
Average Length (m)		0.147
Diam. (mm)	1	72.61
	2	72.07
	3	72.14
	4	71.04
Average Diameter (m)		0.072

Volume (m³)	5.97E-04
Bulk Unit Weight (kN/m³)	17.2
Bulk Unit Weight (pcf)	109.6
Dry Unit Weight (kN/m³)	12.6
Dry Unit Weight (pcf)	80.3

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-13
Sample # T124
Depth (m) 3.3 - 3.9
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Unconfined Strength

	kPa	ksf
Max q_u	97.5	2.0
Max S_u	48.8	1.0

Specimen Data

Description CLAY - silty, trace sand, trace gravel (<10mm diam.), trace silt inclusions (<30mm diam), trace oxidation, brown, moist, stiff, high plasticity, grey clay lenses (<15mm thick)

Length	146.7	(mm)	Moisture %	36%
Diameter	72.0	(mm)	Bulk Unit Wt.	17.2 (kN/m ³)
L/D Ratio	2.0		Dry Unit Wt.	12.6 (kN/m ³)
Initial Area	0.00407	(m ²)	Liquid Limit	-
Load Rate	1.00	(%/min)	Plastic Limit	-
			Plasticity Index	-

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.85	83.4	1.74
Vane Size		
m		

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.70	83.4	1.74
1.70	83.4	1.74
1.80	88.3	1.84
Average	1.73	85.0

Failure Geometry

Sketch:

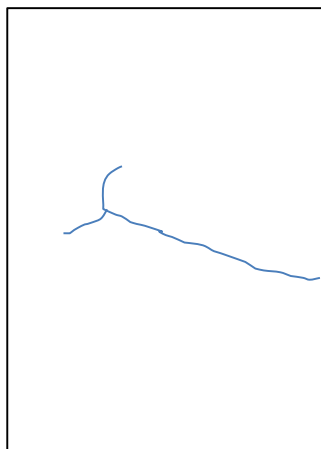
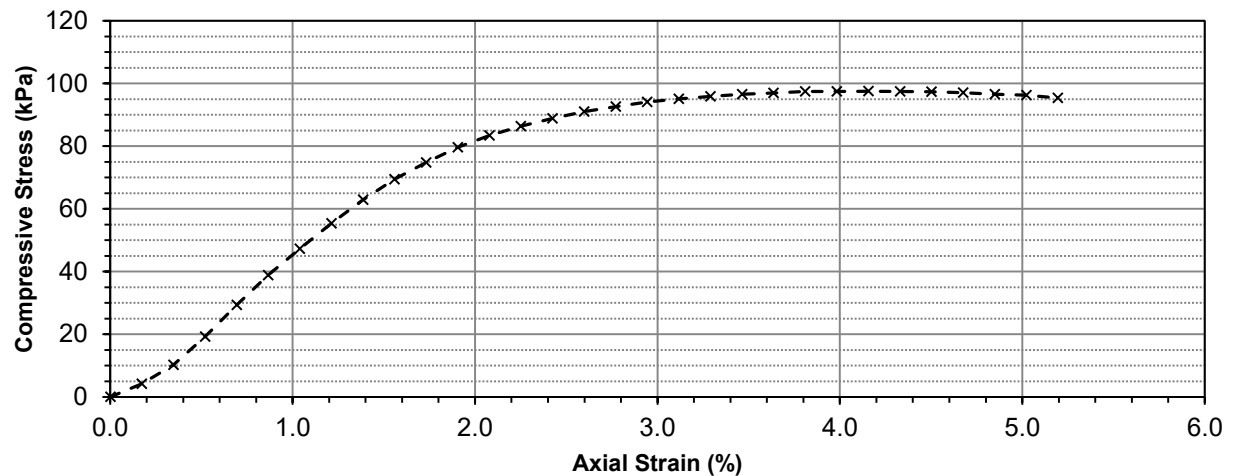


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.35	0.0000	0.00	0.004068	0.0	0.00	0.00
10	0.69	0.2540	0.17	0.004075	17.1	4.21	2.10
20	1.18	0.5080	0.35	0.004082	41.8	10.25	5.12
30	1.91	0.7620	0.52	0.004089	78.6	19.23	9.62
40	2.73	1.0160	0.69	0.004096	120.0	29.29	14.64
50	3.51	1.2700	0.87	0.004103	159.3	38.82	19.41
60	4.20	1.5240	1.04	0.004110	194.1	47.21	23.61
70	4.87	1.7780	1.21	0.004117	227.8	55.33	27.67
80	5.50	2.0320	1.39	0.004125	259.6	62.93	31.47
90	6.04	2.2860	1.56	0.004132	286.8	69.41	34.70
100	6.49	2.5400	1.73	0.004139	309.5	74.77	37.38
110	6.90	2.7940	1.90	0.004147	330.1	79.62	39.81
120	7.22	3.0480	2.08	0.004154	346.3	83.36	41.68
130	7.48	3.3020	2.25	0.004161	359.4	86.36	43.18
140	7.70	3.5560	2.42	0.004169	370.5	88.87	44.43
150	7.89	3.8100	2.60	0.004176	380.0	91.01	45.50
160	8.04	4.0640	2.77	0.004183	387.6	92.65	46.33
170	8.17	4.3180	2.94	0.004191	394.2	94.05	47.02
180	8.27	4.5720	3.12	0.004198	399.2	95.08	47.54
190	8.35	4.8260	3.29	0.004206	403.2	95.87	47.94
200	8.42	5.0800	3.46	0.004213	406.8	96.54	48.27
210	8.47	5.3340	3.64	0.004221	409.3	96.96	48.48
220	8.53	5.5880	3.81	0.004229	412.3	97.50	48.75
230	8.54	5.8420	3.98	0.004236	412.8	97.44	48.72

Unconfined Compression Test Data (cont'd)



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Unconfined Compressive Strength ASTM D2166

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q _u (kPa)	Shear Stress, S _u (kPa)
240	8.56	6.0960	4.16	0.004244	413.8	97.51	48.75
250	8.57	6.3500	4.33	0.004252	414.3	97.45	48.72
260	8.58	6.6040	4.50	0.004259	414.8	97.39	48.70
270	8.57	6.8580	4.68	0.004267	414.3	97.10	48.55
280	8.54	7.1120	4.85	0.004275	412.8	96.57	48.28
290	8.53	7.3660	5.02	0.004283	412.3	96.27	48.14
300	8.47	7.6200	5.19	0.004290	409.3	95.39	47.70



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-13
Sample # T128
Depth (m) 9.4 - 10.0
Sample Date 22-Sep-22
Test Date 07-Nov-22
Technician JC

Tube Extraction

Recovery (mm)	400			
	9.77 m	9.61 m	9.46 m	
Bottom - 10 m				Top - 9.6 m
Toss	Qu Bulk	Keep	Moisture Content PP/TV Visual	
20 mm	160 mm	150 mm	70 mm	

Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<10mm diam.)	
trace silt inclusions (<10mm diam.)	
trace precipitates (gypsum, <5mm diam.)	
Color	grey
Moisture	moist
Consistency	frim
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.48
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	47.1

Pocket Penetrometer

Reading	1	1.00
	2	0.80
	3	0.90
Average		0.90
Undrained Shear Strength (kPa)		44.1

Moisture Content

Tare ID	E2
Mass tare (g)	8.6
Mass wet + tare (g)	315.8
Mass dry + tare (g)	227.6
Moisture %	40.3%

Unit Weight

Bulk Weight (g)		1071.5
Length (mm)	1	149.34
	2	149.44
	3	149.12
	4	149.69
Average Length (m)		0.149
Diam. (mm)	1	72.08
	2	72.41
	3	73.06
	4	72.00
Average Diameter (m)		0.072

Volume (m³)	6.15E-04
Bulk Unit Weight (kN/m³)	17.1
Bulk Unit Weight (pcf)	108.8
Dry Unit Weight (kN/m³)	12.2
Dry Unit Weight (pcf)	77.6

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-13
Sample # T128
Depth (m) 9.4 - 10.0
Sample Date 22-Sep-22
Test Date 7-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	67.1	1.4
Max S_u	33.6	0.7

Specimen Data

Description CLAY - silty, trace sand, trace gravel (<10mm diam.), trace silt inclusions (<10mm diam.), trace precipitates (gypsum, <5mm diam.), grey, moist, firm, high plasticity

Length 149.4 (mm)
Diameter 72.4 (mm)
L/D Ratio 2.1
Initial Area 0.00412 (m²)
Load Rate 1.00 (%/min)

Moisture % 40%
Bulk Unit Wt. 17.1 (kN/m³)
Dry Unit Wt. 12.2 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.48	47.1	0.98
trace precipitates (gypsom, <5mm diam.)		
m		

Average

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.00	49.1	1.02
0.80	39.2	0.82
0.90	44.1	0.92
Average	44.1	0.92

Failure Geometry

Sketch:

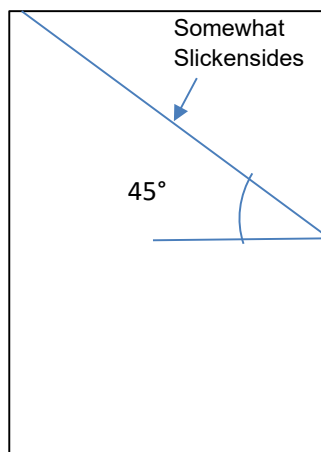
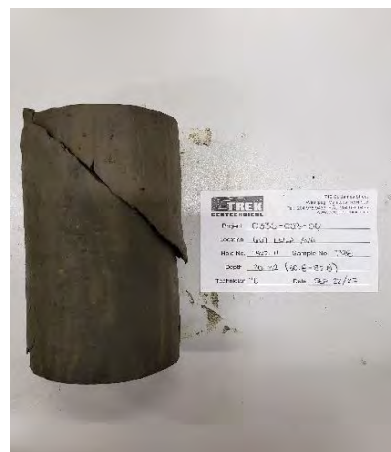
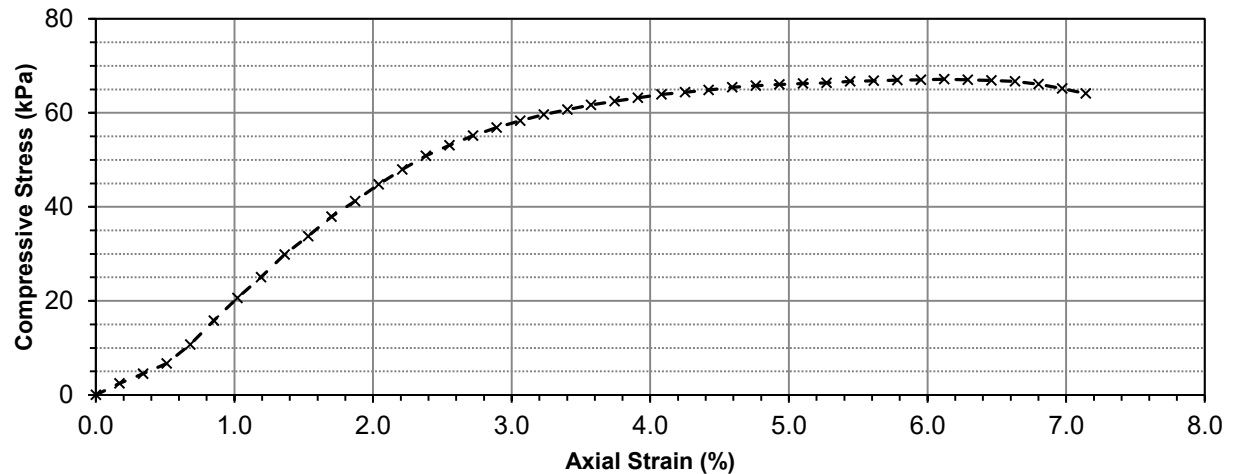


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.32	0.0000	0.00	0.004115	0.0	0.00	0.00
10	0.52	0.2540	0.17	0.004122	10.1	2.45	1.22
20	0.69	0.5080	0.34	0.004129	18.6	4.52	2.26
30	0.87	0.7620	0.51	0.004137	27.7	6.70	3.35
40	1.20	1.0160	0.68	0.004144	44.4	10.70	5.35
50	1.62	1.2700	0.85	0.004151	65.5	15.79	7.89
60	2.02	1.5240	1.02	0.004158	85.7	20.61	10.30
70	2.39	1.7780	1.19	0.004165	104.3	25.05	12.53
80	2.79	2.0320	1.36	0.004172	124.5	29.84	14.92
90	3.12	2.2860	1.53	0.004179	141.1	33.77	16.88
100	3.47	2.5400	1.70	0.004187	158.8	37.92	18.96
110	3.75	2.7940	1.87	0.004194	172.9	41.22	20.61
120	4.05	3.0480	2.04	0.004201	188.0	44.75	22.38
130	4.32	3.3020	2.21	0.004208	201.6	47.91	23.95
140	4.57	3.5560	2.38	0.004216	214.2	50.81	25.41
150	4.77	3.8100	2.55	0.004223	224.3	53.11	26.56
160	4.95	4.0640	2.72	0.004231	233.4	55.16	27.58
170	5.10	4.3180	2.89	0.004238	240.9	56.85	28.42
180	5.23	4.5720	3.06	0.004245	247.5	58.29	29.15
190	5.35	4.8260	3.23	0.004253	253.5	59.61	29.81
200	5.45	5.0800	3.40	0.004260	258.6	60.69	30.35
210	5.54	5.3340	3.57	0.004268	263.1	61.65	30.82
220	5.62	5.5880	3.74	0.004275	267.1	62.48	31.24
230	5.69	5.8420	3.91	0.004283	270.7	63.20	31.60

Unconfined Compression Test Data (cont'd)

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q _u (kPa)	Shear Stress, S _u (kPa)
240	5.76	6.0960	4.08	0.004291	274.2	63.91	31.95
250	5.81	6.3500	4.25	0.004298	276.7	64.38	32.19
260	5.86	6.6040	4.42	0.004306	279.2	64.85	32.43
270	5.92	6.8580	4.59	0.004313	282.3	65.44	32.72
280	5.96	7.1120	4.76	0.004321	284.3	65.79	32.89
290	5.99	7.3660	4.93	0.004329	285.8	66.02	33.01
300	6.02	7.6200	5.10	0.004337	287.3	66.25	33.12
310	6.04	7.8740	5.27	0.004344	288.3	66.36	33.18
320	6.08	8.1280	5.44	0.004352	290.3	66.71	33.35
330	6.10	8.3820	5.61	0.004360	291.3	66.82	33.41
340	6.12	8.6360	5.78	0.004368	292.3	66.93	33.46
350	6.14	8.8900	5.95	0.004376	293.3	67.04	33.52
360	6.16	9.1440	6.12	0.004384	294.4	67.15	33.57
370	6.16	9.3980	6.29	0.004392	294.4	67.02	33.51
380	6.16	9.6520	6.46	0.004400	294.4	66.90	33.45
390	6.15	9.9060	6.63	0.004408	293.8	66.67	33.33
400	6.11	10.1600	6.80	0.004416	291.8	66.09	33.04
410	6.04	10.4140	6.97	0.004424	288.3	65.17	32.59
420	5.96	10.6680	7.14	0.004432	284.3	64.14	32.07



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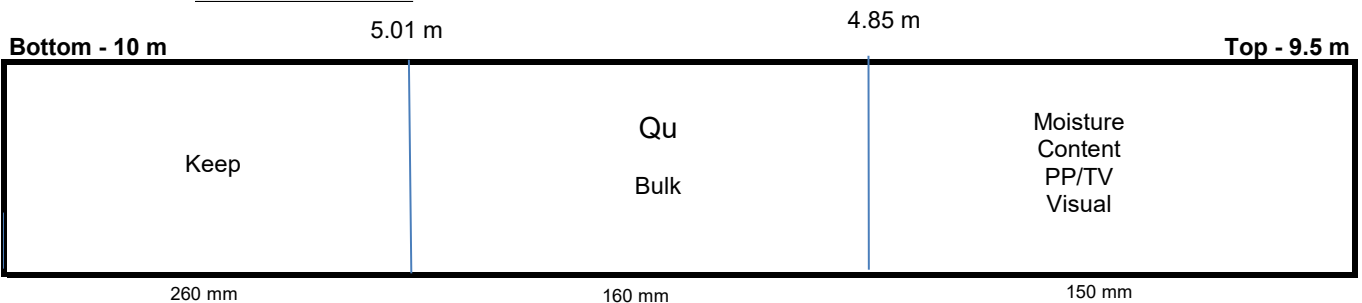
Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-13
Sample # T130
Depth (m) 9.4 - 10.0
Sample Date 19-Sep-22
Test Date 09-Nov-22
Technician DS

Tube Extraction

Recovery (mm) 525



Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<10mm diam.)	
trace silt inclusions (<20mm diam.)	

Color	dark brown
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	stratified (clay and silt, <10mm thick)
Gradation	-

Torvane

Reading	0.60
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	58.8

Pocket Penetrometer

Reading	1	1.20
	2	1.30
	3	1.30
Average		1.27
Undrained Shear Strength (kPa)		62.1

Moisture Content

Tare ID	N19
Mass tare (g)	8.8
Mass wet + tare (g)	238.4
Mass dry + tare (g)	165.4
Moisture %	46.6%

Unit Weight

Bulk Weight (g)	1137.6
------------------------	--------

Length (mm)	1	153.65
	2	153.47
	3	153.47
	4	153.38

Average Length (m)	0.153
---------------------------	-------

Diam. (mm)	1	72.03
	2	72.22
	3	71.86
	4	71.76

Average Diameter (m)	0.072
-----------------------------	-------

Volume (m³)	6.24E-04
Bulk Unit Weight (kN/m³)	17.9
Bulk Unit Weight (pcf)	113.7
Dry Unit Weight (kN/m³)	12.2
Dry Unit Weight (pcf)	77.6

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-13
Sample # T130
Depth (m) 9.4 - 10.0
Sample Date 19-Sep-22
Test Date 9-Nov-22
Technician DS

Unconfined Strength

	kPa	ksf
Max q_u	147.1	3.1
Max S_u	73.5	1.5

Specimen Data

Description CLAY - silty, trace sand, trace gravel (<10mm diam.), trace silt inclusions (<20mm diam.), dark brown, moist, firm, high plasticity, stratified (clay and silt, <10mm thick)

Length 153.5 (mm)
Diameter 72.0 (mm)
L/D Ratio 2.1
Initial Area 0.00407 (m²)
Load Rate 1.00 (%/min)

Moisture % 47%
Bulk Unit Wt. 17.9 (kN/m³)
Dry Unit Wt. 12.2 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.60	58.8	1.23

Vane Size
m

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.20	58.9	1.23
1.30	63.8	1.33
1.30	63.8	1.33
Average	1.27	62.1

Failure Geometry

Sketch:

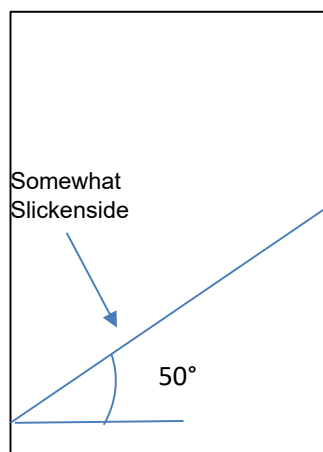
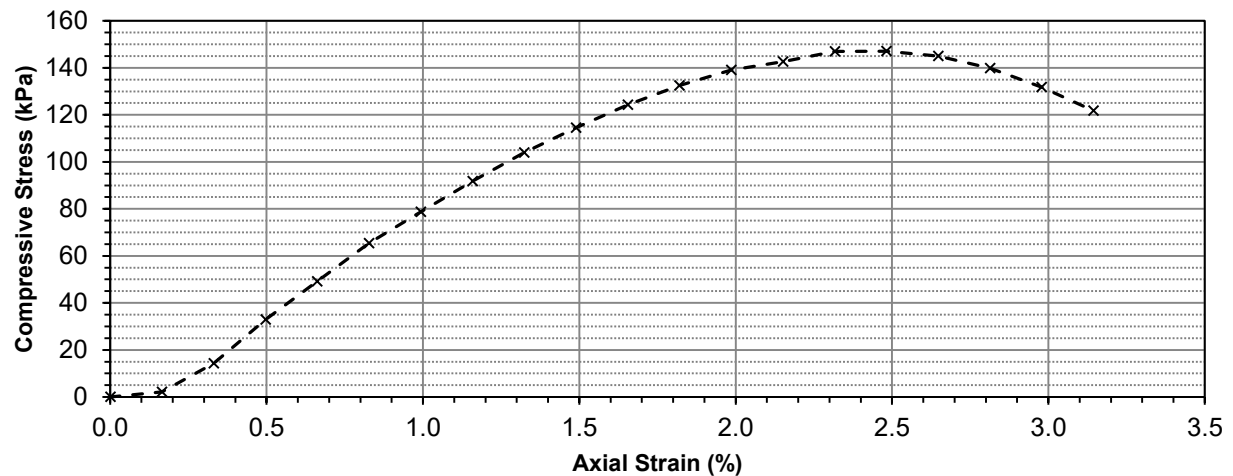


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.33	0.0000	0.00	0.004068	0.0	0.00	0.00
10	0.50	0.2540	0.17	0.004075	8.6	2.10	1.05
20	1.49	0.5080	0.33	0.004081	58.5	14.33	7.16
30	3.00	0.7620	0.50	0.004088	134.6	32.92	16.46
40	4.32	1.0160	0.66	0.004095	201.1	49.11	24.56
50	5.65	1.2700	0.83	0.004102	268.1	65.37	32.69
60	6.75	1.5240	0.99	0.004109	323.6	78.76	39.38
70	7.82	1.7780	1.16	0.004116	377.5	91.73	45.87
80	8.83	2.0320	1.32	0.004122	428.4	103.93	51.96
90	9.71	2.2860	1.49	0.004129	472.8	114.49	57.25
100	10.53	2.5400	1.65	0.004136	514.1	124.29	62.15
110	11.22	2.7940	1.82	0.004143	548.9	132.48	66.24
120	11.78	3.0480	1.99	0.004150	577.1	139.06	69.53
130	12.09	3.3020	2.15	0.004157	592.7	142.58	71.29
140	12.47	3.5560	2.32	0.004164	611.9	146.94	73.47
150	12.50	3.8100	2.48	0.004171	613.4	147.05	73.53
160	12.35	4.0640	2.65	0.004178	605.8	144.99	72.50
170	11.94	4.3180	2.81	0.004186	585.2	139.81	69.90
180	11.29	4.5720	2.98	0.004193	552.4	131.76	65.88
190	10.48	4.8260	3.14	0.004200	511.6	121.81	60.91

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-18
Sample # T166
Depth (m) 4.8 - 5.4
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Tube Extraction

Recovery (mm) 515

Bottom - 5.4 m		5.17 m	5.05 m	4.88 m	Top - 4.9 m
Keep	Moisture Content PP/TV Visual	Qu	Toss		
160 mm	120 mm	175 mm	60 mm		
		Bulk			

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<30mm diam)	
trace precipitates (sulphates, <5mm diam.)	
Color	brown
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	silt seam (<2 mm thick)
Gradation	-

Torvane

Reading	0.80
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	78.5

Pocket Penetrometer

Reading	1	1.70
	2	1.60
	3	1.90
Average		1.73
Undrained Shear Strength (kPa)		85.0

Moisture Content

Tare ID	F135
Mass tare (g)	8.8
Mass wet + tare (g)	291.4
Mass dry + tare (g)	195.2
Moisture %	51.6%

Unit Weight

Bulk Weight (g)		1066.0
Length (mm)	1	148.48
	2	148.57
	3	148.75
	4	148.75
Average Length (m)		0.149
Diam. (mm)	1	72.13
	2	72.32
	3	72.11
	4	72.04
Average Diameter (m)		0.072

Volume (m³)	6.08E-04
Bulk Unit Weight (kN/m³)	17.2
Bulk Unit Weight (pcf)	109.5
Dry Unit Weight (kN/m³)	11.3
Dry Unit Weight (pcf)	72.2

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-18
Sample # T166
Depth (m) 4.8 - 5.4
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Unconfined Strength

	kPa	ksf
Max q_u	158.3	3.3
Max S_u	79.2	1.7

Specimen Data

Description CLAY - silty, trace silt inclusions (<30mm diam), trace precipitates (sulphates, <5mm diam.), brown, moist, stiff, high plasticity, silt seam (<2 mm thick)

Length 148.6 (mm)
Diameter 72.2 (mm)
L/D Ratio 2.1
Initial Area 0.00409 (m²)
Load Rate 1.00 (%/min)

Moisture % 52%
Bulk Unit Wt. 17.2 (kN/m³)
Dry Unit Wt. 11.3 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.80	78.5	1.64

Vane Size
m

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.70	83.4	1.74
1.60	78.5	1.64
1.90	93.2	1.95
Average	1.73	85.0
		1.78

Failure Geometry

Sketch:

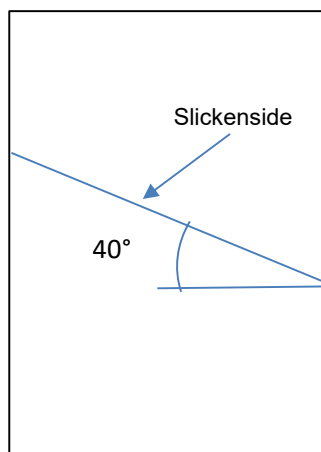
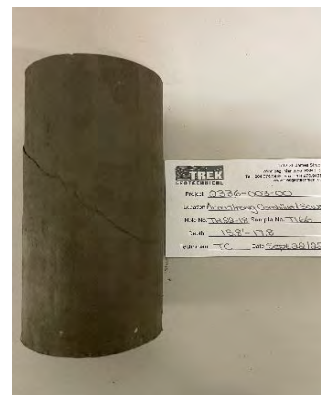
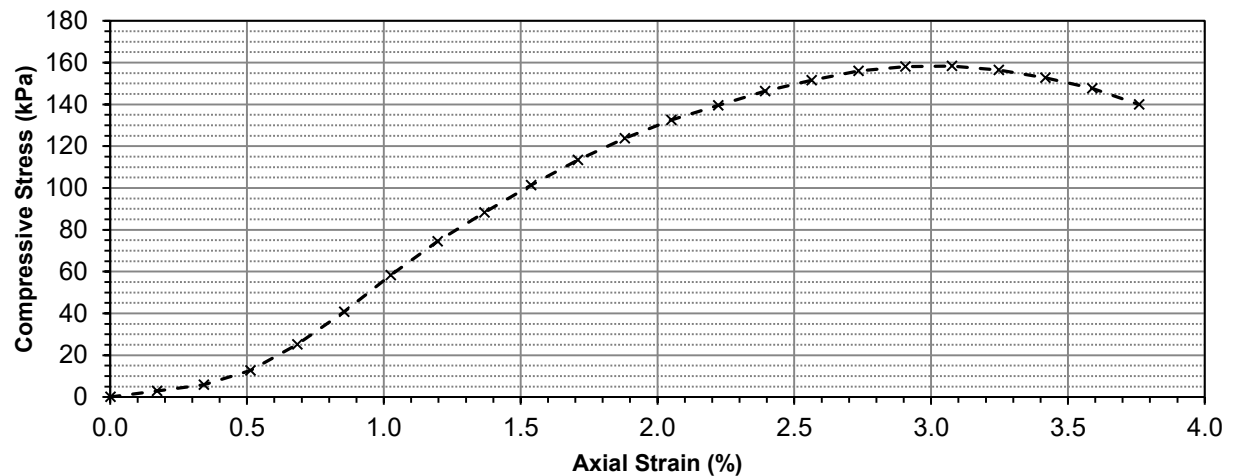


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004088	0.0	0.00	0.00
10	0.57	0.2540	0.17	0.004095	11.6	2.83	1.42
20	0.81	0.5080	0.34	0.004103	23.7	5.77	2.89
30	1.37	0.7620	0.51	0.004110	51.9	12.63	6.32
40	2.39	1.0160	0.68	0.004117	103.3	25.10	12.55
50	3.67	1.2700	0.85	0.004124	167.8	40.70	20.35
60	5.12	1.5240	1.03	0.004131	240.9	58.32	29.16
70	6.45	1.7780	1.20	0.004138	308.0	74.42	37.21
80	7.60	2.0320	1.37	0.004145	365.9	88.28	44.14
90	8.69	2.2860	1.54	0.004152	420.9	101.36	50.68
100	9.69	2.5400	1.71	0.004160	471.3	113.30	56.65
110	10.57	2.7940	1.88	0.004167	515.6	123.75	61.87
120	11.31	3.0480	2.05	0.004174	552.9	132.47	66.23
130	11.91	3.3020	2.22	0.004181	583.2	139.47	69.73
140	12.50	3.5560	2.39	0.004189	612.9	146.32	73.16
150	12.95	3.8100	2.56	0.004196	635.6	151.47	75.74
160	13.35	4.0640	2.73	0.004203	655.7	156.00	78.00
170	13.54	4.3180	2.91	0.004211	665.3	158.00	79.00
180	13.59	4.5720	3.08	0.004218	667.8	158.32	79.16
190	13.45	4.8260	3.25	0.004226	660.8	156.37	78.19
200	13.16	5.0800	3.42	0.004233	646.2	152.64	76.32
210	12.76	5.3340	3.59	0.004241	626.0	147.62	73.81
220	12.13	5.5880	3.76	0.004248	594.3	139.88	69.94



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-11
Sample # T198
Depth (m) 3.3 - 3.9
Sample Date 19-Sep-22
Test Date 07-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 550

3.66 m		3.49 m	3.36 m
Bottom - 3.9 m			Top - 3.4 m
Keep	Qu Bulk	Moisture Content PP/TV Visual	Toss
170 mm	170 mm	130 mm	65 mm

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10 mm diam.)	
trace organics	
trace oxidation	

Color	brownish grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	laminated clay and silt (<5mm thick)
Gradation	-

Torvane

Reading	0.69
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	67.7

Pocket Penetrometer

Reading	1	1.40
	2	1.40
	3	1.50
	Average	1.43
Undrained Shear Strength (kPa)		70.3

Moisture Content

Tare ID	AH18
Mass tare (g)	8.6
Mass wet + tare (g)	337.8
Mass dry + tare (g)	220.8
Moisture %	55.1%

Unit Weight

Bulk Weight (g)	1044.8
------------------------	--------

Length (mm)	1	149.90
	2	150.60
	3	150.05
	4	150.16

Average Length (m)	0.150
---------------------------	-------

Diam. (mm)	1	71.84
	2	72.33
	3	72.63
	4	72.00

Average Diameter (m)	0.072
-----------------------------	-------

Volume (m³)	6.15E-04
Bulk Unit Weight (kN/m³)	16.7
Bulk Unit Weight (pcf)	106.1
Dry Unit Weight (kN/m³)	10.7
Dry Unit Weight (pcf)	68.4

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-11
Sample # T198
Depth (m) 3.3 - 3.9
Sample Date 19-Sep-22
Test Date 7-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	101.4	2.1
Max S_u	50.7	1.1

Specimen Data

Description CLAY - silty, trace silt inclusions (<10 mm diam.), trace organics, trace oxidation, brownish grey, moist, stiff, high plasticity, laminated clay and silt (<5mm thick)

Length 150.2 (mm)
Diameter 72.2 (mm)
L/D Ratio 2.1
Initial Area 0.00409 (m²)
Load Rate 1.00 (%/min)

Moisture % 55%
Bulk Unit Wt. 16.7 (kN/m³)
Dry Unit Wt. 10.7 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading
tsf
0.69
Vane Size
m

Undrained Shear Strength
kPa
67.7
ksf
1.41

Pocket Penetrometer

Reading
tsf
1.40
1.40
1.50
Average **1.43**

Undrained Shear Strength
kPa
68.7
68.7
73.6
70.3
ksf
1.43
1.43
1.54
1.47

Failure Geometry

Sketch:

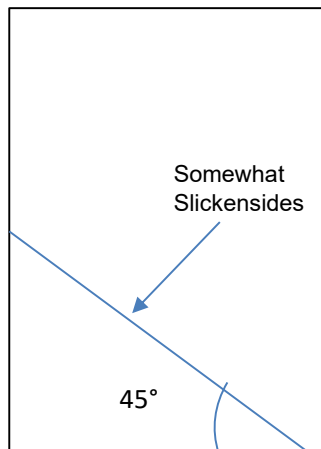
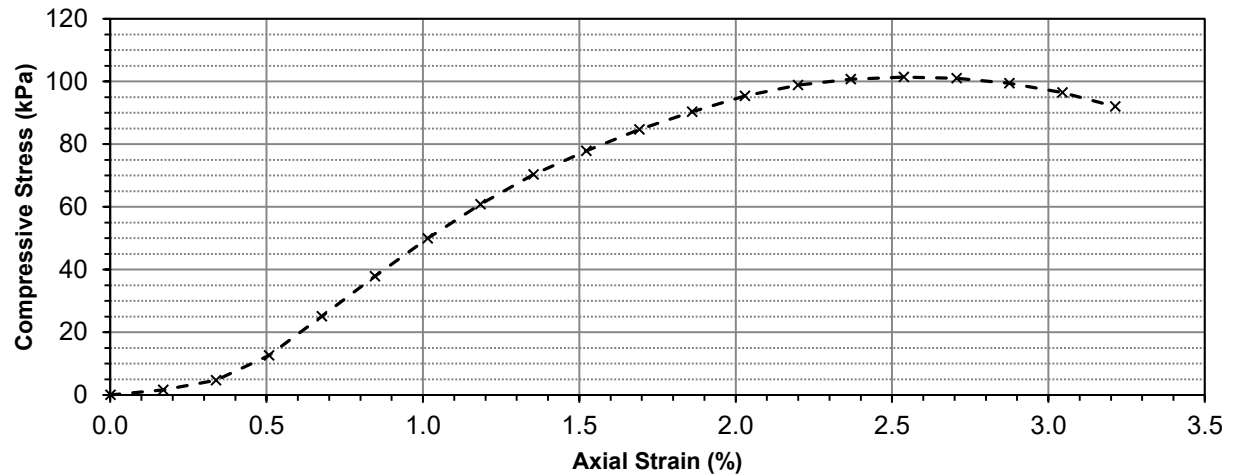


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.32	0.0000	0.00	0.004094	0.0	0.00	0.00
10	0.45	0.2540	0.17	0.004101	6.6	1.60	0.80
20	0.70	0.5080	0.34	0.004108	19.2	4.66	2.33
30	1.35	0.7620	0.51	0.004115	51.9	12.62	6.31
40	2.37	1.0160	0.68	0.004122	103.3	25.07	12.53
50	3.42	1.2700	0.85	0.004129	156.2	37.84	18.92
60	4.42	1.5240	1.01	0.004136	206.7	49.96	24.98
70	5.32	1.7780	1.18	0.004143	252.0	60.83	30.41
80	6.11	2.0320	1.35	0.004150	291.8	70.32	35.16
90	6.74	2.2860	1.52	0.004157	323.6	77.83	38.92
100	7.32	2.5400	1.69	0.004165	352.8	84.72	42.36
110	7.80	2.7940	1.86	0.004172	377.0	90.37	45.19
120	8.23	3.0480	2.03	0.004179	398.7	95.40	47.70
130	8.53	3.3020	2.20	0.004186	413.8	98.85	49.43
140	8.70	3.5560	2.37	0.004193	422.4	100.72	50.36
150	8.77	3.8100	2.54	0.004201	425.9	101.39	50.69
160	8.75	4.0640	2.71	0.004208	424.9	100.97	50.49
170	8.64	4.3180	2.88	0.004215	419.4	99.48	49.74
180	8.40	4.5720	3.04	0.004223	407.3	96.44	48.22
190	8.04	4.8260	3.21	0.004230	389.1	91.99	45.99



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-24
Sample # T227
Depth (m) 4.8 - 5.4
Sample Date 21-Sep-22
Test Date 07-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 570

5.30 m

5.13 m

5.05 m

4.88 m

Bottom - 5.4 m

Top - 4.9 m

Toss	Qu Bulk	Moisture Content PP/TV Visual	Keep	Toss
45 mm	170 mm	85 mm	180 mm	60 mm

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<20mm diam.)	
trace organics	
trace oxidation	

Color	grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.73
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	71.6

Pocket Penetrometer

Reading	1	1.70
	2	1.50
	3	1.60
	Average	1.60
Undrained Shear Strength (kPa)		78.5

Moisture Content

Tare ID	W35
Mass tare (g)	8.2
Mass wet + tare (g)	261.4
Mass dry + tare (g)	171.6
Moisture %	55.0%

Unit Weight

Bulk Weight (g)	1031.6
------------------------	--------

Length (mm)	1	149.85
	2	150.11
	3	149.78
	4	150.44

Average Length (m)	0.150
---------------------------	-------

Diam. (mm)	1	72.35
	2	72.63
	3	72.56
	4	72.55

Average Diameter (m)	0.073
-----------------------------	-------

Volume (m³)	6.20E-04
Bulk Unit Weight (kN/m³)	16.3
Bulk Unit Weight (pcf)	103.9
Dry Unit Weight (kN/m³)	10.5
Dry Unit Weight (pcf)	67.1

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-24
Sample # T227
Depth (m) 4.8 - 5.4
Sample Date 21-Sep-22
Test Date 7-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	97.0	2.0
Max S_u	48.5	1.0

Specimen Data

Description CLAY - silty, trace silt inclusions (<20mm diam.), trace organics, trace oxidation, grey, moist, stiff, high plasticity

Length 150.0 (mm)
Diameter 72.5 (mm)
L/D Ratio 2.1
Initial Area 0.00413 (m²)
Load Rate 1.00 (%/min)

Moisture % 55%
Bulk Unit Wt. 16.3 (kN/m³)
Dry Unit Wt. 10.5 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength
tsf	kPa ksf
0.73	71.6 1.50

Vane Size
m

Average

Pocket Penetrometer

Reading	Undrained Shear Strength
tsf	kPa ksf
1.70	83.4 1.74
1.50	73.6 1.54
1.60	78.5 1.64
Average	78.5 1.64

Failure Geometry

Sketch:

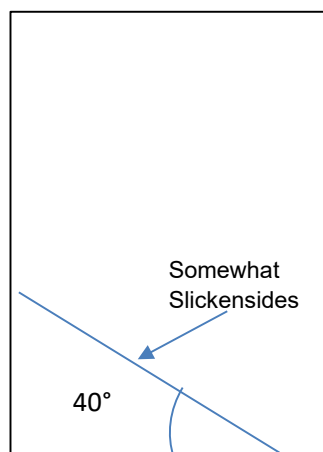
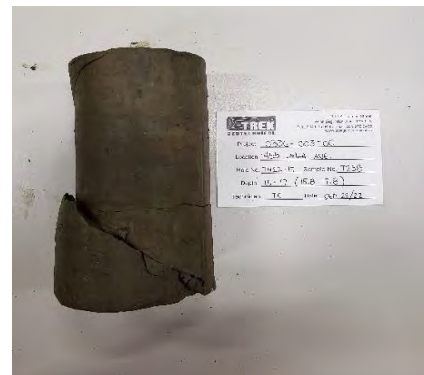
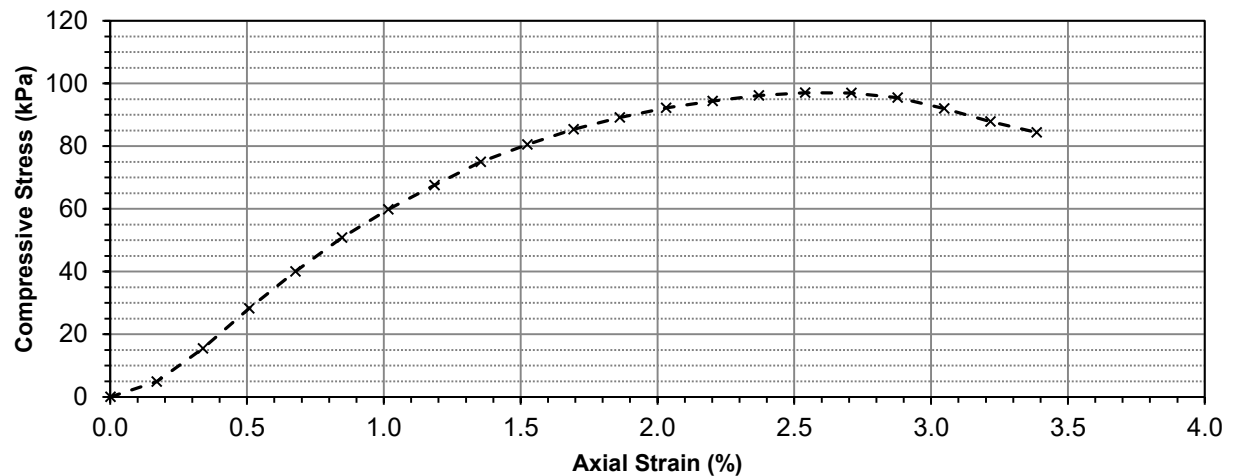


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.36	0.0000	0.00	0.004131	0.0	0.00	0.00
10	0.76	0.2540	0.17	0.004138	20.2	4.87	2.44
20	1.63	0.5080	0.34	0.004145	64.0	15.44	7.72
30	2.69	0.7620	0.51	0.004152	117.4	28.29	14.14
40	3.66	1.0160	0.68	0.004159	166.3	39.99	20.00
50	4.56	1.2700	0.85	0.004166	211.7	50.81	25.41
60	5.31	1.5240	1.02	0.004173	249.5	59.79	29.89
70	5.96	1.7780	1.18	0.004180	282.3	67.52	33.76
80	6.59	2.0320	1.35	0.004188	314.0	74.99	37.49
90	7.06	2.2860	1.52	0.004195	337.7	80.51	40.25
100	7.48	2.5400	1.69	0.004202	358.9	85.41	42.70
110	7.80	2.7940	1.86	0.004209	375.0	89.09	44.55
120	8.07	3.0480	2.03	0.004216	388.6	92.16	46.08
130	8.27	3.3020	2.20	0.004224	398.7	94.39	47.20
140	8.43	3.5560	2.37	0.004231	406.8	96.13	48.07
150	8.52	3.8100	2.54	0.004238	411.3	97.04	48.52
160	8.53	4.0640	2.71	0.004246	411.8	96.99	48.49
170	8.42	4.3180	2.88	0.004253	406.2	95.52	47.76
180	8.14	4.5720	3.05	0.004261	392.1	92.04	46.02
190	7.80	4.8260	3.22	0.004268	375.0	87.86	43.93
200	7.52	5.0800	3.39	0.004276	360.9	84.41	42.20



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-16
Sample # T240
Depth (m) 7.9 - 8.5
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Tube Extraction

Recovery (mm) 575

Bottom - 8.5 m		8.22 m	8.06 m	Top - 7.9 m
Keep		Qu	Moisture Content	
		Bulk	PP/TV	
			Visual	
220 mm		160 mm	195 mm	

Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<5mm diam.)	
trace silt inclusions (<10mm diam)	
sand seam (<25mm thick)	
Color	grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.52
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	51.0

Pocket Penetrometer

Reading	1	1.10
	2	1.10
	3	1.20
	Average	1.13
Undrained Shear Strength (kPa)		55.6

Moisture Content

Tare ID	C10
Mass tare (g)	8.8
Mass wet + tare (g)	285.8
Mass dry + tare (g)	193.8
Moisture %	49.7%

Unit Weight

Bulk Weight (g)		1072.8
Length (mm)	1	148.81
	2	149.22
	3	149.26
	4	148.99
Average Length (m)		0.149
Diam. (mm)	1	72.22
	2	71.91
	3	72.21
	4	72.17
Average Diameter (m)		0.072

Volume (m³)	6.09E-04
Bulk Unit Weight (kN/m³)	17.3
Bulk Unit Weight (pcf)	110.0
Dry Unit Weight (kN/m³)	11.5
Dry Unit Weight (pcf)	73.4

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-16
Sample # T240
Depth (m) 7.9 - 8.5
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Unconfined Strength

	kPa	ksf
Max q_u	120.1	2.5
Max S_u	60.1	1.3

Specimen Data

Description CLAY - silty, trace sand, trace gravel (<5mm diam.), trace silt inclusions (<10mm diam), sand seam (<25mm thick), grey, moist, stiff, high plasticity

Length 149.1 (mm)
Diameter 72.1 (mm)
L/D Ratio 2.1
Initial Area 0.00409 (m²)
Load Rate 1.00 (%/min)

Moisture % 50%
Bulk Unit Wt. 17.3 (kN/m³)
Dry Unit Wt. 11.5 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength
tsf	kPa ksf
0.52	51.0 1.07

Vane Size
m

Pocket Penetrometer

Reading	Undrained Shear Strength
tsf	kPa ksf
1.10	54.0 1.13
1.10	54.0 1.13
1.20	58.9 1.23
Average	1.13 55.6 1.16

Failure Geometry

Sketch:

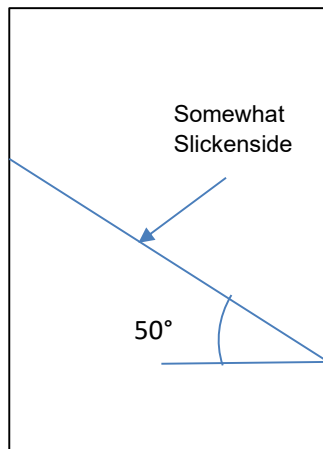
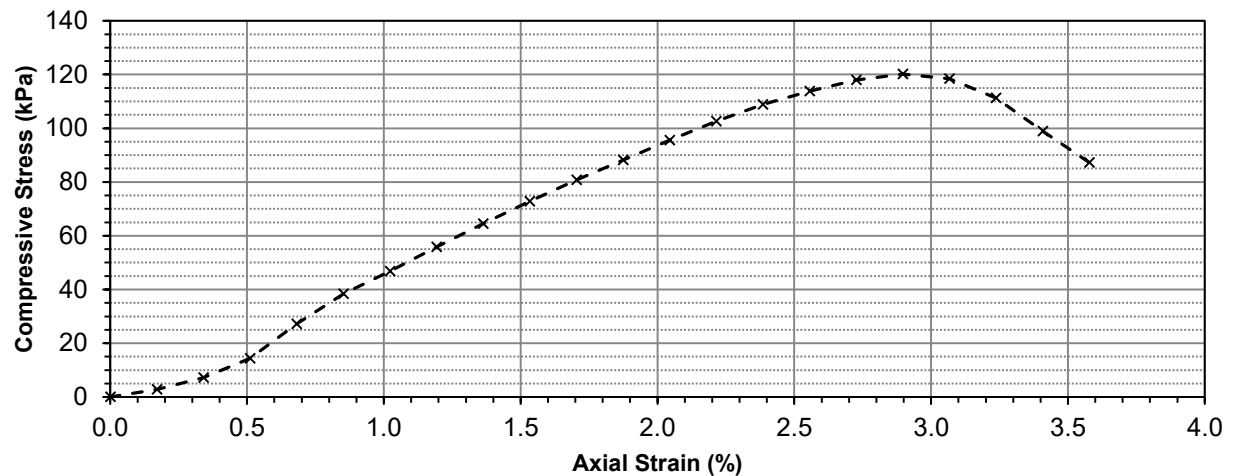


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.35	0.0000	0.00	0.004086	0.0	0.00	0.00
10	0.58	0.2540	0.17	0.004093	11.6	2.83	1.42
20	0.93	0.5080	0.34	0.004100	29.2	7.13	3.57
30	1.52	0.7620	0.51	0.004107	59.0	14.36	7.18
40	2.57	1.0160	0.68	0.004114	111.9	27.20	13.60
50	3.49	1.2700	0.85	0.004121	158.3	38.40	19.20
60	4.18	1.5240	1.02	0.004128	193.0	46.76	23.38
70	4.93	1.7780	1.19	0.004135	230.8	55.82	27.91
80	5.65	2.0320	1.36	0.004142	267.1	64.49	32.24
90	6.34	2.2860	1.53	0.004150	301.9	72.76	36.38
100	7.01	2.5400	1.70	0.004157	335.7	80.76	40.38
110	7.63	2.7940	1.87	0.004164	366.9	88.12	44.06
120	8.26	3.0480	2.04	0.004171	398.7	95.58	47.79
130	8.86	3.3020	2.22	0.004178	428.9	102.65	51.33
140	9.39	3.5560	2.39	0.004186	455.6	108.85	54.43
150	9.82	3.8100	2.56	0.004193	477.3	113.83	56.92
160	10.18	4.0640	2.73	0.004200	495.5	117.95	58.98
170	10.38	4.3180	2.90	0.004208	505.5	120.14	60.07
180	10.25	4.5720	3.07	0.004215	499.0	118.38	59.19
190	9.67	4.8260	3.24	0.004223	469.8	111.25	55.62
200	8.65	5.0800	3.41	0.004230	418.3	98.90	49.45
210	7.68	5.3340	3.58	0.004238	369.5	87.19	43.59



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-15
Sample # T258
Depth (m) 4.8 - 5.4
Sample Date 21-Sep-22
Test Date 07-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 570
5.29 m

Bottom - 5.4 m		5.13 m	5.04 m	4.86 m	Top - 4.8 m
Toss	Qu Bulk	Moisture Content PP/TV Visual	Keep	Toss	
30 mm	160 mm	90 mm	180 mm	110 mm	

Visual Classification

Material	CLAY
Composition	silty
trace gravel (<10mm diam.)	
trace silt inclusions (<10mm diam.)	
trace organics	

Color	brownish grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	laminated silt and clay (<5mm thick)
Gradation	-

Torvane

Reading	0.64
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	62.8

Pocket Penetrometer

Reading	1	1.50
	2	1.30
	3	1.40
	Average	1.40
Undrained Shear Strength (kPa)		68.6

Moisture Content

Tare ID	f22
Mass tare (g)	8.7
Mass wet + tare (g)	277.2
Mass dry + tare (g)	181.4
Moisture %	55.5%

Unit Weight

Bulk Weight (g)	1068.7
------------------------	--------

Length (mm)	1	151.13
	2	151.09
	3	150.72
	4	150.98

Average Length (m)	0.151
---------------------------	-------

Diam. (mm)	1	73.12
	2	72.96
	3	72.92
	4	72.63

Average Diameter (m)	0.073
-----------------------------	-------

Volume (m³)	6.30E-04
Bulk Unit Weight (kN/m³)	16.6
Bulk Unit Weight (pcf)	105.9
Dry Unit Weight (kN/m³)	10.7
Dry Unit Weight (pcf)	68.1

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-15
Sample # T258
Depth (m) 4.8 - 5.4
Sample Date 21-Sep-22
Test Date 7-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	110.7	2.3
Max S_u	55.4	1.2

Specimen Data

Description CLAY - silty, trace gravel (<10mm diam.), trace silt inclusions (<10mm diam.), trace organics, brownish grey, moist, stiff, high plasticity, laminated silt and clay (<5mm thick)

Length 151.0 (mm)
Diameter 72.9 (mm)
L/D Ratio 2.1
Initial Area 0.00417 (m²)
Load Rate 1.00 (%/min)

Moisture % 55%
Bulk Unit Wt. 16.6 (kN/m³)
Dry Unit Wt. 10.7 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.64	62.8	1.31

Vane Size
m

Average

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.50	73.6	1.54
1.30	63.8	1.33
1.40	68.7	1.43
Average	68.7	1.43

Failure Geometry

Sketch:

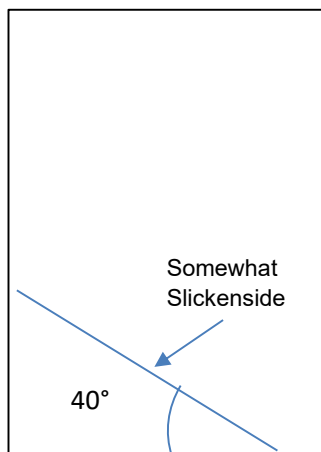
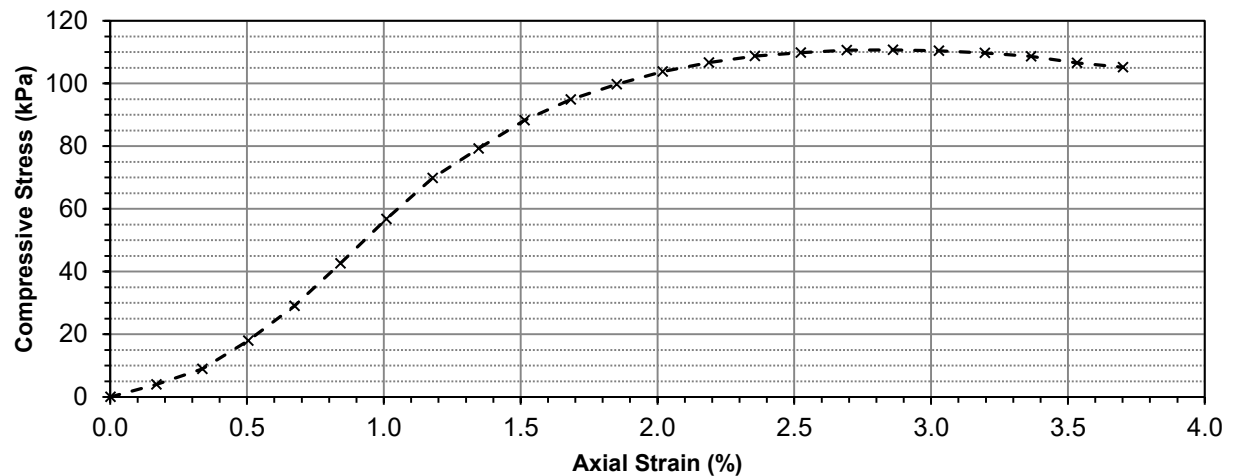


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.35	0.0000	0.00	0.004175	0.0	0.00	0.00
10	0.68	0.2540	0.17	0.004182	16.6	3.98	1.99
20	1.09	0.5080	0.34	0.004189	37.3	8.90	4.45
30	1.84	0.7620	0.50	0.004196	75.1	17.90	8.95
40	2.77	1.0160	0.67	0.004203	122.0	29.02	14.51
50	3.91	1.2700	0.84	0.004210	179.4	42.62	21.31
60	5.10	1.5240	1.01	0.004217	239.4	56.77	28.38
70	6.20	1.7780	1.18	0.004225	294.9	69.80	34.90
80	7.00	2.0320	1.35	0.004232	335.2	79.21	39.60
90	7.77	2.2860	1.51	0.004239	374.0	88.23	44.11
100	8.34	2.5400	1.68	0.004246	402.7	94.84	47.42
110	8.77	2.7940	1.85	0.004254	424.4	99.78	49.89
120	9.12	3.0480	2.02	0.004261	442.0	103.74	51.87
130	9.38	3.3020	2.19	0.004268	455.1	106.64	53.32
140	9.57	3.5560	2.36	0.004275	464.7	108.69	54.35
150	9.68	3.8100	2.52	0.004283	470.3	109.80	54.90
160	9.77	4.0640	2.69	0.004290	474.8	110.67	55.33
170	9.79	4.3180	2.86	0.004298	475.8	110.71	55.36
180	9.78	4.5720	3.03	0.004305	475.3	110.40	55.20
190	9.74	4.8260	3.20	0.004313	473.3	109.74	54.87
200	9.66	5.0800	3.36	0.004320	469.3	108.62	54.31
210	9.50	5.3340	3.53	0.004328	461.2	106.57	53.28
220	9.40	5.5880	3.70	0.004335	456.1	105.22	52.61



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-28
Sample # T280
Depth (m) 3.0 - 3.7
Sample Date 28-Sep-22
Test Date 07-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 430
5.30 m

5.05 m

4.88 m

Bottom - 3.7 m

Top - 3.2 m

Toss	Qu Bulk	Moisture Content PP/TV Visual	Keep
30 mm	170 mm	100 mm	160 mm

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<20mm diam.)	
trace organics	
trace oxidation	

Color	grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	laminated clay and silt (<5mm thick)
Gradation	-

Torvane

Reading	0.59
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	57.9

Pocket Penetrometer

Reading	1	1.40
	2	1.50
	3	1.30
	Average	1.40
Undrained Shear Strength (kPa)		68.6

Moisture Content

Tare ID	H3
Mass tare (g)	8.7
Mass wet + tare (g)	281.5
Mass dry + tare (g)	187.6
Moisture %	52.5%

Unit Weight

Bulk Weight (g)	1065.6
------------------------	--------

Length (mm)	1	151.14
	2	150.98
	3	151.41
	4	150.44

Average Length (m)	0.151
---------------------------	-------

Diam. (mm)	1	72.35
	2	72.63
	3	72.56
	4	72.55

Average Diameter (m)	0.073
-----------------------------	-------

Volume (m³)	6.24E-04
Bulk Unit Weight (kN/m³)	16.8
Bulk Unit Weight (pcf)	106.7
Dry Unit Weight (kN/m³)	11.0
Dry Unit Weight (pcf)	69.9

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-28
Sample # T280
Depth (m) 3.0 - 3.7
Sample Date 28-Sep-22
Test Date 7-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	74.1	1.5
Max S_u	37.0	0.8

Specimen Data

Description CLAY - silty, trace silt inclusions (<20mm diam.), trace organics, trace oxidation, grey, moist, stiff, high plasticity, laminated clay and silt (<5mm thick)

Length 151.0 (mm)
Diameter 72.5 (mm)
L/D Ratio 2.1
Initial Area 0.00413 (m²)
Load Rate 1.00 (%/min)

Moisture % 52%
Bulk Unit Wt. 16.8 (kN/m³)
Dry Unit Wt. 11.0 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.59	57.9	1.21
Vane Size		
m		

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.40	68.7	1.43
1.50	73.6	1.54
1.30	63.8	1.33
Average	1.40	68.7
		1.43

Failure Geometry

Sketch:

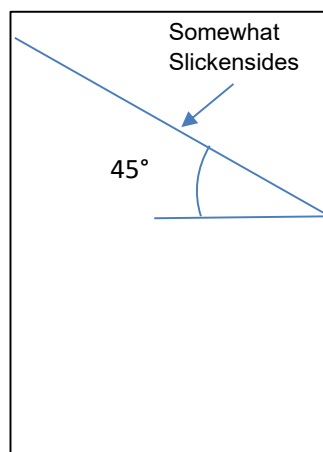
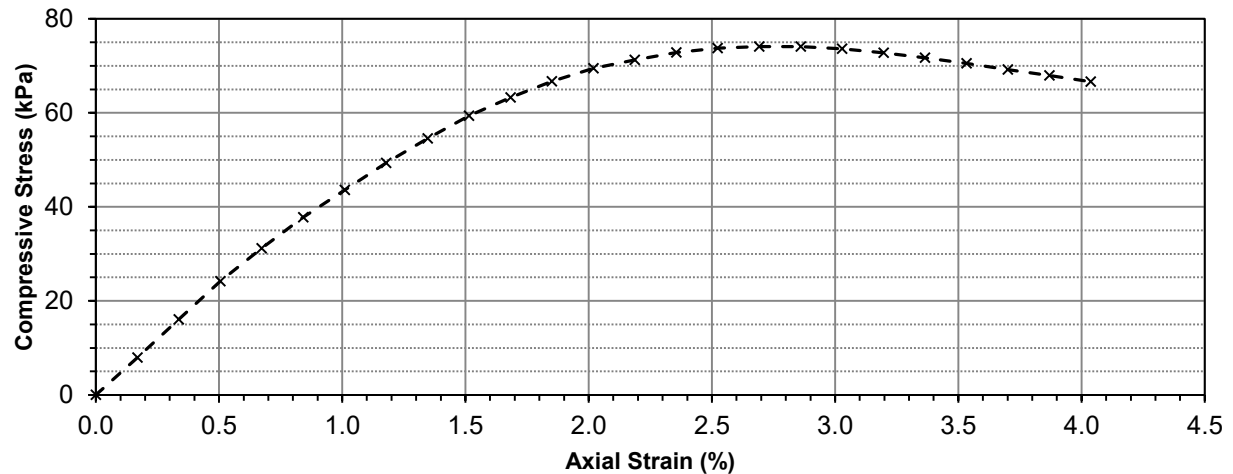


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.35	0.0000	0.00	0.004131	0.0	0.00	0.00
10	1.00	0.2540	0.17	0.004138	32.8	7.92	3.96
20	1.67	0.5080	0.34	0.004145	66.5	16.05	8.03
30	2.34	0.7620	0.50	0.004152	100.3	24.16	12.08
40	2.92	1.0160	0.67	0.004159	129.5	31.15	15.57
50	3.47	1.2700	0.84	0.004166	157.3	37.75	18.87
60	3.96	1.5240	1.01	0.004173	182.0	43.60	21.80
70	4.44	1.7780	1.18	0.004180	206.1	49.32	24.66
80	4.88	2.0320	1.35	0.004187	228.3	54.53	27.26
90	5.29	2.2860	1.51	0.004194	249.0	59.36	29.68
100	5.62	2.5400	1.68	0.004201	265.6	63.22	31.61
110	5.92	2.7940	1.85	0.004209	280.7	66.71	33.35
120	6.16	3.0480	2.02	0.004216	292.8	69.46	34.73
130	6.32	3.3020	2.19	0.004223	300.9	71.25	35.63
140	6.46	3.5560	2.36	0.004230	308.0	72.80	36.40
150	6.55	3.8100	2.52	0.004238	312.5	73.74	36.87
160	6.59	4.0640	2.69	0.004245	314.5	74.09	37.04
170	6.60	4.3180	2.86	0.004252	315.0	74.08	37.04
180	6.57	4.5720	3.03	0.004260	313.5	73.60	36.80
190	6.51	4.8260	3.20	0.004267	310.5	72.76	36.38
200	6.43	5.0800	3.36	0.004275	306.5	71.69	35.85
210	6.34	5.3340	3.53	0.004282	301.9	70.51	35.25
220	6.24	5.5880	3.70	0.004290	296.9	69.21	34.60
230	6.14	5.8420	3.87	0.004297	291.8	67.91	33.96

Unconfined Compression Test Data (cont'd)



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Unconfined Compressive Strength

ASTM D2166

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q _u (kPa)	Shear Stress, S _u (kPa)
240	6.04	6.0960	4.04	0.004305	286.8	66.62	33.31



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-02
Sample # T296
Depth (m) 4.8 - 5.4
Sample Date 28-Sep-22
Test Date 04-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 560

5.32 m		5.15 m		5.05 m		4.88 m	
Bottom - 5.4 m						Top - 4.9 m	
Toss	Qu	Moisture Content		Keep		Toss	
	Bulk	PP/TV					
		Visual					
60 mm	170 mm	100 mm		170 mm		60 mm	

Visual Classification

Material	CLAY
Composition	silty
trace gravel (<10 mm diam)	
trace silt inclusions (<10 mm diam.)	
Color	dark grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.60
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	58.8

Pocket Penetrometer

Reading	1	1.20
	2	1.20
	3	1.10
	Average	1.17
Undrained Shear Strength (kPa)		57.2

Moisture Content

Tare ID	W05
Mass tare (g)	8.4
Mass wet + tare (g)	297.1
Mass dry + tare (g)	196.2
Moisture %	53.7%

Unit Weight

Bulk Weight (g)		1047.6
Length (mm)	1	150.85
	2	150.75
	3	151.40
	4	151.55
Average Length (m)		0.151
Diam. (mm)	1	72.25
	2	72.77
	3	72.58
	4	72.52
Average Diameter (m)		0.073

Volume (m³)	6.24E-04
Bulk Unit Weight (kN/m³)	16.5
Bulk Unit Weight (pcf)	104.7
Dry Unit Weight (kN/m³)	10.7
Dry Unit Weight (pcf)	68.1

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-02
Sample # T296
Depth (m) 4.8 - 5.4
Sample Date 28-Sep-22
Test Date 4-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	89.6	1.9
Max S_u	44.8	0.9

Specimen Data

Description CLAY - silty, trace gravel (<10 mm diam), trace silt inclusions (<10 mm diam.), dark grey, moist, stiff, high plasticity

Length 151.1 (mm)
Diameter 72.5 (mm)
L/D Ratio 2.1
Initial Area 0.00413 (m²)
Load Rate 1.00 (%/min)

Moisture % 54%
Bulk Unit Wt. 16.5 (kN/m³)
Dry Unit Wt. 10.7 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.60	58.8	1.23
Vane Size		
m		

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.20	58.9	1.23
1.20	58.9	1.23
1.10	54.0	1.13
Average	1.17	57.2
		1.20

Failure Geometry

Sketch:

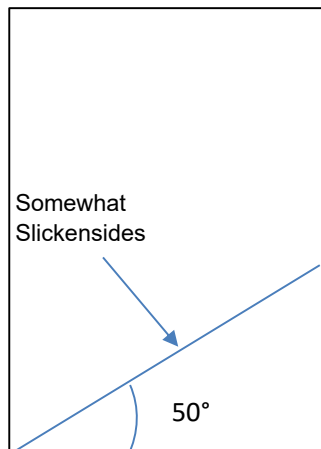
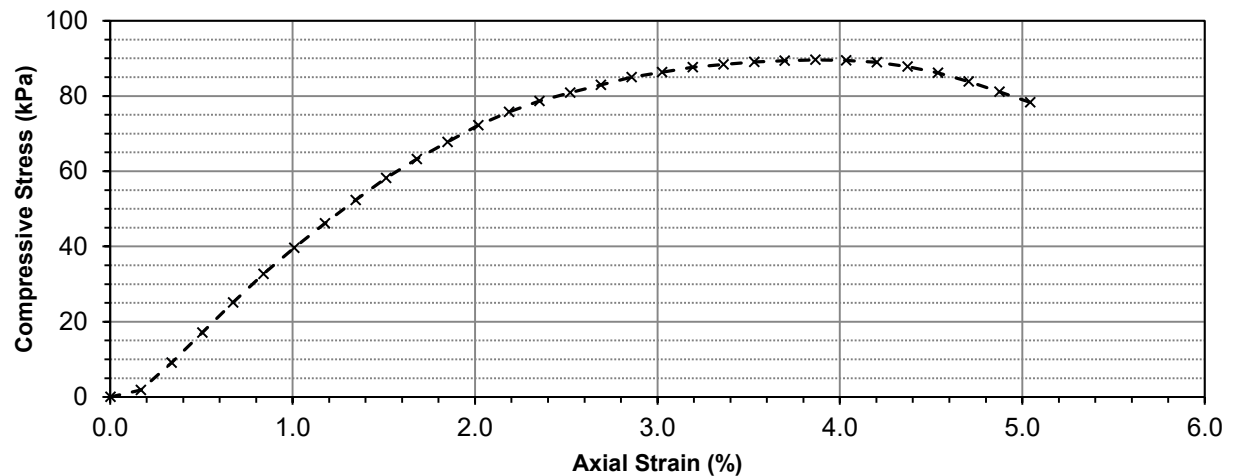


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004132	0.0	0.00	0.00
10	0.49	0.2540	0.17	0.004139	7.6	1.83	0.91
20	1.09	0.5080	0.34	0.004146	37.8	9.12	4.56
30	1.75	0.7620	0.50	0.004153	71.1	17.11	8.56
40	2.41	1.0160	0.67	0.004160	104.3	25.08	12.54
50	3.04	1.2700	0.84	0.004167	136.1	32.66	16.33
60	3.62	1.5240	1.01	0.004174	165.3	39.61	19.80
70	4.17	1.7780	1.18	0.004181	193.0	46.17	23.09
80	4.69	2.0320	1.34	0.004188	219.3	52.35	26.18
90	5.18	2.2860	1.51	0.004195	244.0	58.15	29.08
100	5.61	2.5400	1.68	0.004202	265.6	63.21	31.60
110	6.00	2.7940	1.85	0.004209	285.3	67.77	33.89
120	6.38	3.0480	2.02	0.004217	304.4	72.20	36.10
130	6.69	3.3020	2.18	0.004224	320.1	75.77	37.89
140	6.94	3.5560	2.35	0.004231	332.7	78.62	39.31
150	7.14	3.8100	2.52	0.004239	342.7	80.86	40.43
160	7.33	4.0640	2.69	0.004246	352.3	82.98	41.49
170	7.51	4.3180	2.86	0.004253	361.4	84.97	42.48
180	7.64	4.5720	3.03	0.004261	367.9	86.36	43.18
190	7.76	4.8260	3.19	0.004268	374.0	87.63	43.81
200	7.84	5.0800	3.36	0.004275	378.0	88.42	44.21
210	7.91	5.3340	3.53	0.004283	381.6	89.09	44.54
220	7.95	5.5880	3.70	0.004290	383.6	89.40	44.70
230	7.98	5.8420	3.87	0.004298	385.1	89.60	44.80



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Unconfined Compressive Strength ASTM D2166

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	7.98	6.0960	4.03	0.004305	385.1	89.44	44.72
250	7.95	6.3500	4.20	0.004313	383.6	88.94	44.47
260	7.87	6.6040	4.37	0.004320	379.5	87.85	43.92
270	7.74	6.8580	4.54	0.004328	373.0	86.18	43.09
280	7.55	7.1120	4.71	0.004336	363.4	83.82	41.91
290	7.33	7.3660	4.87	0.004343	352.3	81.12	40.56
300	7.10	7.6200	5.04	0.004351	340.7	78.31	39.15



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-02
Sample # T299
Depth (m) 7.9 - 8.5
Sample Date 28-Sep-22
Test Date 04-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 605

8.43 m		8.26 m		8.10 m		7.90 m	
Bottom - 8.5 m						Top - 7.9 m	
Toss	Qu	Moisture Content		Keep		Toss	
	Bulk	PP/TV					
		Visual					
40 mm	170 mm	150 mm		200 mm		40 mm	

Visual Classification

Material	CLAY
Composition	silty
trace gravel (<25 mm diam)	
trace silt inclusions (<40 mm diam.)	
Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.48
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	47.1

Pocket Penetrometer

Reading	1	1.00
	2	1.10
	3	0.90
	Average	1.00
Undrained Shear Strength (kPa)		49.0

Moisture Content

Tare ID	AH18
Mass tare (g)	8.7
Mass wet + tare (g)	292.3
Mass dry + tare (g)	196
Moisture %	51.4%

Unit Weight

Bulk Weight (g)		1090.0
Length (mm)	1	150.40
	2	150.33
	3	150.20
	4	150.90
Average Length (m)		0.150
Diam. (mm)	1	72.68
	2	72.40
	3	72.42
	4	72.91
Average Diameter (m)		0.073

Volume (m³)	6.23E-04
Bulk Unit Weight (kN/m³)	17.2
Bulk Unit Weight (pcf)	109.2
Dry Unit Weight (kN/m³)	11.3
Dry Unit Weight (pcf)	72.2

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-02
Sample # T299
Depth (m) 7.9 - 8.5
Sample Date 28-Sep-22
Test Date 4-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	88.0	1.8
Max S_u	44.0	0.9

Specimen Data

Description CLAY - silty, trace gravel (<25 mm diam), trace silt inclusions (<40 mm diam.), grey, moist, firm, high plasticity

Length 150.5 (mm)
Diameter 72.6 (mm)
L/D Ratio 2.1
Initial Area 0.00414 (m²)
Load Rate 1.00 (%/min)

Moisture % 51%
Bulk Unit Wt. 17.2 (kN/m³)
Dry Unit Wt. 11.3 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.48	47.1	0.98
Vane Size		
m		

Average

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.00	49.1	1.02
1.10	54.0	1.13
0.90	44.1	0.92
Average	49.1	1.02

Failure Geometry

Sketch:

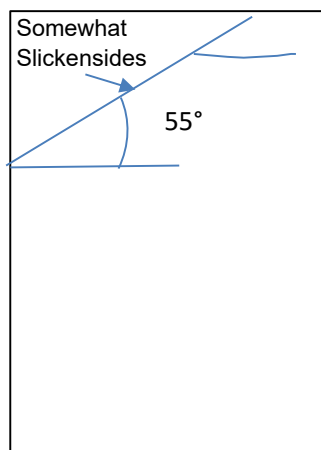
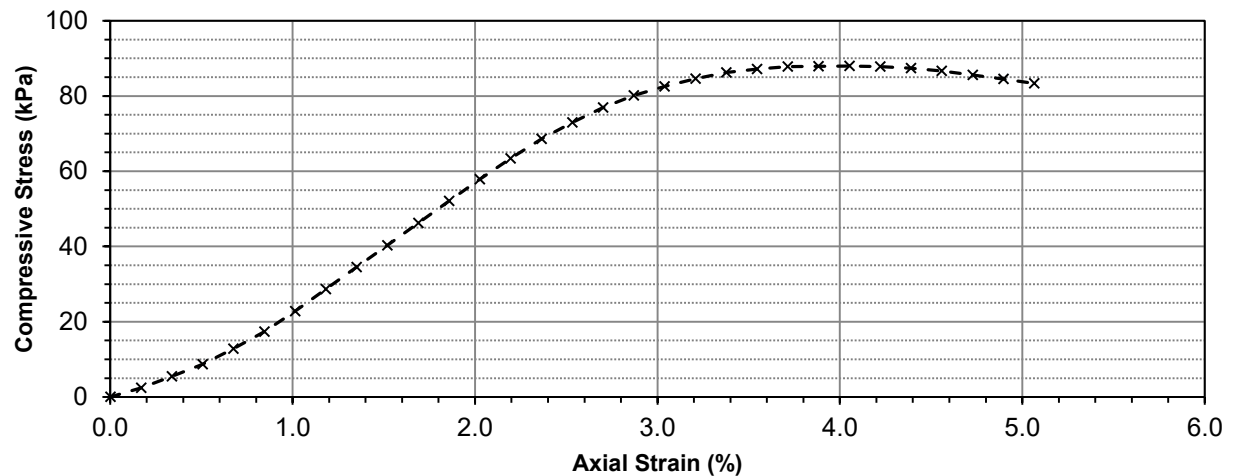


Photo:



Project No. 0336-003-00
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Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004140	0.0	0.00	0.00
10	0.54	0.2540	0.17	0.004147	10.1	2.43	1.22
20	0.79	0.5080	0.34	0.004154	22.7	5.46	2.73
30	1.06	0.7620	0.51	0.004161	36.3	8.72	4.36
40	1.40	1.0160	0.68	0.004168	53.4	12.82	6.41
50	1.78	1.2700	0.84	0.004175	72.6	17.38	8.69
60	2.23	1.5240	1.01	0.004182	95.3	22.78	11.39
70	2.72	1.7780	1.18	0.004189	120.0	28.63	14.32
80	3.21	2.0320	1.35	0.004197	144.7	34.47	17.23
90	3.70	2.2860	1.52	0.004204	169.4	40.29	20.14
100	4.20	2.5400	1.69	0.004211	194.6	46.20	23.10
110	4.70	2.7940	1.86	0.004218	219.8	52.10	26.05
120	5.19	3.0480	2.03	0.004226	244.5	57.85	28.93
130	5.66	3.3020	2.19	0.004233	268.1	63.35	31.67
140	6.11	3.5560	2.36	0.004240	290.8	68.59	34.29
150	6.49	3.8100	2.53	0.004247	310.0	72.98	36.49
160	6.83	4.0640	2.70	0.004255	327.1	76.88	38.44
170	7.12	4.3180	2.87	0.004262	341.7	80.18	40.09
180	7.33	4.5720	3.04	0.004270	352.3	82.52	41.26
190	7.52	4.8260	3.21	0.004277	361.9	84.61	42.31
200	7.67	5.0800	3.38	0.004285	369.5	86.23	43.11
210	7.76	5.3340	3.55	0.004292	374.0	87.13	43.57
220	7.83	5.5880	3.71	0.004300	377.5	87.80	43.90
230	7.85	5.8420	3.88	0.004307	378.5	87.88	43.94



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Unconfined Compressive Strength ASTM D2166

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	7.87	6.0960	4.05	0.004315	379.5	87.96	43.98
250	7.87	6.3500	4.22	0.004322	379.5	87.81	43.90
260	7.85	6.6040	4.39	0.004330	378.5	87.42	43.71
270	7.80	6.8580	4.56	0.004338	376.0	86.68	43.34
280	7.72	7.1120	4.73	0.004345	372.0	85.60	42.80
290	7.64	7.3660	4.90	0.004353	367.9	84.53	42.26
300	7.55	7.6200	5.06	0.004361	363.4	83.33	41.67



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-02
Sample # T302
Depth (m) 10.9 - 11.5
Sample Date 28-Sep-22
Test Date 04-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 575

Bottom - 11.5 m		11.27 m	11.09 m	10.97 m	Top - 10.9 m
Keep		Qu	Moisture Content PP/TV Visual	Toss	
215 mm		180 mm	120 mm	60 mm	
		Bulk			

Visual Classification

Material	CLAY
Composition	silty
trace gravel (<15 mm diam)	
trace silt inclusions (<25 mm diam.)	
Color	dark grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.43
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	42.2

Pocket Penetrometer

Reading	1	0.90
	2	0.80
	3	0.90
	Average	0.87
Undrained Shear Strength (kPa)		42.5

Moisture Content

Tare ID	F99
Mass tare (g)	8.7
Mass wet + tare (g)	284.9
Mass dry + tare (g)	178.4
Moisture %	62.8%

Unit Weight

Bulk Weight (g)		1034.9
Length (mm)	1	149.54
	2	149.90
	3	149.63
	4	149.35
Average Length (m)		0.150
Diam. (mm)	1	73.39
	2	72.89
	3	72.55
	4	72.96
Average Diameter (m)		0.073

Volume (m³)	6.25E-04
Bulk Unit Weight (kN/m³)	16.2
Bulk Unit Weight (pcf)	103.3
Dry Unit Weight (kN/m³)	10.0
Dry Unit Weight (pcf)	63.5

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-02
Sample # T302
Depth (m) 10.9 - 11.5
Sample Date 28-Sep-22
Test Date 4-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	96.8	2.0
Max S_u	48.4	1.0

Specimen Data

Description CLAY - silty, trace gravel (<15 mm diam), trace silt inclusions (<25 mm diam.), dark grey, moist, firm, high plasticity

Length 149.6 (mm)
Diameter 72.9 (mm)
L/D Ratio 2.1
Initial Area 0.00418 (m²)
Load Rate 1.00 (%/min)

Moisture % 63%
Bulk Unit Wt. 16.2 (kN/m³)
Dry Unit Wt. 10.0 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.43	42.2	0.88
Vane Size		
m		

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.90	44.1	0.92
0.80	39.2	0.82
0.90	44.1	0.92
Average	0.87	42.5
		0.89

Failure Geometry

Sketch:

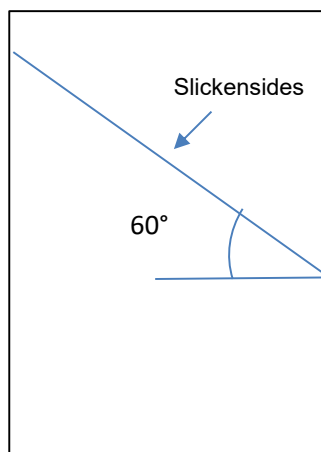
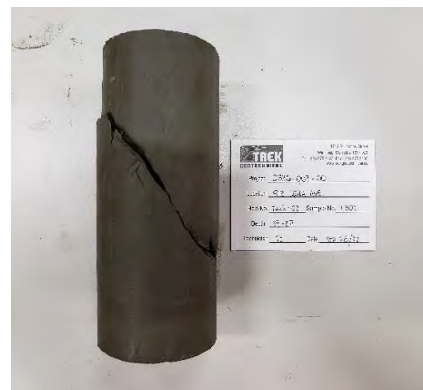
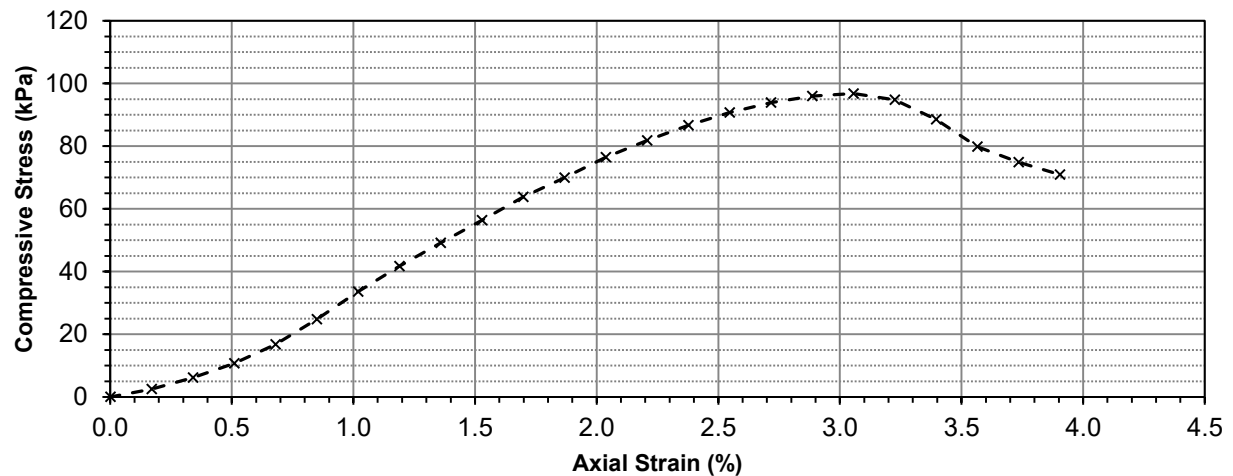


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.35	0.0000	0.00	0.004179	0.0	0.00	0.00
10	0.56	0.2540	0.17	0.004186	10.6	2.53	1.26
20	0.86	0.5080	0.34	0.004194	25.7	6.13	3.06
30	1.24	0.7620	0.51	0.004201	44.9	10.68	5.34
40	1.75	1.0160	0.68	0.004208	70.6	16.77	8.38
50	2.42	1.2700	0.85	0.004215	104.3	24.75	12.38
60	3.16	1.5240	1.02	0.004222	141.6	33.54	16.77
70	3.85	1.7780	1.19	0.004230	176.4	41.71	20.85
80	4.48	2.0320	1.36	0.004237	208.2	49.13	24.57
90	5.10	2.2860	1.53	0.004244	239.4	56.41	28.20
100	5.73	2.5400	1.70	0.004252	271.2	63.78	31.89
110	6.26	2.7940	1.87	0.004259	297.9	69.94	34.97
120	6.82	3.0480	2.04	0.004266	326.1	76.44	38.22
130	7.29	3.3020	2.21	0.004274	349.8	81.85	40.92
140	7.71	3.5560	2.38	0.004281	371.0	86.65	43.33
150	8.07	3.8100	2.55	0.004289	389.1	90.73	45.37
160	8.35	4.0640	2.72	0.004296	403.2	93.86	46.93
170	8.54	4.3180	2.89	0.004304	412.8	95.92	47.96
180	8.63	4.5720	3.06	0.004311	417.3	96.80	48.40
190	8.47	4.8260	3.23	0.004319	409.3	94.77	47.38
200	7.95	5.0800	3.40	0.004326	383.1	88.54	44.27
210	7.21	5.3340	3.57	0.004334	345.8	79.78	39.89
220	6.80	5.5880	3.74	0.004342	325.1	74.88	37.44
230	6.47	5.8420	3.90	0.004349	308.5	70.92	35.46



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-22
Sample # T313
Depth (m) 6.3 - 6.9
Sample Date 28-Sep-22
Test Date 02-Nov-22
Technician AD

Tube Extraction

Recovery (mm) 675 (overpush)

6.74 m		6.56 m	6.39 m	Top - 6.2 m
Bottom - 6.9 m				
Qu	Moisture Content	Keep	Toss	
Bulk	PP/TV Visual			
210 mm	180 mm	170 mm	115 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10 mm diam.)	
Color	dark grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.58
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	56.9

Pocket Penetrometer

Reading	1	1.30
	2	1.50
	3	1.20
	Average	1.33
Undrained Shear Strength (kPa)		65.4

Moisture Content

Tare ID	Z72
Mass tare (g)	8.9
Mass wet + tare (g)	315
Mass dry + tare (g)	202.8
Moisture %	57.9%

Unit Weight

Bulk Weight (g)		1053.5
Length (mm)	1	151.61
	2	151.40
	3	151.79
	4	151.54
Average Length (m)		0.152
Diam. (mm)	1	72.60
	2	71.93
	3	72.48
	4	72.85
Average Diameter (m)		0.072

Volume (m³)	6.25E-04
Bulk Unit Weight (kN/m³)	16.5
Bulk Unit Weight (pcf)	105.2
Dry Unit Weight (kN/m³)	10.5
Dry Unit Weight (pcf)	66.6



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-22
Sample # T318
Depth (m) 12.4 - 13.0
Sample Date 28-Sep-22
Test Date 02-Nov-22
Technician AD

Tube Extraction

Recovery (mm) 510

Bottom - 13 m		12.71 m	12.61 m	12.44 m	Top - 12.5 m
Qu	Moisture Content		Keep		Toss
Bulk	PP/TV				
	Visual				
170 mm		100 mm	170 mm	70 mm	

Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<15 mm diam)	
trace silt inclusions (<10 mm diam.)	

Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.45
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	44.1

Pocket Penetrometer

Reading	1	0.90
	2	1.00
	3	1.00
	Average	0.97
Undrained Shear Strength (kPa)		47.4

Moisture Content

Tare ID	F128
Mass tare (g)	8.6
Mass wet + tare (g)	287.2
Mass dry + tare (g)	196.2
Moisture %	48.5%

Unit Weight

Bulk Weight (g)		1065.5
Length (mm)	1	151.10
	2	150.96
	3	150.77
	4	150.58
Average Length (m)		0.151
Diam. (mm)	1	72.19
	2	72.79
	3	72.28
	4	72.62
Average Diameter (m)		0.072

Volume (m³)	6.22E-04
Bulk Unit Weight (kN/m³)	16.8
Bulk Unit Weight (pcf)	106.9
Dry Unit Weight (kN/m³)	11.3
Dry Unit Weight (pcf)	72.0

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-22
Sample # T318
Depth (m) 12.4 - 13.0
Sample Date 28-Sep-22
Test Date 02-Nov-22
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	88.8	1.9
Max S_u	44.4	0.9

Specimen Data

Description CLAY - silty, trace sand, trace gravel (<15 mm diam), trace silt inclusions (<10 mm diam.), grey, moist, firm, high plasticity

Length 150.9 (mm)
Diameter 72.5 (mm)
L/D Ratio 2.1
Initial Area 0.00412 (m²)
Load Rate 1.00 (%/min)

Moisture % 49%
Bulk Unit Wt. 16.8 (kN/m³)
Dry Unit Wt. 11.3 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading
tsf
0.45
Vane Size
m

Undrained Shear Strength
kPa
44.1
ksf
0.92

Pocket Penetrometer

Reading
tsf
0.90
1.00
1.00
Average **0.97**

Undrained Shear Strength
kPa
44.1
49.1
49.1
47.4
ksf
0.92
1.02
1.02
0.99

Failure Geometry

Sketch:

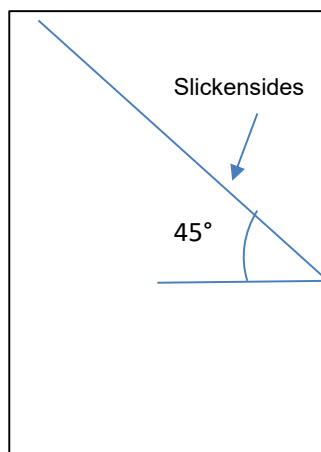
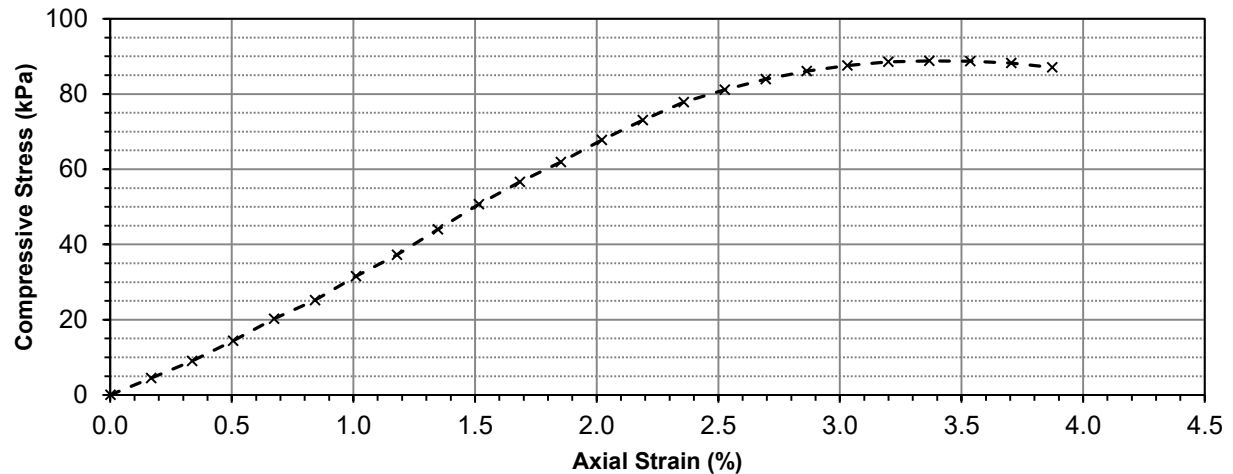


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.35	0.0000	0.00	0.004125	0.0	0.00	0.00
10	0.72	0.2540	0.17	0.004132	18.6	4.51	2.26
20	1.09	0.5080	0.34	0.004139	37.3	9.01	4.51
30	1.53	0.7620	0.51	0.004146	59.5	14.35	7.17
40	2.02	1.0160	0.67	0.004153	84.2	20.27	10.13
50	2.43	1.2700	0.84	0.004160	104.8	25.20	12.60
60	2.96	1.5240	1.01	0.004167	131.6	31.57	15.79
70	3.43	1.7780	1.18	0.004174	155.2	37.19	18.60
80	4.00	2.0320	1.35	0.004181	184.0	44.00	22.00
90	4.56	2.2860	1.52	0.004188	212.2	50.66	25.33
100	5.06	2.5400	1.68	0.004195	237.4	56.58	28.29
110	5.51	2.7940	1.85	0.004203	260.1	61.88	30.94
120	6.01	3.0480	2.02	0.004210	285.3	67.76	33.88
130	6.46	3.3020	2.19	0.004217	308.0	73.03	36.51
140	6.87	3.5560	2.36	0.004224	328.6	77.79	38.90
150	7.16	3.8100	2.53	0.004232	343.2	81.11	40.56
160	7.41	4.0640	2.69	0.004239	355.8	83.94	41.97
170	7.60	4.3180	2.86	0.004246	365.4	86.05	43.03
180	7.74	4.5720	3.03	0.004254	372.5	87.56	43.78
190	7.84	4.8260	3.20	0.004261	377.5	88.60	44.30
200	7.87	5.0800	3.37	0.004269	379.0	88.80	44.40
210	7.88	5.3340	3.54	0.004276	379.5	88.76	44.38
220	7.85	5.5880	3.70	0.004284	378.0	88.25	44.13
230	7.76	5.8420	3.87	0.004291	373.5	87.04	43.52

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-22
Sample # T313
Depth (m) 6.3 - 6.9
Sample Date 28-Sep-22
Test Date 2-Nov-22
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	95.9	2.0
Max S_u	47.9	1.0

Specimen Data

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

Length 151.6 (mm)
Diameter 72.5 (mm)
L/D Ratio 2.1
Initial Area 0.00412 (m²)
Load Rate 1.00 (%/min)

Moisture % 58%
Bulk Unit Wt. 16.5 (kN/m³)
Dry Unit Wt. 10.5 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength
tsf	kPa ksf
0.58	56.9 1.19

Vane Size
m

Average

Pocket Penetrometer

Reading	Undrained Shear Strength
tsf	kPa ksf
1.30	63.8 1.33
1.50	73.6 1.54
1.20	58.9 1.23
1.33	65.4 1.37

Failure Geometry

Sketch:

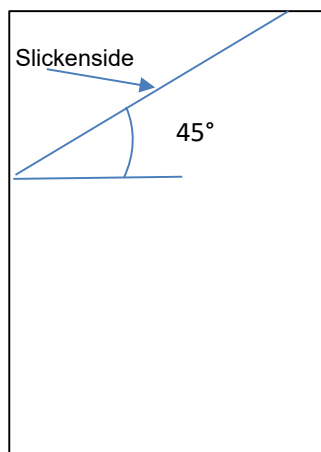
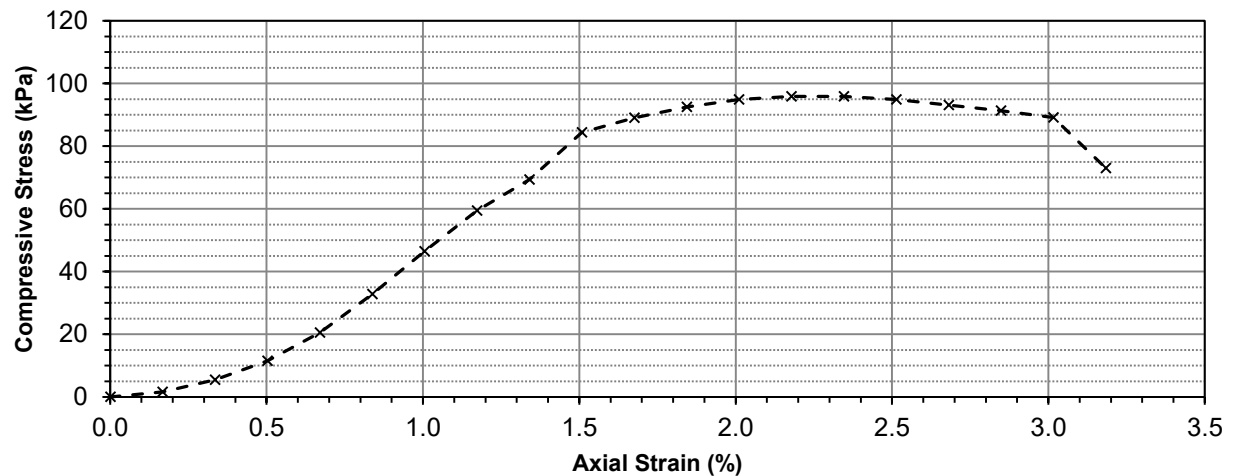


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004124	0.0	0.00	0.00
10	0.47	0.2540	0.17	0.004131	6.6	1.59	0.79
20	0.79	0.5080	0.34	0.004138	22.7	5.48	2.74
30	1.29	0.7620	0.50	0.004145	47.9	11.55	5.78
40	2.03	1.0160	0.67	0.004152	85.2	20.52	10.26
50	3.05	1.2700	0.84	0.004159	136.6	32.84	16.42
60	4.18	1.5240	1.01	0.004166	193.5	46.46	23.23
70	5.26	1.7780	1.17	0.004173	248.0	59.42	29.71
80	6.09	2.0320	1.34	0.004180	289.8	69.33	34.66
90	7.35	2.2860	1.51	0.004187	353.3	84.38	42.19
100	7.75	2.5400	1.68	0.004195	373.5	89.04	44.52
110	8.05	2.7940	1.84	0.004202	388.6	92.49	46.24
120	8.26	3.0480	2.01	0.004209	399.2	94.84	47.42
130	8.36	3.3020	2.18	0.004216	404.2	95.88	47.94
140	8.37	3.5560	2.35	0.004223	404.7	95.83	47.92
150	8.30	3.8100	2.51	0.004231	401.2	94.83	47.42
160	8.17	4.0640	2.68	0.004238	394.7	93.13	46.56
170	8.03	4.3180	2.85	0.004245	387.6	91.30	45.65
180	7.86	4.5720	3.02	0.004253	379.0	89.13	44.57
190	6.51	4.8260	3.18	0.004260	311.0	73.00	36.50



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-29
Sample # T331
Depth (m) 4.7 - 5.3
Sample Date 28-Sep-22
Test Date 03-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 585

5.14 m		5.03 m	4.87 m	
Bottom - 5.3 m				Top - 4.7 m
Keep	Moisture Content PP/TV Visual	Qu Bulk	Toss	
170 mm	110 mm	160 mm	145 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<20 mm diam.)	
Color	grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	stratified clay and silt (15 mm thick)
Gradation	-

Torvane

Reading	0.71
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	69.6

Pocket Penetrometer

Reading	1	1.30
	2	1.40
	3	1.40
	Average	1.37
Undrained Shear Strength (kPa)		67.0

Moisture Content

Tare ID	C30
Mass tare (g)	8.3
Mass wet + tare (g)	338.1
Mass dry + tare (g)	223.1
Moisture %	53.5%

Unit Weight

Bulk Weight (g)		1032.1
Length (mm)	1	147.90
	2	147.44
	3	147.56
	4	147.70
Average Length (m)		0.148
Diam. (mm)	1	72.86
	2	72.45
	3	72.65
	4	72.11
Average Diameter (m)		0.073

Volume (m³)	6.10E-04
Bulk Unit Weight (kN/m³)	16.6
Bulk Unit Weight (pcf)	105.7
Dry Unit Weight (kN/m³)	10.8
Dry Unit Weight (pcf)	68.8

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-29
Sample # T331
Depth (m) 4.7 - 5.3
Sample Date 28-Sep-22
Test Date 3-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	119.1	2.5
Max S_u	59.6	1.2

Specimen Data

Description CLAY - silty, trace silt inclusions (<20 mm diam.), grey, moist, stiff, high plasticity, stratified clay and silt (15 mm thick)

Length 147.7 (mm)
Diameter 72.5 (mm)
L/D Ratio 2.0
Initial Area 0.00413 (m²)
Load Rate 1.00 (%/min)

Moisture % 54%
Bulk Unit Wt. 16.6 (kN/m³)
Dry Unit Wt. 10.8 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.71	69.6	1.45

Vane Size
m

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.30	63.8	1.33
1.40	68.7	1.43
1.40	68.7	1.43
Average	1.37	67.0
		1.40

Failure Geometry

Sketch:

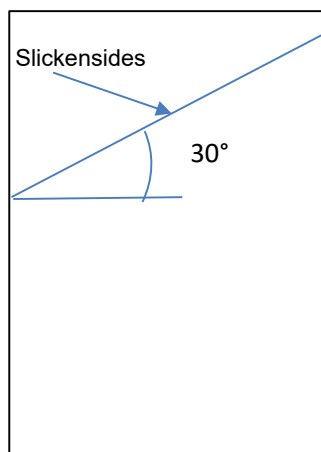
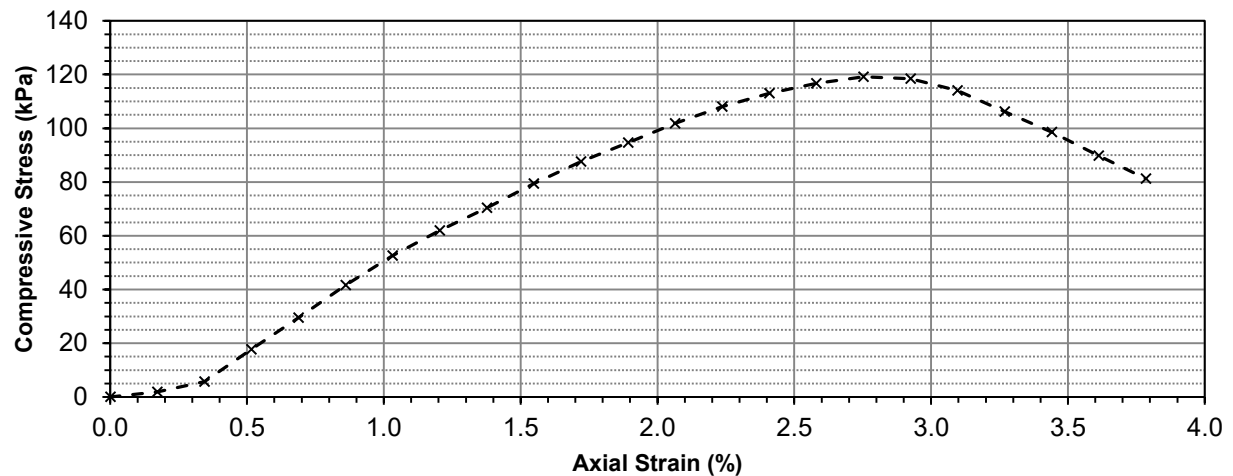


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q _u (kPa)	Shear Stress, S _u (kPa)
0	0.33	0.0000	0.00	0.004130	0.0	0.00	0.00
10	0.48	0.2540	0.17	0.004137	7.6	1.83	0.91
20	0.80	0.5080	0.34	0.004145	23.7	5.72	2.86
30	1.79	0.7620	0.52	0.004152	73.6	17.73	8.86
40	2.76	1.0160	0.69	0.004159	122.5	29.45	14.73
50	3.77	1.2700	0.86	0.004166	173.4	41.62	20.81
60	4.68	1.5240	1.03	0.004173	219.3	52.54	26.27
70	5.47	1.7780	1.20	0.004181	259.1	61.97	30.99
80	6.18	2.0320	1.38	0.004188	294.9	70.41	35.20
90	6.94	2.2860	1.55	0.004195	333.2	79.42	39.71
100	7.63	2.5400	1.72	0.004203	367.9	87.55	43.78
110	8.23	2.7940	1.89	0.004210	398.2	94.58	47.29
120	8.85	3.0480	2.06	0.004217	429.4	101.83	50.91
130	9.39	3.3020	2.24	0.004225	456.7	108.09	54.05
140	9.82	3.5560	2.41	0.004232	478.3	113.02	56.51
150	10.15	3.8100	2.58	0.004240	495.0	116.75	58.37
160	10.37	4.0640	2.75	0.004247	506.0	119.15	59.57
170	10.33	4.3180	2.92	0.004255	504.0	118.47	59.23
180	9.97	4.5720	3.10	0.004262	485.9	114.00	57.00
190	9.33	4.8260	3.27	0.004270	453.6	106.24	53.12
200	8.69	5.0800	3.44	0.004277	421.4	98.51	49.26
210	7.96	5.3340	3.61	0.004285	384.6	89.75	44.87
220	7.25	5.5880	3.78	0.004293	348.8	81.25	40.63



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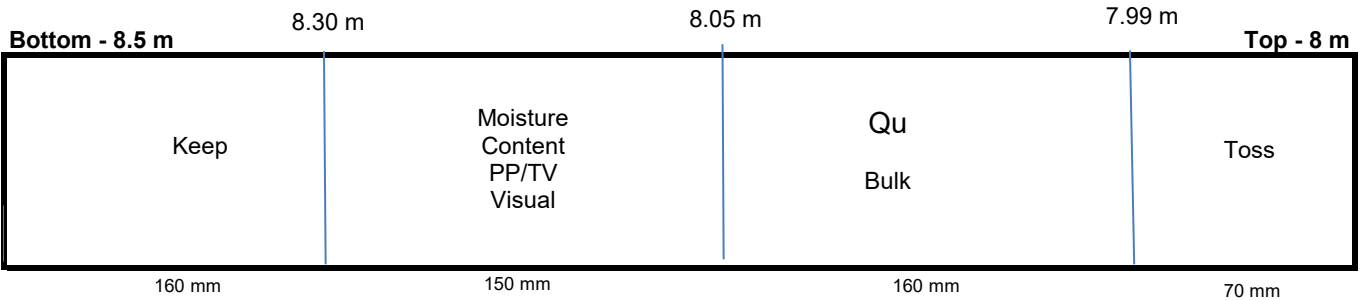
Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-32
Sample # T340
Depth (m) 7.9 - 8.5
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Tube Extraction

Recovery (mm) 540



Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10mm diam)	
Color	grey
Moisture	moist
Consistency	firm to stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.50
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	49.0

Pocket Penetrometer

Reading	1	1.00
	2	1.00
	3	1.00
	Average	1.00
Undrained Shear Strength (kPa)		49.0

Moisture Content

Tare ID	N80
Mass tare (g)	268
Mass wet + tare (g)	177.2
Mass dry + tare (g)	193.8
Moisture %	22.4%

Unit Weight

Bulk Weight (g)		1017.8
Length (mm)	1	144.83
	2	145.22
	3	144.96
	4	144.89
Average Length (m)		0.145
Diam. (mm)	1	72.26
	2	72.37
	3	72.81
	4	72.76
Average Diameter (m)		0.073

Volume (m³)	5.99E-04
Bulk Unit Weight (kN/m³)	16.7
Bulk Unit Weight (pcf)	106.0
Dry Unit Weight (kN/m³)	13.6
Dry Unit Weight (pcf)	86.6

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-32
Sample # T340
Depth (m) 7.9 - 8.5
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Unconfined Strength

	kPa	ksf
Max q_u	119.9	2.5
Max S_u	59.9	1.3

Specimen Data

Description CLAY - silty, trace silt inclusions (<10mm diam), grey, moist, firm to stiff, high plasticity

Length 145.0 (mm)
Diameter 72.6 (mm)
L/D Ratio 2.0
Initial Area 0.00413 (m²)
Load Rate 1.00 (%/min)

Moisture % 22%
Bulk Unit Wt. 16.7 (kN/m³)
Dry Unit Wt. 13.6 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.50	49.0	1.02
Vane Size		
m		

Average

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.00	49.1	1.02
1.00	49.1	1.02
1.00	49.1	1.02
Average	49.1	1.02

Failure Geometry

Sketch:

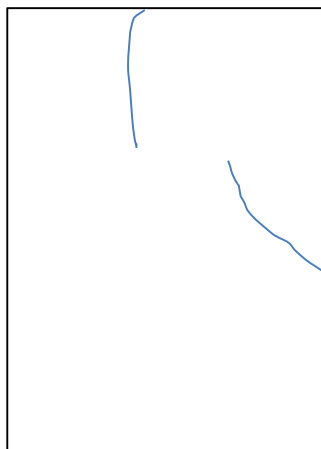
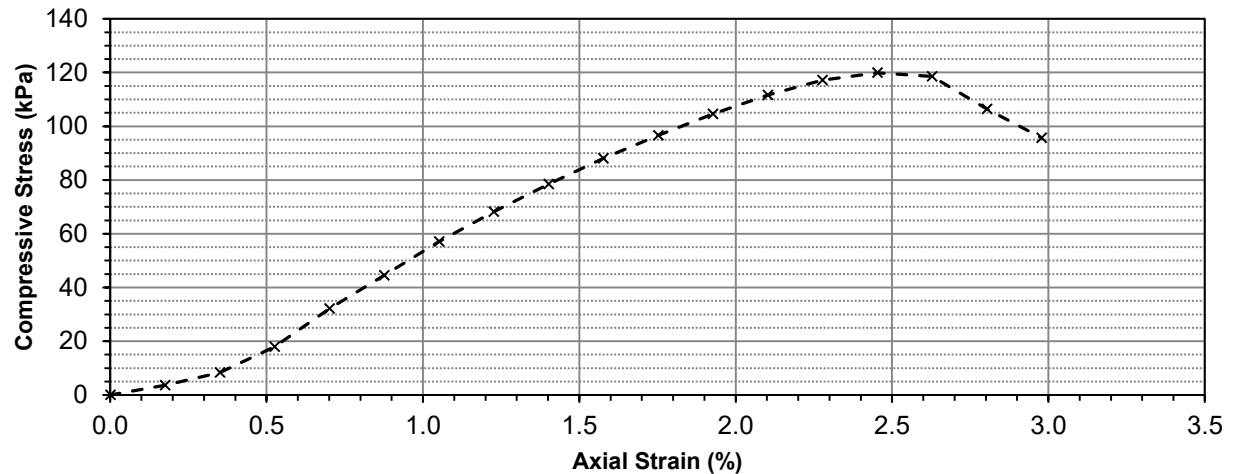


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q _u (kPa)	Shear Stress, S _u (kPa)
0	0.34	0.0000	0.00	0.004134	0.0	0.00	0.00
10	0.64	0.2540	0.18	0.004141	15.1	3.65	1.83
20	1.03	0.5080	0.35	0.004148	34.8	8.38	4.19
30	1.82	0.7620	0.53	0.004156	74.6	17.95	8.98
40	2.99	1.0160	0.70	0.004163	133.6	32.08	16.04
50	4.02	1.2700	0.88	0.004170	185.5	44.48	22.24
60	5.07	1.5240	1.05	0.004178	238.4	57.06	28.53
70	6.00	1.7780	1.23	0.004185	285.3	68.16	34.08
80	6.87	2.0320	1.40	0.004193	329.1	78.50	39.25
90	7.68	2.2860	1.58	0.004200	370.0	88.08	44.04
100	8.40	2.5400	1.75	0.004208	406.2	96.55	48.27
110	9.09	2.7940	1.93	0.004215	441.0	104.63	52.31
120	9.69	3.0480	2.10	0.004223	471.3	111.60	55.80
130	10.17	3.3020	2.28	0.004230	495.5	117.12	58.56
140	10.42	3.5560	2.45	0.004238	508.1	119.89	59.94
150	10.33	3.8100	2.63	0.004246	503.5	118.60	59.30
160	9.32	4.0640	2.80	0.004253	452.6	106.42	53.21
170	8.43	4.3180	2.98	0.004261	407.8	95.70	47.85



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-17
Sample # T353
Depth (m) 9.4 - 10.0
Sample Date 29-Sep-22
Test Date 03-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 555

9.82 m		9.65 m		9.47 m		Top - 9.4 m
Bottom - 10 m						
Moisture Content PP/TV Visual	Qu Bulk		Keep		Toss	
95 mm	170 mm		180 mm		110 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<20 mm diam.)	
Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.40
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	39.2

Pocket Penetrometer

Reading	1	0.90
	2	0.90
	3	0.90
	Average	0.90
Undrained Shear Strength (kPa)		44.1

Moisture Content

Tare ID	F54
Mass tare (g)	8.4
Mass wet + tare (g)	236.7
Mass dry + tare (g)	158.8
Moisture %	51.8%

Unit Weight

Bulk Weight (g)		1070.2
Length (mm)	1	151.16
	2	151.40
	3	151.35
	4	151.80
Average Length (m)		0.151
Diam. (mm)	1	72.45
	2	72.95
	3	72.50
	4	72.69
Average Diameter (m)		0.073

Volume (m³)	6.28E-04
Bulk Unit Weight (kN/m³)	16.7
Bulk Unit Weight (pcf)	106.4
Dry Unit Weight (kN/m³)	11.0
Dry Unit Weight (pcf)	70.1

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-17
Sample # T353
Depth (m) 9.4 - 10.0
Sample Date 29-Sep-22
Test Date 3-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	86.1	1.8
Max S_u	43.0	0.9

Specimen Data

Description CLAY - silty, trace silt inclusions (<20 mm diam.), grey, moist, firm, high plasticity

Length 151.4 (mm)
Diameter 72.6 (mm)
L/D Ratio 2.1
Initial Area 0.00415 (m²)
Load Rate 1.00 (%/min)

Moisture % 52%
Bulk Unit Wt. 16.7 (kN/m³)
Dry Unit Wt. 11.0 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.40	39.2	0.82
Vane Size		
m		

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.90	44.1	0.92
0.90	44.1	0.92
0.90	44.1	0.92
Average	0.90	44.1
		0.92

Failure Geometry

Sketch:

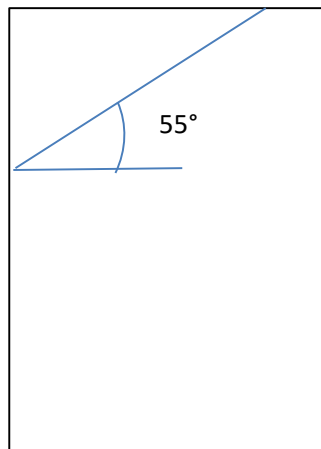
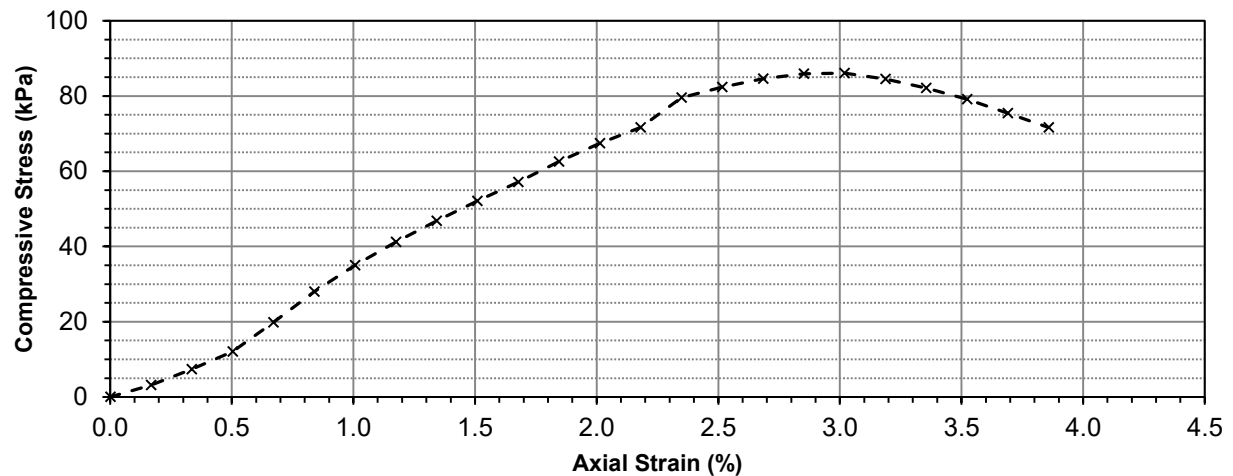


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004145	0.0	0.00	0.00
10	0.60	0.2540	0.17	0.004152	13.1	3.16	1.58
20	0.95	0.5080	0.34	0.004159	30.7	7.39	3.70
30	1.34	0.7620	0.50	0.004166	50.4	12.10	6.05
40	1.98	1.0160	0.67	0.004173	82.7	19.81	9.90
50	2.66	1.2700	0.84	0.004180	116.9	27.97	13.99
60	3.25	1.5240	1.01	0.004187	146.7	35.03	17.51
70	3.77	1.7780	1.17	0.004194	172.9	41.22	20.61
80	4.24	2.0320	1.34	0.004201	196.6	46.79	23.39
90	4.69	2.2860	1.51	0.004209	219.3	52.10	26.05
100	5.12	2.5400	1.68	0.004216	240.9	57.15	28.57
110	5.58	2.7940	1.85	0.004223	264.1	62.54	31.27
120	6.00	3.0480	2.01	0.004230	285.3	67.44	33.72
130	6.36	3.3020	2.18	0.004237	303.4	71.61	35.80
140	7.04	3.5560	2.35	0.004245	337.7	79.56	39.78
150	7.29	3.8100	2.52	0.004252	350.3	82.38	41.19
160	7.49	4.0640	2.68	0.004259	360.4	84.61	42.30
170	7.61	4.3180	2.85	0.004267	366.4	85.88	42.94
180	7.64	4.5720	3.02	0.004274	367.9	86.09	43.04
190	7.52	4.8260	3.19	0.004282	361.9	84.52	42.26
200	7.33	5.0800	3.35	0.004289	352.3	82.15	41.07
210	7.09	5.3340	3.52	0.004296	340.2	79.19	39.59
220	6.78	5.5880	3.69	0.004304	324.6	75.42	37.71
230	6.47	5.8420	3.86	0.004311	309.0	71.66	35.83



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-33
Sample # T373
Depth (m) 4.8 - 5.4
Sample Date 29-Sep-22
Test Date 03-Nov-22
Technician JC

Tube Extraction

Recovery (mm) 550

5.14 m		4.97 m	4.82 m
Bottom - 5.4 m			Top - 4.8 m
Keep	Qu Bulk	Moisture Content PP/TV Visual	Toss
165 mm	165 mm	155 mm	65 mm

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10 mm diam.)	
Color	brown
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.72
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	70.6

Pocket Penetrometer

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

Moisture Content

Tare ID	D30
Mass tare (g)	8.5
Mass wet + tare (g)	242.6
Mass dry + tare (g)	160.7
Moisture %	53.8%

Unit Weight

Bulk Weight (g)		1048.2
Length (mm)	1	150.13
	2	150.28
	3	150.83
	4	150.66
Average Length (m)		0.150
Diam. (mm)	1	72.88
	2	71.81
	3	72.05
	4	72.75
Average Diameter (m)		0.072

Volume (m³)	6.19E-04
Bulk Unit Weight (kN/m³)	16.6
Bulk Unit Weight (pcf)	105.7
Dry Unit Weight (kN/m³)	10.8
Dry Unit Weight (pcf)	68.7

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-33
Sample # T373
Depth (m) 4.8 - 5.4
Sample Date 29-Sep-22
Test Date 3-Nov-22
Technician JC

Unconfined Strength

	kPa	ksf
Max q_u	117.9	2.5
Max S_u	59.0	1.2

Specimen Data

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

Length 150.5 (mm)
Diameter 72.4 (mm)
L/D Ratio 2.1
Initial Area 0.00411 (m²)
Load Rate 1.00 (%/min)

Moisture % 54%
Bulk Unit Wt. 16.6 (kN/m³)
Dry Unit Wt. 10.8 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.72	70.6	1.47

Vane Size
m

Pocket Penetrometer

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

Failure Geometry

Sketch:

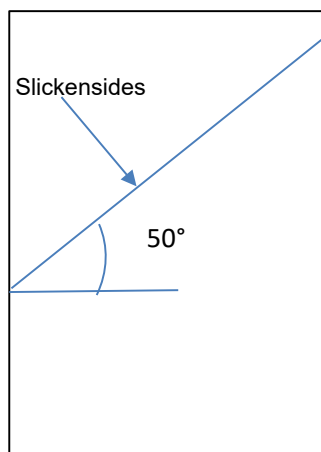
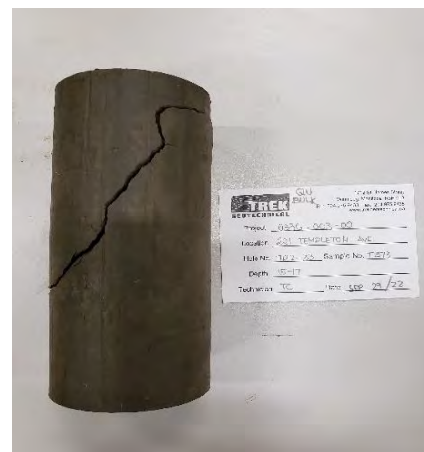
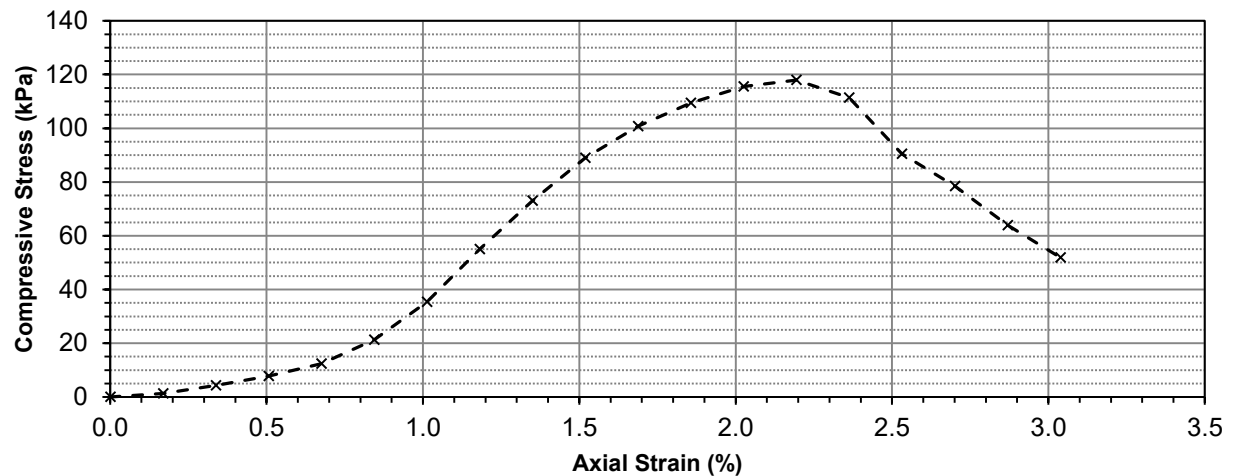


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.34	0.0000	0.00	0.004114	0.0	0.00	0.00
10	0.45	0.2540	0.17	0.004121	5.5	1.35	0.67
20	0.69	0.5080	0.34	0.004128	17.6	4.27	2.14
30	0.98	0.7620	0.51	0.004135	32.3	7.80	3.90
40	1.36	1.0160	0.68	0.004142	51.4	12.41	6.21
50	2.09	1.2700	0.84	0.004149	88.2	21.26	10.63
60	3.26	1.5240	1.01	0.004156	147.2	35.41	17.71
70	4.88	1.7780	1.18	0.004163	228.8	54.97	27.48
80	6.38	2.0320	1.35	0.004170	304.4	73.00	36.50
90	7.71	2.2860	1.52	0.004177	371.5	88.93	44.46
100	8.70	2.5400	1.69	0.004184	421.4	100.70	50.35
110	9.44	2.7940	1.86	0.004192	458.7	109.43	54.71
120	9.97	3.0480	2.03	0.004199	485.4	115.60	57.80
130	10.18	3.3020	2.19	0.004206	496.0	117.92	58.96
140	9.65	3.5560	2.36	0.004213	469.3	111.37	55.69
150	7.92	3.8100	2.53	0.004221	382.1	90.52	45.26
160	6.92	4.0640	2.70	0.004228	331.7	78.44	39.22
170	5.71	4.3180	2.87	0.004235	270.7	63.91	31.95
180	4.71	4.5720	3.04	0.004243	220.3	51.92	25.96



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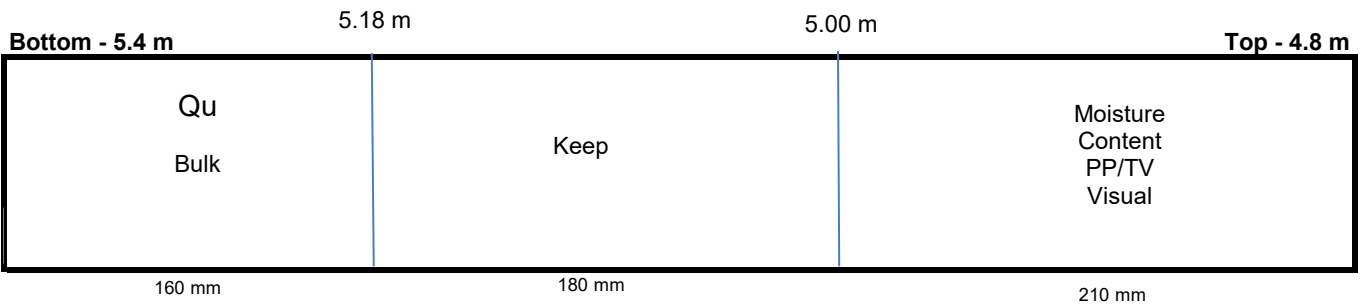
Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-26
Sample # T386
Depth (m) 4.8 - 5.4
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Tube Extraction

Recovery (mm) 550



Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10mm diam)	
Color	grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	laminated silt and clay (<5mm thick)
Gradation	-

Torvane

Reading	0.69
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	67.7

Pocket Penetrometer

Reading	1	1.80
	2	1.70
	3	1.70
	Average	1.73
Undrained Shear Strength (kPa)		85.0

Moisture Content

Tare ID	Q01
Mass tare (g)	8.4
Mass wet + tare (g)	309.6
Mass dry + tare (g)	210.4
Moisture %	49.1%

Unit Weight

Bulk Weight (g)		1053.6
Length (mm)	1	150.06
	2	150.20
	3	150.32
	4	150.23
Average Length (m)		0.150
Diam. (mm)	1	72.52
	2	72.29
	3	72.43
	4	72.24
Average Diameter (m)		0.072

Volume (m³)	6.18E-04
Bulk Unit Weight (kN/m³)	16.7
Bulk Unit Weight (pcf)	106.5
Dry Unit Weight (kN/m³)	11.2
Dry Unit Weight (pcf)	71.4

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Test Hole TH22-26
Sample # T386
Depth (m) 4.8 - 5.4
Sample Date 20-Sep-22
Test Date 11-Nov-22
Technician DS

Unconfined Strength

	kPa	ksf
Max q_u	91.1	1.9
Max S_u	45.6	1.0

Specimen Data

Description CLAY - silty, trace silt inclusions (<10mm diam), grey, moist, stiff, high plasticity, laminated silt and clay (<5mm thick)

Length 150.2 (mm)
Diameter 72.4 (mm)
L/D Ratio 2.1
Initial Area 0.00411 (m²)
Load Rate 1.00 (%/min)

Moisture % 49%
Bulk Unit Wt. 16.7 (kN/m³)
Dry Unit Wt. 11.2 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.69	67.7	1.41
Vane Size		
m		

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.80	88.3	1.84
1.70	83.4	1.74
1.70	83.4	1.74
Average	1.73	85.0
		1.78

Failure Geometry

Sketch:

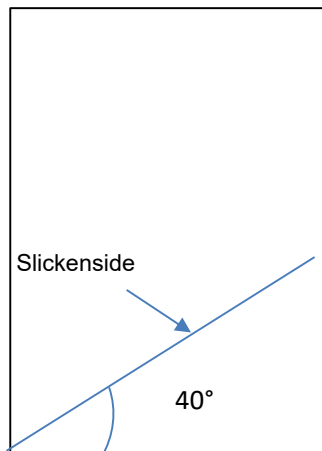
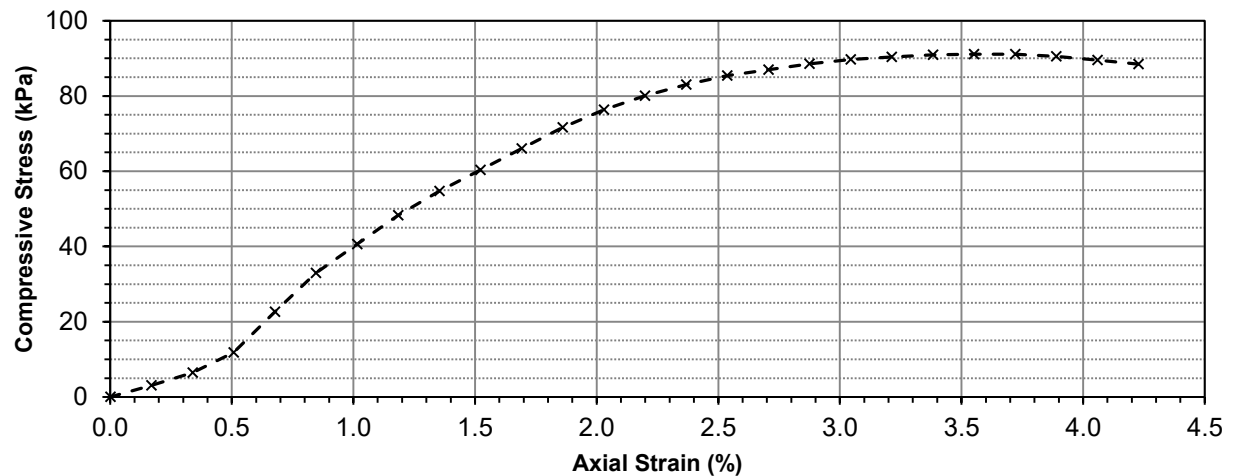


Photo:



Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.33	0.0000	0.00	0.004113	0.0	0.00	0.00
10	0.58	0.2540	0.17	0.004120	12.6	3.06	1.53
20	0.86	0.5080	0.34	0.004127	26.7	6.47	3.24
30	1.30	0.7620	0.51	0.004134	48.9	11.83	5.91
40	2.19	1.0160	0.68	0.004141	93.7	22.64	11.32
50	3.04	1.2700	0.85	0.004149	136.6	32.93	16.46
60	3.68	1.5240	1.01	0.004156	168.9	40.63	20.32
70	4.32	1.7780	1.18	0.004163	201.1	48.31	24.16
80	4.86	2.0320	1.35	0.004170	228.3	54.76	27.38
90	5.33	2.2860	1.52	0.004177	252.0	60.33	30.17
100	5.81	2.5400	1.69	0.004184	276.2	66.01	33.01
110	6.29	2.7940	1.86	0.004191	300.4	71.67	35.84
120	6.69	3.0480	2.03	0.004199	320.6	76.35	38.17
130	7.01	3.3020	2.20	0.004206	336.7	80.05	40.03
140	7.27	3.5560	2.37	0.004213	349.8	83.02	41.51
150	7.48	3.8100	2.54	0.004221	360.4	85.39	42.69
160	7.63	4.0640	2.71	0.004228	367.9	87.03	43.51
170	7.77	4.3180	2.87	0.004235	375.0	88.54	44.27
180	7.88	4.5720	3.04	0.004243	380.5	89.70	44.85
190	7.95	4.8260	3.21	0.004250	384.1	90.37	45.18
200	8.01	5.0800	3.38	0.004257	387.1	90.92	45.46
210	8.04	5.3340	3.55	0.004265	388.6	91.12	45.56
220	8.05	5.5880	3.72	0.004272	389.1	91.08	45.54
230	8.02	5.8420	3.89	0.004280	387.6	90.56	45.28

Unconfined Compression Test Data (cont'd)



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Unconfined Compressive Strength

ASTM D2166

Project No. 0336-003-00
Client Jacobs Canda Inc.
Project Armstrong Combined Sewer

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q _u (kPa)	Shear Stress, S _u (kPa)
240	7.95	6.0960	4.06	0.004287	384.1	89.58	44.79
250	7.87	6.3500	4.23	0.004295	380.0	88.48	44.24



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MEMORANDUM

Date	February 3, 2023
To	Tyson Roeland
From	Angela Fidler-Kliewer, TREK Geotechnical
Project No.	0336-003-00
Project	Armstrong Combined Sewer
Subject	Laboratory Testing Results – Lab Req. R23-021

Distribution	Michael Van Helden
---------------------	--------------------

Attached are the laboratory testing results for the above noted project. The testing included moisture content determinations and Atterberg Limits test results.

