Geotechnical Investigation

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Geotechnical Investigation
Proposed Avalon III Elementary School
2666 Tenth Line Road
Orleans (Ottawa), Ontario

Project Number:
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Executive Summary

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed Avalon III Elementary school to be located on the parcel of land registered by the street address of 2666 Tenth Line Road, City of Ottawa, Ontario (Figure 1). Written authorization to proceed with this geotechnical investigation was provided by the Conseil Catholique de Centre East (CECCE).

The proposed school will consist of a two-storey basementless structure with associated outdoor sports fields, parking lots and access roads, future portables and the installation of underground municipal services. The finished ground floor of the proposed school building and exterior grades were not available at the time of preparation of this report.

The site is currently occupied by several residential buildings which will be demolished to allow the construction of the proposed school. The rest of the site is currently used as a storage facility for a local developer.

A Phase I and II environmental site assessments were also completed by exp concurrently with the geotechnical investigation and were presented under separate cover.

The fieldwork was undertaken from December 8 to 22, 2022 and on January 12, 2023, and consisted of the drilling of thirteen (13) boreholes and excavating seventeen (17) test pits advanced to depths ranging between 1 m and 37.7 m below grade. Standpipes and monitoring wells were installed in selected boreholes for long term monitoring and sampling of the groundwater table at the site.

The borehole information indicates the subsurface conditions consist of surficial fill underlain by an original topsoil layer which extends to depths of 1.2 m to 2. 4 m (Elevation 84.5 to 85.7 m). The fill and topsoil are underlain by a thick deposit of soft to hard clay extending to the maximum depth investigated in all the boreholes except in Borehole No. 1 where the clay deposit was proven to extend to a depth of 33 m (Elevation 54.1 m). It is underlain by a 0.8 m thick glacial till layer and limestone bedrock proven to a depth of 37.7 m below grade (Elevation 49.4 m). The groundwater is expected to be at a depth of 3 m to 4 m below the existing ground surface, i.e., Elevation 83.0 m to Elevation 86.9 m approximately.

One-dimensional consolidation tests conducted on two undisturbed clay samples revealed the clay to be pre-consolidated to 65 kPa to 115 kPa.

Based on the results of the Multi-channel Analysis of Surface Waves (MASW) survey (shear wave velocity) and comparison of the survey results to Table 4.1.8.4.A of the 2012 Ontario Building Code (as amended May 2, 2019), the site classification for seismic response is **Class E.** The subsurface soils are not susceptible to liquefaction during a seismic event.

The site is underlain by a clay deposit that is prone to consolidation settlement if overstressed by loads imposed on it by site grade raise, foundations and by permanent lowering of the groundwater level following construction. Overstressing of the clay will result in its consolidation and subsequent settlement of foundations, which may exceed tolerable limits of the structure resulting in cracking of the structure.

Based on a review of the engineering properties of the existing on-site fill and clay in conjunction with the recommended bearing pressure at serviceability limit state (SLS) for foundations presented in Section 8 of the report, it is considered that the existing grades at the site should not be raised.

Based on a review of the borehole information and laboratory test results, it is considered feasible to support the proposed school building on strip and spread square footings founded on the native upper desiccated brown clay crust or engineered fill provided that the conditions listed in Section 8.1 of the report are satisfied. If these conditions cannot be satisfied, the proposed structure should be founded on piles. Assuming that the conditions listed in Section 8.1 can be satisfied, the structure may be founded on spread and strip footings using Serviceability Limit State (SLS) bearing pressure of 60 kPa and factored geotechnical resistance of 75 kPa. The maximum width of the strip footing should be limited to 1.0 m and that of the square footings 3 m by 3 m. The settlements of the structure under the recommended design loads are expected to be close to 25 mm total and 19 mm differential.

If the above grade raise restriction and available SLS bearing pressure is insufficient to use spread and strip foundations, it would be necessary to found the proposed school building on end bearing piles as per the recommendation stated in this report.

The fill and original topsoil should be removed from the envelope of the proposed school building, access road, parking lot and future portable and replaced with well engineered material as per the recommendations of the report. Handling of excess soil off site should be undertaken as per the recommendations of the Phase I/II environmental assessment reports completed by exp for the site.

The lowest level floor slab (ground floor) of the proposed building may be designed as a slab-on-grade constructed on the engineered fill pad. Perimeter drains are recommended. Underfloor drains will not be required.

All excavations must be undertaken in accordance with the Occupational Health and Safety Act (OHSA), Ontario Reg. 213/91. Based on the definitions provided in OHSA, the subsurface soils on site are considered to be Type 3 and as such the sidewalls of the excavation must be cut back at 1H:1V from the bottom of the excavation. Below the groundwater level, the excavation side slopes are expected to slough and eventually stabilize at a slope of 3H:1V to 2H:1V.

Seepage of the surface and subsurface water into the excavations is anticipated and it should be possible to collect any water entering the excavations at low points and to remove it by conventional pumping techniques.

It is anticipated that all the material required for backfilling purposes in the interior and exterior of the building and for trench backfill would have to be imported and should preferably conform to the requirement presented in Section 12 of the report.

The above and other related considerations are discussed in greater detail in the main body of the report.

1. Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed Avalon III Elementary school to be located on the parcel of land registered by the street address of 2666 Tenth Line Road, City of Ottawa, Ontario (Figure 1). Written authorization to proceed with this geotechnical investigation was provided by the Conseil Catholique de Centre East (CECCE).

The proposed school will consist of a two-storey basementless structure with associated outdoor sports fields, parking lots and access roads, future portables, and the installation of underground municipal services. The finished ground floor of the proposed school building and exterior grades were not available at the time of preparation of this report.

The site is currently occupied by several residential buildings which will be demolished to allow the construction of the proposed school. The rest of the site is used as a storage facility by a local developer.

A Phase I and II environmental site assessments were also completed by exp concurrently with the geotechnical investigation and were presented under separate cover.

The geotechnical investigation was undertaken to:

a) Establish the subsurface soil and groundwater conditions at thirteen (13) boreholes and seventeen (17) test pits put down throughout the site;

b) Classify the site for seismic site response in accordance with the requirements of the 2012 Ontario Building Code (as amended May 2, 2019) and assess the potential for liquefaction of the subsurface soils during a seismic event;

c) Comment on grade-raise restrictions;

d) Make recommendations regarding the most suitable type of foundations, founding depth and bearing pressure at serviceability limit state (SLS) and factored geotechnical resistance at ultimate limit state (ULS) of the founding strata and comment on the anticipated total and differential settlements of the recommended foundation type;

e) Provide comment regarding slab-on-grade construction and the requirement for perimeter and underfloor drainage systems;

f) Comment on excavation conditions and de-watering requirements during construction;

g) Provide pipe bedding requirements for underground services;

h) Discuss backfilling requirements and suitability of on-site soils for backfilling purposes;

i) Recommend pavement structure thicknesses for access roads and parking lots; and,

j) Comment on subsurface concrete requirements and corrosion potential of subsurface soils to buried metal structures/ members.

The comments and recommendations given in this report are based on the assumption that the above-described design concepts will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2. Site Description

The site is bounded by Tenth Line Road to the east, Sweetvalley Drive to the north, McKinnon Creek to the west and a single-family residential dwelling to the south. McKinnon Creek of the South Nation Conservation Authority flows north to south along the west site boundary towards bear brook. The site is located in a residential area with vacant land to the west.

The site is a relatively flat parcel of land currently occupied by an abandoned single-family residential dwelling, a temporary construction site office, and a garage and yard used for storage of construction materials. The ground cover of the site consists primarily of tall grass, gravel driveways and parking surfaces.

3. Procedure

The fieldwork was undertaken on December 8 to 22, 2022, and January 12, 2023, and consisted of thirteen (13) boreholes advanced to termination and cone refusal depths of 4.9 m to 37.7 m below existing grade, and seventeen (17) test pits advanced to termination depths of 1 m to 2.6 m below existing grade. The borehole and test pit locations and geodetic elevations were established on site by EXP. The borehole and test pit locations are shown on the borehole location plan, Figure 2. The fieldwork was supervised on a full-time basis by a representative from EXP.

The borehole locations were cleared of private and public underground services, prior to the start of drilling operations. The boreholes were drilled using a CME-45 track mounted drill rig equipped with continuous flight hollow stem augers and soil sampling capabilities. Auger samples were obtained in some of the boreholes from the ground surface to a 0.6 m depth. Standard penetration tests (SPTs) were performed in all the boreholes at 0.75 m to 1.5 m depth intervals with the soil samples retrieved by the split-barrel sampler. Dynamic cone penetration test (DCPT) was conducted in Borehole No. 3 from an 8.5 m depth to cone refusal depth at 36.3 m below existing grade. The shear strength of the clayey soils was measured by conducting penetrometer and in-situ vane (field and Nilcon) tests at selected depth intervals. Relatively undisturbed samples (Shelby tube samples) of the clayey soils were retrieved at selected depth intervals. Borehole No. 1 was advanced with casing and wash boring techniques from 6.1 m depth to 33.0 m depth and then coring techniques were used to retrieve samples of bedrock to a termination depth of 37.7 m below ground surface.

Nineteen-millimetre diameter standpipes with slotted sections were installed in three (3) boreholes and 50 mm diameter monitoring wells with screened section were installed in three (3) boreholes for long-term monitoring of the groundwater levels. The standpipes were installed in accordance with EXP standard practice and the installation configuration is documented on the respective borehole log. All boreholes were backfilled upon completion of drilling and the installation of the standpipes and monitoring wells.

All the soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. On completion of the fieldwork, all soil and rock samples were transported to the EXP laboratory in Ottawa.

A multi-channel analysis of surface waves (MASW) survey was conducted on site on November 24, 2022, by Geophysics (GPR) International Inc. in order to measure the shear wave velocity and to determine the site classification for seismic site response based on the shear wave velocity measurements. The procedure and report of the MASW survey are included in Appendix A.

A summary of the soil and rock sample laboratory testing program is shown in Table I. The laboratory testing program for selected soil samples from the boreholes were undertaken in accordance with the American Society for Testing and Materials (ASTM) specificatons. The corrosion analysis of selected soil samples was undertaken in accordance with the methods outlined in the Laboratory Certificate of Analysis included in Appendix B.

Table I: Summary of Laboratory Testing Program

Type of Test	Number of Tests Completed
Soil Samples	
Moisture Content Determination	129
Unit Weight Determination	25
Grain Size Analysis	7
Atterberg Limit Determination	6
One-Dimensional Consolidation Test	2
Corrosion Analysis (pH, sulphate, chloride and resistivity)	3

Table I: Summary of Laboratory Testing Program	
Type of Test	**Number of Tests Completed**
Rock Cores	
Unit Weight Determination	2
Unconfined Compressive Strength	2

4. Subsurface Conditions and Groundwater Levels

A detailed description of the subsurface conditions and groundwater levels from the test holes are given on the attached borehole logs and test pit logs, Figures 3 to 32. The test hole logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted.

Test holes were completed to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions.

It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling operations. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Note on Sample Descriptions" preceding the borehole logs form an integral part of this report and should be read in conjunction with this report.

A review of the test hole logs indicates the following subsurface conditions with depth and groundwater level measurements.

4.1 Topsoil

A surficial topsoil layer was contacted in Borehole Nos. 10, 12 and 15 as well as Test Pit Nos. 1, 2, 8, 9, 11, 13, and 14. The topsoil ranges in thickness from 100 mm to 300 mm.

A buried topsoil layer was encountered in Borehole Nos. 1, 2, 3, 5, 11, 12, and 13, as well as Test Pit Nos. 1, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, and 16. It was encountered at depths of 0.8 m to 2.0 m (Elevation 86.0 m to 85.3 m) and extended to depths of 1.1 m to 2.3 m (Elevation 85.7 m to 85.1 m)

4.2 Granular Fill

Granular fill consisting of crushed limestone sand and gravel, sometimes containing topsoil inclusions was encountered from the surface in Borehole Nos. 2, 3, and 8 as well as Test Pit Nos. 4, 5, 6, and 10. Granular fill was buried in Test Pit No. 13 at a depth of 0.7 m and extends to a depth of 1.0 m (Elevation 86.6 m to 86.3 m). The granular fill had a moisture content ranging from 5 percent to 23 percent.

4.3 Reclaimed Asphalt Pavement (RAP) Fill

Reclaimed asphalt pavement was encountered from the surface in Borehole No. 11 and Test Pit No. 7 with a thickness of 130 mm to 150 mm respectively.

4.4 Fill

Pre-grade fill materials were found in Borehole Nos. 1, 2, 5, 6, 7, 8, 10, 11, 12, 13, 14, and 15, as well as all of the test pits. The pre-grade fill material is found at the surface or directly underlying surficial topsoil, granular fill or RAP material and extends to depths of 0.8 m to 2.3 m (Elevation 86.5 m to 84.6 m). The fill materials varied in soil classification from sand to silty sand to clayey silt to silty clay containing topsoil inclusions, cobbles and boulders measured up to 1 m diameter and often containing construction debris such as concrete, asphalt, brick, and wood pieces. The SPT "N" values range from 7 to 48 blows per 300 mm of penetration of the sampler. The higher N values may be due to the presence of large debris or frozen soil. The moisture content of the fill ranges from 6 percent to 39 percent and its unit weight was measured as 18.5 kN/m^3 and 19.8 kN/m^3.

Grain size analysis was conducted on one (1) sample of the fill and the test results are summarized in Table II. The grain size distribution curve is shown in Figure 34.

