

Appendix I

Geotechnical Investigation

March 18, 2021

Prepared for



BRAMPTON
Flower City

Prepared by



IBI GROUP





SNC · LAVALIN

Geotechnical Investigation: Proposed Johnston Transit Facility (Transit Bus Garage)

10192 Highway 50, Brampton, Ontario

The City of Brampton



INFRASTRUCTURE

04 | Dec | 2019

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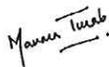
Geotechnical Investigation For Proposed Johnston Transit Facility (Transit Bus Garage)

10192 Highway 50, Brampton, Ontario

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This report consists of 238 pages including appendices and may not be reproduced in whole or in part without the permission of Legal entity.

NOTICE TO READER

This document contains the professional opinion of *SNC-Lavalin GEM Ontario Inc. (SNCL)*, as to the matters set out herein, based on professional judgment and reasonable care. It is to be read in the context of the agreement (the “Agreement”) between *SNCL* and the City of Brampton (herein after referred to as the “Client”), the methodology, procedures and techniques used *SNCL*’s assumptions, and the circumstances and constraints under which its mandate was performed. This document is written solely for the purpose stated in the Agreement, and for the sole and exclusive benefit of the Client, whose remedies are limited to those set out in the Agreement. This document is meant to be read as a whole, and sections or parts thereof should thus not be read or relied upon out of context.

SNCL has, in preparing the geotechnical parameters and recommendations, followed accepted methodology and procedures, and exercised due care consistent with the intended level of accuracy, using its professional judgment and reasonable care, and is thus of the opinion that there is a high probability that actual site geotechnical conditions will fall within the predicted range. However, no warranty should be implied as to the accuracy of estimates. Unless expressly stated otherwise, assumptions, data, and information supplied by, or gathered from other sources (including the Client, other consultants, testing laboratories and equipment suppliers, etc.) upon which *SNCL*’s opinions as set out herein are based, have not been verified by *SNCL*; *SNCL* makes no representation as to their accuracy and disclaims all liability with respect thereto.

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1 Introduction

SNC-Lavalin Inc. (SNCL), was retained by the City of Brampton to conduct a geotechnical investigation for a proposed bus transit facility, namely Johnston Transit Facility, to be constructed at 10192 Highway 50, Brampton, Ontario, as shown in Figure 1 of Appendix A.

The site is located at south of Cadetta Road, west of Highway 50 in Brampton, Ontario, with an unconfined creek (i.e. Rainbow Creek) and TRCA floodplain in the northwest quadrant of the site. The site is approximately 45.5 acres (43 acres for Parcel A and 1.5 acres for the Parcel B) and is predominantly gently rolling farmland. The eastern portion of this site consists of a City of Brampton Satellite yard and laydown area, which has been re-graded with asphaltic concrete gravel, but is generally flat with some stockpiles and berms. Based on information provided by the Client, it is understood that the City already owns the northeast portion of the Parcel A, approximately 19 acres in size and plans to purchase rest of the land of Parcel A and Parcel B.

The purpose of this geotechnical investigation was to obtain information on the subsurface conditions at the site by means of advancing a limited number of boreholes, in-situ tests and laboratory tests of select soil samples. Based on SNCL's interpretation of the obtained field information, recommendations are provided on the geotechnical aspects of the project.

It is understood that the proposed bus facility will consist of a slab-on-grade building without basement, approximately 55,742 m² (600,000 sq.ft) in size, with associated parking for light and heavy duty vehicles. No drawings or further details (such as final floor grading) about the proposed facility were available at the time of preparation of this report.

The geotechnical investigation was carried out in conjunction with Phase I and Phase II Environmental Site Assessments, and their findings are presented under separate cover.

The field work for this investigation was carried out on business days between June 3rd and 21st, 2019 for Parcel A and then October 15th and 16th, 2019 for Parcel B. It consisted of drilling seventy-seven (77) boreholes in the footprint of the proposed transit facility and associated structures. Seventy-three (73) boreholes, namely BH01 to BH73 were drilled for Parcel A and four (04) boreholes, namely BH74 to BH77, for Parcel B. The boreholes were advanced under the full-time supervision of experienced geotechnical personnel from SNCL.

A previous geotechnical report, titled "Preliminary Geotechnical Investigation Proposed Williams Parkway Satellite Yard, 10192 Highway 50, Brampton, Ontario" prepared by Trow Associates Inc, dated November 2008 was reviewed for this project site.

The field investigation on Parcel A was completed in accordance with SNCL's approved proposal (Ref. No. 634196-14002, dated April 01, 2019). Additional investigation for Parcel B was completed in accordance with SNCL's approved proposal (Ref. No. 643196_14004, dated September 12, 2019)

This report contains the findings of SNCL's geotechnical investigation, together with recommendations and comments. These recommendations and comments are based on factual information and are intended only for the use of the design engineers. The recommendations and

opinions in this report are applicable only to the proposed project as described in this Section. The Report Limitations is an integral part of this report.

2 Method of Investigation

2.1 Fieldwork

The fieldwork for the geotechnical investigation was performed between June 3rd and 21st, 2019 (Parcel A: BH01 to BH73) and on October 15th and 16th, 2019 (Parcel B: BH73 to BH77), consisted of advancing a total of seventy-seven (77) boreholes. SNCL conducted a survey for borehole elevations and coordinates, where borehole location UTM coordinates and geodetic above mean sea level (MASL) elevations were taken by Trimble RX 5800 high precision unit. It should be noted that the ground surface elevations and coordinates at the borehole locations are approximate and should not be used for design and construction purposes.

The summary of borehole identification, depths, elevations and coordinates is presented in the following Table:

Table 1: Summary of Borehole Depths, Elevations, and Coordinates

Borehole ID	Borehole Depth (mbgs*)	Approximate Ground Elevation (MASL)	Borehole Easting (UTM Zone 17)	Borehole Northing (UTM Zone 17)
BH01	5.2	210.06	606423.57	4852185.92
BH02	9.8	210.12	606377.19	4852223.96
BH03	6.7	208.90	606450.93	4852124.65
BH04	9.5	209.27	606427.73	4852143.69
BH05	3.7	209.82	606381.35	4852181.74
BH06	9.6	208.59	606478.28	4852063.42
BH07	9.8	208.46	606455.09	4852082.45
BH08	9.8	209.24	606431.9	4852101.46
BH09	8.2	209.69	606385.52	4852139.52
BH10	3.2	210.64	606339.12	4852177.58
BH11	2.9	210.59	606315.93	4852196.60
BH12	6.4	208.84	606436.06	4852059.24
BH13	9.6	209.48	606389.68	4852097.30
BH14	9.8	209.94	606366.48	4852116.32
BH15	4.4	210.59	606343.29	4852135.36
BH16	3.5	208.06	606509.82	4851959.94
BH17	9.7	208.31	606486.62	4851978.98
BH18	9.8	208.95	606440.23	4852017.03
BH19	9.8	209.24	606417.04	4852036.05
BH20	9.2	209.52	606393.84	4852055.08
BH21	3.7	209.88	606370.65	4852074.10
BH22	6.7	210.23	606347.46	4852093.13

Borehole ID	Borehole Depth (mbgs*)	Approximate Ground Elevation (MASL)	Borehole Easting (UTM Zone 17)	Borehole Northing (UTM Zone 17)
BH23	3.5	210.26	606301.07	4852131.2
BH24	3.7	208.18	606490.79	4851936.75
BH25	9.6	208.65	606444.40	4851974.81
BH26	9.7	209.42	606398.01	4852012.85
BH27	9.8	209.68	606374.81	4852031.88
BH28	9.5	209.90	606351.62	4852050.92
BH29	3.6	209.98	606305.24	4852088.98
BH30	6.2	208.46	606448.57	4851932.58
BH31	9.8	209.60	606402.18	4851970.64
BH32	3.7	209.61	606378.98	4851989.67
BH33	7.3	209.83	606355.80	4852008.70
BH34	9.7	209.82	606309.40	4852046.74
BH35	9.8	209.24	606263.02	4852084.80
BH36	6.7	209.51	606359.95	4851966.48
BH37	3.7	208.68	606267.18	4852042.59
BH38	9.4	208.65	606410.51	4851886.19
BH39	9.8	209.06	606364.12	4851924.26
BH40	6.7	209.04	606317.73	4851962.30
BH41	9.3	207.62	606271.34	4852000.36
BH42	3.7	207.92	606224.96	4852038.41
BH43	3.1	208.67	606414.67	4851843.97
BH44	8.2	208.87	606368.28	4851882.04
BH45	6.7	208.18	606275.51	4851958.14
BH46	3.7	207.61	606229.13	4851996.19
BH47	5.9	208.76	606372.46	4851839.81
BH48	9.2	208.72	606326.06	4851877.86
BH49	9.5	208.27	606279.68	4851915.92
BH50	9.3	207.60	606233.29	4851953.98
BH51	6.7	208.99	606376.62	4851797.58
BH52	3.7	208.13	606283.85	4851873.71
BH53	3.7	207.78	606237.46	4851911.75
BH54	5.9	208.37	606334.41	4851793.41
BH55	9.8	207.96	606288.01	4851831.47

Borehole ID	Borehole Depth (mbgs*)	Approximate Ground Elevation (MASL)	Borehole Easting (UTM Zone 17)	Borehole Northing (UTM Zone 17)
BH56	3.7	207.62	606241.63	4851869.53
BH57	6.7	208.10	606292.18	4851789.25
BH58	6.7	207.48	606245.80	4851827.32
BH59	9.8	208.25	606296.34	4851747.04
BH60	9.6	207.80	606249.96	4851785.10
BH61	9.8	207.29	606226.77	4851804.11
BH62	5.9	207.95	606300.51	4851704.81
BH63	3.7	207.86	606277.31	4851723.83
BH64	3.7	207.91	606254.12	4851742.86
BH65	3.7	207.86	606258.29	4851700.64
BH66	6.5	207.48	606235.10	4851719.67
BH67	3.7	207.43	606211.90	4851738.70
BH68	3.7	207.06	606188.70	4851757.73
BH69	6.7	207.75	606262.45	4851658.43
BH70	8.1	207.58	606239.26	4851677.44
BH71	3.7	207.24	606216.07	4851696.48
BH72	5.0	208.98	606362.00	4851769.60
BH73	6.1	208.83	606359.90	4851771.20
BH74	5.9	207.93	606484.17	4851890.91
BH75	4.3	208.09	606531.45	4851945.29
BH76	6.7	208.01	606505.43	4851930.42
BH77	6.7	207.89	606528.74	4851913.36

* mbgs = metres below ground surface

The Site Location Plan (Figure 1) and Borehole Location Plan (Figure 2) are presented in Appendix A of this report.

The boreholes were advanced using 150 and 200 mm hollow-stem continuous-flight augers with a track mounted drill rig and a 100 mm solid-stem geo-probe under the full-time supervision of experienced geotechnical personnel from SNCL. Details of hole diameters, augers and rig types are provided in the individual Borehole logs in Appendix B.

Soil samples were generally taken at 0.76 m intervals from the ground surface to 3.1 mbgs and at 1.5 m intervals thereafter to termination depths while performing the Standard Penetration Test (SPT) in accordance with ASTM D1586. This consisted of freely dropping a 63.5 kg (140 lbs.) hammer for a vertical distance of 0.76 m (30 inches) to drive a 51 mm (2 inches) outer diameter (O.D.) split-barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of

0.30 m (12 inches) was recorded as the SPT 'N' value of the soil which indicated the consistency of cohesive soils or the relative density of non-cohesive soils. Select environmental boreholes were sampled continuously. Vane shear testing and advancement of thin-walled intact samples / Shelby tube were not possible due to the nature of the till deposit (refusal).

Groundwater observations were made in the boreholes upon completion of drilling. Freestanding water was encountered in twenty-two (22) boreholes identified as BH02 to BH04, BH06 to BH09, BH15 to BH17, BH21, BH24, to BH28, BH30 to BH32, BH44, BH51 and BH77 upon completion of drilling. It should be noted that there was not sufficient time available for the groundwater to stabilize inside the open boreholes. Twelve (12) monitoring wells were installed in boreholes BH02/MW02, BH03/MW03, BH22/MW22, BH30/MW30, BH33/MW33, BH35/MW35, BH50/MW50, BH51/MW51 BH60/BH60, BH70/MW70, BH74/MW74, and BH75/MW75 to enable us to measure a stabilized groundwater reading.

Upon completion of drilling, the soil samples were transported to our soil laboratory in our Vaughan office for further examination and laboratory testing.

3 Subsoil Conditions

Based on the soil conditions encountered in the boreholes, the soil profile consists of topsoil/ loose overburden asphalt underlain by earth fill material. The fill materials were underlain by native soil deposits (sandy silty clay, sandy silt to silty sand, sand). The stratigraphic units and groundwater conditions are discussed in the following sections. More details are provided in the Record of Boreholes (Appendix B).

The following summary is to assist the designers of the project with an understanding of the anticipated soil conditions across the site. However, it should be noted that the soil and groundwater conditions may vary between and beyond the borehole locations.

3.1 Ground Cover

The boreholes identified as BH01 to BH05, BH08 to BH11, BH15, BH18 to BH22, BH26 to BH28, and BH 31 to BH33 were advanced through an approximately 0.3 to 1.2 m thick layer of loose overburden asphaltic concrete. The remained boreholes encountered approximately 100 mm to 200 mm thick layer of topsoil at the ground surface. It should be noted that loose asphalt and topsoil thicknesses may vary between and beyond borehole locations.

3.2 Fill Materials

3.2.1 Silty Clay Fill

A fill layer consisting predominantly of silty clay with trace to some sand and trace rootlets was encountered immediately beneath the ground cover in all boreholes, except in BH20 and BH30 to BH33. The depths of this layer extended to 2.3 mbgs. The recovered samples were generally described to be in moist to very moist condition. Moisture content measurements obtained on the extracted samples were found to be approximately 5 to 25 % by weight.

SPT 'N' Values for this stratum varied between 4 and 45 blows per 300 mm, indicating very soft to hard state.

3.3 Native Strata

3.3.1 Sandy Silty Clay to Sandy Clayey Silt Till

A heterogenous stratum of native soil consisting predominantly of sandy silty clay with trace to some gravel was encountered below the fill layer in most of the boreholes at various depths ranging from 0.6 to 2.3 mbgs. Trace broken cobbles were encountered randomly at various depths in this layer.

The recovered samples of the sandy silty clay soils were generally described to be in a moist to wet condition. Moisture content measurements obtained on the extracted samples were found to be between 8% and 26% by weight indicating moist to wet state.

SPT 'N' Values for this stratum varied between 11 blows per 300 mm and 50 blows per 50 mm, indicating a stiff to hard state.

Liquid Limits, Plastic Limits and Plasticity Indices were from 18 % to 37 % 11 % to 18 %, and 7 % to 19 % respectively.

3.3.2 Sandy Silt to Silt Till

A stratum of native soil consisting predominantly of sandy silt to silt with trace to some clay and trace gravel was encountered between the depths of 2.3 to 9.8 mbgs in various boreholes.

The recovered samples soils were generally described to be in a moist to wet condition. Moisture content measurements obtained on the extracted samples were found to be between 8% and 20% by weight indicating moist to wet state.

SPT 'N' Values for this stratum varied between 12 blows per 300 mm and 50 blows per 50 mm, indicating a compact to very dense relative density.

3.3.3 Silty Sand to Sand Till

A stratum of native soil consisting predominantly of silty sand to sand trace to some clay and trace gravel was encountered between the depths of 3.6 to 9.1 mbgs in various boreholes. The soils were more gravelly approximately between 4.0 to 6.1 mbgs in boreholes BH25, BH27, BH30 and BH34. Some clayey cores were present approximately at 6 to 7 mbgs.

The recovered samples were generally described to be in a moist to very moist condition. Moisture content measurements obtained on the extracted samples were found to be between 9% and 19%.

SPT 'N' Values for this stratum varied between 11 blows per 300 mm and 50 blows per 50 mm, indicating a compact to very dense relative density.

4 Laboratory Testing

Visual soil classifications made in the field were verified by peer review in the lab. Moisture content determinations were completed on all recovered samples.

Grain size analysis (sieve and hydrometer) was performed on eighteen (18) select samples. The results of these tests are summarized in Table 2 and are also presented in Appendix C of the report.

Table 2: Grain-Size Laboratory Testing Results

Sample ID	Sample Depth (mbgs)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH01 / SS05	3.1 – 3.7	4	33	48	15
BH08 / SS07A	6.1 – 6.5	0	38	59	3
BH12 / SS06	4.6 – 5.0	11	29	45	15
BH18 / SS08	6.1 – 6.7	2	13	63	22
BH21 / SS01	0.8 – 1.4	9	26	47	18
BH30 / SS02	0.8 – 1.4	2	28	49	21
BH34 / SS05	3.1 – 3.7	5	32	48	15
BH46 / SS05	3.1 – 3.7	3	13	76	8
BH48 / SS04	2.3 – 2.9	5	24	49	22
BH49 / SS03	1.5 – 2.1	4	26	49	21
BH51 / SS08	5.3 – 5.9	23	26	37	14
BH59 / SS07	6.1 – 6.7	5	28	49	18
BH61 / SS02	0.8 – 1.4	3	23	50	24
BH71 / SS03	1.5 – 2.1	7	27	47	19
BH76 / SS02	0.8 – 1.4	1	12	40	47
BH77 / SS02	0.8 – 1.4	3	33		64
BH77 / SS03	1.5 – 2.1	1	28	51	20
BH77 / SS06	4.5 – 5.1	3	43		54

Atterberg Limits tests were conducted on eleven (11) select samples. The results of these tests are presented in Table 3 and also presented in Appendix C of the report.

Table 3: Atterberg Limits Results

Sample ID	Sample Depth (mgs)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Soil Classification
BH12 / SS06	4.6 – 5.0	18	11	7	Low Plasticity Inorganic Clay (CL)
BH18 / SS08	6.1 – 6.7	23	14	9	Low Plasticity Inorganic Clay (CL)
BH21 / SS01	0.8 – 1.4	20	12	8	Low Plasticity Inorganic Clay (CL)
BH30 / SS02	0.8 – 1.4	23	14	9	Low Plasticity Inorganic Clay (CL)
BH34 / SS05	3.1 – 3.7	20	12	8	Low Plasticity Inorganic Clay (CL)
BH46 / SS05	3.1 – 3.7	-	-	-	Non-plastic
BH49 / SS03	1.5 – 2.1	23	13	10	Low Plasticity Inorganic Clay (CL)
BH61 / SS02	0.8 – 1.4	25	13	12	Low Plasticity Inorganic Clay (CL)
BH71 / SS03	1.5 – 2.1	22	12	10	Low Plasticity Inorganic Clay (CL)
BH76 / SS02	0.8 – 1.4	37	18	19	Low Plasticity Inorganic Clay (CL)
BH77 / SS03	1.5 – 2.1	25	15	10	Low Plasticity Inorganic Clay (CL)

4.1 Chemical Attack Potential

Twenty (20) samples of native soil, identified as in table 10, were submitted to an external analytical laboratory (ALS Laboratories) to assess the potential for the attack to buried concrete and ductile iron. Laboratory results and certificates are attached in Appendix D of this report.

A summary of the test results is presented in the following table:

Table 4: Buried Metal Attack Parameters

Sample ID	Depth (m bgs)	Parameters					Total Points	Corrosivity Potential
		Resistivity (ohm.cm)	pH	Redox Potential (mv)	Moisture (%)	Sulphides ⁽²⁾ (%)		
BH14/SS02	0.8 – 1.4	4720	7.65	198	15.7	<0.20	3	No
BH16/SS02	0.8 – 1.4	7320	7.81	211	13.0	<0.02	3	No
BH34/SS02	0.8 – 1.4	8600	7.74	208	11.6	<0.02	3	No
BH37/SS02	0.8 – 1.4	6320	7.85	245	10.7	<0.02	3	No
BH39/SS02	0.8 – 1.4	5050	7.75	232	14.2	<0.02	3	No
BH41/SS02	0.8 – 1.4	5190	7.76	205	16.4	<0.02	3	No
BH45/SS02	0.8 – 1.4	4810	7.70	220	16.2	<0.02	3	No
BH48/SS02	0.8 – 1.4	5600	7.47	246	18.1	<0.02	3	No
BH49/SS02	0.8 – 1.4	4880	7.77	193	18.1	<0.02	3	No
BH53/SS02	0.8 – 1.4	4550	7.78	244	10.9	<0.02	3	No
BH57/SS02	0.8 – 1.4	3760	7.76	209	17.3	<0.02	3	No
BH59/SS02	0.8 – 1.4	4670	7.81	197	16.0	<0.02	3	No
BH60/SS02	0.8 – 1.4	4420	7.50	224	19.9	<0.02	3	No
BH61/SS02	0.8 – 1.4	4950	7.76	209	14.6	<0.02	3	No
BH64/SS02	0.8 – 1.4	2770	7.92	210	15.6	<0.02	4	No
BH66/SS02	0.8 – 1.4	4570	7.75	209	16.8	<0.02	3	No
BH67/SS02	0.8 – 1.4	5640	7.86	202	10.7	<0.02	3	No
BH69/SS02	0.8 – 1.4	3310	7.55	241	16.0	<0.02	3	No
BH76/SS02	0.8 – 1.4	5230	7.55	260	17.8	<0.02	3	No
BH77/SS03	1.5 – 2.1	4520	7.52	269	11.7	<0.02	3	No

Note:

(1) Soil test evaluation carried out using AWWA C105/A21.5-05. A score of ten points or more indicates the soil is corrosive to ductile iron. Additional protection would be recommended if the score is 10 or greater.

(2) It was assumed that samples with a laboratory result less than the reported detection limit (RDL) for sulphides would be considered a trace condition (score of 2) and results greater than the RDL would be considered positive (score of 3.5).

The following Table of refereeing from CSA A23.1-04/A23.2-04 'Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Procedure for Concrete' divides the degree of exposure of concrete structures to sulphate attack into the following classes:

Table 5: Sulphate Exposure Classes

Degree of Exposure (Class)	Water Soluble Sulphate (SO ₄) in Soil Samples (%)
Very Severe (S-1)	> 0.20
Severe (S-2)	0.20 – 2.0
Moderate (S-3)	0.10 – 0.20

The laboratory results indicated that the sulphate content of samples identified are in the S-3 class, indicating a low potential for sulphate attack on concrete to be placed below the ground surface. Based on these results, standard Portland cement should be suitable for use on this project.

5 Groundwater Conditions

Groundwater observations were made in the boreholes as drilling proceeded and upon completion of drilling. Freestanding water was encountered upon completion of drilling in twenty-one (21) boreholes identified as BH02 to BH04, BH06 to BH09, BH15 to BH17, BH21, BH24, to BH28, BH30 to BH32, BH44, and BH51. Twelve (12) 51 mm outside diameter (O.D). monitoring wells were installed in BH02/MW02, BH03/MW03, BH22/MW22, BH30/MW30, BH33/MW33, BH35/MW35, BH50/MW51, BH51/MW51, BH60/MW60, BH70/MW70, BH74/MW74, and BH75/MW75. A summary of groundwater and cave-in recordings is presented in Table 4. It should be noted that there was not sufficient time available for the groundwater to stabilize inside the open boreholes.

Table 6: Groundwater and Cave-in Conditions

Borehole ID	Drilling Completion date	Groundwater Level Upon Completion of Drilling (mbgs)	Groundwater Level on June 24, 2019 (mbgs)	Groundwater Level on October 21, 2019 (mbgs)	Cave-in Level Upon Completion of Drilling (mbgs)
BH01	June 21, 2019	dry	n/a	n/a	1.5
BH02/MW02	June 10, 2019	5.6	3.4	4.4	9.1
BH03/MW02	June 10, 2019	4.6	2.1	3.1	5.9
BH04	June 3, 2019	9.1	n/a	n/a	4.6
BH05	June 3, 2019	dry	n/a	n/a	2.6
BH06	June 3, 2019	9.5	n/a	n/a	3.1
BH07	June 6, 2019	5.2	n/a	n/a	8.5
BH08	June 7, 2019	5.5	n/a	n/a	6.7
BH09	June 7, 2019	4.9	n/a	n/a	n/a
BH10	June 21, 2019	dry	n/a	n/a	2.4
BH12	June 6, 2019	dry	n/a	n/a	5.5
BH13	June 6, 2019	dry	n/a	n/a	8.5
BH14	June 5, 2019	dry	n/a	n/a	9.1
BH15	June 5, 2019	1.4	n/a	n/a	n/a
BH16	June 4, 2019	2.6	n/a	n/a	n/a
BH17	June 17, 2019	6.0	n/a	n/a	n/a
BH19	June 13, 2019	dry	n/a	n/a	8.8
BH20	June 13, 2019	dry	n/a	n/a	7.7
BH21	June 5, 2019	3.1	n/a	n/a	n/a
BH22/MW22	June 12, 2019	dry	0.1	0.8	n/a
BH24	June 4, 2019	3.0	n/a	n/a	n/a

BH25	June 17, 2019	2.6	n/a	n/a	n/a
BH26	June 14, 2019	3.4	n/a	n/a	8.8
BH27	June 14, 2019	7.6	n/a	n/a	n/a
BH28	June 18, 2019	1.8	n/a	n/a	7.0
BH30/MW30	June 11, 2019	5.2	2.0	3.2	6.1
BH31	June 17, 2019	3.4	n/a	n/a	7.9
BH32	June 4, 2019	0.6	n/a	n/a	n/a
BH33/MW33	June 12, 2019	dry	2.3	0.9	n/a
BH34	June 5, 2019	dry	n/a	n/a	8.8
BH35/MW35	June 12, 2019	dry	0.95	2.4	n/a
BH36	June 19, 2019	dry	n/a	n/a	6.1
BH38	June 4, 2019	dry	n/a	n/a	3.4
BH39	June 17, 2019	dry	n/a	n/a	7.9
BH40	June 19, 2019	dry	n/a	n/a	6.1
BH41	June 5, 2019	dry	n/a	n/a	8.5
BH44	June 19, 2019	7.2	n/a	n/a	n/a
BH45	June 20, 2019	dry	n/a	n/a	6.1
BH48	June 17, 2019	dry	n/a	n/a	8.2
BH49	June 4, 2019	dry	n/a	n/a	8.2
BH50/MW50	June 20, 2019	dry	0.8 ¹	n/a	n/a
BH51/MW51	June 11, 2019	4.7	6.1	2.2	n/a
BH55	June 18, 2019	dry	n/a	n/a	7.9
BH58	June 19, 2019	dry	n/a	n/a	6.1
BH59	June 4, 2019	dry	n/a	n/a	7.9
BH60/MW60	June 18, 2019	dry	1.5 ¹	n/a	7.5
BH61	June 4, 2019	dry	n/a	n/a	8.2
BH69	June 21, 2019	dry	n/a	n/a	6.1
BH70/MW70	June 11, 2019	n/a	1.23	2.3	n/a
BH74/MW74	October 16, 2019	dry	n/a	2.6	5.6
BH75/MW75	October 16, 2019	dry	n/a	3.4	5.6
BH76	October 15, 2019	3.1	n/a	n/a	5.5
BH77	October 15, 2019	3.1	n/a	n/a	1.2

Note:

1- Date measured: 02 July 2019.

The groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher in response to major weather events. No long-term groundwater monitoring provisions were made in this geotechnical investigation program.

6 Engineering Discussion and Assessment

Based on communication with the Client and a site visit to an existing transit facility located at 130 Sandalwood Parkway West in Brampton, Ontario, it is our understanding that the proposed development will consist of transit service and storage facility with a two-storey office building. The facility also contains above-grade bus parking bay and stormwater management pond. Seventy-three (73) boreholes were advanced in Parcel A and four (4) boreholes were advanced in Parcel B (See Appendix A for locations). Further details such as structural drawings, anticipated loading, Finished Floor Elevations (FFE), etc. were not available at the time of preparation of this report.

Freestanding groundwater was encountered in twenty-one (21) boreholes in the site upon completion of drilling. A detailed hydrogeological study was beyond the scope of work for this geotechnical investigation and will be provided in a separate cover. However, based on groundwater observations, excavations for shallow foundations may be anticipated to encounter groundwater during construction.

Based on above comments and the borehole information, and assuming them to be representative of the subsoil conditions across the site, following comments and recommendations are offered.

6.1 Site Preparation and Grading

Based on the conditions encountered in the boreholes as summarized in Section 3.0, the parking lot footprint area of the site primarily consists of ground cover of topsoil and asphaltic concrete gravel underlain by fill materials extending to depths ranging between 0.6 and 1.5 m bgs, with the exception of BH03 where fill was encountered to a depth of 2.3 m bgs. The fill consisted of clayey earth fill (ie. disturbed native from farming activities) and asphaltic concrete gravel in the eastern portion of the site (ie. existing City of Brampton laydown facility). In general, the existing earth fill was found to contain intermixed organics immediately below ground surface and decreasing with depth.

Prior to any construction, the existing ground surface cover and earthen berms are to be removed from the area of the proposed development. The asphaltic concrete gravel is not suitable for site grading or foundation purposes and should be removed entirely from the footprint of the building. Any organics, deleterious materials, asphaltic concrete and unsuitable fill exposed have to be removed from the area of the proposed building and parking lot. All subgrade surfaces which will support the footings and evaluation of suitable fill materials are to be examined by qualified geotechnical personnel.

The native and clayey fill soils encountered at the Site are generally suitable for reuse as backfill, provided it is free of organic and deleterious material and is within the optimum moisture content. Prior to any fill placement, the material needs to be inspected and approved by SNCL's qualified geotechnical engineer. Further comments regarding the use of backfill are discussed in Section 6.4. However, re-use of removed topsoil should be limited to landscaping areas (as applicable).

6.2 Building Foundations

The following section provides recommendations for geotechnical design of foundations for the proposed building based on the subsurface conditions encountered at the Site:

6.2.1 Conventional Spread Footings

The existing fill layers that overlay the proposed building footprint are unsuitable to support building foundations. Footings may be placed on the native strata at depths ranging approximately 1.2 m to 2.3 m, using a geotechnical bearing resistance of 200 kPa for a Serviceability Limit States (SLS) and 300 kPa for a factored Ultimate Limit State (ULS) design (assuming a 3 m by 3 m footing). It should be noted that the SLS bearing resistances is for total and differential settlements up to 25 mm and 20 mm respectively. The minimum founding depth at each of the borehole locations is provided in the Table below.

Table 7: Maximum Footing Depth / Elevation

Borehole	Approximate Depth (mbgs)	Approximate Elevation (MASL)
BH03	2.3	206.6
BH04	1.5	207.7
BH06	1.5	207.1
BH07	1.5	206.9
BH08	1.5	207.7
BH09	1.2	208.5
BH12	1.5	207.3
BH13	1.2	208.3
BH14	1.2	208.7
BH17	1.2	207.1
BH18	1.5	207.4
BH19	1.5	207.7
BH20	1.2	208.3
BH21	1.2	208.7
BH22	1.5	208.7
BH25	1.2	207.5
BH26	1.2	208.2
BH27	1.5	208.5
BH28	1.2	208.7
BH30	1.5	207.3
BH31	1.5	208.1
BH32	1.2	208.4
BH33	1.2	208.6
BH34	1.5	208.3
BH36	1.2	208.3
BH38	1.2	207.5
BH39	1.2	207.9
BH40	1.5	207.5
BH41	1.2	206.4
BH47	1.2	207.6
BH48	1.5	207.2
BH49	2.0	206.3
BH50	1.5	206.1
BH52	1.2	206.9
BH54	1.2	207.2
BH55	1.2	206.8

BH57	1.2	206.9
BH58	1.5	206.3
BH59	2.0	206.3
BH60	1.5	206.3
BH61	1.5	205.8

Conventional spread footings must be founded at least 0.2 metres into the native stratum for the geotechnical bearing resistance values provided. A permanent soil cover of a minimum of 1.2 m or its thermal equivalent in insulation is required for frost protection of all foundations. Higher geotechnical bearing resistances would be available at a greater depth, if required.

It is recommended that our office is allowed to review the structural drawings.

The exposed footing subgrades are to be inspected, evaluated and approved by SNCL's qualified geotechnical engineer or their designate.

Excavation for sump pits, utility trenches, footings, or similar should not intersect a zone which would extend downward and an angle of 10 horizontal to 7 vertical from the outside underside of existing or proposed footings.

6.3 Dewatering

As mentioned in Section 5, at the time of this investigation the groundwater table at the site (near Rainbow Creek for example) was at a shallow depths in some boreholes (e.g. BH35 approximately at 208.30 MASL). Based on the relatively shallow static groundwater elevation which was observed during this investigation, active dewatering may be required for excavations on this project in areas where groundwater cannot be controlled through the use of gravity fed sumps and pumps.

Any form of dewatering must consider possible settlements that may be caused on the adjacent areas, including the possible adverse effects on the existing and nearby structures, roads, underground services etc. It should also consider the large body of water present (e.g. the stream) as well as the relatively high permeability of the soils encountered in the boreholes.

As previously noted, a hydrogeological assessment has been prepared under separate cover. Nevertheless, the following general guidance is provided for designers of a dewatering system for this Site:

- Standby pumping capacity should be provided, in addition to an adequate primary capacity;
- Effective filters must be utilized in order to prevent migration of soil fines and ground loss;
- Pumped water must be discharged such that it will not interfere with excavations;
- Groundwater must be maintained at least 0.5 m below the base of any open excavations, including any progressively rising backfill during its placement in order to prevent 'pumping' of the base due to construction traffic/compaction efforts;
- Adequate monitoring of groundwater levels must be carried out – this may involve installation of further monitoring wells prior to construction; and

- On completion of construction activities, dewatering systems should be gradually shut down to prevent the creation of transient critical exit gradient conditions, which may result in migration of fines.

It should be noted that if pumping volumes for construction dewatering are less than 400,000L per day, a Permit to Take Water (PTTW) from the Ontario Ministry of the Environment (MOE) is not required. However, registration under the Environmental Activity and Sector Registry (EASR) from the MOE will be required.

6.4 Backfill Considerations

Backfilling, if required can be accomplished by reusing the excavated soils or similar fill material provided the moisture content is maintained within 2 percent of optimum and the fill is free of topsoil, organics and any deleterious material. The fill placed in excavated foundations should be in thin lifts not exceeding 200 mm thick and compacted to not less than 98 percent of its Standard Proctor Maximum Dry Density (SPMDD) up to 500 mm below pavement structure or hardscaped areas.

In general, the on-site excavated clayey soils including silty clay and clayey fills, will be excavated in cohesive blocks and will be difficult to handle and compact, requiring the use of heavy compactors for proper compaction. For use as backfill, the cohesive blocks will have to be pulverized and placed in thin layers, provided their moisture contents are at or near the optimum moisture content. Unless the clayey soils are properly reduced in sized and compacted in sufficiently thin lifts, post-construction settlements could occur.

Backfill placed in the upper 500 mm below pavement structure or hardscaped areas should be compacted to 98 % to 100% of that material's SPMDD.

For any fill operation to be considered Engineered Fill, the following criteria must be satisfied:

- Engineered Fill should consist of uniform, homogeneous material. The fill material should also be free of organics, deleterious materials (i.e. building debris such as bricks, metal etc.). Materials meeting Ontario Provincial Standard Specification, such as Select Subgrade material, and/or OPSS Granular B Type I or II specifications or of better quality would be considered a suitable Engineered Fill material;
- Prior to the placement of Engineered Fill, it must be evaluated for suitability in the Geotechnical Laboratory. Samples should be provided to the Geotechnical Engineer and submitted for Standard Proctor, grain size analysis and moisture content determination;
- Engineered Fill must be compactable, and of a suitable moisture content such that it is within +/- 2.0% of its optimum moisture content, as determined through laboratory testing, and compacted to not less than 100% of the materials' Standard Proctor Maximum Dry Density (SPMDD), and placed and compacted in separate lifts up to 250mm in thickness or as otherwise noted;
- Engineered Fill must be placed under the continuous supervision of a Geotechnical Engineer or their designate;

- Field density tests must be taken under the supervision of the Geotechnical Engineer on each lift of Engineered Fill. Any Engineered Fill which is tested and found to be out of specification shall be either removed, reworked or retested;
- Material to be used as Engineered Fill must be environmentally acceptable, subject to confirmatory testing; and
- Engineered Fill placed underneath foundations must extend laterally a minimum of 0.6 D, but not less than 0.9 m from the outside edge of the footings, where D is the depth of Engineered Fill placed.

6.4.1 Engineered Fill Foundations

Engineered fill could be considered for supporting foundations or if grade raise is required. Due to the gentle slope at the site, if existing grades are required to be raised for general site grading, and to avoid stepping down footings, it is understood that proposed foundations for this building may be placed on engineered fill. If this is desired, the following procedure should be implemented.

- The existing fill material within the proposed building area should be removed to an appropriate depth that leaves up to 0.5 m of existing fill in place;
- A series of test pits within the building footprint should be excavated through the existing fill layer on a 20 m grid pattern to the top of the underlying native soils in order to visually assess the fill quality, measure the thickness of the fill layer left in place (not exceeding 0.5 m), and to assess the condition of the underlying native subgrade;
- The exposed subgrade should be inspected, evaluated and approved by a geotechnical engineer or designate. The exposed fill surface should be compacted to a minimum of 100 percent SPMDD and a proof roll inspection is to be carried out using heavy construction equipment to identify any soft areas that should be subexcavated and replaced with compacted engineered fill;
- Provided the fill quality, layer thickness, and compaction of the existing fill layer is determined to be acceptable and the underlying native soils are found suitable to support engineered fill then subsequent fill layers can be placed to raise Site grades; and
- If appropriate compaction is not achieved or if the existing fill or native soils are deemed unacceptable, additional measures such as subexcavation will be required. These measures should be determined at the time of construction.

Provided the Engineered fill is used underneath the footings as noted above, a geotechnical bearing resistance of 150 kPa for a Serviceability Limit States (SLS) and 225 kPa for a factored Ultimate Limit State (ULS) design quoted can be used for foundations placed within the engineered fill area (for a 3 m by 3 m foundation at 1.2 m embedment).

The selected backfill materials should reasonably match the existing soil profile within the zone of frost penetration (1.2 m below finished grades). Alternatively, if imported backfill (including

granular material) are used, excavations should be provided with frost tapers – designers should refer to applicable OPSD for taper requirements.

6.5 Slab-on-Grade

In order to have a floor slab with minimum maintenance, we recommend that all objectionable materials (i.e. organic, wet, soft etc.) and fill soils are removed and the exposed subgrade should be inspected, evaluated and approved and thoroughly proof rolled. The engineered fill can consist of inorganic soil, placed in shallow lifts and compacted to not less than 100 percent of Standard Proctor Maximum Dry Density (SPMDD).

It should be possible for some fill to remain in place, subject to a field examination at the time of construction by SNCL's qualified geotechnical engineer. The slab-on-grade areas should be proof rolled. Underneath slabs, a minimum 200mm thick base layer consisting of Ontario Provincial Standard Specifications (OPSS) Granular A should be placed and compacted to 100% of its SPMDD. It is also recommended that the final lift of material beneath the slab consist of 150mm of clear stone material in order to provide a capillary break as well as for fine grading purposes.

The modulus of subgrade reaction appropriate for slab design would depend on the condition of the subgrade and the extent of sub-excavation required. If all unsuitable materials are removed beneath the proposed slab-on-grade and replaced with well-compacted Engineered Fill, then a modulus of subgrade reaction of 27,000 kN/m²/m to 32,500 kN/m²/m (100 to 120 pci) can be used for design purposes. Once the size of the slab is confirmed, SNCL needs to be notified and the modulus of subgrade reaction may need to be modified.

6.6 Drainage

Perimeter drainage is not considered necessary for a structure with no basement and a floor slab set a minimum of 0.3 m above finished exterior grades. Appendix 7 presents typical sections of perimeter drains in accordance to the latest edition of the Canadian Foundation Engineering Manual. The drainage system should discharge to a protected and frost-resistant sump. The uppermost backfill should be impermeable soil.

It is generally recommended that all slabs-on-grade which are located at or near exterior grades be located a minimum of 300 mm above the final exterior grade, and that the ground surface around the perimeter of the buildings slope downward and away from the building walls.

Dampproofing should be applied to exterior foundation walls in order to prevent moisture infiltration from the backfill materials. Waterproofing membranes could be considered as an additional precaution.

6.7 Seismic Site Classification

Buildings foundations are required to be structurally designed to resist a minimum earthquake force, as defined in the National Building Code of Canada, 2015 (NBCC).

In accordance with Section 4.1.8.4 of NBCC, the site classification for seismic site response was verified by measurement of the in-situ shear wave velocity by geophysical techniques. Geophysics GPR conducted multi-channel analysis of shear waves (MASW) at the project site at

two locations, as shown in Appendix E. Based on the analysis, the average shear wave velocity for the top 30 m at the site was 571 m/s and therefore, a seismic site classification of 'C' can be considered at this project site.

