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AECOM

Glancaster Road – Municipal Class Environmental Assessment

Geotechnical Investigation Report

The City of Hamilton

60637047

May 2022



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May 3, 2022

Project #
60637047

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Subject: Glancaster Road – Municipal Class Environmental Assessment – Geotechnical Investigation Report

Dear Ms. Fazio:

AECOM Canada Ltd. (AECOM) is pleased to submit this Draft Geotechnical Investigation Report to City of Hamilton for the above captioned project for your review.

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

Sincerely,
AECOM Canada Ltd.

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Sanket Shah, P. Eng.
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cc:

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The City of Hamilton

Glancaster Road – Municipal Class Environmental Assessment
Geotechnical Investigation Report

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Executive Summary

This report provides the findings of the geotechnical investigation in support of municipal class environmental assessment phases 3 and 4 for Glancaster Road in City of Hamilton. The Hamilton Airport Employment Growth District Transportation Master Plan classifies Glancaster Road as a North-South roadway with a proposed widening from two to four lanes.

Field work was carried out between January 4, 2022 and January 21, 2022. The subsurface investigation consisted of drilling and sampling eleven (11) boreholes to a depth of 6.7m below ground surface (bgs). Further, seven (7) monitoring wells were installed to a depth of 6.2m to 6.7m provisioned with flush mount. In addition, four (4) asphaltic concrete cores (CH1 to CH4) were also extracted from the existing pavement of Glancaster Road using a diamond core barrel to measure the thicknesses of the various asphaltic concrete layers and to see the bonding condition between each layer. After drilling, sampling, and logging of the soil samples, the boreholes were reinstated using bentonite pellets or backfilling with selected auger cuttings. The boreholes located on the existing pavement were patched with cold-mixed asphaltic concrete.

The borehole locations were established by AECOM’s geotechnical personnel prior to the field work. The geodetic elevations of the ground surface at the borehole locations were determined by AECOM surveying team. Due to the presence of existing utilities including watermain in the shoulders/ditches, all the boreholes were located on the roadway. Borehole locations are provided in the Borehole Location Plan, attached in **Appendix A**.

A truck mounted Diedrich D50 drill rig, owned and operated by ALTECH Drilling & Investigative Services Ltd., was used to drill all the boreholes. Boreholes were advanced using 125 mm outer diameter solid-stem augers, whereas, Monitoring wells were advanced using 190 mm outer diameter hollow-stem augers under the full-time supervision of AECOM geotechnical personnel. A summary of borehole locations is provided in the **Table ES-1** below.

Table ES-1: Summary of Borehole Details

Borehole ID	Proposed Development	Borehole Depth (m bgs)	Date of Completion	Elevation (m ASL)	Northing	Easting
BH-1/MW	Pavement Design and Road Widening	6.7	January 21, 2022	232.5	4784660.5	587009.5
BH-2		6.7	January 21, 2022	233.3	4784486.4	587037.3
BH-3		6.7	January 14, 2022	234.8	4784385.4	587014.6
BH-4/MW		6.7	January 20, 2022	236.5	4784178.0	586949.4
BH-5		6.7	January 12, 2022	235.9	4783987.8	586894.3
BH-6		6.7	January 12, 2022	236.5	4783925.9	586869.5
BH-7/MW		6.7	January 20, 2022	239.0	4783793.3	586828.0
BH-8		6.7	January 20, 2022	239.2	4783650.6	586787.2
BH-9		6.7	January 10, 2022	242.0	4783498.7	586739.6
BH-10/MW		6.7	January 14, 2022	242.8	4783359.5	586692.2
BH-11		6.7	January 10, 2022	242.7	4783199.6	586647.2
BH-12/MW		6.7	January 14, 2022	242.0	4783045.9	586600.1
BH-13		6.7	January 12, 2022	242.4	4782883.5	586546.6
BH-14		6.7	January 10, 2022	241.8	4782750.6	586510.1

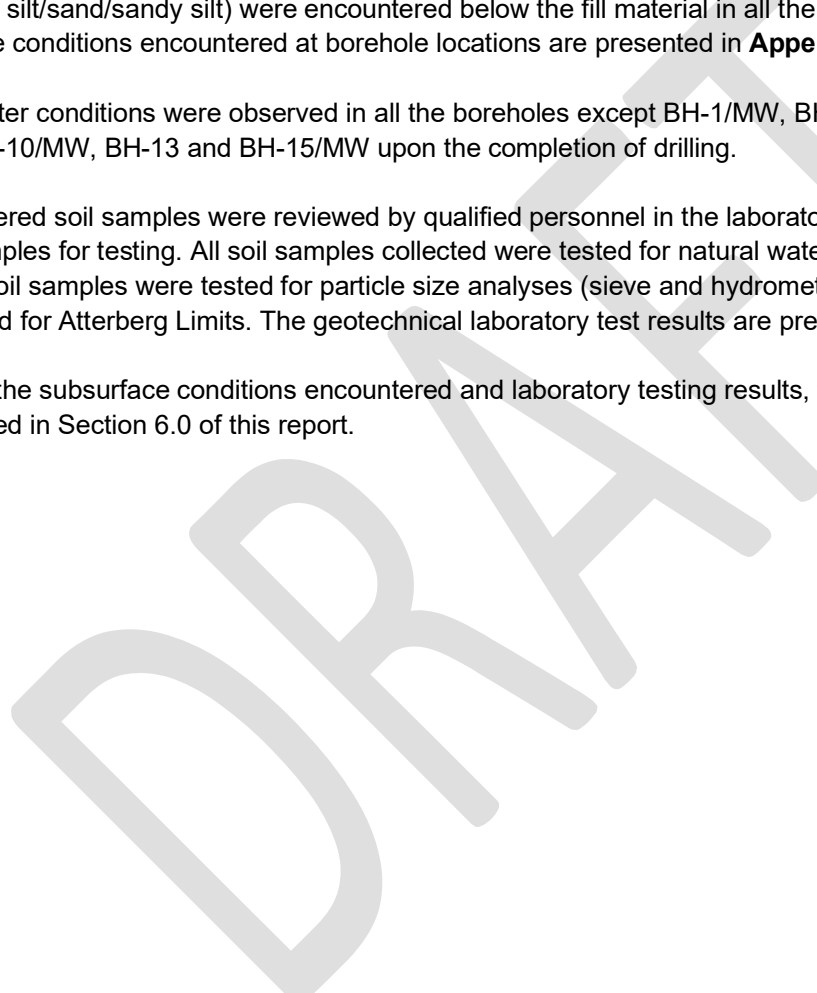
Borehole ID	Proposed Development	Borehole Depth (m bgs)	Date of Completion	Elevation (m ASL)	Northing	Easting
BH-15/MW		6.2	January 7,2022	241.4	4782586.9	586459.8
BH-16		6.7	January 4,2022	241.2	4782456.7	586420.3
BH-17		6.7	January 12,2022	240.7	4782315.9	586373.5
BH-18/MW		6.2	January 11,2022	240.2	4782192.9	586335.7

Based on the subsurface conditions encountered at the borehole locations, the subsoils predominantly consisted of pavement structure (asphalt and granular fill) underlain by fill material (sandy silt/sand/clayey silt). Native soils (silt/clayey silt/sand/sandy silt) were encountered below the fill material in all the boreholes. Details of the subsurface conditions encountered at borehole locations are presented in **Appendix B**.

Groundwater conditions were observed in all the boreholes except BH-1/MW, BH-3, BH-4/MW, BH-5, BH-7/MW, BH-10/MW, BH-13 and BH-15/MW upon the completion of drilling.

The recovered soil samples were reviewed by qualified personnel in the laboratory for further identification and to select samples for testing. All soil samples collected were tested for natural water content tests. Eighteen (18) selected soil samples were tested for particle size analyses (sieve and hydrometer analyses) and two (2) samples were tested for Atterberg Limits. The geotechnical laboratory test results are presented in **Appendix C**.

Based on the subsurface conditions encountered and laboratory testing results, the geotechnical recommendations are provided in Section 6.0 of this report.



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1. Introduction

AECOM Canada Limited (AECOM) was retained by the City of Hamilton (City) to complete a Municipal Class Environmental Assessment (MCEA) Phase 3 and 4 in support of road corridor improvements for Glancaster Road (from Garner Road to Dickenson Road). The Hamilton Airport Employment Growth District Transportation Master Plan classifies Glancaster Road as a North-South roadway with a proposed widening from two to four lanes.

The geotechnical investigation has been carried out in conjunction with a Municipal Class Environmental Assessment study. It is expected that the section of Glancaster Road from Garner Road/Rymal Rd W to Dickenson Road Drive will be improved to urban standards and may include pavement widening and improvements to the pavement structure and replacement or modification of existing structures as well as other geometric improvements as needed.

The purpose of the investigation was to obtain information about the existing pavement structure and subsurface conditions of existing road by means of advancing boreholes, to determine the geotechnical engineering characteristics of the subsurface soils by means of field and laboratory tests, and to provide geotechnical recommendations to the proposed road widening.

The data, conclusions and recommendations presented herein are limited to the information available at the time of preparation of this report, and they are only applicable to the specific areas mentioned, unless otherwise stated.

1.1 Project and Site Descriptions

The section of Glancaster Road under consideration is approximately 2.7 km long, extending from Garner Road / Rymal Road W at the north limit to Dickenson Road at the south limit and generally consists of an undivided 2-lane road with a rural cross-section with posted speeds of 50km/hr, asphalt surfaced, rural road with gravel shoulders and roadside ditches. Turning lanes presently exist at Garner Road/Rymal Rd W in the vicinity of the intersection.

The ground surface topography was relatively flat and there were no major structures in the study area. The east side of Glancaster Road mainly consist of rural residential lands and the west side characterized by a mixture of urban and rural residential lands.

The proposed improvements generally consist of road widening with increase in ROW from 20 m to 37 m and consider the following:

- transit, with transit stop at Dickenson,
- future multi-use recreational trail,
- reserved bike lanes /Multi-Use Path (MUP)'s
- sidewalks (i.e. complete street).
- inclusion of centre turn lanes and/or a median with turn lanes at intersections.
- review of the recommendations, to identify alternatives, and to select the preferred alternative, from existing centre line.

Based on Airport Employment Growth District (AEGD) Transportation Master Plan (TMP), it is recommended to widen Glancaster Road, from Garner Road East to Dickenson Road West, from 2 to 4 lanes and a 37m Right-of-Way. This work was identified as a Schedule C Municipal Class Environmental Assessment (EA). The Hamilton Airport Employment Growth District: Transportation Master Plan satisfies Phases 1 & 2 of the EA process for this Project. **Figure 1** presents a typical cross section for the proposed 4-lane arterial roadway.



Figure 1: Proposed 4-Lane Arterial Cross Section (as per AEGD)

1.2 Scope of Work for Geotechnical Investigation

Following scope of work was completed as part of the current geotechnical services for the proposed development:

- a) A thorough background information review including available study area reports and drawings.
- b) Field investigation and laboratory Testing, as follows:
 - Drilled eleven (11) boreholes and installed seven (7) monitoring wells to a depth of 6.2 m to 6.7 m bgs.
 - In all boreholes, Standard Penetration Tests (SPTs) were carried out at regular intervals, and soil samples were collected;
 - Boreholes were backfilled in accordance with O. Reg. 903.
 - Geotechnical laboratory testing was carried out on selected soil samples including moisture content, particle size analysis (sieve and hydrometer analyses) and Atterberg Limits tests, Standard Proctor Test and California Bearing Ratio Test;
 - Borehole locations were surveyed upon completion of drilling; and,
- c) Data Analysis and Reporting
- d) Prepared borehole logs; and,
- e) Provided the geotechnical recommendations for the proposed development based on the results obtained from the field and laboratory investigation.

This report presents the findings of the investigation including the following:

- f) Presentation of factual geotechnical data including borehole logs, test results, description of subsurface conditions, soil properties, and groundwater information; and,
- g) Recommendations on the geotechnical aspects to support the proposed road improvements and possible widening.

2. Physiographic and Geologic Setting

The project area is located south of the Niagara escarpment. The high elevation area; compared with the area to the north of the escarpment is underlain by the Middle and Lower Silurian, sandstone, shale, dolostone, and siltstone based on Ontario Geological Society (OGS) mapping. Specifically, the project area is underlain by the Lockport formation (OGS, 1991).

The Project area is within the Haldimand clay plain physiographic region, which occupies nearly all of the Niagara Peninsula. The region was submerged by Lake Warren and much of the underlying till is buried by stratified clay, however in some areas till come to the surface. Based on physiographic mapping the project area is with a clay plain with till moraines to the northeast and south (Chapman and Putnam, 1984).

The Quaternary geology within the project area is glaciomarine deposits of silt and clay. Ontario Geological Survey 2000. Quaternary geology, seamless coverage of the Province of Ontario; Ontario Geological Survey, Data Set 14-Revised.

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3. Historical Geotechnical Investigations

The City provided several historical reports related to the project area. These reports provide geotechnical investigations for utility construction and pavement recommendations near the project location. Most of these reports were completed before 2003, had limited pavement recommendations, and were not necessarily within the project limits. However, AECOM reviewed the historical reports better to understand existing subsurface conditions in general site location, and a summary of available information is provided in **Table 1**.

Table 1: Summary of Available Geotechnical Information

Report ID	Project	Location	Data of Issue	Available information	Comments
147-A	Pumping Station	North of Rymal Rd W	1978	<ul style="list-style-type: none"> - Geotech Investigation - Borehole to a max. depth of 18.5m - Gradation analysis 	<ul style="list-style-type: none"> - the site is located outside of the project study area and does not provide information about the existing pavement thickness. - the information is considered old and could not be reliable in pavement design, particularly in estimating the subgrade resilient modulus/soil consistency and moisture condition that most likely change over time.
324	Watermain	Glancaster Road (between Twenty Rd and Book Rd)	1983	<ul style="list-style-type: none"> - Geotechnical Investigation - Borehole to a max. depth of 3.0m 	<ul style="list-style-type: none"> - the information is considered old and could not be reliable in pavement design, particularly in estimating the subgrade resilient modulus/soil consistency and moisture condition that most likely change over time and the site may have been graded/surface modification since 1983. -the maximum depth for this exploration is 3 m which is insufficient for our proposed pavement and watermain design investigation (i.e., 6m). -no laboratory testing is provided in this report.
754	Proposed watermain	Twenty Road West, east of Glancaster	1995	<ul style="list-style-type: none"> - Geotechnical Investigation - Boreholes to a depth of 3.5 m 	<ul style="list-style-type: none"> - the site is located outside of the project study area and mainly drilled on the road shoulder so does not provide information about the existing pavement thickness for Glancaster Rd. - the information is considered old and could not be reliable in pavement design, particularly in estimating the subgrade resilient modulus/soil consistency and moisture condition that most likely change over time. -the maximum depth for this exploration is 3.5 m which is insufficient for our proposed pavement and watermain design investigation (i.e., 6 m).

Report ID	Project	Location	Data of Issue	Available information	Comments
GTR_1016A	Proposed Sanitary Sewer Construction	Rymal Road East, Glancaster Road And Hydro One Corridor at Glancaster Road	2003	- Environmental Sampling and Testing Report - Boreholes to a depth of 4.7 to 8.1 m	- this project covers about 535 m on the north portion of the proposed study area. - the information is considered old and could not be reliable in pavement design, particularly in estimating the subgrade resilient modulus/soil consistency and moisture condition that most likely change over time. The site may have been graded/surface modification since 2003 so the near surface soils may be different and not representative comparing to the existing condition. - This investigation was mainly for environmental sampling purposes, and therefore there is no geotechnical laboratory testing available in this report.
GTR_1112B	Pavement Rehabilitation	Ancaster, Glanbrook, Stoney Creek and Flamborough	2003	- Geotechnical and Pavement Investigations for a multiple street - Shallow boreholes	- the site is located outside of the project study area and does not provide consistence related / subsurface information. - the information is considered old and could not be reliable in pavement design, particularly in estimating the subgrade resilient modulus/soil consistency and moisture condition that most likely change over time. -the maximum depth for this exploration is 1.7 m which is insufficient for our proposed pavement and watermain design investigation (i.e., 6 m).
GTR_1599	Archaeological Assessment for Class Environmental Assessment of Glancaster Rd	North of Rymal Rd W	1992	- Archaeological Assessment	This report does not provide subsurface or soil testing information.

4. AECOM Investigation Procedures

Borehole drilling work was carried out between January 4, 2022 to January 21, 2022. The subsurface investigation consisted of drilling and sampling eighteen (18) boreholes to a depth of 6.7m below ground surface (bgs). Further, seven (7) monitoring wells were installed to a depth of 6.7m provisioned with flush mount.

The borehole locations were marked by AECOM staff before commencing the drilling work. Subsurface utilities were located and cleared by public utility owners, and private locators that were retained by AECOM. Upon the completion of drilling, the borehole locations were surveyed by AECOM staff. A Borehole Location Plan, showing approximate locations of the boreholes, is provided in **Appendix A**. All boreholes were located within roadway limits due to major underground utilities (i.e., watermain) is present along the road shoulders and ditches.

A truck mounted Diedrich D50 drill rig, owned and operated by ALTECH Drilling & Investigative Services Ltd., was used to drill all the boreholes. Boreholes were advanced using 130 mm outer diameter solid-stem augers, whereas, Monitoring wells were advanced using 190 mm outer diameter hollow-stem augers under the full-time supervision of AECOM geotechnical personnel.

Standard Penetration Tests (SPT) were carried out in general accordance with ASTM D1586. The test consists of freely dropping a 63.6 kg hammer over a vertical distance of 760 mm to drive a 51 mm outside diameter (O.D) split spoon sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground over a vertical distance of 300 mm was recorded as the Standard Penetration Resistance or the N-value of the soil, which is indicative of the compactness of cohesionless soils (gravels, sands, silts) or the consistency of cohesive soils (clays and clayey soils).

Monitoring wells were installed in the open boreholes in seven (7) locations (BH-01/MW, BH-04/MW, BH-07/MW, BH-10/MW, BH-12/MW, BH-15/MW and Bh-18/MW) upon completion of auguring/split spoon driving in accordance with the requirements prescribed in R.R.O. 1990, Ontario Regulation 903 “Wells” (as amended) (Ontario Water Resources Act, 1990), and they were constructed using 51 mm diameter PVC Schedule 40 well screens and solid riser pipes. Commercially manufactured well screen pipe with a standard slot size of 10 were used for these installations. Monitoring wells were completed using a well point cap that was threaded to the screen bottom. A J-plug was used to cover the top of the well riser pipe. A filter pack consisting of clean, inert rounded to sub-rounded 1 to 3 mm diameter silica sand was installed around each well screen, and the bentonite in pellet (free of chemical additives) was used as a non-permeable seal within the borehole annulus above the silica sand. The wells were completed using a flush-mounted steel cap at all locations. The monitoring wells were tagged in accordance with O. Reg. 903 (as amended) and a water well record was submitted by the drilling contractor to the MECP.

All other boreholes without monitoring wells were backfilled in accordance with O. Reg. 903.

Table 2 below presents a summary of the borehole locations and the borehole termination depths in metres below the ground surface (mBGS) and elevations in metres above sea level (mASL).

Table 2: Summary of Borehole Locations, Depths and Elevations

Borehole ID	Proposed Development	Borehole Depth (m bgs)	Date of Completion	Elevation (m ASL)	Northing	Easting
BH-1/MW	Pavement Design and Road Widening	6.7	January 21, 2022	232.5	4784660.5	587009.5
BH-2		6.7	January 21, 2022	233.3	4784486.4	587037.3
BH-3		6.7	January 14, 2022	234.8	4784385.4	587014.6
BH-4/MW		6.7	January 20, 2022	236.5	4784178.0	586949.4
BH-5		6.7	January 12 ,2022	235.9	4783987.8	586894.3
BH-6		6.7	January 12 ,2022	236.5	4783925.9	586869.5
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BH-8		6.7	January 20, 2022	239.2	4783650.6	586787.2
BH-9		6.7	January 10 ,2022	242.0	4783498.7	586739.6
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BH-16		6.7	January 4,2022	241.2	4782456.7	586420.3
BH-17		6.7	January 12,2022	240.7	4782315.9	586373.5
BH-18/MW		6.2	January 11,2022	240.2	4782192.9	586335.7

The recovered soil samples were reviewed by qualified personnel in the laboratory for further identification and to select samples for testing. All soil samples collected were tested for natural water content tests. Eighteen (18) selected soil samples were tested for particle size analyses (sieve and hydrometer analyses) and two (2) samples were tested for Atterberg Limits and one (1) California Bering Raito (CBR) test.

The borehole logs are presented in **Appendix B**. Geotechnical laboratory testing results are presented in **Appendix C**.

5. Environmental Soil Sampling/Testing

A limited environmental soil sampling program was completed as a part of the AECOM geotechnical and hydrogeological investigations for evaluating the environmental quality of the fill material and the upper level of native subsurface soil. This sampling/testing program was conducted for the future on-site waste management of excess soil for the waste disposal and re-use options during the construction. This sampling program comprised of collecting and analyzing soil samples as followed.

5.1 Soil Sampling Program and Procedures

Fieldwork was performed between January 4 and 21, 2022. The subsurface investigation consisted of drilling and sampling a total of 14 select boreholes within the Site. The borehole locations are presented in **Appendix A**. As a part of the combined investigation, AECOM retrieved 31 selected soil samples and submitted them for laboratory analyses as shown below in **Table 3**. This soil sampling program was designed based on the area of potential environmental concern (APEC) in the study area.

Table 3: Summary of Soil Samples Submitted for Laboratory Analysis

Sample ID	Analytical Parameters
BH-14 SS3(3'-5'), BH11 SS2(1'-3'), BH9 SS2(1'-3'), BH9 SS7 (15'-17'), BH15 SS3 (3'-5'), BH16 SS3 (3'-5'), BH18 SS3 (3'-5'), BH01-SS4 (5-7), BH02-SS3 (3-5), BH03-SS3B (3-5), BH04-SS4 (5-7), BH05-SS3A (3-5), BH05-SS4 (5-7), BH07-SS3 (3-5), BH10-SS2B (1-3), BH07-SS4 (5-7), and BH17-SS3A (3-5)	Selected Inorganic Parameters and Metals (M&I)
BH14 SS3 (3'-5'), BH11 SS2 (1'-3'), BH9 SS2 (1'-3'), BH9 SS7 (15'-17'), BH15 SS3 (3'-5'), BH16 SS3 (3'-5'), BH18 SS3 (3'-5'), BH02-SS3 (3-5), BH03-SS3B (3-5), BH05-SS3A (3-5), BH07-SS3 (3-5), BH10-SS2B (1-3), and BH17-SS3A (3-5)	Polychlorinated Biphenyls (PCBs)
TCLP - 01 (representing BH01-SS4 (5-7))	O. Reg. 347 – Toxicity characteristic leaching procedure (TCLP Metals extraction)

Soil samples were collected at selected intervals and screened for potential impacts, with the intent of the most impacted samples from both fill and native material being submitted for analysis as worst-case conservative assessments. In addition, field observation of impacts of soil contamination including staining or soil odours were taken into consideration during the selection of samples, however, none were observed in the samples. Therefore, representative samples from each stratigraphic unit were submitted for laboratory analysis for selected inorganic parameters and metals, and polychlorinated biphenyls (PCBs).

AECOM staff wore new nitrile gloves during the collection of each soil sample to reduce the potential for cross-contamination. Samples were transferred from the sample collection bag to appropriate laboratory-supplied jars once drilling was completed and PID vapour readings had been collected. All samples were placed on ice for

preservation until received by the AGAT laboratories, which is certified to ISO 9001:2015 and accredited to ISO 17025:2005 UKAS ref 4028.

Chain-of-custody (COC) procedures were followed during the submission of samples to the laboratory. Sample packaging and submission procedures were followed per the project sampling procedures, to ensure sample integrity from the point of sampling up until submission to the analytical laboratory. Samples were packaged and submitted to the laboratory as outlined below:

- Sample name, project number, and date were written on each sample container.
- Caps on the sample containers were checked to ensure they are properly sealed.
- Chain-of-custody forms were completed with the required information and signed and dated to document the sample custody transfer.
- Sample containers were protected in bubble wrap in coolers.
- Sample containers were placed in a cooler with ice.
- All samples were delivered by field staff directly to AGAT Laboratories (Mississauga, ON) to be analyzed within the recommended hold times.
- Original chain-of-custody forms accompanied each submission, and copies were retained.

A copy of the chain-of-custody for soil samples can be found in **Appendix E**.

All analytical testing of soil samples was performed by AGAT Laboratory and the Certificates of Analysis are provided in **Appendix E**. The results of the analyses on the soil samples were compared with the Ministry of the Environment, Conservation and Parks (MECP) Table 2 Full Depth Generic Condition Standards (SCS) in a Potable Groundwater Conditions for Industrial/Commercial/Community (ICC) property use, for medium fine-textured soil (Table 2 SCS). The SCS was selected based on the site location, the average thickness of the overburdened soil, groundwater conditions, the current property uses, and sieve and hydrometer test results carried out on soil samples.

6. Subsurface Conditions

Based on the subsurface conditions encountered at the borehole locations, the subsoils predominantly consisted of pavement structure (asphalt/granular fill) underlain by fill material (clayey silt/sand/sandy silt/). Native soils (clayey silt/silt/silty sand/sand) were encountered below the fill material.

Details of the subsurface conditions encountered at the borehole locations are presented in the Borehole Logs provided in **Appendix B**.

6.1 Pavement Structure

The pavement consists of an asphalt layer with a thickness ranging from 127 mm to 152 mm. The asphalt layer was underlain by granular materials ranged in thickness from 300 mm to 1040 mm. A summary of the existing pavement structure at the borehole locations is presented in **Table 4**.

Table 4: Existing Pavement Structure

Route	BH's/No. of Observation	Pavement Structure Layers	Thickness Range (mm)
Northbound	BH-02, BH-05, BH-07/MW, BH-08, BH-09, BH-11, BH-12/MW, BH-14, BH-15/MW, BH-16	Asphaltic Concrete	127-152
		Granular Base/Sub-base Materials	300-1040
Southbound	BH-01/MW, BH-03, BH-04/MW, BH-06, BH-10/MW, BH-13	Asphaltic Concrete	152
		Granular Base/Sub-base Materials	300-1040

A total of two samples of the granular materials from boreholes BH-7 and BH-12 were tested for grain size distribution analysis. The results indicated fine materials passing sieve 75 μ were 17% and 24% in boreholes BH-7 and BH-12, respectively. This indicates that the granular materials contain excessive fines than OPSS gradation requirements. It is noted that borehole size samples of aggregate are not sufficient for standardized laboratory tests according to ASTM and MTO/LS criteria, and if necessary, should be verified using appropriate bulk-size samples. The grain size distribution analyses for the two samples of the granular material are provided in **Appendix C** and summarized in **Table 5**.

Table 5: Summary of Grain size Distribution for Granular Material

Soil Unit	Percentage passing
Gravel (>4.75 mm size)	29 and 24
Sand (4.75 mm to 75 μ size)	54 and 52
Fines, Silt and Clay (< 75 μ size)	17 and 24

6.2 Fill Materials

Fill material (sand/sandy silt/clayey silt) was encountered below ground surface cover in all the boreholes except BH-11 and BH-12/MW and extended down to depths varying from 1.1m to 3.0m bgs.

SPT N values within the fill material ranged from 5 to 26 blows per 0.3 m penetration indicating loose to compact degree of compactness for cohesionless fill. The natural water content of the fill samples was 4% to 29%.

Two (2) grain size distribution analyses (sieve and hydrometer analyses) tests were conducted on the fill material and the results are summarized in **Table 6**.

Table 6: Summary of Laboratory Testing Results – Fill Material

Borehole ID	Sample ID	Depth (m)	Moisture Content (%)	Grain Size Distribution Analysis			
				Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH-1	SS4	1.5 to 2.1	20	0	5	80	15
BH-5	SS4	1.5 to 2.1	25	0	4	76	20

6.3 Native Soils

6.3.1 Clayey Silt

Clayey silt was encountered below the fill material in boreholes BH-3, BH-4/MW, BH-7/MW, BH-8, BH-9, BH-11, BH-12, BH-13, BH-14, BH-15 and BH-16 and extended to a depth of 3.05 m to 6.71 m bgs. SPT N values ranged from 11 to more than 50 blows per 0.3 m penetration indicating stiff to hard consistency. The natural water content of the samples ranged from 9% to 26%.

Eleven (11) grain size distribution analyses (sieve and hydrometer analyses) tests and two (2) Atterberg's Limit tests were conducted on the clayey silt material and the results are summarized in **Table 7**.

Table 7: Summary of Laboratory Testing Results – Clayey Silt

Borehole ID	Sample ID	Depth (m)	Moisture Content (%)	Grain Size Distribution Analysis				Atterberg's Limits		
				Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
BH-3	SS4	1.5 to 2.1	21	1	3	71	25	-	-	-
BH-4/MW	SS5B	2.4 to 2.9	19	-	4	73	23	-	-	-
BH-5	SS4	1.5 to 2.1	24	-	4	76	20	-	-	-
BH-7MW	SS4	1.5 to 2.1	24	-	6	68	26	34	21	7
BH-9	SS4	1.5 to 2.1	18	-	7	67	26	-	-	-
BH-11	SS4	1.5 to 2.1	18	1	3	69	27	33	20	13
BH-12	SS5	2.3 to 2.9	17	-	3	65	32	-	-	-
BH-13	SS6	3.0 to 3.6	13	1	4	68	27	-	-	-
BH-14	SS4	1.5 to 2.1	17	1	6	67	26	-	-	-
BH-15	SS5	2.3 to 2.9	14	-	3	74	23	-	-	-
BH-16	SS5	2.3 to 2.9	18	-	5	73	22	-	-	-

6.3.2 Silt

Silt was encountered below the fill material in boreholes BH-1/MW, BH-2, BH-5, BH-6, BH-8, BH-10/MW, and BH-17/MW and extended to a depth of 3.33 m to 6.71 m bgs. Silt layer also encountered below native clayey silt in BH-17/MW and BH-9 and extended to the termination depth of 6.7m bgs. SPT N values ranged from 5 to more than 50 blows per 0.3 m penetration indicating loose to very dense consistency. The natural water content of the samples ranged from 11% to 29%.

seven (7) grain size distribution analyses (sieve and hydrometer analyses) tests were conducted on the silt material and the results are summarized in **Table 8**.

Table 8: Summary of Laboratory Testing Results – Silt

Borehole ID	Sample ID	Depth (m)	Moisture Content (%)	Grain Size Distribution Analysis			
				Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH-1	SS4	1.5 to 2.1	20	-	5	80	15
BH-2	SS7	4.6 to 5.2	17	2	9	71	18
BH-6	SS6	3.0 to 3.6	16	1	11	71	17
BH-8	SS4	1.5 to 2.1	18	-	3	85	12
BH-10/MW	SS5	2.3 to 2.9	16	-	4	77	19
BH-17	SS3B	3.75 to 5.0	18	-	8	74	18
BH-18/MW	SS4	1.5 to 2.1	24	-	4	85	11

6.3.3 Sand to Silty Sand

Sand was encountered in boreholes BH-6, BH-11, BH-17 and extended to a depth of 4.57 m to 6.71 m bgs. SPT N values ranged from 10 to more than 50 blows per 0.3 m penetration indicating compact to very dense consistency. The natural water content of the samples ranged from 19% to 22%.

Silty Sand was encountered only in BH-13 extended to a depth of 6.38 m bgs. SPT N values are more than 50 blows per 0.3 m penetration indicating very dense consistency. The natural water content of the samples ranged from 14% to 18%.

6.4 Groundwater Conditions

Monitoring well construction details and groundwater levels was observed upon the completion of the drilling in the boreholes BH-01/MW, BH-04/MW, BH-07/MW, BH-10/MW, BH-12/MW, BH-15/MW and BH-18/MW. Monitoring wells were installed with 51 mm PVC risers and screens in both boreholes. The groundwater levels were measured upon the completion of drilling and in the monitoring wells (before well development), and these are presented in **Table 9** below.

Table 9: Groundwater Level Measurements

Borehole Number	Borehole Location	Ground Surface Elevation (mASL)	Top of Screen Depth (mbgs) / Elevation (mASL)	Well Depth (mbgs) / Screen Bottom (mASL)	Screen Length (m)	Date (YYYY-MM-DD)	Water Level Depth (mbgs) / Elevation (mASL)
BH-01/MW	Southbound	232.5	3.1	6.1	3	2022-02-15	2.03 / 230.45
						2022-03-15	1.96 / 230.52
BH-04/MW	Southbound	236.5	3.1	6.1	3	2022-02-15	1.89 / 234.58
						2022-03-15	1.74 / 234.73
BH-07/MW	Southbound	239.0	3.1	6.1	3	2022-02-15	0.62 / 238.43
						2022-03-15	0.53 / 238.52
BH-10/MW	Southbound	242.8	3.1	6.1	3	2022-02-15	2.14 / 240.65
						2022-03-15	1.76 / 241.03
BH-12/MW	Northbound	242.0	3.1	6.1	3	2022-02-15	1.54 / 240.51
						2022-03-15	1.26 / 240.79
BH-15/MW	Northbound	241.4	3.1	6.1	3	2022-02-15	0.86 / 240.54
						2022-03-15	0.73 / 240.67
BH-18/MW	Southbound	240.2	3.1	6.1	3	2022-02-15	1.06 / 239.14
						2022-03-15	0.91 / 239.29

For details on the monitoring well measurements, refer to AECOMs “Hydrogeological Investigation” technical memorandum dated May 03, 2022.

Groundwater conditions were also observed in all the boreholes except BH-1/MW, BH-3, BH-4/MW, BH-5, BH-7/MW, BH-10/MW, BH-13 and BH-15/MW upon the completion of drilling at depth ranged from 3 to 5.5 m bgs.

It should be noted that during spring months and times of heavy precipitation the groundwater table elevation is anticipated to fluctuate. Groundwater varies with seasonal conditions including precipitation, temperature, site drainage characteristics, etc. They may also be a potential for the development of perched groundwater tables following periods of intense rainfall

7. Discussions and Recommendations

This discussion is intended for use in planning and preliminary design of the proposed improvements to Glancaster Road from Garner Road to Dickenson Road. It is understood that a detailed design will be carried out by adding further geotechnical investigation to address the findings in the proposed widening area within proposed Right-of-Way (ROW).

7.1 Pavement

This section of the report provides engineering information for the geotechnical/pavement design aspects of the project, based on our interpretation of the information obtained during this investigation, and our understanding of the project requirements. The information in this portion of the report is provided for the guidance of the design engineers. Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

7.1.1 Traffic Data and Road Classification

AECOM prepared an Existing Condition Traffic Operation Assessment Draft Report dated December 2021 which includes existing and future Turning Movement Volume/Count (TMC) at three intersections as follows:

- Glancaster Road and Garner Road / Rymal Road (Signalized – October 31, 2019);
- Glancaster Road and Twenty Road (Unsignalized – September 20, 2011); and,
- Glancaster Road and Book Road (Unsignalized – May 17, 2018).

The report also provides existing heavy vehicle percentages and growth rates for existing and future conditions. It should be noted that the report does not provide Annual Average Daily Traffic (AADT), hence AECOM has further reviewed the available published traffic data from Hamilton traffic data management system "The Traffic Count Database System (TCDS) – MS2 Portal <http://hamilton.ms2soft.com>" to estimate Equivalent Single Axle Loads (ESALs) and carry out the pavement design analyses for preliminary purpose.

It is understood that current intersections with other roads within the corridor in accordance with the AEGD TMP. AEGD TMP is currently undergoing an update, and intended to confirm functional road classifications, and Municipal Class Environmental Assessment Classifications. Glancaster Road will likely retain its classification of a Minor Arterial.

Based on the available traffic data from TCDS, there are several count stations/locations along Glancaster Road within project limits as summarized in **Table 10**.

Table 10: Summary of Traffic Count Data

Location ID (as per TCDS)	Station Location	NB Count (Year)	SB Count (Year)	AADT (Year)
1406	Glancaster Rd, 315 m north of Grassyplain Dr	3,358 (2019)	3,021 (2019)	6,379 (2019)
7560	Intersection of Glancaster Rd and Grassyplain Dr	-	-	5,738 (2018)
31310	Glancaster Rd, 175 m north of Kopperfield Ln	2,232 (2019)	1,966 (2019)	4,200 (2019)
7700	Intersection of Glancaster Rd and Twenty Rd	-	-	5,719 (2011)
1414	Glancaster Rd, 310 m south of Twenty Rd W	4,016 (2019)	4,834 (2019)	8,850 (2019)
7701	Intersection of Glancaster Rd and Book Rd E	-	-	9,440 (2018)
8482	Intersection of Glancaster Rd and Dickenson Rd W	-	-	1,656 (2008)

To calculate the minimum pavement structural requirement, higher AADT of 8,850 for 2019 is considered.

Based on AECOM's Existing Condition Traffic Operation Assessment Draft Report, heavy vehicles percentage is ranged from 4 to 5% and an average annual growth rate of 0.57%. For the purpose of preliminary pavement design for future road widening, traffic volumes considered in the design are presented in **Table 11**. It should be noted that at the time of this report, construction year (base year) is not available, hence it is assumed that construction will not start before 2024.

Table 11: Summary of Traffic Data

2019 AADT	2024 AADT	% Truck Traffic	%Traffic Growth (2019-2024)	%Traffic Growth (2024-2034)	Directional Distribution	Lane Distribution ¹
8,850	9,293	7	1	2	0.5	0.9

1. Lane Distribution for 2-Lane for each direction

The resilient modulus of subgrade for the westerly portion of the study area site has been assumed to be 28 MPa, based on Table D-8 recommendations for “low plasticity clays and compressible silts” in “fair” to “good” condition in MTO MI-183 Adaption and Verification of AASHTO Pavement Design Guide for Ontario Conditions The pavement design and material parameters considered are summarized in **Table 12** below.

Table 12: Pavement Design Parameters

Design Criteria	Parameters
	Rehabilitation / Widening
Design Life	20 Years
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level (%)	85
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus (MPa)	28
Structural Coefficients for New Hot Mix Asphalt, a_1	0.42
Structural Coefficients for New Granular Base (Granular "A"), a_2	0.14
Structural Coefficients for New Granular Base (Granular "B" Type II), a_3	0.11
Drainage Coefficient, m	1.0
Structural Coefficients for the Existing Hot Mix Asphalt	0.25
Average Thickness for the Existing Hot Mix Asphalt (mm)	149
Structural Coefficients for the Existing Granular Material	0.08
Average Thickness for the Existing Granular Material (mm)	660
Drainage Coefficient for the Existing Granular Material	0.9

7.1.2 Equivalent Single Axle Loads (ESALs)

The equivalent single axle loads (ESAL) for the design lanes within the study limits, were calculated using the traffic data presented in **Tables 10 to 12**. The input parameters for the design lane ESAL calculation were derived from MTO publication MI-183 ‘Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions and ‘Procedures for Estimating Traffic Loads for Pavement Design, 1995’. **Table 13** presents the calculated ESALs.