Table II: Summary of Grain-size Analysis Results – Fill Sample					
Borehole No. – Sample No.	Depth (m)	Grain-size Analysis (%)			Soil Classification (USCS)
		Gravel	Sand	Fines (Silt and Clay)	
BH13 – SS2	0.8 - 1.4	21	40	39	Silty Sand with gravel (SM)

4.5 Clay

A clay was contacted beneath the topsoil and fill materials in all of the boreholes and test pits. The clay consists of two (2) parts, an upper brown desiccated crust underlain by a grey non-desiccated zone.

4.5.1 Upper Brown Desiccated Clay to Clay Crust

The upper brown desiccated clay crust extends to approximate depths of 2.1 m to 3.4 m (Elevation 84.8 m to Elevation 83.3 m) below existing grade. The undrained shear strength of the crust ranges from 53 kPa to 120 kPa based on vane shear test results, and up to 215 kPa based on penetrometer readings, indicating the crust has a stiff to hard consistency. The sensitivity values of the brown crust are 6.7 to 12.0 indicating the crust has low to medium sensitivity. The natural moisture content of the crust ranges from 27 percent to 45 percent. The natural unit weight of the crust is 17.3 kN/m^3 to 21.2 kN/m^3.

Grain size analysis and Atterberg limit determination were conducted on three (3) samples of the crust and the test results are summarized in Table III. The grain size distribution curves are shown in Figure 35 to Figure 37. Atterberg Limit Test results are shown on Figures 38 to 40.

Table III: Summary of Grain-size Analysis and Atterberg Limits Test Results – Brown Clay Crust Samples									
Borehole No. – Sample No.	Depth (m)	Grain-size Analysis (%)			Atterberg Limits (%)				Soil Classification (USCS)
		Gravel	Sand	Fines (Silt and Clay)	Natural Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	
BH 1 – SS4	2.3 – 2.9	0	4	96	32	61	19	42	Clay of High Plasticity (CH)
BH 8 - SS3	2.3 – 2.9	0	0	100	41	70	29	41	Clay of High Plasticity (CH)
BH14 – SS3	1.5 – 2.1	0	2	98	34	67	27	40	Clay of High Plasticity (CH)

Based on a review of the results of the grain-size analysis and Atterberg limits, the tested soil samples may be classified as clay of high plasticity (CH) in accordance with the USCS.

4.5.2 Lower Grey Clay

The upper brown desiccated clay crust is underlain by grey clay contacted at approximate depths of 2.1 m to 3.4 m (Elevation 84.8 m to Elevation 83.3 m) below existing grade in all of the boreholes. The grey clay extends to inferred and observed depths of approximately 31.5 m and 33.0 m (Elevation 55.3 m to Elevation 54.1 m) in Borehole Nos. 3 and 1, respectively. The depth of 31.5 m (Elevation 55.3 m) was inferred from the DCPT conducted in Borehole No. 3. The remaining boreholes were terminated within the grey clay at 4.9 m to 8.5 m depths (Elevation 82.3 m to Elevation 78.4 m). The undrained shear strength of the grey clay typically ranges from 10 kPa to 34 kPa indicating a very soft to firm consistency. The sensitivity values of the clay range from 2.0 to 20.0, and in some cases the clay had no remolded strength, indicating the clay is of a sensitive to ultra-sensitive nature.

The natural moisture content of the grey clay ranges from 39 percent to 95 percent. The natural unit weight of the grey clay was measured at 17.2 kN/m^3.

Grain size analysis and Atterberg limit determination were conducted on three (3) samples of the grey clay and the test results are summarized in Table IV. The grain size distribution curves and Atterberg Limit Tests are shown in Figures 41 to 43 and Figures 44 to 46 respectively.

Table IV: Summary of Grain-size Analysis and Atterberg Limits Test Results – Grey Clay Samples

Borehole No. – Sample No.	Depth (m)	Grain-size Analysis (%)			Atterberg Limits (%)				Soil Classification (USCS)
		Gravel	Sand	Fines (Silt and Clay)	Natural Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	
BH2 – SS8	7.6 – 8.2	0	0	100	45	66	26	40	Clay of High Plasticity (CH)
BH5 – SS7	6.1 – 6.7	0	0	100	70	66	22	44	Clay of High Plasticity (CH)
BH8 – SS4	3.8 – 4.4	0	0	100	59	70	27	43	Clay of High Plasticity (CH)

Based on a review of the results of the grain-size analysis and Atterberg limits, the tested soil samples may be classified as a clay of high plasticity (CH) in accordance with the USCS.

One dimensional consolidation tests were performed on two (2) samples of the grey clay. The test results are summarized in Table V and presented in Figures 47 and 48.

Table V: One-Dimensional Oedometer Test Results - Grey Clay Samples

Borehole No.- Sample No.	Sample Depth (m)	σ'_{v0} (kPa)	w_c (%)	γ (kN/m^3)	σ'_p (kPa)	e_o	c_r	c_c	OCR
5/ST5	3.0 – 3.6	59.0	53.03	16.76	115.0	1.462	0.046	0.551	1.95
3/ST7	6.0 – 6.6	73.8	65.66	15.9	65.0	1.812	0.033	0.457	0.88*

σ'_{v0} = calculated effective overburden pressure (kPa); Wc: natural moisture content (%), γ: estimated natural unit weight σ'; p = pre-consolidation pressure (kPa); e_o = initial void ratio; c_r = re-compression index; c_c = compression index; OCR= Over-Consolidation Ratio; * sample likely disturbed

Based on a review of the consolidation test results, the over-consolidation ratio is greater than 1 for the sample from Borehole 5 from 3.0 to 3.6 m depth, indicating the grey clay in the upper levels is over-consolidated. The results of soil sample from Borehole 3 indicate that the sample was somewhat disturbed. The clay is expected to be normally consolidated.

4.6 Glacial Till

The clay is underlain by glacial till contacted in Borehole No. 1 and inferred in Borehole No. 3 at 33.0 m and 31.5 m depths respectively (Elevation 54.1 m to Elevation 55.3 m). The glacial till contains cobbles and boulders. Based on dynamic cone penetration test (DCPT) N-values of 43 to 95, the glacial till is in a dense to very dense state. The higher N-values may be a result of the soil sampler making contact with a cobble or boulder within the glacial till.

4.7 Cone Refusal

Dynamic cone penetration test (DCPT) conducted in Borehole No. 3 encountered cone refusal at a 36.3 m depth (Elevation 50.5 m). Cone refusal may have been met on possible cobbles or boulders within the glacial till or on possible bedrock.

4.8 Limestone Bedrock

Bedrock was cored in Borehole 1. Grey limestone bedrock was contacted at 33.8 m depth (Elevation 53.3 m) and cored to a termination depth of 37.7 m (Elevation 49.4 m). The Total Core Recovery (TCR) varied from 0 to 98% for the runs. Rock Quality Designation (RQD) varied from 0 to 87%. On this basis, the bedrock quality may be described as very poor in the upper levels to good quality below 34.5 m depth.

The bedrock geology map (Map 1508A – Generalized Bedrock Geology, Ottawa-Hull, Ontario and Quebec, Geological Survey of Canada, printed by the Surveys and Mapping Branch, 1979) indicates the site is underlain by Limestone bedrock of the Ottawa formation containing some shaly partings and some sandstone in the basal part.

4.9 Groundwater Level Measurements

A summary of the groundwater level measurements taken in the boreholes equipped with standpipes is shown in Table VI.

Table VI: Summary of Groundwater Level Measurements

Borehole No.	Ground Surface Elevation (m)	Groundwater level measurements in depth below ground surface (elevation), m At date of measurement [time in days from date of installation]	
		January 6, 2023	January 10, 2023
BH-05	86.96	0.68 (86.28) [22]	0.61 (86.35) [26]
BH-08	87.39	0.57 (86.82) [15]	0.83 (86.56) [19]
BH-10	87.69	1.45 (86.24) [15]	1.45 (86.24) [19]
BH-11	86.95	0.75 (86.20) [15]	0.93 (86.02) [19]
BH-12	87.22	0.59 (86.63) [16]	0.67 (86.55) [20]
BH-14	86.67	0.41 (86.26) [16]	0.47 (86.20) [20]

The groundwater level in the boreholes equipped with standpipes was measured at 0.4 m to 1.5 m depths (Elevation 86.82 m to Elevation 86.02 m). This water table is likely perched in the fill. Based on a review of the moisture content of the soil samples, the groundwater table is expected to be at a depth of 3 m to 4 m below the existing ground surface, i.e., Elevation 83.0 m to Elevation 86.9 m approximately.

Note that fluctuations in the level of groundwater may occur due to a seasonal variation such as precipitation, snowmelt, rainfall activities, and other factors not evident at the time of measurement and therefore may be at a higher level during wet weather periods.

5. Site Classification for Seismic Site Response and Liquefaction Potential of Soils

5.1 Site Classification for Seismic Site Response

Based on the results from the Multi-channel Analysis of Surface Waves (MASW) survey (shear wave velocity) shown in Appendix A and comparison of the survey results with Table 4.1.8.4.A of the 2012 Ontario Building Code (as amended May 2, 2019), the site classification for seismic response is **Class E**.

5.2 Liquefaction Potential of Soils

The subsurface soils are not susceptible to liquefaction during a seismic event.

6. Grade Raise Restrictions

The site is underlain by a clay deposit that is prone to consolidation settlement if overstressed by loads imposed on it by site grade raise, foundations and by permanent lowering of the groundwater level following construction. Overstressing of the clay will result in its consolidation and subsequent settlement of foundations, which may exceed tolerable limits of the structure resulting in cracking of the structure.

It is noted that approximately 0.8 m to 2.1 m of fill has already been placed on the site. The time of placement of the fill on the site is not known. It appears that the fill has partly consolidated the clay in the upper levels. However, the degree of consolidation of the clay could not be established as the time of placement of fill and stages of its placement on the site are not known. It is therefore considered that the clay is not capable of supporting any additional grade raise loads from the current grades. It is recommended that the grade at the site should not be raised above the existing grade. The average existing ground surface elevation in the building area was computed based on the elevation of the boreholes as Elevation 87.1 m. It is understood that this elevation approximately coincides with the road level and that the proposed grade will be approximately 0.3 m lower than the road level. Therefore, it has been assumed that the finished grade at the site will be at Elevation 86.8 m, approximately.

An allowance for permanent groundwater lowering is not required, since the foundations will be at or above the groundwater level and measures will be employed by the installation of clay seals in new municipal service trenches to minimize the permanent lowering of the groundwater level at the site, as discussed in Section 11 of this report.

Once the exterior grades and Finished floor of the proposed school building are set, this office must be contacted to update the recommendation of this reports as deemed required.

7. Site Grading

Site grading within the footprint of the proposed building, paved areas, future portables and outdoor sports fields should consist of the excavation and removal of all existing surficial topsoil and organic stained soils, fill and buried original topsoil layer from the site down to the native undisturbed clay.

The exposed subgrade should be reviewed by a geotechnician prior to placement of engineered fill to raise the site grades. Granular B Type II in accordance with Ontario Provincial Standard Specification (OPSS) 1010 should be used as engineered fill to raise the site grades to the underside of the floor slab inside the proposed building. The engineered fill should be placed in 300 mm thick lifts and compacted to 98 percent of the standard Proctor maximum dry density (SPMDD) in the interior of the building. Exterior to the building against foundation walls and in footing trenches, OPSS 1010 Granular B Type II should be placed and compacted to 95 percent of the SPMDD.

For the proposed outdoor sports fields, parking lot and access roads, the site grades may be raised to the design subgrade level by the placement of soil fill meeting the requirements of OPSS 1010 select subgrade material (SSM) placed in 300 mm thick lifts and compacted to 95 percent of the SPMDD. In any wet soft areas, crusher-run granular material may be required in the lower levels of the fill to stabilize the subgrade.

In place density tests should be performed on each lift of placed material to ensure that it has been compacted to the project specifications.

8. Foundation Considerations

8.1 Spread and Strip Footings

Finished floor elevation and exterior grades of the proposed school building and facilities were not available at the time of preparation of this report. Therefore, once this information become available, they should be forwarded to EXP so the recommendations below are reviewed and validated.

The feasibility of using spread and strip footings for the proposed school building was investigated. It is considered that it may be feasible to support the proposed building on spread and strip footings provided all conditions listed below can be satisfied.

1. The finished grade at the site should be set at Elevation 86.8 m, i.e., no grade raise above existing grades.
2. All existing fill and buried topsoil will need to be removed from the envelope of the building as noted in Section 7.0 of the report.
3. All the exterior spread and strip footings should be set either on the engineered fill or on the desiccated clay at a depth of 1.5 m below the finished grade in order to provide the requisite frost cover, i.e., at Elevation 85.3 m. Interior footings may be set at higher level. If any footings need to be set at lower elevations than noted above, this office must be consulted for additional recommendation
4. The maximum width of the strip footings should be limited to 1 m and that of the spread footings to 3.0 m by 3.0 m.
5. The footings should be designed using a maximum Ultimate Serviceability Limit State bearing pressure of 60 kPa and factored geotechnical resistance at Ultimate State of 75 kPa. Settlement of the footings are expected to be 25 mm total and 19 mm differential. The anticipated settlements may be reduced by placing the footings at a higher level, i.e., at 0.5 to 0.75 m below the finished grade and providing a combination of earth cover and extruded polystyrene insulation as frost protection. This would result in reducing the stress on the soft clay underlying the desiccated clay crust and the resultant settlements.
6. 50 mm mud slab is recommended to be placed on the surface of the clay immediately upon review and approval.