6.8 Excavation and Temporary Shoring

6.8.1 Open Cut

The OHSA regulations require that if workmen must enter an excavation deeper than 1.2 m, the excavation must be suitably sloped and/or braced in accordance with the OHSA requirements. OHSA specifies the maximum slope of the excavations for four broad soil types as summarized in the following table:

Table 8: Maximum Slope of Excavation for Soil Type

Soil Type	Base of Slope	Maximum Slope Inclination
Type 1	Within 1.2 metre of bottom	1 horizontal to 1 vertical
Type 2	Within 1.2 metre of bottom of trench	1 horizontal to 1 vertical
Type 3	From bottom of excavation	1 horizontal to 1 vertical
Type 4	From bottom of excavation	3 horizontal to 1 vertical

The fill at the Site above the groundwater can be classified as Type 3 soils. The Native clayey soils can be classified as Type 1 (hard) to 3 (firm to stiff) soils. The cohesionless soils encountered at depth at this site can be classified as Type 1 (very dense) to type 3 (compact) soils. If affected by groundwater or surface water seepage, the fill and native soils must be considered as Type 4 soils. The highest number of soil type identified in an excavation must govern the excavation slopes from top to bottom of the excavation.

If the above-recommended excavation side slopes cannot be maintained due to lack of space (i.e. due to building addition) or any other reason, the excavation sides must be supported by an engineered shoring system. The shoring system should be designed in accordance with relevant codes, standards, and regulations such as the latest version of the Canadian Engineering Foundation Manual and the OHSA Regulations for Construction Projects.

For all temporary construction excavation slopes, the stability of the cut slopes will have to be frequently monitored by the geotechnical engineer. If the temporary construction excavation slopes are subject to erosion (e.g., due to rainfall, high groundwater flow, etc.), slope stabilization measures (e.g., covering the slope/trench faces with plastic sheets, excavating flatter slope, etc.) will have to be implemented.

Stockpiles of excavated materials should be kept at least 3 m from the edge of the excavation to prevent slope instability, subject to confirmation by the geotechnical engineer. Care should also be taken to avoid overloading of any underground services/structures by stockpiles.

No major excavation difficulties are foreseen in the existing overburden soils within the depths drilled for this investigation, but allowance should be made for the possible presence of boulders

and cobbles that may be found within the soil strata, so the use of appropriate equipment is recommended.

Temporary support for underground utilities (e.g. gas, water, cable, sewer, and telephone) and any existing footings/structures which may be exposed during the excavation may be required. Approval should be obtained from relevant authorities and utilities companies regarding excavation works around such services/footings.

6.8.2 Temporary Shoring and Lateral Earth Pressures

No basement is anticipated in proposed building area, however, service pits are anticipated. Any permanent walls or temporary shoring systems must be designed by a qualified engineer in order to resist unbalanced lateral earth pressures.

If required, shoring systems such as trench boxes could be employed for the site, if insufficient space is available to properly backslope excavation sidewalls. The temporary shoring system should be designed and provided in accordance with the latest version of the Canadian Foundation Engineering Manual, 4th Edition, and Ontario Health and Safety Regulations.

For design purposes, the following table presents geotechnical parameters related to lateral earth pressures can be considered:

Table 9: Lateral Earth Pressure Parameters

Soil Type	Bulk Unit Weight, γ (kN/m ³)	Angle of Internal Friction (Φ)	Coefficient of Lateral Earth Pressure		
			K_a	K_o	K_p
Silty to Clayey Fill	19	27	0.38	0.55	2.66
Native Silty Clayey Till Soils (stiff)	18.5	29	0.35	0.52	2.88
Native Silty Clayey Till Soils (very stiff to hard)	21	30	0.34	0.5	3.0
Native Cohesionless Tills (compact)	21	30	0.34	0.5	3.0
Native Cohesionless Tills (Dense)	21.5	32	0.31	0.47	3.25
Native Cohesionless Tills (Very Dense)	22	34	0.28	0.44	3.54
Compacted Granular 'B' Type II / "A"	21.5	35	0.27	0.43	3.70

Note: the above values were calculated considering a level surface behind the wall

Horizontal earth pressures can be calculated based on the following equation:

$$P = K [\gamma(h-h_w) + \gamma' h_w + q] + \gamma_w \cdot h_w$$

where:

P = the horizontal pressure at depth, h (m)

K = the earth pressure coefficient,

γ = the bulk unit weight of soil, (kN/m³)

γ' = the submerged unit weight of soil, (kN/m³)

γ_w = the unit weight of water, (kN/m³)

h_w = the depth below the groundwater level (m)

q = the complete surcharge loading (kPa)

Where elevated groundwater level is not anticipated to be present or that a perimeter drainage system is used to eliminate hydrostatic pressures on the soil retaining structure, the above noted expression will be simplified as follows:

$$P = K(\gamma h + q)$$

This equation assumes a drainage system which eliminates hydrostatic pressures would be present shoring system. It should be noted that shoring systems should be restrained and not allow lateral yielding, therefore the at-rest earth pressure coefficient should be used for their design. Surcharge loads related to compaction equipment should be taken into considerations for all designs.

6.9 Site Services

The boreholes showed that in their undisturbed state, the native soil will generally provide adequate support for utilities and allow the use of normal Class 'B' Type bedding (i.e. compacted granular bedding material - as per applicable OSPD standards e.g. OSPD 802.032). The recommended minimum thickness of granular bedding below proposed utilities is 150 mm. The thickness of the bedding may, however, have to be increased depending on the pipe diameter, as per specifications, or if wet or weak subgrade conditions are encountered. The Class 'B' Type bedding may need to be wrapped by a geotextile (e.g., Terrafix 270R or equivalent), as directed by the geotechnical engineer. HL6 clear stone wrapped in geo-textile and/or high performance bedding (HBP) can be considered as alternative bedding if wet or unsuitable conditions are present at the subgrade.

In any event, after installing the pipe on the bedding, the compacted bedding material must surround the pipe and extend above the top of the pipe as set by the applicable standards, but not less than 300 mm, to avoid damage to the pipe during backfilling. Backfill immediately overlying the bedding must be compacted carefully using a suitable compactor to avoid damage to the pipe.

6.10 Noise Walls

Based on information provided by the client, it is our understanding that noise barrier walls are proposed to be located along the southern boundary of the site. It is anticipated that the noise barrier wall foundations will be supported by caissons, and that lateral resistance of the soil will govern the design. The resistance to lateral loading in front of a vertical caisson can be estimated

using the subgrade reaction theory, where the coefficient of horizontal subgrade reaction K_s (kN/m^3) is described in detail below.

Lateral resistance of pile / caissons foundation can be derived from:

$$P = -K y$$

where:

P = is the soil reaction in load per unit length of the pile (kN/m);

K = is the horizontal spring constant (kN/m^2);

y = is the pile deflection (m).

The horizontal subgrade modulus k_s is defined as:

$$P/D = -k_s y$$

where:

D = is the width of the pile / caisson (m);

k_s = is the horizontal soil modulus (kN/m^3).

Lateral resistance design of pile foundations for soil-caisson interaction may be calculated using values for the coefficient of horizontal subgrade reaction ($k_s - \text{kN/m}^3$) as follows:

$$k_s = n_h z / D \text{ [Terzaghi (1955), non-cohesive soils]}$$

$$k_s = 67 C_u / D \text{ [Davidson (1970), cohesive soils]}$$

where

n_h = horizontal modulus of subgrade reaction (kN/m^3)

z = depth of embedment of pile (m)

C_u = undrained shear strength (kPa)

The following Table presents the recommended soil parameters.

Table 10: Recommended Soil Parameters

Borehole ID	Applicable Elevation (MASL)	Soil Type	Bulk Unit Weight, γ (MN/m ³) ¹	Angle of Internal Friction (Φ)	Recommended n_h value (MN/m ³)	Recommended Undrained Shear Strength (kPa)	Groundwater Elevation (MASL)
BH17	207.1 – 205.3	Native Silty Clay Till	21.0	30	-	150	202.2
	205.3 – 202.2	Sandy Silt Till	22	34	18.0	-	
	202.2 – 198.6	Sand Till	22.5	34	11.0	-	
BH62	206.8 – 206.4	Native Silty Clay Till	21.0	30	-	120	n/a
	206.4 – 202.0	Sandy Silt Till	22	34	18.0	-	
BH69	206.8 – 201.0	Native Silty Clay Till	21.0	30	-	120	n/a
BH72	207.8 – 204.0	Native Silty Clay Till	21.0	30	-	200	n/a

Notes: 1) use buoyant unit weights below groundwater

As noted above, the contribution of lateral resistance of the soil within the frost depth (i.e. 1.2 m below the final grade) should not be included in calculations, except for the weight of soil. Research shows however that the restraint provided at the ground surface level plays a significant role in the performance of laterally loaded structures, and therefore, the placement of well compacted, competent material at and near ground surface immediately around the augered caisson is recommended.

Based on the borehole information as shown in the stratigraphic cross sections, the installation of caissons is anticipated to be carried out typically within cohesive and cohesionless deposits. Depending on the final depth of the proposed foundations, groundwater may be encountered during the installation of the caissons. During construction, caissons will require the use of temporary steel casings (liners) to support the granular soils below groundwater and to reduce the risk of caving. Temporary steel casings will also enable the bases to be properly cleaned of any disturbed soils and enable inspection and approval of the base by the geotechnical engineer, where necessary. The casing would then be carefully withdrawn as the concrete is poured, keeping a sufficient head of concrete in the casing to prevent 'necking'. Alternatively, installation by tremie methods can be used for concreting caissons below groundwater. The clayey silt and silty clay deposits can be expected to be self-supporting and should not yield significant amounts of water in the short term, in caisson holes, even below the groundwater table. However, water bearing layers may cause instability problems during the installation of the caissons. Where these layers are rather thin and the soil is relatively fine grained, it may be possible to effect the construction by pouring the concrete rapidly upon the completion of the excavation of the caisson hole. In other cases however, the sandy layers may cause excessive groundwater seepage in unlined caisson holes and will necessitate special precautions by the contractor.

The use of extensive dewatering techniques to lower the groundwater table during the construction is unlikely to be economically viable due to limited construction efforts required. Within the cohesionless till and/or sandy layers below the groundwater table, the soil is susceptible to disturbance due to the unbalanced hydrostatic head and seepage, and may become unstable, especially with increased depth of excavation below the groundwater table. The contractor should maintain the stability of the soil at the sides and the bases of the holes for concrete foundations at all times, from the commencement of excavation to the completion of pouring the concrete. In view of the above, we recommend that the following special provisions be included in the contract documents:

- The contractor shall install concrete foundations in earth for the foundations. At various foundation locations, strata may consist of fill, silty sand to sandy silt, clayey silt to sandy till deposits. Groundwater is likely to be encountered above the base of the excavations at some locations.
- At various locations, soil deposits may consist of basically granular (i.e. non-cohesive) soils such as silty sand to sandy silt and sandy till. In such cases where the soil is susceptible to conditions of unbalanced hydrostatic head and seepage forces, “boiling” or a quick condition may occur and the soil may become unstable.
- The contractor shall maintain the stability of the soil along the side and base of the holes for the concrete caissons at all times, from the commencement of construction to the placement of concrete.
- Dewatering may be required to maintain a sufficiently dry condition for proper placement of the concrete.

We recommend that the contractor also be advised that the presence of cobbles and boulders can be expected, especially within the till deposits, which can cause problems during the installation of the caissons, such as increasing the time for drilling, employment of special equipment, etc., as well as possible dewatering requirements.

6.11 Pavement Design Selection and Recommendations

Based on the findings of the boreholes and visual condition of the project site to fit the proposed new bus terminal/garage and access road (heavy-duty traffic) and car parking areas (light duty traffic), new construction is recommended. The following table shows the summary of major reasons for pavement design selection. The pavement designs include a light duty section for passenger vehicle parking areas, and a heavy duty section for bus terminal and access roads (ie. trucks / buses).

Table 11: Asphalt Pavement Design

Route	Recommended Option	Reason
Bus Terminal/Garage and Access Road (Heavy Duty)	Rigid Pavement	Mitigate potential for pavement rutting and distortion due to frequent stop, move and turning movements of buses More Durable Less maintenance and longer design period Eliminate transition from flexible to rigid along the bus garage/access road
Car Parking Lot (Light Duty)	Flexible Pavement	Less expensive in terms of initial investment and maintenance Absence of heavy trucks or buses Easy and fast for rehabilitation and maintenance

Based on above table, Rigid Pavement Option is recommended for Bus Terminal and Access Road; Flexible Pavement is recommended for the car parking lot.

6.11.1 Rigid Pavement: Heavy Duty Parking Area (Bus Terminal and Access Road)

The recommended minimum required pavement structure for the Bus Terminal and Access Road is as follows:

- Excavate/remove the existing topsoil and underlying material in order to accommodate 730 mm (Granular A) or 630 mm (OGDL) pavement structure below the proposed final grade of the proposed parking area;
- Perform subgrade preparation with 3% crossfall toward drainage outlets (catch basins, storm sewers, or ditch);
- Place and compact 300 mm Granular B Type II to minimum 100% of Standard Proctor Maximum Dry Density (SPMDD);
- Place and compact 200 mm Granular A or 100 mm OGDL (Open Graded Drainage Layer), with 2% crossfall toward drainage outlets to minimum 100% SPMDD;
- Place 230 mm JPCP (Jointed Plain Concrete Pavement) in slabs not exceeding 4.5m in joint spacing, with 32mm dowel bars at slab joints (all directions) with 300mm dowel spacing.

6.11.2 Flexible Pavement: Light Duty Parking Lot (Car Parking)

- Excavate/remove the existing topsoil and underlying material in order to accommodate 540 mm pavement structure below the proposed final grade of the proposed parking area;
- Perform subgrade preparation with 3% crossfall toward drainage outlets (catch basins, storm sewers, or ditch);

- Place and compact 300 mm Granular B Type II to minimum 100% of Standard Proctor Maximum Dry Density (SPMDD);
- Place and compact 150 mm of Granular A with 2% crossfall toward drainage outlets to minimum 100% SPMDD;
- Pave 50 mm of HL8 binder course;
- Place SS-1 Tack Coat; and
- Pave 40 mm of HL3 surface course.

Design Considerations:

1. It should be noted that the above pavement designs are based on assumed traffic. If more accurate or reliable data are available, the pavement design should be accurate.
2. The permanent ground water level should be at least 1.5 m below the proposed finished grade by providing positive drainage system (e.g. subdrains, storm sewer, etc.) to prevent frost heave. To promote effective surface drainage, the finished pavement surface must be free of depressions and sloped at a minimum grade of two percent towards a positive outlet for runoff. Surface water should not be allowed to pond at the outside edges of any pavement areas.
3. All objectionable materials and surficially softened fill soils are removed and the exposed subgrade base is thoroughly proof rolled. The pavement thicknesses recommended above considers that construction will be carried out during a dry seasonal period and that the subgrade soils are competent. If the subgrade becomes excessively wet or rutted during construction activities, sub-excavation and replacement with additional depth of granular sub-base material may be required. The disturbance of the subgrade material during site preparation, stripping, proofrolling and granular fills must be avoided. If the granular pavement fill is placed on disturbed, undulating soils, water can be trapped and collect in the depression which could lead to differential frost heave and thus damage the asphaltic concrete surface.

6.11.3 Pavement Construction Material

Pavement construction material for new parking areas are summarized as follows:

Flexible Pavement

1. The minimum grade of asphalt cement for this project should be PG 58-28, however, consideration may be given to a high-grade increase to PG 64-28 for the heavy duty parking areas.
2. New asphalt will be paved and compacted to minimum 92% of Maximum Relative Density (MRD)
3. Tack coat should be applied to the top of binder course, as per OPSS PROV 308 and City of Brampton Specification.

4. Civil designers and contractors should refer to and follow all applicable OPSS (Such as OPSS 310, 1010, 1150) and local region/city standards regarding material specifications and construction procedures for new pavement construction.

Rigid Pavement

1. The concrete should satisfy the requirements of CAN/CSA A23.1-04 Class C-2 concrete with a minimum compressive strength of 32 MPa and a minimum flexural strength of 5.0 MPa. The PCC concrete should meet the requirements of local region/city specification.
2. Dowel bars shall be plain round bars of grade 300 or better according to CSA G40.219 and shall be epoxy coated according to OPSS 1442.
3. For concrete base specification, Dowel detail, Joint details, Concrete joint layout and Joint spacing, please refer to OPSS 350, OPSD 552.051, 552.010, 551.031 and 551.010, respectively.
4. Wire shall be according to ATSM A 82M. Wire sizes shall be according to American Steel Wire Gauge.
5. Standard subdrain should be installed as per OPSS and OPSD

7 Closure

The recommendations provided in this report are based on subsoil data obtained at the sounding locations. Experience indicates that the subsoil and groundwater conditions can vary significantly between and beyond the sounding locations. For this reason, the recommendations given in this report are subject to a field verification of the subsoil conditions at the time of construction.

Should any site condition encountered differ from those at the tested locations or any changes in the project, we request that SNCL be notified immediately in order to permit reassessment of the recommendations.

8 General Conditions and Limitations

A. Use of the Report

- A.1 The work performed in this report was carried out in accordance with the terms and conditions made part of our proposal and/or contract pursuant to which the report was issued. The conclusions presented in the report are based solely upon the scope of services, governed by the time and budgetary considerations to which this work is subject.
- A.2 The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation or if the project is not initiated within twelve months of the date of the report, SNCL should be given an opportunity to confirm that the recommendations are still valid.
- A.3 The comments given in this report are intended only for the guidance of the design engineer. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual test hole data, as to how subsurface conditions may affect their work.
- A.4 The reader should be advised that geotechnical opinions, presented in this report, are subject to inherent uncertainties due to sampling limitations.
- A.5 The report must be read as a whole, as sections taken out of context may be misleading. Drafts and working copies of study reports and other deliverables, whether or not marked "draft" and/or "for discussion purposes", do not necessarily reflect SNCL's final opinion following consideration of all matters which are the subject of the study giving rise thereto; they are issued for comment and information purposes only, and are subject to change. The reader should not rely on such documents for any purpose.

B. Follow-up

- B.1 All details of the design and proposed construction may not be known at the time of submission of SNCL's report. It is recommended that SNCL be retained during the final design stage to review the design drawings and specifications related to foundations, earthworks, retaining systems and drainage, to determine that they are consistent with the intent of SNCL's report.
- B.2 Retention of SNCL during construction is recommended to confirm and document that the subsurface conditions throughout the site do not materially differ from those given in SNCL's report and to confirm and document that construction activities did not adversely affect the design intent of SNCL's recommendations.

C. Soil and Rock Conditions

- C.1 Soils and/or rock descriptions in this report are based on commonly accepted methods of classification and identification employed in professional geotechnical practice. Classification and identification of soil and rock involves judgment and

SNCL does not guarantee descriptions as exact, but infers accuracy only to the extent that is common in current geotechnical practice.

- C.2 The soils and rock conditions described in this report are those observed at the time of the study. Unless otherwise noted, those conditions form the basis of the recommendations in the report. The condition of the soil and rock may be significantly altered by construction activities (traffic, excavation, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting or drying. Unless otherwise indicated the soil and rock must be protected from these changes or disturbances during construction.

D. Logs of Test Holes and Subsurface Interpretations

- D.1 The test hole logs indicate the approximate subsurface stratigraphy and conditions only at the locations of the test holes. Soil and rock formations are variable to a greater or lesser extent. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. The precision with which subsurface stratigraphy and conditions are indicated depends on the method of boring, the frequency of sampling, the method of sampling and the uniformity of subsurface stratigraphy and conditions.
- D.2 Subsurface stratigraphy and conditions between test holes are inferred and may vary significantly from stratigraphy and conditions encountered at the test holes.
- D.3 Groundwater elevations and conditions described in this report refer only to those observed at the place and time of observation noted in the report. These elevations and conditions may vary seasonally or as a consequence of construction activities on the site or adjacent sites.

E. Changed Conditions

- E.1 Where conditions encountered at the site differ significantly from those described or anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the use or reliance by the client on this report that *SNCL* is notified of the changes and provided with an opportunity to review the recommendations of this report. Recognition of changed soil and rock conditions requires experience and it is recommended that an experienced geotechnical engineer be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

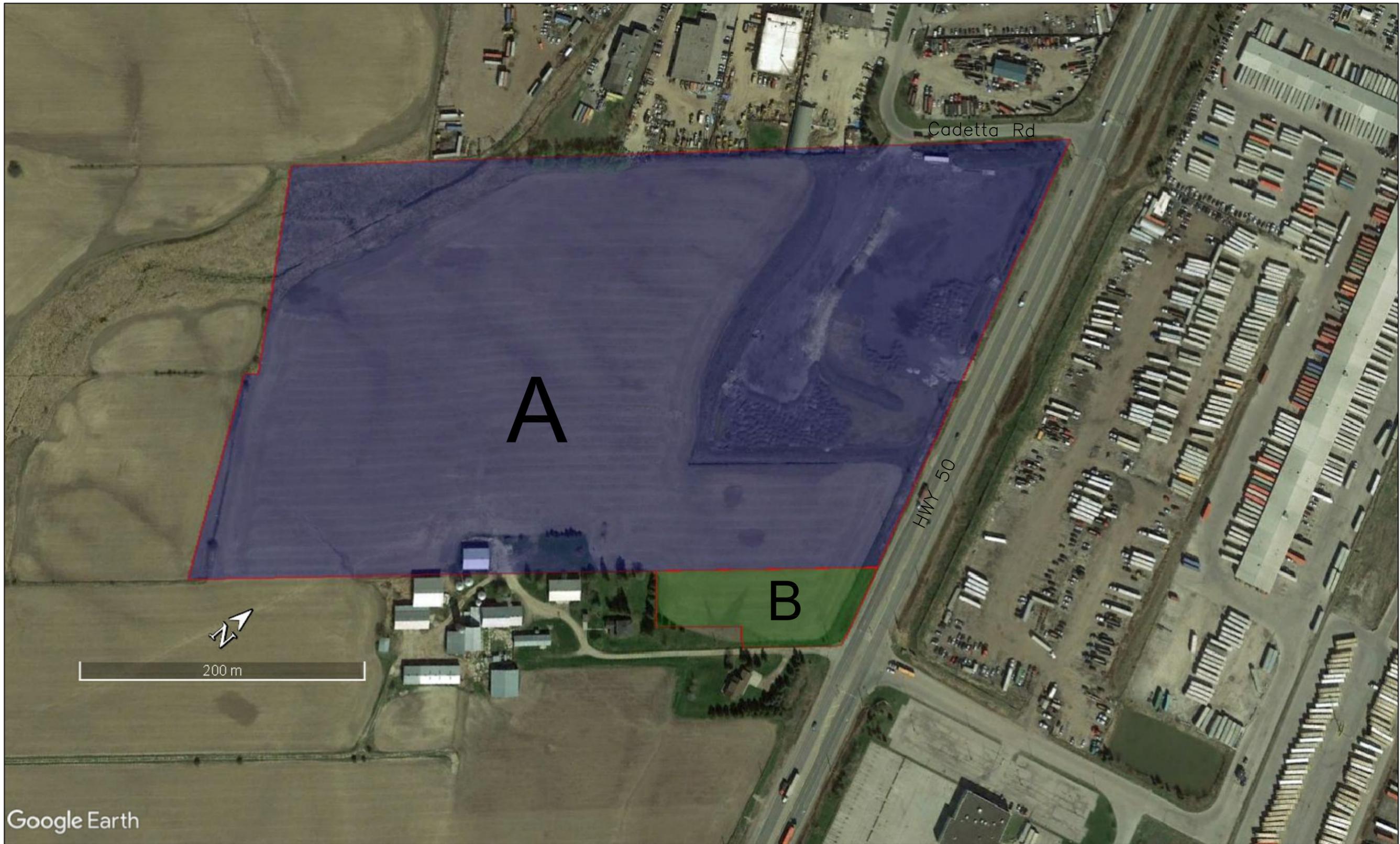
F. Drainage

- F.1 Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage can have serious consequences. *SNCL* can take no responsibility for the effects of drainage unless *SNCL* is specifically involved in the detailed design and follow-up site services during construction of the system.

END OF DOCUMENT

Appendix A

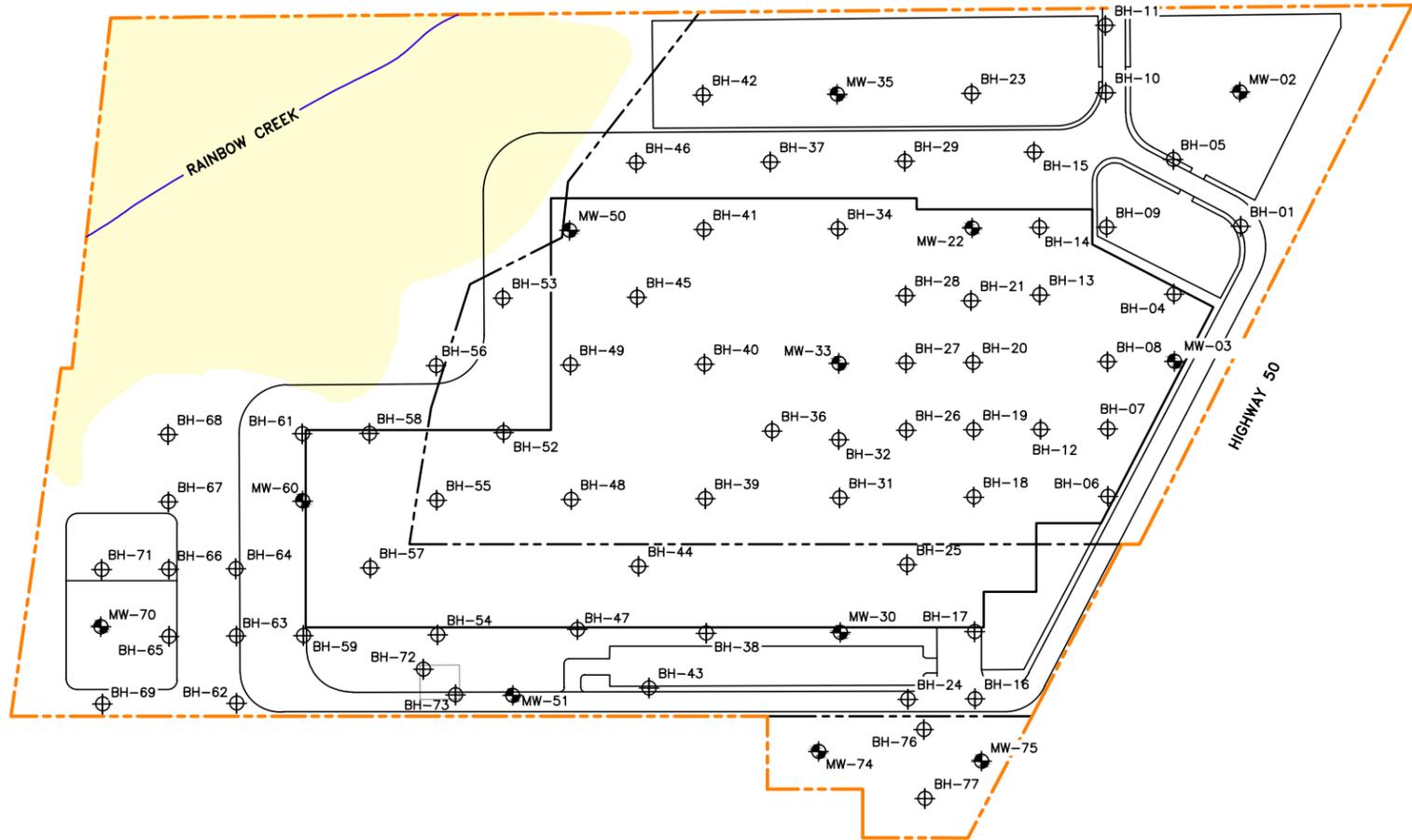
Site and Borehole Location Plan (2 pages)



NOTE(S):
 1. SCALE AND SITE INFRASTRUCTURE LOCATIONS ARE APPROXIMATE
 2. INFORMATION ON THIS FIGURE MAY BE LOST IF IT IS PRINTED, PHOTOCOPIED OR FAXED IN OTHER THAN ITS ORIGINAL SIZE AND COLOURS
 3. PARCELS (A, B, C AND D) ARE REFERENCED FROM RFP DOCUMENTS. ANY FUTURE CHANGES IN SHOULD BE ACCOMMODATED IF NECESSARY.



Client/Location: CITY OF BRAMPTON 10192 HIGHWAY 50, BRAMPTON, ON		Title: SITE PLAN	
Project No: 665125	Filename: 	Date: DEC 2019	Dwg No: FIGURE 1
Drawn: RM	Verified: AY	Project Manager: AY	



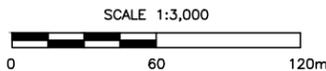
SAMPLE ID	EASTING	NORTHING
BH-01	606423.57	4852185.92
MW-02	606377.19	4852223.96
MW-03	606450.93	4852124.65
BH-04	606417.00	4852146.00
BH-05	606381.35	4852181.74
BH-06	606478.28	4852063.42
BH-07	606455.09	4852082.45
BH-08	606431.90	4852101.46
BH-09	606385.52	4852139.52
BH-10	606339.12	4852177.58
BH-11	606315.93	4852196.60
BH-12	606436.06	4852059.24
BH-13	606389.68	4852097.30
BH-14	606366.48	4852116.32
BH-15	606339.00	4852136.00
BH-16	606509.82	4851959.94
BH-17	606486.62	4851978.98
BH-18	606440.23	4852017.03
BH-19	606417.04	4852036.05
BH-20	606393.84	4852055.08
BH-21	606372.00	4852072.00
MW-22	606347.46	4852093.13
BH-23	606301.07	4852131.20
BH-24	606490.79	4851936.75
BH-25	606444.40	4851974.81
BH-26	606398.01	4852012.85
BH-27	606374.81	4852031.88
BH-28	606351.62	4852050.92
BH-29	606305.24	4852088.98
MW-30	606448.57	4851932.58
BH-31	606402.18	4851970.64
BH-32	606382.00	4851987.00
MW-33	606355.80	4852008.70
BH-34	606309.40	4852046.74
MW-35	606263.02	4852084.80
BH-36	606359.95	4851966.48
BH-37	606267.18	4852042.59
BH-38	606410.51	4851886.19
BH-39	606364.12	4851924.26

SAMPLE ID	EASTING	NORTHING
BH-40	606317.73	4851962.30
BH-41	606271.34	4852000.36
BH-42	606224.96	4852038.41
BH-43	606413.00	4851851.00
BH-44	606368.28	4851882.04
BH-45	606275.51	4851958.14
BH-46	606229.13	4851996.19
BH-47	606372.46	4851843.00
BH-48	606326.06	4851877.86
BH-49	606279.68	4851915.92
MW-50	606233.29	4851953.98
MW-51	606376.62	4851802.00
BH-52	606283.85	4851873.71
BH-53	606237.46	4851911.75
BH-54	606334.41	4851793.41
BH-55	606288.01	4851831.47
BH-56	606241.63	4851869.53
BH-57	606292.18	4851789.25
BH-58	606245.80	4851827.32
BH-59	606296.34	4851747.04
MW-60	606249.96	4851785.10
BH-61	606226.77	4851804.11
BH-62	606300.51	4851704.81
BH-63	606277.31	4851723.83
BH-64	606254.12	4851742.86
BH-65	606258.29	4851700.64
BH-66	606235.10	4851719.67
BH-67	606211.90	4851738.70
BH-68	606188.70	4851757.73
BH-69	606262.45	4851658.43
MW-70	606239.26	4851677.44
BH-71	606216.07	4851696.48
BH-72	606359.90	4851769.60
BH-73	606362.00	4851771.20
MW-74	606484.17	4851890.91
MW-75	606531.45	4851945.30
BH-76	606505.43	4851930.42
BH-77	606528.74	4851913.36

LEGEND

- BOREHOLE
- MONITORING WELL
- TORONTO REGIONAL CONSERVATION AUTHORITY (TRCA) FLOODPLAIN
- SITE PROPERTY LINE
- PROPERTY LINE
- EXISTING BUILDING
- PROPOSED BUILDING
- PROPOSED INFRASTRUCTURE

NOTE(S):
 1. SCALE AND SITE INFRASTRUCTURE LOCATIONS ARE APPROXIMATE
 2. INFORMATION ON THIS FIGURE MAY BE LOST IF IT IS PRINTED, PHOTOCOPIED OR FAXED IN OTHER THAN ITS ORIGINAL SIZE AND COLOURS
 3. ALL UTM COORDINATES ARE IN NAD83 ZONE 17
 4. 'm' : METRES



Client/Location: CITY OF BRAMPTON 10192 HIGHWAY 50, BRAMPTON, ON		Title: BOREHOLE/MONITORING WELL LOCATIONS	
Project No: 665125	Filename: 001F01_665125	Date: OCTOBER 2019	Dwg No: FIGURE 2
Drawn: AG	Verified: RM	Project Manager: AY	

FILENAME: P:\City of Brampton\Johnston Transit Facility\665125\40_Execution\47_Wrkgs_Vers\CAD_GIS\001 (UTM Coord)\001F01_665125.dwg

Appendix B

Record of Borehole Logs (78 pages)

SNC-Lavalin Inc.
NOTES TO RECORD OF BOREHOLES

DRILLING DATA

Method:
 SolSt Auguring - Solid Stem Auguring
 HoSt Auguring - Hollow Stem Auguring
 WB - Washed Boring

SAMPLES

TYPE:
 SS - Split Spoon
 AS - Auger Sample
 TW - Thin wall Open
 TP - Thin wall Piston
 WS - Washed Sample
 BS - Block Sample
 RC - Rock Core
 PH - Sample Advanced Hydraulically
 PM - Sample Advanced Manually

LABORATORY DATA

WP - Plastic Limit (%)
 W - Water Content (%)
 WL - Liquid Limit (%)
 γ - Natural Unit Weight (kN/m³)
 UNDR STRNG or C_u - Undrained Shear Strength (kPa)
 Field Vane: St-sensitivity
 pp - Pocket Penetrometer
 UC - Unconfined Compression
 UU - Unconsolidated Undrained at Overburden Pressure
 CU - Consolidated Undrained
 CD - Consolidated Drained
 TOV - Total Organic Vapors

Standard Penetration Test, 'N'- Values: The Standard Penetration Test (SPT) 'N'-values are the number of blows required to cause a standard 51 millimeters o.d. split barrel sampler to penetrate 0.3 meter into undisturbed ground in a borehole when driven by a hammer with a mass of 63.5 kilograms falling freely a distance of a 0.76 meter. For penetrations of less than 0.3 meter, N-values are indicated as the number of blows for the penetration achieved (e.g. 50/25: 50 blows for 25 centimeters penetration).

Dynamic Cone Penetration Test: Continuous penetration of a conical steel point (51 millimeters o.d. 60° cone angle) driven by 475 J impact energy on a size drill rods. The resistance to cone penetration is measured as the number of blows for each 0.3 meter advance of the conical point into the undisturbed ground.

Soils are described by their composition and consistency or relative density

CONSISTENCY: Cohesive soils are described on the basis of their undrained shear strength (C_u) or 'N'-values as follows:

C _u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	<i>VERY SOFT</i>	<i>SOFT</i>	<i>FIRM</i>	<i>STIFF</i>	<i>VERY STIFF</i>	<i>HARD</i>
N (blows/0.3 meter)	0 - 2	2 - 4	4 - 8	8 - 15	15 - 30	>30

RELATIVE DENSITY: Cohesionless soils are described on the basis of relative density as indicated by 'N'-values as follows:

N (blows/0.3 meters)	0 - 4	4 - 10	10 - 30	30 - 50	>50
	<i>VERY LOOSE</i>	<i>LOOSE</i>	<i>COMPACT</i>	<i>DENSE</i>	<i>VERY DENSE</i>

Rocks are described by their composition and structural features and/or strength

RECOVERY: Sum of all recovered rock core pieces from a coring run expressed as a percent of the total length of the coring run.

ROCK QUALITY

DESIGNATION (RQD): Sum of those intact core pieces, 100 millimeters in length expressed as a percent of the length of the coring run. Classification of a rock based on the RQD value as follows:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	<i>VERY POOR</i>	<i>POOR</i>	<i>FAIR</i>	<i>GOOD</i>	<i>EXCELLENT</i>

JOINTING AND BEDDING:

SPACING	50 millimeters	50 - 300 millimeters	0.3 - 1.0 meter	1.0 - 3.0 meter	>3.0 meters
JOINTING	<i>VERY CLOSE</i>	<i>CLOSE</i>	<i>MOD. CLOSE</i>	<i>WIDE</i>	<i>VERY WIDE</i>
BEDDING	<i>VERY THIN</i>	<i>THIN</i>	<i>MEDIUM</i>	<i>THICK</i>	<i>VERY THICK</i>

RECORD OF BOREHOLE No. **BH01**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 21, 2019** Date Completed: **Jun 21, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606423.57 NORTHING: 4852185.92	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 µm (%) ○ Moisture Content (%) Atterberg Limits W _p W _L		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 210.06 m											
	Loose overburden asphalt ~1.20 m.	SS	01	67	21			○	○ ⁵			
	208.9	SS	02	75	39	1	209	○	○ ⁵			
	FILL Brown, stiff, silty CLAY, trace sand, trace gravel, moist. 1.2 208.5											
	NATIVE TILL Brown, very stiff, sandy silty CLAY, trace to some gravel, some oxidation, moist. 1.5 207.8	SS	03	75	19	2	208	○	○ ¹⁵			
	Brown, compact, sandy SILT, some clay, trace gravel, moist. 2.3	SS	04	100	19			○	○ ¹¹			
	GR: 4%; SA: 33%; Sl: 48%; & CL: 15%	SS	05	100	18	3	207	○	○ ¹¹			
	dense	SS	06	100	35	4	206	○	○ ¹¹			
	compact	SS	07	100	12	5	205	○	○ ¹³			
	End of borehole. 5.2											
	Notes: 1. Borehole was found to be caved-in at 1.52 mbgs with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 4. GR., SA., Sl. & CL. denote Gravel, Sand, Silt & Clay respectively.											



401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: **1.52 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

Scale: 1 : 63

Page: 1 of 1

RECORD OF BOREHOLE No. **BH03/MW03**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Phase II Environmental Site Assessment** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 10, 2019** Date Completed: **Jun 10, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606450.93 NORTHING: 4852124.65	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P 20 40 60 80		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 208.90 m											
	Loose crushed stone / asphalt pieces~ 460 mm. 208.4	SS	01	75								
	FILL Brown to light brown, stiff, silty CLAY, trace gravel, moist. 0.5											
		SS	02	84	8	1	208	○				Top of Riser Elevation = 209.81 m; Height of Riser= 0.92 m PP = 2.0 kg/ sq-cm Sample submitted for laboratory analysis: BH03-01 PP = 3.0 kg/ sq-cm Sample submitted for laboratory analysis: BH03-02 PP = 4.0 kg/ sq-cm
	becomes oxidized, some sand. 206.6											
	NATIVE TILL Brown, hard to very stiff, sandy silty CLAY, trace sand, trace gravel, oxidized, moist. 2.3											
		SS	03	100	9	2	207	○				
	fine sand at bottom. 205.3											
	Brown to brownish grey, compact, SAND, trace gravel, silty clay seams, moist. 0.6											
		SS	04	100	40	3	206	○				PP = 3.0 kg/ sq-cm
	becomes very dense. 204.6											
		SS	05	75	26	4	205	○				PP = 4.5 kg/ sq-cm
	becomes compact, wet. 203.6											
		SS	06	75	24	5	204	○				Sample submitted for laboratory analysis: BH03-07
		SS	07	0	50/50 mm	6	203	■				
	End of borehole. 202.2											
	6.7											Auger refusal.
Notes:												
<ol style="list-style-type: none"> Borehole was found to be caved-in at 5.94 mbgs with freestanding water at 4.57 mbgs upon completion. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019. PP = pocket penetrometer. 												

RECORD OF BOREHOLE No. **BH04**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 3, 2019** Date Completed: **Jun 3, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606427.73 NORTHING: 4852143.69	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _L W _P	Unit Weight (KN/m ³)	COMMENTS			
	Local Ground Surface Elevation: 209.27 m Loose overburden asphalt~ 760 mm.	SS	01	67	18	209	209	○	○ 7		22.53			
	208.5 0.8 FILL Brown, firm, silty CLAY, trace gravel, trace sand, oxidized, rootlets, moist.	SS	02	75	6	1	208	○	○ 24			PP = 3.5 Kg / sq.cm		
	207.7 1.5 NATIVE TILL Brown, very stiff, sandy silty CLAY, trace gravel, oxidized, moist.	SS	03	100	32	2	207	○	○ 16		21.37			
	207.0 2.3 Brown, very dense, sandy SILT, trace clay, trace gravel, oxidized, moist.	SS	04	100	55	3	207	○	○ 11		22.63	PP = 4.5 Kg / sq.cm		
	204.7 4.6 Grey, very dense, SILT, trace clay, trace sand, broken cobble pieces, moist.	SS	06	100	58	5	204	○	○ 9					
	203.2 6.1 Grey, dense, gravelly SAND, trace silt, broken cobble pieces, moist.	SS	07	75	45	6	203	○	○ 12					
	compact	SS	08	75	26	8	201	○	○ 12					
	200.1 1 Grey, very dense, SILT, some sand, trace gravel, moist.	SS	09	108	16/ 230 mm	9	200		○ 10		23.73	PP = 3.5 Kg / sq. cm		
	199.7 9.5 End of borehole. Notes: 1. Borehole was found to be caved in at 4.57 mbgs with freestanding water at 9.14 mbgs upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.													