Regards,

Angela Fidler-Kliewer, C.Tech.

Review Control:

<i>Prepared By:</i> AD	<i>Reviewed By:</i> AD	<i>Checked By:</i> NJF
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CLIENT Jacobs Canada Inc.
PROJECT NAME Armstrong Combined Sewer

PROJECT NO: 0336-003-00
FIELD TECHNICIAN: Tyson Roeland

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILIARY TESTS	Soil Description/Comments
TH22-01	G16	0.0 - 0.5		X							
TH22-01	G17	3.5 - 4.0		X							
TH22-01	G18	6.0 - 6.5		X							
TH22-01	G19	7.0 - 7.5		X							
TH22-01	G20	11.0 - 11.5		X							
TH22-01	G21	14.0 - 14.5		X							
TH22-01	G22	17.0 - 17.5		X							
TH22-01	T23	20.0 - 22.0		X							
TH22-01	G24	24.0 - 24.5		X							
TH22-01	G25	26.0 - 26.5		X							
TH22-01	G26	28.0 - 28.5		X							
TH22-01	T27	30.0 - 32.0		X							
TH22-01	G28	34.0 - 34.5		X							
TH22-01	G29	37.0 - 37.5		X							
TH22-02	G01	0.0 - 0.5		X							
TH22-02	G02	2.0 - 2.5		X							
TH22-02	G03	4.5 - 5.0		X							
TH22-02	G04	6.0 - 6.5		X							
TH22-02	G05	8.0 - 8.5		X							
TH22-02	G06	11.0 - 11.5		X							
TH22-02	G07	13.0 - 13.5		X							
TH22-02	G08	16.0 - 16.5		X							
TH22-02	T09	20.0 - 22.0		X							
TH22-02	G10	24.0 - 24.5		X							
TH22-02	G11	28.0 - 28.5		X							
TH22-02	T12	30.0 - 32.0		X							
TH22-02	G13	33.0 - 33.5		X							
TH22-02	G14	36.0 - 36.5		X							
TH22-02	G15	39.0 - 39.5		X							

4 - Tube Moistures -

REQUESTED BY: Tyson Roeland REPORT TO: TR MVH
REQUISITION DATE: Jan 25 DATE REQUIRED: _____
COMMENTS: _____

REQUISITION NO.
R23-021

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

Sample Date 19-Jan-23
Test Date 30-Jan-23
Technician AD

Test Hole	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01
Depth (m)	0.0 - 0.2	0.9 - 1.2	1.8 - 2.0	2.1 - 2.3	3.4 - 3.5	4.3 - 4.4
Sample #	G16	G17	G18	G19	G20	G21
Tare ID	AB73	H66	AA10	AB54	AC25	E4
Mass of tare	6.7	8.3	6.6	6.7	6.7	8.7
Mass wet + tare	273.2	373.7	337.5	304.8	409.0	216.4
Mass dry + tare	205.1	271.8	256.1	245.8	274.4	146.1
Mass water	68.1	101.9	81.4	59.0	134.6	70.3
Mass dry soil	198.4	263.5	249.5	239.1	267.7	137.4
Moisture %	34.3%	38.7%	32.6%	24.7%	50.3%	51.2%

Test Hole	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01
Depth (m)	5.2 - 5.3	6.1 - 6.7	7.3 - 7.5	7.9 - 8.1	8.5 - 8.7	9.1 - 9.8
Sample #	G22	T23	G24	G25	G26	T27
Tare ID	D40	AB10	P03	Z93	AB46	AB22
Mass of tare	8.4	6.6	8.7	8.5	6.7	6.7
Mass wet + tare	230.5	417.8	283.9	171.1	302.8	341.7
Mass dry + tare	153.7	278.5	193.8	122.3	210.2	241.5
Mass water	76.8	139.3	90.1	48.8	92.6	100.2
Mass dry soil	145.3	271.9	185.1	113.8	203.5	234.8
Moisture %	52.9%	51.2%	48.7%	42.9%	45.5%	42.7%

Test Hole	TH22-01	TH22-01	TH22-02	TH22-02	TH22-02	TH22-02
Depth (m)	10.4 - 10.5	11.3 - 11.4	0.0 - 0.2	0.6 - 0.8	1.4 - 1.5	1.8 - 2.0
Sample #	G28	G29	G01	G02	G03	G04
Tare ID	H25	Z66	P08	N113	W47	P10
Mass of tare	8.4	8.3	8.9	8.9	8.8	8.7
Mass wet + tare	295.6	293.0	198.8	253.6	280.3	224.0
Mass dry + tare	198.9	201.1	146.0	191.8	212.3	178.0
Mass water	96.7	91.9	52.8	61.8	68.0	46.0
Mass dry soil	190.5	192.8	137.1	182.9	203.5	169.3
Moisture %	50.8%	47.7%	38.5%	33.8%	33.4%	27.2%



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Moisture Content Report ASTM D2216-10

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

Sample Date 19-Jan-23
Test Date 30-Jan-23
Technician AD

Test Hole	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02
Depth (m)	2.4 - 2.6	3.4 - 3.5	4.0 - 4.1	4.9 - 5.0	6.1 - 6.7	7.3 - 7.5
Sample #	G05	G06	G07	G08	T09	G10
Tare ID	H15	Z107	AB97	N97	K10	W42
Mass of tare	8.8	8.8	7.1	8.8	8.8	8.9
Mass wet + tare	266.8	178.9	336.0	411.5	301.5	296.2
Mass dry + tare	214.9	144.9	238.2	277.8	205.4	208.3
Mass water	51.9	34.0	97.8	133.7	96.1	87.9
Mass dry soil	206.1	136.1	231.1	269.0	196.6	199.4
Moisture %	25.2%	25.0%	42.3%	49.7%	48.9%	44.1%

Test Hole	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02	
Depth (m)	8.5 - 8.7	9.1 - 9.8	10.1 - 10.2	11.0 - 11.1	8.8 - 12.0	
Sample #	G11	T12	G13	G14	G15	
Tare ID	A107	AB27	Z18	P06	F17	
Mass of tare	8.9	7.1	9.0	8.9	8.8	
Mass wet + tare	261.3	399.4	281.5	225.2	258.3	
Mass dry + tare	180.5	263.6	189.7	157.8	191.3	
Mass water	80.8	135.8	91.8	67.4	67.0	
Mass dry soil	171.6	256.5	180.7	148.9	182.5	
Moisture %	47.1%	52.9%	50.8%	45.3%	36.7%	

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

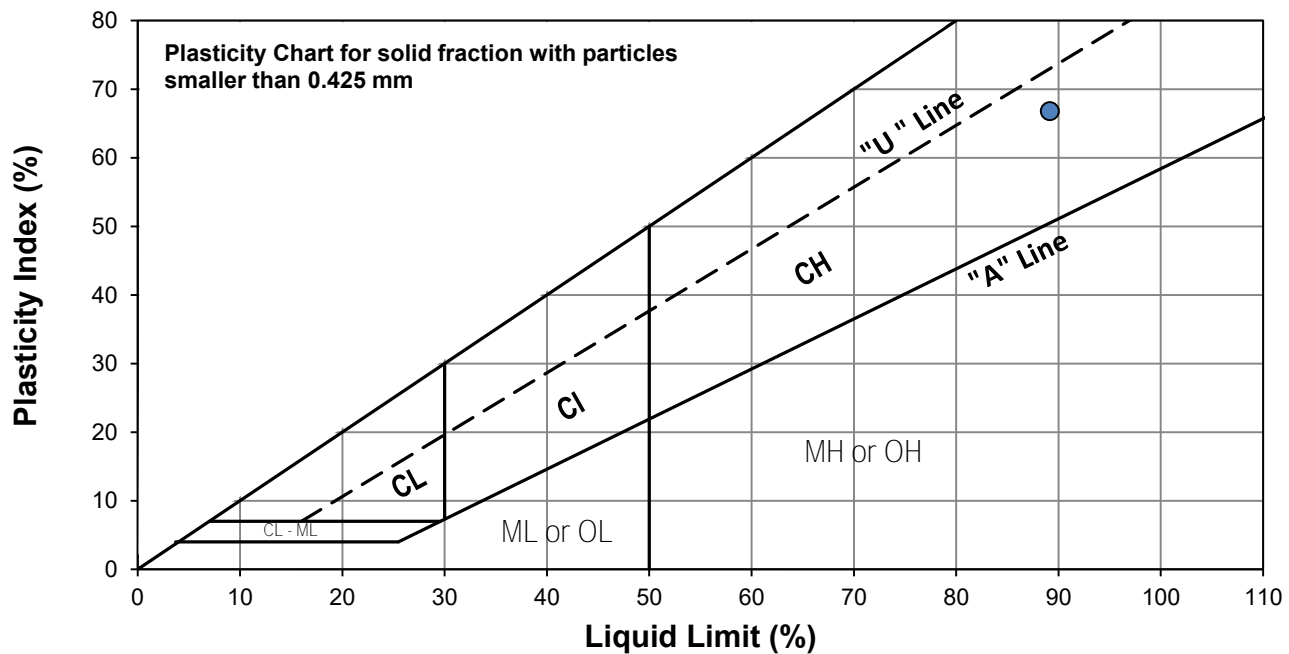
Test Hole TH22-02
Sample # G08
Depth (m) 4.9 - 5.0
Sample Date 19-Jan-23
Test Date 01-Feb-23
Technician AD



Liquid Limit	89
Plastic Limit	22
Plasticity Index	67

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	19	22	35		
Mass Tare (g)	14.173	13.902	14.092		
Mass Wet Soil + Tare (g)	23.040	23.396	24.100		
Mass Dry Soil + Tare (g)	18.813	18.896	19.451		
Mass Water (g)	4.227	4.500	4.649		
Mass Dry Soil (g)	4.640	4.994	5.359		
Moisture Content (%)	91.099	90.108	86.751		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.983	14.408			
Mass Wet Soil + Tare (g)	20.406	21.373			
Mass Dry Soil + Tare (g)	19.241	20.088			
Mass Water (g)	1.165	1.285			
Mass Dry Soil (g)	5.258	5.680			
Moisture Content (%)	22.157	22.623			

Note: Additional information recorded/measured for this test is available upon request.

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

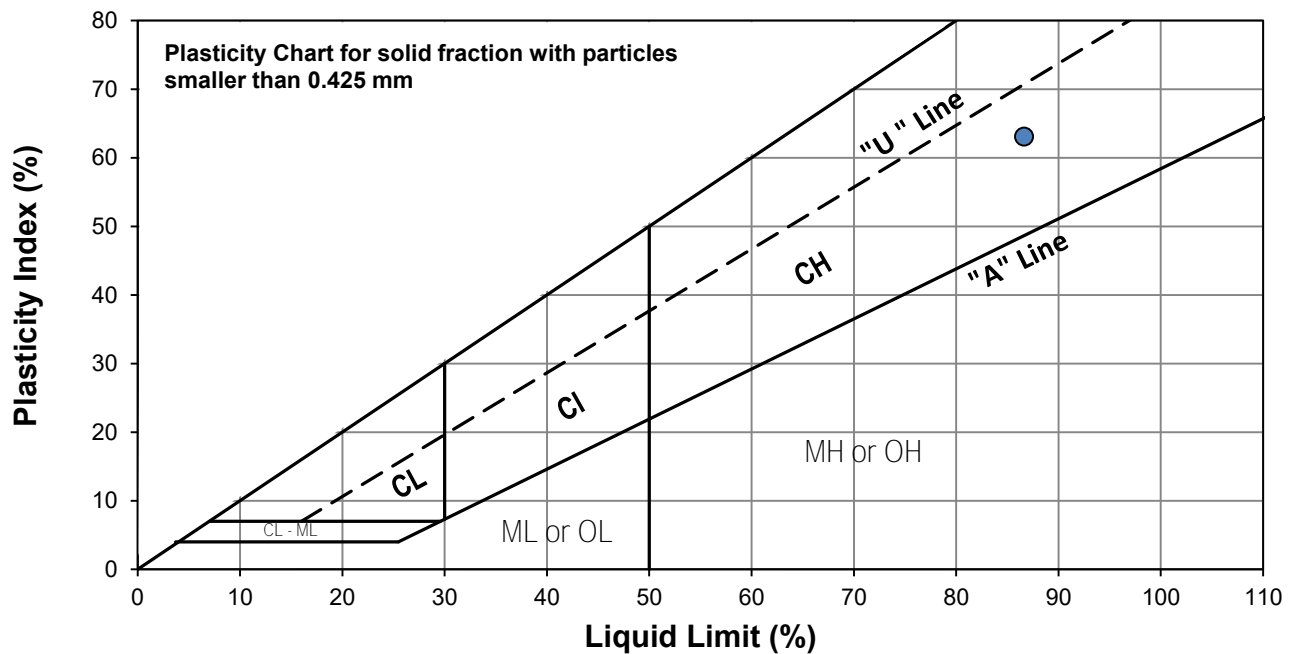
Test Hole TH22-01
Sample # G20
Depth (m) 3.4 - 3.5
Sample Date 19-Jan-23
Test Date 02-Feb-23
Technician AD



Liquid Limit	87
Plastic Limit	24
Plasticity Index	63

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	20	24	29		
Mass Tare (g)	14.039	14.108	13.963		
Mass Wet Soil + Tare (g)	24.127	23.279	24.699		
Mass Dry Soil + Tare (g)	19.408	19.013	19.744		
Mass Water (g)	4.719	4.266	4.955		
Mass Dry Soil (g)	5.369	4.905	5.781		
Moisture Content (%)	87.893	86.972	85.712		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.947	13.885			
Mass Wet Soil + Tare (g)	20.511	20.929			
Mass Dry Soil + Tare (g)	19.243	19.604			
Mass Water (g)	1.268	1.325			
Mass Dry Soil (g)	5.296	5.719			
Moisture Content (%)	23.943	23.168			

Note: Additional information recorded/measured for this test is available upon request.

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

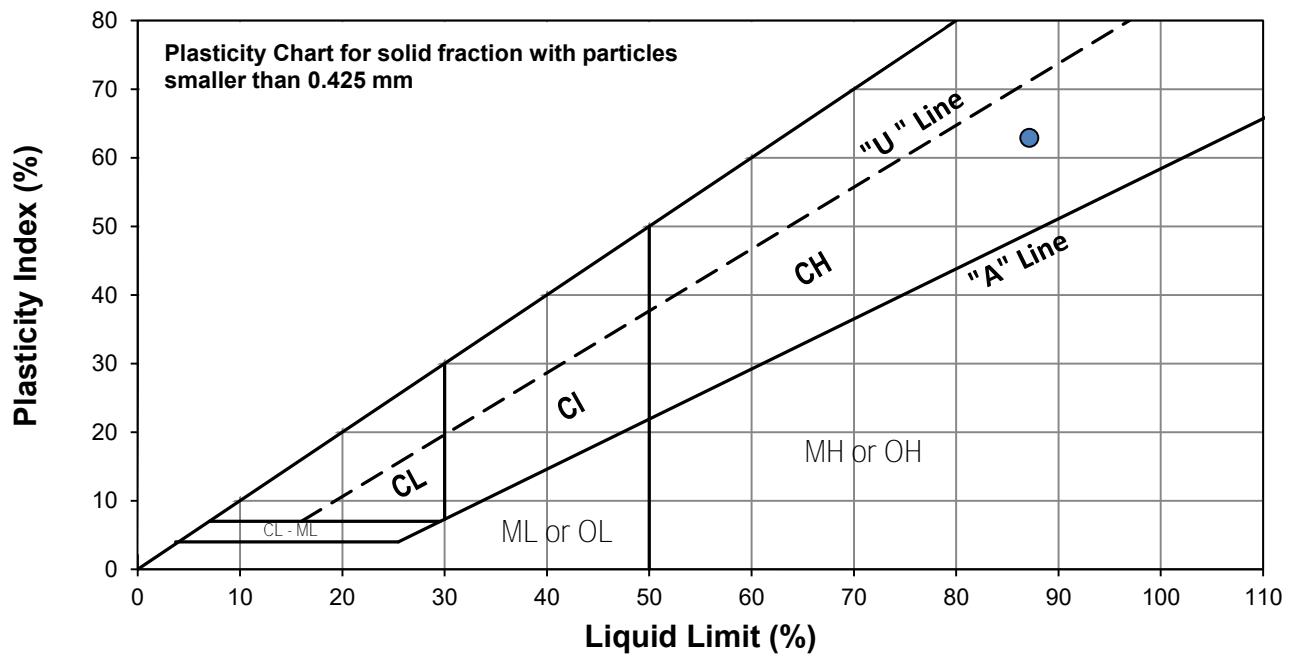
Test Hole TH22-02
Sample # T12
Depth (m) 9.1 - 9.8
Sample Date 19-Jan-23
Test Date 01-Feb-23
Technician KF



Liquid Limit	87
Plastic Limit	24
Plasticity Index	63

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	22	28	31		
Mass Tare (g)	14.026	13.826	14.039		
Mass Wet Soil + Tare (g)	22.263	22.511	20.368		
Mass Dry Soil + Tare (g)	18.420	18.473	17.432		
Mass Water (g)	3.843	4.038	2.936		
Mass Dry Soil (g)	4.394	4.647	3.393		
Moisture Content (%)	87.460	86.895	86.531		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.946	14.197			
Mass Wet Soil + Tare (g)	19.571	22.657			
Mass Dry Soil + Tare (g)	18.476	20.999			
Mass Water (g)	1.095	1.658			
Mass Dry Soil (g)	4.530	6.802			
Moisture Content (%)	24.172	24.375			

Note: Additional information recorded/measured for this test is available upon request.

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

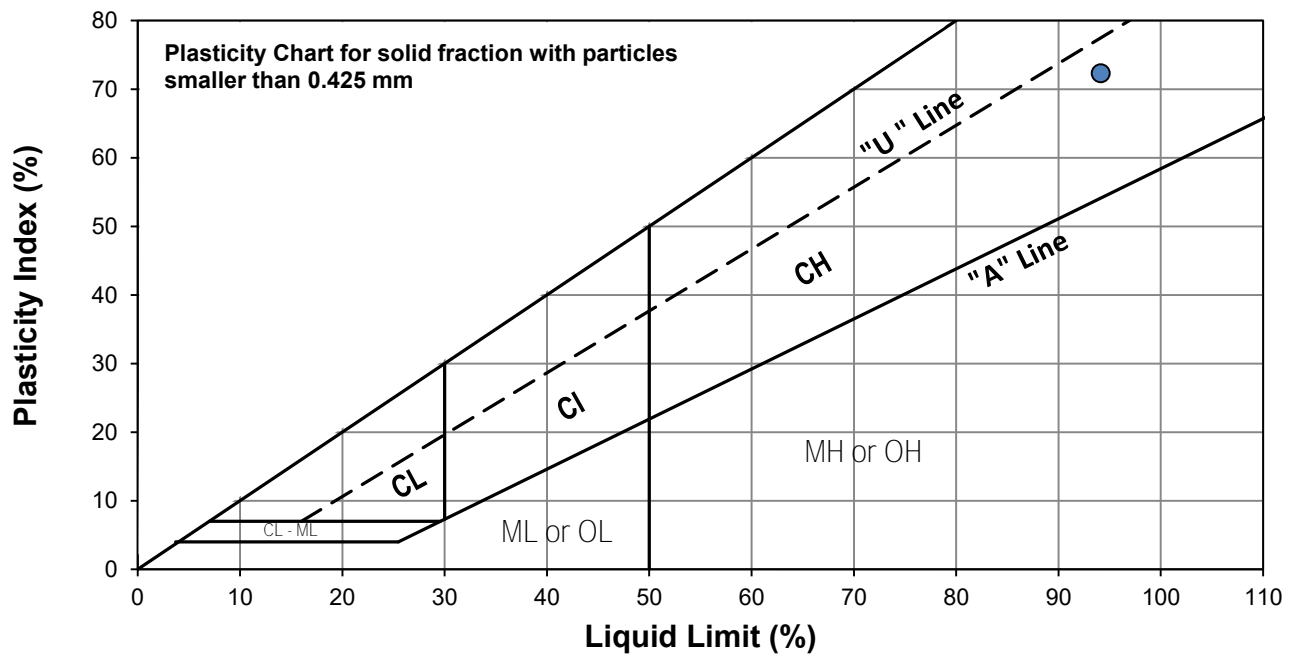
Test Hole TH22-01
Sample # T23
Depth (m) 6.1 - 6.7
Sample Date 19-Jan-23
Test Date 02-Feb-23
Technician MT



Liquid Limit	94
Plastic Limit	22
Plasticity Index	72

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	20	23	31		
Mass Tare (g)	13.933	14.243	14.077		
Mass Wet Soil + Tare (g)	26.008	26.925	25.690		
Mass Dry Soil + Tare (g)	20.089	20.752	20.119		
Mass Water (g)	5.919	6.173	5.571		
Mass Dry Soil (g)	6.156	6.509	6.042		
Moisture Content (%)	96.150	94.838	92.205		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.036	14.369			
Mass Wet Soil + Tare (g)	20.695	20.384			
Mass Dry Soil + Tare (g)	19.514	19.294			
Mass Water (g)	1.181	1.090			
Mass Dry Soil (g)	5.478	4.925			
Moisture Content (%)	21.559	22.132			

Note: Additional information recorded/measured for this test is available upon request.

MEMORANDUM

Date March 3, 2023
To Tyson Roeland
From Angela Fidler-Kliwer, TREK Geotechnical
Project No. 0336-003-00
Project Armstrong Combined Sewer
Subject Laboratory Testing Results – Lab Req. R23-038

Distribution Michael Van Helden

Please see the attached Hydraulic conductivity test results for samples T09 and T23 using a flexible wall permeameter following ASTM D5080-16.

The test report for the sample is attached showing the calculated hydraulic conductivity values corrected to 20°C are as follows:

Sample T09 1.03E-10 m/s (1.03 x 10⁻⁸ cm/s)

Sample T23 2.03E-10 m/s (2.03 x 10⁻⁸ cm/s)

The services undertaken by TREK on this assignment constitutes testing services only and engineering evaluation or interpretation has not been undertaken but is available upon request.

Regards,

Angela Fidler-Kliwer, C.Tech.

Review Control:

Prepared By: AFK	Reviewed By: AFK	Checked By: NJF
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Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined

Test Hole TH23-02
Trek Sample # ST2
Depth (m) 6.17 to 6.78
Sample Date 19-Jan-23
Test Date February 17, 2023 to March 2, 2023
Technician Angela Fidler-Kliewer

Specimen Details

Visual Clay, silty trace silt inclusions (<10 mm diam.), grey, moist, stiff to v. stiff, high plasticity.

Classification

Comments The specific gravity of the soil was assumed to be 2.85.

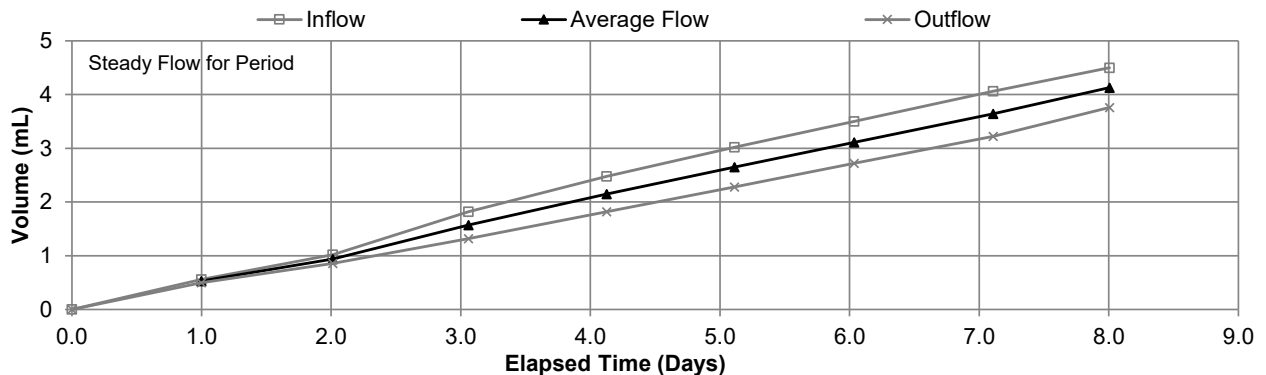
Index Testing

Liquid Limit not requested
Plastic Limit not requested
Plasticity Index not requested
Clay Content (%) not requested

Test Details

Permeant Distilled, de-aired water
Method Constant Rate
Cell Pressure 124.1 kPa
Influent Pressure 97.0 kPa
Effluent Pressure 84.6 kPa
Gradient 12.87

Permeation Graph



Steady Flow Permeation Data

Time Increment (Days)	Elapsed Time (Days)	Flow (Q)		Inflow / Outflow Ratio	Average Flow (mL)	Temperature Correction	Corrected Hydraulic Conductivity, k_{20} (m/s)
		Influent (mL)	Effluent (mL)				
0.99	5.11	3.02	2.28	1.17	0.50	1.00	1.01E-10
0.92	6.03	3.50	2.72	1.09	0.46	0.99	9.91E-11
1.07	7.11	4.06	3.22	1.12	0.53	1.01	1.01E-10
0.90	8.01	4.50	3.76	0.81	0.49	1.01	1.11E-10

Average Temperature Corrected Hydraulic Conductivity, k_{20} (m/s) 1.03E-10 (1.03x10⁻⁸ cm/s)

Consolidation Data

	Average Height (m)	Average Diameter (m)	Moisture Content (%)	Dry Density (kN/m ³)	Degree of Saturation (%)	Cell Pressure	Back Pressure
Initial	0.1004	0.0729	55.9	10.9	101.9	118.9	85.0
Final	0.1012	0.0724	56.8	11.0	105.6	119.3	84.4

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined

Test Hole TH23-01
Trek Sample # ST2
Depth (m) 6.17 to 6.78
Sample Date 19-Jan-23
Test Date February 17, 2023
Technician Angela Fidler-Kliewer

Specimen Details

Visual Clay, silty, trace silt inclusions (<5mm diam.), grey, moist, stiff, high plasticity.

Classification

Comments The specific gravity of the soil was assumed to be 2.85.

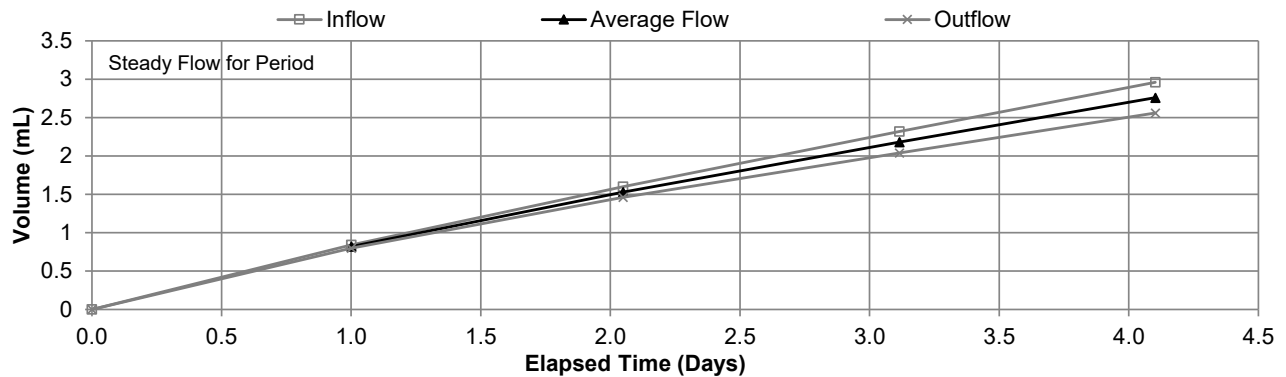
Index Testing

Liquid Limit not requested
Plastic Limit not requested
Plasticity Index not requested
Clay Content (%) not requested

Test Details

Permeant Distilled, de-aired water
Method Constant Rate
Cell Pressure 125.3 kPa
Influent Pressure 93.7 kPa
Effluent Pressure 84.4 kPa
Gradient 9.38

Permeation Graph



Steady Flow Permeation Data

Time Increment (Days)	Elapsed Time (Days)	Flow (Q)		Inflow / Outflow Ratio	Average Flow (mL)	Temperature Correction	Corrected Hydraulic Conductivity, k_{20} (m/s)
		Influent (mL)	Effluent (mL)				
1.00	1.00	0.84	0.80	1.05	0.82	1.00	2.42E-10
1.05	2.05	1.60	1.46	1.15	0.71	1.01	2.03E-10
1.07	3.12	2.32	2.04	1.24	0.65	1.04	1.83E-10
0.99	4.10	2.96	2.56	1.23	0.58	1.03	1.83E-10

Average Temperature Corrected Hydraulic Conductivity, k_{20} (m/s) 2.03E-10 (2.03x10⁻⁸ cm/s)

Consolidation Data

	Average Height (m)	Average Diameter (m)	Moisture Content (%)	Dry Density (kN/m ³)	Degree of Saturation (%)	Cell Pressure	Back Pressure
Initial	0.1000	0.0723	49.3	11.5	97.7	119.9	84.8
Final	0.1008	0.0728	51.9	11.2	98.5	118.9	83.8



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MEMORANDUM

Date	March 8, 2023
To	Tyson Roeland
From	Angela Fidler-Kliewer, TREK Geotechnical
Project No.	0336-003-00
Project	Armstrong Combined Sewer
Subject	Laboratory Testing Results – Lab Req. R23-057

Distribution	Michael Van Helden
---------------------	--------------------

Attached are the laboratory testing results for the above noted project. The testing included Atterberg Limits and grain size analysis (Hydrometer method) test results.

Regards,

Angela Fidler-Kliewer, C.Tech.

Review Control:

<i>Prepared By: AD</i>	<i>Reviewed By: AFK</i>	<i>Checked By: NJF</i>
------------------------	-------------------------	------------------------

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

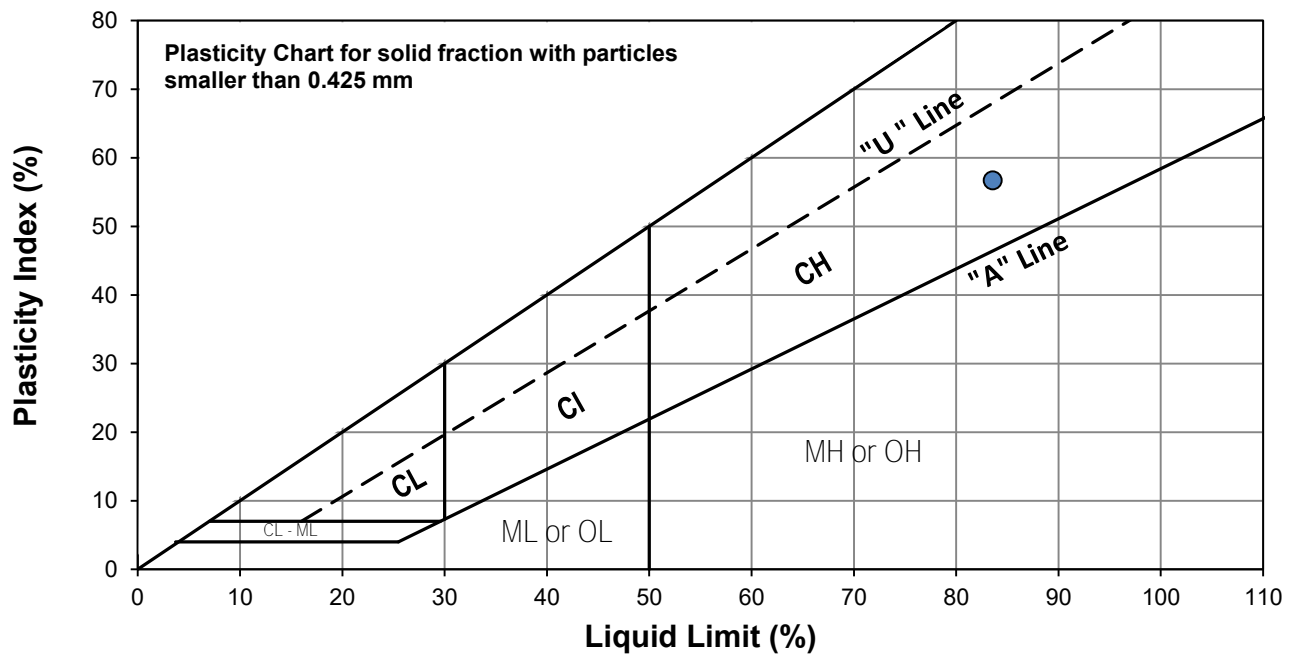
Test Hole TH23-02
Sample # T09
Depth (m) 6.1 - 6.7
Sample Date 27-Feb-23
Test Date 06-Mar-23
Technician KM



Liquid Limit	84
Plastic Limit	27
Plasticity Index	57

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	15	23	33		
Mass Tare (g)	13.907	13.913	14.075		
Mass Wet Soil + Tare (g)	28.498	27.589	27.102		
Mass Dry Soil + Tare (g)	21.723	21.349	21.232		
Mass Water (g)	6.775	6.240	5.870		
Mass Dry Soil (g)	7.816	7.436	7.157		
Moisture Content (%)	86.681	83.916	82.018		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.209	14.057			
Mass Wet Soil + Tare (g)	19.583	20.057			
Mass Dry Soil + Tare (g)	18.440	18.788			
Mass Water (g)	1.143	1.269			
Mass Dry Soil (g)	4.231	4.731			
Moisture Content (%)	27.015	26.823			

Note: Additional information recorded/measured for this test is available upon request.

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

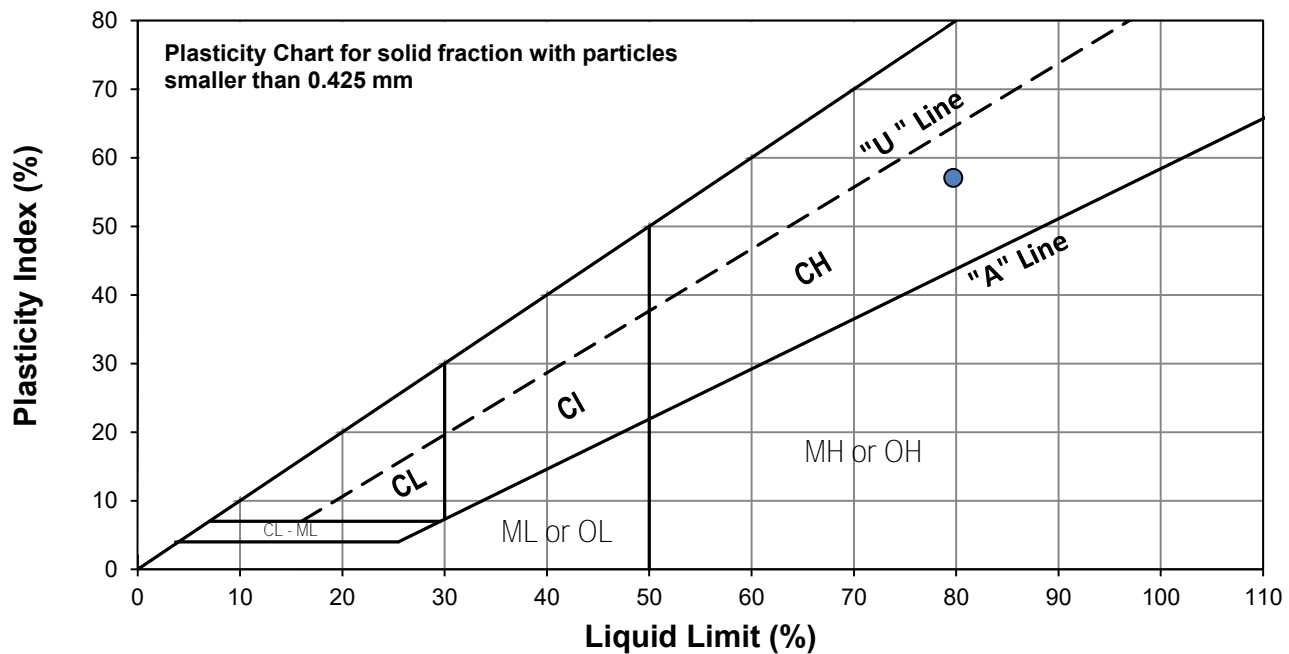
Test Hole TH23-01
Sample # T23
Depth (m) 6.1 - 6.7
Sample Date 27-Feb-23
Test Date 06-Mar-23
Technician AD



Liquid Limit	80
Plastic Limit	23
Plasticity Index	57

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	24	32		
Mass Tare (g)	14.060	13.950	13.957		
Mass Wet Soil + Tare (g)	24.718	23.505	23.851		
Mass Dry Soil + Tare (g)	19.915	19.264	19.505		
Mass Water (g)	4.803	4.241	4.346		
Mass Dry Soil (g)	5.855	5.314	5.548		
Moisture Content (%)	82.032	79.808	78.335		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.948	14.323			
Mass Wet Soil + Tare (g)	21.477	22.417			
Mass Dry Soil + Tare (g)	20.078	20.930			
Mass Water (g)	1.399	1.487			
Mass Dry Soil (g)	6.130	6.607			
Moisture Content (%)	22.822	22.506			

Note: Additional information recorded/measured for this test is available upon request.



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Moisture Content Report ASTM D2216-98

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong combined Sewer - Rail Crossings

Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Test Hole	TH24-01	TH24-01	TH24-01	TH24-01	TH24-01	TH24-01
Depth (m)	0.6 - 0.9	0.9 - 1.2	1.5 - 1.8	2.3 - 2.4	2.6 - 2.7	3.8 - 4.0
Sample #	G01	G02	G03	G04	G05	G06
Tare ID	C6	N48	F91	F152	H29	K9
Mass of tare	8.6	8.4	8.4	8.4	8.4	8.6
Mass wet + tare	260.6	153.8	195.6	240.0	178.6	194.0
Mass dry + tare	225.6	126.6	164.6	197.9	145.2	131.6
Mass water	35.0	27.2	31.0	42.1	33.4	62.4
Mass dry soil	217.0	118.2	156.2	189.5	136.8	123.0
Moisture %	16.1%	23.0%	19.8%	22.2%	24.4%	50.7%

Test Hole	TH24-01	TH24-01	TH24-01	TH24-01	TH24-01	TH24-01
Depth (m)	6.1 - 6.4	8.5 - 8.8	10.5 - 10.7	12.0 - 12.2	13.6 - 13.7	15.1 - 15.2
Sample #	G08	G10	G12	G13	G14	G15
Tare ID	Z21	Z118	Z66	E135	H74	C19
Mass of tare	8.6	8.4	8.4	8.6	8.6	8.6
Mass wet + tare	151.2	135.9	438.2	166.2	158.8	148.4
Mass dry + tare	101.6	94.4	301.6	115.4	111.6	95.8
Mass water	49.6	41.5	136.6	50.8	47.2	52.6
Mass dry soil	93.0	86.0	293.2	106.8	103.0	87.2
Moisture %	53.3%	48.3%	46.6%	47.6%	45.8%	60.3%

Test Hole	TH24-01	TH24-02	TH24-02	TH24-02	TH24-02	TH24-03
Depth (m)	15.8 - 16.2	1.4 - 1.5	2.9 - 3.0	5.9 - 6.1	7.5 - 7.6	1.4 - 1.5
Sample #	G16	G17	G18	G20	G21	G23
Tare ID	W50	K7	Z32	J74	W73	M14
Mass of tare	9.0	8.6	8.8	7.0	8.6	7.0
Mass wet + tare	300.8	218.8	262.0	170.4	226.4	193.2
Mass dry + tare	268.4	171.0	215.0	112.6	154.0	152.8
Mass water	32.4	47.8	47.0	57.8	72.4	40.4
Mass dry soil	259.4	162.4	206.2	105.6	145.4	145.8
Moisture %	12.5%	29.4%	22.8%	54.7%	49.8%	27.7%



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Moisture Content Report ASTM D2216-98

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong combined Sewer - Rail Crossings

Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Test Hole	TH24-03	TH24-03	TH24-03	TH24-03	TH24-04	TH24-04
Depth (m)	2.9 - 3.0	4.6 - 4.7	7.5 - 7.6	9.0 - 9.1	0.6 - 0.9	0.9 - 1.2
Sample #	G24	G25	G27	G28	G29	G30
Tare ID	N43	N53	Z85	W76	W106	N71
Mass of tare	8.4	8.6	8.3	8.6	8.4	8.6
Mass wet + tare	227.2	412.6	153.4	201.8	225.4	202.2
Mass dry + tare	182.6	275.4	110.4	142.2	210.4	178.2
Mass water	44.6	137.2	43.0	59.6	15.0	24.0
Mass dry soil	174.2	266.8	102.1	133.6	202.0	169.6
Moisture %	25.6%	51.4%	42.1%	44.6%	7.4%	14.2%

Test Hole	TH24-04	TH24-04	TH24-04	TH24-04	TH24-04	TH24-04
Depth (m)	1.5 - 1.8	2.3 - 2.4	2.6 - 2.7	4.3 - 4.6	7.6 - 7.9	9.1 - 9.4
Sample #	G31	G32	G33	G34	G36	G37
Tare ID	W15	W45	A100	D20	W20	AC02
Mass of tare	8.4	8.4	8.4	8.8	8.4	6.8
Mass wet + tare	213.0	219.4	174.0	187.8	148.8	161.6
Mass dry + tare	173.2	173.4	128.2	134.4	103.2	109.6
Mass water	39.8	46.0	45.8	53.4	45.6	52.0
Mass dry soil	164.8	165.0	119.8	125.6	94.8	102.8
Moisture %	24.2%	27.9%	38.2%	42.5%	48.1%	50.6%

Test Hole	TH24-04	TH24-04	TH24-04	TH24-04		
Depth (m)	12.2 - 12.5	13.7 - 14.0	15.2 - 15.5	15.8 - 16.2		
Sample #	G39	G40	G41	G42		
Tare ID	Q69	J94	F18	E56		
Mass of tare	6.8	7.0	6.8	6.8		
Mass wet + tare	143.0	147.6	217.6	169.2		
Mass dry + tare	100.8	109.0	144.6	148.8		
Mass water	42.2	38.6	73.0	20.4		
Mass dry soil	94.0	102.0	137.8	142.0		
Moisture %	44.9%	37.8%	53.0%	14.4%		

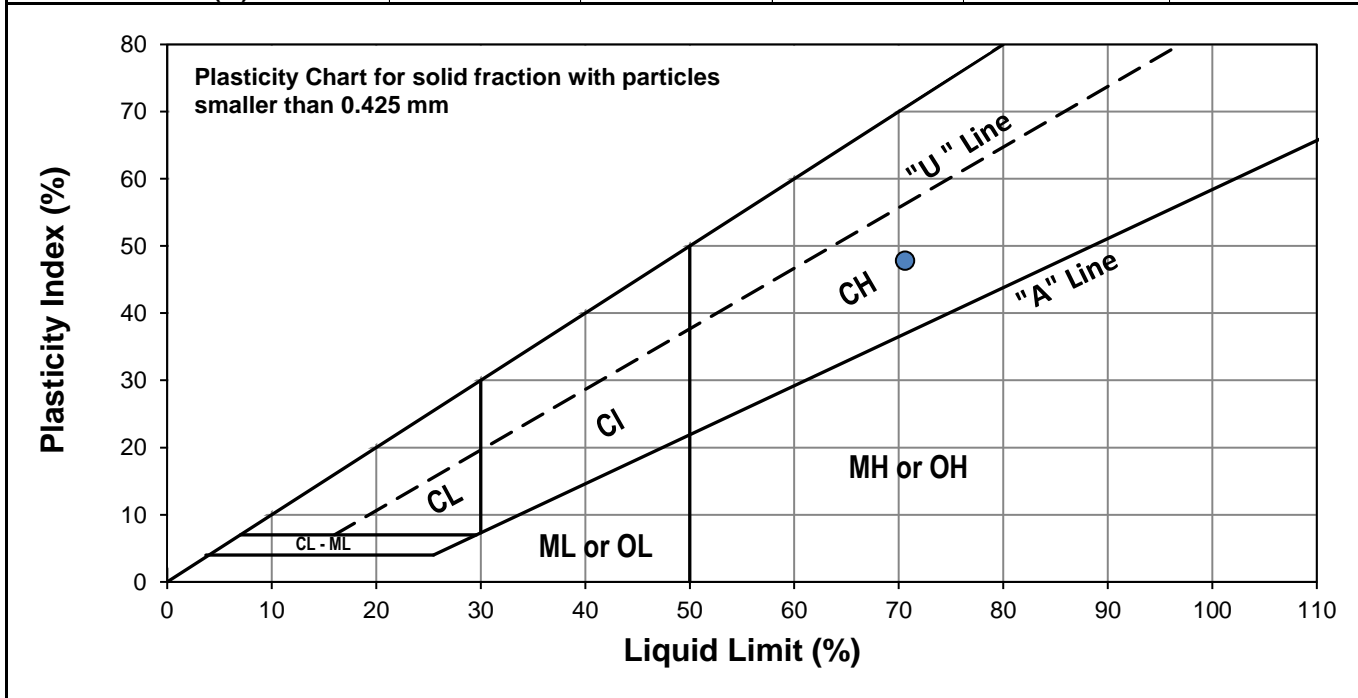
Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer
Test Hole TH24-01
Sample # G12
Depth (m) 10.5 - 10.7
Sample Date 01-Feb-24
Test Date 16-Feb-24
Technician KF



Liquid Limit 71
Plastic Limit 23
Plasticity Index 48

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	22	26		
Mass Tare (g)	14.141	13.988	14.182		
Mass Wet Soil + Tare (g)	23.264	23.749	23.213		
Mass Dry Soil + Tare (g)	19.419	19.687	19.482		
Mass Water (g)	3.845	4.062	3.731		
Mass Dry Soil (g)	5.278	5.699	5.300		
Moisture Content (%)	72.850	71.276	70.396		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.087	14.226			
Mass Wet Soil + Tare (g)	25.216	26.170			
Mass Dry Soil + Tare (g)	23.154	23.953			
Mass Water (g)	2.062	2.217			
Mass Dry Soil (g)	9.067	9.727			
Moisture Content (%)	22.742	22.792			

Note: Additional information recorded/measured for this test is available upon request.

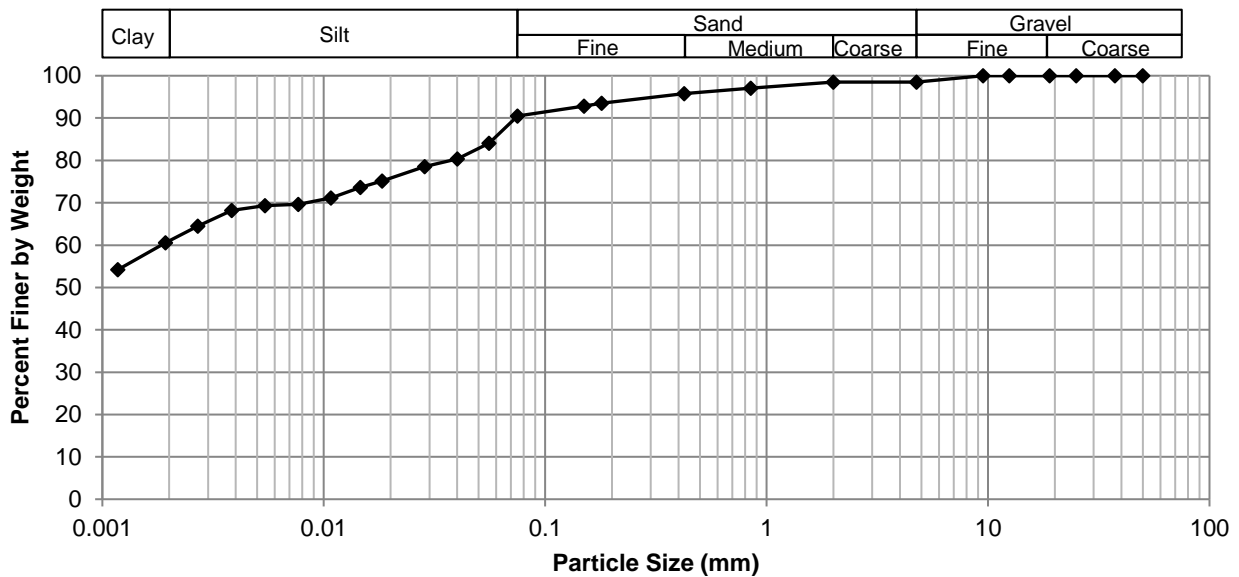
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Client Jacobs Canada
Project Armstrong Combined Sewer



Test Hole TH24-01
Sample # G12
Depth (m) 10.5 - 10.7
Sample Date 1-Feb-24
Test Date 20-Feb-24
Technician DS

Gravel	1.5%
Sand	8.0%
Silt	29.6%
Clay	60.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	98.48	0.0750	90.51
37.5	100.00	2.00	98.47	0.0558	84.09
25.0	100.00	0.850	97.09	0.0401	80.40
19.0	100.00	0.425	95.76	0.0286	78.55
12.5	100.00	0.180	93.51	0.0184	75.16
9.50	100.00	0.150	92.85	0.0146	73.62
4.75	98.48	0.075	90.51	0.0108	71.16
				0.0077	69.62
				0.0054	69.35
				0.0038	68.18
				0.0027	64.52
				0.0019	60.58
				0.0012	54.23

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

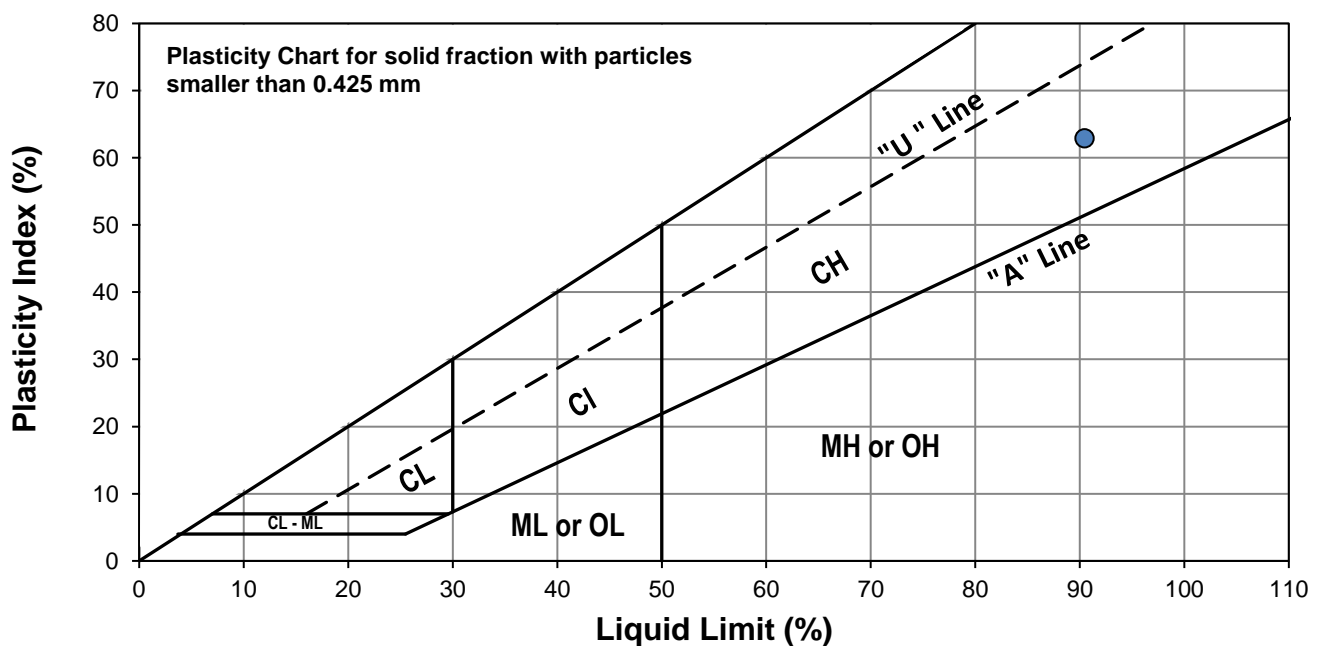
Test Hole TH24-03
Sample # G25
Depth (m) 4.6 - 4.7
Sample Date 01-Feb-24
Test Date 16-Feb-24
Technician DS



Liquid Limit 90
Plastic Limit 28
Plasticity Index 63

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	19	22	34		
Mass Tare (g)	14.041	14.153	14.119		
Mass Wet Soil + Tare (g)	23.298	22.857	23.700		
Mass Dry Soil + Tare (g)	18.832	18.693	19.233		
Mass Water (g)	4.466	4.164	4.467		
Mass Dry Soil (g)	4.791	4.540	5.114		
Moisture Content (%)	93.216	91.718	87.348		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.071	14.061			
Mass Wet Soil + Tare (g)	21.493	21.524			
Mass Dry Soil + Tare (g)	19.897	19.904			
Mass Water (g)	1.596	1.620			
Mass Dry Soil (g)	5.826	5.843			
Moisture Content (%)	27.394	27.725			

Note: Additional information recorded/measured for this test is available upon request.

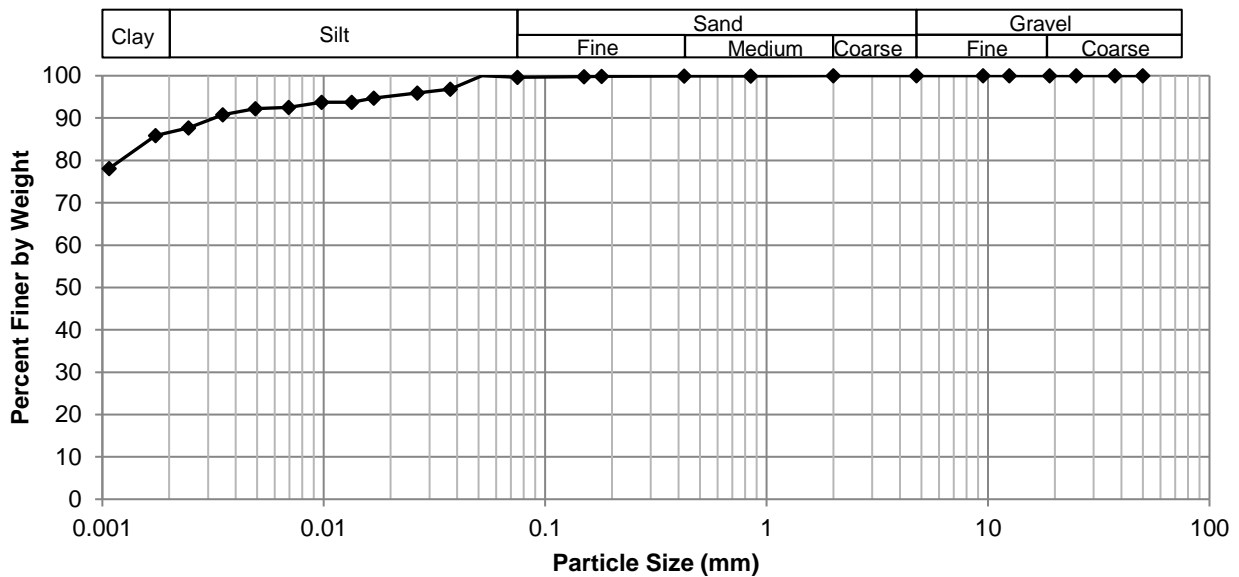
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Client Jacobs Canada
Project Armstrong Combined Sewer



Test Hole TH24-03
Sample # G25
Depth (m) 4.6 - 4.7
Sample Date 1-Feb-24
Test Date 20-Feb-24
Technician DS

Gravel	0.0%
Sand	0.3%
Silt	13.1%
Clay	86.5%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	100.00	0.0750	99.65
37.5	100.00	2.00	100.00	0.0518	100.00
25.0	100.00	0.850	99.95	0.0373	96.87
19.0	100.00	0.425	99.90	0.0265	95.94
12.5	100.00	0.180	99.84	0.0169	94.69
9.50	100.00	0.150	99.82	0.0134	93.75
4.75	100.00	0.075	99.65	0.0098	93.75
				0.0070	92.50
				0.0049	92.23
				0.0035	90.76
				0.0025	87.68
				0.0017	85.90
				0.0011	78.11



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-01
Sample # T07
Depth (m) 4.6 - 5.2
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	500			
Bottom				Top
5.07 m	4.97 m	4.80 m	4.63 m	4.57 m
Moisture Content PP/TV Visual	Bulk Qu	Keep	Toss	
100 mm	170 mm	170 mm	60 mm	

Visual Classification

Material	CLAY
Composition	silty
trace precipitates (sulphates, seams, <15mm thick)	
trace precipitates (sulphates, inclusions, <5mm diam.)	
trace oxidation	
Color	grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	stratified (black and grey clay, <8mm thick)
Gradation	-

Torvane

Reading	0.75
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	73.6

Pocket Penetrometer

Reading	1	1.80
	2	1.80
	3	2.00
	Average	1.87
Undrained Shear Strength (kPa)		91.5

Moisture Content

Tare ID	E13
Mass tare (g)	6.8
Mass wet + tare (g)	318.0
Mass dry + tare (g)	212.6
Moisture %	51.2%

Unit Weight

Bulk Weight (g)		1089.8
Length (mm)	1	150.78
	2	150.91
	3	151.23
	4	151.00
Average Length (m)		0.151
Diam. (mm)	1	72.88
	2	73.21
	3	72.98
	4	72.90
Average Diameter (m)		0.073

Volume (m³)	6.32E-04
Bulk Unit Weight (kN/m³)	16.9
Bulk Unit Weight (pcf)	107.7
Dry Unit Weight (kN/m³)	11.2
Dry Unit Weight (pcf)	71.2

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-01
Sample # T07
Depth (m) 4.6 - 5.2
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	97.6	2.0
Max S_u	48.8	1.0

Specimen Data

Description CLAY - silty, trace precipitates (sulphates, seams, <15mm thick), trace precipitates (sulphates, inclusions, <5mm diam.), trace oxidation, grey, moist, stiff, high plasticity, stratified (black and grey clay, <8mm thick)

Length 151.0 (mm)
Diameter 73.0 (mm)
L/D Ratio 2.1
Initial Area 0.00418 (m²)
Load Rate 1.00 (%/min)

Moisture % 51%
Bulk Unit Wt. 16.9 (kN/m³)
Dry Unit Wt. 11.2 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.75	73.6	1.54
Vane Size		
m	91.5	1.91

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.80	88.3	1.84
1.80	88.3	1.84
2.00	98.1	2.05
Average	1.87	91.6
		1.91

Failure Geometry

Sketch:

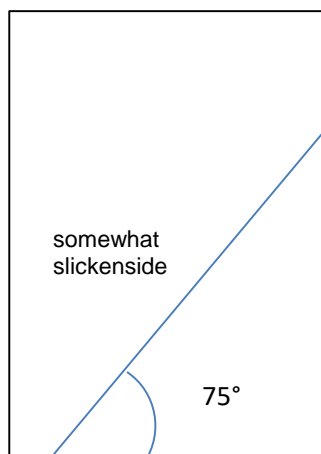
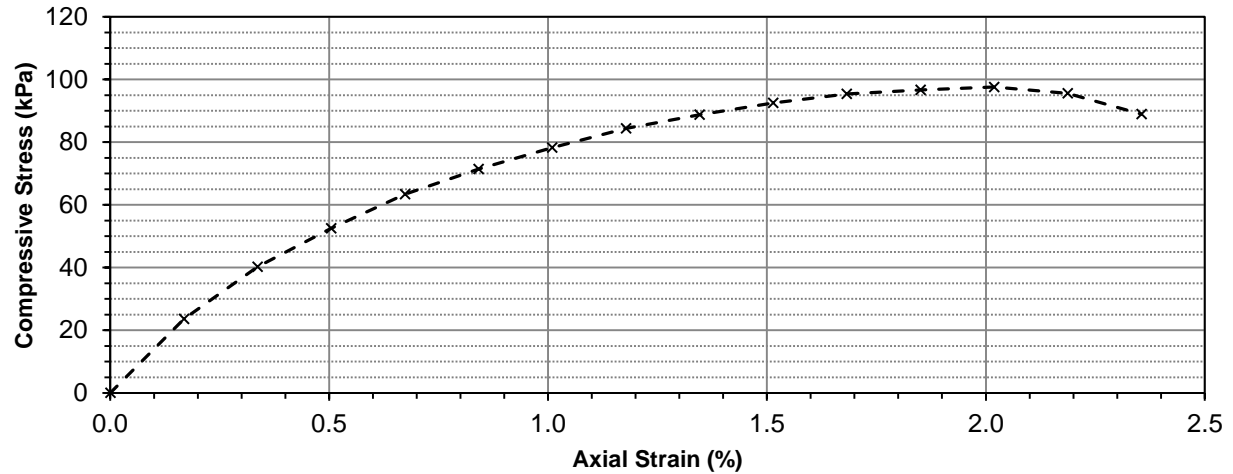


Photo:



Project No. 0336-003-00
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Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.74	0.0000	0.00	0.004185	0.0	0.00	0.00
10	2.70	0.2540	0.17	0.004192	98.8	23.57	11.78
20	4.09	0.5080	0.34	0.004199	168.9	40.22	20.11
30	5.12	0.7620	0.50	0.004206	220.8	52.49	26.25
40	6.04	1.0160	0.67	0.004213	267.1	63.41	31.70
50	6.72	1.2700	0.84	0.004220	301.4	71.42	35.71
60	7.30	1.5240	1.01	0.004227	330.6	78.22	39.11
70	7.83	1.7780	1.18	0.004234	357.4	84.39	42.20
80	8.21	2.0320	1.35	0.004242	376.5	88.77	44.38
90	8.54	2.2860	1.51	0.004249	393.1	92.53	46.26
100	8.79	2.5400	1.68	0.004256	405.7	95.33	47.67
110	8.92	2.7940	1.85	0.004263	412.3	96.71	48.35
120	9.01	3.0480	2.02	0.004271	416.8	97.60	48.80
130	8.85	3.3020	2.19	0.004278	408.8	95.55	47.77
140	8.30	3.5560	2.36	0.004285	381.0	88.92	44.46



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-01
Sample # T11
Depth (m) 9.1 - 9.8
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	490			
Bottom				
9.63 m	9.54 m	9.37 m	9.20 m	Top 9.14 m
Moisture Content PP/TV Visual	Bulk Qu	Keep	Toss	
90 mm	170 mm	170 mm	60 mm	

Visual Classification

Material	CLAY
Composition	silty
trace gravel (<10mm diam.)	
trace silt inclusions (<5mm diam.)	
Color	grey
Moisture	moist
Consistency	firm to stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.50
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	49.0

Pocket Penetrometer

Reading	1	1.20
	2	1.20
	3	1.20
	Average	1.20
Undrained Shear Strength (kPa)		58.8

Moisture Content

Tare ID	J68
Mass tare (g)	7.0
Mass wet + tare (g)	279.6
Mass dry + tare (g)	195.2
Moisture %	44.8%

Unit Weight

Bulk Weight (g)		1102.2
Length (mm)	1	150.04
	2	149.91
	3	149.83
	4	149.56
Average Length (m)		0.150
Diam. (mm)	1	73.01
	2	72.60
	3	72.24
	4	72.35
Average Diameter (m)		0.073

Volume (m³)	6.19E-04
Bulk Unit Weight (kN/m³)	17.5
Bulk Unit Weight (pcf)	111.1
Dry Unit Weight (kN/m³)	12.0
Dry Unit Weight (pcf)	76.7

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-01
Sample # T11
Depth (m) 9.1 - 9.8
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	151.8	3.2
Max S_u	75.9	1.6

Specimen Data

Description CLAY - silty, trace gravel (<10mm diam.), trace silt inclusions (<5mm diam.), grey, moist, firm to stiff, high plasticity

Length 149.8 (mm)
Diameter 72.6 (mm)
L/D Ratio 2.1
Initial Area 0.00413 (m²)
Load Rate 1.00 (%/min)

Moisture % 45%
Bulk Unit Wt. 17.5 (kN/m³)
Dry Unit Wt. 12.0 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.50	49.0	1.02
Vane Size		
m	58.8	1.23

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.20	58.9	1.23
1.20	58.9	1.23
1.20	58.9	1.23
Average	1.20	58.9
		1.23

Failure Geometry

Sketch:

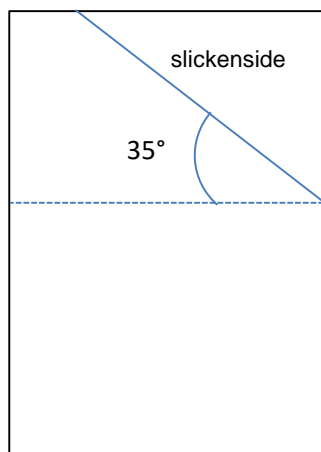
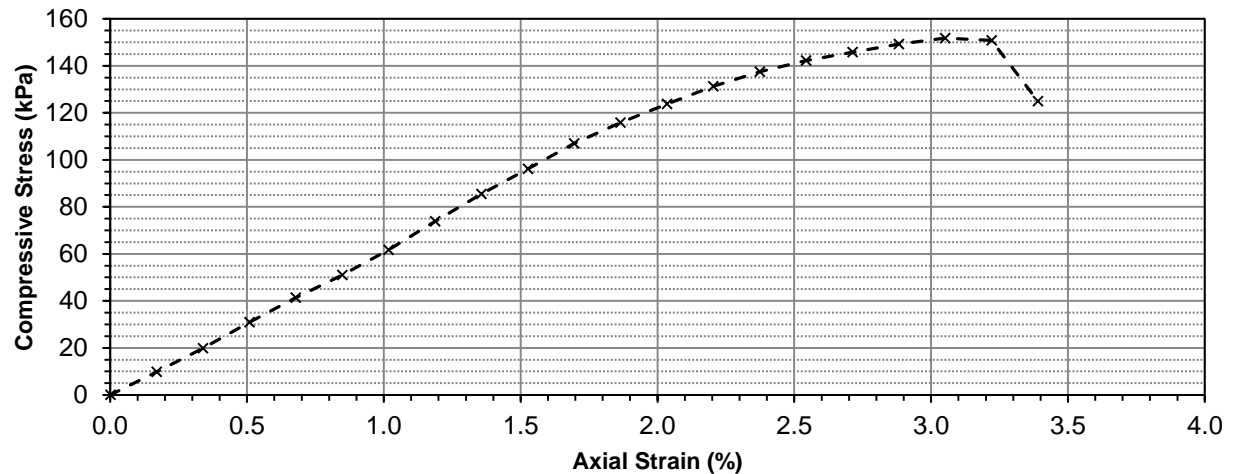


Photo:



Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.77	0.0000	0.00	0.004134	0.0	0.00	0.00
10	1.57	0.2540	0.17	0.004141	40.3	9.74	4.87
20	2.40	0.5080	0.34	0.004148	82.2	19.81	9.90
30	3.32	0.7620	0.51	0.004155	128.5	30.93	15.47
40	4.19	1.0160	0.68	0.004162	172.4	41.42	20.71
50	4.99	1.2700	0.85	0.004169	212.7	51.02	25.51
60	5.88	1.5240	1.02	0.004176	257.6	61.67	30.83
70	6.90	1.7780	1.19	0.004184	309.0	73.85	36.93
80	7.87	2.0320	1.36	0.004191	357.9	85.39	42.70
90	8.78	2.2860	1.53	0.004198	403.7	96.17	48.09
100	9.69	2.5400	1.70	0.004205	449.6	106.91	53.46
110	10.45	2.7940	1.86	0.004212	487.9	115.82	57.91
120	11.13	3.0480	2.03	0.004220	522.2	123.74	61.87
130	11.78	3.3020	2.20	0.004227	554.9	131.28	65.64
140	12.32	3.5560	2.37	0.004234	582.2	137.48	68.74
150	12.74	3.8100	2.54	0.004242	603.3	142.23	71.12
160	13.06	4.0640	2.71	0.004249	619.5	145.78	72.89
170	13.37	4.3180	2.88	0.004257	635.1	149.20	74.60
180	13.61	4.5720	3.05	0.004264	647.2	151.77	75.89
190	13.55	4.8260	3.22	0.004272	644.2	150.80	75.40
200	11.37	5.0800	3.39	0.004279	534.3	124.86	62.43



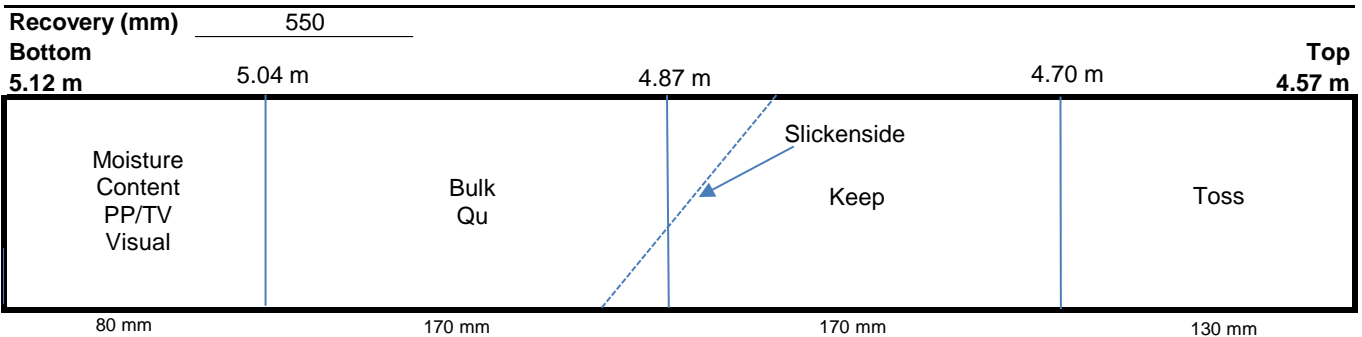
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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-02
Sample # T19
Depth (m) 4.6 - 5.2
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Tube Extraction



Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<5mm diam.)	
trace precipitates (sulphates, <5 mm diam.)	
Color	grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	slickenside, laminated (grey and lt.brown clay, <5mm thick)
Gradation	-

Torvane

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

Pocket Penetrometer

Reading	1	1.30
	2	1.20
	3	1.30
	Average	1.27
Undrained Shear Strength (kPa)		62.1

Moisture Content

Tare ID	M85
Mass tare (g)	6.6
Mass wet + tare (g)	256.0
Mass dry + tare (g)	167.0
Moisture %	55.5%

Unit Weight

Bulk Weight (g)		1041.6
Length (mm)	1	148.05
	2	148.03
	3	148.05
	4	148.15
Average Length (m)		0.148
Diam. (mm)	1	72.57
	2	73.09
	3	72.99
	4	72.55
Average Diameter (m)		0.073

Volume (m³)	6.16E-04
Bulk Unit Weight (kN/m³)	16.6
Bulk Unit Weight (pcf)	105.5
Dry Unit Weight (kN/m³)	10.7
Dry Unit Weight (pcf)	67.9

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-02
Sample # T19
Depth (m) 4.6 - 5.2
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	90.1	1.9
Max S_u	45.0	0.9

Specimen Data

Description CLAY - silty, trace silt inclusions (<5mm diam.), trace precipitates (sulphates, <5 mm diam.), grey, moist, stiff, high plasticity, slickenside, laminated (grey and lt.brown clay, <5mm thick)

Length 148.1 (mm)
Diameter 72.8 (mm)
L/D Ratio 2.0
Initial Area 0.00416 (m²)
Load Rate 1.00 (%/min)

Moisture % 55%
Bulk Unit Wt. 16.6 (kN/m³)
Dry Unit Wt. 10.7 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.65	63.8	1.33
Vane Size		
m	62.1	1.30

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.30	63.8	1.33
1.20	58.9	1.23
1.30	63.8	1.33
Average	1.27	62.1
		1.30

Failure Geometry

Sketch:

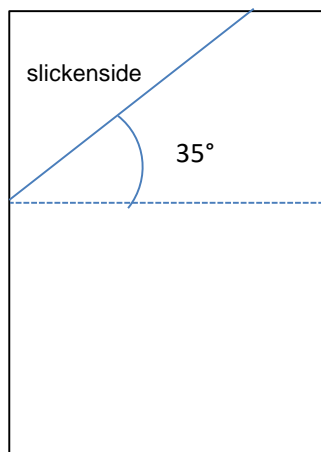
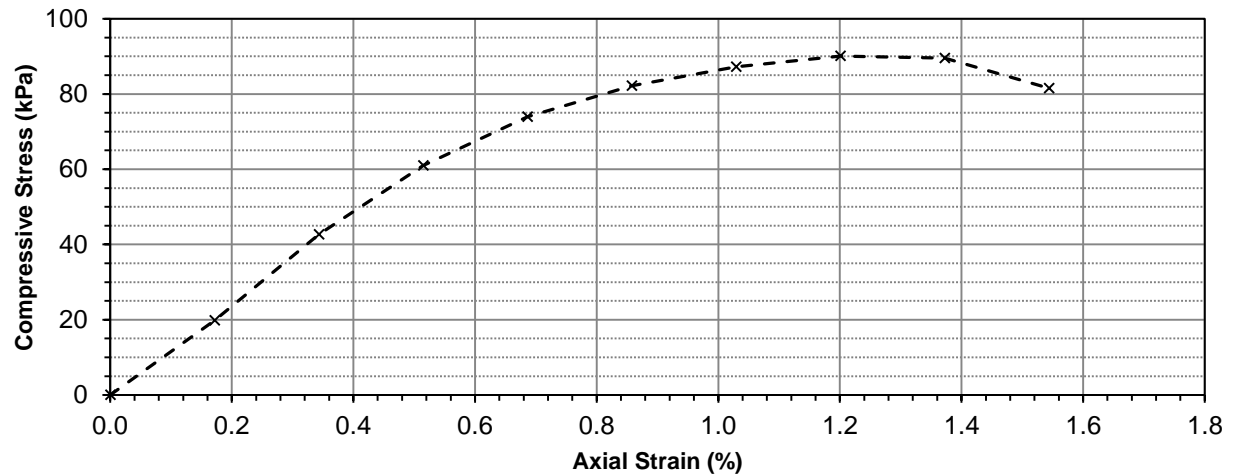


Photo:



Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.82	0.0000	0.00	0.004162	0.0	0.00	0.00
10	2.46	0.2540	0.17	0.004170	82.7	19.82	9.91
20	4.36	0.5080	0.34	0.004177	178.4	42.72	21.36
30	5.88	0.7620	0.51	0.004184	255.0	60.96	30.48
40	6.97	1.0160	0.69	0.004191	310.0	73.96	36.98
50	7.67	1.2700	0.86	0.004198	345.3	82.23	41.12
60	8.10	1.5240	1.03	0.004206	366.9	87.25	43.62
70	8.35	1.7780	1.20	0.004213	379.5	90.08	45.04
80	8.32	2.0320	1.37	0.004220	378.0	89.57	44.79
90	7.66	2.2860	1.54	0.004228	344.8	81.55	40.77



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-02
Sample # T22
Depth (m) 9.1 - 9.8
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	500			
Bottom				Top
9.64 m	9.56 m	9.39 m	9.22 m	9.14 m
Moisture Content PP/TV Visual	Bulk Qu	Keep	Toss	
80 mm	170 mm	170 mm	80 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<5mm diam.)	
Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.50
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	49.0

Pocket Penetrometer

Reading	1	1.00
	2	0.90
	3	1.10
	Average	1.00
Undrained Shear Strength (kPa)		49.0

Moisture Content

Tare ID	M09
Mass tare (g)	5.8
Mass wet + tare (g)	274.2
Mass dry + tare (g)	184.8
Moisture %	49.9%

Unit Weight

Bulk Weight (g)		1072.2
Length (mm)	1	148.15
	2	148.28
	3	148.41
	4	148.18
Average Length (m)		0.148
Diam. (mm)	1	72.39
	2	72.87
	3	71.80
	4	72.82
Average Diameter (m)		0.072

Volume (m³)	6.12E-04
Bulk Unit Weight (kN/m³)	17.2
Bulk Unit Weight (pcf)	109.5
Dry Unit Weight (kN/m³)	11.5
Dry Unit Weight (pcf)	73.0

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-02
Sample # T22
Depth (m) 9.1 - 9.8
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	108.6	2.3
Max S_u	54.3	1.1

Specimen Data

Description CLAY - silty, trace silt inclusions (<5mm diam.), grey, moist, firm, high plasticity

Length 148.3 (mm)
Diameter 72.5 (mm)
L/D Ratio 2.0
Initial Area 0.00412 (m²)
Load Rate 1.00 (%/min)

Moisture % 50%
Bulk Unit Wt. 17.2 (kN/m³)
Dry Unit Wt. 11.5 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.50	49.0	1.02
Vane Size		
m	49.0	1.02

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.00	49.1	1.02
0.90	44.1	0.92
1.10	54.0	1.13
Average	1.00	49.1
		1.02

Failure Geometry

Sketch:

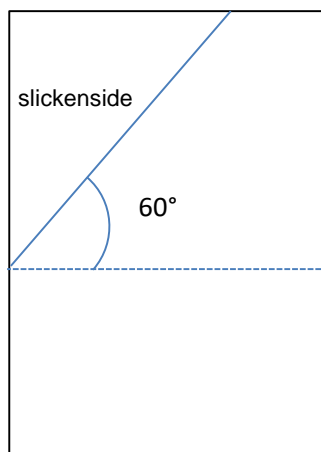
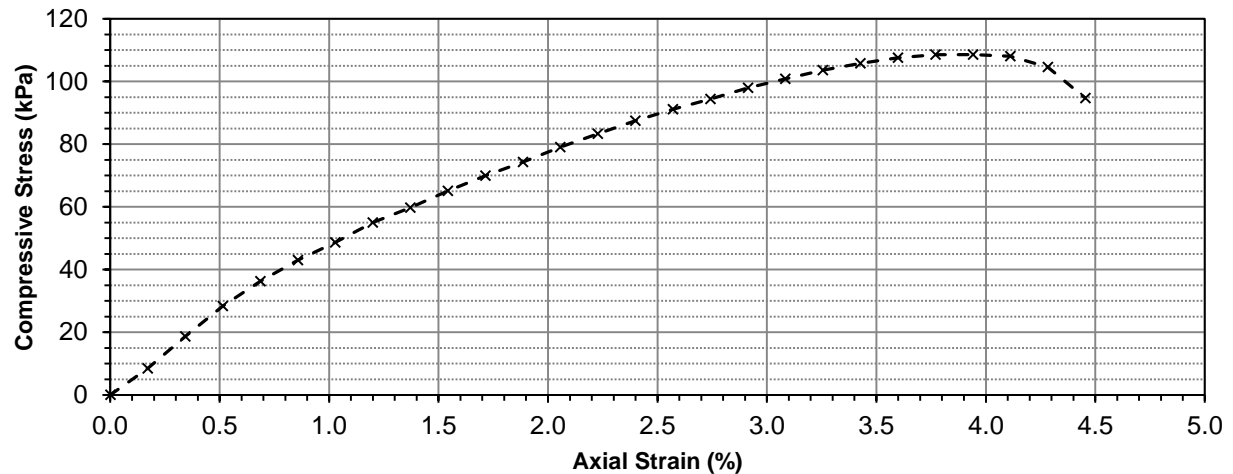


Photo:



Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.77	0.0000	0.00	0.004125	0.0	0.00	0.00
10	1.46	0.2540	0.17	0.004132	34.8	8.42	4.21
20	2.30	0.5080	0.34	0.004139	77.1	18.63	9.32
30	3.10	0.7620	0.51	0.004146	117.4	28.32	14.16
40	3.76	1.0160	0.69	0.004153	150.7	36.29	18.14
50	4.32	1.2700	0.86	0.004160	178.9	43.01	21.50
60	4.79	1.5240	1.03	0.004168	202.6	48.62	24.31
70	5.32	1.7780	1.20	0.004175	229.3	54.93	27.47
80	5.73	2.0320	1.37	0.004182	250.0	59.78	29.89
90	6.18	2.2860	1.54	0.004189	272.7	65.09	32.54
100	6.59	2.5400	1.71	0.004197	293.3	69.90	34.95
110	6.97	2.7940	1.88	0.004204	312.5	74.33	37.17
120	7.37	3.0480	2.06	0.004211	332.7	78.99	39.50
130	7.74	3.3020	2.23	0.004219	351.3	83.27	41.64
140	8.10	3.5560	2.40	0.004226	369.5	87.42	43.71
150	8.42	3.8100	2.57	0.004234	385.6	91.08	45.54
160	8.71	4.0640	2.74	0.004241	400.2	94.36	47.18
170	9.03	4.3180	2.91	0.004249	416.3	97.99	49.00
180	9.28	4.5720	3.08	0.004256	428.9	100.78	50.39
190	9.53	4.8260	3.26	0.004264	441.5	103.56	51.78
200	9.73	5.0800	3.43	0.004271	451.6	105.73	52.87
210	9.90	5.3340	3.60	0.004279	460.2	107.55	53.77
220	10.00	5.5880	3.77	0.004286	465.2	108.53	54.27
230	10.02	5.8420	3.94	0.004294	466.2	108.58	54.29



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Unconfined Compressive Strength ASTM D2166

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	9.99	6.0960	4.11	0.004302	464.7	108.03	54.02
250	9.71	6.3500	4.28	0.004309	450.6	104.56	52.28
260	8.88	6.6040	4.45	0.004317	408.8	94.68	47.34



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-03
Sample # T26
Depth (m) 6.1 - 6.7
Sample Date 01-Feb-24
Test Date 16-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	650				
Bottom	6.70 m	6.21 m	6.15 m		Top 6.10 m
6.75 m					
Toss	Bulk Qu	Keep	Keep	Moisture Content PP/TV Visual	Toss
50 mm	170 mm	170 mm	150 mm	60 mm	50 mm

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<5mm diam.)	
trace sand	
trace rootlets	

Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.35
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	34.3

Pocket Penetrometer

Reading	1	0.80
	2	0.80
	3	0.80
	Average	0.80
Undrained Shear Strength (kPa)		39.2

Moisture Content

Tare ID	N40
Mass tare (g)	9.0
Mass wet + tare (g)	309.2
Mass dry + tare (g)	204.5
Moisture %	53.6%

Unit Weight

Bulk Weight (g)	1018.6
------------------------	--------

Length (mm)	1	144.17
	2	144.42
	3	144.36
	4	144.11

Average Length (m)	0.144
---------------------------	-------

Diam. (mm)	1	72.16
	2	72.33
	3	72.29
	4	71.91

Average Diameter (m)	0.072
-----------------------------	-------

Volume (m³)	5.90E-04
Bulk Unit Weight (kN/m³)	16.9
Bulk Unit Weight (pcf)	107.7
Dry Unit Weight (kN/m³)	11.0
Dry Unit Weight (pcf)	70.2

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-03
Sample # T26
Depth (m) 6.1 - 6.7
Sample Date 01-Feb-24
Test Date 16-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	109.3	2.3
Max S_u	54.7	1.1

Specimen Data

Description CLAY - silty, trace silt inclusions (<5mm diam.), trace sand, trace rootlets, grey, moist, firm, high plasticity

Length	144.3	(mm)	Moisture %	54%
Diameter	72.2	(mm)	Bulk Unit Wt.	16.9 (kN/m ³)
L/D Ratio	2.0		Dry Unit Wt.	11.0 (kN/m ³)
Initial Area	0.00409	(m ²)	Liquid Limit	-
Load Rate	1.00	(%/min)	Plastic Limit	-
			Plasticity Index	-

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.35	34.3	0.72
Vane Size		
m	39.2	0.82

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.80	39.2	0.82
0.80	39.2	0.82
0.80	39.2	0.82
Average	0.80	39.2
		0.82

Failure Geometry

Sketch:

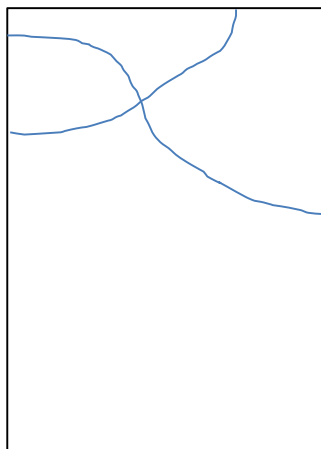
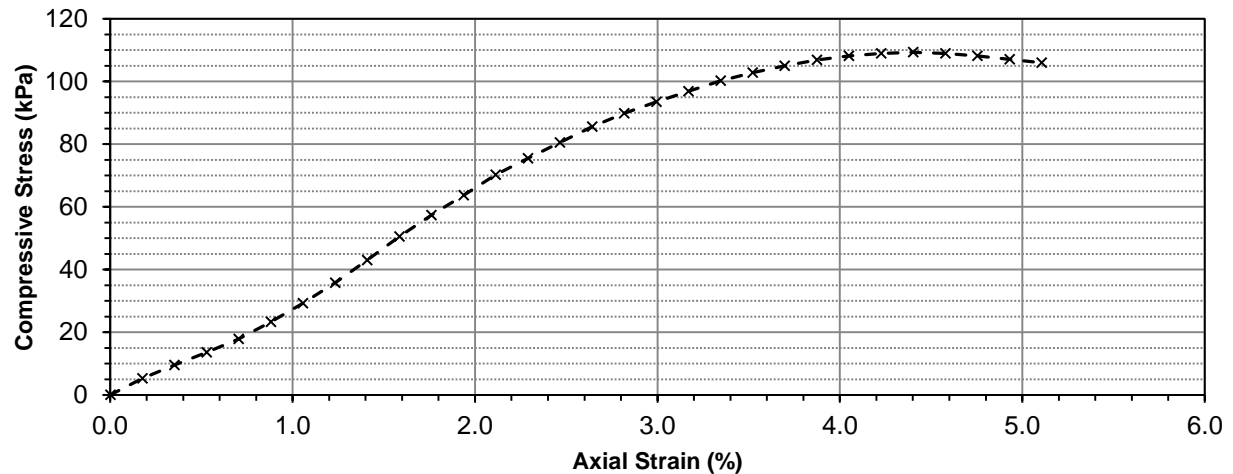


Photo:



Project No. 0336-003-00
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Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.72	0.0000	0.00	0.004091	0.0	0.00	0.00
10	1.15	0.2540	0.18	0.004098	21.7	5.29	2.64
20	1.50	0.5080	0.35	0.004105	39.3	9.58	4.79
30	1.83	0.7620	0.53	0.004113	55.9	13.60	6.80
40	2.18	1.0160	0.70	0.004120	73.6	17.86	8.93
50	2.63	1.2700	0.88	0.004127	96.3	23.32	11.66
60	3.12	1.5240	1.06	0.004135	121.0	29.26	14.63
70	3.66	1.7780	1.23	0.004142	148.2	35.78	17.89
80	4.26	2.0320	1.41	0.004149	178.4	43.00	21.50
90	4.89	2.2860	1.58	0.004157	210.2	50.56	25.28
100	5.46	2.5400	1.76	0.004164	238.9	57.37	28.69
110	5.99	2.7940	1.94	0.004172	265.6	63.67	31.84
120	6.54	3.0480	2.11	0.004179	293.3	70.19	35.09
130	6.99	3.3020	2.29	0.004187	316.0	75.48	37.74
140	7.42	3.5560	2.46	0.004194	337.7	80.51	40.26
150	7.85	3.8100	2.64	0.004202	359.4	85.52	42.76
160	8.22	4.0640	2.82	0.004210	378.0	89.80	44.90
170	8.54	4.3180	2.99	0.004217	394.2	93.46	46.73
180	8.84	4.5720	3.17	0.004225	409.3	96.87	48.44
190	9.14	4.8260	3.35	0.004233	424.4	100.27	50.13
200	9.37	5.0800	3.52	0.004240	436.0	102.82	51.41
210	9.57	5.3340	3.70	0.004248	446.1	105.00	52.50
220	9.74	5.5880	3.87	0.004256	454.6	106.83	53.41
230	9.87	5.8420	4.05	0.004264	461.2	108.17	54.08



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Unconfined Compressive Strength ASTM D2166

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q _u (kPa)	Shear Stress, S _u (kPa)
240	9.95	6.0960	4.23	0.004272	465.2	108.91	54.46
250	10.00	6.3500	4.40	0.004279	467.7	109.30	54.65
260	9.99	6.6040	4.58	0.004287	467.2	108.98	54.49
270	9.94	6.8580	4.75	0.004295	464.7	108.19	54.10
280	9.86	7.1120	4.93	0.004303	460.7	107.06	53.53
290	9.78	7.3660	5.11	0.004311	456.7	105.92	52.96



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-04
Sample # T35
Depth (m) 6.1 - 6.7
Sample Date 02-Feb-24
Test Date 16-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	450					
Bottom	6.15 m Top					
6.55 m	6.49 m	6.32 m			6.10 m	
Moisture Content PP/TV Visual	Bulk	Sand Seam	Keep	Sand Seam	Toss	
60 mm	170 mm	170 mm			50 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<5mm diam.)	
trace to some sand seams (20mm thick)	
Color	grey
Moisture	moist
Consistency	firm to stiff
Plasticity	high plasticity
Structure	blocky
Gradation	-

Torvane

Reading	0.55
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	53.9

Pocket Penetrometer

Reading	1	1.70
	2	1.80
	3	1.70
	Average	1.73
Undrained Shear Strength (kPa)		85.0

Moisture Content

Tare ID	E85
Mass tare (g)	6.8
Mass wet + tare (g)	313.0
Mass dry + tare (g)	204.8
Moisture %	54.6%

Unit Weight

Bulk Weight (g)		913.9
Length (mm)	1	128.93
	2	129.41
	3	128.97
	4	128.83
Average Length (m)		0.129
Diam. (mm)	1	72.72
	2	72.83
	3	72.70
	4	72.89
Average Diameter (m)		0.073

Volume (m³)	5.37E-04
Bulk Unit Weight (kN/m³)	16.7
Bulk Unit Weight (pcf)	106.3
Dry Unit Weight (kN/m³)	10.8
Dry Unit Weight (pcf)	68.7



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-04
Sample # T38
Depth (m) 10.7 - 11.3
Sample Date 02-Feb-24
Test Date 16-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	380		
Bottom	10.97 m	10.80 m	Top
11.05 m			10.67 m
Moisture Content PP/TV Visual	Bulk Qu	Toss Slough	
80 mm	170 mm	130 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10mm diam.)	
trace gravel (<10mm diam.)	
Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.40
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	39.2

Pocket Penetrometer

Reading	1	1.00
	2	1.00
	3	1.00
	Average	1.00
Undrained Shear Strength (kPa)		49.0

Moisture Content

Tare ID	H4
Mass tare (g)	8.6
Mass wet + tare (g)	296.8
Mass dry + tare (g)	202.7
Moisture %	48.5%

Unit Weight

Bulk Weight (g)		1061.4
Length (mm)	1	150.20
	2	149.99
	3	149.80
	4	149.80
Average Length (m)		0.150
Diam. (mm)	1	72.59
	2	72.97
	3	71.10
	4	71.09
Average Diameter (m)		0.072

Volume (m³)	6.09E-04
Bulk Unit Weight (kN/m³)	17.1
Bulk Unit Weight (pcf)	108.7
Dry Unit Weight (kN/m³)	11.5
Dry Unit Weight (pcf)	73.2

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-04
Sample # T11
Depth (m) 10.7 - 11.3
Sample Date 02-Feb-24
Test Date 16-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	42.7	0.9
Max S_u	21.3	0.4

Specimen Data

Description CLAY - silty, trace silt inclusions (<10mm diam.), trace gravel (<10mm diam.), grey, moist, firm, high plasticity

Length	149.9	(mm)	Moisture %	48%
Diameter	71.9	(mm)	Bulk Unit Wt.	17.1 (kN/m ³)
L/D Ratio	2.1		Dry Unit Wt.	11.5 (kN/m ³)
Initial Area	0.00406	(m ²)	Liquid Limit	-
Load Rate	1.00	(%/min)	Plastic Limit	-
			Plasticity Index	-

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.40	39.2	0.82
Vane Size		
m	49.0	1.02

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.00	49.1	1.02
1.00	49.1	1.02
1.00	49.1	1.02
Average	1.00	49.1
		1.02

Failure Geometry

Sketch:

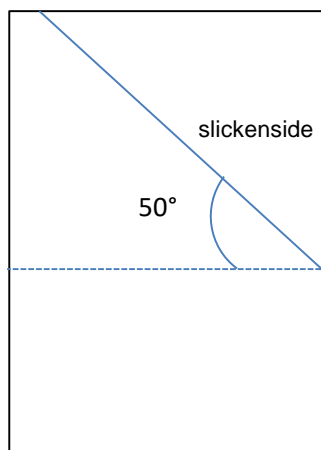
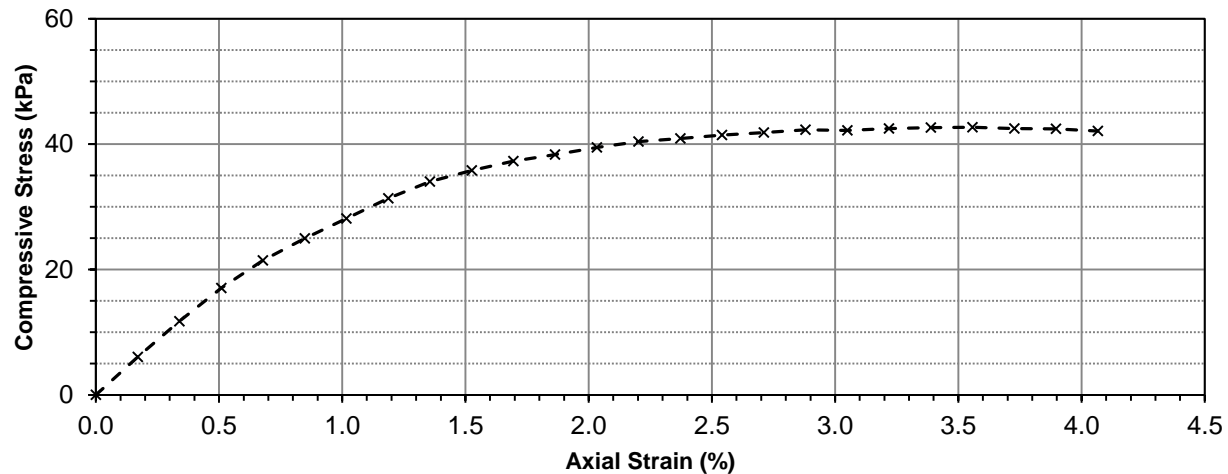


Photo:



Project No. 0336-003-00
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Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.80	0.0000	0.00	0.004064	0.0	0.00	0.00
10	1.29	0.2540	0.17	0.004071	24.7	6.07	3.03
20	1.75	0.5080	0.34	0.004078	47.9	11.74	5.87
30	2.18	0.7620	0.51	0.004085	69.6	17.03	8.51
40	2.54	1.0160	0.68	0.004092	87.7	21.43	10.72
50	2.83	1.2700	0.85	0.004099	102.3	24.96	12.48
60	3.09	1.5240	1.02	0.004106	115.4	28.11	14.05
70	3.36	1.7780	1.19	0.004113	129.0	31.37	15.69
80	3.58	2.0320	1.36	0.004120	140.1	34.01	17.00
90	3.73	2.2860	1.52	0.004127	147.7	35.78	17.89
100	3.86	2.5400	1.69	0.004134	154.2	37.30	18.65
110	3.95	2.7940	1.86	0.004142	158.8	38.34	19.17
120	4.05	3.0480	2.03	0.004149	163.8	39.48	19.74
130	4.13	3.3020	2.20	0.004156	167.8	40.39	20.19
140	4.18	3.5560	2.37	0.004163	170.4	40.92	20.46
150	4.23	3.8100	2.54	0.004170	172.9	41.45	20.73
160	4.27	4.0640	2.71	0.004178	174.9	41.87	20.93
170	4.31	4.3180	2.88	0.004185	176.9	42.27	21.14
180	4.31	4.5720	3.05	0.004192	176.9	42.20	21.10
190	4.34	4.8260	3.22	0.004200	178.4	42.49	21.24
200	4.36	5.0800	3.39	0.004207	179.4	42.65	21.33
210	4.37	5.3340	3.56	0.004214	179.9	42.70	21.35
220	4.36	5.5880	3.73	0.004222	179.4	42.50	21.25
230	4.36	5.8420	3.90	0.004229	179.4	42.43	21.21



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Unconfined Compressive Strength ASTM D2166

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	4.34	6.0960	4.07	0.004237	178.4	42.11	21.06



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Moisture Content Report ASTM D2216-98

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong combined Sewer - Rail Crossings

Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Test Hole	TH24-01	TH24-01	TH24-01	TH24-01	TH24-01	TH24-01
Depth (m)	0.6 - 0.9	0.9 - 1.2	1.5 - 1.8	2.3 - 2.4	2.6 - 2.7	3.8 - 4.0
Sample #	G01	G02	G03	G04	G05	G06
Tare ID	C6	N48	F91	F152	H29	K9
Mass of tare	8.6	8.4	8.4	8.4	8.4	8.6
Mass wet + tare	260.6	153.8	195.6	240.0	178.6	194.0
Mass dry + tare	225.6	126.6	164.6	197.9	145.2	131.6
Mass water	35.0	27.2	31.0	42.1	33.4	62.4
Mass dry soil	217.0	118.2	156.2	189.5	136.8	123.0
Moisture %	16.1%	23.0%	19.8%	22.2%	24.4%	50.7%

Test Hole	TH24-01	TH24-01	TH24-01	TH24-01	TH24-01	TH24-01
Depth (m)	6.1 - 6.4	8.5 - 8.8	10.5 - 10.7	12.0 - 12.2	13.6 - 13.7	15.1 - 15.2
Sample #	G08	G10	G12	G13	G14	G15
Tare ID	Z21	Z118	Z66	E135	H74	C19
Mass of tare	8.6	8.4	8.4	8.6	8.6	8.6
Mass wet + tare	151.2	135.9	438.2	166.2	158.8	148.4
Mass dry + tare	101.6	94.4	301.6	115.4	111.6	95.8
Mass water	49.6	41.5	136.6	50.8	47.2	52.6
Mass dry soil	93.0	86.0	293.2	106.8	103.0	87.2
Moisture %	53.3%	48.3%	46.6%	47.6%	45.8%	60.3%

Test Hole	TH24-01	TH24-02	TH24-02	TH24-02	TH24-02	TH24-03
Depth (m)	15.8 - 16.2	1.4 - 1.5	2.9 - 3.0	5.9 - 6.1	7.5 - 7.6	1.4 - 1.5
Sample #	G16	G17	G18	G20	G21	G23
Tare ID	W50	K7	Z32	J74	W73	M14
Mass of tare	9.0	8.6	8.8	7.0	8.6	7.0
Mass wet + tare	300.8	218.8	262.0	170.4	226.4	193.2
Mass dry + tare	268.4	171.0	215.0	112.6	154.0	152.8
Mass water	32.4	47.8	47.0	57.8	72.4	40.4
Mass dry soil	259.4	162.4	206.2	105.6	145.4	145.8
Moisture %	12.5%	29.4%	22.8%	54.7%	49.8%	27.7%



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Moisture Content Report ASTM D2216-98

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong combined Sewer - Rail Crossings

Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Test Hole	TH24-03	TH24-03	TH24-03	TH24-03	TH24-04	TH24-04
Depth (m)	2.9 - 3.0	4.6 - 4.7	7.5 - 7.6	9.0 - 9.1	0.6 - 0.9	0.9 - 1.2
Sample #	G24	G25	G27	G28	G29	G30
Tare ID	N43	N53	Z85	W76	W106	N71
Mass of tare	8.4	8.6	8.3	8.6	8.4	8.6
Mass wet + tare	227.2	412.6	153.4	201.8	225.4	202.2
Mass dry + tare	182.6	275.4	110.4	142.2	210.4	178.2
Mass water	44.6	137.2	43.0	59.6	15.0	24.0
Mass dry soil	174.2	266.8	102.1	133.6	202.0	169.6
Moisture %	25.6%	51.4%	42.1%	44.6%	7.4%	14.2%

Test Hole	TH24-04	TH24-04	TH24-04	TH24-04	TH24-04	TH24-04
Depth (m)	1.5 - 1.8	2.3 - 2.4	2.6 - 2.7	4.3 - 4.6	7.6 - 7.9	9.1 - 9.4
Sample #	G31	G32	G33	G34	G36	G37
Tare ID	W15	W45	A100	D20	W20	AC02
Mass of tare	8.4	8.4	8.4	8.8	8.4	6.8
Mass wet + tare	213.0	219.4	174.0	187.8	148.8	161.6
Mass dry + tare	173.2	173.4	128.2	134.4	103.2	109.6
Mass water	39.8	46.0	45.8	53.4	45.6	52.0
Mass dry soil	164.8	165.0	119.8	125.6	94.8	102.8
Moisture %	24.2%	27.9%	38.2%	42.5%	48.1%	50.6%

Test Hole	TH24-04	TH24-04	TH24-04	TH24-04		
Depth (m)	12.2 - 12.5	13.7 - 14.0	15.2 - 15.5	15.8 - 16.2		
Sample #	G39	G40	G41	G42		
Tare ID	Q69	J94	F18	E56		
Mass of tare	6.8	7.0	6.8	6.8		
Mass wet + tare	143.0	147.6	217.6	169.2		
Mass dry + tare	100.8	109.0	144.6	148.8		
Mass water	42.2	38.6	73.0	20.4		
Mass dry soil	94.0	102.0	137.8	142.0		
Moisture %	44.9%	37.8%	53.0%	14.4%		

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

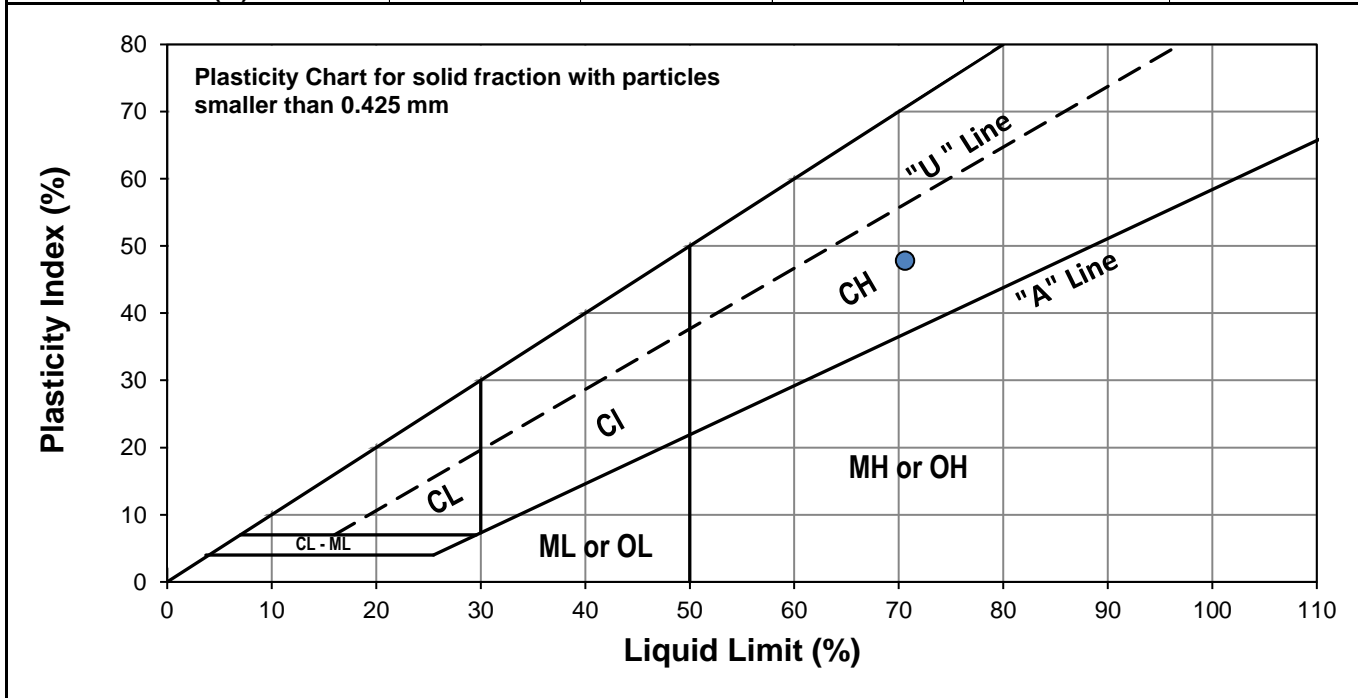
Test Hole TH24-01
Sample # G12
Depth (m) 10.5 - 10.7
Sample Date 01-Feb-24
Test Date 16-Feb-24
Technician KF



Liquid Limit 71
Plastic Limit 23
Plasticity Index 48

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	22	26		
Mass Tare (g)	14.141	13.988	14.182		
Mass Wet Soil + Tare (g)	23.264	23.749	23.213		
Mass Dry Soil + Tare (g)	19.419	19.687	19.482		
Mass Water (g)	3.845	4.062	3.731		
Mass Dry Soil (g)	5.278	5.699	5.300		
Moisture Content (%)	72.850	71.276	70.396		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.087	14.226			
Mass Wet Soil + Tare (g)	25.216	26.170			
Mass Dry Soil + Tare (g)	23.154	23.953			
Mass Water (g)	2.062	2.217			
Mass Dry Soil (g)	9.067	9.727			
Moisture Content (%)	22.742	22.792			

Note: Additional information recorded/measured for this test is available upon request.