Table 13: Input Parameters for ESAL Calculations

Road Section	Base Year AADT ¹	Average Truck Factor	Design No. of days per Year	Design Period (Years)	Cumulative ESALs (million)
Glancaster Rd from Garner Rd to Dickenson Road	9,293	1.184	365	20	2.66

1. Base (Construction) Year = 2024 (assumed)

7.1.3 AASHTO Design Analysis

As mentioned in **Table 13**, 20-years cumulative ESALs of 2.66 million is considered for the pavement design analyses using the “AASHTO Guide for Design of Pavement Structures 1993” and MTO’s “Adaption and Verification of AASHTO Pavement Design Guide for Ontario Conditions, MI-183”, dated March 2008.

City of Hamilton, Engineering Guidelines for Servicing Land Under Development Applications was reviewed to confirm minimum pavement requirements as outlined in Section 2.4.5.4 of Engineering Guideline (December

2012). The City's minimum design requirements have been compared to the minimum design requirements required by AASHTO 1993, and the more conservative design option was selected.

The minimum pavement structural design using City of Hamilton Guideline for Rural Arterial Roads (Major and Minor is as follows:

- Surface Course: 40 mm HL-1
- Binder Course: 120 mm HL-8
- Granular "A": 150 mm
- Granular "B": 450 mm (Type II 100 % Crushed Aggregate)
- Total pavement thickness = 760 mm.

7.1.4 Pavement Design Alternatives

Based on the design analysis and the existing pavement condition, the following two alternative strategies were developed for the proposed road widening of Glancaster Road, from Garner Rd to Dickenson Road:

Option 1 – Full Depth Reconstruction/for Road Widening

The full depth reconstruction option/for road widening is presented below. Remove the existing HMA, granular materials and subgrade soils to 800 mm below proposed finished grade and place the following:

- 40 mm SP 12.5 FC2, Surface Course;
- 60 mm SP 19.0, Upper Binder Course;
- 60 mm SP 19.0, Lower Binder Course;
- 150 mm new Granular 'A' Base; and,
- 500 mm new Granular 'B Type II' Subbase (Thicker subbase recommended due to HSFH subgrade and high groundwater) and subdrain system.

Full depth reconstruction of the existing pavement and for road widening will involve the following:

- Full depth removal of existing asphalt and granular material to the depth of the proposed new pavement structure;
- Sub-excavation of subgrade to design elevation to accommodate the new pavement structure; the prepared subgrade should be carefully proof-rolled in the presence of the geotechnical engineer, and soft or wet areas or other obviously deleterious materials excavated and the grade restored with suitable, approved material;
- Restoration of sub-excavated areas and fine grading of the subgrade may be carried out using the stockpiled recycled granular materials from existing pavements, or OPSS 1010 Granular B Type II material. All backfill material should be placed in uniform lifts not exceeding 200 mm loose thickness and compacted to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD). The finished subgrade should be provided with a continuous centre-to-edge cross fall of 3 percent;
- Place and compact Granular B, Type II, subbase (OPSS 1010) in loose lifts not exceeding 200 mm thickness, uniformly compacted to 100 per cent of SPMDD;
- Place and compact Granular A base (OPSS 1010) uniformly to 100 percent of SPMDD; and
- Pave with new 150 mm HMA (OPSS 1150, OPSS MUNI 1151 and OPSS 310) consist of 40 mm thick SP12.5 FC2 Surface Course, over 50 mm thick SP19.0 Upper Binder Course over 60 mm thick SP19.0 Lower Binder Course.

For any proposed widening or realignment of Glancaster Road or to reconstruct the Glancaster Road within project limits, it is recommended to strip the topsoil from the footprint area of proposed road. At the time of preparing this preliminary report, no information is available for the existing topsoil. Therefore, it is recommended to measure the topsoil thicknesses during the detailed design stage. After stripping the topsoil, excavation/filling should be carried out to sufficient depths to construct the pavement structure as noted below.

The subgrade should be proof-rolled with a heavy roller to identify any soft areas. The soft areas must be repaired by sub-excavating and replacing with granular material as advised by the Contract Administrator.

In areas of road widening or realignment, it is recommended increasing the sub-base thickness to match the existing bottom of the sub-base course to allow lateral sub-surface drainage.

Construction of continuous perforated subdrains in accordance with OPSD 216.021 Subdrain Pipe Connection and Outlet Urban (or alternatively Hamilton STD No. RD-101). Subdrains should consist of perforated 100 mm diameter subdrain pipe surrounded in 19mm clear crushed stone wrapped in a suitable geotextile. The invert of the pipes should be at least 300mm below the subgrade elevation.

Option 2 – Full Depth Asphalt Removal

This option consists of rehabilitation of the existing pavement structure by removing the entire asphalt layers, adding new Granular A material as necessary, and paving with 3 lifts of new HMA as presented below.

- 40 mm SP 12.5 FC2, Surface Course
- 60 mm SP 19.0, Upper Binder Course
- 65 mm SP 19.0, Lower Binder Course

Rehabilitation option for the existing pavement structure will involve the following:

- Full depth removal of asphalt (mill full depth of existing asphalt, average 150mm), partial excavation of granular material (as necessary); and
- Pave with new 150 mm HMA (OPSS 1150, OPSS MUNI 1151 and OPSS 310) consist of 40 mm thick SP12.5 FC2 Surface Course, over 50 mm thick SP19.0 Upper Binder Course over 60 mm thick SP19.0 Lower Binder Course.

This option will result in average 15mm grade raise (i.e., 15mm higher than the existing road profile). The bottom of the new granular material (i.e., for the widening road) recommended to match or lower than the existing granular material and therefore, positive lateral sub-surface drainage cannot be impacted.

For better pavement performance throughout the design life, a provision of continuous perforated subdrains in accordance with OPSD 216.021 Subdrain Pipe Connection and Outlet Urban (or alternatively Hamilton STD No. RD-101) is recommended. Subdrains should consist of perforated 100 mm diameter subdrain pipe surrounded in 19mm clear crushed stone wrapped in a suitable geotextile. The invert of the pipes should be at least 300mm below the subgrade elevation.

7.1.5 PGAC Binder Selection

The performance grade of the asphalt cement shall be as noted below:

- Surface course mixes: PGAC 70-28
- Binder course mixes: PGAC 64-28

7.1.6 Tack Coat

A tack coat should be applied to the surface of all binder courses, including the joint paint as per OPSS.PROV.308. It should also be applied where any binder course has been left open to traffic. All the milled surfaces within the project limits shall also be coated with tack coat.

7.2 Underground Utilities

7.2.1 Excavation and Groundwater Control

It is understood that road improvements will involve utilities relocation and the information regards of utilities depth and location are not available at the time of this report. However, based on typical industry practice, it is anticipated that watermain installation will be in the order of about 3 m below finished grade and sanitary pipes will be the order 3 m below finished grade. It is anticipated that relatively shallow excavation (i.e. less than 4 m) can generally be carried out using conventional open-cut techniques. It is expected that shallow excavations will penetrate strata of fill, silt, clayey silt and sand/silty sand. Based on current investigation, it is not expected that bedrock will be encountered within 4m depth.

Generally, groundwater was recorded at shallow depth ranges from 0.5 to 2.1 m bgs in the seven (7) monitoring wells, it is likely that groundwater in open excavations will be encountered. In such instances, measures to control ground water seepage will be required to properly bed the pipes, and to compact the bedding materials. The results of the boreholes suggest that adequate control of the ground water can probably be achieved by pumping from a series of properly filtered sumps located as required in the excavations. The requirements for dewatering should be reviewed at the final design stage when the locations and invert elevations of the underground services are known and follow the hydrogeological recommendations.

All excavations must be carried out in accordance with the Occupational Health and Safety regulations under the Ontario Labour Act. Based on the soil conditions encountered in the current boreholes, the soils to be excavated can be classified as Type 3 soils above the groundwater level, provided that effective ground water control is achieved where required and surface water is directed away from open excavations and Type 4 if excavation extended below water level. Excavation into fill material can also classified as Type 4. Temporary support will be required for vertically cut trenches and where space restrictions preclude excavation of inclined slopes within the overburden. Supported excavation may be carried out using a trench box or temporary shoring. If the trench depth exceeded 3 m, the support system should be designed by professional engineer.

An inventory of existing underground plant should be undertaken in order to identify any constraints or special requirements that will be needed to maintain the integrity of the services during construction.

7.2.2 Backfill

Bedding for the services should consist of well graded free draining granular material such as Granular "A", which is compatible with the size and type of pipe and consistent with City of Hamilton standards. Care will be required to ensure that softened or disturbed soil is removed prior to placing pipe bedding. The excavated soil will generally consist of fill, silt, clayey silt and sand/silty sand. It is considered that for shallow services, the bedding and the pavement structure will comprise most of the backfill and that in such cases, the remainder of the backfill should also consist of granular material consisting of the existing road base material or imported Type 1 Granular "B" material or select excavated sandy soil where available.

Selective re-use of the existing granular base material as well as the overburden, for backfill in deeper excavations may be feasible provided that excessively wet, frozen or otherwise unsuitable soil is excluded. Re-use of the excavated rock as backfill is not feasible unless the rock is crushed to an appropriate size and gradation.

Trench backfill should be placed in 300 mm thick lifts with each lift uniformly compacted to 95 percent of standard Proctor maximum dry density. The upper 1m of trench backfill, forming the pavement subgrade should be uniformly compacted to at least 98 percent of standard Proctor maximum dry density.

7.3 Subgrade Preparation

All topsoil, organics, soft/loose and otherwise disturbed soils should be stripped from the subgrade area. The exposed subgrade soils will be disturbed by construction traffic when wet; especially if site work is carried out during periods of wet weather. Under inclement weather conditions, an adequate granular working surface may be required to facilitate construction traffic as well as to minimize subgrade disturbance and to protect its integrity.

Immediately prior to placing the granular subbase, the exposed subgrade should be compacted and then proof-rolled with a heavy rubber-tired vehicle (such as a loaded gravel truck) in conjunction with inspection by a geotechnical engineer. The subgrade should be inspected for signs of rutting or displacement. Areas displaying signs of rutting or displacement should be re-compacted and retested, or the material should be sub-excavated and replaced with well-compacted engineered fill materials.

The fill materials may consist of either granular material or local inorganic soils provided that its moisture content is within ± 2 percent of OMC. The new fill should be placed in lift thicknesses not exceeding 200 mm before compaction and should be uniformly compacted to at least 95% of SPMDD, increasing to 98% within upper 1 m of the subgrade.

7.4 Sub-Drainage

Control of surface and sub-surface water is an important factor in achieving a good pavement service life particular in such subsurface conditions consist of high susceptibility to frost heave (i.e., subgrade/roadbed dominated by silt) and high ground water level. Therefore, it is recommended that provisions be made to drain the proposed pavement subgrade and its granular layers. To provide positive drainage across the pavement platform, the surface of pavement should be sloped at a grade of 2 percent and the pavement subgrade should be sloped at a grade of 3 percent towards the sub-drains.

7.5 Site Seismic Classification

In conformance to the criteria in Table 4.1.8.4A, Part 4, Division B of the National Building Code of Canada (NBCC 2010), the project Site may be classified as Site Class “D” and Soil Profile Name: “Stiff Soil”. The four values of the 5% damped spectral response acceleration $S_a(T)$ for different periods and Peak Ground Acceleration (PGA) can be obtained from Table C-2 in Appendix C of Division B of the NBCC (2010). The design values of F_a and F_v for the Site should be calculated in accordance to Table 4.1.8.1 B and C.

7.6 Frost Depth

The frost penetration depth in the City of Hamilton is determined to be approximately 1.2 m based on Figure 3.6 in MTO Pavement Design and Rehabilitation Manual.

The grain size analyses results indicated that the percentage range of fine materials between 5 and 75 µm within frost penetration zone was from 50 to 81 percent, indicating moderate to high susceptibility to frost heave in accordance with frost susceptibility category in MTO Pavement Design and Rehabilitation Manual.

7.7 Geo-environmental Assessment Results

7.7.1 Soil Analytical Results

A total of 31 soil samples were submitted to AGAT Laboratories in Mississauga, Ontario laboratory analysis of one or more of COPCs including one or more of M&I, and PCBs. No contaminants analyzed exceeded the MECP Table 2 SCS in soil samples collected from the Site except the ones listed in **Table 14** below.

Table 14: Summary of Soil Exceedances

Borehole	Sample ID	Depth (m bgs)	Exceedance	MECP Table 2 SCS	Result
BH-1	BH01-SS4 (5-7)	1.5 – 2.1	Boron (Hot Water Soluble)	2.0	4.95
			Electrical Conductivity (EC)* (mS/cm) *	1.4	4.78
			Sodium Adsorption Ratio (SAR)*	12	43.7
BH-3	BH03-SS3B (3-5)	0.9 – 1.5	Electrical Conductivity (EC)* (mS/cm) *	1.4	1.87
			Sodium Adsorption Ratio (SAR)*	12	16.2
BH-4	BH04-SS4 (5-7)	1.5 – 2.1	Electrical Conductivity (EC)* (mS/cm) *	1.4	1.6
			Sodium Adsorption Ratio (SAR)*	12	17.2
BH-5	BH05-SS3A (3-5)	0.9 – 1.5	Electrical Conductivity (EC)* (mS/cm) *	1.4	2.25
BH-9	BH9 SS2 (1'-3')	0.3 – 0.9	Electrical Conductivity (EC)* (mS/cm) *	1.4	1.42
			Sodium Adsorption Ratio (SAR)*	12	18.5
BH-10	BH10-SS2B (1-3)	0.3 – 0.9	Electrical Conductivity (EC)* (mS/cm) *	1.4	1.68
			Sodium Adsorption Ratio (SAR)*	12	17.7
BH-11	BH11-SS2 (1-3)	0.3 – 0.9	Electrical Conductivity (EC)* (mS/cm) *	1.4	1.77
			Sodium Adsorption Ratio (SAR)*	12	21.1
BH-14	BH14-SS3 (3'-5')	0.9 – 1.5	Electrical Conductivity (EC)* (mS/cm) *	1.4	1.78
BH-15	BH15-SS3 (3'-5')	0.9 – 1.5	Electrical Conductivity (EC)* (mS/cm) *	1.4	2.54
			Sodium Adsorption Ratio (SAR)*	12	19.7

Borehole	Sample ID	Depth (m bgs)	Exceedance	MECP Table 2 SCS	Result
BH-16	BH16- SS3 (3'-5')	0.9 – 1.5	Electrical Conductivity (EC)* (mS/cm) *	1.4	1.62
BH-17	BH17-SS3A (3 - 5)	0.9 – 1.5	Electrical Conductivity (EC)* (mS/cm) *	1.4	1.64
			Sodium Adsorption Ratio (SAR)*	12	25.7
BH-18	BH18-SS3 (3' -5')	0.9 – 1.5	Electrical Conductivity (EC)* (mS/cm) *	1.4	2.91
			Sodium Adsorption Ratio (SAR)*	12	33.1

Notes: * Results with salt related exceedances
Bold = concentration exceeded MECP Table 2 SCS
 All units are micrograms per gram (ug/g), unless otherwise specified.

- Of the 18 boreholes, from 14 select boreholes, 17 soil samples were submitted for chemical analysis of M&I parameters. The depth of the samples ranged from 0.3 to 5.2 m below the existing ground surface.
 - The concentration of Boron (Hot Water Soluble) exceeded the Table 2 SCS in samples collected from borehole BH01. The sample was retrieved between 1.5m and 2.1m below the existing ground surface.
 - Except for borehole locations BH02 and BH07, the concentrations of EC and /or SAR exceeded the applicable Table 2 SCS in the remaining 12 boreholes. Of the 17 soil samples, 12 samples exceeded the MECP Table 2 SCS.
 - The concentrations of all the remaining M&I parameters were non-detect and /or below applicable MECP Table 2 SCS in samples collected from all the boreholes at the Site.
- The concentrations of PCBs were non-detect and/or below applicable MECP Table 2 SCS in all 13 samples collected from select boreholes at the Site.
- In addition, analytical results of the TCLP soil sample were below the applicable MECP O. Reg. 558, Schedule 4: Leachate Quality Criteria.

The laboratory certificates of analysis are presented in **Appendix E**.

7.7.2 Quality Assurance and Quality Control

No QA/QC issues were identified by the laboratory that would materially affect the overall results of the soil sampling presented within this report.

Quality assurance and quality control measures were adhered to during the field investigation for the collection of soil samples. AECOM field personnel followed defined procedures for sample collection, handling, storage, and custody to ensure quality control. All samples were handled in accordance with analytical protocols related to sample collection, hold time, preservation, and storage.

7.7.3 Conclusion

Based on the soil investigation completed at the Site, the following summary is provided:

1. A total of 14 boreholes were advanced to evaluate the subsurface soil quality at the Site.
2. A total of 31 soil samples were submitted to AGAT Laboratories in Mississauga, Ontario laboratory analysis of one or more of COPCs including one or more of M&I, and PCBs.
3. No contaminants analyzed exceeded the MECP Table 2 SCS in soil samples collected from the Site except for the following:
 - In total 17 soil samples were submitted for chemical analysis of M&I parameters. The depth of the samples ranged from 0.3 m to 5.2 m below the ground surface.
 - The concentration of Boron (Hot Water Soluble) exceeded the Table 2 SCS in samples collected from borehole BH01. The sample was retrieved between 1.5m and 2.1m below the existing ground surface.
 - Of the 17 soil samples, 12 samples exceeded the MECP Table 2 SCS for EC and SAR.
4. For waste management considerations, one composite soil sample TCLP-1 (composite sample was comprised of the worst-case scenario sample; BH01-SS4) was prepared by the laboratory for TCLP analysis for Metals and Inorganics, SVOCs, VOCs, and PCBs. Analytical results of the TCLP soil sample were below the applicable MECP O. Reg. 558, Schedule 4: Leachate Quality Criteria and classified as non-hazardous solid waste in accordance with Ontario Regulations 347 (as amended), Schedule 4 Leachate Quality Criteria for Non-hazardous material.

7.7.3.1 Salt Impacted Soil

Excess Soil Quality Standards for sodium adsorption ratio and electrical conductivity in Soil, resulting from the use of a substance for the safety of the vehicle or pedestrian traffic applied under ice/snow conditions are deemed to be met if the Excess Soil is placed at a location;

- Where it is reasonable to expect the soil will be affected for the same reason;
- At an industrial or commercial property where non-potable ESQS would apply; or
- At a minimum depth of 1.5 m below the soil surface.

Salt impacted soil shall not be placed;

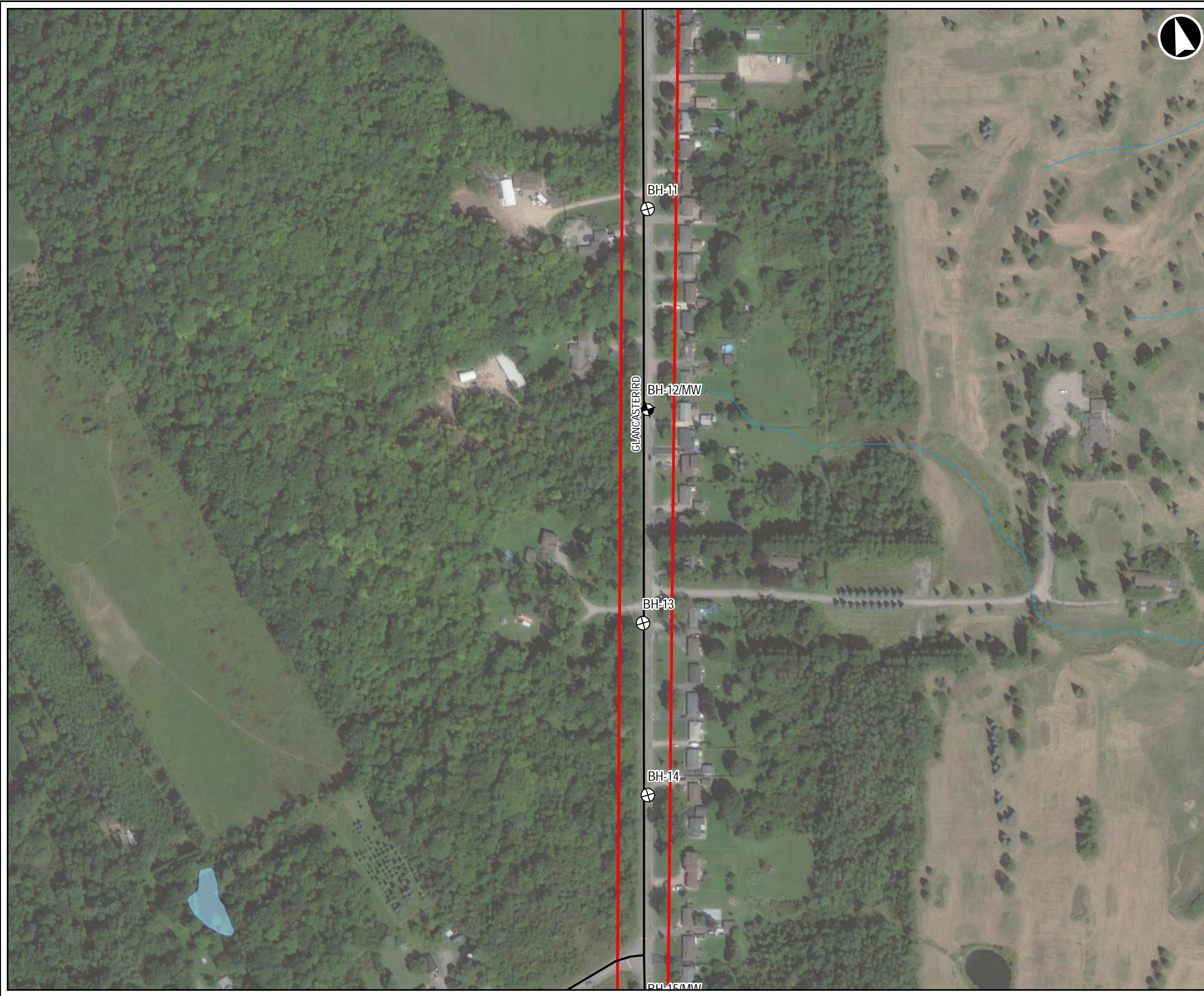
- Within 30 metres of a waterbody;
- Within 100 metres of a potable water well; or
- A location that will be used for agricultural purposes (crops or livestock) unless it is 1.5 m below the soil surface.

The City of Hamilton or the future construction contractor must inform the owner/operator of any Reuse Site if the Excess Soil to be transported and placed at the Reuse Site and provide the owner with sample results. It is also necessary to inform the owner/operator of the Reuse Site of potential risks to surface water and groundwater as a result of the placement of salt impacted Excess Soil.

Appendix **A**

Borehole Location Plans

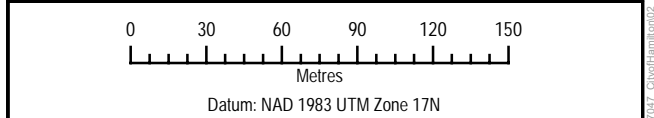




- Legend**
- Borehole
 - Monitoring Well
 - High Voltage Wires
 - Major Road
 - Local Road
 - Waterbody
 - Watercourse

CITY OF HAMILTON - GLANCASTER RD

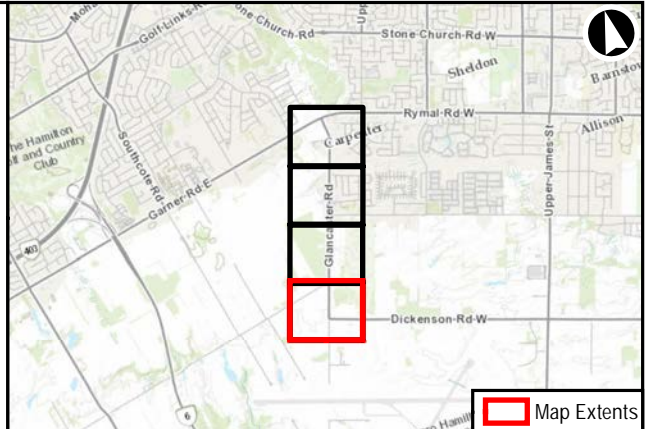
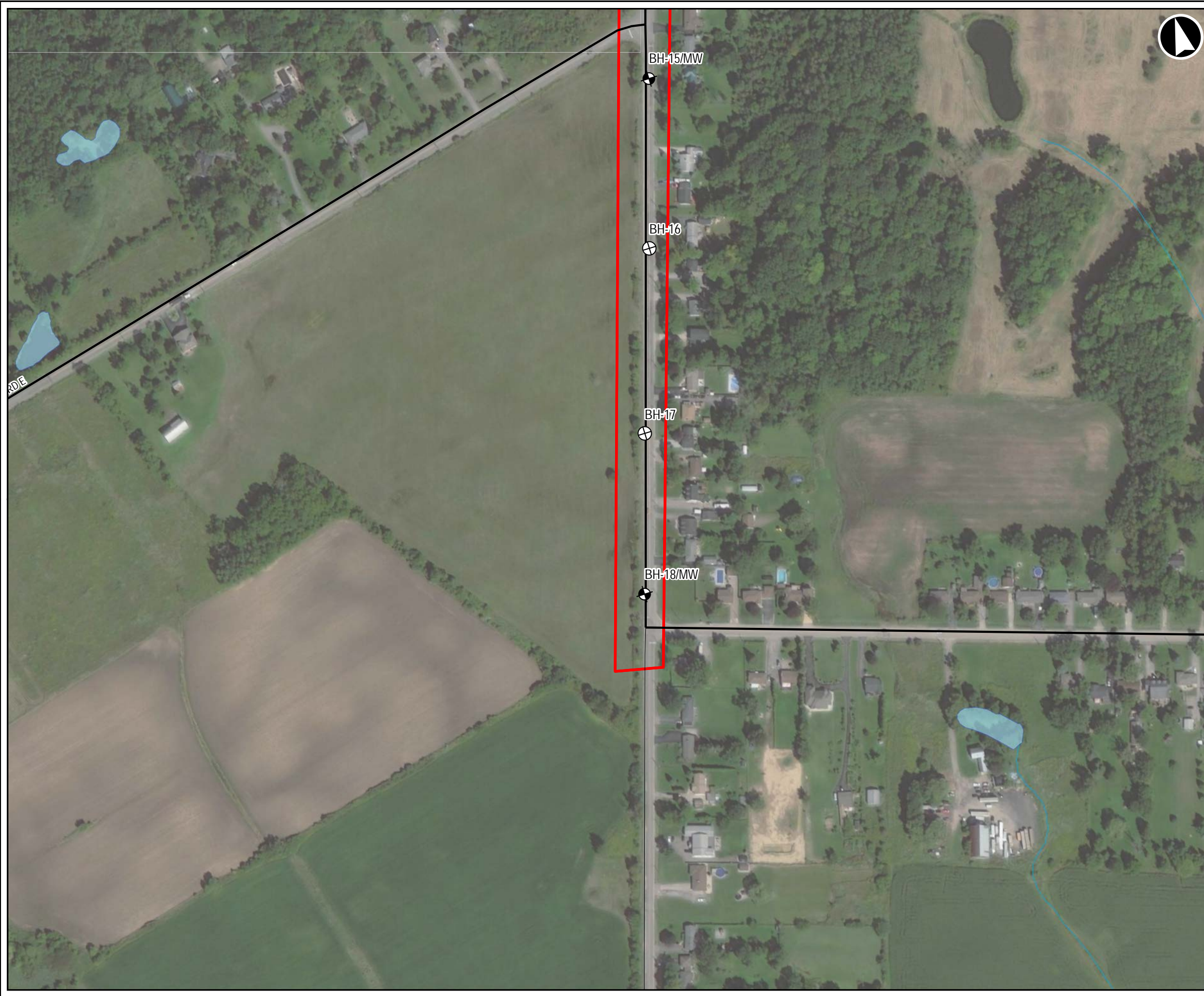
BOREHOLE LOCATION PLAN



Apr, 2022	PN#: 60637047	1:3,000 *when printed 11"x17"	AECOM
Figure 2-3			

Data Sources: LIO
 Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
 Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeBCo, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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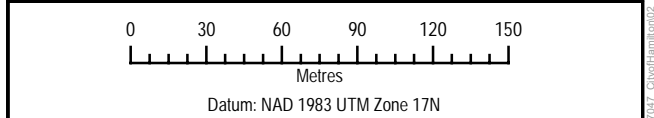
City of Hamilton - Glancaster Rd - Borehole Location Plan.mxd
 Date Saved: 02/29/2022 2:33:14 PM User Name: paula.crossman



- Legend**
- Borehole
 - Monitoring Well
 - High Voltage Wires
 - Major Road
 - Local Road
 - Waterbody
 - Watercourse

CITY OF HAMILTON - GLANCASTER RD

BOREHOLE LOCATION PLAN



Apr, 2022	PN#: 60637047	1:3,000 *when printed 11"x17"	AECOM
Figure 2-4			

Data Sources: LIO
 Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
 Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeBCo, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, Mapbox Contributors, and the GIS User Community
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Appendix **B**

Borehole Records



TERMINOLOGY USED IN BOREHOLE LOGS

Topsoil: Mixture of soil and humus capable of supporting good vegetative growth.

Peat: A mass of organic matter usually fibrous in texture in various stages of decomposition, generally dark brown to black in colour and of spongy consistency.

Fill: The term fill has been used to describe materials which have been placed by non-natural processes. Fills can often be heterogeneous in nature and those relying on this report should expect them to contain deleterious materials. Such materials can include wood, bricks, slag, porcelain, organics, and obstructions such as scrap metal, storage tanks, and abandoned concrete/steel structures.

Due to the uncertainty of the placement method of the material, the boring samples obtained for this report are not expected to represent other materials at any horizontal or vertical distance from where the sample was obtained.

Fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill site. Unless specifically stated, the fill on this site has not been tested for contaminants that can be considered toxic or hazardous. Testing to determine the toxicity of fill materials can be conducted, if requested.

Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Till must be considered heterogeneous in composition and containing pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) and boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the logs. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Due to the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone. Caution is essential when dealing with sensitive excavations or dewatering programs in till materials.

Terminology describing soil structure

Desiccated: having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.

Stratified: alternating layers of varying material or color with the layers greater than 6 mm thick.

Laminated: alternating layers of varying material or color with the layers less than 6 mm thick.

Fissured: material breaks along plane of fracture.

Varved: composed of regular alternating layers of silt and clay.

Slickensided: fracture planes appear polished or glossy, sometimes striated.

Blocky: cohesive soil that can be broken down into small angular lumps which resist further breakdown.

Lensed: inclusion of small pockets of different soil, such as small lenses of sand scattered through a mass of clay; not thickness.

Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

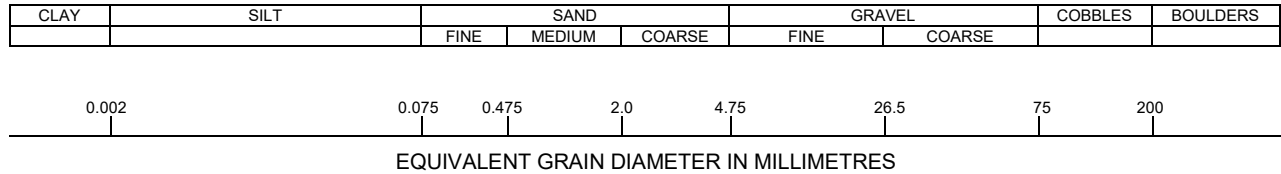
Homogeneous: same color and appearance throughout.

Well Graded: having wide range in grain sized and substantial amounts of all predominantly on grain size.

Uniformly Graded: predominantly on grain size.

All soil sample descriptions included in this report generally follow the Canadian Foundations Engineering Manual and the Unified Soil Classification System. These systems follow the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by AECOM follow the same system. Note that, with exception of those samples where a grain size distribution analysis has been completed, all samples have been classified by visual inspection. Visual inspection classification is not sufficient to provide exact grain sizing.

ISSMFE / USCS SOIL CLASSIFICATION



The standard terminology to describe cohesive soils includes consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests or similar field and laboratory analysis. Standard Penetration Test 'N' values can also be used to provide an approximate indication of the consistency and shear strength of fine grained, cohesive soils.

The standard terminology to describe cohesionless soils includes the compactness condition as determined by the Standard Penetration Test 'N' value.

Cohesionless Soils		Cohesive Soils			Composition	
Compactness Condition	SPT N-Index (blows per 0.3 m)	Consistency	Undrained Shear Strength (kPa)	SPT N-Index (blows per 0.3 m)	Term	Criteria
Very loose	0 – 4	Very soft	< 12	< 2	Trace	1% - 10%
Loose	4 – 10	Soft	12 - 25	2 – 4	Some	10% - 20%
Compact	10 – 30	Firm	25 – 50	4 – 8	Adjective	20% - 35%
Dense	30 – 50	Stiff	50 – 100	8 – 15	And	> 35%
Very Dense	> 50	Very Stiff	100 - 200	15 – 30	Noun	> 35% & largest fraction
		Hard	> 200	> 30		

Standard Penetration Test (SPT):

The number of blows required to drive a 50 mm (2 in.) open split spoon sampler from a depth of 150 mm (6 in.) to 450 mm (18 in.) in undisturbed soil. Each blow is driven by a 63.6 kg (140 lb.) hammer free falling a distance of 0.76 m (30 in.).

Sample & Soil Abbreviations		Contaminant Abbreviations		Strata/Graphic Plot					
CORE	Rock core sample	BNAE	base/neutral/acid extractables		Fill		Asphalt		Cobbles
AS	Auger sample	BTEX	benzene, toluene, ethylbenzene, xylenes		Topsoil		Concrete		Sandy Silt Till
FV	Field vane	OCP	organochlorine pesticides		Clay		Silty Clay		Silty Clay Till
PP	Pocket penetrometer	MI	metals & inorganics		Silt		Clayey Silt		Clayey Silt Till
SG	Specific gravity	PAH	polycyclic aromatic hydrocarbons		Sand		Silty Sand		Silty Gravel
SH	Shelby tube sample	PCB	polychlorinated biphenyls		Gravel		Sand & Gravel		Clayey Gravel
SS	Split spoon sample	PHC	CCME petroleum hydrocarbons (fractions 1 – 4)		Clayey Sand		Shale		Limestone
DCPT	Dynamic cone penetration test	VOC	volatile organic compounds (includes BTEX)						
GR	Gravel	Plasticity Description Liquid Limit (w_l)							
SA	Sand	Low	w _l < 30						
SI	Silt	Medium	30 < w _l < 50						
CL	Clay	High	50 < w _l						

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Southbound Driving Lane
 COORDINATES: N 4784660.5; E 587009.5
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-01/MW

SHEET 1 OF 1

START DATE: January 21, 2022
 END DATE: January 21, 2022
 BORING METHOD: 190 mm O.D Hollow Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, KPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. (■)	Field Vane rem. (□)	Quick (●)				Triaxial Unconfined (△)		
0	Power Auger Drilling 190 mm O.D Hollow Stem Auger	PAVEMENT SURFACE		232.48												
		ASPHALT 152 mm thick		0.00	1	AS										
		GRANULAR MATERIAL sand and gravel, brown, moist		0.15	2A											
		FILL silt, some clay, trace sand, brown, moist, stiff to very stiff		0.61	2B	SS	30									
1					3	SS	26									
2			clayey		4	SS	10									
3					5	SS	5									
3			SILT some clay, trace sand, brown, moist, stiff		229.43	6	SS	8								
4				3.05												
5		hard			7	SS	42									
6		very stiff			8	SS	21									
7		END OF BOREHOLE		225.77												
				6.77												
7		Notes: 1. No groundwater was observed upon drilling completion. 2. Monitoring well was installed at 6.1 m below ground surface with flush mount protection.														

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT 22-5-1

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Northbound Driving Lane
 COORDINATES: N 4784486.4; E 587037.3
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-02

SHEET 1 OF 1

START DATE: January 21, 2022
 END DATE: January 21, 2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, KPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. \oplus	Field Vane rem. $\opl�$	Quick Triaxial Unconfined \bullet				Unconfined Δ		
0		PAVEMENT SURFACE		233.26												
		ASPHALT 152 mm thick		0.00												
		GRANULAR MATERIAL Crusher Run Limestone, light grey to brown, moist		0.15	1	AS	>50/75 mm									
				232.34	2	SS										
1		FILL clayey silt, black, moist, firm to stiff		0.91	3	SS	5									
				231.55	4A											
		SILT some clay, trace sand, trace gravel, brown, moist, stiff to very stiff		1.71	4B	SS	11									
2					5	SS	20									
3	Power Auger Drilling 130 mm O.D. Solid Stem Auger	hard sand seams, wet			6	SS	30									
4																
5		grey			7	SS	41									
6		sand lenses, some gravel, wet			8	SS	>50/125 mm									
		END OF BOREHOLE		228.88												
				6.38												
7		Notes: 1. Groundwater was observed at 3.0 m below ground surface upon drilling completion.														
8																
9																
10																

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Southbound Driving Lane
 COORDINATES: N 4784385.4; E 587014.6
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-03

SHEET 1 OF 1

START DATE: January 14, 2022
 END DATE: January 14, 2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, KPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. (■)	Field Vane rem. (⊕)	Quick Triaxial Unconfined (●)				WATER CONTENT PERCENT (Wp, Wl)
0		PAVEMENT SURFACE		234.75										
		ASPHALT 152 mm thick		0.00										
		GRANULAR MATERIAL Crusher Run Limestone, brown, moist		0.15	1	AC								
					2	SS	35							
1				233.56	3A	SS	48							
		FILL clayey silt, brown, moist, dense		1.19	3B									
				233.23										
		CLAYEY SILT trace sand, trace gravel, brown, dry, stiff to very stiff		1.52	4	SS	12						1 3 71 25	
2														
					5	SS	19							
3			hard		6	SS	>50/ 280 mm							
4														
5			grey		7	SS	69							
6														
				228.53	8	SS	50/ 100 mm							
7		END OF BOREHOLE		4.22										
		Notes: 1. No groundwater was observed upon drilling completion.												

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD.EA - BH LOGS - R6.GPJ GAL-MISS.GDT. 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Southbound Driving Lane
 COORDINATES: N 4784178.0; E 586949.4
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-04/MW

SHEET 1 OF 1

START DATE: January 20, 2022
 END DATE: January 20, 2022
 BORING METHOD: 190 mm O.D Hollow Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, kPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. \oplus	Field Vane rem. \ominus	Quick Triaxial Unconfined \bullet				Quick Triaxial Unconfined Δ	
0		PAVEMENT SURFACE		236.47											
		ASPHALT 152 mm thick		0.00											
		GRANULAR MATERIAL sand and gravel, brown, moist		0.15	1	AC									
					2	SS	50								
					3	SS	56								
		FILL clayey silt, brown, moist, stiff		234.95											
				1.52	4	SS	16								
		CLAYEY SILT trace sand, brown, moist, stiff		234.04	5A										
				2.44	5B	SS	14					0	4	73	23
			hard		6	SS	49								
					77	SS	44								
			grey		8	SS	42								
			wet												
				229.77											
				6.77											
7		END OF BOREHOLE													
		Notes: 1. No groundwater was observed upon drilling completion. 2. Monitoring well was installed at 6.1 m below ground surface with flush mount protection.													