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▽ Groundwater depth on completion of drilling: **9.14 m** ■ Cave in depth recorded on completion of drilling: **4.57 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH05**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **RM**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 21, 2019** Date Completed: **Jun 21, 2019** Revision No.: **0**

Lithology Plot	LITHOLOGY PROFILE DESCRIPTION	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606381.35 NORTHING: 4852181.74	
		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value			Penetration Testing ○ SPT ● DCPT	MTO Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould	★ Rinse pH Values 2 4 6 8 10 12	Soil Vapour Reading parts per million (ppm) 100 200 300 400		Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _p W _L	Unit Weight (KN/m ³)
	Local Ground Surface Elevation: 209.82 m													
	Loose overburden asphalt ~460 mm. 209.4	SS	01	51	9			○		○16				
	FILL Brown, firm, silty CLAY, trace sand, trace gravel, moist. 209.1					1		○		○12				
	NATIVE TILL Brown, very stiff to hard, sandy silty CLAY, trace to some gravel, moist. 0.8	SS	02	100	24			○		○14				PP = 3.5 kg/ sq-cm
	becomes hard	SS	03	100	25	2		○		○11				PP = 3.5 kg/ sq-cm
		SS	04	100	47		207	○		○10				
	End of borehole. 206.2 3.7					3								
	Notes: 1. Borehole was found to be caved-in at 2.59 mbgs with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.													

RECORD OF BOREHOLE No. **BH07**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 6, 2019** Date Completed: **Jun 6, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606455.09 NORTHING: 4852082.45	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L 20 40 60 80 W _p		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 208.46 m											
	Topsoil ~200 mm. 208.3											PP = 4.5 kg/ sq-cm
	FILL 0.2 Brown, firm, silty CLAY, trace sand, rootlets, moist. 207.7	SS	01	75	9		208	○	20			PP = 3.5 kg/ sq-cm
	NATIVE TILL 0.8 Brown, stiff, silty CLAY, trace sand, trace gravel, moist. 206.9	SS	02	100	13	1	207	○	13			PP = 3.0 kg/ sq-cm
	Grey, compact,, sandy SILT, trace to some clay, oxidized, moist. 1.5	SS	03	100	25	2	206	○	10			
	becomes very dense	SS	04	100	61	3	205	○	8			
		SS	05	100	50	4	204	○	14			
	Brown, dense, SAND, trace silt, some oxidation, wet. 4.6	SS	06	75	38	5	203	○	17			
						6	202	○	17			
		SS	07	75	30	7	201	○	17			
	Grey, dense to very dense, sandy SILT, 7.6 trace gravel, trace gravel, wet. 200.8	SS	08	100	44	8	200	○	18			
						9	199	○	11			
	End of borehole. 198.7 Notes: 9.8											

RECORD OF BOREHOLE No. **BH08**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 7, 2019** Date Completed: **Jun 7, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606431.9 NORTHING: 4852101.46	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P	Unit Weight (KN/m ³)	COMMENTS			
	Local Ground Surface Elevation: 209.24 m													
	Loose overburden asphalt~ 360 mm.						209							
	FILL Brown, firm, silty CLAY, trace sand, trace gravel, moist.	SS	01	59	17		209	○	○7					PP = 3.5 kg/ sq-cm
		SS	02	75	8	1	208	○	○28					PP = 4.0 kg/ sq-cm
	NATIVE TILL Brown, very stiff to hard, sandy silty CLAY, trace to some gravel, oxidized, moist to wet.	SS	03	100	17	2	207	○	○20					PP = 4.5 kg/ sq-cm
	becomes hard	SS	04	100	25	3	206	○	○16					PP = 3.0 kg/ sq-cm
		SS	05	100	54	4	205		○9					
		SS	06	100	70/ 280 mm	5	204		○13					PP = 4.0 kg/ sq-cm
	Grey, compact to dense, sandy SILT, trace clay, wet. GR: 0%; SA: 1%; SI: 48%; & CL: 41%	SS	07	84	29	6	203	○	○20					
		SS	08	75	34	8	201	○	○20					
	trace to some gravel	SS	09	75	24	9	200	○	○9					
	End of borehole. Notes: 1. Borehole was found to be caved in at 6.71 mbgs with freestanding water at 5.49 mbgs upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer. 4. GR., SA., SI. & CL. denote Gravel, Sand, Silt & Clay respectively.													

RECORD OF BOREHOLE No. **BH09**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 7, 2019** Date Completed: **Jun 7, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606385.52 NORTHING: 4852139.52			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	△ Intact	◇ Intact				▲ Lower Explosive Limit (LEL)
	Local Ground Surface Elevation: 209.69 m														
	Loose overburden asphalt~ 300 mm.														
	FILL Brown, very stiff, silty CLAY, trace gravel moist.	SS	01	59	25		209.4								PP = 3.0 kg/ sq-cm
	NATIVE TILL Brown, stiff, sandy silty CLAY, trace gravel, some oxidation, moist	SS	02	100	14	1	208.9				○16				PP = 4.0 kg/ sq-cm
	becomes hard trace broken cobble pieces	SS	03	25	33	2	208.6				○11				PP = 4.0 kg/ sq-cm
		SS	04	100	32	3	207.6				○15				PP = 2.5 kg/ sq-cm
		SS	05	100	45	4	207.1				○13				PP = 4.0 kg/ sq-cm
	becomes very stiff,	SS	06	84	24	5	206.1				○11				PP = 2.5 kg/ sq-cm
	becomes hard	SS	07	84	72	6	205.1				○10				PP = 3.0 kg/ sq-cm
	Grey, compact, SAND, wet.	SS	08	84	26	8	202.1				○12				
	End of borehole. Notes: 1. Borehole was found to be open with freestanding water at 4.88 mbgs upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.						201.5								Borehole could not be advanced below 8.23 m due to fall of a 1.52 m auger inside the hole.

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Groundwater depth on completion of drilling: **4.88 m**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH10**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **RM**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 21, 2019** Date Completed: **Jun 21, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606339.12 NORTHING: 4852177.58			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	△ Intact	◇ Intact				▲ Lower Explosive Limit (LEL)
	Local Ground Surface Elevation: 210.64 m														
	Loose overburden asphalt ~410 mm.														
	210.2 0.4 FILL Brown, stiff, silty CLAY, trace sand, trace gravel, moist.	SS	01	84	43		210		○			○ ²⁵			
	209.9 0.8 NATIVE TILL Brown, stiff, sandy silty CLAY, trace to some gravel, oxidized, moist.	SS	02	79	15	1	209		○			○ ¹⁸			
	209.1 1.5 Brown, compact, sandy SILT, trace to some clay, trace gravel, moist	SS	03	100	25	2	208		○			○ ¹²		PP = 2.75 kg/ sq-cm	
	becomes very dense	SS	04	100	50/100 mm		208		■			○ ⁹		PP = 3.5 kg/ sq-cm	
	207.5 3.2 End of borehole.	SS	05	100	50/100 mm	3	207.5					○ ⁸		PP = 3.5 kg/ sq-cm	
	Notes: 1. Borehole was found to be caved in at 2.44 mbgs with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.														

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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ■ Cave in depth recorded on completion of drilling: **2.44 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH11**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 5, 2019** Date Completed: **Jun 5, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606315.93 NORTHING: 4852196.6			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	△ Intact	◇ Intact				▲ Lower Explosive Limit (LEL)
	Local Ground Surface Elevation: 210.59 m														
	Loose overburden asphalt~ 460 mm.														
	210.1 FILL Brown, silty CLAY, trace sand, very moist.						210								
	209.8 NATIVE TILL Brown, very stiff, sandy silty CLAY, some oxidation, moist	SS	02	100	23	1		○							
	0.8														
		SS	03	100	27	2	209	○							
	becomes hard broken cobble pieces.	SS	04	100	44		208	○							
	207.7 End of borehole.														
	2.9 Notes: 1. Borehole was found to be open and no freestanding water upon completion.														

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH12**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 6, 2019** Date Completed: **Jun 6, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606436.06 NORTHING: 4852059.24			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	MTO Vane*	Nilcon Vane*				★ Rinse pH Values
	Local Ground Surface Elevation: 208.84 m														
	Topsoil ~200 mm. 208.6														
	FILL 0.2 Brown, firm, silty CLAY, trace sand, trace gravel, oxidized, moist. 208.1	SS	01	59	5									PP = 3.0 kg/ sq-cm	
	NATIVE TILL 0.8 Brown, stiff, sandy silty CLAY, some gravel, oxidized, moist.	SS	02	100	13	1	208							PP = 4.5 kg/ sq-cm	
	becomes hard	SS	03	67	51	2	207								
		ST	04	33											
	trace broken cobble pieces					3	206							PP = 4.5 kg/ sq-cm	
		SS	05	100	58										
	GR: 11%; SA: 29%; SI: 48%; & CL: 41%					4	205								
		SS	06	49	39	5	204							PP = 4.0 kg/ sq-cm	
						6	203								
	Grey, very dense, SAND, moist. 202.7	SS	07	244	61										
	End of borehole. 6.4													Auger refusal	

Notes:

- Borehole was found to caved in at 5.49 mbgs with no freestanding water upon completion.
- Water table was measured upon completion of drilling inside the hollow stem auger.
- PP = pocket penetrometer.
- GR., SA., SI. & CL. denote Gravel, Sand, Silt & Clay respectively.

∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: **5.49 m.**



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Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH13**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 6, 2019** Date Completed: **Jun 6, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606389.68 NORTHING: 4852097.3	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 209.48 m											
	Topsoil ~100 mm. 209.4											
	FILL Brown, stiff, silty CLAY, some sand, trace gravel, rootlets, oxidation, moist. 208.7	SS	01	75	9		209	○	○ ¹¹			PP = 3.5 kg/ sq-cm
	NATIVE TILL Brown, very stiff to hard, sandy silty CLAY, trace gravel, some oxidation, moist. 0.8	SS	02	84	20		1	○	○ ¹²			PP = 4.0 kg/ sq-cm
							208					PP = 4.5 kg/ sq-cm
	becomes hard						2	○	○ ¹¹			PP = 4.5 kg/ sq-cm
							207	○	○ ¹²			PP = 4.5 kg/ sq-cm
							3					PP = 3.0 kg/ sq-cm
							206	○	○ ⁹			
							4					
							205					
	Grey, dense, SAND, trace silt, trace to some gravel, moist. 204.9	SS	06	33	45		5	○	○ ¹⁶			
							204					
							6					
	Grey, hard, sandy silty CLAY, some gravel, moist. 203.4	SS	07	100	37		6	○	○ ¹³			PP = 3.5 kg/ sq-cm
							7					
							202					
	becomes very stiff						8	○	○ ¹⁵			PP = 3.5 kg/ sq-cm
							201					
							9					
	Grey, very dense, SAND, trace SILT, trace gravel, moist. 200.3	SS	09	100	50/150 mm		9		○ ¹⁰			
							200					
	End of borehole. 9.6											
	Notes: 1. Borehole was found to caved in at 8.53 mbgs with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.											

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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: **8.53 m**.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH14



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 5, 2019** Date Completed: **Jun 5, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606366.48 NORTHING: 4852116.32			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	△ MTO Vane*	◇ Nilcon Vane*				★ Rinse pH Values
	Local Ground Surface Elevation: 209.94 m														
	Topsoil ~100 mm.														
	FILL Brown, firm, silty CLAY, some sand, some gravel, moist.	SS	01	75	4										PP = 3.0 kg/ sq-cm
	NATIVE TILL Brown, very stiff to hard, sandy silty CLAY, trace gravel, moist.	SS	02	100	16	1	209								PP = 3.5 kg/ sq-cm
		SS	03	33	37	2	208								PP = 2.5 kg/ sq-cm
	becomes greyish brown	SS	04	84	43										PP = 3.0 kg/ sq-cm
	Brown, dense, sandy SILT, some clay, some gravel, some oxidation, moist.	SS	05	100	41	3	207								PP = 3.5 kg/ sq-cm
						4	206								
	becomes compact	SS	06	84	21	5	205								PP = 4.0 kg/ sq-cm
						6	204								
	becomes grey	SS	07	84	30										PP = 4.5 kg/ sq-cm
						7	203								
	becomes dense to very dense	SS	08	92	45	8	202								PP = 4.5 kg/ sq-cm
						9	201								
		SS	09	92	54										PP = 4.0 kg/ sq-cm
	End of borehole. Notes:														
	1. Borehole was found to caved in at 9.14 mbgs with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.														

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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: **9.14 m**.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH15**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 5, 2019** Date Completed: **Jun 5, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606343.29 NORTHING: 4852135.36			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	△ Intact	◇ Intact				▲ Lower Explosive Limit (LEL)
	Local Ground Surface Elevation: 210.59 m														
	Loose overburden asphalt~ 460 mm.														
	210.1 FILL Brown, silty CLAY, trace sand, very moist.						210								
	209.8 NATIVE TILL Brown, stiff, sandy silty CLAY, trace gravel, moist to very moist.	SS	01	100	14	1		○							
	0.8 becomes very stiff to hard oxidized cores.	SS	02	100	28	2		○							
		SS	03	100	55	3		○							
	broken cobble pieces.	SS	04	100	52	4		○							
	206.2 End of borehole.	SS	05	100	57	4		○							
	4.4														
	Notes: 1. Borehole was found open with freestanding water at 1.40 mbgs upon completion.														

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Groundwater depth on completion of drilling: **1.4 m**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH16**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 4, 2019** Date Completed: **Jun 4, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606509.82 NORTHING: 4851959.94			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	△ Intact	◇ Intact				▲ Lower Explosive Limit (LEL)
Local Ground Surface Elevation: 208.06 m															
	Topsoil ~ 150 mm.														
	FILL Brown, firm, silty CLAY, trace sand, rootlets, organics, oxidized, moist.	SS	01	33	5									18.93	PP = 1.25 Kg / sq.cm PP = 2.0 Kg / sq.cm
	NATIVE TILL Brown, stiff, sandy silty CLAY, trace gravel, trace broken cobble pieces, moist.	SS	02	100	8	1	207							20.81	
	hard some broken cobble pieces, very moist.	SS	03	51	40	2	206							23.02	
	Light grey, very dense, sandy SILT, trace clay, trace gravel, oxidized, broken cobble pieces, moist.	SS	04	100	75	3	205							23.48	
	End of borehole.	SS	05	91	50 / 100mm									22.07	
Notes: 1. Borehole was found to be open with freestanding water at 2.60 mbgs upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.															

Groundwater depth on completion of drilling: **2.6 m**



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RECORD OF BOREHOLE No. BH17



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 17, 2019** Date Completed: **Jun 17, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606486.62 NORTHING: 4851978.98	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L 20 40 60 80 W _p	COMMENTS				
	Local Ground Surface Elevation: 208.31 m													
	Topsoil~200 mm. 208.1													
	FILL 0.2 Light grey, firm, silty CLAY, trace sand, rootlets, moist.	SS	01	41	8		208	○			○27			PP = 1.5 kg/ sq-cm
	NATIVE TILL 0.8 Brown, very stiff, sandy silty CLAY, trace gravel, broken cobble pieces, oxidized seams, moist.	SS	02	75	16	1	207	○			○21			PP = 3.75 kg/ sq-cm
	hard	SS	03	100	21	2	206	○			○15			
		SS	04	100	50/ 125 mm		206				○12			Higher N value probably due to presence of cobbles.
						3	205				○14			Higher N value probably due to presence of cobbles.
	Grey, very dense, sandy SILT, some clay. 1 trace gravel, broken cobble pieces, moist to wet.	SS	05	33	50/ 75 mm	4	204							
						5	203				○11			
						6	202	○			○13			
	Grey, dense, SAND, trace silt, trace gravel, wet. gravelly	SS	07	100	32	7	201							
						8	200	○			○14			
						9	199							
		SS	09	100	80		199				○10			
	End of borehole. Notes: 1. Borehole was found to be open with freestanding water at 6.0 mbgs upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.													

Groundwater depth on completion of drilling: **6.0 m**



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RECORD OF BOREHOLE No. **BH18**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Phase II Environmental Site Assessment** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 10, 2019** Date Completed: **Jun 11, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606440.23 NORTHING: 4852017.03				
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80					★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P				Unit Weight (KN/m ³)
	Local Ground Surface Elevation: 208.95 m																
	Loose crushed stone / asphalt pieces~ 460 mm. 208.5	SS	01	84												PP = 2.5 kg/ sq-cm	
	FILL Brown, firm, silty CLAY, trace gravel, trace sand, some oxidation, moist. 207.4	SS	02	62	7	1	208	○								PP = 3.0 kg/ sq-cm Sample submitted for laboratory analysis: BH18-02	
	NATIVE TILL Brown, very stiff, sandy silty CLAY, trace to some gravel, moist. 207.4	SS	03	54	25	2	207	○								PP = 2.5 kg/ sq-cm	
	becomes hard	SS	04	67	90					○						PP = 4.5 kg/ sq-cm	
	trace broken cobbles	SS	05	100	65	3	206			○							
	wet sand pockets	SS	06	92	40	4	205	○								PP = 4.5 kg/ sq-cm	
		SS	07	100	30	5	204	○								PP = 4.0 kg/ sq-cm	
	GR: 2%; SA: 13%; SI: 63%; & CL: 22%	SS	08	100	31	6	203	○								PP = 3.5 kg/ sq-cm	
						7	202										
	Grey, very dense, silty SAND, trace clay, trace gravel moist to wet gravel pockets. 201.3	SS	09	100	59	8	201	○									
						9	200	○									
	some clay 199.2	SS	10	100	49			○									
	End of borehole. Notes: 1. Borehole was found to caved in at 9.14 mbgs with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer. 4. GR., SA., SI. & CL. denote Gravel, Sand, Silt & Clay respectively.																

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH19**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 13, 2019** Date Completed: **Jun 13, 2019** Revision No.: **0**

Lithology Profile	DESCRIPTION	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606417.04 NORTHING: 4852036.05	
		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value			Penetration Testing	Soil Vapour Reading	Moisture Content (%)	Atterberg Limits		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 209.24 m													
	Loose overburden asphalt~ 760 mm.	SS	01	67		209				9				
	208.5													
	FILL Brown, firm, silty CLAY, trace gravel, moist.	SS	02	100	7	1	208	○		26				PP = 2.5 kg/ sq-cm
	207.7													
	NATIVE TILL Brown, very stiff to hard, sandy silty CLAY, trace to some gravel, oxidized, moist.	SS	03	100	23	2	207	○		10				PP = 4.0 kg/ sq-cm
	206.2													
	Brown, dense to very dense, sandy SILT, trace clay, some gravel parting, oxidized, moist.	SS	04	84	39	3	206	○		12				PP = 4.0 kg/ sq-cm
	206.2													
	Brown, dense to very dense, sandy SILT, trace clay, some gravel parting, oxidized, moist.	SS	05	100	47	4	205	○		9				PP = 3.0 kg/ sq-cm
	205													
	becomes grey, some cobble particles	SS	06	60	50/125 mm	5	204			9				
	203													
	becomes compact. some clay cores	SS	07	33	17	6	203	○		13				PP = 3.5 kg/ sq-cm
	201.6													
	Grey, compact, SAND, wet.	SS	08	67	22	8	201	○		12 13				
	201.2													
	Grey, very dense, sandy SILT, trace gravel, moist.					9	200	■						
	199.5													
	End of borehole. Notes:	SS	09	84	66					9				PP = 4.0 kg/ sq-cm
	199.5													
	9.8													

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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ■ Cave in depth recorded on completion of drilling: **8.84 m**.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH20**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 13, 2019** Date Completed: **Jun 13, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606393.84 NORTHING: 4852055.08	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa)	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) ■ Atterberg Limits W _p W _L	COMMENTS				
	Local Ground Surface Elevation: 209.52 m													
	Loose overburden asphalt~ 760 mm.	SS	01	51			209			○ ⁶				
	208.8													
	0.8													
	NATIVE TILL Brown, stiff to hard, sandy silty CLAY, trace to some gravel, some oxidation, moist.	SS	02	84	14	1	208	○		○ ¹⁹			PP = 4.5 kg/ sq-cm	
		SS	03	100	15	2	208	○		○ ¹⁵			PP = 4.0 kg/ sq-cm	
	becomes hard	SS	04	33	30	3	207	○		○ ¹⁴			PP = 4.0 kg/ sq-cm	
		SS	05	100	54	4	206		○	○ ⁹			PP = 3.5 kg/ sq-cm	
						5	205	○		○ ⁹			PP = 4.0 kg/ sq-cm	
	becomes greyish brown, very stiff.	SS	06	100	22	6	204							
		SS	07	100	37	7	203	○		○ ¹²			PP = 4.0 kg/ sq-cm	
	becomes hard.					8	202							
	clay cores	SS	08	100	37	9	201	○		○ ¹⁰				
	200.3	SS	09	100	50/ 75		9.2							
	End of borehole. Notes: 1. Borehole was found to be caved in at a depth of 7.70 mbgs with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.													

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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ■ Cave in depth recorded on completion of drilling: **7.70 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH21**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 5, 2019** Date Completed: **Jun 5, 2019** Revision No.: **0**

Lithology Profile	DESCRIPTION	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606370.65 NORTHING: 4852074.1	Unit Weight (KN/m ³)	COMMENTS
		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value			Penetration Testing	Soil Vapour Reading	Atterberg Limits	Moisture Content (%)				
	Local Ground Surface Elevation: 209.88 m														
	Loose overburden asphalt~ 460 mm.														
	209.4														
	FILL														
	0.5														
	209.1														
	0.8														
	NATIVE TILL	SS	01	75	16	1	209	○	●	13					
	Brown, stiff to hard, sandy silty CLAY, trace gravel, some oxidation, moist														
	GR: 9%; SA: 26%; SI: 47%; & CL: 18%														
	broken cobble pieces.	SS	02	100	25	2	208	○	○	14					
	207.0														
	2.9														
	207														
	Brown, dense, silty SAND, some clay, some gravel, wet.	SS	03	104	79				○	10					
	206.2														
	3.7														
	End of borehole.	SS	04	100	43	3	207	○	○	8					
	Notes:														
	1. Borehole was found open with freestanding water at 3.05 mbgs upon completion.														
	2. GR., SA., SI. & CL. denote Gravel, Sand, Silt & Clay respectively.														

Groundwater depth on completion of drilling: **3.05 m**



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Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH22/MW22**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Phase II Environmental Site Assessment** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 12, 2019** Date Completed: **Jun 12, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606347.46 NORTHING: 4852093.13			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	MTO Vane*	Nilcon Vane*				★ Rinse pH Values
	Local Ground Surface Elevation: 210.23 m														
	Loose crushed stone / asphalt pieces ~760 mm.	SS	01	67		210									Top of Riser Elevation = 211.08 m; Height of Riser= 0.86 m
	209.5														
	NATIVE TILL Brown, stiff, sandy silty CLAY, trace to some gravel, oxidized, moist.	SS	02	75	11	1	209	○							PP = 3.5 kg/ sq-cm
	becomes hard	SS	03	100	31	2	208	○							Sample submitted for laboratory analysis: BH22-03 PP = 4.5 kg/ sq-cm
	trace broken cobbles	SS	04	67	75	3	207		○						PP = 4.5 kg/ sq-cm
	oxidized cores	SS	06	100	44	4	206		○						PP = 4.5 kg/ sq-cm
	becomes grey, gravelly sand pockets.	SS	07	84	72	5	205		○						PP = 4.5 kg/ sq-cm
	becomes very stiff.	SS	08	100	29	6	204		○						Sample submitted for laboratory analysis: BH22-08
	203.5														
	End of borehole. 6.7														
	Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019. 3. PP = pocket penetrometer.														

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.
 ∇ Groundwater depth observed on **21/10/2019** at a depth of: **0.76m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH23**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 3, 2019** Date Completed: **Jun 3, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606301.07 NORTHING: 4852131.2	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) ■ Atterberg Limits W _L 20 40 60 80 W _p		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 210.26 m											
	Topsoil ~ 150 mm. 210.1											
	FILL 0.2	SS	01	75	10		210	○			22.04	PP = 2.5 Kg / sq.cm
	Brown, silty CLAY, trace sand, very moist. 209.7											
	NATIVE TILL 0.6	SS	02	100	26	1	209	○			22.31	
	Grey, compact to very dense, sandy silty CLAY, trace gravel, oxidized, moist.											
	broken cobble pieces.	SS	03	100	27	2	208	○			21.62	
		SS	04	100	73			○			22.25	
		SS	05	100	50 / 280mm	3	207	○			21.58	
	End of borehole. 206.8											
	Notes: 3.5											

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH24**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 4, 2019** Date Completed: **Jun 4, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606490.79 NORTHING: 4851936.75		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS
								○ SPT	● DCPT	MTO Vane* △ Intact ▲ Remould	Nilcon Vane* ◇ Intact ◆ Remould			
Local Ground Surface Elevation: 208.18 m														
	Topsoil ~ 150 mm. 208.0 0.2	SS	01	75	5		208	○					19.23	PP = 1.25 Kg / sq.cm
	FILL Brown, firm, silty CLAY, trace sand, rootlets, organics, moist. 207.4 0.8	SS	02	100	16	1	207	○			○23		22.38	PP = 1.5 Kg / sq.cm
	NATIVE TILL Brown, very stiff, sandy silty CLAY, trace gravel, moist.	SS	03	100	27	2	206	○			○13		23.14	
	trace to some broken cobble pieces.	SS	04	100	50 / 280mm	3	205				○8		23.12	
	becomes hard and wet.										○10			
	Brown, very dense, sandy SILT, trace to some clay, trace gravel, wet. 205.1 3.7	SS	05	100	95		205				○12		21.92	
	End of borehole. Notes: 1. Borehole was found to be open with freestanding water at 2.97 mbgs upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.													

Groundwater depth on completion of drilling: **2.97 m**

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Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH26**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 14, 2019** Date Completed: **Jun 14, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606398.01 NORTHING: 4852012.85			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa)		★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _L W _P				Unit Weight (KN/m ³)	COMMENTS	
	Local Ground Surface Elevation: 209.42 m															
	Loose overburden asphalt~ 460 mm.	SS	01	67			209.0									
	FILL Brown, firm, silty CLAY, trace gravel, moist.					1	208.7									PP = 1.5 kg/ sq-cm
	NATIVE TILL Brown, very stiff, sandy silty CLAY, trace to some sand, trace to some gravel, oxidized, moist.	SS	02	100	17		208.0									PP = 4.0 kg/ sq-cm
		SS	03	100	26	2	207.3									PP = 4.5 kg/ sq-cm
	Brown, dense to very dense, sandy SILT, trace clay, some gravel, oxidized, moist.	SS	04	100	36		207.1									PP = 4.5 kg/ sq-cm
		SS	05	100	70/ 250 mm	3	206.3									PP = 4.0 kg/ sq-cm
	becomes silty SAND	SS	06	84	52	5	205.3									PP = 4.0 kg/ sq-cm
		SS	07	75	34	6	204.3									PP = 4.0 kg/ sq-cm
		SS	08	67	73	8	203.3									PP = 3.5 kg/ sq-cm
	sandy gravel pockets	SS	09	73	51	9	200.3									
	End of borehole. Notes: 1. Borehole was found to be caved in at 8.79 mbgs with freestanding water at 3.35 mbgs upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.						199.7									

RECORD OF BOREHOLE No. **BH27**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 14, 2019** Date Completed: **Jun 14, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606374.81 NORTHING: 4852031.88		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _p W _L				Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 209.68 m														
	Loose overburden asphalt~ 760 mm.	SS	01	51			209								
	208.9						209								
	NATIVE TILL Brown, stiff to very stiff, sandy silty CLAY, trace to some sand, trace to some gravel, oxidized, moist.	SS	02	75	11		1	○							PP = 4.0 kg/ sq-cm
		SS	03	67	20		2	○							PP = 4.5 kg/ sq-cm
	becomes hard	SS	04	33	45		3	○							PP = 4.5 kg/ sq-cm
		SS	05	100	52		4	○							PP = 4.5 kg/ sq-cm
							5	○							
	becomes brownish grey, stiff.	SS	06	67	12		6	○							
							7	○							
	203.1	SS	07	84	10		7	○							PP = 4.0 kg/ sq-cm
	Grey, compact, sandy GRAVEL, wet. 6.6						8	○							
	202.1	SS	08	100	16		8	○							PP = 3.5 kg/ sq-cm
	Grey, compact, SAND, trace gravel, wet. 7.6						9	○							
	200.4	SS	09	75	77		9	○							
	Grey, hard, clayey SILT, some sand, some gravel, moist. 9.3						10	○							
	199.9						10								
	End of borehole. 9.8						11								
	Notes: 1. Borehole was found to be open with freestanding water at 7.62 mbgl upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.														

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Groundwater depth on completion of drilling: **7.62 m**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH28**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 14, 2019** Date Completed: **Jun 14, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606351.62 NORTHING: 4852050.92		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa)		★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _p W _L				Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 209.90 m Loose overburden asphalt~ 760 mm.	SS	01	33											
	209.1 NATIVE TILL Brown, stiff to hard, sandy silty CLAY, trace to some gravel, oxidized, moist.	SS	02	84	17	1	209	○							PP = 4.5 kg/ sq-cm
		SS	03	67	55	2	208	○							
		SS	04	100	44			○							PP = 4.0 kg/ sq-cm
	206.8 Brown, very dense, sandy SILT to silty SAND, trace clay, trace gravel, trace cobble pieces, moist	SS	05	100	63	3	207	○							PP = 4.0 kg/ sq-cm
						4	206								
	becomes grey, compact	SS	06	100	25	5	205	○							
						6	204								
	dense	SS	07	84	36			○							PP = 4.0 kg/ sq-cm
						7	203	■							
	broken cobble pieces, compact	SS	08	84	25	8	202	○							PP = 4.0 kg/ sq-cm
						9	201								
	becomes very dense	SS	09	116	50/150 mm										PP = 4.0 kg/ sq-cm
	200.4 End of borehole. Notes: 1. Borehole was found to be caved in at 7.01 mbgs with freestanding water at 1.83 mbgs upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.														

RECORD OF BOREHOLE No. **BH29**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 3, 2019** Date Completed: **Jun 3, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING			EASTING: 606305.24 NORTHING: 4852088.98				
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing		★ Rinse pH Values			INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS
								○ SPT	● DCPT	2	4	6			
Local Ground Surface Elevation: 209.98 m															
	Topsoil ~ 150 mm.						209.8								
	FILL Greyish brown, firm, silty CLAY, trace sand, organics, rootlets, moist.	SS	01	51	6		209.2	○			○.27			21.06	PP = 3.5 Kg / sq.cm
	NATIVE TILL Greyish brown, very stiff to hard, sandy silty CLAY, trace gravel, oxidized, moist.	SS	02	100	15	1	209	○			○.12			21.06	
	trace broken cobble pieces.	SS	03	100	26	2	208	○			○.12			22.66	
		SS	04	100	32		207	○			○.11			22.93	
		SS	05	100	90	3	207				○.10			22.39	
	End of borehole.						206.4								
	Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.						3.6								

RECORD OF BOREHOLE No. BH30/MW30



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Phase II Environmental Site Assessment** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 11, 2019** Date Completed: **Jun 11, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606448.57 NORTHING: 4851932.58	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 208.46 m											
	Topsoil ~200 mm. 208.3											
	FILL 0.2	SS	01	84	5		208	○				Top of Riser Elevation = 209.36 m; Height of Riser=0.88 m
	Brown, firm, silty CLAY, trace gravel, moist. 207.7											Sample submitted for laboratory analysis: BH30-01
	NATIVE TILL 0.8	SS	02	100	12	1	207	○				PP = 1.5 kg/ sq-cm
	Brown, stiff, sandy silty CLAY, trace to some gravel, some oxidation, moist. GR: 2%; SA: 28%; SI: 49%; & CL: 21%											Sample submitted for laboratory analysis: BH30-02
	becomes hard	SS	03	100	33	2	206	○				PP = 3.5 kg/ sq-cm
		SS	04	133	50	3	205	○				PP = 4.5 kg/ sq-cm
		SS	05	100	44	4	204	○				PP = 3.5 kg/ sq-cm
		SS	06	100	40	5	203	○				PP = 4.0 kg/ sq-cm
	becomes brownish grey, very stiff.	SS	07	100	28	6	202.3	○				PP = 3.5 kg/ sq-cm
	Brown, very dense, gravelly SAND to SAND, wet. 203.1	SS	08	100	50/125 mm		203					Sample submitted for laboratory analysis: BH30-08
	End of borehole. 202.3	SS	09	94	50/75 mm		202.3	■				
	Notes: 1. Borehole was found to caved in at 6.10 mbgs with freestanding water at 5.18 mbgs upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019. 3. PP = pocket penetrometer. 4. GR., SA., SI. & CL. denote Gravel, Sand, Silt & Clay respectively.											

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Groundwater depth on completion of drilling: **5.18 m**
 Cave in depth recorded on completion of drilling: **6.1 m**.
 Groundwater depth observed on **21/10/2019** at a depth of: **3.16 m**.
 Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH31**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 17, 2019** Date Completed: **Jun 17, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606402.18 NORTHING: 4851970.64	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P	Unit Weight (KN/m ³)	COMMENTS			
	Local Ground Surface Elevation: 209.60 m													
	Loose overburden asphalt~ 760 mm.	SS	01	67			209							
	208.8													
	NATIVE TILL Brown, stiff to very stiff, sandy silty CLAY, trace gravel, moist.	SS	02	59	9	1	208	○						PP = 4.5 kg/ sq-cm
	becomes oxidized, trace sand.	SS	03	100	17	2	207	○						PP = 3.5 kg/ sq-cm
	207.3													
	Grey, dense, sandy SILT, trace clay, trace to some gravel, some oxidation, moist.	SS	04	100	31	3	206	○						PP = 4.5 kg/ sq-cm
	some broken cobble pieces. dense	SS	05	41	42	4	205	○						PP = 4.5 kg/ sq-cm
	compact	SS	06	84	20	5	204	○						
	broken cobble pieces, wet.	SS	07	8	36	6	203	○						PP = 3.5 kg/ sq-cm
	202.0													
	Grey, compact, SAND, wet.	SS	08	16	16	8	202	○						
	199.8													
	End of borehole. Notes: 1. Borehole was found to be caved in at 7.92 mbgl with freestanding water at 3.35 mbgl upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.	SS	09	84	28	9	200	○						

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Groundwater depth on completion of drilling: **3.35 m** Cave in depth recorded on completion of drilling: **7.92 m**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH32



Project Number: 665125 Drilling Location: As per borehole location plan Logged by: SP
 Client: City of Brampton Drilling Method: 100 mm Solid Stem Augers Compiled by: NT
 Project Name: Geotechnical Investigation- Johnston Transit Facility Drilling Machine: GeoProbe Reviewed by: MT
 Location: 10192 Hwy 50, Brampton, ON Date Started: Jun 4, 2019 Date Completed: Jun 4, 2019 Revision No.: 0

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606378.98 NORTHING: 4851989.67			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	△ Intact	◇ Intact				▲ Lower Explosive Limit (LEL)
	Local Ground Surface Elevation: 209.61 m														
	Loose overburden asphalt~ 760 mm.														
	208.9														
	NATIVE TILL Light brown, stiff, silty CLAY, trace sand, moist.	SS	01	75	14	1	208.9	○						21.67	
	208.1														
	Brown, very stiff, sandy silty CLAY, trace broken cobble pieces, oxidized, moist.	SS	02	100	25	2	208.1	○						22.52	
	hard														
		SS	03	79	65	3	207.5		○					22.76	
		SS	04	100	57	4	207.0		○					23.29	
	206.0														
	End of borehole.						206.0								
	Notes: 1. Borehole was found to be open with freestanding water at 0.6 mbgs upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.														

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Groundwater depth on completion of drilling: 0.6 m

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH33/MW33**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **AB**
 Client: **City of Brampton** Drilling Method: **200 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Phase II Environmental Site Assessment** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 12, 2019** Date Completed: **Jun 19, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606355.8 NORTHING: 4852008.7			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	MTO Vane* △ Intact ▲ Remould	Nilcon Vane* ◇ Intact ◆ Remould				★ Rinse pH Values 2 4 6 8 10 12
	Local Ground Surface Elevation: 209.83 m Loose overburden asphalt~ 760 mm.	SS	01	52											Top of Riser Elevation = 210.77 m; Height of Riser =0.92 m
	209.2 0.6 NATIVE TILL Light brown, very stiff, sandy silty CLAY, some silt, moist.	SS	02	64	15	1	209	○							Sample submitted for laboratory analysis: BH33-02
	hard	SS	03	100	17		208	○							Sample submitted for laboratory analysis: BH33-03
	very stiff	SS	04	100	37	2	207	○							
	becomes hard	SS	05	100	30	3	206	○							
	some sand pockets	SS	06	85	20		205	○							
	trace to some sand.	SS	07	100	58	4	204	○							Sample submitted for laboratory analysis: BH33-07
	SS	08	72	61		5	203	○							
	SS	09	31	36		6		○							
	SS	10	100	33		7		○							
	SS	11	100	32				○							
	SS	12	100	58				○							
	End of borehole. Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019.														

RECORD OF BOREHOLE No. **BH34**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 5, 2019** Date Completed: **Jun 5, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606309.4 NORTHING: 4852046.74			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	△ MTO Vane*	◇ Nilcon Vane*				★ Rinse pH Values
	Local Ground Surface Elevation: 209.82 m														
	Topsoil~ 180 mm. 209.6														
	FILL 0.2 Brown, firm, silty CLAY, trace gravel, trace sand, moist.	SS	01	67	5		209.8	○							
	NATIVE TILL 0.8 Brown, stiff, sandy silty CLAY, trace to some gravel, moist.	SS	02	84	10	1	209.1	○							PP = 1.5 kg/ sq-cm
		SS	03	100	14	2	208.8	○							PP = 1.5 kg/ sq-cm
	becomes hard some oxidation	SS	04	100	32	3	208.4	○							PP = 4.0 kg/ sq-cm
	GR: 5%; SA: 32%; Sl: 38%; & CL: 15%	SS	05	100	34	4	208.0	○							PP = 2.0 kg/ sq-cm
	Grey, very dense, sandy GRAVEL, some silt, some clay, trace broken cobble pieces, moist. 205.2	SS	06	56	68/ 200 mm	5	205.2	○							
	Grey, hard, clayey SILT, some sand, some gravel, moist. 203.7	SS	07	0	18	6	203.7	○							
		SS	08	84	58	8	202.2	○							PP = 4.0 kg/ sq-cm
		SS	09	100	42	9	201.7	○							PP = 4.0 kg/ sq-cm
	End of borehole. 200.1						200.1								
	Notes: 1. Borehole was found to caved in at 8.84 mbgs with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer. 4. GR., SA., Sl. & CL. denote Gravel, Sand, Silt & Clay respectively.														

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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ■ Cave in depth recorded on completion of drilling: **8.84 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH35/MW35**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Phase II Environmental Site Assessment** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 12, 2019** Date Completed: **Jun 12, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606263.02 NORTHING: 4852084.8	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 209.24 m											
	Topsoil ~150 mm. 209.1 FILL 0.2 Brown, soft, silty CLAY, trace gravel, moist.	SS	01	67	3		209	○				Top of Riser Elevation = 210.09m; Height of Riser= 0.90 m PP = 0.5 kg/ sq-cm
	NATIVE TILL 0.8 Brown, stiff to very stiff, sandy silty CLAY, trace gravel, some oxidation, moist.	SS	02	100	10	1	208	○				PP = 3.0 kg/ sq-cm
		SS	03	100	27	2	207	○				Sample submitted for laboratory analysis: BH35-03 PP = 4.0 kg/ sq-cm
	becomes hard	SS	04	100	32	3	206	○				PP = 4.5 kg/ sq-cm
		SS	05	100	38	4	205	○				PP = 3.0 kg/ sq-cm
	becomes brownish grey, stiff.	SS	07	100	14	5	204	○				Sample submitted for laboratory analysis: BH35-07
	becomes very stiff.	SS	08	0	20	6	203	○				PP = 3.5 kg/ sq-cm
		SS	09	67	20	7	202	○				
	Grey, very dense, silty SAND, trace clay, broken cobble pieces, moist. 201.6	SS	10	67	50/150 mm	8	201	○				
		SS	11	100	58	9	200	○				PP = 4.5 kg/ sq-cm
	End of borehole. 199.5 Notes: 9.8											

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.
 ∇ Groundwater depth observed on **21/10/2019** at a depth of: **2.39 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH36**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 19, 2019** Date Completed: **Jun 19, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING			INSTRUMENTATION INSTALLATION	EASTING: 606359.95 NORTHING: 4851966.48	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _p W _L	Unit Weight (KN/m ³)		COMMENTS	
	Local Ground Surface Elevation: 209.51 m												
	Topsoil~ 180 mm. 209.3												
	FILL 0.2 Brown, firm, silty CLAY, trace gravel, trace sand, moist. 208.8	SS	01	67	5		209	○	○18			PP = 2.0 kg/ sq-cm	
	NATIVE TILL 0.8 Brown, very stiff, sandy silty CLAY, trace to some gravel, some oxidation, moist. 208.8	SS	02	4	19	1	208	○	○17				
		SS	03	100	17	2	207	○	○11			PP = 4.5 kg/ sq-cm	
		SS	04	100	24		207	○	○11			PP = 4.5 kg/ sq-cm	
	Brown, dense, sandy SILT, some gravel trace clay, oxidized, moist. 206.5	SS	05	100	42	3	206	○	○9			PP = 4.5 kg/ sq-cm	
	becomes grey, compact					4	205						
		SS	06	100	22	5	204	○	○8				
						6	203	○	○10			PP = 4.0 kg/ sq-cm	
	End of borehole. 202.8 Notes: 6.7												

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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: **6.10 m**.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH37**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 3, 2019** Date Completed: **Jun 3, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606267.18 NORTHING: 4852042.59	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 208.68 m											
	Topsoil ~ 150 mm. 208.5											
	FILL 0.2	SS	01	41	6						20.02	PP = 4.0 Kg / sq.cm
	Dark grey, firm, silty CLAY, trace sand, rootlets, organics, very moist. 207.9											
	NATIVE TILL 0.8	SS	02	100	22	1					21.08	
	Brown, stiff to very stiff, sandy silty CLAY, trace gravel, oxidized, moist. 207.2											
	Brown, very dense, sandy SILT, trace clay, some gravel, broken cobble pieces, moist. 1.5	SS	03	100	50	2					21.70	
	Grey, very dense, SILT, trace to some sand, trace clay, trace gravel, moist. 206.4											
	2.3	SS	04	100	76	3					20.87	
	205.0											
	3.7	SS	05	100	52						23.55	
	End of borehole. Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.											