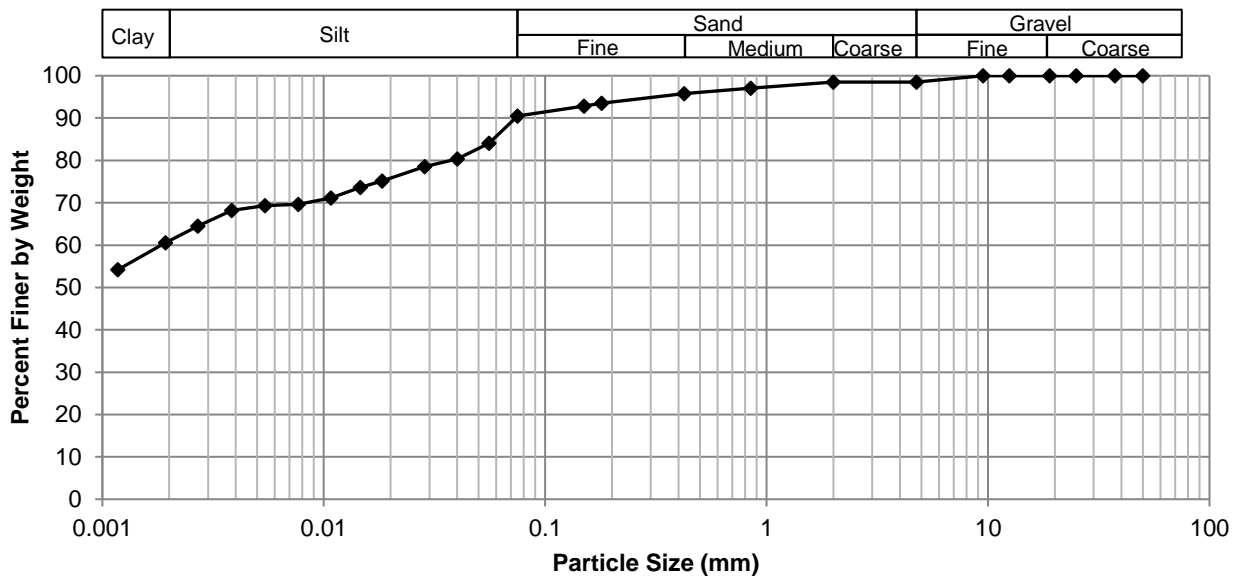
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Project Armstrong Combined Sewer



Test Hole TH24-01
Sample # G12
Depth (m) 10.5 - 10.7
Sample Date 1-Feb-24
Test Date 20-Feb-24
Technician DS

Gravel	1.5%
Sand	8.0%
Silt	29.6%
Clay	60.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	98.48	0.0750	90.51
37.5	100.00	2.00	98.47	0.0558	84.09
25.0	100.00	0.850	97.09	0.0401	80.40
19.0	100.00	0.425	95.76	0.0286	78.55
12.5	100.00	0.180	93.51	0.0184	75.16
9.50	100.00	0.150	92.85	0.0146	73.62
4.75	98.48	0.075	90.51	0.0108	71.16
				0.0077	69.62
				0.0054	69.35
				0.0038	68.18
				0.0027	64.52
				0.0019	60.58
				0.0012	54.23

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer

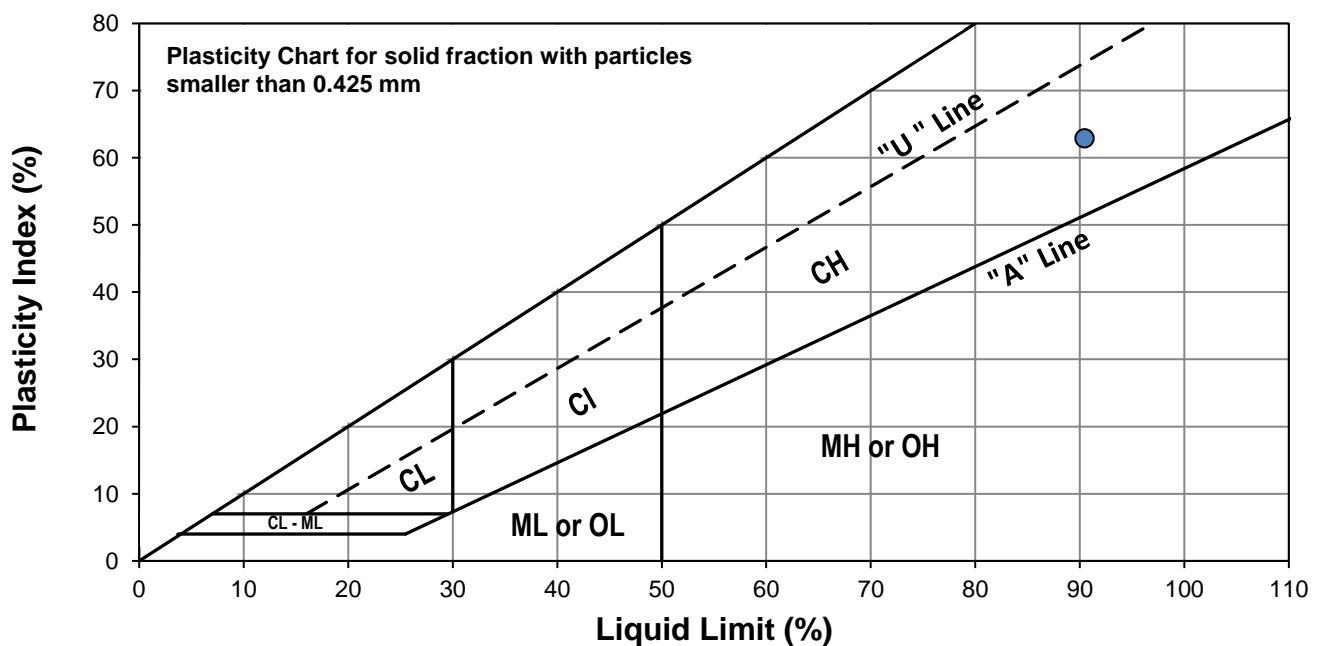
Test Hole TH24-03
Sample # G25
Depth (m) 4.6 - 4.7
Sample Date 01-Feb-24
Test Date 16-Feb-24
Technician DS



Liquid Limit 90
Plastic Limit 28
Plasticity Index 63

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	19	22	34		
Mass Tare (g)	14.041	14.153	14.119		
Mass Wet Soil + Tare (g)	23.298	22.857	23.700		
Mass Dry Soil + Tare (g)	18.832	18.693	19.233		
Mass Water (g)	4.466	4.164	4.467		
Mass Dry Soil (g)	4.791	4.540	5.114		
Moisture Content (%)	93.216	91.718	87.348		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.071	14.061			
Mass Wet Soil + Tare (g)	21.493	21.524			
Mass Dry Soil + Tare (g)	19.897	19.904			
Mass Water (g)	1.596	1.620			
Mass Dry Soil (g)	5.826	5.843			
Moisture Content (%)	27.394	27.725			

Note: Additional information recorded/measured for this test is available upon request.

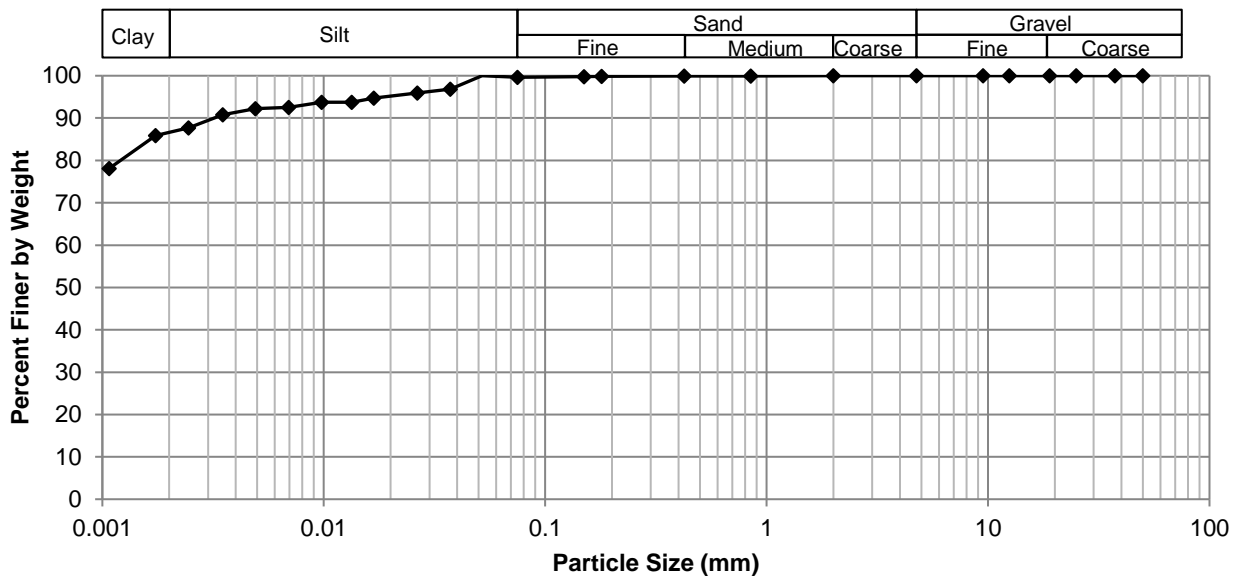
Project No. 0336-003-00
Client Jacobs Canada
Project Armstrong Combined Sewer



Test Hole TH24-03
Sample # G25
Depth (m) 4.6 - 4.7
Sample Date 1-Feb-24
Test Date 20-Feb-24
Technician DS

Gravel	0.0%
Sand	0.3%
Silt	13.1%
Clay	86.5%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	100.00	0.0750	99.65
37.5	100.00	2.00	100.00	0.0518	100.00
25.0	100.00	0.850	99.95	0.0373	96.87
19.0	100.00	0.425	99.90	0.0265	95.94
12.5	100.00	0.180	99.84	0.0169	94.69
9.50	100.00	0.150	99.82	0.0134	93.75
4.75	100.00	0.075	99.65	0.0098	93.75
				0.0070	92.50
				0.0049	92.23
				0.0035	90.76
				0.0025	87.68
				0.0017	85.90
				0.0011	78.11



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-01
Sample # T07
Depth (m) 4.6 - 5.2
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	500			
Bottom				Top
5.07 m	4.97 m	4.80 m	4.63 m	4.57 m
Moisture Content PP/TV Visual	Bulk Qu	Keep	Toss	
100 mm	170 mm	170 mm	60 mm	

Visual Classification

Material	CLAY
Composition	silty
trace precipitates (sulphates, seams, <15mm thick)	
trace precipitates (sulphates, inclusions, <5mm diam.)	
trace oxidation	
Color	grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	stratified (black and grey clay, <8mm thick)
Gradation	-

Torvane

Reading	0.75
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	73.6

Pocket Penetrometer

Reading	1	1.80
	2	1.80
	3	2.00
	Average	1.87
Undrained Shear Strength (kPa)		91.5

Moisture Content

Tare ID	E13
Mass tare (g)	6.8
Mass wet + tare (g)	318.0
Mass dry + tare (g)	212.6
Moisture %	51.2%

Unit Weight

Bulk Weight (g)		1089.8
Length (mm)	1	150.78
	2	150.91
	3	151.23
	4	151.00
Average Length (m)		0.151
Diam. (mm)	1	72.88
	2	73.21
	3	72.98
	4	72.90
Average Diameter (m)		0.073

Volume (m³)	6.32E-04
Bulk Unit Weight (kN/m³)	16.9
Bulk Unit Weight (pcf)	107.7
Dry Unit Weight (kN/m³)	11.2
Dry Unit Weight (pcf)	71.2

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-01
Sample # T07
Depth (m) 4.6 - 5.2
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	97.6	2.0
Max S_u	48.8	1.0

Specimen Data

Description CLAY - silty, trace precipitates (sulphates, seams, <15mm thick), trace precipitates (sulphates, inclusions, <5mm diam.), trace oxidation, grey, moist, stiff, high plasticity, stratified (black and grey clay, <8mm thick)

Length 151.0 (mm)
Diameter 73.0 (mm)
L/D Ratio 2.1
Initial Area 0.00418 (m²)
Load Rate 1.00 (%/min)

Moisture % 51%
Bulk Unit Wt. 16.9 (kN/m³)
Dry Unit Wt. 11.2 (kN/m³)
Liquid Limit -
Plastic Limit -
Plasticity Index -

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.75	73.6	1.54
Vane Size		
m	91.5	1.91

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.80	88.3	1.84
1.80	88.3	1.84
2.00	98.1	2.05
Average	1.87	91.6
		1.91

Failure Geometry

Sketch:

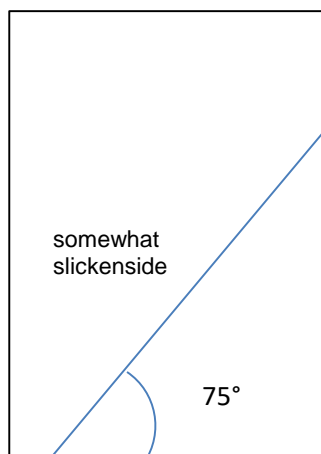
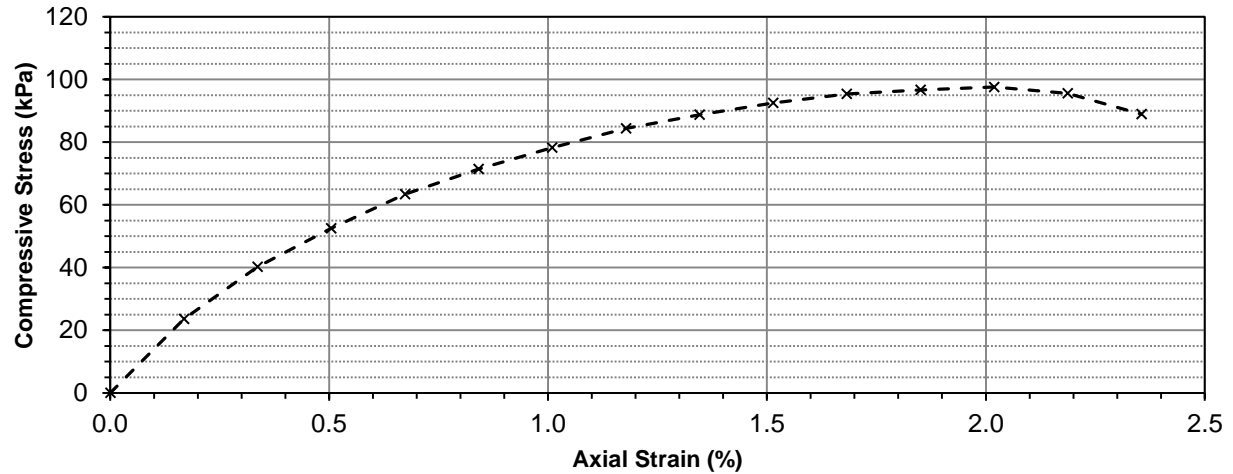


Photo:



Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.74	0.0000	0.00	0.004185	0.0	0.00	0.00
10	2.70	0.2540	0.17	0.004192	98.8	23.57	11.78
20	4.09	0.5080	0.34	0.004199	168.9	40.22	20.11
30	5.12	0.7620	0.50	0.004206	220.8	52.49	26.25
40	6.04	1.0160	0.67	0.004213	267.1	63.41	31.70
50	6.72	1.2700	0.84	0.004220	301.4	71.42	35.71
60	7.30	1.5240	1.01	0.004227	330.6	78.22	39.11
70	7.83	1.7780	1.18	0.004234	357.4	84.39	42.20
80	8.21	2.0320	1.35	0.004242	376.5	88.77	44.38
90	8.54	2.2860	1.51	0.004249	393.1	92.53	46.26
100	8.79	2.5400	1.68	0.004256	405.7	95.33	47.67
110	8.92	2.7940	1.85	0.004263	412.3	96.71	48.35
120	9.01	3.0480	2.02	0.004271	416.8	97.60	48.80
130	8.85	3.3020	2.19	0.004278	408.8	95.55	47.77
140	8.30	3.5560	2.36	0.004285	381.0	88.92	44.46



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-01
Sample # T11
Depth (m) 9.1 - 9.8
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	490			
Bottom				Top
9.63 m	9.54 m	9.37 m	9.20 m	9.14 m
Moisture Content PP/TV Visual	Bulk Qu	Keep	Toss	
90 mm	170 mm	170 mm	60 mm	

Visual Classification

Material	CLAY
Composition	silty
trace gravel (<10mm diam.)	
trace silt inclusions (<5mm diam.)	
Color	grey
Moisture	moist
Consistency	firm to stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.50
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	49.0

Pocket Penetrometer

Reading	1	1.20
	2	1.20
	3	1.20
	Average	1.20
Undrained Shear Strength (kPa)		58.8

Moisture Content

Tare ID	J68
Mass tare (g)	7.0
Mass wet + tare (g)	279.6
Mass dry + tare (g)	195.2
Moisture %	44.8%

Unit Weight

Bulk Weight (g)		1102.2
Length (mm)	1	150.04
	2	149.91
	3	149.83
	4	149.56
Average Length (m)		0.150
Diam. (mm)	1	73.01
	2	72.60
	3	72.24
	4	72.35
Average Diameter (m)		0.073

Volume (m³)	6.19E-04
Bulk Unit Weight (kN/m³)	17.5
Bulk Unit Weight (pcf)	111.1
Dry Unit Weight (kN/m³)	12.0
Dry Unit Weight (pcf)	76.7

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-01
Sample # T11
Depth (m) 9.1 - 9.8
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	151.8	3.2
Max S_u	75.9	1.6

Specimen Data

Description CLAY - silty, trace gravel (<10mm diam.), trace silt inclusions (<5mm diam.), grey, moist, firm to stiff, high plasticity

Length	149.8	(mm)	Moisture %	45%
Diameter	72.6	(mm)	Bulk Unit Wt.	17.5 (kN/m ³)
L/D Ratio	2.1		Dry Unit Wt.	12.0 (kN/m ³)
Initial Area	0.00413	(m ²)	Liquid Limit	-
Load Rate	1.00	(%/min)	Plastic Limit	-
			Plasticity Index	-

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.50	49.0	1.02
Vane Size		
m	58.8	1.23

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.20	58.9	1.23
1.20	58.9	1.23
1.20	58.9	1.23
Average	1.20	58.9
		1.23

Failure Geometry

Sketch:

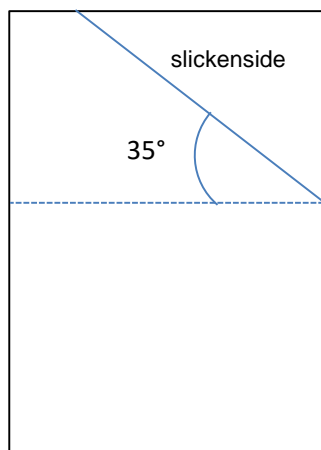
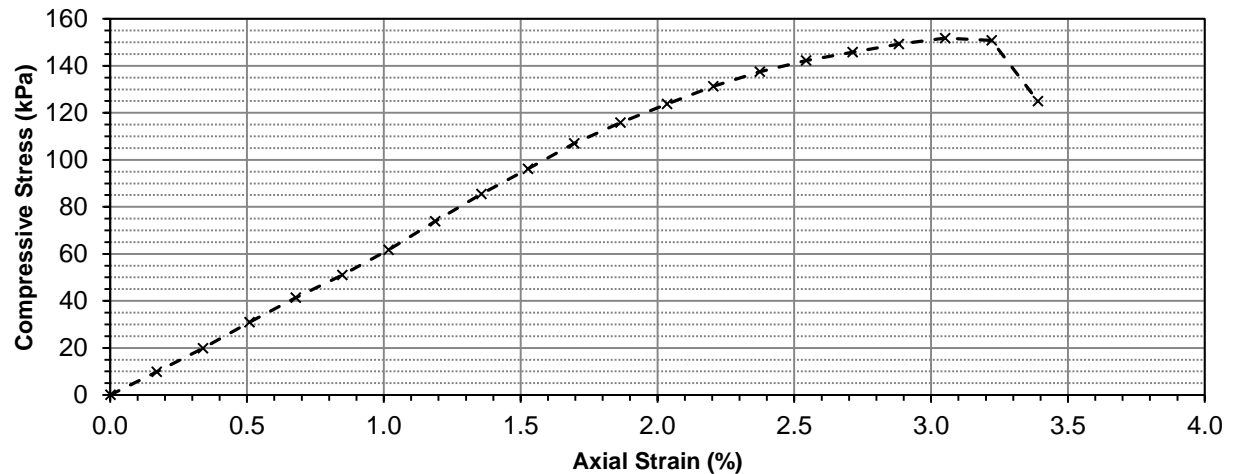


Photo:



Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.77	0.0000	0.00	0.004134	0.0	0.00	0.00
10	1.57	0.2540	0.17	0.004141	40.3	9.74	4.87
20	2.40	0.5080	0.34	0.004148	82.2	19.81	9.90
30	3.32	0.7620	0.51	0.004155	128.5	30.93	15.47
40	4.19	1.0160	0.68	0.004162	172.4	41.42	20.71
50	4.99	1.2700	0.85	0.004169	212.7	51.02	25.51
60	5.88	1.5240	1.02	0.004176	257.6	61.67	30.83
70	6.90	1.7780	1.19	0.004184	309.0	73.85	36.93
80	7.87	2.0320	1.36	0.004191	357.9	85.39	42.70
90	8.78	2.2860	1.53	0.004198	403.7	96.17	48.09
100	9.69	2.5400	1.70	0.004205	449.6	106.91	53.46
110	10.45	2.7940	1.86	0.004212	487.9	115.82	57.91
120	11.13	3.0480	2.03	0.004220	522.2	123.74	61.87
130	11.78	3.3020	2.20	0.004227	554.9	131.28	65.64
140	12.32	3.5560	2.37	0.004234	582.2	137.48	68.74
150	12.74	3.8100	2.54	0.004242	603.3	142.23	71.12
160	13.06	4.0640	2.71	0.004249	619.5	145.78	72.89
170	13.37	4.3180	2.88	0.004257	635.1	149.20	74.60
180	13.61	4.5720	3.05	0.004264	647.2	151.77	75.89
190	13.55	4.8260	3.22	0.004272	644.2	150.80	75.40
200	11.37	5.0800	3.39	0.004279	534.3	124.86	62.43



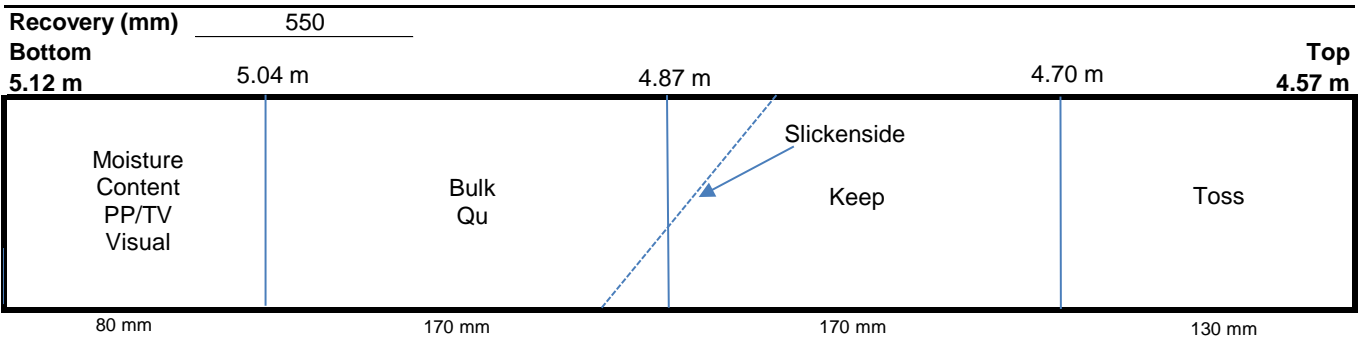
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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-02
Sample # T19
Depth (m) 4.6 - 5.2
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Tube Extraction



Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<5mm diam.)	
trace precipitates (sulphates, <5 mm diam.)	
Color	grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	slickenside, laminated (grey and lt.brown clay, <5mm thick)
Gradation	-

Torvane

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

Pocket Penetrometer

Reading	1	1.30
	2	1.20
	3	1.30
	Average	1.27
Undrained Shear Strength (kPa)		62.1

Moisture Content

Tare ID	M85
Mass tare (g)	6.6
Mass wet + tare (g)	256.0
Mass dry + tare (g)	167.0
Moisture %	55.5%

Unit Weight

Bulk Weight (g)		1041.6
Length (mm)	1	148.05
	2	148.03
	3	148.05
n thick)	4	148.15
Average Length (m)		0.148
Diam. (mm)	1	72.57
	2	73.09
	3	72.99
	4	72.55
Average Diameter (m)		0.073

Volume (m³)	6.16E-04
Bulk Unit Weight (kN/m³)	16.6
Bulk Unit Weight (pcf)	105.5
Dry Unit Weight (kN/m³)	10.7
Dry Unit Weight (pcf)	67.9

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-02
Sample # T19
Depth (m) 4.6 - 5.2
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	90.1	1.9
Max S_u	45.0	0.9

Specimen Data

Description CLAY - silty, trace silt inclusions (<5mm diam.), trace precipitates (sulphates, <5 mm diam.), grey, moist, stiff, high plasticity, slickenside, laminated (grey and lt.brown clay, <5mm thick)

Length	148.1	(mm)	Moisture %	55%
Diameter	72.8	(mm)	Bulk Unit Wt.	16.6 (kN/m ³)
L/D Ratio	2.0		Dry Unit Wt.	10.7 (kN/m ³)
Initial Area	0.00416	(m ²)	Liquid Limit	-
Load Rate	1.00	(%/min)	Plastic Limit	-
			Plasticity Index	-

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.65	63.8	1.33
Vane Size		
m	62.1	1.30

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.30	63.8	1.33
1.20	58.9	1.23
1.30	63.8	1.33
Average	1.27	62.1
		1.30

Failure Geometry

Sketch:

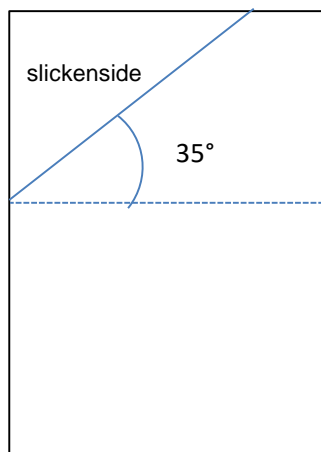
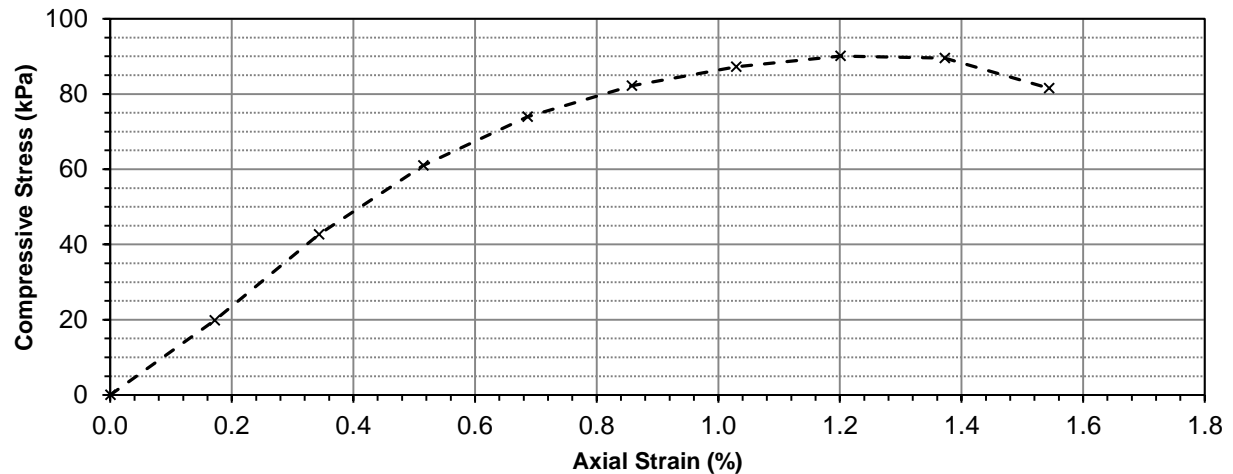


Photo:



Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.82	0.0000	0.00	0.004162	0.0	0.00	0.00
10	2.46	0.2540	0.17	0.004170	82.7	19.82	9.91
20	4.36	0.5080	0.34	0.004177	178.4	42.72	21.36
30	5.88	0.7620	0.51	0.004184	255.0	60.96	30.48
40	6.97	1.0160	0.69	0.004191	310.0	73.96	36.98
50	7.67	1.2700	0.86	0.004198	345.3	82.23	41.12
60	8.10	1.5240	1.03	0.004206	366.9	87.25	43.62
70	8.35	1.7780	1.20	0.004213	379.5	90.08	45.04
80	8.32	2.0320	1.37	0.004220	378.0	89.57	44.79
90	7.66	2.2860	1.54	0.004228	344.8	81.55	40.77



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-02
Sample # T22
Depth (m) 9.1 - 9.8
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	500			
Bottom				Top
9.64 m	9.56 m	9.39 m	9.22 m	9.14 m
Moisture Content PP/TV Visual	Bulk Qu	Keep	Toss	
80 mm	170 mm	170 mm	80 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<5mm diam.)	
Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.50
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	49.0

Pocket Penetrometer

Reading	1	1.00
	2	0.90
	3	1.10
	Average	1.00
Undrained Shear Strength (kPa)		49.0

Moisture Content

Tare ID	M09
Mass tare (g)	5.8
Mass wet + tare (g)	274.2
Mass dry + tare (g)	184.8
Moisture %	49.9%

Unit Weight

Bulk Weight (g)		1072.2
Length (mm)	1	148.15
	2	148.28
	3	148.41
	4	148.18
Average Length (m)		0.148
Diam. (mm)	1	72.39
	2	72.87
	3	71.80
	4	72.82
Average Diameter (m)		0.072

Volume (m³)	6.12E-04
Bulk Unit Weight (kN/m³)	17.2
Bulk Unit Weight (pcf)	109.5
Dry Unit Weight (kN/m³)	11.5
Dry Unit Weight (pcf)	73.0

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-02
Sample # T22
Depth (m) 9.1 - 9.8
Sample Date 01-Feb-24
Test Date 14-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	108.6	2.3
Max S_u	54.3	1.1

Specimen Data

Description CLAY - silty, trace silt inclusions (<5mm diam.), grey, moist, firm, high plasticity

Length	148.3	(mm)	Moisture %	50%
Diameter	72.5	(mm)	Bulk Unit Wt.	17.2 (kN/m ³)
L/D Ratio	2.0		Dry Unit Wt.	11.5 (kN/m ³)
Initial Area	0.00412	(m ²)	Liquid Limit	-
Load Rate	1.00	(%/min)	Plastic Limit	-
			Plasticity Index	-

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.50	49.0	1.02
Vane Size		
m	49.0	1.02

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.00	49.1	1.02
0.90	44.1	0.92
1.10	54.0	1.13
Average	1.00	49.1
		1.02

Failure Geometry

Sketch:

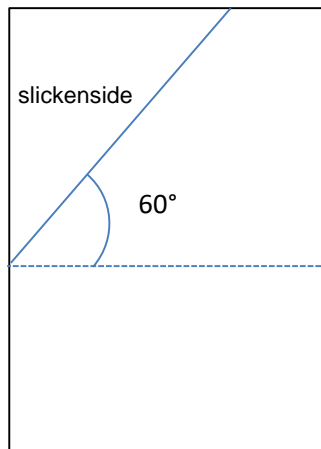
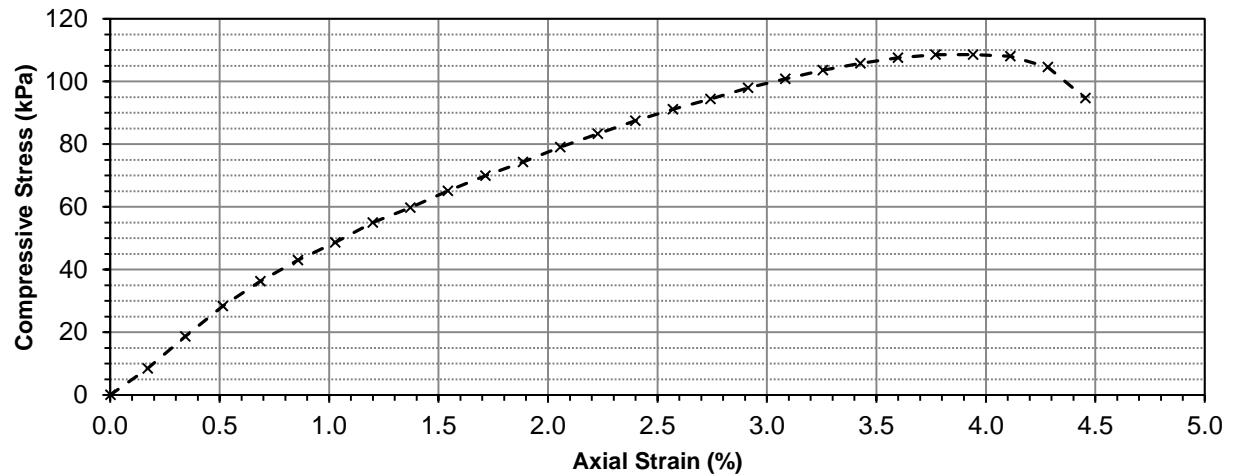


Photo:



Project No. 0336-003-00
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Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q _u (kPa)	Shear Stress, S _u (kPa)
0	0.77	0.0000	0.00	0.004125	0.0	0.00	0.00
10	1.46	0.2540	0.17	0.004132	34.8	8.42	4.21
20	2.30	0.5080	0.34	0.004139	77.1	18.63	9.32
30	3.10	0.7620	0.51	0.004146	117.4	28.32	14.16
40	3.76	1.0160	0.69	0.004153	150.7	36.29	18.14
50	4.32	1.2700	0.86	0.004160	178.9	43.01	21.50
60	4.79	1.5240	1.03	0.004168	202.6	48.62	24.31
70	5.32	1.7780	1.20	0.004175	229.3	54.93	27.47
80	5.73	2.0320	1.37	0.004182	250.0	59.78	29.89
90	6.18	2.2860	1.54	0.004189	272.7	65.09	32.54
100	6.59	2.5400	1.71	0.004197	293.3	69.90	34.95
110	6.97	2.7940	1.88	0.004204	312.5	74.33	37.17
120	7.37	3.0480	2.06	0.004211	332.7	78.99	39.50
130	7.74	3.3020	2.23	0.004219	351.3	83.27	41.64
140	8.10	3.5560	2.40	0.004226	369.5	87.42	43.71
150	8.42	3.8100	2.57	0.004234	385.6	91.08	45.54
160	8.71	4.0640	2.74	0.004241	400.2	94.36	47.18
170	9.03	4.3180	2.91	0.004249	416.3	97.99	49.00
180	9.28	4.5720	3.08	0.004256	428.9	100.78	50.39
190	9.53	4.8260	3.26	0.004264	441.5	103.56	51.78
200	9.73	5.0800	3.43	0.004271	451.6	105.73	52.87
210	9.90	5.3340	3.60	0.004279	460.2	107.55	53.77
220	10.00	5.5880	3.77	0.004286	465.2	108.53	54.27
230	10.02	5.8420	3.94	0.004294	466.2	108.58	54.29



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Unconfined Compressive Strength ASTM D2166

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	9.99	6.0960	4.11	0.004302	464.7	108.03	54.02
250	9.71	6.3500	4.28	0.004309	450.6	104.56	52.28
260	8.88	6.6040	4.45	0.004317	408.8	94.68	47.34



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-03
Sample # T26
Depth (m) 6.1 - 6.7
Sample Date 01-Feb-24
Test Date 16-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	650				
Bottom	6.70 m	6.21 m	6.15 m		Top
6.75 m					6.10 m
Toss	Bulk Qu	Keep	Keep	Moisture Content PP/TV Visual	Toss
50 mm	170 mm	170 mm	150 mm	60 mm	50 mm

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<5mm diam.)	
trace sand	
trace rootlets	

Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.35
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	34.3

Pocket Penetrometer

Reading	1	0.80
	2	0.80
	3	0.80
	Average	0.80
Undrained Shear Strength (kPa)		39.2

Moisture Content

Tare ID	N40
Mass tare (g)	9.0
Mass wet + tare (g)	309.2
Mass dry + tare (g)	204.5
Moisture %	53.6%

Unit Weight

Bulk Weight (g)	1018.6
------------------------	--------

Length (mm)	1	144.17
	2	144.42
	3	144.36
	4	144.11

Average Length (m)	0.144
---------------------------	-------

Diam. (mm)	1	72.16
	2	72.33
	3	72.29
	4	71.91

Average Diameter (m)	0.072
-----------------------------	-------

Volume (m³)	5.90E-04
Bulk Unit Weight (kN/m³)	16.9
Bulk Unit Weight (pcf)	107.7
Dry Unit Weight (kN/m³)	11.0
Dry Unit Weight (pcf)	70.2

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-03
Sample # T26
Depth (m) 6.1 - 6.7
Sample Date 01-Feb-24
Test Date 16-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	109.3	2.3
Max S_u	54.7	1.1

Specimen Data

Description CLAY - silty, trace silt inclusions (<5mm diam.), trace sand, trace rootlets, grey, moist, firm, high plasticity

Length	144.3	(mm)	Moisture %	54%
Diameter	72.2	(mm)	Bulk Unit Wt.	16.9 (kN/m ³)
L/D Ratio	2.0		Dry Unit Wt.	11.0 (kN/m ³)
Initial Area	0.00409	(m ²)	Liquid Limit	-
Load Rate	1.00	(%/min)	Plastic Limit	-
			Plasticity Index	-

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.35	34.3	0.72
Vane Size		
m	39.2	0.82

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.80	39.2	0.82
0.80	39.2	0.82
0.80	39.2	0.82
Average	0.80	39.2
		0.82

Failure Geometry

Sketch:

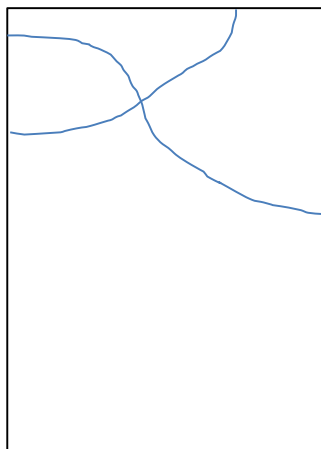
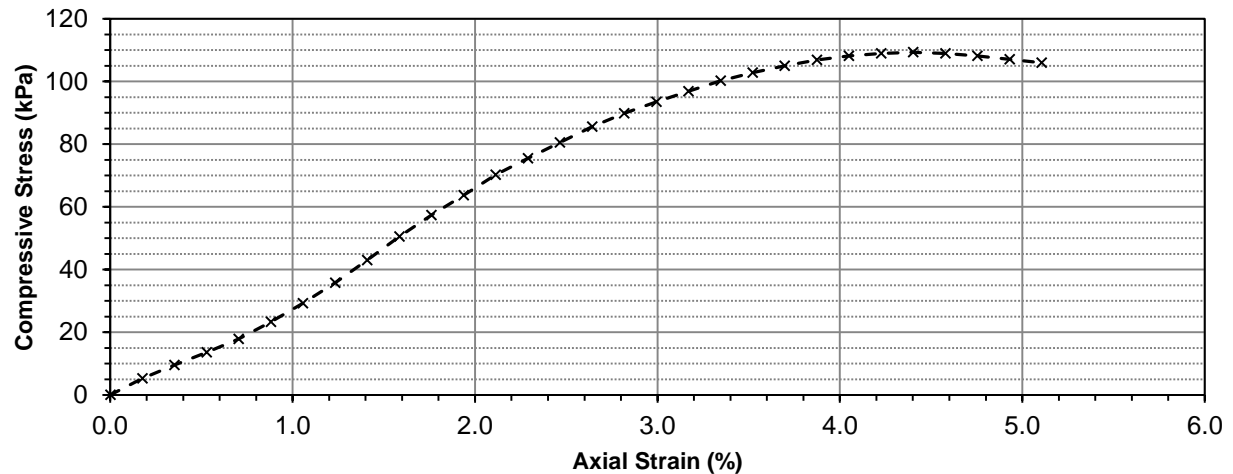


Photo:



Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.72	0.0000	0.00	0.004091	0.0	0.00	0.00
10	1.15	0.2540	0.18	0.004098	21.7	5.29	2.64
20	1.50	0.5080	0.35	0.004105	39.3	9.58	4.79
30	1.83	0.7620	0.53	0.004113	55.9	13.60	6.80
40	2.18	1.0160	0.70	0.004120	73.6	17.86	8.93
50	2.63	1.2700	0.88	0.004127	96.3	23.32	11.66
60	3.12	1.5240	1.06	0.004135	121.0	29.26	14.63
70	3.66	1.7780	1.23	0.004142	148.2	35.78	17.89
80	4.26	2.0320	1.41	0.004149	178.4	43.00	21.50
90	4.89	2.2860	1.58	0.004157	210.2	50.56	25.28
100	5.46	2.5400	1.76	0.004164	238.9	57.37	28.69
110	5.99	2.7940	1.94	0.004172	265.6	63.67	31.84
120	6.54	3.0480	2.11	0.004179	293.3	70.19	35.09
130	6.99	3.3020	2.29	0.004187	316.0	75.48	37.74
140	7.42	3.5560	2.46	0.004194	337.7	80.51	40.26
150	7.85	3.8100	2.64	0.004202	359.4	85.52	42.76
160	8.22	4.0640	2.82	0.004210	378.0	89.80	44.90
170	8.54	4.3180	2.99	0.004217	394.2	93.46	46.73
180	8.84	4.5720	3.17	0.004225	409.3	96.87	48.44
190	9.14	4.8260	3.35	0.004233	424.4	100.27	50.13
200	9.37	5.0800	3.52	0.004240	436.0	102.82	51.41
210	9.57	5.3340	3.70	0.004248	446.1	105.00	52.50
220	9.74	5.5880	3.87	0.004256	454.6	106.83	53.41
230	9.87	5.8420	4.05	0.004264	461.2	108.17	54.08



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Unconfined Compressive Strength ASTM D2166

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	9.95	6.0960	4.23	0.004272	465.2	108.91	54.46
250	10.00	6.3500	4.40	0.004279	467.7	109.30	54.65
260	9.99	6.6040	4.58	0.004287	467.2	108.98	54.49
270	9.94	6.8580	4.75	0.004295	464.7	108.19	54.10
280	9.86	7.1120	4.93	0.004303	460.7	107.06	53.53
290	9.78	7.3660	5.11	0.004311	456.7	105.92	52.96



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-04
Sample # T35
Depth (m) 6.1 - 6.7
Sample Date 02-Feb-24
Test Date 16-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	450					
Bottom	6.15 m Top					
6.55 m	6.49 m	6.32 m			6.10 m	
Moisture Content PP/TV Visual	Bulk	Sand Seam	Keep	Sand Seam	Toss	
60 mm	170 mm	170 mm			50 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<5mm diam.)	
trace to some sand seams (20mm thick)	
Color	grey
Moisture	moist
Consistency	firm to stiff
Plasticity	high plasticity
Structure	blocky
Gradation	-

Torvane

Reading	0.55
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	53.9

Pocket Penetrometer

Reading	1	1.70
	2	1.80
	3	1.70
	Average	1.73
Undrained Shear Strength (kPa)		85.0

Moisture Content

Tare ID	E85
Mass tare (g)	6.8
Mass wet + tare (g)	313.0
Mass dry + tare (g)	204.8
Moisture %	54.6%

Unit Weight

Bulk Weight (g)		913.9
Length (mm)	1	128.93
	2	129.41
	3	128.97
	4	128.83
Average Length (m)		0.129
Diam. (mm)	1	72.72
	2	72.83
	3	72.70
	4	72.89
Average Diameter (m)		0.073

Volume (m³)	5.37E-04
Bulk Unit Weight (kN/m³)	16.7
Bulk Unit Weight (pcf)	106.3
Dry Unit Weight (kN/m³)	10.8
Dry Unit Weight (pcf)	68.7



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Shelby Tube Visual

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-04
Sample # T38
Depth (m) 10.7 - 11.3
Sample Date 02-Feb-24
Test Date 16-Feb-24
Technician AD

Tube Extraction

Recovery (mm)	380		
Bottom	10.97 m	10.80 m	Top
11.05 m			10.67 m
Moisture Content PP/TV Visual	Bulk Qu	Toss Slough	
80 mm	170 mm	130 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10mm diam.)	
trace gravel (<10mm diam.)	
Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.40
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	39.2

Pocket Penetrometer

Reading	1	1.00
	2	1.00
	3	1.00
	Average	1.00
Undrained Shear Strength (kPa)		49.0

Moisture Content

Tare ID	H4
Mass tare (g)	8.6
Mass wet + tare (g)	296.8
Mass dry + tare (g)	202.7
Moisture %	48.5%

Unit Weight

Bulk Weight (g)		1061.4
Length (mm)	1	150.20
	2	149.99
	3	149.80
	4	149.80
Average Length (m)		0.150
Diam. (mm)	1	72.59
	2	72.97
	3	71.10
	4	71.09
Average Diameter (m)		0.072

Volume (m³)	6.09E-04
Bulk Unit Weight (kN/m³)	17.1
Bulk Unit Weight (pcf)	108.7
Dry Unit Weight (kN/m³)	11.5
Dry Unit Weight (pcf)	73.2

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Test Hole TH24-04
Sample # T11
Depth (m) 10.7 - 11.3
Sample Date 02-Feb-24
Test Date 16-Feb-24
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	42.7	0.9
Max S_u	21.3	0.4

Specimen Data

Description CLAY - silty, trace silt inclusions (<10mm diam.), trace gravel (<10mm diam.), grey, moist, firm, high plasticity

Length	149.9	(mm)	Moisture %	48%
Diameter	71.9	(mm)	Bulk Unit Wt.	17.1 (kN/m ³)
L/D Ratio	2.1		Dry Unit Wt.	11.5 (kN/m ³)
Initial Area	0.00406	(m ²)	Liquid Limit	-
Load Rate	1.00	(%/min)	Plastic Limit	-
			Plasticity Index	-

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.40	39.2	0.82
Vane Size		
m	49.0	1.02

Pocket Penetrometer

Reading	Undrained Shear Strength	
tsf	kPa	ksf
1.00	49.1	1.02
1.00	49.1	1.02
1.00	49.1	1.02
Average	1.00	49.1
		1.02

Failure Geometry

Sketch:

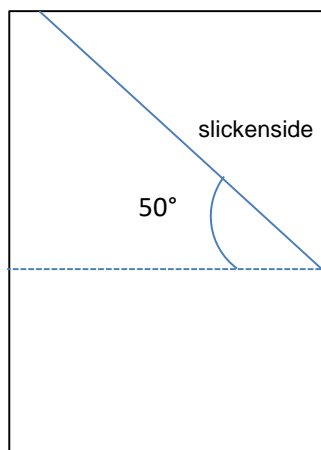
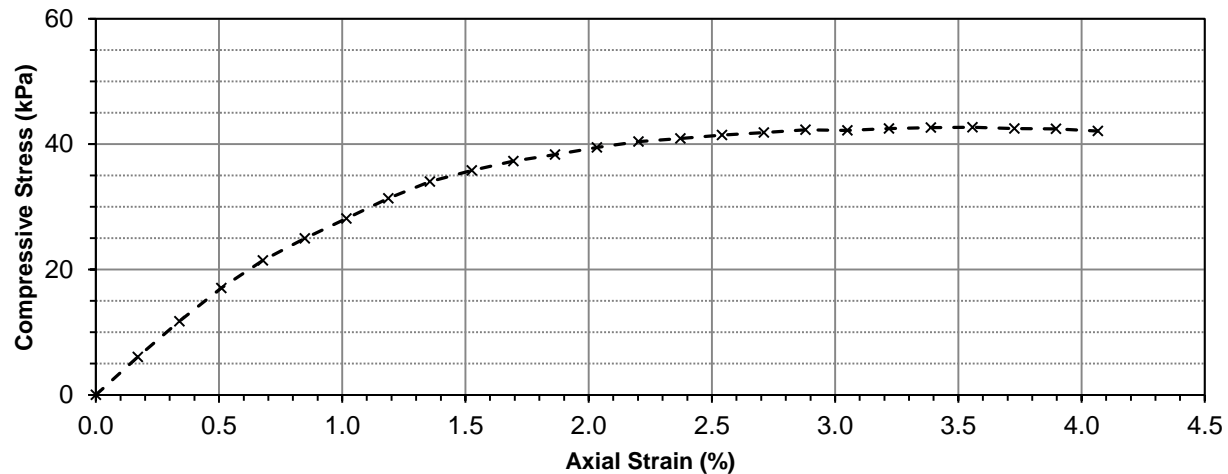


Photo:



Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.80	0.0000	0.00	0.004064	0.0	0.00	0.00
10	1.29	0.2540	0.17	0.004071	24.7	6.07	3.03
20	1.75	0.5080	0.34	0.004078	47.9	11.74	5.87
30	2.18	0.7620	0.51	0.004085	69.6	17.03	8.51
40	2.54	1.0160	0.68	0.004092	87.7	21.43	10.72
50	2.83	1.2700	0.85	0.004099	102.3	24.96	12.48
60	3.09	1.5240	1.02	0.004106	115.4	28.11	14.05
70	3.36	1.7780	1.19	0.004113	129.0	31.37	15.69
80	3.58	2.0320	1.36	0.004120	140.1	34.01	17.00
90	3.73	2.2860	1.52	0.004127	147.7	35.78	17.89
100	3.86	2.5400	1.69	0.004134	154.2	37.30	18.65
110	3.95	2.7940	1.86	0.004142	158.8	38.34	19.17
120	4.05	3.0480	2.03	0.004149	163.8	39.48	19.74
130	4.13	3.3020	2.20	0.004156	167.8	40.39	20.19
140	4.18	3.5560	2.37	0.004163	170.4	40.92	20.46
150	4.23	3.8100	2.54	0.004170	172.9	41.45	20.73
160	4.27	4.0640	2.71	0.004178	174.9	41.87	20.93
170	4.31	4.3180	2.88	0.004185	176.9	42.27	21.14
180	4.31	4.5720	3.05	0.004192	176.9	42.20	21.10
190	4.34	4.8260	3.22	0.004200	178.4	42.49	21.24
200	4.36	5.0800	3.39	0.004207	179.4	42.65	21.33
210	4.37	5.3340	3.56	0.004214	179.9	42.70	21.35
220	4.36	5.5880	3.73	0.004222	179.4	42.50	21.25
230	4.36	5.8420	3.90	0.004229	179.4	42.43	21.21



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Unconfined Compressive Strength ASTM D2166

Project No. 0336-003-00
Client Jacobs Canada Inc.
Project Armstrong Combined Sewer - Rail Crossings

Unconfined Compression Test Data (cont'd)









Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m ²)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	4.34	6.0960	4.07	0.004237	178.4	42.11	21.06

APPENDIX C




2025 KGS Group Borehole Logs

KEY TO SYMBOLS




LITHOLOGIC SYMBOLS

	Asphalt
	Clay (CH, high plasticity)
	Clay (CL, low plasticity)
	Concrete
	Fill
	Limestone
	Till (mix of gravel, sand, clay and silt)
	Topsoil

SAMPLER SYMBOLS

	Auger Grab
	Core Barrel
	SPT Split Spoon

WELL CONSTRUCTION SYMBOLS

	Piezometer (bentonite backfill)
	Piezometer (grout backfill)
	Piezometer (sand backfill)

ABBREVIATIONS

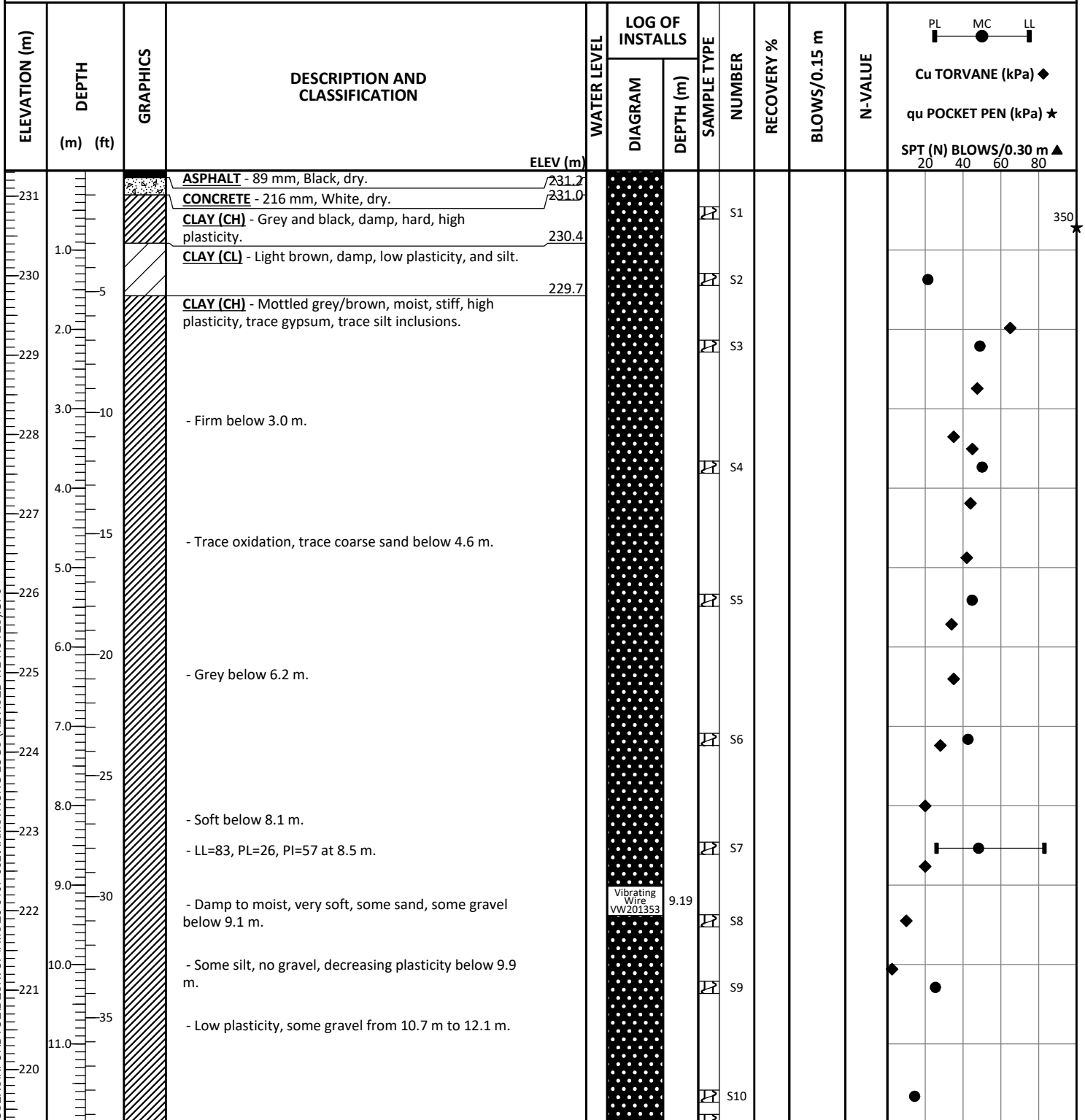
LL	- Liquid Limit	PN	- Pneumatic Piezometer
PL	- Plastic Limit	VW	- Vibrating Wire Piezometer
PI	- Plastic Index	PID	- Photoionization Detector
MC	- Moisture Content	ppm	- Parts Per Million
DD	- Dry Density	▽	Water Level During Drilling
NP	- Non-Plastic	▼	Water Level Upon Completion of Drilling
-200	- Percent Passing No. 200 Sieve	▼	Water Level Remeasured/Static
TV	- Torvane (kPa)		
PP	- Pocket Penetrometer (kPa)		
PSA	- Particle Size Analysis		
TOC	- Top Of Casing		

PROJECT NO. 25-0107-002
SURFACE ELEV. 231.02 m
START DATE 5-29-2025
UTM (m) N 5,535,005.59
E 633,098.59 Zone 14

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL		
					DIAGRAM	DEPTH (m)						Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80		
			ELEV (m)											
			ASPHALT - 89 mm, Black, dry.	230.9										
			CONCRETE - 216 mm, White, dry.	230.7										
			GRAVEL FILL - Brown, dry, medium to coarse, trace silt.	230.1				S1						
			CONCRETE - White, dry.											
				229.5										
			CLAY (CH) - Mottled grey/brown, moist, stiff, high plasticity, trace oxidation, trace gypsum, trace silt inclusions.					S2						
			- Firm below 2.4 m.											
								S3						
			- Grey below 4.7 m.											
			- LL=85, PL=28, PI=57 at 5.3 m.					S4						
			- PSA: 0% gravel, 1% sand, 29% silt, 70% clay at 5.3 m.											
			- Soft from 5.8 m to 6.1 m.											
			- Trace coarse sand below 6.9 m.					S5						
			- Soft below 7.3 m.											
			- Trace sand and gravel below 7.6 m.											
								S6						
								S7						
			- Trace to some silt below 10.4 m.					S8						

KGS_LOG_C:\USERS\KFORDYCE\DESKTOP\FMS\25-0107-002\ARMSTRONG LOGS (REVISED WL NOTES).GPJ

CLIENT	CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Detailed Design and CA/CI	SURFACE ELEV.	231.32 m
LOCATION	Winnipeg, Manitoba	START DATE	5-27-2025
DESCRIPTION	Westbound curb lane at 707 Leila Ave	UTM (m)	N 5,534,756.13
DRILL RIG / HAMMER	Acker Renegade Track Mounted Drill Rig with Auto-Hammer		E 633,631.58 Zone 14
METHOD(S)	0.0 m to 0.3 m: 200 mm ø SSA 0.3 m to 17.7 m: 125 mm ø SSA		



WATER LEVELS	▼ Upon Completion	on 4-27-2025 None Encountered	CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR S. SCHULTZ
			APPROVED K. FORDYCE	DATE 10-14-2025

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	<div> <div>PL</div> <div>MC</div> <div>LL</div> </div> <div>Cu TORVANE (kPa) ◆</div> <div>qu POCKET PEN (kPa) ★</div> <div>SPT (N) BLOWS/0.30 m ▲</div>		
					DIAGRAM	DEPTH (m)								
219	40		SILT TILL - Light brown, damp, compact, low plasticity, with sand, some clay, trace gravel. - LL=19, PL=12, PI=7 at 13.1 m. - PSA: 6% gravel, 30% sand, 48% silt, 16% clay at 13.1 m. - Light brown-grey below 13.3 m. - Grey below 13.7 m. - PSA: 4% gravel, 34% sand, 46% silt, 16% clay at 16.2 m. - Dry to damp, very dense below 16.8 m.	ELEV (m) 219.2 213.6		S11 S12 S13 S14 S15 S16 S17 S18 S19	21 54 42 25	7 7 5 5 6 6 10 12 6 6 8 8 7 10 36 50	12 16 14 46	<div> <div>PL</div> <div>MC</div> <div>LL</div> </div> <div>Cu TORVANE (kPa) ◆</div> <div>qu POCKET PEN (kPa) ★</div> <div>SPT (N) BLOWS/0.30 m ▲</div>				
218	45													
217	45													
216	50													
215	55													
214	55													
213	60													
212	65													
211	65													
210	70													
209	75													
208	75													
207	80													
206	85													
205	85													
Notes: 1. End of test hole at 17.7 m. 2. Refusal encountered in silt till at a depth of 17.7 m. 3. Test hole caved to 10.4 m upon completion of drilling/digging. 4. Test hole backfilled with grout. 5. Grout mix consisted of 3 part cement, 1 part bentonite, 1 part water. 6. Flush mount well cover installed at surface.														

WATER LEVELS ▼ Upon Completion on 4-27-2025 None Encountered

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
S. SCHULTZ

APPROVED
K. FORDYCE

DATE
10-14-2025

CLIENT	CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Detailed Design and CA/CI	SURFACE ELEV.	230.88 m
LOCATION	Winnipeg, Manitoba	START DATE	5-28-2025
DESCRIPTION	Westbound curb lane at 595 Leila Ave	UTM (m)	N 5,534,560.52
DRILL RIG / HAMMER	Acker Renegade Track Mounted Drill Rig with Auto-Hammer		E 634,048.56 Zone 14
METHOD(S)	0.0 m to 1.5 m: 200 mm ø SSA 1.5 m to 17.1 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL			SPT (N) BLOWS/0.30 m ▲
					DIAGRAM	DEPTH (m)						Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★			
ELEV (m)															
			ASPHALT - 89 mm, Black, dry.	230.8											
			CONCRETE - 216 mm, White, dry.	230.6											
230	1.0		CLAY FILL - Black, damp, trace silt, some sand, with to some gravel.	230.0				S1							
	5		CONCRETE - White, dry.	229.4											
229	2.0		CLAY (CL) - Light brown, damp, low plasticity, and silt.	228.6				S2							
228	3.0		CLAY (CH) - Mottled grey/brown, moist, stiff, high plasticity, trace silt pockets (5 mm in diameter), trace fine gravel.					S3							
	10		- Firm, trace gypsum below 3.0 m.												
227	4.0							S4							
226	5.0		- LL=93, PL=28, PI=65 at 5.2 m.					S5							
225	6.0		- Grey, trace oxidation, trace silt inclusions, trace coarse sand below 6.1 m.												
224	7.0		- Mottled grey-brown, some silt from 6.7 m to 7.2 m.					S6							
	25		- Soft below 7.4 m.												
223	8.0		- Very soft from 8.2 m to 9.1 m.					S7							
222	9.0														
221	10.0		- LL=88, PL=35, PI=53 at 9.8 m.					S8							
	35		- PSA: 0% gravel, 6% sand, 31% silt, 63% clay at 9.8 m.												
220	11.0							S9							
219															

WATER ▼ Upon Completion

LEVELS

17.07 m on 5-28-2025

CONTRACTOR

Maple Leaf Drilling Ltd.

APPROVED

K. FORDYCE

INSPECTOR

S. SCHULTZ

DATE

10-14-2025

WATER LEVELS ▼ Upon Completion 17.07 m on 5-28-2025

CONTRACTOR
Maple Leaf Drilling Ltd.

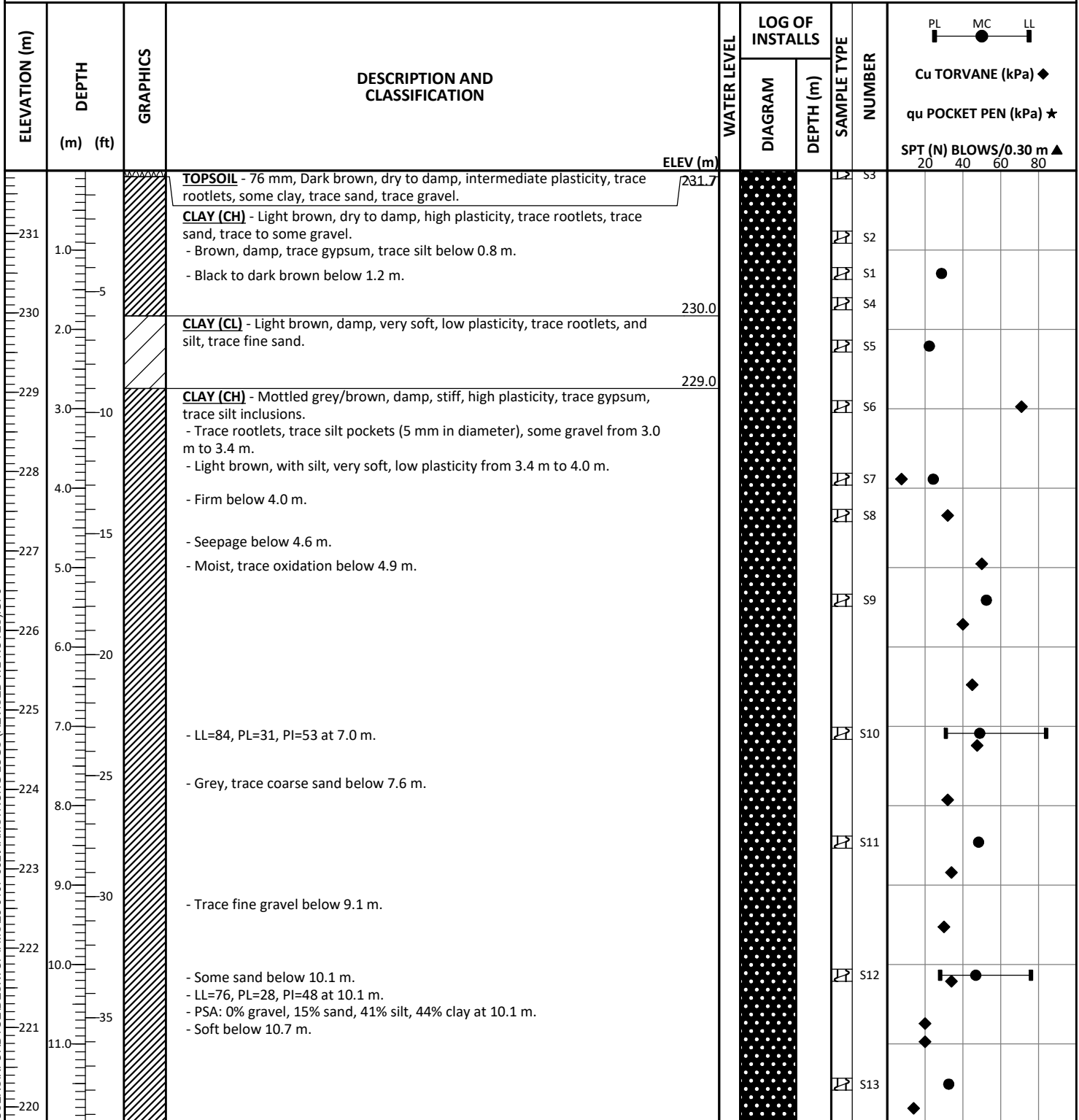
INSPECTOR
S. SCHULTZ

APPROVED
K. FORDYCE

DATE
10-14-2025

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲			
					DIAGRAM	DEPTH (m)						20	40	60	80
218	13.0		- Some sand, some gravel below 13.7 m.		Vibrating Wire VW201642	12.06						◆			
217	14.0						⊔	S10				◆		●	
216	15.0			215.9			⊔	S11				◆			
215	16.0		SILT TILL - Light brown, damp, compact, low plasticity, with sand , some gravel, some clay.				⊔	S12							
214	17.0		- PSA: 18% gravel, 29% sand, 37% silt, 16% clay at 16.2 m.	213.8	Vibrating Wire VW202426	16.64	⊔	S13		22 45 50/ 30mm		●			
213	18.0		Notes: 1. End of test hole at 17.1 m. 2. Refusal encountered in silt till at a depth of 17.1 m. 3. Test hole remained open to 17.1 m upon completion of drilling/digging. 4. Test hole backfilled with grout. 5. Grout mix consisted of 3 part cement, 1 part bentonite, 1 part water. 6. Flush mount well cover installed at surface.			17.09	▲	S14	100		+100				>>▲
212	19.0														
211	20.0														
210	21.0														
209	22.0														
208	23.0														
207	24.0														
206	25.0														
205	26.0														
WATER LEVELS ▼ Upon Completion 17.07 m on 5-28-2025					CONTRACTOR Maple Leaf Drilling Ltd.					INSPECTOR S. SCHULTZ					
					APPROVED K. FORDYCE					DATE 10-14-2025					

CLIENT	CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Detailed Design and CA/CI	SURFACE ELEV.	231.79 m
LOCATION	Winnipeg, Manitoba	START DATE	5-26-2025
DESCRIPTION	In the median southeast of the Leila Ave	UTM (m)	N 5,534,369.32
DRILL RIG / HAMMER	Mobile B54X Track Mounted Drill Rig with Auto-Hammer		E 634,373.5 Zone 14
METHOD(S)	0.0 m to 17.5 m: 125 mm ø SSA		



WATER LEVELS	▼ Upon Completion	12.80 m on 5-26-2025	CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR S. SCHULTZ
			APPROVED K. FORDYCE	DATE 10-14-2025

KGS LOG C:\USERS\KFOR\DESKTOP\FMS\25-0107-002\ARMSTRONG LOGS (REVISED WL NOTES).GPJ

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	<div> <div>PL</div> <div>MC</div> <div>LL</div> </div> Cu TORVANE (kPa) ◆			qu POCKET PEN (kPa) ★			SPT (N) BLOWS/0.30 m ▲																																											
					DIAGRAM	DEPTH (m)																																																				
219	13.0		- Very soft below 14.2 m.			14.17	S14																																																			
218	14.0																		14.17	S15																																						
217	15.0																																14.17	S16																								
216	16.0																																														14.17	S17										
215	17.0																																																									
215.3			SILT TILL - Light brown, moist, compact, low plasticity, with sand, some clay, trace gravel. - PSA: 5% gravel, 30% sand, 50% silt, 15% clay at 16.6 m.																																																							
214.3			Notes: 1. End of test hole at 17.5 m. 2. Refusal encountered in silt till at a depth of 17.5 m. 3. Test hole caved to 14.9 m upon completion of drilling/digging. 4. Test hole backfilled with grout. 5. Grout mix consisted of 3 part cement, 1 part bentonite, 1 part water. 6. Flush mount well cover installed at surface.																																																							
214	18.0																																																									
213	19.0																																																									
212	20.0																																																									
211	21.0																																																									
210	22.0																																																									
209	23.0																																																									
208	24.0																																																									
207	25.0																																																									
206	26.0																																																									

WATER LEVELS ▼ Upon Completion

12.80 m on 5-26-2025

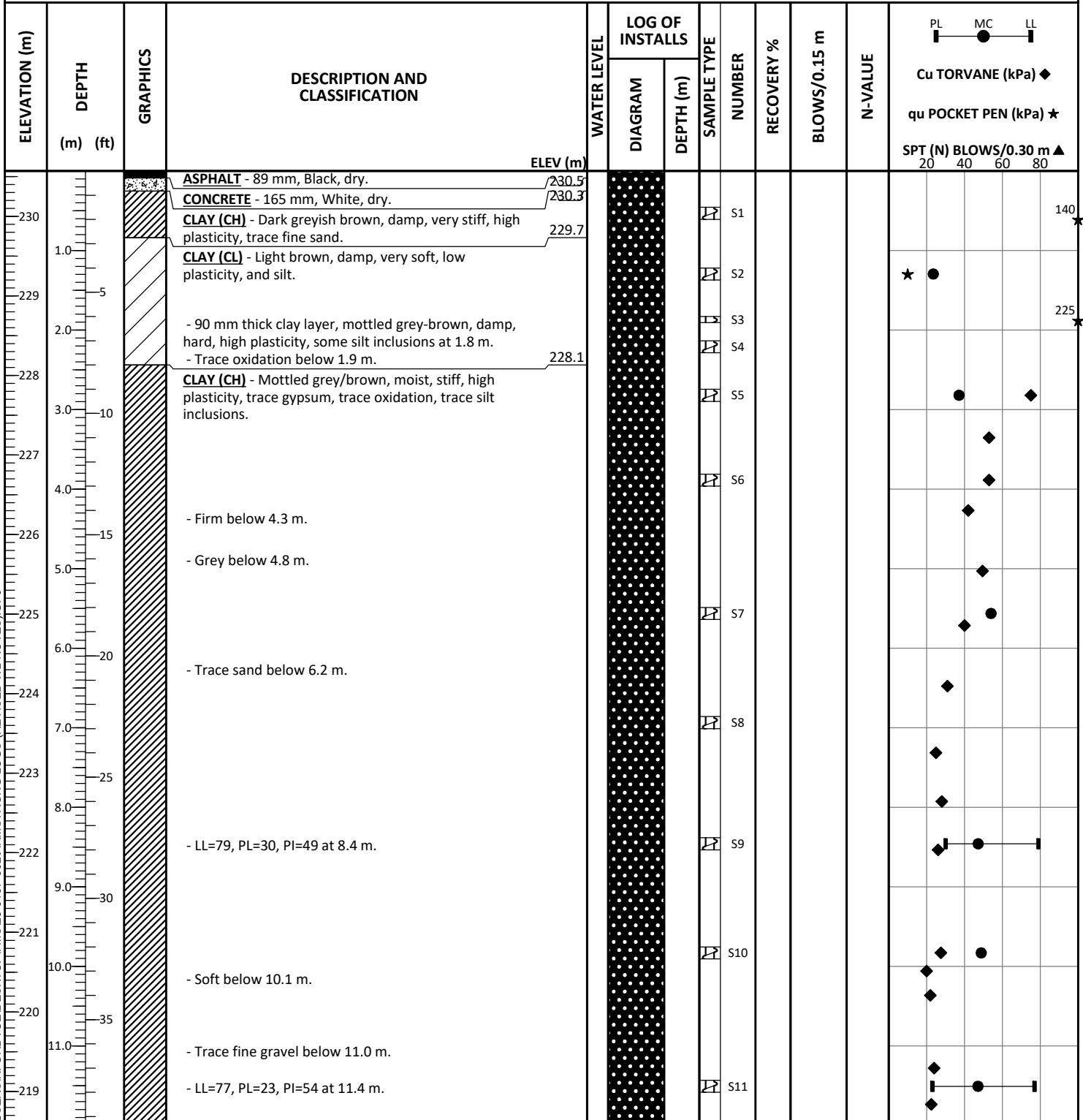
CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
S. SCHULTZ







APPROVED
K. FORDYCE

DATE
10-14-2025

CLIENT	CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Detailed Design and CA/CI	SURFACE ELEV.	230.57 m
LOCATION	Winnipeg, Manitoba	START DATE	5-30-2025
DESCRIPTION	Westbound curb lane at 313 Leila Ave	UTM (m)	N 5,534,122.42
DRILL RIG / HAMMER	Acker Renegade Track Mounted Drill Rig with Auto-Hammer		E 634,952.71 Zone 14
METHOD(S)	0.0 m to 0.1 m: 200 mm ø SSA 0.1 m to 18.3 m: 125 mm ø SSA		



WATER LEVELS	▼ Upon Completion	on 5-30-2025 None Encountered	CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR S. SCHULTZ
			APPROVED K. FORDYCE	DATE 10-14-2025

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL					
					DIAGRAM	DEPTH (m)						Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80					
218	13.0		- Trace coarse gravel below 13.6 m.														
217	14.0																
216	15.0						14.66										
215	16.0																
214	17.0																
213	18.0		<u>SILT TILL</u> - Light brown, damp, compact, low plasticity, with clay, some sand, trace gravel.	213.7			17.53										
212	18.31																
211	20.0		Notes: 1. End of test hole at 18.3 m. 2. Refusal encountered in silt till at a depth of 18.3 m. 3. Test hole remained open to 18.3 m upon completion of drilling/digging. 4. Test hole backfilled with grout. 5. Grout mix consisted of 3 part cement, 1 part bentonite, 1 part water. 6. Flush mount well cover installed at surface.	212.3			18.31		79	9 32 22 50/ 30mm	+100					>>▲	
210	21.0																
209	22.0																
208	23.0																
207	24.0																
206	25.0																
205	26.0																

WATER LEVELS ▼ Upon Completion	on 5-30-2025 None Encountered	CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR S. SCHULTZ
		APPROVED K. FORDYCE	DATE 10-14-2025

WATER LEVELS ▼ Upon Completion

on 5-30-2025 None Encountered

CONTRACTOR
Maple Leaf Drilling Ltd.INSPECTOR
S. SCHULTZAPPROVED
K. FORDYCEDATE
10-14-2025

CLIENT	CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Detailed Design and CA/CI	SURFACE ELEV.	230.59 m
LOCATION	Winnipeg, Manitoba	START DATE	6-2-2025
DESCRIPTION	Southbound curb lane along Aikins St next to 260 Leila Ave	UTM (m)	N 5,534,002.41
DRILL RIG / HAMMER	Acker Renegade Track Mounted Drill Rig with Auto-Hammer		E 635,155.48 Zone 14
METHOD(S)	0.0 m to 0.2 m: 200 mm ø SSA 0.2 m to 20.0 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL			
					DIAGRAM	DEPTH (m)						Cu TORVANE (kPa) ◆	qu POCKET PEN (kPa) ★	SPT (N) BLOWS/0.30 m ▲	
			ELEV (m)									20	40	60	80
			CONCRETE - 203 mm, White, dry.												
230	1.0		CLAY (CH) - Dark greyish brown, damp, stiff, high plasticity, trace organics.					S1							
			- Brown, trace gypsum, trace to some silt inclusion below 0.9 m.					S2							
229	5							S3							
	2.0		CLAY (CL) - Light brown, damp, soft, low plasticity, and silt, trace oxidation.					S4							
228			- Very soft, trace clay from 1.8 m to 2.4 m.												
	3.0		- LL=27, PL=18, PI=9 at 2.3 m.												
			- Soft below 2.4 m.					S5							
227															
	4.0		CLAY (CH) - Brown, moist, firm, high plasticity, trace gypsum, trace oxidation, trace silt inclusions.					S6							
226			- Mottled grey-brown below 3.9 m.												
	5.0							S7							
225	6.0		- Grey below 5.9 m.												
	7.0		- Soft below 6.7 m.					S8							
			- Trace fine gravel below 6.9 m.												
223	25		- Mottled grey-brown below 7.6 m.												
	8.0							S9							
222			- LL=84, PL=34, PI=50 at 8.2 m.												
	9.0														
221	30							S10							
	10.0							S12							
220			- 2 mm thick light brown silt layer at 10.7 m.					S11							
			- Trace sand below 10.7 m.												
	11.0		- 2 mm thick light brown silt layer at 10.9 m.												
219															






WATER LEVELS ▼ Upon Completion on 6-2-2025 None Encountered

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
S. SCHULTZ

APPROVED
K. FORDYCE

DATE
10-14-2025

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL			Cu TORVANE (kPa) ◆	qu POCKET PEN (kPa) ★	SPT (N) BLOWS/0.30 m ▲															
					DIAGRAM	DEPTH (m)						20 40 60 80																				
218	13.0		- Very soft.					S13						◆		●																
217	14.0																															
216	15.0																						S15						◆			
215	16.0																						S14						◆			
214	17.0																						S16						◆			
213	18.0		- Some sand.	211.4				S17					◆	◆		●																
212	19.0																															
211	20.0																		SILT TILL - Light brown, damp, compact, low plasticity, with sand, some clay, trace gravel.	210.6			S18						◆			
210	21.0																		Notes: 1. End of test hole at 20.0 m. 2. Refusal encountered in silt till at a depth of 20.0 m. 3. Test hole caved to 12.2 m upon completion of drilling/digging. 4. Test hole backfilled with grout. 5. Grout mix consisted of 3 part cement, 1 part bentonite, 1 part water. 6. Flush mount well cover installed at surface.				S19	36	50/ 140mm	+100		●				>>
209	22.0																															
208	23.0																															
207	24.0																															
206	25.0																															
205	26.0																															

WATER LEVELS

▼ Upon Completion

on 6-2-2025 None Encountered

CONTRACTOR

Maple Leaf Drilling Ltd.

INSPECTOR

S. SCHULTZ

APPROVED

K. FORDYCE

DATE

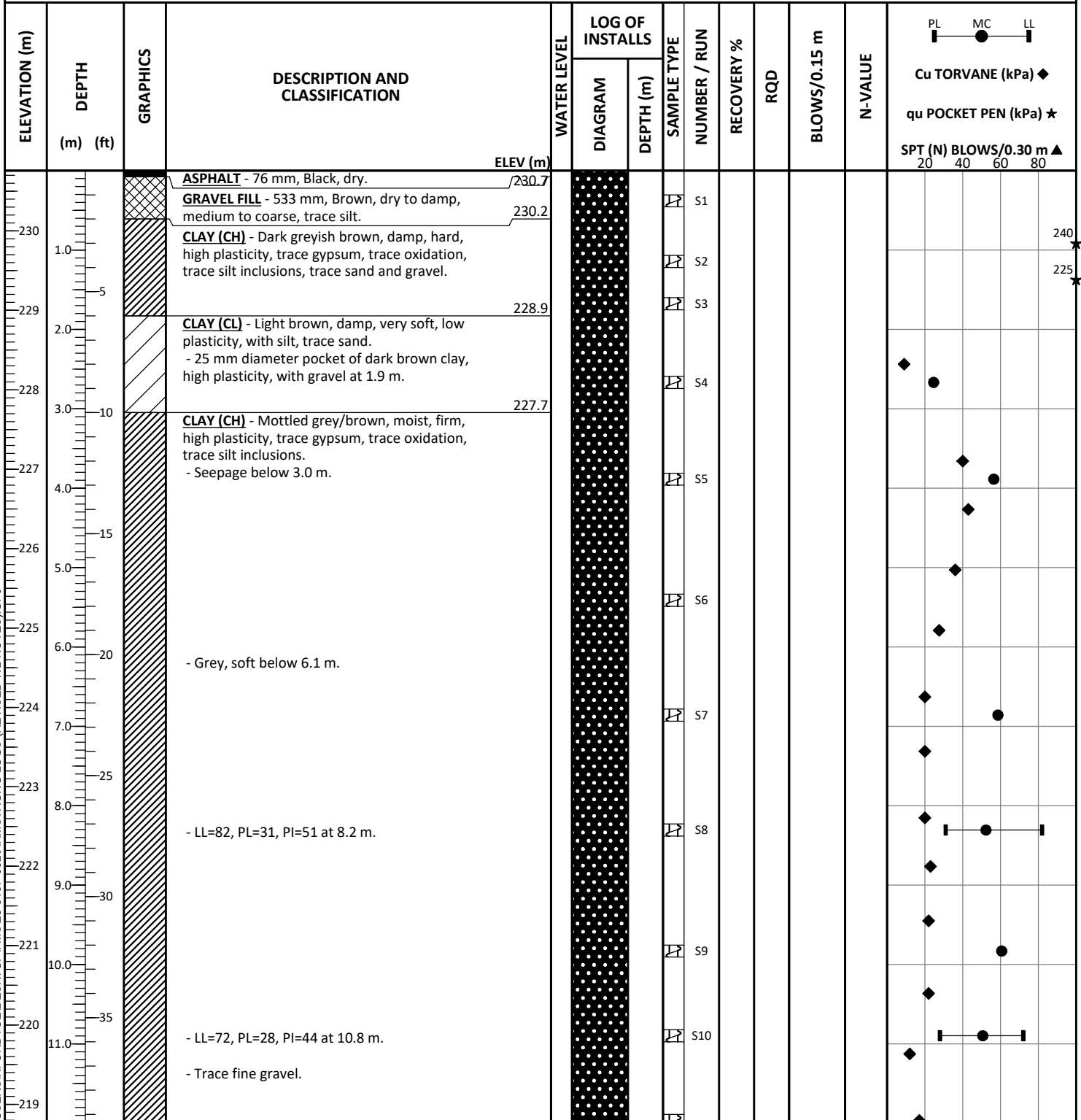
10-14-2025

WATER LEVELS ▼ Upon Completion

on 6-2-2025 None Encountered

CONTRACTOR
Maple Leaf Drilling Ltd.INSPECTOR
S. SCHULTZAPPROVED
K. FORDYCEDATE
10-14-2025

CLIENT	CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Detailed Design and CA/CI	SURFACE ELEV.	230.76 m
LOCATION	Winnipeg, Manitoba	START DATE	6-3-2025
DESCRIPTION	Westbound curb lane at 256 Armstrong Ave	UTM (m)	N 5,534,178.31
DRILL RIG / HAMMER	Acker Renegade Track Mounted Drill Rig with Auto-Hammer		E 635,235.19 Zone 14
METHOD(S)	0.0 m to 0.3 m: 200 mm ø SSA 0.3 m to 20.3 m: 125 mm ø SSA 20.3 m to 23.2 m: Triple Tube, HQ Core		



WATER LEVELS ▼ Upon Completion on 6-3-2025 None Encountered

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
S. SCHULTZ

APPROVED
K. FORDYCE

DATE
10-14-2025

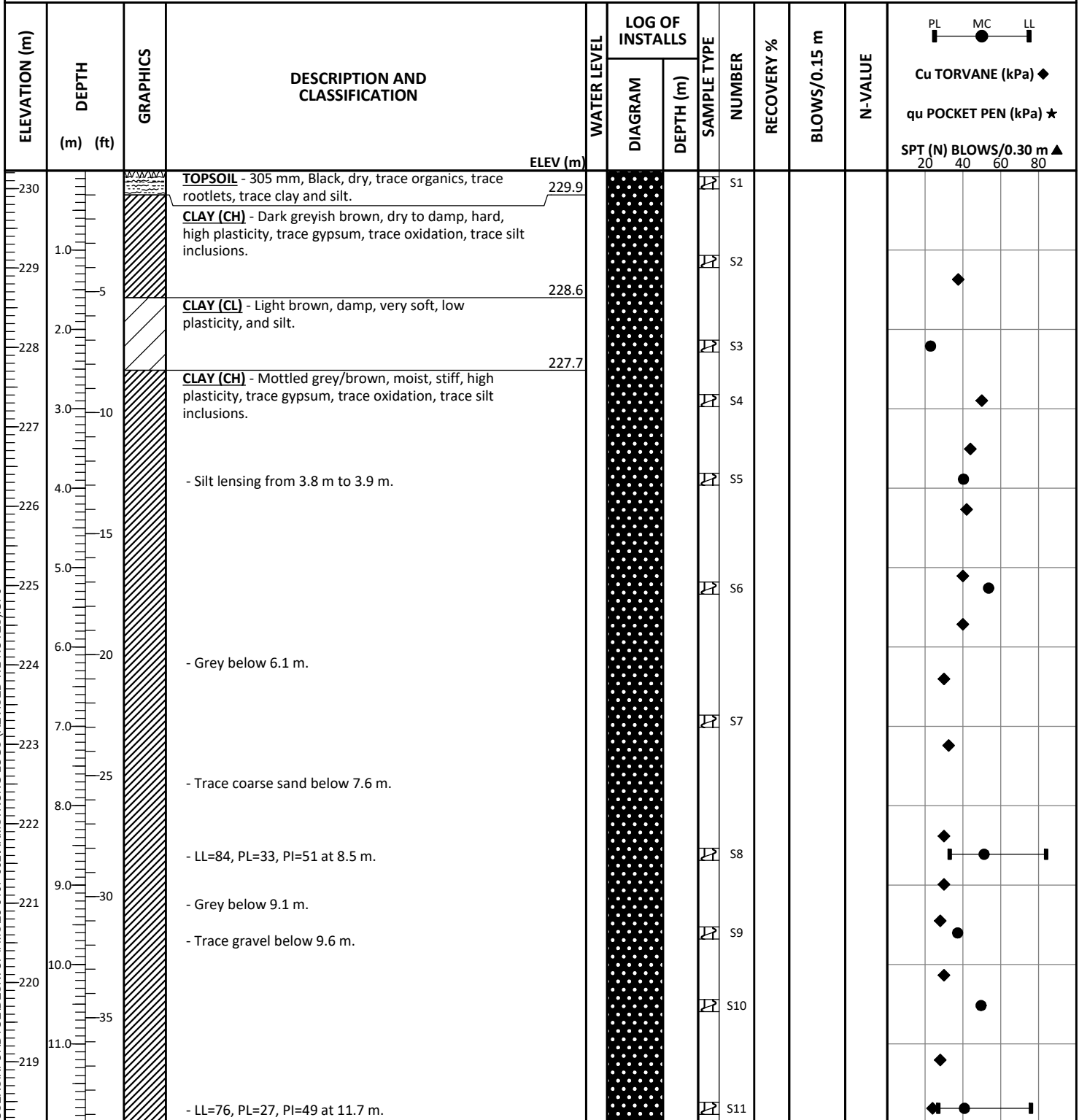
ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER / RUN	RECOVERY %	RQD	BLOWS/0.15 m	N-VALUE	PL MC LL			
					DIAGRAM	DEPTH (m)							Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲			
				ELEV (m)												
								S11								
								S12								
								S13								
								S14								
								S15								
								S16								
								S17								
								S18								

WATER LEVELS ▼ Upon Completion

on 6-3-2025 None Encountered

CONTRACTOR
Maple Leaf Drilling Ltd.INSPECTOR
S. SCHULTZAPPROVED
K. FORDYCEDATE
10-14-2025

CLIENT	CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Detailed Design and CA/CI	SURFACE ELEV.	230.23 m
LOCATION	Winnipeg, Manitoba	START DATE	6-4-2025
DESCRIPTION	East of Main St in greenspace of Kildonan Park.	UTM (m)	N 5,534,096.82
DRILL RIG / HAMMER	Acker Renegade Track Mounted Drill Rig with Auto-Hammer		E 635,483.92 Zone 14
METHOD(S)	0.0 m to 21.0 m: 125 mm ø SSA		



WATER LEVELS ▼ Upon Completion on 6-4-2025 None Encountered

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
S. SCHULTZ

APPROVED
K. FORDYCE

DATE
10-14-2025

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL			
					DIAGRAM	DEPTH (m)						Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲			
218	40														
13.0								S12							
217															
45															
14.0			- Trace sandy silt inclusions below 14.0 m.					S13							
216															
50															
15.0															
215															
16.0															
214															
55															
17.0															
213															
212.5															
18.0			SILT TILL - Light brown, damp, compact, low plasticity, with sand, some clay, trace gravel.												
212															
19.0															
211															
65			- LL=18, PL=11, PI=7 at 19.6 m. - PSA: 5% gravel, 27% sand, 53% silt, 15% clay at 19.6 m.												
210			- Some to with coarse angular gravel below 20.4 m.												
20.0															
210															
65															
21.0			- Dense below 20.8 m.												
209															
70			Notes: 1. End of test hole at 21.0 m. 2. Refusal encountered in silt till at a depth of 21.0 m. 3. Test hole caved to 20.4 m upon completion of drilling/digging. 4. Test hole backfilled with grout. 5. Grout mix consisted of 3 part cement, 1 part bentonite, 1 part water. 6. Flush mount well cover installed at surface.												
22.0															
208															
75															
23.0															
207															
80															
24.0															
206															
85															
25.0															
205															
26.0															
85															

WATER LEVELS

▼ Upon Completion

on 6-4-2025 None Encountered

CONTRACTOR

Maple Leaf Drilling Ltd.

APPROVED

K. FORDYCE

INSPECTOR

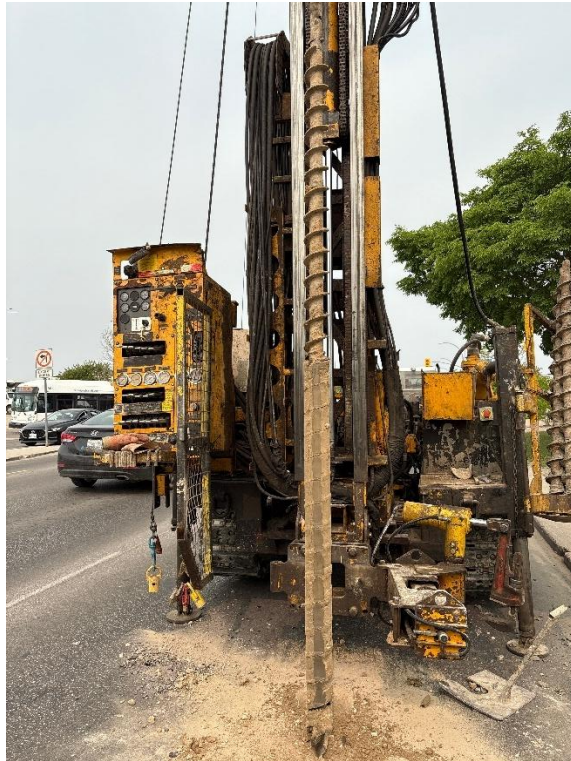
S. SCHULTZ

DATE

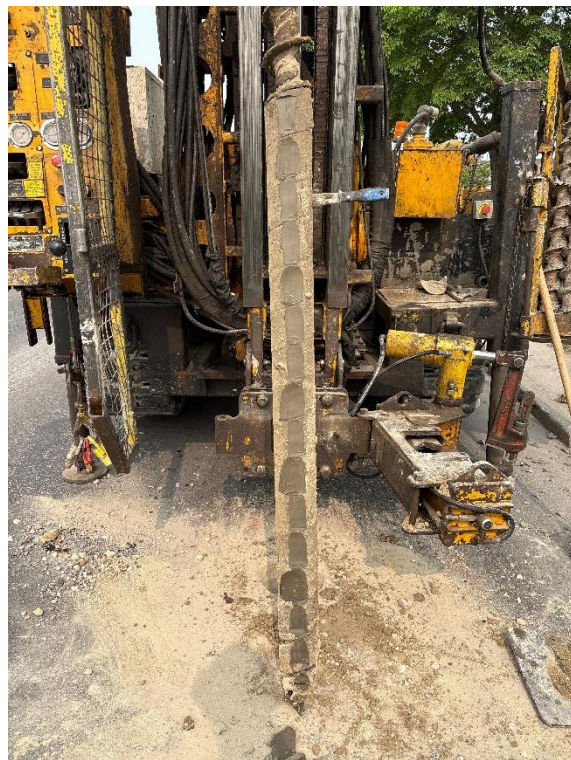
10-14-2025

APPENDIX D

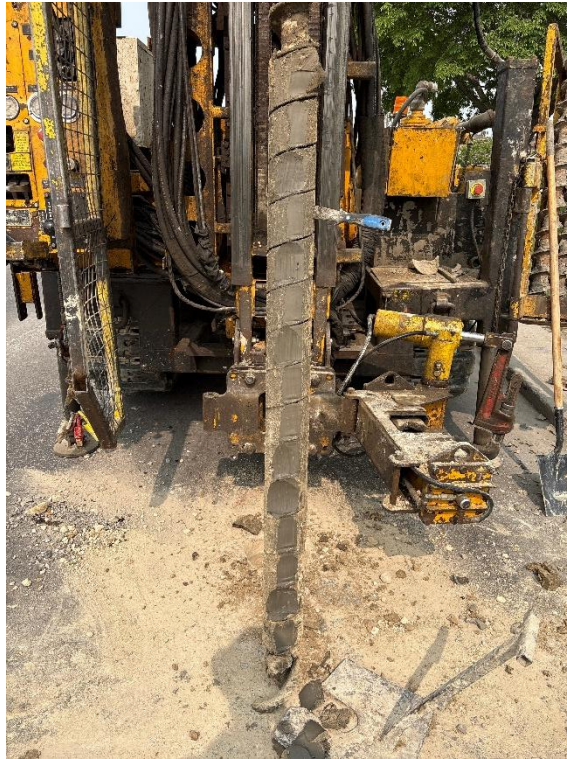
2025 Select Drilling Photos



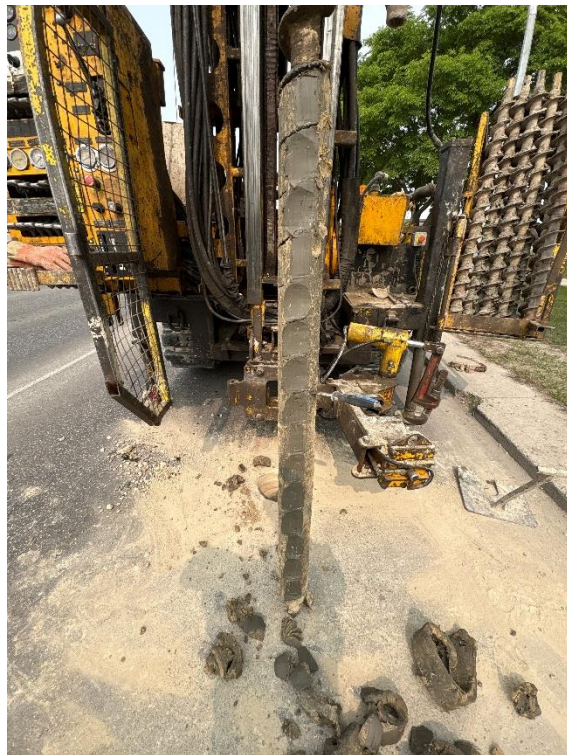
TH25-01 Photo 1: 1.5 to 3.0 m (5 to 10 ft)



TH25-01 Photo 2: 3.0 to 4.5 m (10 to 15 ft)



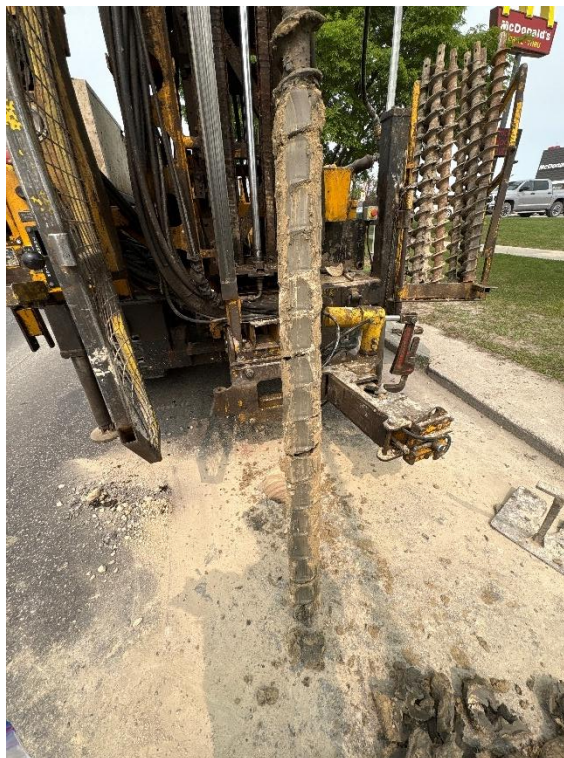
TH25-01 Photo 3: 4.5 to 6.0 m (15 to 20 ft)



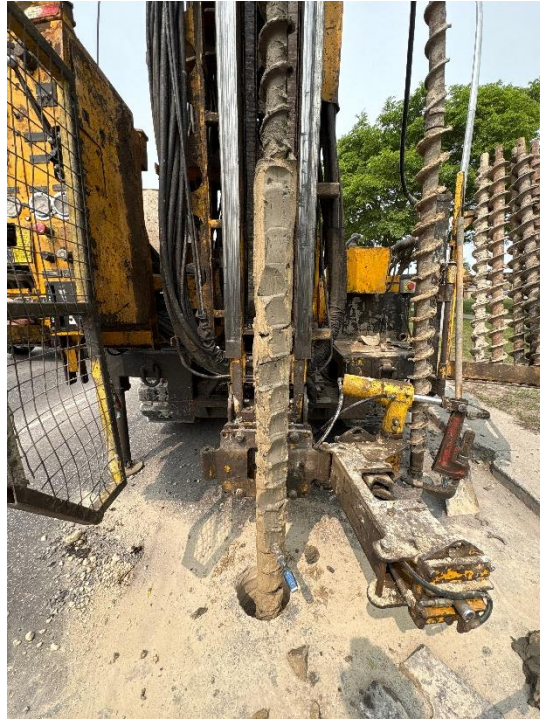
TH25-01 Photo 4: 6.0 to 7.5 m (20 to 25 ft)



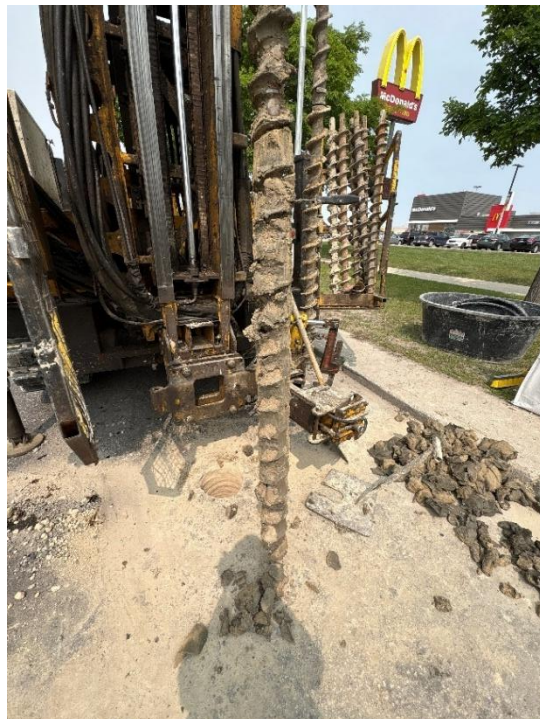
TH25-01 Photo 5: 7.5 to 9.0 m (25 to 30 ft)



TH25-01 Photo 6: 10.5 to 12 m (35 to 40 ft)



TH25-01 Photo 7: 12 to 13.5 m (40 to 45 ft)

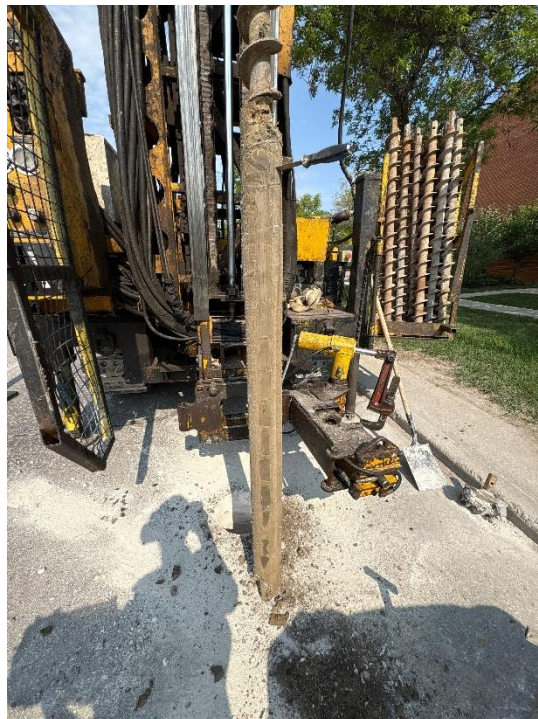


TH25-01 Photo 8: 13.5 to 15.3 m (45 to 50 ft)

****Missing: 0 to 1.5 m (0 to 5 ft)**



TH25-02 Photo 1: 0 to 1.5 m (0 to 5 ft)



TH25-02 Photo 2: 1.5 to 3.0 m (5 to 10 ft)



TH25-02 Photo 3: 3.0 m to 4.5 m (10 ft to 15 ft)



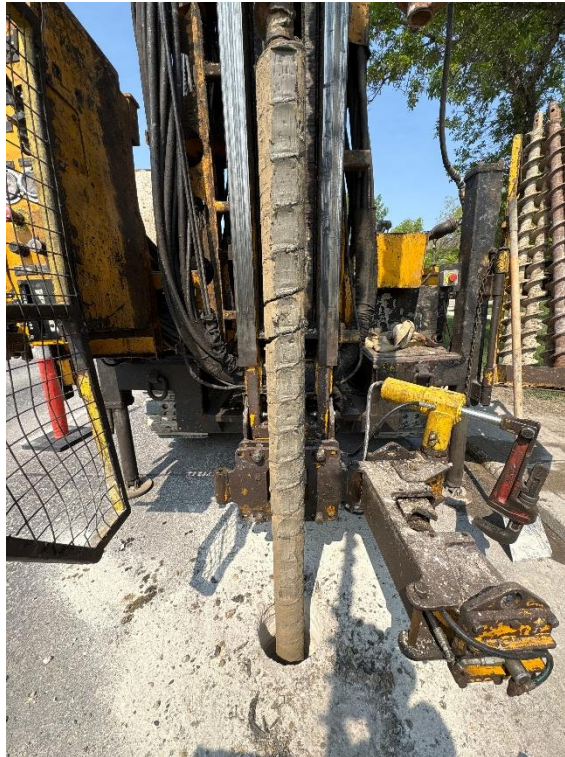
TH25-02 Photo 4: 4.5 to 6.0 m (15 to 20 ft)



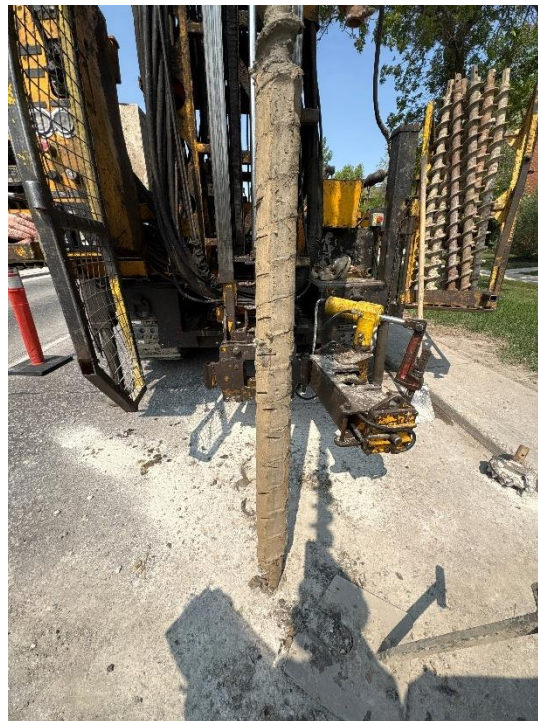
TH25-02 Photo 5: 6.0 to 7.5 m (20 to 25 ft)



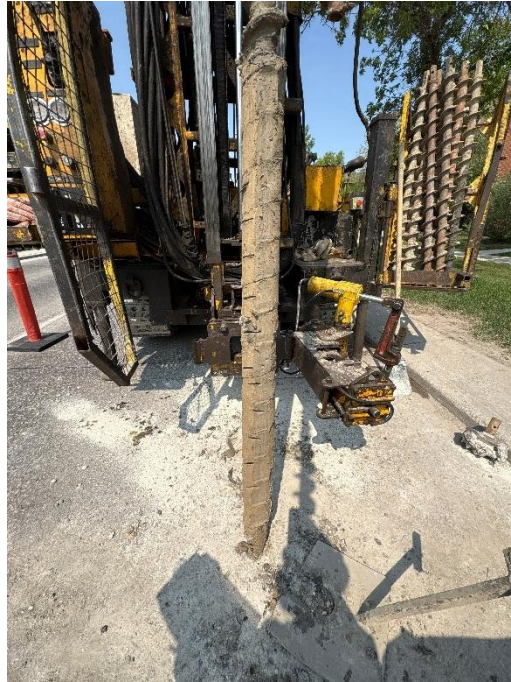
TH25-02 Photo 6: 7.5 to 9.0 m (25 to 30 ft)



TH25-02 Photo 7: 9.0 to 10.5 m (30 to 35 ft)



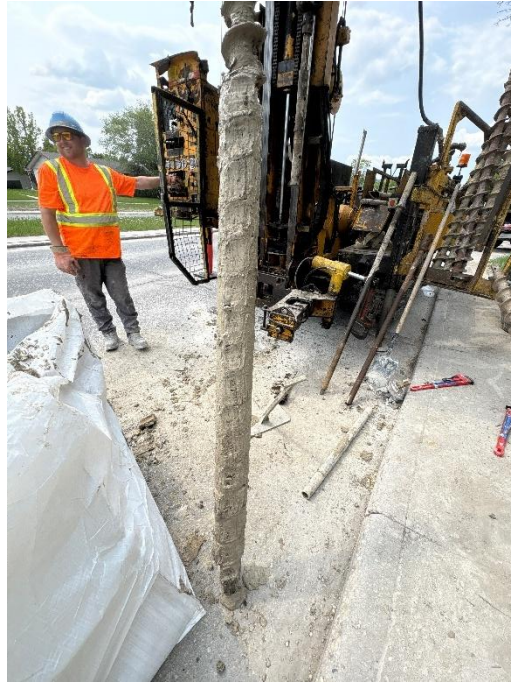
TH25-02 Photo 8: 10.5 to 12 m (35 to 40 ft)



TH25-02 Photo 9: 12 to 13.5 m (40 to 45 ft))



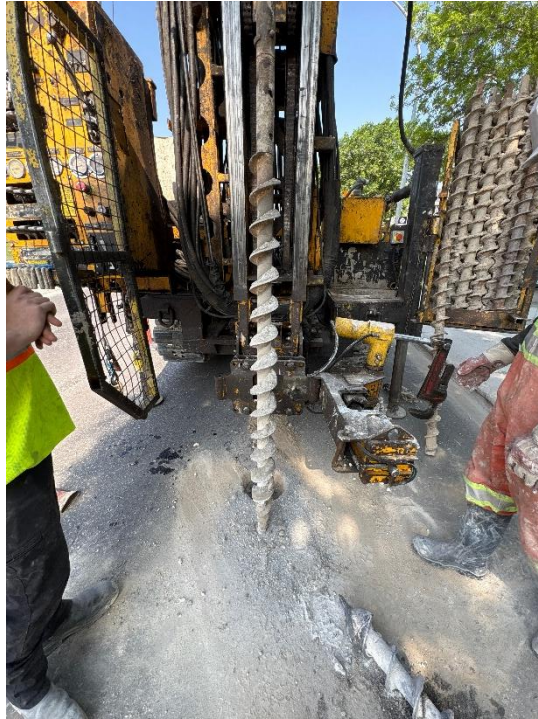
TH25-02 Photo 10: 13.5 to 15 m (45 to 50 ft)



TH25-02 Photo 11: 15 to 16.5 m (50 to 55 ft)



TH25-02 Photo 12: 16.5 to 18 m (55 to 58 ft)



TH25-03 Photo 1: 0 to 1.5 m (0 to 5 ft)



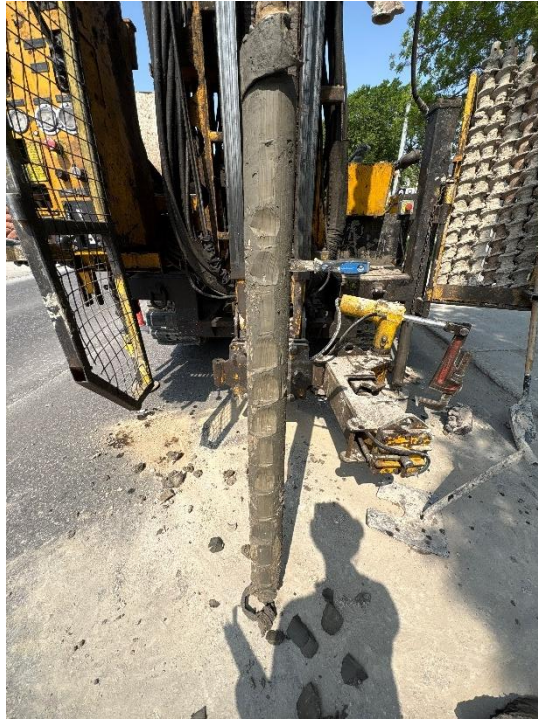
TH25-03 Photo 2: 1.5 to 3.0 m (5 to 10 ft)



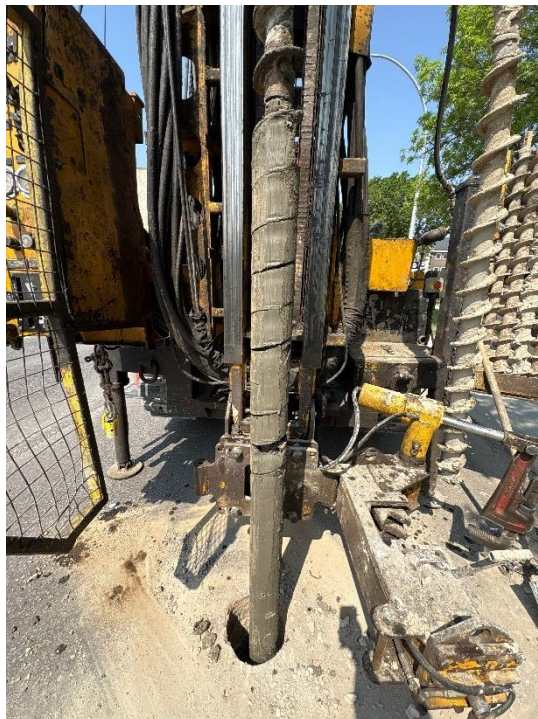
TH25-03 Photo 3: 3.0 to 4.5 m (10 to 15 ft)



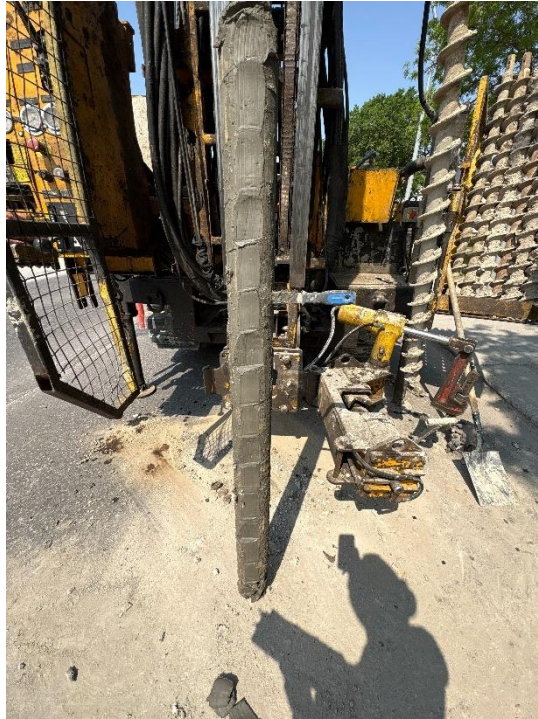
TH25-03 Photo 4: 4.5 to 6.0 m (15 to 20 ft)



TH25-03 Photo 5: 6.0 to 7.5 m (20 to 25 ft)