If the above conditions cannot be satisfied, the proposed structure would have to be founded on end bearing piles as described below.

8.2 Pile Foundation

The proposed school addition may be supported by steel H or concrete filled pipe piles designed in end-bearing and driven to practical refusal into the underlying bedrock. The bedrock is anticipated to be present at or below a depth of 32 m to 34 m below the existing ground surface, i.e., Elevation 53.1 m to Elevation 55.1 m approximately. Additional boreholes are recommended to collect data on the depth/elevation of the bedrock throughout the site if the piling option is selected.

Since the piles are expected to meet refusal in the bedrock, the factored geotechnical resistance at ultimate limit state (ULS) will govern the design. The factored geotechnical resistance values at ULS for various pile sections are shown in Table VII. The factored geotechnical resistance values at ULS are based on steel piles with a yield strength of 350 MPa and concrete compressive strength of 35 MPa and a geotechnical resistance factor of 0.4.

It is noted that the piles will be subjected to down-drag forces (negative skin friction) due to consolidation of the marine clay as a result of the grade raise at the site. The negative skin friction that the piles would be subjected to is also listed in Table VII. The allowable load on a pile may be computed by subtracting the negative skin friction from the factored geotechnical resistance at ULS.

Table VII: Factored Geotechnical Resistance at Ultimate Limit State (ULS) and Estimated Negative Skin Friction of Steel Pipe and H-Piles				
Pile Section	Description	Factored Geotechnical Resistance at ULS (kN)	Estimated Negative Skin Friction (kN)	Estimated Load Carrying Capacity of Pile (kN)
Steel Pipe	245 mm O.D. by 10 mm wall thickness	1275	610	665
	245 mm O.D. by 12 mm wall thickness	1445	610	835
	324 mm O.D. by 12 mm wall thickness	2120	805	1315
Steel H	HP 310 x 79	1260	960	300
	HP 310 x 110	1775	980	795
	HP 310 x 125	2000	990	1010

Total and differential settlement of the piles are expected to be less than 10 mm.

To achieve the capacity given previously, the pile-driving hammer must seat the pile in the overburden without overstressing the pile material. For guidance purposes, it is estimated that a hammer with rated energy of 54 kJ to 70 kJ (40,000 to 52,000 ft. lbs.) per blow would be required to drive the piles to practical refusal. Practical refusal is considered to have been achieved at a set of 5 blows for 6 mm or less of pile penetration. However, the driving criteria for a particular hammer-pile system must be established at the beginning of the project using the Pile Driving Analyzer.

The site is underlain by glacial till with cobbles and boulders in the lower levels. It is therefore recommended that the piles should be equipped with driving shoes to protect them from damage during driving as per Ontario Provincial Standard Drawing (OPSD) 3001.100, Type II, Revision No. 2 dated November 2017 shown in Figure 13.

A number of test piles should be monitored with the Pile Driving Analyzer during the initial driving and re-striking at the beginning of the project. This monitoring will allow for the evaluation of transferred energy into the pile from the hammer, determination of driving criteria and an evaluation of the ultimate bearing capacity of the piles. Depending on the results of the pile driving analysis, the pile capacity may have to be proven by at least one pile load test for each pile type before production piling begins. If necessary, the pile load test should be performed in accordance with the American Society for Testing and Materials (ASTM) D 1143.

Closed end pipe piles tend to displace a relatively large volume of soil. When driven in a cluster or group, they may tend to jack up the adjacent piles in the group. Consequently, the elevation and the location of the top of each pile in a group should be monitored immediately after driving and after all the piles in the group have been driven. This is to ensure that the piles are not heaving or being displaced. Any piles found to heave more than 3 mm should be re-tapped.

Piles driven at the site may be subject to relaxation (loss of set with time). It is therefore recommended that all the piles should be re-tapped at least 24 hours after initially driving and at 24-hour intervals thereafter until it can be proven that relaxation is no longer a problem.

The installation of the piles at the site should be monitored on a full-time basis by a geotechnician working under the direction and supervision of a qualified geotechnical engineer to verify that the piles are driven in accordance with the project specifications.

The concrete grade beams and pile caps for heated structures should be protected from frost action by providing the beams and caps with 1.5 m of earth cover. For non-heated structures, the pile caps and beams should be provided with 2.4 m of earth cover in areas where the snow will be removed and 2.1 m of earth cover where the snow will not be removed. Alternatively, frost protection may be provided by rigid insulation or a combination of rigid insulation and earth cover.

It is recommended that a 50 mm thick concrete mud slab should be installed under the grade beams and pile caps immediately upon excavation and approval of the subgrade to protect the surface of the clay from disturbance from water, freeze and thaw effects, and foot traffic from construction workers.

Temporary granular roads and mats (at least 900 mm thick) will be required to provide access to the pile driving rig. The actual thickness required for the granular roads and mats will have to be established by the piling contractor, based on the type of piling rig that will be used on site and subsurface condition.

The recommended factored geotechnical resistances at ULS have been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes, when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field monitoring provided by an experienced geotechnical engineer to validate the information for use during the construction stage.

8.3 General Comments

A minimum of 1.5 m of earth cover should be provided to the footings to protect them from damage due to frost penetration. The frost cover should be increased to 2.1 m for unheated structures if snow will not be removed from their vicinity. If snow will be removed from the vicinity of the unheated structures, the frost cover should be increased to 2.4 m. Rigid insulation thermally equivalent to the required soil cover may be used instead of the soil cover. Alternatively, a combination of rigid insulation and soil cover may be used to achieve the required frost protection for the footings.

The recommended factored geotechnical resistance at ULS and bearing pressure at SLS have been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field monitoring provided by an experienced geotechnical engineer to validate the information for use during the construction stage.

9. Floor Slab and Drainage Requirements

The lowest level floor slab of the proposed school building will be the ground floor and may be constructed as slab-on-grade provided it is set on a bed of well compacted 19 mm clear stone of at least 200 mm thick placed on the engineered fill pad as described in Section 7. The clear stone would minimize the capillary rise of moisture from the sub-soil to the floor slab. Adequate saw cuts should be provided in the floor slab to control cracking. Alternatively, the floor slab may be cast on a 200 mm thick bed of OPSS 1010 Granular A overlain by a vapour barrier.

As indicated above, all fill must be removed from the envelope of the proposed school building and replaced with well compacted engineered fill as per Section 7 of the report.

It is recommended that perimeter drains should be provided for the proposed school building. Underfloor drains are not required.

The finished floor slab should be set at least 150 mm higher than the finished exterior grade.

The finished exterior grade should be sloped away from the building to prevent ponding of surface water close to the exterior walls of the proposed building.

Modulus of subgrade reaction of 16 kN/mm may be used for designing the floor slab.

10. Excavation and De-Watering Requirements

10.1 Excess Soil Management

Ontario Regulation 406/19 made under the Environmental Protection Act (November 28, 2019) is scheduled to be implemented on January 1, 2021. The new regulation will dictate the testing protocol that will be required for the management and disposal of excess soils. As set forth in the regulation, specific analytical testing protocols will need to be implemented and followed based on the volume of soil to be managed. The testing protocols are specific as to whether the soils are stockpiled or *in situ*. In either scenario, the testing protocols are far more onerous than have been historically carried out as part of standard industry practices. These decisions should be factored in and accounted for prior to the initiation of the project-defined scope of work. Disposal of any excess soils must be completed as per the recommendation stated in the Phase I/II Environmental site assessment reports completed by exp for this site.

10.2 Excavations

Excavations for the construction of the foundations and underground services of the proposed facility are expected to extend to a depth of 2.0 m to 3.0 m below the existing ground surface. These excavations will be undertaken through the topsoil and into the brown and grey clay and are expected to extend below the perched water table but will be above the groundwater table.

Excavations maybe undertaken by conventional heavy equipment. The native clay is susceptible to disturbance due to movement of construction equipment and personnel on its surface. It is therefore recommended that the excavation at the site should be undertaken by equipment that does not travel on the excavated surface, such as a Gradall or mechanical shovel. It is anticipated that temporary gravel roads may be required to gain access to the site by heavy construction equipment during construction.

The excavation within the subsurface soils should comply with the most recent Occupational Health and Safety Act (OHSA), Ontario Regulations 213/91 (August 1, 1991). Based on the definitions contained in OHSA, the subsurface soils at the site are classified as Type 3 soil and excavation sidewalls must be cut back at 1H:1V from the bottom of the excavation. Below the groundwater table, the excavation side slopes are expected to slough and will eventually stabilize at a slope of 2H:1V to 3H:1V. If space restrictions prevent open cut excavations, underground services may be installed within the confines of a prefabricated support system which is designed and installed in accordance with the above-noted regulations.

Base heave type failure is not anticipated in excavations that extend to a 3.0 m depth below existing grade. If excavations will extend below 3 m depth below existing grade, EXP should be contacted to determine if the deeper excavation will be susceptible to base heave type failure.

Many geologic materials deteriorate rapidly upon exposure to meteorological elements. Unless otherwise specifically indicated in this report, walls and floors of excavations must be protected from moisture, desiccation, and frost action throughout the course of construction.

10.3 De-Watering Requirements

Seepage of the surface and subsurface water into the excavations is anticipated. However, it should be possible to collect any water entering the excavations in perimeter ditches and to remove it by pumping from sumps. In areas of high infiltration or in areas where more permeable soil layers (such as sand seams and layers) may exist, a higher seepage rate should be anticipated. Therefore, the need of high-capacity pumps to keep the excavation dry should not be ignored.

The dewatering of excavations on site during short-term construction operations is not expected to adversely impact adjacent existing structures and infrastructure. Further, since the lowest slab and the footings for the proposed school building are anticipated to be at or above the groundwater level, the permanent perimeter drainage system recommended for the proposed building is also not expected to adversely impact adjacent existing structures and infrastructure.

It is anticipated that groundwater will need to be removed from the excavations. It is noteworthy to mention that new legislation came into force in Ontario on March 29, 2016, to regulate groundwater takings for construction dewatering purposes. Prior to

March 29, 2016, a Category 2 Permit to Take Water (PTTW) was required from the Ontario Ministry of the Environment, Conservation and Parks (MECP) for groundwater takings related to construction dewatering, where taking volumes in excess of 50 m^3/day, but less than 400 m^3/day, and the taking duration was no more than 30 consecutive days. The new legislation replaces the Category 2 PTTW for construction dewatering with a new process under the Environmental Activity and Sector Registry (EASR). The EASR is an on-line registry, which allows persons engaged in prescribed activities, such as water takings, to register with the MECP instead of applying for a PTTW.

To be eligible for the new EASR process, the construction dewatering taking must be less than 400 m^3/day under normal conditions. The water taking can be groundwater, storm water, or a combination of both. It should be noted that the 30-consecutive day limit on the water taking under the old Category 2 PTTW process has been removed in the new EASR process. Also, it should be noted that the EASR process requires two technical studies be prepared by a Qualified Person, prior to any water taking. These studies include a Water Taking Report, which provides assurance that the taking will not cause any unacceptable impacts, and a Discharge Plan, which provides assurance that the discharge will not result in any adverse impacts to the environment. EXP has qualified persons who can prepare these types of reports, if required. A significant advantage of the new EASR process over the former Category 2 PTTW process, is that the groundwater taking may begin immediately after completing the on-line registration of the taking and paying the applicable fee, assuming the accompanying technical studies have been completed. The former PTTW process typically took more than 90 days, which had the potential to impact construction schedules.

Although this investigation has estimated the groundwater levels at the time of the fieldwork, and commented on dewatering and general construction problems, conditions may be present which are difficult to establish from standard boring and excavating techniques and which may affect the type and nature of dewatering procedures used by the contractor in practice. These conditions include local and seasonal fluctuations in the groundwater table, erratic changes in the soil profile, thin layers of soil with large or small permeabilities compared with the soil mass, etc. Only carefully controlled tests using pumped wells and observation wells will yield the quantitative data on groundwater volumes and pressures that are necessary to adequately engineer construction dewatering systems.

11. Pipe Bedding Requirements

For site servicing, it is anticipated that the subgrade for the proposed underground services will consist of native clay set at a maximum depth of 4 m below the existing grade.

It is recommended that the bedding for the underground services including material specifications, thickness of cover material and compaction requirements conform to municipal requirements and/or Ontario Provincial Standard Specification and Drawings (OPSS and OPSD).

It is recommended that the pipe bedding be 300 mm thick and consist of OPSS Granular A. The bedding material should be placed along the sides and on top of the pipe to provide a minimum cover of 300 mm. The bedding should be compacted to at least 98 percent of the SPMDD. In areas of soft subgrade, a 300 mm thick sub-bedding of OPSS Granular B Type II material completely wrapped with non-woven geotextile should be placed beneath the Granular A bedding.

Since paved surfaces are anticipated to be located over service trenches, it is recommended that the trench backfill material within the frost zone (up to 1.8 m below finished grade), should match the existing material in the roadway to minimize differential frost heaving of the subgrade. The trench backfill should be placed in 300 mm thick lifts and each lift should be compacted to 95 percent SPMDD.

If the backfill for the service trenches will consist of granular fill, clay seals should be installed in the service trenches at select intervals as per City of Ottawa Drawing No. S8. The seals should be 1 m long, extend over the entire trench width and extend from the bottom of the trench to the underside of the pavement structure. The clay should be compacted to 95 percent SPMDD. The purpose of the clay seals is to prevent the permanent lowering of the groundwater level.