∇ No freestanding groundwater measured in open borehole upon completion of drilling.



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Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. **BH39**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 17, 2019** Date Completed: **Jun 17, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING			INSTRUMENTATION INSTALLATION	EASTING: 606364.12 NORTHING: 4851924.26	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 µm (%) ○ Moisture Content (%) Atterberg Limits W _p W _L	Unit Weight (KN/m ³)		COMMENTS	
	Local Ground Surface Elevation: 209.06 m												
	Topsoil ~ 100 mm.						209.0						
	FILL Brown, soft, silty CLAY, trace gravel, moist.	SS	01	67	4		208.4					PP = 2.0 kg/ sq-cm	
	NATIVE TILL Brown, stiff to hard, sandy silty CLAY, trace to some gravel, some oxidation, moist.	SS	02	84	14	1	208.3					PP = 4.5 kg/ sq-cm	
	Brown to grey, compact, sandy SILT, some gravel, trace clay, moist.	SS	03	100	21	2	207.5					PP = 4.5 kg/ sq-cm	
	becomes dense	SS	04	51	35	3	207.1					PP = 4.0 kg/ sq-cm	
	becomes very dense	SS	06	84	54	5	204.5						
	becomes dense	SS	07	67	30	6	203.5					PP = 3.5 kg/ sq-cm	
	becomes very dense	SS	08	12	98/250 mm	8	201.5						
	Grey, very stiff, clayey SILT, some sand, some broken cobble pieces, moist.	SS	09	0	29	9	200.0						
	End of borehole. Notes: 1. Borehole was found to caved in at 7.92 mbgs with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.						199.3						

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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: **7.92 m**.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH40**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **250 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 19, 2019** Date Completed: **Jun 19, 2019** Revision No.: **0**

Lithology Profile	DESCRIPTION	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606317.73 NORTHING: 4851962.3	
		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value			Penetration Testing	Soil Vapour Reading	Atterberg Limits	Unit Weight (KN/m ³)		COMMENTS	
	Local Ground Surface Elevation: 209.04 m													
	Top soil ~152 mm.													
	FILL Brown, soft, silty CLAY, trace gravel, moist.	SS	01	67	4		208.9			24			PP = 2.0 kg/ sq-cm	
	NATIVE TILL Brown, firm to stiff, sandy silty CLAY, trace gravel, oxidized, moist.	SS	02	100	8	1	208.3			13			PP = 2.5 kg/ sq-cm	
		SS	03	100	15	2	207.8			12			PP = 4.0 kg/ sq-cm	
	becomes hard	SS	04	100	43	3	206.8			12			PP = 4.5 kg/ sq-cm	
		SS	05	100	58	4	205.8			8				
	becomes very stiff	SS	06	100	25	5	204.8			9				
	some clay cores	SS	07	100	21	6	203.8			11			PP = 2.5 kg/ sq-cm	
	End of borehole. Notes: 1. Borehole was found to be caved in at 6.10 mbgs upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.						202.3							

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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: **6.10 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH42**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 3, 2019** Date Completed: **Jun 3, 2019** Revision No.: **0**

Lithology Profile	SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606224.96 NORTHING: 4852038.41		
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _L W _P	Unit Weight (KN/m ³)		COMMENTS		
<p>Local Ground Surface Elevation: 207.92 m</p> <p>Topsoil ~ 150 mm. 207.8 0.2</p> <p>FILL Light grey, stiff, silty CLAY to clayey SILT, trace sand, organics, rootlets, moist. 207.2 0.8</p> <p>NATIVE TILL Brown, stiff to very stiff, sandy silty CLAY, trace gravel, oxidized, moist.</p> <p>becomes hard broken cobble pieces.</p> <p>becomes grey, sand pocket.</p> <p>End of borehole. 204.3 3.7</p> <p>Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.</p>														
	SS	01	100	8			○	○ ₃₀			19.76	PP = 3.5 Kg / sq.cm		
	SS	02	100	11	1	207	○	○ ₁₃			22.57	PP = 4.0 Kg / sq.cm		
	SS	03	100	22	2	206	○	○ ₁₁			22.06			
	SS	04	100	77				○ ₉			22.59			
	SS	05	100	79	3	205		○ ₉			21.49			

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH43**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 4, 2019** Date Completed: **Jun 4, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606414.67 NORTHING: 4851843.97	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 208.67 m											
	Topsoil ~ 150 mm.						208.5					
	FILL Brown, firm, silty CLAY, trace sand, trace gravel, organics, rootlets, oxidized, moist.	SS	01	84	6		208.2	○			19.34	PP = 2.0 Kg / sq.cm
	NATIVE TILL Brown, very stiff to hard, sandy silty CLAY, trace gravel, oxidized, moist.	SS	02	100	25	1	207.9	○			23.01	PP = 2.0 Kg / sq.cm
	trace broken cobble pieces.	SS	03	100	28	2	207.8	○			23.00	
		SS	04	100	50/76mm		206.8	○			23.48	
		SS	05	63	50/76mm	3	205.5	○				
	End of borehole.						205.3					

- Notes:
- Borehole was found to be open with no freestanding water upon completion.
 - Water table was measured inside the hollow stem auger upon completion.
 - PP= Pocket Penetrometer.

∇ No freestanding groundwater measured in open borehole upon completion of drilling.



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Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH45**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **250 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 20, 2019** Date Completed: **Jun 20, 2019** Revision No.: **0**

Lithology Profile	DESCRIPTION	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	EASTING: 606275.51 NORTHING: 4851958.14	
		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value						Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 208.18 m											
	Topsoil ~150 mm. 208.0											
	FILL 0.2	SS	01	67	4						PP = 1.5 kg/ sq-cm	
	Brown, soft, silty CLAY, trace sand, trace sand, moist. 207.4											
	NATIVE TILL 0.8	SS	02	84	11	1					PP = 3.5 kg/ sq-cm	
	Brown, stiff, silty CLAY to clayey SILT, trace sand, trace to some gravel, some oxydation, moist.											
	Become very stiff.	SS	03	100	23	2					PP = 4.5 kg/ sq-cm	
	205.9											
	Brown, hard, sandy SILT, some clay, trace to some gravel, moist, oxidized. 2.3	SS	04	100	32	3					PP = 4.5 kg/ sq-cm	
		SS	05	109	51	4						
	203.6											
	brown very stiff, clayey SILT, some sand, trace to some gravel, moist. 6	SS	06	25	12	5					PP = 3.0 kg/ sq-cm	
	202.1											
	Grey, dense, sandy SILT, trace gravel, trace clay, dry. 6.1	SS	07	67	32	6						
	201.5											
	End of borehole. 6.7											
	Notes: 1. Borehole was found to be open and dry upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.											

RECORD OF BOREHOLE No. **BH46**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 3, 2019** Date Completed: **Jun 3, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606229.13 NORTHING: 4851996.19		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS
								○ SPT	● DCPT	MTO Vane*	Nilcon Vane*			
	Local Ground Surface Elevation: 207.61 m													
	Topsoil ~ 150 mm. FILL Grey, stiff, silty CLAY, trace sand, organics, rootlets, moist.	SS	01	92	10		207.5 0.2						20.30	PP = 4.0 Kg / sq.cm
	NATIVE TILL Brown, compact, sandy silty CLAY, trace gravel, oxidized, moist.	SS	02	100	17	1	206.8 0.8						22.00	
	very dense	SS	03	100	25	2	206.0						21.35	
		SS	04	100	55		205.0						22.60	
	Grey, dense, SILT, some sand, trace gravel, broken cobble pieces, oxidized, moist. GR: 3%; SA: 13%; SI: 76%; & CL: 8%	SS	05	100	68	3	204.6 3.1 203.9 3.7						21.07 23.65	No Plasticity
	End of borehole. Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer. 4. GR., SA., SI. & CL. denote Gravel, Sand, Silt & Clay respectively.													

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH47**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 18, 2019** Date Completed: **Jun 19, 2019** Revision No.: **0**

Lithology Profile	DESCRIPTION	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	EASTING: 606372.46 NORTHING: 4851839.81	COMMENTS
		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value							
	Local Ground Surface Elevation: 208.76 m											
	Top soil~ 200 mm. 208.6											
	FILL 0.2 Brown, stiff, silty CLAY, trace sand, very moist.	SS	01	67	10		○	○18			PP = 1.71kg/ sq-cm	
	NATIVE TILL 0.8 Brown, very stiff, sandy silty CLAY, some oxidation, moist.	SS	02	100	27	1	○	○15				
	trace broken cobble pieces.	SS	03	100	27	2	○	○16				
	Brown, very dense, sandy SILT, some clay, trace gravel, moist 2.3	SS	04	100	51	3	○	○11				
	trace broken cobble pieces	SS	05	100	56	4	○	○9				
	becomes light grey.	SS	06	100	46	4	○	○10				
						5						
		SS	07	100	51		○	○9				
	End of borehole. 5.9											
	Notes: 1. Borehole was found to be dry and open upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.											



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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH48**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 17, 2019** Date Completed: **Jun 17, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606326.06 NORTHING: 4851877.86	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa)	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P	Unit Weight (KN/m ³)	COMMENTS			
	Local Ground Surface Elevation: 208.72 m													
	Topsoil ~100 mm. 208.6 0.1													
	FILL Brown, firm, silty CLAY, trace sand, trace gravel, moist. 208.0	SS	01	75										
	NATIVE TILL Brown, very stiff, sandy silty CLAY, trace gravel, oxidized, moist. 0.8	SS	02	84	10	1							PP = 3.0 kg/ sq-cm	
	become very stiff, some sand pockets	SS	03	100	22	2							PP = 4.0 kg/ sq-cm	
	GR: 5%; SA: 24%; Sl: 49%; & CL: 22%	SS	04	100	30								PP = 4.5 kg/ sq-cm	
	Brown, very dense, silty SAND, trace clay, trace gravel, oxidized cores, moist. 205.7 3.1	SS	05	67	54	3							PP = 4.0 kg/ sq-cm	
	dense	SS	06	8	42	5								
	very dense	SS	07	92	45	6							No sample recovery	
	Grey, very dense, sand, trace silt, moist. 199.6 199.5	SS	09	100	50/100mm	9								
	End of borehole. 9.2													
	Notes: 1. Borehole was found to caved in at 8.23 mbgs with no freestanding water reported upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer. 4. GR., SA., Sl. & CL. denote Gravel, Sand, Silt & Clay respectively.													

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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: **8.23 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH50/MW50



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **250 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 20, 2019** Date Completed: **Jun 21, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606233.29 NORTHING: 4851953.98	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa)	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) ■ Atterberg Limits W _p W _L	Unit Weight (KN/m ³)	COMMENTS			
	Local Ground Surface Elevation: 207.60 m													
	Topsoil ~170 mm.													
	FILL Brown, firm, silty CLAY, trace gravel, moist.	SS	01	67			207				○ ₃₁			
	NATIVE TILL Brown, firm to very stiff, sandy silty CLAY, trace to some gravel, moist. becomes oxydized.	SS	02	75	8	1	206.8	○			○ ₂₁			PP = 1.5 kg/ sq-cm
		SS	03	16	25	2	206	○			○ ₂₃			PP = 1.5 kg/ sq-cm
		SS	04	92	26	3	205	○			○ ₁₀			PP = 4.5 kg/ sq-cm
		SS	05	84	17	4	204	○			○ ₁₀			PP = 4.5 kg/ sq-cm
	becomes grey.	SS	06	92	18	5	203	○			○ ₁₁			PP = 3.5 kg/ sq-cm
	Grey, very dense, silty SAND to gravelly SAND, some gravel, some silt, moist.	SS	07	92	60	6	201.5	○			○ ₁₃			
		SS	08	100	50/125mm	8	200	■			○ ₉			
	End of borehole.	SS	09	100	50/125mm	9	198.3				○ ₉			
	Notes: 1. Borehole was found to caved in at 6.10 mbgs with freestanding water at 5.18 mbgs upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger													



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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ■ Cave in depth recorded on completion of drilling: **7.75 m**.
 ∇ Groundwater depth observed on **02/07/2019** at a depth of: **0.80 m**.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH52**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Phase II Environmental Site Assessment** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 12, 2019** Date Completed: **Jun 12, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606283.85 NORTHING: 4851873.71				
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing		★ Rinse pH Values				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS
								○ SPT	● DCPT	2	4	6	8			
Local Ground Surface Elevation: 208.13 m																
	Topsoil ~ 150 mm.						208.0									
	FILL Brown, firm, silty CLAY, trace sand, trace gravel, organics, rootlets, oxidized, moist	SS	01	59	5		207.4	○								PP = 2.0 Kg / sq.cm
	NATIVE TILL Brown, very stiff, sandy silty CLAY, trace gravel, oxidized, moist.	SS	02	67	17	1	207.0	○								PP = 4.5 Kg / sq.cm
		SS	03	100	22	2	206.0	○								Sample submitted for laboratory analysis: BH52-03 PP = 4.0 Kg / sq.cm
	broken cobble pieces.	SS	04	100	23		205.5	○								PP = 4.5 Kg / sq.cm
		SS	05	100	28	3	205.0	○								
	End of borehole.						204.5									
	Notes: 1. Borehole was found to be caved in at 3.05 mbgs with freestanding water at 9.14 mbgs upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 2. PP= Pocket Penetrometer.						3.7									

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH53**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 3, 2019** Date Completed: **Jun 3, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606237.46 NORTHING: 4851911.75	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.78 m											
	Topsoil ~ 150 mm. FILL Brown, firm, silty CLAY, trace sand, organics, rootlets, moist.	SS	01	75	7		207.8 0.2	○	○26		19.04	PP = 1.0 Kg / sq.cm
	NATIVE TILL Brown, very stiff to hard, sandy silty CLAY, trace gravel, oxidized, moist.	SS	02	100	10	1	207.0 0.8	○	○13		208.92	PP = 2.0 Kg / sq.cm
		SS	03	100	30	2	206	○	○12		22.78	
	trace broken cobble pieces.	SS	04	105	37	3	205	○	○11		22.80	
	becomes light grey.	SS	05	100	37		204.1	○	○9		23.42	
	End of borehole.						3.7					
	Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.											

∇ No freestanding groundwater measured in open borehole upon completion of drilling.



Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. **BH54**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 18, 2019** Date Completed: **Jun 19, 2019** Revision No.: **0**

Lithology Profile	DESCRIPTION	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS
		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value			Penetration Testing	Soil Vapour Reading parts per million (ppm)					
	Local Ground Surface Elevation: 208.37 m													
	Topsoil ~200 mm. 208.2													
	FILL 0.2	SS	01	75	11		208	○		○ ²¹			PP = 2.5 kg/ sq-cm	
	Brown, stiff, silty CLAY, trace sand, trace gravel, moist. 207.8													
	NATIVE TILL 0.6													
	Brown, very stiff, sandy silty CLAY, trace to some gravel, moist.	SS	02	100	21	1	207	○		○ ¹⁴			PP = NP kg/ sq-cm	
	Oxidized seams.													
		SS	03	33	18	2	206	○		○ ¹⁷				
	206.1													
	Brown, dense, sandy SILT, some clay, trace gravel, moist. 2.3	SS	04	100	37	3	206	○		○ ¹¹				
	oxidized core													
		SS	05	100	37	4	205	○		○ ¹⁰				
	Becomes grey, very dense broken cobble pieces	SS	06	100	57	5	204	○		○ ¹⁰				
		SS	07	100	58		203	○		○ ⁹				
	202.4													
	End of borehole. 5.9													
	Notes: 1. Borehole was found open and dry upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.													

RECORD OF BOREHOLE No. **BH55**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **250 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 18, 2019** Date Completed: **Jun 18, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606288.01 NORTHING: 4851831.47	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa)	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P	Unit Weight (KN/m ³)			COMMENTS	
	Local Ground Surface Elevation: 207.96 m													
	Top soil~ 100 mm. FILL Brown, silty CLAY, trace sand, very moist.	SS	01	41	5		207.9							
	NATIVE TILL Brown, stiff to very stiff, sandy silty CLAY, trace gravel, some oxidation, moist.	SS	02	100	14	1	207.2							PP = 3.0 kg/ sq-cm
		SS	03	100	15	2	206.8							PP = 4.0 kg/ sq-cm
		SS	04	100	23	3	206.0							PP = 4.5 kg/ sq-cm
		SS	05	100	36	4	205.0							PP = 4.5 kg/ sq-cm
	Grey, compact, sandy SILT, some gravel, moist.	SS	06	100	13	5	203.4							PP = 4.5 kg/ sq-cm
	Grey, compact, silty SAND, trace to some gravel, moist.	SS	07	92	26	6	201.9							PP = 2.5 kg/ sq-cm
	very dense	SS	08	67	71	8	200.1							PP = 3.5 kg/ sq-cm
	compact	SS	09	75	22	9	199.8							PP = 4.0 kg/ sq-cm
	End of borehole. Notes: 1. Borehole was found to be caved in at 7.92 mbgs with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.						198.2							

RECORD OF BOREHOLE No. **BH56**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 3, 2019** Date Completed: **Jun 3, 2019** Revision No.: **0**

Lithology Profile	DESCRIPTION	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	EASTING: 606241.63 NORTHING: 4851869.53	
		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value						Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.62 m											
	Topsoil ~ 150 mm. 207.5											
	FILL 0.2 Brown, compact, SAND and GRAVEL, trace silt, moist. 206.9	SS	01	84	10		○	○12		18.84	PP = 0.75 Kg / sq.cm	
	NATIVE TILL 0.8 Brown, stiff to very stiff, sandy silty CLAY, trace to some sand, trace gravel, oxidized, moist.	SS	02	100	14	1	○	○13		22.71	PP = 4.5 Kg / sq.cm	
		SS	03	100	21	2	○	○12		22.54		
	hard trace broken cobble pieces.	SS	04	105	38	3	○	○12		22.99		
		SS	05	100	34		○	○10		21.82		
	End of borehole. 204.0 Notes: 3.7											

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH57**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **250 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 18, 2019** Date Completed: **Jun 18, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606292.18 NORTHING: 4851789.25	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa)	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _p W _L		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 208.10 m											
	Top soil ~ 150 mm. 207.9 0.2	SS	01	100	4		208		○ ²⁴			
	FILL Brown, firm, silty CLAY, trace gravel, trace sand, rootlets moist. 207.3 0.8	SS	02	100	16	1	207	○	○ ¹⁷		PP = 4.5 kg/ sq-cm	
	NATIVE TILL Brown, very stiff, sandy silty CLAY, trace to some gravel, some oxidation, moist. stiff	SS	03	100	14	2	206	○	○ ¹³		PP = 3.5 kg/ sq-cm	
	oxidized cores very stiff	SS	04	100	26			○	○ ¹¹		PP = 4.0 kg/ sq-cm	
	becomes greyish brown	SS	05	100	15	3	205	○	○ ¹¹			
	becomes silty sand	SS	07	92	59	6	202	○	○ ¹¹		PP = 3.0 kg/ sq-cm	
	203.5 4.6 Brownish grey, very dense, sandy SILT, some clay, some cobbles pieces, moist.	SS	06	92	43	5	203	○	○ ¹¹			
	201.4 6.7 End of borehole.											
	Notes: 1. Borehole was open and dry upon completion. 2. Water table was measured completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.											

∇ No freestanding groundwater measured in open borehole upon completion of drilling.



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Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH58**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **250 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 19, 2019** Date Completed: **Jun 19, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606245.8 NORTHING: 4851827.32	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _p W _L		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.48 m											
	Top soil ~ 150 mm. 207.3 0.2 FILL Brown, firm, silty CLAY, trace gravel, trace sand, moist.	SS	01	59	4		207		○ ²⁴			
	206.7 0.8 NATIVE TILL Brown, stiff, sandy silty CLAY, trace to some gravel, oxidized, moist.	SS	02	100	10	1	206		○ ¹³			PP = 3.5 kg/ sq-cm
		SS	03	100	17	2	205		○ ¹⁰			PP = 4.5 kg/ sq-cm
		SS	04	100	26	3	204		○ ¹¹			PP = 4.5 kg/ sq-cm
		SS	05	100	44	4	203		○ ¹²			PP = 4.5 kg/ sq-cm
	becomes grey and sandy	SS	06	33	58	5	202		○ ⁷			
	201.4 6.1 Compact, grey, SILT, some sand, some clay at the tip, moist.	SS	07	70	17	6	201		○ ¹⁴			
	200.8 6.7 End of borehole.											
	Notes: 1. Borehole was open and dry upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.											



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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: **6.10 m**.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH59**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 4, 2019** Date Completed: **Jun 4, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606296.34 NORTHING: 4851747.04	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _p W _L	Unit Weight (KN/m ³)	COMMENTS			
	Local Ground Surface Elevation: 208.25 m													
	Top Soil ~150 mm. 208.1													
	FILL 0.2	SS	01	67	6		208	○	○ ²³			19.59	PP = 2.5 Kg / sq.cm	
	Brown, firm, silty CLAY, trace gravel, trace sand, rootlets moist. 207.5													
	NATIVE TILL 0.8	SS	02	75	9	1	207	○	○ ²³			20.36	PP = 3.0 Kg / sq.cm	
	Brown, firm to hard, sandy silty CLAY, trace gravel, trace sand, moist.													
		SS	03	100	10	2	206	○	○ ²⁵ ○ ²⁵			21.52	PP = 2.5 Kg / sq.cm	
		SS	04	100	25		206	○	○ ¹³			22.18		
		SS	05	100	34	3	205	○	○ ¹²			22.91	PP = 4.5 Kg / sq. cm	
						4	204							
						5	203	○	○ ⁹ ○ ¹⁰			21.41	PP = 4.0 Kg / sq. cm	
	Brown, very dense, sandy SILT, some clay, trace gravel, oxidized, moist. 203.7	SS	06	100	40	5	203							
						6	202	○	○ ¹²			22.37	PP = 3.0 Kg / sq. cm	
	GR: 5%; SA: 28%; SI: 49%; & CL: 18%	SS	07	100	15		202							
						7	201							
		SS	08	100	66	8	200	○	○ ⁸			21.39	PP = 4.5 Kg / sq. cm	
						9	199							
		SS	09	75	51		199	○	○ ¹⁰			22.97		
	End of borehole. 198.5													
	Notes: 9.8													

RECORD OF BOREHOLE No. BH60/MW60



Project Number: 665125 Drilling Location: As per borehole location plan Logged by: MF
 Client: City of Brampton Drilling Method: 250 mm Hollow Stem Augering Compiled by: NT
 Project Name: Geotechnical Investigation- Johnston Transit Facility Drilling Machine: Track Mounted Drill Reviewed by: MT
 Location: 10192 Hwy 50, Brampton, ON Date Started: Jun 18, 2019 Date Completed: Jun 18, 2019 Revision No.: 0

Lithology Profile	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	EASTING: 606249.96 NORTHING: 4851785.1	
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)						SPT 'N' Value	Unit Weight (KN/m ³)
Local Ground Surface Elevation: 207.80 m											
Topsoil ~200 mm.											
FILL Brown, firm, silty CLAY, trace gravel, trace sand, moist.	SS	01	51	4				24			PP = 3.5 kg/ sq-cm
NATIVE TILL Brown, stiff, sandy silty CLAY, trace to some gravel, oxidized, moist.	SS	02	59	12	1			21			PP = 3.5 kg/ sq-cm
	SS	03	100	14	2			12			PP = 3.0 kg/ sq-cm
	SS	04	133	22	3			12			PP = 4.5 kg/ sq-cm
	SS	05	100	22	4			8			PP = 4.5 kg/ sq-cm
becomes very dense	SS	06	100	30/50mm	5			26			PP = 3.5 kg/ sq-cm
	SS	07	78	72/300mm	6			11			PP = 2.5 kg/ sq-cm
	SS	08	0	50/50mm	8						No recovery
becomes silty SAND	SS	09	67	83/300mm	9			17			
End of borehole.											
Notes: 1. Borehole was found to caved in at 7.47 mbgs no with freestanding water was recorded upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger.											



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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: 7.47 m.
 ∇ Groundwater depth observed on 02/07/2019 at a depth of: 1.54 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. **BH62**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 18, 2019** Date Completed: **Jun 18, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606300.51 NORTHING: 4851704.81		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS
								○ SPT	● DCPT	△ Intact	◇ Intact			
	Local Ground Surface Elevation: 207.95 m													
	Topsoil~ 100 mm. FILL Brown, firm, silty CLAY, trace gravel, moist.	SS	01	100	9		207.8							
	NATIVE TILL Brown, very stiff, sandy silty CLAY, trace to some gravel, some oxidation, moist	SS	02	100	16	1	207.2							PP = 3.5 kg/ sq-cm
	Brown, compact, sandy SILT, some clay, trace gravel, moist	SS	03	100	22	2	206.4							PP = 3.5 kg/ sq-cm
	becomes very dense	SS	04	100	51	3	206.0							PP = 4.0 kg/ sq-cm
	becomes dense	SS	05	100	43	4	205.5							PP = 4.0 kg/ sq-cm
	Becomes grey.	SS	06	100	50	5	204.5							PP = 2.5 kg/ sq-cm
	trace broken cobbles	SS	07	100	42		202.0							
	End of borehole. Notes: 1. Borehole was found open and dry upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.						5.9							PP =3.0 kg/ sq-cm

RECORD OF BOREHOLE No. **BH63**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 4, 2019** Date Completed: **Jun 4, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606277.31 NORTHING: 4851723.83	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.86 m											
	Topsoil ~ 150 mm. 207.7											
	FILL 0.2 Brown, firm, silty CLAY, trace sand, trace gravel, rootlets, moist. 207.1	SS	01	92	6						19.15	PP = 1.5 Kg / sq.cm
	NATIVE TILL 0.8 Brown, stiff to very stiff, sandy silty CLAY, trace gravel, broken cobble pieces, moist. 207.1	SS	02	100	14	1	207				17.52	PP = 3.0 Kg / sq.cm
		SS	03	100	18	2	206				17.20	
	becomes hard	SS	04	100	39		205				17.16	
		SS	05	100	43	3					17.05	
	End of borehole. 204.2 Notes: 3.7											

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH64**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 4, 2019** Date Completed: **Jun 4, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606254.12 NORTHING: 4851742.86	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.91 m											
	Topsoil ~ 150 mm. 207.8											
	FILL 0.2 Brown, firm, silty CLAY, trace sand, trace gravel, rootlets, moist. 207.2	SS	01	84	7		207.8	○			18.48	PP = 1.25 Kg / sq.cm PP = 4.25 Kg / sq.cm
	NATIVE TILL 0.8 Brown, stiff, sandy silty CLAY, trace to some sand, trace gravel, moist. 207.2	SS	02	100	13	1	207.0	○			18.80	
		SS	03	100	16	2	206.0	○			17.73	
	becomes greyish brown.	SS	04	100	50 / 75 mm		205.5	○			17.15	
	trace broken cobble pieces. 204.3	SS	05	100	35	3	204.3	○			17.26	
	End of borehole. 3.7 Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.											

∇ No freestanding groundwater measured in open borehole upon completion of drilling.



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RECORD OF BOREHOLE No. **BH65**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 4, 2019** Date Completed: **Jun 4, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING			EASTING: 606258.29 NORTHING: 4851700.64		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing			INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS
								○ SPT	● DCPT	△ Intact			
Local Ground Surface Elevation: 207.86 m													
	Topsoil ~ 150 mm.						207.7						
	FILL Brown, firm, silty CLAY, trace sand, trace gravel, rootlets, moist.	SS	01	84	7		207.2	○				18.94	PP = 1.25 Kg / sq.cm
	NATIVE TILL Brown, very stiff, sandy silty CLAY, trace gravel, broken cobble pieces, moist.	SS	02	33	18	1	207.1	○				18.20	
	becomes hard	SS	03	100	22	2	206.8	○				17.38	
		SS	04	100	42		206.0	○				17.07	
		SS	05	100	35	3	205.0	○				17.20	
	End of borehole.						204.2						
	Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.						3.7						

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

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RECORD OF BOREHOLE No. **BH66**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **250 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 18, 2019** Date Completed: **Jun 19, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606235.1 NORTHING: 4851719.67	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _p W _L 20 40 60 80			Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.48 m													
	Topsoil~ 100 mm. 207.4 0.1													
	FILL Brown, firm, silty CLAY, trace gravel, moist. 206.7 0.8	SS	01	33	5		207	○						PP = 2.5 kg/ sq-cm
	NATIVE TILL Brown, stiff, sandy silty CLAY, trace to some gravel, some oxidation, moist, 205.2 2.3	SS	02	67	10		1	○						PP = 4.0 kg/ sq-cm
	Brown, compact, sandy SILT, some clay trace gravel, moist 204.3 2.3	SS	03	100	22		2	○						PP = 3.0 kg/ sq-cm
	Brown, compact, sandy SILT, some clay trace gravel, moist 203.3 2.3	SS	04	84	25		205	○						PP = 4.5 kg/ sq-cm
	Brown, compact, sandy SILT, some clay trace gravel, moist 202.3 2.3	SS	05	75	24		204	○						PP = 4.5 kg/ sq-cm
	Brown, compact, sandy SILT, some clay trace gravel, moist 201.3 2.3	SS	06	84	35		203	○						PP = 4.5 kg/ sq-cm
	Brown, compact, sandy SILT, some clay trace gravel, moist 201.0 6.5	SS	07	12	76/279mm		201	○						PP = 4.5 kg/ sq-cm
	End of borehole. Notes: 1. Borehole was found open and dry upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger.													

∇ No freestanding groundwater measured in open borehole upon completion of drilling.

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Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH67**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 4, 2019** Date Completed: **Jun 4, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606211.9 NORTHING: 4851738.7	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.43 m											
	Topsoil ~ 150 mm. 207.3											
	FILL 0.2	SS	01	67	5		207	○	○ 28		20.06	PP = 1.25 Kg / sq.cm
	Brown, firm, silty CLAY, trace sand, trace gravel, rootlets, moist. 206.7											
	NATIVE TILL 0.8	SS	02	100	15	1		○	○ 12		17.48	PP = 2.5 Kg / sq.cm
	Brown, very stiff, sandy silty CLAY, trace gravel, oxidized, moist.											
	hard	SS	03	100	23	2		○	○ 12		17.50	
	very stiff	SS	04	100	32	3		○	○ 11		17.22	
	broken cobble pieces. 203.8											
	End of borehole. 3.7											
	Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer.											

∇ No freestanding groundwater measured in open borehole upon completion of drilling.

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Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. **BH68**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 4, 2019** Date Completed: **Jun 4, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606188.7 NORTHING: 4851757.73	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.06 m											
	Topsoil ~ 150 mm. 206.9											
	FILL 0.2 Brown, firm, silty CLAY, trace sand, trace gravel, rootlets, moist. 206.3	SS	01	84	6						19.15	PP = 1.5 Kg / sq.cm
	NATIVE TILL 0.8 Brown, very stiff, sandy silty CLAY, trace gravel, oxidized, moist. 206.3	SS	02	100	15	1	206				17.25	PP = 2.5 Kg / sq.cm
		SS	03	100	17	2	205				17.09	
	hard	SS	04	100	32						17.04	
						3	204					
	Grey, compact, SILT, trace sand, trace clay, moist. 204.0	SS	05	100	15						17.05	
	End of borehole. 203.4 Notes: 3.7											

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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH69**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **250 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 21, 2019** Date Completed: **Jun 21, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606262.45 NORTHING: 4851658.43	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.75 m											
	Topsoil~ 200 mm. 207.5											
	FILL 0.2 Brown, firm, silty CLAY, trace gravel, moist.	SS	01	84	6		207	○	○ ²¹			PP = 1.5 kg/ sq-cm
	NATIVE TILL 0.8 Brown, very stiff, sandy silty CLAY, trace to some sand, trace to some gravel, some oxidation, moist to very moist.	SS	02	100	14	1	207	○	○ ¹³			PP = 3.5 kg/ sq-cm
	Brown, very stiff, sandy silty CLAY, trace gravel, trace oxidation, moist 206.2	SS	03	100	16	2	206	○	○ ¹³			PP = 4.0 kg/ sq-cm
	Becomes brown grey. clay seams	SS	04	100	24	3	205	○	○ ¹¹			PP = 4.5 kg/ sq-cm
		SS	05	100	14	4	204	○	○ ¹¹			PP = 4.0 kg/ sq-cm
		SS	06	100	17	5	203	○	○ ²⁷			PP = 4.0 kg/ sq-cm
	Grey, dense, sandy SILT, trace gravel, moist. 201.6	SS	07	75	37	6	201.6	○	○ ¹¹			
	End of borehole. Notes: 6.7 1. Borehole was found to be caved in 6.10 mbgs without freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger. 3. PP = pocket penetrometer.											



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∇ No freestanding groundwater measured in open borehole upon completion of drilling. ☐ Cave in depth recorded on completion of drilling: **6.10 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH70/MW70



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Phase II Environmental Site Assessment** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 11, 2019** Date Completed: **Jun 11, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606239.26 NORTHING: 4851677.44	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.58 m											
	Top Soil ~150 mm. 207.4											
	FILL 0.2 Brown, firm, silty CLAY, trace gravel, trace sand, rootlets, moist. 206.8	SS	01	100	5		207	○				Top of Riser Elevation = 208.47 m Height of Riser= 0.94 m Sample submitted for laboratory analysis: BH70-01 PP = 2.5 Kg / sq.cm
	NATIVE TILL 0.8 Brown, stiff to very stiff, sandy silty CLAY, some gravel, trace sand, oxidised, moist. 206.8	SS	02	16	12	1	207	○				
		SS	03	100	19	2	206	○				PP = 4.0 Kg / sq.cm
		SS	04	100	25		205	○				PP = 4.5 Kg / sq.cm
	Grey, compact, SILT, trace to some clay. 204.5 some gravel, trace sand, moist. 204.5	SS	05	100	14	3	205	○				PP = 3.0 Kg / sq.cm
		SS	06	100	14	4	204	○				PP = 3.0 Kg / sq.cm
	Grey, compact, SILT to silty SAND, trace 203.0 gravel, trace clay, moist. 203.0	SS	07	8	20	5	203	○				
		SS	08	8	29		202	○				
	very dense	SS	09	80	100	6	202	○				
					86 / 280 mm		201					
		SS	10	0		8	200					
	End of borehole. 199.5 Notes: 8.1											
	1. Borehole was found to be open with no freestanding water at 4.42 mbgs upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019. 2. PP= Pocket Penetrometer.											



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∇ No freestanding groundwater measured in open borehole upon completion of
drilling. Groundwater depth observed on 21/10/2019 at a depth of: 2.33 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH71**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **SP**
 Client: **City of Brampton** Drilling Method: **100 mm Solid Stem Augers** Compiled by: **NT**
 Project Name: **Geotechnical Investigation- Johnston Transit Facility** Drilling Machine: **GeoProbe** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 4, 2019** Date Completed: **Jun 4, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606216.07 NORTHING: 4851696.48	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.24 m											
	Topsoil ~ 150 mm. 207.1											
	FILL 0.2 Brown, firm, silty CLAY, trace sand, trace gravel, organics, rootlets, moist. 206.5	SS	01	67	4		207	○	○16		20.08	PP = 1.75 Kg / sq.cm PP = 2.5 Kg / sq.cm
	NATIVE TILL 0.8 Brown, very stiff, sandy silty CLAY, trace gravel, oxidized, moist. 206.5	SS	02	100	17	1	206	○	○12		18.98	
	GR: 7%; SA: 27%; SI: 47%; & CL: 19% trace broken cobble pieces. 205.5	SS	03	100	26	2	205	○	●15		17.17	
	becomes hard 204.5	SS	04	100	36	3	204	○	○11		17.20	
	End of borehole. 203.6	SS	05	100	36		204	○	○11		17.09	
	Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured inside the hollow stem auger upon completion. 3. PP= Pocket Penetrometer. 4. GR., SA., SI. & CL. denote Gravel, Sand, Silt & Clay respectively.											

∇ No freestanding groundwater measured in open borehole upon completion of drilling.



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Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH72**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **AB**
 Client: **City of Brampton** Drilling Method: **200 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Phase II Environmental Site Assessment** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 20, 2019** Date Completed: **Jun 20, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606359.9 NORTHING: 4851769.6	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 208.98 m											
	Topsoil~ 100 mm. 208.9 0.1											
	FILL Brown, compact, gravelly SAND, moist 208.4	SS	01	66	28			○				Sample submitted for laboratory analysis: BH72-01
	NATIVE TILL Light brown, stiff, sandy silty CLAY, thin black seam, moist. 0.6	SS	02	82	9	1	208	○				Sample submitted for laboratory analysis: BH72-02
	becomes hard	SS	03	100	20			○				
		SS	04	100	33	2	207	○				Sample submitted for laboratory analysis: BH72-03
		SS	05	66	49			○				
		SS	06	100	48			○				
		SS	07	0	50/125 mm							
	Grey, dense to very dense, sandy SILT, 4.3 trace clay, moist. 204.7	SS	08	100	49			○				
	End of borehole. 204.0	SS	09	100	50/125 mm	5	204					
	Notes: 1. Borehole was found to be open with no freestanding water upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger.											

RECORD OF BOREHOLE No. **BH73**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **AB**
 Client: **City of Brampton** Drilling Method: **200 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Phase II Environmental Site Assessment** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50, Brampton, ON** Date Started: **Jun 20, 2019** Date Completed: **Jun 20, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				EASTING: 606362 NORTHING: 4851771.2			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing				INSTRUMENTATION INSTALLATION	Unit Weight (KN/m ³)	COMMENTS	
								○ SPT	● DCPT	△ Intact	◇ Intact				▲ Lower Explosive Limit (LEL)
	Local Ground Surface Elevation: 208.83 m														
	Topsoil~ 100 mm. 208.7														
	FILL 0.1														
	Brown, compact, gravelly SAND, moist 208.2	SS	01	100	30										
	NATIVE TILL 0.6														
	Light brown, stiff, silty CLAY, some sand, trace gravel, moist. 207.6	SS	02	82	11	1	208								Sample submitted for laboratory analysis: BH73-02
	Light brown, very stiff to hard, silty sandy CLAY, trace gravel, moist. 207.2	SS	03	100	25										
	becomes hard	SS	04	100	35	2	207								
		SS	05	66	40										
		SS	06	100	48	3	206								
		SS	07	100	50	4	205								Sample submitted for laboratory analysis: BH73-07
		SS	08	70	50/ 125 mm										
		SS	09	100	52	5	204								
		SS	10	100	63										
	End of borehole. 202.7					6	203								
	Notes: 6.1														
	1. Borehole was found to be open with no freestanding water upon completion.														
	2. Water table was measured upon completion of drilling inside the hollow stem auger.														