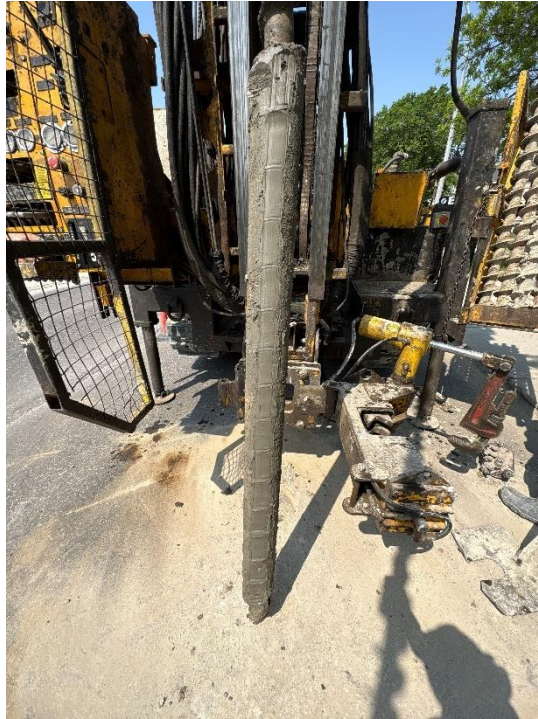
TH25-03 Photo 6: 7.5 to 9.0 m (25 to 30 ft)



TH25-03 Photo 7: 9.0 to 10.5 m (30 to 35 ft)



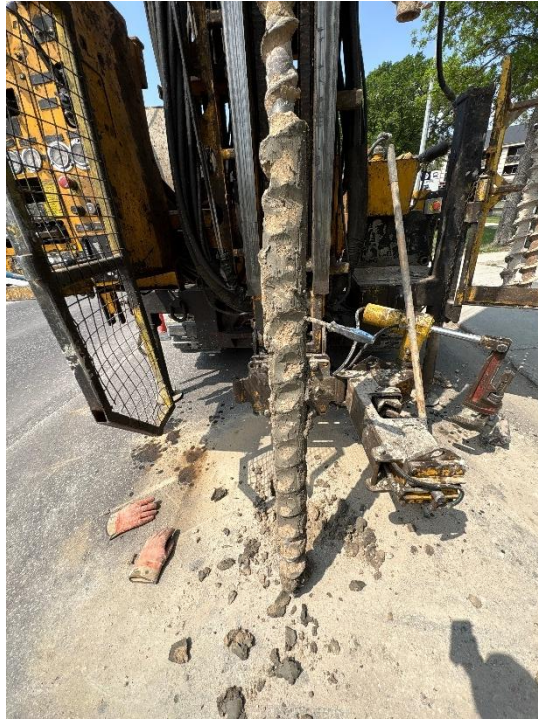
TH25-03 Photo 8: 10.5 to 12 m (35 to 40 ft)



TH25-03 Photo 9: 12 to 13.5 m (40 to 45 ft)



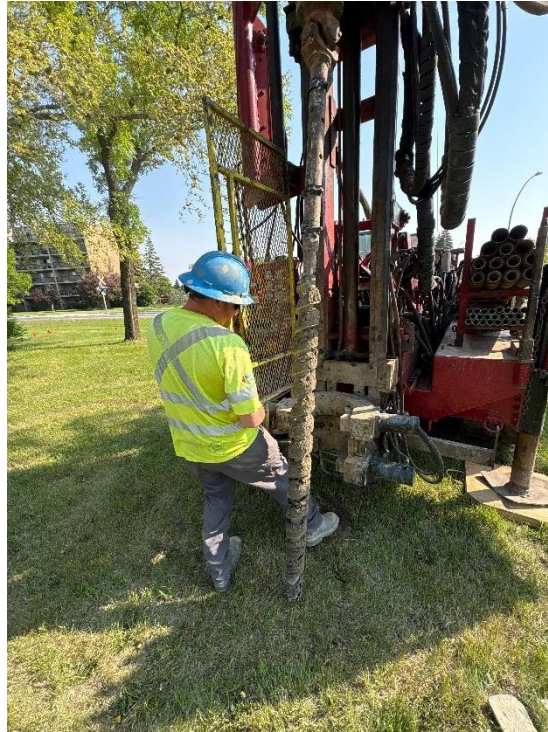
TH25-03 Photo 10: 13.5 to 15 m (45 to 50 ft)



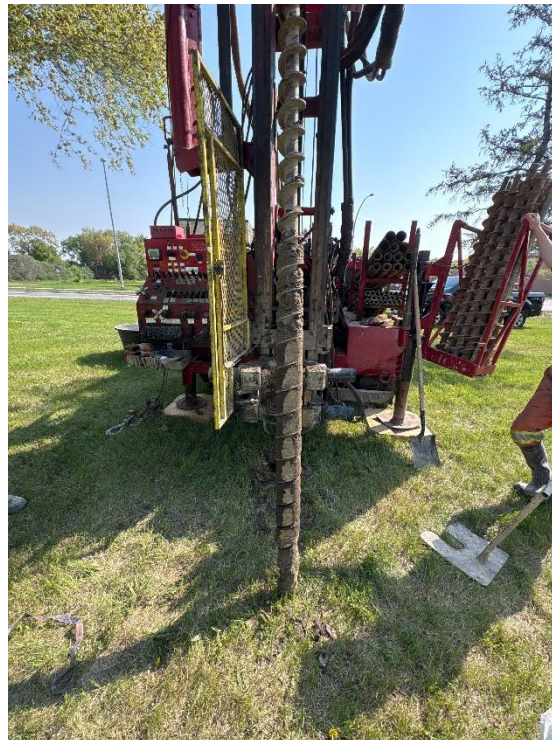
TH25-03 Photo 11: 15 to 16.5 m (50 to 55 ft)



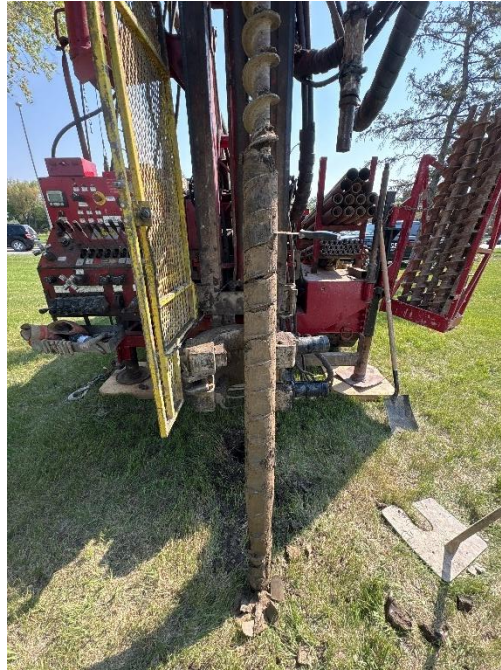
TH25-03 Photo 12: 16.5 to 17.1 m (55 to 56 ft)



TH25-04 Photo 1: 0 to 1.5 m (0 to 5 ft)



TH25-04 Photo 2: 1.5 to 3.0 m (5 to 10 ft)



TH25-04 Photo 3: 3.0 to 4.5 m (10 to 15 ft)



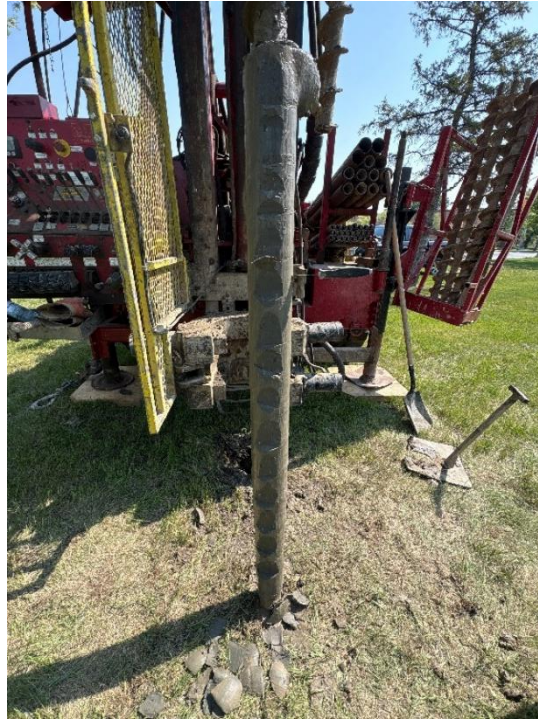
TH25-04 Photo 4: 4.5 to 6.0 m (15 to 20 ft)



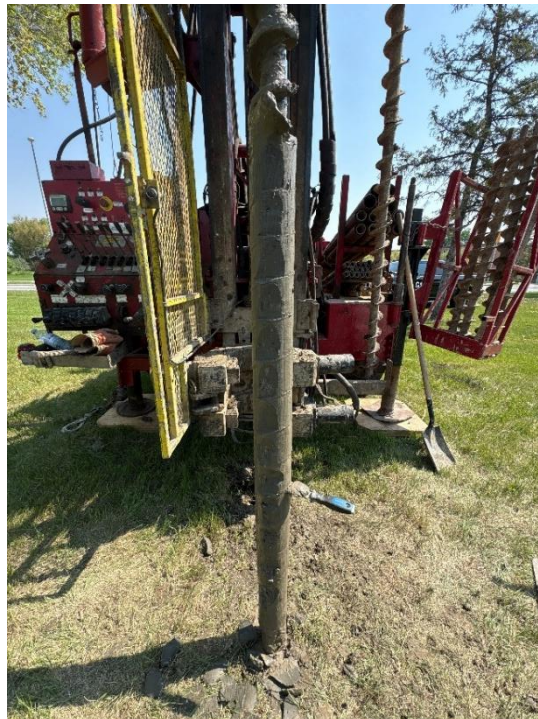
TH25-04 Photo 5: 6.0 to 7.5 m (20 to 25 ft)



TH25-04 Photo 6: 7.5 to 9.0 m (25 to 30 ft)



TH25-04 Photo 7: 9.0 to 10.5 m (30 to 35 ft)



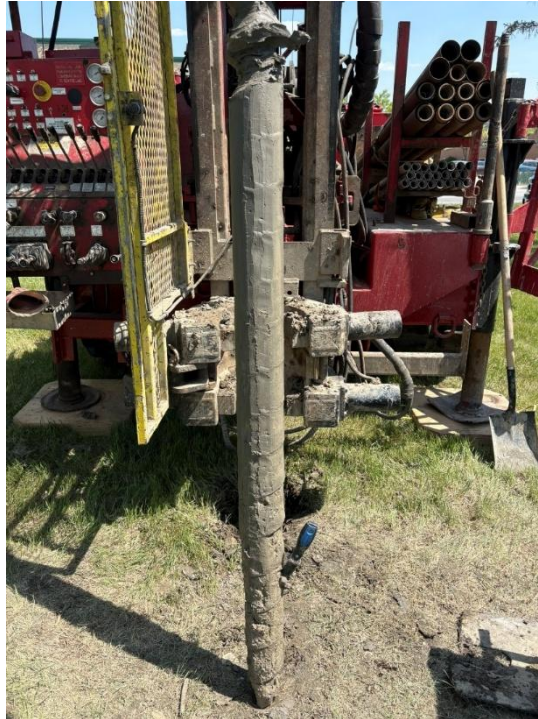
TH25-04 Photo 8: 10.5 to 12 m (35 to 40 ft)



TH25-04 Photo 9: 12 to 13.5 m (40 to 45 ft)



TH25-04 Photo 10: 13.5 to 15 m (45 to 50 ft)



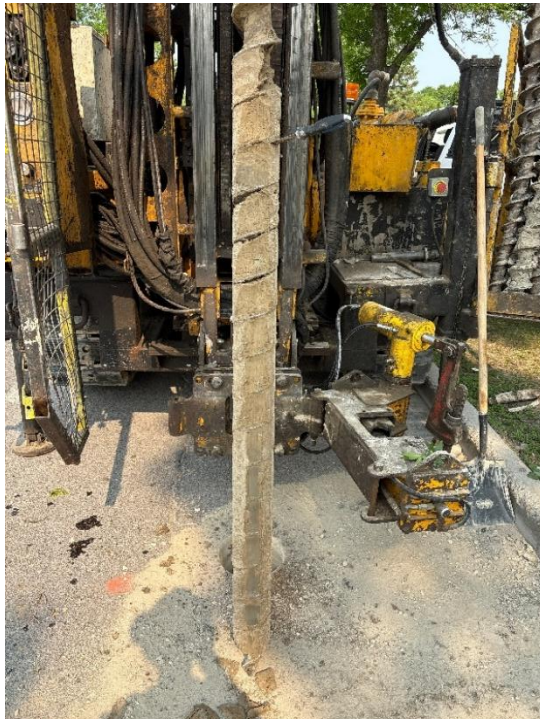
TH25-04 Photo 11: 15 to 16.5 m (50 to 55 ft)



TH25-04 Photo 12: 16.5 to 18 m (55 to 57.5 ft)



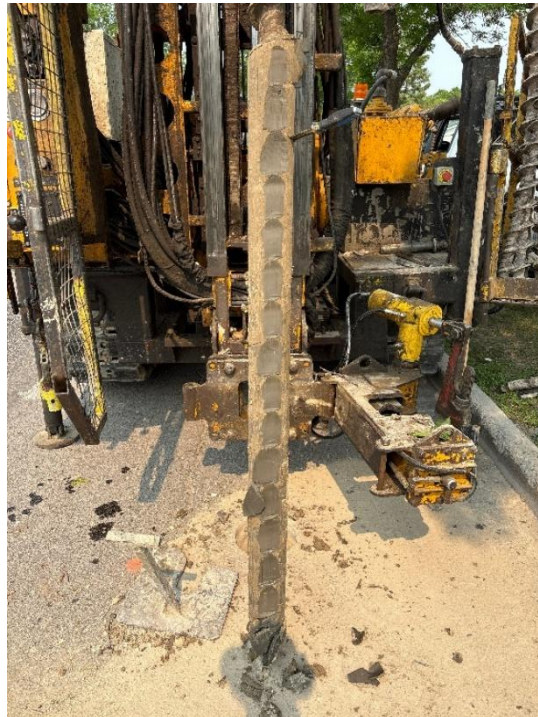
TH25-05 Photo 1: 0 to 1.5 m (0 to 5 ft)



TH25-05 Photo 2: 1.5 to 3.0 m (5 to 10 ft)



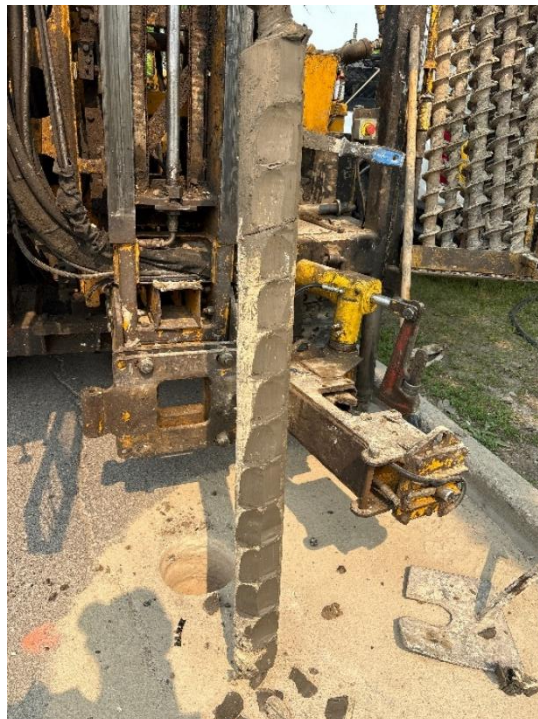
TH25-05 Photo 3: 3.0 to 4.5 m (10 to 15 ft)



TH25-05 Photo 4: 4.5 to 6.0 m (15 to 20 ft)



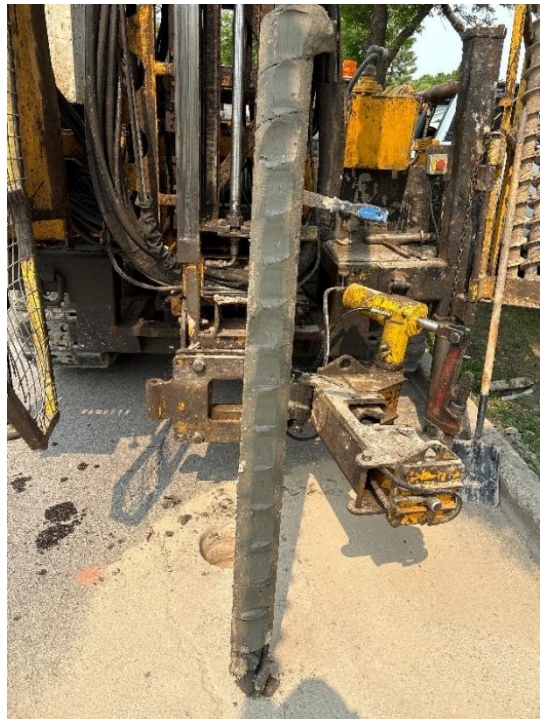
TH25-05 Photo 5: 6.0 to 7.5 m (20 to 25 ft)



TH25-05 Photo 6: 7.5 to 9.0 m (25 to 30 ft)



TH25-05 Photo 7: 9.0 to 10.5 m (30 to 35 ft)



TH25-05 Photo 8: 10.5 to 12 m (35 to 40 ft)



TH25-05 Photo 9: 12 to 13.5 m (40 to 45 ft)



TH25-05 Photo 10: 13.5 to 15 m (45 to 50 ft)



TH25-05 Photo 11: 15 to 16.5 m (50 to 55 ft)



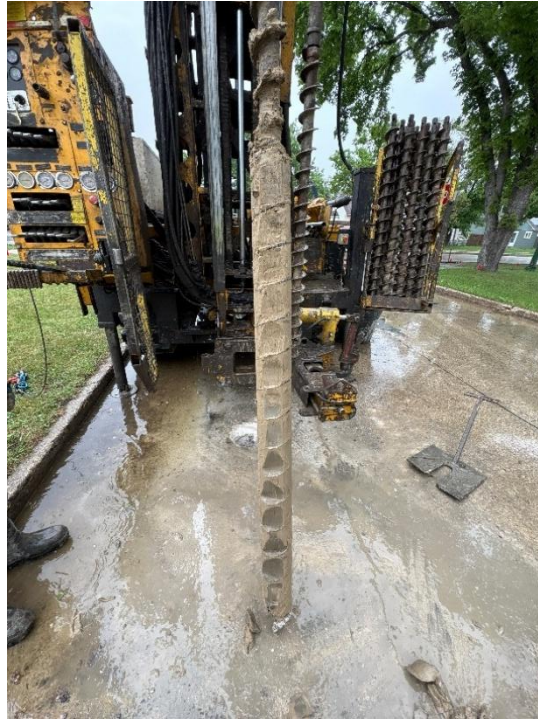
TH25-05 Photo 12: 16.5 to 18 m (55 to 60 ft)



TH25-06 Photo 1: 0 to 1.5 m (0 to 5 ft)



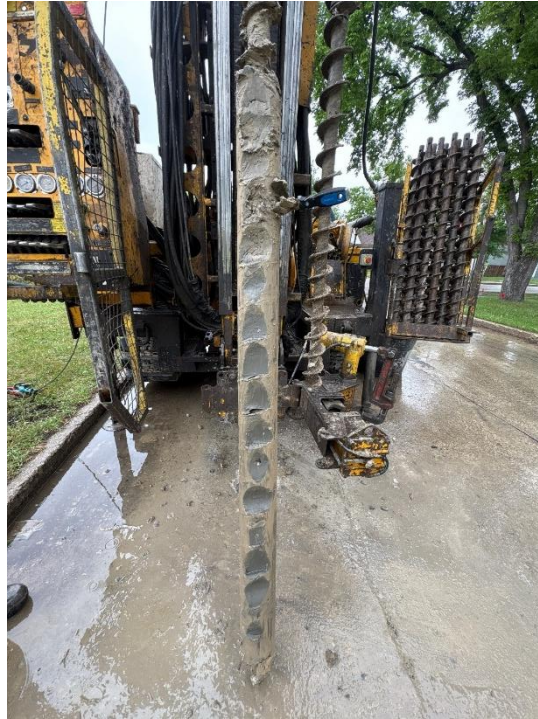
TH25-06 Photo 2: 1.5 to 3.0 m (5 to 10 ft)



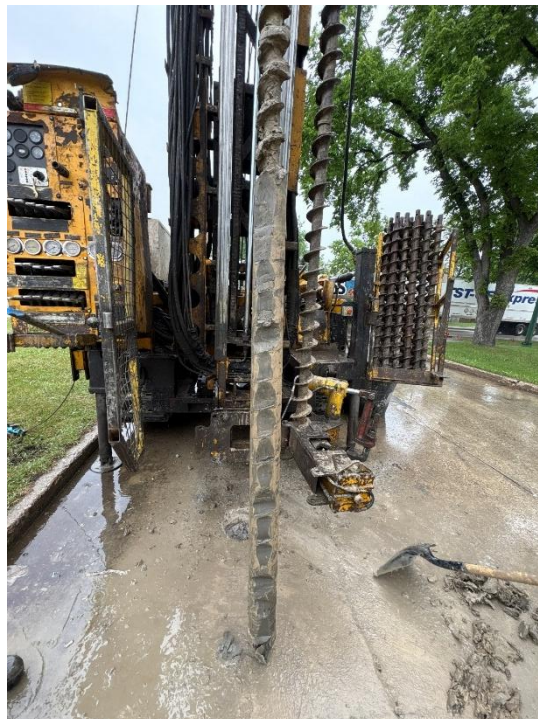
TH25-06 Photo 3: 3.0 to 4.5 m (10 to 15 ft)



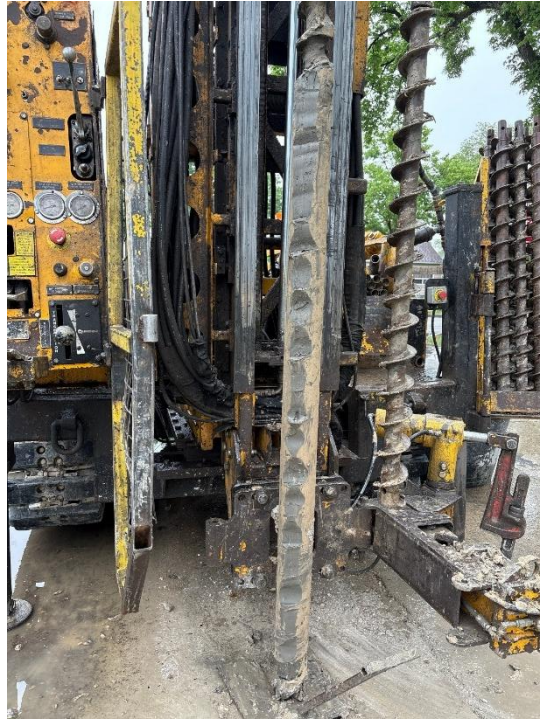
TH25-06 Photo 4: 4.5 to 6.0 m (15 to 20 ft)



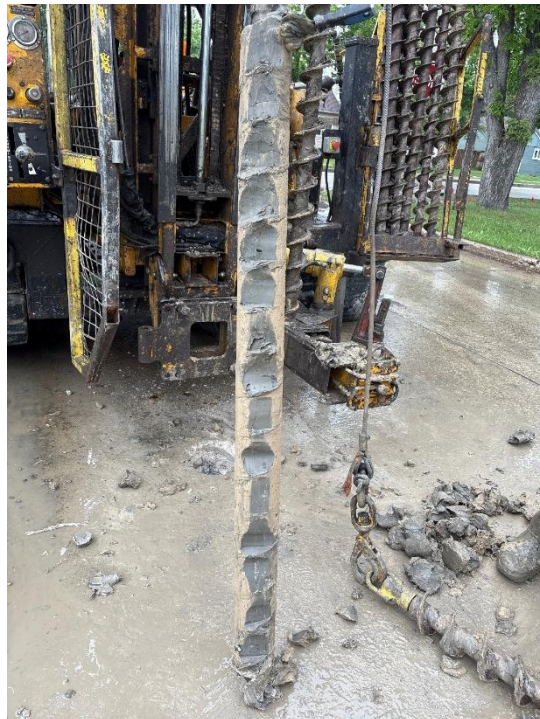
TH25-06 Photo 5: 6.0 to 7.5 m (20 to 25 ft)



TH25-06 Photo 6: 7.5 to 9.0 m (25 to 30 ft)



TH25-06 Photo 7: 9.0 to 10.5 m (30 to 35 ft)



TH25-06 Photo 8: 10.5 to 12 m (35 to 40 ft)



TH25-06 Photo 9: 12 to 13.5 m (40 to 45 ft)



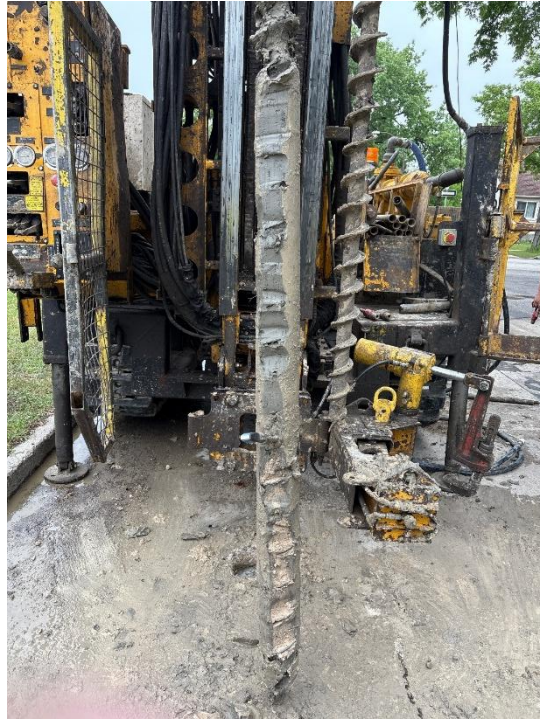
TH25-06 Photo 10: 13.5 to 15 m (45 to 50 ft)



TH25-06 Photo 11: 15 to 16.5 m (50 to 55 ft)



TH25-06 Photo 12: 16.5 to 18 m (55 to 60 ft)



TH25-06 Photo 13: 18 to 20 m (60 to 65.5 ft)



TH25-07 Photo 1: 0 to 1.5 m (0 to 5 ft)



TH25-07 Photo 2: 1.5 to 3.0 m (5 to 10 ft)



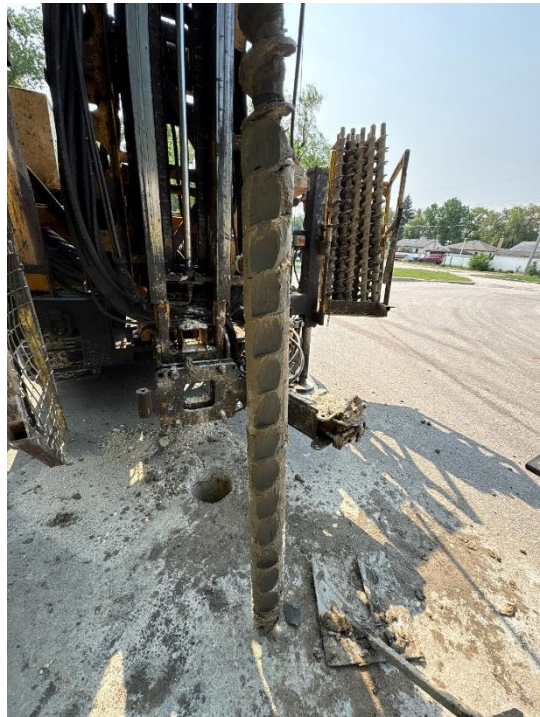
TH25-07 Photo 3: 3.0 to 4.5 m (10 to 15 ft)



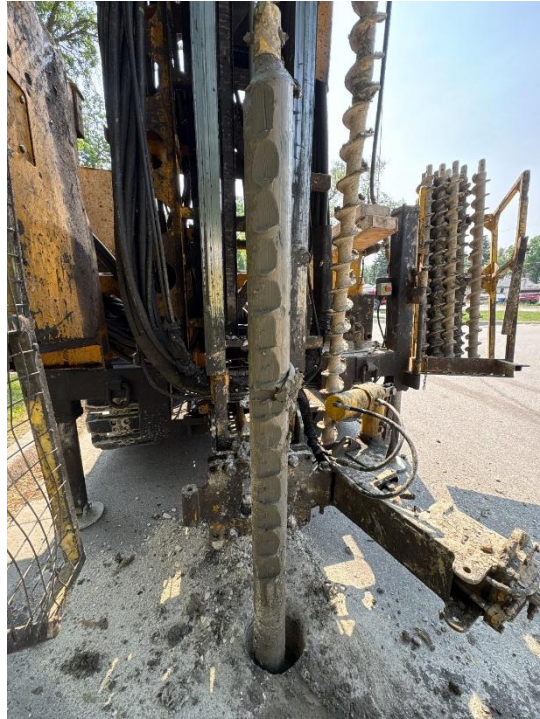
TH25-07 Photo 4: 4.5 to 6.0 m (15 to 20 ft)



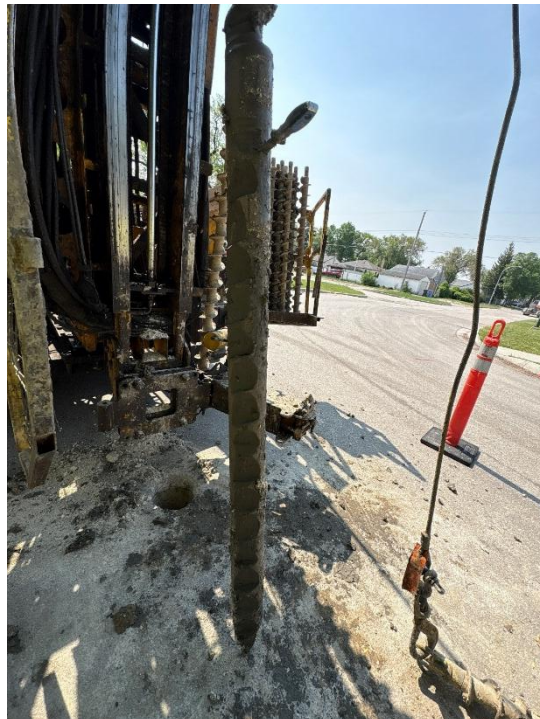
TH25-07 Photo 5: 6.0 to 7.5 m (20 to 25 ft)



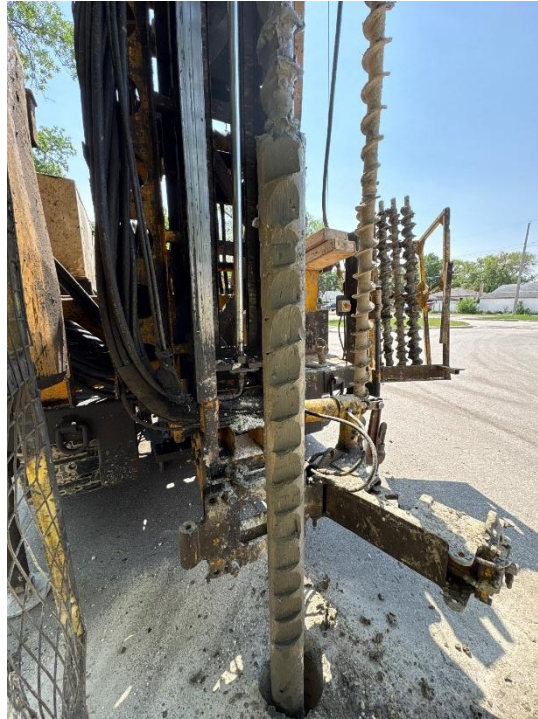
TH25-07 Photo 6: 7.5 to 9.0 m (25 to 30 ft)



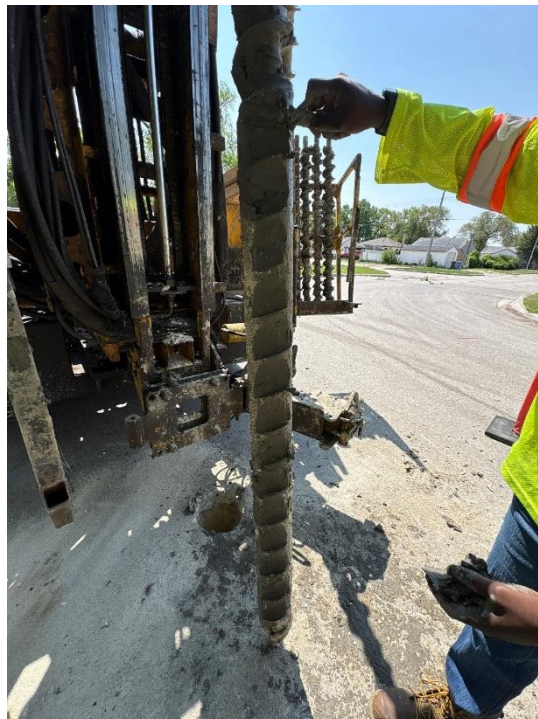
TH25-07 Photo 7: 9.0 to 10.5 m (30 to 35 ft)



TH25-07 Photo 8: 10.5 to 12 m (35 to 40 ft)



TH25-07 Photo 9: 12 to 13.5 m (40 to 45 ft)



TH25-07 Photo 10: 13.5 to 15 m (45 to 50 ft)



TH25-07 Photo 11: 15 to 16.5 m (50 to 55 ft)



TH25-07 Photo 12: 16.5 to 18 m (55 to 60 ft)



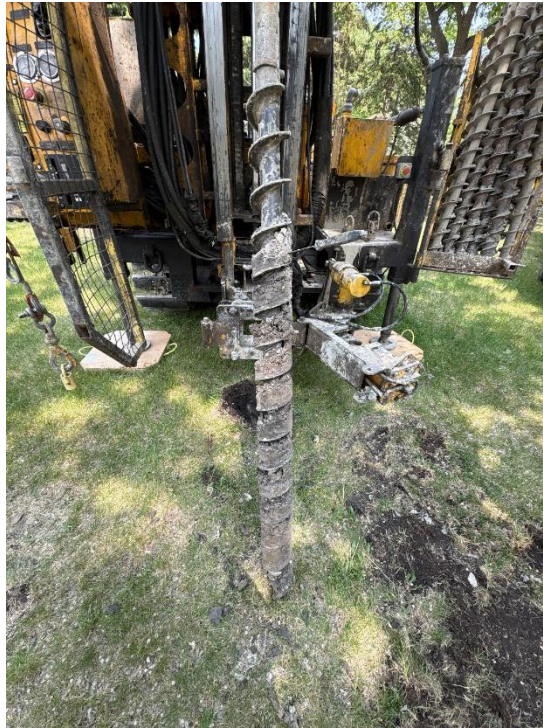
TH25-07 Photo 13: 18 to 19.5 m (60 to 65 ft)



TH25-07 Photo 14: 19.5 to 20.3 m (65 to 66.5 ft)



TH25-07 Photo 15: 20.3 to 23.2 m (66.5 to 76 ft)



TH25-08 Photo 1: 0 to 1.5 m (0 to 5 ft)



TH25-08 Photo 2: 1.5 to 3.0 m (5 to 10 ft)



TH25-08 Photo 3: 3.0 to 4.5 m (10 to 15 ft)



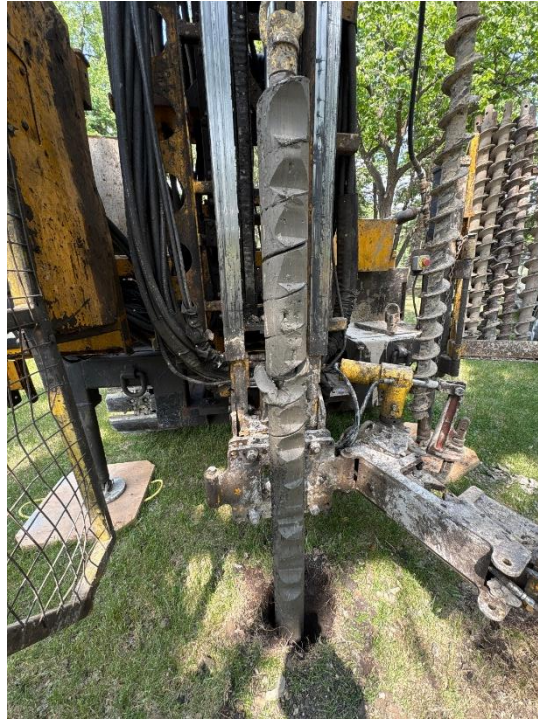
TH25-08 Photo 4: 4.5 to 6.0 m (15 to 20 ft)



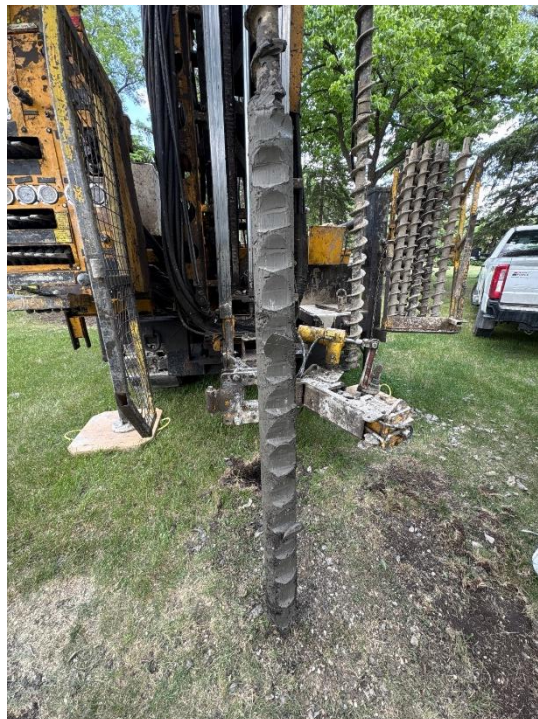
TH25-08 Photo 5: 6.0 to 7.5 m (20 to 25 ft)



TH25-08 Photo 6: 7.5 to 9.0 m (25 to 30 ft)



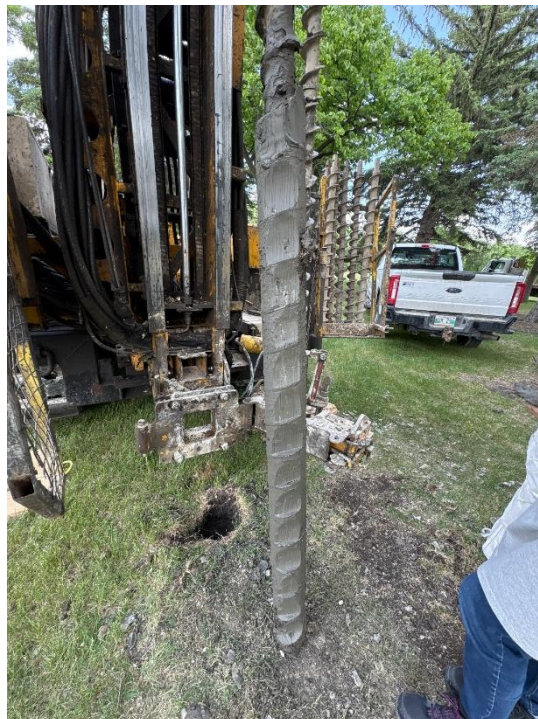
TH25-08 Photo 7: 9.0 to 10.5 m (30 to 35 ft)



TH25-08 Photo 8: 10.5 to 12 m (35 to 40 ft)



TH25-08 Photo 9: 12 to 13.5 m (40 to 45 ft)



TH25-08 Photo 10: 13.5 to 15 m (45 to 50 ft)



TH25-08 Photo 13: 18 to 19.5 m (60 to 65 ft)



TH25-08 Photo 14: 19.5 to 21 m (65 to 69 ft)

****Missing: 15 to 18 m (50 to 60 ft)**

APPENDIX E

2025 KGS Group Laboratory Testing Results

SUMMARY OF INDEX TESTS

Sheet 1 of 2

Test Hole ID	Sample No.	Depth (m)	Classification	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit	Plastic Limit	Plasticity Index	Moisture Content (%)	Dry Density (kN/m3)	Specific Gravity	Saturation (%)	Void Ratio
TH25-01	S2	2.1	CH							42				
TH25-01	S3	3.7	CH							52				
TH25-01	S4	5.3	CH	0	1	99	85	28	57	53				
TH25-01	S5	6.9	CH							52				
TH25-01	S6	8.6	CH							48				
TH25-01	S7	9.3	CH							46				
TH25-01	S8	10.4	CH							23				
TH25-01	S9	11.7	CH				59	19	40	46				
TH25-01	S10	13.1	CH							27				
TH25-01	S11	14.4	TILL	2	44	54				9				
TH25-02	S2	1.3	CL							21				
TH25-02	S3	2.1	CH							49				
TH25-02	S4	3.7	CH							50				
TH25-02	S5	5.3	CH							45				
TH25-02	S6	7.1	CH							43				
TH25-02	S7	8.5	CH				83	26	57	48				
TH25-02	S9	10.2	CH							25				
TH25-02	S10	11.6	CH							14				
TH25-02	S13	13.1	TILL	6	31	63	19	12	7	12				
TH25-02	S17	16.2	TILL	4	33	63				11				
TH25-03	S2	1.9	CL							24				
TH25-03	S3	2.6	CH							47				
TH25-03	S5	5.2	CH				93	28	65	53				
TH25-03	S6	6.9	CH							52				
TH25-03	S7	8.3	CH							52				
TH25-03	S8	9.8	CH	0	5	95	88	35	53	48				
TH25-03	S9	11.4	CH							51				
TH25-03	S10	13.1	CH							68				
TH25-03	S13	16.2	TILL	18	29	53				8				
TH25-04	S1	1.2	CH							29				
TH25-04	S5	2.1	CL							22				
TH25-04	S7	3.8	CL							24				
TH25-04	S9	5.3	CH							52				
TH25-04	S10	7.0	CH				84	31	53	49				
TH25-04	S11	8.4	CH							48				
TH25-04	S12	10.1	CH	0	15	85	76	28	48	47				
TH25-04	S13	11.4	CH							33				
TH25-04	S14	13.0	CH							57				
TH25-04	S15	14.5	CH							57				
TH25-04	S17	16.6	TILL	5	30	65				12				
TH25-05	S2	1.2	CL							24				
TH25-05	S5	2.7	CH							37				

* Moisture conditioned and remolded sample.
 ** Assumed specific gravity.



CLIENT
PROJECT NAME

CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT
Armstrong Detailed Design and CA/CI

PROJECT NO. 25-0107-002
LOCATION Winnipeg, Manitoba

SUMMARY OF INDEX TESTS

Sheet 2 of 2

Test Hole ID	Sample No.	Depth (m)	Classification	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit	Plastic Limit	Plasticity Index	Moisture Content (%)	Dry Density (kN/m3)	Specific Gravity	Saturation (%)	Void Ratio
TH25-05	S7	5.5	CH							54				
TH25-05	S9	8.4	CH				79	30	49	47				
TH25-05	S10	9.8	CH							49				
TH25-05	S11	11.4	CH				77	23	54	47				
TH25-05	S12	13.0	CH							52				
TH25-05	S14	15.7	CH							49				
TH25-05	S16	17.5	TILL	6	17	77				13				
TH25-06	S2	1.2	CH							31				
TH25-06	S4	2.3	CL				27	18	9	24				
TH25-06	S5	3.5	CL							28				
TH25-06	S7	5.3	CH							59				
TH25-06	S9	8.2	CH				84	34	50	53				
TH25-06	S10	9.9	CH							53				
TH25-06	S11	10.7	CH							51				
TH25-06	S13	13.0	CH							51				
TH25-06	S14	16.0	CH							50				
TH25-06	S18	19.5	TILL							11				
TH25-07	S4	2.6	CL							25				
TH25-07	S5	3.8	CH							56				
TH25-07	S7	6.8	CH							59				
TH25-07	S8	8.2	CH				82	31	51	52				
TH25-07	S9	9.8	CH							61				
TH25-07	S10	10.8	CH				72	28	44	51				
TH25-07	S12	13.1	CH							56				
TH25-07	S13	14.6	CH							57				
TH25-07	S15	17.5	CH							63				
TH25-07	S17	19.6	TILL	6	24	70				11				
TH25-08	S3	2.1	CL							23				
TH25-08	S5	3.8	CH							40				
TH25-08	S6	5.2	CH							54				
TH25-08	S8	8.5	CH				84	33	51	51				
TH25-08	S9	9.5	CH							37				
TH25-08	S10	10.4	CH							50				
TH25-08	S11	11.7	CH				76	27	49	41				
TH25-08	S13	14.5	CH							53				
TH25-08	S15	17.1	CH							63				
TH25-08	S18	19.6	TILL	5	28	67	18	11	7	11				

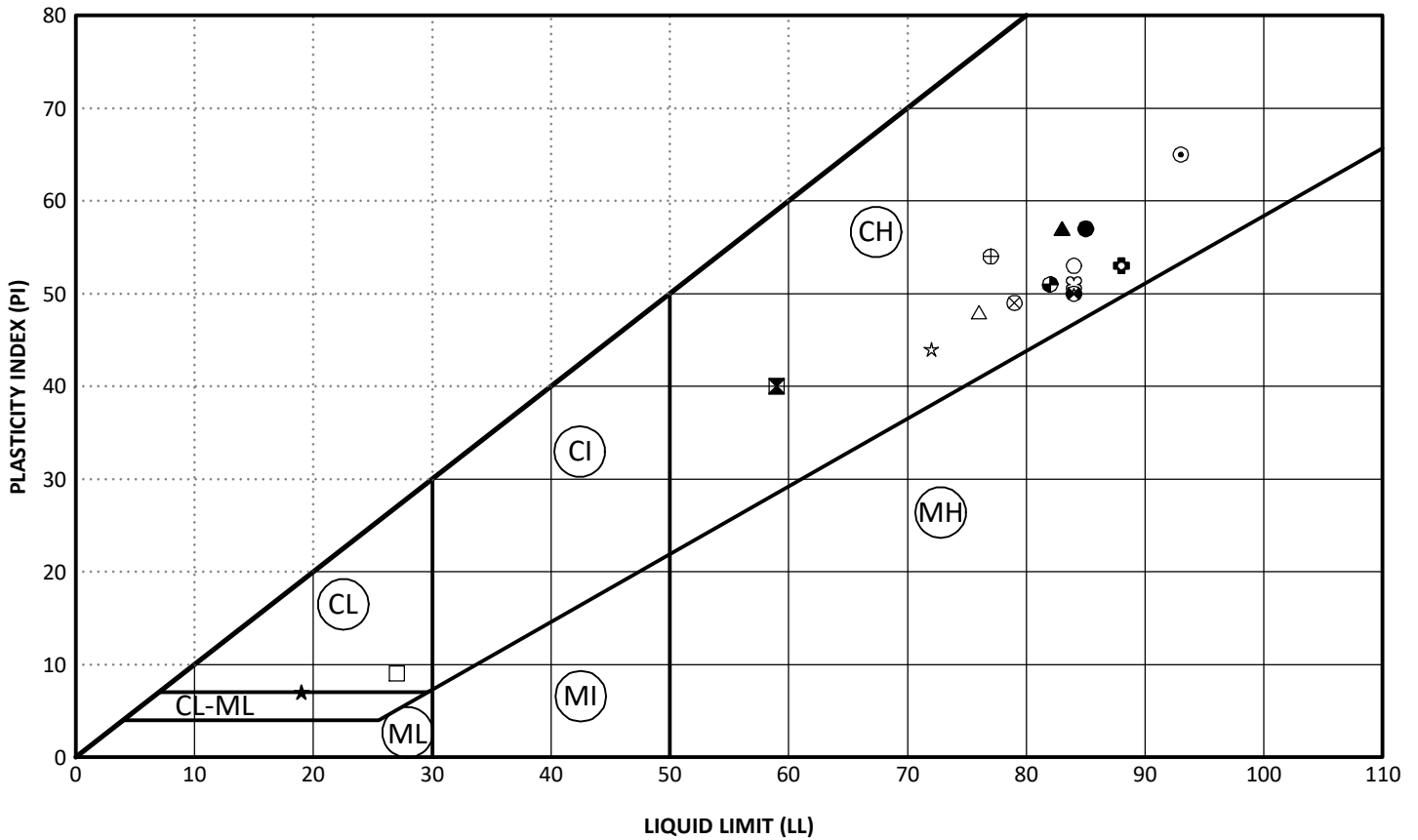
* Moisture conditioned and remolded sample.
 ** Assumed specific gravity.



CLIENT CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT
PROJECT NAME Armstrong Detailed Design and CA/CI

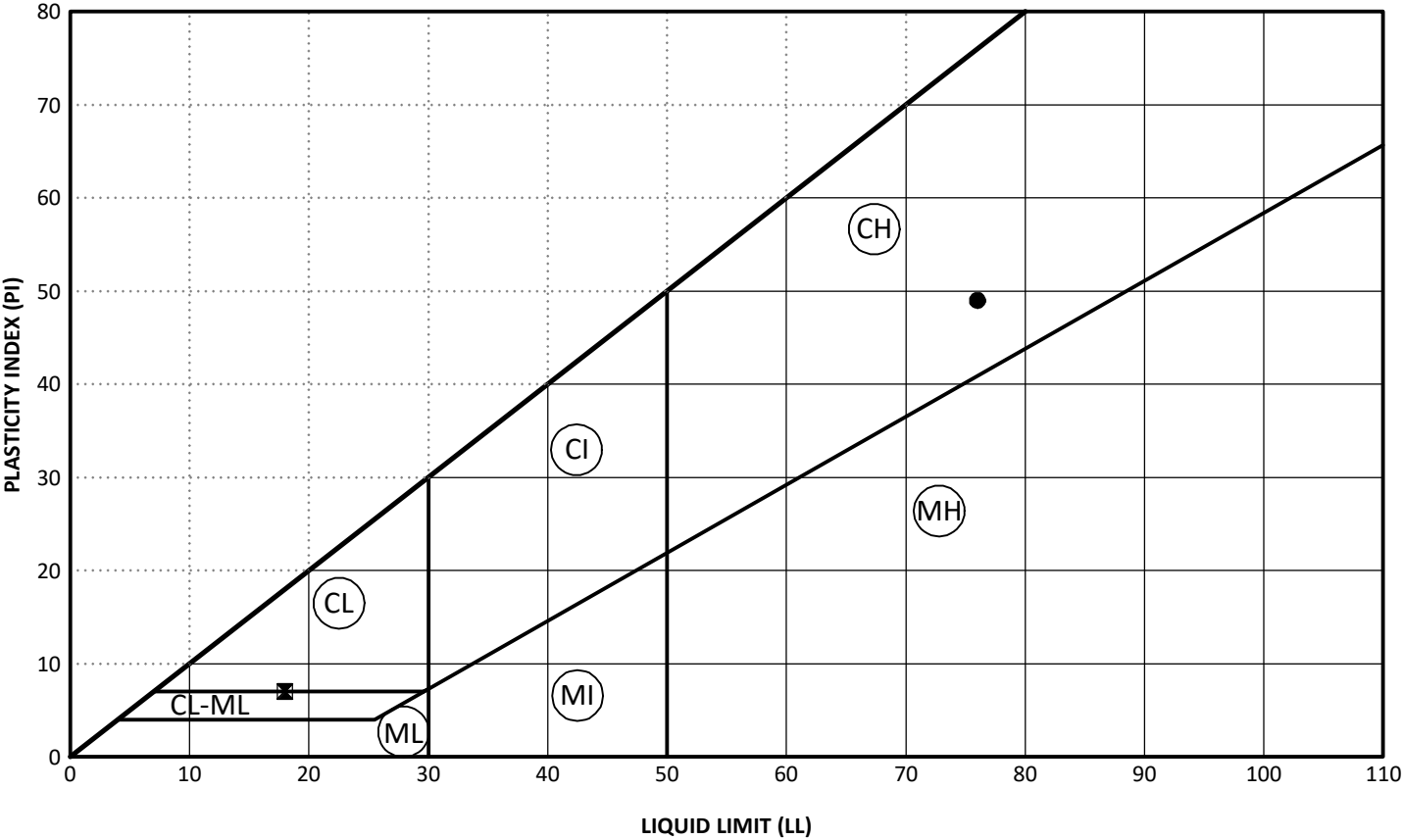
PROJECT NO. 25-0107-002
LOCATION Winnipeg, Manitoba

ATTERBERG LIMITS



	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	SAND (%)	SILT (%)	CLAY (%)	SILT & CLAY (%)	MC (%)	CLASSIFICATION
●	TH25-01	5.3	S4	85	28	57	1	29	70	99	53	CH
⊠	TH25-01	11.7	S9	59	19	40					46	CH
▲	TH25-02	8.5	S7	83	26	57					48	CH
★	TH25-02	13.1	S13	19	12	7	31	48	16	63	12	CL-ML
⊙	TH25-03	5.2	S5	93	28	65					53	CH
⊕	TH25-03	9.8	S8	88	35	53	5	31	63	95	48	CH
○	TH25-04	7.0	S10	84	31	53					49	CH
△	TH25-04	10.1	S12	76	28	48	15	41	44	85	47	CH
⊗	TH25-05	8.4	S9	79	30	49					47	CH
⊕	TH25-05	11.4	S11	77	23	54					47	CH
□	TH25-06	2.3	S4	27	18	9					24	CL
⊗	TH25-06	8.2	S9	84	34	50					53	CH
⊕	TH25-07	8.2	S8	82	31	51					52	CH
★	TH25-07	10.8	S10	72	28	44					51	CH
⊗	TH25-08	8.5	S8	84	33	51					51	CH

ATTERBERG LIMITS



	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	SAND (%)	SILT (%)	CLAY (%)	SILT & CLAY (%)	MC (%)	CLASSIFICATION
●	TH25-08	11.7	S11	76	27	49					41	CH
☒	TH25-08	19.6	S18	18	11	7	28	53	15	67	11	CL-ML

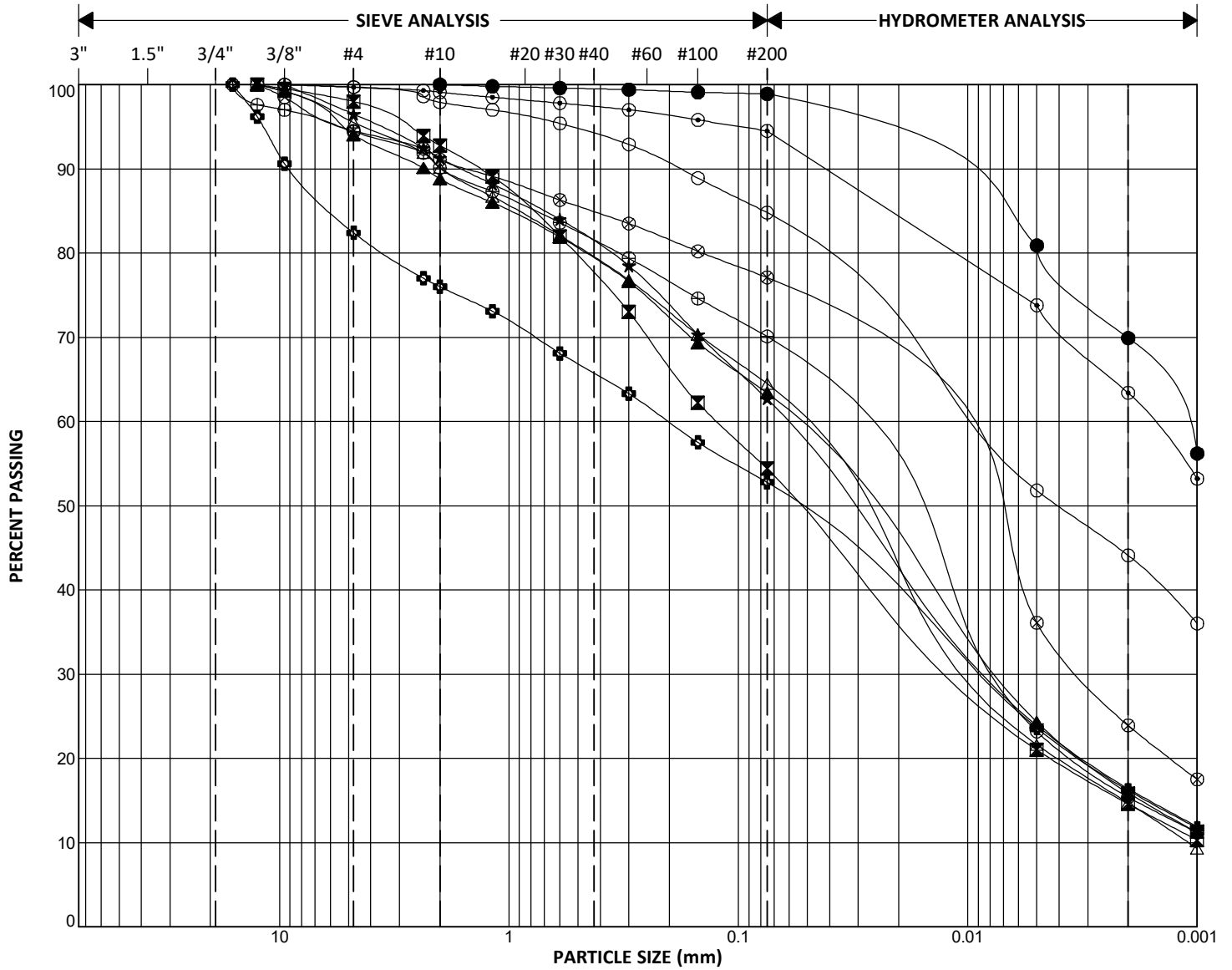
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CLIENT CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT
PROJECT NAME Armstrong Detailed Design and CA/CI

PROJECT NO. 25-0107-002
LOCATION Winnipeg, Manitoba

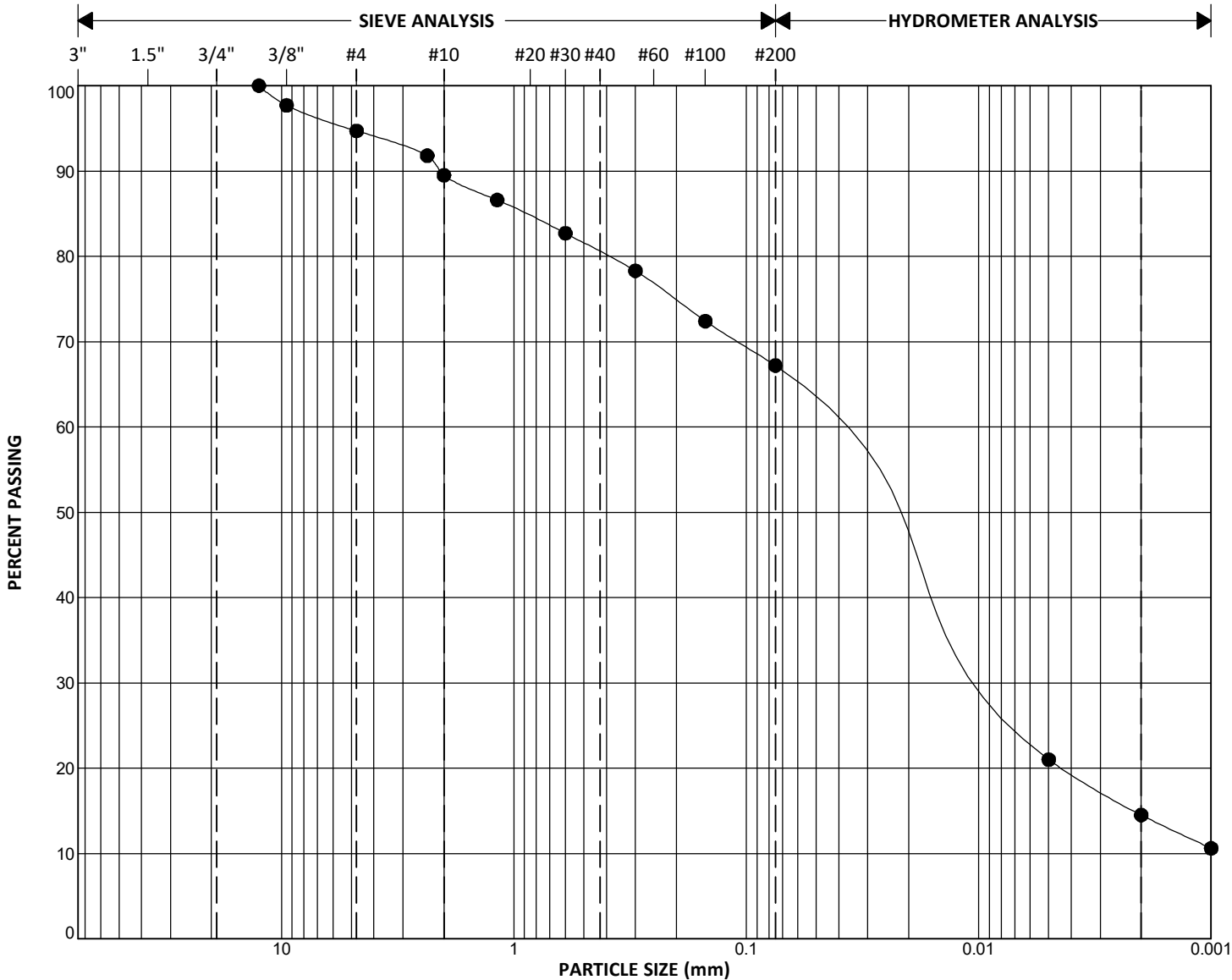
GRAIN SIZE DISTRIBUTION



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

HOLE	DEPTH (m)	SAMPLE #	GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	SILT & CLAY (%)	Cu	Cc	CLASSIFICATION
● TH25-01	5.3	S4	0	1	29	70	99			CH
⊠ TH25-01	14.4	S11	2	44	40	15	54			
▲ TH25-02	13.1	S13	6	31	48	16	63			CL-ML
★ TH25-02	16.2	S17	4	33	46	16	63			
⊙ TH25-03	9.8	S8	0	5	31	63	95			CH
⊕ TH25-03	16.2	S13	18	29	37	16	53			
○ TH25-04	10.1	S12	0	15	41	44	85			CH
△ TH25-04	16.6	S17	5	30	50	15	65	51.60	1.17	
⊗ TH25-05	17.5	S16	6	17	53	24	77			
⊕ TH25-07	19.6	S17	6	24	55	15	70			

GRAIN SIZE DISTRIBUTION



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

HOLE	DEPTH (m)	SAMPLE #	GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	SILT & CLAY (%)	Cu	Cc	CLASSIFICATION
TH25-08	19.6	S18	5	28	53	15	67			CL-ML



CLIENT CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT
PROJECT NAME Armstrong Detailed Design and CA/CI

PROJECT NO. 25-0107-002
LOCATION Winnipeg, Manitoba

SIEVE ANALYSIS C:\USERS\K\FORDYCE\DESKTOP\FMS\25-0107-002\ARMSTRONG LOGS.GPJ

ASTM D2216 - LABORATORY DETERMINATION OF WATER (MOISTURE) CONTENT OF SOIL AND ROCK BY MASS

TO KGS Group Inc.
 3rd Floor - 865 Waverley Street
 Winnipeg, Manitoba
 R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 1

DATE SAMPLED: Not Provided
 SAMPLED BY: KGS Group Inc.

DATE RECEIVED: 2025.Jun.12
 SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.13
 TESTED BY: Larry Presado

TESTHOLE	SAMPLE	MC %
TH25-01	S2	42.1
	S3	52.2
	S4	52.6
	S5	52.4
	S6	47.6
	S7	45.5
	S8	22.9
	S9	45.7
	S10	27.4
	S11	8.6
TH25-02	S2	21.4
	S3	48.9
	S4	50.1
	S5	44.8
	S6	42.6
	S7	48.2
	S9	25.4
	S10	14.4
	S13	12.0
	S17	10.6
TH25-03	S2	24.3
	S3	47.4
	S5	52.9
	S6	51.8
	S7	51.8
	S8	47.5
	S9	51.2
	S10	67.5
	S13	7.7
TH25-04	S1	28.7

TESTHOLE	SAMPLE	MC %
TH25-04	S5	22.2
	S7	24.3
	S9	52.4
	S10	48.9
	S11	48.3
	S12	46.8
	S13	32.5
	S14	57.3
	S15	57.4
	S17	11.6
TH25-05	S2	23.5
	S5	37.1
	S7	54.0
	S9	47.2
	S10	48.8
	S11	47.1
	S12	51.7
	S14	48.6
	S16	13.1
TH25-06	S2	31.0
	S4	24.4
	S5	27.7
	S7	58.5
	S9	52.5
	S10	53.3
	S11	50.8
	S13	50.5
	S14	49.5
TH25-07	S18	10.6
	S4	24.6

REPORT DATE 2025.Jun.24

PAGE 1 OF 2

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided on written request. The data presented is for sole use of client stipulated above. Stantec is not responsible, nor can be held liable, for the use of this report by any other party, with or without the knowledge of Stantec.

ASTM D2216 - LABORATORY DETERMINATION OF WATER (MOISTURE) CONTENT OF SOIL AND ROCK BY MASS

TO KGS Group Inc.
 3rd Floor - 865 Waverley Street
 Winnipeg, Manitoba
 R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 1


DATE SAMPLED: Not Provided
 SAMPLED BY: KGS Group Inc.

DATE RECEIVED: 2025.Jun.12
 SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.13
 TESTED BY: Larry Presado

TESTHOLE	SAMPLE	MC %
TH25-07	S5	56.4
	S7	58.6
	S8	52.3
	S9	60.6
	S10	50.6
	S12	55.5
	S13	57.3
	S15	62.5
	S17	11.0
TH25-08	S3	22.9
	S5	40.3
	S6	53.6
	S8	51.2
	S9	37.2
	S10	49.6
	S11	40.8
	S13	52.6
	S15	63.1
	S18	10.5

REPORT DATE 2025.Jun.24

REVIEWED BY 
 Guillaume Beauce, P.Eng.
 Geotechnical Engineer - Materials Testing Services

PAGE 2 OF 2

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided on written request. The data presented is for sole use of client stipulated above. Stantec is not responsible, nor can be held liable, for the use of this report by any other party, with or without the knowledge of Stantec.

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 1

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.23

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

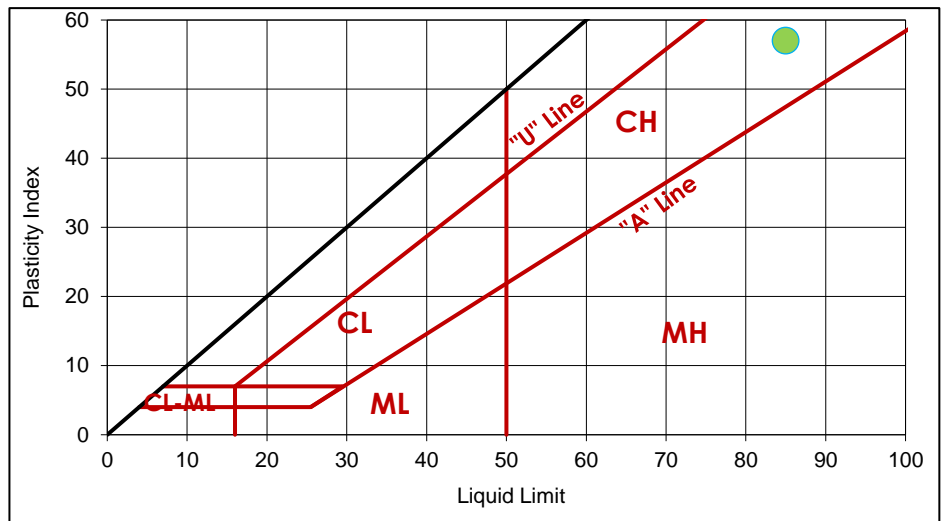
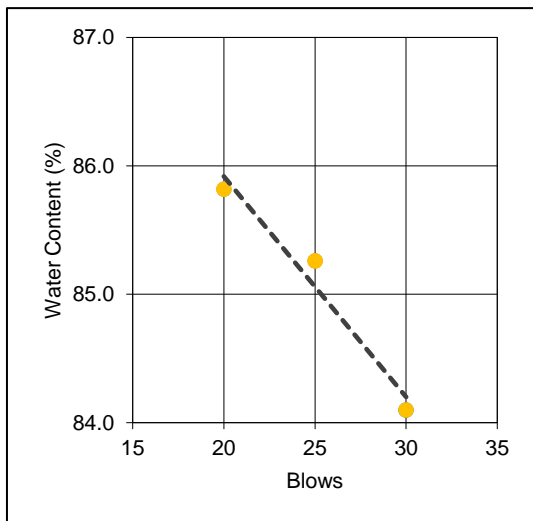
CLIENT FIELD ID TH25-01, S4

STANTEC SAMPLE NO. 1148

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	30	25	20
MC (%)	84	85	86

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	28	28


LIQUID LIMIT, LL	85
PLASTIC LIMIT, PL	28
PLASTICITY INDEX, PI	57
AS REC'D MC (%)	52.6



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 2

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.18

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

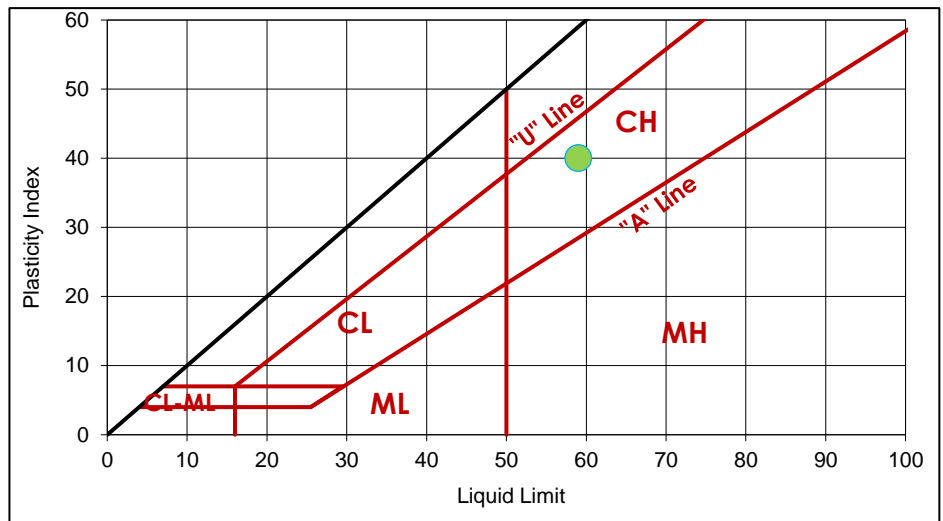
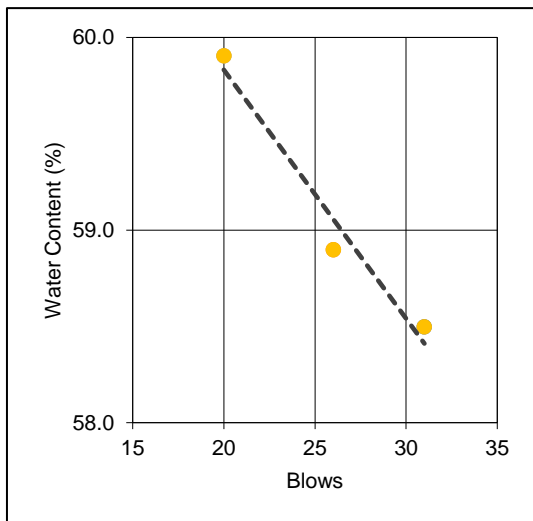
CLIENT FIELD ID TH25-01, S9

STANTEC SAMPLE NO. 1149

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	31	26	20
MC (%)	58	59	60

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	19	19


LIQUID LIMIT, LL	59
PLASTIC LIMIT, PL	19
PLASTICITY INDEX, PI	40
AS REC'D MC (%)	45.7



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 3

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.19

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

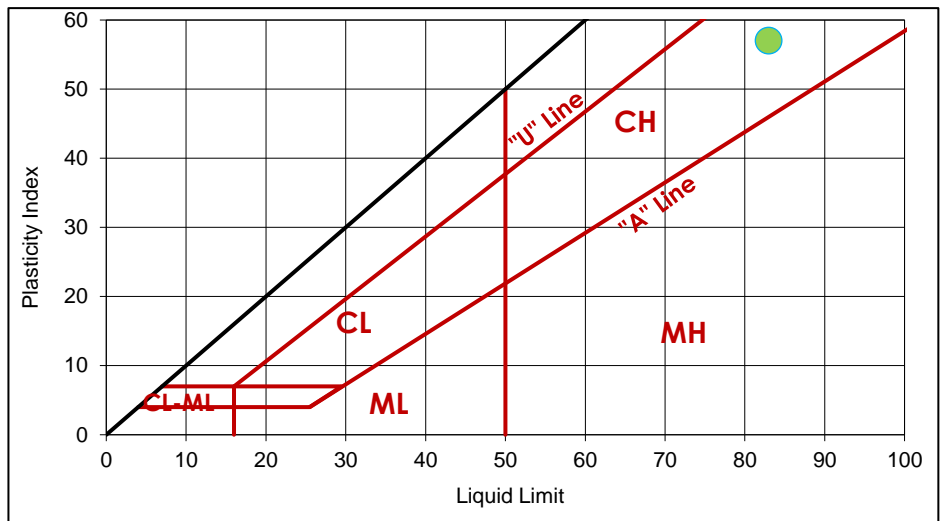
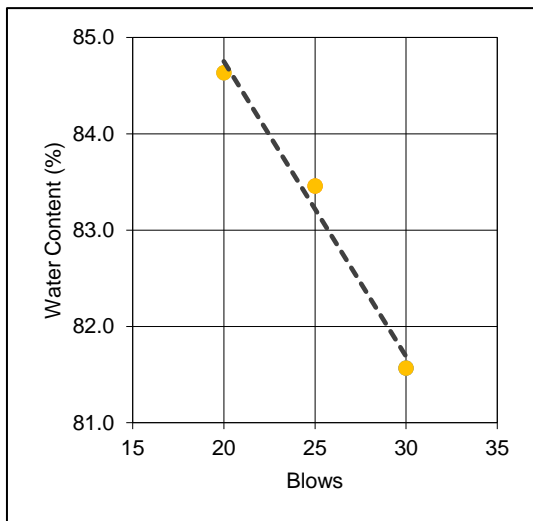
CLIENT FIELD ID TH25-02, S7

STANTEC SAMPLE NO. 1151

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	30	25	20
MC (%)	82	83	85

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	26	26


LIQUID LIMIT, LL	83
PLASTIC LIMIT, PL	26
PLASTICITY INDEX, PI	57
AS REC'D MC (%)	48.2



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 4

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.18

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

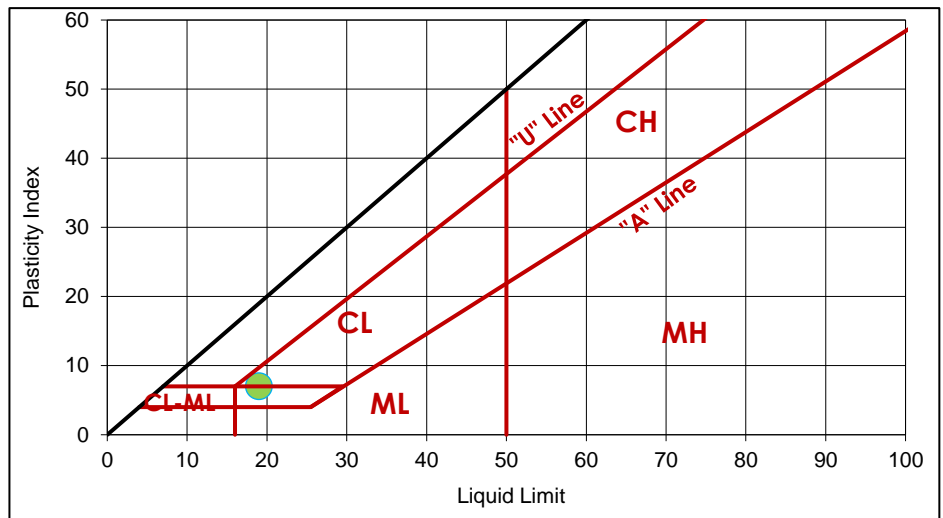
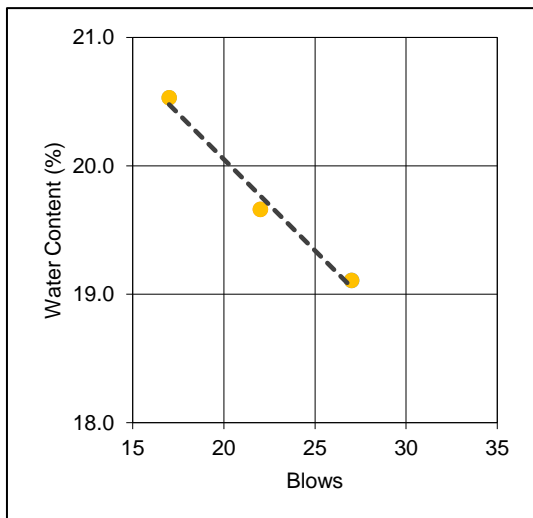
CLIENT FIELD ID TH25-02, S13

STANTEC SAMPLE NO. 1152

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	27	22	17
MC (%)	19	20	21

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	12	12


LIQUID LIMIT, LL	19
PLASTIC LIMIT, PL	12
PLASTICITY INDEX, PI	7
AS REC'D MC (%)	12.0



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 5

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.18

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

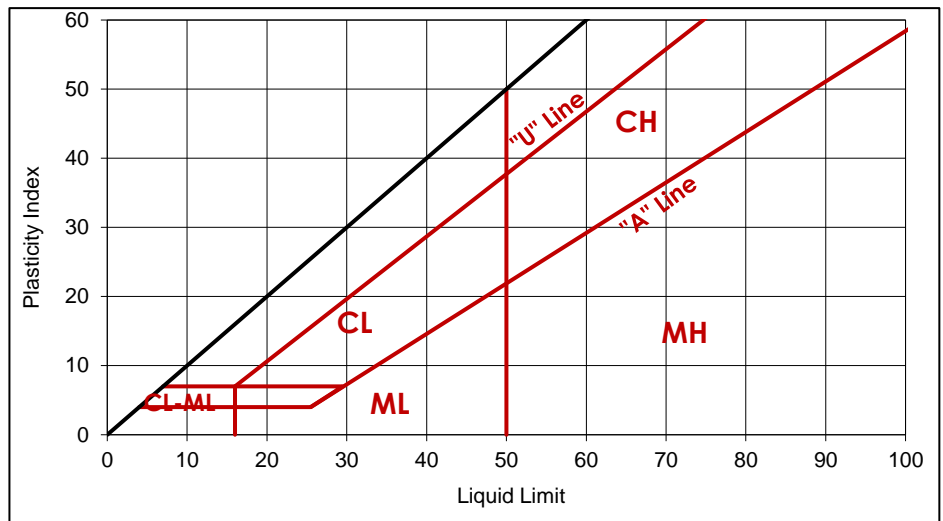
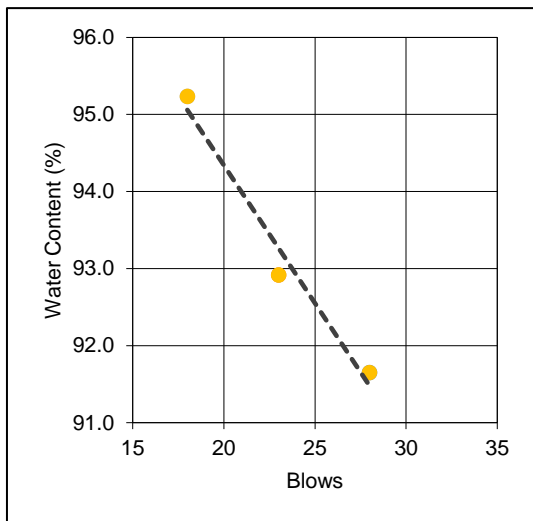
CLIENT FIELD ID TH25-03, S5

STANTEC SAMPLE NO. 1154

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	28	23	18
MC (%)	92	93	95

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	28	28


LIQUID LIMIT, LL	93
PLASTIC LIMIT, PL	28
PLASTICITY INDEX, PI	65
AS REC'D MC (%)	52.9



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 6

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.18

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

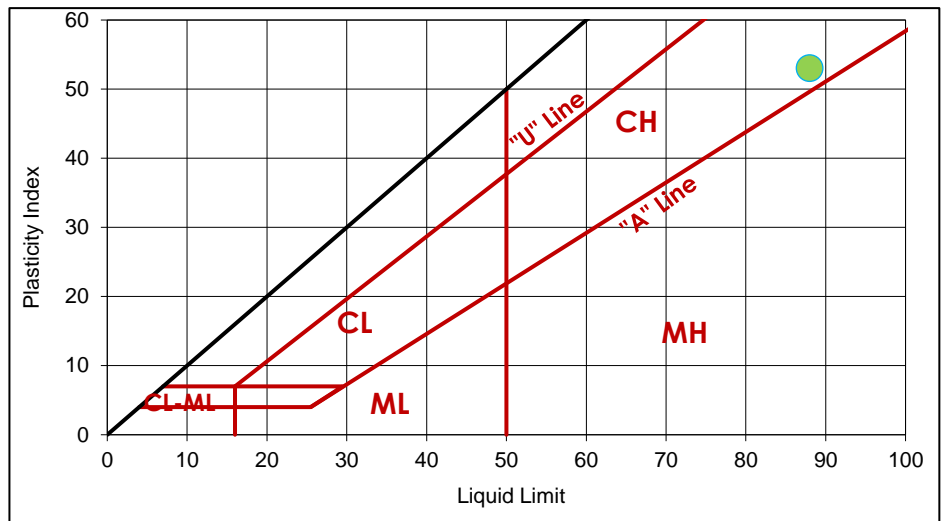
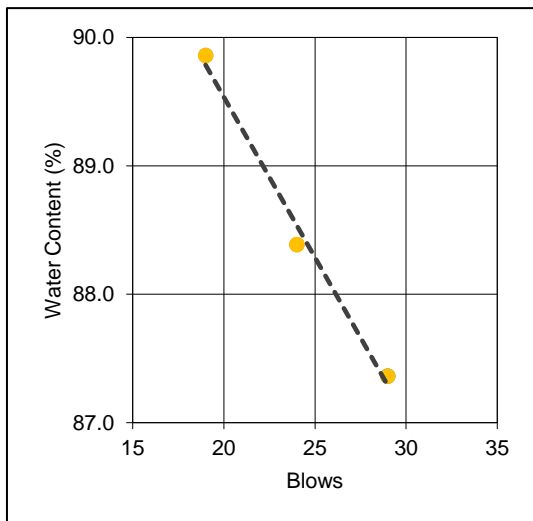
CLIENT FIELD ID TH25-03, S8

STANTEC SAMPLE NO. 1155

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	29	24	19
MC (%)	87	88	90

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	35	35


LIQUID LIMIT, LL	88
PLASTIC LIMIT, PL	35
PLASTICITY INDEX, PI	53
AS REC'D MC (%)	47.5



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 7

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.23

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

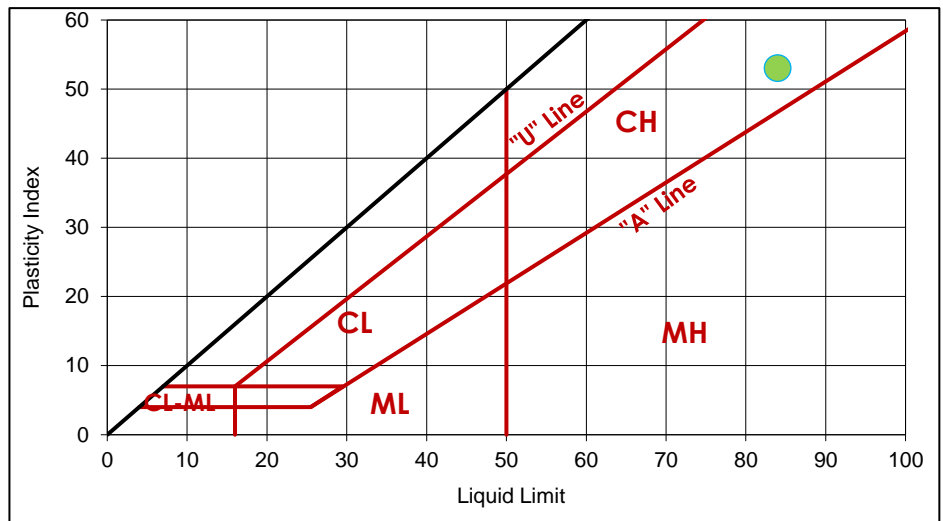
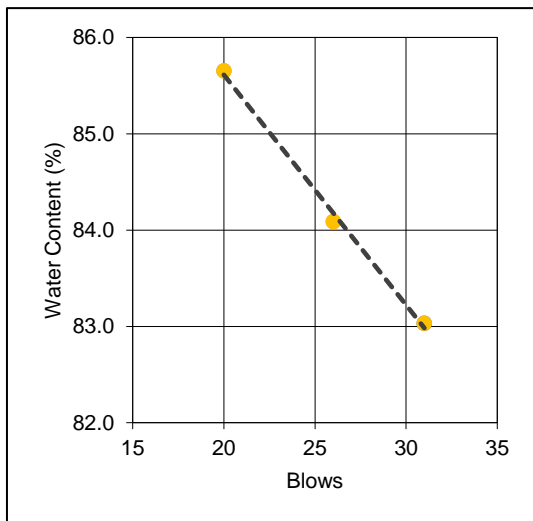
CLIENT FIELD ID TH25-04, S10

STANTEC SAMPLE NO. 1157

TRIAL	LIQUID LIMIT		
	1	2	3
BLOWS	31	26	20
MC (%)	83	84	86

TRIAL	PLASTIC LIMIT	
	1	2
MC (%)	31	31


LIQUID LIMIT, LL	84
PLASTIC LIMIT, PL	31
PLASTICITY INDEX, PI	53
AS REC'D MC (%)	48.9



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 8

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.20

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

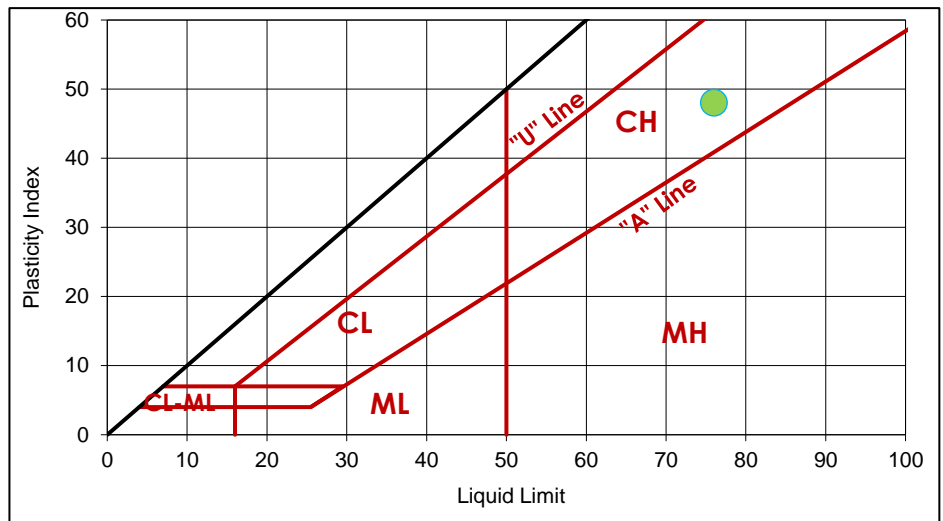
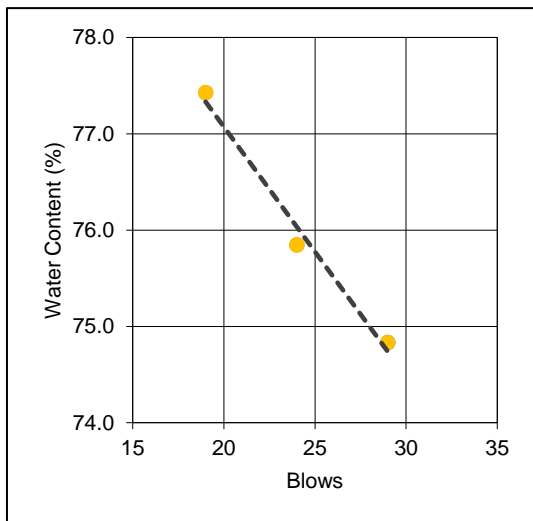
CLIENT FIELD ID TH25-04, S12

STANTEC SAMPLE NO. 1158

TRIAL	LIQUID LIMIT		
	1	2	3
BLOWS	29	24	19
MC (%)	75	76	77

TRIAL	PLASTIC LIMIT	
	1	2
MC (%)	28	28


LIQUID LIMIT, LL	76
PLASTIC LIMIT, PL	28
PLASTICITY INDEX, PI	48
AS REC'D MC (%)	46.8



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 9

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.19

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

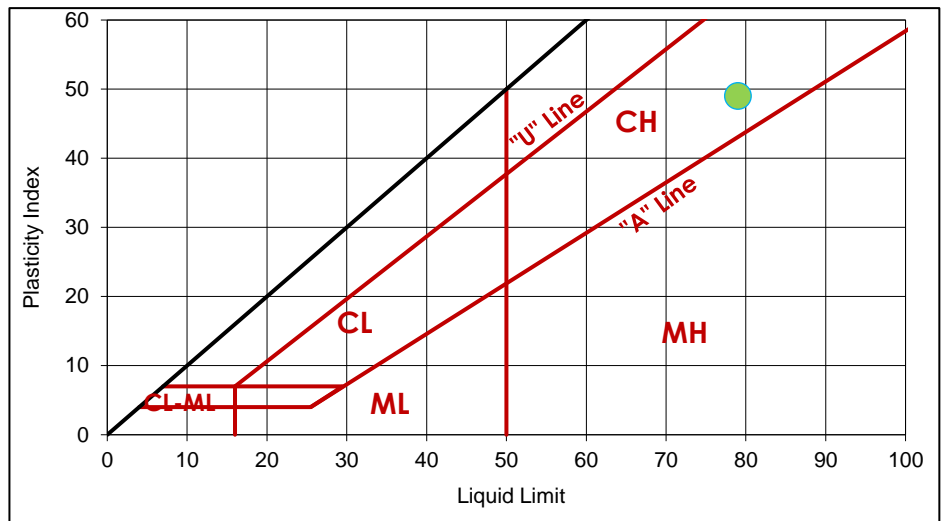
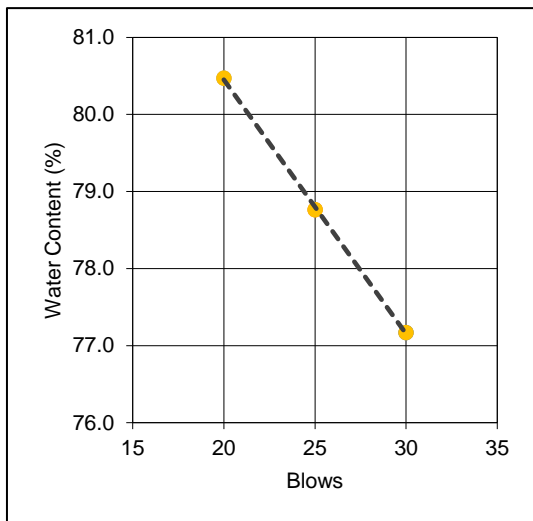
CLIENT FIELD ID TH25-05, S9

STANTEC SAMPLE NO. 1160

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	30	25	20
MC (%)	77	79	80

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	30	30


LIQUID LIMIT, LL	79
PLASTIC LIMIT, PL	30
PLASTICITY INDEX, PI	49
AS REC'D MC (%)	47.2



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 10

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.19

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

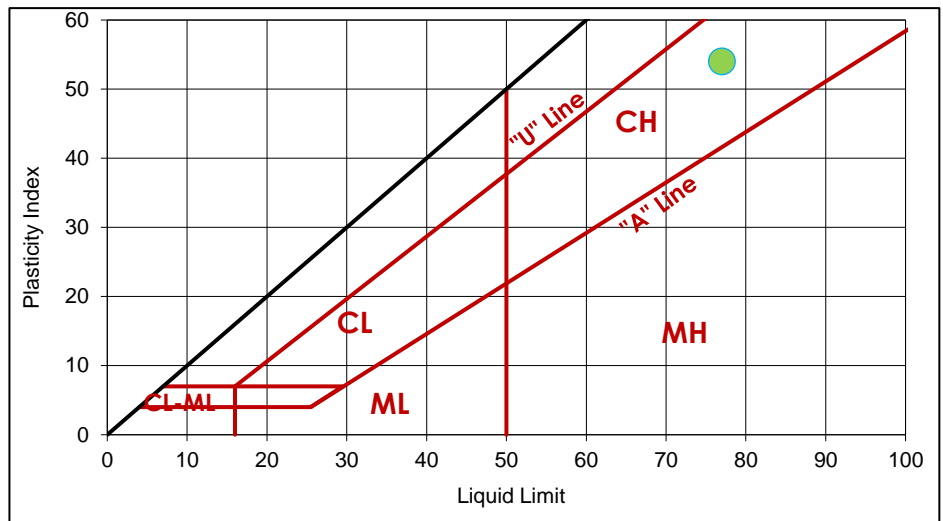
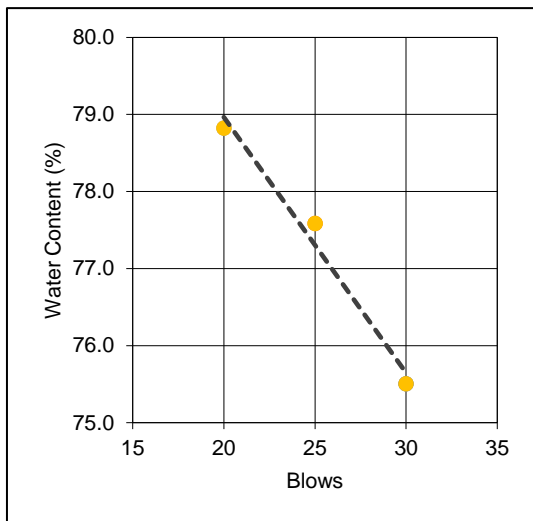
CLIENT FIELD ID TH25-05, S11

STANTEC SAMPLE NO. 1161

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	30	25	20
MC (%)	76	78	79

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	23	23


LIQUID LIMIT, LL	77
PLASTIC LIMIT, PL	23
PLASTICITY INDEX, PI	54
AS REC'D MC (%)	47.1



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 11

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.18

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

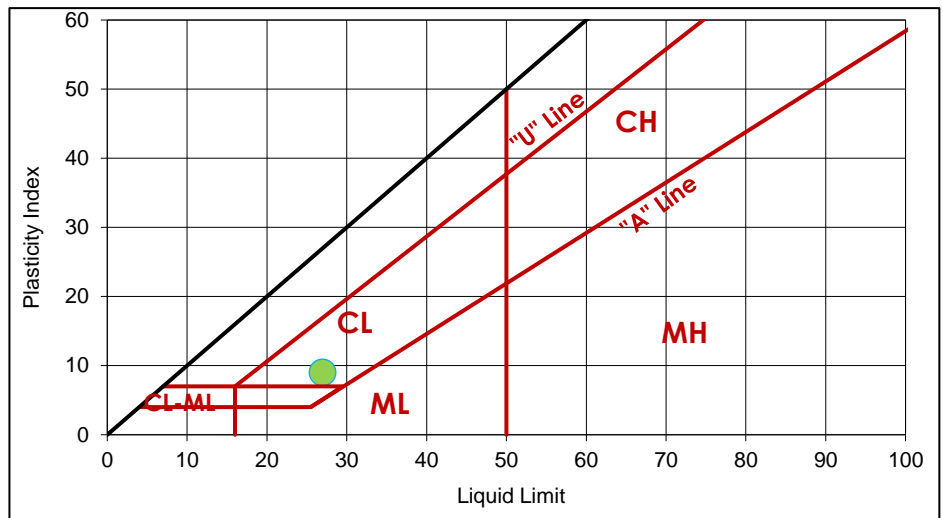
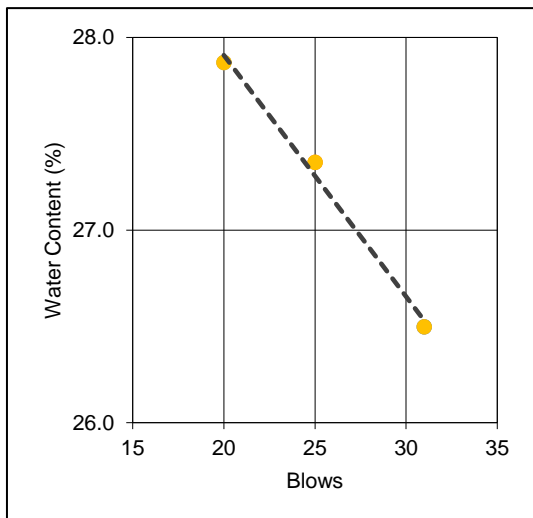
CLIENT FIELD ID TH25-06, S4

STANTEC SAMPLE NO. 1163

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	31	25	20
MC (%)	26	27	28

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	18	18


LIQUID LIMIT, LL	27
PLASTIC LIMIT, PL	18
PLASTICITY INDEX, PI	9
AS REC'D MC (%)	24.4



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 12

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.20

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

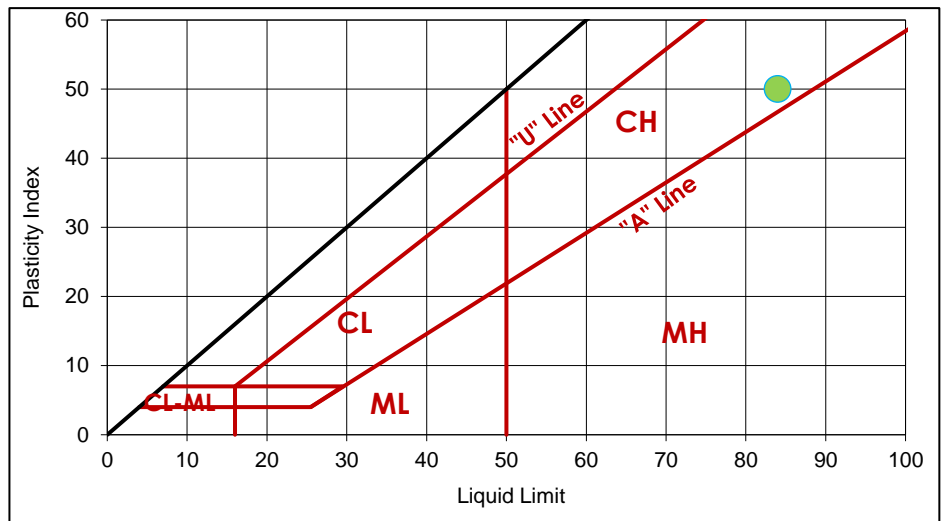
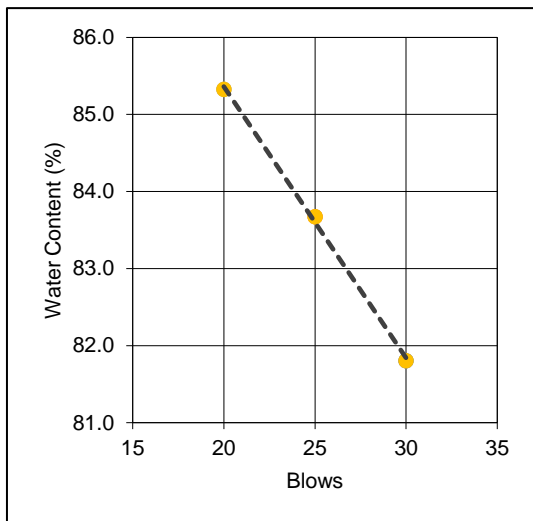
CLIENT FIELD ID TH25-06, S9

STANTEC SAMPLE NO. 1164

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	30	25	20
MC (%)	82	84	85

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	34	34


LIQUID LIMIT, LL	84
PLASTIC LIMIT, PL	34
PLASTICITY INDEX, PI	50
AS REC'D MC (%)	52.5



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 13

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.20

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

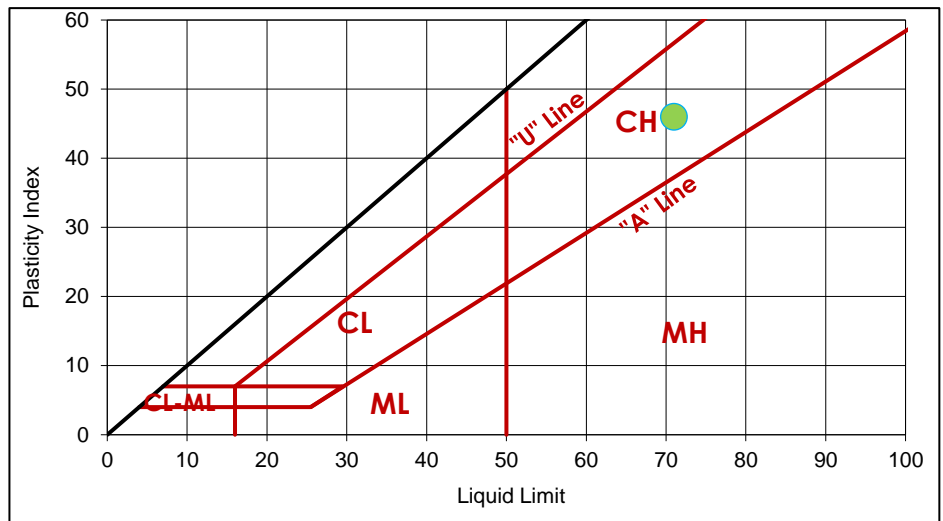
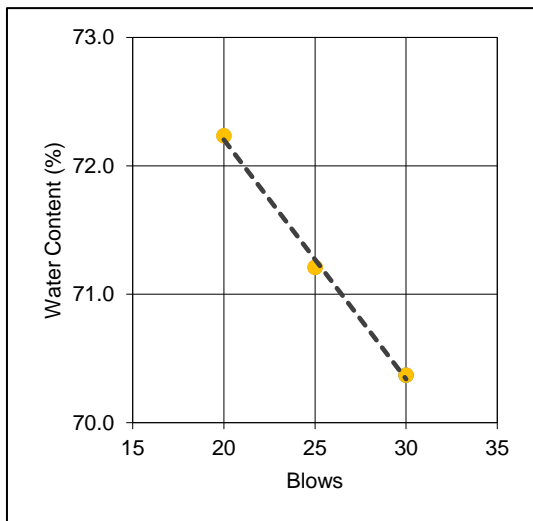
CLIENT FIELD ID TH25-06, S13

STANTEC SAMPLE NO. 1165

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	30	25	20
MC (%)	70	71	72

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	25	25


LIQUID LIMIT, LL	71
PLASTIC LIMIT, PL	25
PLASTICITY INDEX, PI	46
AS REC'D MC (%)	50.5



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 14

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.23

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

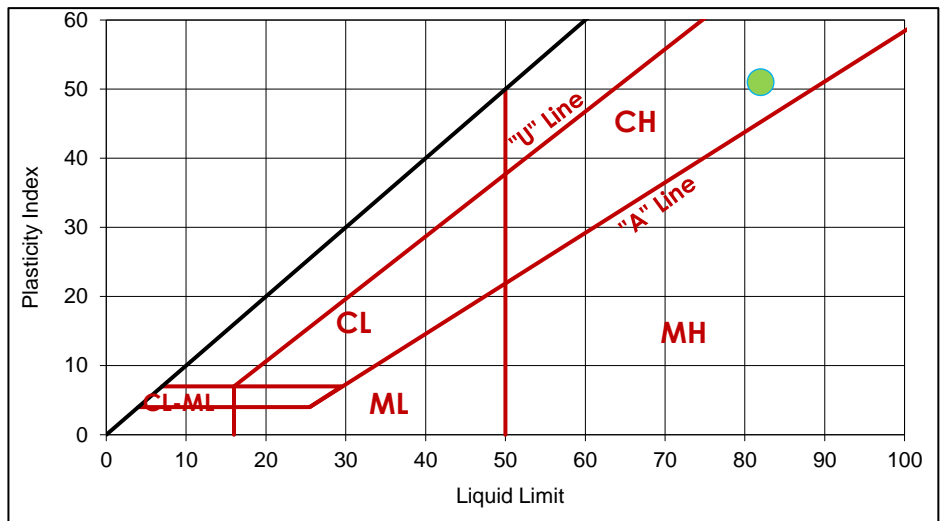
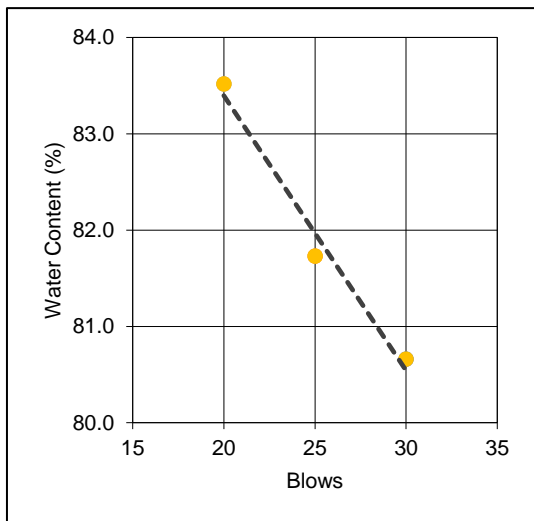
CLIENT FIELD ID TH25-07, S8

STANTEC SAMPLE NO. 1166

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	30	25	20
MC (%)	81	82	84

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	31	31


LIQUID LIMIT, LL	82
PLASTIC LIMIT, PL	31
PLASTICITY INDEX, PI	51
AS REC'D MC (%)	52.3



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 15

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.20

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

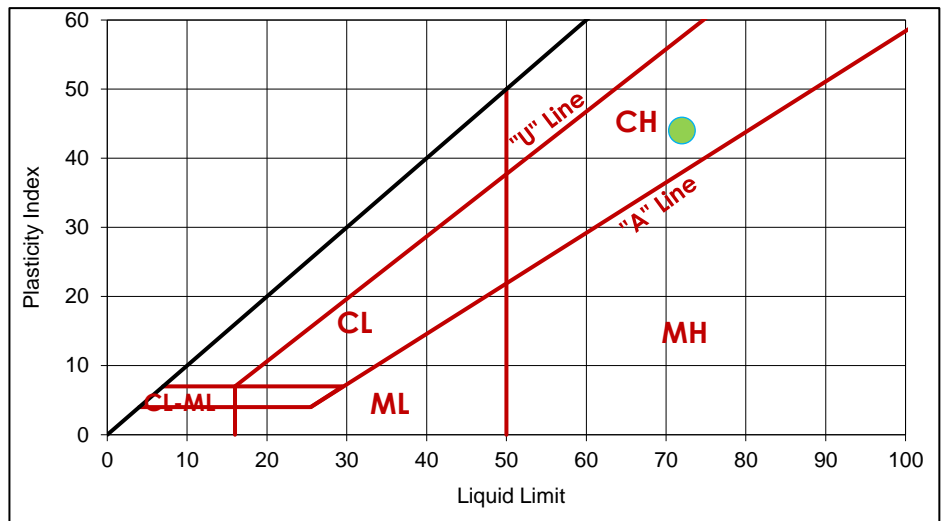
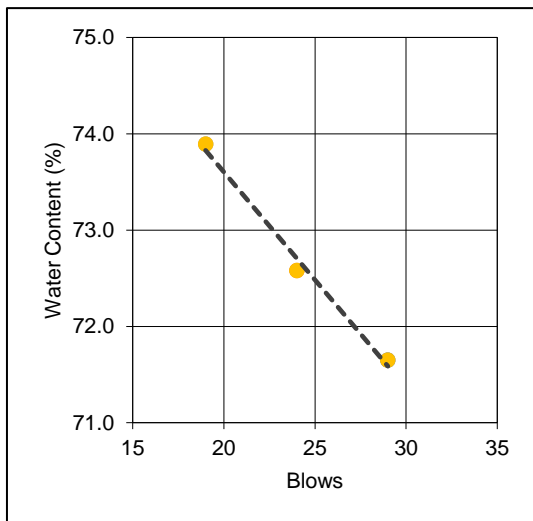
CLIENT FIELD ID TH25-07, S10

STANTEC SAMPLE NO. 1167

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	29	24	19
MC (%)	72	73	74

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	28	28


LIQUID LIMIT, LL	72
PLASTIC LIMIT, PL	28
PLASTICITY INDEX, PI	44
AS REC'D MC (%)	50.6



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 16

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.19

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

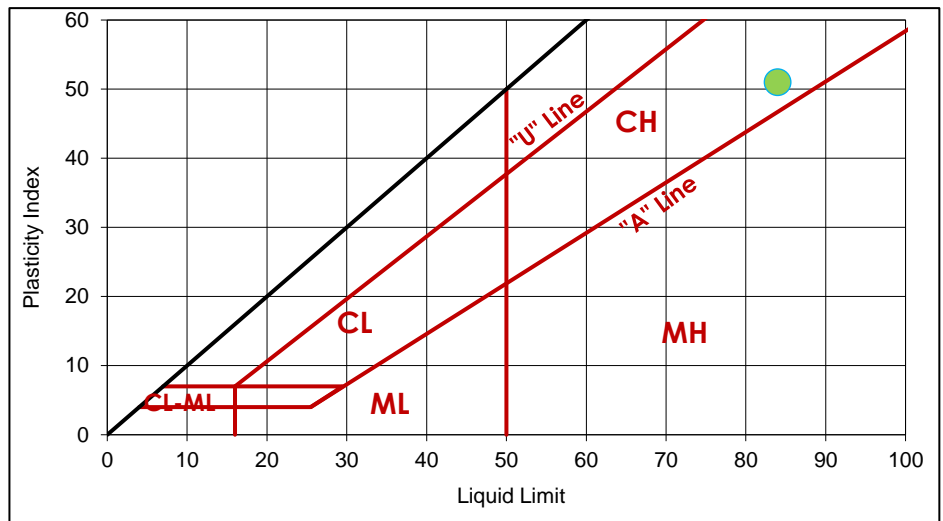
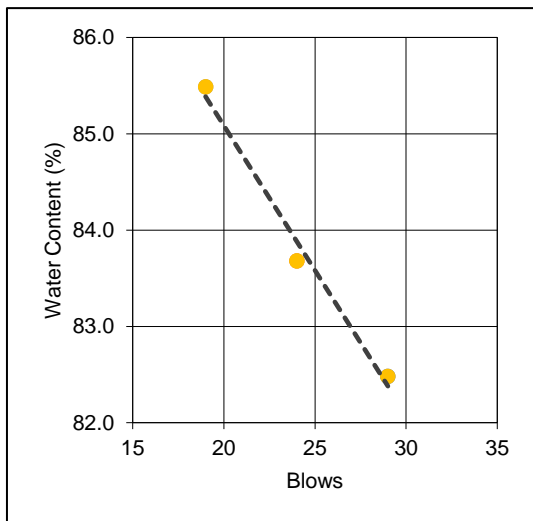
CLIENT FIELD ID TH25-08, S8

STANTEC SAMPLE NO. 1169

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	29	24	19
MC (%)	82	84	85

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	33	33


LIQUID LIMIT, LL	84
PLASTIC LIMIT, PL	33
PLASTICITY INDEX, PI	51
AS REC'D MC (%)	51.2



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 17

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.19

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

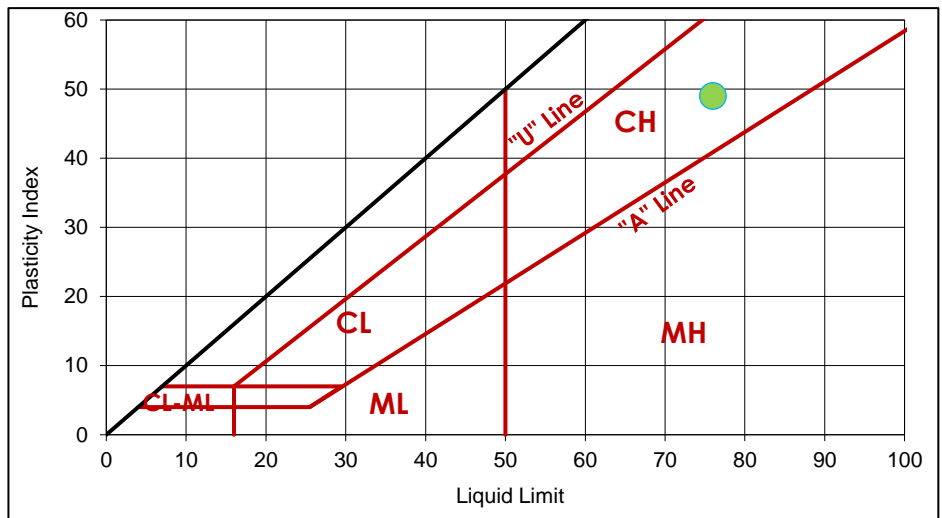
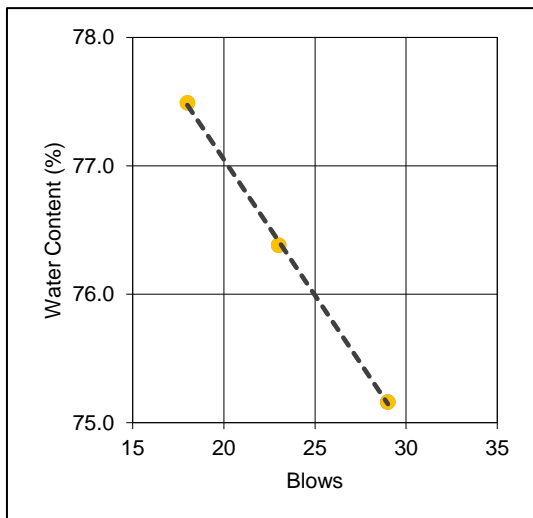
CLIENT FIELD ID TH25-08, S11

STANTEC SAMPLE NO. 1170

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	29	23	18
MC (%)	75	76	77

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	27	27


LIQUID LIMIT, LL	76
PLASTIC LIMIT, PL	27
PLASTICITY INDEX, PI	49
AS REC'D MC (%)	40.8



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D4318 - LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS (LL METHOD A - MULTIPOINT)

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 18

DATE SAMPLED: Not Provided

DATE RECEIVED: 2025.Jun.12

DATE TESTED: 2025.Jun.18

SAMPLED BY: KGS Group Inc.

SUBMITTED BY: KGS Group Inc.

TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

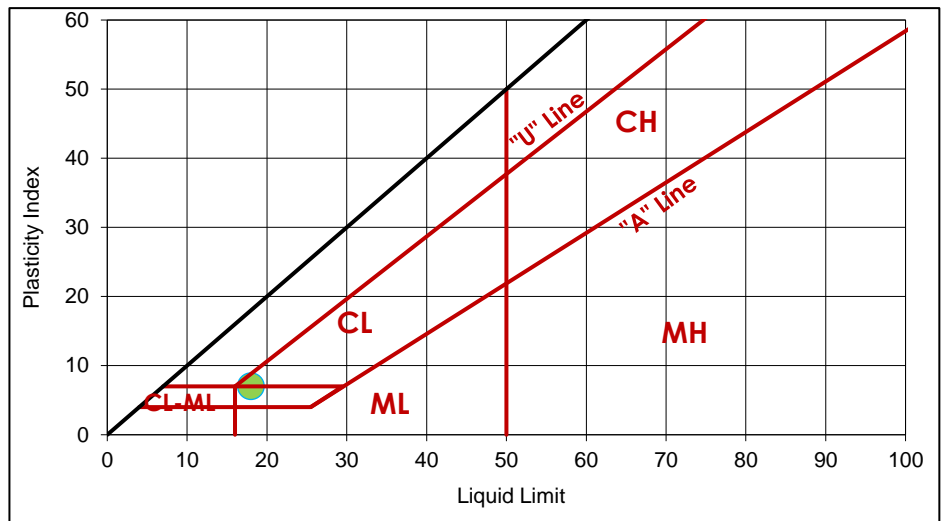
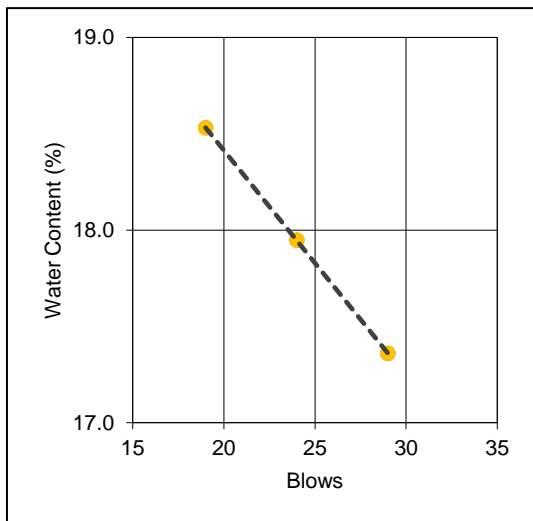
CLIENT FIELD ID TH25-08, S18

STANTEC SAMPLE NO. 1171

	LIQUID LIMIT		
TRIAL	1	2	3
BLOWS	29	24	19
MC (%)	17	18	19

	PLASTIC LIMIT	
TRIAL	1	2
MC (%)	11	11


LIQUID LIMIT, LL	18
PLASTIC LIMIT, PL	11
PLASTICITY INDEX, PI	7
AS REC'D MC (%)	10.5



COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 1

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

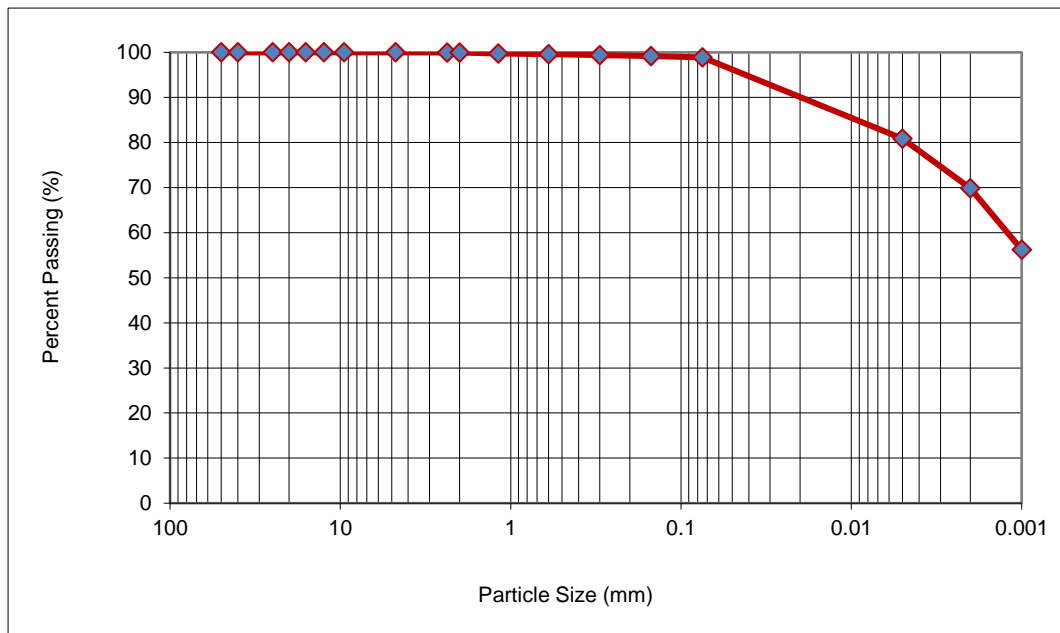
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-01, S4

STANTEC SAMPLE NO. 1148



Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	100.0
9.5	100.0
4.75	100.0
2.36	100.0
2.00	100.0
1.18	99.8
0.600	99.6
0.300	99.4
0.150	99.1
0.075	98.9
0.005	80.9
0.002	69.9
0.001	56.2

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
0.0	0.0	0.5	0.6	29.0	69.9	56.2

COMMENTS
No comments.



REPORT DATE 2025.Jun.24

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 2

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

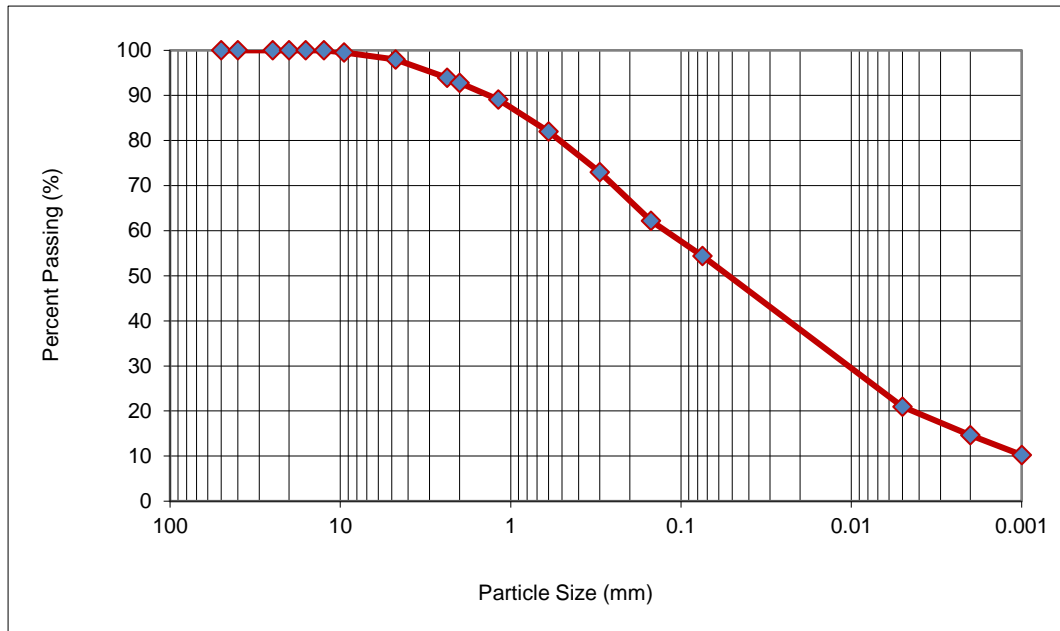
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-01, S11

STANTEC SAMPLE NO. 1150



Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	100.0
9.5	99.5
4.75	98.0
2.36	93.9
2.00	92.8
1.18	89.1
0.600	82.0
0.300	73.0
0.150	62.2
0.075	54.4
0.005	21.0
0.002	14.6
0.001	10.3

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
2.0	5.2	16.1	22.3	39.8	14.6	10.3

COMMENTS
No comments.



REPORT DATE 2025.Jun.24

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 3

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

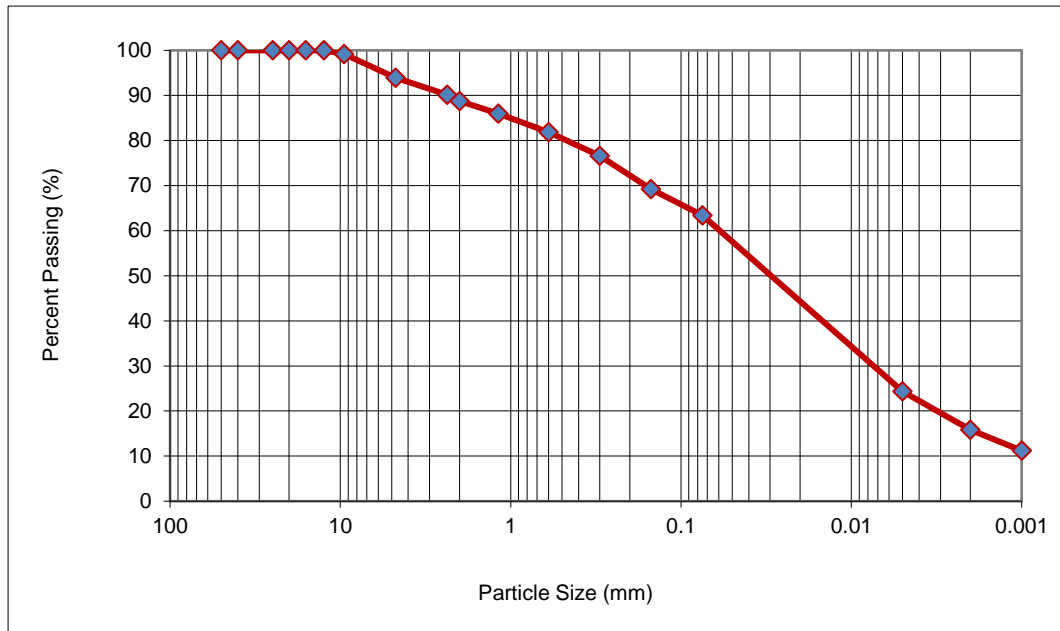
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-02, S13

STANTEC SAMPLE NO. 1152



Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	100.0
9.5	99.2
4.75	94.0
2.36	90.1
2.00	88.8
1.18	86.0
0.600	81.9
0.300	76.6
0.150	69.3
0.075	63.4
0.005	24.3
0.002	15.9
0.001	11.2

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
6.0	5.2	10.0	15.4	47.5	15.9	11.2

COMMENTS
No comments.



REPORT DATE 2025.Jun.24

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 4

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

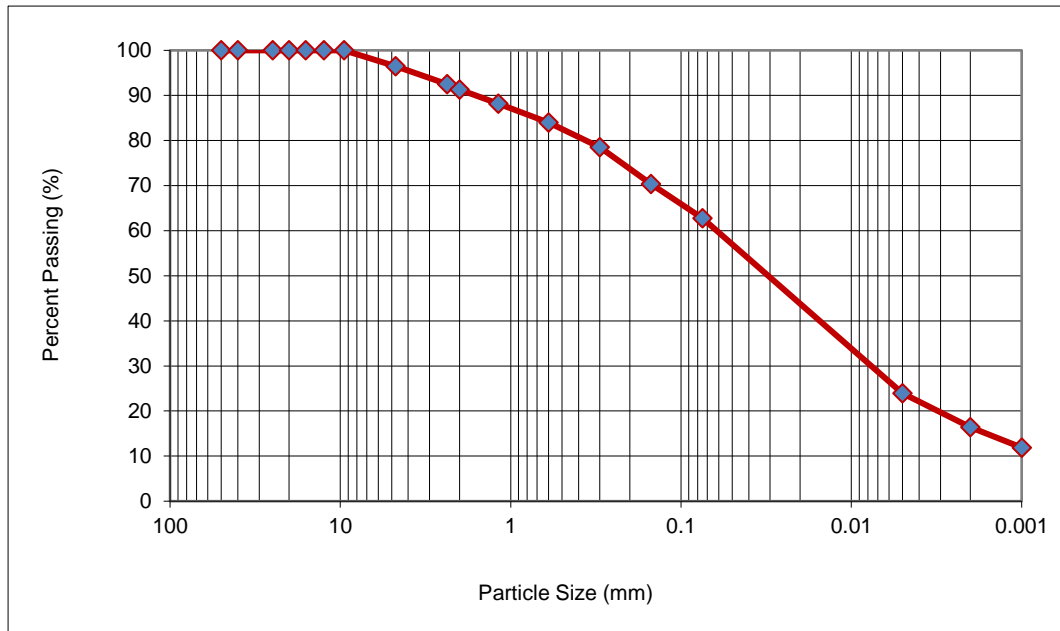
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-02, S17

STANTEC SAMPLE NO. 1153




Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	100.0
9.5	100.0
4.75	96.5
2.36	92.5
2.00	91.3
1.18	88.2
0.600	84.0
0.300	78.5
0.150	70.3
0.075	62.7
0.005	23.9
0.002	16.4
0.001	11.9

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
3.5	5.2	10.5	18.1	46.3	16.4	11.9

COMMENTS
No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY  Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 5

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

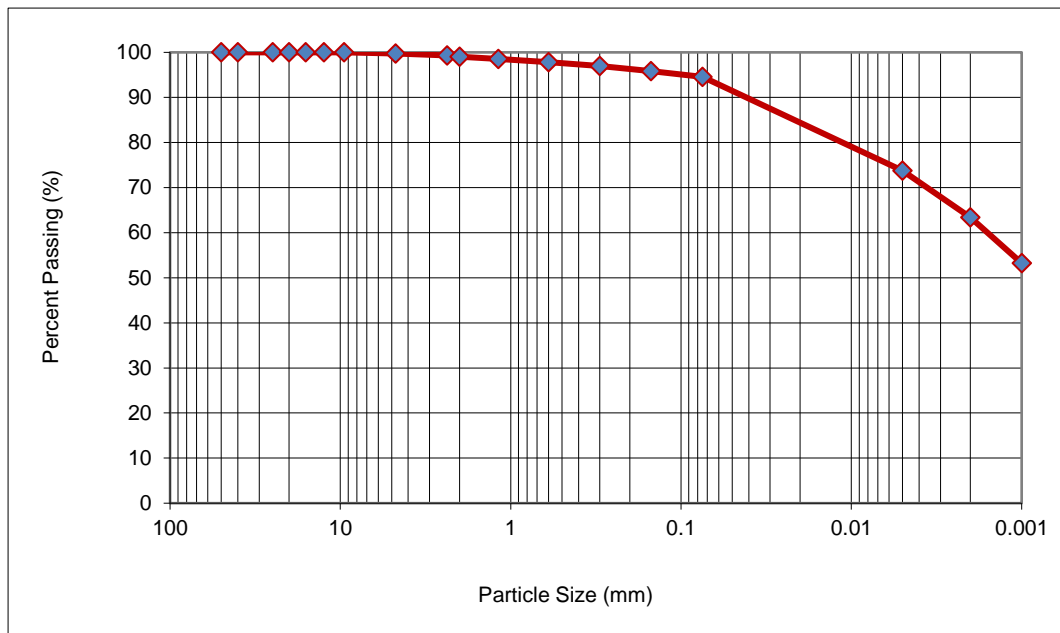
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-03, S8

STANTEC SAMPLE NO. 1155



Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	100.0
9.5	100.0
4.75	99.7
2.36	99.3
2.00	99.1
1.18	98.5
0.600	97.8
0.300	97.0
0.150	95.8
0.075	94.5
0.005	73.8
0.002	63.4
0.001	53.2

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
0.3	0.6	1.8	2.8	31.1	63.4	53.2

COMMENTS

No comments.



REPORT DATE 2025.Jun.24

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

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Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 6

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

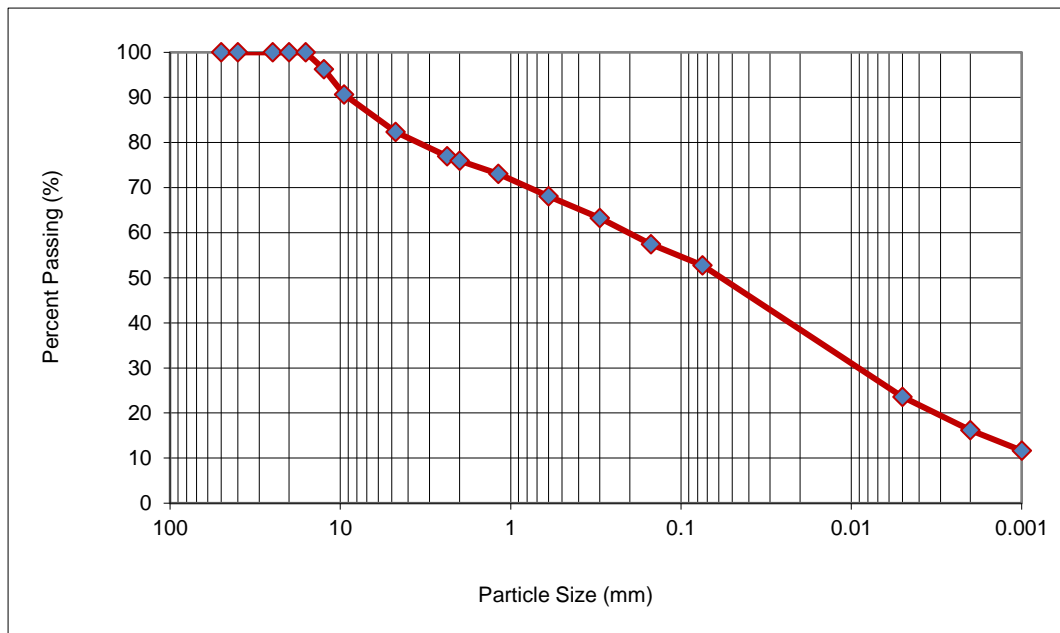
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-03, S13

STANTEC SAMPLE NO. 1156




Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	96.2
9.5	90.6
4.75	82.4
2.36	77.0
2.00	76.0
1.18	73.1
0.600	68.1
0.300	63.3
0.150	57.5
0.075	52.8
0.005	23.6
0.002	16.2
0.001	11.7

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
17.6	6.4	10.7	12.5	36.6	16.2	11.7

COMMENTS
No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY 
Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 7

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

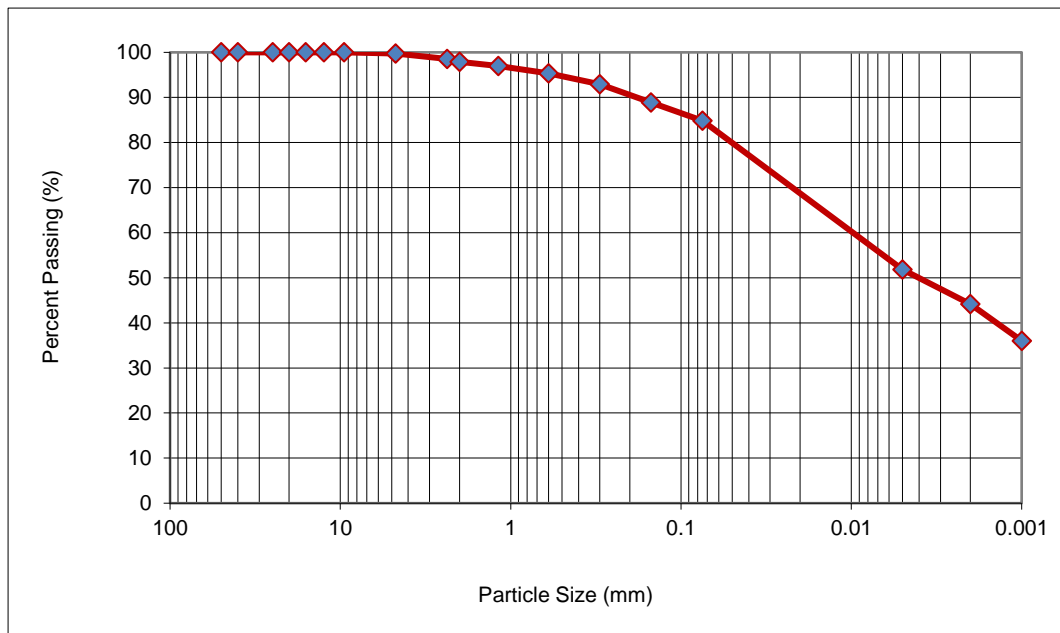
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-04, S12

STANTEC SAMPLE NO. 1158



Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	100.0
9.5	100.0
4.75	99.7
2.36	98.6
2.00	97.9
1.18	97.0
0.600	95.4
0.300	92.9
0.150	88.9
0.075	84.8
0.005	51.8
0.002	44.1
0.001	36.0

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
0.3	1.8	4.0	9.1	40.7	44.1	36.0

COMMENTS

No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

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3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 8

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

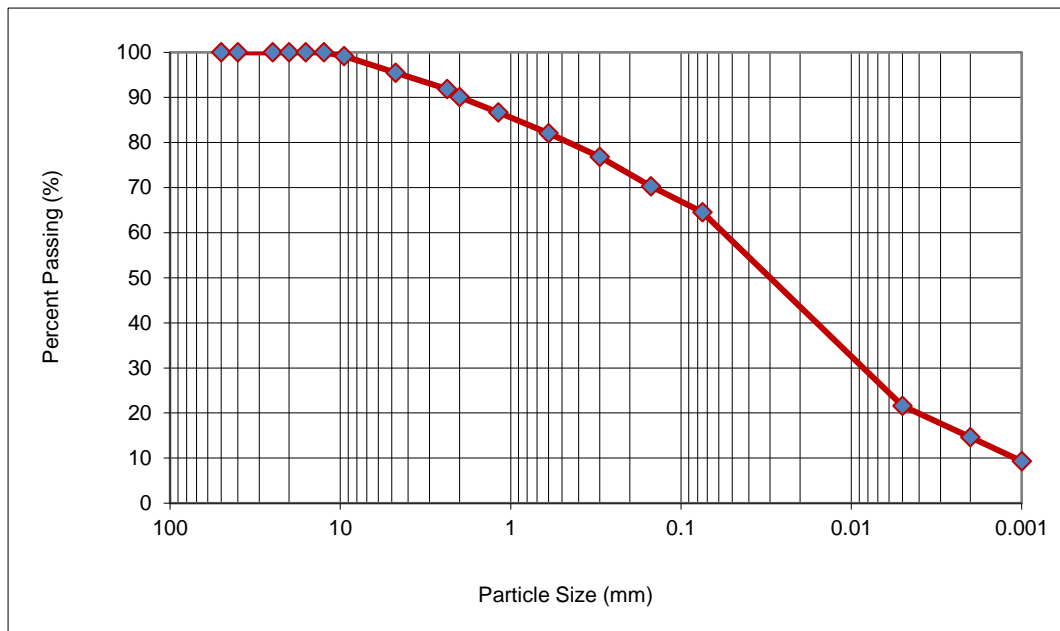
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Rimanshi Gorasiya

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-04, S17

STANTEC SAMPLE NO. 1159



Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	100.0
9.5	99.2
4.75	95.5
2.36	91.9
2.00	90.1
1.18	86.7
0.600	82.1
0.300	76.8
0.150	70.3
0.075	64.5
0.005	21.6
0.002	14.7
0.001	9.3

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
4.5	5.4	11.1	14.5	49.8	14.7	9.3

COMMENTS
No comments.



REPORT DATE 2025.Jun.24

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 9

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

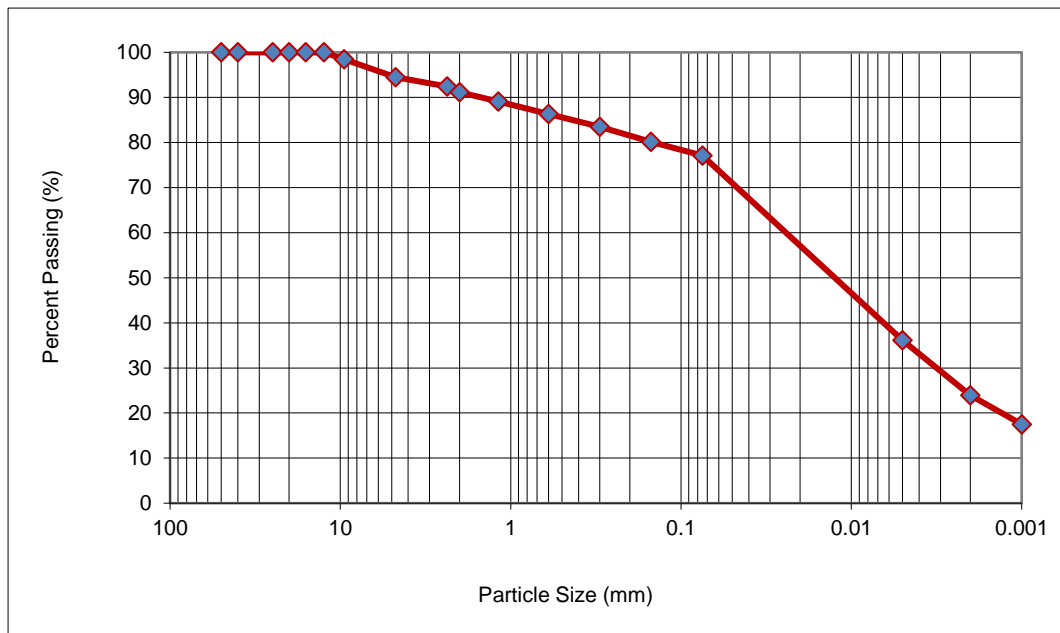
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Larry Presado

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-05, S16

STANTEC SAMPLE NO. 1162



Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	100.0
9.5	98.5
4.75	94.5
2.36	92.4
2.00	91.1
1.18	89.1
0.600	86.3
0.300	83.5
0.150	80.2
0.075	77.1
0.005	36.1
0.002	23.9
0.001	17.5

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
5.5	3.4	6.4	7.6	53.2	23.9	17.5

COMMENTS
No comments.



REPORT DATE 2025.Jun.24

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 10

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

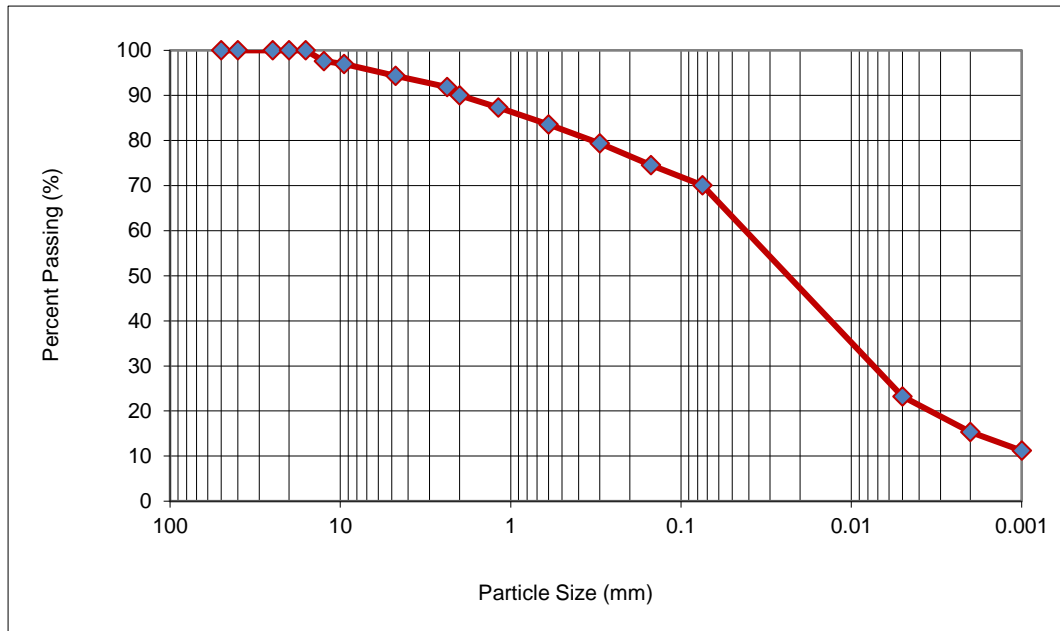
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Larry Presado

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-07, S17

STANTEC SAMPLE NO. 1168



Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	97.6
9.5	97.0
4.75	94.4
2.36	91.9
2.00	90.1
1.18	87.3
0.600	83.6
0.300	79.4
0.150	74.6
0.075	70.1
0.005	23.2
0.002	15.4
0.001	11.2

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
5.6	4.3	9.0	11.0	54.7	15.4	11.2

COMMENTS
No comments.



REPORT DATE 2025.Jun.24

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

ASTM D7928 - PARTICLE-SIZE DISTRIBUTION OF FINE-GRAINED SOILS USING THE SEDIMENTATION ANALYSIS

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

PROJECT Armstrong CA/CI (25-0107-002)

PROJECT NO. 123317744

ATTN Suzanne Schultz

REPORT NO. 11

DATE SAMPLED: Not Provided
SAMPLED BY: KGS Group Inc.

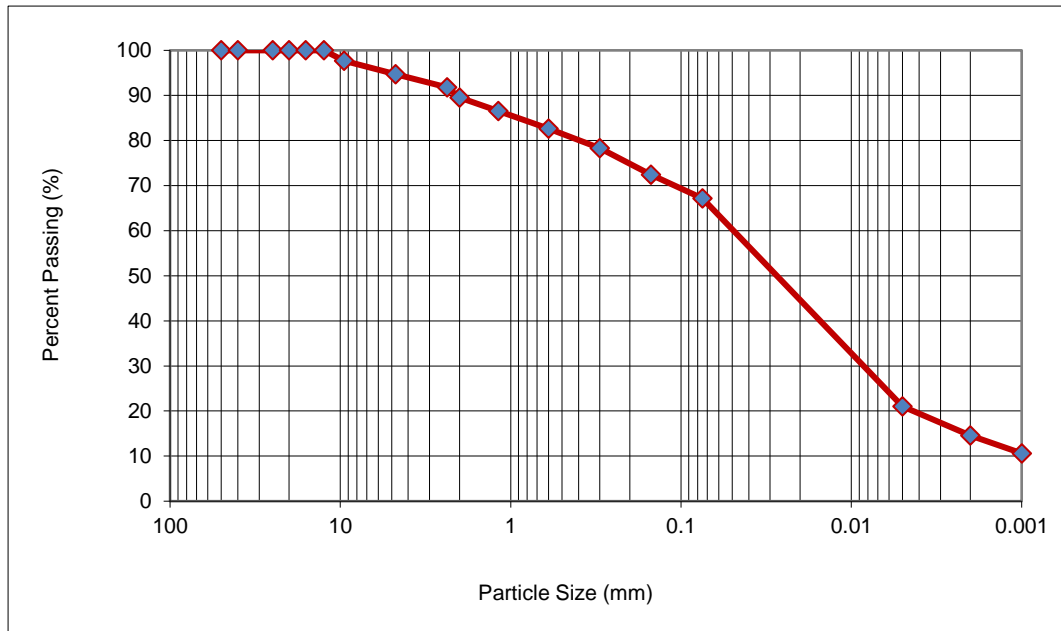
DATE RECEIVED: 2025.Jun.12
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2025.Jun.17
TESTED BY: Larry Presado

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH25-08, S18

STANTEC SAMPLE NO. 1171




Sieve Size (mm)	% Passing
50.0	100.0
40.0	100.0
25.0	100.0
20.0	100.0
16.0	100.0
12.5	100.0
9.5	97.7
4.75	94.7
2.36	91.8
2.00	89.5
1.18	86.6
0.600	82.7
0.300	78.3
0.150	72.4
0.075	67.2
0.005	21.0
0.002	14.5
0.001	10.6

Gravel	Sand			Silt	Clay	Colloids
	Coarse	Medium	Fine			
5.3	5.2	9.4	12.9	52.7	14.5	10.6

COMMENTS
No comments.

REPORT DATE 2025.Jun.24

REVIEWED BY  Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

APPENDIX F

2025 KGS Group Hydrogeological Study Memo

Memorandum

To:	Kelly Fordyce, B.Sc., P.Eng. Geotechnical Engineer, KGS Group	Date:	March 12, 2026
		Project No.:	25-0107-002
From:	Paul Lindell, B.Sc., P.Eng. KGS Group Simratpal Singh, M.Sc. EIT KGS Group	Cc:	Dami Adedapo, Ph.D., P.Eng. Principal & Geotechnical Department Head Jason Mann, M.Sc., P.Geo., FGC Principal, KGS Group
Re:	Hydrogeological Desktop Review for the Armstrong Sewer District (Final Rev 1)		

1.0 BACKGROUND

The Armstrong Combined Sewer (CS) district is a mix of combined sewers and storm relief sewers, located in the West Kildonan neighborhood of Winnipeg. The City of Winnipeg intends to install a new land drainage and wastewater sewer network to separate from the existing CS network. This separation work is set to stage over eight (8) contracts, with the first constructed length to be Contract 1, currently scheduled for late 2025 and early 2026. The pipe sizes and invert depths are being confirmed by the project team, but it is anticipated that the pipe depth will vary between 5.5 m and 10 m below ground surface; and that all piping will be installed using trenchless methods. KGS Group understands that deep shafts will be constructed to facilitate the installation of the sewer lines and associated manholes. It is anticipated that the bottom depth of each shaft will be one (1) meter below the sewer pipe invert depth.

KGS Group completed this hydrogeological desktop study to understand the geology of the area and to interpret the existing groundwater conditions for estimating the groundwater conditions that might be encountered during construction of the proposed installation shafts. The objective of this desktop study was to outline any potential construction risks related to the detailed design of deep shaft excavation in proximity to the underlying till deposits, and to estimate the potential need for groundwater depressurization at the discrete shaft locations. As a part of this desktop study, KGS Group reviewed the University of Manitoba Department of Geological Engineering Maps and Report for Urban Development of Winnipeg to gather information on regional clay and till surfaces, transmissivity, potentiometric surface, etc., for the project site and the surrounding areas. A well inventory was also prepared from the Province of Manitoba's drilling database (GWDrill) to assess historical drilling and well logs in the region. The findings of this desktop study are presented in the following sections along with the interpretation of potential need for groundwater depressurization at the Site.

2.0 METHODOLOGY

To prepare for any potential challenges related to groundwater seepage during excavation and construction, KGS Group reviewed the following historical and recent investigation reports:

- 1) University of Manitoba's Department of Geological Engineering Report for Urban Development of Winnipeg (Baracos, A., et al., 1983) was reviewed to gather information on regional clay and till surfaces, transmissivity, potentiometric surface, etc., for the project and surrounding areas. Plates from the report are included in Appendix A.
- 2) Bedrock Topography and Surface Deposit Maps (Appendix B) developed by Department of Natural Resources at Province of Manitoba (J. Little, 1974).
- 3) Borehole logs and groundwater monitoring results from the geotechnical investigation conducted by TREK Geotechnical Inc. at the project site.
- 4) Borehole logs and groundwater monitoring results from the geotechnical investigation conducted by KGS Group at the project site during May-June 2025. The borehole logs (TH25-01 to TH25-08) are included in the Geotechnical Data Report by KGS Group (2025).
- 5) An inventory of well logs extracted from the Province of Manitoba's drilling database (GWDriII) within and around the project area (Appendix C)

The following subsections include the details of findings from this desktop review.

3.0 DESKTOP REVIEW

3.1.1 GEOLOGICAL ENGINEERING REPORT AND GROUNDWATER AVAILABILITY MAP SERIES

The Geological Engineering Report outlines that a layer of glacial till exists above the confined limestone bedrock (upper carbonate bedrock) in the Winnipeg area. The till is overlain by a surficial layer of glaciolacustrine silts and clays, resulting in the flat topography that exists today. The Geological Engineering Report further describes this uppermost lithological unit, which extends from the surface to approximately 4.5 m below the surface, as a *complex zone* that consists of silty clays, silt, organic soils, sands, along with varying amounts of human-made fill.

The findings outlined in the Geological Engineering Report align with the drilling investigation conducted by TREK Geotechnical for the Armstrong Combined Sewer Preliminary Design (TREK Geotechnical Inc., 2023). The logs for the fourteen boreholes reported by TREK Geotechnical along the proposed sewer network indicate the presence of an asphalt cover on ground surface, underlain by sand and gravel fill, along with a layer of silt and clay, all within the top two (2) meters of ground surface. A layer of clay lies underneath the upper silt and clay layer which extends to the top of till (Figure 6 of the Geotechnical Investigation Report by TREK Geotechnical, 2023). Similarly, the borehole logs from the geotechnical investigation by KGS Group in 2025 revealed the presence of clay layer underneath the upper *complex zone* underlain by a silt till unit. These findings correlate with the Surface Deposits Map (Appendix B) developed by the Natural Resources Branch of the Province of Manitoba that indicates the presence of a surficial clay layer in majority of the Winnipeg area.

The Geological Engineering Report mentions that in the Winnipeg area, the top of the till layer lies at approximately 15.2 m (50 ft) depth below ground surface, while the top of confined bedrock is approximately 3 m (10 ft) deeper than the top of till, i.e. at about 18.2 m (60 ft) depth. In general, the top of confined bedrock in majority of the Winnipeg area ranges between 15.2 to 18.2 m (50 to 70 ft) depth below ground surface. This indicates that the till layer above the bedrock extends up to about 18.2 m (70 ft) depth below ground surface in the areas where the top of bedrock is deeper. The Bedrock Topography map (Appendix B) also indicates that the top of bedrock in the project area is around 213.3 m (700 ft) elevation which is approximately 20 m below the ground surface.

Plate 2 – Depth to Till (Appendix A) shows that the top of till layer is between 12.4 to 15.2 m (41 to 50 ft) in the western half of the Contract 1 area, while it is between 15.2 to 18.2 m (50 to 60 ft) in the eastern half of the contract 1 Armstrong District Site.

The new main sanitary sewer line is proposed to be constructed at elevations between 221 m and 226 m which is approximately 5 to 10 meters below the existing ground elevation. KGS Group understands that the temporary shafts will be constructed approximately 1 meter deeper than the new sewer line. Based on these proposed elevations, KGS Group interprets that the base of shaft will be within the clay zone.

The groundwater elevation in the overburden wells installed by TREK in the project area was within 225.66 m and 230.84 m for the period between October 2022 and June 2023. Later in June 2025, the groundwater elevations within the clay and silt till units were monitored by KGS Group using a vibratory wire piezometer installed within each unit. The groundwater elevation within the clay unit was between 223.9 m and 230.4 m while it ranged between 222.3 m and 229.4 m in the silt till during the period between June 16 and 25, 2025.

Plate 11 – Potentiometric Surface Upper Carbonate Aquifer 1974 (Appendix A) shows the potentiometric surface elevation in the upper carbonate aquifer within the Winnipeg area. Based on this plate, the groundwater elevations in the upper limestone bedrock are interpreted to be close to 222.5 m and 225.5 m (730 and 740 ft) with geodetic elevation. The historical water level monitoring data for seven provincial observation wells around the project site is shown below in Figure 1 (Section 3.0), however, looking at the data for the nearest provincial monitoring well (G05OJ159 NEWPCC #1), located within 1 km northeast of the project site, it is evident that the groundwater elevation was within 222.5 and 226.9 m for the period between January 2020 and March 2025, which correlates with the findings from Plate 11. Seasonal groundwater fluctuations were also observed in the provincial monitoring well data (discussed in the section 3.0 below). Generally, it is observed that groundwater elevations were higher during the winter months (September to April), and trended lower during the spring and summer months (May to August).

According to Plate 13 – Transmissivity of the Upper Carbonate Aquifer (Appendix A), the regional transmissivity values for the upper carbonate aquifer in the contract 1 area, are within a range of 10,000 to 50,000 USgpd/ft.

Based on the above desktop review, it is interpreted from piezometric pressures/elevations within that subsurface strata that groundwater depressurization might be required at the project site during shaft construction and operation depending on the depth of shaft and groundwater pressures; however, the depressurization rates will depend on the overburden (clay and till zones) and upper bedrock transmissivities, as well as the confining pressures between these zones.

To assess the groundwater quality that might be encountered during depressurization, Plate 15 - Total Dissolved Solids in Upper Carbonate Aquifer in September 1980, Plate 16 - Chloride Ion Concentration in Upper Carbonate Aquifer in 1980, and Plate 17 - Sulphate Ion Concentration in Upper Carbonate Aquifer in 1980 (Appendix A) were reviewed for the Contract 1 area and compared with the applicable regulatory guidelines for its management. The contaminated sites within Manitoba are managed under The Contaminated Sites Remediation Act (CSRA) and the Contaminated Sites Remediation Regulation (CSRR). The Health Canada's Guidelines for Canadian Drinking Water Quality are listed as the primary guidelines under the CSRR that outlines an Aesthetic Objective (AO) guideline of 250 mg/L for chloride and 500 mg/L for sulphate and TDS. These AO guidelines refer to the characteristics in water that affects its taste or colour and are not related or pose any risk to human health. According to the Geological Engineering Report Plates, the groundwater in the upper carbonate zone in the Site area is estimated to have TDS values around 1000 mg/L, the chloride ion concentrations in the range of 200 to 300 mg/L, and sulphate ion concentrations between 100 and 300 mg/L. Based on Health Canada's Drinking Water Quality guidelines, the estimated water quality at the site area is interpreted to not require any treatment of groundwater for disposal, however, a groundwater testing program must be included as a part of the overall dewatering program, if required.

3.1.2 PROVINCIAL WELL INVENTORY (GWDRILL)

KGS Group reviewed the Province of Manitoba's well record database (GWDrill) for the area surrounding the Armstrong Region Sewer District Site. The inventory near the Site area consists of provincial observation wells and production wells. Through this well record database, the stratigraphy at these well locations were reviewed and is provided in Appendix C. Overall, the review of GWDrill well logs reveal the presence of overburden material comprising of the clay and till layer above the carbonate bedrock.

TABLE 1: NEARBY GROUNDWATER WELL DATABASE

S.No.	Well Name	Well PID	UTM X (m)	UTM Y (m)	UTM Z (m)	Location
1	G05OJ135 GM191	101628	631846	5536993	233.812	RIVER LOT 0025 IN PARISH OF Kildonan
2	G05OJ161 GF #6 MCPHILLIPS	118131	631352	5531687	232.244	LX36-11-3E
3	G05OJ026 MO-12	10808	631323	5530951	232.96	RIVER LOT 0035 IN PARISH OF St. John
4	G05OJ009 RED R F 045	4178	640251	5532455	230.968	NW18-11-4E
5	G05OJ159 NEWPCC #1	116777	635176	5535173	232.404	RIVER LOT 0023 IN PARISH OF Kildonan
6	G05OJ025 MO-14	10807	631318	5530962	233.071	RIVER LOT 0035 IN PARISH OF St. John
7	G05OJ022 MO-2	6910	626830	5538434	234.864	NE3-12-2E
8	-	124839	634609	5534897	229	RIVER LOT 0019 IN PARISH OF Kildonan
9	-	17701	634609	5534897	229	RIVER LOT 0019 IN PARISH OF Kildonan
10	-	10536	634609	5534897	229	RIVER LOT 0019 IN PARISH OF Kildonan
11	-	124726	634609	5534897	229	RIVER LOT 0019 IN PARISH OF Kildonan
12	-	68296	634466	5534738	228	RIVER LOT 0018 IN PARISH OF Kildonan

S.No.	Well Name	Well PID	UTM X (m)	UTM Y (m)	UTM Z (m)	Location
13	-	21471	634466	5534738	228	RIVER LOT 0018 IN PARISH OF Kildonan
14	-	11879	634466	5534738	228	RIVER LOT 0018 IN PARISH OF Kildonan
15	-	27596	634466	5534738	228	RIVER LOT 0018 IN PARISH OF Kildonan
16	-	11881	634198	5534471	232	RIVER LOT 0015 IN PARISH OF Kildonan
17	-	11883	634121	5534395	231	RIVER LOT 0014 IN PARISH OF Kildonan
18	-	25107	633908	5534104	231	RIVER LOT 0012 IN PARISH OF Kildonan
19	-	11880	634007	5534281	232	RIVER LOT 0013 IN PARISH OF Kildonan
20	-	34601	633859	5533969	231	RIVER LOT 0011 IN PARISH OF Kildonan
21	-	170449	633908	5534104	231	RIVER LOT 0012 IN PARISH OF Kildonan

The historical groundwater elevation data at seven provincial monitoring wells (S.No. 1 to 7 in Table 1) was provided to KGS Group by the Manitoba Environment and Climate Change (MECC) and is shown in Figure 1 below. Seasonal groundwater fluctuations can be seen in most of these wells installed in the limestone bedrock aquifer. Generally, it is interpreted that groundwater elevations trend downward during the spring and summer months while it recovers back to higher elevations during the winter months. These seasonal fluctuations of groundwater elevation varied between 1 to 4 m for the available historical data provided by MECC. Of this groundwater elevation data, the highest groundwater elevation was observed in the monitoring well G05OJ022 at 235.7 m on July 17, 2005, while the lowest groundwater elevation was observed in the monitoring well G05OJ009 at 219.6 m on July 31, 1980. Additionally, the groundwater elevation at the nearest provincial monitoring well (G05OJ159 NEWPCC #1), located within 1 km northeast of the project site, was within 222.5 and 226.9 m for the period between January 2020 and March 2025 (Figure 1) which correlates with the findings from Plate 11 (Appendix A) of the Geological Engineering Report. Based on the groundwater monitoring data provided by the Province, it is observed that the groundwater elevation remains higher at the well, G05OJ022, which is located at approx. 6.9 km East of the Site, in comparison to the lower groundwater elevations that were consistently observed at provincial monitoring well, G05OJ009, located at approx. 5 kms to the West of the Site.

Generally, the groundwater pressures in the overburden clay and till layers are in equilibrium with the underlying bedrock aquifer. Hence, depending on the depth of shaft, groundwater depressurization may be required during shaft construction. However, it must be noted that this study includes only an interpretation of the piezometric pressures/elevations within the subsurface strata and does not consider the strength of the intact soil immediately below the proposed deep shafts to resist excavation basal heave.

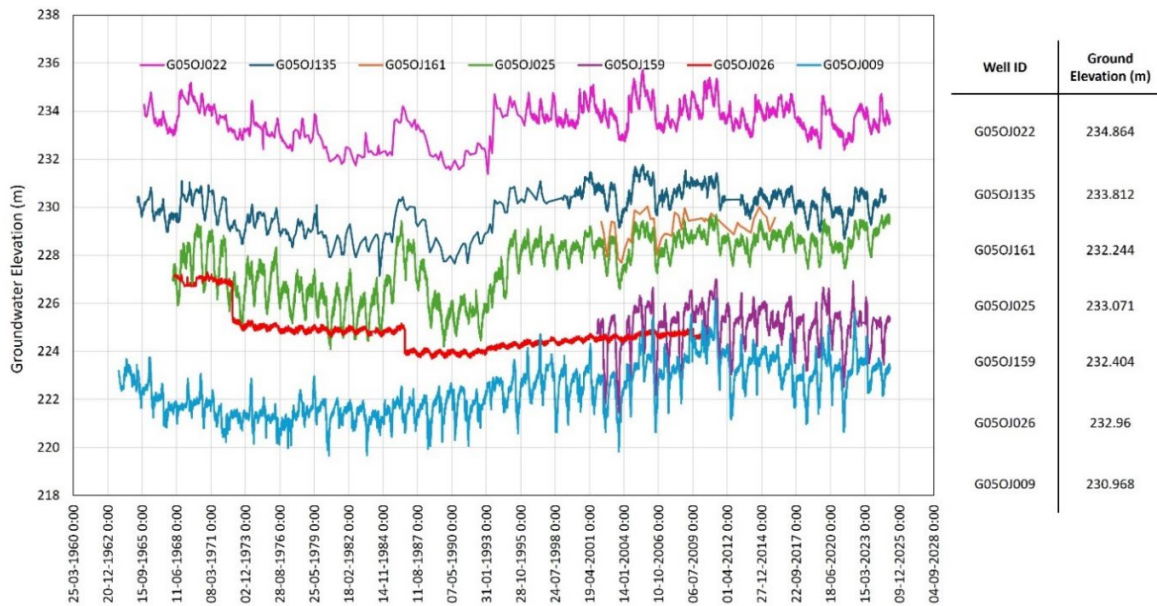


FIGURE 1: GROUNDWATER ELEVATION DATA FOR THE PROVINCIAL MONITORING WELLS AROUND THE ARMSTRONG SEWER DISTRICT SITE

4.0 CONCLUSIONS

KGS Group conducted this desktop review study to understand the existing hydrogeological data at and around the Armstrong Combined Sewer Site to understand the potential need for groundwater dewatering during temporary shaft construction.

Based on the review of available resources, groundwater is interpreted to occur in both the overburden and underlying bedrock. The new sewer pipe as well as the base of the temporary shafts are expected to be installed within the clay overburden layer. The groundwater elevation in the nearest provincial monitoring well (G05OJ159 NEWPCC #1), located within 1 km northeast of the project site, was between 222.5 and 226.9 m for the recent monitoring period between January 2020 and March 2025 and is interpreted to be representative of the project site conditions.

In general, it is observed that groundwater pressures in the overburden clay and till layers are in equilibrium with the underlying bedrock aquifer. Hence, depending on the location and depth of shaft, groundwater dewatering may be required during construction and there is potential for basal heave. Additionally, seasonal fluctuations in groundwater elevation are estimated at the project site, and hence the groundwater depressurization program should be planned accordingly. According to Plate 13 – Transmissivity of the Upper Carbonate Aquifer (Appendix A), the regional transmissivity values for the upper carbonate aquifer in the contract 1 area, are within a range of 10,000 to 50,000 USgpd/ft.

Based on the review of the Geological Engineering Report Plates, the groundwater quality during dewatering is estimated to have a TDS in the range of 1000 mg/L, while the chloride ion and sulphate ion concentrations are expected in the range of 200 to 300 mg/L, and 100 and 300 mg/L, respectively. These estimated

concentrations were compared with the Health Canada’s Drinking Water Quality guidelines, and it is interpreted that groundwater treatment will likely not be required for its disposal on surface or in the nearby sewer system, however, a groundwater testing program must be included as a part of the overall dewatering program, if required.

5.0 REFERENCES

Baracos, A., et al. *Geological Engineering Report for Urban Development of Winnipeg*. Context Publications, 1983.

J. Little, 1974. Groundwater Availability Study. Winnipeg Area. Water Resources Branch. Department of Natural Resources. Province of Manitoba. Revised 1980.

TREK Geotechnical Inc., 2023. Armstrong Combined Sewer Preliminary Design Geotechnical Investigation Report.

STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This memorandum has been prepared for City of Winnipeg in accordance with the agreement between KGS Group and City of Winnipeg (the “Agreement”). This memorandum represents KGS Group’s professional judgment and exercising due care consistent with the preparation of similar documents. The information, data, recommendations, and conclusions in this memorandum are subject to the constraints and limitations in the Agreement and the qualifications in this memorandum. This memorandum must be read as a whole, and sections or parts should not be read out of context.

This memorandum is based on information made available to KGS Group by City of Winnipeg. Unless stated otherwise, KGS Group has not verified the accuracy, completeness, or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this memorandum apply only as they existed at the time of KGS Group’s work.

Third Party Use of Memorandum

Any use a third party makes of this memorandum 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 memorandum.

Geo-Environmental Statement of Limitations

KGS Group prepared the geo-environmental conclusions and recommendations for this memorandum in a professional manner using the degree of skill and care exercised for similar projects under similar conditions by reputable and competent environmental consultants. The information contained in this memorandum is based on the information that was made available to KGS Group during the investigation and upon the services described, which were performed within the time and budgetary requirements of City of Winnipeg. As this memorandum is based on the available information, some of its conclusions could be different if the information upon which it is based is determined to be false, inaccurate, or contradicted by additional information. KGS Group makes no representation concerning the legal significance of its findings or the value of the property investigated.

Geotechnical Investigation Statement of Limitations

The geotechnical investigation findings and recommendations of this memorandum 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 the site at the time of drilling. 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, KGS Group should be notified in order that the recommendations can be reviewed and modified if necessary.

Prepared By:



Simratpal Singh, M.Sc., EIT
Environmental Hydrogeologist

Reviewed By:



Paul Lindell, P.Eng.
Environmental Engineer

Approved By:



Jason Mann, M.Sc. P.Geo., FGC
Principal

SPS/PJL/kv/jr

Attached:

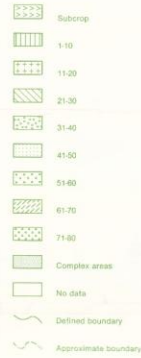
- Appendix A - Geological Engineering Report for Urban Development of Winnipeg (University of Manitoba, 1983) - Plates
- Appendix B - Groundwater Availability Study Maps (Natural Resources Department, Province of Manitoba)
- Appendix C - Borehole Logs (TREK Geotechnical)
- Appendix D - GWDrill Well Logs

APPENDIX A

Geological Engineering Report for Urban
Development of Winnipeg (University of Manitoba,
1983) - Plates

LEGEND

Depth to glacial till in feet



Scale 1:50,000

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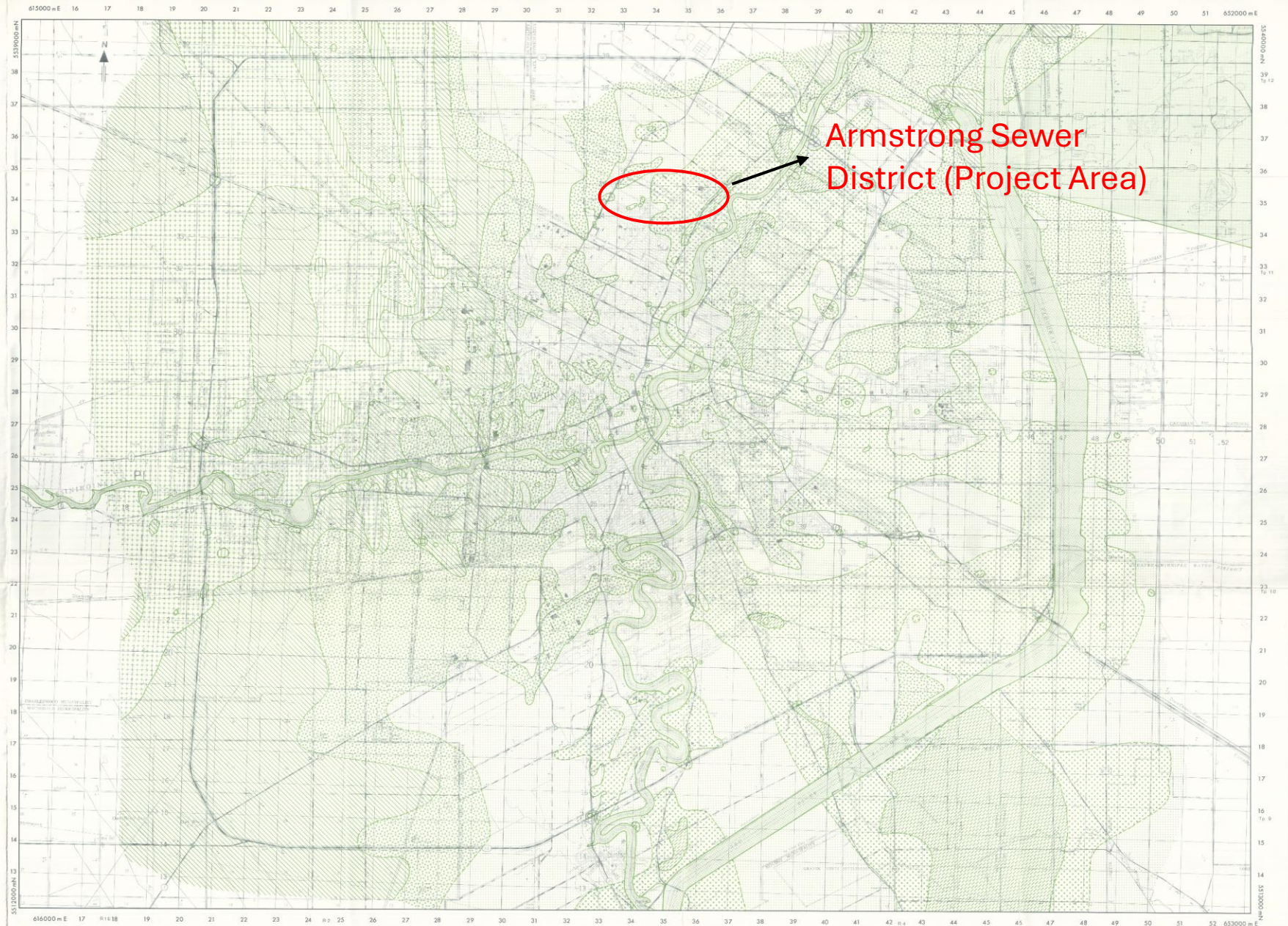
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ENGINEERING

GEOLOGICAL ENGINEERING REPORT
FOR
URBAN DEVELOPMENT
WINNIPEG

PLATE 2
DEPTH TO TILL



To accompany report edited by:
A. Barbeau, D. H. Shields, D. H. Kitchener



LEGEND

- Control Well
- 750 Potentiometric Contour Line with Geodetic Elevation in Feet

ACKNOWLEDGEMENT
Map provided by the Manitoba Water Resources Branch



Scale 1:50,000

Base Map provided by the SURVEYS AND MAPPING BRANCH, DEPARTMENT OF ENERGY, MINES AND RECLAMATION, updated from aerial photography taken in 1964. Revised 1975. Modified by ARMSTRONG SURVEYS LIMITED, Winnipeg, in 1981.



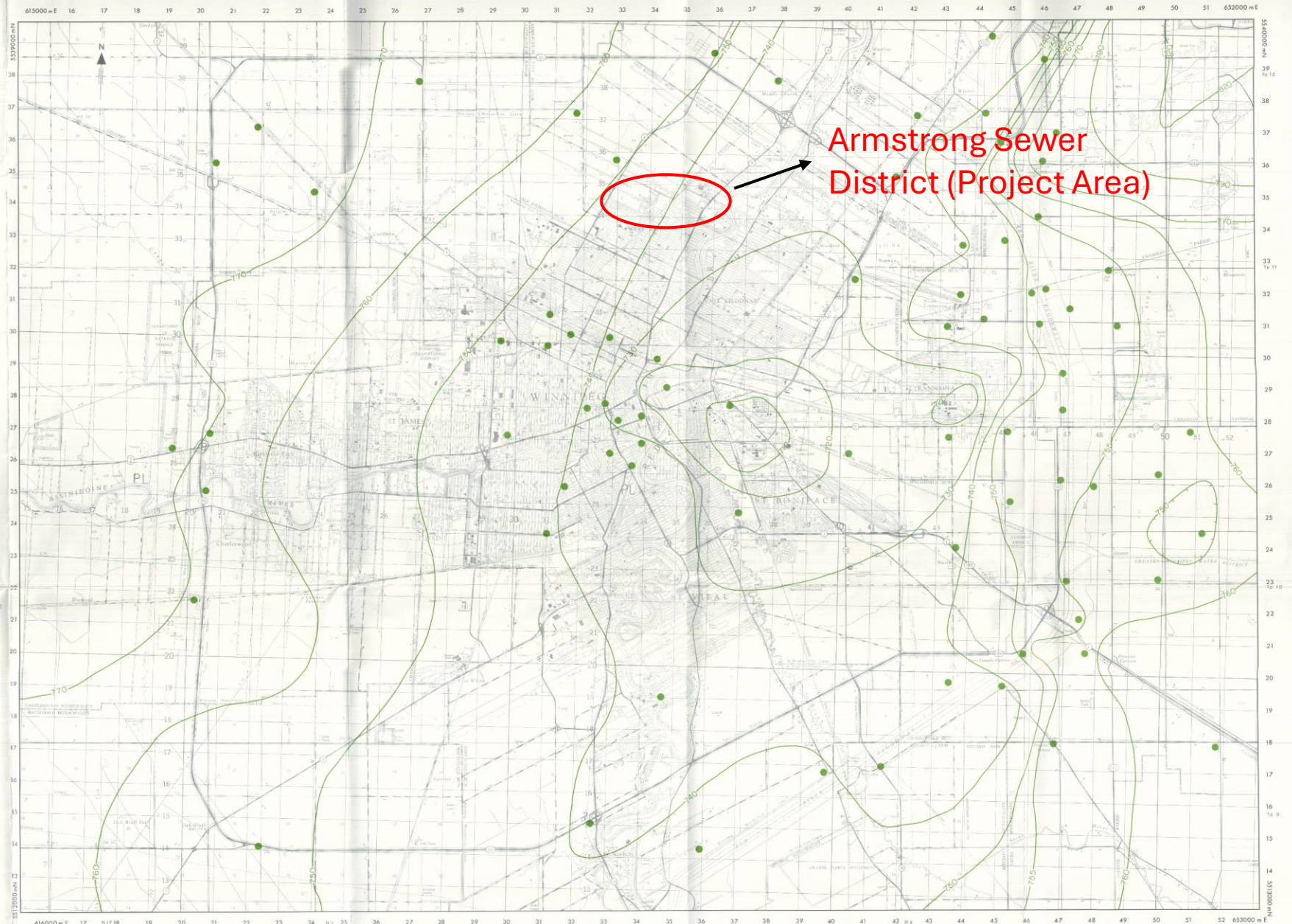
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ENGINEERING

GEOLOGICAL ENGINEERING REPORT
FOR
URBAN DEVELOPMENT
WINNIPEG

PLATE 11

POTENTIOMETRIC SURFACE
UPPER CARBONATE AQUIFER
APRIL 1974

To accompany report edited by:
A. Baracos, D. H. Shrods, B. H. Kierulff



LEGEND

● Pumping Test Site
 10,000 Line of Equal Transmissivity with Value in Gallons/US Day per Foot. Based on Aquifer Pumping Tests and Interpretation of Potentiometric Contour Spacing.

CAUTION:
 Due to the nature of the carbonate rock aquifer transmissivities can vary dramatically within short distances. This map should therefore be used as a guide to general trends in transmissivity.

ACKNOWLEDGEMENT:
 Map provided by the Manitoba Water Resources Branch.

Roads Major Minor Railway Light Rail Bus Rapid Transit Streetcar Waterway Canal Lake Pond Marsh Swamp Forest Park Cemetery Airport Industrial Commercial Residential Institutional Public Works Utilities Sewer Water Gas Electric Telephone Cable Fiber Optic Data Other	Symbols North Arrow Scale Index Title Date Author Editor Designer Checker Approver Project Manager Client Consultant Contractor Subcontractor Supplier Manufacturer Distributor Retailer Wholesaler Importer Exporter Agent Broker Dealer Franchisee Licensee Affiliate Partner Joint Venture Consortium Alliance Network System Platform Framework Infrastructure Core Backbone Hub Spoke Node Link Path Route Network System Platform Framework Infrastructure Core Backbone Hub Spoke Node Link Path Route Network
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Scale 1:50,000

Base Map provided by the SURVEYS
 AND MAPPING BRANCH, DEPARTMENT
 OF ENERGY, MINES AND RESOURCES
 Updated from aerial photography taken
 in 1986. Revised 1988. Modified by
 MANITOBA SURVEYS LIMITED,
 Winnipeg, in 1988.

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GEOLOGICAL ENGINEERING REPORT
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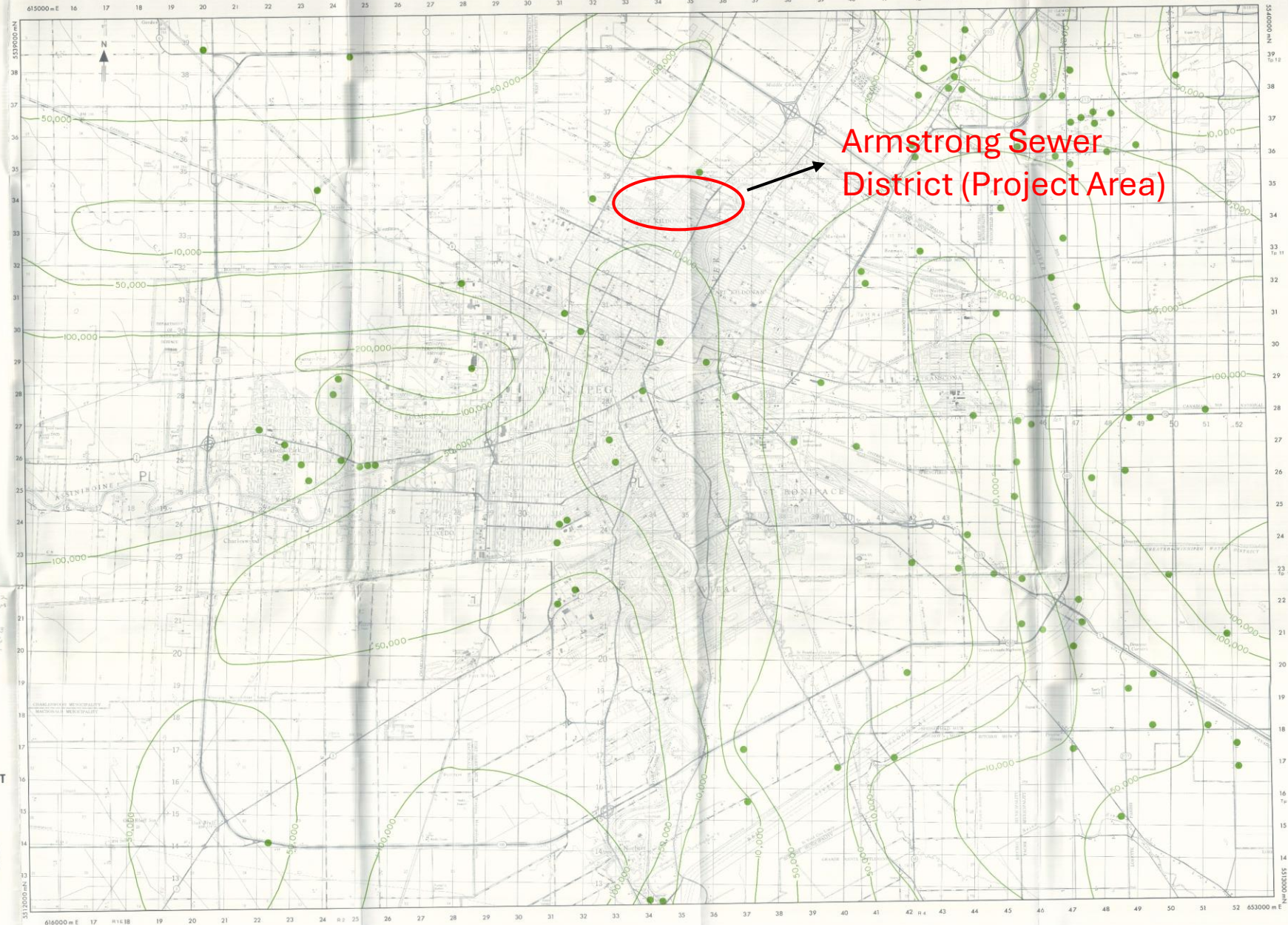
PLATE 13

TRANSMISSIVITY
 OF THE
 UPPER CARBONATE AQUIFER

To accompany report edited by:
 A. BARNES, D. H. SHAW, B. H. KAPLAN

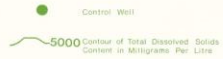


6.62
 11.14
 0.6
 0.55
 0.46
 0.3



Armstrong Sewer
 District (Project Area)

LEGEND



ACKNOWLEDGEMENT:
Map provided by the Manitoba Water Resources Branch.



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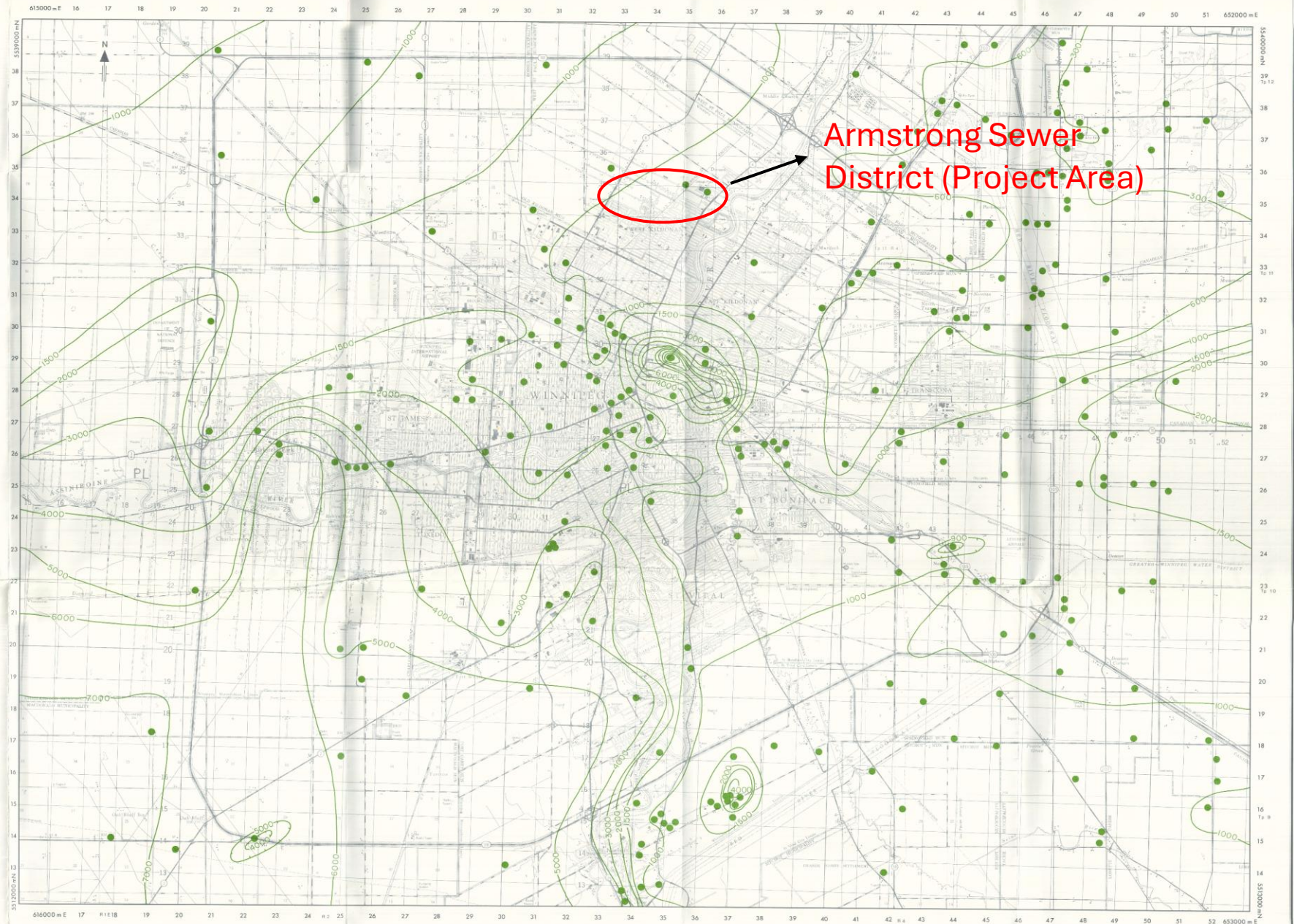
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FOR
URBAN DEVELOPMENT
WINNIPEG



PLATE 15

TOTAL DISSOLVED SOLIDS
UPPER CARBONATE AQUIFER
SEPTEMBER 1980

To accompany report submit to:
A. Bence, D.H. Shields, B.H. Kjarman



● Control Well

300 Chloride Ion Contour Line with Concentration in Milligrams Per Litre

ACKNOWLEDGEMENT:
Map provided by the Manitoba Water Resources Branch



Scale 1:50,000



Base Maps provided by the SURVEYS
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OF ENERGY, MINES AND RESOURCES.
Updated from aerial photography taken
in 1958. Printed 1970. Modified by
AIRQUEST SURVEYS LIMITED,
Winnipeg, in 1981.



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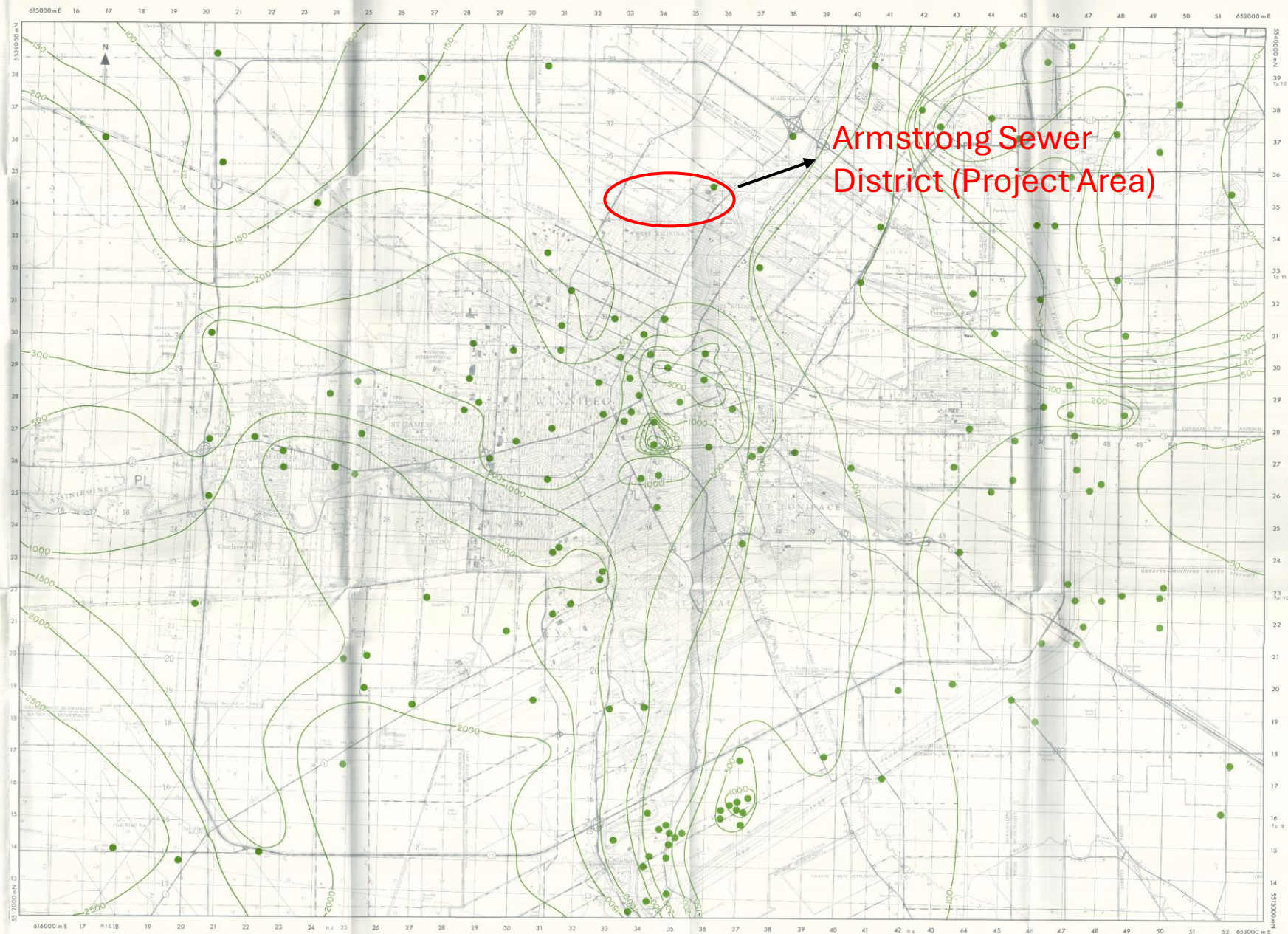
GEOLOGICAL ENGINEERING REPORT
FOR
URBAN DEVELOPMENT
WINNIPEG

PLATE 16

UPPER CARBONATE AQUIFER
CHLORIDE ION
1980



To accompany report edited by:
A. Hansen, D. H. Shields, B. H. Kyrtangen



Control Well

300 Sulfate Ion Contour Line with Concentration in Milligrams Per Litre

ACKNOWLEDGEMENT:
Map provided by the Manitoba Water Resources Branch.



Base Maps provided by the SURVEYS
AND MAPPING BRANCH, DEPARTMENT
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Updated from aerial photography taken
in 1965. Printed 1970. Modified by
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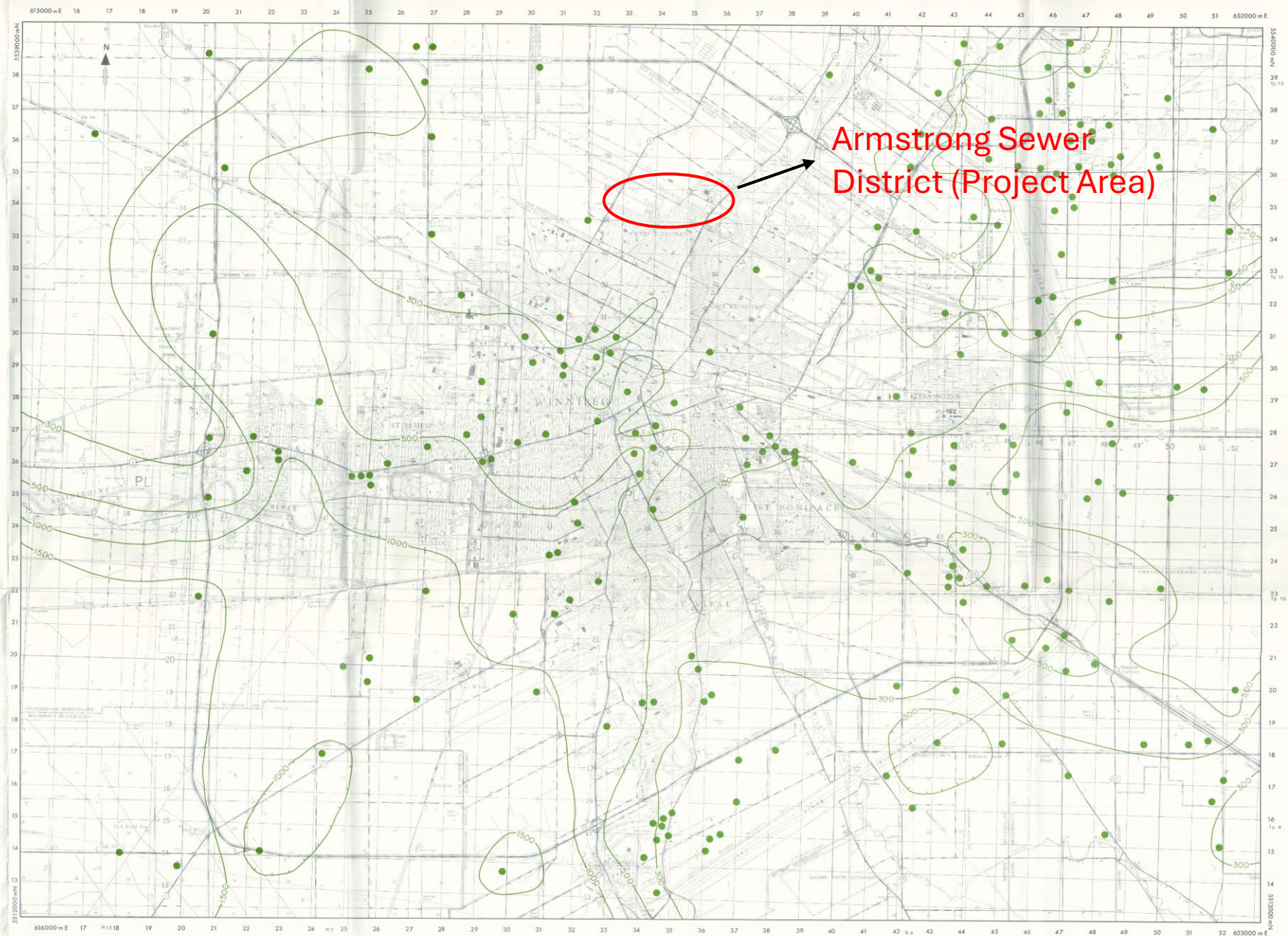
GEOLOGICAL ENGINEERING REPORT
FOR
URBAN DEVELOPMENT
WINNIPEG

PLATE 17

UPPER CARBONATE AQUIFER
SULPHATE ION CONCENTRATION
1980

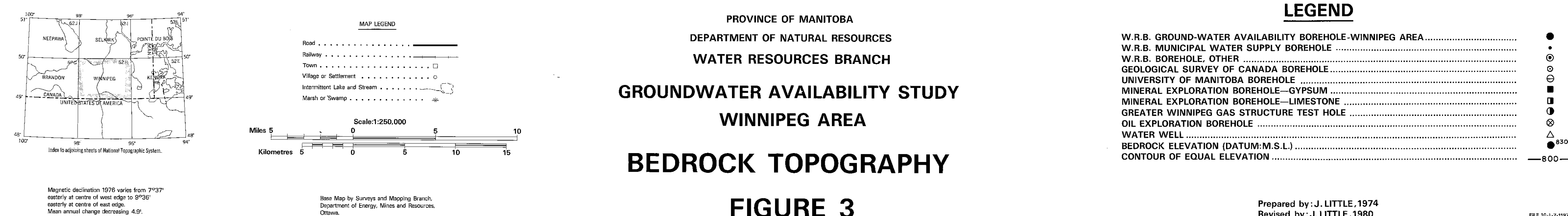
1980

To accompany report edited by:
A. Benscos, D.H. Shields, B.H. Kirtenson



APPENDIX B

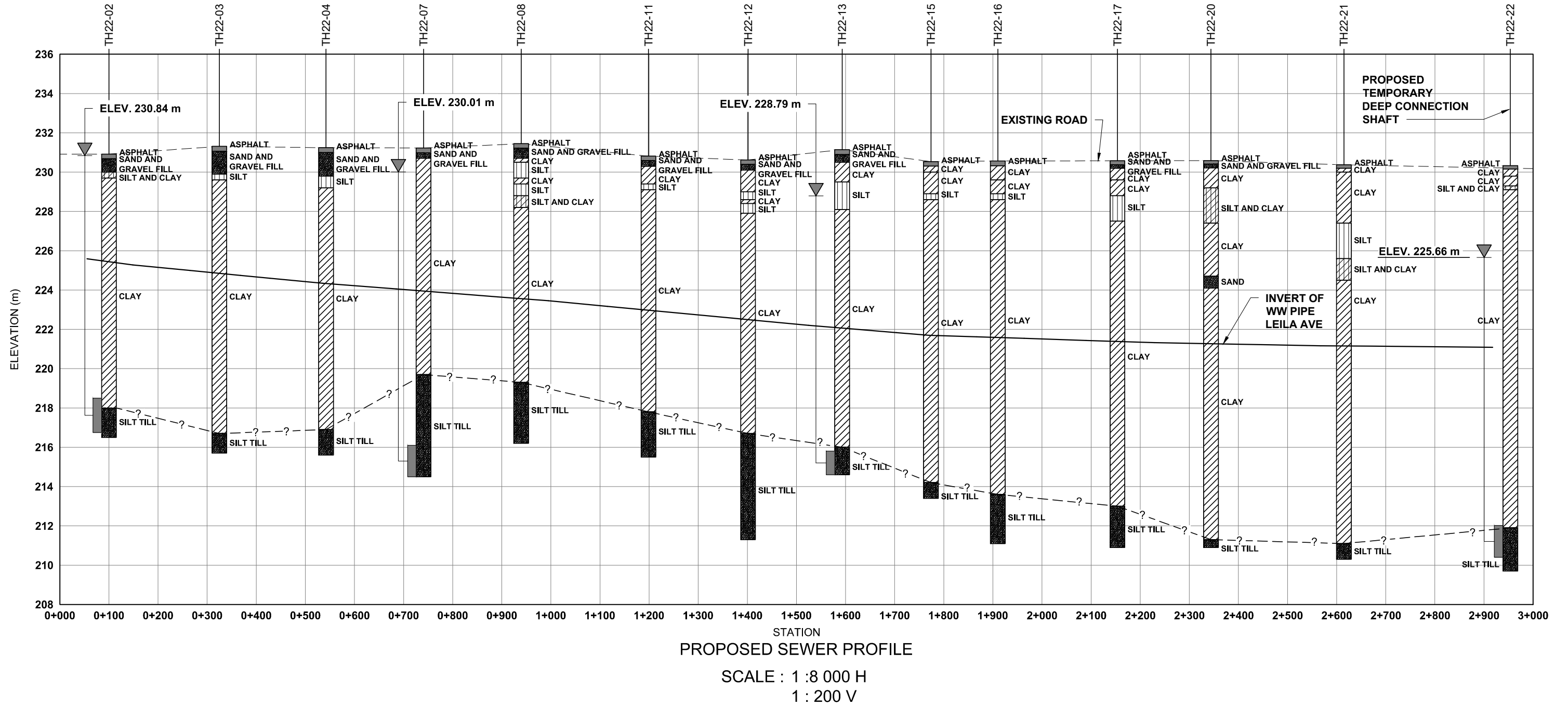
Groundwater Availability Study Maps (Department of Natural Resources, Province of Manitoba)



APPENDIX C

Borehole Logs (TREK Geotechnical)

Z:\Projects\0336 Jacobs Canada Inc\0336 003 00 Armstrong Combined Sewer\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\Fig 06 2023-06-29 Armstrong Combined Sewer 0_1 0336-003-00.dwg, 2023-06-29 7:57:17 AM



LEGEND: ▼ TILL GROUNDWATER LEVEL

NOTES:

1. SEWER INVERT PROFILE AS PROVIDED BY JACOBS (DRAWINGS ISSUED FOR 30 % DESIGN DRAWINGS DATED JUNE 14, 2023).
2. GROUNDWATER HIGHEST ELEVATIONS TAKEN BETWEEN OCTOBER 13, 2022 AND JUNE 8, 2023.

Figure 06
Proposed Sewer Profile

APPENDIX D

GWDrill Well Logs

Location: RIVER LOT 0025 IN PARISH OF Kildonan

Well PID: 101628
Owner: MICHEAL LISI/WRB
Driller: UNKNOWN
Well Name: G05OJ135 GM191
Well Use: OBSERVATION
Water Use:
UTMX: 631846
UTMY: 5536993
Accuracy XY: 1 EXACT [<5M] [GPS]
UTMZ: 233.8120
Accuracy Z: 1 EXACT <10CM
Date Completed: 1911 Aug 23

WELL LOG

From (ft.)	To (ft.)	Log
0	38.0	CLAY; DARK GREY AND YELLOW
38.0	62.0	BOULDERS AND GRAVEL
62.0	80.0	SHELL LIMESTONE
80.0	305.0	SOLID LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	63.0	CASING	12.00			T & C	IRON
63.0	305.0	OPEN HOLE		10.00			

Top of Casing:

No pump test data for this well.

REMARKS

WINNIPEG REGION. CITY WELL NO. 9, 700 PIPELINE RD, NW CORNER OF
STORIE RD AND PIPELINE RD. OWNER AS OF 1997 INFORMATION.

Location: RIVER LOT 0023 IN PARISH OF Kildonan

Well_PID: 116777
Owner: WRB

Driller: Friesen Drillers Ltd.
Well Name: G05OJ159 NEWPCC #1
Well Use: OBSERVATION
Water Use:
UTMX: 635176
UTMY: 5535173
Accuracy XY: 1 EXACT [<5M] [GPS]
UTMZ: 232.4040
Accuracy Z: 1 EXACT <10CM
Date Completed: 2001 Nov 27

WELL LOG

From (ft.)	To (ft.)	Log
0	1.0	TOPSOIL
1.0	33.0	CLAY, KHAKI, STIFF
33.0	50.0	CLAY, GREY, SOFT
50.0	79.0	TILL, LIGHT BEIGE, SOME STONE
79.0	82.0	LIMESTONE, BROWN, VERY HARD
82.0	115.0	LIMESTONE, LIGHT BEIGE, FRACTURES AT 84, 86 AND 114 FEET

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	82.0	CASING	5.00			INSERT	BLACK IRON
82.0	115.0	OPEN HOLE		4.30			

Top of Casing: 3.000 ft. above ground

PUMPING TEST

Date: 2001 Nov 27
Pumping Rate: 100.000 Imp. gallons/minute
Water level before pumping: 27.0 ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: ??? hours, ?? minutes
Water temperature: ?? degrees F

REMARKS

WINNIPEG REGION. SW CORNER OF NORTH END POLLUTION CONTROL CENTRE

PROPERTY.

Location: LX36-11-3E

Well_PID: 118131
Owner: MANITOBA HYDRO/WRB
Driller: Perimeter Drilling Ltd.
Well Name: G05OJ161 GF #6 MCPHILLIPS
Well Use: OBSERVATION
Water Use:
UTMX: 631352.6270
UTMY: 5531687.2640
Accuracy XY: 1 EXACT [<5M] [GPS]
UTMZ: 232.2440
Accuracy Z: 1 EXACT <10CM
Date Completed: 2001 Oct 12

WELL LOG

From (ft.)	To (ft.)	Log
0	0.5	SILT AND ORGANICS
0.5	10.0	CLAY, SOME SILT
10.0	28.0	CLAY
28.0	43.0	CLAY, TILL
43.0	52.0	CARBONATE ROCK, HEAVILY FRACTURED
52.0	60.0	CARBONATE ROCK
60.0	62.0	SHALE
62.0	100.0	CARBONATE ROCK

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	53.0	CASING	5.00		INSERT	PVC	
53.0	100.0	OPEN HOLE					
0	53.0	CASING GROUT				BENTONITE	

Top of Casing: 2.295 ft. above ground

No pump test data for this well.

REMARKS

WINNIPEG REGION. MANITOBA HYDRO SUBSTATION AT 640 MCPHILLIPS STREET, NEAR CORNER OF SELKIRK AVENUE. WELL INSTALLED BY U OF MANITOBA/GRANT FERGUSON AS PART OF A GEOTHERMAL PROJECT. THE PROVINCE THEN INCORPORATED THE WELL INTO ITS PROVINCIAL GROUNDWATER MONITORING PROGRAM. THE WELL WAS WELL SEALED ON JULY 14, 2016 DUE TO A EXPANSION OF THE HYDRO SUBSTATION. BOTTOM OF WELL MEASURED TO BE 100' BGS. CONTRACTOR (VALARD CONSTRUCTION) TO CUT CASING OUT AT WORKING DEPTH NEEDED FOR PROPERTY EXPANSION.

Location: RIVER LOT 0035 IN PARISH OF St. John

Well_PID: 10807
Owner: WRB
Driller: PRUDEN DRILLING CO. LTD.
Well Name: G05OJ025 MO-14
Well Use: OBSERVATION
Water Use:
UTMX: 631318
UTMY: 5530962
Accuracy XY: 1 EXACT [<5M] [GPS]
UTMZ: 233.0710
Accuracy Z: 1 EXACT <10CM
Date Completed: 1968 Feb 28

WELL LOG

From	To	Log
(ft.)	(ft.)	
0	38.0	CLAY
38.0	42.0	CLAY, SOME SAND AND GRAVEL
42.0	49.0	GLACIAL TILL
49.0	51.0	BROKEN LIMESTONE
51.0	141.0	SOLID LIMESTONE BEDROCK

WELL CONSTRUCTION

From	To	Casing	Inside	Outside	Slot	Type	Material
(ft.)	(ft.)	Type	Dia.(in)	Dia.(in)	Size(in)		
0	50.7	casing	4.00			IRON	
50.7	141.0	open hole	3.80				

Top of Casing: 1.502 ft. above ground

No pump test data for this well.

REMARKS

WINNIPEG REGION. AT CITY PUMPING STATION, NORTH OF BUILDINGS ON CITY PROPERTY.

Location: RIVER LOT 0035 IN PARISH OF St. John

Well_PID: 10808
Owner: WRB
Driller: PRUDEN DRILLING CO. LTD.
Well Name: G05OJ026 MO-12
Well Use: OBSERVATION
Water Use:
UTMX: 631323
UTMY: 5530951
Accuracy XY: 1 EXACT [<5M] [GPS]
UTMZ: 232.96
Accuracy Z: 1 EXACT <10CM
Date Completed: 1968 Apr 09

WELL LOG

From (ft.)	To (ft.)	Log
0	38.0	CLAY
38.0	42.0	CLAY; SOME SAND AND GRAVEL
42.0	49.0	GLACIAL TILL
49.0	51.0	BROKEN LIMESTONE
51.0	494.7	SOLID LIMESTONE BEDROCK
494.7	509.7	SHALE
509.7	527.7	SANDSTONE; LOOSELY CEMENTED
527.7	573.6	SHALE
573.6	581.6	SANDSTONE; LOOSELY CEMENTED
581.6	614.6	SHALE; LOOSELY CEMENTED
614.6	623.6	SANDSTONE; LOOSELY CEMENTED

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	499.7	casing	6.00			WELDED	BLACK IRON

499.7 623.6 open hole 6.00
0 499.7 casing grout 6.00 12.00 CEMENT

Top of Casing: 3.400 ft. above ground

PUMPING TEST

Date: 1968 Sep 07
Pumping Rate: 165.937 Imp. gallons/minute
Water level before pumping: 28.0 ft. below ground
Pumping level at end of test: 42.0 ft. below ground
Test duration: 2 hours, minutes
Water temperature: ?? degrees F

REMARKS

WINNIPEG REGION - DISCONTINUED WATER LEVEL (1968-2010) AND WATER QUALITY (1967-2009) STATION. NW CORNER OF LOGAN AVE & McPHILLIPS STREET AT CITY PUMPING STATION, NORTH OF CITY BUILDINGS ON CITY PROPERTY, PUMP TEST ZONE 52-442 FT AT 166 IGPM FOR 5 HRS, SWL=27.5 FT, THIS WAS A STEPDOWN TEST, GROUND LEVEL ELEV MEASURED 232.960 M. SEALED REMARKS CONTINUATION: 1 INCH POLYTREMIE LINE CEMENTED IN CASING FROM 4 TO 510' BGS, LINE FULL OF CEMENT. PRIOR TO ADDING BENTONITE HOLEPLUG, CASING WATER PUMPED OUT & FRESH WATER USED TO HYDRATE THE BENTONITE.

Location: NE3-12-2E

Well_PID: 6910
Owner: WRB
Driller: PRUDEN DRILLING CO. LTD.
Well Name: G05OJ022 MO-2
Well Use: OBSERVATION
Water Use:
UTMX: 626830
UTMY: 5538434
Accuracy XY: 1 EXACT [<5M] [GPS]
UTMZ: 234.8640
Accuracy Z: 1 EXACT <10CM
Date Completed: 1965 Nov 13

WELL LOG

From (ft.)	To (ft.)	Log
0	19.0	CLAY
19.0	30.5	TILL
30.5	79.9	CLAY
79.9	141.9	CARBONATE BEDROCK

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	122.9	casing	4.00			IRON	
122.9	141.9	open hole	4.00				

Top of Casing: 2.000 ft. above ground

PUMPING TEST

Date:
Pumping Rate: ?? Imp. gallons/minute
Water level before pumping: 5.0 ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: ??? hours, ?? minutes
Water temperature: ?? degrees F

REMARKS

WINNIPEG REGION. LOST WATER AT 120.1 FT.

Location: NW18-11-4E

Well_PID: 4178
Owner: WRB
Driller: PRUDEN DRILLING CO. LTD.
Well Name: G05OJ009 RED R F 045
Well Use: OBSERVATION
Water Use:
UTMX: 640251
UTMY: 5532455
Accuracy XY: 1 EXACT [<5M] [GPS]
UTMZ: 230.9680
Accuracy Z: 1 EXACT <10CM
Date Completed: 1963 Nov 08

WELL LOG

From To Log
(ft.) (ft.)

0 10.0 STIFF, DARK BROWN CLAY
10.0 20.0 FAIRLY SOFT, LIGHTER TAN BROWN CLAY
20.0 25.0 DARK BROWN CLAY WITH ONE OR TWO.25 INCH CARBONATE
PEBBLES
25.0 56.0 DARK GREY BROWN CLAYEY SILT, LOSING WATER 53-54 FEET
56.0 62.5 PEBBLEY CLAY TILL
62.5 76.4 TYNDALL LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	62.0	casing	4.00			IRON	
62.0	76.4	open hole	4.00				

Top of Casing: 1.000 ft. above ground

PUMPING TEST

Date:

Pumping Rate: 50.000 Imp. gallons/minute

Water level before pumping: 29.0 ft. below ground

Pumping level at end of test: ?? ft. below ground

Test duration: ??? hours, ?? minutes

Water temperature: ?? degrees F

REMARKS

WINNIPEG REGION. APPROX 70 FT SOUTH OF CORDITE DRAIN.

Location: RIVER LOT 0019 IN PARISH OF Kildonan

Well_PID: 124839

Owner: R. JABLONSKI

Driller: Perimeter Drilling Ltd.

Well Name:

Well Use: PRODUCTION

Water Use: Domestic

UTMX: 634609

UTMY: 5534897
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 229
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 2002 Aug 15

WELL LOG

From (ft.)	To (ft.)	Log
0	55.0	CLAY
55.0	79.0	BROKEN LIMESTONE
79.0	240.0	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	81.0	CASING	5.00			INSERT	PVC
81.0	240.0	OPEN HOLE					

Top of Casing: 2.502 ft. above ground

PUMPING TEST

Date: 2002 Aug 15
Pumping Rate: 20.000 Imp. gallons/minute
Water level before pumping: 30.0 ft. below ground
Pumping level at end of test: 30.0 ft. below ground
Test duration: ??? hours, ?? minutes
Water temperature: ?? degrees F

REMARKS

1206 TEMPLETON AVE

Location: RIVER LOT 0019 IN PARISH OF Kildonan

Well_PID: 17701
Owner: G RUFF
Driller: Paul Slusarchuk Well Drilling LTd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic

UTMX: 634609
UTMY: 5534897
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 229
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 1972 May 12

WELL LOG

From (ft.)	To (ft.)	Log
0	5.0	PIT
5.0	8.0	SILT
8.0	49.0	GREY CLAY
49.0	56.0	GRAVEL AND FRACTURED LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	56.0	casing	4.00				GALVANIZED
56.0	62.0	open hole					

Top of Casing: 3.997 ft. above ground

PUMPING TEST

Date: 1972 May 12
Pumping Rate: 59.974 Imp. gallons/minute
Water level before pumping: 8.0 ft. below ground
Pumping level at end of test: 10.0 ft. below ground
Test duration: 1 hours, minutes
Water temperature: ?? degrees F

REMARKS

TITLE #13708, LOT 7, TEMPLETON AVE, SE OF INTERSECTION OF TEMPLETON
AVE + PIPELINE RD

Location: RIVER LOT 0019 IN PARISH OF Kildonan

Well_PID: 10536
Owner: L WITTENBERG
Driller: Paul Slusarchuk Well Drilling LTd.

Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 634609
UTMY: 5534897
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 229
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 1967 Nov 10

WELL LOG

From (ft.)	To (ft.)	Log
0	10.0	GREY SILT
10.0	37.0	DARK CLAY
37.0	62.0	GREY SANDY CLAY, GRAVEL PEBBLES AND A FEW BOULDERS
62.0	71.0	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	62.0	casing	4.00				
62.0	71.0	open hole					

Top of Casing: 0 ft. below ground

PUMPING TEST

Date: 1967 Nov 10
Pumping Rate: 34.987 Imp. gallons/minute
Water level before pumping: 12.0 ft. below ground
Pumping level at end of test: 16.0 ft. below ground
Test duration: 2 hours, minutes
Water temperature: ?? degrees F

REMARKS

SW OF INTERSECTION OF TEMPLETON AVE + PIPELINE RD, GROUND LEVEL ELEV
EST 760 FT

Location: RIVER LOT 0019 IN PARISH OF Kildonan

Well_PID: 124726
Owner: JOHN TAMBORKO
Driller: Maple Leaf Drilling Ltd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 634609
UTMY: 5534897
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 229
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 2003 Aug 01

WELL LOG

From (ft.)	To (ft.)	Log
0	43.0	CLAY
43.0	50.0	TILL
50.0	56.0	GRAVEL
56.0	62.0	LIMESTONE
62.0	65.0	BROKEN LIMESTONE
65.0	69.0	SHALE
69.0	70.0	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	57.0	CASING	5.00			PVC	
57.0	70.0	OPEN HOLE		4.50			
10.0	40.0	CASING GROUT					BENTONITE

Top of Casing:

PUMPING TEST

Date: 2003 Aug 01
Pumping Rate: 15.000 Imp. gallons/minute
Water level before pumping: 11.0 ft. below ground
Pumping level at end of test: 11.0 ft. below ground
Test duration: ??? hours, ?? minutes
Water temperature: ?? degrees F

REMARKS

1209 COURT AVE - PREVIOUSLY CORK AVE.

Location: RIVER LOT 0018 IN PARISH OF Kildonan

Well_PID: 68296

Owner: SHAAREY ZEDEK CEMETERY

Driller: Perimeter Drilling Ltd.

Well Name:

Well Use: PRODUCTION

Water Use: Irrigation

UTMX: 634466

UTMY: 5534738

Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]

UTMZ: 228

Accuracy Z: 5 General - Shuttle at Centroid

Date Completed: 1989 Aug 17

WELL LOG

From (ft.)	To (ft.)	Log
0	45.0	CLAY
45.0	46.0	LAYERS OF HARDPAN
46.0	65.0	CLAY
65.0	68.0	BROKEN LIMESTONE
68.0	266.8	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	72.0	casing	5.00		INSERT	PVC	
72.0	266.8	open hole		4.60			

Top of Casing: 0 ft. below ground

PUMPING TEST

Date: 1989 Aug 17

Pumping Rate: 60.000 Imp. gallons/minute

Water level before pumping: 29.5 ft. below ground

Pumping level at end of test: 49.5 ft. below ground
Test duration: 3 hours, minutes
Water temperature: ?? degrees F

REMARKS

SHAAREY ZEDEK CEMETERY, ARMSTONG AVE

Location: RIVER LOT 0018 IN PARISH OF Kildonan

Well_PID: 21471
Owner: A MEIER
Driller: AQUARIUS WELL DRILLING
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 634466
UTMY: 5534738
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 228
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 1974 Sep 26

WELL LOG

From	To	Log
(ft.)	(ft.)	
0	30.0	CLAY
30.0	43.0	CLAY& BOULDERS
43.0	64.0	GRAVEL
64.0	68.0	FRACTURED LIMESTONE
68.0	82.9	WHITE LIMESTONE

WELL CONSTRUCTION

From	To	Casing	Inside	Outside	Slot	Type	Material
(ft.)	(ft.)	Type	Dia.(in)	Dia.(in)	Size(in)		
0	70.5	casing	4.50		INSERT		BLACK IRON
70.5	82.9	open hole	4.00				

Top of Casing: 0 ft. below ground

PUMPING TEST

Date:
Pumping Rate: 19.987 Imp. gallons/minute
Water level before pumping: 10.0 ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: 1 hours, minutes
Water temperature: ?? degrees F

REMARKS

1260 TEMPLETON

Location: RIVER LOT 0018 IN PARISH OF Kildonan

Well_PID: 11879
Owner: A YACKEL
Driller: Paul Slusarchuk Well Drilling LTd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 634466
UTMY: 5534738
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 228
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 1968 Aug 26

WELL LOG

From (ft.)	To (ft.)	Log
0	5.0	PIT
5.0	42.0	DARK CLAY
42.0	54.0	GREY CLAY, GRAVEL, BOULDERS
54.0	62.0	GRAVEL, GREY SANDY, CLAY
62.0	66.0	BROWN AND GREY SHALE
66.0	88.9	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	66.0	casing		4.00			
66.0	88.9	open hole					

Top of Casing: 0 ft. below ground

PUMPING TEST

Date: 1968 Aug 26
Pumping Rate: 29.987 Imp. gallons/minute
Water level before pumping: 9.0 ft. below ground
Pumping level at end of test: 27.0 ft. below ground
Test duration: 3 hours, minutes
Water temperature: ?? degrees F

REMARKS

CORK AVE, W OF MCPHILLIPS + 85 FT N OF CORK AVE GROUND LEVEL ELEV EST
760 FT

Location: RIVER LOT 0018 IN PARISH OF Kildonan

Well_PID: 27596
Owner: G LUCZENCZYN
Driller: JOHN B. CASWELL DRILLING
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 634466
UTMY: 5534738
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 228
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 1976 Nov 10

WELL LOG

From (ft.)	To (ft.)	Log
0	31.0	CLAY
31.0	49.0	TILL
49.0	63.0	RUBBLE ZONE MIXED WITH GRAVEL
63.0	84.9	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
---------------	-------------	----------------	--------------------	---------------------	------------------	------	----------

0	60.0 casing	4.00	GALVANIZED
60.0	66.0 perforations	4.00	SL. PIPE
66.0	84.9 open hole	3.60	

Top of Casing: 0 ft. below ground

PUMPING TEST

Date:

Pumping Rate: 15.000 Imp. gallons/minute

Water level before pumping: 13.0 ft. below ground

Pumping level at end of test: ?? ft. below ground

Test duration: 1 hours, minutes

Water temperature: ?? degrees F

REMARKS

110 FT OFF CORK AVE, 900 FT FROM PIPELINE RD

Location: RIVER LOT 0017 IN PARISH OF Kildonan

Well_PID: 11878

Owner: MCEWAN BROS

Driller: PRUDEN DRILLING CO. LTD.

Well Name:

Well Use: PRODUCTION

Water Use: Domestic

UTMX: 634385

UTMY: 5534620

Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]

UTMZ: 230

Accuracy Z: 5 General - Shuttle at Centroid

Date Completed: 1968 Dec 16

WELL LOG

From To Log

(ft.) (ft.)

0 9.0 SANDY CLAY, CAVING

9.0 40.0 BLUE CLAY

40.0 50.0 TILL

50.0 57.0 SAND AND GRAVEL

57.0 62.0 DECOMPOSED ROCK

62.0 80.9 RED ROCK

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	62.0	casing	4.00				
62.0	80.9	open hole					

Top of Casing: 0 ft. below ground

PUMPING TEST

Date: 1968 Dec 16
Pumping Rate: 10.000 Imp. gallons/minute
Water level before pumping: 8.0 ft. below ground
Pumping level at end of test: 8.0 ft. below ground
Test duration: 1 hours, minutes
Water temperature: ?? degrees F

REMARKS

LOT 17, PIPELINE RD, AT INTERSECTION OF PIPELINE + CORK AVE, 400 FT E
OF PIPELINE + 200 FT S OF CORK, GROUND LEVEL ELEV EST 760 FT

Location: RIVER LOT 0015 IN PARISH OF Kildonan

Well_PID: 11881
Owner: G RUFF
Driller: Paul Slusarchuk Well Drilling LTd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 634198
UTMY: 5534471
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 232
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 1968 Jun 06

WELL LOG

From (ft.)	To (ft.)	Log
0	5.0	SANDY TOPSOIL

5.0 39.0 DARK CLAY
39.0 46.0 GREY CLAY GRAVEL PEBBLES
46.0 55.0 GRAVEL
55.0 62.0 GREY CLAY GRAVEL BOULDERS
62.0 66.0 COARSE GRAVEL

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	64.0	casing	4.00				

Top of Casing: 0 ft. below ground

PUMPING TEST

Date: 1968 Jun 06
Pumping Rate: 29.987 Imp. gallons/minute
Water level before pumping: 10.0 ft. below ground
Pumping level at end of test: 24.0 ft. below ground
Test duration: 1 hours, 30 minutes
Water temperature: ?? degrees F

REMARKS

LOT 8, PLAN 3851, LEILA AVE, AT INTERSECTION PIPELINE RD + LEILA AVE
W OF PIPELINE AND 60 FT S OF LEILA, GROUND LEVEL ELEV EST 760 FT

Location: RIVER LOT 0014 IN PARISH OF Kildonan

Well_PID: 11883
Owner: 7 OAKS SCHOOL DIV 10
Driller: PRUDEN DRILLING CO. LTD.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 634121
UTMY: 5534395
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 231
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 1968 May 01

WELL LOG

From (ft.)	To (ft.)	Log
0	2.0	TILL
2.0	5.0	CLAY
5.0	9.0	CAVING SILT
9.0	43.0	CLAY
43.0	50.0	HARDPAN
50.0	61.0	GRAVEL WITH SOME ROCK
61.0	65.0	HARDPAN, CLAY
65.0	68.0	GRAVELLY
68.0	155.9	BEDROCK

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	68.0	casing		4.00			
68.0	155.9	open hole					

Top of Casing: 0 ft. below ground

PUMPING TEST

Date: 1968 May 01
 Pumping Rate: 10.000 Imp. gallons/minute
 Water level before pumping: 13.0 ft. below ground
 Pumping level at end of test: 60.0 ft. below ground
 Test duration: hours, 30 minutes
 Water temperature: ?? degrees F

REMARKS

2200 MCPHILLIPS, AT INTERSECTION OF MCPHILLIPS AND KINGSBURY, S OF
WORKSHOP AND 250 FT E OF MCPHILLIPS, GROUND LEVEL ELEV EST 760 FT

Location: RIVER LOT 0013 IN PARISH OF Kildonan

Well_PID: 11880
 Owner: COROZ
 Driller: D.C.L. DRILLING
 Well Name:
 Well Use: PRODUCTION
 Water Use: Domestic

UTMX: 634007
UTMY: 5534281
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 232
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 1968 Jun 11

WELL LOG

From (ft.)	To (ft.)	Log
0	23.0	BLUE AND BROWN CLAY
23.0	45.5	TILL
45.5	63.0	LAYERS OF LIMESTONE AND RED SHALE
63.0	101.9	LIMESTONE WITH SOME RED SHALE LAYERS

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	65.0	casing		4.00			
65.0	101.9	open hole					

Top of Casing: 0 ft. below ground

PUMPING TEST

Date: 1968 Jun 11
Pumping Rate: 17.995 Imp. gallons/minute
Water level before pumping: 11.0 ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: 8 hours, minutes
Water temperature: ?? degrees F

REMARKS

LOT 13, PIPELINE RD, GROUND LEVEL ELEV EST 760 FT

Location: RIVER LOT 0012 IN PARISH OF Kildonan

Well_PID: 25107
Owner: L HINATAU
Driller: HYGAARD'S WELL DRILLING
Well Name:

Well Use: PRODUCTION
Water Use: Domestic
UTMX: 633908
UTMY: 5534104
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 231
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 1975 Jun 13

WELL LOG

From (ft.)	To (ft.)	Log
0	46.0	GREY CLAY& BOULDERS
46.0	58.0	SAND& GREY CLAY
58.0	94.9	LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	58.0	casing	4.00		T & C		GALVANIZED
58.0	94.9	open hole		4.00			

Top of Casing: 0 ft. below ground

PUMPING TEST

Date:
Pumping Rate: 10.000 Imp. gallons/minute
Water level before pumping: 10.0 ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: 1 hours, minutes
Water temperature: ?? degrees F

Location: RIVER LOT 0012 IN PARISH OF Kildonan

Well_PID: 170449
Owner: BERTRAND DYCK
Driller: Echo Drilling Ltd.
Well Name:
Well Use: PRODUCTION
Water Use: Domestic
UTMX: 633908

UTMY: 5534104

Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]

UTMZ: 231

Accuracy Z: 5 General - Shuttle at Centroid

Date Completed: 2011 Jun 29

WELL LOG

From To Log

(ft.) (ft.)

0 25.0 CLAY

25.0 45.0 BROWN TILL

45.0 118.0 LIMESTONE

WELL CONSTRUCTION

From To Casing Inside Outside Slot Type Material

(ft.) (ft.) Type Dia.(in) Dia.(in) Size(in)

0 47.0 CASING 5.00 INSERT PVC

47.0 118.0 OPEN HOLE 4.00

0 47.0 CASING GROUT BENTONITE

Top of Casing: 2.000 ft. above ground

PUMPING TEST

Date: 2011 Jun 29

Pumping Rate: 77.995 Imp. gallons/minute

Water level before pumping: 3.0 ft. below ground

Pumping level at end of test: 15.0 ft. below ground

Test duration: 1 hours, minutes

Water temperature: ?? degrees F

REMARKS

4100 PIPELINE RD

Location: RIVER LOT 0011 IN PARISH OF Kildonan

Well_PID: 34601

Owner: L WOZNEY

Driller: AQUARIUS WELL DRILLING

Well Name:

Well Use: PRODUCTION

Water Use: Domestic
UTMX: 633859
UTMY: 5533969
Accuracy XY: 3 ACCURATE [50-350M] [WITHIN 1/4-SECTION]
UTMZ: 231
Accuracy Z: 5 General - Shuttle at Centroid
Date Completed: 1978 Jun 21

WELL LOG

From (ft.)	To (ft.)	Log
0	60.0	CLAY
60.0	67.0	CLAY& BROKEN LIMESTONE
67.0	75.0	YELLOW LIMESTONE

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	66.0	casing	4.25				GALVANIZED
66.0	75.0	open hole		4.00			

Top of Casing: 0 ft. below ground

PUMPING TEST

Date:
Pumping Rate: 39.987 Imp. gallons/minute
Water level before pumping: 0 ft. below ground
Pumping level at end of test: 27.0 ft. below ground
Test duration: 1 hours, minutes
Water temperature: ?? degrees F

APPENDIX G

2026 KGS Group Hydrogeological Investigation Report

Memorandum

To:	Tristan Eldridge, C.E.T., Eng.L. Municipal Assistant Department Head KGS Group	Date:	March 12, 2026
		Project No.:	25-0107-002
From:	Paul Lindell, B.Sc., P.Eng. KGS Group Simratpal Singh, M.Sc. EIT KGS Group	Cc:	Kelly Fordyce, B.Sc., P.Eng. Geotechnical Engineer Jason Mann, M.Sc., P.Geo., FGC Principal, KGS Group
Re:	Hydrogeological Investigation Report for the Armstrong Sewer District (Final: Rev 0)		

1.0 INTRODUCTION

KGS Group completed a hydrogeological investigation program to assess the aquifer conditions and parameters at three key locations identified during the detailed design analyses completed by KGS Group Geotechnical. The locations include:

- **Eastern (Zone 3) Site:** The interceptor connection at Main Street and Armstrong Avenue (AM);
- **Middle (Zone 2) Site:** The shaft location near the Canadian Pacific Kansas City (CPKC) railway crossing at Leila Avenue and McGregor Street (LM); and
- **Western (Zone 1) Site:** The construction location spanning along Leila Avenue and crossing at Jack Donner Drive (LJ).

The results of the hydrogeological investigations provided estimates of aquifer transmissivity which may be used by contractors to assist with the design of excavation/shaft dewatering/depressurization systems throughout the project site to achieve specified minimum factor of safety values against excavation base instability as defined by the construction contract documents. This document provides details of the field activities conducted including utility locates, drilling, and pumping tests conducted at each location, as well as results and interpretation of the site-specific pumping tests.

2.0 SCOPE OF WORK

KGS Group completed the following scope of work at each of the three investigation locations within the Armstrong Sewer District during January and February 2026:

- 1) Development of a pumping test design for each investigation location.

- 2) Scanning and marking of all private and public utilities at each investigation location by a third-party utility locating company (Structure Scan Inc.).
- 3) Drilling of one Pumping Well (PW) and two Monitoring Wells (MWs) at each investigation location by a qualified drilling contractor (Maple Leaf Drilling).
- 4) Completion of a short-term pumping and recovery test at each location.
- 5) Analysis and interpretation of pumping test results.
- 6) Comparison of transmissivity results from this investigation with the regional transmissivity map (Plate 13) developed by Baracos, A., et al., 1983 for the Winnipeg Area.

The following subsections include the details of findings of field and desktop work conducted at the three investigation locations.

3.0 METHODOLOGY

3.1.1 SITE DESCRIPTION

During the planning phase of this investigation program, a total of three key Sites were identified within Contract 1 area of Armstrong Sewer District (Figure 1) where drilling and pumping test activities were conducted. The Eastern (Zone 3) Site is located in the Kildonan Park area near its southwest corner and at approximately 40 m northeast of Armstrong Ave and Main St. intersection. The Middle (Zone 2) Site is located within the green-space boulevard between westbound Leila Ave and eastbound Patridge Ave, 40 m southwest of Leila Ave and McGregor St intersection. The Western (Zone 1) Site is located within the eastern boulevard of Jack Donner Dr, at a distance of approximately 25 m north of Leila Ave. and Jack Donner Dr. intersection.

3.1.2 UTILITY LOCATES

Prior to starting the drilling work at each Site, KGS Group worked with a private underground utility locator from Structure Scan Inc. to conduct utility clearances at the proposed drill locations, in addition to obtaining information about public utilities from *Click Before You Dig MB*. At each site, no public or private utilities were identified within 10 feet of disturbance areas.

3.1.3 DRILLING PROGRAM

Two PVC standpipe piezometer monitoring wells (MW) of 5.1 cm (2-inch) diameter and one steel-casing pumping well (PW) of 12.7 cm (5-inch) diameter were installed at each of the three sites as a part of this investigation program. A photo-log of drilling and pumping test activities is included in Appendix A of this report.

At the Eastern (Zone 3) Site, Maple Leaf Drilling Ltd. commenced drilling of PW, PW26-AM-01, on January 12, 2026, under the direction of KGS Group field staff. Drilling at this Site was conducted using Canterra CT 250 truck-mounted mud-rotary drill rig and Versa 140x truck-mounted drill rig, interchangeably based on the rig availability. The drilling method was switched from mud rotary in the overburden clay and till, to air rotary in the Paleozoic limestone bedrock to prevent the loss of mud in the fractures that were expected to be encountered in the limestone. The bottom of the steel 12.7 cm (5-inch) casing was installed at 21.3 m bgs with an open hole drilled in the limestone bedrock from 21.3 m to 30.5 m bgs. Two (2) MWs were drilled

using mud-rotary method in the overburden and air-rotary in the bedrock and installed with 5.1 cm (2-inch) diameter PVC standpipe piezometers. Upon completion of drilling to the required depth at each location and prior to PVC standpipe installation, the open-hole bedrock zones were developed by airlifting. The groundwater pumped from each well location was discharged into the nearby approved sewer system under an approved discharge permit issued by the City of Winnipeg (Appendix B).

Similar methods of drilling were used at the Middle (Zone 2) and Western (Zone 1) Sites and a summary of drilling and well installation is provided in Table 1. At each PW location, a 12.7 cm (5-inch) steel casing was used as a stick-up well above the ground surface. The 5.1 cm (2-inch) MWs were completed with stick-up steel protective covers for use during the pumping tests, then all PWs and MWs were converted to steel flush-mount covers after the tests were completed. All wells were drilled into the upper carbonate aquifer of the Paleozoic limestones and dolomites as indicated in Table 1 below. The drilling scope of work under this investigation program was completed on February 4, 2026. The borehole logs are included in Appendix C.