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT 22-5-1

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Northbound Driving Lane
 COORDINATES: N 4783987.8; E 586894.3
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-05

SHEET 1 OF 1

START DATE: January 12, 2022
 END DATE: January 12, 2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, kPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. \oplus	Field Vane rem. $\opl�$	Quick Triaxial Unconfined \bullet				Unconfined Δ
0		PAVEMENT SURFACE		235.87										
		ASPHALT 152 mm thick		0.00										
		GRANULAR MATERIAL sand and gravel, brown, moist		0.15	1	AC								
		FILL clayey silt, trace sand, black, moist, stiff		235.35	2	SS 21								
1				0.52	2	SS 21								
					3A	SS 39								
					3B	SS 39								
2		brown			4	SS 8							0 4 76 20	
				233.58										
		SILT some clay to clayey, brown, moist, dense to very dense		2.29	5	SS 30								
3														
		grey			6	SS 60								
4														
5					7	SS >50/ 125 mm								
6		sand seams			8	SS 80								
				229.21										
7		END OF BOREHOLE		6.65										
		Notes: 1. No groundwater was observed upon drilling completion.												
8														
9														
10														

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT, 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Southbound Driving Lane
 COORDINATES: N 4783925.9; E 586869.5
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-06

SHEET 1 OF 1

START DATE: January 12, 2022
 END DATE: January 12, 2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, kPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. \oplus	Field Vane rem. $\opl�$	Quick Triaxial Unconfined \bullet				Unconfined Δ		
0		PAVEMENT SURFACE		236.51												
		ASPHALT 152 mm thick		0.00												
		GRANULAR MATERIAL Crusher Run Limestone, brown, moist		0.15	1	AC										
					2	SS	>50/ 100 mm									
1		FILL clayey silt, trace sand, black to brown, moist, very stiff, trace organics		235.45	3A	SS	20									
				1.07	3B											
					4A	SS	6									
2		SILT some clay, some sand, trace gravel, brown, wet, firm to stiff		234.53	4B											
				1.98												
					5	SS	9									
3	Power Auger Drilling 130 mm O.D Solid Stem Auger		hard grey, moist		6	SS	62								1	11 71 17
4																
5					7	SS	62									
6		SAND grey, wet, loose		230.42	8	SS	10									
				6.10												
				229.81												
				6.77												
7		END OF BOREHOLE														
		Notes: 1. Groundwater was observed at 3.0 m below ground surface upon drilling completion.														
8																
9																
10																

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Southbound Driving Lane
 COORDINATES: N 4783793.3; E 586828.0
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-07/MW

SHEET 1 OF 1

START DATE: January 20, 2022
 END DATE: January 20, 2022
 BORING METHOD: 190 mm O.D Hollow Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH C_u , kPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. \oplus	Quick Triaxial Unconfined \ominus	Field Vane rem. \oplus				Quick Triaxial Unconfined \ominus		
0	Power Auger Drilling 190 mm O.D Hollow Stem Auger	PAVEMENT SURFACE		239.05												
		ASPHALT 152 mm thick		0.00	1	AC										
		GRANULAR MATERIAL sand and gravel, brown, moist		238.49	2A											
		FILL clayey silt, brown to black, moist, firm, trace organics		0.56	2B	SS	25									
1						3	SS	7								
		CLAYEY SILT trace sand, brown, moist, stiff		237.52		4	SS	8								
2				1.52												
		SILT some clay, trace sand, brown, moist, very stiff		236.00		5	SS	9								
3			3.05		6	SS	>50/ 280 mm									
4																
5		grey			7	SS	>50/ 280 mm									
6																
					8	SS	61									
7		END OF BOREHOLE		232.39												
				6.65												
Notes:	1. No groundwater was observed upon drilling completion. 2. Monitoring well was installed at 6.1 m below ground surface with flush mount protection.															

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT. 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Northbound Driving Lane
 COORDINATES: N 4783650.6; E 586787.2
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-08

SHEET 1 OF 1

START DATE: January 20, 2022
 END DATE: January 20, 2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, kPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. (■)	Field Vane rem. (⊕)	Quick Triaxial Unconfined (●)				WATER CONTENT PERCENT (Wp, Wl)
0		PAVEMENT SURFACE		239.19										
		ASPHALT 152 mm thick		0.00										
		GRANULAR MATERIAL sand and gravel, brown, moist		0.15	1	AC								
		FILL clayey silt, some sand, brown, moist, stiff		238.58	2A									
				0.61		SS	27							
				238.28	2B									
		SILT some clay, trace sand, brown, moist, stiff		0.91	3	SS	19							
1														
2					4A	SS	48							
					4B									
		grey												
					5	SS	11							
		wet, very stiff to hard												
3														
					6	SS	23							
4														
		moist												
5					7	SS	>50/ 125 mm							
6														
		wet			8	SS	64							
				232.49										
				6.77										
7		END OF BOREHOLE												
		Notes: 1. Groundwater was observed at 4.0 m below ground surface upon drilling completion.												
8														
9														
10														

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD.EA - BH LOGS - R6.GPJ GAL-MISS.GDT, 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Northbound Driving Lane
 COORDINATES: N 4783498.7; E 586739.6
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-09

SHEET 1 OF 1

START DATE: January 10 ,2022
 END DATE: January 10 ,2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, kPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. \blacksquare	Field Vane rem. \oplus	Quick Triaxial Unconfined \bullet				Unconfined Δ	
0		PAVEMENT SURFACE		242.04											
		ASPHALT 152 mm thick		0.00											
		FILL sandy silt, brown to black, moist, compact		0.15	1	AC									
		sand, some silt, brown, loose		241.43	2A										
				0.61	2B	SS	19								
1		wet silt layer			3	SS	8								
		CLAYEY SILT trace sand, brown, moist, very stiff to hard		240.52	4	SS	17								
2				1.52											
					5	SS	36								
3															
					6	SS	47								
4															
5		SILT some clay, trace sand, grey, moist, very stiff		237.47	7	SS	33								
				4.57											
6		wet			8	SS	27								
7		END OF BOREHOLE		235.34											
		Notes: 1. Groundwater was observed at 4.6 m below ground surface upon drilling completion.		6.77											
8															
9															
10															

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Northbound Driving Lane
 COORDINATES: N 4783199.6; E 586647.2
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-11

SHEET 1 OF 1

START DATE: January 10 ,2022
 END DATE: January 10 ,2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, kPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS					
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. \oplus	Quick Triaxial Unconfined \bullet	Field Vane rem. $\opl�$				Unconfined Δ				
0		PAVEMENT SURFACE		242.73														
		ASPHALT 152 mm thick		0.00														
		GRANULAR MATERIAL sand, some gravel, brown, moist		0.15	1	AC												
					2	SS	20											
1		CLAYEY SILT trace sand, trace gravel, brown, moist, very stiff		241.82														
				0.91	3	SS	17											
					4	SS	23											
2																		
					5	SS	52											
3	Power Auger Drilling 130 mm O.D Solid Stem Auger																	
		grey			6	SS	27											
4																		
5		150 mm thick wet fine sand			7	SS	23											
6		SAND grey, wet, very dense END OF BOREHOLE		6.10	8	SS	>50 125 mm											
				4.22														
7		Notes: 1. Groundwater was observed at 4.4 m below ground surface upon drilling completion.																
8																		
9																		
10																		

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Northbound Driving Lane
 COORDINATES: N 4783045.9; E 586600.1
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-12/MW

SHEET 1 OF 1

START DATE: January 14, 2022
 END DATE: January 14, 2022
 BORING METHOD: 190 mm O.D Hollow Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH C_u , kPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS				
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. \oplus	Field Vane rem. $\opl�$	Quick Triaxial Unconfined \bullet				Unconfined Δ			
0	Power Auger Drilling 190 mm O.D Hollow Stem Auger	PAVEMENT SURFACE		242.05													
		ASPHALT 152 mm thick		0.00	1	AC											
		GRANULAR MATERIAL sand and gravel, brown, moist		0.15	2	SS	34										
1		CLAYEY SILT trace sand, brown, moist, stiff to very stiff		241.13	3	SS	12										
				0.91	4	SS	11										
2					5	SS	28										
3					6	SS	33										
4					7A	SS	48										
5				7B	SS	48											
6				8	SS	63											
7		END OF BOREHOLE		235.34													
				6.77													
7		Notes: 1. Groundwater was observed at 5.2 m below ground surface upon drilling completion. 2. Monitoring well was installed at 6.1 m below ground surface with flush mount protection.															
8																	
9																	
10																	

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT 22-5-1

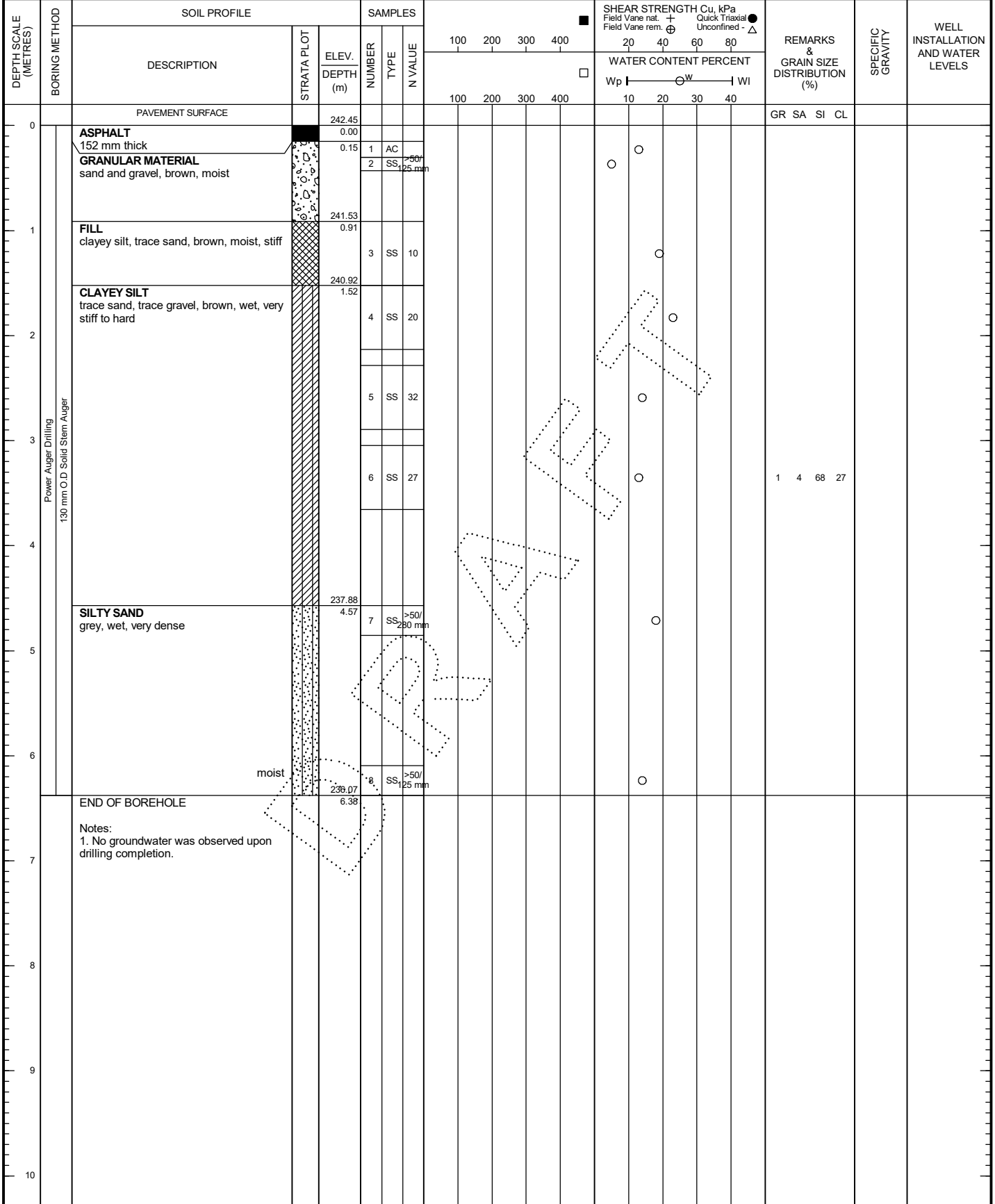
PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Southbound Driving Lane
 COORDINATES: N 4782883.5; E 586546.6
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-13

SHEET 1 OF 1

START DATE: January 12, 2022
 END DATE: January 12, 2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm



(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD.EA - BH LOGS - R6.GPJ GAL-MISS.GDT. 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Northbound Driving Lane
 COORDINATES: N 4782750.6; E 586510.1
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-14

SHEET 1 OF 1

START DATE: January 10 ,2022
 END DATE: January 10 ,2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, KPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. (■)	Field Vane rem. (⊕)	Quick Triaxial Unconfined (●)				WATER CONTENT PERCENT (Wp, Wl)
0		PAVEMENT SURFACE		241.79										
		ASPHALT 152 mm thick		0.00										
		GRANULAR MATERIAL sand and gravel, brown, moist		0.15	1	AC								
					2	SS	19							
1		FILL clayey silt, black to brown, trace organics, moist, loose		240.88										
				0.91	3	SS	9							
		CLAYEY SILT trace sand, trace gravel, brown, moist, stiff		240.27										
				1.52	4	SS	14						1	6
2			hard											
					5	SS	34							
3			grey sand seams											
					6	SS	43							
4														
			wet											
5					7	SS	>50/ 125 mm							
6														
					8	SS	33							
7		END OF BOREHOLE		235.09										
				6.77										
		Notes: 1. Groundwater was observed at 5.2 m below ground surface upon drilling completion.												

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT, 22-5-1

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Northbound Driving Lane
 COORDINATES: N 4782586.9; E 586459.8
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-15/MW

SHEET 1 OF 1

START DATE: January 7, 2022
 END DATE: January 7, 2022
 BORING METHOD: 190 mm O.D Hollow Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH		REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. (■)			
0	Power Auger Drilling 190 mm O.D Hollow Stem Auger	PAVEMENT SURFACE		241.40					GR SA SI CL		
		ASPHALT 152 mm thick		0.00							
		GRANULAR MATERIAL sand and gravel, brown, moist		0.15	1	AC					Grout
					2	SS	23				
1		FILL clayey silt, brown, moist, stiff		0.91	3	SS	9				Bentonite
					4	SS	11				
2		CLAYEY SILT trace sand, brown, moist, stiff		1.52	5	SS	33			0 3 74 23	Sand
					6	SS	30				
3				7	SS	62					
4				8	SS	>50/ 25mm					
5											
6											
6.38		END OF BOREHOLE		235.03							
7		Notes: 1. No groundwater was observed upon drilling completion. 2. Monitoring well was installed at 6.1 m below ground surface with flush mount protection.		6.38							
8											
9											
10											

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Northbound Driving Lane
 COORDINATES: N 4782456.7; E 586420.3
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-16

SHEET 1 OF 1

START DATE: January 4, 2022
 END DATE: January 4, 2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, kPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. (■)	Field Vane rem. (⊕)	Quick Triaxial Unconfined (●)				WATER CONTENT PERCENT (Wp, Wl)
0		PAVEMENT SURFACE		241.17										
		ASPHALT 152 mm thick		0.00										
		GRANULAR MATERIAL sand and gravel, brown to black, moist		0.15	1	AUGER								
					2	SS	38							
1		FILL clayey silt, black to brown, moist, stiff		240.26										
				0.91	3	SS	11							
					4A	SS	10							
2		CLAYEY SILT trace sand, brown, moist, very stiff to hard		239.34										
				1.83	4B	SS								
					5	SS	24							
					6	SS	40							
					7	SS	>50/ 280 mm							
					8	SS	>50/ 280 mm							
				234.64										
				6.53										
7		END OF BOREHOLE												
		Notes: 1. Groundwater was observed at 3.6 m below ground surface upon drilling completion.												

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD.EA - BH LOGS - R6.GPJ GAL-MISS.GDT, 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Southbound Driving Lane
 COORDINATES: N 4782315.9; E 586373.5
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-17

SHEET 1 OF 1

START DATE: January 12, 2022
 END DATE: January 12, 2022
 BORING METHOD: 130 mm O.D Solid Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. \blacksquare	Field Vane rem. \oplus	Quick Triaxial Unconfined \bullet				Unconfined Δ		
0	Power Auger Drilling 130 mm O.D Solid Stem Auger	PAVEMENT SURFACE		240.68												
		ASPHALT 152 mm thick		0.00	1	AC										
		GRANULAR MATERIAL sand, some gravel, brown, moist		0.15	2A											
		FILL clayey silt, brown, moist, firm to stiff		0.61	2B	SS	40									
1				0.61	3A											
		SILT some clay, trace sand, brown, moist, stiff very stiff to hard		1.14	3B	SS	10									0 8 74 18
2					4	SS	16									
3					5	SS	23									
4					6A											
		SAND some silt, brown, moist, dense		3.33	6B	SS	49									
5				7	SS	>50/ 280 mm										
6				8	SS	>50/ 280 mm										
	SILT some clay, trace sand, grey, moist, hard		4.57													
7		END OF BOREHOLE		6.53												
7		Notes: 1. Groundwater was observed at 2.7 m below ground surface upon drilling completion.														

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50



LOGGED BY: IA

CHECKED BY: MA

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT 22-5-1

PROJECT: Glancaster Road MCEA
 LOCATION: Glancaster Rd, Southbound Driving Lane
 COORDINATES: N 4782192.9; E 586335.7
 DATUM: Geodetic
 AECOM PROJECT No.: 60637047
 CLIENT: City of Hamilton

RECORD OF BOREHOLE: BH-18/MW

SHEET 1 OF 1

START DATE: January 11,2022
 END DATE: January 11,2022
 BORING METHOD: 190 mm O.D Hollow Stem Auger
 CONTRACTOR: ALTECH Drilling Services

SAMPLER HAMMER, 64kg; DROP, 762mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE		SAMPLES			SHEAR STRENGTH Cu, KPa				REMARKS & GRAIN SIZE DISTRIBUTION (%)	SPECIFIC GRAVITY	WELL INSTALLATION AND WATER LEVELS		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	N VALUE	Field Vane nat. (■)	Field Vane rem. (□)	Quick Triaxial Unconfined (●)				Unconfined (△)	
0		PAVEMENT SURFACE		240.20											
		ASPHALT 152 mm thick		0.00											
		GRANULAR MATERIAL sand and gravel, brown, moist		0.15	1	AC									
					2	SS	46								
1		FILL clayey silt, brown, moist, compact		239.28											
				0.91	3	SS	11								
2		SILT some clay, trace sand, brown, moist, firm to stiff		238.68											
				1.52	4	SS	7					0	4	85	11
					5	SS	14								
					6	SS	19								
					7	SS	67								
					8	SS	>50/125 mm								
				233.82											
				6.38											
7		END OF BOREHOLE													
		Notes: 1. Groundwater was observed at 5.5 m below ground surface upon drilling completion. 2. Monitoring well was installed at 6.1 m below ground surface with flush mount protection.													

1 GLANCASTER RD EA - BH LOGS - R6.GPJ GAL-MISS.GDT 22-5-1

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE

1 : 50

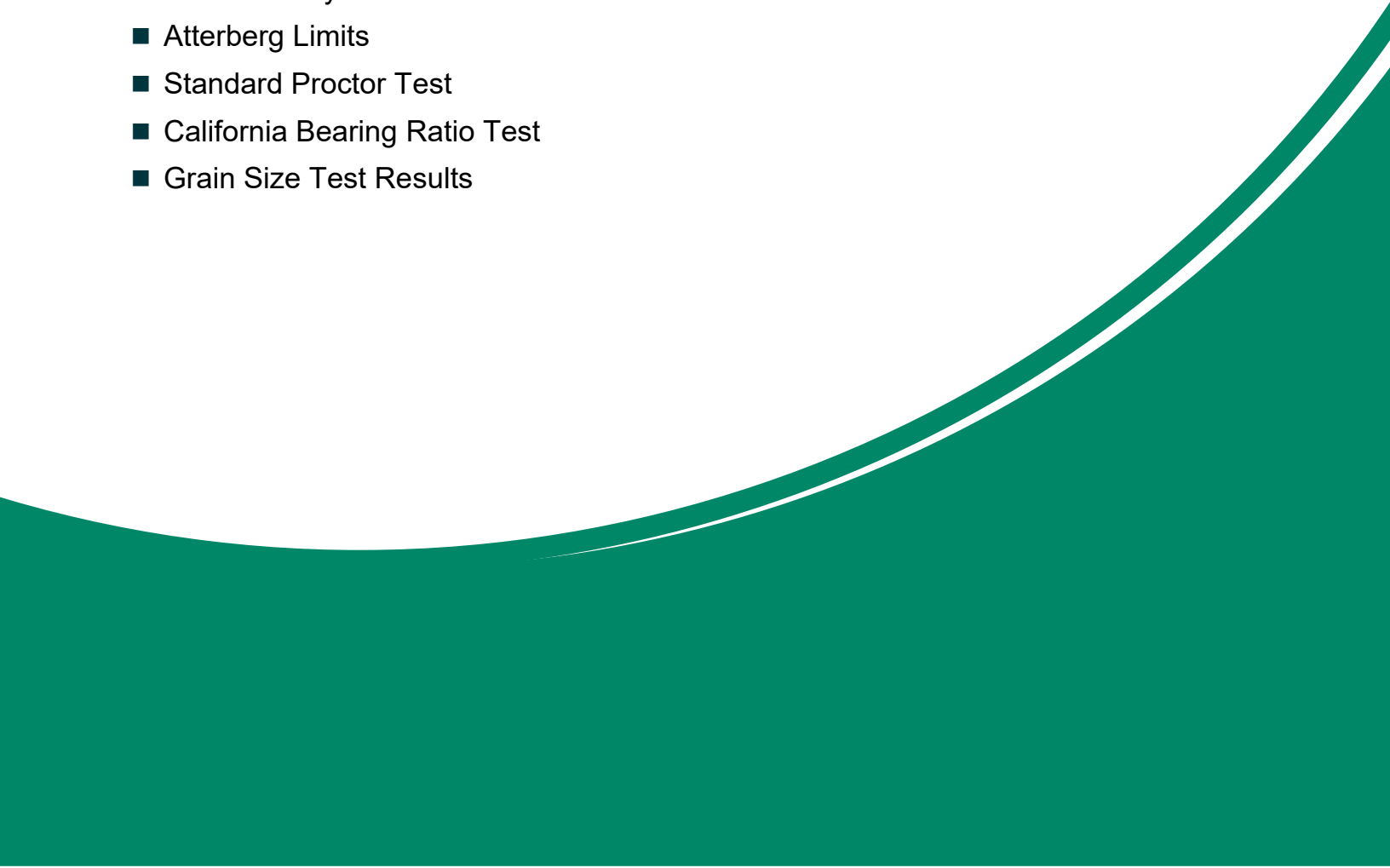


LOGGED BY: IA

CHECKED BY: MA

Appendix **C**

Geotechnical Laboratory Test Results

- Moisture Content Test Results
 - Sieve and Hydrometer Test Results
 - Atterberg Limits
 - Standard Proctor Test
 - California Bearing Ratio Test
 - Grain Size Test Results
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- **Moisture Content Test Results**

MOISTURE CONTENT DETERMINATION

CLIENT				AECOM			DATE		January 25, 2022	
PROJECT NUMBER				60637047			TESTED BY		SAM	
PROJECT NAME							REVIEWED BY		Ramana M	
LOCATION				Glancaster Road						
Borehole Name	Sample Id	Depth (feet)	Can Id	Observations			Formula			
				Weight of Empty Can (g) W ₁	Weight of Wet Soil + Can (g) W ₂	Weight of Dry Soil + Can (g) W ₃	Weight of Water (g) W _w = (W ₂ -W ₃)	Weight of Dry soil (g) W _s = (W ₃ -W ₁)	Moisture Content (%) w = (W _w /W _s)*100	
BH-1	AS1	0-1	139	13.58	73.90	71.01	2.89	57.43	5.03	
	SS2A	1-3	87	13.65	70.18	66.18	4.00	52.53	7.61	
	SS2B	1-3	93	13.41	63.86	56.55	7.31	43.14	16.94	
	SS3	3-5	80	13.64	73.13	64.81	8.32	51.17	16.26	
	SS4	5-7	134	13.70	65.67	57.12	8.55	43.42	19.69	
	SS5	7.5-9.5	88	13.52	72.17	59.97	12.20	46.45	26.26	
	SS6	10-12	178	13.52	90.71	75.21	15.50	61.69	25.13	
	SS7	15-17	78	13.74	73.54	64.17	9.37	50.43	18.58	
	SS8	20-22	89	13.58	81.27	72.75	8.52	59.17	14.40	
BH-2	AS1	0-1	85	13.42	67.01	63.86	3.15	50.44	6.25	
	SS2	1-3	114	13.40	66.00	63.13	2.87	49.73	5.77	
	SS3	3-5	81	13.59	64.71	53.10	11.61	39.51	29.38	
	SS4A	5-7	184	13.54	68.54	54.04	14.50	40.50	35.80	
	SS4B	5-7	65	13.60	70.07	60.27	9.80	46.67	21.00	
	SS5	7.5-9.5	161	13.38	79.41	69.34	10.07	55.96	17.99	
	SS6	10-12	102	13.48	81.71	71.20	10.51	57.72	18.21	
	SS7	15-17	167	13.52	76.48	67.52	8.96	54.00	16.59	
	SS8	20-22	141	13.62	100.76	91.19	9.57	77.57	12.34	
BH-3	AS1	0-1	92	13.41	72.52	69.95	2.57	56.54	4.55	
	SS2	1-3	156	13.41	69.10	66.44	2.66	53.03	5.02	
	SS3A	3-5	55	13.31	74.11	71.59	2.52	58.28	4.32	
	SS3B	3-5	169	13.41	61.69	56.17	5.52	42.76	12.91	
	SS4	5-7	68	13.47	65.67	56.58	9.09	43.11	21.09	
	SS5	7.5-9.5	185	13.47	80.81	71.71	9.10	58.24	15.63	
	SS6	10-12	86	13.44	73.50	65.87	7.63	52.43	14.55	
	SS7	15-17	128	13.71	81.29	74.06	7.23	60.35	11.98	
	SS8	20-22	67	13.59	82.48	76.70	5.78	63.11	9.16	

BH-4	AS1	0-1	70	13.61	69.31	66.20	3.11	52.59	5.91
	SS2	1-3	170	13.60	69.11	66.47	2.64	52.87	4.99
	SS3	3-5	100	13.64	69.73	66.75	2.98	53.11	5.61
	SS4	5-7	75	13.57	55.09	49.68	5.41	36.11	14.98
	SS5A	7.5-9.5	192	13.68	74.22	65.59	8.63	51.91	16.62
	SS5B	7.5-9.5	118	13.65	73.77	64.10	9.67	50.45	19.17
	SS6	10-12	66	13.43	30.58	28.78	1.80	15.35	11.73
	SS7	15-17	143	13.54	86.59	78.33	8.26	64.79	12.75
	SS8	20-22	164	13.56	79.20	68.89	10.31	55.33	18.63
BH-5	AS1	0-1	139	13.58	73.80	72.81	0.99	59.23	1.67
	SS2	1-3	87	13.68	83.89	81.06	2.83	67.38	4.20
	SS3A	3-5	156	13.45	51.05	47.82	3.23	34.37	9.40
	SS3B	3-5	80	13.67	68.51	62.48	6.03	48.81	12.35
	SS4	5-7	134	13.71	61.17	51.82	9.35	38.11	24.53
	SS5	7.5-9.5	88	13.54	81.26	69.79	11.47	56.25	20.39
	SS6	10-12	178	13.57	73.00	66.93	6.07	53.36	11.38
	SS7	15-17	78	13.72	69.01	62.22	6.79	48.50	14.00
	SS8	20-22	89	13.57	83.40	75.09	8.31	61.52	13.51

Total Samples	45
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MOISTURE CONTENT DETERMINATION

CLIENT				AECOM			DATE		January 26, 2022	
PROJECT NUMBER				60637047			TESTED BY		SAM/IAN	
PROJECT NAME							REVIEWED BY		Ramana M	
LOCATION				Glancaster Road						
Borehole Name	Sample Id	Depth (feet)	Can Id	Observations			Formula			
				Weight of Empty Can (g) W ₁	Weight of Wet Soil + Can (g) W ₂	Weight of Dry Soil + Can (g) W ₃	Weight of Water (g) W _w = (W ₂ -W ₃)	Weight of Dry soil (g) W _s = (W ₃ -W ₁)	Moisture Content (%) w = (W _w /W _s)*100	
BH-6	AS1	0-1	85	13.45	56.78	54.64	2.14	41.19	5.20	
	SS2	1-3	92	13.44	65.73	62.36	3.37	48.92	6.89	
	SS3A	3-5	65	13.64	67.91	60.21	7.70	46.57	16.53	
	SS3B	3-5	184	13.55	59.81	52.05	7.76	38.50	20.16	
	SS4A	5-7	170	13.64	67.93	57.21	10.72	43.57	24.60	
	SS4B	5-7	161	13.38	56.68	49.52	7.16	36.14	19.81	
	SS5	7.5-9.5	102	13.51	84.36	69.47	14.89	55.96	26.61	
	SS6	10-12	192	13.68	70.41	62.45	7.96	48.77	16.32	
	SS7	15-17	141	13.83	102.71	90.40	12.31	76.57	16.08	
	SS8	20-22	167	13.53	98.43	83.36	15.07	69.83	21.58	
BH-7	AS1	0-1	55	13.35	75.92	72.74	3.18	59.39	5.35	
	SS2A	1-3	100	13.61	65.65	62.71	2.94	49.10	5.99	
	SS2B	1-3	68	13.46	35.22	31.18	4.04	17.72	22.80	
	SS3	3-5	86	13.46	59.93	51.53	8.40	38.07	22.06	
	SS4	5-7	185	13.52	60.24	51.07	9.17	37.55	24.42	
	SS5	7.5-9.5	118	13.65	71.88	60.31	11.57	46.66	24.80	
	SS6	10-12	128	13.76	70.31	65.20	5.11	51.44	9.93	
	SS7	15-17	70	13.57	78.29	70.48	7.81	56.91	13.72	
	SS8	20-22	143	13.54	78.20	71.65	6.55	58.11	11.27	
BH-8	AS1	0-1	54	13.47	63.19	61.18	2.01	47.71	4.21	
	SS2A	1-3	111	13.57	74.53	71.37	3.16	57.80	5.47	
	SS2B	1-3	147	13.55	67.90	57.83	10.07	44.28	22.74	
	SS3	3-5	76	13.67	66.27	58.19	8.08	44.52	18.15	
	SS4A	5-7	150	13.66	68.92	61.02	7.90	47.36	16.68	
	SS4B	5-7	61	13.47	83.01	74.26	8.75	60.79	14.39	
	SS5	7.5-9.5	129	13.57	70.15	61.33	8.82	47.76	18.47	
	SS6	10-12	171	13.59	74.51	65.60	8.91	52.01	17.13	

	SS7	15-17	190	13.57	75.19	67.95	7.24	54.38	13.31
	SS8	20-22	109	13.65	98.36	88.73	9.63	75.08	12.83
BH-9	AS1	0-1	126	13.75	76.23	69.36	6.87	55.61	12.35
	SS2A	1-3	146	13.82	75.72	71.59	4.13	57.77	7.15
	SS2B	1-3	153	13.59	64.04	56.87	7.17	43.28	16.57
	SS3	3-5	180	13.52	119.67	99.12	20.55	85.60	24.01
	SS4	5-7	123	13.68	69.07	60.55	8.52	46.87	18.18
	SS5	7.5-9.5	90	13.58	71.63	63.33	8.30	49.75	16.68
	SS6	10-12	182	13.53	112.54	97.82	14.72	84.29	17.46
	SS7	15-17	189	13.45	118.04	103.19	14.85	89.74	16.55
	SS8	20-22	149	13.56	94.83	80.09	14.74	66.53	22.16
	BH-10	AS1	0-1	64	13.52	78.72	76.05	2.67	62.53
SS2A		1-3	193	13.49	65.77	63.81	1.96	50.32	3.90
SSS2B		1-3	59	13.52	43.07	39.66	3.41	26.14	13.05
SS3		3-5	74	13.70	50.87	45.00	5.87	31.30	18.75
SS4		5-7	77	13.48	93.22	75.40	17.82	61.92	28.78
SS5		7.5-9.5	172	13.50	103.05	90.62	12.43	77.12	16.12
SS6		10-12	103	13.62	61.52	53.05	8.47	39.43	21.48
SS7		15-17	106	13.58	76.32	68.67	7.65	55.09	13.89
SS8		20-22	165	13.72	76.38	67.68	8.70	53.96	16.12

Total Samples	47
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MOISTURE CONTENT DETERMINATION

CLIENT				AECOM			DATE		January 27, 2022	
PROJECT NUMBER				60637047			TESTED BY		IAN	
PROJECT NAME							REVIEWED BY		Ramana M	
LOCATION				Glancaster Road						
Borehole Name	Sample Id	Depth (feet)	Can Id	Observations			Formula			
				Weight of Empty Can (g) W ₁	Weight of Wet Soil + Can (g) W ₂	Weight of Dry Soil + Can (g) W ₃	Weight of Water (g) W _w = (W ₂ -W ₃)	Weight of Dry soil (g) W _s = (W ₃ -W ₁)	Moisture Content (%) w = (W _w /W _s)*100	
BH-11	AS1	0-1	122	13.70	76.69	74.19	2.50	60.49	4.13	
	SS2	1-3	96	13.48	61.39	56.19	5.20	42.71	12.18	
	SS3	3-5	94	13.57	55.53	49.61	5.92	36.04	16.43	
	SS4	5-7	112	13.58	75.42	66.05	9.37	52.47	17.86	
	SS5	7.5-9.5	71	13.73	96.23	85.61	10.62	71.88	14.77	
	SS6	10-12	140	13.76	68.43	61.06	7.37	47.30	15.58	
	SS7	15-17	174	13.65	114.98	100.56	14.42	86.91	16.59	
	SS8	20-22	157	13.66	67.83	58.70	9.13	45.04	20.27	
BH-12	AS1	0-1	162	13.57	41.21	39.85	1.36	26.28	5.18	
	SS2	1-3	173	13.67	57.69	55.92	1.77	42.25	4.19	
	SS3	3-5	72	13.61	65.83	57.25	8.58	43.64	19.66	
	SS4	5-7	52	13.70	73.92	64.68	9.24	50.98	18.12	
	SS5	7.5-9.5	124	13.73	84.54	74.38	10.16	60.65	16.75	
	SS6	10-12	194	13.77	74.09	65.50	8.59	51.73	16.61	
	SS7A	15-17	97	13.54	70.56	61.16	9.40	47.62	19.74	
	SS7B	15-17	99	13.66	57.97	51.00	6.97	37.34	18.67	
	SS8	20-22	168	13.67	63.29	56.33	6.96	42.66	16.32	

Total Samples 17

MOISTURE CONTENT DETERMINATION

CLIENT				AECOM			DATE		January 27, 2022	
PROJECT NUMBER				60637047			TESTED BY		IAN	
PROJECT NAME							REVIEWED BY		Ramana M	
LOCATION				Glancaster Road						
Borehole Name	Sample Id	Depth (feet)	Can Id	Observations			Formula			
				Weight of Empty Can (g) W ₁	Weight of Wet Soil + Can (g) W ₂	Weight of Dry Soil + Can (g) W ₃	Weight of Water (g) W _w = (W ₂ -W ₃)	Weight of Dry soil (g) W _s = (W ₃ -W ₁)	Moisture Content (%) w = (W _w /W _s)*100	
BH-13	AS1	0-1	13	13.63	49.28	45.28	4.00	31.65	12.64	
	SS2	1-3	63	13.47	48.20	46.57	1.63	33.10	4.92	
	SS3	3-5	177	13.85	84.90	73.65	11.25	59.80	18.81	
	SS4	5-7	79	13.41	51.92	44.65	7.27	31.24	23.27	
	SS5	7.5-9.5	155	13.31	58.49	52.88	5.61	39.57	14.18	
	SS6	10-12	125	13.56	69.46	63.06	6.40	49.50	12.93	
	SS7	15-17	110	13.86	51.51	45.72	5.79	31.86	18.17	
	SS8	20-22	53	13.56	54.78	49.61	5.17	36.05	14.34	
BH-14	AS1	0-1	120	13.75	84.38	81.64	2.74	67.89	4.04	
	SS2	1-3	101	13.49	44.15	39.87	4.28	26.38	16.22	
	SS3	3-5	181	13.60	40.79	36.30	4.49	22.70	19.78	
	SS4	5-7	58	13.48	91.95	80.56	11.39	67.08	16.98	
	SS5	7.5-9.5	16	13.54	46.20	41.72	4.48	28.18	15.90	
	SS6	10-12	152	13.29	67.83	60.23	7.60	46.94	16.19	
	SS7	15-17	191	13.70	61.95	54.62	7.33	40.92	17.91	
	SS8	20-22	136	13.63	83.03	74.83	8.20	61.20	13.40	
BH-15	AS1	0-1	138	13.57	67.23	62.13	5.10	48.56	10.50	
	SS2	1-3	133	13.55	55.00	49.15	5.85	35.60	16.43	
	SS3	3-5	186	13.56	63.40	55.03	8.37	41.47	20.18	
	SS4	5-7	83	13.75	71.19	61.98	9.21	48.23	19.10	
	SS5	7.5-9.5	188	13.52	74.64	67.31	7.33	53.79	13.63	
	SS6	10-12	164	13.72	70.66	61.63	9.03	47.91	18.85	
	SS7	15-17	144	13.71	62.53	56.60	5.93	42.89	13.83	
	AS1	0-1	95	13.62	46.37	45.14	1.23	31.52	3.90	
	SS2	1-3	82	13.62	56.79	49.42	7.37	35.80	20.59	
	SS3	3-5	130	13.48	63.98	54.80	9.18	41.32	22.22	
	SS4A	5-7	163	13.72	61.30	52.45	8.85	38.73	22.85	