RECORD OF BOREHOLE No. **BH74/MW74**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **JP**
 Client: **City of Brampton** Drilling Method: **200 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation-Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **Brampton** Date Started: **Oct 16, 2019** Date Completed: **Oct 16, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	EASTING: 606484.167 NORTHING: 4851890.911	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L 20 40 60 80 W _p		Unit Weight (KN/m ³)	COMMENTS
	Local Ground Surface Elevation: 207.93 m											
	Topsoil ~ 200 mm											
	FILL Light brown, loose, silty SAND, some clay, moist.	SS	01	100	13			○	○18			Top of Riser = 208.82 m Height of Riser = 0.89 m Sample submitted for laboratory analysis : BH74-01
	NATIVE TILL Light brown, hard, sandy silty CLAY, trace gravel, moist.	SS	02	100	31	1	207	○	○11			Sample submitted for laboratory analysis : BH74-02
		SS	03	100	38	2	206	○				
		SS	04	100	55	3	205	○				Some grey clay mottling.
		SS	05	100	70			○				
	Brown to light brownish grey, very dense, silty SAND, trace clay, moist to wet.	SS	06	100	70	4	204	○	○11			Sample submitted for laboratory analysis : BH74-06
	Light greyish brown, very dense, SAND, some silt and gravel, wet.	SS	07	8	60	5	203	○				
	becomes compact.	SS	08	51	16			○				Borehole cave in at 5.64 mbgl due to wet soil.
	End of Borehole. Notes: 1. Borehole was found to be cave at 5.64 mbgs and no freestanding water 2. Water table was measured upon completion of drilling inside the hollow stem auger and on October 21, 2019.						202					



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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

∇ Groundwater depth observed on **21/10/2019** at a depth of: **2.59 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH75/MW75



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **JP**
 Client: **City of Brampton** Drilling Method: **200 mm Hollow Stem Augering** Compiled by: **NT**
 Project Name: **Geotechnical Investigation-Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **Brampton** Date Started: **Oct 16, 2019** Date Completed: **Oct 16, 2019** Revision No.: **0**

Lithology Profile	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	EASTING: 606531.454 NORTHING: 4851945.297	
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)						SPT 'N' Value	Unit Weight (KN/m ³)
LITHOLOGY PLOT Local Ground Surface Elevation: 208.09 m											
FILL Light brown, very stiff, silty CLAY, trace gravel, moist.	SS	01	100	16				19			Top of Riser = 208.95 m Height of Riser = 0.86 m. Sample submitted for laboratory analysis : BH75-01
NATIVE STRATA Light brown, very stiff, silty CLAY, trace gravel, trace sand, moist.	SS	02	100	18	1	207		18			Sample submitted for laboratory analysis : BH75-02
	SS	03	100	33	2	206					
NATIVE TILL Light brown to brownish grey, hard, sandy silty CLAY, moist.	SS	04	100	89 / 255 mm	3	205					Some grey clay mottling.
	SS	05	74	72	4	204					
Light brownish grey, silty CLAY, some sand, moist.	SS	06	100	50 / 125 mm	4	204		11			Sample submitted for laboratory analysis : BH76-06
End of Borehole. Notes: 1. Borehole was found to be open and no freestanding water. 2. Water table was measured upon completion of drilling inside the hollow stem auger and on October 21, 2019.											Auger to 4.27 and refusal at 4.27 mbgs.



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∇ No freestanding groundwater measured in open borehole upon completion of drilling.

∇ Groundwater depth observed on **21/10/2019** at a depth of: **3.41 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH76**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **MF**
 Project Name: **Geotechnical Investigation-Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50** Date Started: **Oct 15, 2019** Date Completed: **Oct 15, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606505.43 NORTHING: 4851930.42
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P	COMMENTS			
	Local Ground Surface Elevation: 208.01 m												
	Topsoil ~ 150 mm												
	FILL Brown, stiff, silty CLAY, some sand, trace gravel, rootlets, moist.	SS	01	75	11			○		○22			
	NATIVE TILL Brown, silty CLAY, trace to some sand, trace gravel, oxidized, moist. GR: 1%; SA: 12%; SI: 40%; CL: 47%	SS	02	100	24	1	207	○		●16			
		SS	03	100	23	2	206	○		○14			
	Brown, very dense, silty SAND, trace clay, oxidized, trace gravel, moist.	SS	04	100	88	3	205			○9			
	Brown, very dense, sandy silty CLAY, trace to some gravel, oxidized, moist.	SS	05	16	50	4	204	○		○11			
	Brown, very dense, SAND, trace gravel, trace silt, moist.	SS	06	100	66	5	203	○		○20 ○18			
	becomes fine.	SS	07	51	50	6	202	○		○10 ○17			
	End of Borehole.												
Notes: 1. Borehole was found to be open and freestanding water was at 3.05 mbgs upon completion. 2. Borehole was found to cave in 1.07m mbgs upon completion. 3. GR, SA, SI, CL denotes Gravel, Sand, Silt and Clay, respectively													

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Groundwater depth on completion of drilling: **3.05 m** Cave in depth recorded on completion of drilling: **5.5 m**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. **BH77**



Project Number: **665125** Drilling Location: **As per borehole location plan** Logged by: **MF**
 Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **MF**
 Project Name: **Geotechnical Investigation-Johnston Transit Facility** Drilling Machine: **Track Mounted Drill** Reviewed by: **MT**
 Location: **10192 Hwy 50** Date Started: **Oct 15, 2019** Date Completed: **Oct 15, 2019** Revision No.: **0**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	EASTING: 606528.74 NORTHING: 4851913.36
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12 △ Soil Vapour Reading parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) * Passing 75 um (%) ○ Moisture Content (%) Atterberg Limits W _L W _P	COMMENTS			
	Local Ground Surface Elevation: 207.89 m												
	Topsoil ~ 150 mm												
	FILL brown, stiff, silty CLAY, trace sand, trace gravel, rootlets, moist.	SS	01	75	12			○		○20			
	NATIVE TILL Brown, very stiff, sandy silty CLAY, trace gravel, trace oxidation, moist. GR: 3%; SA: 33%; SI & CL: 64.1%	SS	02	75	25	1	207	○		○11			Wet Unit Weight= 1957.23 kg/m ³ .
	GR: 1%; SA: 28%; SI: 51% ; CL: 20%	SS	03	100	40	2	206	○		○13			Wet Unit Weight= 1832.03 kg/m ³ .
		SS	04	100	90	3	205			○10			
		SS	05	100	73	4	204			○18 ○12			
		SS	06	100	88	5	203			○24 ○25			
		SS	07	100	51	6	202			○20 ○18			
	End of Borehole.												
	Notes: 1. Borehole was found to be open and freestanding water was at 3.05 mbgs upon completion. 2. Borehole was found to cave in up to 1.22 mbgs upon completion. 3. GR, SA, SI, & CL denote Gravel, Sand, Silt and Clay, respectively.												

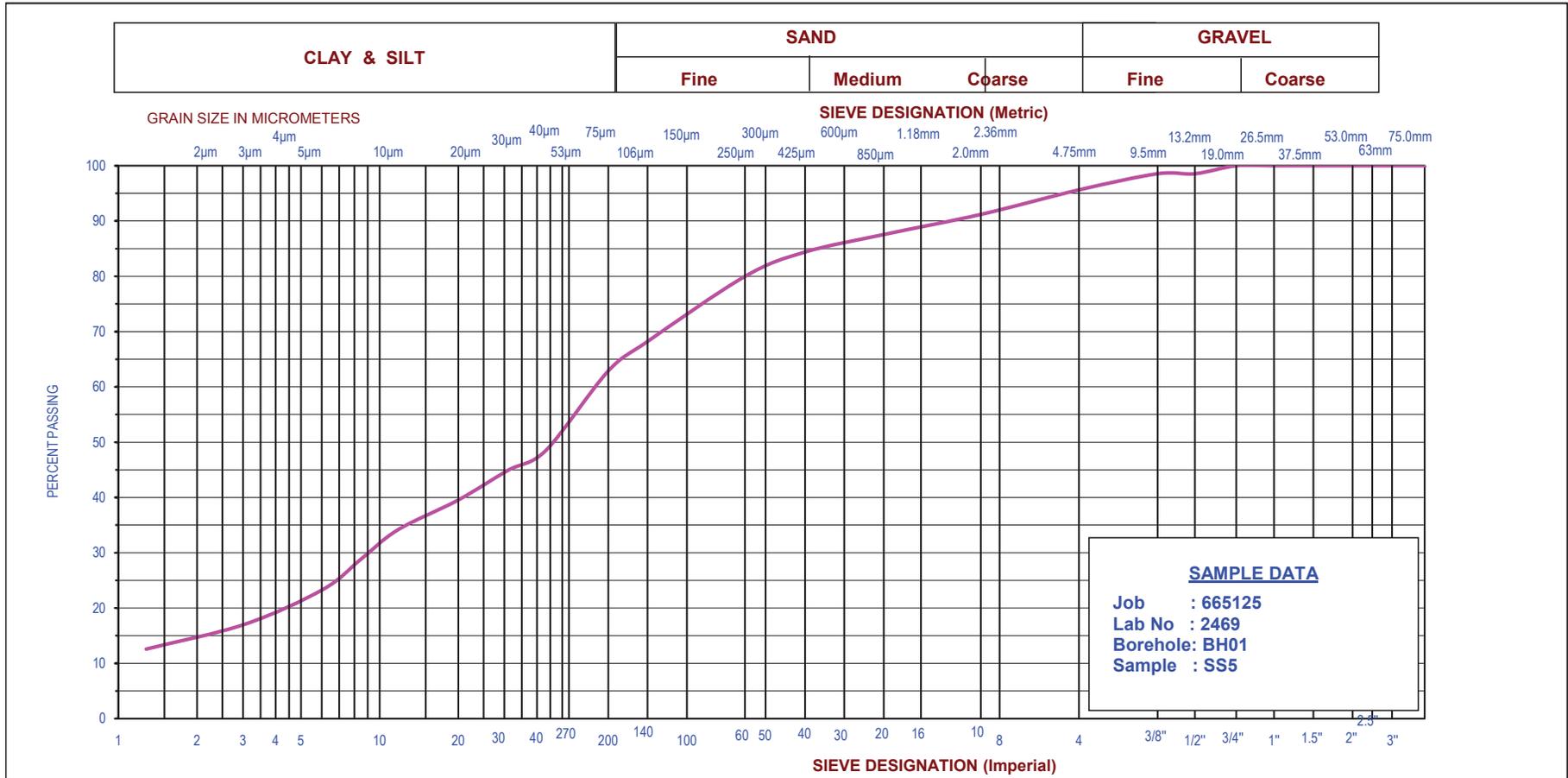
Appendix C

Laboratory Testing Results (21 pages)



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UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2469
 Borehole: BH01
 Sample : SS5

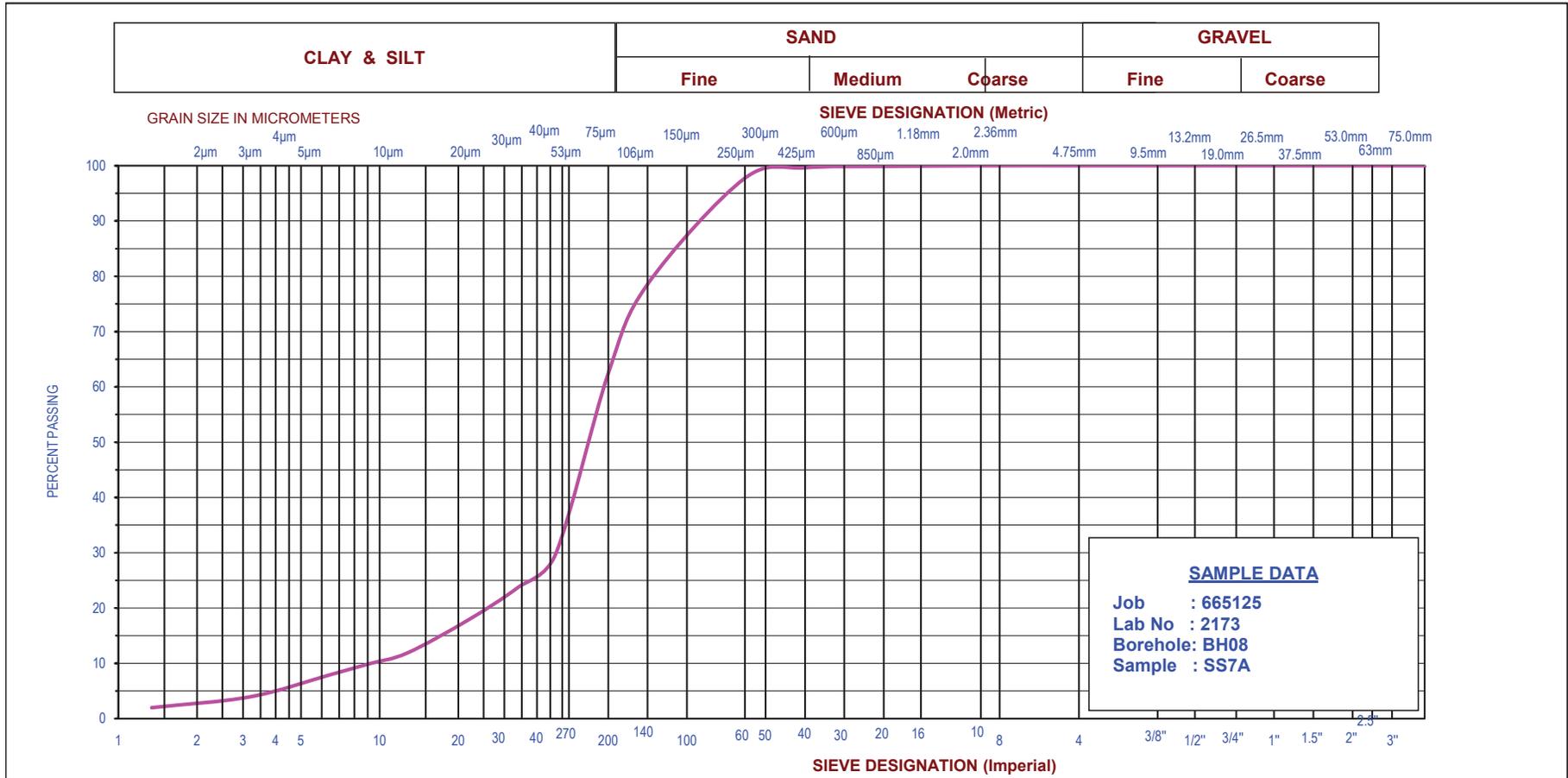
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	4	4	7	22	48	15

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY SILT some clay, trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
			Date: July 2019	



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UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2173
 Borehole: BH08
 Sample : SS7A

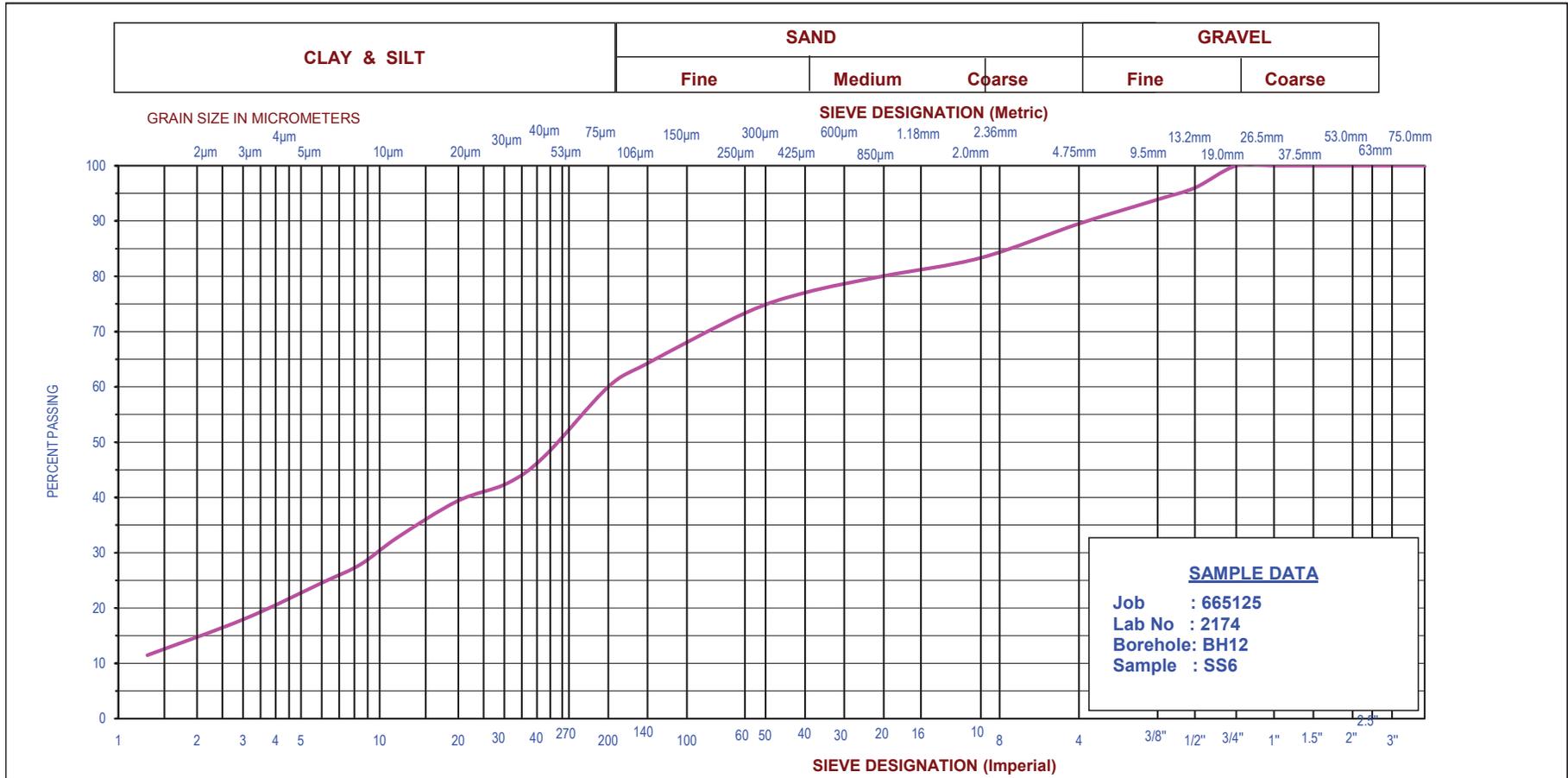
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	0	0	0	38	59	3

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY SILT trace clay		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
		Date: June 2019		



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UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2174
 Borehole: BH12
 Sample : SS6

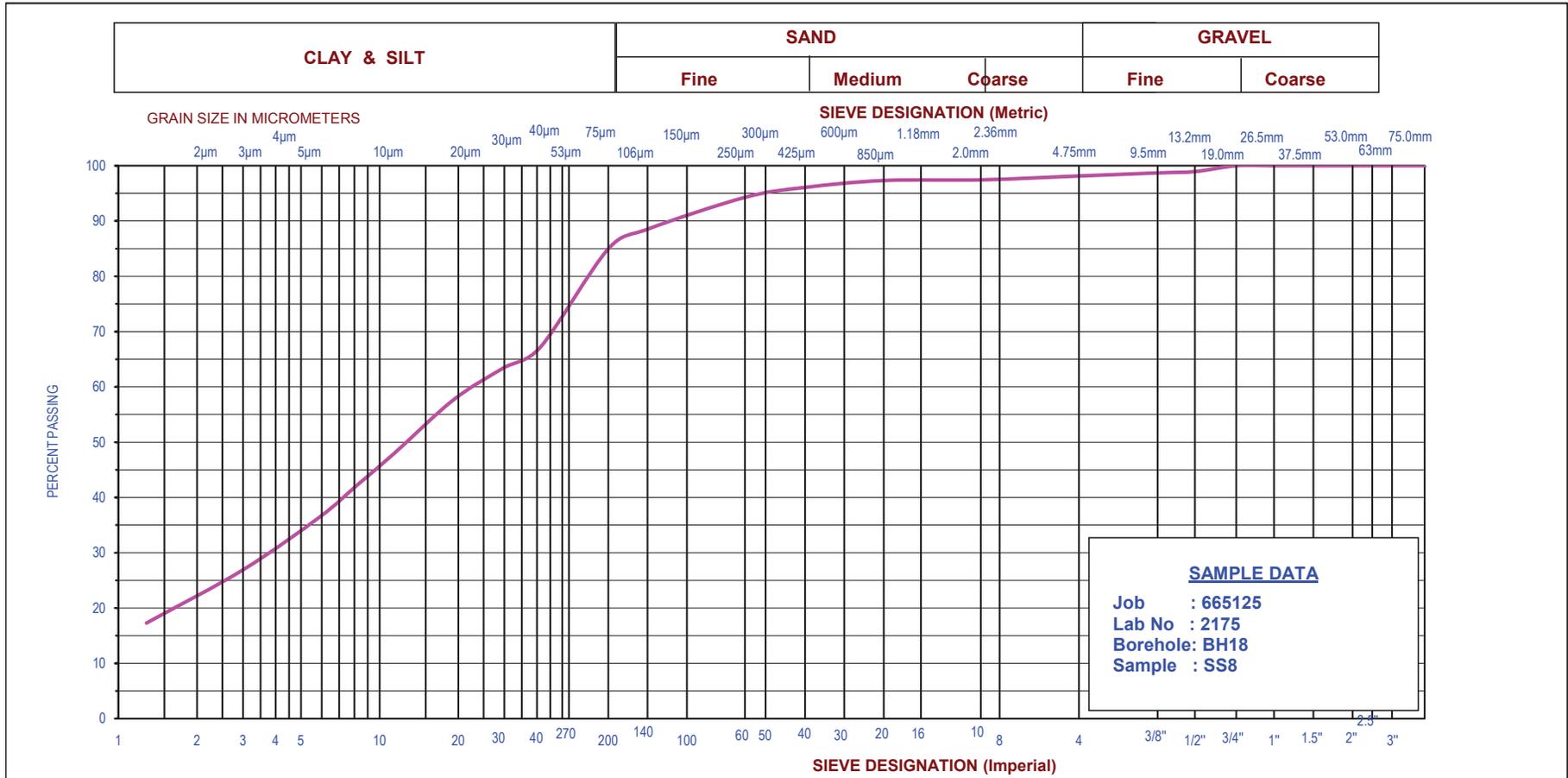
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	11	6	6	17	45	15

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY SILT some clay, some gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
			Date: June 2019	



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SAMPLE DATA
 Job : 665125
 Lab No : 2175
 Borehole: BH18
 Sample : SS8

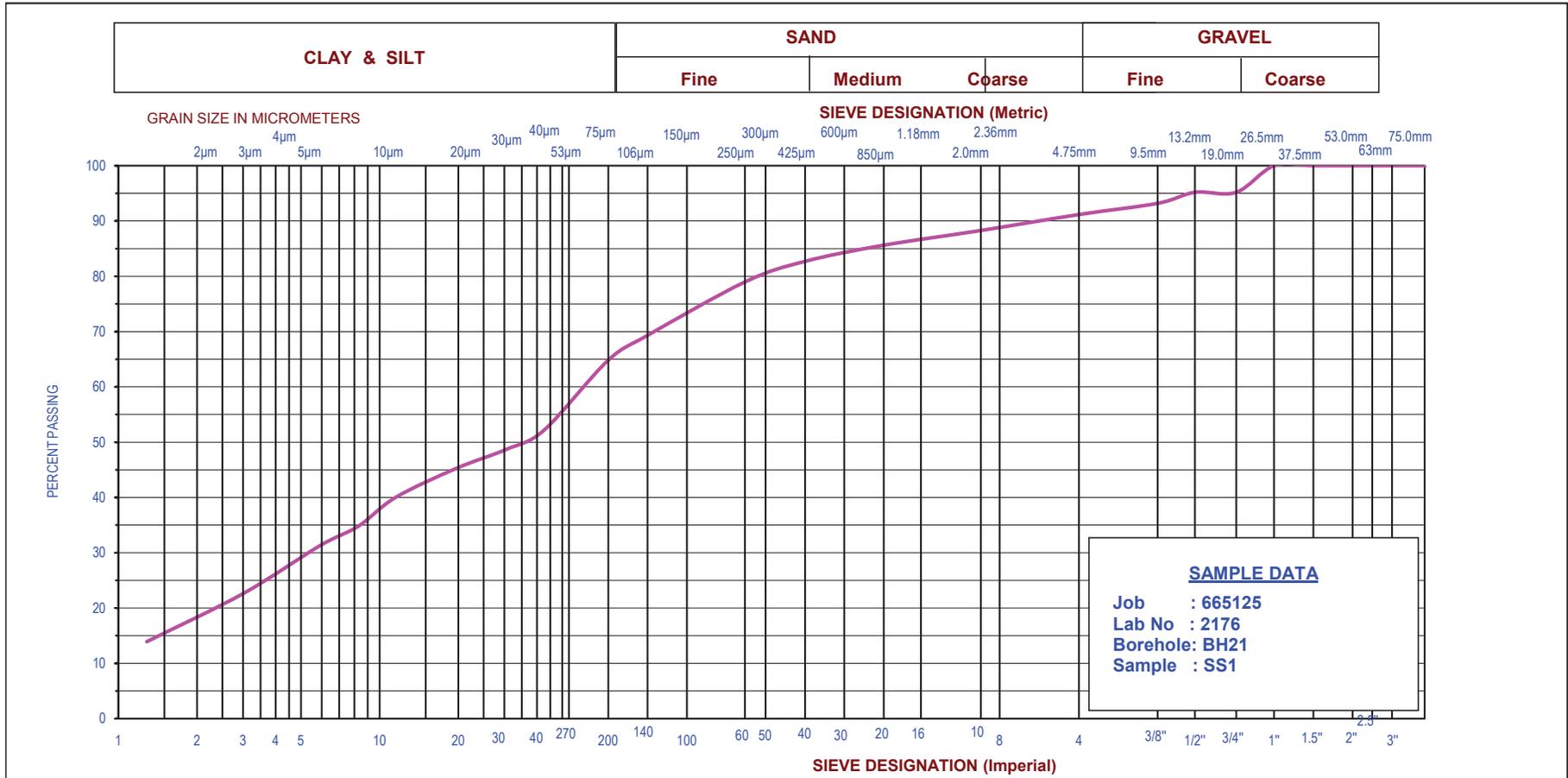
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	2	1	1	11	63	22

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	CLAYEY SILT some sand, trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
		Date: June 2019		



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SAMPLE DATA
 Job : 665125
 Lab No : 2176
 Borehole: BH21
 Sample : SS1

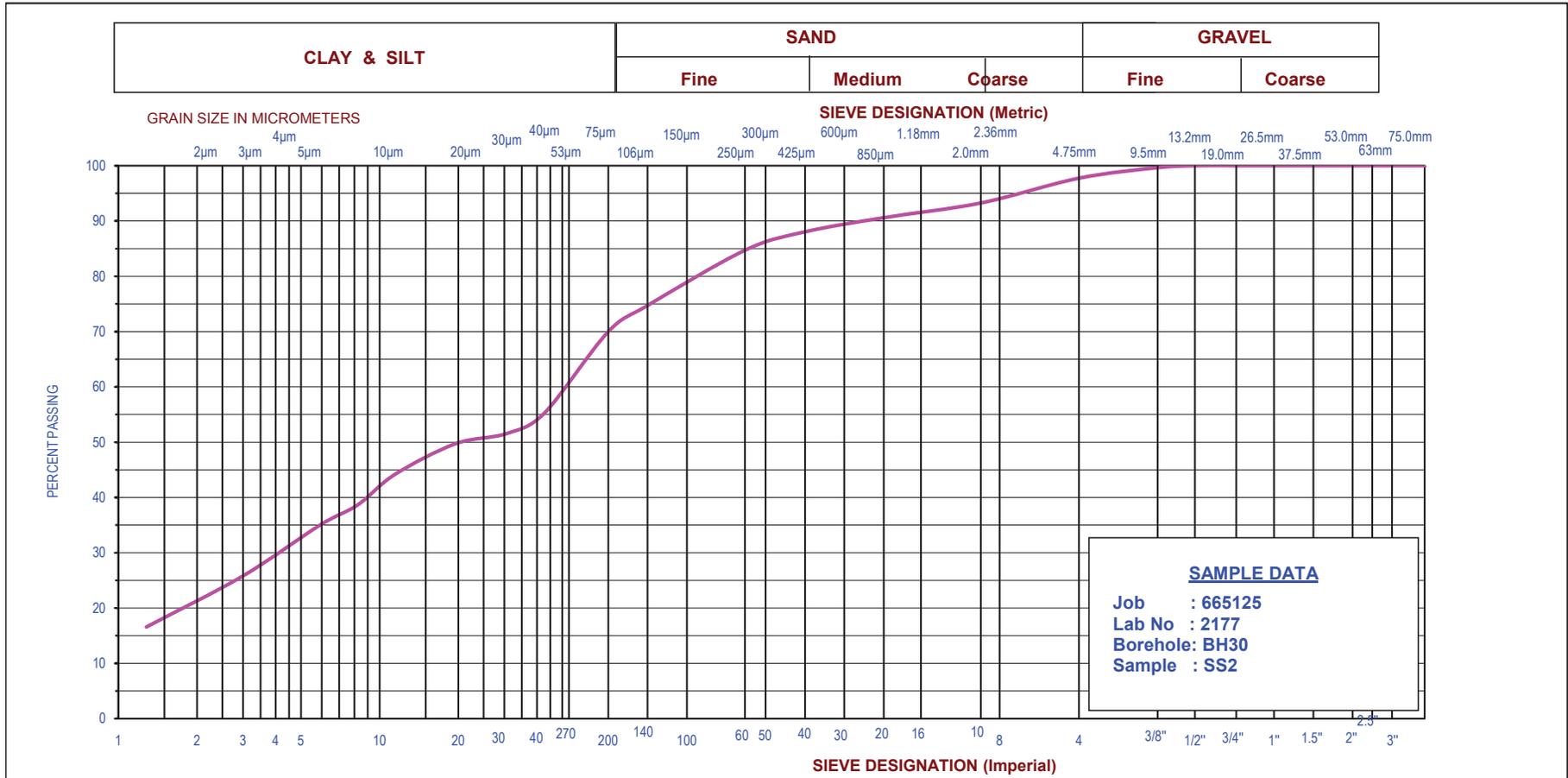
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	5	4	3	5	18	47	18

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY SILT some clay, trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
		Date: June 2019		



SNC • LAVALIN

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2177
 Borehole: BH30
 Sample : SS2

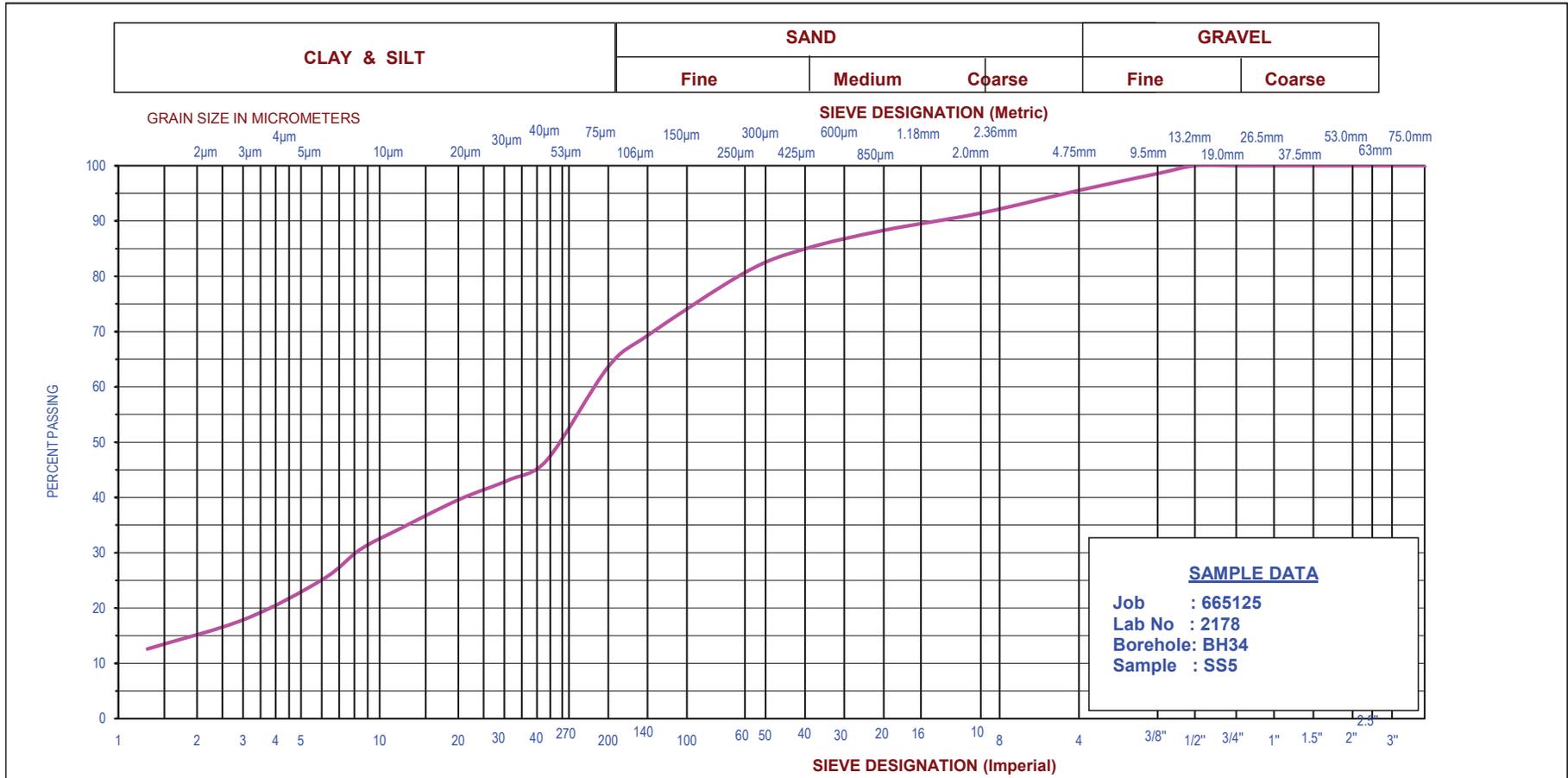
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	2	5	5	18	49	21

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY/CLAYEY SILT trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
		Date: June 2019		



SNC • LAVALIN

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2178
 Borehole: BH34
 Sample : SS5

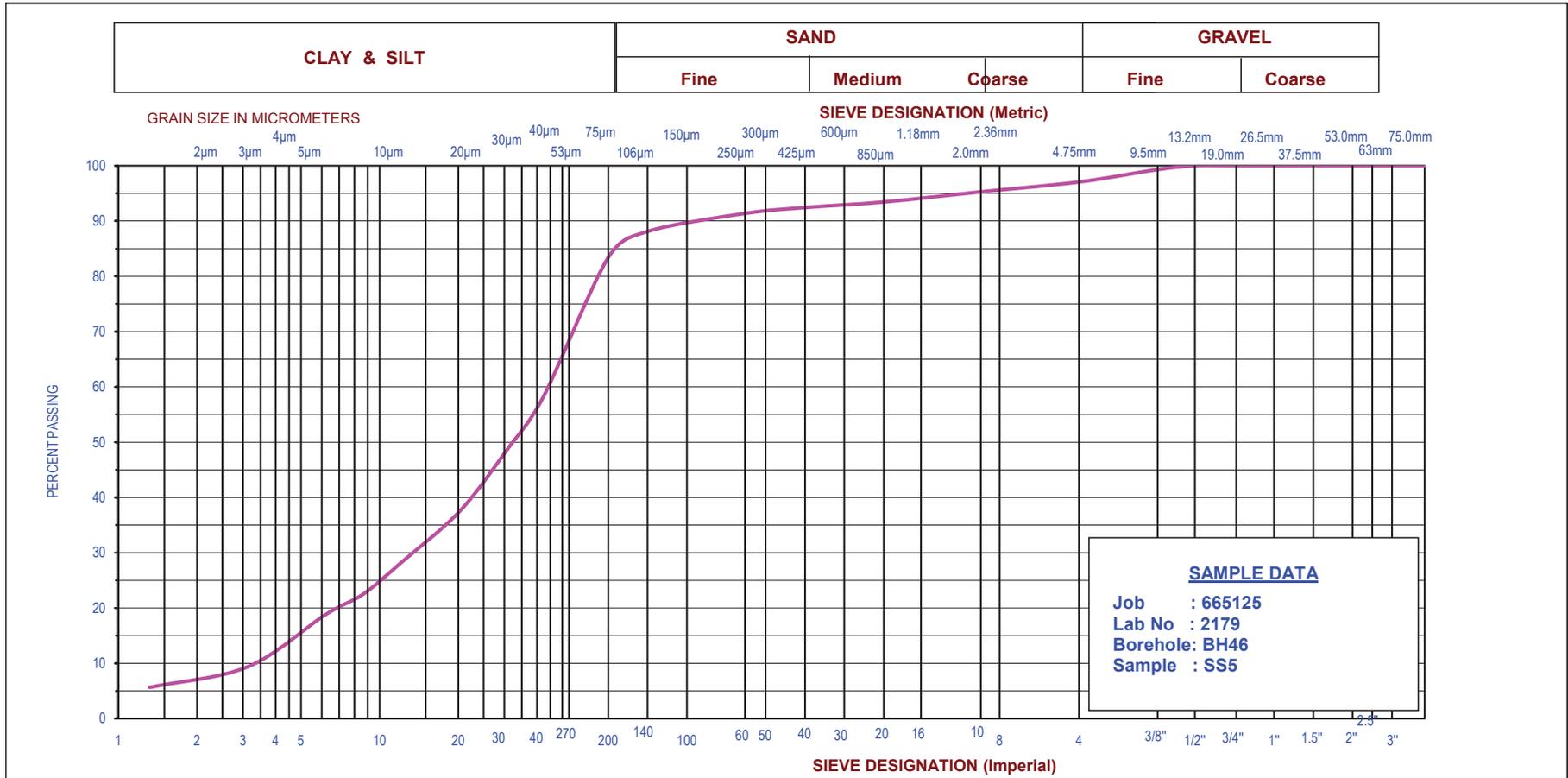
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	5	4	7	21	48	15

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY SILT some clay, trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
			Date: June 2019	



SNC • LAVALIN

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2179
 Borehole: BH46
 Sample : SS5

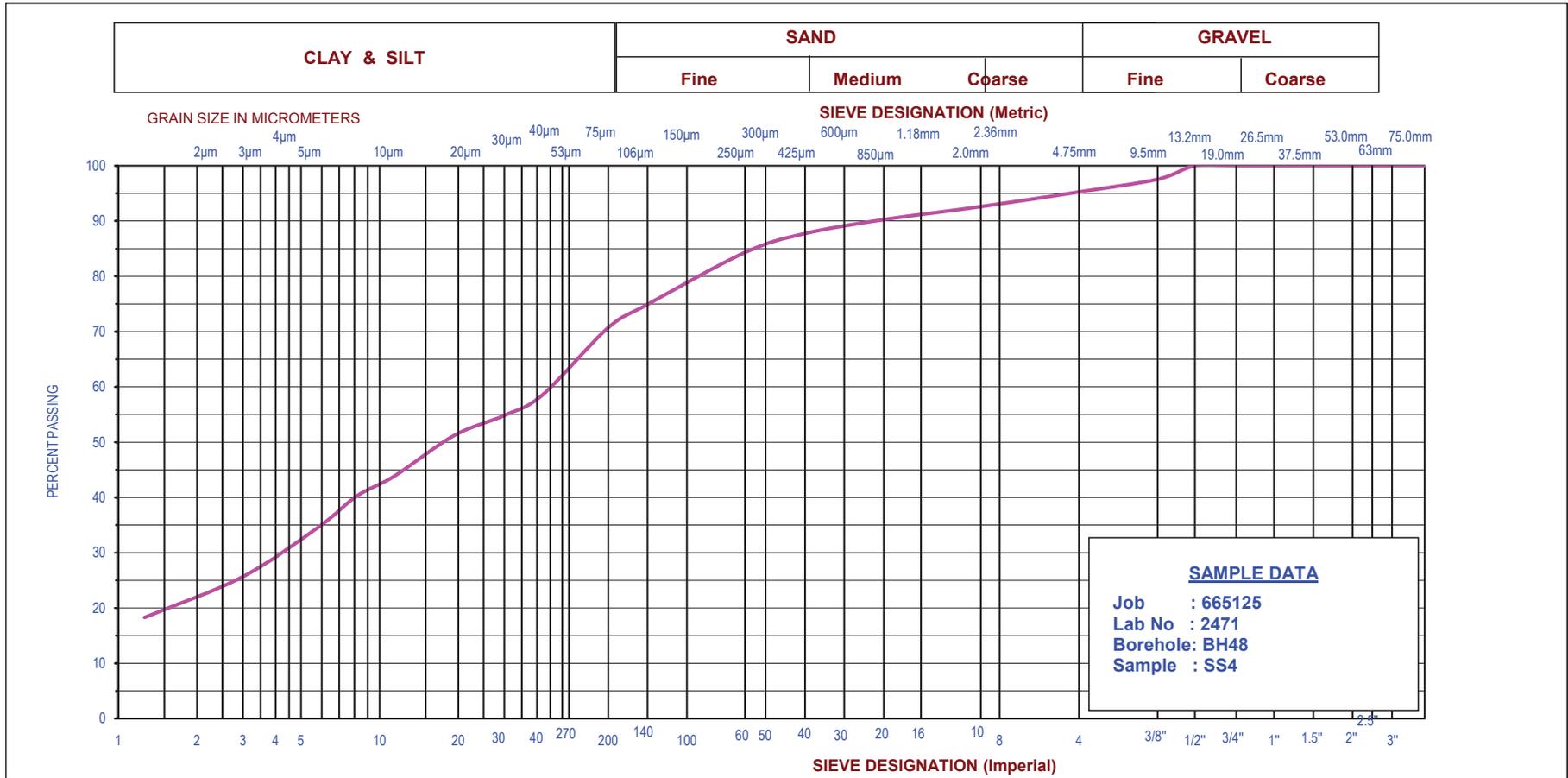
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	3	1	3	9	76	8

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SILT some sand, trace clay, trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
		Date: June 2019		



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UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2471
 Borehole: BH48
 Sample : SS4