3.1.4 PROVINCIAL WELL DATABASE

Appendix C contains the list of wells and information obtained from the provincial GWDrill database within a 800 m radius (well inclusion zone) from each site, and are shown in Figures 2, 3, and 4. A total of fifty-two wells were plotted from the database within the well inclusion zone, out of which, only six were listed as active wells. The four active wells with PIDs 170449, 124839, 124726, and 134130 were plotted on the database map within the 800 m radius of the Middle (Zone 2) Site, however, upon investigation, the associated street addresses as listed in the well logs located them outside the well inclusion zone. The only two active production wells that are known to be located within the well inclusion zone of Eastern (Zone 3) Site are with PIDs 183290 and 194125 (Figure 2, Table C1 – Appendix C). According to the provincial database, no known active wells were indicated to be within the inclusion zones of the Middle (Zone 2) and Western (Zone 1) Sites.

3.1.5 SITE GEOLOGY AND HYDROGEOLOGY

During the drilling phase of this investigation, a layer of confining glacial till was identified above the limestone bedrock aquifer at all three Sites. The till layer is overlain by a surficial layer of glaciolacustrine silts and low-permeability clays which are further overlain by an uppermost 0 to 1.5 m thick *complex zone* near the ground surface that consists of organic soils, silty clays and varying amounts of human-made fills (Baracos, A., et al., 1983). The depth below ground surface (bgs) of top of each geological unit encountered during hydrogeological drilling is shown below in Table 1. Overall, the top of clay layer was identified between near-ground surface and 3.7 m bgs while the top of glacial till was encountered between 12.8 to 24.1 m bgs. As indicated in Table 1, the thickness of till layer was approximately 1.5 to 2.4 m at the Eastern (Zone 3) Site, while it was thicker at the Middle (Zone 2) Site (11.1 to 13.7 m). At the Western (Zone 1) Site, the thickness of the till layer encountered above the limestone was between 16.9 and 18.0 m. The bedrock surface throughout the drilling investigation was encountered between 20.3 and 30.2 m bgs. Overall, the bedrock surface was at a shallower depth at the Eastern (Zone 3) Site (20.3 to 21.2 m) while it was deeper at the Middle (Zone 2) and Western (Zone 1) Sites (28.2 to 30.2 m).

Water-producing fractures in the bedrock were noted at the Eastern (Zone 3) and Middle (Zone 2) Sites during the drilling investigation. Strong connectivity between the fractures and groundwater extraction rates (approximately 545 m³/day or 100 USgpm) were observed during drilling at both Eastern (Zone 3) and Middle

(Zone 2) Sites however, low groundwater production rates (approximately 11 to 22 m³/day or 2 to 4 USgpm) and lack of fracture-connectivity were observed at the Western (Zone 1) Site. The pumping rates of the short-term pumping tests were determined based on water production rates observed during borehole development by airlifting at each investigation Site. According to the regional transmissivity map for the upper carbonate aquifer (Appendix D), developed by Baracos, A., et al., 1983, the three Sites are located within a transmissivity range of 10,000 to 50,000 USgpd/ft. The transmissivities resulting from the pumping tests conducted at the three Sites are compared with the regional values in Section 4.0 of this report.

TABLE 1: DRILLING AND WELL INSTALLATION SUMMARY

Site	Well ID	Complex Zone ¹ - bgs -		Top of Clay - bgs - (elevation)		Top of Till - bgs - (elevation)		Top of Bedrock - bgs - (elevation)		Total Depth - bgs - (elevation)		Casing Diameter and Material (φ)		Casing Depth - bgs -		Screen/Open Hole Depth - bgs -		Drilling Rig	Date of Drilling	Easting ² (UTM)	Northing ² (UTM)
		m	ft	m	ft	m	ft	m	ft	m	ft	cm	inch	m	ft	m	ft				
Eastern (Zone 3) Site	PW26-AM-01	0 - 3.7	0 - 12.1	3.7 (226.3)	12.1	18 (212.0)	59.1	20.4 (209.6)	66.9	30.5 (199.5)	100	12.7 cm Steel	5-inch Steel	21.3 (208.7)	69.9	Open hole below 21.3 m	Open hole below 70 ft	Canterra CT 250	Jan 12, 2026	635473	5534099
	MW26-AM-01	0 - 3.4	0 - 11.1	3.4 (226.6)	11.1	18.6 (211.4)	61.0	20.3 (209.7)	66.6	23.5 (206.5)	77	5.1 cm PVC	2-inch PVC	23.5 (206.5)	77.1	20.4 – 23.5	67 - 77	Versa-140X	Jan 14, 2026	635474	5534102
	MW26-AM-02	0 - 3.7	0 - 12.1	3.7 (226.8)	12.1	19.7 (210.8)	64.6	21.2 (209.3)	69.6	24.2 (206.3)	80	5.1 cm PVC	2-inch PVC	24.2 (206.3)	79.4	21.2 – 24.2	69.5 - 79.5	Versa-140X	Jan 14, 2026	635484	5534127
Middle (Zone 2) Site	PW26-LM-01	0 - 3.7	0 - 12.1	3.7 (228.2)	12.1	17.1 (214.8)	56.1	28.2 (203.7)	92.5	36 (195.9)	118	12.7 cm Steel	5-inch Steel	28.3 (203.6)	92.8	Open hole below 28.3 m	Open hole below 93 ft	Versa-140X	Jan 20, 2026	634375	5534376
	MW26-LM-01	0 - 3.7	0 - 12.1	3.7 (228.1)	12.1	17.1 (214.7)	56.1	28.2 (203.6)	92.5	31.2 (200.6)	102.5	5.1 cm PVC	2-inch PVC	31.2 (200.6)	102.4	28.2 – 31.2	92.5 - 102.5	Versa-140X	Jan 21, 2026	634378	5534374
	MW26-LM-02	0 - 0.6	0 - 1.97	0.6 (230.7)	1.97	14.6 (216.7)	47.9	28.3 (203.0)	92.8	31.4 (199.9)	103	5.1 cm PVC	2-inch PVC	31.4 (199.9)	103.0	27.4 – 31.4	90 - 103	Canterra CT 250	Jan 26, 2026	634399	5534360
Western (Zone 1) Site	PW26-LJ-01	0 - 0.2	0 - 0.66	0.2 (231.5)	0.66	12.2 (219.5)	40.0	30.2 (201.5)	99.1	45.7 (186.0)	150	12.7 cm Steel	5-inch Steel	30.5 (201.2)	100.1	Open hole below 30.5 m	Open hole below 100 ft	Canterra CT 250	Feb 3, 2026	633541	5534814
	MW26-LJ-01	0 - 0.2	0 - 0.66	0.2 (231.5)	0.66	12.8 (218.9)	42.0	29.9 (201.8)	98.1	36.6 (195.1)	120	5.1 cm PVC	2-inch PVC	36.6 (195.1)	120.1	29.9 – 36.6	98 - 120	Canterra CT 250	Feb 4, 2026	633548	5534816
	MW26-LJ-02	0 - 0.2	0 - 0.66	0.2 (231.6)	0.66	12.8 (219.0)	42.0	29.7 (202.1)	97.4	35 (196.8)	115	5.1 cm PVC	2-inch PVC	35 (196.8)	114.8	29.7 – 35.0	97.5 - 115	Canterra CT 250	Jan 29, 2026	633555	5534842

¹**Complex Zone** consists of silty clays, silts, organic soils, sands, along with varying amounts of human-made fill (Baracos, A., et al., 1983).

²**Topographic Survey Accuracy:** +/- 5 mm

3.1.6 AQUIFER TESTING

A pumping test was conducted at each of the three investigation Sites to evaluate the bedrock aquifer properties. Each pumping test consisted of a pumping well, two monitoring wells and where applicable, vibrating wire piezometers (VWs) installed by KGS Group as part of the 2025 site investigations. Static water levels and pressures were monitored in all available wells and VWs. The static levels/pressures were collected and logged prior to the start of pumping to measure changes in the different stratigraphic zones during the pumping test. Level and pressure monitoring was continuous during the pumping and recovery phases at each Site. The VW sensors installed in the till and clay zones were available at two of the three Sites (Middle (Zone 2) and Eastern (Zone 3)). Groundwater-pressure changes in the PWs and MWs were monitored using Solinst non-vented M30/F100 automatic data logging pressure transducers, while the groundwater pressures in the till and clay layers were monitored using a Durham Geo Slope Indicator (DGSI) Vibrating Wire Quattro Logger. Manual water levels were recorded in all wells using a water level meter as a backup data collection measure and as verification of the continuous pressure transducer readings.

A Solinst barometric pressure logger was deployed onsite to barometrically compensate the non-vented pressure transducers. Pressure transducers and the barologger were installed at least half hour prior to the start of pumping to collect static water level readings and stabilize before pumping began. The barologger was installed inside a well just below the frost line to avoid freezing, but above the static water level in the well to avoid getting the unit wet. A submersible pump, powered by a portable generator, was used to induce drawdown in the PWs. The submersible pump was generally installed at the bottom of the steel casing in each PW, this depth varied by PW. The pump tests were of varying durations, between 2-3 hours in length.

The transducer plots and drawdowns measured in each observation well are shown in the set of figures attached with this report (Figures AM-01 to AM-12; Figures LM-01 to LM-12; Figures LJ-01 to LJ-08). The groundwater was extracted under approved Groundwater Exploration Permits (Appendix E) issued by Manitoba Environment and Climate Change (MECC) and was discharged to select nearby City of Winnipeg sewer manholes under discharge permits (Appendix B) approved by City of Winnipeg. Upon pump shut off, the levels in all wells and VW pressures were allowed to recover to at least 90% of static pressure conditions or for the same duration as that of pumping, whichever came first. The test results and recovery levels achieved at the end of each test are discussed in Section 5. Table 2 below shows the summary of pumping tests conducted at each Site.

The Solinst transducer installed in the PW during each test included Electrical Conductivity (EC) readings to monitor changes throughout the tests. EC data for each pump test is plotted on the hydrograph Figures (AM-01, LM-01, and LJ-01) for each Site.

TABLE 2: PUMPING TEST SUMMARY

Site	Pumping Well (PW)	Monitoring Wells (MWs)	Pumping Start Date and Time	Pumping End Date and Time	Pumping Duration (hr-min)	Pumping Rate, Q		
						m³/day	USgpm	Duration
Eastern (Zone 3) Site	PW26-AM-01	PW26-AM-01	January 16, 2026 09:30:00	January 16, 2026 11:30:00	2hr 0min	545	100	09:30 to 11:30
		MW26-AM-01						
		MW26-AM-02						
		TH25-08 VW Clay (202214)						
		TH25-08 VW Till (202431)						
Middle (Zone 2) Site	PW26-LM-01	PW26-LM-01	January 28, 2026 11:20:00	January 28, 2026 14:02:00	2hr 42min	676	124	11:20 to 14:02
		MW26-LM-01						
		MW26-LM-02						
		TH25-04 VW Clay (202425)						
		TH25-04 VW Till (202480)						
Western (Zone 1) Site	PW26-LJ-01	PW26-LJ-01	February 5, 2026 09:40:00	February 5, 2026 12:30:00	2hr 50min	18.5	3.4	09:40 to 10:04
						21.8	4.0	10:04 to 11:26
		MW26-LJ-01				24.5	4.5	11:26 to 11:39
		MW26-LJ-02				21.8	4.0	11:39 to 12:30

4.0 PUMPING TEST DATA ANALYSIS

KGS Group utilized The Cooper-Jacob (1946) method, a semi-log approximation of the Theis (1935) method, to analyze the pumping test data derived from each of the tests and to estimate the transmissivity and storativity (S) of the bedrock aquifer. Notably, the bedrock aquifer does not appear to meet the isotropic hydraulic conductivity condition that this method is based on. The yielding capacity of PWs (Eastern (Zone 3): PW26-AM-01, Middle (Zone 2): PW26-LM-01, and Western (Zone 1): PW26-LJ-01) appear to be distinct mainly due to variability of the water-producing fractures at each of the Sites; however, the limestone aquifer, in general is confined as clay and silt till were observed at all locations. The maximum drawdown, in metres, observed during each test are reported below in Table 3.

Western (Zone 1) Site: The pumping rate during the test was adjusted in response to documented increases in water levels in PW26-LJ-01 and MW26-LJ-01 while the pumping rate was set at a consistent flowrate of 4.0 USgpm (see Figure LJ-01). High sensitivity of water level changes in response to slight alterations to the pumping rate were observed during the test. (see Table 2, Figure LJ-01). Also of note, the maximum drawdown in PW26-LJ-01 (23.10 m) and MW26-LJ-01 (6.32 m) was greater than the drawdown values observed at the end of the pump test.

TABLE 3: PUMPING TEST DRAWDOWN RESULTS

Site	Well ID	Static Groundwater Level (measurement below Top of Casing)		Static Groundwater Elevation		Static Piezometric Elevation		Pumping Rate (Q)		Maximum Drawdown		Drawdown Before Pump Shut Off (if different than Maximum)	
		m	ft	m	ft	m	ft	m ³ /day	USgpm	m	ft	m	ft
Eastern (Zone 3) Site	PW26-AM-01	6.01	19.72	224.76	737.40	-	-	545	100	4.47	14.67	-	-
	MW26-AM-01	6.08	19.95	224.71	737.24	-	-			3.4	11.15	-	-
	MW26-AM-02	6.76	22.18	224.64	737.01	-	-			2.89	9.48	-	-
	TH25-08 VW Clay (202214)	N/A	N/A	N/A	N/A	224.48	736.48			0.38	1.25	-	-
	TH25-08 VW Till (202431)	N/A	N/A	N/A	N/A	224.09	735.20			1.91	6.27	-	-
Middle (Zone 2) Site	PW26-LM-01	7.98	26.18	224.81	737.57	-	-	676	124	9.42	30.91	-	-
	MW26-LM-01	7.36	24.15	225.35	739.34	-	-			3.77	12.37	-	-
	MW26-LM-02	6.89	22.60	225.27	739.07	-	-			1.5	4.92	-	-
	TH25-04 VW Clay (202425)	N/A	N/A	N/A	N/A	226.62	743.50			-0.005	-0.016	-	-
	TH25-04 VW Till (202480)	N/A	N/A	N/A	N/A	226.22	742.19			-0.035	-0.115	-	-
Western (Zone 1) Site	PW26-LJ-01	2.8	9.19	229.91	754.30	-	-	18.5 to 21.8	3.4 to 4.5	23.1	75.79	20.47	67.16
	MW26-LJ-01	3.14	10.30	229.54	753.08	-	-			6.32	20.73	5	16.40
	MW26-LJ-02	2.99	9.81	229.7	753.61	-	-			0.83	2.72	-	-

Eastern (Zone 3) Site: Drawdown of 1.91 m and 0.38 m in the till and clay layers, respectively, was observed during the pumping. The VW sensor in the clay zone (VW202214) was installed at a depth of 15.29 m bgs while the sensor in the till zone (VW202431) was installed at 20.47 m bgs, as can be seen in the borehole log for TH25-08 (Appendix C). The bedrock surface was encountered just below the VW sensor in till at 20.98 m bgs. A strong hydraulic connection between the till and bedrock is evident from the pumping test results.

Middle (Zone 2) Site: A weak pumping effect was observed at the VW202480 sensor installed in the till layer (17.32 m bgs) at TH25-04 (located at a horizontal distance of 7.5 m from PW26-LM-01). This is likely due to an 11.03 m vertical spacing between the VW202480 sensor and the bedrock surface (28.35 m bgs at PW26-LM-01).

The results of the site-specific aquifer analyses using the Cooper-Jacob (1946) method are shown in Table 4.

TABLE 4: TRANSMISSIVITY AND STORATIVITY CALCULATIONS FROM PUMPING TESTS

Site	Data Source	Plot Type	Transmissivity (T) (m ² /day)	Transmissivity (T) (USgpd/ft)	Storativity (S)
Eastern (Zone 3) Site: Armstrong Ave. & Main St. (AM)	PW26-AM-01	Time Drawdown	73	5,900	-
	MW26-AM-01	Time Drawdown	88	7,000	-
	MW26-AM-02	Time Drawdown	91	7,300	-
	PW26-AM-01	Residual Drawdown	104	8,400	-
	MW26-AM-01	Residual Drawdown	93	7,500	-
	MW26-AM-02	Residual Drawdown	90	7,200	-
	All Wells	Distance-Drawdown	384	30,900	Est. 0.0002 to 0.002*
Middle (Zone 2) Site: Leila Ave. & McGregor St. (LM)	PW26-LM-01	Time Drawdown - T ₁ (Q ₁ = 100 USgpm)	62	5,000	-
		Time Drawdown - T ₂ (Q ₂ = 124 USgpm)	26	2,100	-
		<i>Average</i>	<i>44</i>	<i>3,550</i>	
	MW26-LM-01	Time Drawdown - T ₁ (Q = 100 USgpm)	185	14,900	-
		Time Drawdown - T ₂ (Q = 124 USgpm)	80	6,500	-
		<i>Average</i>	<i>133</i>	<i>10,700</i>	
	MW26-LM-02	Time Drawdown	243	19,500	-
	PW26-LM-01	Residual Drawdown	263	21,000	-
	MW26-LM-01	Residual Drawdown	263	21,100	-
	MW26-LM-02	Residual Drawdown	281	22,600	-
	All Wells	Distance-Drawdown	98	7,870	2.43E-03
Western (Zone 1) Site: Leila Ave. & Jack Donner Dr. (LJ)	PW26-LJ-01	Time Drawdown - T ₁	0.8	62	-
		Time Drawdown - T ₂	0.2	18	-
		<i>Average</i>	<i>0.5</i>	<i>40</i>	
	MW26-LJ-01	Time Drawdown	1.8	146	-
	MW26-LJ-02	Time Drawdown	11.7	940	-
	PW26-LJ-01	Residual Drawdown	0.3	20	-
	MW26-LJ-01	Residual Drawdown	0.8	65	-
	MW26-LJ-02	Residual Drawdown	4.1	326	-
	All Wells	Distance-Drawdown	2.0	160	2.36E-04

*Radius of Influence (r_o) value calculated from Distance Drawdown plot was not plausible due to the physical conditions of the bedrock, which indicated fractures that were highly interconnected between wells. Range of r_o calculated separately between approximately 250 m and 550 m using an estimated S range based on the other two sites (between 0.002 and 0.0002).

Eastern (Zone 3) Site: Armstrong Ave. & Main St. (AM)

The time-drawdown plots in Figures AM-02 to AM-06 demonstrate that after 120 minutes of pumping at approximately 6.3 L/sec (100 USgpm), a maximum drawdown of 4.47 m was observed at PW, PW26-AM-01, 3.40 m at monitoring well, MW26-AM-01, 2.89 m at MW26-AM-02, 1.91 m in the VW till zone (S/N 202431)

at TH25-08, and 0.38 m in the VW clay zone (S/N 202214). The transmissivity estimates based on the pumping-phase data ranged between 73 and 90.7 m²/day (5,900 and 7,300 USgpd/ft) (Figures AM-02 to AM-04). Based on the residual drawdown data (Figures AM-07 to AM-09) during the recovery phase of the test, the transmissivity values were estimated between 90 and 104 m²/day (7,200 and 8,400 USgpd/ft).

The transmissivity estimated from distance drawdown plot (Figure AM-12) was high, at 384 m²/day (30,900 USgpd/ft). The distance drawdown plot produced a large radius of influence on the plot which appears skewed due to the direct interconnection of a common water producing fracture observed in the bedrock zone at 23.5 m bgs at each of the three wells on this Site. Storativity (S) values for the other two sites were calculated based on the Radius of Influence (r_o) determined from the Distance Drawdown plots at each site. The r_o value at the Eastern (Zone 3) site calculated from the Distance Drawdown plot was assessed as being not plausible due to the highly interconnected fracture identified at the same depth in each of the three wells on site. In this case, r_o for the Eastern (Zone 3) site was back-calculated separately using an estimated S value range based on results from the other two sites, which had storativity values ranging between approximately 0.002 and 0.0002. The resulting r_o values ranged between 250 m and 550 m for this site.

Middle (Zone 2) Site: Leila Ave. & McGregor St. (LM)

The time-drawdown plots in Figures LM-02 to LM-06 demonstrate that after 161 minutes of pumping at approximately 7.8 L/sec (124 USgpm), a maximum drawdown of 9.42 m was observed at pumping well, PW26-LM-01, 3.77 m at monitoring well, MW26-LM-01, and 1.50 m at MW26-LM-02. No drawdown or depressurization was observed in the till and clay VWs. The transmissivity estimates based on the pumping data ranged between 44 and 242.5 m²/day (3,550 and 19,500 USgpd/ft) (Figures LM-02 to LM-04). Based on the residual drawdown data (Figures LM-07 to LM-09), the transmissivity values were estimated between 263 and 281 m²/day (21,000 and 22,600 USgpd/ft). The transmissivity estimated from the distance drawdown plot (Figure LM-12) was 108 m²/day (8,700 USgpd/ft). The radius of influence calculated from the distance-drawdown plot at the Eastern (Zone 3) Site was 101 m.

Western (Zone 1) Site: Leila Ave. & Jack Donner Dr. (LJ)

The time-drawdown plots in Figures LJ-02, LJ-03, and LJ-04 demonstrate that after 169 minutes of pumping at a variable rate between 0.21 and 0.28 L/sec (3.4 and 4.5 USgpm), a maximum drawdown of 23.1 m was observed at pumping well, PW26-LJ-01, 6.31 m at monitoring well, MW26-LJ-01, and 0.83 m at MW-26-LJ-02. The transmissivity estimates based on the pumping data ranged between 0.5 and 11.7 m²/day (40 to 940 USgpd/ft) (Figures LJ-02 to LJ-04). Based on the residual drawdown data (Figures LJ-05 to LJ-07), the transmissivity values were estimated between 0.3 and 4.1 m²/day (20 to 326 USgpd/ft). The transmissivity estimated from the distance drawdown plot (Figure LJ-08) was at 2.0 m²/day (160 USgpd/ft). The radius of influence calculated from the distance-drawdown plot at the Western (Zone 1) Site was 47 m.

The residual drawdown (recovery period) is generally more accurate for assessment since variability in pump flow rates can affect the drawdown data plots, while the recovery data typically generates smoother curves. Therefore, the transmissivity of the bedrock aquifer based on the recovery data, has been estimated to range between 90 and 104 m²/day (7,200 and 8,400 USgpd/ft) at the Eastern (Zone 3) Site, between 263 and 281 m²/day (21,000 and 22,600 USgpd/ft) at the Middle (Zone 2) Site, and lower transmissivity values between 0.25 and 4.05 m²/day (20 and 326 USgpd/ft) at for the Western (Zone 1) Site.

The transmissivity values estimated for the Eastern (Zone 3) and Middle (Zone 2) Sites align with the range of known transmissivities as presented on the “Transmissivity of the Upper Carbonate Aquifer”, Plate 13 Map (Appendix D), developed by University of Manitoba’s Geological Engineering Department (Baracos, A., et al., 1983), ranging between 124 and 621 m²/day (10,000 to 50,000 USgpd/ft). Lower transmissivity values were estimated at the Western (Zone 1) Site (20 and 326 USgpd/ft) due to weaker connectivity of water producing bedrock fractures at this specific location.

5.0 GROUNDWATER CHEMISTRY

The groundwater chemistry results for field parameters are included in Table 5, and the laboratory results for dissolved metals and general chemistry parameters are included in Tables 6 and 7 respectively. The field chemistry parameters were consistent at the three investigation Sites. The field pH was in the range of 7.39 to 7.85, electrical conductivity was between 1,384 and 1,656 µS/cm, temperature was between 6.2°C and 8.1°C, dissolved oxygen between 5.99 and 15.62 mg/L, and the ORP stayed between 65.5 and 168.2 mV.

In total, three groundwater samples with sample IDs PW26-AM-01, PW26-LM-01 and PW26-LJ, collected on January 16, January 28, and February 5, 2026 were submitted to ALS laboratories as a part of this investigation program. All samples were analyzed for dissolved metals and routine chemistry parameters. The laboratory analytical results were compared with the Health Canada - Canadian Drinking Water Guidelines (HC-CDWQ), and Ontario Ministry of Environment (MOE) 2011 guidelines for groundwater used for potable and non-potable purposes.

The concentrations of dissolved metals and routine water chemistry parameters in all groundwater samples were generally below the applicable guidelines except for turbidity and TDS concentrations which exceeded the HC-CDWQ. According to the University of Manitoba’s Department of Geological Engineering Maps, the groundwater in the upper carbonate zone in the Site area is estimated to have TDS values around 1000 mg/L which is consistent with the findings of laboratory analysis in this investigation. Additionally, the chloride concentration of all samples collected during this investigation were between 237 and 245 mg/L whereas the sulphate concentrations were estimated between 184 and 213 mg/L. These findings also align closely with the University of Manitoba’s Department of Geological Engineering Maps including Plate 16 (chloride ion) and Plate 17 (sulphate ion). The Plate 16 and Plate 17 maps were included in Appendix A of “*Hydrogeological Desktop Review for the Armstrong Sewer District (Final Rev0)*” that has been previously issued to the City of Winnipeg in October 2025.

The laboratory certificate of analysis is included in Appendix F. Based on HC-CDWQ, the estimated water quality pumped at the Sites was interpreted to not require treatment of pumped groundwater prior to discharge to the approved City of Winnipeg Sewer catchments utilized during the pump testing program. A groundwater testing program during dewatering is an expected part of a MECC Groundwater Exploration Permit for planning of discharge management and by the City of Winnipeg for approval of discharge to sewer as well as expected flow rates and total program discharge volumes.

6.0 CONCLUSIONS

KGS Group conducted a site-specific hydrogeological investigation at three key locations identified in the project area. The following conclusions are made upon completion of the hydrogeological investigation program and data analysis:

- A total of three (3) pumping wells (PWs) and six (6) monitoring wells (MWs) were drilled and installed in the limestone bedrock at three (3) Sites between January 12, 2026, and February 4, 2026, using a combination of mud-rotary and air-rotary methods of drilling.
- Pumping tests were conducted at each site to estimate the site-specific hydrogeological properties of the bedrock aquifer.
- The transmissivity of the limestone bedrock aquifer, based on the regional transmissivity map, is in the range of 10,000 to 50,000 USgpd/ft.
- The transmissivity of the limestone bedrock aquifer, based on the recovery period data, is in the following approximate range:
 - Eastern (Zone 3) Site: between 90 and 104 m²/day (7,200 to 8,400 USgpd/ft)
 - Middle (Zone 2) Site: between 263 and 281 m²/day (21,000 to 22,600 USgpd/ft), and
 - Western (Zone 1) Site: between 0.3 and 4.1 m²/day (20 to 326 USgpd/ft).
- The concentrations of dissolved metals and routine water chemistry parameters in all groundwater samples were generally below the applicable guidelines except for turbidity and TDS concentrations which exceeded the Canadian Drinking Water Guidelines.

7.0 REFERENCES

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STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This memorandum has been prepared for City of Winnipeg in accordance with the agreement between KGS Group and City of Winnipeg (the “Agreement”). This memorandum represents KGS Group’s professional judgment and exercising due care consistent with the preparation of similar documents. The information, data, recommendations, and conclusions in this memorandum are subject to the constraints and limitations in the Agreement and the qualifications in this memorandum. This memorandum must be read as a whole, and sections or parts should not be read out of context.

This memorandum is based on information made available to KGS Group by City of Winnipeg. Unless stated otherwise, KGS Group has not verified the accuracy, completeness, or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this memorandum apply only as they existed at the time of KGS Group’s work.

Third Party Use of Memorandum

Any use a third party makes of this memorandum 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 memorandum.

Geo-Environmental Statement of Limitations

KGS Group prepared the geo-environmental conclusions and recommendations for this memorandum in a professional manner using the degree of skill and care exercised for similar projects under similar conditions by reputable and competent environmental consultants. The information contained in this memorandum is based on the information that was made available to KGS Group during the investigation and upon the services described, which were performed within the time and budgetary requirements of City of Winnipeg. As this memorandum is based on the available information, some of its conclusions could be different if the information upon which it is based is determined to be false, inaccurate, or contradicted by additional information. KGS Group makes no representation concerning the legal significance of its findings or the value of the property investigated.

Geotechnical Investigation Statement of Limitations

The geotechnical investigation findings and recommendations of this memorandum 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 the site at the time of drilling. 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, KGS Group should be notified in order that the recommendations can be reviewed and modified if necessary.

Prepared By:



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Principal

SPS/PJL/kv/jr

Attached:

- Appendix A – Photo Log
- Appendix B – Discharge Permits
- Appendix C – Borehole Logs
- Appendix D – Transmissivity Contour Map
- Appendix E – Groundwater Exploration Permit
- Appendix F – Laboratory Certificate of Analysis

TABLES

TABLE 5
2026 GROUNDWATER FIELD CHEMISTRY
ARMSTRONG SEWER DISTRICT, WINNIPEG MB

Well ID	Date & Time (dd/mm/yyyy hh:mm)	pH (units)	E.C. (μ S/cm)	Temp (°C)	D.O. (mg/L)	O.R.P. (mV)
PW26-AM-01	16/01/2026 10:35	7.39	1609	8.1	5.99	168.2
PW26-LM-01	28/01/2026 10:59	7.78	1656	6.2	3.25	84.3
PW26-LJ-01	02/02/2026 13:45	7.85	1384	6.3	15.62	65.5

Notes:

E.C. = Electrical Conductivity

D.O. = Dissolved Oxygen

O.R.P. = Oxidation Reduction Potential

TABLE 6
METALS IN GROUNDWATER
ARMSTRONG SEWER DISTRICT, WINNIPEG MB

Sample ID	Date	Parameter ⁽¹⁾											
		Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Cesium	Chromium	Cobalt
PW26-AM-01	16 Jan 2026	<0.0010	<0.00010	0.00012	0.0174	<0.000020	<0.000050	0.316	<0.0000050	82.9	0.000018	<0.00050	0.00022
PW26-LM-01	28 Jan 2026	0.0027	<0.00010	0.00076	0.0158	<0.000020	<0.000050	0.301	<0.0000050	70.6	0.000011	<0.00050	0.00026
PW26-LJ-01	05 Feb 2026	<0.0010	<0.00010	0.00103	0.0158	<0.000020	<0.000050	0.349	<0.0000050	84.1	0.000023	<0.00050	0.00024
Laboratory Detection Limits		0.001	0.0001	0.0001	0.0001	0.00002	0.00005	0.01	0.000005	0.05	0.00001	0.0005	0.0001
HC-CDWQ ⁽²⁾													
Drinking Water - MAC		2.9 ⁽³⁾	0.006	0.010	2.0	-	-	5.0	0.007	⁽⁴⁾	-	0.05	-
Drinking Water - AO		0.1 ⁽³⁾ (OG)	-	-	-	-	-	-	-	-	-	-	-
MOE Standards ⁽⁶⁾ - All Types of Property Use													
Table 2		-	0.006	0.025	1	0.004	-	5	0.0027	-	-	0.05	0.0038
Table 3		-	20	1.9	29	0.067	-	45	0.0027	-	-	0.81	0.066
Sample ID	Date	Parameter ⁽¹⁾											
		Copper	Iron	Lead	Lithium	Magnesium	Manganese	Molybdenum	Nickel	Phosphorus	Potassium	Selenium	Silicon
PW26-AM-01	16 Jan 2026	0.00033	<0.010	<0.000050	0.0763	67.5	0.00863	0.000576	0.00058	<0.050	11.8	0.000115	6.09
PW26-LM-01	28 Jan 2026	0.00352	<0.010	<0.000050	0.057	65.4	0.0176	0.00083	0.00058	<0.050	9.57	0.000065	6.40
PW26-LJ-01	05 Feb 2026	0.00047	<0.010	<0.000050	0.0663	67.7	0.0154	0.000982	0.00067	<0.050	9.6	0.000062	5.59
Laboratory Detection Limits		0.0002	0.01	0.00005	0.001	0.005	0.0001	0.00005	0.0005	0.05	0.05	0.00005	0.05
HC-CDWQ ⁽²⁾													
Drinking Water - MAC		2.0	-	0.005	-	-	0.12	-	-	-	-	0.05	-
Drinking Water - AO		1.0	0.3	-	-	-	0.02	-	-	-	-	-	-
MOE Standards ⁽⁶⁾ - All Types of Property Use													
Table 2		0.087	-	0.01	-	-	-	0.07	0.1	-	-	0.01	-
Table 3		0.087	-	0.025	-	-	-	9.2	0.49	-	-	0.063	-
Sample ID	Date	Parameter ⁽¹⁾											
		Silver	Strontium	Tellurium	Thallium	Thorium	Tin	Titanium	Tungsten	Uranium	Vanadium	Zinc	Zirconium
PW26-AM-01	16 Jan 2026	<0.000010	0.697	<0.0002	<0.000010	<0.00010	<0.00010	<0.00030	<0.00010	0.0019	<0.00050	0.0064	<0.0003
PW26-LM-01	28 Jan 2026	<0.000010	0.63	<0.0002	<0.000010	<0.00010	<0.00010	<0.00030	<0.00010	0.0017	<0.00050	0.0216	<0.0003
PW26-LJ-01	05 Feb 2026	<0.000010	0.623	<0.0002	<0.000010	<0.00010	<0.00010	<0.00030	<0.00010	0.000547	<0.00050	0.0024	<0.0003
Laboratory Detection Limits		0.00001	0.0002	0.0002	0.00001	0.0001	0.0001	0.0003	0.0001	0.00001	0.0005	0.001	0.0003
HC-CDWQ ⁽²⁾													
Drinking Water - MAC		⁽⁵⁾	7.0	-	-	-	-	-	-	0.02	-	-	-
Drinking Water - AO		-	-	-	-	-	-	-	-	-	-	5	-
MOE Standards ⁽⁶⁾ - All Types of Property Use													
Table 2		0.0015	-	-	0.002	-	-	-	-	0.02	0.0062	1.1	-
Table 3		0.0015	-	-	0.51	-	-	-	-	0.42	0.25	1.1	-

Notes:

"-" = No Data

- All values are expressed in milligrams per litre (mg/L) unless otherwise specified.
- Health Canada - Canadian Drinking Water Quality Guidelines (HC-CDWQ). Updated Sept 2020.
MAC = Maximum Acceptable Concentration = The maximum concentration of a parameter that is designed to protect those individuals most at risk, such as children and the elderly.
AO = Aesthetic Objective = A guideline which addresses a parameter that may affect consumer acceptance of drinking water, such as taste, odour, and colour.
OG = Operational Guideline = Guideline meant for a parameter which may affect treatment plant processes or drinking water distribution systems.
- The MAC and OG apply to all drinking water supplies (including groundwater) and are to be applied as locational running annual averages.
The OG value is established to minimize the potential for the accumulation and release of metals in the distribution system and to avoid other operational and aesthetic issues. It takes treatment achievability into consideration.
- Guideline value not required, as there is no evidence of adverse health effects from calcium in drinking water. Calcium contributes to hardness.
- Guideline value not required. Drinking water does not contribute significantly to an individual's intake of silver.
- MOE 2011 - Ontario Ministry of Environment. Soil, Ground Water and Sediment Standards
for Use Under Part XV.1 of the Environmental Protection Act.
Table 2 - Full Depth Generic Site Condition Standards in a Potable Ground Water Condition
Table 3 - Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition

	- Exceedance of HC-CDWQ Criteria
BOLD	- Exceedance of MOE Criteria

TABLE 7
2026 GENERAL GROUNDWATER QUALITY
ARMSTRONG SEWER DISTRICT, WINNIPEG MB

Sample ID	Date	Parameter ⁽¹⁾									
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as CaCO ₃	Bicarbonate as CaCO ₃	Carbonate as CaCO ₃	Hydroxide as CaCO ₃	Hardness as CaCO ₃	Chloride	Fluoride
PW26-AM-01	16 Jan 2026	2.51	8.02	1,630	335	335	<1.0	<1.0	485	237	0.173
PW26-LM-01	28 Jan 2026	284	7.77	1,600	317	317	<1.0	<1.0	446	245	0.249
PW26-LJ-01	05 Feb 2026	72.7	7.8	1,650	303	303	<1.0	<1.0	489	238	0.235
Laboratory Detection Limits		0.1	0.1	1	1	1	1	1	0.5	0.5	0.1
HC-CDWQ ⁽²⁾											
Drinking Water - MAC		0.1/0.3/1.0 ⁽³⁾	-	-	-	-	-	-	-	-	1.5
Drinking Water - AO		-	7.0 - 10.5	-	-	-	-	-	80-100 ⁽⁵⁾	250	-
MOE Standards ⁽⁶⁾ - All Types of Property Use											
Table 2		-	-	NA	-	-	-	-	-	790	-
Table 3		-	-	NA	-	-	-	-	-	2300	-

Sample ID	Date	Parameter ⁽¹⁾									
		Sulphate	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	Sodium	T.D.S.	Anion Sum (meq/L)	Cation Sum (meq/L)	Ionic Balance (%)	Sulphur
PW26-AM-01	16 Jan 2026	184	<0.025	<0.0250	<0.0050	178	979	17.2	17.7	1.43	75.6
PW26-LM-01	28 Jan 2026	196	<0.025	<0.0250	<0.0050	193	987	17.3	17.5	0.57	77.5
PW26-LJ-01	05 Feb 2026	213	<0.025	<0.0250	<0.0050	195	1,000	17.2	18.5	3.64	85.8
Laboratory Detection Limits		1.5	0.025	0.025	0.005	0.05	1	0.1	0.1	0.01	0.5
HC-CDWQ ⁽²⁾											
Drinking Water - MAC		-	-	10 ⁽⁴⁾	1.0 ⁽⁴⁾	-	-	-	-	-	-
Drinking Water - AO		500	-	-	-	200	500	-	-	-	-
MOE Standards ⁽⁶⁾ - All Types of Property Use											
Table 2		-	-	-	-	490	-	-	-	-	-
Table 3		-	-	-	-	2300	-	-	-	-	-

Notes:
"- " = No Data

E.C. = Electrical Conductivity
NTU = Nephelometric Turbidity Units
T.D.S. = Total Dissolved Solids

1. All values are expressed in milligrams per litre (mg/L) unless otherwise specified.
2. Health Canada - Canadian Drinking Water Quality Guidelines (HC-CDWQ). Updated Sept 2020.

MAC = Maximum Acceptable Concentration = The maximum concentration of a parameter that is designed to protect those individuals most at risk, such as children and the elderly.

AO = Aesthetic Objective = A guideline which addresses a parameter that may affect consumer acceptance of drinking water, such as taste, odour, and colour.
3. Waterworks systems that use a surface water source or a groundwater source under the direct influence of surface water should filter the source water to meet the following health-based turbidity limits, as defined for specific treatment technologies. Where possible, filtration systems should be designed and operated to reduce turbidity levels as low as possible, with a treated water turbidity target of less than 0.1 NTU at all times. Where this is not achievable, the treated water turbidity levels from individual filters:

a) For chemically assisted filtration, shall be less than or equal to 0.3 NTU in at least 95% of the measurements made, or at least 95% of the time each calendar month, and shall not exceed 1.0 NTU at any time.

b) For slow sand or diatomaceous earth filtration, shall be less than or equal to 1.0 NTU in at least 95% of the measurements made, or at least 95% of the time each calendar month, and shall not exceed 3.0 NTU at any time.

c) For membrane filtration, shall be less than or equal to 0.1 NTU in at least 99% of the measurements made, or at least 99% of the time each calendar month, and shall not exceed 0.3 NTU at any time.

If membrane filtration is the sole treatment technology employed, some form of virus inactivation* should follow the filtration process. Turbidity values greater than 1 NTU are shaded.
4. Systems using chloramine disinfection or that have naturally occurring ammonia should monitor the level of nitrate/nitrite in the distribution system.

Homeowners with a well should test the concentration of nitrate/nitrite in their water supply.
5. Public acceptance of hardness varies considerably. Generally, hardness levels between 80 and 100 mg/L (as CaCO3) provide acceptable balance between corrosion and incrustation.

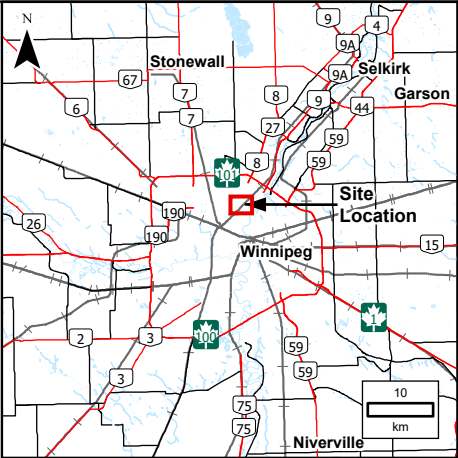
Where water is softened by sodium ion exchange, it is recommended that a separate, unsoftened supply be retained for culinary and drinking purposes.
6. MOE 2011 - Ontario Ministry of Environment. Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act (All Types of Property)

Table 2 - Full Depth Generic Site Condition Standards in a Potable Ground Water Condition

Table 3 - Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition

	- Exceedance of HC-CDWQ Criteria
Bold	- Exceedance of MOE Criteria

FIGURES



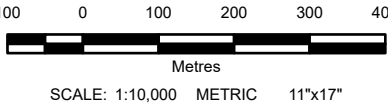
LEGEND:



- 0.051 m Φ Monitoring Well
- 0.127 m Φ Production Well
- Discharge Location
- KGS Group Test Hole (2025)

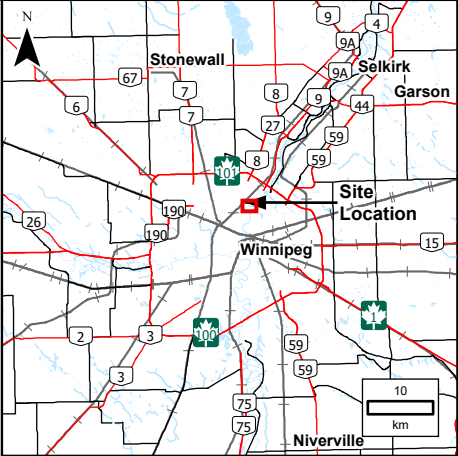
NOTES:

1. All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14.
Elevations are in metres referencing vertical datum (CGVD28).

2. Image Source: ESRI / Maxar (2025).



0	26/03/12	ISSUED WITH FINAL REPORT	SSS	PJL
NO.	YYMMDD	DESCRIPTION	ISSUED BY	CHECK BY
REVISIONS / ISSUE				
				
PUMPING TEST - GROUNDWATER DEPRESSURIZATION PROGRAM ARMSTRONG SEWER DISTRICT				
SITE OVERVIEW				
MARCH 2026		FIGURE 01	REV:	0



LEGEND:

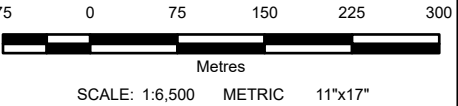
- 0.051 m Φ Monitoring Well
- 0.127 m Φ Production Well
- Discharge Location
- KGS Group Test Hole (2025)



Provincial Wells Database

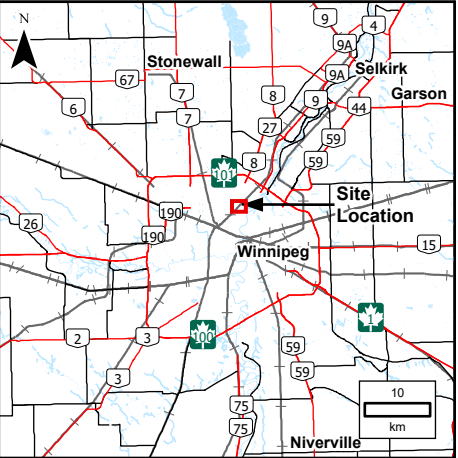
- Production Well
- Other Well

NOTES:

- All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 14. Elevations are in metres referencing vertical datum (CGVD28).
- Image Source: Google Earth, Airbus (2025).
- Accuracy of provincial database wells shown on map: +/- 1m.



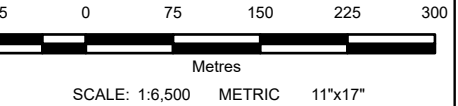
0	26/03/12	ISSUED WITH FINAL REPORT	SSS	PJL
NO.	YYMMDD	DESCRIPTION	ISSUED BY	CHECK BY
REVISIONS / ISSUE				
				
PUMPING TEST - GROUNDWATER DEPRESSURIZATION PROGRAM ARMSTRONG SEWER DISTRICT				
EASTERN (ZONE 3) SITE MAIN ST & ARMSTRONG AVE				
MARCH 2026		FIGURE 02	REV:	0





- LEGEND:**
- 0.051 m Φ Monitoring Well
 - 0.127 m Φ Production Well
 - Discharge Location
 - KGS Group Test Hole (2025)

- NOTES:**
- All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 14. Elevations are in metres referencing vertical datum (CGVD28).
 - Image Source: Google Earth, Airbus (2025).
 - Accuracy of provincial database wells shown on map: +/- 1m.
 - Provincial database wells with the 'ACTIVE' designation have accuracies of between +/- 50m and +/- 350m and may fall outside the 800m radius. They are listed by Well PID Below:

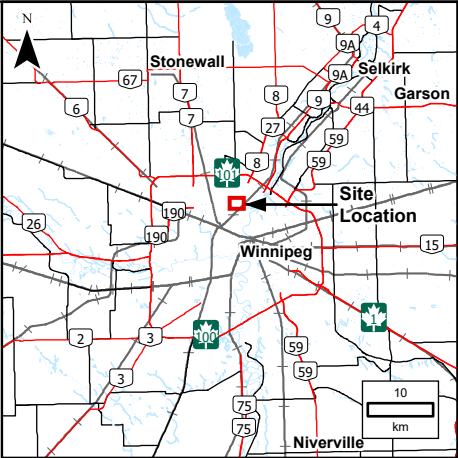
Well 11880	Well 19189	Well 40926
Well 11883	Well 20730	Well 27507
Well 11882	Well 27714	Well 45987
Well 11881	Well 14618	Well 60856
Well 25107	Well 17706	Well 68297
Well 13289	Well 17705	Well 134130
Well 170449	Well 17704	Well 48747
Well 34601	Well 17703	Well 19224
Well 11878	Well 7899	Well 15782
Well 45986	Well 14569	Well 106142
Well 19217	Well 19188	Well 124726
Well 68296	Well 25468	Well 10536
Well 21471	Well 29907	Well 17701
Well 11879	Well 33945	Well 124839
Well 14568	Well 61977	Well 75596
Well 68295	Well 63016	Well 25981
Well 75541		



0	26/03/12	ISSUED WITH FINAL REPORT	SSS	PJL
NO.	YYMMDD	DESCRIPTION	ISSUED BY	CHECK BY
REVISIONS / ISSUE				
				
PUMPING TEST - GROUNDWATER DEPRESSURIZATION PROGRAM ARMSTRONG SEWER DISTRICT				
MIDDLE (ZONE 2) SITE LEILA AVE & MCGREGOR ST				
MARCH 2026		FIGURE 03		REV: 0



Well ID	N	E	Z
MW26-LJ-02	5534841.909	633554.597	231.79
MW26-LJ-01	5534816.201	633542.690	231.69
PW26-LJ-01	5534813.671	633541.446	232.713
Discharge_LJ	5534788.000	633567.000	-



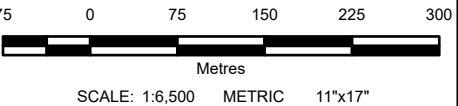
LEGEND:



- 0.051 m Φ Monitoring Well
- 0.127 m Φ Production Well
- Discharge Location

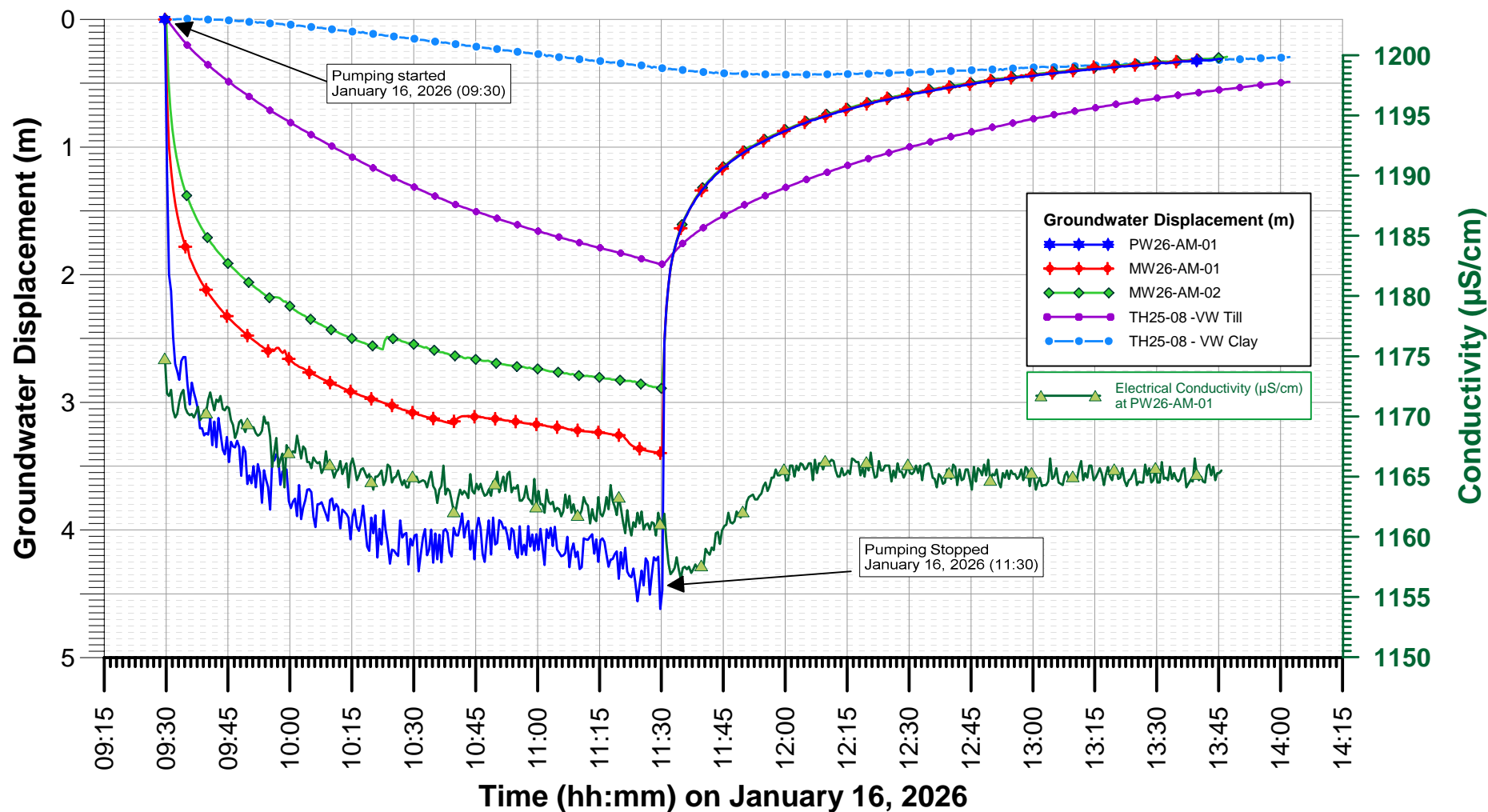
NOTES:

- All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 14. Elevations are in metres referencing vertical datum (CGVD28).
- Image Source: Google Earth, Airbus (2025).
- Accuracy of provincial database wells shown on map: +/- 1m.
- Provincial database wells with the 'ACTIVE' designation have accuracies of between +/- 50m and +/- 350m and may fall outside the 800m radius. They are listed by Well PID Below:

Well 11880
Well 11881
Well 11882
Well 11883






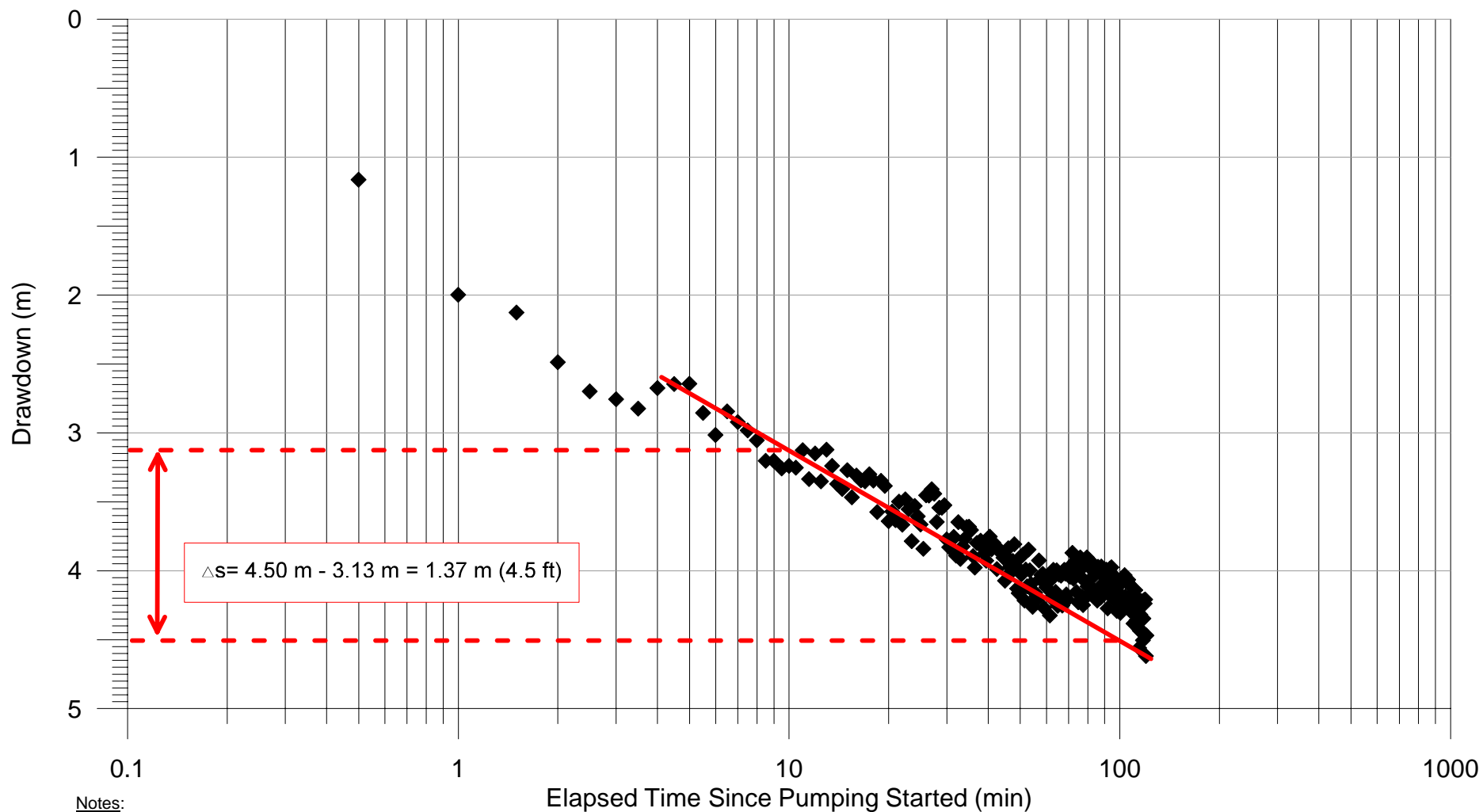
0	26/03/12	ISSUED WITH FINAL REPORT	SSS	PJL
NO.	YYMM/DD	DESCRIPTION	ISSUED BY	CHECK BY
REVISIONS / ISSUE				
				
PUMPING TEST - GROUNDWATER DEPRESSURIZATION PROGRAM ARMSTRONG SEWER DISTRICT				
WESTERN (ZONE 1) SITE LEILA AVE & JACK DONNER DR				
MARCH 2026		FIGURE 04	REV:	0



Notes:

Date of Test	January 16, 2026
Pumping Well	PW26-AM-01
Observation Wells	MW26-AM-01 (2.9 m N of pumping well) MW26-AM-02 (30.0 m N of pumping well)
PW26-AM-01: Drawdown - Maximum	4.47 m
MW26-AM-01: Drawdown - Maximum	3.40 m
MW26-AM-02: Drawdown - Maximum	2.89 m
TH25-08 (Till, VW 202431): Drawdown - Maximum	1.91 m
TH25-08 (Clay, VW 202214): Drawdown - Maximum	0.38 m
Pumping Rate (Q)	100 USgpm

	0	26/03/12	ISSUED WITH FINAL REPORT	PJL	JDM
	NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
REVISIONS / ISSUE					
					
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT					
EASTERN (ZONE 3) SITE PUMPING TEST AT PW26-AM-01 GROUNDWATER DISPLACEMENT HYDROGRAPH					
MARCH 2026			FIGURE AM-01		REV: 0



Notes:

Date of Test: January 16, 2026
Pumping Well: PW26-AM-01
Observation Well: PW26-AM-01
Drawdown: 4.47 m
Pumping Rate (Q): 545.1 m³/day (100 USgpm)



Transmissivity

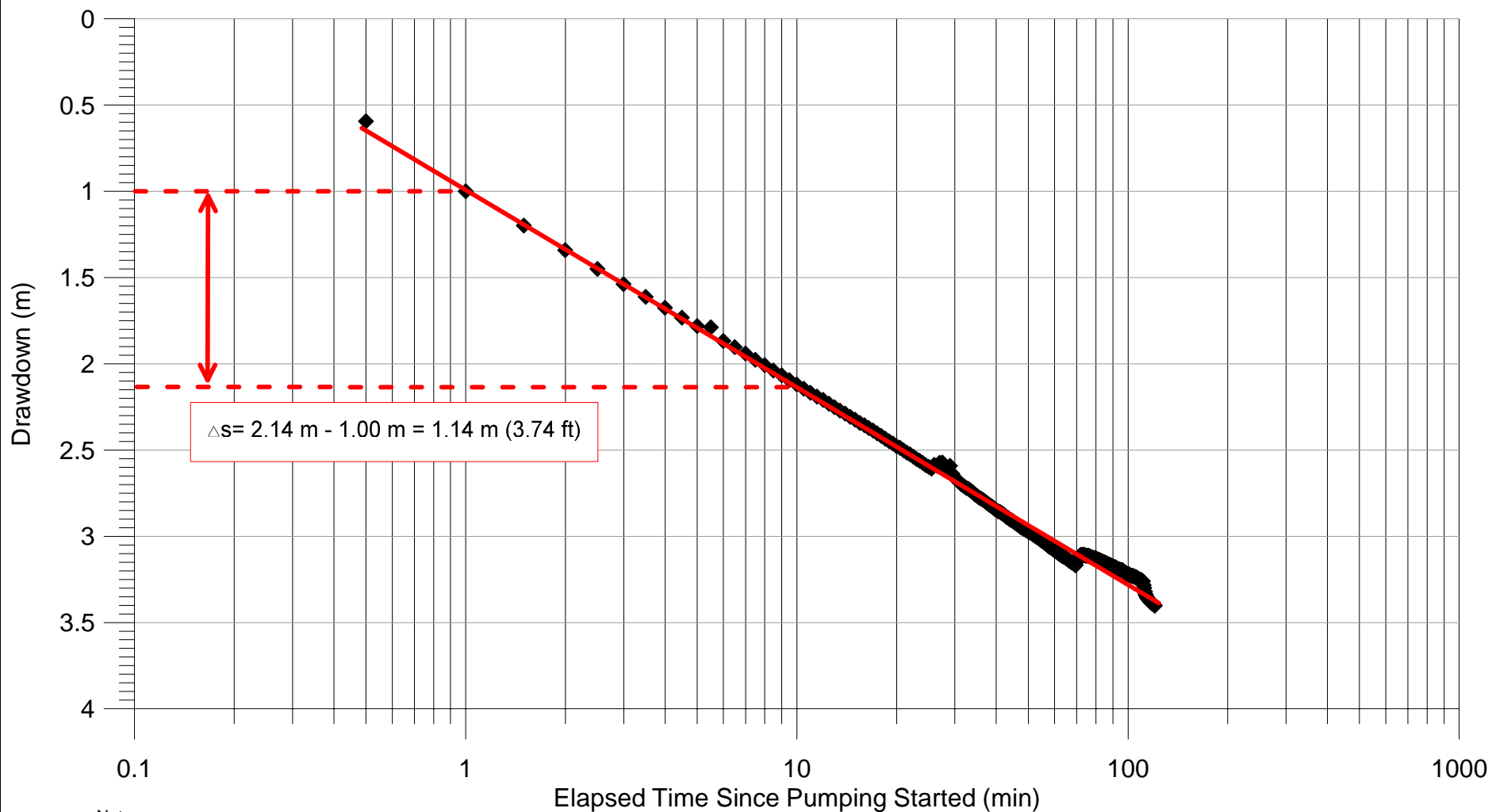
$$T = (0.183)(Q)/\Delta s \quad Q = 545.1 \text{ m}^3/\text{day} (100 \text{ USgpm})$$

$$\Delta s = 1.37 \text{ m} (4.5 \text{ ft}) \quad T = 73 \text{ m}^2/\text{day} (5,900 \text{ gpd/ft})$$

Drawdown (m)

◆ PW26-AM-01

0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO	YYMM/DD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-AM-01 TIME VS DRAWDOWN OBSERVATION AT PW26-AM-01				
MARCH 2026		FIGURE AM-02		REV: 0



Notes:

Date of Test: January 16, 2026
Pumping Well: PW26-AM-01
Observation Well: MW26-AM-01 (2.9 m N of PW26-AM-01)
Drawdown: 3.40 m
Pumping Rate (Q): 545.1 m³/day (100 USgpm)



Transmissivity

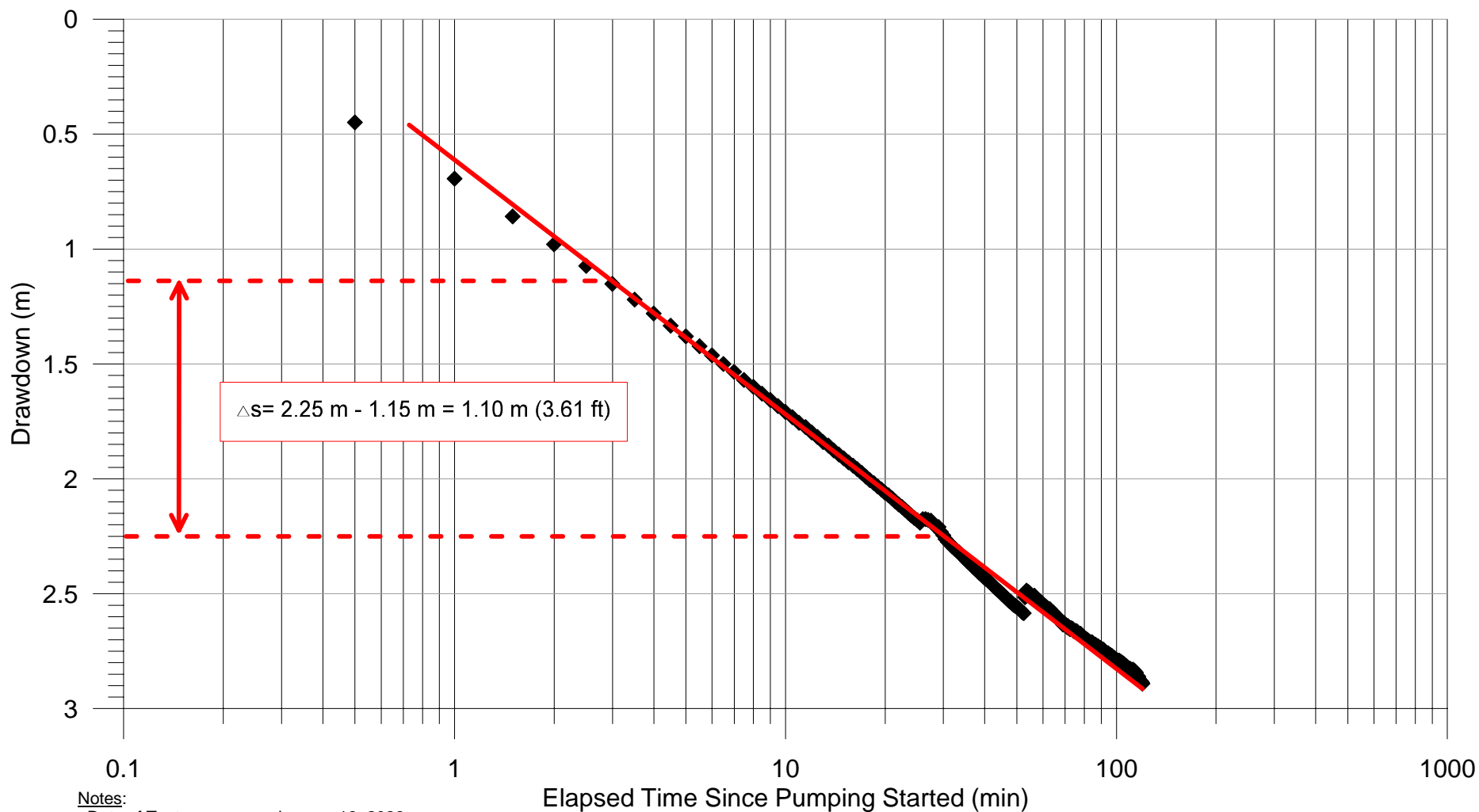
$$T = (0.183)(Q)/\Delta s \quad Q = 545.1 \text{ m}^3/\text{day} (100 \text{ USgpm})$$

$$\Delta s = 1.14 \text{ m} (3.74 \text{ ft}) \quad T = 87.5 \text{ m}^2/\text{day} (7,000 \text{ gpd/ft})$$

Drawdown (m)

◆ MW26-AM-01

0	26/03/12	ISSUED WITH FINAL REPORT		PJL	JDM
NO.	YYMM/DD	DESCRIPTION		Design By	Design Check
REVISIONS / ISSUE					
					
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT					
PUMPING AT PW26-AM-01 TIME VS DRAWDOWN OBSERVATION AT MW26-AM-01					
MARCH 2026		FIGURE AM-03		REV:	0



Notes:

Date of Test: January 16, 2026
Pumping Well: PW26-AM-01
Observation Well: MW26-AM-02 (30 m N of PW26-AM-01)
Drawdown: 2.89 m
Pumping Rate (Q): 545.1 m³/day (100 USgpm)



Transmissivity

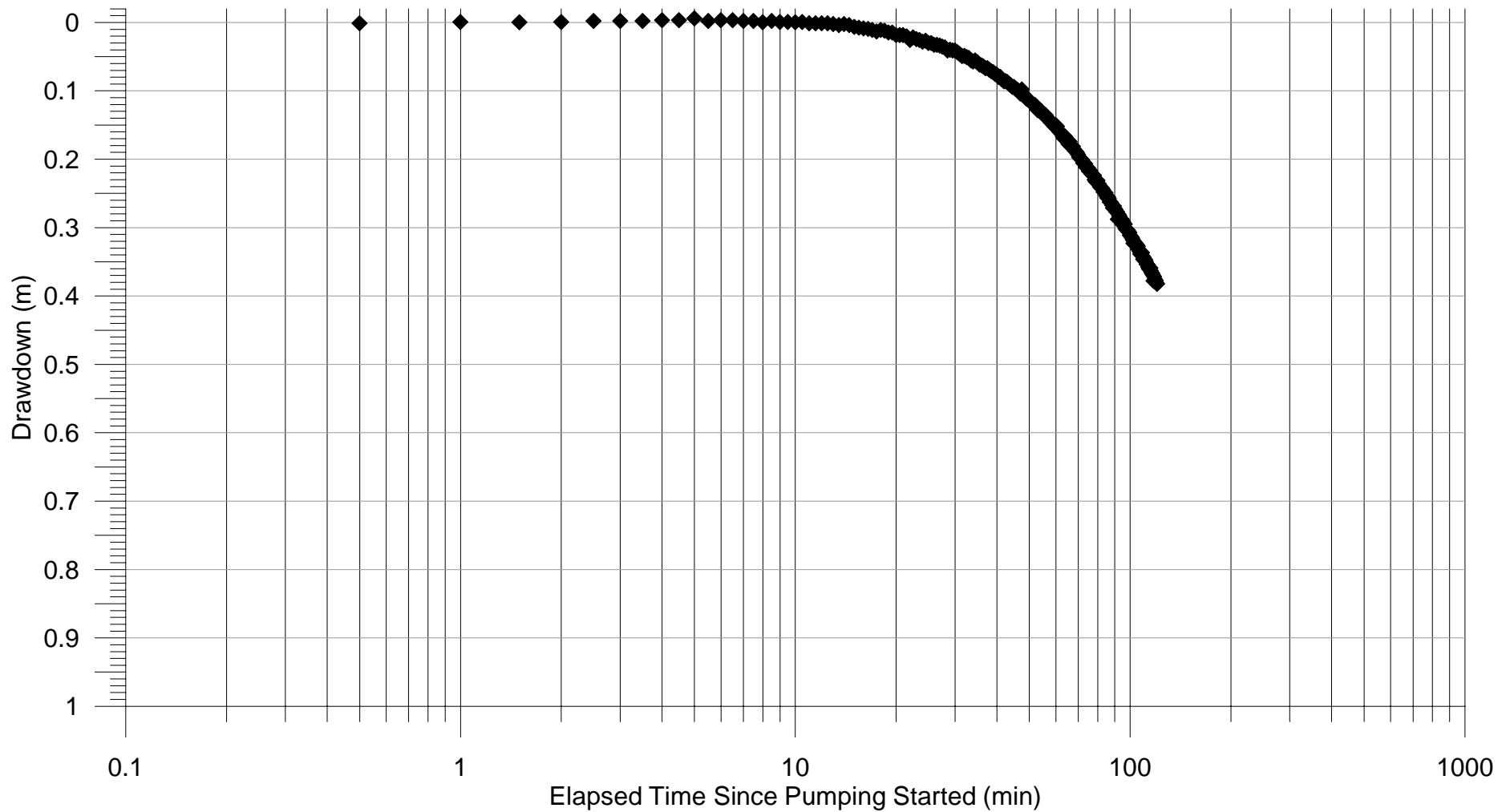
$$T = (0.183)(Q)/\Delta s \quad Q = 545.1 \text{ m}^3/\text{day} (100 \text{ USgpm})$$

$$\Delta s = 1.10 \text{ m} (3.61 \text{ ft}) \quad T = 90.7 \text{ m}^2/\text{day} (7,300 \text{ gpd/ft})$$

Drawdown (m)

◆ MW26-AM-02

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NO.	YYMMDD	DESCRIPTION		Design By	Design Check
REVISIONS / ISSUE					
					
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT					
PUMPING AT PW26-AM-01 TIME VS DRAWDOWN OBSERVATION AT MW26-AM-02					
MARCH 2026		FIGURE AM-04		REV:	0





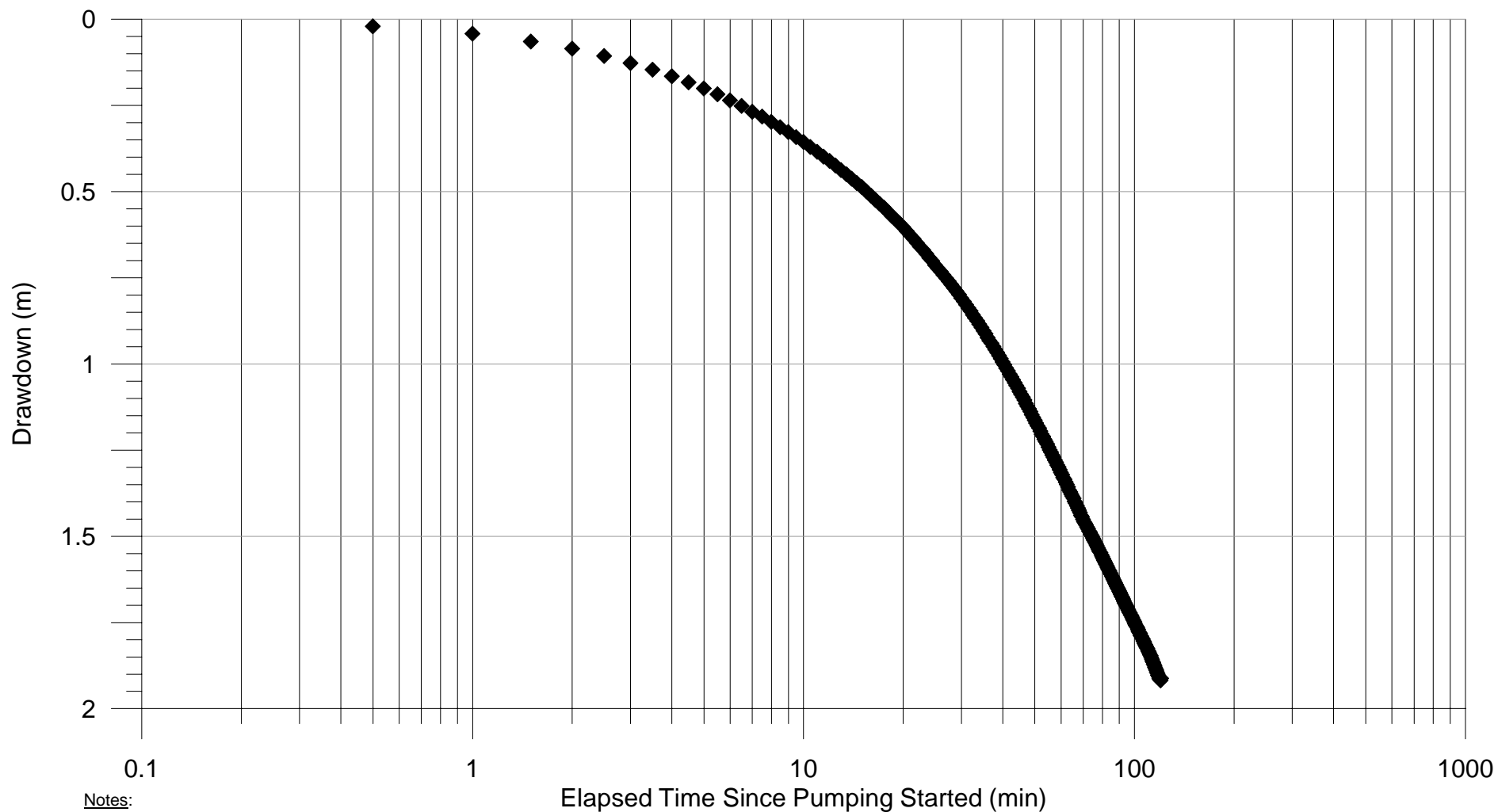
Notes:

Date of Test: January 16, 2026
 Pumping Well: PW26-AM-01
 Observation Well: TH25-08 - VW202214 Clay (10.75 m E of PW26-AM-01)
 Drawdown: 0.38 m
 Pumping Rate (Q): 545.1 m³/day (100 USgpm)

Drawdown (m)
 TH25-08 - VW202214 Clay

➡

0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L	J.D.M			
NO.	YYMMDD	DESCRIPTION	Design By	Design Check			
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GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT							
PUMPING AT PW26-AM-01 TIME VS DRAWDOWN OBSERVATION AT TH25-08 - VW202214 Clay							
MARCH 2026		FIGURE AM-05		REV 0			



Notes:

Date of Test: January 16, 2026
Pumping Well: PW26-AM-01 (Bedrock)
Observation Well: TH25-08 - VW202431 Till (10.75 m E of PW26-AM-01)
Drawdown: 1.91 m
Pumping Rate (Q): 545.1 m³/day (100 USgpm)

Drawdown (m)

◆ TH25-08 - VW202431 Till

0

26/03/12

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J.D.M.

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GROUP



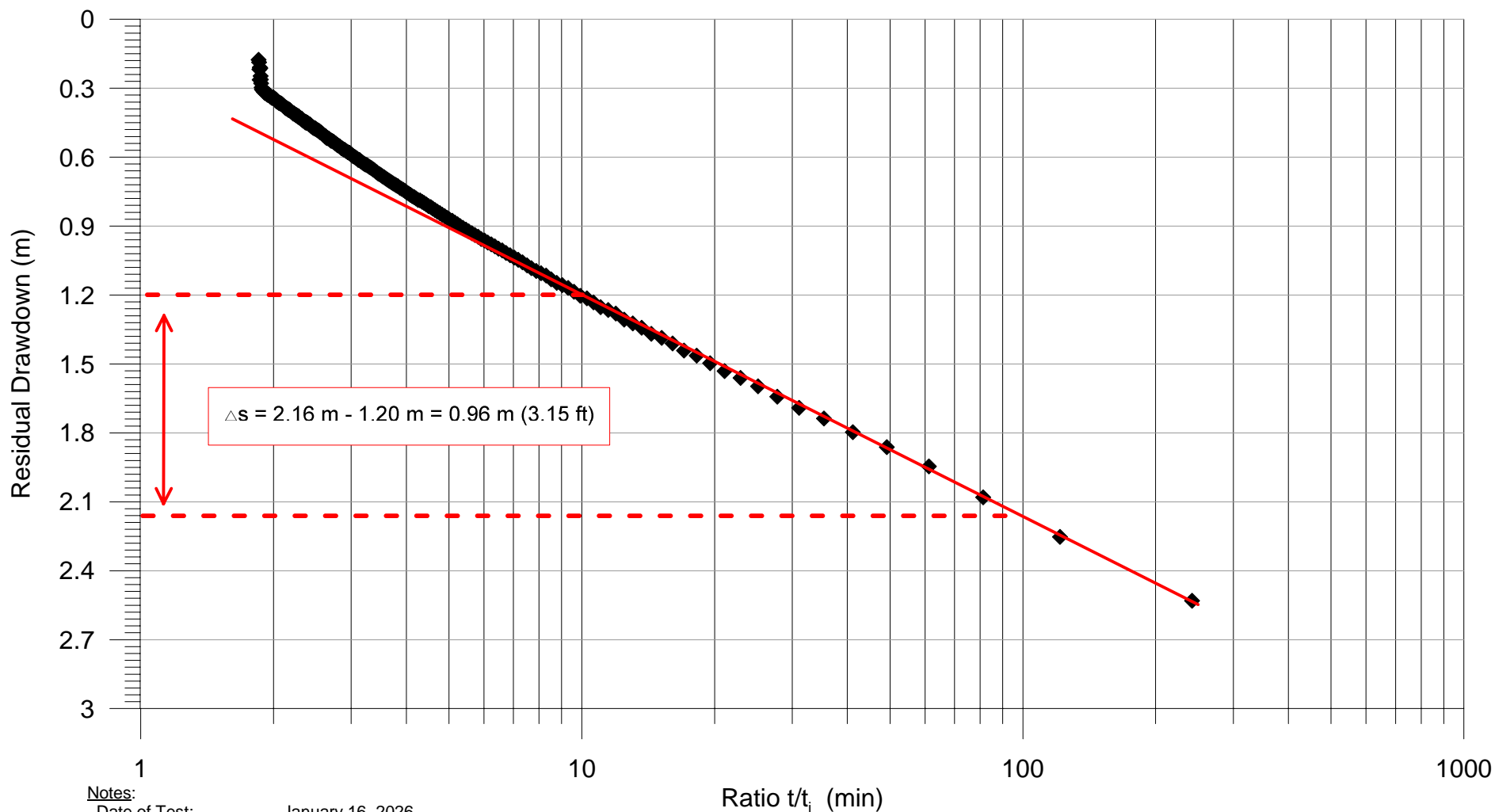
GROUNDWATER DEPRESSURIZATION
INVESTIGATION
ARMSTRONG SEWER DISTRICT
PUMPING AT PW26-AM-01
TIME VS DRAWDOWN
OBSERVATION AT TH25-08 - VW202431 Till

MARCH 2026

FIGURE AM-06

REV:

0



Notes:

Date of Test: January 16, 2026
Pumping Well: PW26-AM-01
Observation Well: PW26-AM-01
Drawdown: 4.47 m
Pumping Rate (Q): 545.1 m³/day (100 USgpm)



Transmissivity

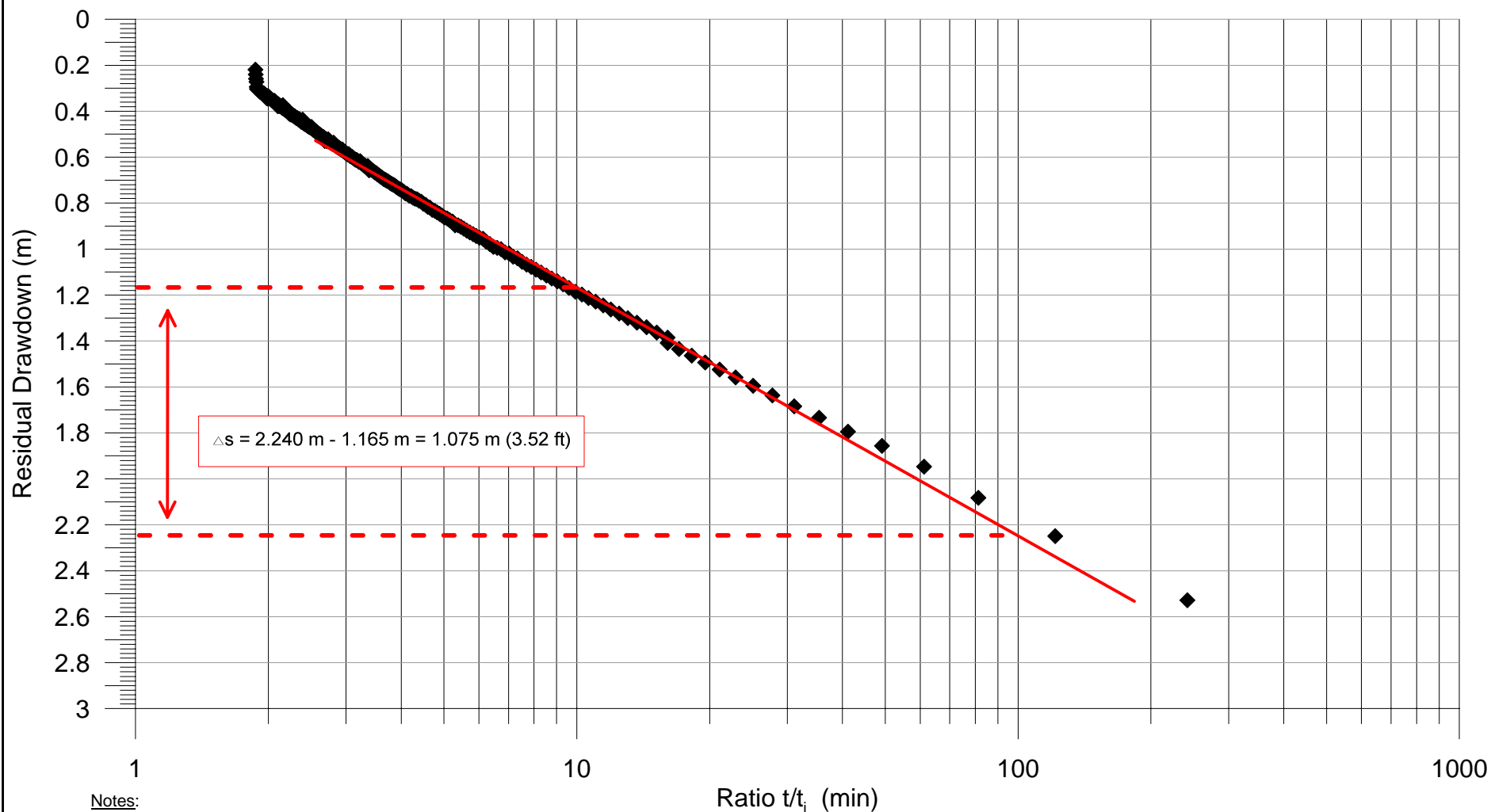
$$T = (0.183)(Q)/\Delta s \quad Q = 545.1 \text{ m}^3/\text{day} (100 \text{ USgpm})$$

$$\Delta s = 0.96 \text{ m} (3.15 \text{ ft}) \quad T = 104 \text{ m}^2/\text{day} (8,400 \text{ gpd/ft})$$

Drawdown (m)

◆ PW26-AM-01

0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO	YYMM/DD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-AM-01 RESIDUAL DRAWDOWN OBSERVATION AT PW26-AM-01				
MARCH 2026		FIGURE AM-07		REV: 0



Notes:

Date of Test: January 16, 2026
Pumping Well: PW26-AM-01
Observation Well: MW26-AM-01 (2.9 m N of PW26-AM-01)
Drawdown: 3.40 m
Pumping Rate (Q): 545.1 m³/day (100 USgpm)



Transmissivity

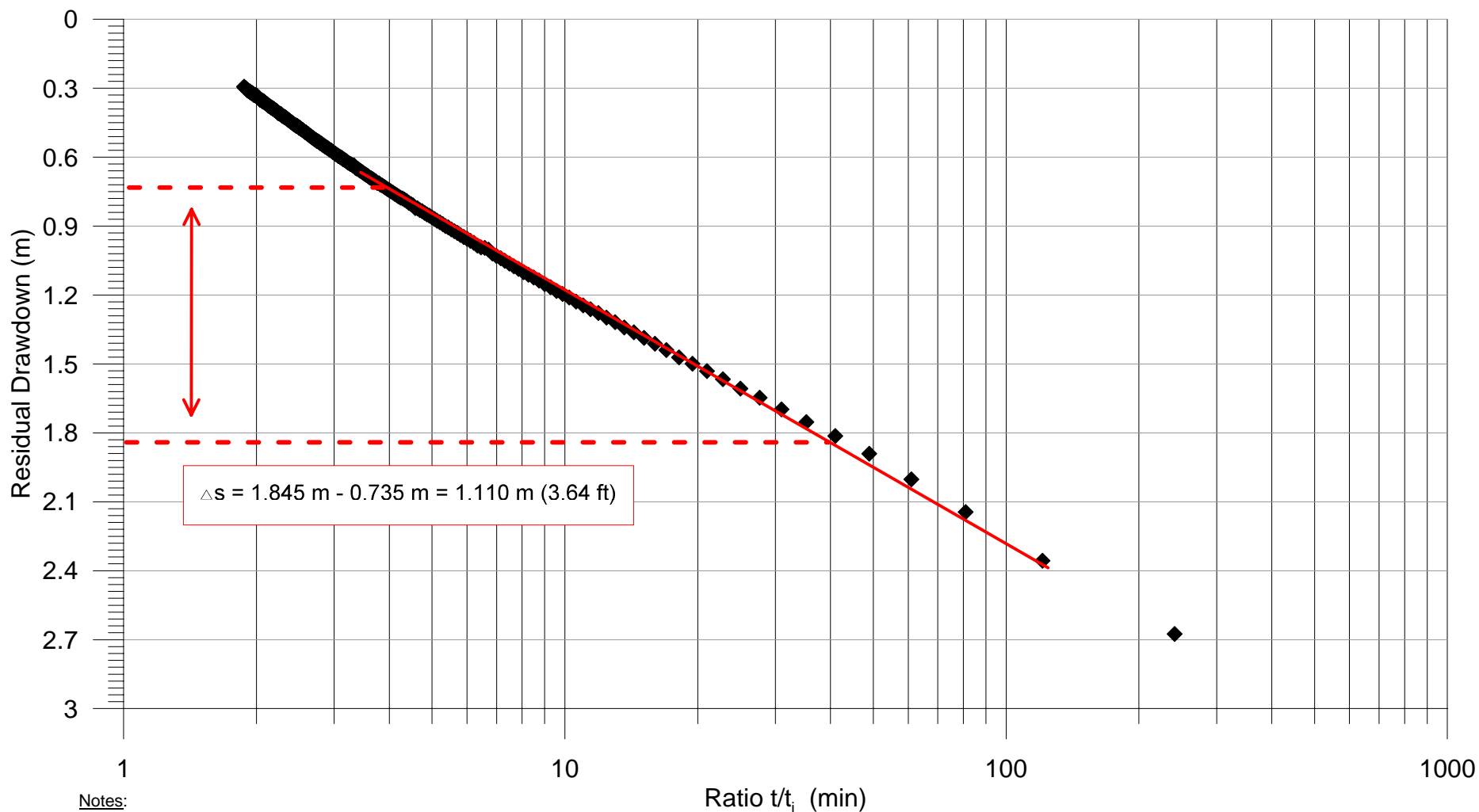
$$T = (0.183)(Q)/\Delta s \quad Q = 545.1 \text{ m}^3/\text{day} (100 \text{ USgpm})$$

$$\Delta s = 1.075 \text{ m} (3.52 \text{ ft}) \quad T = 93 \text{ m}^2/\text{day} (7,500 \text{ gpd/ft})$$

Drawdown (m)

◆ MW26-AM-01

0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO.	YYMM/DD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-AM-01 RESIDUAL DRAWDOWN OBSERVATION AT MW26-AM-01				
MARCH 2026		FIGURE AM-08		REV: 0



Notes:



Date of Test: January 16, 2026
 Pumping Well: PW26-AM-01
 Observation Well: MW26-AM-02 (30 m N of PW26-AM-01)
 Drawdown: 2.89 m
 Pumping Rate (Q): 545.1 m³/day (100 USgpm)

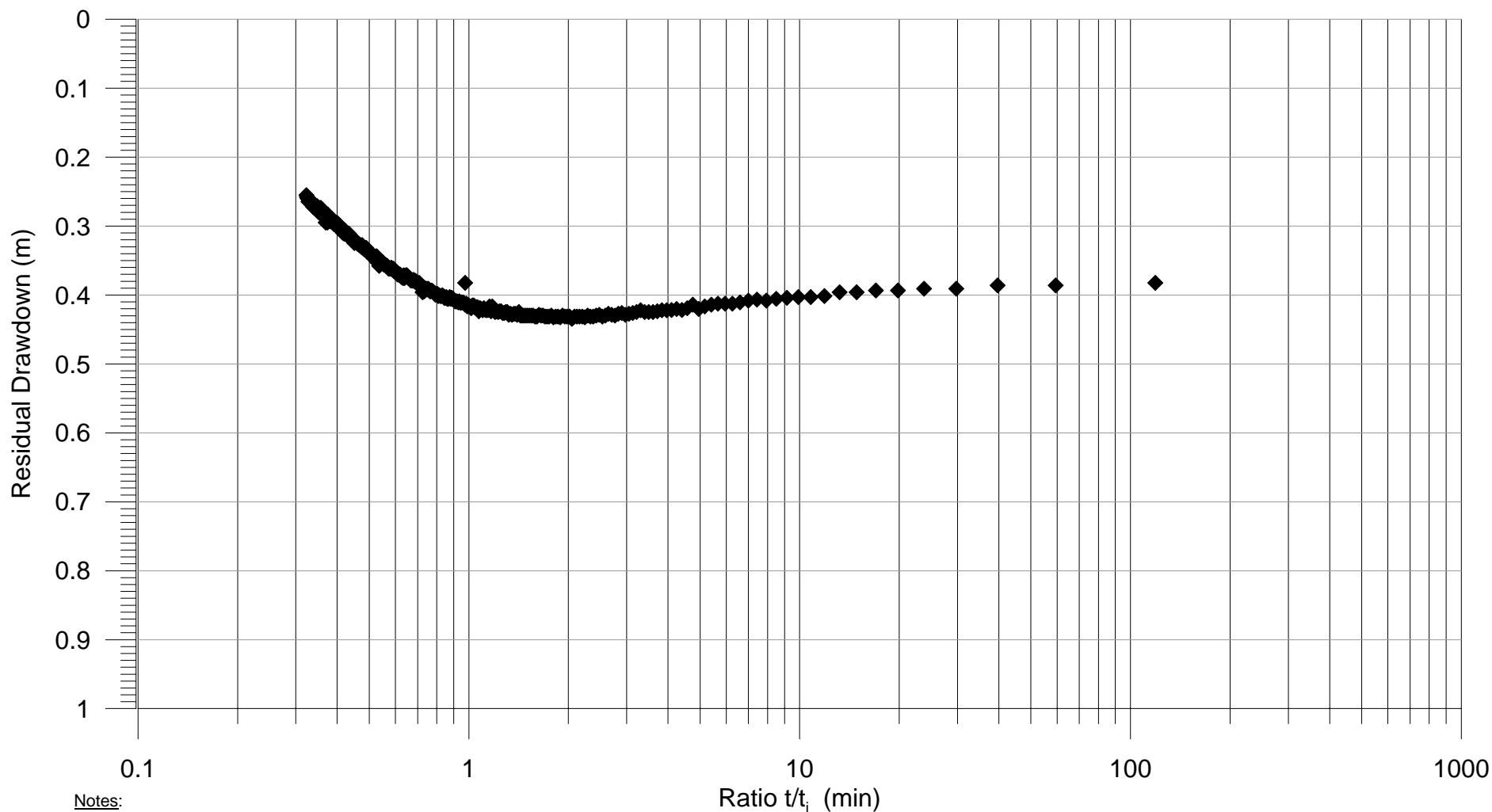
Transmissivity

$$T = (0.183)(Q)/\Delta s \quad Q = 545.1 \text{ m}^3/\text{day} (100 \text{ USgpm})$$

$$\Delta s = 1.110 \text{ m} (3.64 \text{ ft}) \quad T = 90 \text{ m}^2/\text{day} (7,200 \text{ gpd/ft})$$

Drawdown (m)
 ◆ MW26-AM-02

0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO.	YYMMDD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-AM-01 RESIDUAL DRAWDOWN OBSERVATION AT MW26-AM-02				
MARCH 2026		FIGURE AM-09		REV: 0





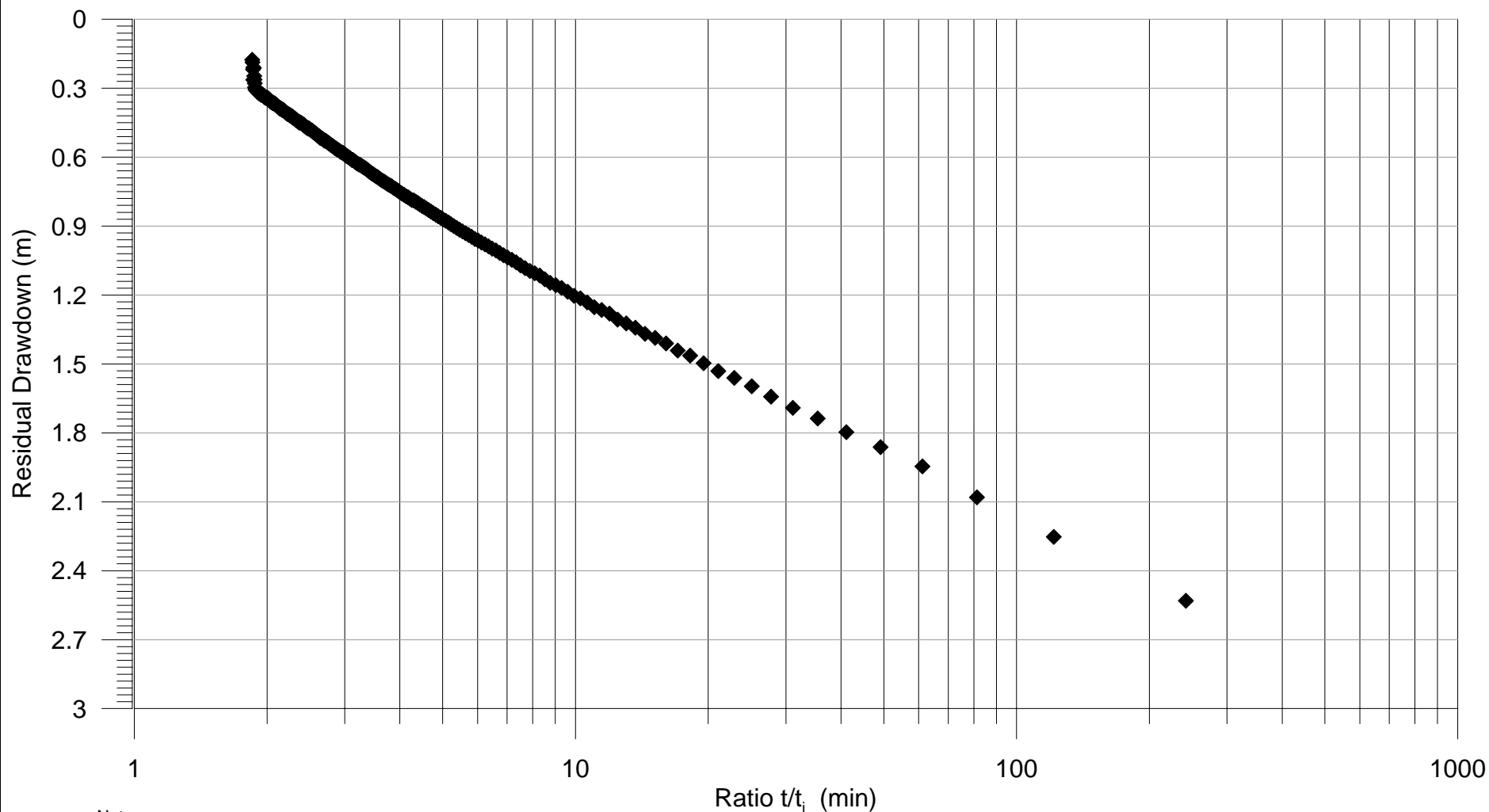
Notes:

Date of Test: January 16, 2026
Pumping Well: PW26-AM-01
Observation Well: TH25-08 - VW202214 Clay (10.75 m E of PW26-AM-01)
Drawdown: 0.38 m
Pumping Rate (Q): 545.1 m³/day (100 USgpm)

Residual Drawdown (m)

◆ TH25-08-VW202214 Clay

0	26/03/12	ISSUED WITH FINAL REPORT		P.J.L.	J.D.M.
NO.	YYMM/DD	DESCRIPTION		Design By	Design Check
REVISIONS / ISSUE					
					
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT					
PUMPING AT PW26-AM-01 RESIDUAL DRAWDOWN OBSERVATION AT TH25-08 - VW202214 Clay					
MARCH 2026		FIGURE AM-10		REV	0





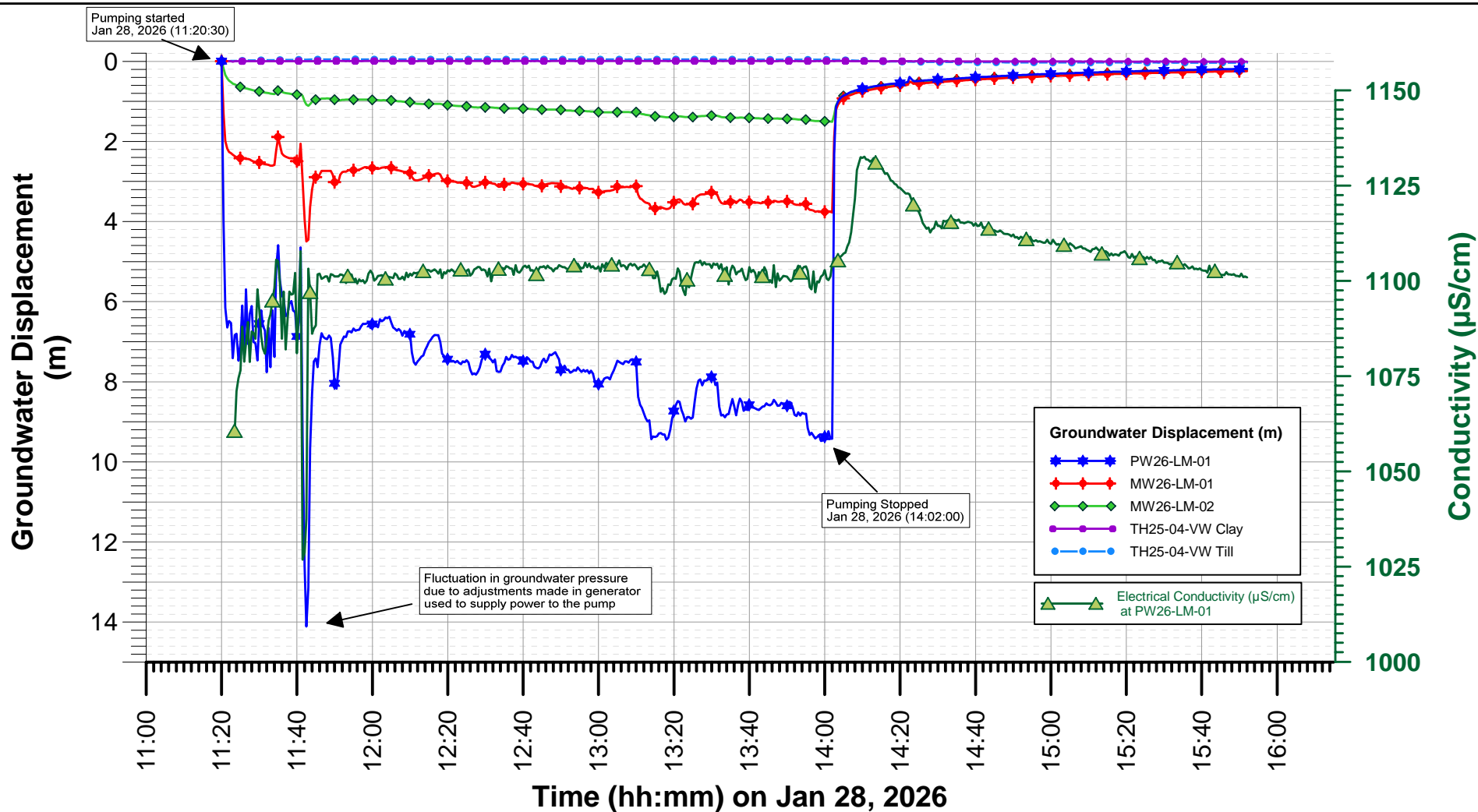
Notes:

Date of Test: January 16, 2026
Pumping Well: PW26-AM-01 (Bedrock)
Observation Well: TH25-08 - VW202431 Till (10.75 m E of PW26-AM-01)
Drawdown: 1.91 m
Pumping Rate (Q): 545.1 m³/day (100 USgpm)

Residual Drawdown (m)



◆ TH25-08-VW202431 Till

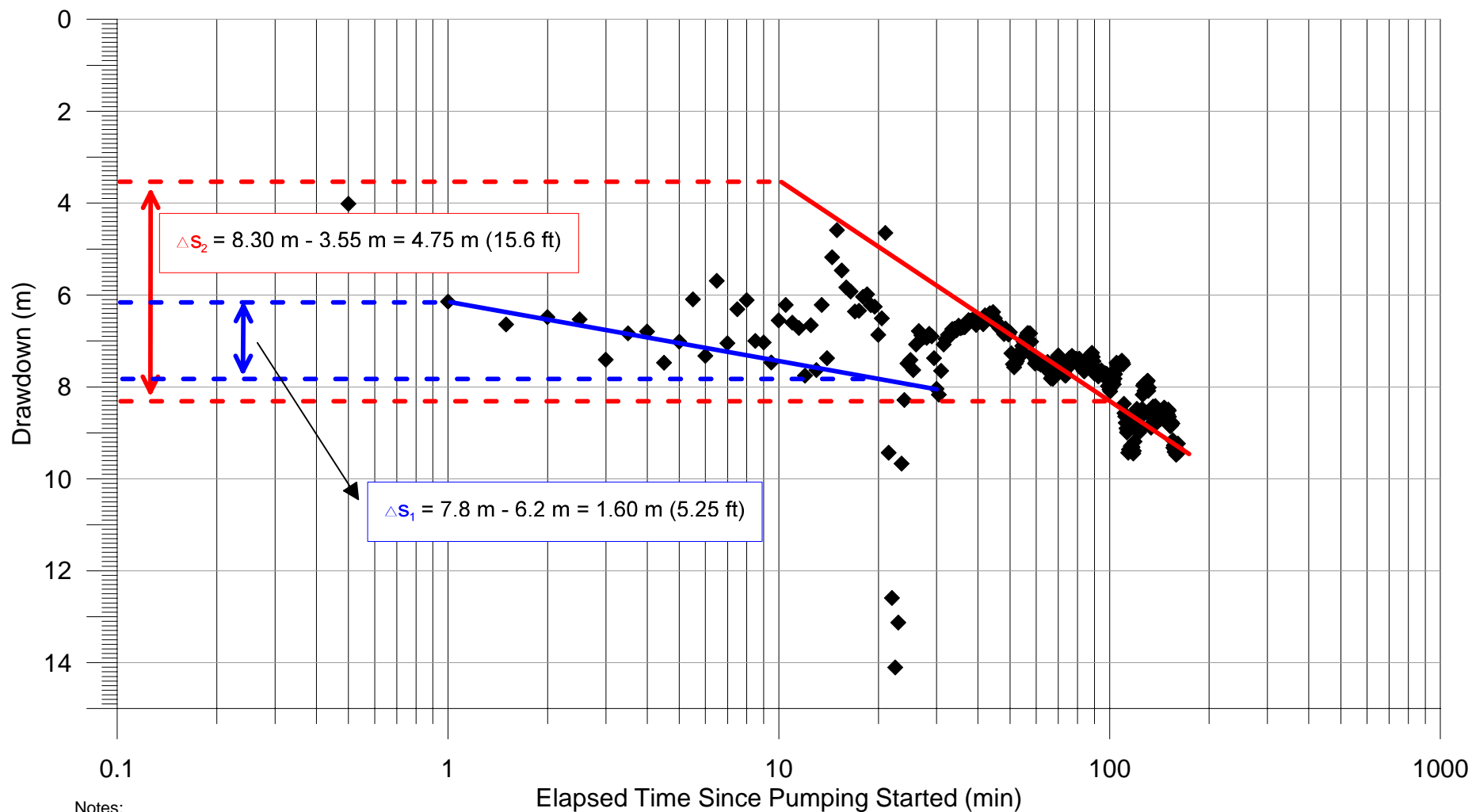
0	26/03/12	ISSUED WITH FINAL REPORT		P.J.L.	J.D.M.
NO	YYMM/DD	DESCRIPTION		Design By	Design Check
REVISIONS / ISSUE					
					
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT					
PUMPING AT PW26-AM-01 RESIDUAL DRAWDOWN OBSERVATION AT TH25-08 - VW202431 Till					
MARCH 2026		FIGURE AM-11			REV: 0



Notes:

Date	January 28, 2026
Pumping Well	PW26-LM-01
Observation Wells	MW26-LM-01 (3.5 m E of pumping well) MW26-LM-02 (29.0 m E of pumping well)
PW26-LM-01: Drawdown - Maximum	9.42 m
MW26-LM-01: Drawdown - Maximum	3.77 m
MW26-LM-02: Drawdown - Maximum	1.50 m
Pumping Rate (Q)	124 USgpm

0	26/03/12	ISSUED WITH FINAL REPORT	PJL	JDM
NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
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GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
MIDDLE (ZONE 2) SITE PUMPING TEST AT PW26-LM-01 HYDROGRAPH				
MARCH 2026		FIGURE LM-01		REV: 0



Notes:

Date of test: January 28, 2026
Pumping Well: PW26-LM-01
Observation: PW26-LM-01
Drawdown: 13.41 m
Pumping Rate (Q): 675.9 m³/day (124 USgpm)

Transmissivity

$$T = (0.183)(Q)/\Delta s$$

$Q_1 = 545 \text{ m}^3/\text{day} (100 \text{ USgpm})$

$\Delta S_1 = 1.60 \text{ m} (5.25 \text{ ft})$

$T_1 = 62 \text{ m}^2/\text{day} (5,000 \text{ gpd/ft})$



Transmissivity

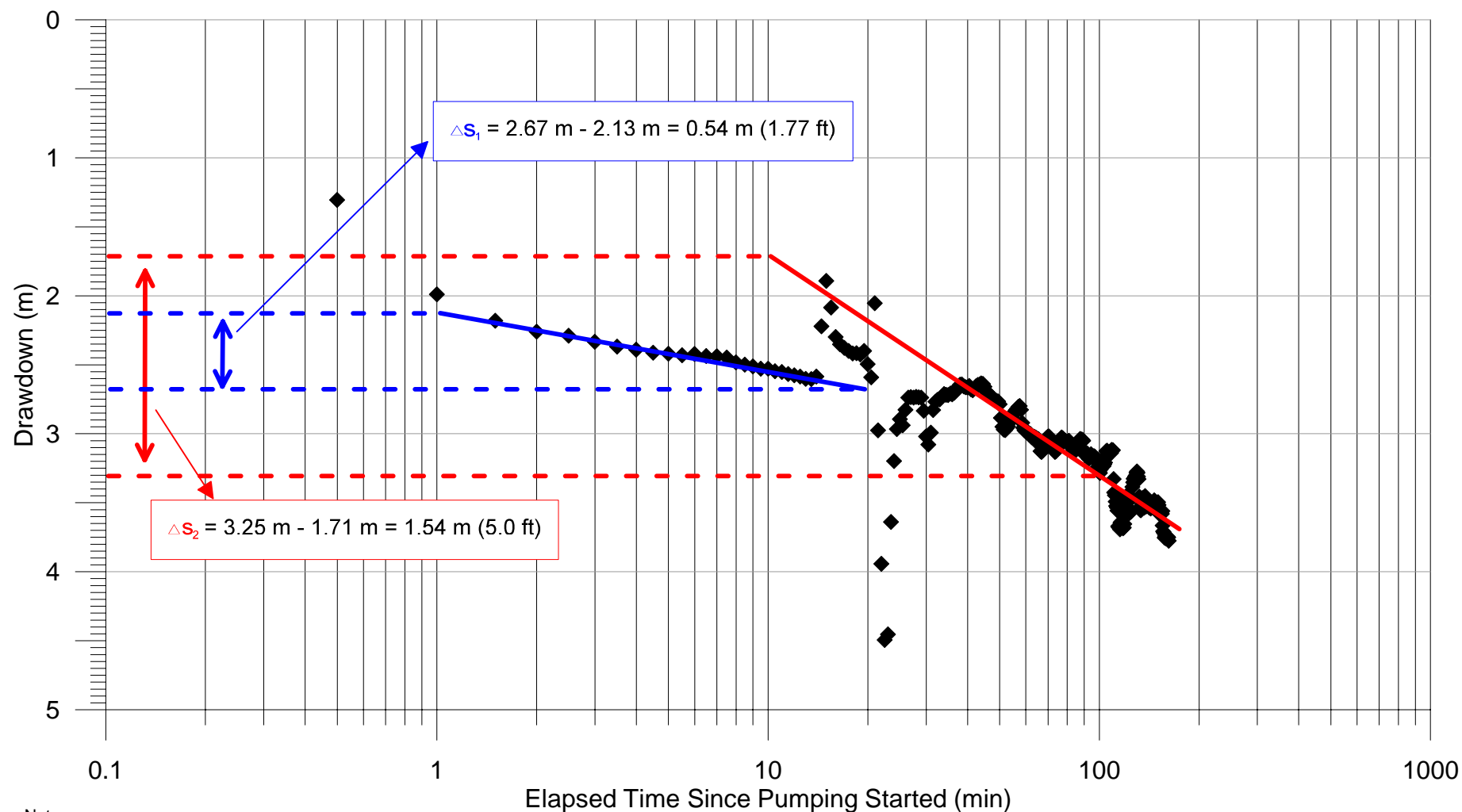
$$T = (0.183)(Q)/\Delta s$$

$Q_2 = 675.9 \text{ m}^3/\text{day} (124 \text{ USgpm})$

$\Delta S_2 = 4.75 \text{ m} (15.5 \text{ ft})$

$T_2 = 26 \text{ m}^2/\text{day} (2,100 \text{ gpd/ft})$

0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO.	YYMM/DD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT PUMPING AT PW26-LM-01 TIME VS DRAWDOWN OBSERVATION AT PW26-LM-01				
MARCH 2026		FIGURE LM-02		REV: 0



Notes:

Date of Test: January 28, 2026
Pumping Well: PW26-LM-01
Observation: MW26-LM-01 (3.5 m E of PW26-LM-01)
Drawdown: 3.78 m
Pumping Rate (Q): 675.9 m³/day (124 USgpm)

◆ Drawdown at MW26-LM-01

Transmissivity

$$T = (0.183)(Q)/\Delta s$$

$Q_1 = 545 \text{ m}^3/\text{day} (100 \text{ USgpm})$

$\Delta s_1 = 0.54 \text{ m} (1.77 \text{ ft})$

$T_1 = 185 \text{ m}^2/\text{day} (14,900 \text{ gpd/ft})$


Transmissivity

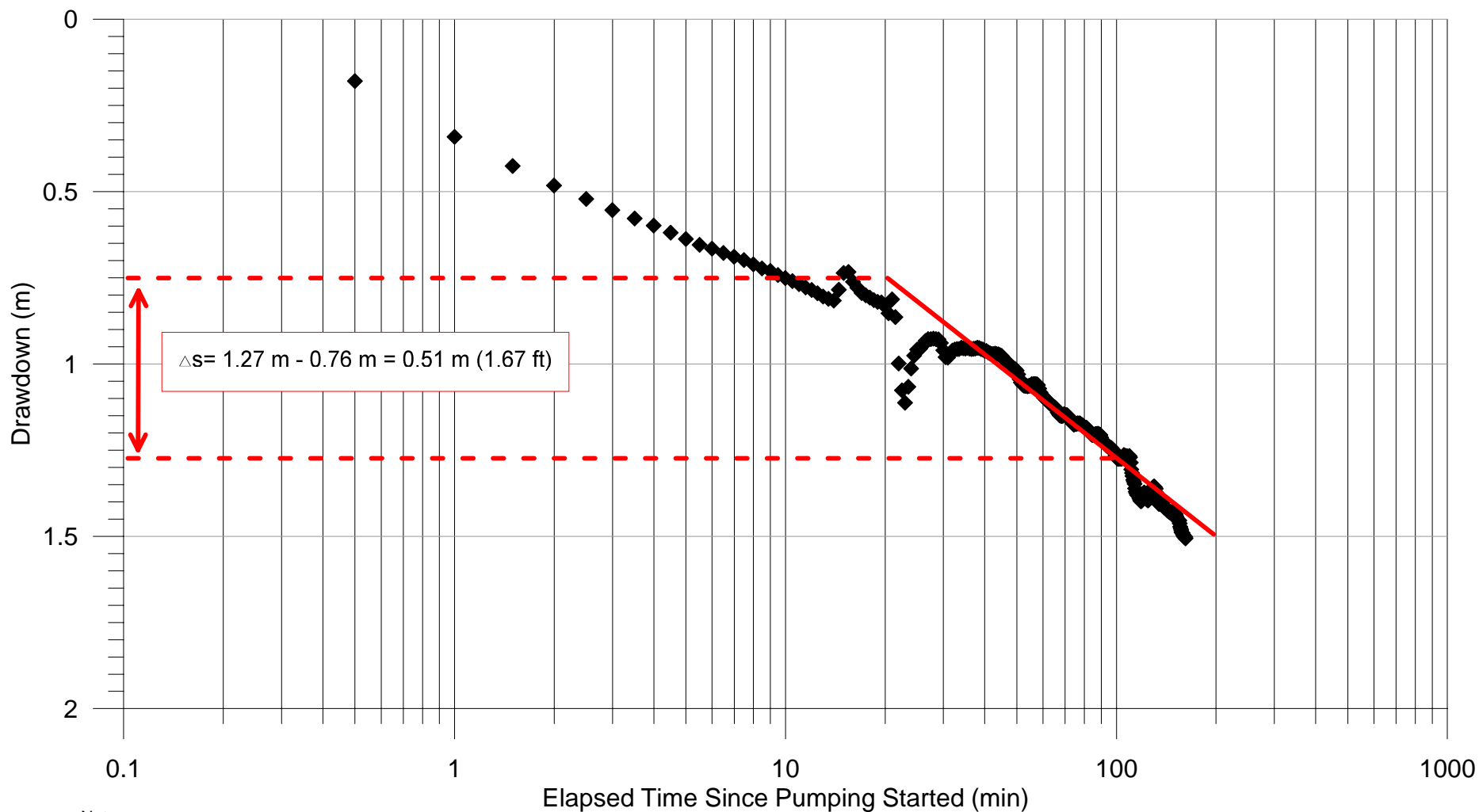
$$T = (0.183)(Q)/\Delta s$$

$Q_2 = 675.9 \text{ m}^3/\text{day} (124 \text{ USgpm})$

$\Delta s_2 = 1.54 \text{ m} (5.0 \text{ ft})$

$T_2 = 80.3 \text{ m}^2/\text{day} (6,500 \text{ gpd/ft})$

0	26/03/12	ISSUED WITH FINAL REPORT	PJL	JDM
NO.	YYMMDD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
<div>KGS GROUP</div>		<div></div>		
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-LM-01 TIME VS DRAWDOWN OBSERVATION AT MW26-LM-01				
MARCH 2026		FIGURE LM-03		REV: 0