The underground services should be installed in short open trench sections that are excavated and backfilled the same day.

12. Backfilling Requirements and Suitability of On-Site Soils for Backfilling Purposes

The on-site soils to be excavated are fill, topsoil and clay. These soils are not considered suitable for re-use as material beneath structural elements, paved areas and portable or for backfilling purposes. However, these materials may be re-used for general grading purposes in landscaped areas.

It is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the building and for trench backfill would have to be imported and should preferably conform to the following specifications. The listed materials should be placed in 300 mm thick lifts and compacted to the specified degree of compaction indicated below.

- Engineered Fill under footings and floor slab - OPSS 1010 Granular B Type II – compacted to 100 and 98 percent of the SPMDD respectively;
- Backfill material for footing trenches and against foundation walls located inside and outside the building – OPSS 1010 Granular B Type II - compacted to 98 percent SPMDD inside the building and 95 percent of the SPMDD outside the building; and,
- Trench backfill and subgrade fill in outdoor sports field areas, parking areas and access roads – OPSS 1010 Select Subgrade Material (SSM) - compacted to 95 percent of the SPMDD.

It is noted that the on-site clay is wet of its optimum moisture content. Therefore, its use for construction of the clay dykes may necessitate either drying the clay (if construction is undertaken during dry summer months) or a suitable source of compactible clay may have to be procured from off-site.

13. Access Roads and Parking Lots

Pavement structures for the surface parking lot, access roads, playgrounds, walkways and pathways are given on Table VII below for the anticipated engineered fill and clay subgrades. The pavement structures are based upon the assumption that the subgrade will be properly prepared and assumes a functional design life of fifteen (15) to eighteen (18) years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table VIII: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Pathways and Walkways	Play Ground	Pavement Design to be used by Light Duty Vehicles (Cars)	Heavy Duty Vehicles (Cars and Trucks, Bus Drop off)
Asphaltic Concrete (PG 58-34)	92 to 97 percent MRD*	50 mm HL3F	50 mm HL3	40 mm HL3/SP12.5 Category B 40 mm HL8/SP19.0 Cat B	50 mm HL3/SP12.5 Caty B 60 mm HL8/SP19.0 Cat B
OPSS 1010 Granular A Base	100 percent SPMDD**	150	150	150 mm	150 mm
OPSS 1010 Granular B Sub-Base, Type II	100 percent SPMDD**	300	300	450 mm	600 mm

**Denotes maximum relative density.*

*** Denotes standard Proctor maximum dry density, ASTM-D698-12e2.*

Additional comments on the construction of the access roads and parking lots are as follows:

1. As part of the subgrade preparation, the proposed parking areas and access roads should be stripped of topsoil, fill, buried original topsoil and other obviously unsuitable material. The subgrade should be properly shaped, crowned, then proofrolled with a heavy vibratory roller in the full-time presence of a representative of this office. Any soft or spongy subgrade areas detected should be sub excavated and properly replaced with suitable approved backfill compacted to 95 percent SPMDD (ASTM D698-12e2).
2. The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved. The need for adequate drainage cannot be over-emphasized. Subdrains should be installed on both sides of the access road(s). Subdrains must be installed in the proposed parking area at low points and should be continuous between catchbasins to intercept excess surface and subsurface moisture and to prevent subgrade softening. This will ensure no water collects in the granular course, which could result in pavement failure during the spring thaw. The location and extent of subdrains required within the paved areas should be reviewed by this office in conjunction with the proposed site grading.
3. To minimize the problems of differential movement between the pavement and catchbasins/manhole due to frost action, the backfill around the structures should consist of free-draining granular material preferably conforming to OPSS Granular B Type II material. Weep holes should be provided in the catchbasins/manholes to facilitate drainage of any water that may accumulate in the granular fill.
4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving and/or temporary construction roadways may be required, especially if construction is carried out during unfavorable weather.

5. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum cross fall of two (2) percent) to provide effective surface drainage towards catch basins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.
6. Relatively weaker subgrade may develop over service trenches at subgrade level. These areas may require the use of thicker/coarser sub-base material and the use of a geotextile at the subgrade level. If this is the case, it is recommended that additional 150 mm thick granular sub-base, OPSS Granular B Type II, should be provided in these areas, in addition to the use of a geotextile at the subgrade level.
7. The granular materials used for pavement construction should conform to Ontario Provincial Standard Specifications (OPSS 1010) for Granular A and Granular B Type II and should be compacted to 100 percent of the SPMDD.

The asphaltic concrete used, and its placement should meet OPSS 1150 or 1151 requirements. It should be compacted from 92 percent to 97 percent of the MRD (ASTM D2041). Asphalt placement should be in accordance with OPSS 310 and OPSS 313.

It is recommended that EXP be retained to review the final pavement structure design and drainage plans prior to construction to ensure they are consistent with the recommendations of this report.

14. Chemical Test Results and Corrosion Potential of Subsurface Soils

Chemical tests limited to pH, sulphate, chloride and resistivity were undertaken on three (3) soil samples. A summary of the results is shown in Table VIII. The laboratory certificate of analysis is shown in Appendix A

Table IX: Chemical Analyses Test Results and Corrosion Potential of Soil						
Borehole – Sample No.	**Depth (m)**	**Soil Type**	**pH**	**Sulphate (%)**	**Chloride (%)**	**Resistivity (ohm-cm)**
BH1 - SS5	3.0 - 3.6	Grey Clay	9.24	0.0108	0.0456	1040
BH6 - SS3	1.5-2.1	Brown Clay Crust	8.19	0.0089	0.0022	5050
BH7 – SS8	7.6 - 7.9	Grey Clay	9.43	0.0084	0.15	256

The results indicate the soils have a negligible potential of sulphate attack on subsurface concrete. The concrete should be designed in accordance with CSA A.23.1-14.

The results of the resistivity tests indicate that the brown clay crust is mildly corrosive and the grey clay samples are corrosive to very corrosive to bare steel as per the National Association of Corrosion Engineers (NACE). Appropriate measures should be taken to protect any buried bare steel from corrosion.

15. Tree Planting Restrictions

The modified plasticity index of the upper brown desiccated clay crust is estimated at 36 percent and for the grey clay the modified plasticity index is estimated to range from 13 percent to 21 percent.

The City of Ottawa document titled, “Tree Planting in Sensitive Marine Clay Soils – 2017 Guidelines” indicates that for a modified plasticity index of less than 40 percent, the soil has a low/medium potential for soil volume change and the tree planting restrictions and setbacks from structures should follow the 2017 guidelines.

A landscape architect should be consulted to ensure the applicable tree planting restrictions and setbacks for the proposed school development are in accordance with the 2017 guidelines.

16. Additional Comments

All earthwork activities from placement and compaction of fill in the service trenches to subgrade preparation, engineered fill pad construction, placement and compaction of granular materials and asphaltic concrete should be inspected by qualified geotechnicians to ensure that construction of the sewers and pavement proceeds according to the specifications. All the footing beds should also be examined by a geotechnical engineer to ensure that the design bearing pressure is available at the founding level and that the footing beds have been properly cleaned.

If piles are considered, it is recommended to drill additional holes to confirm the depth/elevation of bedrock throughout the site in order to reduce potential claims by the piling contractors.

17. General Comments

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for the design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

The information contained in this report is not intended to reflect on environmental aspects of the soils. Should specific information be required, including for example, the presence of pollutants, contaminants or other hazards in the soil, additional testing may be required.

We trust that the information contained in this report will be satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

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Earth & Environment

Ismail M. Taki, M. Eng., P.Eng.
Senior Manager
Earth & Environment
Eastern Region

Figures

0 100m 200m 400m

HORIZONTAL 1:10,000

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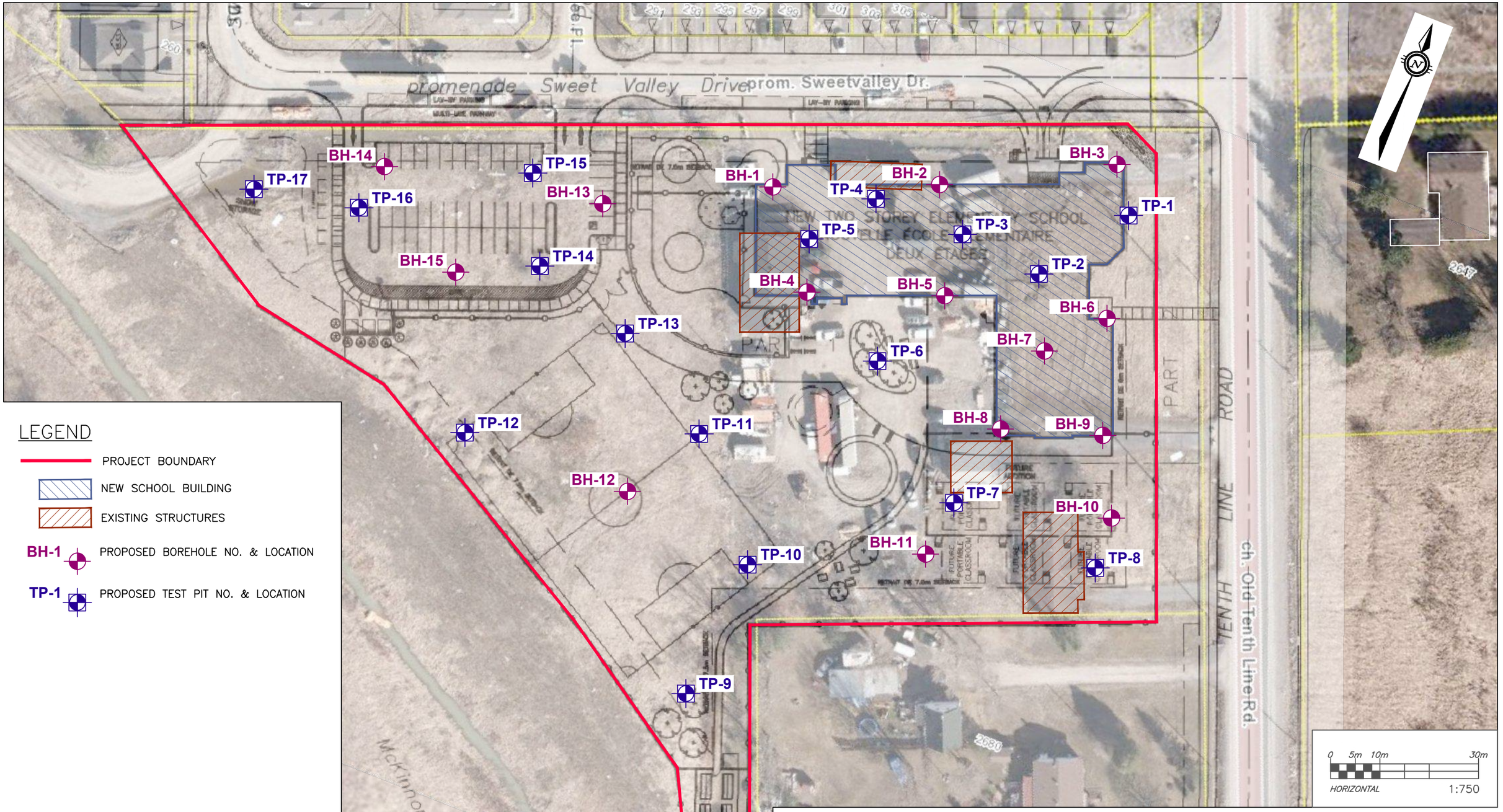
DESIGN	IT
DRAWN	AS
DATE	NOVEMBER 2022
FILE NO	OTT-22017859-A0

GEOTECHNICAL INVESTIGATION
NOUVELLE ÉCOLE ÉLÉMENTAIRE CATHOLIQUE AVALON III
SWEETVALLEY DR. AT OLD TENTH LINE RD., OTTAWA, ON

SITE LOCATION PLAN

SCALE 1:10,000

SKETCH NO FIG 1



LEGEND

- PROJECT BOUNDARY
- NEW SCHOOL BUILDING
- EXISTING STRUCTURES
- BH-1 — PROPOSED BOREHOLE NO. & LOCATION
- TP-1 — PROPOSED TEST PIT NO. & LOCATION

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GEOTECHNICAL INVESTIGATION
NOUVELLE ÉCOLE ÉLÉMENTAIRE CATHOLIQUE AVALON III
SWEETVALLEY DR. AT OLD TENTH LINE RD., OTTAWA, ON

BOREHOLE/TEST PIT LOCATION PLAN

SCALE 1:750
SKETCH NO FIG 2

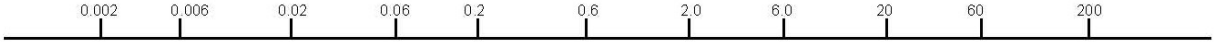
Filename: C:\Users\SeverA\OneDrive - EXP\Desktop\AntonSever\Work\TEMP\OTT-22017859-A0_Nouvelle école élémentaire catholique Avalon III\22017859-A0_Geo.dwg
Last Saved: Nov 29, 2022 10:02 AM Last Plotted: Nov 29, 2022 10:14 AM Plotted by: SeverA

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Societv for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