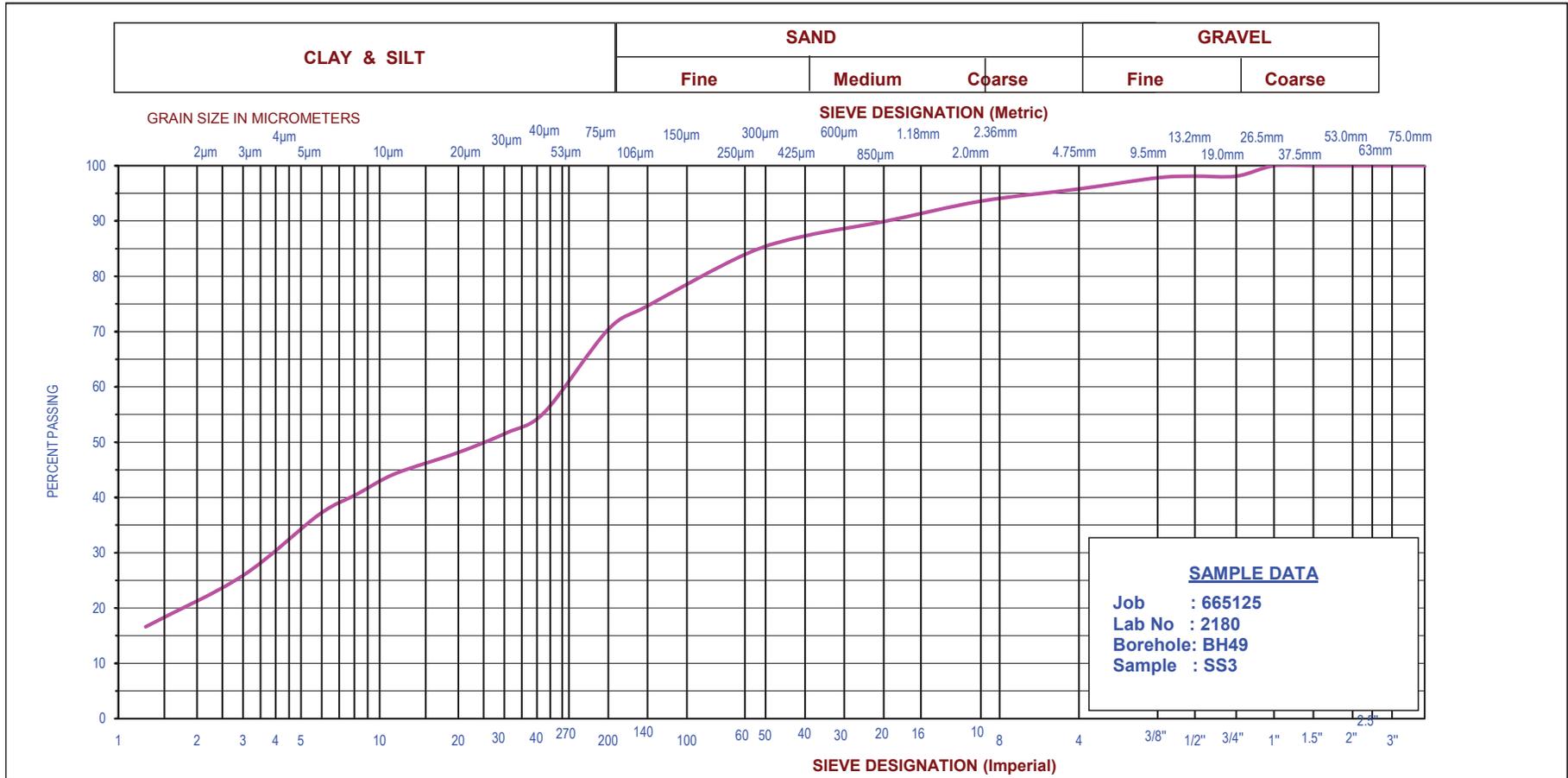
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	5	2	5	17	49	22

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY / CLAYEY SILT trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
		Date: July 2019		



SNC • LAVALIN

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2180
 Borehole: BH49
 Sample : SS3

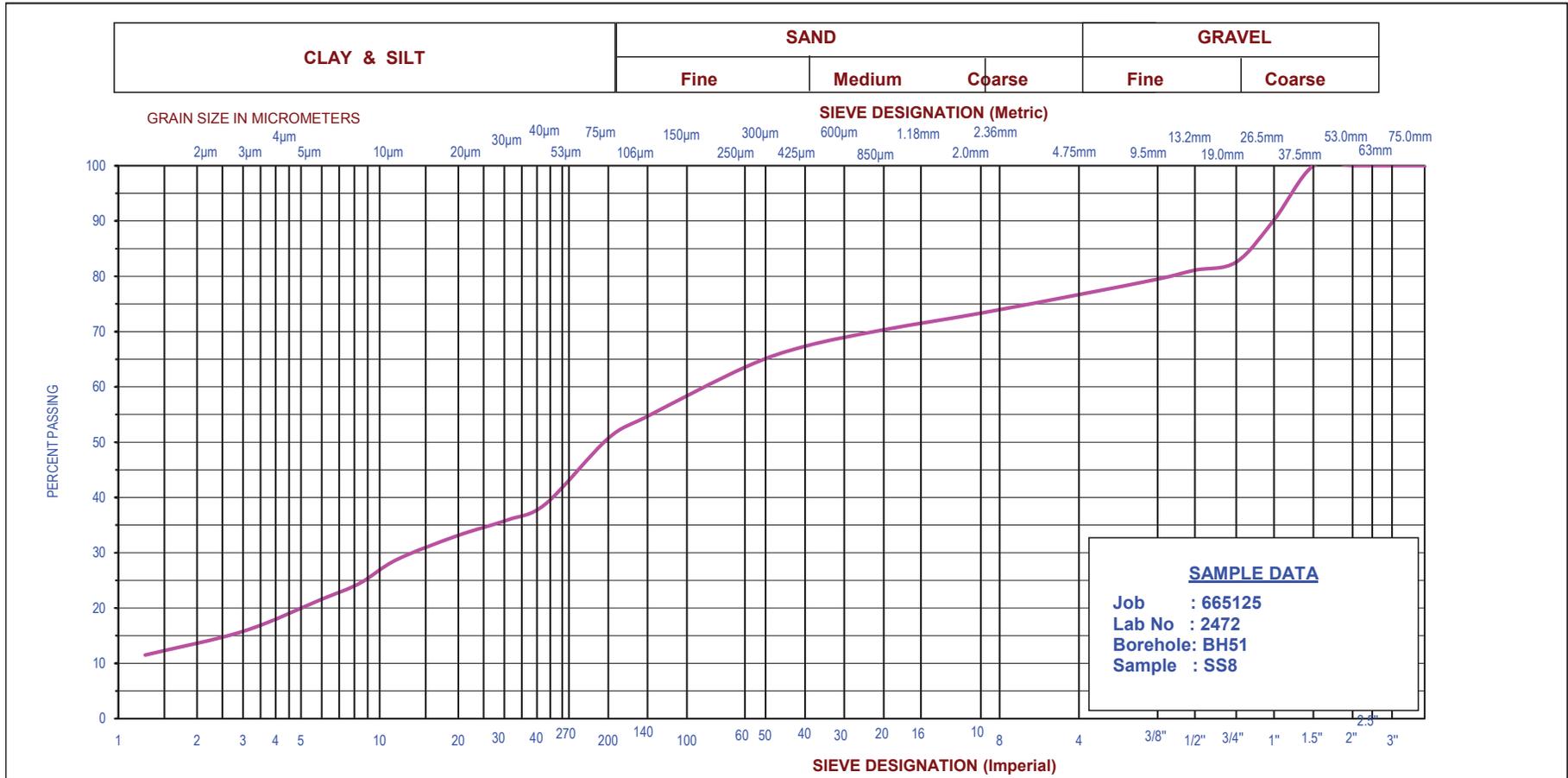
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	2	2	2	7	17	49	21

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY / CLAYEY SILT trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
			Date: June 2019	



SNC • LAVALIN

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2472
 Borehole: BH51
 Sample : SS8

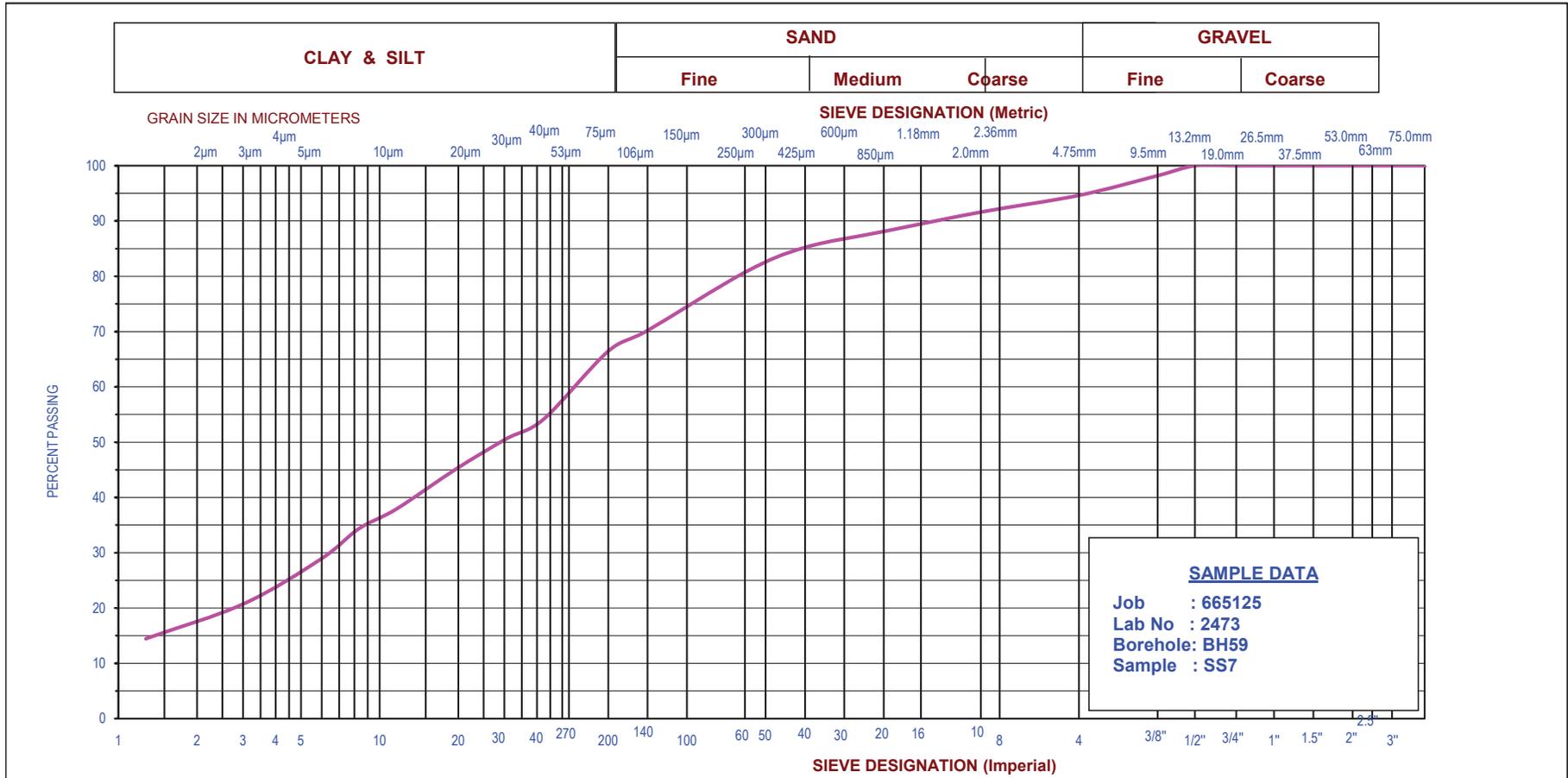
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	17	6	3	6	17	37	14

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	GRAVELLY / SANDY SILT some clay		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
		Date: July 2019		



SNC • LAVALIN

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2473
 Borehole: BH59
 Sample : SS7

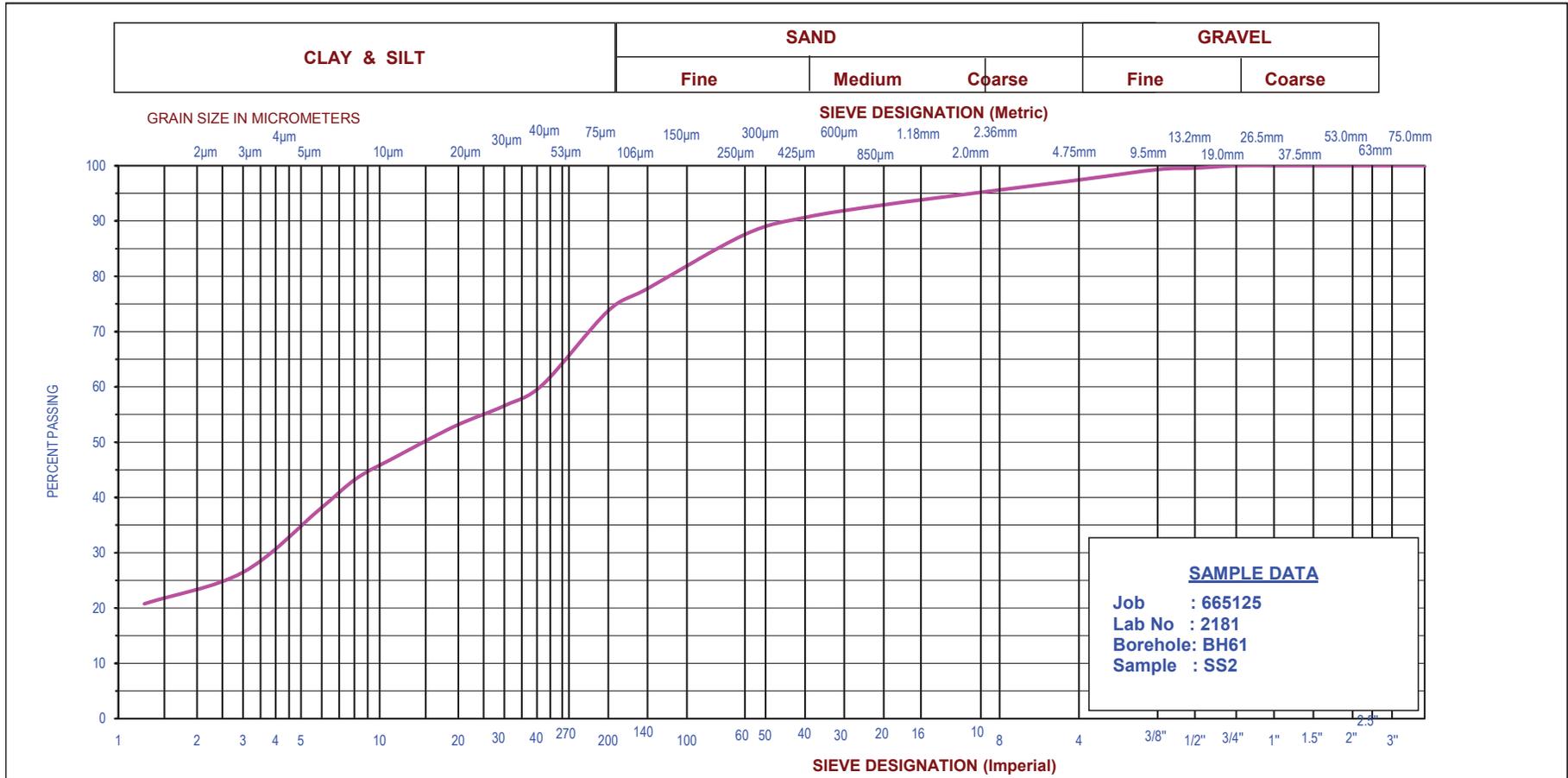
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	5	3	6	19	49	18

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY SILT some clay, trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
			Date: July 2019	



SNC • LAVALIN

UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2181
 Borehole: BH61
 Sample : SS2

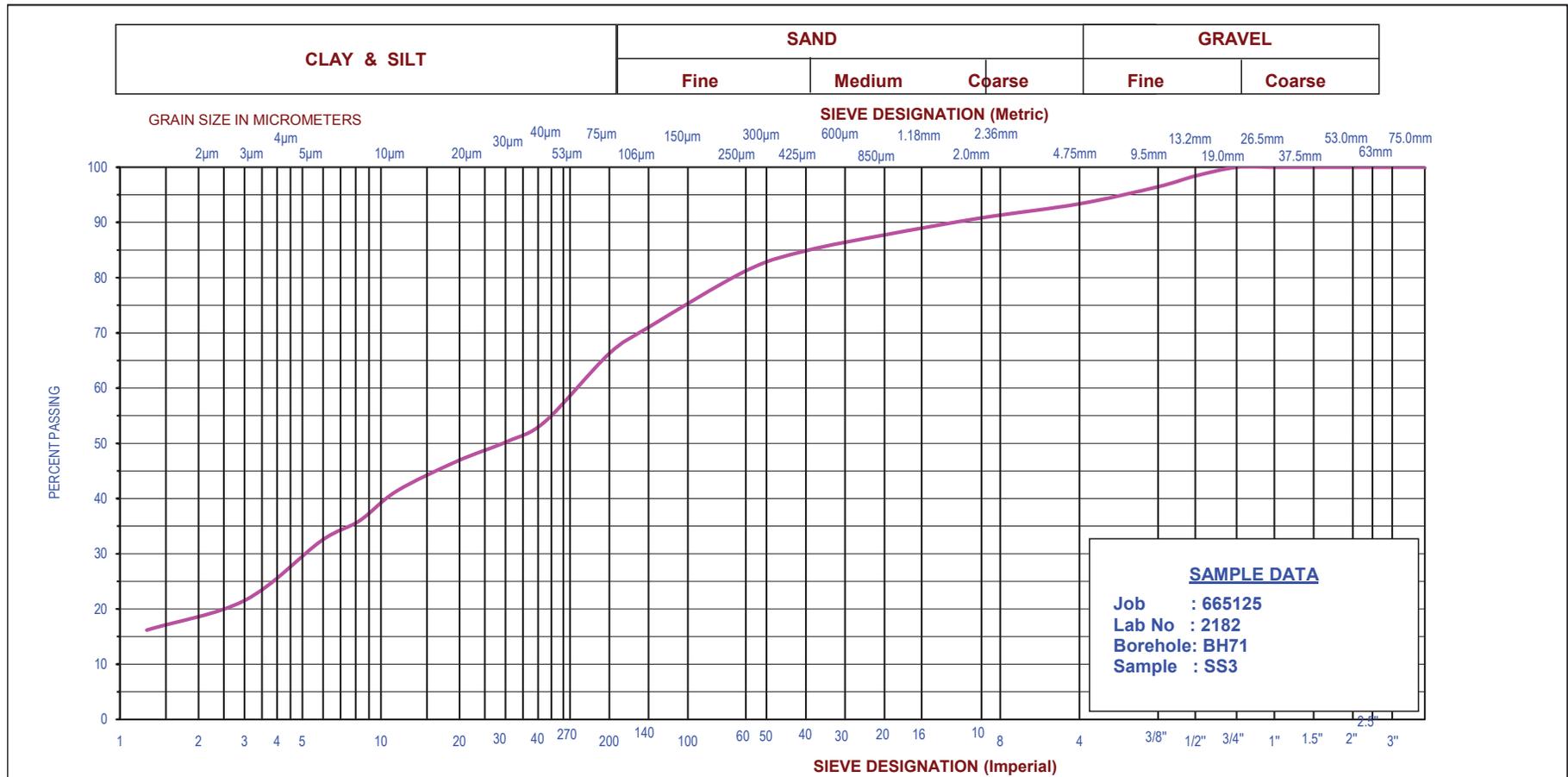
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	3	2	4	17	50	24

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY / CLAYEY SILT trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
			Date: June 2019	



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UNIFIED SOIL CLASSIFICATION SYSTEM



SAMPLE DATA
 Job : 665125
 Lab No : 2182
 Borehole: BH71
 Sample : SS3

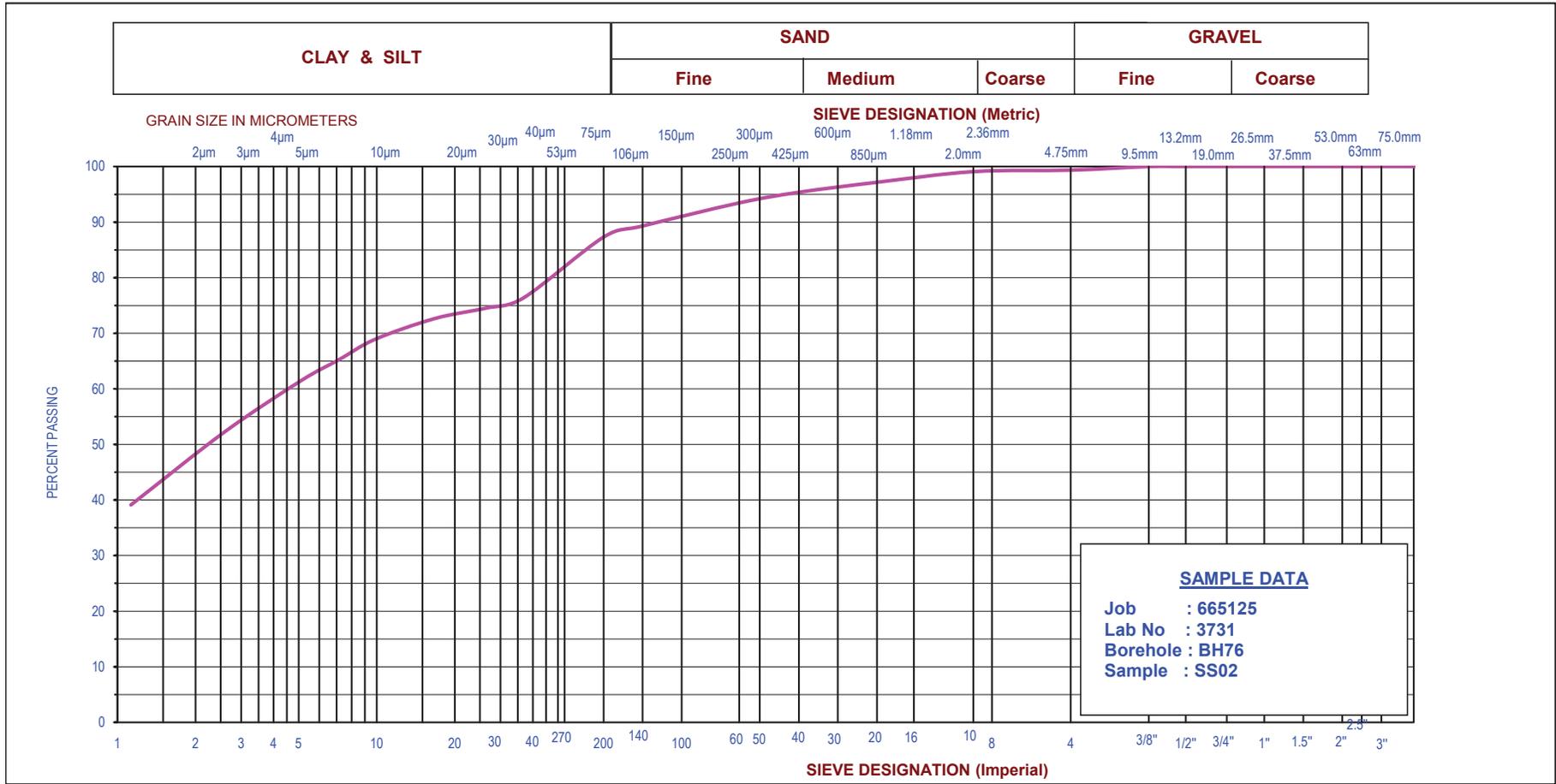
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	7	2	6	19	47	19

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION		Client: SNC-Lavalin	
	SANDY SILT some clay, trace gravel		Project : Geo. Inv. Johnston Transit Facility-10192 Hwy 50 Brampton	
			Location: 10192 Hwy 50, Brampton, ON	
			Date: June 2019	



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UNIFIED SOIL CLASSIFICATION SYSTEM



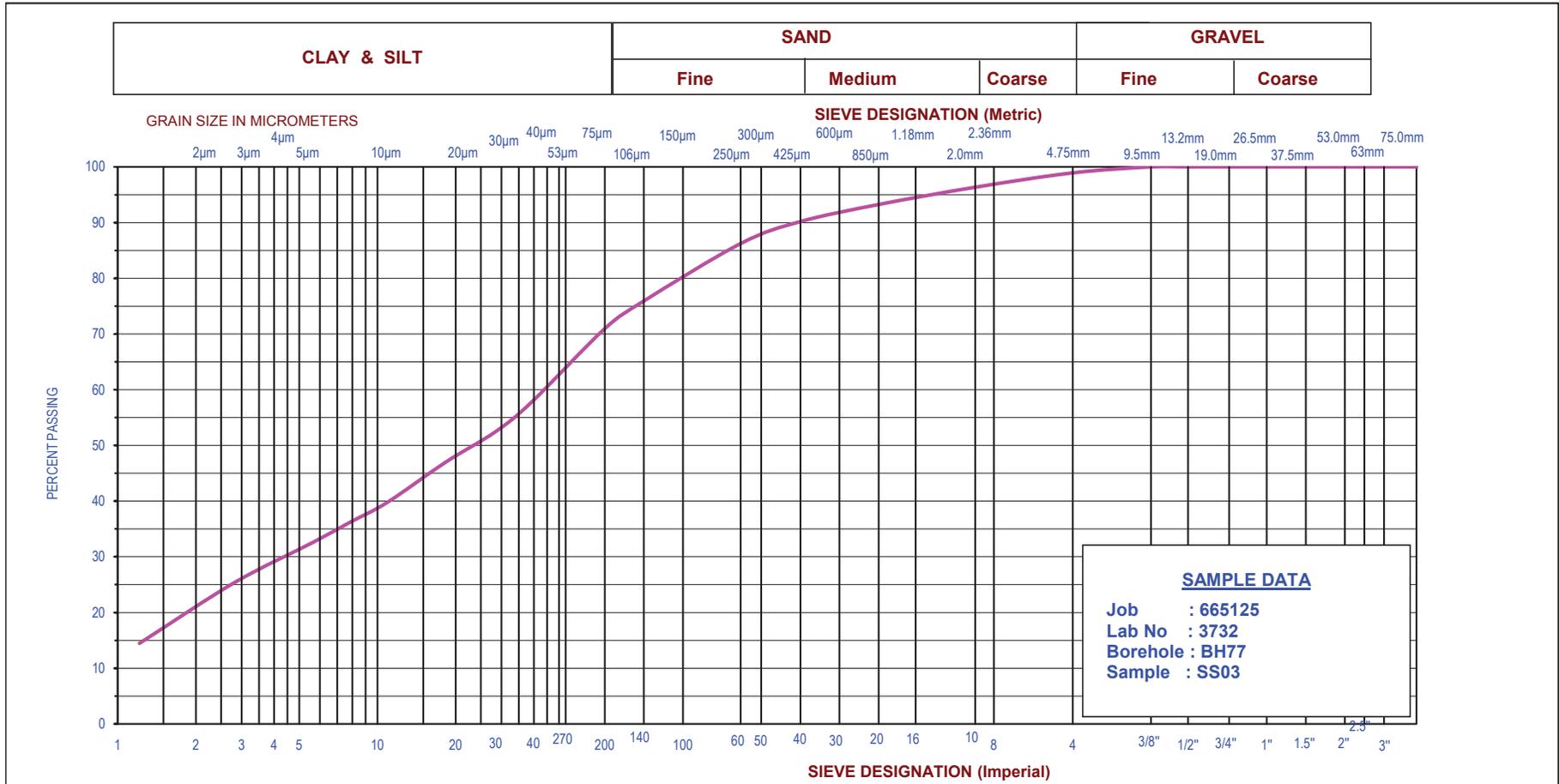
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	1	0	4	8	40	47

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION	Client: SNC Lavalin Inc. Project: Geo. Investigation for Johnston Transit Facility
	SILT & CLAY some sand, trace gravel	Location: 10192 Hwy 50, Brampton, ON. Date: October 2019



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UNIFIED SOIL CLASSIFICATION SYSTEM



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0	1	3	6	19	51	20

SNC-Lavalin GEM Ontario Inc. 401 Hanlan Road Vaughan, Ontario, Canada, L4L 3T1 ☎ 905.851.0090 📠 905.851.0091	GRAIN SIZE DISTRIBUTION	Client: SNC Lavalin Inc. Project: Geo. Investigation for Johnston Transit Facility
	SANDY/CLAYEY SILT trace gravel	Location: 10192 Hwy 50, Brampton, ON. Date: October 2019



Grain Size Analysis Test Report

Project No.: 665125

Description: Environmental & Geo. Consulting Services, Highway 5 Date: Oct 27, 2019

Project Location:

SAMPLE DATA

Material: Soil
 Date Sampled: Oct 24, 2019
 Time Sampled:
 Sample Type: Borehole
 Sample Location: BH77, SS02
 Lot: Sublot: Station
 Source: Insitu
 Sampled By: Mahdi Tavakouli

Contract No.:

Sieve Sizes (mm)	Percent Passing	
	Sample	Specification
150.0	100	0 - 100
106.0	100	-
75.0	100	-
53.0	100	-
37.5	100	-
26.5	100	-
22.4	100	-
19.0	100	-
16.0	100	-
13.2	100	-
9.5	99.3	-
6.7	-	-
4.75	96.8	-
2.36	94.3	-
1.18	90.8	-
0.600	87.2	-
0.300	82	-
0.150	73.9	-
0.075	64.1	0 - 100

LAB DATA

Lab No.: 3734 Date Tested: Oct 25, 2019

Specification:

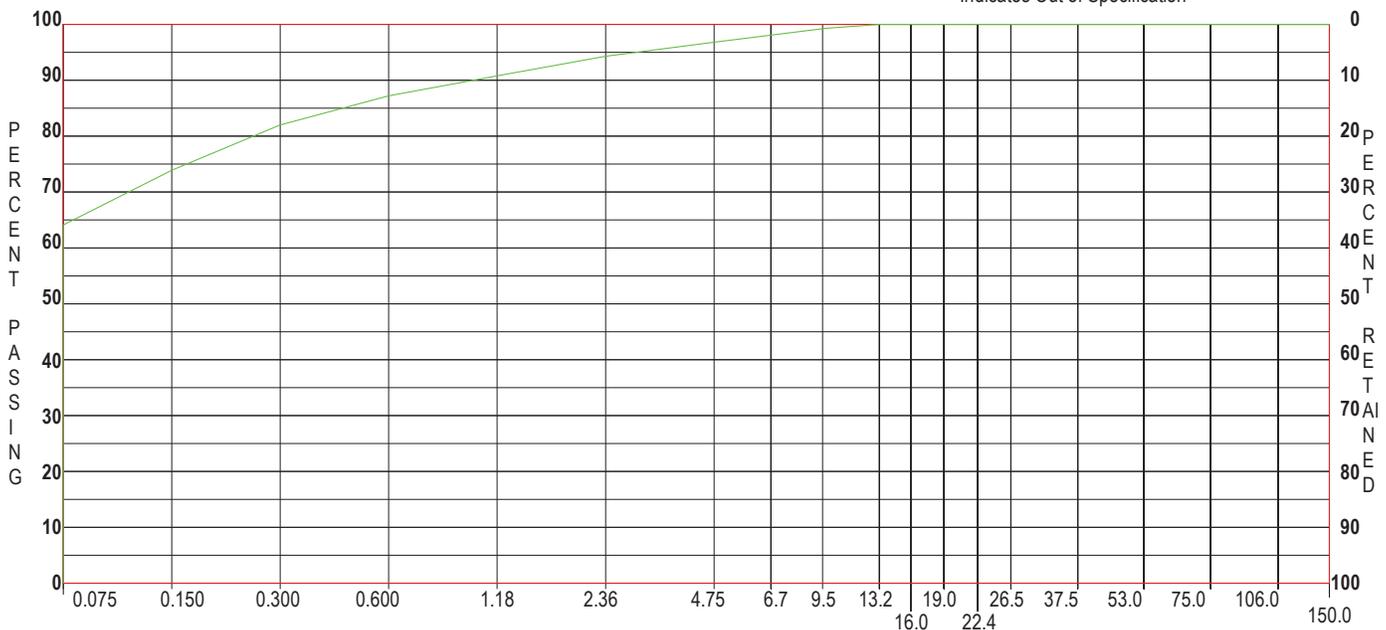
TEST	Sample	Specification
Percent Crushed:		
% Asphalt Coated:		
% Flat and Elongated		

WASH PASS 0.075mm		
TEST	Sample	Specs
Wash Pass 0.075 mm:		
FINENESS MODULUS	0.76	

Comments:

Sample: — Specs: —

* Indicates Out of Specification



Data presented hereon is for the sole use of the stipulated client. SNCL is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of SNCL. The testing services reported herein have been performed by a SNCL technician to recognized industry standards, unless otherwise noted. No other warranty is made. This data does not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, SNCL will provide it upon written request.

Project Manager: Mavara Turab





Grain Size Analysis Test Report

Project No.: 665125

Description: Environmental & Geo. Consulting Services, Highway 5 Date: Oct 27, 2019

Project Location:

SAMPLE DATA

Material: Soil
 Date Sampled: Oct 24, 2019
 Time Sampled:
 Sample Type: Borehole
 Sample Location: BH77, SS06
 Lot: Sublot: Station
 Source: Insitu
 Sampled By: Mahdi Tavakouli

Contract No.:

Sieve Sizes (mm)	Percent Passing	
	Sample	Specification
150.0	100	0 - 100
106.0	100	-
75.0	100	-
53.0	100	-
37.5	100	-
26.5	100	-
22.4	100	-
19.0	100	-
16.0	100	-
13.2	98.3	-
9.5	97.5	-
6.7		-
4.75	97	-
2.36	96.7	-
1.18	96.4	-
0.600	96.3	-
0.300	95.7	-
0.150	82.4	-
0.075	53.7	0 - 100

LAB DATA

Lab No.: 3733 Date Tested: Oct 25, 2019

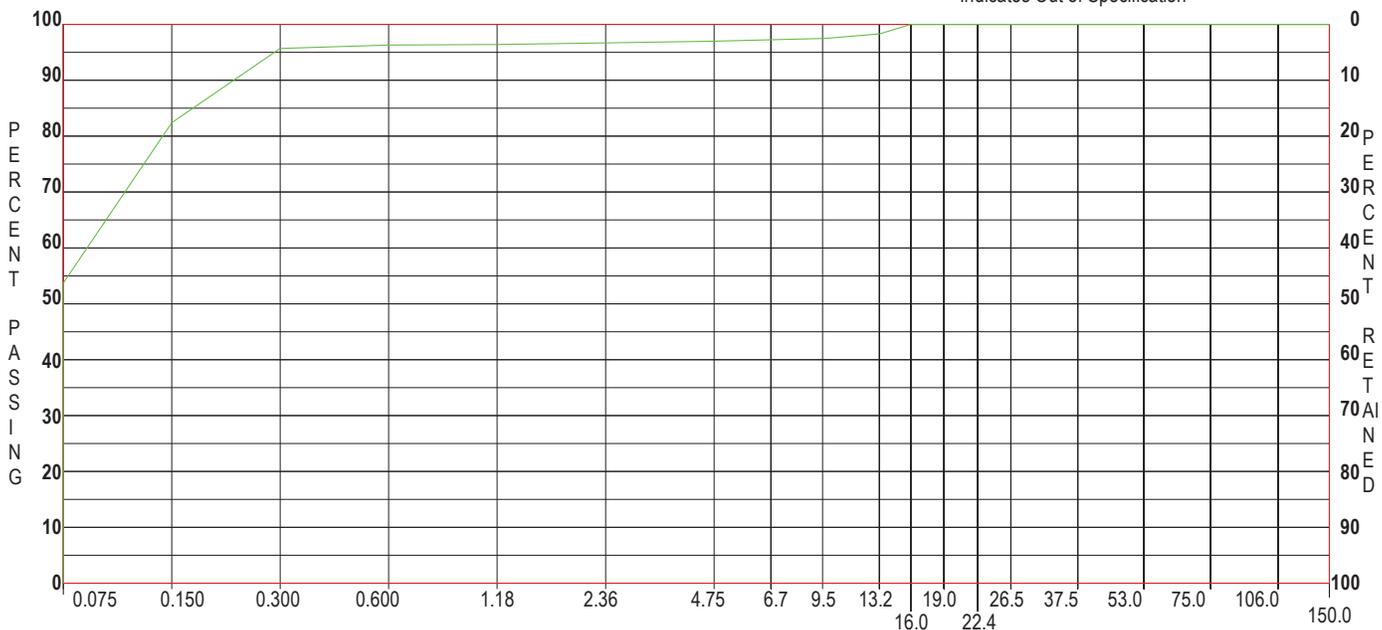
Specification:

TEST	Sample	Specification
Percent Crushed:		
% Asphalt Coated:		
% Flat and Elongated		

WASH PASS 0.075mm		
TEST	Sample	Specs
Wash Pass 0.075 mm:		
FINENESS MODULUS	0.38	

Comments:

Sample: — Specs: —



Data presented hereon is for the sole use of the stipulated client. SNCL is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of SNCL. The testing services reported herein have been performed by a SNCL technician to recognized industry standards, unless otherwise noted. No other warranty is made. This data does not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, SNCL will provide it upon written request.

Project Manager: Mavara Turab





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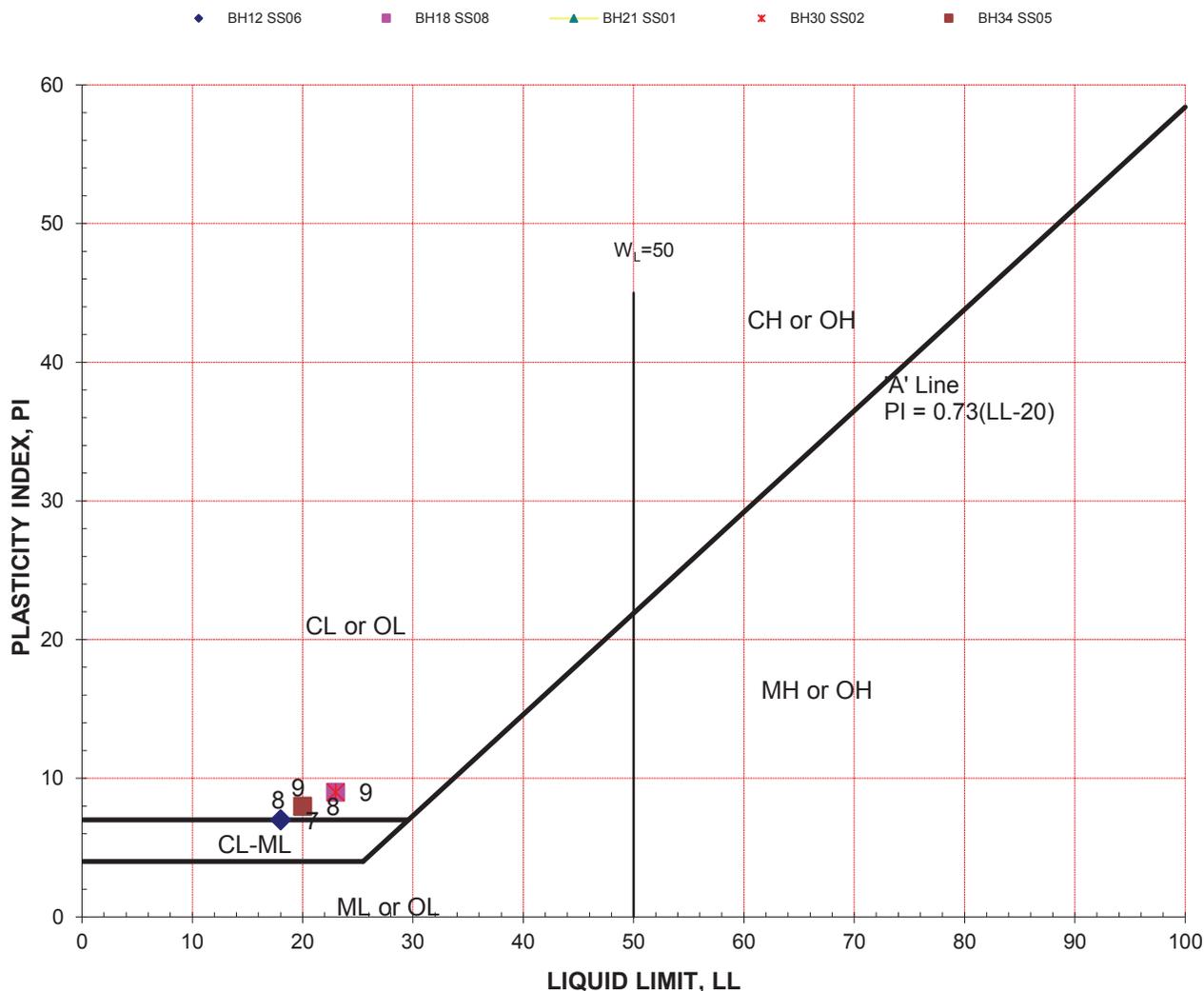
SNC-Lavalin GEM Ontario Inc.
401 Hanlan Road
Vaughan, Ontario, Canada, L4L 3T1
905.851.0090 905.851.0091

PLASTICITY CHART

Job #	: 665125	Technician	: UC
Project Client	: SNC Lavalin	Supervisor	: KL
Project	: Geotechnical Investigation for Johnston Transit Facility	Date	: 20/7/2019
Location	: 10192 HWY 50, Brampton, ON.		