BH-16	SS4B	5-7	107	13.67	86.35	71.14	15.21	57.47	26.47	
	SS5	7.5-9.5	175	13.71	73.76	64.45	9.31	50.74	18.35	
	SS6	10-12	60	13.33	55.11	48.81	6.30	35.48	17.76	
	SS7	15-17	145	13.93	74.98	67.75	7.23	53.82	13.43	
	SS8	20-22	142	13.70	88.11	78.43	9.68	64.73	14.95	
BH-17	AS1	0-1	91	13.56	40.38	38.90	1.48	25.34	5.84	
	SS2A	1-3	121	13.79	59.54	57.58	1.96	43.79	4.48	
	SS2B	1-3	131	13.65	42.38	38.95	3.43	25.30	13.56	
	SS3A	3-5	158	13.56	37.50	34.66	2.84	21.10	13.46	
	SS3B	3-5	132	13.68	44.07	39.38	4.69	25.70	18.25	
	SS4	5-7	160	13.33	64.92	56.34	8.58	43.01	19.95	
	SS5	7.5-9.5	135	13.64	59.87	53.02	6.85	39.38	17.39	
	SS6A	10-12	116	13.74	68.12	60.88	7.24	47.14	15.36	
	SS6B	10-12	127	13.67	71.99	62.61	9.38	48.94	19.17	
	SS7	15-17	115	13.62	82.83	74.36	8.47	60.74	13.94	
	SS8	20-22	69	13.57	94.15	83.39	10.76	69.82	15.41	
BH-18	AS1	0-1	62	13.51	75.91	74.48	1.43	60.97	2.35	
	SS2	1-3	187	13.45	69.65	65.93	3.72	52.48	7.09	
	SS3	3-5	108	13.69	27.39	24.83	2.56	11.14	22.98	
	SS4	5-7	166	13.54	68.08	57.59	10.49	44.05	23.81	
	SS5	7.5-9.5	84	13.48	63.46	55.54	7.92	42.06	18.83	
	SS6	10-12	176	13.49	69.80	61.30	8.50	47.81	17.78	
	SS7	15-17	113	13.65	74.27	66.62	7.65	52.97	14.44	
	SS8	20-22	285	13.59	79.47	72.85	6.62	59.26	11.17	
							Total Samples	51		

- **Sieve and Hydrometer Test Results**

Hydrometer Analysis

Lab No	202202088S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-1	Tested by	Dharmik/IAN
Sample Id	SS4	Reviewed by	Ramana M
Depth (feet)	10-12	Date	28-Jan-22
Soil Classification	Silt, some clay, trace sand (ML)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information

Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	297.8 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details

Volume of Bulb (V _b)	63.1	cm ³
Length of Bulb (L _b)	14.15	cm
Length from '1.0' reading to top of Bulb (L _s)	10.5	cm
Scale Dimension (hs)	0.27	cm/Div
Cross-sectional Area of Cylinder (A)	28.1351	cm ²
Meniscus Correction (Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass (W _o)	38.82	g
Air Dried Mass (W _a)	38.936	g
Hygroscopic Corr Factor (F)	0.997	
Air Dried Mass in Analysis (M _a)	50	g
Oven Dried Mass in Analysis (M _o)	49.9	g
% Passing 2.0 mm Sieve (P ₁₀)	99.6	
Sample Represented (W)	50.0	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	1.0	296.8	99.7
2.0	1.1	296.8	99.6

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.9	99.6
0.850	0.2	49.6	99.2
0.425	0.4	49.4	98.8
0.25	0.6	49.2	98.4
0.106	1.4	48.5	96.9
0.075	2.2	47.7	95.2
Pass 0.075	1.7		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{[(30 \cdot \eta) / (980 \cdot (Gs - Gw))] \cdot (L/T)\} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L₂ - V_b / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
29-Jan-22	10:05:00 AM	1.0	1.0280	0.0030	23.5	1.0250	79.4	8.65	9.28431	0.01293037	0.0380
	10:06:00 AM	2.0	1.0250	0.0030	23.5	1.0220	69.8	9.46	9.28431	0.01293037	0.0281
	10:09:00 AM	5.0	1.0200	0.0030	23.4	1.0170	54.0	10.81	9.30578	0.01294531	0.0190
	10:19:00 AM	15.0	1.0150	0.0030	23.3	1.0120	38.1	12.16	9.32733	0.01296029	0.0117
	10:34:00 AM	30.0	1.0130	0.0030	23.3	1.0100	31.7	12.70	9.32733	0.01296029	0.0084
	11:04:00 AM	60.0	1.0110	0.0030	23.4	1.0080	25.4	13.24	9.30578	0.01294531	0.0061
	2:14:00 PM	250.0	1.0090	0.0030	23.7	1.0060	19.0	13.78	9.24165	0.01290063	0.0030
30-Jan-22	10:04:00 AM	1440.0	1.0070	0.0030	24.0	1.0040	12.7	14.32	9.17830	0.01285634	0.0013

L1 cm	Viscosity		K (η/(Gs-1))
	C		
2.70	-0.464269		5.4613609
3.51	-0.464269		5.4613609
4.86	-0.461960		5.4739861
6.21	-0.459647		5.4866631
6.75	-0.459647		5.4866631
7.29	-0.461960		5.4739861
7.83	-0.468875		5.4362642
8.37	-0.475753		5.3989998

Mass Retained on Sieve # 10	38.73
Mass Passed Sieve # 10	259.1
Jar Number	

Hygroscopic Data

Can Id	115
Empty Can Weight (g)	13.66
Can+ Air Dried Soil (g)	52.60
Can + Oven Dried Soil (g)	52.48

Hydrometer Analysis

Lab No	202202089S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-2	Tested by	Dharmik/IAN
Sample Id	SS7	Reviewed by	Ramana M
Depth (feet)	15-17	Date	28-Jan-22
Soil Classification	Silt, some clay trace sand, trace gravel (ML)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information	
Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	348.4 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details	
Volume of Bulb (V _b)	61.1 cm ³
Length of Bulb (L _b)	14.44 cm
Length from '1.0' reading to top of Bulb (L _s)	10.17 cm
Scale Dimension (hs)	0.27 cm/Div
Cross-sectional Area of Cylinder (A)	28.3535 cm ²
Meniscus Correction (Hm)	0.0005 Divisions

Calculation of Dry Soil Mass	
Oven Dried Mass (W _o)	62.78 g
Air Dried Mass (W _a)	63.48 g
Hygroscopic Corr Factor (F)	0.989
Air Dried Mass in Analysis (M _a)	50 g
Oven Dried Mass in Analysis (M _o)	49.4 g
% Passing 2.0 mm Sieve (P ₁₀)	96.4
Sample Represented (W)	51.3 g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	6.2	342.2	98.2
2.0	12.6	335.7	96.4

Sieve Analysis of Hydrometer Material (M7)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.4	96.4
0.850	1.0	48.5	94.5
0.425	1.7	47.8	93.1
0.25	2.2	47.2	92.1
0.106	3.1	46.4	90.4
0.075	3.6	45.9	89.4
Pass 0.075	0.3		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{[(30 * \eta) / (980 * (Gs - Gw))] * (L/T)\} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L₂ - V_b / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

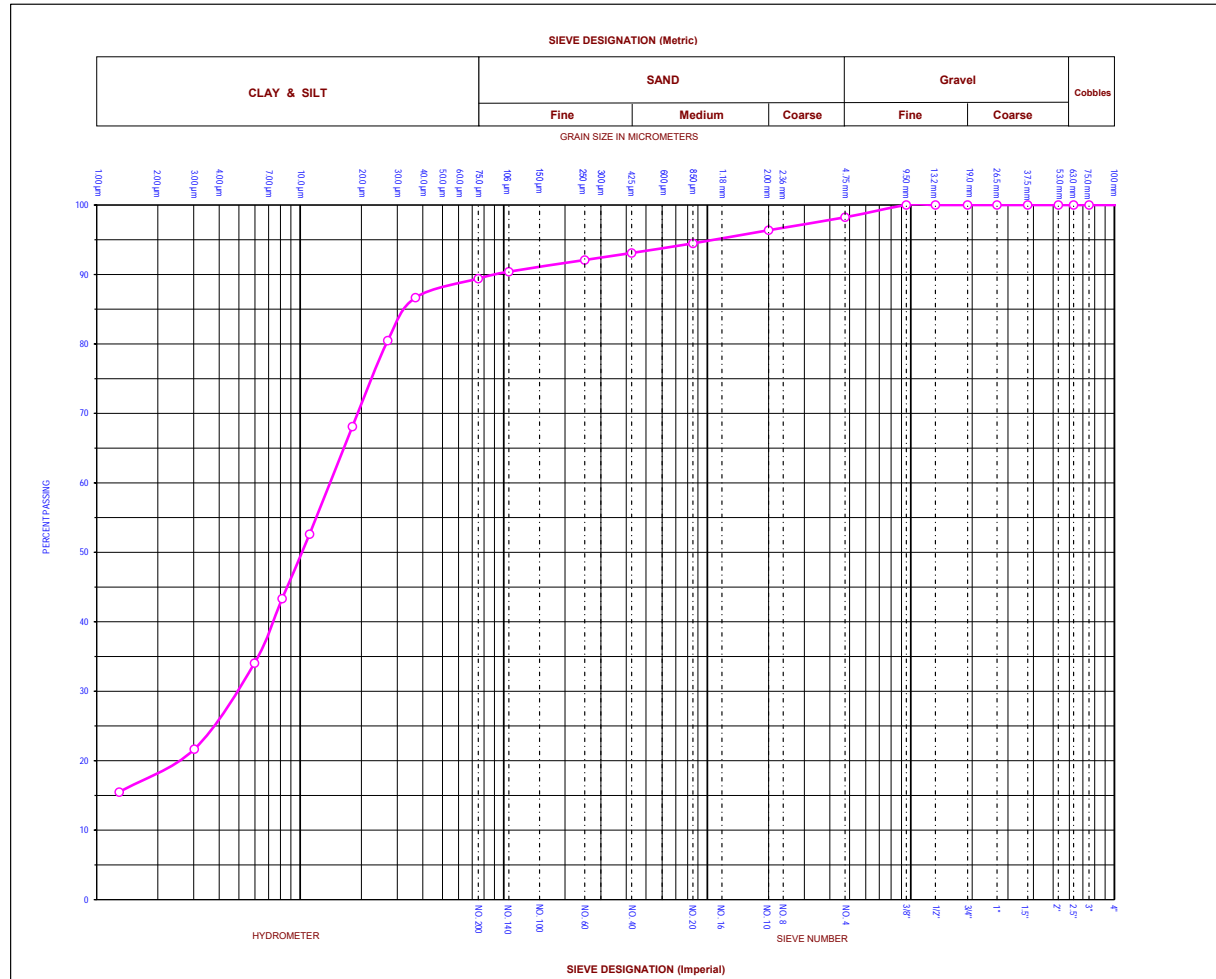
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
29-Jan-22	10:11:00 AM	1.0	1.0310	0.0030	23.0	1.0280	86.7	8.03	9.39251	0.0130055	0.0369
	10:12:00 AM	2.0	1.0290	0.0030	23.0	1.0260	80.5	8.57	9.39251	0.0130055	0.0269
	10:15:00 AM	5.0	1.0250	0.0030	23.1	1.0220	68.1	9.65	9.37069	0.01299039	0.0180
	10:25:00 AM	15.0	1.0200	0.0030	23.1	1.0170	52.6	11.00	9.37069	0.01299039	0.0111
	10:40:00 AM	30.0	1.0170	0.0030	23.1	1.0140	43.3	11.81	9.37069	0.01299039	0.0082
	11:10:00 AM	60.0	1.0140	0.0030	23.0	1.0110	34.0	12.62	9.39251	0.0130055	0.0060
	2:20:00 PM	250.0	1.0100	0.0030	23.7	1.0070	21.7	13.70	9.24165	0.01299063	0.0030
30-Jan-22	10:10:00 AM	1440.0	1.0080	0.0030	23.1	1.0050	15.5	14.24	9.37069	0.01299039	0.0013

L1 cm	Viscosity	
	C	K
1.89	-0.452682	5.5250065
2.43	-0.452682	5.5250065
3.51	-0.455008	5.512173
4.86	-0.455008	5.512173
5.67	-0.455008	5.512173
6.48	-0.452682	5.5250065
7.56	-0.468875	5.4362642
8.10	-0.455008	5.512173

Mass Retained on Sieve # 10	62.01
Mass Passed Sieve # 10	286.34
Jar Number	

Hygroscopic Data	Can Id	166
	Empty Can Weight (g)	13.48
	Can+ Air Dried Soil (g)	76.96
	Can + Oven Dried Soil (g)	76.26

UNIFIED SOIL CLASSIFICATION SYSTEM



Hydrometer Analysis

Lab No	202202090S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-3	Tested by	Dharmik/IAN
Sample Id	SS4	Reviewed by	Ramana M
Depth (feet)	5-7	Date	28-Jan-22
Soil Classification	Lean Clay, trace sand, trace gravel (CL)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information

Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	431.2 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details

Volume of Bulb (V _b)	63.1	cm ³
Length of Bulb (L ₂)	14.15	cm
Length from '1.0' reading to top of Bulb (L _s)	10.5	cm
Scale Dimension (hs)	0.27	cm/Div
Cross-sectional Area of Cylinder (A)	28.1351	cm ²
Meniscus Correction (Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass (W _o)	55.37	g
Air Dried Mass (W _a)	55.56	g
Hygroscopic Corr Factor (F)	0.997	
Air Dried Mass in Analysis (M _a)	50	g
Oven Dried Mass in Analysis (M _o)	49.8	g
% Passing 2.0 mm Sieve (P ₁₀)	99.0	
Sample Represented (W)	50.3	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	3.8	427.4	99.1
2.0	4.4	426.8	99.0

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.8	99.0
0.850	0.3	49.6	98.5
0.425	0.5	49.3	98.0
0.25	0.8	49.1	97.5
0.106	1.3	48.5	96.4
0.075	1.7	48.1	95.6
Pass 0.075	0.1		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{ [(30 \cdot \eta) / (980 \cdot (Gs - Gw))] * (L/T) \} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L2 - Vb / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

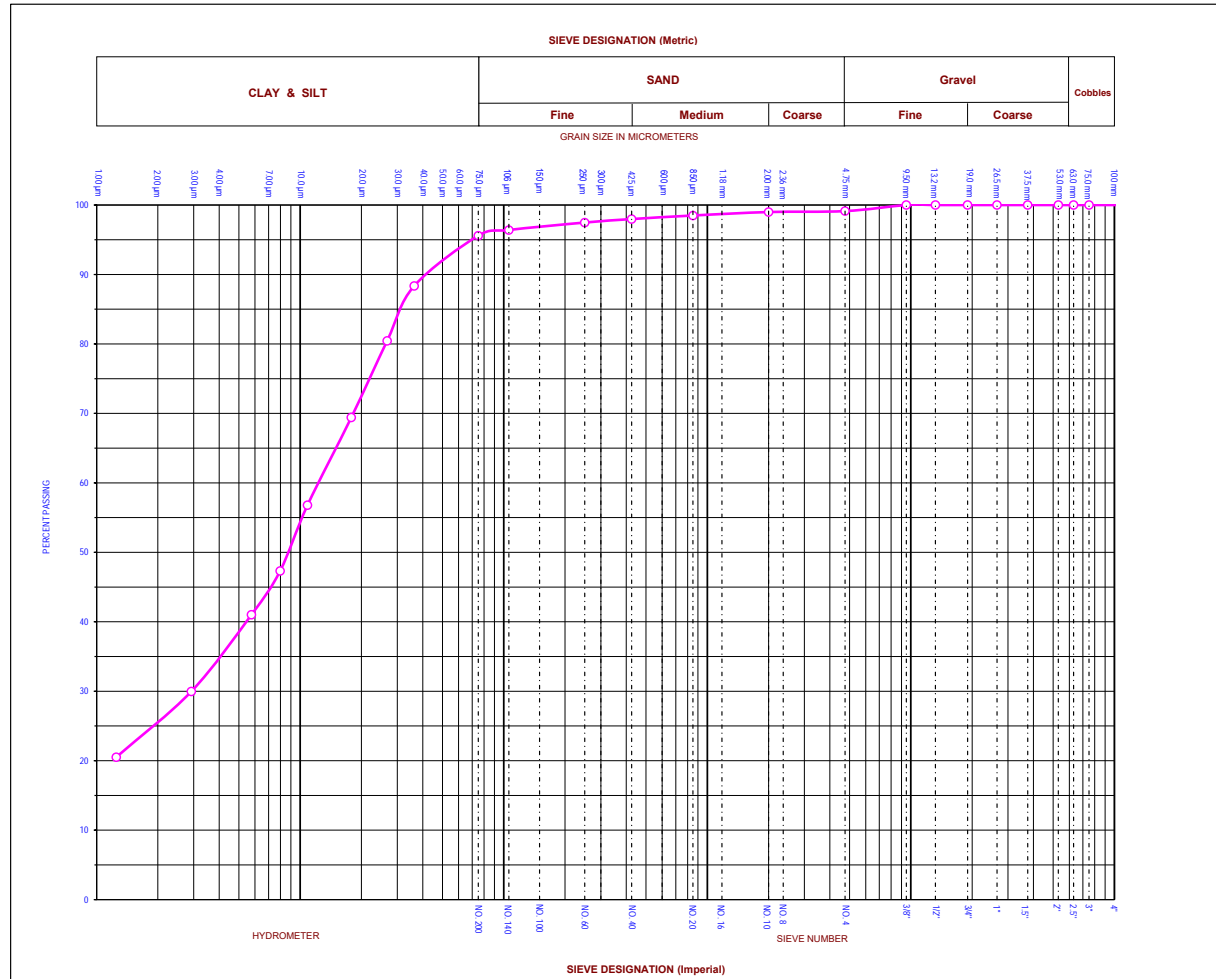
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
29-Jan-22	10:24:00 AM	1.0	1.0310	0.0030	23.3	1.0280	88.3	7.84	9.32733	0.01296029	0.0363
	10:25:00 AM	2.0	1.0285	0.0030	23.3	1.0255	80.5	8.52	9.32733	0.01296029	0.0267
	10:28:00 AM	5.0	1.0250	0.0030	23.3	1.0220	69.4	9.46	9.32733	0.01296029	0.0178
	10:38:00 AM	15.0	1.0210	0.0030	23.3	1.0180	56.8	10.54	9.32733	0.01296029	0.0109
	10:53:00 AM	30.0	1.0180	0.0030	23.3	1.0150	47.3	11.35	9.32733	0.01296029	0.0080
	11:23:00 AM	60.0	1.0160	0.0030	23.4	1.0130	41.0	11.89	9.30578	0.01294531	0.0058
	2:33:00 PM	250.0	1.0125	0.0030	23.8	1.0095	30.0	12.84	9.22045	0.01288582	0.0029
30-Jan-22	10:23:00 AM	1440.0	1.0095	0.0030	24.2	1.0065	20.5	13.65	9.13849	0.01282703	0.0012

L1 cm	Viscosity		K (η/(Gs-1))
	C		
1.89	-0.459647		5.4866631
2.57	-0.459647		5.4866631
3.51	-0.459647		5.4866631
4.59	-0.459647		5.4866631
5.40	-0.459647		5.4866631
5.94	-0.461960		5.4739861
6.89	-0.471171		5.4237923
7.69	-0.480318		5.3744072

Mass Retained on Sieve # 10	104.72
Mass Passed Sieve # 10	326.443
Jar Number	

Hygroscopic Data	Can Id	69
	Empty Can Weight (g)	13.57
	Can+ Air Dried Soil (g)	69.13
	Can + Oven Dried Soil (g)	68.94

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 28, 2022	Project Number	60637047	Gravel (%)	1				
	Sample ID	BH-3 SS4	Depth (feet)	5-7	Project Name	Glancaster Road Improvements	Sand (%)	3				
	Lab Sample No:	2022020905			Project Location	Hamilton, Ontario	Silt (%)	71				
	Soil Classification	Lean Clay, trace sand, trace gravel (CL)					Clay (%)	25				
	Figure No.		D10	N/A	D30	0.003	D60	0.013	Cu	N/A	Cc	N/A

Hydrometer Analysis

Lab No	202202091S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-4	Tested by	Dharmik/IAN
Sample Id	SS5B	Reviewed by	Ramana M
Depth (feet)	N/A	Date	28-Jan-22
Soil Classification	Lean Clay, trace sand (CL)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information

Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	231.7 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details

Volume of Bulb (V _b)	61.1	cm ³
Length of Bulb (L _b)	14.44	cm
Length from '1.0' reading to top of Bulb (L _s)	10.17	cm
Scale Dimension (hs)	0.27	cm/Div
Cross-sectional Area of Cylinder (A)	28.3535	cm ²
Meniscus Correction (Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass (W _o)	51.71	g
Air Dried Mass (W _a)	51.903	g
Hygroscopic Corr Factor (F)	0.996	
Air Dried Mass in Analysis (M _a)	50	g
Oven Dried Mass in Analysis (M _o)	49.8	g
% Passing 2.0 mm Sieve (P ₁₀)	99.8	
Sample Represented (W)	49.9	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	0.5	231.2	99.8
2.0	0.5	231.2	99.8

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.8	99.8
0.850	0.2	49.6	99.3
0.425	0.4	49.4	98.9
0.25	0.6	49.2	98.6
0.106	1.1	48.7	97.6
0.075	1.8	48.0	96.3
Pass 0.075	0.3		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw)$ in percent (for Soil Hydrometer 151 H)

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$D = \text{SQRT of } \{ [(30 * \eta) / (980 * (Gs - Gw))] * (L/T) \}$ in mm

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = $L_1 + 0.5 * [L_2 - V_b / A]$ in cm
L₁ = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

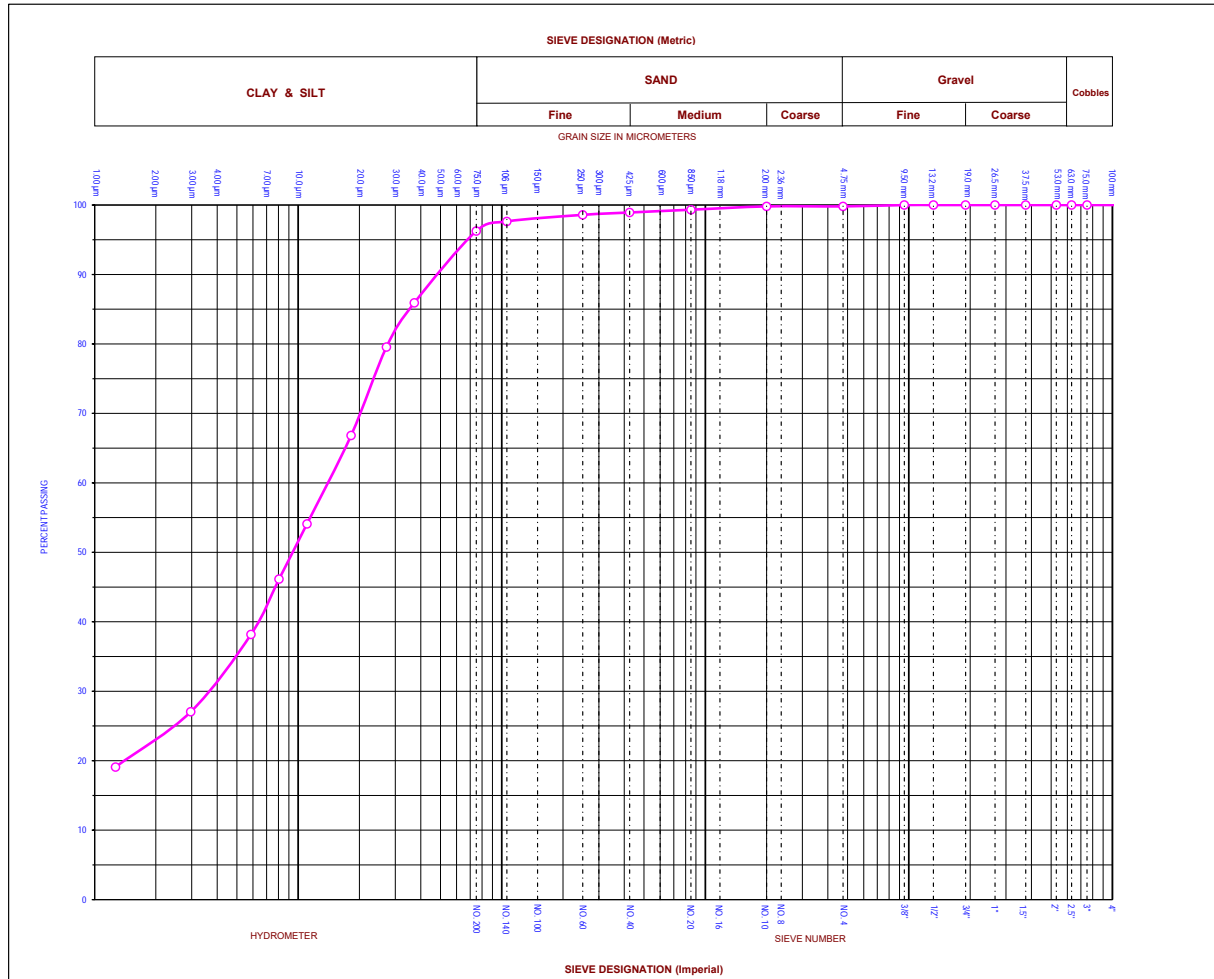
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
29-Jan-22	10:42:00 AM	1.0	1.0300	0.0030	23.6	1.0270	85.9	8.30	9.26294	0.01291548	0.0372
	10:43:00 AM	2.0	1.0280	0.0030	23.6	1.0250	79.6	8.84	9.26294	0.01291548	0.0272
	10:46:00 AM	5.0	1.0240	0.0030	23.6	1.0210	66.8	9.92	9.26294	0.01291548	0.0182
	10:56:00 AM	15.0	1.0200	0.0030	23.7	1.0170	54.1	11.00	9.24165	0.01290063	0.0110
	11:11:00 AM	30.0	1.0175	0.0030	23.6	1.0145	46.1	11.68	9.26294	0.01291548	0.0081
	11:41:00 AM	60.0	1.0150	0.0030	23.5	1.0120	38.2	12.35	9.28431	0.01293037	0.0059
	2:51:00 PM	250.0	1.0115	0.0030	23.9	1.0085	27.0	13.30	9.19933	0.01287106	0.0030
30-Jan-22	10:41:00 AM	1440.0	1.0090	0.0030	24.0	1.0060	19.1	13.97	9.17830	0.01285634	0.0013

L1 cm	Viscosity		K (η/(Gs-1))
	C		
2.16	-0.466574		5.448787
2.70	-0.466574		5.448787
3.78	-0.466574		5.448787
4.86	-0.468875		5.4362642
5.53	-0.466574		5.448787
6.21	-0.464269		5.4613609
7.15	-0.473464		5.4113709
7.83	-0.475753		5.3989998

Mass Retained on Sieve # 10	23.283
Mass Passed Sieve # 10	208.406
Jar Number	

Hygroscopic Data	Can Id	84
	Empty Can Weight (g)	13.49
	Can+ Air Dried Soil (g)	65.39
	Can + Oven Dried Soil (g)	65.20

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 28, 2022	Project Number	60637047	Gravel (%)	0			
	Sample ID	BH-4 SSSB	Depth (feet)	N/A	Project Name	Glancaster Road Improvements	Sand (%)	4			
	Lab Sample No:	202202091S			Project Location	Hamilton, Ontario	Silt (%)	73			
	Soil Classification	Lean Clay, trace sand (CL)					Clay (%)	23			
	Figure No.		D10	N/A	D30	0.004	D60	0.014	Cu	N/A	Cc

Hydrometer Analysis

Lab No	202202092S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-5	Tested by	Dharmik/IAN
Sample Id	SS4	Reviewed by	Ramana M
Depth (feet)	5-7	Date	28-Jan-22
Soil Classification	Silt, some clay, trace sand (ML)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information	
Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	198.3 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details	
Volume of Bulb (V _b)	63.1 cm ³
Length of Bulb (L _b)	14.15 cm
Length from '1.0' reading to top of Bulb (L _s)	10.5 cm
Scale Dimension (hs)	0.27 cm/Div
Cross-sectional Area of Cylinder (A)	28.1351 cm ²
Meniscus Correction (Hm)	0.0005 Divisions

Calculation of Dry Soil Mass	
Oven Dried Mass (W _o)	47.046 g
Air Dried Mass (W _a)	47.337 g
Hygroscopic Corr Factor (F)	0.994
Air Dried Mass in Analysis (M _a)	50 g
Oven Dried Mass in Analysis (M _o)	49.7 g
% Passing 2.0 mm Sieve (P ₁₀)	99.8
Sample Represented (W)	49.8 g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	0.1	198.1	99.9
2.0	0.4	197.9	99.8

Sieve Analysis of Hydrometer Material (M7)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.7	99.8
0.850	0.3	49.4	99.2
0.425	0.5	49.2	98.8
0.25	0.8	48.9	98.2
0.106	1.5	48.2	96.8
0.075	2.1	47.6	95.6
Pass 0.075	0.2		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{ [(30 \cdot \eta) / (980 \cdot (Gs - Gw))] * (L/T) \} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L2 - Vb / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
29-Jan-22	10:57:00 AM	1.0	1.0290	0.0030	23.7	1.0260	82.9	8.38	9.24165	0.01290063	0.0374
	10:58:00 AM	2.0	1.0260	0.0030	23.7	1.0230	73.4	9.19	9.24165	0.01290063	0.0277
	11:01:00 AM	5.0	1.0220	0.0030	23.7	1.0190	60.6	10.27	9.24165	0.01290063	0.0185
	11:11:00 AM	15.0	1.0170	0.0030	23.6	1.0140	44.7	11.62	9.26294	0.01291548	0.0114
	11:26:00 AM	30.0	1.0145	0.0030	23.6	1.0115	36.7	12.30	9.26294	0.01291548	0.0083
	11:56:00 AM	60.0	1.0120	0.0030	23.5	1.0090	28.7	12.97	9.28431	0.01293037	0.0060
	3:06:00 PM	250.0	1.0100	0.0030	23.8	1.0070	22.3	13.51	9.22045	0.01288582	0.0030
30-Jan-22	10:56:00 AM	1440.0	1.0085	0.0030	24.0	1.0055	17.5	13.92	9.17830	0.01285634	0.0013

L1 cm	Viscosity	
	C	K
	(η/(Gs-1))	
2.43	-0.468875	5.4362642
3.24	-0.468875	5.4362642
4.32	-0.468875	5.4362642
5.67	-0.466574	5.448787
6.35	-0.466574	5.448787
7.02	-0.464269	5.4613609
7.56	-0.471171	5.4237923
7.97	-0.475753	5.3989998

Mass Retained on Sieve # 10	22.18
Mass Passed Sieve # 10	176.085
Jar Number	

Hygroscopic Data	Can Id	127
	Empty Can Weight (g)	13.69
	Can+ Air Dried Soil (g)	61.03
	Can + Oven Dried Soil (g)	60.74

Hydrometer Analysis

Lab No	202202093S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-6	Tested by	Dharmik/IAN
Sample Id	SS6	Reviewed by	Ramana M
Depth (feet)	10-12	Date	31-Jan-22
Soil Classification	Silt, some clay, some sand, trace gravel (ML)		

Soil Hydrometer Used		
151 H SN#	993585	<input type="radio"/>
	115105	<input checked="" type="radio"/>

Soil Information

Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	480.3 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details

Volume of Bulb (V _b)	61.1	cm ³
Length of Bulb (L _b)	14.44	cm
Length from '1.0' reading to top of Bulb (L _s)	10.17	cm
Scale Dimension (hs)	0.27	cm/Div
Cross-sectional Area of Cylinder (A)	28.3535	cm ²
Meniscus Correction (Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass (W _o)	14.44	g
Air Dried Mass (W _a)	14.49	g
Hygroscopic Corr Factor (F)	0.997	
Air Dried Mass in Analysis (M _a)	50	g
Oven Dried Mass in Analysis (M _o)	49.8	g
% Passing 2.0 mm Sieve (P ₁₀)	95.5	
Sample Represented (W)	52.1	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	7.0	473.4	98.6
2.0	21.4	458.9	95.5

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.8	95.5
0.850	1.1	48.7	93.5
0.425	1.8	48.0	92.1
0.25	2.3	47.5	91.1
0.106	3.3	46.5	89.2
0.075	4.1	45.7	87.7
Pass 0.075	0.4		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{ [(30 \cdot \eta) / (980 \cdot (Gs - Gw))] \cdot (L/T) \} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L₂ - V_b / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

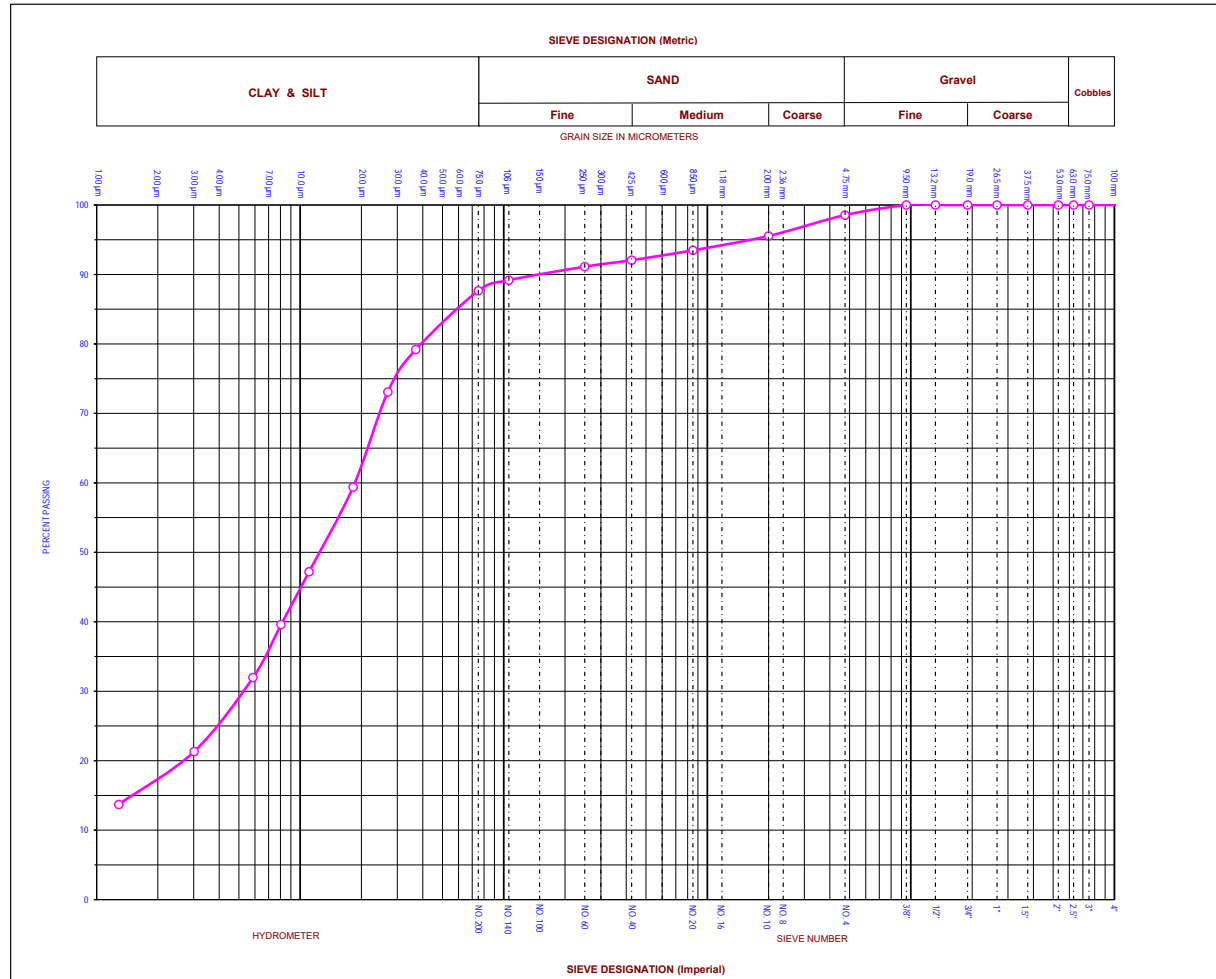
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	9:20:00 AM	1.0	1.0290	0.0030	25.6	1.0260	79.2	8.57	8.85306	0.0126265	0.0370
	9:21:00 AM	2.0	1.0270	0.0030	25.6	1.0240	73.1	9.11	8.85306	0.0126265	0.0270
	9:24:00 AM	5.0	1.0225	0.0030	25.4	1.0195	59.4	10.33	8.89259	0.01265465	0.0182
	9:34:00 AM	15.0	1.0185	0.0030	25.2	1.0155	47.2	11.41	8.93243	0.01268297	0.0111
	9:49:00 AM	30.0	1.0160	0.0030	25.1	1.0130	39.6	12.08	8.95247	0.01269719	0.0081
	10:19:00 AM	60.0	1.0135	0.0030	24.9	1.0105	32.0	12.76	8.99279	0.01272575	0.0059
2-Feb-22	1:29:00 PM	250.0	1.0100	0.0030	23.9	1.0070	21.3	13.70	9.19933	0.01287106	0.0030
	9:19:00 AM	1440.0	1.0075	0.0030	24.0	1.0045	13.7	14.38	9.17830	0.01285634	0.0013

L1 cm	Viscosity		K (η/(Gs-1))
	C		
2.43	-0.511832		5.2076811
2.97	-0.511832		5.2076811
4.19	-0.507377		5.2309329
5.27	-0.502906		5.25437
5.94	-0.500665		5.2661586
6.61	-0.496171		5.2898775
7.56	-0.473464		5.4113709
8.23	-0.475753		5.3989998

Mass Retained on Sieve # 10	150.21
Mass Passed Sieve # 10	330.09
Jar Number	

Hygroscopic Data	Can Id	69
	Empty Can Weight (g)	13.62
	Can+ Air Dried Soil (g)	28.11
	Can + Oven Dried Soil (g)	28.06

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 31, 2022	Project Number	60637047	Gravel (%)	1			
	Sample ID	BH-6 SS6	Depth (feet)	10-12	Project Name	Glancaster Road Improvements	Sand (%)	11			
	Lab Sample No:	202202093S			Project Location	Hamilton, Ontario	Silt (%)	71			
	Soil Classification	Silt, some clay, some sand, trace gravel (ML)					Clay (%)	17			
	Figure No.		D10	N/A	D30	0.005	D60	0.019	Cu	N/A	Cc

Hydrometer Analysis

Lab No	202202095S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-7	Tested by	Dharmik/IAN
Sample Id	SS4	Reviewed by	Ramana M
Depth (feet)	5-7	Date	31-Jan-22
Soil Classification	Lean Clay, trace sand (CL)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information

Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	282.1 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details

Volume of Bulb (V _b)	63.1	cm ³
Length of Bulb (L _b)	14.15	cm
Length from '1.0' reading to top of Bulb (L _s)	10.5	cm
Scale Dimension (hs)	0.27	cm/Div
Cross-sectional Area of Cylinder (A)	28.1351	cm ²
Meniscus Correction (Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass (W _o)	5.48	g
Air Dried Mass (W _a)	5.51	g
Hygroscopic Corr Factor (F)	0.995	
Air Dried Mass in Analysis (M _a)	50	g
Oven Dried Mass in Analysis (M _o)	49.7	g
% Passing 2.0 mm Sieve (P ₁₀)	98.1	
Sample Represented (W)	50.7	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	1.0	281.1	99.7
2.0	5.2	276.9	98.1

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.7	98.1
0.850	0.2	49.5	97.7
0.425	0.5	49.2	97.2
0.25	0.7	49.0	96.7
0.106	1.4	48.3	95.3
0.075	1.9	47.8	94.3
Pass 0.075	0.1		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw)$ in percent (for Soil Hydrometer 151 H)