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

Log of Borehole BH-01

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 3

Page. 1 of 3

Date Drilled: 'Dec. 19, 2022

Drill Type: CME-45 Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test — | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits |—○—| | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth
		FILL Sand and gravel, with topsoil inclusions, some clay, moist,	87.14	0
			85.7	
		TOPSOIL Brown, wet (soft)	85.3	
		CLAY Brown, moist, high plasticity (very stiff to hard)		2
			84.3	
		CLAY Grey, wet (soft to firm)		3
				4
				5
				6
				7
				8
				9
				10
				11
				12

Standard Penetration Test N Value: 20 40 60 80

Shear Strength kPa: 50 100 150 200

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

Depth	Standard Penetration Test N Value	Shear Strength kPa	Combustible Vapour Reading (ppm)	Natural Moisture Content % Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
0					AS1	
1	10				SS2	
2	8	215 kPa			SS3	19.8
2	6	161 kPa			SS4	18.2
3		29 kPa				
3	4 s = 4				SS5	
4		29 kPa				
4		s = 3				
5	Hammer Weight				SS6	
5		19 kPa				
6		s = 4				
6	Hammer Weight				SS7	
7		24 kPa				
7		s - 5				

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	3.7	no cave

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	33 - 33.8	0	0
2	33.8 - 34.5	88	0
3	34.5 - 36.2	97	78
4	36.2 - 37.7	98	86

Log of Borehole BH-01

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Figure No. 3

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		CLAY Grey, wet (soft to firm) *(continued)*	75.14	12	20 40 60 80 Shear Strength 50 100 150 200 kPa	250 500 750 Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60		
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				
				23				
				24				
				25				
				26				

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	3.7	no cave

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	33 - 33.8	0	0
2	33.8 - 34.5	88	0
3	34.5 - 36.2	97	78
4	36.2 - 37.7	98	86

Log of Borehole BH-01

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Figure No. 3

Page. 3 of 3

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa (20 40 60 80 / 50 100 150 200)	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60	SAMPLES	Natural Unit Wt. kN/m³
		CLAY Grey, wet (soft to firm) *(continued)*	60.74	27 28 29 30 31 32				
		GLACIAL TILL Clayey, silty sand with gravel, cobbles and boulders	54.1	33			Run 1	
		LIMESTONE BEDROCK Grey (very poor to good quality)	53.3	34 35 36			Run 2 Run 3	
		Borehole Terminated at 37.7 m Depth	49.4	37			Run 4	

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	3.7	no cave

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	33 - 33.8	0	0
2	33.8 - 34.5	88	0
3	34.5 - 36.2	97	81
4	36.2 - 37.7	98	87

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/23/23

Log of Borehole BH-02

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 4

Page. 1 of 1

Date Drilled: 'Dec. 14, 2022

Drill Type: CME-45 Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test —
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○—|
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL Sand and gravel, brown, moist	86.89 / 86.6	0			AS1	
		FILL Sand and gravel, with topsoil inclusions, some clay, moist,	85.9	1	10		SS2	19.6
		TOPSOIL Brown, wet (soft)	85.5					
		CLAY Brown, moist (very stiff to hard)	84.8	2	10 / 161 kPa		SS3	19.1
		CLAY Grey, wet, high plasticity (soft to firm)			27 kPa / 24 kPa		SS4	
				3	Hammer Vs - 5		SS5	
					19 kPa; s = 2.7			
				4				
				5	14 kPa		ST6	
				6	Hammer Weight	90	SS7	
					26 kPa; s = 3.7			
				7				
					Hammer Weight		SS8	
				8	19 kPa; s = 2			
		Borehole Terminated at 8.5 m Depth	78.4					

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	4.6	no cave

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-03

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 5

Page. 1 of 3

Date Drilled: 'Dec. 16, 2022

Drill Type: CME-45 Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test — | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits |—○—| | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth
		GRANULAR FILL Sand and gravel, with topsoil inclusions, brown, moist	86.81	0
			86.0	
		TOPSOIL Brown, wet (soft)	85.6	1
		CLAY Brown, moist (stiff to hard)		2
			84.2	3
		CLAY Grey, wet (soft to firm)		4
				5
				6
				7
				8
			78.3	9
		Dynamic Cone Penetration Test (DCPT) Conducted from 9 m depth to cone refusal at 36.1 m depth		10
				11
				12

Standard Penetration Test N Value: 20 40 60 80

Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

9 | 215 kPa

8 | 215 kPa

2 | 80 kPa

24 kPa | s = 3.3

19 kPa | s = 4

Hammer Weight | 85

14 kPa | s = 3

34 kPa | s = 3.5

Hammer Weight

29 kPa | s = 4

SAMPLES	Natural Unit Wt. kN/m³
AS1	
SS2	
SS3	17.8
SS4	
SS5	
SS6	
ST7	
SS8	

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	3.0	no cave

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Borehole BH-03

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Figure No. 5

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		Dynamic Cone Penetration Test (DCPT) Conducted from 9 m depth to cone refusal at 36.1 m depth *(continued)*	74.81	12–26	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Upon Completion	3.0	no cave

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-03

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Figure No. 5

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth
		Dynamic Cone Penetration Test (DCPT) Conducted from 9 m depth to cone refusal at 36.1 m depth *(continued)*	60.41	27 28 29 30 31 32 33 34 35 36
		Cone Refusal at 36.3 m Depth	50.5	

Standard Penetration Test N Value: 20 40 60 80

Shear Strength kPa: 50 100 150 200

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m^3

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	3.0	no cave

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-04

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 5A

Page. 1 of 2

Date Drilled: 'Dec. 15, 2022

Drill Type: CME-45 Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth
		FILL Auger through fill to start Nilcon vane at 2.1 m depth	87.24	0
				1
				2
				3
		CLAY Nilcon vane completed from 2.1 m 18.7 m depth	84.0	4
				5
				6
				7
				8
				9
				10
				11
				12

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

28 kPa
8 kPa
21 kPa
S = 12
28 kPa
25 kPa
S = 14
28 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-04

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Figure No. 5A

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		CLAY Nilcon vane completed from 2.1 m 18.7 m depth *(continued)*	75.24	12	36 kPa S = 13.6			
				13				
				14				
				15	> 46 kPa			
				16				
				17				
				18	> 47 kPa			
		Borehole Terminated at 18.7 m Depth	68.5					

Standard Penetration Test N Value: 20 40 60 80
Shear Strength kPa: 50 100 150 200
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Borehole BH-05

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 6

Page. 1 of 1

Date Drilled: 'Dec. 15, 2022

Drill Type: CME-45 Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)
Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Sand and gravel, with topsoil inclusions, some clay, moist,	86.96	0			AS1	
			86.36					
		TOPSOIL Brown, wet (soft)	85.8	1	6		SS2	
			85.5					
		CLAY Brown, moist (very stiff to hard)		2	9; 215 kPa		SS3	19.2
			84.4		6; 80 kPa; 24 kPa; s = 5		SS4	17.3
		CLAY Grey, wet, high plasticity (soft to firm)		3			ST5	
				4	14 kPa; s = 3			
				5	Hammer Weight; 14 kPa; s = 3		SS6	
				6	Hammer Weight		SS7	
				7	19 kPa; s = 2.7			
				8	Hammer Weight; 24 kPa; s = 3.3		SS8	
			78.5					
		Borehole Terminated at 8.5 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	4.6	no cave
Jan 6, 2023	0.7	
Jan 10, 2023	0.6	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Borehole BH-06

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 7

Page. 1 of 1

Date Drilled: 'Dec. 14, 2022

Drill Type: CME-45 Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)
Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Sand and gravel, with topsoil inclusions, some clay, moist,	86.94	0			AS1	
		CLAY Brown, moist (very stiff to hard)	85.7	1	9		SS2	19.8
				2	7; 188 kPa		SS3	19.0
		CLAY Grey, wet (very soft to firm)	84.5	3	27 kPa; 29 kPa; 2; s = 4		SS4	
				4	19 kPa; s = 4		SS5	
				5	Hammer Weight; 14 kPa; s = 6	83	SS6	
				6	Hammer Weight	86	SS7	
				7	14 kPa; s = 3			
				8	Hammer Weight; 10 kPa; s = 2		SS8	
		Borehole Terminated at 8.5 m Depth	78.4					

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	3.0	no cave

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Borehole BH-07

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 8

Page. 1 of 1

Date Drilled: 'Dec. 14, 2022

Drill Type: CME-45 Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test — | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits ⊢○ | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Sand and gravel, with topsoil inclusions, some clay, moist,	86.94	0			AS1	
				1	11		SS2	
				2	9		SS3	
			84.8					
		CLAY Brown, moist (firm to stiff)	84.3	2	4		SS4	
		CLAY Grey, wet (soft to firm)		3	29 kPa; 2 s = 4		SS5	
				4	24 kPa; s = 3.3			
				5	1; 19 kPa; s = 4		SS6	
				6	Hammer Weight	86	SS7	
				7	19 kPa; s = 4			
				8	Hammer Weight; 29 kPa; s = 1.5		SS8	
			78.4					
		Borehole Terminated at 8.5 m Depth						

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Upon Completion	3.0	no cave

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-08

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 9

Page. 1 of 1

Date Drilled: 'Dec. 22, 2022

Drill Type: CME-75 Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL Sand and gravel, brown, moist	87.39	0			AS1	
		FILL Sand and gravel, with topsoil inclusions, some clay, moist,	87.1					
			86.79	1	48		SS1	
				2	8		SS2	
		CLAY Brown, moist, high plasticity (stiff to very stiff)	85.3		9 114 kPa		SS3	18.6
		CLAY Grey, wet, high plasticity (soft to firm)	84.5	3	50 kPa s = 5			
					Hammer Weight		SS4	
				5	34 kPa s = 7			
					Hammer Weight		SS5	
				6	24 kPa			
		Borehole Terminated at 6.4 m Depth	81.0					

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50 mm diameter monitoring well was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon Completion	no water	no cave
Jan 6, 2023	0.6	
Jan 10, 2023	0.8	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-10

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 10

Page. 1 of 1

Date Drilled: 'Dec. 22, 2022

Drill Type: CME-75 Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)
Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~150 mm thick	87.69	0				
		FILL Sand, trace gravel, brown, damp to wet (loose)	87.5				AS1	
				1	11		SS1	
			86.19					
				2	6		SS2	
			85.6					
		CLAY Brown, moist (stiff)			8 94 kPa		SS3	21.2
				3	100 kPa s = 6.7			
			84.3					
		CLAY Grey, wet (soft to firm)			Hammer Weight		SS4	
					24 kPa			
				5				
					Hammer Weight		95 SS5	
				6	29 kPa			
			81.3					
		Borehole Terminated at 6.4 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50 mm diameter monitoring well was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Jan 6, 2023	1.5	
Jan 10, 2023	1.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Borehole BH-11

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 11

Page. 1 of 1

Date Drilled: 'Dec. 22, 2022

Drill Type: CME-75 Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		RECYCLED ASPHALT PAVEMENT ~150 mm thick	86.95 86.8	0			AS1	
		FILL Silty clay with gravel and topsoil inclusions, dark brown, moist, no odours or stains	86.15	1	11		SS1	
		TOPSOIL Brown, wet (soft)	85.6 85.2	2	7		SS2	19.9
		CLAY Black to brown, moist (stiff to very stiff)			5 94 kPa		SS3	18.4
		CLAY Grey, wet (soft to firm)	84.0	3	60 kPa s = 12			
					Hammer Weight		SS4	
				5	24 kPa			
					Hammer Weight		SS5	
				6			ST1	
			80.3					
		Borehole Terminated at 6.7 m Depth						

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50 mm diameter monitoring well was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Jan 6, 2023	0.8	
Jan 10, 2023	0.9	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-12

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 12

Page. 1 of 1

Date Drilled: 'Dec. 21, 2022

Drill Type: CME-55LC Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~300 mm thick With plastic and asphalt pieces	87.22 86.9	0	3		SS1	
		FILL Silty clay with topsoil inclusions, brown and grey, moist,	86.62	1	11		SS2	18.5
			85.4	2	8	161 kPa	SS3	
		TOPSOIL Dark brown, wet (soft)	85.2					
		CLAY Brown, moist (very stiff to hard)			7	94 kPa	SS4	18.3
			83.8	3		>120 kPa		
		CLAY Grey, wet (soft to firm)			Hammer Weight		SS5	
			82.3		24 kPa s = 10			
		Borehole Terminated at 4.9 m Depth						

Standard Penetration Test N Value: 20 40 60 80
Shear Strength kPa: 50 100 150 200
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Jan 6, 2023	0.6	
Jan 10, 2023	0.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Borehole BH-13

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 13

Page. 1 of 1

Date Drilled: 'Dec. 21, 2022

Drill Type: CME-55LC Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand with gravel, some clay, topsoil inclusions, brown and grey, moist,	86.97	0	13		SS1	
				1	15		SS2	
			85.5					
		TOPSOIL Dark brown, wet (soft)	85.2	2	9, 107 kPa		SS3	19.7
		CLAY Brown, moist (very stiff)			6, 107 kPa		SS4	18.2
				3	72 kPa, s = 7.5			
			83.6					
		CLAY Grey, wet (soft to firm)			Hammer Weight		SS5	
					24 kPa, s = 20			
			82.1					
		Borehole Terminated at 4.9 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Borehole BH-14

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 14

Page. 1 of 1

Date Drilled: 'Dec. 21, 2022

Drill Type: CME-55LC Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty clay with topsoil inclusions, asphalt pieces, brown, moist,	86.67	0	19		SS1	
			86.27	1	8		SS2	
		CLAY Brown, moist, high plasticity (very stiff)	85.2	2	9 80 kPa		SS3	19.3
					4 54 kPa		SS4	19.1
				3	53 kPa s = 8.8			
		CLAY Grey, wet (soft)	83.3		Hammer Weight		SS5	
					24 kPa			
		Borehole Terminated at 4.9 m Depth	81.8					

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Jan 6, 2023	0.4	
Jan 10, 2023	0.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Borehole BH-15

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Orleans, ON

Figure No. 15

Page. 1 of 1

Date Drilled: 'Dec. 21, 2022

Drill Type: CME-55LC Track Mounted Drill Rig

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~300 mm thick Clayey, with wood pieces	86.92	0	21	×	SS1	
		FILL Silty clay with topsoil inclusions, brown and grey, moist,	86.6	1				
				2	7		SS2	
		CLAY Brown, moist (stiff)	84.6	3	5 54 kPa 56 kPa s = 7.8	×	SS3	18.4
		CLAY Grey, wet (soft to firm)	83.5		Hammer Weight	×	SS4	
					26 kPa			
		Borehole Terminated at 4.9 m Depth	82.0					

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-22017859-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE OTT-22017859 - AVALON III - BH LOGS FEB 22, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-01

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 16

Page. 1 of 1

Date Drilled: 'Dec 9, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~200 mm thick	86.84	0				
		FILL Clayey, silty sand with gravel, cobbles, boulders (measured up to 1 m diameter), topsoil inclusions, brown, moist	86.6			10 ppm	GS1	
		TOPSOIL	86.0					
		CLAY Red and brown, moist to wet	85.7	1		0 ppm	GS2	
		Test Pit Terminated at 2.0 m Depth	84.8	2				

Note:

1) Water seeping in from base of test pit at 2.0 m depth.