TEST RESULTS

Specimen #	Sample #	Depth	LL%	PL%	PI	Fines	W%	Classification	Remarks
BH12	SS06		18	11	7		8	CL-ML/CL	Lab # 2174
BH18	SS08		23	14	9			CL	Lab # 2175
BH21	SS01		20	12	8		13	CL	Lab # 2176
BH30	SS02		23	14	9			CL	Lab # 2177
BH34	SS05		20	12	8		10	CL	Lab # 2178





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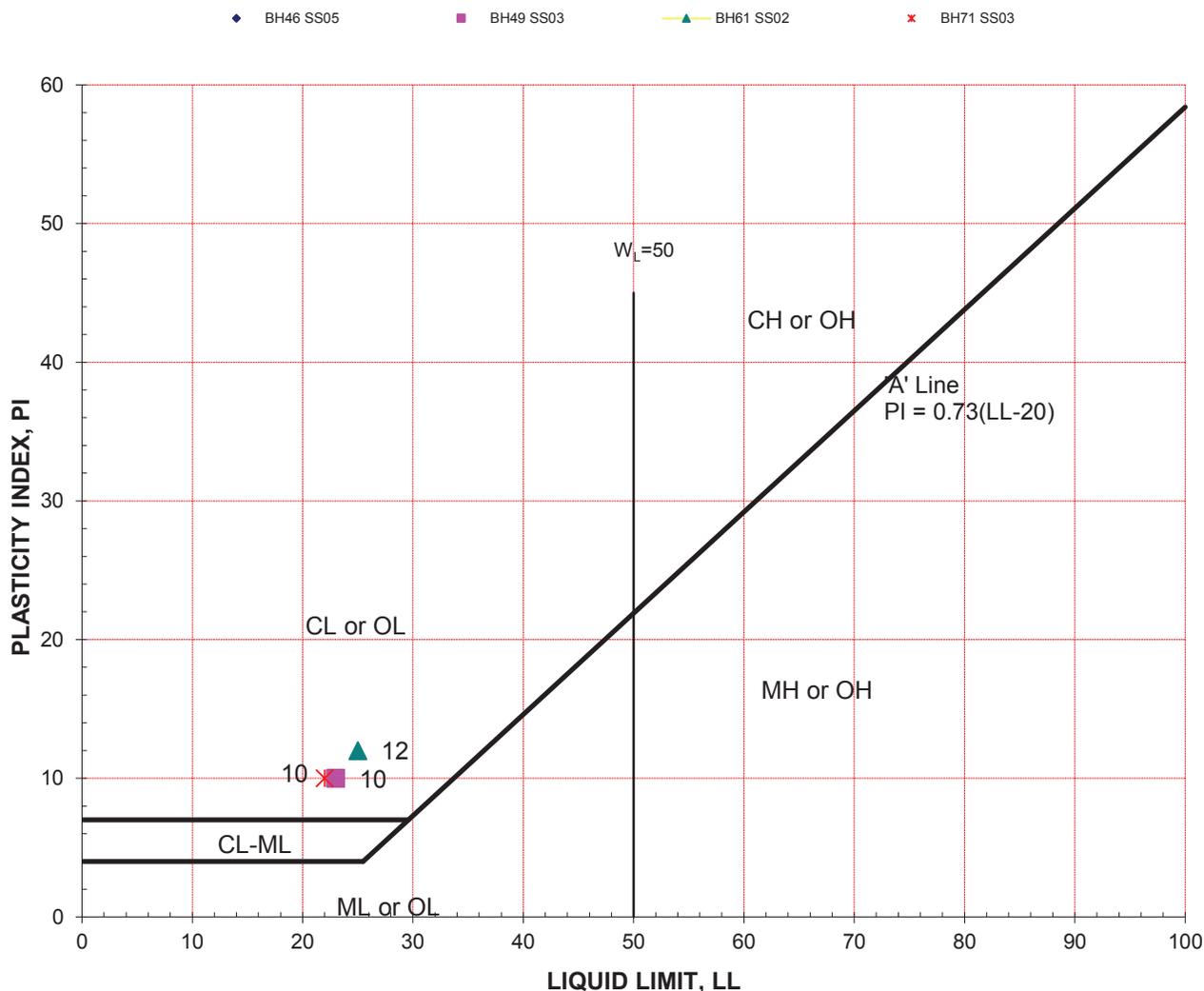
SNC-Lavalin GEM Ontario Inc.
401 Hanlan Road
Vaughan, Ontario, Canada, L4L 3T1
905.851.0090 905.851.0091

PLASTICITY CHART

Job #	: 665125	Technician	: UC
Project Client	: SNC Lavalin	Supervisor	: KL
Project	: Geotechnical Investigation for Johnston Transit Facility	Date	: 20/7/2019
Location	: 10192 HWY 50, Brampton, ON.		

TEST RESULTS

Specimen #	Sample #	Depth	LL%	PL%	PI	Fines	W%	Classification	Remarks
BH46	SS05						9	No Plasticity	Lab # 2179
BH49	SS03		23	13	10		15	CL	Lab # 2180
BH61	SS02		25	13	12		18	CL	Lab # 2181
BH71	SS03		22	12	10		15	CL	Lab # 2182





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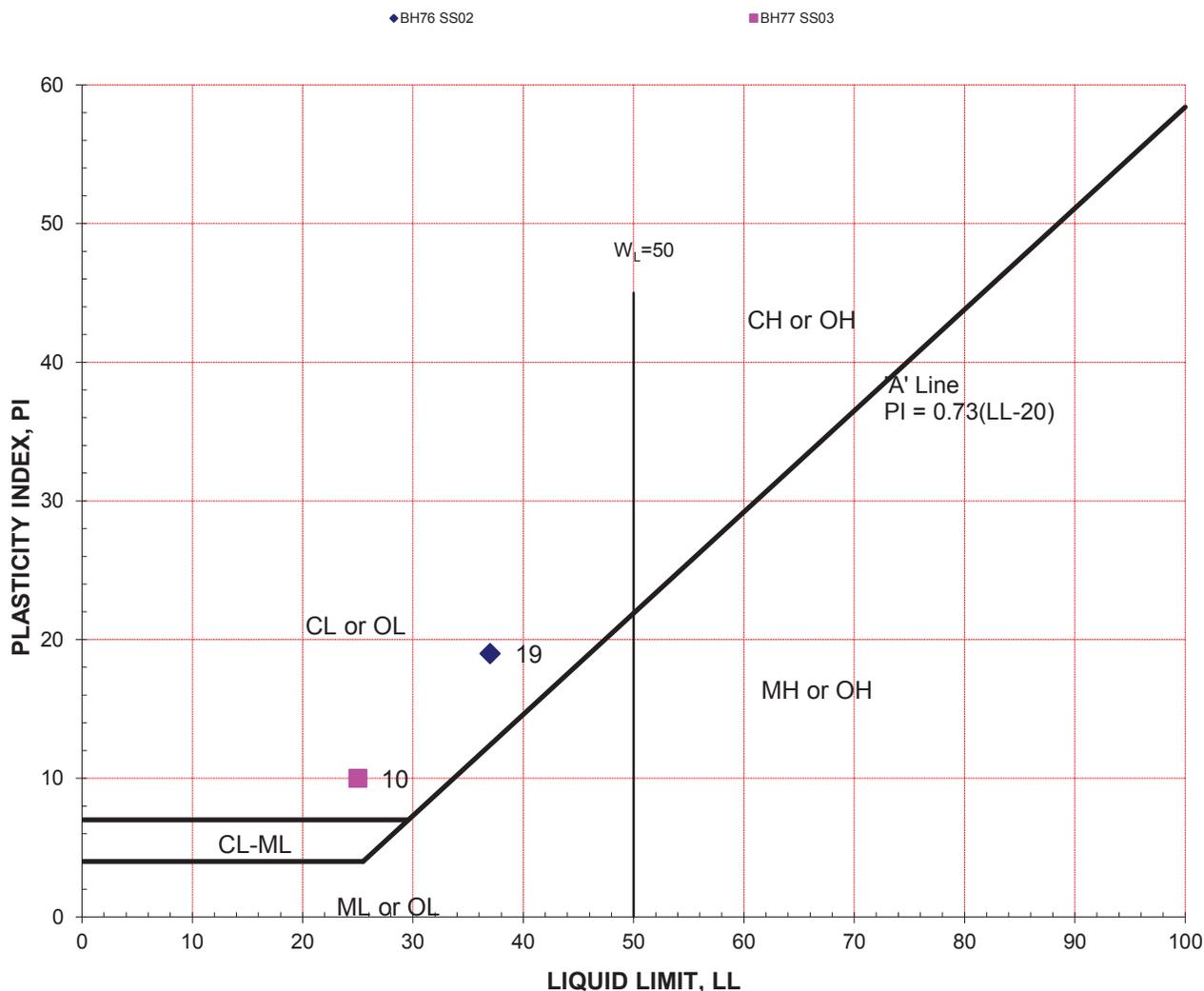
SNC-Lavalin GEM Ontario Inc.
401 Hanlan Road
Vaughan, Ontario, Canada, L4L 3T1
905.851.0090 905.851.0091

PLASTICITY CHART

Job #	: 665125	Technician	: UC
Project Client	: SNC Lavalin Inc.	Supervisor	: KL
Project	: Geotechnical Investigation for Johnston Transit Facility	Date	: 30/10/2019
Location	: 10192 HWY 50, Brampton, ON.		

TEST RESULTS

Specimen #	Sample #	Depth	LL%	PL%	PI	Fines	W%	Classification	Remarks
BH76	SS02		37	18	19		16	CL	Lab # 3731
BH77	SS03		25	15	10		13	CL	Lab # 3732



Appendix D

Analytical Laboratory Results (85 pages)



SNC-Lavalin GEM Ontario Inc. (Vaughan)
ATTN: Brendan Weaver
401 Hanlan Road
Vaughan ON L4L 3T1

Date Received: 04-JUN-19
Report Date: 11-JUN-19 12:02 (MT)
Version: FINAL

Client Phone: 905-851-0090

Certificate of Analysis

Lab Work Order #: L2285075
Project P.O. #: NOT SUBMITTED
Job Reference: 665125
C of C Numbers: 17-732945
Legal Site Desc:

Mathy Mahadera
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 5730 Coopers Avenue, Unit #26, Mississauga, ON L4Z 2E9 Canada | Phone: +1 905 507 6910 | Fax: +1 905 507 6927
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

Summary of Guideline Exceedances

Guideline							
ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit	
Ontario Regulation 153/04 - April 15, 2011 Standards - T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use							
(No parameter exceedances)							

Physical Tests - SOIL

Lab ID	L2285075-1	L2285075-2
Sample Date	03-JUN-19	03-JUN-19
Sample ID	BH37-SS02	BH53-SS02

Analyte	Unit	Guide Limits			
		#1	#2		
Conductivity	mS/cm	0.57	-	0.158	0.220
% Moisture	%	-	-	10.7	10.9
pH	pH units	-	-	7.85	7.78
Redox Potential	mV	-	-	245	244
Resistivity	ohm*cm	-	-	6320	4550

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Leachable Anions & Nutrients - SOIL

Lab ID	L2285075-1	L2285075-2
Sample Date	03-JUN-19	03-JUN-19
Sample ID	BH37-SS02	BH53-SS02

Analyte	Unit	Guide Limits		5.3	7.1
		#1	#2		
Chloride	ug/g	-	-	5.3	7.1

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Anions and Nutrients - SOIL

Lab ID	L2285075-1	L2285075-2
Sample Date	03-JUN-19	03-JUN-19
Sample ID	BH37-SS02	BH53-SS02

Analyte	Unit	Guide Limits		75	74
		#1	#2		
Sulphate	mg/kg	-	-	75	74

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Inorganic Parameters - SOIL

Lab ID	L2285075-1	L2285075-2
Sample Date	03-JUN-19	03-JUN-19
Sample ID	BH37-SS02	BH53-SS02

Guide Limits

Analyte	Unit	#1	#2
---------	------	----	----

Acid Volatile Sulphides	mg/kg	-	-	<0.20	<0.20
-------------------------	-------	---	---	-------	-------

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0
<p>5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
EC-WT	Soil	Conductivity (EC)	MOEE E3138
<p>A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A
<p>A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
<p>This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
SO4-WT	Soil	Sulphate	EPA 300.0
<p>5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p>			
SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J
<p>This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H₂S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.</p>			

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

17-732945

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code Laboratory Location

WT ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Reference Information

L2285075 CONT'D....
Job Reference: 665125
PAGE 8 of 8
11-JUN-19 12:02 (MT)

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.



Quality Control Report

Workorder: L2285075

Report Date: 11-JUN-19

Page 1 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: Brendan Weaver

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT		Soil						
Batch	R4663324							
WG3072202-3	CRM	AN-CRM-WT						
Chloride			100.2		%		70-130	10-JUN-19
WG3072202-4	DUP	L2285075-1						
Chloride		5.3	5.3		ug/g	0.5	30	10-JUN-19
WG3072202-2	LCS							
Chloride			102.9		%		80-120	10-JUN-19
WG3072202-1	MB							
Chloride			<5.0		ug/g		5	10-JUN-19
EC-WT		Soil						
Batch	R4662549							
WG3072201-4	DUP	WG3072201-3						
Conductivity		0.324	0.334		mS/cm	3.0	20	10-JUN-19
WG3072201-2	IRM	WT SAR3						
Conductivity			104.8		%		70-130	10-JUN-19
WG3072326-1	LCS							
Conductivity			100.2		%		90-110	10-JUN-19
WG3072201-1	MB							
Conductivity			<0.0040		mS/cm		0.004	10-JUN-19
MOISTURE-WT		Soil						
Batch	R4659710							
WG3067846-3	DUP	L2284971-6						
% Moisture		14.2	15.1		%	5.8	20	06-JUN-19
WG3067846-2	LCS							
% Moisture			99.9		%		90-110	06-JUN-19
WG3067846-1	MB							
% Moisture			<0.10		%		0.1	06-JUN-19
PH-WT		Soil						
Batch	R4661669							
WG3067615-1	DUP	L2283122-7						
pH		7.39	7.38	J	pH units	0.01	0.3	07-JUN-19
WG3071086-1	LCS							
pH			7.06		pH units		6.9-7.1	07-JUN-19
REDOX-POTENTIAL-WT		Soil						
Batch	R4660250							
WG3068764-1	CRM	WT-REDOX						
Redox Potential			98.3		%		80-120	06-JUN-19
WG3067645-1	DUP	L2285078-1						



Quality Control Report

Workorder: L2285075

Report Date: 11-JUN-19

Page 2 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: Brendan Weaver

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
REDOX-POTENTIAL-WT	Soil							
Batch	R4660250							
WG3067645-1	DUP	L2285078-1						
Redox Potential		245	242		mV	1.2	25	06-JUN-19
SO4-WT	Soil							
Batch	R4661440							
WG3067929-4	CRM	AN-CRM-WT						
Sulphate			94.8		%		60-140	06-JUN-19
WG3067929-3	DUP	L2285075-2						
Sulphate		74	75		mg/kg	2.2	30	06-JUN-19
WG3067929-2	LCS							
Sulphate			102.4		%		80-120	06-JUN-19
WG3067929-1	MB							
Sulphate			<20		mg/kg		20	06-JUN-19
SULPHIDE-WT	Soil							
Batch	R4659035							
WG3068180-3	DUP	L2285078-1						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	05-JUN-19
WG3068180-2	LCS							
Acid Volatile Sulphides			85.8		%		70-130	05-JUN-19
WG3068180-1	MB							
Acid Volatile Sulphides			<0.20		mg/kg		0.2	05-JUN-19

Quality Control Report

Workorder: L2285075

Report Date: 11-JUN-19

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Page 3 of 3

Contact: Brendan Weaver

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



SNC-Lavalin GEM Ontario Inc. (Vaughan)
ATTN: Brendan Weaver
401 Hanlan Road
Vaughan ON L4L 3T1

Date Received: 05-JUN-19
Report Date: 11-JUN-19 12:04 (MT)
Version: FINAL

Client Phone: 905-851-0090

Certificate of Analysis

Lab Work Order #: L2285990
Project P.O. #: NOT SUBMITTED
Job Reference: 665125
C of C Numbers: 17-732946
Legal Site Desc:

Mathy Mahadera
Account Manager

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ADDRESS: 5730 Coopers Avenue, Unit #26, Mississauga, ON L4Z 2E9 Canada | Phone: +1 905 507 6910 | Fax: +1 905 507 6927
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Summary of Guideline Exceedances

Guideline							
ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit	
Ontario Regulation 153/04 - April 15, 2011 Standards - T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use							
(No parameter exceedances)							

Physical Tests - SOIL

Lab ID	L2285990-1	L2285990-2	L2285990-3	L2285990-4	L2285990-5	L2285990-6
Sample Date	04-JUN-19	04-JUN-19	04-JUN-19	04-JUN-19	04-JUN-19	04-JUN-19
Sample ID	BH64-SS02	BH61-SS02	BH16-SS02	BH59-SS02	BH67-SS02	BH49-SS02

Analyte	Unit	Guide Limits							
		#1	#2						
Conductivity	mS/cm	0.57	-	0.361	0.202	0.137	0.214	0.177	0.205
% Moisture	%	-	-	15.6	14.6	13.0	16.0	10.7	18.1
pH	pH units	-	-	7.92	7.76	7.81	7.81	7.86	7.77
Redox Potential	mV	-	-	210	209	211	197	202	193
Resistivity	ohm*cm	-	-	2770	4950	7320	4670	5640	4880

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

ANALYTICAL REPORT

Leachable Anions & Nutrients - SOIL

Lab ID	L2285990-1	L2285990-2	L2285990-3	L2285990-4	L2285990-5	L2285990-6
Sample Date	04-JUN-19	04-JUN-19	04-JUN-19	04-JUN-19	04-JUN-19	04-JUN-19
Sample ID	BH64-SS02	BH61-SS02	BH16-SS02	BH59-SS02	BH67-SS02	BH49-SS02

Analyte	Unit	Guide Limits							
		#1	#2						
Chloride	ug/g	-	-	38.2	9.9	9.7	12.9	5.7	<5.0

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

ANALYTICAL REPORT

Anions and Nutrients - SOIL

Lab ID	L2285990-1	L2285990-2	L2285990-3	L2285990-4	L2285990-5	L2285990-6
Sample Date	04-JUN-19	04-JUN-19	04-JUN-19	04-JUN-19	04-JUN-19	04-JUN-19
Sample ID	BH64-SS02	BH61-SS02	BH16-SS02	BH59-SS02	BH67-SS02	BH49-SS02

Analyte	Unit	Guide Limits							
		#1	#2						
Sulphate	mg/kg	-	-	118	75	29	92	66	78

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Inorganic Parameters - SOIL

Analyte	Unit	Guide Limits							
		#1	#2						
Acid Volatile Sulphides	mg/kg	-	-	<0.20	0.78	0.25	0.30	0.39	<0.20

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0
<p>5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
EC-WT	Soil	Conductivity (EC)	MOEE E3138
<p>A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A
<p>A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
<p>This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
SO4-WT	Soil	Sulphate	EPA 300.0
<p>5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p>			
SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J
<p>This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H₂S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.</p>			

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

17-732946

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Reference Information

L2285990 CONT'D....
Job Reference: 665125
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11-JUN-19 12:04 (MT)

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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Quality Control Report

Workorder: L2285990

Report Date: 11-JUN-19

Page 1 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
 401 Hanlan Road
 Vaughan ON L4L 3T1

Contact: Brendan Weaver

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	Soil							
Batch	R4663324							
WG3072202-3	CRM	AN-CRM-WT						
Chloride			100.2		%		70-130	10-JUN-19
WG3072202-4	DUP	L2285075-1						
Chloride		5.3	5.3		ug/g	0.5	30	10-JUN-19
WG3072202-2	LCS							
Chloride			102.9		%		80-120	10-JUN-19
WG3072202-1	MB							
Chloride			<5.0		ug/g		5	10-JUN-19
EC-WT	Soil							
Batch	R4662549							
WG3072201-4	DUP	WG3072201-3						
Conductivity		0.324	0.334		mS/cm	3.0	20	10-JUN-19
WG3072201-2	IRM	WT SAR3						
Conductivity			104.8		%		70-130	10-JUN-19
WG3072326-1	LCS							
Conductivity			100.2		%		90-110	10-JUN-19
WG3072201-1	MB							
Conductivity			<0.0040		mS/cm		0.004	10-JUN-19
Batch	R4663425							
WG3073270-4	DUP	WG3073270-3						
Conductivity		2.84	2.79		mS/cm	1.8	20	11-JUN-19
WG3073270-2	IRM	WT SAR3						
Conductivity			102.4		%		70-130	11-JUN-19
WG3073515-1	LCS							
Conductivity			99.1		%		90-110	11-JUN-19
WG3073270-1	MB							
Conductivity			<0.0040		mS/cm		0.004	11-JUN-19
MOISTURE-WT	Soil							
Batch	R4661118							
WG3070383-3	DUP	L2285946-1						
% Moisture		20.7	20.8		%	0.1	20	07-JUN-19
WG3070383-2	LCS							
% Moisture			100.3		%		90-110	07-JUN-19
WG3070383-1	MB							
% Moisture			<0.10		%		0.1	07-JUN-19
PH-WT	Soil							



Quality Control Report

Workorder: L2285990

Report Date: 11-JUN-19

Page 2 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
 401 Hanlan Road
 Vaughan ON L4L 3T1

Contact: Brendan Weaver

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-WT	Soil							
Batch	R4662809							
WG3070126-2	DUP	L2285967-6						
pH		7.98	7.97	J	pH units	0.01	0.3	10-JUN-19
WG3072312-1	LCS							
pH			7.06		pH units		6.9-7.1	10-JUN-19
REDOX-POTENTIAL-WT	Soil							
Batch	R4662871							
WG3072471-1	CRM	WT-REDOX						
Redox Potential			99.0		%		80-120	10-JUN-19
WG3071300-1	DUP	L2284516-9						
Redox Potential		263	272		mV	3.4	25	10-JUN-19
SO4-WT	Soil							
Batch	R4662516							
WG3070305-4	CRM	AN-CRM-WT						
Sulphate			109.5		%		60-140	07-JUN-19
WG3070305-3	DUP	L2285990-3						
Sulphate		29	26		mg/kg	9.9	30	07-JUN-19
WG3070305-2	LCS							
Sulphate			103.1		%		80-120	07-JUN-19
WG3070305-1	MB							
Sulphate			<20		mg/kg		20	07-JUN-19
SULPHIDE-WT	Soil							
Batch	R4661044							
WG3069416-3	DUP	L2285990-1						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	06-JUN-19
WG3069416-2	LCS							
Acid Volatile Sulphides			90.2		%		70-130	06-JUN-19
WG3069416-1	MB							
Acid Volatile Sulphides			<0.20		mg/kg		0.2	06-JUN-19

Quality Control Report

Workorder: L2285990

Report Date: 11-JUN-19

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Page 3 of 3

Contact: Brendan Weaver

Legend:

Limit ALS Control Limit (Data Quality Objectives)
DUP Duplicate
RPD Relative Percent Difference
N/A Not Available
LCS Laboratory Control Sample
SRM Standard Reference Material
MS Matrix Spike
MSD Matrix Spike Duplicate
ADE Average Desorption Efficiency
MB Method Blank
IRM Internal Reference Material
CRM Certified Reference Material
CCV Continuing Calibration Verification
CVS Calibration Verification Standard
LCSD Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



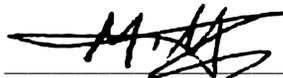
SNC-Lavalin GEM Ontario Inc. (Vaughan)
ATTN: Mavara Turab
401 Hanlan Road
Vaughan ON L4L 3T1

Date Received: 19-JUN-19
Report Date: 25-JUN-19 10:36 (MT)
Version: FINAL

Client Phone: 905-851-0090

Certificate of Analysis

Lab Work Order #: L2295097
Project P.O. #: NOT SUBMITTED
Job Reference: 665125
C of C Numbers: 17-621536
Legal Site Desc:



Mathy Mahadera
Account Manager

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ADDRESS: 5730 Coopers Avenue, Unit #26, Mississauga, ON L4Z 2E9 Canada | Phone: +1 905 507 6910 | Fax: +1 905 507 6927
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Summary of Guideline Exceedances

Guideline							
ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit	
Ontario Regulation 153/04 - April 15, 2011 Standards - T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use							
(No parameter exceedances)							

Physical Tests - SOIL

	Lab ID	L2295097-1	L2295097-2
Sample Date		17-JUN-19	17-JUN-19
Sample ID		BH#39 SS2	BH#48 SS2

Analyte	Unit	Guide Limits			
		#1	#2		
Conductivity	mS/cm	0.57	-	0.198	0.179
% Moisture	%	-	-	14.2	18.1
pH	pH units	-	-	7.75	7.47
Redox Potential	mV	-	-	232	246
Resistivity	ohm*cm	-	-	5050	5600

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Leachable Anions & Nutrients - SOIL

Lab ID	L2295097-1	L2295097-2
Sample Date	17-JUN-19	17-JUN-19
Sample ID	BH#39 SS2	BH#48 SS2

Analyte	Unit	Guide Limits		#1	#2
		#1	#2		
Chloride	ug/g	-	-	<5.0	<5.0

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Anions and Nutrients - SOIL

Lab ID	L2295097-1	L2295097-2
Sample Date	17-JUN-19	17-JUN-19
Sample ID	BH#39 SS2	BH#48 SS2

Analyte	Unit	Guide Limits			
		#1	#2		
Sulphate	mg/kg	-	-	91	47

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Inorganic Parameters - SOIL

Lab ID	L2295097-1	L2295097-2
Sample Date	17-JUN-19	17-JUN-19
Sample ID	BH#39 SS2	BH#48 SS2

Guide Limits

Analyte	Unit	Guide Limits	
		#1	#2

Acid Volatile Sulphides	mg/kg	-	-	<0.20	<0.20
-------------------------	-------	---	---	-------	-------

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0
<p>5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
EC-WT	Soil	Conductivity (EC)	MOEE E3138
<p>A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A
<p>A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
<p>This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
SO4-WT	Soil	Sulphate	EPA 300.0
<p>5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p>			
SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J
<p>This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H₂S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.</p>			

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

17-621536

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Reference Information

L2295097 CONT'D....
Job Reference: 665125
PAGE 8 of 8
25-JUN-19 10:36 (MT)

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.



Environmental

Quality Control Report

Workorder: L2295097

Report Date: 25-JUN-19

Page 1 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: Mavara Turab

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	Soil							
Batch	R4683547							
WG3085870-3	CRM	AN-CRM-WT						
Chloride			91.5		%		70-130	24-JUN-19
WG3085870-4	DUP	L2296665-3						
Chloride		10.9	10.8		ug/g	0.7	30	24-JUN-19
WG3085870-2	LCS							
Chloride			102.8		%		80-120	24-JUN-19
WG3085870-1	MB							
Chloride			<5.0		ug/g		5	24-JUN-19
EC-WT	Soil							
Batch	R4682502							
WG3084826-4	DUP	WG3084826-3						
Conductivity		2.45	2.35		mS/cm	4.2	20	24-JUN-19
WG3084826-2	IRM	WT SAR3						
Conductivity			91.7		%		70-130	24-JUN-19
WG3086139-1	LCS							
Conductivity			99.6		%		90-110	24-JUN-19
WG3084826-1	MB							
Conductivity			<0.0040		mS/cm		0.004	24-JUN-19
MOISTURE-WT	Soil							
Batch	R4677554							
WG3082614-3	DUP	L2295203-3						
% Moisture		15.8	16.1		%	2.1	20	21-JUN-19
WG3082614-2	LCS							
% Moisture			100.0		%		90-110	21-JUN-19
WG3082614-1	MB							
% Moisture			<0.10		%		0.1	21-JUN-19
PH-WT	Soil							
Batch	R4677828							
WG3082460-1	DUP	L2294997-1						
pH		7.74	7.78	J	pH units	0.04	0.3	20-JUN-19
WG3082812-1	LCS							
pH			7.04		pH units		6.9-7.1	20-JUN-19
REDOX-POTENTIAL-WT	Soil							
Batch	R4681505							
WG3084413-1	CRM	WT-REDOX						
Redox Potential			98.5		%		80-120	21-JUN-19
WG3083830-1	DUP	L2295097-1						



Quality Control Report

Workorder: L2295097

Report Date: 25-JUN-19

Page 2 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: Mavara Turab

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
REDOX-POTENTIAL-WT	Soil							
Batch	R4681505							
WG3083830-1	DUP	L2295097-1						
Redox Potential		232	228		mV	1.7	25	21-JUN-19
SO4-WT	Soil							
Batch	R4682445							
WG3082907-4	CRM	AN-CRM-WT						
Sulphate			120.3		%		60-140	21-JUN-19
WG3082907-3	DUP	L2295105-1						
Sulphate		54	57		mg/kg	5.5	30	21-JUN-19
WG3082907-2	LCS							
Sulphate			102.4		%		80-120	21-JUN-19
WG3082907-1	MB							
Sulphate			<20		mg/kg		20	21-JUN-19
SULPHIDE-WT	Soil							
Batch	R4677926							
WG3082745-3	DUP	L2292733-5						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	20-JUN-19
WG3082745-2	LCS							
Acid Volatile Sulphides			80.6		%		70-130	20-JUN-19
WG3082745-1	MB							
Acid Volatile Sulphides			<0.20		mg/kg		0.2	20-JUN-19

Quality Control Report

Workorder: L2295097

Report Date: 25-JUN-19

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Page 3 of 3

Contact: Mavara Turab

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



SNC-Lavalin GEM Ontario Inc. (Vaughan)
ATTN: Mavara Turab
401 Hanlan Road
Vaughan ON L4L 3T1

Date Received: 21-JUN-19
Report Date: 28-JUN-19 09:36 (MT)
Version: FINAL

Client Phone: 905-851-0090

Certificate of Analysis

Lab Work Order #: L2296665
Project P.O. #: NOT SUBMITTED
Job Reference: 665125
C of C Numbers: 17-621538
Legal Site Desc:



Mathy Mahadera
Account Manager

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ADDRESS: 5730 Coopers Avenue, Unit #26, Mississauga, ON L4Z 2E9 Canada | Phone: +1 905 507 6910 | Fax: +1 905 507 6927
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Summary of Guideline Exceedances

Guideline							
ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit	
Ontario Regulation 153/04 - April 15, 2011 Standards - T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use							
(No parameter exceedances)							

Physical Tests - SOIL

Lab ID	L2296665-1	L2296665-2	L2296665-3	L2296665-4
Sample Date	18-JUN-19	18-JUN-19	18-JUN-19	20-JUN-19
Sample ID	BH#57 SS2	BH#60 SS2	BH#66 SS2	BH#45 SS2

Analyte	Unit	Guide Limits					
		#1	#2				
Conductivity	mS/cm	0.57	-	0.266	0.226	0.219	0.208
% Moisture	%	-	-	17.3	19.9	16.8	16.2
pH	pH units	-	-	7.76	7.50	7.75	7.70
Redox Potential	mV	-	-	209	224	209	220
Resistivity	ohm*cm	-	-	3760	4420	4570	4810

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

ANALYTICAL REPORT

Leachable Anions & Nutrients - SOIL

Analyte	Unit	Guide Limits					
		#1	#2	#3	#4		
Chloride	ug/g	-	-	22.8	8.9	10.9	<5.0

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Anions and Nutrients - SOIL

Lab ID	L2296665-1	L2296665-2	L2296665-3	L2296665-4
Sample Date	18-JUN-19	18-JUN-19	18-JUN-19	20-JUN-19
Sample ID	BH#57 SS2	BH#60 SS2	BH#66 SS2	BH#45 SS2

Analyte	Unit	Guide Limits					
		#1	#2				
Sulphate	mg/kg	-	-	113	94	76	72

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.



ANALYTICAL REPORT

Inorganic Parameters - SOIL

Lab ID	L2296665-1	L2296665-2	L2296665-3	L2296665-4
Sample Date	18-JUN-19	18-JUN-19	18-JUN-19	20-JUN-19
Sample ID	BH#57 SS2	BH#60 SS2	BH#66 SS2	BH#45 SS2

Analyte	Unit	Guide Limits					
		#1	#2				
Acid Volatile Sulphides	mg/kg	-	-	<0.20	0.46	0.24	0.41

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0
<p>5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
EC-WT	Soil	Conductivity (EC)	MOEE E3138
<p>A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A
<p>A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
<p>This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
SO4-WT	Soil	Sulphate	EPA 300.0
<p>5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p>			
SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J
<p>This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H₂S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.</p>			

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

17-621538

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Reference Information

L2296665 CONT'D....
Job Reference: 665125
PAGE 8 of 8
28-JUN-19 09:36 (MT)

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

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Quality Control Report

Workorder: L2296665

Report Date: 28-JUN-19

Page 1 of 4

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: Mavara Turab

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	Soil							
Batch	R4683547							
WG3085870-3	CRM	AN-CRM-WT						
Chloride			91.5		%		70-130	24-JUN-19
WG3085870-4	DUP	L2296665-3						
Chloride		10.9	10.8		ug/g	0.7	30	24-JUN-19
WG3085870-2	LCS							
Chloride			102.8		%		80-120	24-JUN-19
WG3085870-1	MB							
Chloride			<5.0		ug/g		5	24-JUN-19
Batch	R4689912							
WG3089486-3	CRM	AN-CRM-WT						
Chloride			90.4		%		70-130	27-JUN-19
WG3089486-4	DUP	L2297191-1						
Chloride		182	180		ug/g	1.2	30	27-JUN-19
WG3089486-2	LCS							
Chloride			103.6		%		80-120	27-JUN-19
WG3089486-1	MB							
Chloride			<5.0		ug/g		5	27-JUN-19
EC-WT	Soil							
Batch	R4683186							
WG3085873-4	DUP	WG3085873-3						
Conductivity		1.18	1.20		mS/cm	1.7	20	24-JUN-19
WG3085873-2	IRM	WT SAR3						
Conductivity			100.5		%		70-130	24-JUN-19
WG3086146-1	LCS							
Conductivity			99.9		%		90-110	24-JUN-19
WG3085873-1	MB							
Conductivity			<0.0040		mS/cm		0.004	24-JUN-19
Batch	R4689209							
WG3088682-4	DUP	WG3088682-3						
Conductivity		0.0101	0.0102		mS/cm	0.4	20	27-JUN-19
WG3088682-2	IRM	WT SAR3						
Conductivity			97.1		%		70-130	27-JUN-19
WG3089759-1	LCS							
Conductivity			100.4		%		90-110	27-JUN-19
WG3088682-1	MB							
Conductivity			<0.0040		mS/cm		0.004	27-JUN-19
MOISTURE-WT	Soil							



Quality Control Report

Workorder: L2296665

Report Date: 28-JUN-19

Page 2 of 4

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: Mavara Turab

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT		Soil						
Batch	R4682273							
WG3085200-3	DUP	L2296781-6						
% Moisture		12.4	12.4		%	0.3	20	23-JUN-19
WG3085200-2	LCS		100.7		%		90-110	23-JUN-19
% Moisture								
WG3085200-1	MB		<0.10		%		0.1	23-JUN-19
% Moisture								
Batch	R4682849							
WG3086170-3	DUP	L2296791-9						
% Moisture		5.63	6.39		%	13	20	24-JUN-19
WG3086170-2	LCS		100.1		%		90-110	24-JUN-19
% Moisture								
WG3086170-1	MB		<0.10		%		0.1	24-JUN-19
% Moisture								
PH-WT		Soil						
Batch	R4682809							
WG3084760-1	DUP	L2296536-1						
pH		7.66	7.67	J	pH units	0.01	0.3	24-JUN-19
WG3086103-1	LCS		7.02		pH units		6.9-7.1	24-JUN-19
pH								
Batch	R4683179							
WG3086209-1	DUP	L2296665-4						
pH		7.70	7.74	J	pH units	0.04	0.3	24-JUN-19
WG3086780-1	LCS		7.01		pH units		6.9-7.1	24-JUN-19
pH								
REDOX-POTENTIAL-WT		Soil						
Batch	R4682990							
WG3086204-1	CRM	WT-REDOX						
Redox Potential			98.3		%		80-120	24-JUN-19
WG3085188-1	DUP	L2296665-1						
Redox Potential		209	201		mV	3.9	25	24-JUN-19
Batch	R4688994							
WG3087692-1	CRM	WT-REDOX						
Redox Potential			97.9		%		80-120	26-JUN-19
WG3086039-1	DUP	L2296625-9						
Redox Potential		197	217		mV	9.7	25	26-JUN-19
SO4-WT		Soil						



Quality Control Report

Workorder: L2296665

Report Date: 28-JUN-19

Page 3 of 4

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
 401 Hanlan Road
 Vaughan ON L4L 3T1

Contact: Mavara Turab

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-WT								
	Soil							
Batch	R4683547							
WG3085199-4	CRM	AN-CRM-WT						
Sulphate			88.2		%		60-140	24-JUN-19
WG3085199-3	DUP	L2296665-1						
Sulphate		113	107		mg/kg	4.8	30	24-JUN-19
WG3085199-2	LCS							
Sulphate			102.6		%		80-120	24-JUN-19
WG3085199-1	MB							
Sulphate			<20		mg/kg		20	24-JUN-19
Batch	R4688448							
WG3086156-4	CRM	AN-CRM-WT						
Sulphate			99.5		%		60-140	25-JUN-19
WG3086156-3	DUP	L2296625-9						
Sulphate		69	72		mg/kg	3.7	30	25-JUN-19
WG3086156-2	LCS							
Sulphate			102.9		%		80-120	25-JUN-19
WG3086156-1	MB							
Sulphate			<20		mg/kg		20	25-JUN-19
SULPHIDE-WT								
	Soil							
Batch	R4682952							
WG3086248-3	DUP	L2295053-1						
Acid Volatile Sulphides		0.46	0.39		mg/kg	16	30	24-JUN-19
WG3086248-2	LCS							
Acid Volatile Sulphides			93.3		%		70-130	24-JUN-19
WG3086248-1	MB							
Acid Volatile Sulphides			<0.20		mg/kg		0.2	24-JUN-19
Batch	R4688414							
WG3088655-3	DUP	L2296625-5						
Acid Volatile Sulphides		0.35	0.38		mg/kg	9.1	30	26-JUN-19
WG3088655-2	LCS							
Acid Volatile Sulphides			84.6		%		70-130	26-JUN-19
WG3088655-1	MB							
Acid Volatile Sulphides			<0.20		mg/kg		0.2	26-JUN-19

Quality Control Report

Workorder: L2296665

Report Date: 28-JUN-19

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Page 4 of 4

Contact: Mavara Turab

Legend:

Limit ALS Control Limit (Data Quality Objectives)
DUP Duplicate
RPD Relative Percent Difference
N/A Not Available
LCS Laboratory Control Sample
SRM Standard Reference Material
MS Matrix Spike
MSD Matrix Spike Duplicate
ADE Average Desorption Efficiency
MB Method Blank
IRM Internal Reference Material
CRM Certified Reference Material
CCV Continuing Calibration Verification
CVS Calibration Verification Standard
LCSD Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
-----------	-------------

J	Duplicate results and limits are expressed in terms of absolute difference.
---	---

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



SNC-Lavalin GEM Ontario Inc. (Vaughan)
ATTN: Mavara Turab
401 Hanlan Road
Vaughan ON L4L 3T1

Date Received: 24-JUN-19
Report Date: 28-JUN-19 09:45 (MT)
Version: FINAL

Client Phone: 905-851-0090

Certificate of Analysis

Lab Work Order #: L2297331
Project P.O. #: NOT SUBMITTED
Job Reference: 665125
C of C Numbers: 17-621541
Legal Site Desc:

Mathy Mahadera
Account Manager

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Summary of Guideline Exceedances

Guideline							
ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit	
Ontario Regulation 153/04 - April 15, 2011 Standards - T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use							
(No parameter exceedances)							

Physical Tests - SOIL

Lab ID L2297331-1
Sample Date 21-JUN-19
Sample ID BH#69 SS2

Analyte	Unit	Guide Limits		
		#1	#2	
Conductivity	mS/cm	0.57	-	0.302
% Moisture	%	-	-	16.0
pH	pH units	-	-	7.55
Redox Potential	mV	-	-	241
Resistivity	ohm*cm	-	-	3310

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Leachable Anions & Nutrients - SOIL

Lab ID L2297331-1
Sample Date 21-JUN-19
Sample ID BH#69 SS2

Analyte	Unit	Guide Limits		
		#1	#2	
Chloride	ug/g	-	-	47.8

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Comm Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Anions and Nutrients - SOIL

Lab ID L2297331-1
Sample Date 21-JUN-19
Sample ID BH#69 SS2

Analyte	Unit	Guide Limits		
		#1	#2	
Sulphate	mg/kg	-	-	70

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Inorganic Parameters - SOIL

Lab ID L2297331-1
Sample Date 21-JUN-19
Sample ID BH#69 SS2

Guide Limits
Unit #1 #2

Analyte	Unit	#1	#2	
Acid Volatile Sulphides	mg/kg	-	-	<0.20

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0
<p>5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
EC-WT	Soil	Conductivity (EC)	MOEE E3138
<p>A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A
<p>A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
<p>This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
SO4-WT	Soil	Sulphate	EPA 300.0
<p>5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p>			
SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J
<p>This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H₂S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.</p>			

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

17-621541

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Reference Information

L2297331 CONT'D....
Job Reference: 665125
PAGE 8 of 8
28-JUN-19 09:45 (MT)

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.