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$D = \text{SQRT of } \{ [(30 * \eta) / (980 * (Gs - Gw))] * (L/T) \}$ in mm

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = $L_1 + 0.5 * [L_2 - V_b / A]$ in cm
L₁ = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

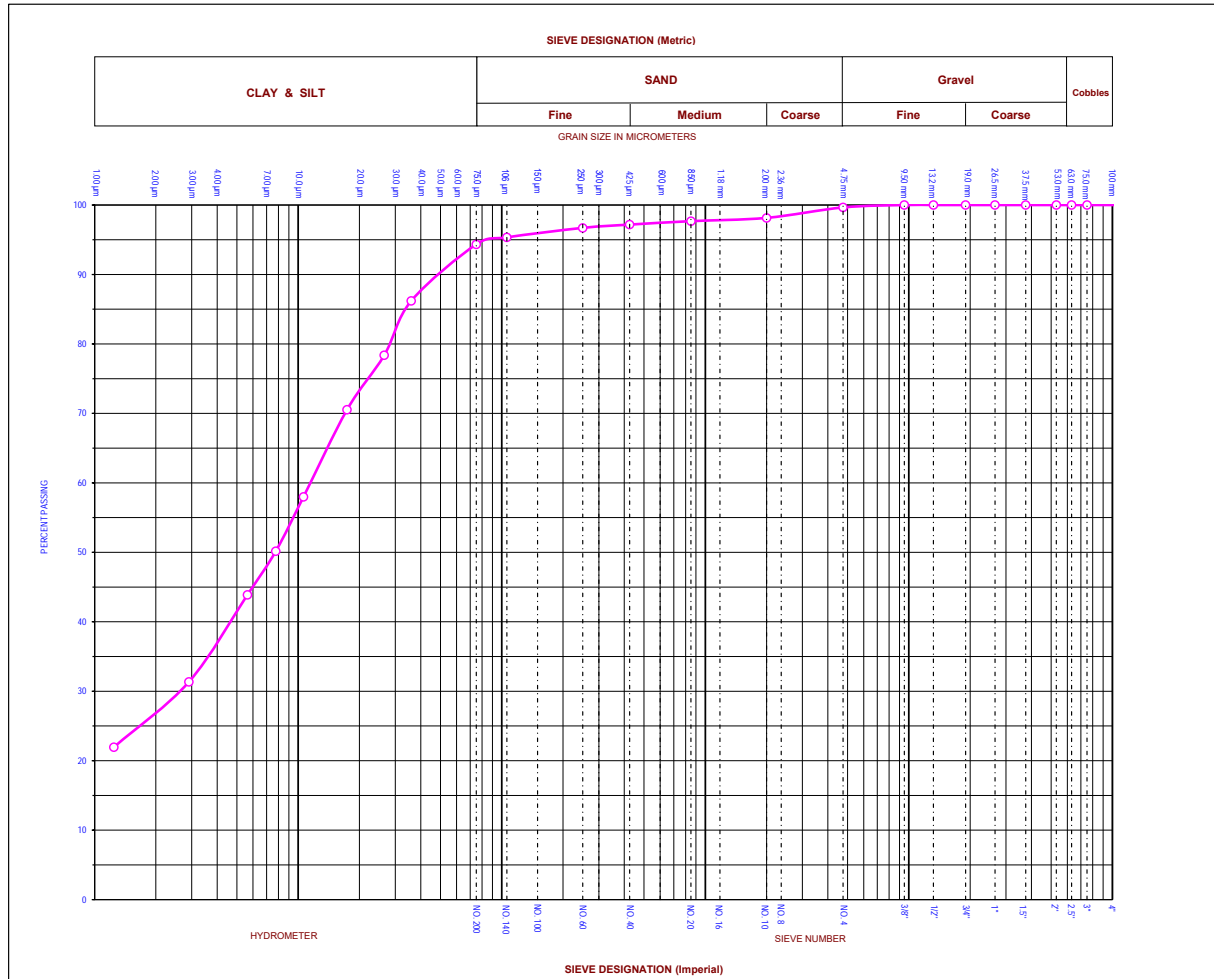
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	9:29:00 AM	1.0	1.0305	0.0030	24.9	1.0275	86.2	7.98	8.99279	0.01272575	0.0359
	9:30:00 AM	2.0	1.0280	0.0030	24.9	1.0250	78.4	8.65	8.99279	0.01272575	0.0265
	9:33:00 AM	5.0	1.0255	0.0030	24.9	1.0225	70.5	9.33	8.99279	0.01272575	0.0174
	9:43:00 AM	15.0	1.0215	0.0030	24.7	1.0185	58.0	10.41	9.03344	0.01275448	0.0106
	9:58:00 AM	30.0	1.0190	0.0030	24.6	1.0160	50.2	11.08	9.05388	0.0127689	0.0078
	10:28:00 AM	60.0	1.0170	0.0030	24.4	1.0140	43.9	11.62	9.09502	0.01279788	0.0056
2-Feb-22	1:38:00 PM	250.0	1.0130	0.0030	23.8	1.0100	31.3	12.70	9.22045	0.01288582	0.0029
	9:28:00 AM	1440.0	1.0100	0.0030	24.2	1.0070	21.9	13.51	9.13849	0.01282703	0.0012

L1 cm	Viscosity	
	C	K
2.03	-0.496171	5.2898775
2.70	-0.496171	5.2898775
3.37	-0.496171	5.2898775
4.45	-0.491662	5.3137869
5.13	-0.489401	5.3258136
5.67	-0.484868	5.3500126
6.75	-0.471171	5.4237923
7.56	-0.480318	5.3744072

Mass Retained on Sieve # 10	65.56
Mass Passed Sieve # 10	216.55
Jar Number	

Hygroscopic Data	Can Id	113
	Empty Can Weight (g)	13.62
	Can+ Air Dried Soil (g)	19.13
	Can + Oven Dried Soil (g)	19.10

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 31, 2022	Project Number	60637047	Gravel (%)	0			
	Sample ID	BH-7 SS4	Depth (feet)	5-7	Project Name	Glancaster Road Improvements	Sand (%)	6			
	Lab Sample No:	2022020955			Project Location	Hamilton, Ontario	Silt (%)	68			
	Soil Classification	Lean Clay, trace sand (CL)					Clay (%)	26			
	Figure No.		D10	N/A	D30	0.003	D60	0.012	Cu	N/A	Cc

Hydrometer Analysis

Lab No	202202096S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-8	Tested by	Dharmik/IAN
Sample Id	SS4	Reviewed by	Ramana M
Depth (feet)	5-7	Date	31-Jan-22
Soil Classification	Silt, some clay, trace sand (ML)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information	
Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	341.3 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details	
Volume of Bulb (V _b)	61.1 cm ³
Length of Bulb (L _b)	14.44 cm
Length from '1.0' reading to top of Bulb (L _s)	10.17 cm
Scale Dimension (hs)	0.27 cm/Div
Cross-sectional Area of Cylinder (A)	28.3535 cm ²
Meniscus Correction (Hm)	0.0005 Divisions

Calculation of Dry Soil Mass	
Oven Dried Mass (W _o)	30.16 g
Air Dried Mass (W _a)	30.22 g
Hygroscopic Corr Factor (F)	0.998
Air Dried Mass in Analysis (M _a)	50 g
Oven Dried Mass in Analysis (M _o)	49.9 g
% Passing 2.0 mm Sieve (P ₁₀)	99.8
Sample Represented (W)	50.0 g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	0.0	341.3	100.0
2.0	0.6	340.7	99.8

Sieve Analysis of Hydrometer Material (M7)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.9	99.8
0.850	0.1	49.8	99.6
0.425	0.2	49.7	99.4
0.25	0.3	49.6	99.2
0.106	0.7	49.3	98.5
0.075	1.2	48.7	97.4
Pass 0.075	0.3		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{[(30 * \eta) / (980 * (Gs - Gw))] * (L/T)\} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L₂ - V_b / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

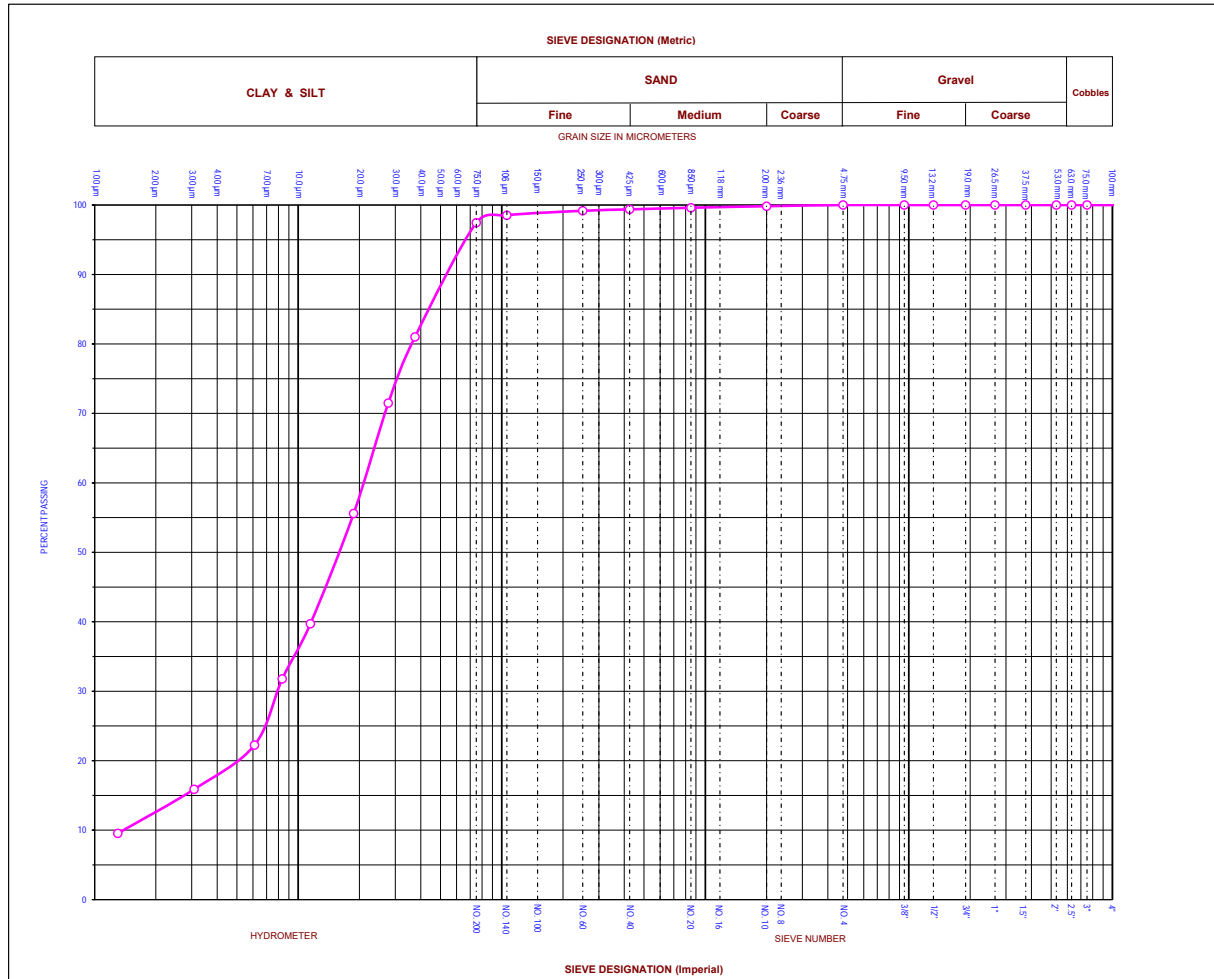
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	9:37:00 AM	1.0	1.0285	0.0030	25.0	1.0255	81.0	8.71	8.97259	0.01271145	0.0375
	9:38:00 AM	2.0	1.0255	0.0030	25.0	1.0225	71.5	9.52	8.97259	0.01271145	0.0277
	9:41:00 AM	5.0	1.0205	0.0030	25.0	1.0175	55.6	10.87	8.97259	0.01271145	0.0187
	9:51:00 AM	15.0	1.0155	0.0030	24.9	1.0125	39.7	12.22	8.99279	0.01272575	0.0115
	10:06:00 AM	30.0	1.0130	0.0030	24.8	1.0100	31.8	12.89	9.01307	0.0127401	0.0084
	10:36:00 AM	60.0	1.0100	0.0030	24.6	1.0070	22.2	13.70	9.05388	0.0127689	0.0061
2-Feb-22	1:46:00 PM	250.0	1.0080	0.0030	23.6	1.0050	15.9	14.24	9.26294	0.01291548	0.0031
	9:36:00 AM	1440.0	1.0060	0.0030	24.2	1.0030	9.5	14.78	9.13849	0.01282703	0.0013

L1 cm	Viscosity		K (η/(Gs-1))
	C		
2.57	-0.498420		5.2779944
3.37	-0.498420		5.2779944
4.73	-0.498420		5.2779944
6.07	-0.496171		5.2898775
6.75	-0.493919		5.3018083
7.56	-0.489401		5.3258136
8.10	-0.466574		5.448787
8.64	-0.480318		5.3744072

Mass Retained on Sieve # 10	18.75
Mass Passed Sieve # 10	322.51
Jar Number	

Hygroscopic Data	Can Id	62
	Empty Can Weight (g)	13.59
	Can+ Air Dried Soil (g)	43.81
	Can + Oven Dried Soil (g)	43.75

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 31, 2022	Project Number	60637047	Gravel (%)	0			
	Sample ID	BH-8 SS4	Depth (feet)	5-7	Project Name	Glancaster Road Improvements	Sand (%)	3			
	Lab Sample No:	202202096S			Project Location	Hamilton, Ontario	Silt (%)	85			
	Soil Classification	Silt, some clay, trace sand (ML)						Clay (%)	12		
	Figure No.		D10	0.001	D30	0.008	D60	0.021	Cu	14.8	Cc

Hydrometer Analysis

Lab No	202202097S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-9	Tested by	Dharmik/IAN
Sample Id	SS4	Reviewed by	Ramana M
Depth (feet)	5-7	Date	31-Jan-22
Soil Classification	Lean Clay, trace gravel (CL)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information

Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	261.3 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details

Volume of Bulb (V _b)	63.1	cm ³
Length of Bulb (L ₂)	14.15	cm
Length from '1.0' reading to top of Bulb (L _s)	10.5	cm
Scale Dimension (hs)	0.27	cm/Div
Cross-sectional Area of Cylinder (A)	28.1351	cm ²
Meniscus Correction (Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass (W _o)	20.44	g
Air Dried Mass (W _a)	20.54	g
Hygroscopic Corr Factor (F)	0.995	
Air Dried Mass in Analysis (M _a)	50	g
Oven Dried Mass in Analysis (M _o)	49.8	g
% Passing 2.0 mm Sieve (P ₁₀)	98.4	
Sample Represented (W)	50.6	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	0.4	260.9	99.9
2.0	4.2	257.1	98.4

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.8	98.4
0.850	0.6	49.2	97.2
0.425	1.1	48.7	96.3
0.25	1.4	48.4	95.7
0.106	2.0	47.7	94.4
0.075	2.8	46.9	92.8
Pass 0.075	0.2		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw)$ in percent (for Soil Hydrometer 151 H)

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$D = \text{SQRT of } \{[(30 * \eta) / (980 * (Gs - Gw))] * (L/T)\}$ in mm

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = $L_1 + 0.5 * [L_2 - V_b / A]$ in cm
L₁ = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

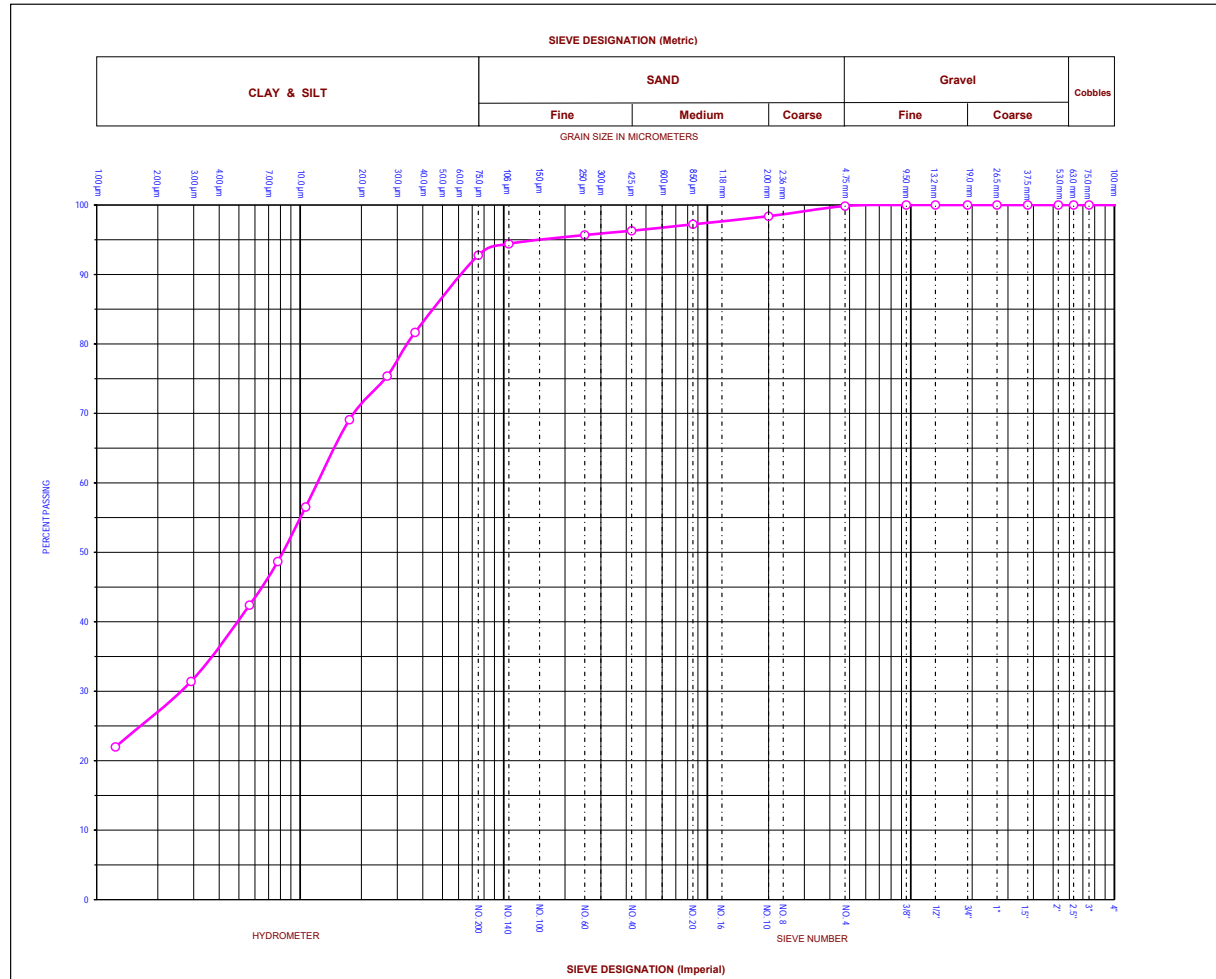
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	9:53:00 AM	1.0	1.0290	0.0030	25.3	1.0260	81.7	8.38	8.91247	0.01266879	0.0367
	9:54:00 AM	2.0	1.0270	0.0030	25.3	1.0240	75.4	8.92	8.91247	0.01266879	0.0268
	9:57:00 AM	5.0	1.0250	0.0030	25.2	1.0220	69.1	9.46	8.93243	0.01268297	0.0174
	10:07:00 AM	15.0	1.0210	0.0030	25.1	1.0180	56.5	10.54	8.95247	0.01269719	0.0106
	10:22:00 AM	30.0	1.0185	0.0030	25.1	1.0155	48.7	11.22	8.95247	0.01269719	0.0078
	10:52:00 AM	60.0	1.0165	0.0030	24.9	1.0135	42.4	11.76	8.99279	0.01272575	0.0056
2-Feb-22	2:02:00 PM	250.0	1.0130	0.0030	23.7	1.0100	31.4	12.70	9.24165	0.01290063	0.0029
	9:52:00 AM	1440.0	1.0100	0.0030	24.6	1.0070	22.0	13.51	9.05388	0.0127689	0.0012

L1 cm	Viscosity		K (η/(Gs-1))
	C		
2.43	-0.505144		5.2426281
2.97	-0.505144		5.2426281
3.51	-0.502906		5.25437
4.59	-0.500665		5.2661586
5.27	-0.500665		5.2661586
5.81	-0.496171		5.2898775
6.75	-0.468875		5.4362642
7.56	-0.489401		5.3258136

Mass Retained on Sieve # 10	37.53
Mass Passed Sieve # 10	223.79
Jar Number	

Hygroscopic Data	Can Id	134
	Empty Can Weight (g)	13.70
	Can+ Air Dried Soil (g)	34.24
	Can + Oven Dried Soil (g)	34.14

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 31, 2022	Project Number	60637047	Gravel (%)	0			
	Sample ID	BH-9 SS4	Depth (feet)	5-7	Project Name	Glancaster Road Improvements	Sand (%)	7			
	Lab Sample No:	202202097S			Project Location	Hamilton, Ontario	Silt (%)	67			
	Soil Classification	Lean Clay, trace gravel (CL)					Clay (%)	26			
	Figure No.		D10	N/A	D30	0.003	D60	0.013	Cu	N/A	Cc

Hydrometer Analysis

Lab No	202202098S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-10	Tested by	Dharmik/IAN
Sample Id	SS5	Reviewed by	Ramana M
Depth (feet)	7.5-9.5	Date	31-Jan-22
Soil Classification	Silt, some clay, tracesand (ML)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information	
Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	295.3 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details	
Volume of Bulb (V _b)	61.1 cm ³
Length of Bulb (L _b)	14.44 cm
Length from '1.0' reading to top of Bulb (L _s)	10.17 cm
Scale Dimension (hs)	0.27 cm/Div
Cross-sectional Area of Cylinder (A)	28.3535 cm ²
Meniscus Correction (Hm)	0.0005 Divisions

Calculation of Dry Soil Mass	
Oven Dried Mass (W _o)	15.06 g
Air Dried Mass (W _a)	15.11 g
Hygroscopic Corr Factor (F)	0.997
Air Dried Mass in Analysis (M _a)	50 g
Oven Dried Mass in Analysis (M _o)	49.8 g
% Passing 2.0 mm Sieve (P ₁₀)	99.6
Sample Represented (W)	50.1 g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	0.0	295.3	100.0
2.0	1.3	294.0	99.6

Sieve Analysis of Hydrometer Material (M7)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.8	99.6
0.850	0.1	49.7	99.3
0.425	0.2	49.7	99.2
0.25	0.2	49.6	99.2
0.106	0.6	49.2	98.4
0.075	2.0	47.9	95.6
Pass 0.075	2.0		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{ [(30 * \eta) / (980 * (Gs - Gw))] * (L/T) \} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L2 - Vb / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	10:10:00 AM	1.0	1.0265	0.0030	26.2	1.0235	74.6	9.25	8.73633	0.01254298	0.0381
	10:11:00 AM	2.0	1.0230	0.0030	26.2	1.0200	63.5	10.19	8.73633	0.01254298	0.0283
	10:14:00 AM	5.0	1.0185	0.0030	26.0	1.0155	49.2	11.41	8.77493	0.01257066	0.0190
	10:24:00 AM	15.0	1.0150	0.0030	25.9	1.0120	38.1	12.35	8.79435	0.01258456	0.0114
	10:39:00 AM	30.0	1.0135	0.0030	25.7	1.0105	33.3	12.76	8.83341	0.01261248	0.0082
	11:09:00 AM	60.0	1.0120	0.0030	25.4	1.0090	28.6	13.16	8.89259	0.01265465	0.0059
2-Feb-22	2:19:00 PM	250.0	1.0105	0.0030	25.3	1.0075	23.8	13.57	8.91247	0.01266879	0.0030
	10:09:00 AM	1440.0	1.0080	0.0030	24.6	1.0050	15.9	14.24	9.05388	0.0127689	0.0013

L1 cm	Viscosity		K (η/(Gs-1))
	C		
3.11	-0.525104		5.1390178
4.05	-0.525104		5.1390178
5.27	-0.520695		5.1617255
6.21	-0.518485		5.1731466
6.61	-0.514053		5.1961241
7.02	-0.507377		5.2309329
7.43	-0.505144		5.2426281
8.10	-0.489401		5.3258136

Mass Retained on Sieve # 10	47.79
Mass Passed Sieve # 10	247.51
Jar Number	

Hygrosopic Data	Can Id	166
	Empty Can Weight (g)	16.52
	Can+ Air Dried Soil (g)	31.63
	Can + Oven Dried Soil (g)	31.58

Hydrometer Analysis

Lab No	202202099S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-11	Tested by	Dharmik/IAN
Sample Id	SS4	Reviewed by	Ramana M
Depth (feet)	5-7	Date	31-Jan-22
Soil Classification	Lean Clay, trace sand (CL)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information

Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	274.3 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details

Volume of Bulb (V _b)	63.1	cm ³
Length of Bulb (L ₂)	14.15	cm
Length from '1.0' reading to top of Bulb (L _s)	10.5	cm
Scale Dimension (hs)	0.27	cm/Div
Cross-sectional Area of Cylinder (A)	28.1351	cm ²
Meniscus Correction (Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass (W _o)	6.77	g
Air Dried Mass (W _a)	6.8	g
Hygroscopic Corr Factor (F)	0.996	
Air Dried Mass in Analysis (M _a)	50	g
Oven Dried Mass in Analysis (M _o)	49.8	g
% Passing 2.0 mm Sieve (P ₁₀)	98.7	
Sample Represented (W)	50.4	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	2.1	272.2	99.2
2.0	3.5	270.8	98.7

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.8	98.7
0.850	0.1	49.6	98.5
0.425	0.3	49.5	98.1
0.25	0.4	49.4	97.9
0.106	0.9	48.9	97.0
0.075	1.3	48.5	96.2
Pass 0.075	0.2		

Percent in Suspension (P) as per Section 14.3 of ASTM D 422

$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw)$ in percent (for Soil Hydrometer 151 H)

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$D = \text{SQRT of } \{ [(30 \cdot \eta) / (980 \cdot (Gs - Gw))] * (L/T) \}$ in mm

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = $L_1 + 0.5 \cdot [L_2 - V_b / A]$ in cm
L₁ = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

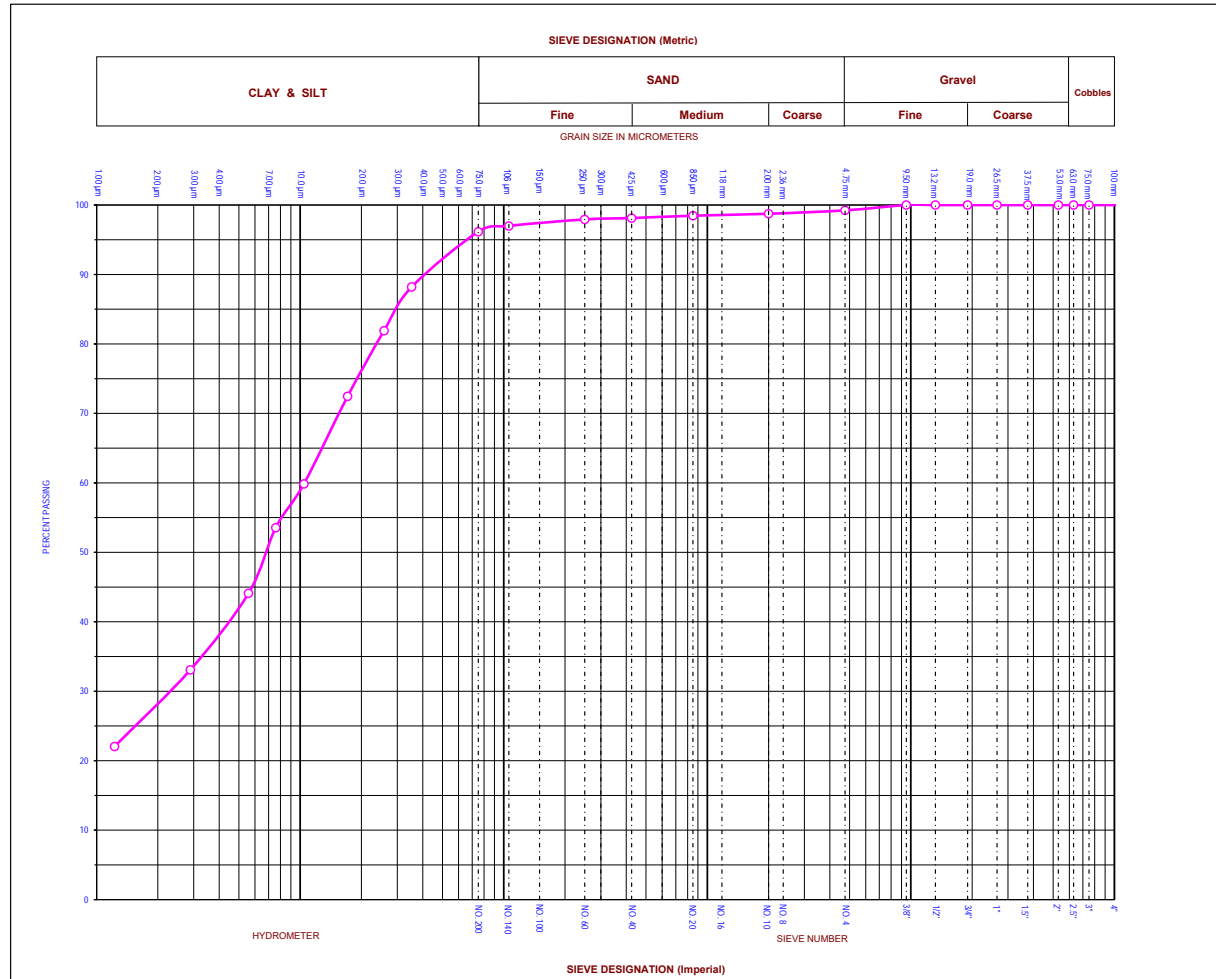
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	10:29:00 AM	1.0	1.0310	0.0030	25.7	1.0280	88.2	7.84	8.83341	0.01261248	0.0353
	10:30:00 AM	2.0	1.0290	0.0030	25.7	1.0260	81.9	8.38	8.83341	0.01261248	0.0258
	10:33:00 AM	5.0	1.0260	0.0030	25.7	1.0230	72.5	9.19	8.83341	0.01261248	0.0171
	10:43:00 AM	15.0	1.0220	0.0030	25.7	1.0190	59.9	10.27	8.83341	0.01261248	0.0104
	10:58:00 AM	30.0	1.0200	0.0030	25.5	1.0170	53.6	10.81	8.87278	0.01264055	0.0076
	11:28:00 AM	60.0	1.0170	0.0030	25.3	1.0140	44.1	11.62	8.91247	0.01266879	0.0056
2-Feb-22	2:38:00 PM	250.0	1.0135	0.0030	23.9	1.0105	33.1	12.57	9.19933	0.01287106	0.0029
	10:28:00 AM	1440.0	1.0100	0.0030	25.4	1.0070	22.1	13.51	8.89259	0.01265465	0.0012

L1 cm	Viscosity	
	C	K (η/(Gs-1))
1.89	-0.514053	5.1961241
2.43	-0.514053	5.1961241
3.24	-0.514053	5.1961241
4.32	-0.514053	5.1961241
4.86	-0.509606	5.2192839
5.67	-0.505144	5.2426281
6.61	-0.473464	5.4113709
7.56	-0.507377	5.2309329

Mass Retained on Sieve # 10	24.36
Mass Passed Sieve # 10	249.92
Jar Number	

Hygroscopic Data	Can Id	127
	Empty Can Weight (g)	13.72
	Can+ Air Dried Soil (g)	20.52
	Can + Oven Dried Soil (g)	20.49

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 31, 2022	Project Number	60637047	Gravel (%)	1				
	Sample ID	BH-11 SS4	Depth (feet)	5-7	Project Name	Glancaster Road Improvements	Sand (%)	3				
	Lab Sample No:	202202099S			Project Location	Hamilton, Ontario	Silt (%)	69				
	Soil Classification	Lean Clay, trace sand (CL)					Clay (%)	27				
	Figure No.		D10	N/A	D30	0.002	D60	0.011	Cu	N/A	Cc	N/A

Hydrometer Analysis

Lab No	202202101S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-12	Tested by	Dharmik/IAN
Sample Id	SS5	Reviewed by	Ramana M
Depth (feet)	7.5-9.5	Date	31-Jan-22
Soil Classification	Lean Clay, trace sand (CL)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information	
Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	444.0 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details	
Volume of Bulb (V _b)	61.1 cm ³
Length of Bulb (L _b)	14.44 cm
Length from '1.0' reading to top of Bulb (L _s)	10.17 cm
Scale Dimension (hs)	0.27 cm/Div
Cross-sectional Area of Cylinder (A)	28.3535 cm ²
Meniscus Correction (Hm)	0.0005 Divisions

Calculation of Dry Soil Mass	
Oven Dried Mass (W _o)	25.34 g
Air Dried Mass (W _a)	25.45 g
Hygroscopic Corr Factor (F)	0.996
Air Dried Mass in Analysis (M _a)	50 g
Oven Dried Mass in Analysis (M _o)	49.8 g
% Passing 2.0 mm Sieve (P ₁₀)	99.0
Sample Represented (W)	50.3 g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	1.9	442.1	99.6
2.0	4.3	439.7	99.0

Sieve Analysis of Hydrometer Material (M7)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.8	99.0
0.850	0.2	49.6	98.7
0.425	0.4	49.4	98.3
0.25	0.5	49.3	98.0
0.106	0.9	48.9	97.3
0.075	1.3	48.5	96.5
Pass 0.075	0.2		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{[(30 * \eta) / (980 * (Gs - Gw))] * (L/T)\} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L₂ - V_b / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

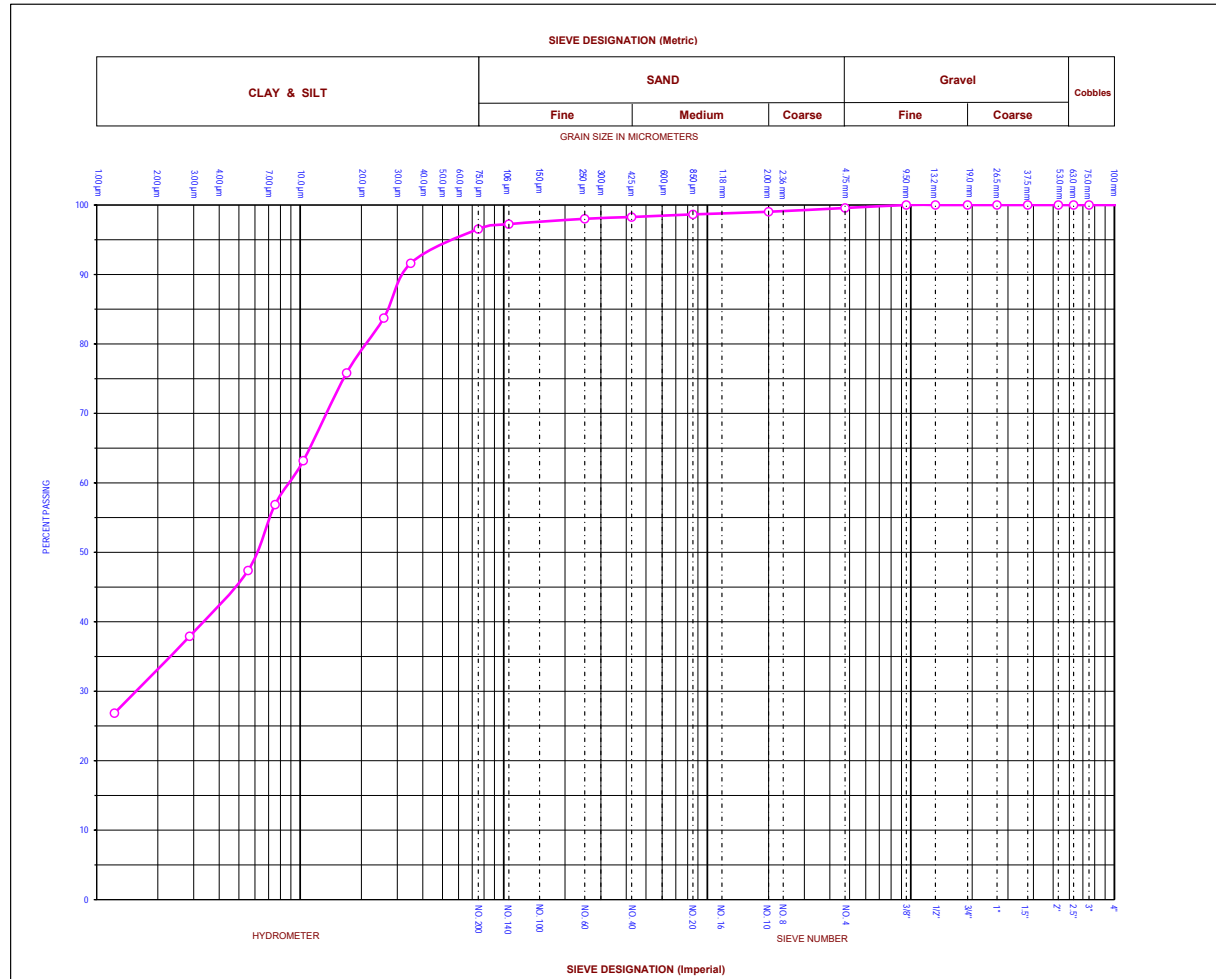
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	10:40:00 AM	1.0	1.0320	0.0030	26.3	1.0290	91.6	7.76	8.71714	0.0125292	0.0349
	10:41:00 AM	2.0	1.0295	0.0030	26.3	1.0265	83.7	8.44	8.71714	0.0125292	0.0257
	10:44:00 AM	5.0	1.0270	0.0030	26.3	1.0240	75.8	9.11	8.71714	0.0125292	0.0169
	10:54:00 AM	15.0	1.0230	0.0030	26.0	1.0200	63.2	10.19	8.77493	0.01257066	0.0104
	11:09:00 AM	30.0	1.0210	0.0030	25.9	1.0180	56.9	10.73	8.79435	0.01258456	0.0075
	11:39:00 AM	60.0	1.0180	0.0030	25.5	1.0150	47.4	11.54	8.87278	0.01264055	0.0055
	2:49:00 PM	250.0	1.0150	0.0030	23.8	1.0120	37.9	12.35	9.22045	0.01288582	0.0029
2-Feb-22	10:39:00 AM	1440.0	1.0115	0.0030	24.8	1.0085	26.9	13.30	9.01307	0.0127401	0.0012

L1 cm	Viscosity		K (η/(Gs-1))
	C		
1.62	-0.527303		5.1277306
2.29	-0.527303		5.1277306
2.97	-0.527303		5.1277306
4.05	-0.520695		5.1617255
4.59	-0.518485		5.1731466
5.40	-0.509606		5.2192839
6.21	-0.471171		5.4237923
7.15	-0.493919		5.3018083