Notes:

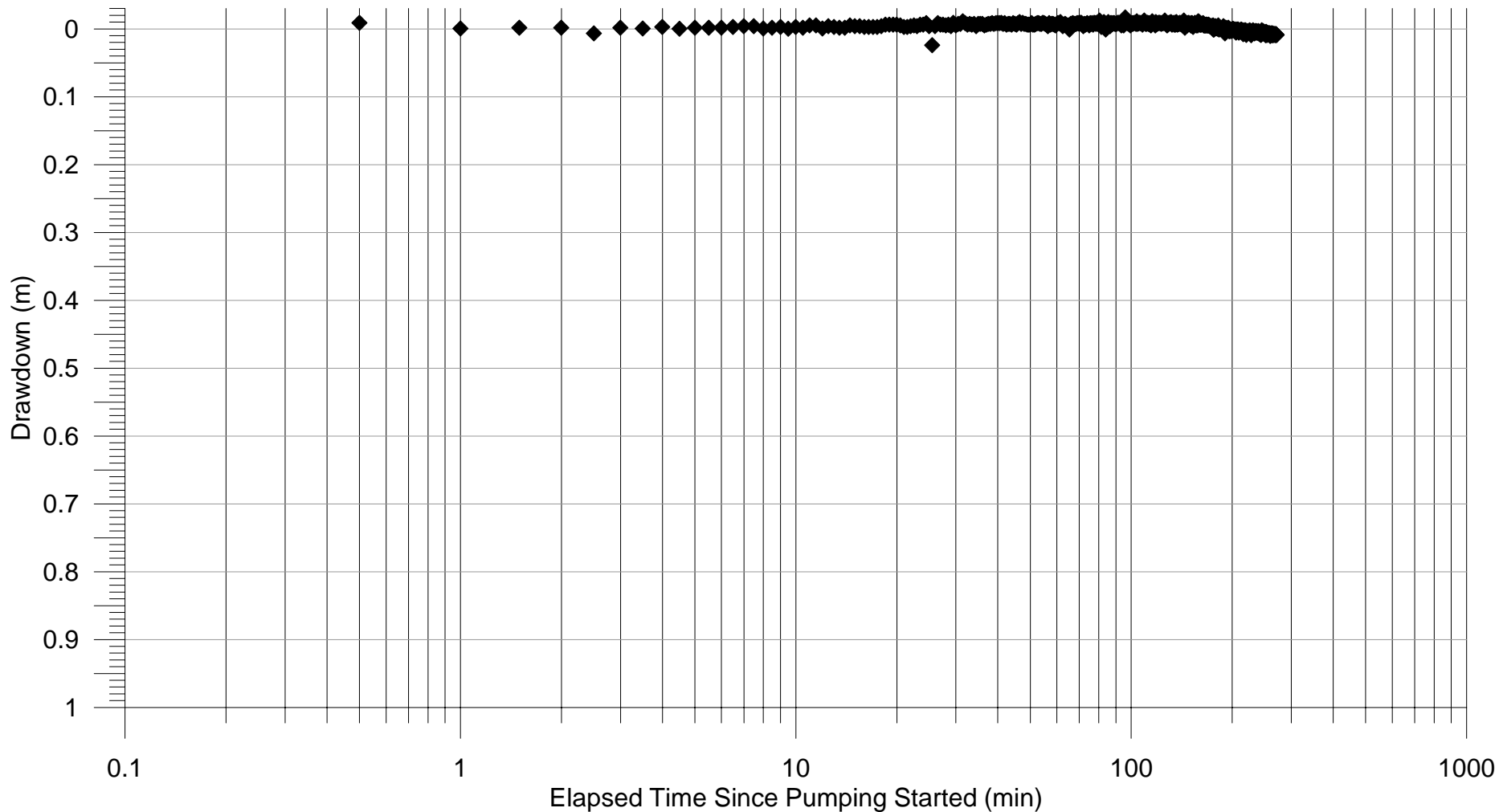
Date of Test: January 28, 2026
Pumping Well: PW26-LM-01
Observation: MW26-LM-02 (29.0 m E of PW26-LM-01)
Drawdown: 1.50 m
Pumping Rate (Q): 675.9 m³/day (124 USgpm)

Transmissivity

$$T = (0.183)(Q)/\Delta s \quad Q = 675.9 \text{ m}^3/\text{day} (124 \text{ USgpm})$$



$$\Delta s = 0.51 \text{ m} (1.67 \text{ ft}) \quad T = 242.53 \text{ m}^2/\text{day} (19,500 \text{ gpd/ft})$$

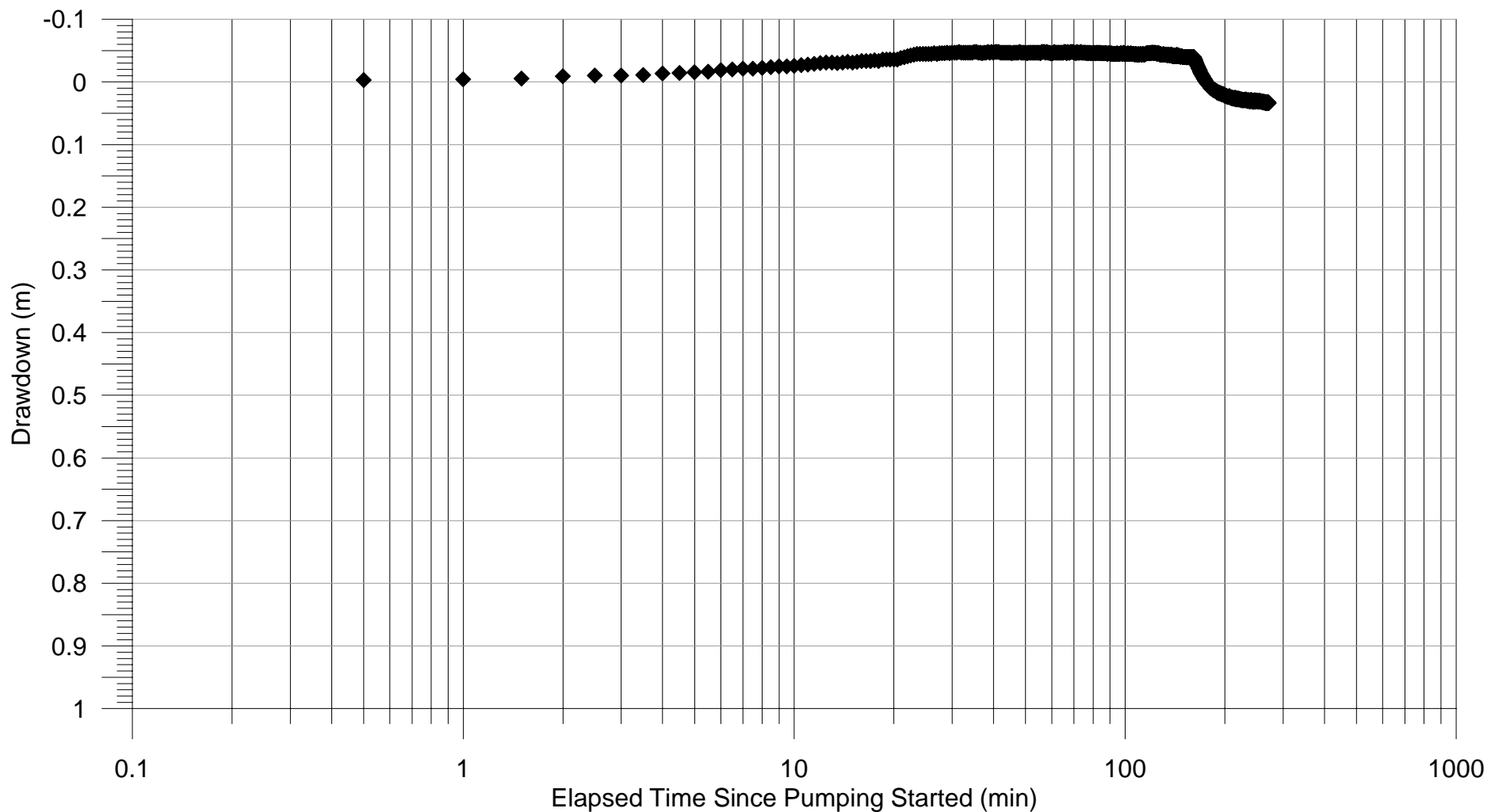
0	26/02/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO.	YYMMDD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-LM-01 TIME VS DRAWDOWN OBSERVATION AT MW26-LM-02				
MARCH 2026		FIGURE LM-04		REV: 0



Notes:



Date of Test: January 28, 2026
Pumping Well: PW26-LM-01
Observation Well: TH25-04 - VW202425 Clay (7.5 m S of PW26-LM-01)
Drawdown: -0.005 m
Pumping Rate (Q): 675.9 m³/day (124 USgpm)

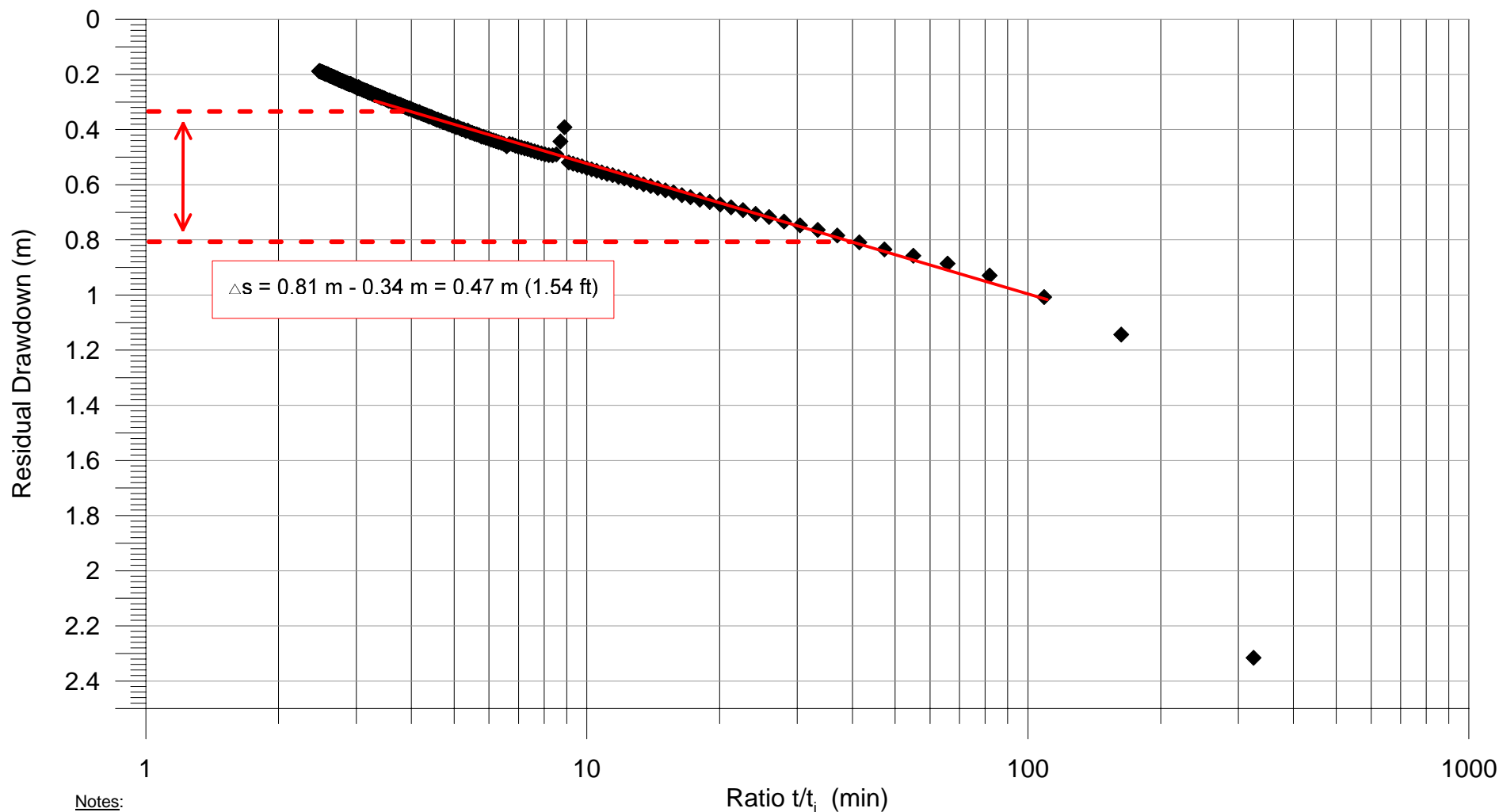
0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L	JDM			
NO	YYMM/DD	DESCRIPTION	Design By	Design Check			
REVISIONS / ISSUE							
							
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT							
PUMPING AT PW26-LM-01 TIME VS DRAWDOWN OBSERVATION AT TH25-04 - VW202425 Clay							
MARCH 2026		FIGURE LM-05		REV: 0			



Notes:

Date of Test: January 28, 2026
Pumping Well: PW26-LM-01
Observation Well: TH25-04 - VW202480 Till (7.5 m S of PW26-LM-01)
Drawdown: -0.035 m
Pumping Rate (Q): 675.9 m³/day (124 USgpm)

0	26/03/12	ISSUED WITH FINAL REPORT		P.J.L.	J.D.M.	
NO.	YYMMDD	DESCRIPTION			Design By	Design Check
REVISIONS / ISSUE						
						
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT						
PUMPING AT PW26-LM-01 TIME VS DRAWDOWN OBSERVATION AT TH25-04 - VW202480 Till						
MARCH 2026		FIGURE LM-06			REV: 0	



Notes:



Date of Test: January 28, 2026
Pumping Well: PW26-LM-01
Observation Well: PW26-LM-01
Drawdown: 9.42 m
Pumping Rate (Q): 675.9 m³/day (124 USgpm)

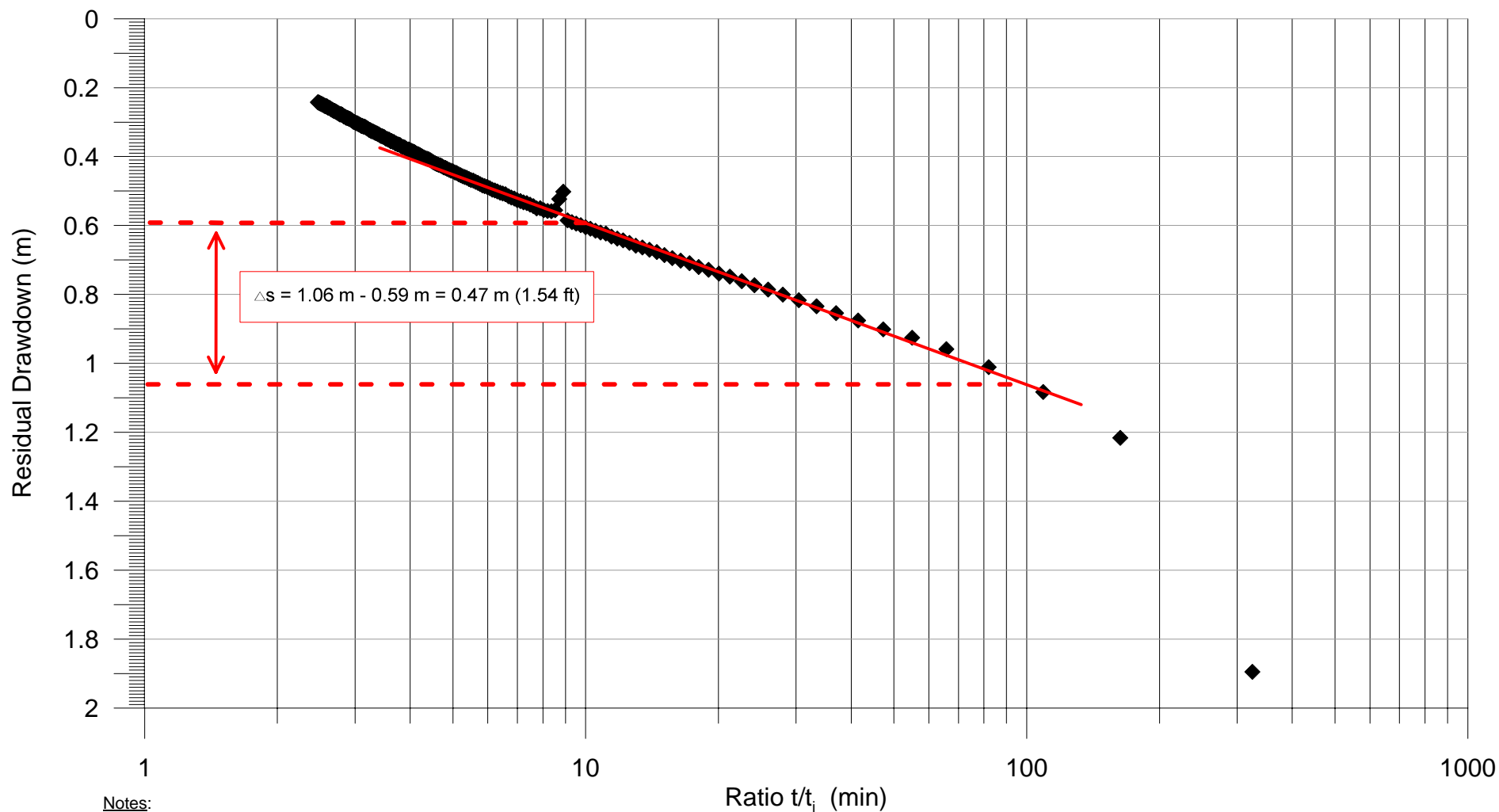
Transmissivity

$$T = (0.183)(Q)/\Delta s \quad Q = 675.9 \text{ m}^3/\text{day} (124 \text{ USgpm})$$

$$\Delta s = 0.47 \text{ m} (1.54 \text{ ft}) \quad T = 263.1 \text{ m}^2/\text{day} (21,000 \text{ gpd/ft})$$

◆ Residual Drawdown at PW26-LM-01

0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
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REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-LM-01 RESIDUAL DRAWDOWN OBSERVATION AT PW26-LM-01				
MARCH 2026		FIGURE LM-07		REV: 0



Notes:




Date of Test: January 28, 2026
Pumping Well: PW26-LM-01
Observation Well: MW26-LM-01 (3.5 m E of PW26-LM-01)
Drawdown: 3.77 m
Pumping Rate (Q): 675.9 m³/day (124 USgpm)

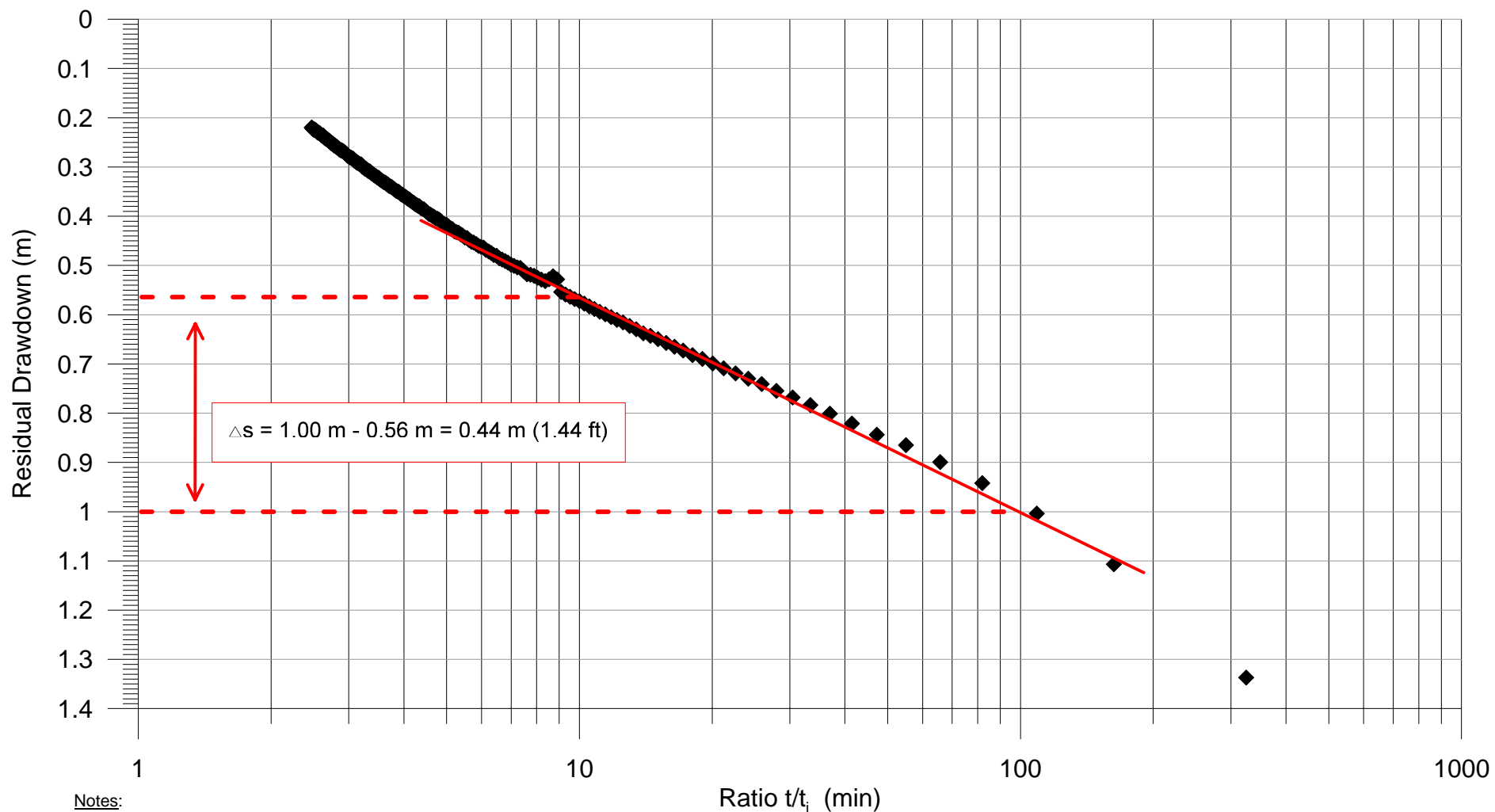
Transmissivity

$$T = (0.183)(Q)/\Delta s \quad Q = 675.9 \text{ m}^3/\text{day} (124 \text{ USgpm})$$

$$\Delta s = 0.47 \text{ m} (1.54 \text{ ft}) \quad T = 263 \text{ m}^2/\text{day} (21,100 \text{ gpd/ft})$$

◆ Residual Drawdown at MW26-LM-01

	0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
	NO.	YYMMDD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE					
					
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT					
PUMPING AT PW26-LM-01 RESIDUAL DRAWDOWN OBSERVATION AT MW26-LM-01					
MARCH 2026			FIGURE LM-08		REV: 0



Notes:


Date of Test: January 28, 2026
Pumping Well: PW26-LM-01
Observation Well: MW26-LM-02 (29.0 m E of PW26-LM-01)
Drawdown: 1.50 m
Pumping Rate (Q): 675.9 m³/day (124 USgpm)



Transmissivity

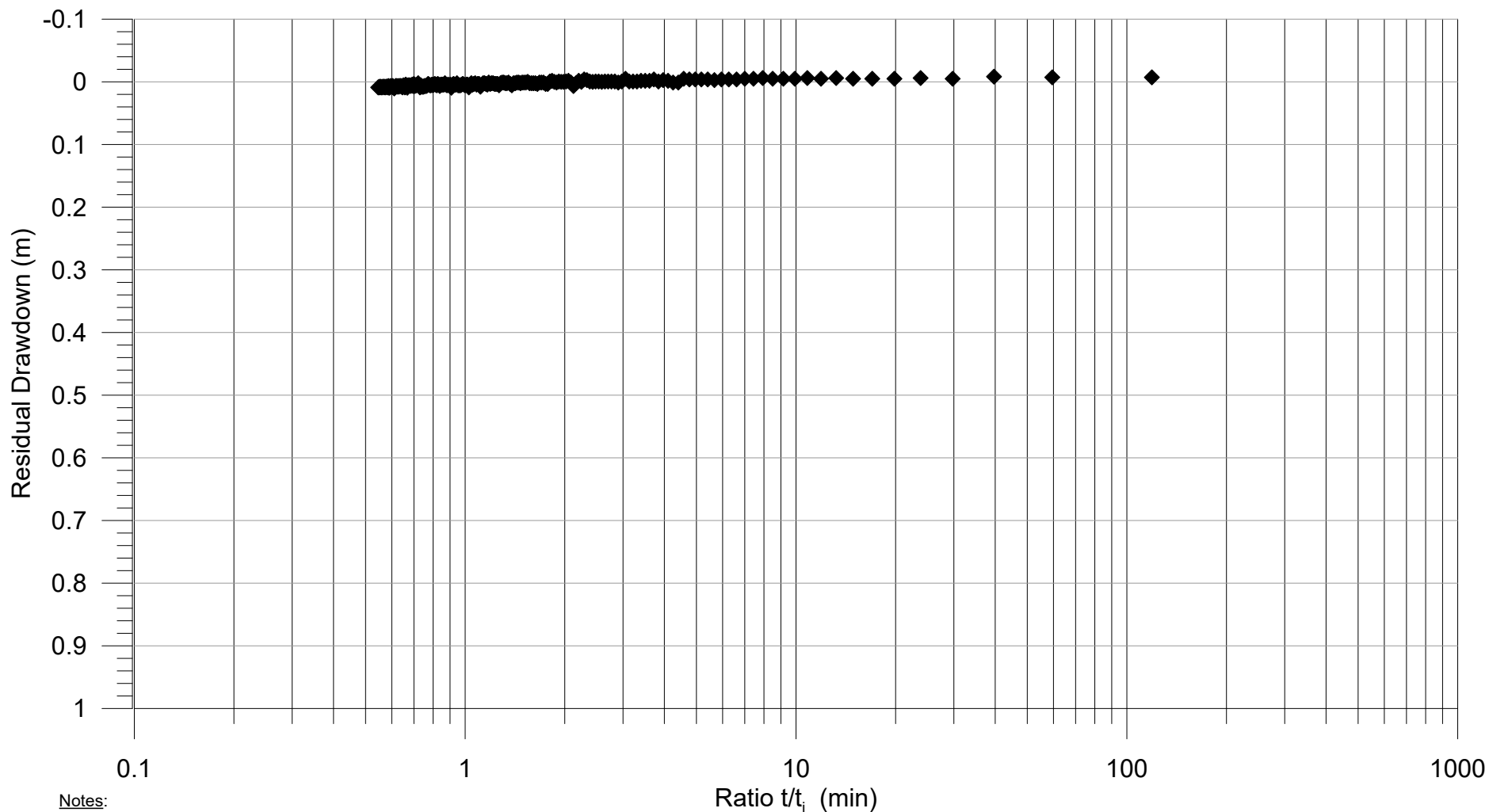
$$T = (0.183)(Q)/\Delta s \quad Q = 675.9 \text{ m}^3/\text{day} (124 \text{ USgpm})$$

$$\Delta s = 0.44 \text{ m} (1.44 \text{ ft}) \quad T = 281 \text{ m}^2/\text{day} (22,600 \text{ gpd/ft})$$

◆ Residual Drawdown at MW26-LM-02





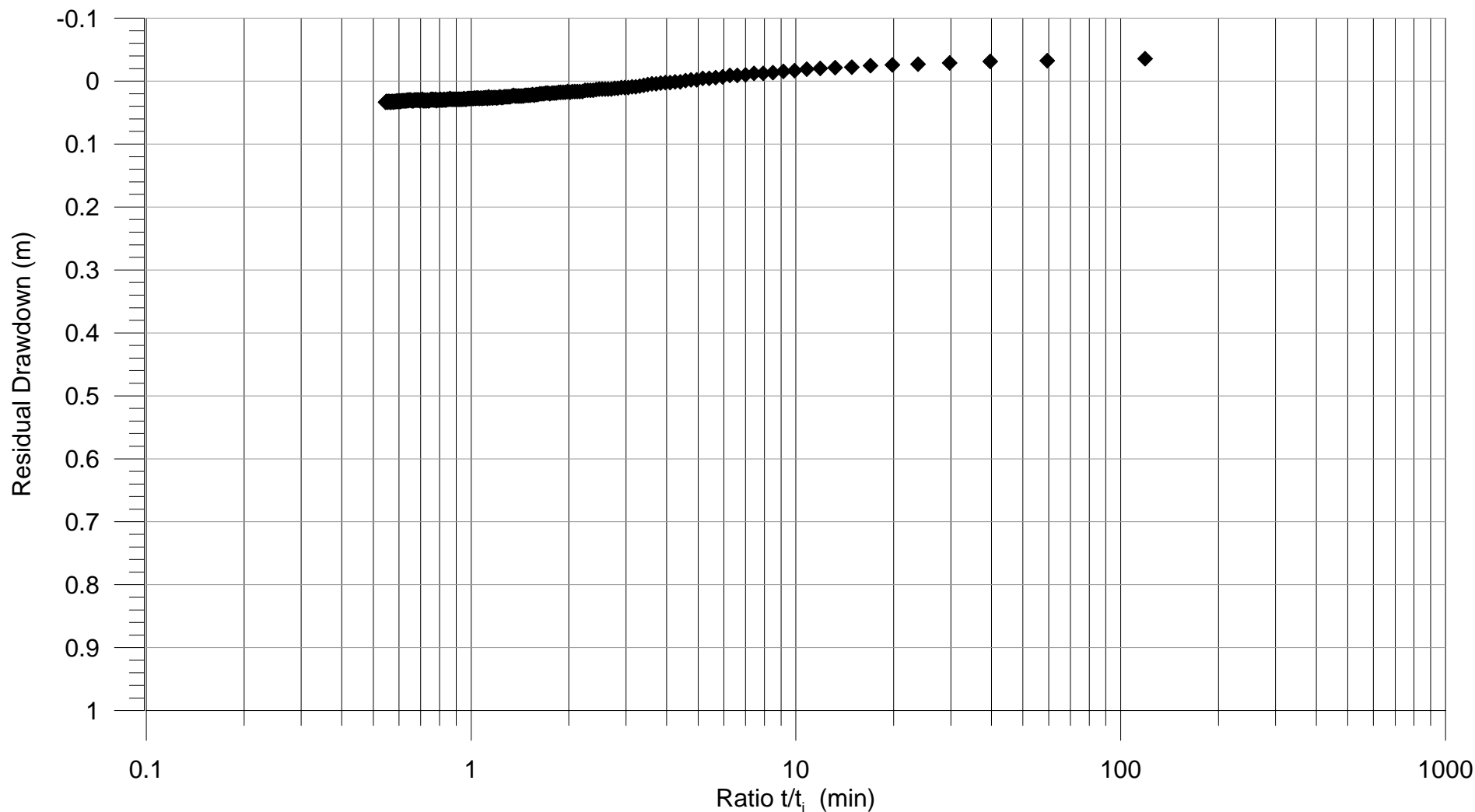
O	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO.	YYMMDD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT PUMPING AT PW26-LM-01 RESIDUAL DRAWDOWN OBSERVATION AT MW26-LM-02				
MARCH 2026		FIGURE LM-09		REV: 0



Notes:



Date of Test: January 28, 2026
Pumping Well: PW26-LM-01
Observation Well: TH25-04 - VW202425 Clay (7.5 m S of PW26-LM-01)
Drawdown: -0.005 m
Pumping Rate (Q): 675.9 m³/day (124 USgpm)

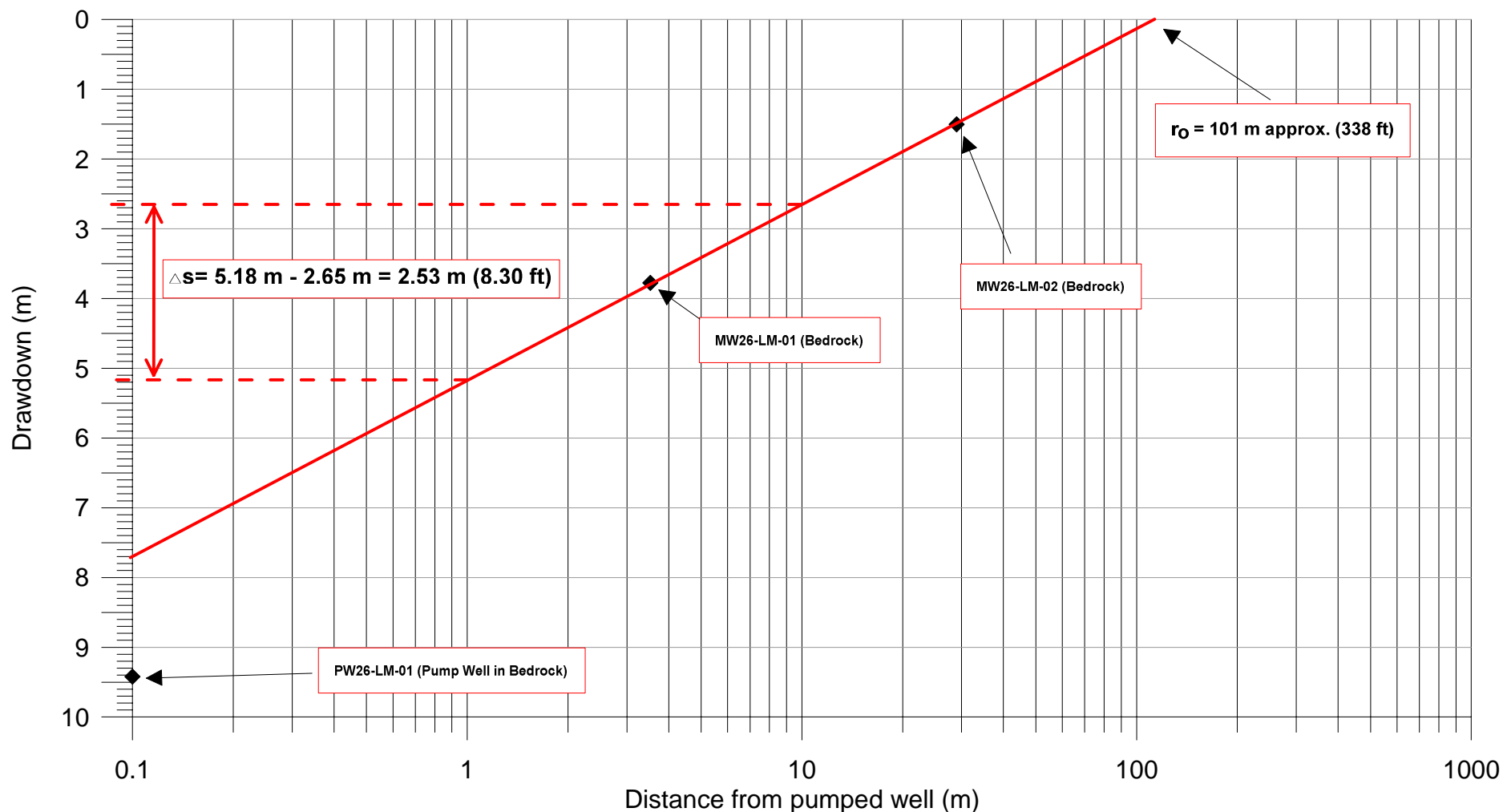
0	26/03/12	ISSUED WITH FINAL REPORT		P.J.L.	J.D.M.
NO.	YYMMDD	DESCRIPTION		Design By	Design Check
REVISIONS / ISSUE					
					
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT					
PUMPING AT PW26-LM-01 RESIDUAL DRAWDOWN OBSERVATION AT TH25-04 - VW202425 Clay					
MARCH 2026		FIGURE LM-10		REV:	0






Notes:

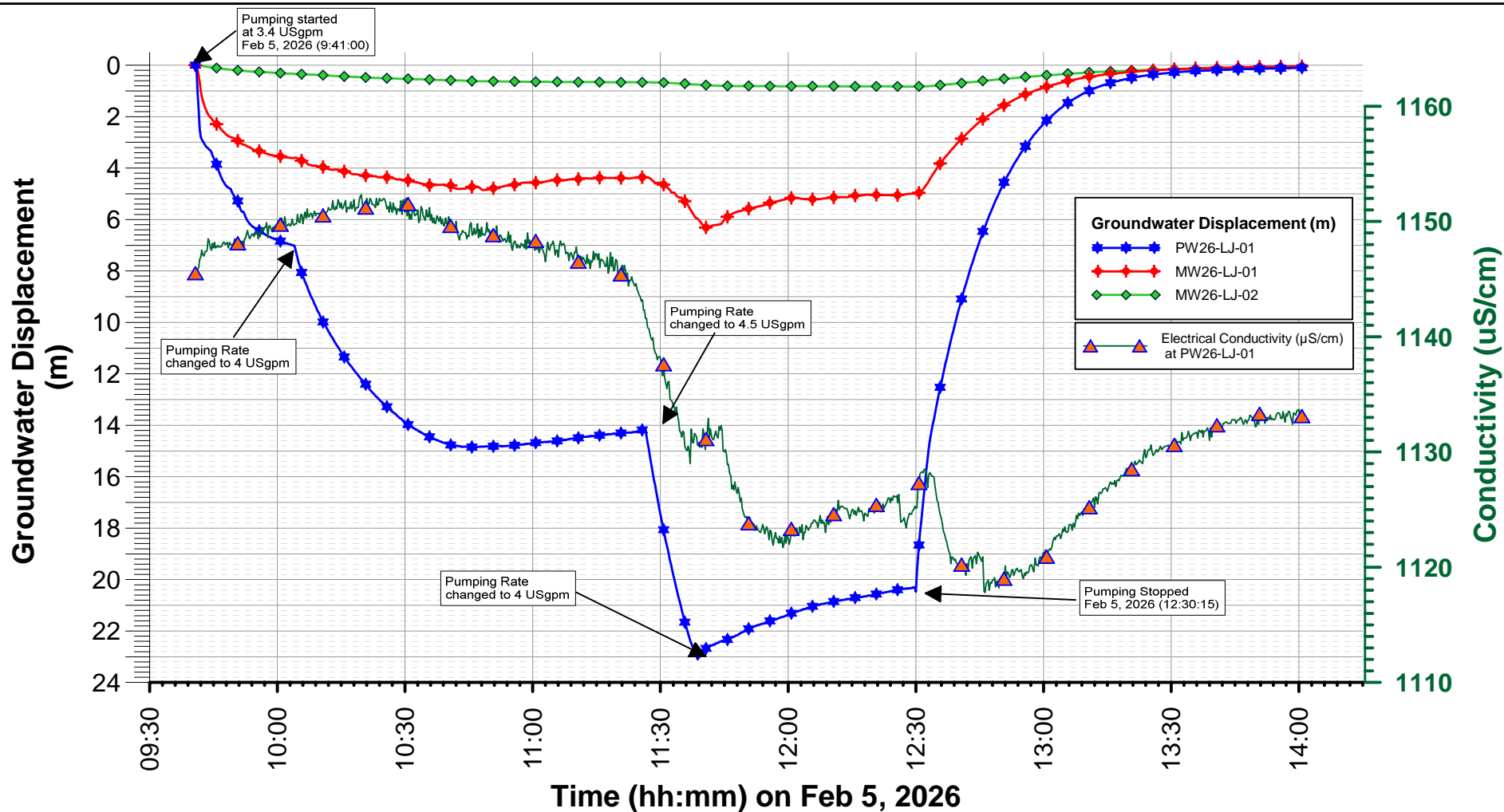
Date of Test: January 28, 2026
Pumping Well: PW26-LM-01
Observation Well: TH25-04 - VW202480 Till (7.5 m S of PW26-LM-01)
Drawdown: -0.035 m
Pumping Rate (Q): 675.9 m³/day (124 USgpm)

	0	26/03/12	ISSUED WITH FINAL REPORT		P.J.L.	J.D.M.
NO.	YYMMDD		DESCRIPTION		Design By	Design Check
REVISIONS / ISSUE						
						
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT PUMPING AT PW26-LM-01 RESIDUAL DRAWDOWN OBSERVATION AT TH25-04 - VW202480 Till						
MARCH 2026			FIGURE LM-11		REV:	0








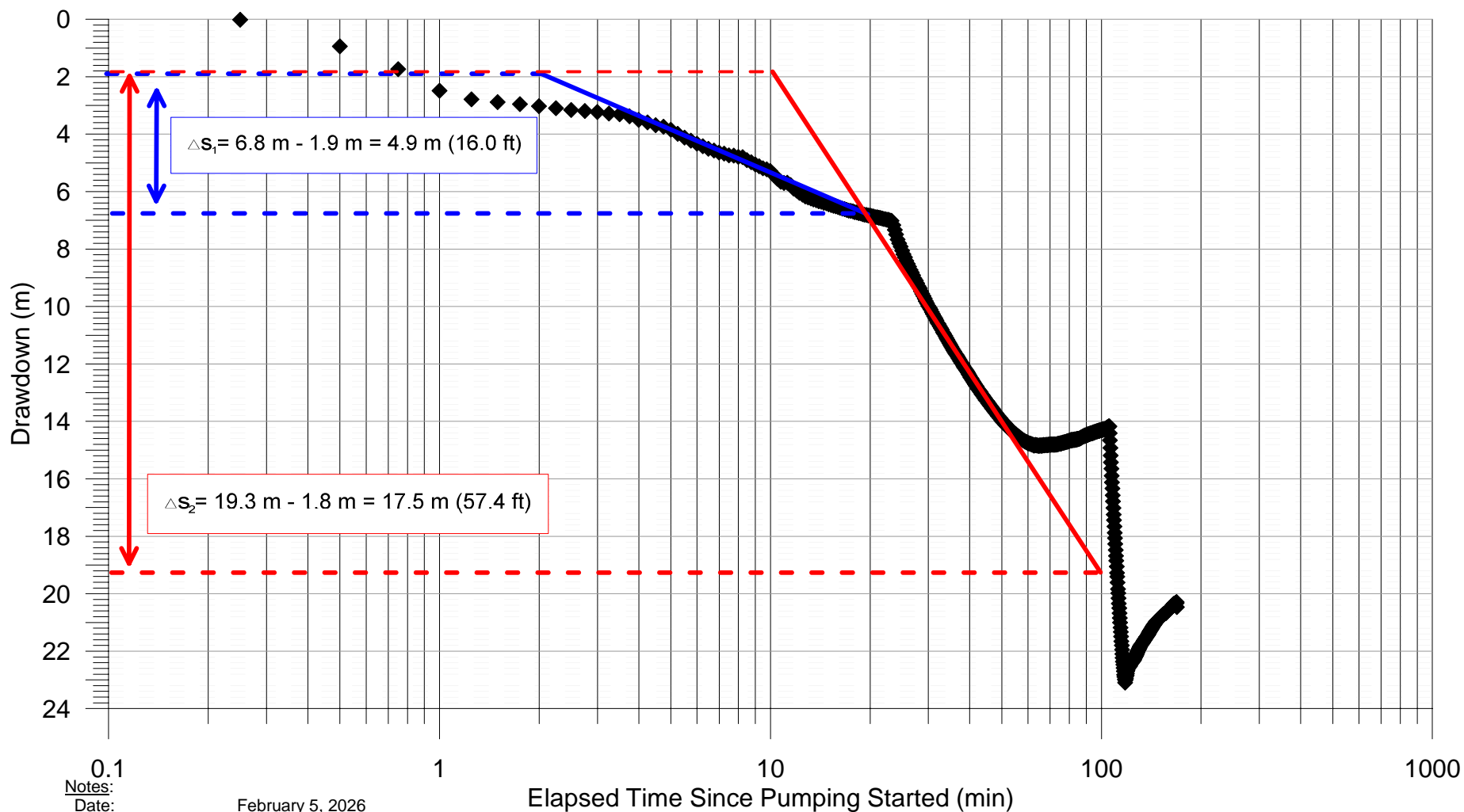
O	26/03/12	ISSUED WITH FINAL REPORT	P.JL	J.DI
NO.	YYMMDD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMP TEST AT PW26-LM-01 DISTANCE DRAWDOWN				
MARCH 2026		FIGURE LM-12		REV: 0



Notes:

Date	February 5, 2026
Pumping Well	PW26-LJ-01
Observation Wells	MW26-LJ-01 (2.8 m N of pumping well) MW26-LJ-02 (31.2 m N of pumping well)
PW26-LJ-01: Drawdown - Maximum	23.099 m
PW26-LJ-01: Drawdown prior to pump shutoff	20.468 m
MW26-LJ-01: Drawdown - Maximum	6.318 m
MW26-LJ-01: Drawdown prior to pump shutoff	4.995 m
MW26-LJ-02: Maximum drawdown at pump shutoff	0.828 m
Pumping Rates (Q)	3.4 US gpm - 9:40 am to 10:04 am 4.0 US gpm - 10:04 am to 11:26 am 4.5 US gpm - 11:26 am to 11:39 am 4.0 US gpm - 11:39 am to 12:30 pm

	0	26/03/12	ISSUED WITH FINAL REPORT		P.J.L	J.D.
	NO.	YY/MM/DD	DESCRIPTION		DESIGN BY	DESIGN CHECK
REVISIONS / ISSUE						
						
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT						
WESTERN (ZONE 1) SITE PUMPING TEST AT LEILA/JACK DONNER SITE DRAWDOWN HYDROGRAPHS						
MARCH 2026			FIGURE LJ-01		REV: 0	



Notes:

Date: February 5, 2026
 Pumping Well: PW26-LJ-01
 Observation: PW26-LJ-01
 Drawdown: 20.47 m
 Pumping Rate, Q_1 : 20.7 m³/day (3.8 USgpm)
 Pumping Rate, Q_2 : 21.8 m³/day (4.0 USgpm)



Transmissivity, $T = (0.183)(Q)/\Delta s$

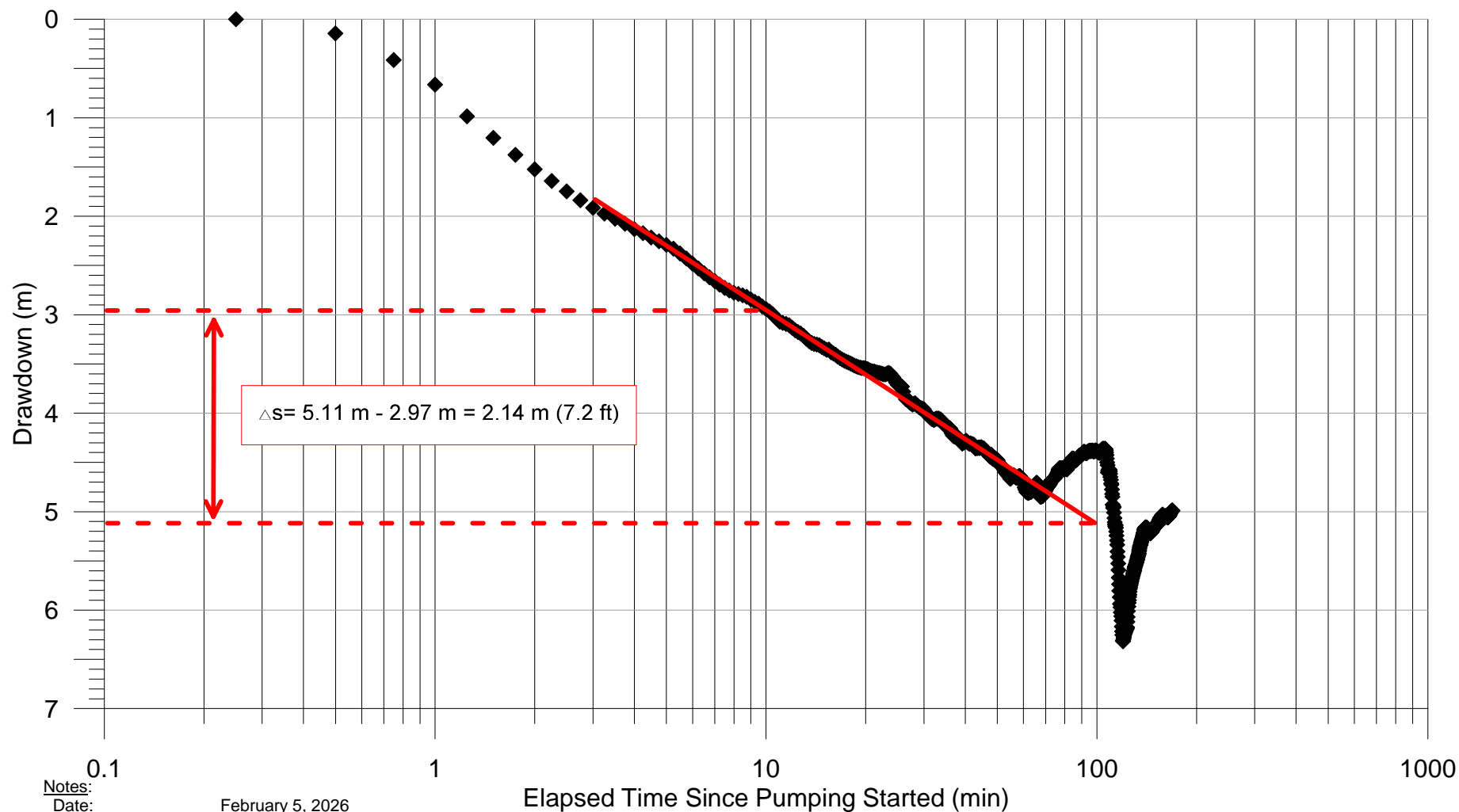
$Q_1 = 20.7 \text{ m}^3/\text{day} (3.8 \text{ USgpm})$

$\Delta s_1 = 4.9 \text{ m} (16.0 \text{ ft})$ $T_1 = 0.77 \text{ m}^2/\text{day} (62 \text{ gpd/ft})$

$Q_2 = 21.8 \text{ m}^3/\text{day} (4.0 \text{ USgpm})$

$\Delta s_2 = 17.5 \text{ m} (57.4 \text{ ft})$ $T_2 = 0.23 \text{ m}^2/\text{day} (18 \text{ gpd/ft})$

0	26/03/12	ISSUED WITH FINAL REPORT		P.J.L.	J.D.M.
NO	YYMM/DD	DESCRIPTION		Design By	Design Check
REVISIONS / ISSUE					
					
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT					
PUMPING AT PW26-LJ-01 TIME VS DRAWDOWN OBSERVATION AT PW26-LJ-01					
MARCH 2026		FIGURE LJ-02		REV:	0





Notes:

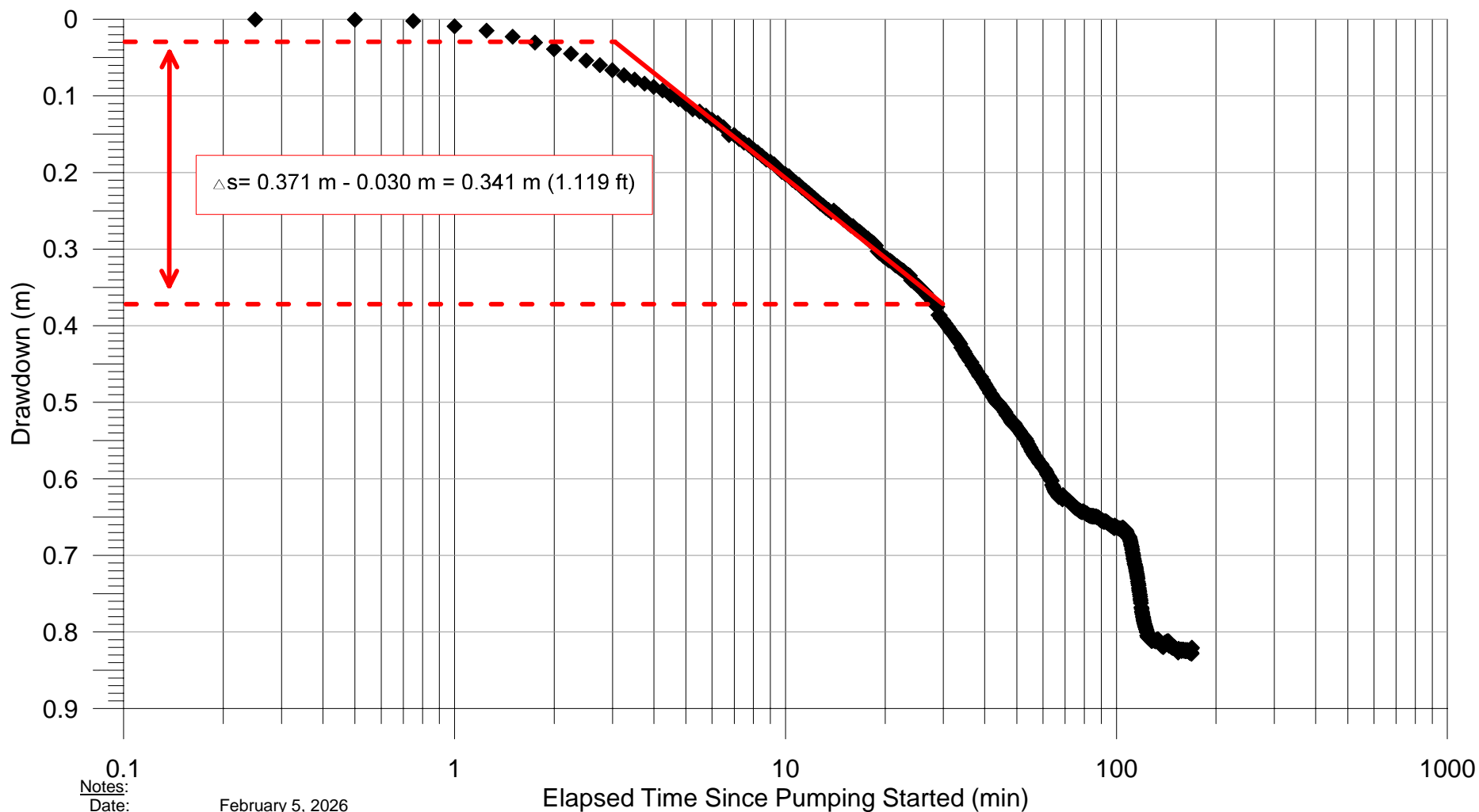
Date: February 5, 2026
Pumping Well: PW26-LJ-01
Observation: MW26-LJ-01 (2.8 m N of pumping well)
Drawdown: 4.99 m
Pumping Rate (Q_2): 21.8 m³/day (4.0 USgpm)

Transmissivity

$T = (0.183)(Q)/\Delta s$ $Q = 21.8 \text{ m}^3/\text{day} (4.0 \text{ USgpm})$

$\Delta s = 2.14 \text{ m} (7.2 \text{ ft})$ $T = 1.8 \text{ m}^2/\text{day} (146 \text{ gpd/ft})$

0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO.	YYMMDD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-LJ-01 TIME VS DRAWDOWN OBSERVATION AT MW26-LJ-01				
MARCH 2026		FIGURE LJ-03		REV: 0





Notes:

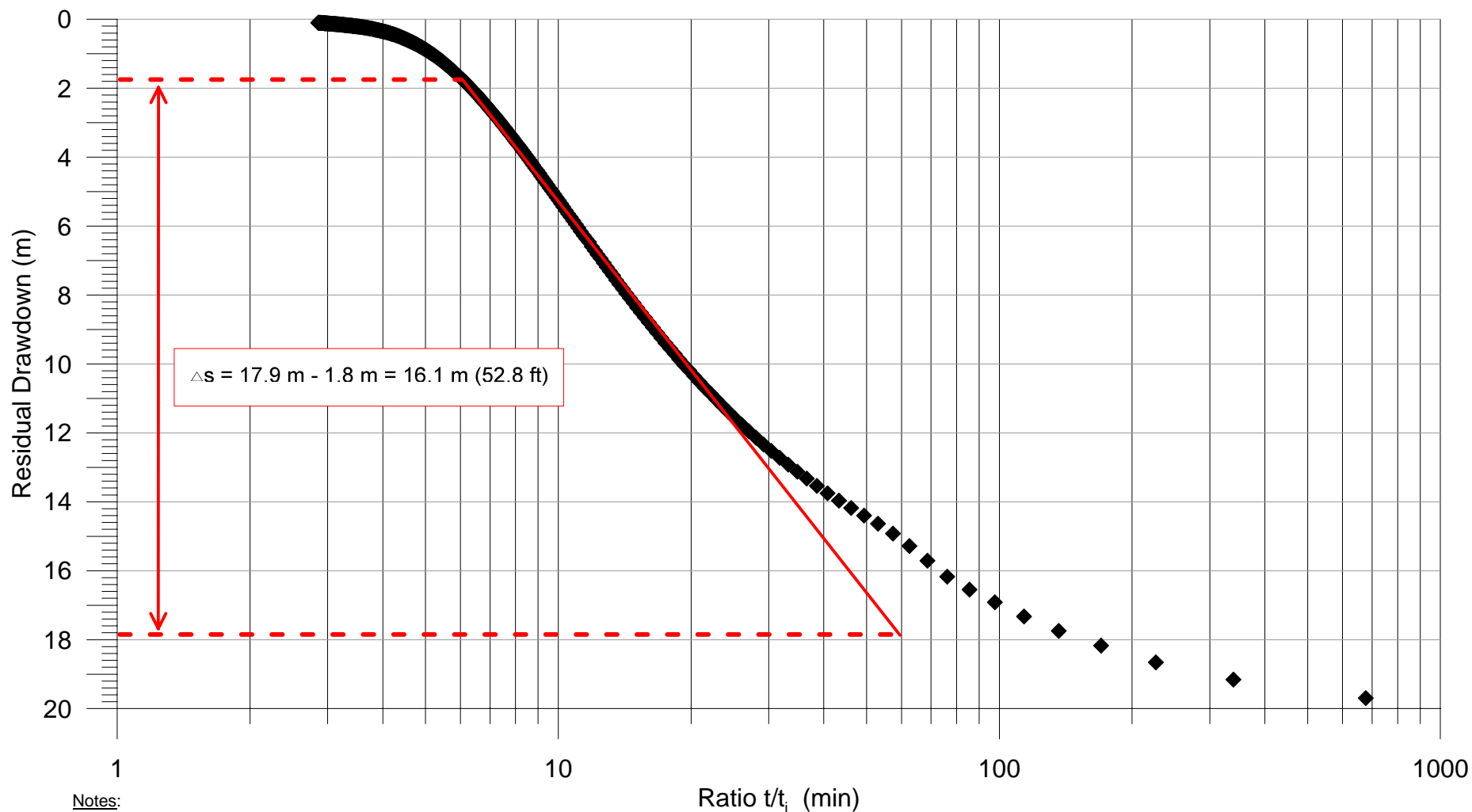
Date: February 5, 2026
Pumping Well: PW26-LJ-01
Observation: MW26-LJ-02 (31.2 m N of pumping well)
Drawdown: 0.82 m
Pump Rate (Q): 21.8 m³/day (4.0 USgpm)

Transmissivity

$T = (0.183)(Q)/\Delta s$ $Q = 21.8 \text{ m}^3/\text{day (4.0 USgpm)}$

$\Delta s = 0.341 \text{ m (1.12 ft)}$ $T = 11.70 \text{ m}^2/\text{day (940 gpd/ft)}$

0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO.	YYMMDD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-LJ-01 TIME VS DRAWDOWN OBSERVATION AT MW26-LJ-02				
MARCH 2026		FIGURE LJ-04		REV: 0





Notes:

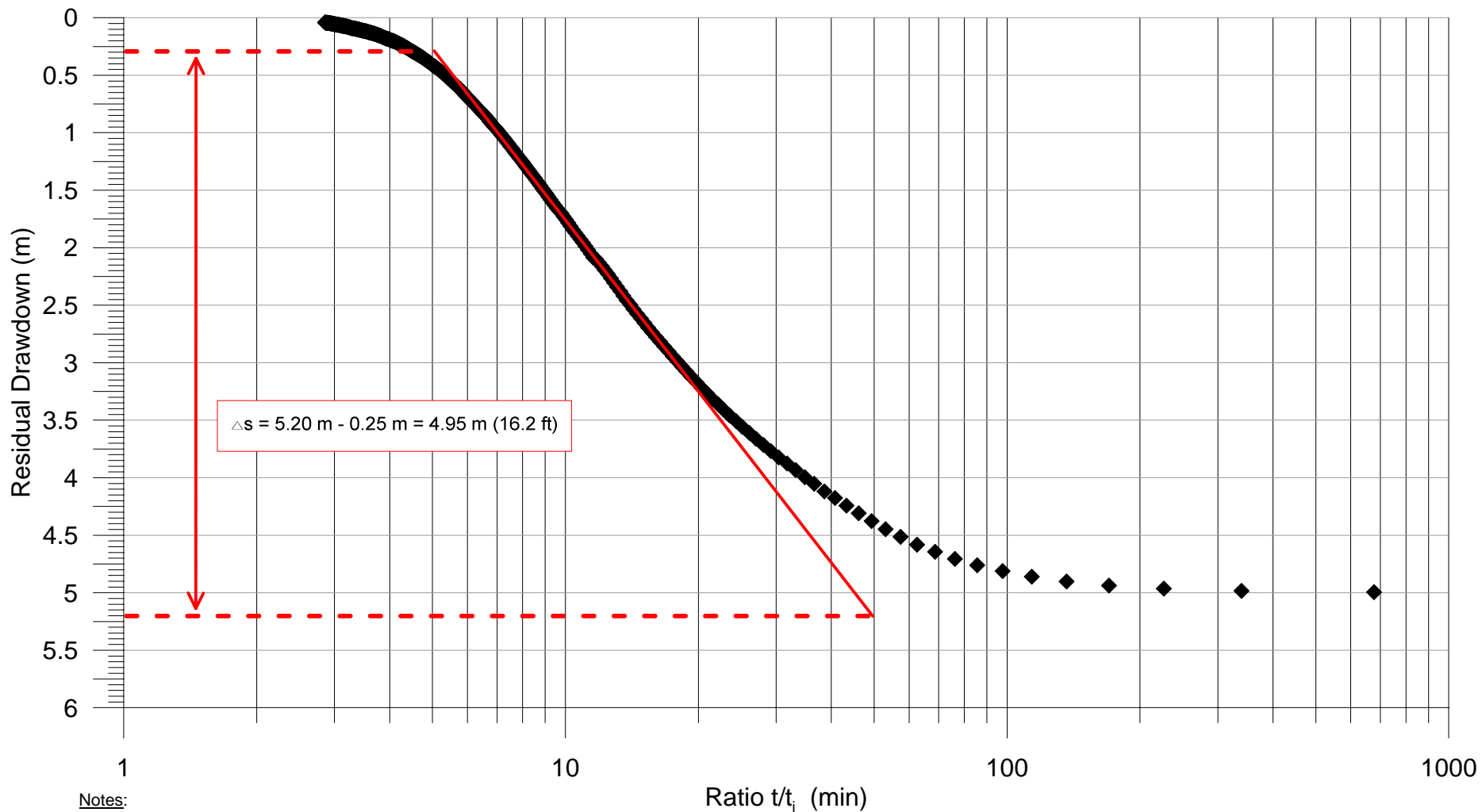
Date: February 5, 2026
Pumping Well: PW26-LJ-01
Observation: PW26-LJ-01
Drawdown: 20.47 m
Pumping Rate (Q): 21.8 m³/day (4.0 USgpm)

Transmissivity

$$T = (0.183)(Q)/\Delta s \quad Q = 21.8 \text{ m}^3/\text{day} (4.0 \text{ USgpm})$$

$$\Delta s = 16.10 \text{ m} (52.8 \text{ ft}) \quad T = 0.25 \text{ m}^2/\text{day} (20.0 \text{ gpd/ft})$$

0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO.	YYMM/DD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-LJ-01 RESIDUAL DRAWDOWN OBSERVATION AT PW26-LJ-01				
MARCH 2026		FIGURE LJ-05		REV: 0




Notes:



Date: February 5, 2026
Pumping Well: PW26-LJ-01
Observation: MW26-LJ-01 (2.8 m N of pumping well)
Drawdown: 4.99 m
Pump Rate (Q): 21.8 m³/day (4.0 USgpm)

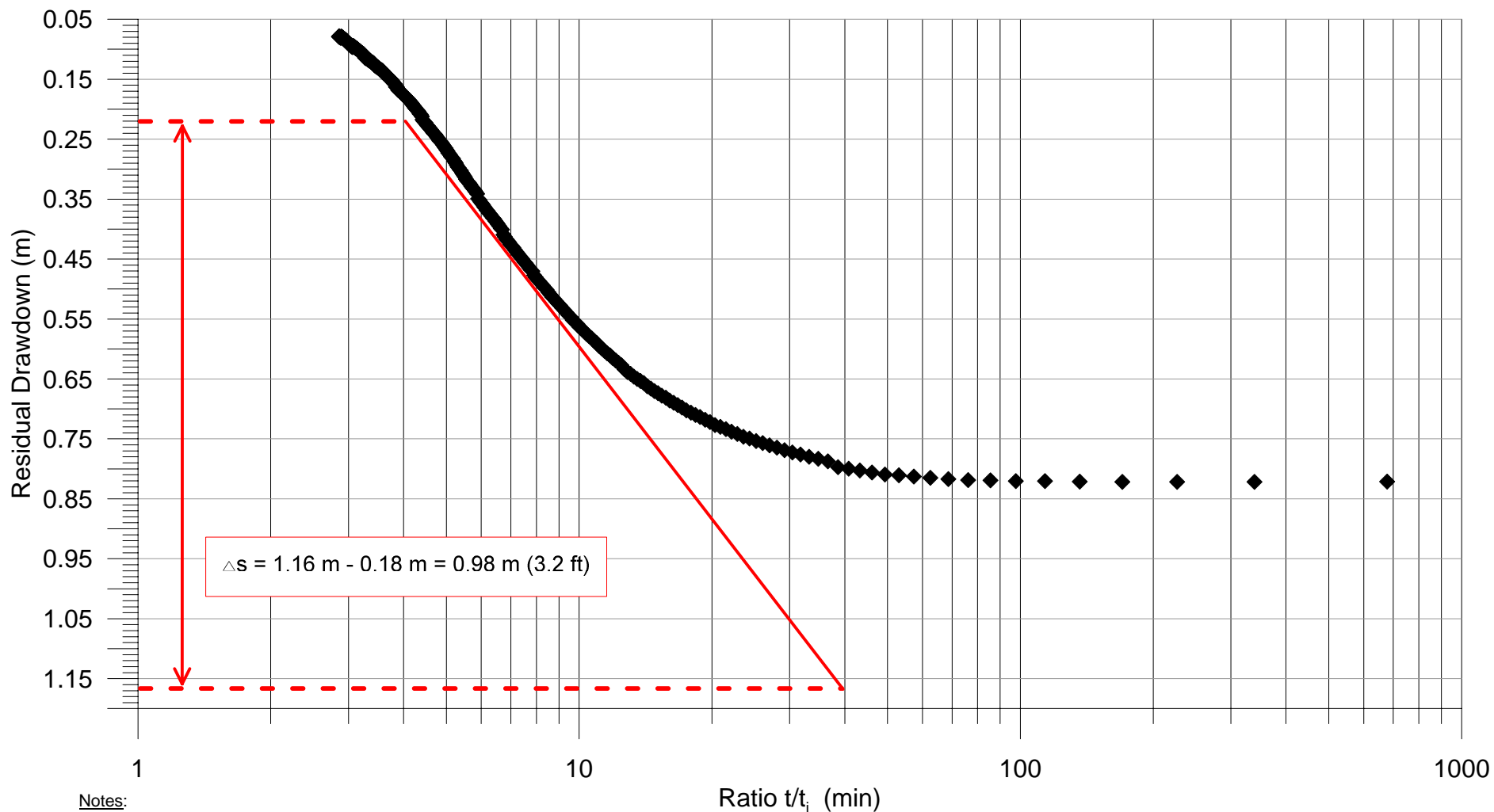
Transmissivity

$$T = (0.183)(Q)/\Delta s \quad Q = 21.8 \text{ m}^3/\text{day} (4.0 \text{ USgpm})$$

$$\Delta s = 4.95 \text{ m} (16.2 \text{ ft}) \quad T = 0.81 \text{ m}^2/\text{day} (65.0 \text{ gpd/ft})$$



0	26/03/12	ISSUED WITH FINAL REPORT	P.J.L.	J.D.M.
NO.	YYMMDD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION INVESTIGATION ARMSTRONG SEWER DISTRICT				
PUMPING AT PW26-LJ-01 RESIDUAL DRAWDOWN OBSERVATION AT MW26-LJ-01				
MARCH 2026		FIGURE LJ-06		REV: 0





Notes:

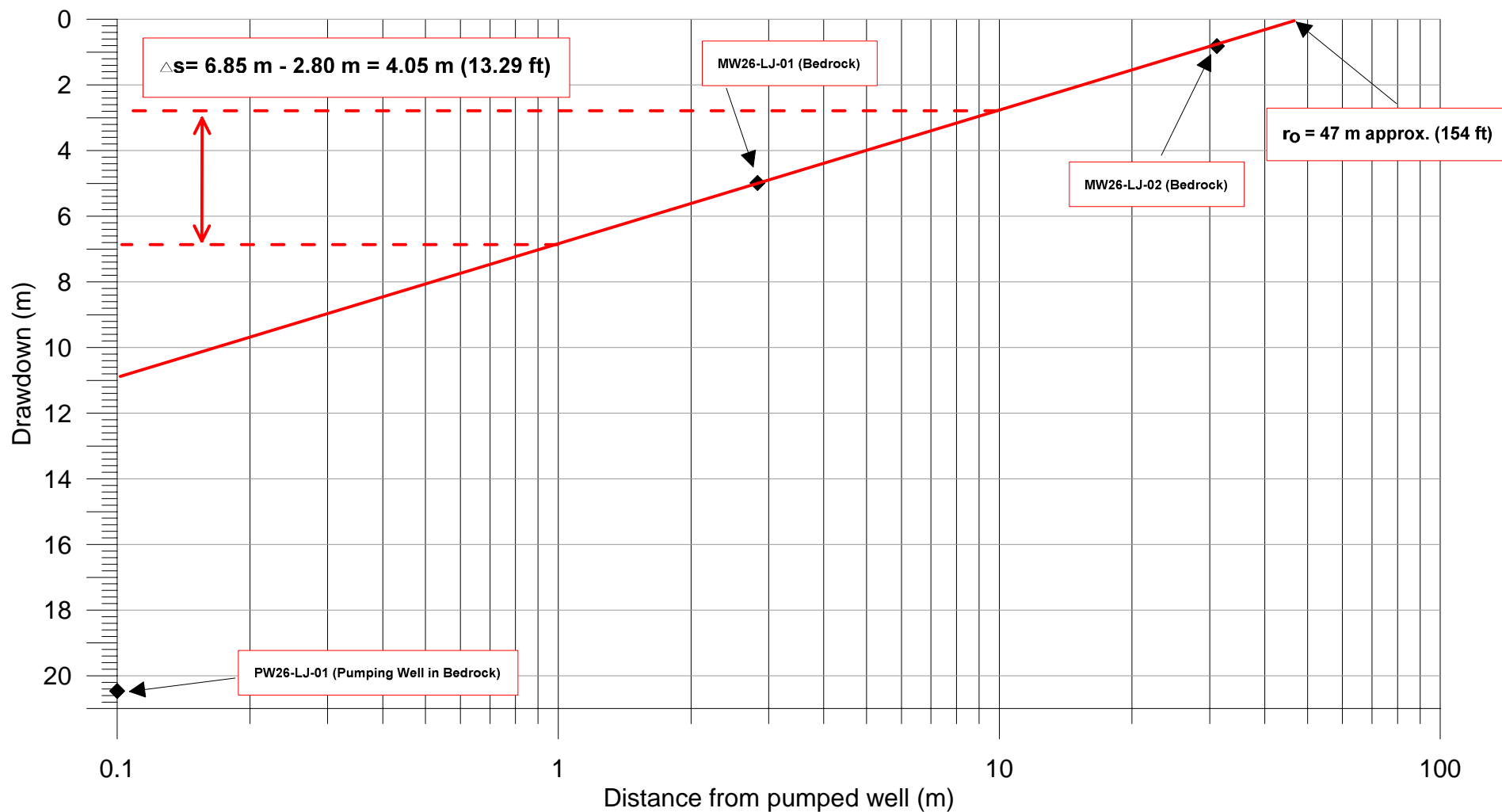
Date: February 5, 2026
Pumping Well: PW26-LJ-01
Observation: MW26-LJ-02 (31.2 m N of pumping well)
Drawdown: 0.82 m
Pumping Rate (Q): 21.8 m³/day (4.0 USgpm)

Transmissivity

$$T = (0.183)(Q)/\Delta s \quad Q = 21.8 \text{ m}^3/\text{day} (4.0 \text{ USgpm})$$

$$\Delta s = 0.98 \text{ m} (3.2 \text{ ft}) \quad T = 4.05 \text{ m}^2/\text{day} (326.1 \text{ gpd/ft})$$

0	26/03/12	ISSUED WITH FINAL REPORT		P.J.L.	J.D.M.
NO	YYMM/DD	DESCRIPTION		Design By	Design Check
REVISIONS / ISSUE					
					
GROUNDWATER DEPRESSURIZATION PROGRAM, ARMSTRONG SEWER DISTRICT					
PUMPING AT PW26-LJ-01 RESIDUAL DRAWDOWN OBSERVATION AT MW26-LJ-02					
MARCH 2026		FIGURE LJ-07			REV: 0



Notes:

Date: February 5, 2026
Pumping Well: PW26-LJ-01
Observation Wells: MW26-LJ-01 (2.8 m N of pumping well) and MW26-LJ-02 (31.2 m N of pumping well)
Drawdown
Pump Rate (Q): 21.8 m³/day (4.0 USgpm)

Transmissivity

$$T = (0.366)(Q)/\Delta s \quad Q = 21.8 \text{ m}^3/\text{day (4.0 USgpm)}$$

$$\Delta s = 4.05 \text{ m (14.1 ft)} \quad T = 1.97 \text{ m}^2/\text{day (160 gpd/ft)}$$

Storativity

$$S = 2.25Tt/r_o^2$$


$$T = 1.97 \text{ m}^2/\text{day}$$



$$r_o = 47 \text{ m}$$

$$t = 0.12 \text{ days (169 min)}$$

$$S = 0.000236$$





O	26/03/12	ISSUED WITH FINAL REPORT	P.J.L	J.D.I
NO.	YYMMDD	DESCRIPTION	Design By	Design Check
REVISIONS / ISSUE				
				
GROUNDWATER DEPRESSURIZATION PROGRAM, ARMSTRONG SEWER DISTRICT				
PUMPING TEST AT PW26-LJ-01 DISTANCE DRAWDOWN PLOT				
MARCH 2026		FIGURE LJ-08		REV: 0

APPENDIX A

Photo Log



Photo 1: Drilling MW26-AM-01 at the Eastern (Zone 3) Site on January 14, 2026



Photo 2: Drilling MW26-AM-02 at the Eastern (Zone 3) Site on January 14, 2026



Photo 3: Pumping Test at Eastern (Zone 3) Site on January 16, 2026



Photo 4: View of MW26-AM-01



Photo 5: View of PW26-AM-01



Photo 6: Discharge Manhole at Eastern (Zone 3) Site



Photo 7: Soft digging with hydrovac at MW26-LM-02 on January 19



Photo 8: Drilling PW26-LM-01 at Middle (Zone 2) Site on January 20, 2026



Photo 9: Drilling MW26-LM-02 at Middle (Zone 2) Site on January 26, 2026



Photo 10: View of MW26-LM-01 (red protective cover) and PW26-LM-01 (black steel stick-up)



Photo 11: Drilling MW26-LM-02 at Middle (Zone 2) Site on January 29, 2026



Photo 13: Discharge Manhole at Western (Zone 1) Site

Photo 12: Pumping Test at Western (Zone 1) Site on February 5. View of PW26-LJ-01 (black casing) and MW26-LJ-01.



Photo 14: View of PW26-LJ-01 and MW26-LJ-01 (stick-up removed and flush-mount cover installed) at Western (Zone 1) Site on February 6, 2026.

APPENDIX B

Discharge Permits



Water and Waste
Eaux et déchets

TEMPORARY OVERLAND DISCHARGE PERMIT

SEWER BY-LAW NO. 106/2018

Permit No: TDP01653

Approved date: Jan 12, 2026

Permit holder:

KONTZAMANIS GRAUMANN SMITH MACMILLAN INC

195 ARMSTRONG AVE, WINNIPEG, MB,
Canada,

This permit certifies that the Permit Holder is authorized to discharge the discharge type identified in this permit (the “Discharge”) into the discharge location identified in this permit (the “Sewer System”), subject to the terms and conditions attached.

Recommended:

A handwritten signature in blue ink, appearing to read 'M. Marsland'.

Meghan Marsland, Industrial Waste Services Branch Head

Approved:

A handwritten signature in blue ink, appearing to read 'R. Grosselle'.

Renee Grosselle, Manager of Environmental Standards Division

Date: Jan 12, 2026

Terms and conditions for permit number: TDP01653

Discharge Start Date: January 12, 2026

Discharge End Date: January 30, 2026

Discharge type: Ground water

Discharge location: MH00000683

Discharge flow rate (maximum): 6.5 Litre/s

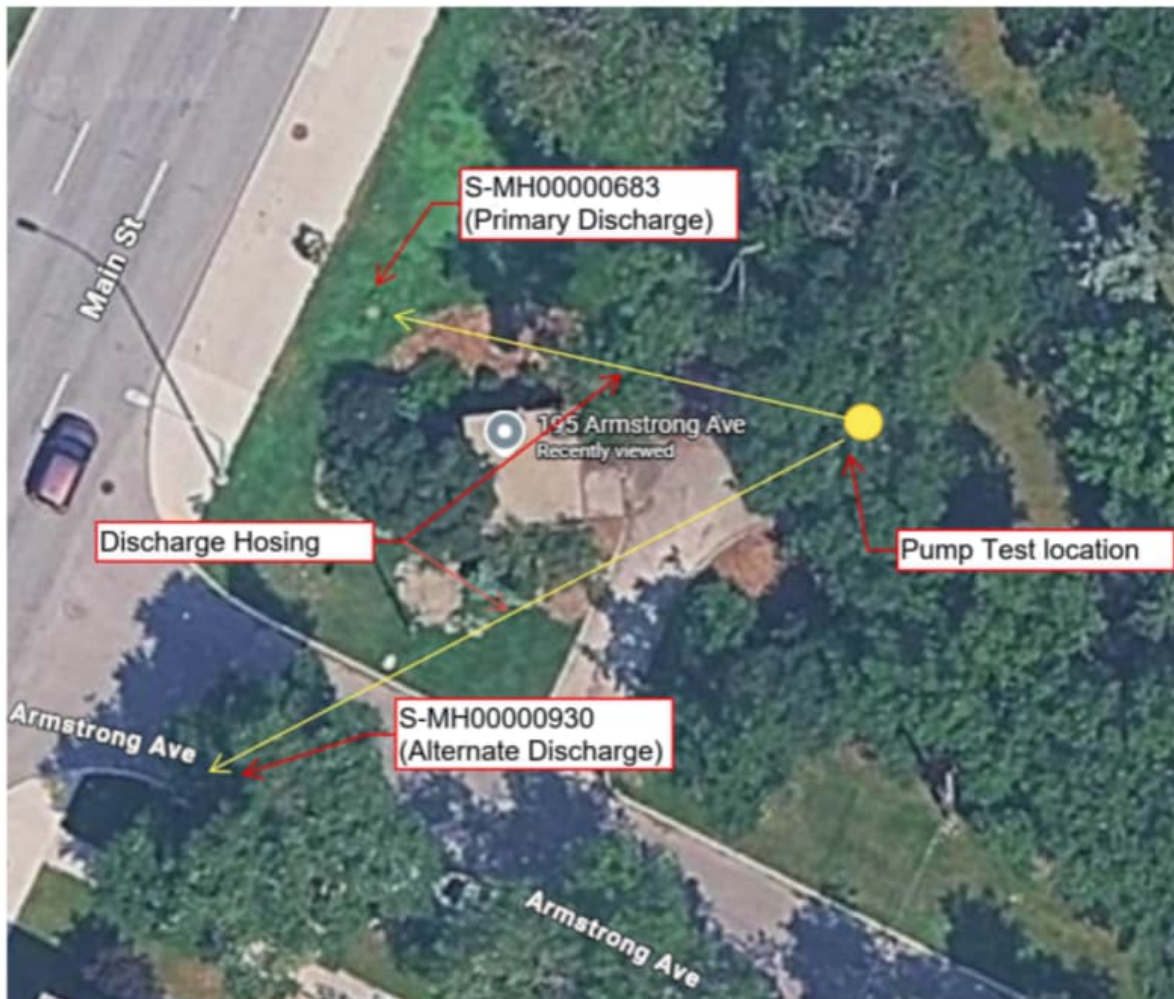
Discharge daily volume (maximum): 45,000 Litres


1. The Permit Holder must contact the Water and Waste Department, McPhillips Control Centre (204-986-7948):
 - a minimum of 24 hours in advance of the Discharge, and provide the intended start date and time, of each discharge
 - immediately before commencing each discharge
2. The Permit Holder must ensure that a contact person, or an on-site designate, overseeing the Discharge is available on site at all times during the discharge.
3. The Permit Holder must ensure that the total discharge does not exceed the limits listed above.
4. The Permit Holder must ensure that the Discharge at the above-named discharge location:
 - only occurs at the Sewer System connection indicated on the attached map,
 - occurs between the dates outlined in the permit information
 - does not contain prohibited substances listed in Schedules A or C of the Sewer By-law,
 - does not contain substances that exceed the limits listed in Schedule B or D of the Sewer By-law,
 - does not create a nuisance or hazardous condition.
5. The Permit Holder must stop discharging:
 - in the event of wet weather, or forecasted wet weather, and can only resume after receiving approval from the Water and Waste Department contact,
 - immediately upon request from the Water and Waste Department.

Terms and conditions for permit number: TDP01653

6. The Permit Holder must comply with all conditions of this permit and all provisions of the Sewer By-law.
7. This Permit does not authorize usage of the City's street or any property (separate permits or approvals may be required for these uses).
8. The Permit Holder agrees to fully indemnify the City of Winnipeg for any costs, damages or expenses arising from any actions, claims, demands and proceedings brought by any person for any harm or damage caused as a result of the issuance of the permit by the City.
9. The Permit Holder must comply with the following requirements, or this permit is subject to suspension or cancellation:
 - None
10. This permit replaces any previous permits which are hereby rescinded.
11. This permit is being issued under the authority of the Sewer By-law as designated by the Director of the Water and Waste Department.

MAP OF APPROVED DISCHARGE LOCATION



 Discharge source



Water and Waste
Eaux et déchets

TEMPORARY OVERLAND DISCHARGE PERMIT

SEWER BY-LAW NO. 106/2018

Permit No: TDP01667

Approved date: Jan 15, 2026

Permit holder:

KONTZAMANIS GRAUMANN SMITH MACMILLAN INC

22 MCGREGOR ST, WINNIPEG, MB,

Canada,

This permit certifies that the Permit Holder is authorized to discharge the discharge type identified in this permit (the “Discharge”) into the discharge location identified in this permit (the “Sewer System”), subject to the terms and conditions attached.

Recommended:

A handwritten signature in blue ink, appearing to read 'M. Marsland'.

Meghan Marsland, Industrial Waste Services Branch Head

Approved:

A handwritten signature in blue ink, appearing to read 'R. Grosselle'.

Renee Grosselle, Manager of Environmental Standards Division

Date:

Jan 15, 2026

Terms and conditions for permit number: TDP01667

Discharge Start Date: January 15, 2026

Discharge End Date: January 30, 2026

Discharge type: Ground Water

Discharge location: MH00001362

Discharge flow rate (maximum): 6.5 Litres/second

Discharge daily volume (maximum): 45,000 Litres

1. The Permit Holder must contact the Water and Waste Department, McPhillips Control Centre (204-986-7948):
 - a minimum of 24 hours in advance of the Discharge, and provide the intended start date and time, of each discharge
 - immediately before commencing each discharge
2. The Permit Holder must ensure that a contact person, or an on-site designate, overseeing the Discharge is available on site at all times during the discharge.
3. The Permit Holder must ensure that the total discharge does not exceed the limits listed above.
4. The Permit Holder must ensure that the Discharge at the above-named discharge location:
 - only occurs at the Sewer System connection indicated on the attached map,
 - occurs between the dates outlined in the permit information
 - does not contain prohibited substances listed in Schedules A or C of the Sewer By-law,
 - does not contain substances that exceed the limits listed in Schedule B or D of the Sewer By-law,
 - does not create a nuisance or hazardous condition.
5. The Permit Holder must stop discharging:
 - in the event of wet weather, or forecasted wet weather, and can only resume after receiving approval from the Water and Waste Department contact,
 - immediately upon request from the Water and Waste Department.

Terms and conditions for permit number: TDP01667

6. The Permit Holder must comply with all conditions of this permit and all provisions of the Sewer By-law.
7. This Permit does not authorize usage of the City's street or any property (separate permits or approvals may be required for these uses).
8. The Permit Holder agrees to fully indemnify the City of Winnipeg for any costs, damages or expenses arising from any actions, claims, demands and proceedings brought by any person for any harm or damage caused as a result of the issuance of the permit by the City.
9. The Permit Holder must comply with the following requirements, or this permit is subject to suspension or cancellation:
 - None
10. This permit replaces any previous permits which are hereby rescinded.
11. This permit is being issued under the authority of the Sewer By-law as designated by the Director of the Water and Waste Department.

MAP OF APPROVED DISCHARGE LOCATION





Water and Waste
Eaux et déchets

TEMPORARY OVERLAND DISCHARGE PERMIT

SEWER BY-LAW NO. 106/2018

Permit No: TDP01693-R1


Approved date: Feb 3, 2026

Permit holder:

KONTZAMANIS GRAUMANN SMITH MACMILLAN INC

761 LEILA AVE, WINNIPEG, MB,
Canada,

This permit certifies that the Permit Holder is authorized to discharge the discharge type identified in this permit (the “Discharge”) into the discharge location identified in this permit (the “Sewer System”), subject to the terms and conditions attached.

Recommended: 

Meghan Marsland, Industrial Waste Services Branch Head

Approved: 

Renee Grosselle, Manager of Environmental Standards Division

Date: Feb 3, 2026



Terms and conditions for permit number: TDP01693-R1

Discharge Start Date: January 23, 2026

Discharge End Date: February 13, 2026

Discharge type: Ground water

Discharge location: Catch basin S-CI00014392

Discharge flow rate (maximum): 6.5 Litres/second

Discharge daily volume (maximum): 45,000 Liters

1. The Permit Holder must contact the Water and Waste Department, McPhillips Control Centre (204-986-7948):
 - a minimum of 24 hours in advance of the Discharge, and provide the intended start date and time, of each discharge
 - immediately before commencing each discharge
2. The Permit Holder must ensure that a contact person, or an on-site designate, overseeing the Discharge is available on site at all times during the discharge.
3. The Permit Holder must ensure that the total discharge does not exceed the limits listed above.
4. The Permit Holder must ensure that the Discharge at the above-named discharge location:
 - only occurs at the Sewer System connection indicated on the attached map,
 - occurs between the dates outlined in the permit information
 - does not contain prohibited substances listed in Schedules A or C of the Sewer By-law,
 - does not contain substances that exceed the limits listed in Schedule B or D of the Sewer By-law,
 - does not create a nuisance or hazardous condition.
5. The Permit Holder must stop discharging:
 - in the event of wet weather, or forecasted wet weather, and can only resume after receiving approval from the Water and Waste Department contact,
 - immediately upon request from the Water and Waste Department.



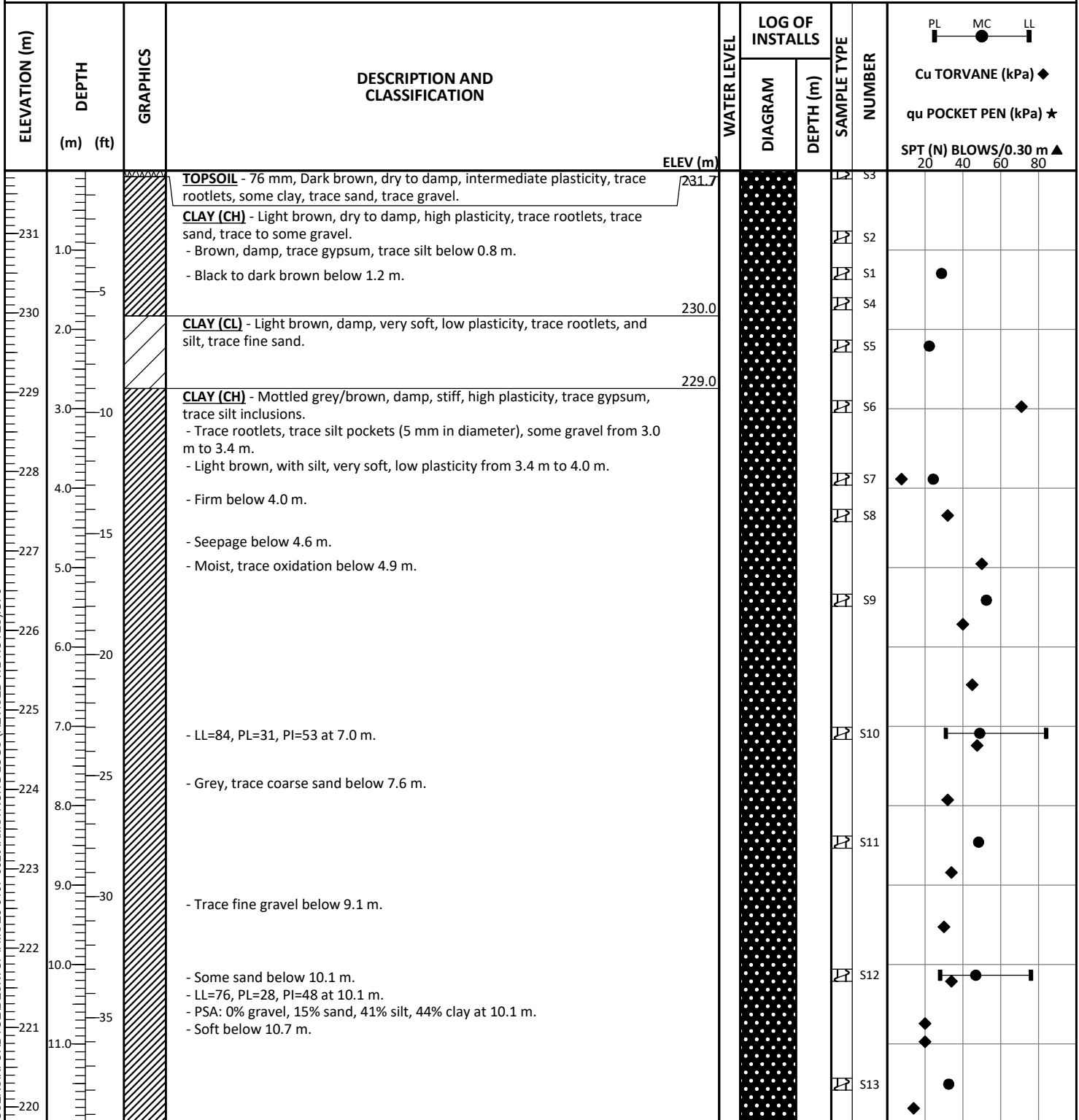
Terms and conditions for permit number: TDP01693-R1

6. The Permit Holder must comply with all conditions of this permit and all provisions of the Sewer By-law.
7. This Permit does not authorize usage of the City's street or any property (separate permits or approvals may be required for these uses).
8. The Permit Holder agrees to fully indemnify the City of Winnipeg for any costs, damages or expenses arising from any actions, claims, demands and proceedings brought by any person for any harm or damage caused as a result of the issuance of the permit by the City.
9. The Permit Holder must comply with the following requirements, or this permit is subject to suspension or cancellation:
 - None
10. This permit replaces any previous permits which are hereby rescinded.
11. This permit is being issued under the authority of the Sewer By-law as designated by the Director of the Water and Waste Department.

APPENDIX C

Borehole Logs

CLIENT	CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Detailed Design and CA/CI	SURFACE ELEV.	231.79 m
LOCATION	Winnipeg, Manitoba	START DATE	5-26-2025
DESCRIPTION	In the median southeast of the Leila Ave	UTM (m)	N 5,534,369.32
DRILL RIG / HAMMER	Mobile B54X Track Mounted Drill Rig with Auto-Hammer		E 634,373.5 Zone 14
METHOD(S)	0.0 m to 17.5 m: 125 mm ø SSA		



WATER LEVELS	▼ Upon Completion	12.80 m on 5-26-2025	CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR S. SCHULTZ
			APPROVED K. FORDYCE	DATE 10-14-2025

KGS LOG C:\USERS\KFOR\DESKTOP\FMS\25-0107-002\ARMSTRONG LOGS (REVISED WL NOTES).GPJ

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	<div> <div>PL</div> <div>MC</div> <div>LL</div> </div> <div>Cu TORVANE (kPa) ◆</div> <div>qu POCKET PEN (kPa) ★</div> <div>SPT (N) BLOWS/0.30 m ▲</div> <div>20 40 60 80</div>		
					DIAGRAM	DEPTH (m)					
219	13.0		- Very soft below 14.2 m.			14.17		S14			
218	14.0										
217	15.0										
216	16.0										
215	17.0		SILT TILL - Light brown, moist, compact, low plasticity, with sand, some clay, trace gravel. - PSA: 5% gravel, 30% sand, 50% silt, 15% clay at 16.6 m.			17.32		S17			
214	18.0										
213	19.0		Notes: 1. End of test hole at 17.5 m. 2. Refusal encountered in silt till at a depth of 17.5 m. 3. Test hole caved to 14.9 m upon completion of drilling/digging. 4. Test hole backfilled with grout. 5. Grout mix consisted of 3 part cement, 1 part bentonite, 1 part water. 6. Flush mount well cover installed at surface.			17.53		S18			
212	20.0										
211	21.0										
210	22.0										
209	23.0										
208	24.0										
207	25.0										
206	26.0										
205	27.0										
204	28.0										
WATER LEVELS ▼ Upon Completion 12.80 m on 5-26-2025				<div> <div>CONTRACTOR</div> <div>Maple Leaf Drilling Ltd.</div> </div> <div> <div>INSPECTOR</div> <div>S. SCHULTZ</div> </div> <div> <div>APPROVED</div> <div>K. FORDYCE</div> </div> <div> <div>DATE</div> <div>10-14-2025</div> </div>							

CLIENT CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT
PROJECT Armstrong Detailed Design and CA/CI
LOCATION Winnipeg, Manitoba
DESCRIPTION East of Main St in greenspace of Kildonan Park.
DRILL RIG / HAMMER Acker Renegade Track Mounted Drill Rig with Auto-Hammer
METHOD(S) 0.0 m to 21.0 m: 125 mm ø SSA

PROJECT NO. 25-0107-002
SURFACE ELEV. 230.23 m
START DATE 6-4-2025
UTM (m) N 5,534,096.82
E 635,483.92 Zone 14

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL			Cu TORVANE (kPa) ◆	qu POCKET PEN (kPa) ★	SPT (N) BLOWS/0.30 m ▲
					DIAGRAM	DEPTH (m)											
230			TOPSOIL - 305 mm, Black, dry, trace organics, trace rootlets, trace clay and silt. 229.9					S1									
229	1.0		CLAY (CH) - Dark greyish brown, dry to damp, hard, high plasticity, trace gypsum, trace oxidation, trace silt inclusions. 228.6					S2									
228	2.0		CLAY (CL) - Light brown, damp, very soft, low plasticity, and silt. 227.7					S3									
227	3.0		CLAY (CH) - Mottled grey/brown, moist, stiff, high plasticity, trace gypsum, trace oxidation, trace silt inclusions.					S4									
226	4.0		- Silt lensing from 3.8 m to 3.9 m.					S5									
225	5.0							S6									
224	6.0		- Grey below 6.1 m.					S7									
223	7.0		- Trace coarse sand below 7.6 m.					S8									
222	8.0		- LL=84, PL=33, PI=51 at 8.5 m.					S9									
221	9.0		- Grey below 9.1 m.					S10									
220	10.0		- Trace gravel below 9.6 m.					S11									
219	11.0		- LL=76, PL=27, PI=49 at 11.7 m.														
WATER LEVELS ▼ Upon Completion on 6-4-2025 None Encountered				CONTRACTOR Maple Leaf Drilling Ltd.				INSPECTOR S. SCHULTZ									
				APPROVED K. FORDYCE				DATE 10-14-2025									

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL		
					DIAGRAM	DEPTH (m)						Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲		
218	40													
13.0								S12						
217														
45														
14.0			- Trace sandy silt inclusions below 14.0 m.					S13						
216														
50						15.29								
15.0								S14						
215														
16.0								S15						
214														
55								S16						
17.0														
213								S17	83	7 12 16	28			
212.5														
18.0			SILT TILL - Light brown, damp, compact, low plasticity, with sand, some clay, trace gravel.					S18						
212	60							S19	67	5 6 10	16			
19.0			- LL=18, PL=11, PI=7 at 19.6 m. - PSA: 5% gravel, 27% sand, 53% silt, 15% clay at 19.6 m.					S20						
211			- Some to with coarse angular gravel below 20.4 m.					S21	58	13 50/ 0mm	+100			
210	65		- Dense below 20.8 m.											
209	70		Notes: 1. End of test hole at 21.0 m. 2. Refusal encountered in silt till at a depth of 21.0 m. 3. Test hole caved to 20.4 m upon completion of drilling/digging. 4. Test hole backfilled with grout. 5. Grout mix consisted of 3 part cement, 1 part bentonite, 1 part water. 6. Flush mount well cover installed at surface.											
22.0														
208														
75														
207														
23.0	75													
206	80													
205														
25.0														
205	85													
26.0														

WATER LEVELS

▼ Upon Completion

on 6-4-2025 None Encountered

CONTRACTOR

Maple Leaf Drilling Ltd.

APPROVED

K. FORDYCE

INSPECTOR

S. SCHULTZ

DATE

10-14-2025

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Combined Sewer Relief Project	SURFACE ELEV.	231.67 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	1.05 m / 232.71 m (Standpipe)
DESCRIPTION	E blvd. on Jack Donner Dr.; 6 m N of N sidewalk on Leila Ave.	START DATE	2026-02-03
DRILL RIG / HAMMER	Canterra CT 250 Truck Mounted Drill Rig	UTM (m)	N 5,534,813.67
METHOD(S)	0.00 m to 30.48 m: Mud Rotary, 200 mm ø Tricone Bit		E 633,541.45 Zone 14
	30.48 m to 31.09 m: Mud Rotary, 150 mm ø Tricone Bit - switched due to encountering bedrock		
	31.09 m to 45.72 m: Air Rotary, 100 mm ø Tricone Bit		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	<div> <div>PL MC LL</div> <div>Cu TORVANE (kPa) ◆</div> <div>qu POCKET PEN (kPa) ★</div> <div>SPT (N) BLOWS/0.30 m ▲</div> <div>20 40 60 80</div> </div>
					DIAGRAM	DEPTH (m)			
231	1.0		<u>TOPSOIL FILL</u> - black.						
230	2.0		<u>CLAY (CH)</u> - grey.						
229	3.0								
228	4.0								
227	5.0								
226	6.0								
225	7.0								
224	8.0								
223	9.0								
222	10.0								
221	11.0								
220	12.0								
219	13.0		<u>SILT TILL.</u>						
218	14.0								
217	15.0								
216	16.0								
215	17.0								
214	18.0								
213	19.0								
212	20.0								
211	21.0								
210	22.0								
209	23.0								
208	24.0								
207	25.0		- gravelly till from 24 m to 30.1 m.						
206	26.0								
205	27.0								
204	28.0								
203	29.0								
202									

WATER LEVELS	▼ Remeasured/Static	2.80 m on 2026-02-05 DTW below TOC	CONTRACTOR	INSPECTOR
			Maple Leaf Drilling Ltd.	S. SINGH
			APPROVED	DATE
			P. LINDELL	2026-02-11

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	<div> <div>PL MC LL</div> <div>Cu TORVANE (kPa) ◆</div> <div>qu POCKET PEN (kPa) ★</div> <div>SPT (N) BLOWS/0.30 m ▲</div> <div>20 40 60 80</div> </div>
					DIAGRAM	DEPTH (m)			
201	31.0		<u>LIMESTONE</u> - brown.	201.49		30.48			
200	32.0					31.09			
199	33.0								
198	34.0								
197	35.0								
196	36.0								
195	37.0								
194	38.0								
193	39.0								
192	40.0								
191	41.0								
190	42.0								
189	43.0								
188	44.0								
187	45.0								
186	46.0			185.95		45.72			
185	47.0		Notes: 1. End of test hole at 45.72 m. 2. Protective well cover installed at surface. 3. 127 mm (5") steel pump well casing installed.						
184	48.0								
183	49.0								
182	50.0								
181	51.0								
180	52.0								
179	53.0								
178	54.0								
177	55.0								
176	56.0								
175	57.0								
174	58.0								
173	59.0								
172	60.0								
171	61.0								
170	62.0								
169	63.0								
168	64.0								
167	65.0								

WATER LEVELS ▼ Remeasured/Static 2.80 m on 2026-02-05 DTW below TOC

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
S. SINGH

APPROVED
P. LINDELL

DATE
2026-02-11

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Combined Sewer Relief Project	SURFACE ELEV.	231.68 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	-0.01 m / 231.67 m (Standpipe)
DESCRIPTION	3 m N of PW26-LJ-01	START DATE	2026-02-04
DRILL RIG / HAMMER	Canterra CT 250 Truck Mounted Drill Rig	UTM (m)	N 5,534,816.2
METHOD(S)	0.00 m to 34.14 m: Mud Rotary, 200 mm ø Tricone Bit		E 633,542.69 Zone 14
	34.14 m to 36.58 m: Air Rotary, 100 mm ø Tricone Bit - switched due to drilling in bedrock and airlifting		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	<div> <div>PL MC LL</div> <div>Cu TORVANE (kPa) ◆</div> <div>qu POCKET PEN (kPa) ★</div> <div>SPT (N) BLOWS/0.30 m ▲</div> <div>20 40 60 80</div> </div>
					DIAGRAM	DEPTH (m)			
231	1.0		<u>TOPSOIL FILL</u> - black.						
230	2.0		<u>CLAY (CH)</u> - grey.			0.61			
229	3.0								
228	4.0								
227	5.0								
226	6.0								
225	7.0								
224	8.0								
223	9.0								
222	10.0								
221	11.0								
220	12.0								
219	13.0		<u>SILT TILL.</u>						
218	14.0								
217	15.0								
216	16.0								
215	17.0								
214	18.0								
213	19.0								
212	20.0								
211	21.0								
210	22.0								
209	23.0								
208	24.0								
207	25.0								
206	26.0								
205	27.0								
204	28.0								
203	29.0								
202						29.57			

WATER LEVELS	<div> <div>▼ Remeasured/Static</div> <div>3.14 m on 2026-02-05 DTW below TOC</div> </div>	<div> <div>CONTRACTOR</div> <div>Maple Leaf Drilling Ltd.</div> </div>	<div> <div>INSPECTOR</div> <div>S. SINGH</div> </div>
		<div> <div>APPROVED</div> <div>P. LINDELL</div> </div>	<div> <div>DATE</div> <div>2026-02-11</div> </div>

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PROJECT NO.	25-0107-002
SURFACE ELEV.	231.78 m
TOC STICK-UP / ELEV.	-0.01 m / 231.77 m (Standpipe)
START DATE	2026-01-29
UTM (m)	N 5,534,841.91
	E 633,554.6 Zone 14

31.09 m to 35.05 m: Air Rotary, 100 mm ø Tricone Bit - switched due to drilling in bedrock and airlifting

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2026-02-11

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CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Combined Sewer Relief Project	SURFACE ELEV.	231.91 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	0.88 m / 232.79 m (Standpipe)
DESCRIPTION	Blvd. on Leila Ave.; W of Leila Ave. and McGregor St. intersection	START DATE	2026-01-20
DRILL RIG / HAMMER	VERSA-DRILL V-140X	UTM (m)	N 5,534,376.05
METHOD(S)	0.00 m to 28.35 m: Mud Rotary, 200 mm ø Tricone Bit		E 634,374.88 Zone 14
	28.35 m to 28.96 m: Mud Rotary, 150 mm ø Tricone Bit - switched due to encountering bedrock		
	28.96 m to 35.97 m: Air Rotary, 100 mm ø Tricone Bit		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	<div> <div>PL MC LL</div> <div>Cu TORVANE (kPa) ◆</div> <div>qu POCKET PEN (kPa) ★</div> <div>SPT (N) BLOWS/0.30 m ▲</div> <div>20 40 60 80</div> </div>			
					DIAGRAM	DEPTH (m)						
				231.30								
231	1.0		TOPSOIL FILL - black.									
230	2.0		CLAY (CL) - brown.									
229	3.0											
228	4.0			228.25								
227	5.0		CLAY (CH) - grey.									
226	6.0											
225	7.0											
224	8.0											
223	9.0											
222	10.0											
221	11.0											
220	12.0			219.72								
219	13.0		BOULDERS.	219.41								
218	14.0		CLAY (CH).									
217	15.0											
216	16.0											
215	17.0			214.84								
214	18.0		SILT TILL - grey gravel till.									
213	19.0											
212	20.0											
211	21.0											
210	22.0											
209	23.0											
208	24.0											
207	25.0											
206	26.0											
205	27.0											
204	28.0			203.71								
203	29.0		LIMESTONE - brown.									
202			- fracture in limestone at 29.26 m.									

WATER LEVELS ▼ Remeasured/Static 7.98 m on 2026-01-28 DTW below TOC

CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR S. SINGH
APPROVED P. LINDELL	DATE 2026-02-11

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	PL MC LL Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80
					DIAGRAM	DEPTH (m)			
201	31.0			195.94		35.97			
200	32.0								
199	33.0								
198	34.0								
197	35.0								
196	36.0								
195	37.0								
194	38.0								
193	39.0								
192	40.0								
191	41.0								
190	42.0								
189	43.0								
188	44.0								
187	45.0								
186	46.0								
185	47.0								
184	48.0								
183	49.0								
182	50.0								
181	51.0								
180	52.0								
179	53.0								
178	54.0								
177	55.0								
176	56.0								
175	57.0								
174	58.0								
173	59.0								
172	60.0								
171	61.0								
170	62.0								
169	63.0								
168	64.0								
167	65.0								
WATER LEVELS ▼ Remeasured/Static 7.98 m on 2026-01-28 DTW below TOC			CONTRACTOR Maple Leaf Drilling Ltd.		INSPECTOR S. SINGH				
			APPROVED P. LINDELL		DATE 2026-02-11				

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CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Combined Sewer Relief Project	SURFACE ELEV.	231.81 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	-0.01 m / 231.80 m (Standpipe)
DESCRIPTION	3 m E of PW26-LM-01	START DATE	2026-01-21
DRILL RIG / HAMMER	VERSA-DRILL V-140X	UTM (m)	N 5,534,374.07
METHOD(S)	0.00 m to 28.04 m: Mud Rotary, 200 mm ø Tricone Bit		E 634,377.81 Zone 14
	28.04 m to 28.65 m: Mud Rotary, 150 mm ø Tricone Bit - switched due to encountering bedrock		
	28.65 m to 31.24 m: Air Rotary, 100 mm ø Tricone Bit		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	PL MC LL	Cu TORVANE (kPa) ◆	qu POCKET PEN (kPa) ★	SPT (N) BLOWS/0.30 m ▲
					WATER LEVEL	DIAGRAM						
231	1.0		<u>TOPSOIL FILL</u> - black.	231.20			0.61					
230	2.0		<u>CLAY (CL)</u> - brown.									
229	3.0											
228	4.0		<u>CLAY (CH)</u> - grey.	228.15								
227	5.0											
226	6.0											
225	7.0											
224	8.0											
223	9.0											
222	10.0											
221	11.0											
220	12.0											
219	13.0											
218	14.0											
217	15.0											
216	16.0											
215	17.0			214.74								
214	18.0		<u>SILT TILL</u> - grey gravel till.									
213	19.0											
212	20.0											
211	21.0											
210	22.0											
209	23.0											
208	24.0											
207	25.0											
206	26.0											
205	27.0											
204	28.0			203.61			27.89					
203	29.0		<u>LIMESTONE</u> - brown, competent.				28.19					
202			- fracture in limestone at 28.96 m.									

WATER LEVELS ▼ Remeasured/Static 6.89 m on 2026-01-28 DTW below TOC

CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR S. SINGH
APPROVED P. LINDELL	DATE 2026-02-11

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CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Combined Sewer Relief Project	SURFACE ELEV.	231.26 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	-0.01 m / 231.25 m (Standpipe)
DESCRIPTION	30 m E of PW26-LM-01	START DATE	2026-01-26
DRILL RIG / HAMMER	Canterra CT 250 Truck Mounted Drill Rig	UTM (m)	N 5,534,360.47
METHOD(S)	0.00 m to 1.83 m: Hydrovac		E 634,399.37 Zone 14
	1.83 m to 27.43 m: Mud Rotary, 200 mm ø Tricone Bit		
	27.43 m to 28.35 m: Mud Rotary, 150 mm ø Tricone Bit - switched due to encountering bedrock		
	28.35 m to 31.39 m: Air Rotary, 100 mm ø Tricone Bit		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	PL MC LL	Cu TORVANE (kPa) ◆	qu POCKET PEN (kPa) ★	SPT (N) BLOWS/0.30 m ▲
					DIAGRAM	DEPTH (m)						
231			TOPSOIL FILL - black.									
230	1.0		FILL - clay mixed with broken pieces of concrete used as backfill material.			0.61						
229	2.0		CLAY (CH).									
228	3.0											
227	4.0											
226	5.0											
225	6.0											
224	7.0											
223	8.0											
222	9.0											
221	10.0											
220	11.0											
219	12.0											
218	13.0											
217	14.0											
216	15.0		SILT TILL - grey gravel till.									
215	16.0											
214	17.0											
213	18.0											
212	19.0											
211	20.0											
210	21.0											
209	22.0											
208	23.0											
207	24.0											
206	25.0											
205	26.0											
204	27.0											
203	28.0		LIMESTONE - Broken Limestone.			27.13						
202	29.0		LIMESTONE - brown, competent.			27.43						

WATER LEVELS	▼ Remeasured/Static	6.00 m on 2026-02-11 DTW below TOC	CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR S. SINGH
			APPROVED P. LINDELL	DATE 2026-02-11

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CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Combined Sewer Relief Project	SURFACE ELEV.	230.02 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	0.75 m / 230.77 m (Standpipe)
DESCRIPTION	SW sect. of Kil. Pk.; 10 m E of Main St.; 20 m N of Armstrong Ave.	START DATE	2026-01-12
DRILL RIG / HAMMER	Canterra CT 250 Truck Mounted Drill Rig	UTM (m)	N 5,534,099.22
METHOD(S)	0.00 m to 20.73 m: Mud Rotary, 200 mm ø Tricone Bit		E 635,473.05 Zone 14
	20.73 m to 21.34 m: Mud Rotary, 150 mm ø Tricone Bit - switched due to encountering bedrock		
	21.34 m to 30.48 m: Air Rotary, 100 mm ø Tricone Bit		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	PL MC LL	Cu TORVANE (kPa) ◆	qu POCKET PEN (kPa) ★	SPT (N) BLOWS/0.30 m ▲
						DIAGRAM	DEPTH (m)						
229	1.0		<u>TOPSOIL FILL</u> - Dark brown.	229.71									
			<u>CLAY (CH)</u> - Grey.	228.49									
228	2.0		<u>CLAY (CL)</u> - Brown.										
227	3.0			226.36									
226	4.0		<u>CLAY (CH)</u> - Grey.										
225	5.0												
224	6.0												
223	7.0												
222	8.0												
221	9.0												
220	10.0												
219	11.0												
218	12.0												
217	13.0			216.61									
216	14.0		<u>CLAY TILL.</u>										
215	15.0												
214	16.0												
213	17.0			212.03									
212	18.0		<u>SILT TILL.</u>										
211	19.0			209.60									
210	20.0		<u>LIMESTONE</u> - competent.										
209	21.0						21.34						
208	22.0						21.95						
207	23.0		fracture in limestone.										
206	24.0												
205	25.0												
204	26.0												
203	27.0												
202	28.0												
201	29.0												
200	30.0			199.54									
199	31.0		Notes:										
198	32.0		1. End of test hole at 30.48 m.										
			2. Protective well cover installed at surface.										
			3. 127 mm (5") steel pump well casing installed.										