Quality Control Report

Workorder: L2297331

Report Date: 28-JUN-19

Page 1 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: Mavara Turab

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	Soil							
Batch	R4689912							
WG3089486-3	CRM	AN-CRM-WT						
Chloride			90.4		%		70-130	27-JUN-19
WG3089486-4	DUP	L2297191-1						
Chloride		182	180		ug/g	1.2	30	27-JUN-19
WG3089486-2	LCS							
Chloride			103.6		%		80-120	27-JUN-19
WG3089486-1	MB							
Chloride			<5.0		ug/g		5	27-JUN-19
EC-WT	Soil							
Batch	R4688439							
WG3087975-4	DUP	WG3087975-3						
Conductivity		0.531	0.544		mS/cm	2.4	20	26-JUN-19
WG3087975-2	IRM	WT SAR3						
Conductivity			92.3		%		70-130	26-JUN-19
WG3088604-1	LCS							
Conductivity			100.1		%		90-110	26-JUN-19
WG3087975-1	MB							
Conductivity			<0.0040		mS/cm		0.004	26-JUN-19
MOISTURE-WT	Soil							
Batch	R4683316							
WG3086619-3	DUP	L2297030-1						
% Moisture		4.13	4.07		%	1.7	20	25-JUN-19
WG3086619-2	LCS							
% Moisture			100.3		%		90-110	25-JUN-19
WG3086619-1	MB							
% Moisture			<0.10		%		0.1	25-JUN-19
PH-WT	Soil							
Batch	R4685930							
WG3087026-1	DUP	L2297433-7						
pH		7.59	7.62	J	pH units	0.03	0.3	25-JUN-19
WG3087423-1	LCS							
pH			7.00		pH units		6.9-7.1	25-JUN-19
REDOX-POTENTIAL-WT	Soil							
Batch	R4688994							
WG3087692-1	CRM	WT-REDOX						
Redox Potential			97.9		%		80-120	26-JUN-19
WG3086039-1	DUP	L2296625-9						



Quality Control Report

Workorder: L2297331

Report Date: 28-JUN-19

Page 2 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: Mavara Turab

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
REDOX-POTENTIAL-WT	Soil							
Batch	R4688994							
WG3086039-1	DUP	L2296625-9						
Redox Potential		197	217		mV	9.7	25	26-JUN-19
SO4-WT	Soil							
Batch	R4688448							
WG3087190-4	CRM	AN-CRM-WT						
Sulphate			90.6		%		60-140	25-JUN-19
WG3087190-3	DUP	L2297628-1						
Sulphate		71	73		mg/kg	1.7	30	25-JUN-19
WG3087190-2	LCS							
Sulphate			102.1		%		80-120	25-JUN-19
WG3087190-1	MB							
Sulphate			<20		mg/kg		20	25-JUN-19
SULPHIDE-WT	Soil							
Batch	R4689508							
WG3090035-3	DUP	L2297191-1						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	27-JUN-19
WG3090035-2	LCS							
Acid Volatile Sulphides			92.4		%		70-130	27-JUN-19
WG3090035-1	MB							
Acid Volatile Sulphides			<0.20		mg/kg		0.2	27-JUN-19

Quality Control Report

Workorder: L2297331

Report Date: 28-JUN-19

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Page 3 of 3

Contact: Mavara Turab

Legend:

Limit ALS Control Limit (Data Quality Objectives)
DUP Duplicate
RPD Relative Percent Difference
N/A Not Available
LCS Laboratory Control Sample
SRM Standard Reference Material
MS Matrix Spike
MSD Matrix Spike Duplicate
ADE Average Desorption Efficiency
MB Method Blank
IRM Internal Reference Material
CRM Certified Reference Material
CCV Continuing Calibration Verification
CVS Calibration Verification Standard
LCSD Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

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Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Chain of Custody (COC) / Analytical Request Form



COC Number: 17 - 621541

Canada Toll Free: 1 800 668 9878

L2297331-COFC

Page of

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Report To Contact and company name below will appear on the final report		Report Format / Distribution			Flow - Contact your AM to confirm all E&P TATs (surcharges may apply)				
Company:	SNCL	Select Report Format:	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)	Regular [R]	<input checked="" type="checkbox"/>	Standard TAT if received by 3 pm - business days - no surcharges apply			
Contact:	Manava Turab	Quality Control (QC) Report with Report	<input type="checkbox"/> YES <input type="checkbox"/> NO	4 day [P4-20%]	<input checked="" type="checkbox"/>	1 Business day [E-100%]			
Phone:	905 851 0090	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked		3 day [P3-25%]	<input type="checkbox"/>	Same Day, Weekend or Statutory holiday [E2-200%] (Laboratory opening fees may apply)			
Company address below will appear on the final report		Select Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	2 day [P2-50%]	<input type="checkbox"/>				
Street:	401 Hanlan Rd	Email 1 or Fax		E&P TATs:					
City/Province:	Woodbridge	Email 2	Manava.Turab@sncl.com	For tests that can not be performed according to the service level selected, you will be contacted.					
Postal Code:	L4L 3T1	Email 3	Brendan.Beaver@sncl.com	Analysis Request					
Invoice To	Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Invoice Distribution			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below				
	Copy of Invoice with Report <input type="checkbox"/> YES <input type="checkbox"/> NO	Select Invoice Distribution:	<input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	CORRECTIVITY / REINSTATED				SAMPLES ON HOLD	Sample is hazardous (please provide further details)
Company:		Email 1 or Fax							
Contact:		Email 2							
Project Information									
ALS Account # / Quote #:		AFE/Cost Center:		PO#:					
Job #:	665125	Major/Minor Code:		Routing Code:					
PO / AFE:		Requisitioner:							
LSD:		Location:							
ALS Lab Work Order # (lab use only):	L2297331	ALS Contact:		Sampler:	n.f				
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type					
	BH# 69 552	21-06-19	10:56am	S.S	X				
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)				
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input type="checkbox"/> NO					Frozen	<input type="checkbox"/>	SIF Observations	Yes <input type="checkbox"/> No <input type="checkbox"/>	
Are samples for human consumption/ use? <input type="checkbox"/> YES <input type="checkbox"/> NO					Ice Packs	<input type="checkbox"/>	Ice Cubes	<input type="checkbox"/>	
					Custody seal intact	Yes <input type="checkbox"/> No <input type="checkbox"/>	Initial Cooler Temperatures °C	Final Cooler Temperatures °C	
					Cooling Initiated	<input type="checkbox"/>		11.3	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)				
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:	
Manava Turab	24 June 2019	11:40					24/19	14:30	



SNC-Lavalin GEM Ontario Inc. (Vaughan)
ATTN: MAVARA TURAB
401 Hanlan Road
Vaughan ON L4L 3T1

Date Received: 16-OCT-19
Report Date: 22-OCT-19 08:20 (MT)
Version: FINAL

Client Phone: 905-851-0090

Certificate of Analysis

Lab Work Order #: L2366164
Project P.O. #: NOT SUBMITTED
Job Reference: 665125
C of C Numbers: 17-730642
Legal Site Desc:

Gayle Braun
Senior Account Manager

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ALS CANADA LTD Part of the ALS Group An ALS Limited Company

Summary of Guideline Exceedances

Guideline							
ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit	
Ontario Regulation 153/04 - April 15, 2011 Standards - T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use							
(No parameter exceedances)							

Physical Tests - SOIL

Lab ID	L2366164-1	L2366164-2
Sample Date	15-OCT-19	15-OCT-19
Sample ID	BH#76 SS2	BH#77 SS3

Analyte	Unit	Guide Limits			
		#1	#2		
Conductivity	mS/cm	0.57	-	0.191	0.221
% Moisture	%	-	-	17.8	11.7
pH	pH units	-	-	7.55	7.52
Redox Potential	mV	-	-	260	269
Resistivity	ohm*cm	-	-	5230	4520

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Leachable Anions & Nutrients - SOIL

Lab ID	L2366164-1	L2366164-2
Sample Date	15-OCT-19	15-OCT-19
Sample ID	BH#76 SS2	BH#77 SS3

Analyte	Unit	Guide Limits			
		#1	#2		
Chloride	ug/g	-	-	13.6	45.0

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Comm Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Anions and Nutrients - SOIL

Lab ID	L2366164-1	L2366164-2
Sample Date	15-OCT-19	15-OCT-19
Sample ID	BH#76 SS2	BH#77 SS3

Guide Limits

Analyte	Unit	Guide Limits			
		#1	#2		
Sulphate	mg/kg	-	-	<20	<20

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Inorganic Parameters - SOIL

Lab ID	L2366164-1	L2366164-2
Sample Date	15-OCT-19	15-OCT-19
Sample ID	BH#76 SS2	BH#77 SS3

Analyte	Unit	Guide Limits		<0.20	<0.20
		#1	#2		
Acid Volatile Sulphides	mg/kg	-	-	<0.20	<0.20

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0
<p>5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
EC-WT	Soil	Conductivity (EC)	MOEE E3138
<p>A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A
<p>A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
<p>This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
SO4-WT	Soil	Sulphate	EPA 300.0
<p>5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p>			
SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J
<p>This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H₂S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.</p>			

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

17-730642

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Reference Information

L2366164 CONT'D....
Job Reference: 665125
PAGE 8 of 8
22-OCT-19 08:20 (MT)

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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Quality Control Report

Workorder: L2366164

Report Date: 22-OCT-19

Page 1 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: MAVARA TURAB

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	Soil							
Batch	R4876149							
WG3194396-3	CRM	AN-CRM-WT						
Chloride			90.8		%		70-130	18-OCT-19
WG3194396-4	DUP	L2366164-2						
Chloride		45.0	40.2		ug/g	11	30	18-OCT-19
WG3194396-2	LCS							
Chloride			102.5		%		80-120	18-OCT-19
WG3194396-1	MB							
Chloride			<5.0		ug/g		5	18-OCT-19
EC-WT	Soil							
Batch	R4875868							
WG3196316-4	DUP	WG3196316-3						
Conductivity		0.858	0.803		mS/cm	6.6	20	21-OCT-19
WG3196316-2	IRM	WT SAR3						
Conductivity			94.4		%		70-130	21-OCT-19
WG3196390-1	LCS							
Conductivity			101.2		%		90-110	21-OCT-19
WG3196316-1	MB							
Conductivity			<0.0040		mS/cm		0.004	21-OCT-19
Batch	R4875874							
WG3196315-4	DUP	WG3196315-3						
Conductivity		0.199	0.196		mS/cm	1.3	20	21-OCT-19
WG3196315-2	IRM	WT SAR3						
Conductivity			98.1		%		70-130	21-OCT-19
WG3196391-1	LCS							
Conductivity			102.3		%		90-110	21-OCT-19
WG3196315-1	MB							
Conductivity			<0.0040		mS/cm		0.004	21-OCT-19
MOISTURE-WT	Soil							
Batch	R4872392							
WG3192963-3	DUP	L2366055-7						
% Moisture		3.01	2.96		%	1.6	20	17-OCT-19
WG3192963-2	LCS							
% Moisture			99.7		%		90-110	17-OCT-19
WG3192963-1	MB							
% Moisture			<0.25		%		0.25	17-OCT-19
PH-WT	Soil							



Quality Control Report

Workorder: L2366164

Report Date: 22-OCT-19

Page 2 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: MAVARA TURAB

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-WT	Soil							
Batch	R4873288							
WG3191799-1	DUP	L2365228-9						
pH		7.94	7.99	J	pH units	0.05	0.3	17-OCT-19
WG3193199-1	LCS							
pH			6.96		pH units		6.9-7.1	17-OCT-19
REDOX-POTENTIAL-WT	Soil							
Batch	R4874266							
WG3194843-1	CRM	WT-REDOX						
Redox Potential			102.7		%		80-120	18-OCT-19
WG3193716-1	DUP	L2366120-2						
Redox Potential		275	274		mV	0.4	25	18-OCT-19
SO4-WT	Soil							
Batch	R4876149							
WG3193734-4	CRM	AN-CRM-WT						
Sulphate			105.9		%		60-140	18-OCT-19
WG3193734-3	DUP	L2366164-2						
Sulphate		<20	<20	RPD-NA	mg/kg	N/A	30	18-OCT-19
WG3193734-2	LCS							
Sulphate			103.2		%		80-120	18-OCT-19
WG3193734-1	MB							
Sulphate			<20		mg/kg		20	18-OCT-19
SULPHIDE-WT	Soil							
Batch	R4874286							
WG3194692-3	DUP	L2367347-1						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	18-OCT-19
WG3194692-2	LCS							
Acid Volatile Sulphides			87.3		%		70-130	18-OCT-19
WG3194692-1	MB							
Acid Volatile Sulphides			<0.20		mg/kg		0.2	18-OCT-19

Quality Control Report

Workorder: L2366164

Report Date: 22-OCT-19

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Page 3 of 3

Contact: MAVARA TURAB

Legend:

Limit ALS Control Limit (Data Quality Objectives)
DUP Duplicate
RPD Relative Percent Difference
N/A Not Available
LCS Laboratory Control Sample
SRM Standard Reference Material
MS Matrix Spike
MSD Matrix Spike Duplicate
ADE Average Desorption Efficiency
MB Method Blank
IRM Internal Reference Material
CRM Certified Reference Material
CCV Continuing Calibration Verification
CVS Calibration Verification Standard
LCSD Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

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Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



SNC-Lavalin GEM Ontario Inc. (Vaughan)
ATTN: Brendan Weaver
401 Hanlan Road
Vaughan ON L4L 3T1

Date Received: 07-JUN-19
Report Date: 13-JUN-19 14:14 (MT)
Version: FINAL

Client Phone: 905-851-0090

Certificate of Analysis

Lab Work Order #: L2287933
Project P.O. #: NOT SUBMITTED
Job Reference: 665725
C of C Numbers: 17-621535
Legal Site Desc:

Mathy Mahadera
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 5730 Coopers Avenue, Unit #26, Mississauga, ON L4Z 2E9 Canada | Phone: +1 905 507 6910 | Fax: +1 905 507 6927
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Summary of Guideline Exceedances

Guideline							
ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit	
Ontario Regulation 153/04 - April 15, 2011 Standards - T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use							
(No parameter exceedances)							

Physical Tests - SOIL

Lab ID	L2287933-1	L2287933-2	L2287933-3
Sample Date	05-JUN-19	05-JUN-19	05-JUN-19
Sample ID	BH14 SS2	BH34 SS2	BH41 SS2

Analyte	Unit	Guide Limits				
		#1	#2			
Conductivity	mS/cm	0.57	-	0.212	0.116	0.193
% Moisture	%	-	-	15.7	11.6	16.4
pH	pH units	-	-	7.65	7.74	7.76
Redox Potential	mV	-	-	198	208	205
Resistivity	ohm*cm	-	-	4720	8600	5190

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

ANALYTICAL REPORT

Leachable Anions & Nutrients - SOIL

Lab ID	L2287933-1	L2287933-2	L2287933-3
Sample Date	05-JUN-19	05-JUN-19	05-JUN-19
Sample ID	BH14 SS2	BH34 SS2	BH41 SS2

Analyte	Unit	Guide Limits		
		#1	#2	
Chloride	ug/g	-	-	45.2 <5.0 <5.0

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Anions and Nutrients - SOIL

Lab ID	L2287933-1	L2287933-2	L2287933-3
Sample Date	05-JUN-19	05-JUN-19	05-JUN-19
Sample ID	BH14 SS2	BH34 SS2	BH41 SS2

Analyte	Unit	Guide Limits		
		#1	#2	
Sulphate	mg/kg	-	-	56 35 82

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Inorganic Parameters - SOIL

Lab ID	L2287933-1	L2287933-2	L2287933-3
Sample Date	05-JUN-19	05-JUN-19	05-JUN-19
Sample ID	BH14 SS2	BH34 SS2	BH41 SS2

Analyte	Unit	Guide Limits		
		#1	#2	#3
Acid Volatile Sulphides	mg/kg	-	-	0.37
				<0.20
				<0.20

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0
<p>5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
EC-WT	Soil	Conductivity (EC)	MOEE E3138
<p>A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A
<p>A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
<p>This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138
<p>Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.</p>			
SO4-WT	Soil	Sulphate	EPA 300.0
<p>5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p>			
SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J
<p>This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H₂S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.</p>			

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

17-621535

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Reference Information

L2287933 CONT'D....
Job Reference: 665725
PAGE 8 of 8
13-JUN-19 14:14 (MT)

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.



Quality Control Report

Workorder: L2287933

Report Date: 13-JUN-19

Page 1 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: Brendan Weaver

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	Soil							
Batch	R4667967							
WG3074465-3	CRM	AN-CRM-WT						
Chloride			99.6		%		70-130	12-JUN-19
WG3074465-4	DUP	L2287418-15						
Chloride		9170	9110		ug/g	0.6	30	12-JUN-19
WG3074465-2	LCS							
Chloride			102.7		%		80-120	12-JUN-19
WG3074465-1	MB							
Chloride			<5.0		ug/g		5	12-JUN-19
EC-WT	Soil							
Batch	R4667870							
WG3075682-4	DUP	WG3075682-3						
Conductivity		1.66	1.75		mS/cm	5.4	20	13-JUN-19
WG3075682-2	IRM	WT SAR3						
Conductivity			99.0		%		70-130	13-JUN-19
WG3075894-1	LCS							
Conductivity			97.9		%		90-110	13-JUN-19
WG3075682-1	MB							
Conductivity			<0.0040		mS/cm		0.004	13-JUN-19
MOISTURE-WT	Soil							
Batch	R4663189							
WG3072238-3	DUP	L2287933-3						
% Moisture		16.4	16.7		%	2.2	20	10-JUN-19
WG3072238-2	LCS							
% Moisture			98.6		%		90-110	10-JUN-19
WG3072238-1	MB							
% Moisture			<0.10		%		0.1	10-JUN-19
PH-WT	Soil							
Batch	R4665792							
WG3072182-1	DUP	L2287721-1						
pH		7.50	7.55	J	pH units	0.05	0.3	12-JUN-19
WG3074771-1	LCS							
pH			7.05		pH units		6.9-7.1	12-JUN-19
REDOX-POTENTIAL-WT	Soil							
Batch	R4662871							
WG3072471-1	CRM	WT-REDOX						
Redox Potential			99.0		%		80-120	10-JUN-19
WG3071300-1	DUP	L2284516-9						



Quality Control Report

Workorder: L2287933

Report Date: 13-JUN-19

Page 2 of 3

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Contact: Brendan Weaver

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
REDOX-POTENTIAL-WT	Soil							
Batch	R4662871							
WG3071300-1	DUP	L2284516-9						
Redox Potential		263	272		mV	3.4	25	10-JUN-19
SO4-WT	Soil							
Batch	R4663324							
WG3072184-4	CRM	AN-CRM-WT						
Sulphate			103.6		%		60-140	10-JUN-19
WG3072184-3	DUP	L2287525-1						
Sulphate		<20	<20	RPD-NA	mg/kg	N/A	30	10-JUN-19
WG3072184-2	LCS							
Sulphate			102.3		%		80-120	10-JUN-19
WG3072184-1	MB							
Sulphate			<20		mg/kg		20	10-JUN-19
SULPHIDE-WT	Soil							
Batch	R4668848							
WG3076035-3	DUP	L2287525-1						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	13-JUN-19
WG3076035-2	LCS							
Acid Volatile Sulphides			84.1		%		70-130	13-JUN-19
WG3076035-1	MB							
Acid Volatile Sulphides			<0.20		mg/kg		0.2	13-JUN-19

Quality Control Report

Workorder: L2287933

Report Date: 13-JUN-19

Client: SNC-Lavalin GEM Ontario Inc. (Vaughan)
401 Hanlan Road
Vaughan ON L4L 3T1

Page 3 of 3

Contact: Brendan Weaver

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

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Appendix E

MASW Test Results (6 pages)



GEOPHYSICS GPR INTERNATIONAL INC.

6741 Columbus Road
Unit 14
Mississauga, Ontario
Canada L5T 2G9

Tel.: (905) 696-0656
Fax: (905) 696-0570
gprtor@gprtor.com
www.geophysicgpr.com

July 4, 2019

GPR file: T191494

Marva Turab, PMP
Geotechnical Project Manager
SNC-Lavalin
401 Hanlan Road
Vaughan, ON
L4L 3T1

RE: Shear-wave velocity sounding at 10192 Highway 50, Brampton, Ontario

Dear Ms Turab:

Geophysics GPR International Inc. has been requested by SNC to carry out a shear-wave velocity sounding at the above site in Brampton. Figure 1 shows the location of the test profile.

The survey was performed on June 25th, 2019.

The investigation included the multi-channel analysis of surface waves (MASW), the micro-tremor array measurements (MAM) and the refraction methods to generate a shear-wave velocity model (Figures 4 & 5).

The following paragraphs describe the survey design, the principles of the test method, the methodology for interpreting the data, and provide a culmination of the results in table format.



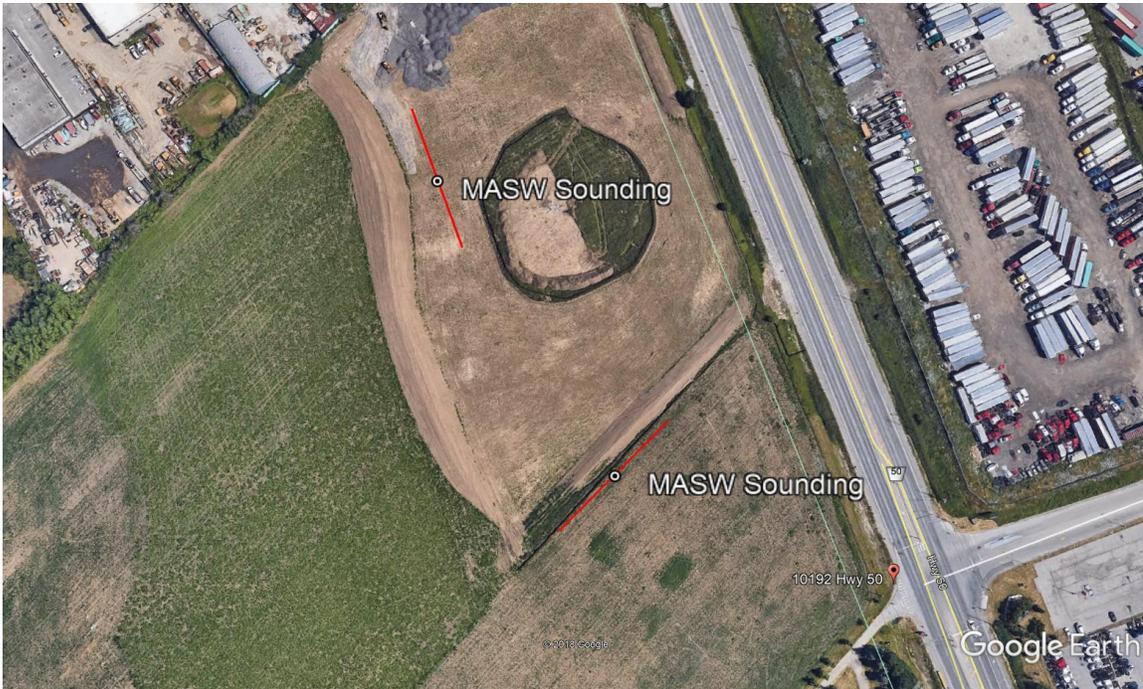


Figure 1: Approximate location of the shear-wave velocity soundings

MASW and MAM Surveys

Basic Theory

The Multi-channel Analysis of Surface Waves (MASW) and the Micro-tremor Array Measurements (MAM) are seismic methods used to evaluate the shear-wave velocities of subsurface materials through the analysis of the dispersion properties of Rayleigh surface waves (“ground roll”). The dispersion properties are measured as a change in phase velocity with frequency. Surface wave energy will decay exponentially with depth. Lower frequency surface waves will travel deeper and thus be more influenced by deeper velocity layering than the shallow higher frequency waves. Inversion of the Rayleigh wave dispersion curve yields a shear-wave (V_s) velocity depth profile (sounding). Figure 2 outlines the basic operating procedure for the MASW method. Figure 3 is an example image of a typical MASW record and resulting 1D V_s model. A more detailed description of the method can be found in the paper *Multi-channel Analysis of Surface Waves*, Park, C.B., Miller, R.D. and Xia, J. Geophysics, Vol. 64, No. 3 (May-June 1999); P. 800–808.

Survey Design

The geometry of an MASW survey is similar to that of a seismic refraction investigation (i.e. 24 geophones in a linear array). The fundamental principle involves intentionally generating an acoustic wave at the surface and digitally recording the surface waves from the moment of source impact with a linear series of geophones on the surface. This is referred to as an “active source” method. An elastic-wave hammer was used as the primary energy source with traces being recorded at 6 locations: approximately 6 m off both ends, 25 to 30 m off both



ends, and in the middle of the spread. Data were collected with geophones spacing of 3m and 1m for a total of 10 shot records per sounding.

Unlike the refraction method, which produces a data point beneath each geophone, the shear-wave depth profile is the average of the bulk area within the middle third of the geophone spread.

The theoretical maximum depth of penetration (34.5m) is half of the maximum seismic array length (69 m), in practice the maximum depth of penetration is often influenced by the geology.

The MAM/passive survey used the same geophone array set up as for the MASW survey. Unlike the MASW survey, the MAM method is considered a “passive source” method in that there is no time break and the motions recorded are from ambient energy generated by cultural noise such as traffic, wind, wave motion, etc. Data collection for the passive method involves recording approximately 10 minutes of background “noise.” The records generated by the MAM method contain lower frequency data, thus increasing the data resolution at greater depths of investigation. Typically the MAM results aid in clarifying the MASW results for depths greater than 20 m; however, the direction of noise propagation relative to the spread orientation can influence the results.

Interpretation Method and Accuracy of Results

The main processing sequence involved plotting, picking, and 1-D inversion of the MASW/MAM shot records using the SeisimagerSW™ software package. In theory, all MASW shot records should produce a similar shear-wave velocity profile. In practice, however, differences can arise due to energy dissipation and localized surface variations. The results of the inversion process are inherently non-unique and the final model must be judged to be geologically realistic. The inversion modelling also assumes that all layering is flat/horizontal and laterally uniform.

The results of the MASW/MAM tests are presented in chart format as Figures 4 & 5. The chart presents the 1-D shear wave velocity values from the inversion models of the passive and active seismic records.

The V_{s30} values for the sounding are presented in Table 1. The V_{s30} values are based on the harmonic mean of the shear wave velocities over the upper 30 m. The V_{s30} value is calculated by dividing the total depth of interest (e.g. 30 m) by the sum of the time spent in each velocity layer up to that depth. This harmonic mean value reflects the equivalent single layer response.

The estimated error in the average V_{s30} value determined through MASW tests is typically +/-10 to 15% for overburden sites. The shear-wave velocities modelled through the MASW method within bedrock have a higher estimated error.



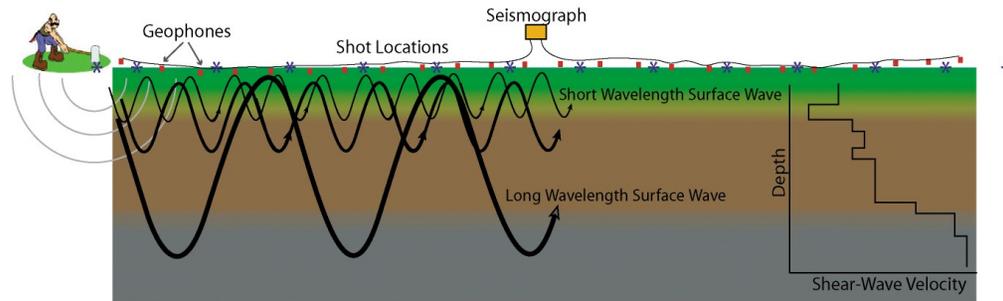


Figure 2: MASW Operating Principle

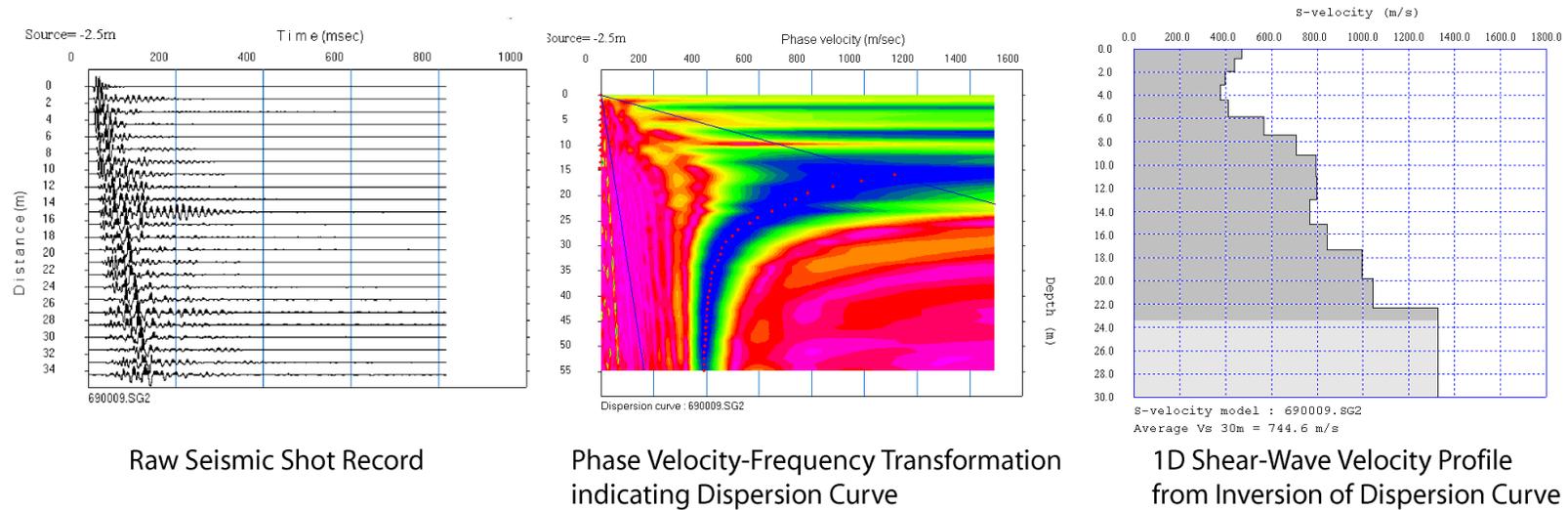


Figure 3: Example of a typical MASW shot record, phase velocity/frequency curve and resulting 1D shear-wave velocity model.



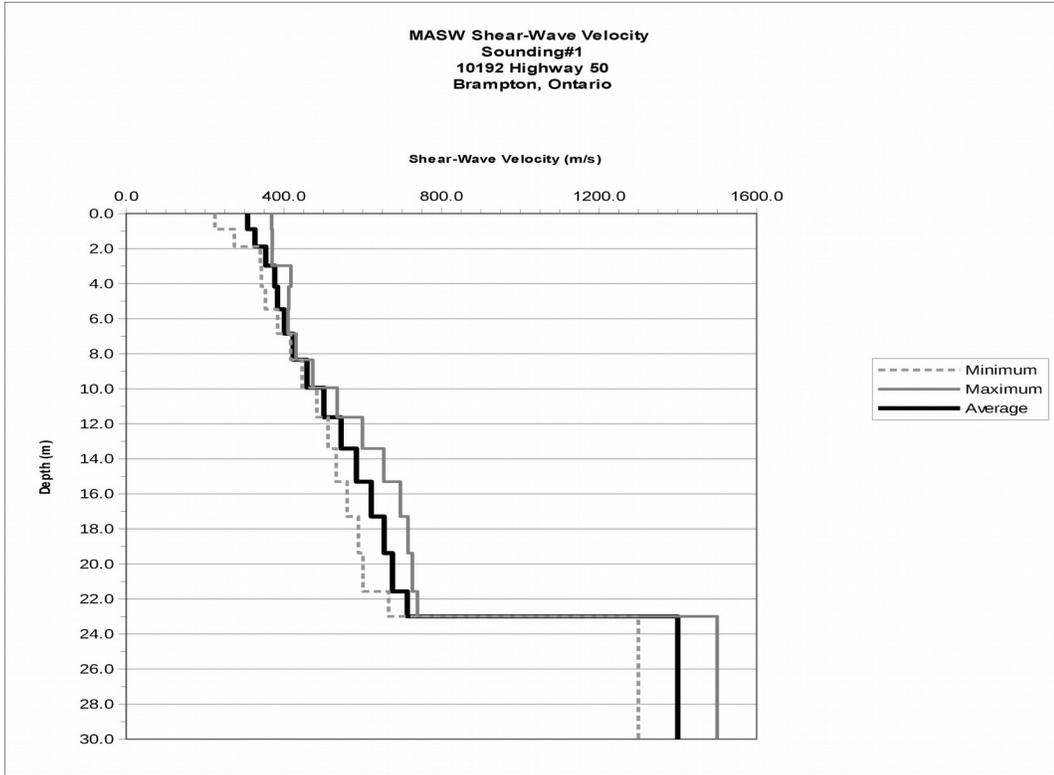


Figure 4: MASW Shear-wave Velocity Sounding

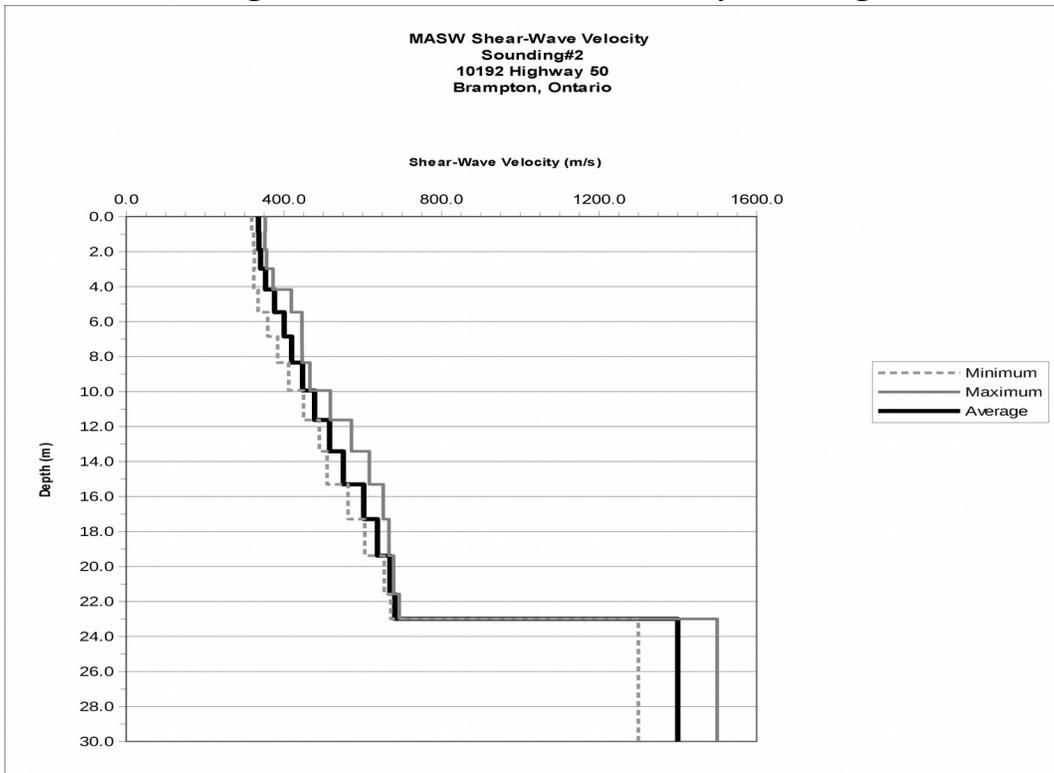


Figure 5: MASW Shear-wave Velocity Sounding



CONCLUSIONS

The approximate location of the shear-wave soundings is indicated in Figure 1.

The MASW shear-wave models are presented in Figures 4 & 5. The results are summarized in Table 1. The background seismic noise levels at this site were moderate. The quality of the seismic records and the resulting dispersion curves was good.

Simple critical distance calculations from refracted P-waves show that the water table could be at 2m deep. The bedrock could be at 23m deep.

Only limited boreholes data were available at the time of this report.

Table 1: Calculated V_{s30} values (m/s) from the MASW data (0 to 30m)

Sounding	Minimum	Average	Maximum	Site Class
1	522	571	616	C
2	523	560	598	C

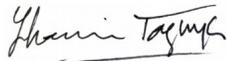
The calculated average V_{s30} values from the 1D MASW soundings collected was 571 and 560m/s +/-10% to 15% respectively for soundings 1 and 2.

The V_{s30} values calculated for the minimum and the maximum envelopes ranged from 522 to 616m/s.

Based on the average V_{s30} values (as determined through the MASW method) and table 4.1.8.4.A of the National Building Code of Canada, 2015 Edition, the investigated area is site class "C" ($360 < V_{s30} \leq 760$ m/s).

It must be noted that the site classification provided in this report is based solely on the V_{s30} value as derived from the MASW method and that it can be superseded by other geotechnical information. This geotechnical information includes, but is not limited to, the presence of sensitive and/or liquefiable soils, more than 3m of soft clays, high moisture content, etc. The reader is referred to section 4.1.8.4 of the National Building Code of Canada, 2015 Edition for more information on the requirements for site classification.

This report has been written by Lhoucin Taghya, P.Geo.

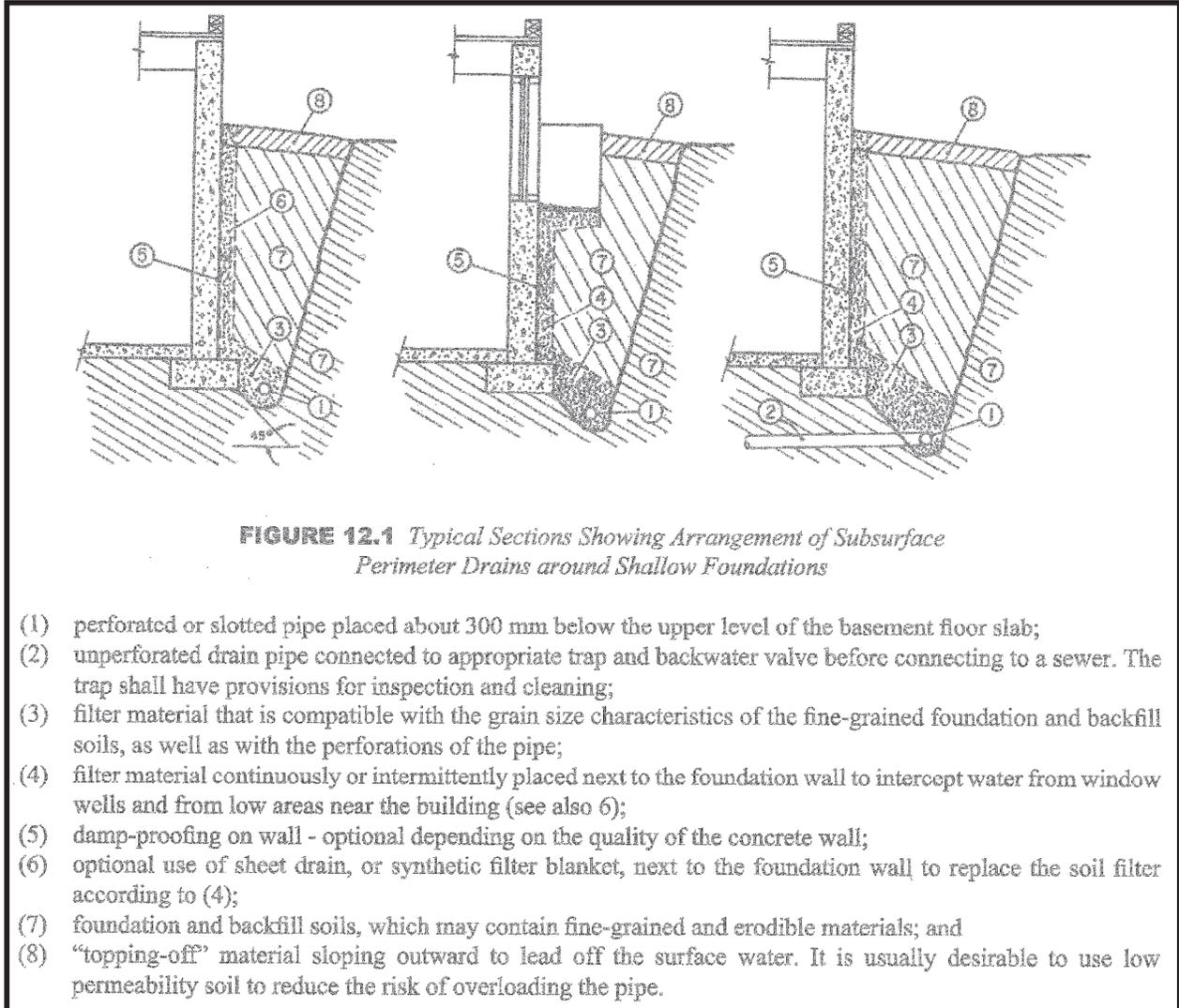


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Appendix F

Perimeter Drainage Details (1 pages)



Refer to : Canadian Foundation Engineering Manual (2006), 4th Edition, Canadian Geotechnical Society, p. 184



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