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-02

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 17

Page. 1 of 1

Date Drilled: 'Dec 9, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~100 mm thick	87.03	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		TOPSOIL ~100 mm thick	86.9					
		FILL Silty sand with gravel, clay clumps, cobbles and boulders, asphalt pieces, brown, moist				10 ppm	GS1	
			86.0	1				
		CLAY Brown, moist				0 ppm	GS2	
			84.8	2				
		Test Pit Terminated at 2.2 m Depth						

Note:

1) Water seeping into test pit at 1.0 m depth.
2) cave-in of fill material above 1m depth

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-03

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 18

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Silty sand with gravel, cobbles, red brick fragments, brown, moist	86.68	0
		CLAY Brown and red to grey, moist	85.9	1
		Test Pit Terminated at 2.3 m Depth	84.4	2

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

20 ppm
0 ppm

SAMPLES: GS1, GS2

Natural Unit Wt. kN/m³

Note:

1) No water seepage or cave-in

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-04

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 19

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL 50 mm Crushed Limestone, sand and gravel, grey, moist over geotextile at 0.2 m depth	86.98 86.8	0				
		FILL Silty clay with gravel, red brick fragments, moist				0 ppm	GS1	
		TOPSOIL	85.9 85.7	1				
		CLAY Reddish brown, moist				0 ppm	GS2	
		Test Pit Terminated at 2.0 m Depth	85.0	2				

Note:

1) No water seepage or cave-in

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-05

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 20

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—⊖
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		GRANULAR FILL 50 mm Crushed Limestone, sand and gravel, grey, moist	87.11	0
		FILL Silty clay with gravel and sand, concrete boulders, moist	86.8	
			85.7	1
		TOPSOIL	85.5	
		CLAY Brown and red to grey, moist		
			84.9	2
		Test Pit Terminated at 2.2 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

5 ppm
0 ppm
0 ppm

SAMPLES: GS1, GS2, GS3

Natural Unit Wt. kN/m³

Note:

1) No water seepage or cave-in

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-06

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 21

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits —⊖—
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL 50 mm Crushed Limestone, sand and gravel, grey, moist	87.04	0				
		FILL Sand and gravel, with boulders, shale fragments, steel reinforcing bar, wood, and brick fragments, moist	86.8			0 ppm	GS1	
		FILL Silty clay with gravel, moist	86.2	1		0 ppm	GS2	
		TOPSOIL	85.8			0 ppm	GS3	
		CLAY Grey, moist	85.5			0 ppm	GS4	
		Test Pit Terminated at 2.0 m Depth	85.0	2				

Note:

1) Test pit is wet at base
2) No cave-in

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-07

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 22

Page. 1 of 1

Date Drilled: 'Dec 9, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		RECYCLED ASPHALT PAVEMENT ~ 130 mm thick	86.89	0				
		FILL Silty sand with gravel, moist very thin organic layer less than 5 cm thick at 0.3 m depth	86.8			10 ppm	GS1	
		FILL Silty clay, with gravel, cobbles, asphalt pieces, moist	86.6			0 ppm	GS2	
		TOPSOIL	85.8	1				
		CLAY Brown, moist	85.5			0 ppm	GS3	19.8
		Test Pit Terminated at 2.3 m Depth	84.6	2				

Note:

1) Water seeping into test pit at 1.4 m depth.
2) No cave-in

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-08

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 23

Page. 1 of 1

Date Drilled: 'Dec 9, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~ 130 mm thick	87.71	0				
		FILL Clean sand, brown, damp	87.6			0 ppm	GS1	
			87.3					
		GEOTEXTILE	87.3					
		CLEAR STONE 19 mm size limestone	87.1					
		FILL Clean sand, brown, damp		1				
			86.0					
		FILL Silty clay, with cobbles, moist	85.7	2		0 ppm	GS2	
		TOPSOIL	85.4					
		CLAY Brown, moist				0 ppm	GS3	
			85.1					
		Test Pit Terminated at 2.6 m Depth						

Note:

1) No water seepage
2) Fighting cave-in of sand for entire excavation

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-09

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 24

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—⊖
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~200 mm thick	86.35	0
		FILL Silty clay with topsoil inclusions, brown, moist	86.2	
			85.4	1
		TOPSOIL		
			85.1	
		CLAY Brown, moist		
			84.3	2
		Test Pit Terminated at 2.1 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

0 ppm □ ×

0 ppm □ ×

SAMPLES	Natural Unit Wt. kN/m³
GS1	
GS2	

Note:

1) No water seepage or cave-in.

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-10

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 25

Page. 1 of 1

Date Drilled: 'Dec 9, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL 50 mm Crushed Limestone, sand and gravel, grey, moist	86.62	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
			86.4					
		FILL Silty clay with topsoil inclusions, cobbles, garden hose, moist				10 ppm	GS1	
			85.5	1				
		TOPSOIL						
			85.2					
		CLAY Brown, moist				10 ppm	GS2	19.9
			84.6	2				
		Test Pit Terminated at 2.0 m Depth						

Note:

1) No water seepage or cave-in

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-11

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 26

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~200 mm thick	87.27	0				
		FILL Silty sand with asphalt, concrete and red brick fragments, hub cap, topsoil inclusions, brown, moist	87.1			10 ppm	GS1	
		CLAY Grey, moist	86.5	1		5 ppm	GS2	
		Test Pit Terminated at 2.0 m Depth	85.3	2				

Note:

1) Water seepage from 0.4 m depth
2) Slight cave-in of fill layer

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-12

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 27

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Pile of silty sand with gravel and topsoil inclusions, dark brown	87.74	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
						0 ppm	GS1	
			86.4	1				
		FILL Silty clay with gravel, bricks, and vinyl siding				5 ppm	GS2	
			85.6	2				
		CLAY grey, moist				20 ppm	GS3	
			85.3					
		Test Pit Terminated at 2.4 m Depth						

Note:

1) No water seepage in test pit

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-13

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 28

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits —⊖—
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~ 100mm thick	87.26	0				
		FILL Silty sand with topsoil inclusions, asphalt pieces and brick fragments	87.2			5 ppm	GS1	
			86.6					
		GRANULAR FILL 50 mm Crushed Limestone, sand and gravel, grey, wet	86.3			0 ppm	GS2	
		FILL Silty clay, grey, moist		1		0 ppm	GS3	
			85.5					
		TOPSOIL dark brown, wet, soft	85.3			0 ppm	GS4	
		CLAY Grey, wet	85.1	2				
		Test Pit Terminated at 2.2 m Depth						

Note:

1) No water seepage or cave-in

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-14

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 29

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~ 100 mm thick	87.01	0				
		FILL Silty sand, brown, moist	86.9			5 ppm	GS1	
		FILL Silty clay with cobbles, moist	86.3	1		0 ppm	GS2	19.8
		TOPSOIL	85.3			0 ppm	GS3	
		CLAY Grey, moist	85.1	2				
		Test Pit Terminated at 2.2 m Depth	84.8					

Note:

1) Water seeping in from 0.7 m depth
2) No cave-in

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-15

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 30

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand with boulder size asphalt and concrete pieces, wood and brick fragments, brown, wet	86.61	0	Shear Strength: 20 40 60 80 kPa; 50 100 150 200	Combustible Vapour Reading (ppm): 250 500 750; Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60		
				1		5 ppm	GS1	
		TOPSOIL	85.4					
			85.2					
		CLAY Brown, moist		2		5 ppm	GS2	
			84.3					
		Test Pit Terminated at 2.3 m Depth						

Note:

1) Water seeping in from 1.2 m depth
2) Slight cave-in from fill layer

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-16

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 31

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty clay with topsoil inclusions, cobbles and boulders measured up to 1 m diameter, brown, moist	86.73	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
						0 ppm	GS1	
		TOPSOIL Wet	85.7	1		15 ppm	GS2	
			85.4					
		CLAY Brown, wet	85.2			10 ppm	GS3	19.5
		Test Pit Terminated at 1.5 m Depth						

Note:

1) Water gushing in from 1.0 m depth filling test pit to 1 m depth

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

Log of Test Pit TP-17

Project No: OTT-22017859-A0

Project: Proposed Avalon III School

Location: 2666 Tenth Line Road, Ottawa, ON

Figure No. 32

Page. 1 of 1

Date Drilled: 'Dec 8, 2022

Drill Type: Case 580 Rubber Tire Backhoe

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Clayey silt sand with gravel, topsoil inclusions, household waste, brown, saturated	86.28	0	Shear Strength: 20 40 60 80 / 50 100 150 200 kPa	Combustible Vapour Reading (ppm): 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60		
						5 ppm	GS1	
			85.4					
		CLAY Brown, wet	85.3	1		0 ppm	GS2	19.9
		Test Pit Terminated at 1.0 m Depth						

Note:

1) Water level above ground surface. Samples observed from excavator bucket

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-22017859-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT TP LOGS - 22017859 - FEB 21, 2023.GPJ TROW OTTAWA.GDT 2/22/23

DRY BEDROCK CORES

WET BEDROCK CORES

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2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

borehole no.		project	project no.
BH-1	Run 1: 33.0m - 33.8m Run 2: 33.8m - 34.5m Run 3: 34.5m - 36.2m Run 4: 36.2m - 37.7m end of borehole	New Avalon III School - 2666 Tenth Line Road, Ottawa	OTT-22017859-A0
date cored Jan 12, 2023		Borehole 1 Rock Core Photographs	FIG 33

EXP Services Inc.
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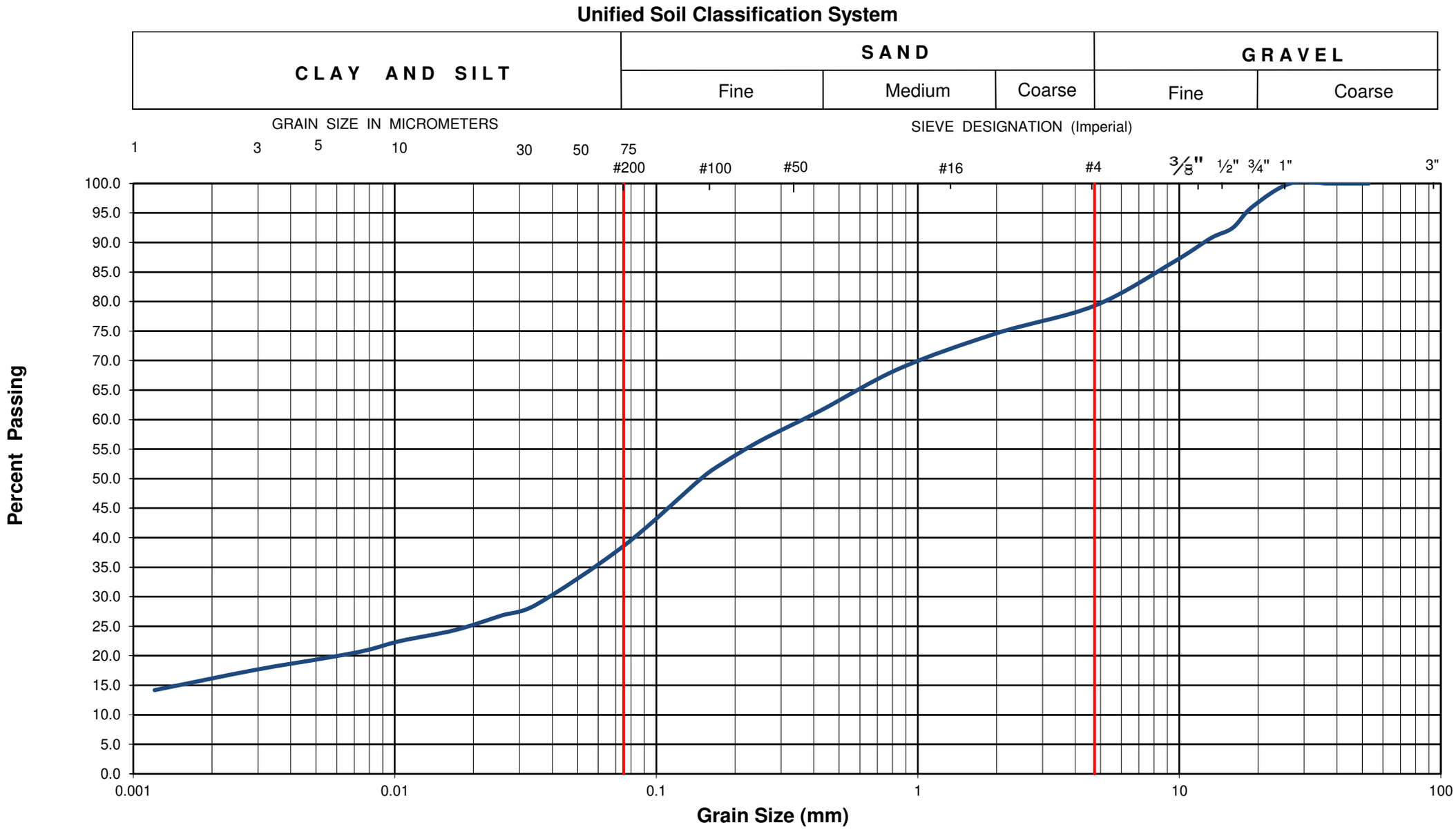
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22017859-A0**	**Project Name :**	**Proposed New Avalon III Elementary School**						
Client :	**CECCE**	**Project Location :**	**Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa**						
Date Sampled :	**December 21, 2023**	**Borehole No:**	**BH13**		**Sample No.:**	**SS2**		**Depth (m) :**	**0.8-1.4**
Sample Description :		**% Silt and Clay**	**39**	**% Sand**	**40**	**% Gravel**	**21**	**Figure :**	**34**
Sample Description :	**FILL: Silty Sand with Gravel (SM), Some Clay**								