Mass Retained on Sieve # 10	108.7
Mass Passed Sieve # 10	335.33
Jar Number	

Hygroscopic Data	Can Id	192
	Empty Can Weight (g)	13.67
	Can+ Air Dried Soil (g)	39.12
	Can + Oven Dried Soil (g)	39.01

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 31, 2022	Project Number	60637047	Gravel (%)	0			
	Sample ID	BH-12 SSS	Depth (feet)	7.5-9.5	Project Name	Glancaster Road Improvements	Sand (%)	3			
	Lab Sample No:	202202101S			Project Location	Hamilton, Ontario	Silt (%)	65			
	Soil Classification	Lean Clay, trace sand (CL)					Clay (%)	32			
	Figure No.		D10	N/A	D30	0.002	D60	0.009	Cu	N/A	Cc

Hydrometer Analysis

Lab No	202202102S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-13	Tested by	Dharmik/IAN
Sample Id	SS6	Reviewed by	Ramana M
Depth (feet)	10-12	Date	31-Jan-22
Soil Classification	Lean Clay, trace sand, trace gravel (CL)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information

Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	403.8 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details

Volume of Bulb (V _b)	63.1	cm ³
Length of Bulb (L _b)	14.15	cm
Length from '1.0' reading to top of Bulb (L _s)	10.5	cm
Scale Dimension (hs)	0.27	cm/Div
Cross-sectional Area of Cylinder (A)	28.1351	cm ²
Meniscus Correction (Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass (W _o)	11.72	g
Air Dried Mass (W _a)	11.75	g
Hygroscopic Corr Factor (F)	0.997	
Air Dried Mass in Analysis (M _a)	50	g
Oven Dried Mass in Analysis (M _o)	49.9	g
% Passing 2.0 mm Sieve (P ₁₀)	98.4	
Sample Represented (W)	50.7	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	3.9	399.9	99.0
2.0	6.5	397.3	98.4

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.9	98.4
0.850	0.3	49.6	97.9
0.425	0.5	49.4	97.4
0.25	0.7	49.2	97.1
0.106	1.1	48.8	96.2
0.075	1.6	48.3	95.3
Pass 0.075	0.3		

Percent in Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{ [(30 \cdot \eta) / (980 \cdot (Gs - Gw))] \cdot (L/T) \} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L₂ - V_b / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

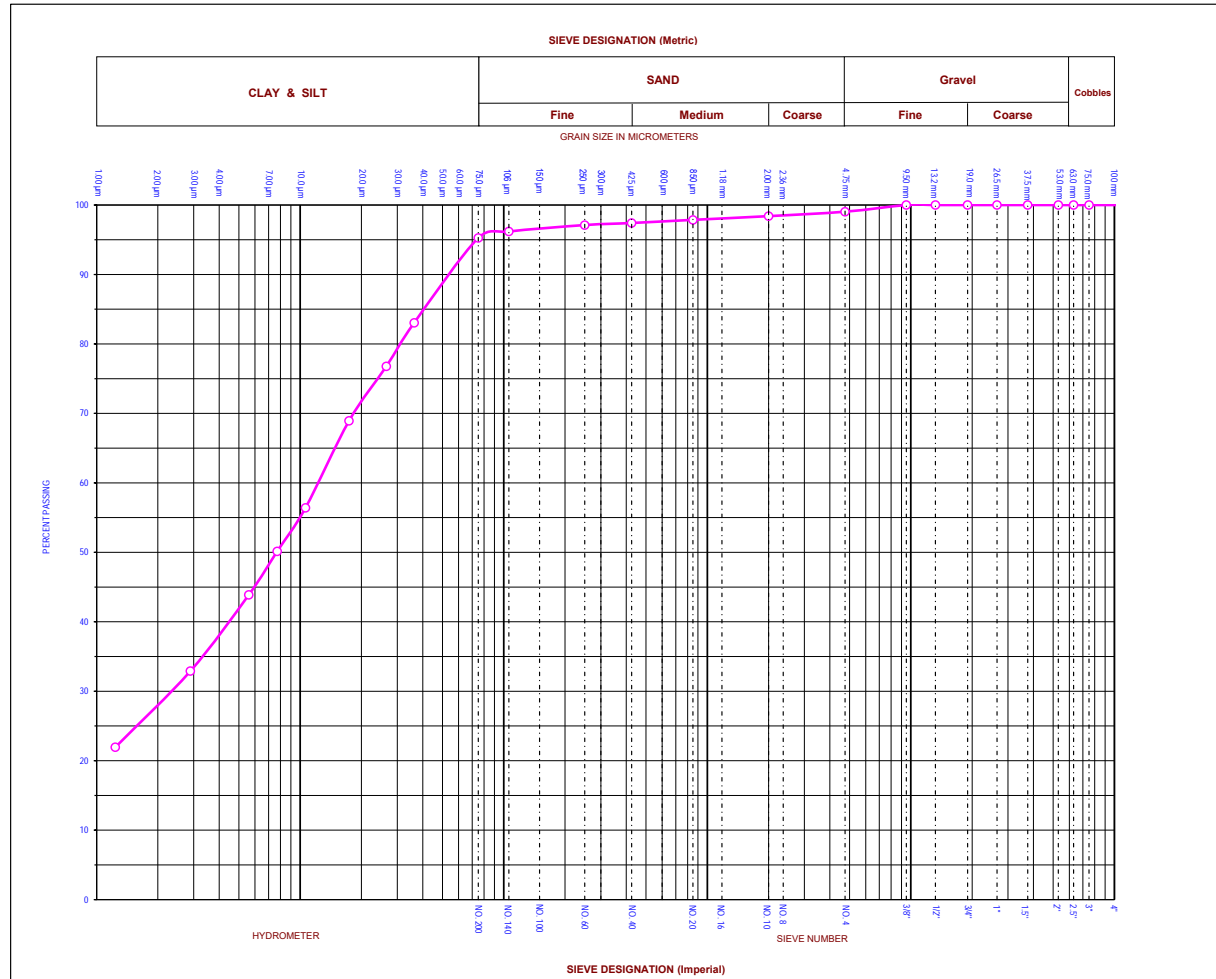
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	10:56:00 AM	1.0	1.0295	0.0030	25.5	1.0265	83.0	8.25	8.87278	0.01264055	0.0363
	10:57:00 AM	2.0	1.0275	0.0030	25.5	1.0245	76.8	8.79	8.87278	0.01264055	0.0265
	11:00:00 AM	5.0	1.0250	0.0030	25.5	1.0220	68.9	9.46	8.87278	0.01264055	0.0174
	11:10:00 AM	15.0	1.0210	0.0030	25.3	1.0180	56.4	10.54	8.91247	0.01266879	0.0106
	11:25:00 AM	30.0	1.0190	0.0030	25.2	1.0160	50.1	11.08	8.93243	0.01268297	0.0077
	11:55:00 AM	60.0	1.0170	0.0030	25.1	1.0140	43.9	11.62	8.95247	0.01269719	0.0056
2-Feb-22	3:05:00 PM	250.0	1.0135	0.0030	23.8	1.0105	32.9	12.57	9.22045	0.01288582	0.0029
	10:55:00 AM	1440.0	1.0100	0.0030	24.7	1.0070	21.9	13.51	9.03344	0.01275448	0.0012

L1 cm	Viscosity		K (η/(Gs-1))
	C		
2.29	-0.509606		5.2192839
2.83	-0.509606		5.2192839
3.51	-0.509606		5.2192839
4.59	-0.505144		5.2426281
5.13	-0.502906		5.25437
5.67	-0.500665		5.2661586
6.61	-0.471171		5.4237923
7.56	-0.491662		5.3137869

Mass Retained on Sieve # 10	100.91
Mass Passed Sieve # 10	302.9
Jar Number	

Hygroscopic Data	Can Id	167
	Empty Can Weight (g)	13.57
	Can+ Air Dried Soil (g)	25.32
	Can + Oven Dried Soil (g)	25.29

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 31, 2022	Project Number	60637047	Gravel (%)	1				
	Sample ID	BH-13 SS6	Depth (feet)	10-12	Project Name	Glancaster Road Improvements	Sand (%)	4				
	Lab Sample No:	2022021025			Project Location	Hamilton, Ontario	Silt (%)	68				
	Soil Classification	Lean Clay, trace sand, trace gravel (CL)					Clay (%)	27				
	Figure No.		D10	N/A	D30	0.002	D60	0.013	Cu	N/A	Cc	N/A

Hydrometer Analysis

Lab No	202202103S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-14	Tested by	Dharmik/IAN
Sample Id	SS4	Reviewed by	Ramana M
Depth (feet)	5-7	Date	31-Jan-22
Soil Classification	Lean Clay, trace sand, tracegravel (CL)		

Soil Hydrometer Used		
151 H SN#	993585	<input type="radio"/>
	115105	<input checked="" type="radio"/>

Soil Information	
Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	345.8 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details	
Volume of Bulb (V _b)	61.1 cm ³
Length of Bulb (L _b)	14.44 cm
Length from '1.0' reading to top of Bulb (L _s)	10.17 cm
Scale Dimension (hs)	0.27 cm/Div
Cross-sectional Area of Cylinder (A)	28.3535 cm ²
Meniscus Correction (Hm)	0.0005 Divisions

Calculation of Dry Soil Mass	
Oven Dried Mass (W _o)	22.89 g
Air Dried Mass (W _a)	22.97 g
Hygroscopic Corr Factor (F)	0.997
Air Dried Mass in Analysis (M _a)	50 g
Oven Dried Mass in Analysis (M _o)	49.8 g
% Passing 2.0 mm Sieve (P ₁₀)	98.0
Sample Represented (W)	50.8 g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	3.7	342.1	98.9
2.0	6.9	338.9	98.0

Sieve Analysis of Hydrometer Material (M7)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.8	98.0
0.850	0.3	49.5	97.4
0.425	0.6	49.2	96.8
0.25	0.9	49.0	96.3
0.106	1.7	48.1	94.6
0.075	2.6	47.3	93.0
P _{Pass} 0.075	0.2		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{[(30 * \eta) / (980 * (Gs - Gw))] * (L/T)\} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L2 - V_b / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	9:29:00 AM	1.0	1.0300	0.0030	25.3	1.0270	84.4	8.30	8.91247	0.01266879	0.0365
	9:30:00 AM	2.0	1.0280	0.0030	25.3	1.0250	78.1	8.84	8.91247	0.01266879	0.0266
	9:33:00 AM	5.0	1.0250	0.0030	25.2	1.0220	68.7	9.65	8.93243	0.01268297	0.0176
	9:43:00 AM	15.0	1.0210	0.0030	25.2	1.0180	56.2	10.73	8.93243	0.01268297	0.0107
	9:58:00 AM	30.0	1.0190	0.0030	25.1	1.0160	50.0	11.27	8.95247	0.01269719	0.0078
	10:28:00 AM	60.0	1.0165	0.0030	25.0	1.0135	42.2	11.95	8.97259	0.01271145	0.0057
2-Feb-22	1:38:00 PM	250.0	1.0130	0.0030	24.8	1.0100	31.2	12.89	9.01307	0.0127401	0.0029
	9:28:00 AM	1440.0	1.0100	0.0030	23.7	1.0070	21.9	13.70	9.24165	0.01290063	0.0013

L1 cm	Viscosity	
	C	K
2.16	-0.505144	5.2426281
2.70	-0.505144	5.2426281
3.51	-0.502906	5.25437
4.59	-0.502906	5.25437
5.13	-0.500665	5.2661586
5.81	-0.498420	5.2779944
6.75	-0.493919	5.3018083
7.56	-0.468875	5.4362642

Mass Retained on Sieve # 10	56.24
Mass Passed Sieve # 10	289.52
Jar Number	

Hygroscopic Data	Can Id	108
	Empty Can Weight (g)	13.60
	Can+ Air Dried Soil (g)	36.57
	Can + Oven Dried Soil (g)	36.49

Hydrometer Analysis

Lab No	202202104S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-15	Tested by	Dharmik/IAN
Sample Id	SS5	Reviewed by	Ramana M
Depth (feet)	7.5-9.5	Date	31-Jan-22
Soil Classification	Lean Clay, trace sand (CL)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information

Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	350.1 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details

Volume of Bulb (V _b)	63.1	cm ³
Length of Bulb (L _b)	14.15	cm
Length from '1.0' reading to top of Bulb (L _s)	10.5	cm
Scale Dimension (hs)	0.27	cm/Div
Cross-sectional Area of Cylinder (A)	28.1351	cm ²
Meniscus Correction (Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass (W _o)	19.07	g
Air Dried Mass (W _a)	19.12	g
Hygroscopic Corr Factor (F)	0.997	
Air Dried Mass in Analysis (M _a)	50	g
Oven Dried Mass in Analysis (M _o)	49.9	g
% Passing 2.0 mm Sieve (P ₁₀)	99.6	
Sample Represented (W)	50.1	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	0.3	349.8	99.9
2.0	1.3	348.8	99.6

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.9	99.6
0.850	0.1	49.8	99.4
0.425	0.2	49.6	99.2
0.25	0.3	49.5	99.0
0.106	0.7	49.2	98.2
0.075	1.4	48.5	96.9
Pass 0.075	0.5		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw)$ in percent (for Soil Hydrometer 151 H)

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$D = \text{SQRT of } \{ [(30 \cdot \eta) / (980 \cdot (Gs - Gw))] * (L/T) \}$ in mm

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = $L_1 + 0.5 \cdot [L_2 - V_b / A]$ in cm
L₁ = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

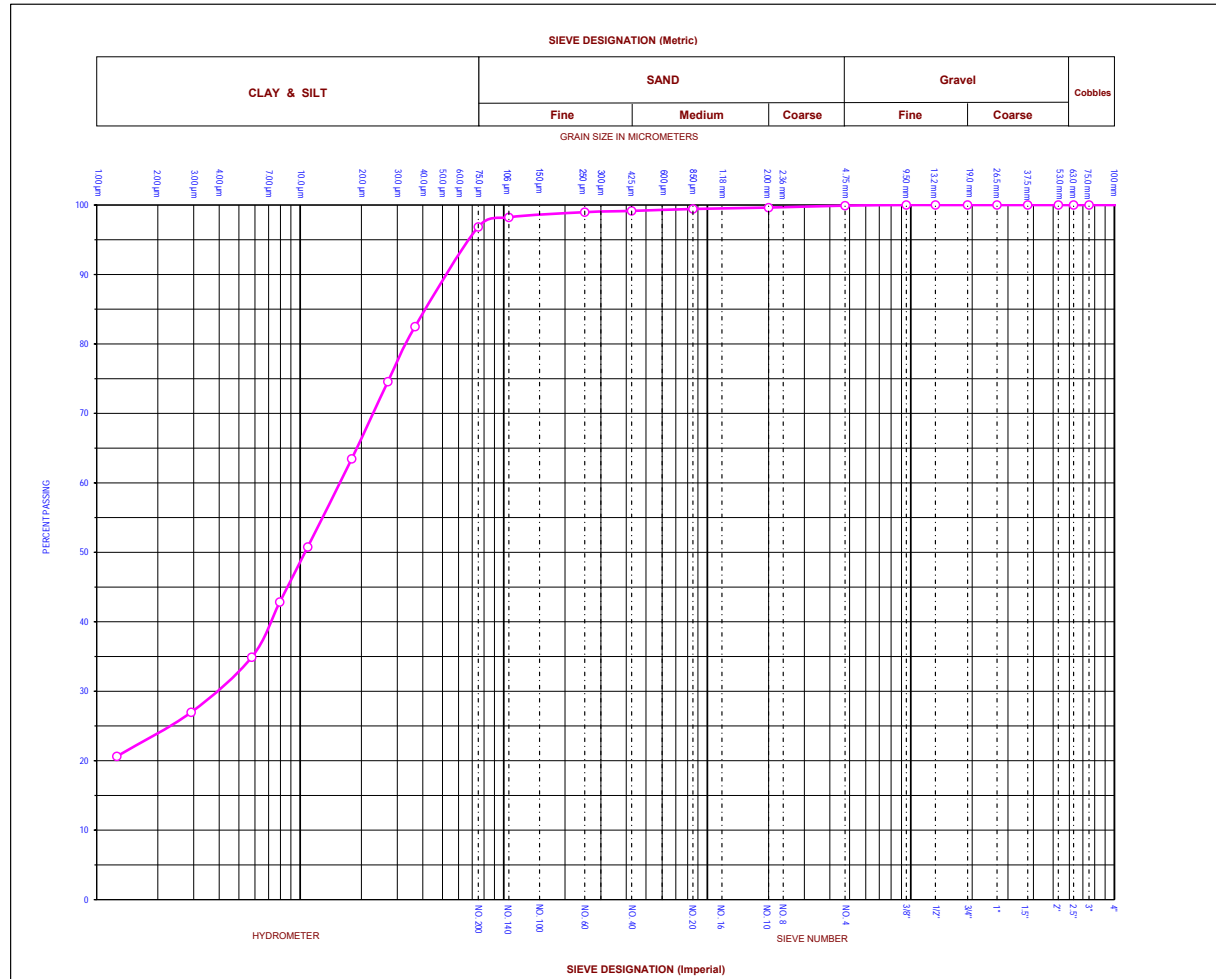
Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	9:37:00 AM	1.0	1.0290	0.0030	25.3	1.0260	82.5	8.38	8.91247	0.01266879	0.0367
	9:38:00 AM	2.0	1.0265	0.0030	25.3	1.0235	74.6	9.06	8.91247	0.01266879	0.0270
	9:41:00 AM	5.0	1.0230	0.0030	25.3	1.0200	63.5	10.00	8.91247	0.01266879	0.0179
	9:51:00 AM	15.0	1.0190	0.0030	25.3	1.0160	50.8	11.08	8.91247	0.01266879	0.0109
	10:06:00 AM	30.0	1.0165	0.0030	25.2	1.0135	42.8	11.76	8.93243	0.01268297	0.0079
	10:36:00 AM	60.0	1.0140	0.0030	25.1	1.0110	34.9	12.43	8.95247	0.01269719	0.0058
2-Feb-22	1:46:00 PM	250.0	1.0115	0.0030	24.9	1.0085	27.0	13.11	8.99279	0.01272575	0.0029
	9:36:00 AM	1440.0	1.0095	0.0030	23.6	1.0065	20.6	13.65	9.26294	0.01291548	0.0013

L1 cm	Viscosity	
	C	K
2.43	-0.505144	5.2426281
3.11	-0.505144	5.2426281
4.05	-0.505144	5.2426281
5.13	-0.505144	5.2426281
5.81	-0.502906	5.25437
6.48	-0.500665	5.2661586
7.15	-0.496171	5.2898775
7.69	-0.466574	5.448787

Mass Retained on Sieve # 10	76.07
Mass Passed Sieve # 10	274.03
Jar Number	

Hygroscopic Data	Can Id	84
	Empty Can Weight (g)	13.53
	Can+ Air Dried Soil (g)	32.65
	Can + Oven Dried Soil (g)	32.60

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 31, 2022	Project Number	60637047	Gravel (%)	0			
	Sample ID	BH-15 SSS	Depth (feet)	7.5-9.5	Project Name	Glancaster Road Improvements	Sand (%)	3			
	Lab Sample No:	2022021045			Project Location	Hamilton, Ontario	Silt (%)	74			
	Soil Classification	Lean Clay, trace sand (CL)					Clay (%)	23			
	Figure No.		D10	N/A	D30	0.004	D60	0.016	Cu	N/A	Cc

Hydrometer Analysis

Lab No	202202105S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-16	Tested by	Dharmik/IAN
Sample Id	SS5	Reviewed by	Ramana M
Depth (feet)	7.5-9.5	Date	31-Jan-22
Soil Classification	Lean Clay, trace sand (CL)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information	
Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	410.2 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details	
Volume of Bulb (V _b)	61.1 cm ³
Length of Bulb (L _b)	14.44 cm
Length from '1.0' reading to top of Bulb (L _s)	10.17 cm
Scale Dimension (hs)	0.27 cm/Div
Cross-sectional Area of Cylinder (A)	28.3535 cm ²
Meniscus Correction (Hm)	0.0005 Divisions

Calculation of Dry Soil Mass	
Oven Dried Mass (W _o)	12.1 g
Air Dried Mass (W _a)	12.16 g
Hygroscopic Corr Factor (F)	0.995
Air Dried Mass in Analysis (M _a)	50 g
Oven Dried Mass in Analysis (M _o)	49.8 g
% Passing 2.0 mm Sieve (P ₁₀)	99.4
Sample Represented (W)	50.1 g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	1.2	409.0	99.7
2.0	2.5	407.7	99.4

Sieve Analysis of Hydrometer Material (M7)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.8	99.4
0.850	0.1	49.7	99.2
0.425	0.2	49.6	99.0
0.25	0.3	49.5	98.8
0.106	1.1	48.7	97.2
0.075	2.0	47.7	95.3
Pass 0.075	0.4		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{ [(30 * \eta) / (980 * (Gs - Gw))] * (L/T) \} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L2 - Vb / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	9:46:00 AM	1.0	1.0290	0.0030	25.8	1.0260	82.5	8.57	8.81384	0.0125985	0.0369
	9:47:00 AM	2.0	1.0260	0.0030	25.8	1.0230	73.0	9.38	8.81384	0.0125985	0.0273
	9:50:00 AM	5.0	1.0220	0.0030	25.7	1.0190	60.3	10.46	8.83341	0.01261248	0.0182
	10:00:00 AM	15.0	1.0185	0.0030	25.6	1.0155	49.2	11.41	8.85306	0.0126265	0.0110
	10:15:00 AM	30.0	1.0160	0.0030	25.5	1.0130	41.3	12.08	8.87278	0.01264055	0.0080
	10:45:00 AM	60.0	1.0135	0.0030	25.3	1.0105	33.3	12.76	8.91247	0.01266879	0.0058
2-Feb-22	1:55:00 PM	250.0	1.0110	0.0030	24.9	1.0080	25.4	13.43	8.99279	0.01272575	0.0029
	9:45:00 AM	1440.0	1.0090	0.0030	23.6	1.0060	19.0	13.97	9.26294	0.01291548	0.0013

L1 cm	Viscosity		K (η/(Gs-1))
	C		
2.43	-0.516271		5.1846127
3.24	-0.516271		5.1846127
4.32	-0.514053		5.1961241
5.27	-0.511832		5.2076811
5.94	-0.509606		5.2192839
6.61	-0.505144		5.2426281
7.29	-0.496171		5.2898775
7.83	-0.466574		5.448787

Mass Retained on Sieve # 10	30.87
Mass Passed Sieve # 10	379.29
Jar Number	

Hygroscopic Data	Can Id	187
	Empty Can Weight (g)	13.48
	Can+ Air Dried Soil (g)	25.64
	Can + Oven Dried Soil (g)	25.58

Hydrometer Analysis

Lab No	202202106S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-17	Tested by	Dharmik/IAN
Sample Id	SS3	Reviewed by	Ramana M
Depth (feet)	3-5	Date	31-Jan-22
Soil Classification	Silt, some clay, trace sand (ML)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information

Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	246.9 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details

Volume of Bulb (V _b)	61.1	cm ³
Length of Bulb (L _b)	14.44	cm
Length from '1.0' reading to top of Bulb (L _s)	10.17	cm
Scale Dimension (hs)	0.27	cm/Div
Cross-sectional Area of Cylinder (A)	28.3535	cm ²
Meniscus Correction (Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass (W _o)	12.29	g
Air Dried Mass (W _a)	12.32	g
Hygroscopic Corr Factor (F)	0.998	
Air Dried Mass in Analysis (M _a)	50	g
Oven Dried Mass in Analysis (M _o)	49.9	g
% Passing 2.0 mm Sieve (P ₁₀)	99.2	g
Sample Represented (W)	50.3	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	0.9	245.9	99.6
2.0	2.0	244.9	99.2

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.9	99.2
0.850	0.1	49.7	98.9
0.425	0.3	49.6	98.7
0.25	0.4	49.5	98.4
0.106	1.8	48.1	95.7
0.075	3.5	46.4	92.2
Pass 0.075	3.2		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{ [(30 \cdot \eta) / (980 \cdot (Gs - Gw))] \cdot (L/T) \} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L₂ - V_b / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	10:19:00 AM	1.0	1.0285	0.0030	26.5	1.0255	80.5	8.71	8.67899	0.01250175	0.0369
	10:20:00 AM	2.0	1.0260	0.0030	26.5	1.0230	72.6	9.38	8.67899	0.01250175	0.0271
	10:23:00 AM	5.0	1.0215	0.0030	26.4	1.0185	58.4	10.60	8.69803	0.01251545	0.0182
	10:33:00 AM	15.0	1.0165	0.0030	26.2	1.0135	42.6	11.95	8.73633	0.01254298	0.0112
	10:48:00 AM	30.0	1.0140	0.0030	26.0	1.0110	34.7	12.62	8.77493	0.01257066	0.0082
	11:18:00 AM	60.0	1.0115	0.0030	25.9	1.0085	26.8	13.30	8.79435	0.01258456	0.0059
2-Feb-22	2:28:00 PM	250.0	1.0095	0.0030	25.2	1.0065	20.5	13.84	8.93243	0.01268297	0.0030
	10:18:00 AM	1440.0	1.0080	0.0030	24.0	1.0050	15.8	14.24	9.17830	0.01285634	0.0013

L1 cm	Viscosity C	K (η/(Gs-1))
2.57	-0.531689	5.1052883
3.24	-0.531689	5.1052883
4.45	-0.529498	5.1164875
5.81	-0.525104	5.1390178
6.48	-0.520695	5.1617255
7.15	-0.518485	5.1731466
7.69	-0.502906	5.25437
8.10	-0.475753	5.3989998

Mass Retained on Sieve # 10	31.87
Mass Passed Sieve # 10	214.98
Jar Number	

Hygroscopic Data

Can Id	176
Empty Can Weight (g)	13.46
Can+ Air Dried Soil (g)	25.78
Can + Oven Dried Soil (g)	25.75

Hydrometer Analysis

Lab No	202202107S
Project Name	Glancaster Road Improvements
Project Number	60637047
Location	Hamilton, Ontario

Borehole No	BH-18	Tested by	Dharmik/IAN
Sample Id	SS4	Reviewed by	Ramana M
Depth (feet)	5-7	Date	31-Jan-22
Soil Classification	Silt, some clay, trace sand (ML)		

Soil Hydrometer Used	
151 H SN#	993585
	115105

Soil Information	
Liquid Limit (LL)	
Plasticity Index (PI)	
Specific Gravity of Soil (Gs)	2.70
Specific Gravity of Water (Gw)	1
Sg Correction Factor (α)	0.989
Total Mass of sample	466.9 g
Soil Particles Greater Than This Are Excluded From Graph	9.50 mm

Hydrometer Details	
Volume of Bulb (V _b)	63.1 cm ³
Length of Bulb (L _b)	14.15 cm
Length from '1.0' reading to top of Bulb (L _s)	10.5 cm
Scale Dimension (hs)	0.27 cm/Div
Cross-sectional Area of Cylinder (A)	28.1351 cm ²
Meniscus Correction (Hm)	0.0005 Divisions

Calculation of Dry Soil Mass	
Oven Dried Mass (W _o)	13.76 g
Air Dried Mass (W _a)	13.83 g
Hygroscopic Corr Factor (F)	0.995
Air Dried Mass in Analysis (M _a)	50 g
Oven Dried Mass in Analysis (M _o)	49.7 g
% Passing 2.0 mm Sieve (P ₁₀)	99.6
Sample Represented (W)	49.9 g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	1.2	465.7	99.7
2.0	1.7	465.3	99.6

Sieve Analysis of Hydrometer Material (M7)			
Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.7	99.6
0.850	0.1	49.6	99.4
0.425	0.2	49.5	99.2
0.25	0.4	49.4	98.9
0.106	1.0	48.8	97.7
0.075	1.7	48.1	96.3
Pass 0.075	0.4		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

$$P = [(100000/W) * (Gs/(Gs - Gw))] * (R - Gw) \text{ in percent (for Soil Hydrometer 151 H)}$$

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc = Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

$$D = \text{SQRT of } \{ [(30 \cdot \eta) / (980 \cdot (Gs - Gw))] \cdot (L/T) \} \text{ in mm}$$

Where η = Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1 + 0.5 * [L2 - Vb / A] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elapsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Feb-22	10:02:00 AM	1.0	1.0255	0.0030	25.9	1.0225	71.6	9.33	8.79435	0.01258456	0.0384
	10:03:00 AM	2.0	1.0220	0.0030	25.9	1.0190	60.4	10.27	8.79435	0.01258456	0.0285
	10:06:00 AM	5.0	1.0170	0.0030	25.8	1.0140	44.5	11.62	8.81384	0.0125985	0.0192
	10:16:00 AM	15.0	1.0125	0.0030	25.6	1.0095	30.2	12.84	8.85306	0.0126265	0.0117
	10:31:00 AM	30.0	1.0100	0.0030	25.6	1.0070	22.3	13.51	8.85306	0.0126265	0.0085
	11:01:00 AM	60.0	1.0080	0.0030	25.4	1.0050	15.9	14.05	8.89259	0.01265465	0.0061
2-Feb-22	2:11:00 PM	250.0	1.0070	0.0030	25.2	1.0040	12.7	14.32	8.93243	0.01268297	0.0030
	10:01:00 AM	1440.0	1.0060	0.0030	24.0	1.0030	9.5	14.59	9.17830	0.01285634	0.0013

L1 cm	Viscosity		K (η/(Gs-1))
	C		
3.37	-0.518485		5.1731466
4.32	-0.518485		5.1731466
5.67	-0.516271		5.1846127
6.89	-0.511832		5.2076811
7.56	-0.511832		5.2076811
8.10	-0.507377		5.2309329
8.37	-0.502906		5.25437
8.64	-0.475753		5.3989998

Mass Retained on Sieve # 10	25.22
Mass Passed Sieve # 10	441.72
Jar Number	

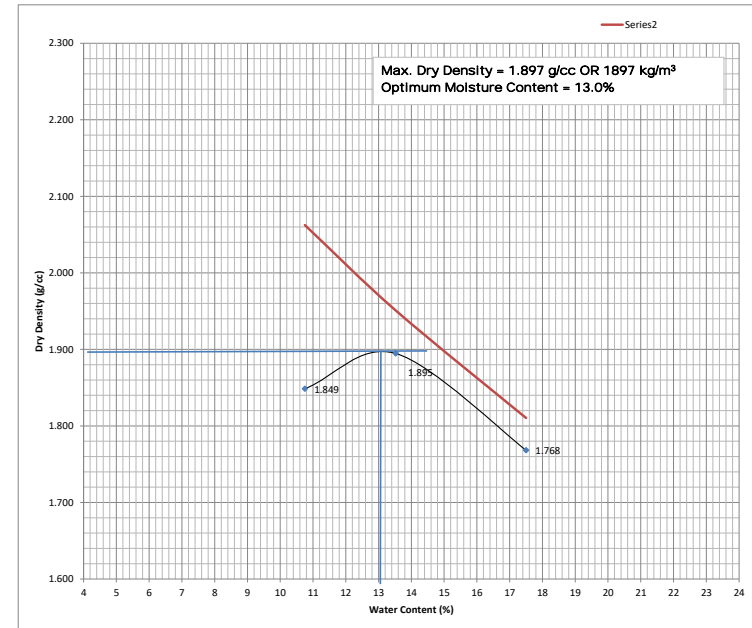
Hygroscopic Data	Can Id	115
	Empty Can Weight (g)	13.66
	Can+ Air Dried Soil (g)	27.49
	Can + Oven Dried Soil (g)	27.42

- **Standard Proctor Test**

PROCTOR TEST - METHOD A

Client	AECOM	Project Number	60637047		Date	February 3, 2022
Project name	Glancaster Rd Improvements				Tested by	Ian P
Location	Hamilton, Ontario				Reviewed by	Ramana M
Sample Location		Sample Id	Combined BH 1,3,4,6,7,8,12,14, 18	Lab#	202202108S	
Grain Specific Gravity (Assumed)	2.65		% Air Voids (n _a)	0	Unit Weight of Water (g/cc)	1
Height of Mould (cm)	11.65	Dia of Mould (cm)	10.15	Volume of the Mould (cc) V		
Weight of Empty Mould with base Plate (g) W ₁			4149.2	Weight of Dry Soil taken (g) W _s		
Description	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
Weight of Mould with base Plate + compacted soil(g) W ₂	6079.3	6177	6108			
Weight of Water added (g) W _w	200	263	325.7			
Weight of Compacted soil in mould (g) W	1930.1	2027.8	1958.8			
Bulk Unit Weight (g/cc)	2.047	2.151	2.078			
Dry Unit Weight (g/cc)	1.849	1.895	1.768			
Dry Unit Weight at ZAV (g/cc)	2.06	1.95	1.81			
Moisture Content Determination						
Container Number	231	222	238			
Weight of Empty Container (g) W ₃	32.1	31.9	32			
Weight of Container + Wet Soil (g) W ₄	101	101.6	113.9			
Weight of Container + Dry Soil (g) W ₅	94.31	93.3	101.7			
Water Content (%) w	10.75	13.52	17.5			

Weight of Compacted Soil W = W₂ - W₁ g
 Bulk Unit Weight = W/V
 Water Content
 = ((W₄-W₅) / (W₅-W₃)) * 100
 Dry Unit Weight
 = Bulk Unit Weight / (1+ water content)
 Dry Unit Weight at Zero Air Voids (ZAV)
 = ((1-n_a) * Unit weight of Water * Sp. Gravity of Soils) / (1 - Water content * sp. Gravity of soils)



- **California Bearing Ratio Test**

CBR COMPUTATION SHEET

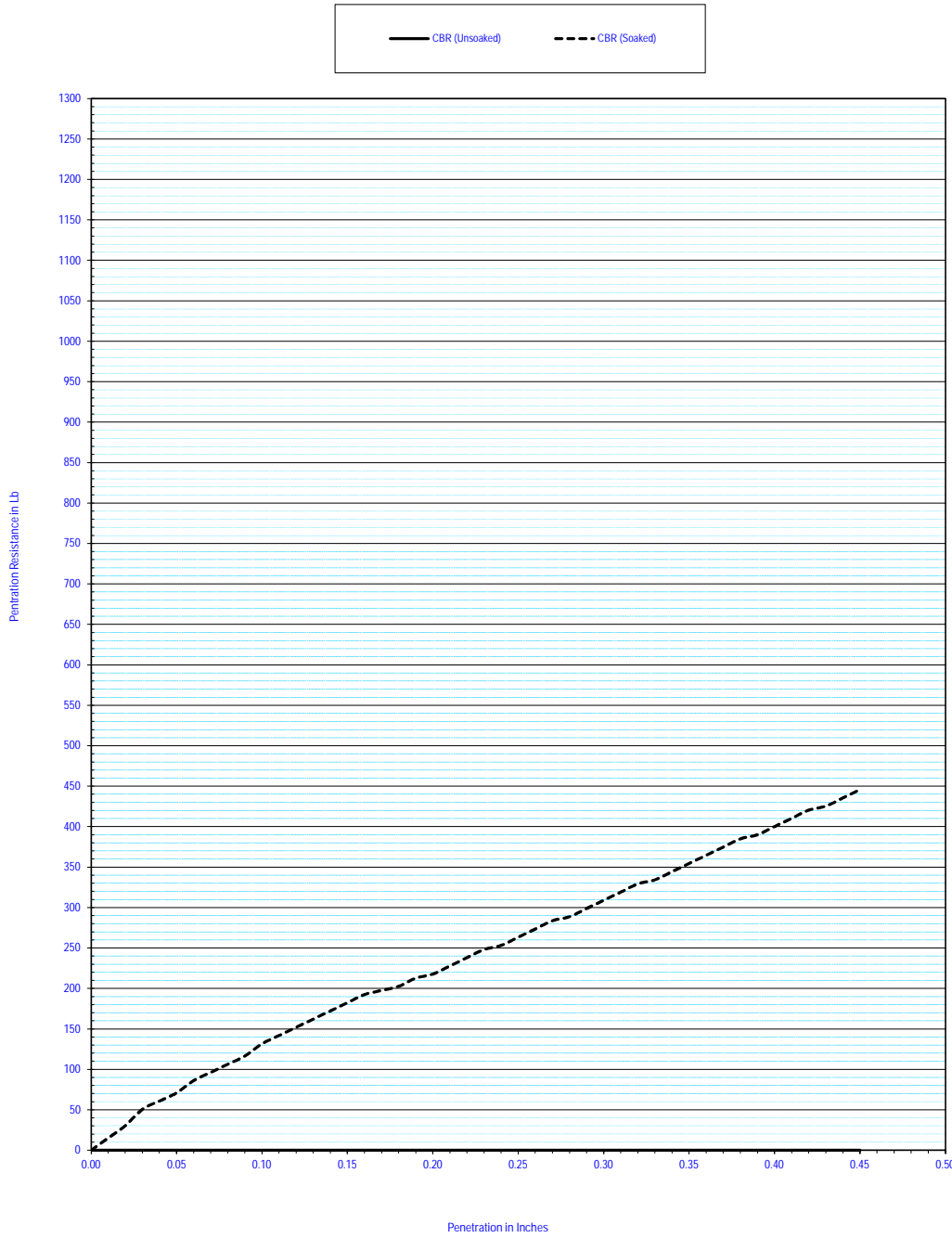


Project No:		60637047		Lab No:		202202108S	
Project Name:		Glancaster Road Improvements		Borehole:		1,3,4,6,7,8,12,14,18(COMBINED)	
Client:		AECOM		Sample:		Combined Sample	
Location:		Hamilton, Ontario		Depth:		1.0 m	
MDD kg/m ³ :		1.897		OMC %		13	
Penetration Dial Constant (inch)		0.001	Proving Ring Constant (lbf/0.0001")			10.13	
		Date	Feb 4,2022	Date	February 8, 2022		
		UNSOAKED			SOAKED		
Penetrometer Reading	Penetration (inch)	Proving Ring Reading (X0.0001")	Penetration Resistance	Proving Ring Reading (X0.0001")	Penetration Resistance		
0	0		0	0	0		
10	0.01		0	1.5	15.195		
20	0.02		0	3	30.39		
30	0.03		0	5	50.65		
40	0.04		0	6	60.78		
50	0.05		0	7	70.91		
60	0.06		0	8.5	86.105		
70	0.07		0	9.5	96.235		
80	0.08		0	10.5	106.365		
90	0.09		0	11.5	116.495		
100	0.1		0	13	131.69		
110	0.11		0	14	141.82		
120	0.12		0	15	151.95		
130	0.13		0	16	162.08		
140	0.14		0	17	172.21		
150	0.15		0	18	182.34		
160	0.16		0	19	192.47		
170	0.17		0	19.5	197.535		
180	0.18		0	20	202.6		
190	0.19		0	21	212.73		
200	0.2		0	21.5	217.795		
210	0.21		0	22.5	227.925		
220	0.22		0	23.5	238.055		
230	0.23		0	24.5	248.185		
240	0.24		0	25	253.25		
250	0.25		0	26	263.38		
260	0.26		0	27	273.51		
270	0.27		0	28	283.64		
280	0.28		0	28.5	288.705		
290	0.29		0	29.5	298.835		
300	0.3		0	30.5	308.965		
310	0.31		0	31.5	319.095		
320	0.32		0	32.5	329.225		
330	0.33		0	33	334.29		

340	0.34		0	34	344.42
350	0.35		0	35	354.55
360	0.36		0	36	364.68
370	0.37		0	37	374.81
380	0.38		0	38	384.94
390	0.39		0	38.5	390.005
400	0.4		0	39.5	400.135
410	0.41		0	40.5	410.265
420	0.42		0	41.5	420.395
430	0.43		0	42	425.46
440	0.44		0	43	435.59
450	0.45		0	44	445.72
Sample Height (Inches)	4.6	Swell (Inches)	0.022	Swell (%)	0.48

AECOM CANADA LTD.