WATER LEVELS ▼ Remeasured/Static 6.16 m on 2026-02-06 DTW below TOC

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
S. SINGH

APPROVED
P. LINDELL

DATE
2026-02-11

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Combined Sewer Relief Project	SURFACE ELEV.	229.98 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	-0.01 m / 229.97 m (Standpipe)
DESCRIPTION	3 m N of PW26-AM-01	START DATE	2026-01-14
DRILL RIG / HAMMER	VERSA-DRILL V-140X	UTM (m)	N 5,534,102.02
METHOD(S)	0.00 m to 20.27 m: Mud Rotary, 200 mm ø Tricone Bit		E 635,474.04 Zone 14
	20.27 m to 20.73 m: Mud Rotary, 150 mm ø Tricone Bit - switched due to encountering bedrock		
	20.73 m to 23.47 m: Mud Rotary, 100 mm ø Drag Bit		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	PL MC LL
					DIAGRAM	DEPTH (m)			
									Cu TORVANE (kPa) ◆ qu POCKET PEN (kPa) ★ SPT (N) BLOWS/0.30 m ▲ 20 40 60 80
229	1.0		TOPSOIL FILL - Grey and black, damp, stiff.	229.67		0.61			
228	2.0		CLAY (CH) - Grey.	228.46					
227	3.0		CLAY (CL) - Brown.						
226	4.0		CLAY (CH) - Grey.	226.63					
225	5.0								
224	6.0								
223	7.0								
222	8.0								
221	9.0								
220	10.0								
219	11.0								
218	12.0								
217	13.0								
216	14.0								
215	15.0								
214	16.0								
213	17.0								
212	18.0								
211	19.0		SILT TILL.	211.39					
210	20.0			209.71		20.12			
209	21.0		LIMESTONE - brown, competent.			20.42			
208	22.0								
207	23.0		- fracture in limestone at 23.16 m.	206.51		23.47			
206	24.0		Notes: 1. End of test hole at 23.47 m. 2. Flush mount well cover installed at surface. 3. 50.8 mm (2") PVC Monitoring Well casing installed.						
205	25.0								
204	26.0								
203	27.0								
202	28.0								
201	29.0								
200	30.0								

WATER LEVELS	▼ Remeasured/Static 5.33 m on 2026-02-06 DTW below TOC	CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR S. SINGH
		APPROVED P. LINDELL	DATE 2026-02-11

CLIENT	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	PROJECT NO.	25-0107-002
PROJECT	Armstrong Combined Sewer Relief Project	SURFACE ELEV.	230.52 m
LOCATION	Winnipeg, Manitoba	TOC STICK-UP / ELEV.	-0.01 m / 230.51 m (Standpipe)
DESCRIPTION	30 m N of PW26-AM-01	START DATE	2026-01-14
DRILL RIG / HAMMER	VERSA-DRILL V-140X	UTM (m)	N 5,534,127.14
METHOD(S)	0.00 m to 21.18 m: Mud Rotary, 200 mm ø Tricone Bit		E 635,484.1 Zone 14
	21.18 m to 21.79 m: Mud Rotary, 150 mm ø Tricone Bit - switched due to encountering bedrock		
	21.79 m to 24.38 m: Mud Rotary, 100 mm ø Drag Bit		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	WATER LEVEL	LOG OF INSTALLS		SAMPLE TYPE	NUMBER	<div> <div>PL MC LL</div> <div>Cu TORVANE (kPa) ◆</div> <div>qu POCKET PEN (kPa) ★</div> <div>SPT (N) BLOWS/0.30 m ▲</div> <div>20 40 60 80</div> </div>
					DIAGRAM	DEPTH (m)			
230	1.0		<u>TOPSOIL FILL.</u>			0.61			
229	2.0		<u>CLAY (CL)</u> - Brown.						
228	3.0								
227	4.0		<u>CLAY (CH)</u> - Grey.						
226	5.0								
225	6.0								
224	7.0								
223	8.0								
222	9.0								
221	10.0								
220	11.0								
219	12.0								
218	13.0								
217	14.0								
216	15.0								
215	16.0								
214	17.0								
213	18.0								
212	19.0								
211	20.0		<u>SILT TILL.</u>						
210	21.0					20.73			
209	22.0		<u>LIMESTONE</u> - brown, competent.			21.18			
208	23.0								
207	24.0					24.23			
206	25.0		Notes:						
205	26.0		1. End of test hole at 24.38 m.						
204	27.0		2. Flush mount well cover installed at surface.						
203	28.0		3. 50.8 mm (2") PVC Monitoring Well casing installed.						
202	29.0								
201									

WATER LEVELS	▼ Remeasured/Static	5.33 m on 2026-02-06 DTW below TOC	CONTRACTOR Maple Leaf Drilling Ltd.	INSPECTOR S. SINGH
			APPROVED P. LINDELL	DATE 2026-02-11

TABLE C1
Provincial Well Records (Within 800m of Each Investigation Site)
ARMSTRONG SEWER DISTRICT, WINNIPEG MB

Site	Well PID	Date Completed	Well Use	Owner	UTM Easting (m)	UTM Northing (m)	Accuracy XY	Well Status	Remarks	Distance from Investigation Sites
Eastern Site	183290	2014 Mar 25	Active - Production	KGS GROUP/ JOHN BURNS	635944	5534127	1 exact [<5M] [GPS]	ACTIVE	Peguis Drive	~460 m E of Eastern Site
Main St & Armstrong	194125	2014 Mar 25	Other	KILDONAN PARK DUCK POND	635943	5534128	1 exact [<5M] [GPS]	ACTIVE	Peguis Drive	~460 m E of Eastern Site
Middle Site Leila Ave & McGregor St	11880	1968 Jun 11	Domestic - Production	COROZ	634007	5534281	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	11883	1968 May 01	Domestic - Production	7 OAKS SCHOOL DIV 10	634121	5534395	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	11882	1968 Aug 08	Domestic - Production	R VEOSOVICH	634198	5534471	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	11881	1968 Jun 06	Domestic - Production	G RUFF	634198	5534471	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	25107	1975 Jun 13	Domestic - Production	L HINATAU	633908	5534104	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	13289	1969 Nov 01	Domestic - Production	W MALZENSKY	633908	5534104	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	170449	2011 Jun 29	Domestic - Production	BERTRAND DYCK	633908	5534104	3 accurate[50-350M] [within 1/4-section]	ACTIVE	4100 Pipeline Rd	~10.28 kms north of Leila/Jack Donner
	34601	1978 Jun 21	Domestic - Production	L WOZNEY	633859	5533969	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	11878	1968 Dec 16	Domestic - Production	MCEWAN BROS	634385	5534620	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	45986	1982 May 11	Domestic - Production	A STOPCHYCKL	634385	5534620	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	19217	1973 Nov 01	Domestic - Production	P MURDOCK	634385	5534620	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	68296	1989 Aug 17	Irrigation - Production	SHAAREY ZEDEK CEMETERY	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	21471	1974 Sep 26	Domestic - Production	A MEIER	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	11879	1968 Aug 26	Domestic - Production	A YACKEL	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	27596	1976 Nov 10	Domestic - Production	G LUCZENCZYN	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	14568	1970 Nov 25	Domestic - Production	D ORSYAK	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	68295	1989 Aug 16	Test Well	SHAAREY ZEDEK CEMETERY	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	75541	1992 Aug 05	Other - Production	CITY OF WINNIPEG	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	48747	1983 Aug 04	Domestic - Production	L YANICKI	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	68297	1989 Aug 16	Test Well	SHAAREY ZEDEK CEMETERY	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	19224	1973 Oct 17	Domestic - Production	J ONESCHUK	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	75596	1992 Aug 05	Other - Production	CITY OF WINNIPEG	634466	5534738	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	124839	2002 Aug 15	Domestic - Production	R. JABLONSKI	634609	5534897	3 accurate[50-350M] [within 1/4-section]	ACTIVE	1206 Templeton Ave	1.52 km West of Leila/Jack Donner
	17701	1972 May 12	Domestic - Production	G RUFF	634609	5534897	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	10536	1967 Nov 10	Domestic - Production	L WITTENBERG	634609	5534897	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	124726	2003 Aug 01	Domestic - Production	JOHN TAMBORKO	634609	5534897	3 accurate[50-350M] [within 1/4-section]	ACTIVE	1209 Court Ave	1.72 km West of Leila/Jack Donner
	106142	1966 Aug 23	Production (Unknown Use)	M191/WRB	634,671.63	5,535,046.07	5 general [1KM-8KM] [within township]	Inactive	-	-
	15782	1971 Aug 24	Production (Unknown Use)	P BILOCESKOWEC	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	19189	1973 Oct 30	Production (Unknown Use)	S STAPOR	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	20730	1973 Apr 04	Production (Unknown Use)	R ORSULAK	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	27714	1976 Dec 02	Production (Unknown Use)	NOT REPORTED	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	14618	1970 Oct 01	Production (Unknown Use)	STEFANCHUK LUMBER CO	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	17705	1972 Mar 29	Production (Unknown Use)	STEFNCHUK LUMBER	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	17703	1972 Nov 06	Production (Unknown Use)	L GRIFFITH	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	17704	1972 May 30	Production (Unknown Use)	W PRINCE	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	7899	1965 Oct 20	Production (Unknown Use)	J MELNYK	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	17706	1972 Nov 08	Production (Unknown Use)	C ROBERTS	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	14569	1970 Nov 18	Production (Unknown Use)	W OMANYK	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	19188	1973 Jun 22	Production (Unknown Use)	L WIEBE	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	25468	1975 Jun 12	Production (Unknown Use)	M MITYCHORUK	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	29907	1977 Sep 12	Production (Unknown Use)	J STANCHUK	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	33945	1978 Aug 02	Production (Unknown Use)	E STORK	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	61977	1988 Sep 07	Production (Unknown Use)	TURNER & SEYMOUR LTD	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	63016	1988 Jul 21	Production (Unknown Use)	T MEIZR	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	25981	1975 Apr 11	Production (Unknown Use)	S KLCO	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	134130	2005 May 10	Active - Production	GARRY & CHERRY KARPYSHIN	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	ACTIVE	1210 Templeton Ave	1.55 km West of Leila/Jack Donner
	40926	1980 Aug 12	Production (Unknown Use)	SHYMKO CONSTRUCTION	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	27507	1976 Sep 01	Production (Unknown Use)	E STARK	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	45987	1982 Oct 01	Production (Unknown Use)	G SIDHU	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	60856	1987 Feb 20	Production (Unknown Use)	FREEMAN STEVENSON	634,672.00	5,535,046.00	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
Western Site Leila Ave & Jack Donner Dr	11880	1968 Jun 11	Domestic - Production	COROZ	634007	5534281	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	11883	1968 May 01	Domestic - Production	7 OAKS SCHOOL DIV 10	634121	5534395	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	11882	1968 Aug 08	Domestic - Production	R VEOSOVICH	634198	5534471	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-
	11881	1968 Jun 06	Domestic - Production	G RUFF	634198	5534471	3 accurate[50-350M] [within 1/4-section]	Unknown	-	-

APPENDIX D

Transmissivity Contour Map

LEGEND

● Pumping Test Site
 10,000 Line of Equal Transmissivity with Value in Gallons/US Foot Day per Foot. Based on Aquifer Pumping Tests and Interpretation of Intersecting Contour Spacing.

CAREFUL
 Due to the nature of the data and the equipment used, the data may be subject to some error. This map should therefore be used as a guide to general trends in transmissivity.

ACKNOWLEDGEMENT:
 Map provided by The Manitoba Water Resources Branch.

Scale 1:50,000	1" = 1000'
0 1000 2000 3000 4000	0 1000 2000 3000 4000
0 1000 2000 3000 4000	0 1000 2000 3000 4000

Basic Map provided by The SURVEY AND MAPPING BRANCH, DEPARTMENT OF ENERGY, MINES AND PETROLEUM, updated from water, hydrogeology, and geology data, compiled by the SURVEY AND MAPPING BRANCH, DEPARTMENT OF ENERGY, MINES AND PETROLEUM, Winnipeg, in 1981.

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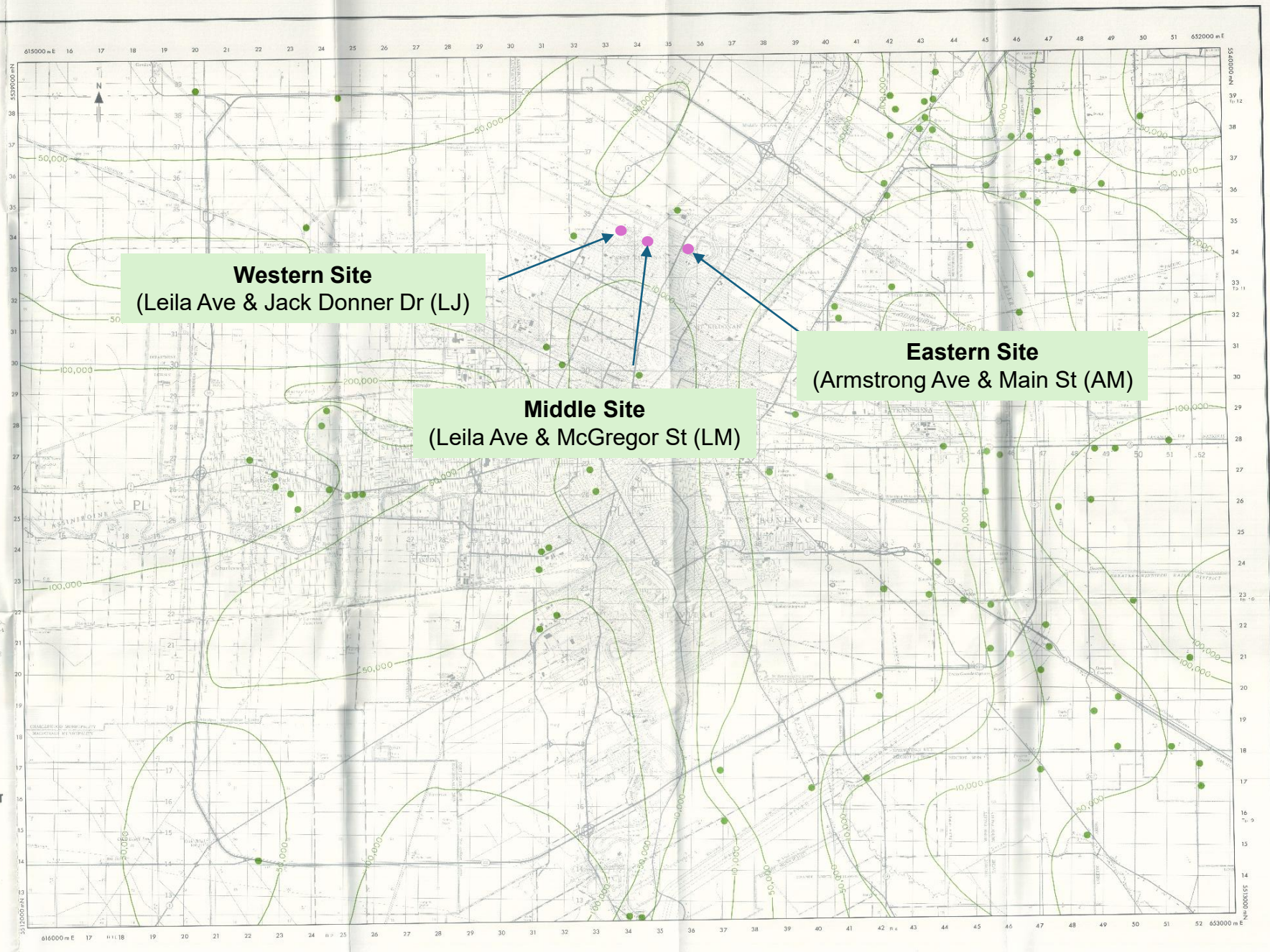
THE UNIVERSITY OF MANITOBA
 DEPARTMENT OF GEOLOGICAL
 ENGINEERING

GEOLOGICAL ENGINEERING REPORT
 FOR
 URBAN DEVELOPMENT
 WINNIPEG

PLATE 13

TRANSMISSIVITY
 OF THE
 UPPER CARBONATE AQUIFER

To accompany report entitled: (a)
 (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (l) (m) (n) (o) (p) (q) (r) (s) (t) (u) (v) (w) (x) (y) (z)



APPENDIX E

Groundwater Extraction Permits

Issued in accordance with the provisions
The Water Rights Act and regulations made thereunder.

Project: Armstrong Separated Sewer Construction - Armstrong and Main

Subject to the terms and conditions contained in this Groundwater Exploration Permit, the Minister charged with administration of The Water Rights Act authorizes:

The City of Winnipeg

In the province of Manitoba, to explore for groundwater; as well as construct water well(s), install pump(s) and transmittal pipeline(s) (the "WORKS") for **hydrogeologic site assessment** purposes on the following land:

River Lot 17, Parish of Kildonan

This Groundwater Exploration Permit does not authorize diversion and use of water for **hydrogeologic site assessment** purposes.

The WORKS shall be constructed in accordance with the terms and conditions described as follows:

1. This Permit expires within twelve (12) months of the date of issuance. Failure to construct all of the necessary WORKS and use water for **hydrogeologic site assessment** purposes prior to the permit expiry date may result in cancellation of the application for a Water Rights Licence.
2. This Permit is not transferable or assignable to any other party.
3. The Permittee must have legal access to all lands occupied by the project.
4. The Permittee must hold and maintain all regulatory approvals and requirements for the construction of the WORKS as provided by this Permit.
5. Prior to undertaking any work or construction of any WORKS authorized by this Permit, the Permittee must retain the services of a hydrogeologist registered with Engineers Geoscientists Manitoba, who is required to:
 - a. Plan and supervise the drilling of boreholes, test well(s), production well(s), observation well(s) and well pump testing.
 - b. Conduct a constant rate pumping test on the proposed production well(s) in accordance with Form H. (https://www.gov.mb.ca/sd/pubs/water/form_h_july.pdf)
 - c. Conduct a recovery test for a period equal to pump test or 90% recovery, whichever comes first.
 - d. Conduct an inventory of private, agricultural and commercial wells within a one mile radius of the project well(s) site. The inventory may be expanded based on the assessment of the expected area of water level draw-down impact resulting from future pumping.
 - e. Install a lockable and permanent two-inch observation well with the location to be determined by the Hydrogeologist if the supply well(s) will be less than 800 m from any existing wells.
 - f. Prepare and submit to the Water Use Licensing Section a technical report on the drilling of boreholes and test wells, pump testing of wells, well inventory and water quality sampling. The report must contain: well driller's report for test well(s) production well(s) and observation well(s); a location plan of the well(s) on the property and/or GPS locations of the well(s); an analysis of aquifer pumping tests; and calculations of transmissivity. The report must also indicate if any local wells are expected to be adversely affected by the proposed use of water and where these wells are located. A digital copy of the report must be submitted.
6. The Permittee must cease pumping immediately if any local water supplies are negatively impacted as a result of the pumping tests. The Permittee is also responsible to correct any water supply problems or provide a temporary water supply to anyone whose water supplies are negatively impacted as a result of the tests.
7. The Permittee shall assume any liability that may result from the construction of the WORKS.
8. The Province of Manitoba shall hereby be released from any liability or claims for damages that may result from the construction of the WORKS.
9. The Minister or Minister's agents have the right of unrestricted access for the purpose of inspection of any WORKS constructed under this Permit.
10. The issuance of this Permit does not imply that the Department will extend or renew the Permit in subsequent years.

11. A water use monitoring device must be installed on the pipeline from the supply well(s), positioned to accurately measure instantaneous pumping rate and accumulative withdrawals.

FOR OFFICE USE ONLY

Issued at the City of Winnipeg, in the Province of Manitoba, this 21st day of January A.D. 2026.

<u>Kylene Wiseman</u>	
Print Name	Signature

Signed by the Minister charged with the administration of The Water Rights Act (or her/his designate)

**GROUNDWATER
EXPLORATION
PERMIT**



Issued in accordance with the provisions
The Water Rights Act and regulations made thereunder.

Project: Armstrong Separated Sewer Construction - Leila & McGregor

Subject to the terms and conditions contained in this Groundwater Exploration Permit, the Minister charged with administration of The Water Rights Act authorizes:

The City of Winnipeg

In the province of Manitoba, to explore for groundwater; as well as construct water well(s), install pump(s) and transmittal pipeline(s) (the “WORKS”) for **hydrogeologic site assessment** purposes on the following land:

River Lot 15, Parish of Kildonan

This Groundwater Exploration Permit does not authorize diversion and use of water for **hydrogeologic site assessment** purposes.

The WORKS shall be constructed in accordance with the terms and conditions described as follows:

1. This Permit expires within twelve (12) months of the date of issuance. Failure to construct all of the necessary WORKS and use water for **hydrogeologic site assessment** purposes prior to the permit expiry date may result in cancellation of the application for a Water Rights Licence.
2. This Permit is not transferable or assignable to any other party.
3. The Permittee must have legal access to all lands occupied by the project.
4. The Permittee must hold and maintain all regulatory approvals and requirements for the construction of the WORKS as provided by this Permit.
5. Prior to undertaking any work or construction of any WORKS authorized by this Permit, the Permittee must retain the services of a hydrogeologist registered with Engineers Geoscientists Manitoba, who is required to:
 - a. Plan and supervise the drilling of boreholes, test well(s), production well(s), observation well(s) and well pump testing.
 - b. Conduct a constant rate pumping test on the proposed production well(s) in accordance with Form H. (https://www.gov.mb.ca/sd/pubs/water/form_h_july.pdf)
 - c. Conduct a recovery test for a period equal to pump test or 90% recovery, whichever comes first.
 - d. Conduct an inventory of private, agricultural and commercial wells within a one mile radius of the project well(s) site. The inventory may be expanded based on the assessment of the expected area of water level draw-down impact resulting from future pumping.
 - e. Install a lockable and permanent two-inch observation well with the location to be determined by the Hydrogeologist if the supply well(s) will be less than 800 m from any existing wells.
 - f. Prepare and submit to the Water Use Licensing Section a technical report on the drilling of boreholes and test wells, pump testing of wells, well inventory and water quality sampling. The report must contain: well driller's report for test well(s) production well(s) and observation well(s); a location plan of the well(s) on the property and/or GPS locations of the well(s); an analysis of aquifer pumping tests; and calculations of transmissivity. The report must also indicate if any local wells are expected to be adversely affected by the proposed use of water and where these wells are located. A digital copy of the report must be submitted.
6. The Permittee must cease pumping immediately if any local water supplies are negatively impacted as a result of the pumping tests. The Permittee is also responsible to correct any water supply problems or provide a temporary water supply to anyone whose water supplies are negatively impacted as a result of the tests.
7. The Permittee shall assume any liability that may result from the construction of the WORKS.
8. The Province of Manitoba shall hereby be released from any liability or claims for damages that may result from the construction of the WORKS.
9. The Minister or Minister's agents have the right of unrestricted access for the purpose of inspection of any WORKS constructed under this Permit.
10. The issuance of this Permit does not imply that the Department will extend or renew the Permit in subsequent years.

11. A water use monitoring device must be installed on the pipeline from the supply well(s), positioned to accurately measure instantaneous pumping rate and accumulative withdrawals.

FOR OFFICE USE ONLY

Issued at the City of Winnipeg, in the Province of Manitoba, this 21st day of January A.D. 2026.

Kylene Wiseman

Print Name

Signature

Signed by the Minister charged with the administration of The Water Rights Act (or her/his designate)

**GROUNDWATER
EXPLORATION
PERMIT**



Issued in accordance with the provisions
The Water Rights Act and regulations made thereunder.

Project: Armstrong Separated Sewer Construction - Leila & Jack Donner

Subject to the terms and conditions contained in this Groundwater Exploration Permit, the Minister charged with administration of The Water Rights Act authorizes:

The City of Winnipeg

In the province of Manitoba, to explore for groundwater; as well as construct water well(s), install pump(s) and transmittal pipeline(s) (the “WORKS”) for **hydrogeologic site assessment** purposes on the following land:

River Lot 15, Parish of Kildonan

This Groundwater Exploration Permit does not authorize diversion and use of water for **hydrogeologic site assessment** purposes.

The WORKS shall be constructed in accordance with the terms and conditions described as follows:

1. This Permit expires within twelve (12) months of the date of issuance. Failure to construct all of the necessary WORKS and use water for **hydrogeologic site assessment** purposes prior to the permit expiry date may result in cancellation of the application for a Water Rights Licence.
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 - b. Conduct a constant rate pumping test on the proposed production well(s) in accordance with Form H. (https://www.gov.mb.ca/sd/pubs/water/form_h_july.pdf)
 - c. Conduct a recovery test for a period equal to pump test or 90% recovery, whichever comes first.
 - d. Conduct an inventory of private, agricultural and commercial wells within a one mile radius of the project well(s) site. The inventory may be expanded based on the assessment of the expected area of water level draw-down impact resulting from future pumping.
 - e. Install a lockable and permanent two-inch observation well with the location to be determined by the Hydrogeologist if the supply well(s) will be less than 800 m from any existing wells.
 - f. Prepare and submit to the Water Use Licensing Section a technical report on the drilling of boreholes and test wells, pump testing of wells, well inventory and water quality sampling. The report must contain: well driller's report for test well(s) production well(s) and observation well(s); a location plan of the well(s) on the property and/or GPS locations of the well(s); an analysis of aquifer pumping tests; and calculations of transmissivity. The report must also indicate if any local wells are expected to be adversely affected by the proposed use of water and where these wells are located. A digital copy of the report must be submitted.
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7. The Permittee shall assume any liability that may result from the construction of the WORKS.
8. The Province of Manitoba shall hereby be released from any liability or claims for damages that may result from the construction of the WORKS.
9. The Minister or Minister's agents have the right of unrestricted access for the purpose of inspection of any WORKS constructed under this Permit.
10. The issuance of this Permit does not imply that the Department will extend or renew the Permit in subsequent years.

11. A water use monitoring device must be installed on the pipeline from the supply well(s), positioned to accurately measure instantaneous pumping rate and accumulative withdrawals.

FOR OFFICE USE ONLY

Issued at the City of Winnipeg, in the Province of Manitoba, this 21st day of January A.D. 2026.

<u>Kylene Wiseman</u>	
Print Name	Signature

Signed by the Minister charged with the administration of The Water Rights Act (or her/his designate)

APPENDIX F

Laboratory Certificates of Analysis

CERTIFICATE OF ANALYSIS

Work Order : WP2600606**Amendment : 2****Client : KGS Group****Contact : Paul Lindell****Address : 3rd Floor - 865 Waverly Street
Winnipeg Manitoba Canada R3T 5P4****Telephone : 204 803 0720****Project : 25-0107-002 phase.task 5000.03****PO : ----****C-O-C number : ----****Sampler : ----****Site : ----****Quote number : 2026 standing offer pricing****No. of samples received : 1****No. of samples analysed : 1****Laboratory : ALS Environmental - Winnipeg****Account Manager : Judy Dalmaijer****Address : 1329 Niakwa Road East, Unit 12
Winnipeg MB Canada R2J 3T4****E-mail : Judy.Dalmaijer@ALSGlobal.com****Telephone : +1 204 255 9720****Date Samples Received : 16-Jan-2026 15:22****Date Analysis Commenced : 16-Jan-2026****Issue Date : 18-Feb-2026 13:58**

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Lee McTavish		Metals, Winnipeg, Manitoba
Lee McTavish		Inorganics, Winnipeg, Manitoba



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key: CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
LOR: Limit of Reporting (detection limit).

Unit	Description
-	no units
%	percent
meq/L	milliequivalents per litre
mg/L	milligrams per litre
NTU	nephelometric turbidity units
pH units	pH units
µS/cm	microsiemens per centimetre

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED ON SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Workorder Comments

Amendment (23-Jan-26): This report has been amended to alter the project reference code. All analysis results are as per the previous report.

Amendment (18-Feb-26): This report has been amended as a result of a request to change sample identification numbers (IDs) received by. All analysis results are as per the previous report.

Qualifiers

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).



Analytical Results

Sub-Matrix: Water

(Matrix: Water)

					Client sample ID	PW26-AM-01	----	----	----	----
					Client sampling date / time	16-Jan-2026 00:00	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2600606-001	----	----	----	----	----
Result						----	----	----	----	----
Physical Tests										
Alkalinity, bicarbonate (as CaCO ₃)	----	E290/WP	1.0	mg/L	335	----	----	----	----	----
Alkalinity, carbonate (as CaCO ₃)	----	E290/WP	1.0	mg/L	<1.0	----	----	----	----	----
Alkalinity, hydroxide (as CaCO ₃)	----	E290/WP	1.0	mg/L	<1.0	----	----	----	----	----
Alkalinity, total (as CaCO ₃)	----	E290/WP	1.0	mg/L	335	----	----	----	----	----
Conductivity	----	E100/WP	1.0	µS/cm	1630	----	----	----	----	----
Hardness (as CaCO ₃), dissolved	----	EC100/WP	0.50	mg/L	485	----	----	----	----	----
pH	----	E108/WP	0.10	pH units	8.02	----	----	----	----	----
Solids, total dissolved [TDS], calculated	----	EC103/WP	1.0	mg/L	979	----	----	----	----	----
Turbidity	----	E121/WP	0.10	NTU	2.51	----	----	----	----	----
Anions and Nutrients										
Chloride	16887-00-6	E235.Cl-L/WP	0.10	mg/L	237	----	----	----	----	----
Fluoride	16984-48-8	E235.F/WP	0.020	mg/L	0.173	----	----	----	----	----
Nitrate (as N)	14797-55-8	E235.NO ₃ -L/WP	0.0050	mg/L	<0.0250 ^{DLM}	----	----	----	----	----
Nitrite (as N)	14797-65-0	E235.NO ₂ -L/WP	0.0010	mg/L	<0.0050 ^{DLM}	----	----	----	----	----
Sulfate (as SO ₄)	14808-79-8	E235.SO ₄ /WP	0.30	mg/L	184	----	----	----	----	----
Nitrate + Nitrite (as N)	----	EC235.N+N/WP	0.0050	mg/L	<0.025	----	----	----	----	----
Ion Balance										
Anion sum	----	EC101/WP	0.10	meq/L	17.2	----	----	----	----	----
Cation sum	----	EC101/WP	0.10	meq/L	17.7	----	----	----	----	----
Ion balance (APHA)	----	EC101/WP	0.01	%	1.43	----	----	----	----	----



Analytical Results

Sub-Matrix: Water
 (Matrix: Water)

					Client sample ID	PW26-AM-01	----	----	----	----
					Client sampling date / time	16-Jan-2026 00:00	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2600606-001	----	----	----	----	----
						Result	----	----	----	----
Dissolved Metals										
Aluminum, dissolved	7429-90-5	E421/WP	0.0010	mg/L	0.00058	----	----	----	----	----
Antimony, dissolved	7440-36-0	E421/WP	0.00010	mg/L	0.000022	----	----	----	----	----
Arsenic, dissolved	7440-38-2	E421/WP	0.00010	mg/L	0.00012	----	----	----	----	----
Barium, dissolved	7440-39-3	E421/WP	0.00010	mg/L	0.0174	----	----	----	----	----
Beryllium, dissolved	7440-41-7	E421/WP	0.000020	mg/L	Not Detected	----	----	----	----	----
Bismuth, dissolved	7440-69-9	E421/WP	0.000050	mg/L	Not Detected	----	----	----	----	----
Boron, dissolved	7440-42-8	E421/WP	0.010	mg/L	0.316	----	----	----	----	----
Cadmium, dissolved	7440-43-9	E421/WP	0.0000050	mg/L	0.0000011	----	----	----	----	----
Calcium, dissolved	7440-70-2	E421/WP	0.050	mg/L	82.9	----	----	----	----	----
Cesium, dissolved	7440-46-2	E421/WP	0.000010	mg/L	0.000018	----	----	----	----	----
Chromium, dissolved	7440-47-3	E421/WP	0.00050	mg/L	Not Detected	----	----	----	----	----
Cobalt, dissolved	7440-48-4	E421/WP	0.00010	mg/L	0.00022	----	----	----	----	----
Copper, dissolved	7440-50-8	E421/WP	0.00020	mg/L	0.00033	----	----	----	----	----
Iron, dissolved	7439-89-6	E421/WP	0.010	mg/L	Not Detected	----	----	----	----	----
Lead, dissolved	7439-92-1	E421/WP	0.000050	mg/L	Not Detected	----	----	----	----	----
Lithium, dissolved	7439-93-2	E421/WP	0.0010	mg/L	0.0763	----	----	----	----	----
Magnesium, dissolved	7439-95-4	E421/WP	0.0050	mg/L	67.5	----	----	----	----	----
Manganese, dissolved	7439-96-5	E421/WP	0.00010	mg/L	0.00863	----	----	----	----	----
Molybdenum, dissolved	7439-98-7	E421/WP	0.000050	mg/L	0.000576	----	----	----	----	----
Nickel, dissolved	7440-02-0	E421/WP	0.00050	mg/L	0.00058	----	----	----	----	----



Analytical Results

Sub-Matrix: Water
 (Matrix: Water)

					Client sample ID	PW26-AM-01	----	----	----	----
					Client sampling date / time	16-Jan-2026 00:00	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2600606-001	----	----	----	----	----
					Result	----	----	----	----	----
Dissolved Metals										
Phosphorus, dissolved	7723-14-0	E421/WP	0.050	mg/L	0.0065	----	----	----	----	----
Potassium, dissolved	7440-09-7	E421/WP	0.050	mg/L	11.8	----	----	----	----	----
Rubidium, dissolved	7440-17-7	E421/WP	0.00020	mg/L	0.00458	----	----	----	----	----
Selenium, dissolved	7782-49-2	E421/WP	0.000050	mg/L	0.000115	----	----	----	----	----
Silicon, dissolved	7440-21-3	E421/WP	0.050	mg/L	6.09	----	----	----	----	----
Silver, dissolved	7440-22-4	E421/WP	0.000010	mg/L	Not Detected	----	----	----	----	----
Sodium, dissolved	7440-23-5	E421/WP	0.050	mg/L	178	----	----	----	----	----
Strontium, dissolved	7440-24-6	E421/WP	0.00020	mg/L	0.697	----	----	----	----	----
Sulfur, dissolved	7704-34-9	E421/WP	0.50	mg/L	75.6	----	----	----	----	----
Tellurium, dissolved	13494-80-9	E421/WP	0.00020	mg/L	0.000033	----	----	----	----	----
Thallium, dissolved	7440-28-0	E421/WP	0.000010	mg/L	0.0000067	----	----	----	----	----
Thorium, dissolved	7440-29-1	E421/WP	0.00010	mg/L	Not Detected	----	----	----	----	----
Tin, dissolved	7440-31-5	E421/WP	0.00010	mg/L	Not Detected	----	----	----	----	----
Titanium, dissolved	7440-32-6	E421/WP	0.00030	mg/L	0.000039	----	----	----	----	----
Tungsten, dissolved	7440-33-7	E421/WP	0.00010	mg/L	Not Detected	----	----	----	----	----
Uranium, dissolved	7440-61-1	E421/WP	0.000010	mg/L	0.00190	----	----	----	----	----
Vanadium, dissolved	7440-62-2	E421/WP	0.00050	mg/L	0.00033	----	----	----	----	----
Zinc, dissolved	7440-66-6	E421/WP	0.0010	mg/L	0.0064	----	----	----	----	----
Zirconium, dissolved	7440-67-7	E421/WP	0.00030	mg/L	Not Detected	----	----	----	----	----
Dissolved metals filtration location	----	EP421/WP	-	-	Laboratory	----	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.



QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WP2600606	Page	: 1 of 8
Amendment	: 2		
Client	: KGS Group	Laboratory	: ALS Environmental - Winnipeg
Contact	: Paul Lindell	Account Manager	: Judy Dalmajjer
Address	: 3rd Floor - 865 Waverly Street Winnipeg MB Canada R3T 5P4	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg, Manitoba Canada R2J 3T4
Telephone	: 204 803 0720	Telephone	: +1 204 255 9720
Project	: 25-0107-002 phase.task 5000.03	Date Samples Received	: 16-Jan-2026 15:22
PO	: ----	Issue Date	: 18-Feb-2026 13:58
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: 2026 standing offer pricing_V2		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Anions and Nutrients : Chloride in Water by IC (Low Level)										
HDPE PW26-AM-01	E235.Cl-L	16-Jan-2026	16-Jan-2026	28 days	1 days	✓	16-Jan-2026	28 days	1 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE PW26-AM-01	E235.F	16-Jan-2026	16-Jan-2026	28 days	1 days	✓	16-Jan-2026	28 days	1 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE PW26-AM-01	E235.NO3-L	16-Jan-2026	16-Jan-2026	3 days	1 days	✓	16-Jan-2026	3 days	1 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE PW26-AM-01	E235.NO2-L	16-Jan-2026	16-Jan-2026	3 days	1 days	✓	16-Jan-2026	3 days	1 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE PW26-AM-01	E235.SO4	16-Jan-2026	16-Jan-2026	28 days	1 days	✓	16-Jan-2026	28 days	1 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) PW26-AM-01	E421	16-Jan-2026	21-Jan-2026	180 days	6 days	✓	21-Jan-2026	180 days	6 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE PW26-AM-01	E290	16-Jan-2026	19-Jan-2026	14 days	4 days	✓	19-Jan-2026	14 days	4 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Conductivity in Water										
HDPE PW26-AM-01	E100	16-Jan-2026	19-Jan-2026	28 days	4 days	✓	19-Jan-2026	28 days	4 days	✓
Physical Tests : pH by Meter										
HDPE PW26-AM-01	E108	16-Jan-2026	19-Jan-2026	0.25 hrs	86 hrs	✖ EHTR-FM	19-Jan-2026	0.25 hrs	86 hrs	✖ EHTR-FM
Physical Tests : Turbidity by Nephelometry										
HDPE PW26-AM-01	E121	16-Jan-2026	----	----	----		19-Jan-2026	3 days	4 days	✓

Legend & Qualifier Definitions

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water** Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Conductivity in Water	E100	2422312	1	15	6.6	5.0	✓
pH by Meter	E108	2422314	1	20	5.0	5.0	✓
Turbidity by Nephelometry	E121	2422296	1	1	100.0	5.0	✓
Chloride in Water by IC (Low Level)	E235.Cl-L	2421735	0	1	0.0	5.0	✗
Fluoride in Water by IC	E235.F	2421734	1	2	50.0	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2421737	0	1	0.0	5.0	✗
Nitrate in Water by IC (Low Level)	E235.NO3-L	2421736	0	1	0.0	5.0	✗
Sulfate in Water by IC	E235.SO4	2421732	1	2	50.0	5.0	✓
Alkalinity Species by Titration	E290	2422313	1	13	7.6	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2425271	1	10	10.0	5.0	✓
Laboratory Control Samples (LCS)							
Conductivity in Water	E100	2422312	1	15	6.6	5.0	✓
pH by Meter	E108	2422314	1	20	5.0	5.0	✓
Turbidity by Nephelometry	E121	2422296	1	1	100.0	5.0	✓
Chloride in Water by IC (Low Level)	E235.Cl-L	2421735	1	1	100.0	5.0	✓
Fluoride in Water by IC	E235.F	2421734	1	2	50.0	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2421737	1	1	100.0	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	2421736	1	1	100.0	5.0	✓
Sulfate in Water by IC	E235.SO4	2421732	1	2	50.0	5.0	✓
Alkalinity Species by Titration	E290	2422313	1	13	7.6	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2425271	1	10	10.0	5.0	✓
Method Blanks (MB)							
Conductivity in Water	E100	2422312	1	15	6.6	5.0	✓
Turbidity by Nephelometry	E121	2422296	1	1	100.0	5.0	✓
Chloride in Water by IC (Low Level)	E235.Cl-L	2421735	1	1	100.0	5.0	✓
Fluoride in Water by IC	E235.F	2421734	1	2	50.0	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2421737	1	1	100.0	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	2421736	1	1	100.0	5.0	✓
Sulfate in Water by IC	E235.SO4	2421732	1	2	50.0	5.0	✓
Alkalinity Species by Titration	E290	2422313	1	13	7.6	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2425271	1	10	10.0	5.0	✓
Matrix Spikes (MS)							
Chloride in Water by IC (Low Level)	E235.Cl-L	2421735	0	1	0.0	5.0	✗
Fluoride in Water by IC	E235.F	2421734	1	2	50.0	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2421737	0	1	0.0	5.0	✗

Page : 6 of 8
 Work Order : WP2600606 Amendment 2
 Client : KGS Group
 Project : 25-0107-002 phase.task 5000.03



Matrix: **Water**
Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
<i>Analytical Methods</i>	<i>Method</i>	<i>QC Lot #</i>	<i>QC</i>	<i>Regular</i>	<i>Actual</i>	<i>Expected</i>	<i>Evaluation</i>
Matrix Spikes (MS) - Continued							
Nitrate in Water by IC (Low Level)	E235.NO3-L	2421736	0	1	0.0	5.0	✖
Sulfate in Water by IC	E235.SO4	2421732	1	2	50.0	5.0	✔
Dissolved Metals in Water by CRC ICPMS	E421	2425271	1	10	10.0	5.0	✔



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Water	E100 ALS Environmental - Winnipeg	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 ALS Environmental - Winnipeg	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally $20 \pm 5^\circ\text{C}$). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
Turbidity by Nephelometry	E121 ALS Environmental - Winnipeg	Water	APHA 2130 B (mod)	Turbidity is measured by the nephelometric method, by measuring the intensity of light scatter under defined conditions.
Chloride in Water by IC (Low Level)	E235.Cl-L ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite in Water by IC (Low Level)	E235.NO2-L ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC (Low Level)	E235.NO3-L ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 ALS Environmental - Winnipeg	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Dissolved Metals in Water by CRC ICPMS	E421 ALS Environmental - Winnipeg	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Hardness (Calculated)	EC100 ALS Environmental - Winnipeg	Water	APHA 2340B	"Hardness (as CaCO ₃), dissolved" is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations.
Ion Balance using Dissolved Metals	EC101 ALS Environmental - Winnipeg	Water	APHA 1030E	Cation Sum, Anion Sum, and Ion Balance are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present. Ion Balance cannot be calculated accurately for waters with very low electrical conductivity (EC).
TDS in Water (Calculation)	EC103 ALS Environmental - Winnipeg	Water	APHA 1030E (mod)	Total Dissolved Solids is calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N ALS Environmental - Winnipeg	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Dissolved Metals Water Filtration	EP421 ALS Environmental - Winnipeg	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO ₃ .



QUALITY CONTROL REPORT

Work Order	: WP2600606		
Amendment	: 2		
Client	: KGS Group	Laboratory	: ALS Environmental - Winnipeg
Contact	: Paul Lindell	Account Manager	: Judy Dalmajjer
Address	: 3rd Floor - 865 Waverly Street Winnipeg MB Canada R3T 5P4	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg MB Canada R2J 3T4
Telephone	: 204 803 0720	Telephone	: +1 204 255 9720
Project	: 25-0107-002 phase.task 5000.03	Date Samples Received	: 16-Jan-2026 15:22
PO	: ----	Date Analysis Commenced	: 16-Jan-2026
C-O-C number	: ----	Issue Date	: 18-Feb-2026 13:58
Sampler	: ----		
Site	: ----		
Quote number	: 2026 standing offer pricing		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Lee McTavish		Winnipeg Inorganics, Winnipeg, Manitoba
Lee McTavish		Winnipeg Metals, Winnipeg, Manitoba



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key:

- Anonymous=Refers to samples which are not part of this work order, but which formed part of the QC process lot.
- CAS Number=Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
- DQO=Data Quality Objective.
- LOR=Limit of Reporting (detection limit).
- RPD=Relative Percent Difference
- # =Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test specific).

Sub-Matrix: Water

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests(QC Lot: 2422296)											
WP2600606-001	PW26-AM-01	Turbidity	----	E121	0.10	NTU	2.51	2.42	3.41 %	15%	---
Physical Tests(QC Lot: 2422312)											
WP2600577-001	Anonymous	Conductivity	----	E100	2.0	µS/cm	589	589	0.00 %	10%	---
Physical Tests(QC Lot: 2422313)											
WP2600577-001	Anonymous	Alkalinity, total (as CaCO3)	----	E290	1.0	mg/L	99.4	98.6	0.808 %	20%	---
Physical Tests(QC Lot: 2422314)											
WP2600577-001	Anonymous	pH	----	E108	0.10	pH units	7.65	7.69	0.522 %	4%	---
Anions and Nutrients(QC Lot: 2421732)											
WP2600597-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	4.23	4.17	1.30 %	20%	---
Anions and Nutrients(QC Lot: 2421734)											
WP2600597-001	Anonymous	Fluoride	16984-48-8	E235.F	0.020	mg/L	0.065	0.062	0.003	Diff <2x LOR	---
Dissolved Metals(QC Lot: 2425271)											
WP2600577-001	Anonymous	Aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	---
		Antimony, dissolved	7440-36-0	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.00055	0.00053	0.00002	Diff <2x LOR	---
		Barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.0172	0.0168	1.84 %	20%	---
		Beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	---
		Bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	---
		Boron, dissolved	7440-42-8	E421	0.010	mg/L	0.064	0.064	0.0007	Diff <2x LOR	---
		Cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	---
		Calcium, dissolved	7440-70-2	E421	0.050	mg/L	37.4	38.8	3.90 %	20%	---
		Cesium, dissolved	7440-46-2	E421	0.000010	mg/L	0.000018	0.000022	0.000003	Diff <2x LOR	---
		Chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	---
		Cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00159	0.00159	0.000008	Diff <2x LOR	---
		Iron, dissolved	7439-89-6	E421	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	---
		Lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	---
		Lithium, dissolved	7439-93-2	E421	0.0010	mg/L	0.0029	0.0030	0.00006	Diff <2x LOR	---
		Magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	9.82	9.66	1.70 %	20%	---
		Manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.00100	0.00099	0.000009	Diff <2x LOR	---
		Molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.00271	0.00273	1.01 %	20%	---
		Nickel, dissolved	7440-02-0	E421	0.00050	mg/L	0.00073	0.00076	0.00002	Diff <2x LOR	---
		Phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	---
		Potassium, dissolved	7440-09-7	E421	0.050	mg/L	3.66	3.67	0.247 %	20%	---



Sub-Matrix: Water

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Dissolved Metals(QC Lot: 2425271)											
		Rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	0.00344	0.00340	1.35 %	20%	---
		Selenium, dissolved	7782-49-2	E421	0.000050	mg/L	0.000060	0.000055	0.000006	Diff <2x LOR	---
		Silicon, dissolved	7440-21-3	E421	0.050	mg/L	0.722	0.697	3.56 %	20%	---
		Silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	---
		Sodium, dissolved	7440-23-5	E421	0.050	mg/L	68.3	65.9	3.67 %	20%	---
		Strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.238	0.232	2.68 %	20%	---
		Sulfur, dissolved	7704-34-9	E421	0.50	mg/L	10.8	10.7	1.03 %	20%	---
		Tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	---
		Thallium, dissolved	7440-28-0	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	---
		Thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Tin, dissolved	7440-31-5	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Titanium, dissolved	7440-32-6	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	---
		Tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.000215	0.000229	6.35 %	20%	---
		Vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	---
		Zinc, dissolved	7440-66-6	E421	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	---
		Zirconium, dissolved	7440-67-7	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	---

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests(QC Lot: 2422296)						
Turbidity	----	E121	0.1	NTU	<0.10	----
Physical Tests(QC Lot: 2422312)						
Conductivity	----	E100	1	µS/cm	<1.0	----
Physical Tests(QC Lot: 2422313)						
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Physical Tests(QC Lot: 2422314)						
pH	----	E108	----	pH units	----	----



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Anions and Nutrients(QC Lot: 2421732)						
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients(QC Lot: 2421734)						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients(QC Lot: 2421735)						
Chloride	16887-00-6	E235.Cl-L	0.1	mg/L	<0.10	----
Anions and Nutrients(QC Lot: 2421736)						
Nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	<0.0050	----
Anions and Nutrients(QC Lot: 2421737)						
Nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	<0.0010	----
Dissolved Metals(QC Lot: 2425271)						
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	----
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
Bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	<0.000050	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
Cesium, dissolved	7440-46-2	E421	0.00001	mg/L	<0.000010	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
Lithium, dissolved	7439-93-2	E421	0.001	mg/L	<0.0010	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
Phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	<0.050	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
Rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	<0.00020	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
Silicon, dissolved	7440-21-3	E421	0.05	mg/L	<0.050	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals(QC Lot: 2425271)						
Strontium, dissolved	7440-24-6	E421	0.0002	mg/L	<0.00020	----
Sulfur, dissolved	7704-34-9	E421	0.5	mg/L	<0.50	----
Tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	<0.00020	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----
Thorium, dissolved	7440-29-1	E421	0.0001	mg/L	<0.00010	----
Tin, dissolved	7440-31-5	E421	0.0001	mg/L	<0.00010	----
Titanium, dissolved	7440-32-6	E421	0.0003	mg/L	<0.00030	----
Tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	<0.00010	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	<0.00050	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----
Zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	<0.00020	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests(QC Lot: 2422296)									
Turbidity	----	E121	0.1	NTU	200 NTU	99.1	85.0	115	----
Physical Tests(QC Lot: 2422312)									
Conductivity	----	E100	1	µS/cm	1412 µS/cm	99.1	90.0	110	----
Physical Tests(QC Lot: 2422313)									
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	100 mg/L	101	85.0	115	----
Physical Tests(QC Lot: 2422314)									
pH	----	E108	----	pH units	7 pH units	101	98.0	102	----
Anions and Nutrients(QC Lot: 2421732)									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	101	90.0	110	----
Anions and Nutrients(QC Lot: 2421734)									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	100	90.0	110	----
Anions and Nutrients(QC Lot: 2421735)									
Chloride	16887-00-6	E235.Cl-L	0.1	mg/L	100 mg/L	99.8	90.0	110	----
Anions and Nutrients(QC Lot: 2421736)									
Nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	100.0	90.0	110	----



Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Anions and Nutrients(QC Lot: 2421737)									
Nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	101	90.0	110	----
Dissolved Metals(QC Lot: 2425271)									
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	98.8	80.0	120	----
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	103	80.0	120	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	99.6	80.0	120	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	100	80.0	120	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	101	80.0	120	----
Bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	97.9	80.0	120	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	102	80.0	120	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	99.9	80.0	120	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	99.3	80.0	120	----
Cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	101	80.0	120	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	99.2	80.0	120	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	97.2	80.0	120	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	99.2	80.0	120	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	97.3	80.0	120	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	98.8	80.0	120	----
Lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	97.8	80.0	120	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	103	80.0	120	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	96.9	80.0	120	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	100	80.0	120	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	96.6	80.0	120	----
Phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	104	80.0	120	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	94.0	80.0	120	----
Rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	0.1 mg/L	99.8	80.0	120	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	97.0	80.0	120	----
Silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	101	80.0	120	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	88.9	80.0	120	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	99.2	80.0	120	----
Strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	101	80.0	120	----
Sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	101	80.0	120	----
Tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	95.8	80.0	120	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	97.9	80.0	120	----
Thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	99.0	80.0	120	----
Tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	101	80.0	120	----
Titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	95.4	80.0	120	----
Tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	101	80.0	120	----



Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Dissolved Metals(QC Lot: 2425271)									
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	100	80.0	120	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	99.7	80.0	120	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	96.9	80.0	120	----
Zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	96.9	80.0	120	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for

Sub-Matrix: Water

					Matrix Spike (MS) Report				
					Spike		Recovery (%)	Recovery (%)	
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High
Anions and Nutrients(QC Lot: 2421732)									
WP2600597-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	98.2 mg/L	100 mg/L	98.2	75.0	125
Anions and Nutrients(QC Lot: 2421734)									
WP2600597-001	Anonymous	Fluoride	16984-48-8	E235.F	1.00 mg/L	1 mg/L	100	75.0	125
Dissolved Metals(QC Lot: 2425271)									
WP2600577-001	Anonymous	Aluminum, dissolved	7429-90-5	E421	0.213 mg/L	0.2 mg/L	107	70.0	130
		Antimony, dissolved	7440-36-0	E421	0.0207 mg/L	0.02 mg/L	104	70.0	130
		Arsenic, dissolved	7440-38-2	E421	0.0228 mg/L	0.02 mg/L	114	70.0	130
		Barium, dissolved	7440-39-3	E421	0.0213 mg/L	0.02 mg/L	107	70.0	130
		Beryllium, dissolved	7440-41-7	E421	0.0423 mg/L	0.04 mg/L	106	70.0	130
		Bismuth, dissolved	7440-69-9	E421	0.00981 mg/L	0.01 mg/L	98.1	70.0	130
		Boron, dissolved	7440-42-8	E421	0.101 mg/L	0.1 mg/L	101	70.0	130
		Cadmium, dissolved	7440-43-9	E421	0.00435 mg/L	0.004 mg/L	109	70.0	130
		Calcium, dissolved	7440-70-2	E421	ND	----	ND	70.0	130
		Cesium, dissolved	7440-46-2	E421	0.0105 mg/L	0.01 mg/L	105	70.0	130
		Chromium, dissolved	7440-47-3	E421	0.0424 mg/L	0.04 mg/L	106	70.0	130
		Cobalt, dissolved	7440-48-4	E421	0.0207 mg/L	0.02 mg/L	103	70.0	130
		Copper, dissolved	7440-50-8	E421	0.0207 mg/L	0.02 mg/L	104	70.0	130
		Iron, dissolved	7439-89-6	E421	2.09 mg/L	2 mg/L	104	70.0	130
		Lead, dissolved	7439-92-1	E421	0.0203 mg/L	0.02 mg/L	102	70.0	130
		Lithium, dissolved	7439-93-2	E421	0.105 mg/L	0.1 mg/L	105	70.0	130



Sub-Matrix: Water

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery (%)		Qualifier
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	
Dissolved Metals(QC Lot: 2425271)										
		Magnesium, dissolved	7439-95-4	E421	ND	----	ND	70.0	130	---
		Manganese, dissolved	7439-96-5	E421	0.0204 mg/L	0.02 mg/L	102	70.0	130	---
		Molybdenum, dissolved	7439-98-7	E421	0.0207 mg/L	0.02 mg/L	103	70.0	130	---
		Nickel, dissolved	7440-02-0	E421	0.0407 mg/L	0.04 mg/L	102	70.0	130	---
		Phosphorus, dissolved	7723-14-0	E421	11.3 mg/L	10 mg/L	113	70.0	130	---
		Potassium, dissolved	7440-09-7	E421	4.23 mg/L	4 mg/L	106	70.0	130	---
		Rubidium, dissolved	7440-17-7	E421	0.0210 mg/L	0.02 mg/L	105	70.0	130	---
		Selenium, dissolved	7782-49-2	E421	0.0441 mg/L	0.04 mg/L	110	70.0	130	---
		Silicon, dissolved	7440-21-3	E421	9.80 mg/L	10 mg/L	98.0	70.0	130	---
		Silver, dissolved	7440-22-4	E421	0.00311 mg/L	0.004 mg/L	77.8	70.0	130	---
		Sodium, dissolved	7440-23-5	E421	ND	----	ND	70.0	130	---
		Strontium, dissolved	7440-24-6	E421	ND	----	ND	70.0	130	---
		Sulfur, dissolved	7704-34-9	E421	22.1 mg/L	20 mg/L	110	70.0	130	---
		Tellurium, dissolved	13494-80-9	E421	0.0411 mg/L	0.04 mg/L	103	70.0	130	---
		Thallium, dissolved	7440-28-0	E421	0.00401 mg/L	0.004 mg/L	100	70.0	130	---
		Thorium, dissolved	7440-29-1	E421	0.0221 mg/L	0.02 mg/L	110	70.0	130	---
		Tin, dissolved	7440-31-5	E421	0.0203 mg/L	0.02 mg/L	101	70.0	130	---
		Titanium, dissolved	7440-32-6	E421	0.0407 mg/L	0.04 mg/L	102	70.0	130	---
		Tungsten, dissolved	7440-33-7	E421	0.0208 mg/L	0.02 mg/L	104	70.0	130	---
		Uranium, dissolved	7440-61-1	E421	0.00437 mg/L	0.004 mg/L	109	70.0	130	---
		Vanadium, dissolved	7440-62-2	E421	0.109 mg/L	0.1 mg/L	109	70.0	130	---
		Zinc, dissolved	7440-66-6	E421	0.418 mg/L	0.4 mg/L	105	70.0	130	---
		Zirconium, dissolved	7440-67-7	E421	0.0402 mg/L	0.04 mg/L	101	70.0	130	---



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: **23 - 109**

Page 1 of 1

Environmental Division
Winnipeg

Work Order Reference
WP2600606

[illegible]

Telephone : +1 204 255 9720



For all tests with rush TATs requested, please contact your AM to confirm availability

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JAN 2023 FRONT

CERTIFICATE OF ANALYSIS

Work Order	: WP2601180		
Amendment	: 1		
Client	: KGS Group	Laboratory	: ALS Environmental - Winnipeg
Contact	: Simratpal Singh	Account Manager	: Judy Dalmajjer
Address	: 3rd Floor - 865 Waverly Street Winnipeg Manitoba Canada R3T 5P4	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg MB Canada R2J 3T4
Telephone	: ----	E-mail	: Judy.Dalmajjer@ALSGlobal.com
Project	: 25-0107-002.5000.07	Telephone	: +1 204 255 9720
PO	: ----	Date Samples Received	: 30-Jan-2026 08:04
C-O-C number	: ----	Date Analysis Commenced	: 30-Jan-2026
Sampler	: ----	Issue Date	: 18-Feb-2026 13:55
Site	: ----		
Quote number	: 2026 standing offer pricing		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Lee McTavish		Metals, Winnipeg, Manitoba
Lee McTavish		Inorganics, Winnipeg, Manitoba
Leila Conyard	Lab Assistant	Metals, Winnipeg, Manitoba



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key: CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
LOR: Limit of Reporting (detection limit).

Unit	Description
-	no units
%	percent
meq/L	milliequivalents per litre
mg/L	milligrams per litre
NTU	nephelometric turbidity units
pH units	pH units
µS/cm	microsiemens per centimetre

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).



Analytical Results

Sub-Matrix: Water

(Matrix: Water)

					Client sample ID	PW26-LM-01	----	----	----	----
					Client sampling date / time	28-Jan-2026 00:00	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2601180-001	----	----	----	----	----
						Result	----	----	----	----
Physical Tests										
Alkalinity, bicarbonate (as CaCO ₃)	----	E290/WP	1.0	mg/L	317	----	----	----	----	----
Alkalinity, carbonate (as CaCO ₃)	----	E290/WP	1.0	mg/L	<1.0	----	----	----	----	----
Alkalinity, hydroxide (as CaCO ₃)	----	E290/WP	1.0	mg/L	<1.0	----	----	----	----	----
Alkalinity, total (as CaCO ₃)	----	E290/WP	1.0	mg/L	317	----	----	----	----	----
Conductivity	----	E100/WP	1.0	µS/cm	1600	----	----	----	----	----
Hardness (as CaCO ₃), dissolved	----	EC100/WP	0.50	mg/L	446	----	----	----	----	----
pH	----	E108/WP	0.10	pH units	7.77	----	----	----	----	----
Solids, total dissolved [TDS], calculated	----	EC103/WP	1.0	mg/L	987	----	----	----	----	----
Turbidity	----	E121/WP	0.10	NTU	284	----	----	----	----	----
Anions and Nutrients										
Chloride	16887-00-6	E235.Cl-L/WP	0.10	mg/L	245	----	----	----	----	----
Fluoride	16984-48-8	E235.F/WP	0.020	mg/L	0.249	----	----	----	----	----
Nitrate (as N)	14797-55-8	E235.NO3-L/WP	0.0050	mg/L	<0.0250 ^{DLM}	----	----	----	----	----
Nitrite (as N)	14797-65-0	E235.NO2-L/WP	0.0010	mg/L	<0.0050 ^{DLM}	----	----	----	----	----
Sulfate (as SO ₄)	14808-79-8	E235.SO4/WP	0.30	mg/L	196	----	----	----	----	----
Nitrate + Nitrite (as N)	----	EC235.N+N/WP	0.0050	mg/L	<0.025	----	----	----	----	----
Ion Balance										
Anion sum	----	EC101/WP	0.10	meq/L	17.3	----	----	----	----	----
Cation sum	----	EC101/WP	0.10	meq/L	17.5	----	----	----	----	----
Ion balance (APHA)	----	EC101/WP	0.01	%	0.57	----	----	----	----	----



Analytical Results

Sub-Matrix: Water
 (Matrix: Water)

					Client sample ID	PW26-LM-01	----	----	----	----
					Client sampling date / time	28-Jan-2026 00:00	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2601180-001	----	----	----	----	----
						Result	----	----	----	----
Dissolved Metals										
Aluminum, dissolved	7429-90-5	E421/WP	0.0010	mg/L	0.0027	----	----	----	----	----
Antimony, dissolved	7440-36-0	E421/WP	0.00010	mg/L	0.000012	----	----	----	----	----
Arsenic, dissolved	7440-38-2	E421/WP	0.00010	mg/L	0.00076	----	----	----	----	----
Barium, dissolved	7440-39-3	E421/WP	0.00010	mg/L	0.0158	----	----	----	----	----
Beryllium, dissolved	7440-41-7	E421/WP	0.000020	mg/L	Not Detected	----	----	----	----	----
Bismuth, dissolved	7440-69-9	E421/WP	0.000050	mg/L	Not Detected	----	----	----	----	----
Boron, dissolved	7440-42-8	E421/WP	0.010	mg/L	0.301	----	----	----	----	----
Cadmium, dissolved	7440-43-9	E421/WP	0.0000050	mg/L	0.0000012	----	----	----	----	----
Calcium, dissolved	7440-70-2	E421/WP	0.050	mg/L	70.6	----	----	----	----	----
Cesium, dissolved	7440-46-2	E421/WP	0.000010	mg/L	0.000011	----	----	----	----	----
Chromium, dissolved	7440-47-3	E421/WP	0.00050	mg/L	Not Detected	----	----	----	----	----
Cobalt, dissolved	7440-48-4	E421/WP	0.00010	mg/L	0.00026	----	----	----	----	----
Copper, dissolved	7440-50-8	E421/WP	0.00020	mg/L	0.00352	----	----	----	----	----
Iron, dissolved	7439-89-6	E421/WP	0.010	mg/L	0.0011	----	----	----	----	----
Lead, dissolved	7439-92-1	E421/WP	0.000050	mg/L	0.000017	----	----	----	----	----
Lithium, dissolved	7439-93-2	E421/WP	0.0010	mg/L	0.0570	----	----	----	----	----
Magnesium, dissolved	7439-95-4	E421/WP	0.0050	mg/L	65.4	----	----	----	----	----
Manganese, dissolved	7439-96-5	E421/WP	0.00010	mg/L	0.0176	----	----	----	----	----
Molybdenum, dissolved	7439-98-7	E421/WP	0.000050	mg/L	0.000830	----	----	----	----	----
Nickel, dissolved	7440-02-0	E421/WP	0.00050	mg/L	0.00058	----	----	----	----	----



Analytical Results

Sub-Matrix: Water
 (Matrix: Water)

					Client sample ID	PW26-LM-01	----	----	----	----
					Client sampling date / time	28-Jan-2026 00:00	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2601180-001	----	----	----	----	----
						Result	----	----	----	----
Dissolved Metals										
Phosphorus, dissolved	7723-14-0	E421/WP	0.050	mg/L	Not Detected	----	----	----	----	----
Potassium, dissolved	7440-09-7	E421/WP	0.050	mg/L	9.57	----	----	----	----	----
Rubidium, dissolved	7440-17-7	E421/WP	0.00020	mg/L	0.00282	----	----	----	----	----
Selenium, dissolved	7782-49-2	E421/WP	0.000050	mg/L	0.000065	----	----	----	----	----
Silicon, dissolved	7440-21-3	E421/WP	0.050	mg/L	6.40	----	----	----	----	----
Silver, dissolved	7440-22-4	E421/WP	0.000010	mg/L	Not Detected	----	----	----	----	----
Sodium, dissolved	7440-23-5	E421/WP	0.050	mg/L	193	----	----	----	----	----
Strontium, dissolved	7440-24-6	E421/WP	0.00020	mg/L	0.630	----	----	----	----	----
Sulfur, dissolved	7704-34-9	E421/WP	0.50	mg/L	77.5	----	----	----	----	----
Tellurium, dissolved	13494-80-9	E421/WP	0.00020	mg/L	Not Detected	----	----	----	----	----
Thallium, dissolved	7440-28-0	E421/WP	0.000010	mg/L	0.0000077	----	----	----	----	----
Thorium, dissolved	7440-29-1	E421/WP	0.00010	mg/L	Not Detected	----	----	----	----	----
Tin, dissolved	7440-31-5	E421/WP	0.00010	mg/L	Not Detected	----	----	----	----	----
Titanium, dissolved	7440-32-6	E421/WP	0.00030	mg/L	0.00019	----	----	----	----	----
Tungsten, dissolved	7440-33-7	E421/WP	0.00010	mg/L	0.000062	----	----	----	----	----
Uranium, dissolved	7440-61-1	E421/WP	0.000010	mg/L	0.00170	----	----	----	----	----
Vanadium, dissolved	7440-62-2	E421/WP	0.00050	mg/L	0.000065	----	----	----	----	----
Zinc, dissolved	7440-66-6	E421/WP	0.0010	mg/L	0.0216	----	----	----	----	----
Zirconium, dissolved	7440-67-7	E421/WP	0.00030	mg/L	0.000027	----	----	----	----	----
Dissolved metals filtration location	----	EP421/WP	-	-	Laboratory	----	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.



QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WP2601180	Page	: 1 of 9
Amendment	: 1		
Client	: KGS Group	Laboratory	: ALS Environmental - Winnipeg
Contact	: Simratpal Singh	Account Manager	: Judy Dalmajjer
Address	: 3rd Floor - 865 Waverly Street Winnipeg MB Canada R3T 5P4	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg, Manitoba Canada R2J 3T4
Telephone	: ----	Telephone	: +1 204 255 9720
Project	: 25-0107-002.5000.07	Date Samples Received	: 30-Jan-2026 08:04
PO	: ----	Issue Date	: 18-Feb-2026 13:54
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: 2026 standing offer pricing_V2		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- Matrix Spike outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.



Outliers : Quality Control Samples
Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Water**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Matrix Spike (MS) Recoveries								
Dissolved Metals	Anonymous	Anonymous	Arsenic, dissolved	7440-38-2	E421	131 % ^{MES}	70.0-130%	Recovery greater than upper data quality objective
Dissolved Metals	Anonymous	Anonymous	Selenium, dissolved	7782-49-2	E421	140 % ^{MES}	70.0-130%	Recovery greater than upper data quality objective

Result Qualifiers

Qualifier	Description
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Anions and Nutrients : Chloride in Water by IC (Low Level)										
HDPE PW26-LM-01	E235.Cl-L	28-Jan-2026	30-Jan-2026	28 days	2 days	✓	30-Jan-2026	28 days	2 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE PW26-LM-01	E235.F	28-Jan-2026	30-Jan-2026	28 days	2 days	✓	30-Jan-2026	28 days	2 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE PW26-LM-01	E235.NO3-L	28-Jan-2026	30-Jan-2026	3 days	2 days	✓	30-Jan-2026	3 days	2 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE PW26-LM-01	E235.NO2-L	28-Jan-2026	30-Jan-2026	3 days	2 days	✓	30-Jan-2026	3 days	2 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE PW26-LM-01	E235.SO4	28-Jan-2026	30-Jan-2026	28 days	2 days	✓	30-Jan-2026	28 days	2 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) PW26-LM-01	E421	28-Jan-2026	30-Jan-2026	180 days	2 days	✓	30-Jan-2026	180 days	2 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE PW26-LM-01	E290	28-Jan-2026	02-Feb-2026	14 days	6 days	✓	02-Feb-2026	14 days	6 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Conductivity in Water										
HDPE PW26-LM-01	E100	28-Jan-2026	02-Feb-2026	28 days	6 days	✓	02-Feb-2026	28 days	6 days	✓
Physical Tests : pH by Meter										
HDPE PW26-LM-01	E108	28-Jan-2026	02-Feb-2026	0.25 hrs	142 hrs	✖ EHTR-FM	02-Feb-2026	0.25 hrs	142 hrs	✖ EHTR-FM
Physical Tests : Turbidity by Nephelometry										
HDPE PW26-LM-01	E121	28-Jan-2026	----	----	----		30-Jan-2026	3 days	2 days	✓

Legend & Qualifier Definitions

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water** Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Conductivity in Water	E100	2437965	1	20	5.0	5.0	✓
pH by Meter	E108	2437963	1	20	5.0	5.0	✓
Turbidity by Nephelometry	E121	2435764	1	15	6.6	5.0	✓
Chloride in Water by IC (Low Level)	E235.Cl-L	2436273	0	8	0.0	5.0	✗
Fluoride in Water by IC	E235.F	2436267	1	11	9.0	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2436272	0	9	0.0	5.0	✗
Nitrate in Water by IC (Low Level)	E235.NO3-L	2436271	0	9	0.0	5.0	✗
Sulfate in Water by IC	E235.SO4	2436270	1	15	6.6	5.0	✓
Alkalinity Species by Titration	E290	2437964	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2435669	1	16	6.2	5.0	✓
Laboratory Control Samples (LCS)							
Conductivity in Water	E100	2437965	1	20	5.0	5.0	✓
pH by Meter	E108	2437963	1	20	5.0	5.0	✓
Turbidity by Nephelometry	E121	2435764	1	15	6.6	5.0	✓
Chloride in Water by IC (Low Level)	E235.Cl-L	2436273	1	8	12.5	5.0	✓
Fluoride in Water by IC	E235.F	2436267	1	11	9.0	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2436272	1	9	11.1	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	2436271	1	9	11.1	5.0	✓
Sulfate in Water by IC	E235.SO4	2436270	1	15	6.6	5.0	✓
Alkalinity Species by Titration	E290	2437964	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2435669	1	16	6.2	5.0	✓
Method Blanks (MB)							
Conductivity in Water	E100	2437965	1	20	5.0	5.0	✓
Turbidity by Nephelometry	E121	2435764	1	15	6.6	5.0	✓
Chloride in Water by IC (Low Level)	E235.Cl-L	2436273	1	8	12.5	5.0	✓
Fluoride in Water by IC	E235.F	2436267	1	11	9.0	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2436272	1	9	11.1	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	2436271	1	9	11.1	5.0	✓
Sulfate in Water by IC	E235.SO4	2436270	1	15	6.6	5.0	✓
Alkalinity Species by Titration	E290	2437964	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2435669	1	16	6.2	5.0	✓
Matrix Spikes (MS)							
Chloride in Water by IC (Low Level)	E235.Cl-L	2436273	0	8	0.0	5.0	✗
Fluoride in Water by IC	E235.F	2436267	1	11	9.0	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2436272	0	9	0.0	5.0	✗

Page : 7 of 9
 Work Order : WP2601180 Amendment 1
 Client : KGS Group
 Project : 25-0107-002.5000.07



Matrix: **Water**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Matrix Spikes (MS) - Continued							
Nitrate in Water by IC (Low Level)	E235.NO3-L	2436271	0	9	0.0	5.0	✖
Sulfate in Water by IC	E235.SO4	2436270	1	15	6.6	5.0	✔
Dissolved Metals in Water by CRC ICPMS	E421	2435669	1	16	6.2	5.0	✔



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Water	E100 ALS Environmental - Winnipeg	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 ALS Environmental - Winnipeg	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
Turbidity by Nephelometry	E121 ALS Environmental - Winnipeg	Water	APHA 2130 B (mod)	Turbidity is measured by the nephelometric method, by measuring the intensity of light scatter under defined conditions.
Chloride in Water by IC (Low Level)	E235.Cl-L ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite in Water by IC (Low Level)	E235.NO2-L ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC (Low Level)	E235.NO3-L ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 ALS Environmental - Winnipeg	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.



<i>Analytical Methods</i>	<i>Method / Lab</i>	<i>Matrix</i>	<i>Method Reference</i>	<i>Method Descriptions</i>
Dissolved Metals in Water by CRC ICPMS	E421 ALS Environmental - Winnipeg	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Hardness (Calculated)	EC100 ALS Environmental - Winnipeg	Water	APHA 2340B	"Hardness (as CaCO ₃), dissolved" is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations.
Ion Balance using Dissolved Metals	EC101 ALS Environmental - Winnipeg	Water	APHA 1030E	Cation Sum, Anion Sum, and Ion Balance are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present. Ion Balance cannot be calculated accurately for waters with very low electrical conductivity (EC).
TDS in Water (Calculation)	EC103 ALS Environmental - Winnipeg	Water	APHA 1030E (mod)	Total Dissolved Solids is calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N ALS Environmental - Winnipeg	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).
<i>Preparation Methods</i>	<i>Method / Lab</i>	<i>Matrix</i>	<i>Method Reference</i>	<i>Method Descriptions</i>
Dissolved Metals Water Filtration	EP421 ALS Environmental - Winnipeg	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO ₃ .



QUALITY CONTROL REPORT

Work Order : **WP2601180****Amendment** : **1**

Client : KGS Group
Contact : Simratpal Singh
Address : 3rd Floor - 865 Waverly Street
Winnipeg MB Canada R3T 5P4

Telephone : ----
Project : 25-0107-002.5000.07

PO : ----

C-O-C number : ----

Sampler : ----

Site : ----

Quote number : 2026 standing offer pricing

No. of samples received : 1

No. of samples analysed : 1

Laboratory : ALS Environmental - Winnipeg
Account Manager : Judy Dalmaijer
Address : 1329 Niakwa Road East, Unit 12
Winnipeg MB Canada R2J 3T4

Telephone : +1 204 255 9720
Date Samples Received : 30-Jan-2026 08:04
Date Analysis Commenced : 30-Jan-2026
Issue Date : 18-Feb-2026 13:55

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Lee McTavish		Winnipeg Inorganics, Winnipeg, Manitoba
Lee McTavish		Winnipeg Metals, Winnipeg, Manitoba
Leila Conyard	Lab Assistant	Winnipeg Metals, Winnipeg, Manitoba



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key:

- Anonymous=Refers to samples which are not part of this work order, but which formed part of the QC process lot.
- CAS Number=Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
- DQO=Data Quality Objective.
- LOR=Limit of Reporting (detection limit).
- RPD=Relative Percent Difference
- # =Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test specific).

Sub-Matrix: Surface Water

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Dissolved Metals(QC Lot: 2435669)											
WP2601102-001	Anonymous	Aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	2.1 µg/L	0.0023	0.0001	Diff <2x LOR	---
		Antimony, dissolved	7440-36-0	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.00049	0.00047	0.00002	Diff <2x LOR	---
		Barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.0584	0.0596	2.04 %	20%	---
		Beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	---
		Bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	---
		Boron, dissolved	7440-42-8	E421	0.010	mg/L	0.109	0.113	3.57 %	20%	---
		Cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	---
		Calcium, dissolved	7440-70-2	E421	0.050	mg/L	74.8	74.0	0.974 %	20%	---
		Cesium, dissolved	7440-46-2	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	---
		Chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	---
		Cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00026	0.00027	0.00001	Diff <2x LOR	---
		Iron, dissolved	7439-89-6	E421	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	---
		Lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	---
		Lithium, dissolved	7439-93-2	E421	0.0010	mg/L	0.0172	0.0194	12.2 %	20%	---
		Magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	74.8	72.7	2.82 %	20%	---
		Manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.0285	0.0283	0.761 %	20%	---
		Molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.000572	0.000589	2.98 %	20%	---
		Nickel, dissolved	7440-02-0	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	---
		Phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	0.052	<0.050	0.002	Diff <2x LOR	---
		Potassium, dissolved	7440-09-7	E421	0.050	mg/L	8.08	7.82	3.29 %	20%	---
		Rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	0.00363	0.00341	6.39 %	20%	---
		Selenium, dissolved	7782-49-2	E421	0.000050	mg/L	0.00208	0.00193	7.62 %	20%	---
		Silicon, dissolved	7440-21-3	E421	0.050	mg/L	7.06	7.05	0.0778 %	20%	---
		Silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	---
		Sodium, dissolved	7440-23-5	E421	0.050	mg/L	52.5	51.1	2.57 %	20%	---
		Strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.302	0.314	3.66 %	20%	---
		Sulfur, dissolved	7704-34-9	E421	0.50	mg/L	28.8	28.6	0.721 %	20%	---
		Tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	---
		Thallium, dissolved	7440-28-0	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	---
		Thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Tin, dissolved	7440-31-5	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---



Sub-Matrix: Surface Water					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Dissolved Metals(QC Lot: 2435669)											
		Titanium, dissolved	7440-32-6	E421	0.00030	mg/L	0.00032	<0.00030	0.00002	Diff <2x LOR	---
		Tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.00323	0.00317	1.71 %	20%	---
		Vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	0.00065	0.00067	0.00001	Diff <2x LOR	---
		Zinc, dissolved	7440-66-6	E421	0.0010	mg/L	0.0030	0.0033	0.0002	Diff <2x LOR	---
		Zirconium, dissolved	7440-67-7	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	---

Sub-Matrix: Water					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests(QC Lot: 2435764)											
WP2601175-001	Anonymous	Turbidity	----	E121	0.10	NTU	0.14	0.11	0.02	Diff <2x LOR	---
Physical Tests(QC Lot: 2437963)											
WP2601143-001	Anonymous	pH	----	E108	0.10	pH units	7.83	7.84	0.128 %	4%	---
Physical Tests(QC Lot: 2437964)											
WP2601143-001	Anonymous	Alkalinity, total (as CaCO3)	----	E290	1.0	mg/L	282	282	0.00 %	20%	---
Physical Tests(QC Lot: 2437965)											
WP2601143-001	Anonymous	Conductivity	----	E100	2.0	µS/cm	587	588	0.170 %	10%	---
Anions and Nutrients(QC Lot: 2436267)											
WP2601198-001	Anonymous	Fluoride	16984-48-8	E235.F	0.020	mg/L	0.102	0.101	0.002	Diff <2x LOR	---
Anions and Nutrients(QC Lot: 2436270)											
WP2601198-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	123	123	0.476 %	20%	---

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests(QC Lot: 2435764)						
Turbidity	----	E121	0.1	NTU	<0.10	----



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests(QC Lot: 2437963)						
pH	----	E108	----	pH units	----	----
Physical Tests(QC Lot: 2437964)						
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Physical Tests(QC Lot: 2437965)						
Conductivity	----	E100	1	µS/cm	<1.0	----
Anions and Nutrients(QC Lot: 2436267)						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients(QC Lot: 2436270)						
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients(QC Lot: 2436271)						
Nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	<0.0050	----
Anions and Nutrients(QC Lot: 2436272)						
Nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	<0.0010	----
Anions and Nutrients(QC Lot: 2436273)						
Chloride	16887-00-6	E235.Cl-L	0.1	mg/L	<0.10	----
Dissolved Metals(QC Lot: 2435669)						
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	----
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
Bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	<0.000050	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
Cesium, dissolved	7440-46-2	E421	0.00001	mg/L	<0.000010	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
Lithium, dissolved	7439-93-2	E421	0.001	mg/L	<0.0010	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals(QC Lot: 2435669)						
Phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	<0.050	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
Rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	<0.00020	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
Silicon, dissolved	7440-21-3	E421	0.05	mg/L	<0.050	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
Strontium, dissolved	7440-24-6	E421	0.0002	mg/L	<0.00020	----
Sulfur, dissolved	7704-34-9	E421	0.5	mg/L	<0.50	----
Tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	<0.00020	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----
Thorium, dissolved	7440-29-1	E421	0.0001	mg/L	<0.00010	----
Tin, dissolved	7440-31-5	E421	0.0001	mg/L	<0.00010	----
Titanium, dissolved	7440-32-6	E421	0.0003	mg/L	<0.00030	----
Tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	<0.00010	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	<0.00050	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----
Zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	<0.00020	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests(QC Lot: 2435764)									
Turbidity	----	E121	0.1	NTU	200 NTU	98.5	85.0	115	----
Physical Tests(QC Lot: 2437963)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Physical Tests(QC Lot: 2437964)									
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	100 mg/L	99.8	85.0	115	----
Physical Tests(QC Lot: 2437965)									
Conductivity	----	E100	1	µS/cm	1412 µS/cm	98.4	90.0	110	----



Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Anions and Nutrients(QC Lot: 2436267)									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	98.4	90.0	110	----
Anions and Nutrients(QC Lot: 2436270)									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	100	90.0	110	----
Anions and Nutrients(QC Lot: 2436271)									
Nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	98.9	90.0	110	----
Anions and Nutrients(QC Lot: 2436272)									
Nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	102	90.0	110	----
Anions and Nutrients(QC Lot: 2436273)									
Chloride	16887-00-6	E235.Cl-L	0.1	mg/L	100 mg/L	99.0	90.0	110	----
Dissolved Metals(QC Lot: 2435669)									
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	98.6	80.0	120	----
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	98.5	80.0	120	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	101	80.0	120	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	97.4	80.0	120	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	106	80.0	120	----
Bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	99.8	80.0	120	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	103	80.0	120	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	99.8	80.0	120	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	83.4	80.0	120	----
Cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	97.1	80.0	120	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	102	80.0	120	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	103	80.0	120	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	105	80.0	120	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	101	80.0	120	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	98.5	80.0	120	----
Lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	118	80.0	120	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	107	80.0	120	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	98.3	80.0	120	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	93.3	80.0	120	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	102	80.0	120	----
Phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	101	80.0	120	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	97.7	80.0	120	----
Rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	0.1 mg/L	101	80.0	120	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	101	80.0	120	----
Silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	94.8	80.0	120	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	84.3	80.0	120	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	109	80.0	120	----
Strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	92.0	80.0	120	----



Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Dissolved Metals(QC Lot: 2435669)									
Sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	94.4	80.0	120	----
Tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	88.3	80.0	120	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	98.3	80.0	120	----
Thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	98.6	80.0	120	----
Tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	99.3	80.0	120	----
Titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	98.1	80.0	120	----
Tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	98.5	80.0	120	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	101	80.0	120	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	101	80.0	120	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	102	80.0	120	----
Zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	91.7	80.0	120	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for

Sub-Matrix: Surface Water

					Matrix Spike (MS) Report				
					Spike		Recovery (%)	Recovery (%)	
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High
Anions and Nutrients(QC Lot: 2436267)									
WP2601198-001	Anonymous	Fluoride	16984-48-8	E235.F	0.981 mg/L	1 mg/L	98.1	75.0	125
Anions and Nutrients(QC Lot: 2436270)									
WP2601198-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	ND	----	ND	75.0	125
Dissolved Metals(QC Lot: 2435669)									
WP2601102-001	Anonymous	Aluminum, dissolved	7429-90-5	E421	0.220 mg/L	0.2 mg/L	110	70.0	130
		Antimony, dissolved	7440-36-0	E421	0.0214 mg/L	0.02 mg/L	107	70.0	130
		Arsenic, dissolved	7440-38-2	E421	0.0262 mg/L	0.02 mg/L	131	70.0	130
		Barium, dissolved	7440-39-3	E421	ND	----	ND	70.0	130
		Beryllium, dissolved	7440-41-7	E421	0.0346 mg/L	0.04 mg/L	86.5	70.0	130
		Bismuth, dissolved	7440-69-9	E421	0.00956 mg/L	0.01 mg/L	95.6	70.0	130
		Boron, dissolved	7440-42-8	E421	ND	----	ND	70.0	130
		Cadmium, dissolved	7440-43-9	E421	0.00440 mg/L	0.004 mg/L	110	70.0	130
		Calcium, dissolved	7440-70-2	E421	ND	----	ND	70.0	130



Sub-Matrix: Surface Water

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery (%)		Qualifier
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	
Dissolved Metals(QC Lot: 2435669)										
		Cesium, dissolved	7440-46-2	E421	0.0109 mg/L	0.01 mg/L	109	70.0	130	---
		Chromium, dissolved	7440-47-3	E421	0.0439 mg/L	0.04 mg/L	110	70.0	130	---
		Cobalt, dissolved	7440-48-4	E421	0.0210 mg/L	0.02 mg/L	105	70.0	130	---
		Copper, dissolved	7440-50-8	E421	0.0211 mg/L	0.02 mg/L	106	70.0	130	---
		Iron, dissolved	7439-89-6	E421	2.19 mg/L	2 mg/L	109	70.0	130	---
		Lead, dissolved	7439-92-1	E421	0.0201 mg/L	0.02 mg/L	101	70.0	130	---
		Lithium, dissolved	7439-93-2	E421	0.0798 mg/L	0.1 mg/L	79.8	70.0	130	---
		Magnesium, dissolved	7439-95-4	E421	ND	----	ND	70.0	130	---
		Manganese, dissolved	7439-96-5	E421	ND	----	ND	70.0	130	---
		Molybdenum, dissolved	7439-98-7	E421	0.0209 mg/L	0.02 mg/L	104	70.0	130	---
		Nickel, dissolved	7440-02-0	E421	0.0414 mg/L	0.04 mg/L	103	70.0	130	---
		Phosphorus, dissolved	7723-14-0	E421	12.5 mg/L	10 mg/L	125	70.0	130	---
		Potassium, dissolved	7440-09-7	E421	ND	----	ND	70.0	130	---
		Rubidium, dissolved	7440-17-7	E421	0.0215 mg/L	0.02 mg/L	107	70.0	130	---
		Selenium, dissolved	7782-49-2	E421	0.0561 mg/L	0.04 mg/L	140	70.0	130	MES
		Silicon, dissolved	7440-21-3	E421	9.10 mg/L	10 mg/L	91.0	70.0	130	---
		Silver, dissolved	7440-22-4	E421	0.00415 mg/L	0.004 mg/L	104	70.0	130	---
		Sodium, dissolved	7440-23-5	E421	ND	----	ND	70.0	130	---
		Strontium, dissolved	7440-24-6	E421	ND	----	ND	70.0	130	---
		Sulfur, dissolved	7704-34-9	E421	ND	----	ND	70.0	130	---
		Tellurium, dissolved	13494-80-9	E421	0.0430 mg/L	0.04 mg/L	108	70.0	130	---
		Thallium, dissolved	7440-28-0	E421	0.00408 mg/L	0.004 mg/L	102	70.0	130	---
		Thorium, dissolved	7440-29-1	E421	0.0223 mg/L	0.02 mg/L	111	70.0	130	---
		Tin, dissolved	7440-31-5	E421	0.0209 mg/L	0.02 mg/L	104	70.0	130	---
		Titanium, dissolved	7440-32-6	E421	0.0423 mg/L	0.04 mg/L	106	70.0	130	---
		Tungsten, dissolved	7440-33-7	E421	0.0201 mg/L	0.02 mg/L	100	70.0	130	---
		Uranium, dissolved	7440-61-1	E421	0.00410 mg/L	0.004 mg/L	103	70.0	130	---
		Vanadium, dissolved	7440-62-2	E421	0.114 mg/L	0.1 mg/L	114	70.0	130	---
		Zinc, dissolved	7440-66-6	E421	0.429 mg/L	0.4 mg/L	107	70.0	130	---
		Zirconium, dissolved	7440-67-7	E421	0.0408 mg/L	0.04 mg/L	102	70.0	130	---

Qualifiers

Qualifier	Description
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).

COC Number: **22 -**

Canada Toll Free: 1 800 668 9878

Word Order Reference

WP2601180



Received 1 July 2011; accepted 12 July 2011; first published online 12 July 2011

[illegible]

REFER TO BACK PAGE FOR ALL LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

MAY 2023 FROM

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

CERTIFICATE OF ANALYSIS

Work Order	: WP2601502	Laboratory	: ALS Environmental - Winnipeg
Client	: KGS Group	Account Manager	: Judy Dalmaijer
Contact	: Simratpal Singh	Address	: 1329 Niakwa Road East, Unit 12
Address	: 3rd Floor - 865 Waverly Street Winnipeg Manitoba Canada R3T 5P4		: Winnipeg MB Canada R2J 3T4
Telephone	: ----	E-mail	: Judy.Dalmaijer@ALSGlobal.com
Project	: 25-0107-002.5000.07	Telephone	: +1 204 255 9720
PO	: ----	Date Samples Received	: 06-Feb-2026 08:13
C-O-C number	: ----	Date Analysis Commenced	: 06-Feb-2026
Sampler	: ----	Issue Date	: 12-Feb-2026 09:50
Site	: ----		
Quote number	: 2026 standing offer pricing		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Lee McTavish		Metals, Winnipeg, Manitoba
Lee McTavish		Inorganics, Winnipeg, Manitoba



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key: CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
LOR: Limit of Reporting (detection limit).

Unit	Description
-	no units
%	percent
meq/L	milliequivalents per litre
mg/L	milligrams per litre
NTU	nephelometric turbidity units
pH units	pH units
µS/cm	microsiemens per centimetre

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).



Analytical Results

Sub-Matrix: Water

(Matrix: Water)

					Client sample ID	PW26-LJ-01	----	----	----	----
					Client sampling date / time	05-Feb-2026 11:30	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2601502-001	----	----	----	----	----
						Result	----	----	----	----
Physical Tests										
Alkalinity, bicarbonate (as CaCO ₃)	----	E290/WP	1.0	mg/L	303	----	----	----	----	----
Alkalinity, carbonate (as CaCO ₃)	----	E290/WP	1.0	mg/L	<1.0	----	----	----	----	----
Alkalinity, hydroxide (as CaCO ₃)	----	E290/WP	1.0	mg/L	<1.0	----	----	----	----	----
Alkalinity, total (as CaCO ₃)	----	E290/WP	1.0	mg/L	303	----	----	----	----	----
Conductivity	----	E100/WP	1.0	µS/cm	1650	----	----	----	----	----
Hardness (as CaCO ₃), dissolved	----	EC100/WP	0.50	mg/L	489	----	----	----	----	----
pH	----	E108/WP	0.10	pH units	7.80	----	----	----	----	----
Solids, total dissolved [TDS], calculated	----	EC103/WP	1.0	mg/L	1000	----	----	----	----	----
Turbidity	----	E121/WP	0.10	NTU	72.7	----	----	----	----	----
Anions and Nutrients										
Chloride	16887-00-6	E235.Cl-L/WP	0.10	mg/L	238	----	----	----	----	----
Fluoride	16984-48-8	E235.F/WP	0.020	mg/L	0.235	----	----	----	----	----
Nitrate (as N)	14797-55-8	E235.NO3-L/WP	0.0050	mg/L	<0.0250 ^{DLM}	----	----	----	----	----
Nitrite (as N)	14797-65-0	E235.NO2-L/WP	0.0010	mg/L	<0.0050 ^{DLM}	----	----	----	----	----
Sulfate (as SO ₄)	14808-79-8	E235.SO4/WP	0.30	mg/L	213	----	----	----	----	----
Nitrate + Nitrite (as N)	----	EC235.N+N/WP	0.0050	mg/L	<0.025	----	----	----	----	----
Ion Balance										
Anion sum	----	EC101/WP	0.10	meq/L	17.2	----	----	----	----	----
Cation sum	----	EC101/WP	0.10	meq/L	18.5	----	----	----	----	----
Ion balance (APHA)	----	EC101/WP	0.01	%	3.64	----	----	----	----	----



Analytical Results

Sub-Matrix: Water
 (Matrix: Water)

					Client sample ID	PW26-LJ-01	----	----	----	----
					Client sampling date / time	05-Feb-2026 11:30	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2601502-001	----	----	----	----	----
						Result	----	----	----	----
Dissolved Metals										
Aluminum, dissolved	7429-90-5	E421/WP	0.0010	mg/L	0.00044	----	----	----	----	----
Antimony, dissolved	7440-36-0	E421/WP	0.00010	mg/L	0.000013	----	----	----	----	----
Arsenic, dissolved	7440-38-2	E421/WP	0.00010	mg/L	0.00103	----	----	----	----	----
Barium, dissolved	7440-39-3	E421/WP	0.00010	mg/L	0.0158	----	----	----	----	----
Beryllium, dissolved	7440-41-7	E421/WP	0.000020	mg/L	Not Detected	----	----	----	----	----
Bismuth, dissolved	7440-69-9	E421/WP	0.000050	mg/L	Not Detected	----	----	----	----	----
Boron, dissolved	7440-42-8	E421/WP	0.010	mg/L	0.349	----	----	----	----	----
Cadmium, dissolved	7440-43-9	E421/WP	0.0000050	mg/L	0.00000070	----	----	----	----	----
Calcium, dissolved	7440-70-2	E421/WP	0.050	mg/L	84.1	----	----	----	----	----
Cesium, dissolved	7440-46-2	E421/WP	0.000010	mg/L	0.000023	----	----	----	----	----
Chromium, dissolved	7440-47-3	E421/WP	0.00050	mg/L	Not Detected	----	----	----	----	----
Cobalt, dissolved	7440-48-4	E421/WP	0.00010	mg/L	0.00024	----	----	----	----	----
Copper, dissolved	7440-50-8	E421/WP	0.00020	mg/L	0.00047	----	----	----	----	----
Iron, dissolved	7439-89-6	E421/WP	0.010	mg/L	Not Detected	----	----	----	----	----
Lead, dissolved	7439-92-1	E421/WP	0.000050	mg/L	Not Detected	----	----	----	----	----
Lithium, dissolved	7439-93-2	E421/WP	0.0010	mg/L	0.0663	----	----	----	----	----
Magnesium, dissolved	7439-95-4	E421/WP	0.0050	mg/L	67.7	----	----	----	----	----
Manganese, dissolved	7439-96-5	E421/WP	0.00010	mg/L	0.0154	----	----	----	----	----
Molybdenum, dissolved	7439-98-7	E421/WP	0.000050	mg/L	0.000982	----	----	----	----	----
Nickel, dissolved	7440-02-0	E421/WP	0.00050	mg/L	0.00067	----	----	----	----	----



Analytical Results

Sub-Matrix: Water
 (Matrix: Water)

					Client sample ID	PW26-LJ-01	----	----	----	----
					Client sampling date / time	05-Feb-2026 11:30	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2601502-001	----	----	----	----	----
						Result	----	----	----	----
Dissolved Metals										
Phosphorus, dissolved	7723-14-0	E421/WP	0.050	mg/L	Not Detected	----	----	----	----	----
Potassium, dissolved	7440-09-7	E421/WP	0.050	mg/L	9.60	----	----	----	----	----
Rubidium, dissolved	7440-17-7	E421/WP	0.00020	mg/L	0.00492	----	----	----	----	----
Selenium, dissolved	7782-49-2	E421/WP	0.000050	mg/L	0.000062	----	----	----	----	----
Silicon, dissolved	7440-21-3	E421/WP	0.050	mg/L	5.59	----	----	----	----	----
Silver, dissolved	7440-22-4	E421/WP	0.000010	mg/L	Not Detected	----	----	----	----	----
Sodium, dissolved	7440-23-5	E421/WP	0.050	mg/L	195	----	----	----	----	----
Strontium, dissolved	7440-24-6	E421/WP	0.00020	mg/L	0.623	----	----	----	----	----
Sulfur, dissolved	7704-34-9	E421/WP	0.50	mg/L	85.8	----	----	----	----	----
Tellurium, dissolved	13494-80-9	E421/WP	0.00020	mg/L	Not Detected	----	----	----	----	----
Thallium, dissolved	7440-28-0	E421/WP	0.000010	mg/L	0.0000030	----	----	----	----	----
Thorium, dissolved	7440-29-1	E421/WP	0.00010	mg/L	Not Detected	----	----	----	----	----
Tin, dissolved	7440-31-5	E421/WP	0.00010	mg/L	Not Detected	----	----	----	----	----
Titanium, dissolved	7440-32-6	E421/WP	0.00030	mg/L	0.000033	----	----	----	----	----
Tungsten, dissolved	7440-33-7	E421/WP	0.00010	mg/L	0.000014	----	----	----	----	----
Uranium, dissolved	7440-61-1	E421/WP	0.000010	mg/L	0.000547	----	----	----	----	----
Vanadium, dissolved	7440-62-2	E421/WP	0.00050	mg/L	Not Detected	----	----	----	----	----
Zinc, dissolved	7440-66-6	E421/WP	0.0010	mg/L	0.0024	----	----	----	----	----
Zirconium, dissolved	7440-67-7	E421/WP	0.00030	mg/L	Not Detected	----	----	----	----	----
Dissolved metals filtration location	----	EP421/WP	-	-	Laboratory	----	----	----	----	----



Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WP2601502	Page	: 1 of 8
Client	: KGS Group	Laboratory	: ALS Environmental - Winnipeg
Contact	: Simratpal Singh	Account Manager	: Judy Dalmajjer
Address	: 3rd Floor - 865 Waverly Street Winnipeg MB Canada R3T 5P4	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg, Manitoba Canada R2J 3T4
Telephone	: ----	Telephone	: +1 204 255 9720
Project	: 25-0107-002.5000.07	Date Samples Received	: 06-Feb-2026 08:13
PO	: ----	Issue Date	: 12-Feb-2026 09:50
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: 2026 standing offer pricing_V2		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method											
Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Anions and Nutrients : Chloride in Water by IC (Low Level)											
HDPE PW26-LJ-01	E235.Cl-L	05-Feb-2026	06-Feb-2026	28 days	1 days	✓	06-Feb-2026	28 days	1 days	✓	
Anions and Nutrients : Fluoride in Water by IC											
HDPE PW26-LJ-01	E235.F	05-Feb-2026	06-Feb-2026	28 days	1 days	✓	06-Feb-2026	28 days	1 days	✓	
Anions and Nutrients : Nitrate in Water by IC (Low Level)											
HDPE PW26-LJ-01	E235.NO3-L	05-Feb-2026	06-Feb-2026	3 days	1 days	✓	06-Feb-2026	3 days	1 days	✓	
Anions and Nutrients : Nitrite in Water by IC (Low Level)											
HDPE PW26-LJ-01	E235.NO2-L	05-Feb-2026	06-Feb-2026	3 days	1 days	✓	06-Feb-2026	3 days	1 days	✓	
Anions and Nutrients : Sulfate in Water by IC											
HDPE PW26-LJ-01	E235.SO4	05-Feb-2026	06-Feb-2026	28 days	1 days	✓	06-Feb-2026	28 days	1 days	✓	
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS											
HDPE dissolved (nitric acid) PW26-LJ-01	E421	05-Feb-2026	11-Feb-2026	180 days	6 days	✓	11-Feb-2026	180 days	6 days	✓	
Physical Tests : Alkalinity Species by Titration											
HDPE PW26-LJ-01	E290	05-Feb-2026	09-Feb-2026	14 days	4 days	✓	09-Feb-2026	14 days	4 days	✓	



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Conductivity in Water										
HDPE PW26-LJ-01	E100	05-Feb-2026	09-Feb-2026	28 days	4 days	✓	09-Feb-2026	28 days	4 days	✓
Physical Tests : pH by Meter										
HDPE PW26-LJ-01	E108	05-Feb-2026	09-Feb-2026	0.25 hrs	92 hrs	✖ EHTR-FM	09-Feb-2026	0.25 hrs	92 hrs	✖ EHTR-FM
Physical Tests : Turbidity by Nephelometry										
HDPE PW26-LJ-01	E121	05-Feb-2026	----	----	----		09-Feb-2026	3 days	4 days	✖ EHT

Legend & Qualifier Definitions

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended

EHT: Exceeded ALS recommended hold time prior to analysis.

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water** Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Conductivity in Water	E100	2446589	1	20	5.0	5.0	✓
pH by Meter	E108	2448379	2	20	10.0	5.0	✓
Turbidity by Nephelometry	E121	2446774	1	20	5.0	5.0	✓
Chloride in Water by IC (Low Level)	E235.Cl-L	2444664	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	2444660	1	15	6.6	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2444666	1	11	9.0	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	2444665	1	11	9.0	5.0	✓
Sulfate in Water by IC	E235.SO4	2444663	1	17	5.8	5.0	✓
Alkalinity Species by Titration	E290	2446590	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2450641	1	20	5.0	5.0	✓
Laboratory Control Samples (LCS)							
Conductivity in Water	E100	2446589	1	20	5.0	5.0	✓
pH by Meter	E108	2448379	2	20	10.0	5.0	✓
Turbidity by Nephelometry	E121	2446774	1	20	5.0	5.0	✓
Chloride in Water by IC (Low Level)	E235.Cl-L	2444664	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	2444660	1	15	6.6	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2444666	1	11	9.0	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	2444665	1	11	9.0	5.0	✓
Sulfate in Water by IC	E235.SO4	2444663	1	17	5.8	5.0	✓
Alkalinity Species by Titration	E290	2446590	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2450641	1	20	5.0	5.0	✓
Method Blanks (MB)							
Conductivity in Water	E100	2446589	1	20	5.0	5.0	✓
Turbidity by Nephelometry	E121	2446774	1	20	5.0	5.0	✓
Chloride in Water by IC (Low Level)	E235.Cl-L	2444664	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	2444660	1	15	6.6	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2444666	1	11	9.0	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	2444665	1	11	9.0	5.0	✓
Sulfate in Water by IC	E235.SO4	2444663	1	17	5.8	5.0	✓
Alkalinity Species by Titration	E290	2446590	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2450641	1	20	5.0	5.0	✓
Matrix Spikes (MS)							
Chloride in Water by IC (Low Level)	E235.Cl-L	2444664	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	2444660	1	15	6.6	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2444666	1	11	9.0	5.0	✓

Page : 6 of 8
 Work Order : WP2601502
 Client : KGS Group
 Project : 25-0107-002.5000.07



Matrix: **Water**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
<i>Analytical Methods</i>	<i>Method</i>	<i>QC Lot #</i>	<i>QC</i>	<i>Regular</i>	<i>Actual</i>	<i>Expected</i>	<i>Evaluation</i>
Matrix Spikes (MS) - Continued							
Nitrate in Water by IC (Low Level)	E235.NO3-L	2444665	1	11	9.0	5.0	✔
Sulfate in Water by IC	E235.SO4	2444663	1	17	5.8	5.0	✔
Dissolved Metals in Water by CRC ICPMS	E421	2450641	1	20	5.0	5.0	✔



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Water	E100 ALS Environmental - Winnipeg	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 ALS Environmental - Winnipeg	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally $20 \pm 5^\circ\text{C}$). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
Turbidity by Nephelometry	E121 ALS Environmental - Winnipeg	Water	APHA 2130 B (mod)	Turbidity is measured by the nephelometric method, by measuring the intensity of light scatter under defined conditions.
Chloride in Water by IC (Low Level)	E235.Cl-L ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite in Water by IC (Low Level)	E235.NO2-L ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC (Low Level)	E235.NO3-L ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 ALS Environmental - Winnipeg	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 ALS Environmental - Winnipeg	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.



<i>Analytical Methods</i>	<i>Method / Lab</i>	<i>Matrix</i>	<i>Method Reference</i>	<i>Method Descriptions</i>
Dissolved Metals in Water by CRC ICPMS	E421 ALS Environmental - Winnipeg	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Hardness (Calculated)	EC100 ALS Environmental - Winnipeg	Water	APHA 2340B	"Hardness (as CaCO ₃), dissolved" is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations.
Ion Balance using Dissolved Metals	EC101 ALS Environmental - Winnipeg	Water	APHA 1030E	Cation Sum, Anion Sum, and Ion Balance are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present. Ion Balance cannot be calculated accurately for waters with very low electrical conductivity (EC).
TDS in Water (Calculation)	EC103 ALS Environmental - Winnipeg	Water	APHA 1030E (mod)	Total Dissolved Solids is calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N ALS Environmental - Winnipeg	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).
<i>Preparation Methods</i>	<i>Method / Lab</i>	<i>Matrix</i>	<i>Method Reference</i>	<i>Method Descriptions</i>
Dissolved Metals Water Filtration	EP421 ALS Environmental - Winnipeg	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO ₃ .



QUALITY CONTROL REPORT

Work Order : WP2601502

Client : KGS Group
Contact : Simratpal Singh
Address : 3rd Floor - 865 Waverly Street
Winnipeg MB Canada R3T 5P4
Telephone : ----
Project : 25-0107-002.5000.07
PO : ----
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : 2026 standing offer pricing
No. of samples received : 1
No. of samples analysed : 1

Laboratory : ALS Environmental - Winnipeg
Account Manager : Judy Dalmajjer
Address : 1329 Niakwa Road East, Unit 12
Winnipeg MB Canada R2J 3T4
Telephone : +1 204 255 9720
Date Samples Received : 06-Feb-2026 08:13
Date Analysis Commenced : 06-Feb-2026
Issue Date : 12-Feb-2026 09:50

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Lee McTavish		Winnipeg Inorganics, Winnipeg, Manitoba
Lee McTavish		Winnipeg Metals, Winnipeg, Manitoba



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key:

- Anonymous=Refers to samples which are not part of this work order, but which formed part of the QC process lot.
- CAS Number=Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
- DQO=Data Quality Objective.
- LOR=Limit of Reporting (detection limit).
- RPD=Relative Percent Difference
- # =Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test specific).

Sub-Matrix: Drinking Water

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Anions and Nutrients(QC Lot: 2444660)											
WP2601495-001	Anonymous	Fluoride	16984-48-8	E235.F	0.020	mg/L	0.151	0.146	0.005	Diff <2x LOR	---
Anions and Nutrients(QC Lot: 2444663)											
WP2601495-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	123	123	0.315 %	20%	---
Anions and Nutrients(QC Lot: 2444664)											
WP2601495-001	Anonymous	Chloride	16887-00-6	E235.Cl-L	0.10	mg/L	52.4	52.2	0.202 %	20%	---
Anions and Nutrients(QC Lot: 2444665)											
WP2601495-001	Anonymous	Nitrate (as N)	14797-55-8	E235.NO3-L	0.0050	mg/L	10.9	10.9	0.194 %	20%	---
Anions and Nutrients(QC Lot: 2444666)											
WP2601495-001	Anonymous	Nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L	0.0233	0.0233	0.0988 %	20%	---

Sub-Matrix: Water

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests(QC Lot: 2446589)											
WP2601456-023	Anonymous	Conductivity	----	E100	2.0	µS/cm	3910	3920	0.255 %	10%	---
Physical Tests(QC Lot: 2446590)											
WP2601456-023	Anonymous	Alkalinity, total (as CaCO3)	----	E290	1.0	mg/L	133	132	0.602 %	20%	---
Physical Tests(QC Lot: 2446591)											
WP2601514-005	Anonymous	pH	----	E108	0.10	pH units	7.34	7.35	0.136 %	4%	---
Physical Tests(QC Lot: 2446774)											
WP2601469-001	Anonymous	Turbidity	----	E121	0.10	NTU	4.95	5.00	1.05 %	15%	---
Physical Tests(QC Lot: 2448379)											
WP2601476-001	Anonymous	pH	----	E108	0.10	pH units	8.05	8.10	0.619 %	4%	---
Dissolved Metals(QC Lot: 2450641)											
WP2601456-019	Anonymous	Aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	0.0146	0.0137	6.09 %	20%	---
		Antimony, dissolved	7440-36-0	E421	0.00010	mg/L	0.00802	0.00797	0.533 %	20%	---
		Arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.0523	0.0512	2.08 %	20%	---
		Barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.0470	0.0457	2.69 %	20%	---
		Beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	---
		Bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	---
		Boron, dissolved	7440-42-8	E421	0.010	mg/L	0.051	0.051	0.0004	Diff <2x LOR	---
		Cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	0.0000070	0.0000076	0.0000007	Diff <2x LOR	---



Sub-Matrix: Water

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Dissolved Metals(QC Lot: 2450641)											
		Calcium, dissolved	7440-70-2	E421	0.050	mg/L	104	104	0.0977 %	20%	---
		Cesium, dissolved	7440-46-2	E421	0.000010	mg/L	0.000308	0.000311	1.02 %	20%	---
		Chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	---
		Cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	0.00021	0.00021	0.000002	Diff <2x LOR	---
		Copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00471	0.00472	0.194 %	20%	---
		Iron, dissolved	7439-89-6	E421	0.010	mg/L	0.021	0.021	0.0002	Diff <2x LOR	---
		Lead, dissolved	7439-92-1	E421	0.000050	mg/L	0.000060	0.000061	0.000001	Diff <2x LOR	---
		Lithium, dissolved	7439-93-2	E421	0.0010	mg/L	0.0036	0.0037	0.00007	Diff <2x LOR	---
		Magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	9.52	9.63	1.10 %	20%	---
		Manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.0142	0.0139	2.21 %	20%	---
		Molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.000881	0.000876	0.537 %	20%	---
		Nickel, dissolved	7440-02-0	E421	0.00050	mg/L	0.00664	0.00650	2.24 %	20%	---
		Phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	---
		Potassium, dissolved	7440-09-7	E421	0.050	mg/L	12.6	12.2	3.37 %	20%	---
		Rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	0.0151	0.0151	0.0585 %	20%	---
		Selenium, dissolved	7782-49-2	E421	0.000050	mg/L	0.000261	0.000317	0.000056	Diff <2x LOR	---
		Silicon, dissolved	7440-21-3	E421	0.050	mg/L	1.87	1.92	2.54 %	20%	---
		Silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	---
		Sodium, dissolved	7440-23-5	E421	0.050	mg/L	81.8	79.8	2.48 %	20%	---
		Strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.191	0.201	5.03 %	20%	---
		Sulfur, dissolved	7704-34-9	E421	0.50	mg/L	60.8	61.8	1.63 %	20%	---
		Tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	---
		Thallium, dissolved	7440-28-0	E421	0.000010	mg/L	<0.000010	0.000010	0.0000004	Diff <2x LOR	---
		Thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Tin, dissolved	7440-31-5	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	---
		Titanium, dissolved	7440-32-6	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	---
		Tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	0.00043	0.00043	0.000002	Diff <2x LOR	---
		Uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.000209	0.000213	2.03 %	20%	---
		Vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	---
		Zinc, dissolved	7440-66-6	E421	0.0010	mg/L	0.0083	0.0085	0.0001	Diff <2x LOR	---
		Zirconium, dissolved	7440-67-7	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	---

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests(QC Lot: 2446589)						
Conductivity	----	E100	1	µS/cm	<1.0	----
Physical Tests(QC Lot: 2446590)						
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Physical Tests(QC Lot: 2446591)						
pH	----	E108	----	pH units	----	----
Physical Tests(QC Lot: 2446774)						
Turbidity	----	E121	0.1	NTU	<0.10	----
Physical Tests(QC Lot: 2448379)						
pH	----	E108	----	pH units	----	----
Anions and Nutrients(QC Lot: 2444660)						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients(QC Lot: 2444663)						
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients(QC Lot: 2444664)						
Chloride	16887-00-6	E235.Cl-L	0.1	mg/L	<0.10	----
Anions and Nutrients(QC Lot: 2444665)						
Nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	<0.0050	----
Anions and Nutrients(QC Lot: 2444666)						
Nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	<0.0010	----
Dissolved Metals(QC Lot: 2450641)						
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	----
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
Bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	<0.000050	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
Cesium, dissolved	7440-46-2	E421	0.00001	mg/L	<0.000010	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals(QC Lot: 2450641)						
Lithium, dissolved	7439-93-2	E421	0.001	mg/L	<0.0010	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
Phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	<0.050	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
Rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	<0.00020	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
Silicon, dissolved	7440-21-3	E421	0.05	mg/L	<0.050	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
Strontium, dissolved	7440-24-6	E421	0.0002	mg/L	<0.00020	----
Sulfur, dissolved	7704-34-9	E421	0.5	mg/L	<0.50	----
Tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	<0.00020	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----
Thorium, dissolved	7440-29-1	E421	0.0001	mg/L	<0.00010	----
Tin, dissolved	7440-31-5	E421	0.0001	mg/L	<0.00010	----
Titanium, dissolved	7440-32-6	E421	0.0003	mg/L	<0.00030	----
Tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	<0.00010	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	<0.00050	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----
Zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	<0.00020	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests(QC Lot: 2446589)									
Conductivity	----	E100	1	µS/cm	1412 µS/cm	101	90.0	110	----
Physical Tests(QC Lot: 2446590)									
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	100 mg/L	101	85.0	115	----



Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests(QC Lot: 2446591)									
pH	----	E108	----	pH units	7 pH units	102	98.0	102	----
Physical Tests(QC Lot: 2446774)									
Turbidity	----	E121	0.1	NTU	200 NTU	98.5	85.0	115	----
Physical Tests(QC Lot: 2448379)									
pH	----	E108	----	pH units	7 pH units	101	98.0	102	----
Anions and Nutrients(QC Lot: 2444660)									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	100	90.0	110	----
Anions and Nutrients(QC Lot: 2444663)									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	99.0	90.0	110	----
Anions and Nutrients(QC Lot: 2444664)									
Chloride	16887-00-6	E235.Cl-L	0.1	mg/L	100 mg/L	97.8	90.0	110	----
Anions and Nutrients(QC Lot: 2444665)									
Nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	97.9	90.0	110	----
Anions and Nutrients(QC Lot: 2444666)									
Nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	101	90.0	110	----
Dissolved Metals(QC Lot: 2450641)									
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	104	80.0	120	----
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	100	80.0	120	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	104	80.0	120	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	97.9	80.0	120	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	98.6	80.0	120	----
Bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	106	80.0	120	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	99.8	80.0	120	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	101	80.0	120	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	103	80.0	120	----
Cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	93.8	80.0	120	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	102	80.0	120	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	101	80.0	120	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	100	80.0	120	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	94.0	80.0	120	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	102	80.0	120	----
Lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	94.5	80.0	120	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	107	80.0	120	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	99.3	80.0	120	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	99.7	80.0	120	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	100	80.0	120	----
Phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	101	80.0	120	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	96.2	80.0	120	----



Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Dissolved Metals(QC Lot: 2450641)									
Rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	0.1 mg/L	100	80.0	120	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	97.6	80.0	120	----
Silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	103	80.0	120	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	86.0	80.0	120	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	101	80.0	120	----
Strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	91.9	80.0	120	----
Sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	98.7	80.0	120	----
Tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	92.8	80.0	120	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	103	80.0	120	----
Thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	94.1	80.0	120	----
Tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	99.1	80.0	120	----
Titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	98.0	80.0	120	----
Tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	103	80.0	120	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	97.6	80.0	120	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	101	80.0	120	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	97.8	80.0	120	----
Zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	93.4	80.0	120	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for

Sub-Matrix: Drinking Water

					Matrix Spike (MS) Report				
					Spike		Recovery (%)	Recovery (%)	
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High
Anions and Nutrients(QC Lot: 2444660)									
WP2601495-001	Anonymous	Fluoride	16984-48-8	E235.F	0.919 mg/L	1 mg/L	91.9	75.0	125
Anions and Nutrients(QC Lot: 2444663)									
WP2601495-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	ND	----	ND	75.0	125
Anions and Nutrients(QC Lot: 2444664)									
WP2601495-001	Anonymous	Chloride	16887-00-6	E235.Cl-L	93.0 mg/L	100 mg/L	93.0	75.0	125
Anions and Nutrients(QC Lot: 2444665)									
WP2601495-001	Anonymous	Nitrate (as N)	14797-55-8	E235.NO3-L	ND	----	ND	75.0	125



Sub-Matrix: Drinking Water

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery (%)		Qualifier
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	
Anions and Nutrients(QC Lot: 2444666)										
WP2601495-001	Anonymous	Nitrite (as N)	14797-65-0	E235.NO2-L	0.522 mg/L	0.5 mg/L	104	75.0	125	---
Dissolved Metals(QC Lot: 2450641)										
WP2601456-019	Anonymous	Aluminum, dissolved	7429-90-5	E421	0.232 mg/L	0.2 mg/L	116	70.0	130	---
		Antimony, dissolved	7440-36-0	E421	0.0201 mg/L	0.02 mg/L	100	70.0	130	---
		Arsenic, dissolved	7440-38-2	E421	ND	----	ND	70.0	130	---
		Barium, dissolved	7440-39-3	E421	ND	----	ND	70.0	130	---
		Beryllium, dissolved	7440-41-7	E421	0.0460 mg/L	0.04 mg/L	115	70.0	130	---
		Bismuth, dissolved	7440-69-9	E421	0.00995 mg/L	0.01 mg/L	99.5	70.0	130	---
		Boron, dissolved	7440-42-8	E421	0.107 mg/L	0.1 mg/L	107	70.0	130	---
		Cadmium, dissolved	7440-43-9	E421	0.00444 mg/L	0.004 mg/L	111	70.0	130	---
		Calcium, dissolved	7440-70-2	E421	ND	----	ND	70.0	130	---
		Cesium, dissolved	7440-46-2	E421	0.0106 mg/L	0.01 mg/L	106	70.0	130	---
		Chromium, dissolved	7440-47-3	E421	0.0453 mg/L	0.04 mg/L	113	70.0	130	---
		Cobalt, dissolved	7440-48-4	E421	0.0218 mg/L	0.02 mg/L	109	70.0	130	---
		Copper, dissolved	7440-50-8	E421	0.0208 mg/L	0.02 mg/L	104	70.0	130	---
		Iron, dissolved	7439-89-6	E421	2.22 mg/L	2 mg/L	111	70.0	130	---
		Lead, dissolved	7439-92-1	E421	0.0218 mg/L	0.02 mg/L	109	70.0	130	---
		Lithium, dissolved	7439-93-2	E421	0.111 mg/L	0.1 mg/L	111	70.0	130	---
		Magnesium, dissolved	7439-95-4	E421	ND	----	ND	70.0	130	---
		Manganese, dissolved	7439-96-5	E421	0.0218 mg/L	0.02 mg/L	109	70.0	130	---
		Molybdenum, dissolved	7439-98-7	E421	0.0208 mg/L	0.02 mg/L	104	70.0	130	---
		Nickel, dissolved	7440-02-0	E421	0.0419 mg/L	0.04 mg/L	105	70.0	130	---
		Phosphorus, dissolved	7723-14-0	E421	12.3 mg/L	10 mg/L	123	70.0	130	---
		Potassium, dissolved	7440-09-7	E421	ND	----	ND	70.0	130	---
		Rubidium, dissolved	7440-17-7	E421	0.0217 mg/L	0.02 mg/L	108	70.0	130	---
		Selenium, dissolved	7782-49-2	E421	0.0482 mg/L	0.04 mg/L	121	70.0	130	---
		Silicon, dissolved	7440-21-3	E421	10.6 mg/L	10 mg/L	106	70.0	130	---
		Silver, dissolved	7440-22-4	E421	0.00413 mg/L	0.004 mg/L	103	70.0	130	---
		Sodium, dissolved	7440-23-5	E421	ND	----	ND	70.0	130	---
		Strontium, dissolved	7440-24-6	E421	ND	----	ND	70.0	130	---
		Sulfur, dissolved	7704-34-9	E421	ND	----	ND	70.0	130	---
		Tellurium, dissolved	13494-80-9	E421	0.0400 mg/L	0.04 mg/L	100.0	70.0	130	---
		Thallium, dissolved	7440-28-0	E421	0.00398 mg/L	0.004 mg/L	99.6	70.0	130	---
		Thorium, dissolved	7440-29-1	E421	0.0212 mg/L	0.02 mg/L	106	70.0	130	---
		Tin, dissolved	7440-31-5	E421	0.0203 mg/L	0.02 mg/L	101	70.0	130	---
		Titanium, dissolved	7440-32-6	E421	0.0408 mg/L	0.04 mg/L	102	70.0	130	---
		Tungsten, dissolved	7440-33-7	E421	0.0211 mg/L	0.02 mg/L	106	70.0	130	---



Sub-Matrix: Drinking Water

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery (%)		Qualifier
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	
Dissolved Metals(QC Lot: 2450641)										
		Uranium, dissolved	7440-61-1	E421	0.00424 mg/L	0.004 mg/L	106	70.0	130	---
		Vanadium, dissolved	7440-62-2	E421	0.116 mg/L	0.1 mg/L	116	70.0	130	---
		Zinc, dissolved	7440-66-6	E421	0.422 mg/L	0.4 mg/L	105	70.0	130	---
		Zirconium, dissolved	7440-67-7	E421	0.0393 mg/L	0.04 mg/L	98.3	70.0	130	---



Chain of Custody (COC) / Analytical Request Form

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