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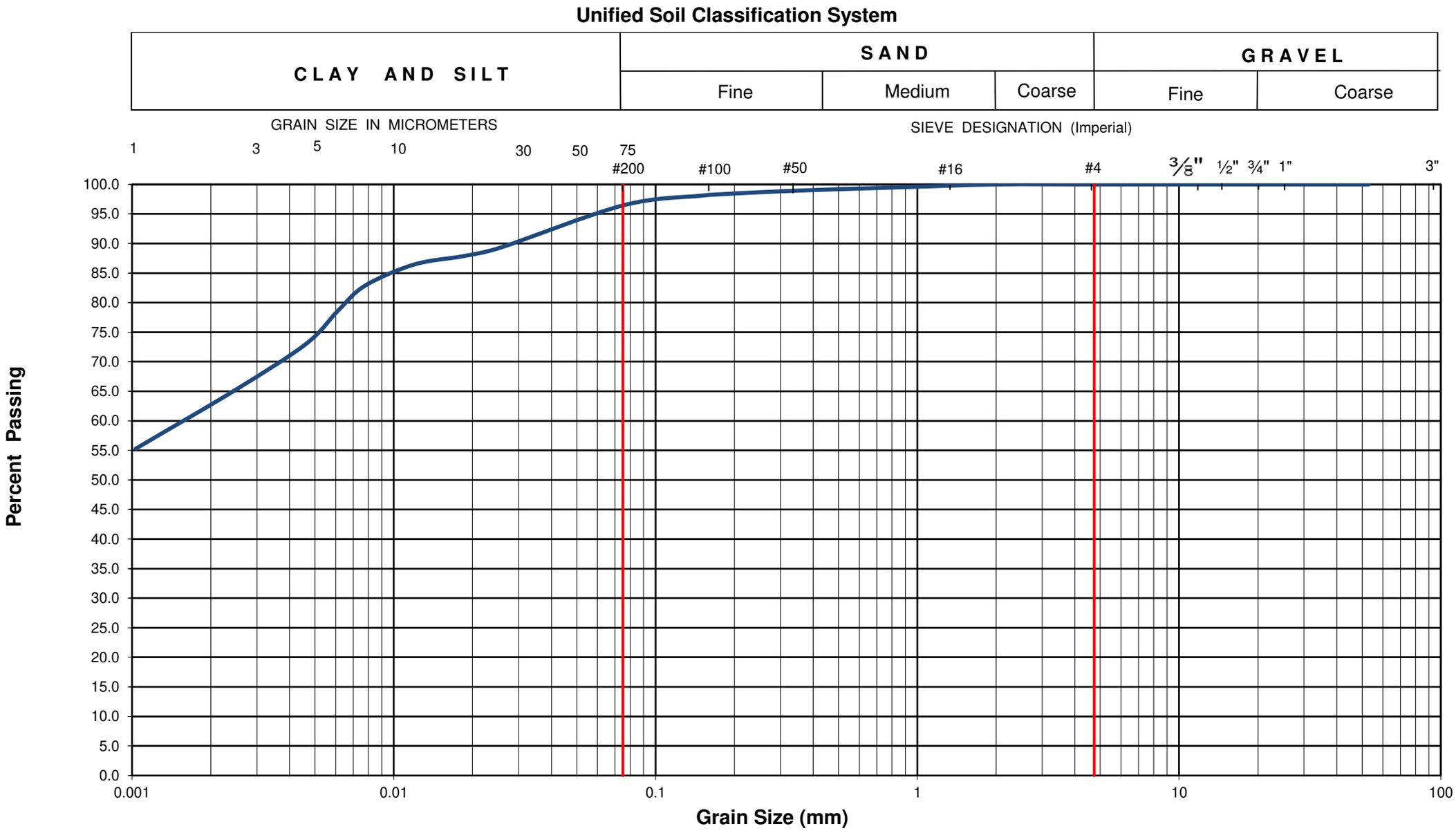
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22017859-A0**	**Project Name :**	**Proposed New Avalon III Elementary School**						
Client :	**CECCE**	**Project Location :**	**Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa**						
Date Sampled :	**December 19, 2023**	**Borehole No:**	**BH1**		**Sample No.:**	**SS4**		**Depth (m) :**	**2.3-2.9**
Sample Description :		**% Silt and Clay**	**96**	**% Sand**	**4**	**% Gravel**	**0**	**Figure :**	**35**
Sample Description :		**Clay of High Plasticity (CH)**							

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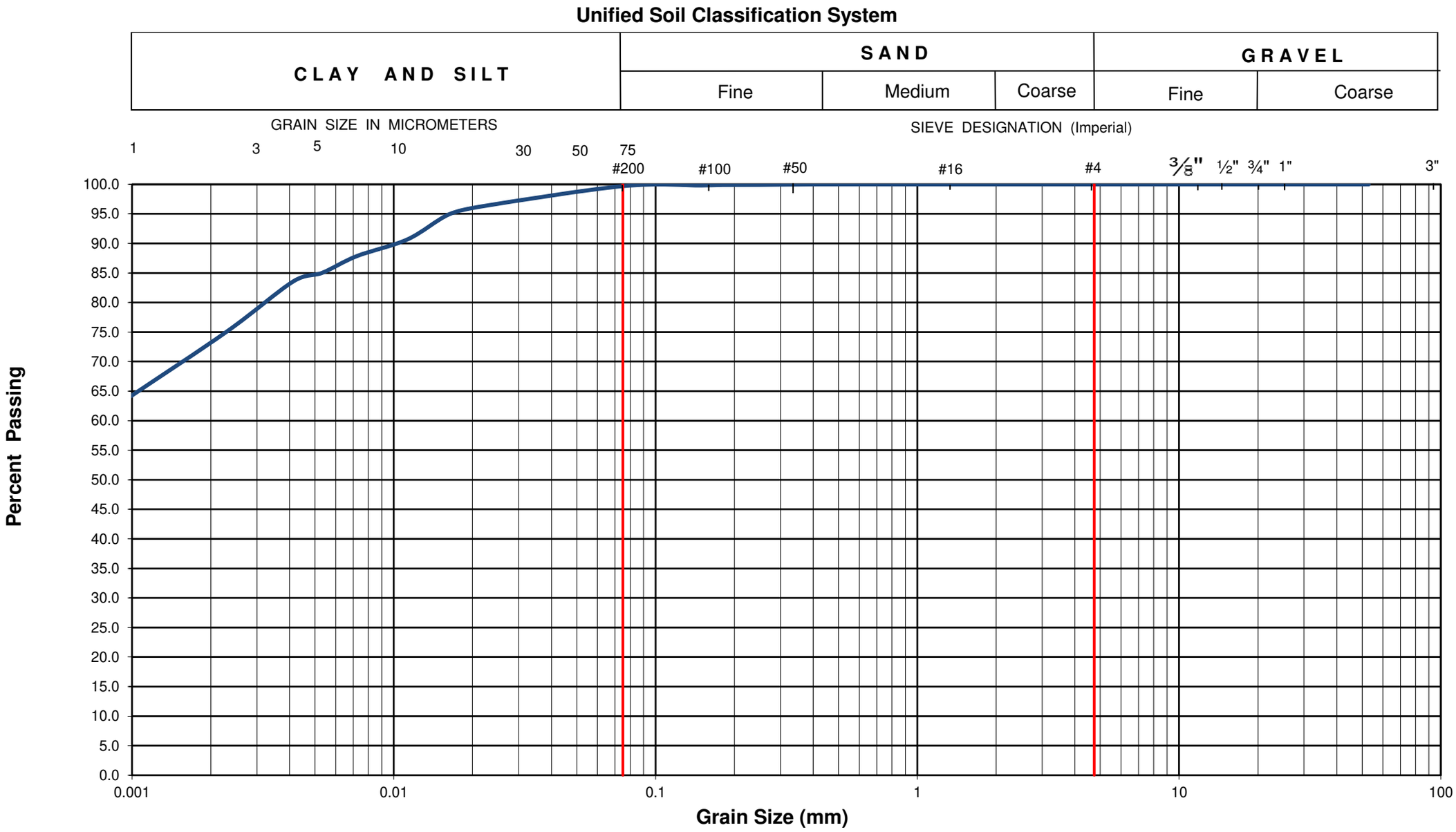
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22017859-A0**	**Project Name :**	**Proposed New Avalon III Elementary School**						
Client :	**CECCE**	**Project Location :**	**Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa**						
Date Sampled :	**December 22, 2023**	**Borehole No:**	**BH8**		**Sample No.:**	**SS3**		**Depth (m) :**	**2.3-2.9**
Sample Description :		**% Silt and Clay**	**100**	**% Sand**	**0**	**% Gravel**	**0**	**Figure :**	**36**
Sample Description :		**Clay of High Plasticity (CH)**							

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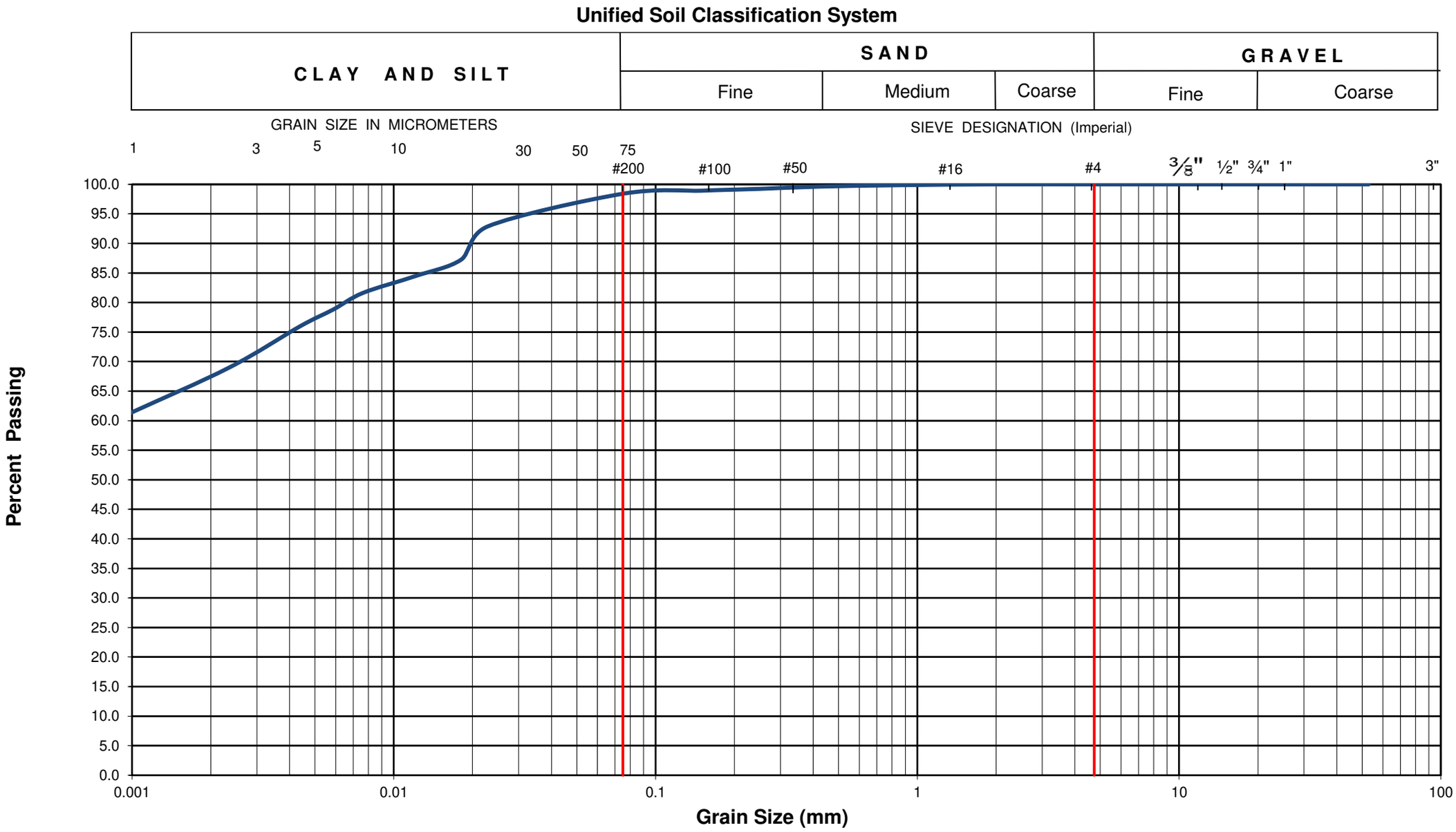
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22017859-A0**	**Project Name :**	**Proposed New Avalon III Elementary School**						
Client :	**CECCE**	**Project Location :**	**Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa**						
Date Sampled :	**December 21, 2023**	**Borehole No:**	**BH14**		**Sample No.:**	**SS3**		**Depth (m) :**	**1.5-2.1**
Sample Description :		**% Silt and Clay**	**98**	**% Sand**	**2**	**% Gravel**	**0**	**Figure :**	**37**
Sample Description :		**Clay of High Plasticity (CH)**							