CALIFORNIA BEARING RATIO TEST



SAMPLE DETAILS

Lab No. : 202202108S
Project No. : 60637047
Project Name : 202202108S
Borehole : 3H-1,3,4,6,7,8,12,14,18(COMBINED)
Sample : Combined Sample
Depth : 1.0 m

CBR TEST RESULTS

Unsoaked CBR Value (%) : 0
Soaked CBR Value (%) : 4
Swell (%) : 0.5
Standard Proctor Density (kg/m³) : 1.897
OMC (%) : 13

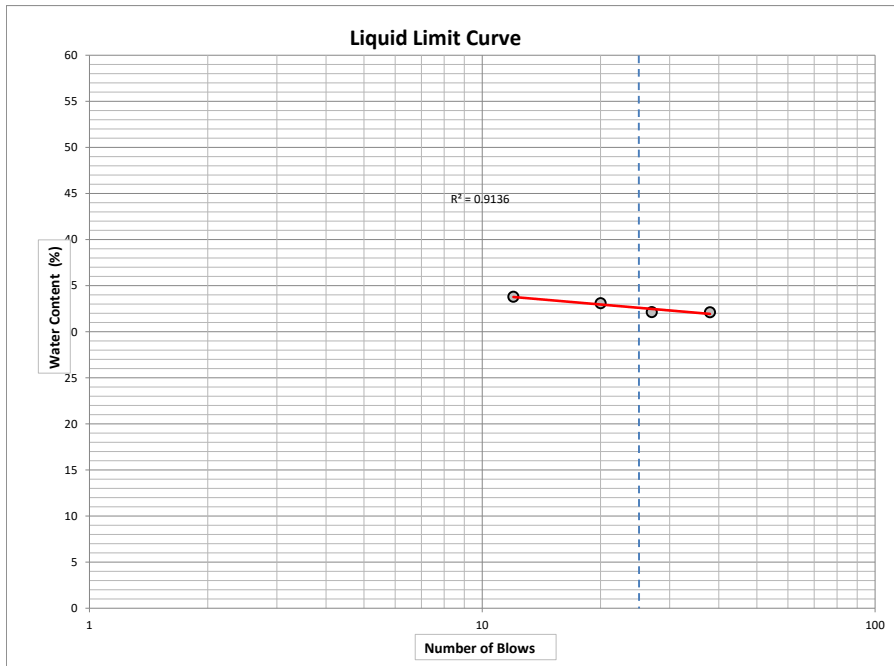
AECOM CANADA LTD.
83 GALAXY BLVD, UNIT 6
TORONTO, ONTARIO
M9W 5X6

Client:	AECOM
Project Name:	Glancaester Road Improvements
Location:	Hamilton, Ontario
Date:	February 8, 2022



- **Atterberg Limits**

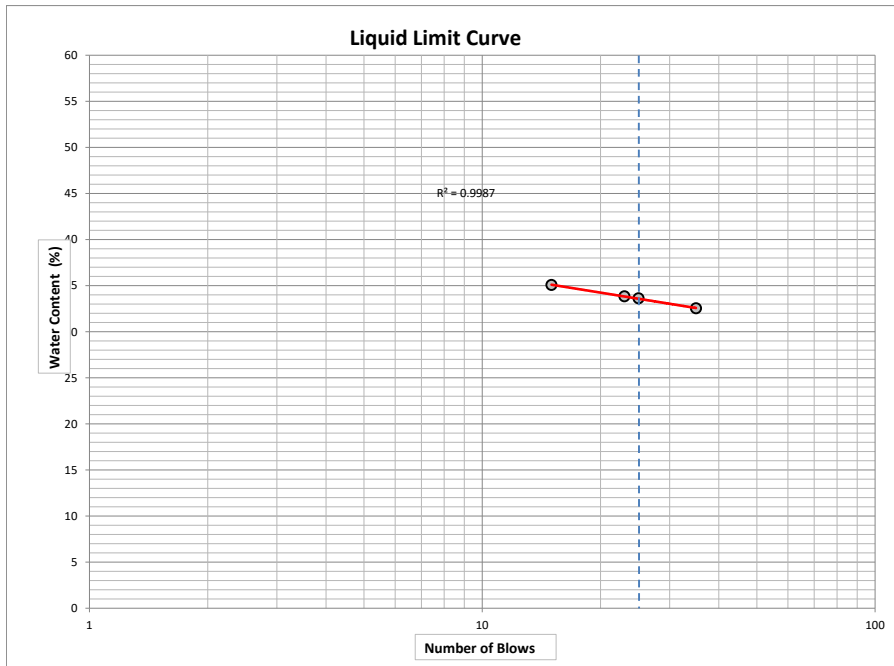
AECOM CANADA LTD.		AECOM					
DETERMINATION OF LIQUID LIMIT							
Client	AECOM	Project Number	60637047		Date	December 1, 2022	
Project Name					Tested By		
Location	Glancaster Rd				Reviewed By	Ramana M	
Borehole Number	BH 11	Sample Id	SS4	Depth (feet)	5-7	Lab Number	202202099S
Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Container Number		184	161	94	68		
Weight of Empty Container (g) W_1		13.53	13.37	13.51	13.45		
Weight of Container + Wet Soil (g) W_2		30.15	27.81	29.86	27.52		
Weight of Container + Dry Soil(g) W_3		26.11	24.30	25.73	24.02		
Weight of Water (g) W_w	$W_w = W_2 - W_3$	4.04	3.51	4.13	3.50		
Weight of Dry Soil (g) W_s	$W_s = W_3 - W_1$	12.58	10.93	12.23	10.57		
Water Content (%)	$w = (W_w / W_s) * 100$	32.13	32.12	33.80	33.09		
Number of Blows		27	38	12	20		
Liquid Limit (%) From Graph		32.6					



AECOM CANADA LTD. AECOM							
DETERMINATION OF PLASTIC LIMIT							
Client	AECOM	Project Number	60637047	Date	December 1, 2022		
Project Name	0			Tested By	0		
Location	Glancaster Rd			Reviewed By	Ramana M		
Borehole Number	BH 11	Sample Id	SS4	Depth (feet)	5-7	Lab Number	202202099S
Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Container Number		131	80	61			
Weight of Empty Container (g) W_1		13.621	13.64	13.45			
Weight of Container + Wet Soil (g) W_2		20.363	20.18	22.63			
Weight of Container + Dry Soil(g) W_3		19.22	19.06	21.11			
Weight of Water (g) W_w	$W_w = W_2 - W_3$	1.14	1.12	1.52			
Weight of Dry Soil (g) W_s	$W_s = W_3 - W_1$	5.60	5.42	7.66			
Plastic Limit (%)	$w = (W_w / W_s) * 100$	20.41	20.72	19.88			
Average Plastic Limit (%) w_p		20.34					

Result Summary	
Liquid Limit (%)	33
Plastic Limit (%)	20
Plasticity Index (%)	13
Sample status	Plastic

AECOM CANADA LTD.		AECOM					
DETERMINATION OF LIQUID LIMIT							
Client	AECOM	Project Number	60637047		Date	December 1, 2022	
Project Name	Glancaster Road Improvements				Tested By		
Location	Hamilton, Ontario				Reviewed By	Ramana M	
Borehole Number	BH 7	Sample Id	SS4	Depth (feet)	5-7	Lab Number	202202095S
Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Container Number		66	92	156	156		
Weight of Empty Container (g) W_1		13.40	13.47	13.49	13.59		
Weight of Container + Wet Soil (g) W_2		21.41	23.99	19.65	20.64		
Weight of Container + Dry Soil(g) W_3		19.33	21.33	18.10	18.91		
Weight of Water (g) W_w	$W_w = W_2 - W_3$	2.08	2.66	1.55	1.73		
Weight of Dry Soil (g) W_s	$W_s = W_3 - W_1$	5.93	7.86	4.61	5.32		
Water Content (%)	$w = (W_w / W_s) * 100$	35.08	33.84	33.62	32.54		
Number of Blows		15	23	25	35		
Liquid Limit (%) From Graph		33.6					



AECOM CANADA LTD. AECOM							
DETERMINATION OF PLASTIC LIMIT							
Client	AECOM	Project Number	60637047	Date	December 1, 2022		
Project Name	Glancaster Road Improvements			Tested By	0		
Location	Hamilton, Ontario			Reviewed By	Ramana M		
Borehole Number	BH 7	Sample Id	SS4	Depth (feet)	5-7	Lab Number	202202095S
Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Container Number		96	74	93			
Weight of Empty Container (g) W_1		13.49	13.66	13.43			
Weight of Container + Wet Soil (g) W_2		15.45	15.64	15.84			
Weight of Container + Dry Soil(g) W_3		15.1	15.30	15.42			
Weight of Water (g) W_w	$W_w = W_2 - W_3$	0.35	0.34	0.42			
Weight of Dry Soil (g) W_s	$W_s = W_3 - W_1$	1.61	1.64	1.99			
Plastic Limit (%)	$w = (W_w / W_s) * 100$	21.74	20.73	21.11			
Average Plastic Limit (%) w_p		21.19					

Result Summary	
Liquid Limit (%)	34
Plastic Limit (%)	21
Plasticity Index (%)	13
Sample status	Plastic

- **Grain Size Test Results**

Client	AECOM	Borehole No	BH-12	Lab No	2022021005
Project Number	60663072	Sample ID	AS1 + SS2	Date	January 28-2022
Project Name				Depth (Feet)	0-3
Location	GLANCASTER ROAD			Tested by	Ian/Sam
Soil Classification	Silty Sand with Gravel (SM)			Reviewed by	Ramona M

Total Sample Mass (A) g	689.7	% Coarse Aggregate (D)	24.0	% Fine Aggregate (E)	76.0
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COARSE AGGREGATE					
Sieve (mm)	Individual Mass Retained (g)	Cumulative Mass Retained (g) [X]	Coarse Aggregate Portion Only		% Passing (Total Sample)
			% Retained	% Passing	
106				100.0	100.0
75.0				100.0	100.0
63.0				100.0	100.0
53.0				100.0	100.0
37.5				100.0	100.0
26.5				100.0	100.0
22.4				100.0	100.0
19.0				100.0	100.0
16.0	23.4	23.4	14.1	85.9	96.6
13.2		23.4	14.1	85.9	96.6
9.5	34.2	57.6	34.8	65.2	91.6
6.7	50.2	107.8	65.2	34.8	84.4
4.75	57.5	165.4	100.0		76.0
Pan	16.0	Pan + [B]	Mass Passing 4.75 mm (g) [C = A-B]		524.3

FINE AGGREGATE			
Sample Mass before washing (g) [F]	224.79	Mass passing 75 µm sieve by washing (g)	69.56
Sample Mass after washing (g)	155.23	Mass passing 75 µm sieve by sieving (g)	1.48

Sieve (mm)	Cumulative Mass Retained (g) [Y]	Fine Aggregate Portion Only		% Passing (Total Sample)
		% Retained	% Passing	
4.75	2.93	1.3	98.7	75.03
2.36	52.03	23.1	76.9	58.43
1.18	90.08	40.1	59.9	45.56
0.600	114.99	51.2	48.8	37.13
0.425	124.51	55.4	44.6	33.91
0.300	131.76	58.6	41.4	31.46
0.150	142.49	63.4	36.6	27.83
0.075	153.75	68.4	31.6	24.03
Pan	1.48	Total Mass passing 75 µm sieve (g)	71.04	

Calculations:

D = (B/A) * 100
 E = (C/A) * 100

Coarse Aggregate Portion:
 % Retained = (X/B) * 100
 % Passing = ((B-X)/B) * 100

Fine Aggregate Portion:
 % Retained = (Y/F) * 100
 % Passing = ((F-Y)/F) * 100

Total Mass Calculations

% Retained on Coarse Aggregate Sieves = (X/A) * 100

% Retained on Fine Aggregate Sieves = (Y/F) * E + % Ret. 4.75

% Passing Coarse Aggregate Sieves = ((A - X)/A) * 100

% Passing on Fine Aggregate Sieves = ((F - Y)/F) * E

Client	AECOM	Borehole No	BH-7	Lab No	2022020945
Project Number	60663072	Sample ID	AS1 + SS2A	Date	January 28-2022
Project Name				Depth (Feet)	0-3
Location	GLANCASTER ROAD			Tested by	Ian/Sam
Soil Classification	Silty Sand with Gravel (SM)			Reviewed by	Ramona M

Total Sample Mass (A) g	647.2	% Coarse Aggregate (D)	29.0	% Fine Aggregate (E)	71.0
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COARSE AGGREGATE					
Sieve (mm)	Individual Mass Retained (g)	Cumulative Mass Retained (g) [X]	Coarse Aggregate Portion Only		% Passing (Total Sample)
			% Retained	% Passing	
106				100.0	100.0
75.0				100.0	100.0
63.0				100.0	100.0
53.0				100.0	100.0
37.5				100.0	100.0
26.5				100.0	100.0
22.4				100.0	100.0
19.0				100.0	100.0
16.0	3.5	3.5	1.9	98.1	99.5
13.2	24.3	27.8	14.8	85.2	95.7
9.5	29.5	57.3	30.6	69.4	91.1
6.7	61.8	119.1	63.6	36.4	81.6
4.75	68.3	187.5	100.0		71.0
Pan	13.3	Pan + [B]	Mass Passing 4.75 mm (g) [C = A-B]		459.7

FINE AGGREGATE			
Sample Mass before washing (g) [F]	231.38	Mass passing 75 µm sieve by washing (g)	52.78
Sample Mass after washing (g)	178.6	Mass passing 75 µm sieve by sieving (g)	1.58

Sieve (mm)	Cumulative Mass Retained (g) [Y]	Fine Aggregate Portion Only		% Passing (Total Sample)
		% Retained	% Passing	
4.75			100.0	71.03
2.36	51.98	22.5	77.5	55.08
1.18	92.46	40.0	60.0	42.65
0.600	121.16	52.4	47.6	33.83
0.425	133.93	57.9	42.1	29.92
0.300	143.99	62.2	37.8	26.83
0.150	160.69	69.4	30.6	21.70
0.075	177.02	76.5	23.5	16.69
Pan	1.58	Total Mass passing 75 µm sieve (g)	54.36	

Calculations:

D = (B/A) * 100
 E = (C/A) * 100

Coarse Aggregate Portion:
 % Retained = (X/B) * 100
 % Passing = ((B-X)/B) * 100

Fine Aggregate Portion:
 % Retained = (Y/F) * 100
 % Passing = ((F-Y)/F) * 100

Total Mass Calculations

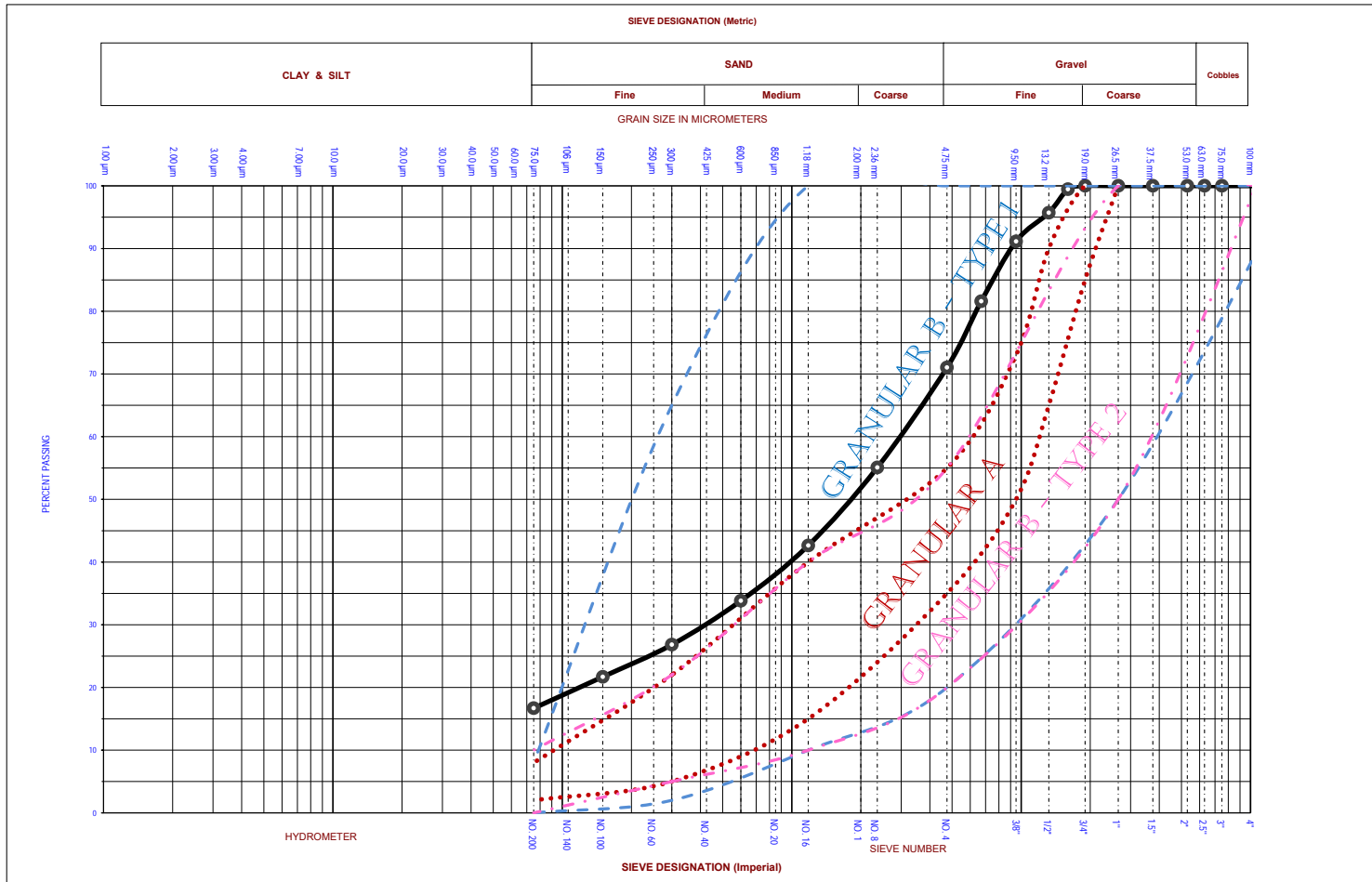
% Retained on Coarse Aggregate Sieves = (X/A) * 100

% Retained on Fine Aggregate Sieves = (Y/F) * E + % Ret. 4.75

% Passing Coarse Aggregate Sieves = ((A - X)/A) * 100

% Passing on Fine Aggregate Sieves = ((F - Y)/F) * E

UNIFIED SOIL CLASSIFICATION SYSTEM

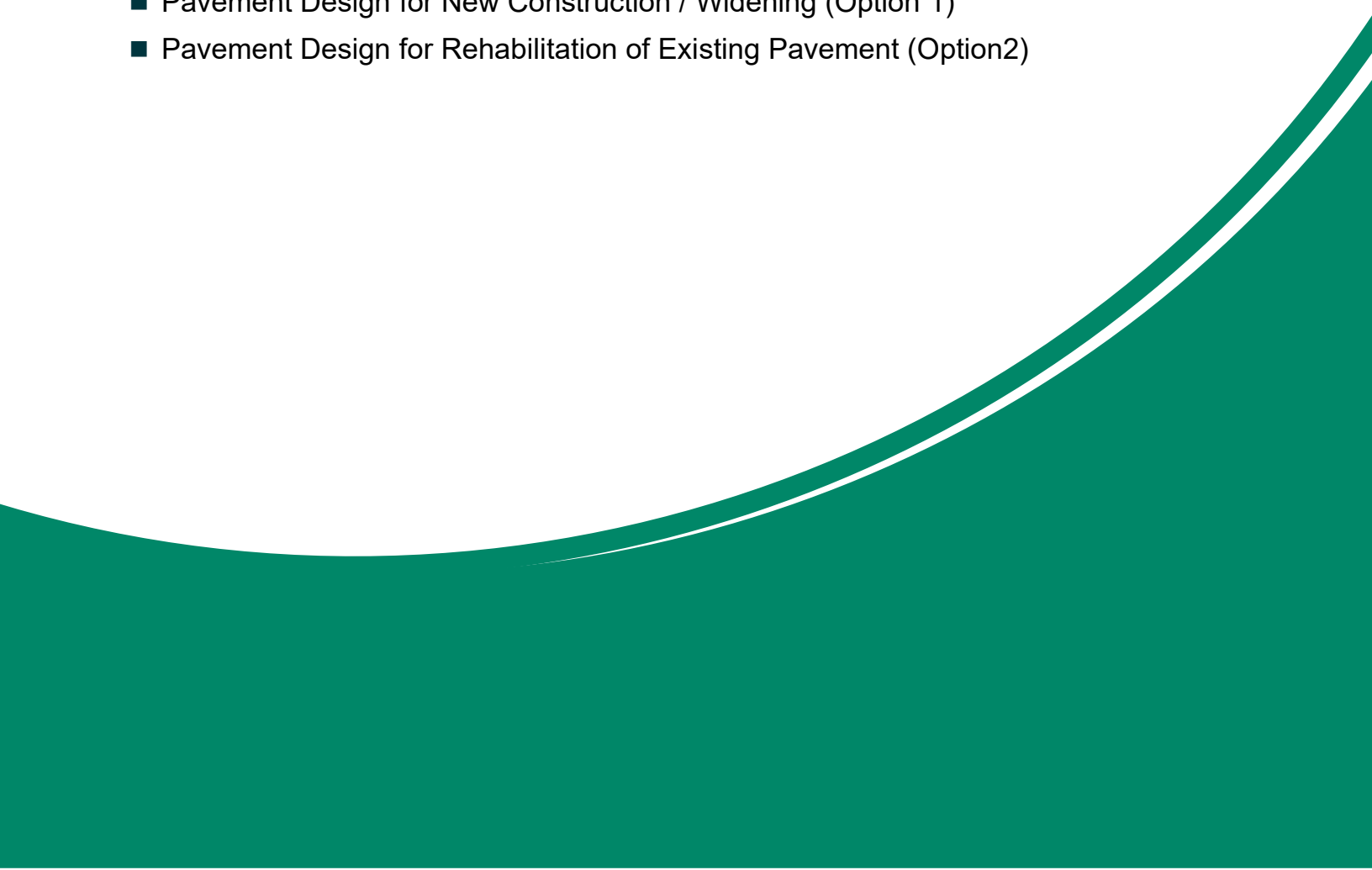


GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM	Date	January 28-2022	Project Number	60663072									
	Borehole No / Sample Id	BH-7 AS1 + SS2A	Depth (feet)	0-3	Lab No	202202094S									
	Project Name				Project Location	GLANCASTER ROAD									
	Soil Classification	Silty Sand with Gravel (SM)				Figure No:									
Gravel(%)	29	Sand(%)	54	Fines(%)	17	D_{60} (mm)	3.098	D_{30} (mm)	0.436	D_{10} (mm)	N/A	C_u	N/A	C_c	N/A

Appendix **D**

Pavement Design Outputs

- Traffic Analysis
 - Pavement Design for New Construction / Widening (Option 1)
 - Pavement Design for Rehabilitation of Existing Pavement (Option2)
- 

WinPAS

Pavement Thickness Design According to
1993 AASHTO Guide for Design of Pavements Structures
 American Concrete Pavement Association

Flexible Design Inputs

Project Name: Glancaster Road – MCEA
 Route: Glancaster Road from Garner Road to Dickenson Road
 Location:
 Owner/Agency: City of Hamilton
 Design Engineer:

Option 1 – Full Depth Reconstruction/Road Widening

Flexible Pavement Design/Evaluation

Structural Number	137.70	Subgrade Resilient Modulus	28.00 MPa
Total Flexible ESALs	2,656,483	Initial Serviceability	4.40
Reliability	85.00 percent	Terminal Serviceability	2.20
Overall Standard Deviation	0.49		

Layer Pavement Design/Evaluation

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
Asphalt Cement Concrete	0.42	1.00	160.00	67.20
Crushed Stone Base	0.14	1.00	150.00	21.00
Granular Subbase	0.11	1.00	450.00	49.50
			Σ SN	137.70

WinPAS

Pavement Thickness Design According to
1993 AASHTO Guide for Design of Pavements Structures
American Concrete Pavement Association

Flexible Design Inputs

Project Name: Glancaster Road – MCEA
Route: Glancaster Road from Garner Road to Dickenson Road
Location: City of Hamilton
Owner/Agency:
Design Engineer:

Option 2 - Full Depth Asphalt Removal

Flexible Pavement Design/Evaluation

Structural Number	116.82	Subgrade Resilient Modulus	28.00 MPa
Total Flexible ESALs	2,656,483	Initial Serviceability	4.40
Reliability	85.00 percent	Terminal Serviceability	2.20
Overall Standard Deviation	0.49		

Layer Pavement Design/Evaluation

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
Asphalt Cement Concrete	0.42	1.00	165.00	69.30
Crushed Stone Base	0.08	0.90	660.00	47.52
			Σ SN	116.82

Appendix **E**

Geo-Environmental Laboratory Test Results

- Laboratory Certificate of Soil Analysis

CLIENT NAME: AECOM CANADA LTD
105 COMMERCE VALLEY DR.W 7TH FLOOR
MARKHAM, ON L3T7W3
(905) 886-7022

ATTENTION TO: Arif Chowdhury
PROJECT: 60637047
AGAT WORK ORDER: 22T854911

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Lab Manager
TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

DATE REPORTED: Jan 31, 2022
PAGES (INCLUDING COVER): 11
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

***Notes**

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.



Certificate of Analysis

AGAT WORK ORDER: 22T854911

PROJECT: 60637047

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE: Hamilton

ATTENTION TO: Arif Chowdhury

SAMPLED BY: Indra

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2022-01-18

DATE REPORTED: 2022-01-31

Parameter	Unit	SAMPLE DESCRIPTION: BH14 SS3 (3'-5') BH11 SS2 (1'-3') BH9 SS2 (1'-3') BH9 SS7 (15'-17') BH15 SS3 (3'-5') BH16 SS3 (3'-5') BH18 SS3 (3'-5')									
		SAMPLE TYPE: Soil		Soil		Soil		Soil		Soil	
		DATE SAMPLED: 2022-01-10 10:00		2022-01-10 10:00		2022-01-10 10:00		2022-01-10 10:00		2022-01-07 10:00	
		G / S	RDL	3438732	3438733	3438734	3438735	3438736	3438737	3438738	
Antimony	µg/g	40	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	
Arsenic	µg/g	18	1	6	6	4	5	8	6	6	
Barium	µg/g	670	2.0	118	97.1	49.2	59.2	77.9	65.0	133	
Beryllium	µg/g	8	0.4	0.6	0.7	<0.4	<0.4	0.6	0.6	0.6	
Boron	µg/g	120	5	5	<5	8	6	7	<5	5	
Boron (Hot Water Soluble)	µg/g	2	0.10	0.43	0.24	0.45	0.13	0.14	0.22	0.23	
Cadmium	µg/g	1.9	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	
Chromium	µg/g	160	5	22	23	14	15	22	18	23	
Cobalt	µg/g	80	0.5	9.3	10.1	6.1	8.3	12.9	8.5	11.1	
Copper	µg/g	230	1.0	28.1	29.9	20.0	42.0	38.5	56.7	16.4	
Lead	µg/g	120	1	29	15	32	9	18	29	28	
Molybdenum	µg/g	40	0.5	1.0	<0.5	0.7	<0.5	0.6	0.6	0.9	
Nickel	µg/g	270	1	18	20	12	17	26	19	19	
Selenium	µg/g	5.5	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	
Silver	µg/g	40	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Thallium	µg/g	3.3	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Uranium	µg/g	33	0.50	1.17	0.66	0.69	0.56	0.61	0.61	1.46	
Vanadium	µg/g	86	0.4	33.6	35.1	21.0	23.0	32.9	29.6	37.5	
Zinc	µg/g	340	5	142	74	167	56	87	141	125	
Chromium, Hexavalent	µg/g	8	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
Cyanide, Free	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	
Mercury	µg/g	3.9	0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	
Electrical Conductivity (2:1)	mS/cm	1.4	0.005	1.78	1.77	1.42	0.433	2.54	1.62	2.91	
Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	N/A	8.55	21.1	18.5	0.701	19.7	7.82	33.1	
pH, 2:1 CaCl2 Extraction	pH Units	5.0-9.0	NA	6.97	7.14	7.36	7.07	7.16	6.89	7.11	

Certified By:





AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T854911

PROJECT: 60637047

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE: Hamilton

ATTENTION TO: Arif Chowdhury

SAMPLED BY: Indra

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2022-01-18

DATE REPORTED: 2022-01-31

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Soil - Industrial/Commercial/Community Property Use - Coarse Textured Soils
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3438732-3438738 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl₂ extract prepared at 2:1 ratio. SAR is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Amrajot Bhela



Certificate of Analysis

AGAT WORK ORDER: 22T854911

PROJECT: 60637047

5835 COOPERS AVENUE
 MISSISSAUGA, ONTARIO
 CANADA L4Z 1Y2
 TEL (905)712-5100
 FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE: Hamilton

ATTENTION TO: Arif Chowdhury

SAMPLED BY: Indra

Total PCBs (soil)

DATE RECEIVED: 2022-01-18

DATE REPORTED: 2022-01-31

Parameter	Unit	SAMPLE DESCRIPTION: BH14 SS3 (3'-5') BH11 SS2 (1'-3') BH9 SS2 (1'-3') BH9 SS7 (15'-17') BH15 SS3 (3'-5') BH16 SS3 (3'-5') BH18 SS3 (3'-5')										
		G / S	RDL	Soil			Soil			Soil		
				DATE SAMPLED: 2022-01-10 10:00			2022-01-10 10:00			2022-01-10 10:00		
				3438732	3438733	3438734	3438735	3438736	3438737	3438738		
Polychlorinated Biphenyls	µg/g	1.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Moisture Content	%		0.1	15.9	10.5	10.3	15.3	16.2	17.8	19.8		
Surrogate	Unit	Acceptable Limits										
Decachlorobiphenyl	%	60-130	76	80	80	112	92	96	80			

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Soil - Industrial/Commercial/Community Property Use - Coarse Textured Soils
 Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3438732-3438738 Results are based on the dry weight of soil extracted.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:





Exceedance Summary

AGAT WORK ORDER: 22T854911

PROJECT: 60637047

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Arif Chowdhury

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
3438732	BH14 SS3 (3'-5')	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	1.78
3438733	BH11 SS2 (1'-3')	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	1.77
3438733	BH11 SS2 (1'-3')	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	21.1
3438734	BH9 SS2 (1'-3')	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	1.42
3438734	BH9 SS2 (1'-3')	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	18.5
3438736	BH15 SS3 (3'-5')	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	2.54
3438736	BH15 SS3 (3'-5')	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	19.7
3438737	BH16 SS3 (3'-5')	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	1.62
3438738	BH18 SS3 (3'-5')	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	2.91
3438738	BH18 SS3 (3'-5')	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	33.1

Quality Assurance

CLIENT NAME: AECOM CANADA LTD
 PROJECT: 60637047
 SAMPLING SITE: Hamilton

AGAT WORK ORDER: 22T854911
 ATTENTION TO: Arif Chowdhury
 SAMPLED BY: Indra

Soil Analysis															
RPT Date: Jan 31, 2022			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE		MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - Metals & Inorganics (Soil)

Antimony	3456599		<0.8	<0.8	NA	< 0.8	132%	70%	130%	92%	80%	120%	95%	70%	130%
Arsenic	3456599		2	2	NA	< 1	116%	70%	130%	100%	80%	120%	109%	70%	130%
Barium	3456599		24.1	23.1	4.3%	< 2.0	100%	70%	130%	100%	80%	120%	106%	70%	130%
Beryllium	3456599		<0.4	<0.4	NA	< 0.4	93%	70%	130%	86%	80%	120%	91%	70%	130%
Boron	3456599		<5	<5	NA	< 5	108%	70%	130%	90%	80%	120%	91%	70%	130%
Boron (Hot Water Soluble)	3438732	3438732	0.43	0.48	NA	< 0.10	104%	60%	140%	101%	70%	130%	103%	60%	140%
Cadmium	3456599		<0.5	<0.5	NA	< 0.5	106%	70%	130%	100%	80%	120%	108%	70%	130%
Chromium	3456599		8	7	NA	< 5	98%	70%	130%	111%	80%	120%	115%	70%	130%
Cobalt	3456599		3.3	3.1	4.5%	< 0.5	99%	70%	130%	111%	80%	120%	109%	70%	130%
Copper	3456599		5.6	5.6	0.5%	< 1.0	96%	70%	130%	114%	80%	120%	107%	70%	130%
Lead	3456599		4	3	NA	< 1	101%	70%	130%	109%	80%	120%	107%	70%	130%
Molybdenum	3456599		<0.5	<0.5	NA	< 0.5	105%	70%	130%	111%	80%	120%	116%	70%	130%
Nickel	3456599		5	5	6.9%	< 1	100%	70%	130%	109%	80%	120%	105%	70%	130%
Selenium	3456599		<0.8	<0.8	NA	< 0.8	102%	70%	130%	107%	80%	120%	113%	70%	130%
Silver	3456599		<0.5	<0.5	NA	< 0.5	119%	70%	130%	108%	80%	120%	109%	70%	130%
Thallium	3456599		<0.5	<0.5	NA	< 0.5	103%	70%	130%	100%	80%	120%	102%	70%	130%
Uranium	3456599		<0.50	<0.50	NA	< 0.50	102%	70%	130%	100%	80%	120%	105%	70%	130%
Vanadium	3456599		15.0	13.7	8.9%	< 0.4	108%	70%	130%	112%	80%	120%	113%	70%	130%
Zinc	3456599		16	15	NA	< 5	103%	70%	130%	110%	80%	120%	114%	70%	130%
Chromium, Hexavalent	3438737	3438737	<0.2	<0.2	NA	< 0.2	102%	70%	130%	101%	80%	120%	92%	70%	130%
Cyanide, Free	3452104		<0.040	<0.040	NA	< 0.040	97%	70%	130%	106%	80%	120%	110%	70%	130%
Mercury	3456599		<0.10	<0.10	NA	< 0.10	114%	70%	130%	99%	80%	120%	105%	70%	130%
Electrical Conductivity (2:1)	3438732	3438732	1.78	1.85	3.9%	< 0.005	105%	80%	120%	NA			NA		
Sodium Adsorption Ratio (2:1) (Calc.)	3438732	3438732	8.55	8.55	0.1%	N/A	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	3452104		6.41	6.71	4.6%	NA	94%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.

pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

More than 90% of the elements met acceptance limits and overall data quality is acceptable for use. For a multi-element scan up to 10% of analytes may exceed the quoted limits by up to 10% absolute.

Certified By:




Quality Assurance

CLIENT NAME: AECOM CANADA LTD
PROJECT: 60637047
SAMPLING SITE: Hamilton

AGAT WORK ORDER: 22T854911
ATTENTION TO: Arif Chowdhury
SAMPLED BY: Indra

Trace Organics Analysis

RPT Date: Jan 31, 2022			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits		
								Lower	Upper		Lower	Upper		Lower	Upper	

Total PCBs (soil)

Polychlorinated Biphenyls	3444004	< 0.1	< 0.1	NA	< 0.1	104%	60%	140%	100%	60%	140%	105%	60%	140%
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Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: _____



QC Exceedance

CLIENT NAME: AECOM CANADA LTD
AGAT WORK ORDER: 22T854911
PROJECT: 60637047
ATTENTION TO: Arif Chowdhury

RPT Date: Jan 31, 2022		REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Sample Id	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
			Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - Metals & Inorganics (Soil)

Antimony	132%	70%	130%	92%	80%	120%	95%	70%	130%
----------	------	-----	------	-----	-----	------	-----	-----	------

Comments: NA signifies Not Applicable.

pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

More than 90% of the elements met acceptance limits and overall data quality is acceptable for use. For a multi-element scan up to 10% of analytes may exceed the quoted limits by up to 10% absolute.

Method Summary

CLIENT NAME: AECOM CANADA LTD
PROJECT: 60637047
SAMPLING SITE: Hamilton

AGAT WORK ORDER: 22T854911
ATTENTION TO: Arif Chowdhury
SAMPLED BY: Indra

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Arsenic	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Barium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Beryllium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	modified from EPA 6010D and MSA PART 3, CH 21	ICP/OES
Cadmium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Cobalt	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Copper	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Lead	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Molybdenum	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Nickel	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Selenium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Silver	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Thallium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Uranium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Vanadium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Zinc	MET 93 -6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium, Hexavalent	INOR-93-6068	modified from EPA 3060 and EPA 7196	SPECTROPHOTOMETER
Cyanide, Free	INOR-93-6052	modified from ON MOECC E3015, SM 4500-CN- I, G-387	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	modified from EPA 7471B and SM 3112 B	ICP-MS
Electrical Conductivity (2:1)	INOR-93-6036	modified from MSA PART 3, CH 14 and SM 2510 B	EC METER
Sodium Adsorption Ratio (2:1) (Calc.)	INOR-93-6007	modified from EPA 6010D & Analytical Protocol	ICP/OES
pH, 2:1 CaCl ₂ Extraction	INOR-93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER

Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 22T854911

PROJECT: 60637047

ATTENTION TO: Arif Chowdhury

SAMPLING SITE: Hamilton

SAMPLED BY: Indra

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Polychlorinated Biphenyls	ORG-91-5113	modified from EPA SW-846 3541 & 8082	GC/ECD
Decachlorobiphenyl	ORG-91-5113	modified from EPA SW-846 3541 & 8082	GC/ECD
Moisture Content	ORG-91-5009	CCME Tier 1 Method	BALANCE

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: AECOM€CANADA€LTD
Contact: ARIF€CHOWDHURY
Address: €€€€105€COMMERCE€VALLEY€DRIVE€WEST
MARKHAM,€ONTARIO
Phone: 416€427€9346 Fax: _____
Reports to be sent to: ARIF.CHOWDHURY@AECOM.COM
1. Email: _____
2. Email: SERGIY.TCHERNIKOV.COM

Regulatory Requirements:

(Please check all applicable boxes)

Regulation 153/04
Table 2 Indicate One
 Ind/Com
 Res/Park
 Agriculture
Soil Texture (Check One)
 Coarse
 Fine

Excess Soils R406
Table _____ Indicate One
 Regulation 558
 CCME

Sewer Use
 Sanitary Storm
Region _____
 Prov. Water Quality Objectives (PWQO)
 Other
Indicate One _____

Is this submission for a Record of Site Condition?

Yes No

Report Guideline on Certificate of Analysis

Yes No

Sample Matrix Legend

B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Field Filtered - Metals, Hg, CrVI, DOC

O. Reg 153

Metals & Inorganics
Metals - CrVI, Hg, HWSB
BTEX, F1-F4, PHCs
Analyze F4G if required Yes No

PAHs

PCBs

VOC

O. Reg 558

Landfill Disposal Characterization TCLP:
TCLP: M&I VOCs ABNs B6/P PCBs

Excess Soils SPLP Rainwater Leach

SPLP: Metals VOCs SVOCs

Excess Soils Characterization Package

pH, ICPMS Metals, BTEX, F1-F4

Salt - EC/SAR

O. Reg 406

Potentially Hazardous or High Concentration (Y/N)

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y/N	Metals & Inorganics	Metals - <input type="checkbox"/> CrVI, <input type="checkbox"/> Hg, <input type="checkbox"/> HWSB BTEX, F1-F4, PHCs Analyze F4G if required <input type="checkbox"/> Yes <input type="checkbox"/> No	PAHs	PCBs	VOC	O. Reg 558 Landfill Disposal Characterization TCLP: TCLP: <input type="checkbox"/> M&I <input type="checkbox"/> VOCs <input type="checkbox"/> ABNs <input type="checkbox"/> B6/P <input type="checkbox"/> PCBs	O. Reg 406 Excess Soils SPLP Rainwater Leach SPLP: <input type="checkbox"/> Metals <input type="checkbox"/> VOCs <input type="checkbox"/> SVOCs	Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR	Potentially Hazardous or High Concentration (Y/N)
BH14SS2A€(3.15)	2022/01/10	10€AM AM PM	2	SOIL			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>						
BH11SS2€(1.13)	2022/01/10	10€AM AM PM	2	SOIL			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>						
BH9SS2A€(1.13)	2022/01/10	10€AM AM PM	2	SOIL			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>						
BH9SS7(15.17)	2022/01/10	10€AM AM PM	1	SOIL			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>						
BH15SS3€(3.15)	2022/01/07	10€AM AM PM	2	SOIL			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>						
BH16SS3€(3.15)	2022/01/07	10€AM AM PM	2	SOIL			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>						
BH18SS3(3.15)	2022/01/07	10€AM AM PM	2	SOIL			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>						
		AM PM														
		AM PM														
		AM PM														
		AM PM														

Samples Relinquished By (Print Name and Sign): <u>€Indrakiran€Reddy€Atturu</u>	Date: <u>2022/01/18</u>	Time: <u>15.00</u>	Samples Received By (Print Name and Sign): <u>HIRAL €</u>	Date: _____	Time: _____	122 JAN 18 4:55 PM
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:	Page <u>1</u> of <u>1</u>
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:	No:

CLIENT NAME: AECOM CANADA LTD
105 COMMERCE VALLEY DR.W 7TH FLOOR
MARKHAM, ON L3T7W3
(905) 886-7022

ATTENTION TO: Arif Chowdhury

PROJECT: 60637047

AGAT WORK ORDER: 22T857227

SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

DATE REPORTED: Feb 04, 2022

PAGES (INCLUDING COVER): 11

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.



Certificate of Analysis

AGAT WORK ORDER: 22T857227

PROJECT: 60637047

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE: Hamilton

ATTENTION TO: Arif Chowdhury

SAMPLED BY: Indra

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2022-01-25

DATE REPORTED: 2022-02-04

Parameter	Unit	SAMPLE DESCRIPTION: BH01-SS4 (5-7) BH02-SS3 (3-5) BH03-SS3B (3-5) BH04-SS4 (5-7) BH05-SS3A (3-5) BH05-SS4 (5-7) BH07-SS3 (3-5) BH10-SS2B (1-3)											
		SAMPLE TYPE: Soil		Soil		Soil		Soil		Soil		Soil	
		DATE SAMPLED: 2022-01-21 10:00		2022-01-21 10:00		2022-01-14 10:00		2022-01-20 10:00		2022-01-12 10:00		2022-01-12 10:00	
		G / S	RDL	3460006	3460022	3460023	3460028	3460030	3460032	3460033	3460036		
Antimony	µg/g	40	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	
Arsenic	µg/g	18	1	5	7	7	5	6	8	7	3	3	
Barium	µg/g	670	2.0	64.3	175	96.4	80.2	79.2	97.0	115	66.6	66.6	
Beryllium	µg/g	8	0.4	0.6	1.3	0.9	0.8	0.7	0.9	1.0	0.4	0.4	
Boron	µg/g	120	5	13	7	8	6	8	7	7	<5	<5	
Boron (Hot Water Soluble)	µg/g	2	0.10	4.95	0.30	0.32	0.34	0.45	0.11	0.19	0.38	0.38	
Cadmium	µg/g	1.9	0.5	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Chromium	µg/g	160	5	20	28	27	23	24	26	30	14	14	
Cobalt	µg/g	80	0.5	10.1	18.1	13.6	11.5	11.0	12.9	15.1	5.6	5.6	
Copper	µg/g	230	1.0	31.5	31.5	38.7	25.5	31.3	41.3	43.4	15.8	15.8	
Lead	µg/g	120	1	12	26	19	19	41	20	16	24	24	
Molybdenum	µg/g	40	0.5	<0.5	0.8	0.6	<0.5	0.6	0.9	<0.5	<0.5	<0.5	
Nickel	µg/g	270	1	19	26	25	21	21	29	33	10	10	
Selenium	µg/g	5.5	0.8	<0.8	1.0	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	
Silver	µg/g	40	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Thallium	µg/g	3.3	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Uranium	µg/g	33	0.50	0.57	2.15	0.77	0.75	0.72	0.79	0.76	0.71	0.71	
Vanadium	µg/g	86	0.4	28.7	45.8	37.3	32.2	34.6	34.0	38.2	21.6	21.6	
Zinc	µg/g	340	5	64	108	92	94	124	80	83	102	102	
Chromium, Hexavalent	µg/g	8	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
Cyanide, Free	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	
Mercury	µg/g	3.9	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	
Electrical Conductivity (2:1)	mS/cm	1.4	0.005	4.78	1.21	1.87	1.60	2.25	0.412	0.415	1.68	1.68	
Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	N/A	43.7	10.9	16.2	17.2	6.78	2.63	3.84	17.7	17.7	
pH, 2:1 CaCl2 Extraction	pH Units	5.0-9.0	NA	7.34	7.47	7.32	7.51	7.35	7.07	7.01	7.42	7.42	

Certified By:





Certificate of Analysis

AGAT WORK ORDER: 22T857227

PROJECT: 60637047

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE: Hamilton

ATTENTION TO: Arif Chowdhury

SAMPLED BY: Indra

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2022-01-25

DATE REPORTED: 2022-02-04

Parameter	Unit	SAMPLE DESCRIPTION: BH07-SS4 (5-7)		BH17-SS3A (3-5)	
		G / S	RDL	G / S	RDL
Antimony	µg/g	40	0.8	<0.8	<0.8
Arsenic	µg/g	18	1	8	5
Barium	µg/g	670	2.0	112	131
Beryllium	µg/g	8	0.4	1.0	0.5
Boron	µg/g	120	5	12	5
Boron (Hot Water Soluble)	µg/g	2	0.10	<0.10	0.47
Cadmium	µg/g	1.9	0.5	<0.5	<0.5
Chromium	µg/g	160	5	34	17
Cobalt	µg/g	80	0.5	16.9	9.3
Copper	µg/g	230	1.0	47.6	20.6
Lead	µg/g	120	1	17	16
Molybdenum	µg/g	40	0.5	0.5	0.6
Nickel	µg/g	270	1	37	16
Selenium	µg/g	5.5	0.8	<0.8	<0.8
Silver	µg/g	40	0.5	<0.5	<0.5
Thallium	µg/g	3.3	0.5	<0.5	<0.5
Uranium	µg/g	33	0.50	0.79	1.09
Vanadium	µg/g	86	0.4	42.5	26.4
Zinc	µg/g	340	5	93	74
Chromium, Hexavalent	µg/g	8	0.2	<0.2	<0.2
Cyanide, Free	µg/g	0.051	0.040	<0.040	<0.040
Mercury	µg/g	3.9	0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	1.4	0.005	0.203	1.64
Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	N/A	2.55	25.7
pH, 2:1 CaCl2 Extraction	pH Units	5.0-9.0	NA	6.83	7.26

Certified By:



Arif Chowdhury



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T857227

PROJECT: 60637047

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
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CLIENT NAME: AECOM CANADA LTD

SAMPLING SITE: Hamilton

ATTENTION TO: Arif Chowdhury

SAMPLED BY: Indra

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2022-01-25

DATE REPORTED: 2022-02-04

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Soil - Industrial/Commercial/Community Property Use - Coarse Textured Soils
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.
3460006-3460038 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. SAR is a calculated parameter.
Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Myne Dasly



Certificate of Analysis

AGAT WORK ORDER: 22T857227

PROJECT: 60637047

5835 COOPERS AVENUE
 MISSISSAUGA, ONTARIO
 CANADA L4Z 1Y2
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<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD
 SAMPLING SITE: Hamilton

ATTENTION TO: Arif Chowdhury
 SAMPLED BY: Indra

Total PCBs (soil)

DATE RECEIVED: 2022-01-25

DATE REPORTED: 2022-02-04

Parameter	Unit	SAMPLE DESCRIPTION: BH02-SS3 (3-5)							
		G / S	RDL	BH03-SS3B	BH05-SS3A	BH07-SS3 (3-5)	BH10-SS2B	BH17-SS3A	
				(3-5)	(3-5)	(1-3)	(3-5)		
				Soil	Soil	Soil	Soil	Soil	
DATE SAMPLED:	2022-01-21	2022-01-14	2022-01-12	2022-01-22	2022-01-14	2022-01-12			
		10:00	10:00	10:00	10:00	10:00	10:00		
		3460022	3460023	3460030	3460033	3460036	3460038		
Polychlorinated Biphenyls	µg/g	1.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Moisture Content	%		0.1	31.0	13.5	11.4	19.0	14.3	21.2
Surrogate	Unit	Acceptable Limits							
Decachlorobiphenyl	%	60-130	92	84	100	76	84	112	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Soil - Industrial/Commercial/Community Property Use - Coarse Textured Soils
 Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3460022-3460038 Results are based on the dry weight of soil extracted.
 Analysis performed at AGAT Toronto (unless marked by *)

Certified By:





Exceedance Summary

AGAT WORK ORDER: 22T857227

PROJECT: 60637047

5835 COOPERS AVENUE
 MISSISSAUGA, ONTARIO
 CANADA L4Z 1Y2
 TEL (905)712-5100
 FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Arif Chowdhury

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
3460006	BH01-SS4 (5-7)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Boron (Hot Water Soluble)	µg/g	2	4.95
3460006	BH01-SS4 (5-7)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	4.78
3460006	BH01-SS4 (5-7)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	43.7
3460023	BH03-SS3B (3-5)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	1.87
3460023	BH03-SS3B (3-5)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	16.2
3460028	BH04-SS4 (5-7)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	1.60
3460028	BH04-SS4 (5-7)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	17.2
3460030	BH05-SS3A (3-5)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	2.25
3460036	BH10-SS2B (1-3)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	1.68
3460036	BH10-SS2B (1-3)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	17.7
3460038	BH17-SS3A (3-5)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	1.4	1.64
3460038	BH17-SS3A (3-5)	ON T2 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	12	25.7

Quality Assurance

CLIENT NAME: AECOM CANADA LTD
 PROJECT: 60637047
 SAMPLING SITE: Hamilton

AGAT WORK ORDER: 22T857227
 ATTENTION TO: Arif Chowdhury
 SAMPLED BY: Indra

Soil Analysis															
RPT Date: Feb 04, 2022			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE		MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - Metals & Inorganics (Soil)

Antimony	3475208		<0.8	<0.8	NA	< 0.8	123%	70%	130%	103%	80%	120%	81%	70%	130%
Arsenic	3475208		3	3	NA	< 1	119%	70%	130%	102%	80%	120%	100%	70%	130%
Barium	3475208		57.1	55.9	2.1%	< 2.0	111%	70%	130%	112%	80%	120%	109%	70%	130%
Beryllium	3475208		0.4	0.5	NA	< 0.4	111%	70%	130%	118%	80%	120%	119%	70%	130%
Boron	3475208		7	6	NA	< 5	86%	70%	130%	99%	80%	120%	103%	70%	130%
Boron (Hot Water Soluble)	3457204		0.10	0.11	NA	< 0.10	107%	60%	140%	103%	70%	130%	110%	60%	140%
Cadmium	3475208		<0.5	<0.5	NA	< 0.5	113%	70%	130%	114%	80%	120%	109%	70%	130%
Chromium	3475208		16	16	NA	< 5	109%	70%	130%	114%	80%	120%	110%	70%	130%
Cobalt	3475208		5.9	6.3	6.6%	< 0.5	110%	70%	130%	113%	80%	120%	107%	70%	130%
Copper	3475208		12.6	12.5	0.8%	< 1.0	103%	70%	130%	120%	80%	120%	107%	70%	130%
Lead	3475208		24	23	4.3%	< 1	109%	70%	130%	118%	80%	120%	102%	70%	130%
Molybdenum	3475208		<0.5	<0.5	NA	< 0.5	121%	70%	130%	112%	80%	120%	115%	70%	130%
Nickel	3475208		11	11	0.0%	< 1	106%	70%	130%	112%	80%	120%	100%	70%	130%
Selenium	3475208		<0.8	<0.8	NA	< 0.8	126%	70%	130%	108%	80%	120%	104%	70%	130%
Silver	3475208		<0.5	<0.5	NA	< 0.5	103%	70%	130%	111%	80%	120%	102%	70%	130%
Thallium	3475208		<0.5	<0.5	NA	< 0.5	119%	70%	130%	110%	80%	120%	99%	70%	130%
Uranium	3475208		0.50	<0.50	NA	< 0.50	116%	70%	130%	115%	80%	120%	105%	70%	130%
Vanadium	3475208		25.3	25.4	0.4%	< 0.4	117%	70%	130%	104%	80%	120%	105%	70%	130%
Zinc	3475208		42	43	2.4%	< 5	108%	70%	130%	116%	80%	120%	118%	70%	130%
Chromium, Hexavalent	3460022	3460022	<0.2	<0.2	NA	< 0.2	92%	70%	130%	93%	80%	120%	86%	70%	130%
Cyanide, Free	3471930		<0.040	<0.040	NA	< 0.040	100%	70%	130%	94%	80%	120%	89%	70%	130%
Mercury	3475208		<0.10	<0.10	NA	< 0.10	111%	70%	130%	106%	80%	120%	102%	70%	130%
Electrical Conductivity (2:1)	3471930		0.146	0.154	5.3%	< 0.005	105%	80%	120%						
Sodium Adsorption Ratio (2:1) (Calc.)	3471930		0.069	0.070	2.1%	NA									
pH, 2:1 CaCl2 Extraction	3471930		6.55	6.66	1.6%	NA	94%	80%	120%						

Comments: NA signifies Not Applicable.

pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:



Nivine Basily

Quality Assurance

 CLIENT NAME: AECOM CANADA LTD
 PROJECT: 60637047
 SAMPLING SITE: Hamilton

 AGAT WORK ORDER: 22T857227
 ATTENTION TO: Arif Chowdhury
 SAMPLED BY: Indra

Trace Organics Analysis

RPT Date: Feb 04, 2022			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Total PCBs (soil)															
Polychlorinated Biphenyls	3470828		< 0.1	< 0.1	NA	< 0.1	109%	60%	140%	98%	60%	140%	92%	60%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:



Method Summary

CLIENT NAME: AECOM CANADA LTD
 PROJECT: 60637047
 SAMPLING SITE: Hamilton

AGAT WORK ORDER: 22T857227
 ATTENTION TO: Arif Chowdhury
 SAMPLED BY: Indra

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Arsenic	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Barium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Beryllium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	modified from EPA 6010D and MSA PART 3, CH 21	ICP/OES
Cadmium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Cobalt	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Copper	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Lead	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Molybdenum	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Nickel	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Selenium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Silver	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Thallium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Uranium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Vanadium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Zinc	MET 93 -6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium, Hexavalent	INOR-93-6068	modified from EPA 3060 and EPA 7196	SPECTROPHOTOMETER
Cyanide, Free	INOR-93-6052	modified from ON MOECC E3015, SM 4500-CN- I, G-387	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	modified from EPA 7471B and SM 3112 B	ICP-MS
Electrical Conductivity (2:1)	INOR-93-6036	modified from MSA PART 3, CH 14 and SM 2510 B	EC METER
Sodium Adsorption Ratio (2:1) (Calc.)	INOR-93-6007	modified from EPA 6010D & Analytical Protocol	ICP/OES
pH, 2:1 CaCl ₂ Extraction	INOR-93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER

Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 22T857227

PROJECT: 60637047

ATTENTION TO: Arif Chowdhury

SAMPLING SITE: Hamilton

SAMPLED BY: Indra

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Polychlorinated Biphenyls	ORG-91-5113	modified from EPA SW-846 3541 & 8082	GC/ECD
Decachlorobiphenyl	ORG-91-5113	modified from EPA SW-846 3541 & 8082	GC/ECD
Moisture Content	ORG-91-5009	CCME Tier 1 Method	BALANCE

Laboratory Use Only

Work Order #: 225857227

Cooler Quantity: 1 Lrg Red (noice)

Arrival Temperatures: 6-5 | 6-3 | 6-7

Custody Seal Intact: Yes No N/A

Notes:

Chain of Custody Record If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: AECOM CANADA LTD

Contact: ARIF CHOWDHURY

Address: 105 COMMERCE VALLEY DRIVE WEST
MARKHAM, ONTARIO

Phone: 416-427-9346 Fax: _____

Reports to be sent to: ARIF.CHOWDHURY@AECOM.COM

1. Email: _____

2. Email: SERGIY.TCHERNIKOV@AECOM.COM

Regulatory Requirements:
(Please check all applicable boxes)

Regulation 153/04 Excess Soils R406 Sewer Use
 Sanitary Storm

Table 2 *Indicate One* Ind/Com Res/Park Agriculture

Table 2.1 *Indicate One* Regulation 558 CCME

Soil Texture (Check One) Coarse Fine

Region: _____

Prov. Water Quality Objectives (PWQO) Other _____

Indicate One

Turnaround Time (TAT) Required:

Regular TAT 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

3 Business Days 2 Business Days Next Business Day

OR Date Required (Rush Surcharges May Apply): _____

Project Information:

Project: 60637047

Site Location: Hamilton

Sampled By: INDRA

AGAT Quote #: _____ PO: _____

Please note: If quotation number is not provided, client will be billed full price for analysis.

Is this submission for a Record of Site Condition?

Yes No

Report Guideline on Certificate of Analysis

Yes No

Please provide prior notification for rush TAT
*TAT is exclusive of weekends and statutory holidays

For 'Same Day' analysis, please contact your AGAT CPM

Invoice Information: Bill To Same: Yes No

Company: AECOM CANADA LTD

Contact: SERGIY TCHERNIKOV

Address: _____

Email: _____

- Sample Matrix Legend**
- B** Biota
 - GW** Ground Water
 - O** Oil
 - P** Paint
 - S** Soil
 - SD** Sediment
 - SW** Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y / N	Field Filtered - Metals, Hg, CrVI, DOC	O. Reg 153				O. Reg 558		O. Reg 406		Potentially Hazardous or High Concentration (Y/N)	
								Metals & Inorganics	Metals - <input type="checkbox"/> CrVI, <input type="checkbox"/> Hg, <input type="checkbox"/> HWSB	BTEX, F1-F4 PHCs	Analyze F4G if required <input type="checkbox"/> Yes <input type="checkbox"/> No	PAHs	PCBs	VOC	Landfill Disposal Characterization TOLP: <input type="checkbox"/> MB& <input type="checkbox"/> VOCs <input type="checkbox"/> ABNs <input type="checkbox"/> Biop <input type="checkbox"/> PCBs		Excess Soils SPLP Rainwater Leach SPLP: <input type="checkbox"/> Metals <input type="checkbox"/> VOCs <input type="checkbox"/> SVOCs
BH01-SS4 (5-7)	2022/01/21	10 AM AM PM	1					<input checked="" type="checkbox"/>									
BH02-SS3 (3-5)	2022/01/21	10 AM AM PM	2					<input checked="" type="checkbox"/>									
BH03-SS3B (3-5)	2022/01/14	10 AM AM PM	2					<input checked="" type="checkbox"/>									
BH04-SS4 (5-7)	2022/01/20	10 AM AM PM	1					<input checked="" type="checkbox"/>									
BH05-SS3A (3-5)	2022/01/12	10 AM AM PM	2					<input checked="" type="checkbox"/>									
BH05-SS4 (5-7)	2022/01/12	10 AM AM PM	1					<input checked="" type="checkbox"/>									
BH07-SS3 (3-5)	2022/01/22	10 AM AM PM	2					<input checked="" type="checkbox"/>									
BH10-SS2B (1-3)	2022/01/14	10 AM AM PM	2					<input checked="" type="checkbox"/>									
BH07-SS4 (5-7)	2022/01/22	10 AM AM PM	1					<input checked="" type="checkbox"/>									
BH17-SS3A (3-5)	2022/01/12	10 AM AM PM	2					<input checked="" type="checkbox"/>									
BH17-SS8 (20-22)	2022/01/12	10 AM AM PM	1					<input checked="" type="checkbox"/>									

Samples Relinquished By (Print Name and Sign): <u>Indrakiran Reddy Atturu</u>	Date: <u>2022/01/25</u>	Time: <u>7:00 PM</u>	Samples Received By (Print Name and Sign): <u>Ned Rommagn</u>	Date:	Time:	122 JAN 25 7:03 AM
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:	Page ____ of ____
Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:	No: T 129157

CLIENT NAME: AECOM CANADA LTD
105 COMMERCE VALLEY DR.W 7TH FLOOR
MARKHAM, ON L3T7W3
(905) 886-7022
ATTENTION TO: Arif Chowdhury
PROJECT: 60637047
AGAT WORK ORDER: 22T858760
SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer
TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist
DATE REPORTED: Feb 07, 2022
PAGES (INCLUDING COVER): 11
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.



Certificate of Analysis

AGAT WORK ORDER: 22T858760

PROJECT: 60637047

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Arif Chowdhury

SAMPLING SITE:

SAMPLED BY:

O. Reg. 558 Metals and Inorganics

DATE RECEIVED: 2022-01-31

DATE REPORTED: 2022-02-07

SAMPLE DESCRIPTION: TCLP-1
SAMPLE TYPE: Soil
DATE SAMPLED: 2022-01-29
10:00
3470134

Parameter	Unit	G / S	RDL	3470134
Arsenic Leachate	mg/L	2.5	0.010	<0.010
Barium Leachate	mg/L	100	0.010	0.641
Boron Leachate	mg/L	500	0.050	0.134
Cadmium Leachate	mg/L	0.5	0.010	<0.010
Chromium Leachate	mg/L	5	0.050	<0.050
Lead Leachate	mg/L	5	0.010	0.019
Mercury Leachate	mg/L	0.1	0.01	<0.01
Selenium Leachate	mg/L	1	0.010	<0.010
Silver Leachate	mg/L	5	0.010	<0.010
Uranium Leachate	mg/L	10	0.050	<0.050
Fluoride Leachate	mg/L	150	0.10	0.21
Cyanide Leachate	mg/L	20	0.05	<0.05
(Nitrate + Nitrite) as N Leachate	mg/L	1000	0.70	<0.70

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 558 - Schedule IV Leachate Quality Criteria
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Arif Chowdhury



Certificate of Analysis

AGAT WORK ORDER: 22T858760

PROJECT: 60637047

5835 COOPERS AVENUE
 MISSISSAUGA, ONTARIO
 CANADA L4Z 1Y2
 TEL (905)712-5100
 FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Arif Chowdhury

SAMPLING SITE:

SAMPLED BY:

O. Reg. 558 - PCBs

DATE RECEIVED: 2022-01-31

DATE REPORTED: 2022-02-07

SAMPLE DESCRIPTION: TCLP-1
 SAMPLE TYPE: Soil
 DATE SAMPLED: 2022-01-29
 10:00

Parameter	Unit	G / S	RDL	3470134
PCB's Leachate	mg/L	0.3	0.005	<0.005
Surrogate	Unit	Acceptable Limits		
Decachlorobiphenyl	%	50-140		118

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 558 - Schedule IV Leachate Quality Criteria
 Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3470134 The soil sample was leached using the Regulation 558 procedure. Analysis was performed on the leachate.

PCB total is a calculated parameter. The calculated value is the sum of Aroclor 1242, Aroclor 1248, Aroclor 1254 and Aroclor 1260.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:





Certificate of Analysis

AGAT WORK ORDER: 22T858760

PROJECT: 60637047

5835 COOPERS AVENUE
 MISSISSAUGA, ONTARIO
 CANADA L4Z 1Y2
 TEL (905)712-5100
 FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Arif Chowdhury

SAMPLING SITE:

SAMPLED BY:

O. Reg. 558 - SVOCs				
DATE RECEIVED: 2022-01-31			DATE REPORTED: 2022-02-07	
SAMPLE DESCRIPTION:		TCLP-1		
SAMPLE TYPE:		Soil		
DATE SAMPLED:		2022-01-29 10:00		
Parameter	Unit	G / S	RDL	3470134
Pyridine Leachate	mg/L	5.0	0.010	<0.010
Cresols Leachate	mg/L	200	0.012	<0.012
o-Cresol Leachate	mg/L		0.004	<0.004
Meta & Para-Cresol Leachate	mg/L	200	0.008	<0.008
Hexachloroethane Leachate	mg/L	3	0.004	<0.004
Nitrobenzene Leachate	mg/L	2.0	0.004	<0.004
Hexachlorobutadiene Leachate	mg/L	0.5	0.004	<0.004
2,4,6-Trichlorophenol Leachate	mg/L	0.5	0.05	<0.05
2,4,5-Trichlorophenol Leachate	mg/L	400	0.004	<0.004
2,4-Dinitrotoluene Leachate	mg/L	0.13	0.004	<0.004
2,3,4,6-Tetrachlorophenol Leachate	mg/L	10	0.004	<0.004
Hexachlorobenzene Leachate	mg/L	0.13	0.004	<0.004
Dinoseb Leachate	mg/L	1	0.004	<0.004
Benzo(a)pyrene Leachate	mg/L	0.001	0.001	<0.001
Pentachlorophenol Leachate	mg/L	6	0.006	<0.006
Surrogate	Unit	Acceptable Limits		
2-Fluorophenol	%	50-140		78
Phenol-d6	%	50-140		84
2,4,6-Tribromophenol	%	50-140		78
Chrysene-d12	%	50-140		89

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 558 - Schedule IV Leachate Quality Criteria
 Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3470134 The sample was leached according to Regulation 558 protocol. Analysis was performed on the leachate.
 Cresols total is a calculated parameter. The calculated value is the sum o-Cresol and m&p-Cresol.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 22T858760

PROJECT: 60637047

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: AECOM CANADA LTD

ATTENTION TO: Arif Chowdhury

SAMPLING SITE:

SAMPLED BY:

O. Reg. 558 - VOCs

DATE RECEIVED: 2022-01-31

DATE REPORTED: 2022-02-07

SAMPLE DESCRIPTION: TCLP-1
SAMPLE TYPE: Soil
DATE SAMPLED: 2022-01-29
10:00
3470134

Parameter	Unit	G / S	RDL	3470134
Vinyl Chloride Leachate	mg/L	0.2	0.030	<0.030
1,1 Dichloroethene Leachate	mg/L	1.4	0.020	<0.020
Dichloromethane Leachate	mg/L	5.0	0.030	<0.030
Methyl Ethyl Ketone Leachate	mg/L	200	0.090	<0.090
Chloroform Leachate	mg/L	10.0	0.020	<0.020
1,2-Dichloroethane Leachate	mg/L	0.5	0.020	<0.020
Carbon Tetrachloride Leachate	mg/L	0.5	0.020	<0.020
Benzene Leachate	mg/L	0.5	0.020	<0.020
Trichloroethene Leachate	mg/L	5.0	0.020	<0.020
Tetrachloroethene Leachate	mg/L	3.0	0.050	<0.050
Chlorobenzene Leachate	mg/L	8.0	0.010	<0.010
1,2-Dichlorobenzene Leachate	mg/L	20.0	0.010	<0.010
1,4-Dichlorobenzene Leachate	mg/L	0.5	0.010	<0.010
Surrogate	Unit	Acceptable Limits		
Toluene-d8	% Recovery	50-140	98	
4-Bromofluorobenzene	% Recovery	50-140	83	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 558 - Schedule IV Leachate Quality Criteria
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3470134 Sample was prepared using Regulation 558 protocol and a zero headspace extractor.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Quality Assurance

CLIENT NAME: AECOM CANADA LTD
 PROJECT: 60637047
 SAMPLING SITE:

AGAT WORK ORDER: 22T858760
 ATTENTION TO: Arif Chowdhury
 SAMPLED BY:

Soil Analysis

RPT Date: Feb 07, 2022			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 558 Metals and Inorganics															
Arsenic Leachate	3460977		<0.010	<0.010	NA	< 0.010	94%	70%	130%	120%	80%	120%	128%	70%	130%
Barium Leachate	3460977		0.243	0.245	0.8%	< 0.010	100%	70%	130%	107%	80%	120%	116%	70%	130%
Boron Leachate	3460977		<0.050	<0.050	NA	< 0.050	106%	70%	130%	99%	80%	120%	115%	70%	130%
Cadmium Leachate	3460977		<0.010	<0.010	NA	< 0.010	101%	70%	130%	106%	80%	120%	109%	70%	130%
Chromium Leachate	3460977		<0.050	<0.050	NA	< 0.050	101%	70%	130%	120%	80%	120%	121%	70%	130%
Lead Leachate	3460977		0.015	0.015	NA	< 0.010	104%	70%	130%	104%	80%	120%	102%	70%	130%
Mercury Leachate	3460977		<0.01	<0.01	NA	< 0.01	96%	70%	130%	90%	80%	120%	99%	70%	130%
Selenium Leachate	3460977		<0.010	<0.010	NA	< 0.010	102%	70%	130%	119%	80%	120%	117%	70%	130%
Silver Leachate	3460977		<0.010	<0.010	NA	< 0.010	100%	70%	130%	101%	80%	120%	104%	70%	130%
Uranium Leachate	3460977		<0.050	<0.050	NA	< 0.050	100%	70%	130%	108%	80%	120%	108%	70%	130%
Fluoride Leachate	3460977		0.24	0.24	NA	< 0.10	100%	90%	110%	102%	90%	110%	97%	70%	130%
Cyanide Leachate	3460977		<0.05	<0.05	NA	< 0.05	100%	70%	130%	94%	80%	120%	114%	70%	130%
(Nitrate + Nitrite) as N Leachate	3460977		<0.70	<0.70	NA	< 0.70	98%	80%	120%	94%	80%	120%	92%	70%	130%

Comments: NA signifies Not Applicable.
 Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:



Quality Assurance

CLIENT NAME: AECOM CANADA LTD
 PROJECT: 60637047
 SAMPLING SITE:

AGAT WORK ORDER: 22T858760
 ATTENTION TO: Arif Chowdhury
 SAMPLED BY:

Trace Organics Analysis

RPT Date: Feb 07, 2022			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits		
								Lower	Upper		Lower	Upper		Lower	Upper	

O. Reg. 558 - VOCs

Vinyl Chloride Leachate	3461970		<0.030	<0.030	NA	< 0.030	86%	50%	140%	91%	50%	140%	87%	50%	140%
1,1 Dichloroethene Leachate	3461970		<0.020	<0.020	NA	< 0.020	87%	50%	140%	83%	60%	130%	94%	50%	140%
Dichloromethane Leachate	3461970		<0.030	<0.030	NA	< 0.030	104%	50%	140%	77%	60%	130%	85%	50%	140%
Methyl Ethyl Ketone Leachate	3461970		<0.090	<0.090	NA	< 0.090	88%	50%	140%	84%	50%	140%	113%	50%	140%
Chloroform Leachate	3461970		<0.020	<0.020	NA	< 0.020	88%	50%	140%	89%	60%	130%	94%	50%	140%
1,2-Dichloroethane Leachate	3461970		<0.020	<0.020	NA	< 0.020	87%	50%	140%	89%	60%	130%	89%	50%	140%
Carbon Tetrachloride Leachate	3461970		<0.020	<0.020	NA	< 0.020	83%	50%	140%	108%	60%	130%	111%	50%	140%
Benzene Leachate	3461970		<0.020	<0.020	NA	< 0.020	84%	50%	140%	75%	60%	130%	74%	50%	140%
Trichloroethene Leachate	3461970		<0.020	<0.020	NA	< 0.020	82%	50%	140%	78%	60%	130%	107%	50%	140%
Tetrachloroethene Leachate	3461970		<0.050	<0.050	NA	< 0.050	84%	50%	140%	74%	60%	130%	72%	50%	140%
Chlorobenzene Leachate	3461970		<0.010	<0.010	NA	< 0.010	89%	50%	140%	82%	60%	130%	90%	50%	140%
1,2-Dichlorobenzene Leachate	3461970		<0.010	<0.010	NA	< 0.010	84%	50%	140%	81%	60%	130%	94%	50%	140%
1,4-Dichlorobenzene Leachate	3461970		<0.010	<0.010	NA	< 0.010	95%	50%	140%	87%	60%	130%	102%	50%	140%

O. Reg. 558 - SVOCs

Pyridine Leachate	3470134	3470134	< 0.010	< 0.010	NA	< 0.010	74%	50%	140%	96%	50%	140%	76%	50%	140%
Cresols Leachate	3470134	3470134	< 0.012	< 0.012	NA	< 0.012									
o-Cresol Leachate	3470134	3470134	< 0.004	< 0.004	NA	< 0.004	89%	50%	140%	75%	50%	140%	84%	50%	140%
Meta & Para-Cresol Leachate	3470134	3470134	< 0.008	< 0.008	NA	< 0.008	78%	50%	140%	76%	50%	140%	72%	50%	140%
Hexachloroethane Leachate	3470134	3470134	< 0.004	< 0.004	NA	< 0.004	85%	50%	140%	84%	50%	140%	84%	50%	140%
Nitrobenzene Leachate	3470134	3470134	< 0.004	< 0.004	NA	< 0.004	87%	50%	140%	75%	50%	140%	75%	50%	140%
Hexachlorobutadiene Leachate	3470134	3470134	< 0.004	< 0.004	NA	< 0.004	76%	50%	140%	78%	50%	140%	78%	50%	140%
2,4,6-Trichlorophenol Leachate	3470134	3470134	< 0.05	< 0.05	NA	< 0.05	85%	50%	140%	82%	50%	140%	85%	50%	140%
2,4,5-Trichlorophenol Leachate	3470134	3470134	< 0.004	< 0.004	NA	< 0.004	86%	50%	140%	84%	50%	140%	84%	50%	140%
2,4-Dinitrotoluene Leachate	3470134	3470134	< 0.004	< 0.004	NA	< 0.004	98%	50%	140%	78%	50%	140%	79%	50%	140%
2,3,4,6-Tetrachlorophenol Leachate	3470134	3470134	< 0.004	< 0.004	NA	< 0.004	85%	50%	140%	85%	50%	140%	86%	50%	140%
Hexachlorobenzene Leachate	3470134	3470134	< 0.004	< 0.004	NA	< 0.004	84%	50%	140%	86%	50%	140%	85%	50%	140%
Dinoseb Leachate	3470134	3470134	< 0.004	< 0.004	NA	< 0.004	78%	50%	140%	85%	50%	140%	84%	50%	140%
Benzo(a)pyrene Leachate	3470134	3470134	< 0.001	< 0.001	NA	< 0.001	85%	50%	140%	84%	50%	140%	78%	50%	140%
Pentachlorophenol Leachate	3470134	3470134	< 0.006	< 0.006	NA	< 0.006	79%	50%	140%	76%	50%	140%	85%	50%	140%

O. Reg. 558 - PCBs

PCB's Leachate	3468845		< 0.005	< 0.005	NA	< 0.005	105%	50%	140%	89%	50%	140%	98%	50%	140%
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Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: _____



Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 22T858760

PROJECT: 60637047

ATTENTION TO: Arif Chowdhury

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Arsenic Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B ICP-MS	
Barium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B ICP-MS	
Boron Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B ICP-MS	
Cadmium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B ICP-MS	
Chromium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B ICP-MS	
Lead Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B ICP-MS	
Mercury Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B ICP-MS	
Selenium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B ICP-MS	
Silver Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B ICP-MS	
Uranium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B ICP-MS	
Fluoride Leachate	INOR-93-6018	EPA 1311 & modified from SM4500-F-C	ION SELECTIVE ELECTRODE
Cyanide Leachate	INOR-93-6052	EPA 1311 modified from MOE 3015 SM 4500 CN-I,G387	TECHNICON AUTO ANALYZER
(Nitrate + Nitrite) as N Leachate	INOR-93-6053	EPA SW 846-1311 & modified from SM 4500 - NO3- I	LACHAT FIA

Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 22T858760

PROJECT: 60637047

ATTENTION TO: Arif Chowdhury

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
PCB's Leachate	ORG-91-5112	Regulation 558, EPA SW846 3510C/8082	GC/ECD
Decachlorobiphenyl	ORG-91-5112	EPA SW846 3510C/8082	GC/ECD
Pyridine Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Cresols Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	CALCULATION
o-Cresol Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Meta & Para-Cresol Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Hexachloroethane Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Nitrobenzene Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Hexachlorobutadiene Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
2,4,6-Trichlorophenol Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
2,4,5-Trichlorophenol Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
2,4-Dinitrotoluene Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
2,3,4,6-Tetrachlorophenol Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Hexachlorobenzene Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Dinoseb Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Benzo(a)pyrene Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Pentachlorophenol Leachate	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
2-Fluorophenol	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Phenol-d6	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
2,4,6-Tribromophenol	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Chrysene-d12	ORG-91-5114	modified from EPA 3510C, 8270E & ON MOECC E3265	GC/MS
Vinyl Chloride Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
1,1 Dichloroethene Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
Dichloromethane Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
Methyl Ethyl Ketone Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
Chloroform Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
1,2-Dichloroethane Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
Carbon Tetrachloride Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS

Method Summary

CLIENT NAME: AECOM CANADA LTD

AGAT WORK ORDER: 22T858760

PROJECT: 60637047

ATTENTION TO: Arif Chowdhury

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Benzene Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
Trichloroethene Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
Tetrachloroethene Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
Chlorobenzene Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
1,2-Dichlorobenzene Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
1,4-Dichlorobenzene Leachate	VOL-91-5001	EPA 1311, modified from EPA 5030C & EPA 8260D	(P&T)GC/MS
Toluene-d8	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS

Mustafa Alkiki, P.Eng.
Geotechnical Engineer

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