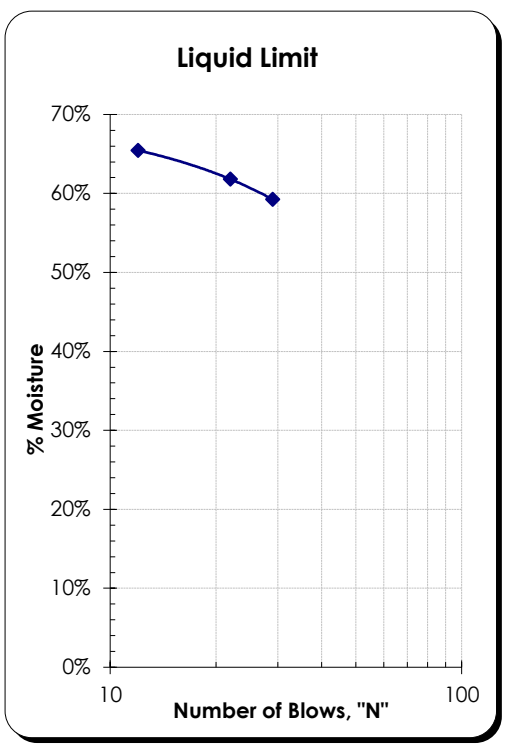
ATTERBERG LIMITS (ASTM D-4318)

Project: Geotechnical Investigation - Proposed New Avalon III Elementary
Project Location: Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa
Client CECCE
Borehole No. BH1 SS4 **Sample Depth** 2.3-2.9m

ASTM D-2487, Unified Soils Classification System
Clay of High Plasticity (CH)

Liquid Limit Determination

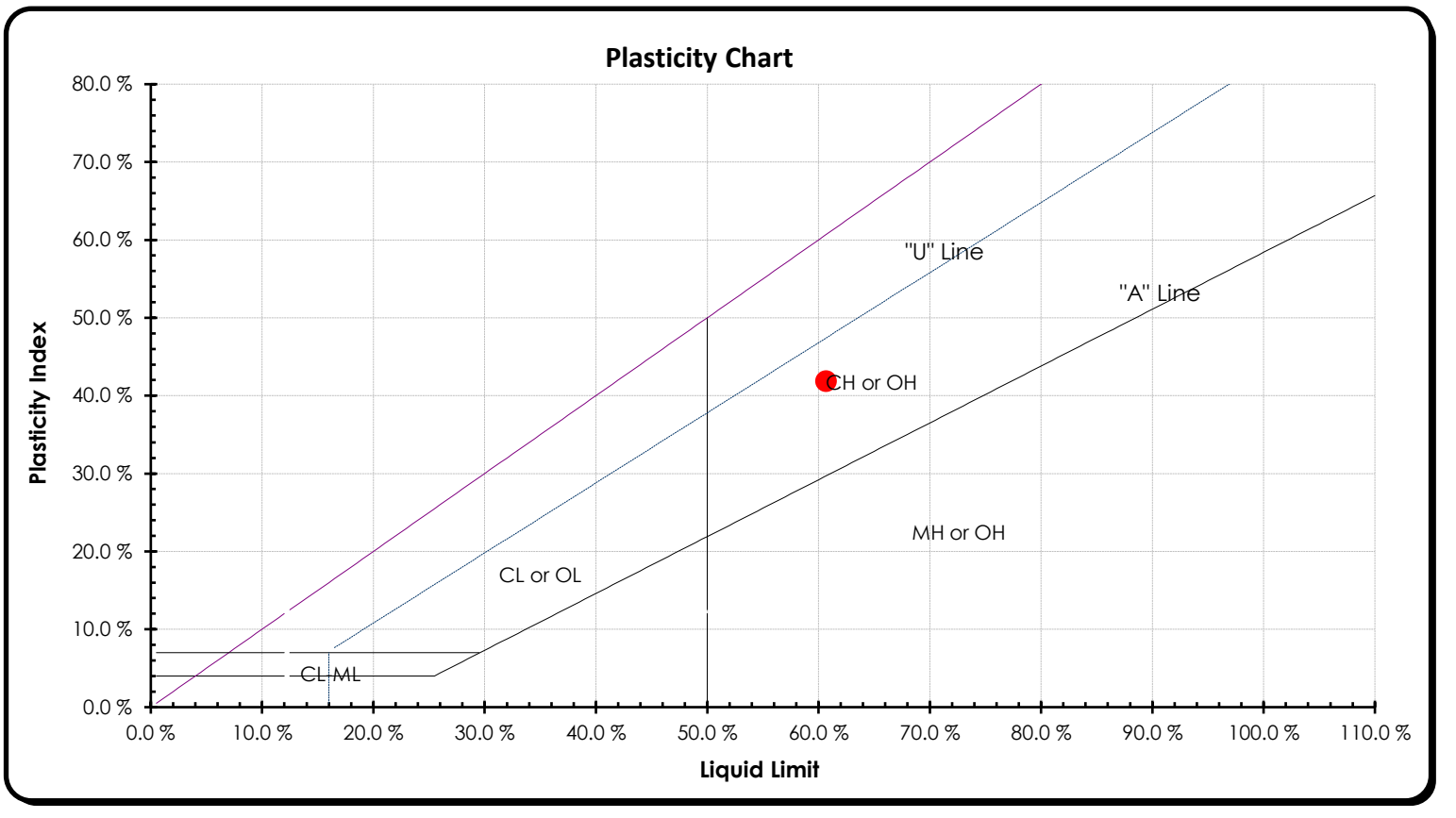
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	31.90	29.36	31.94			
Weight of Dry Soils + Pan:	27.35	25.59	27.09			
Weight of Pan:	19.67	19.49	19.68			
Weight of Dry Soils:	7.68	6.10	7.41			
Weight of Moisture:	4.55	3.77	4.85			
% Moisture:	59.2 %	61.8 %	65.5 %			
N:	29	22	12			



Liquid Limit @ 25 Blows: 60.7 %
Plastic Limit: 18.9 %
Plasticity Index, I_P: 41.8 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	20.57	20.37				
Weight of Dry Soils + Pan:	20.40	20.25				
Weight of Pan:	19.49	19.62				
Weight of Dry Soils:	0.91	0.63				
Weight of Moisture:	0.17	0.12				
% Moisture:	18.7 %	19.1 %				



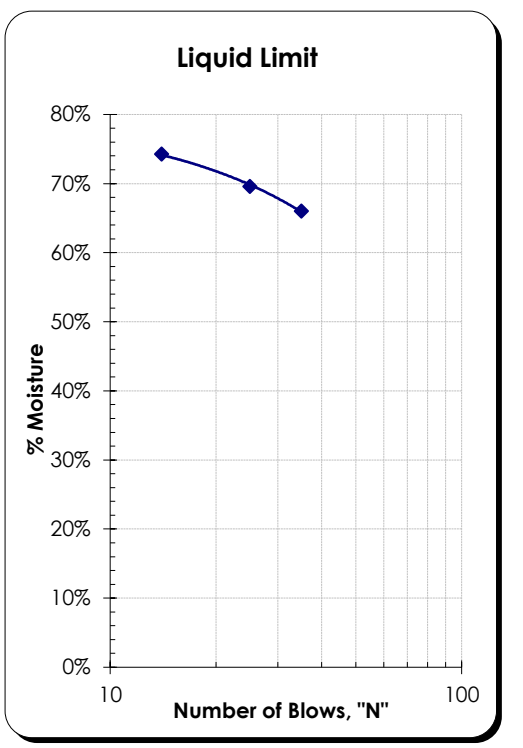
ATTERBERG LIMITS (ASTM D-4318)

Project: Geotechnical Investigation - Proposed New Avalon III Elementary
Project Location: Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa
Client CECCE
Borehole No. BH8 SS3 **Sample Depth** 2.3-2.9m

ASTM D-2487, Unified Soils Classification System
Clay of High Plasticity (CH)

Liquid Limit Determination

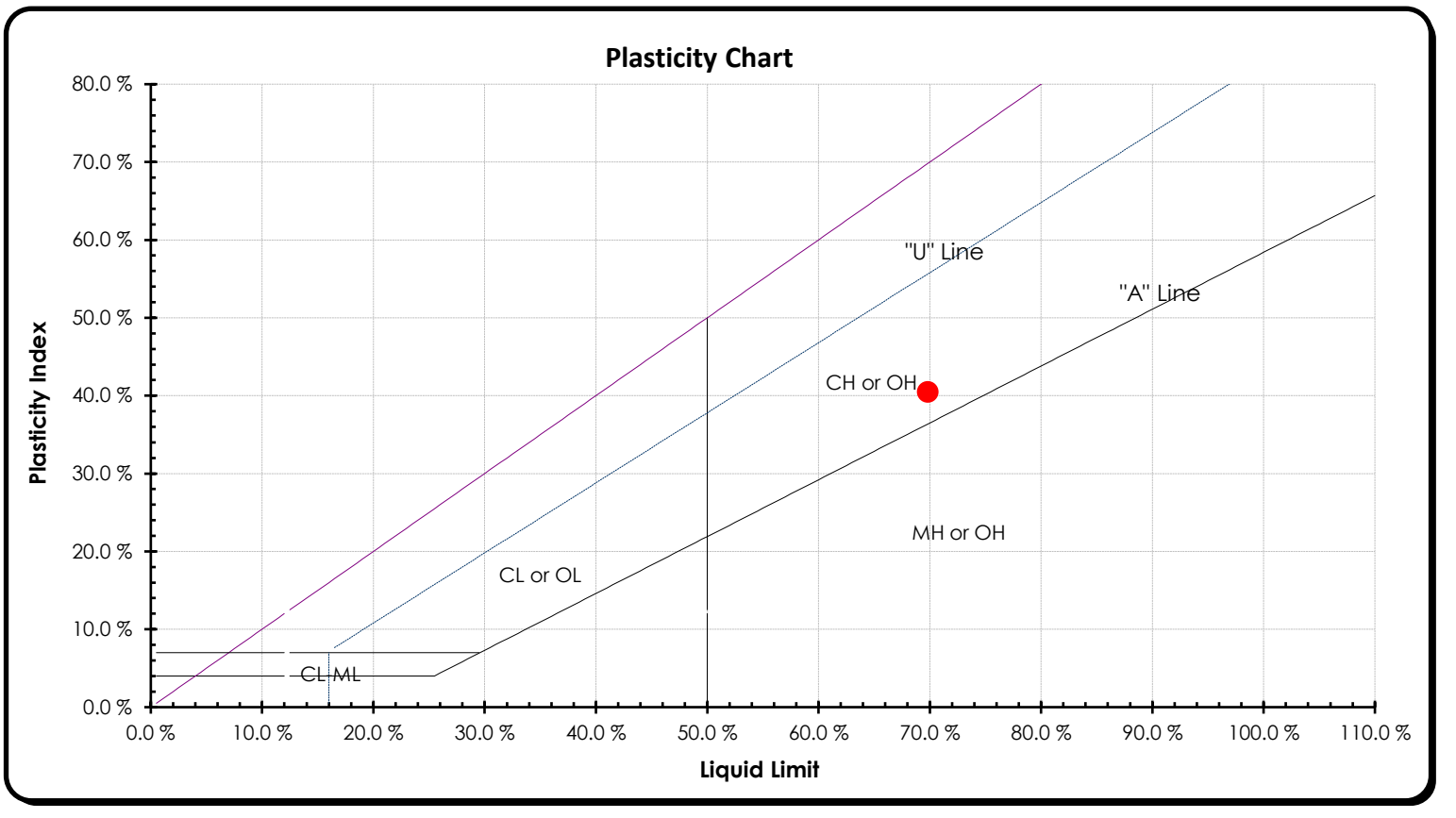
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	28.03	28.86	28.79			
Weight of Dry Soils + Pan:	24.65	24.97	24.78			
Weight of Pan:	19.53	19.38	19.38			
Weight of Dry Soils:	5.12	5.59	5.40			
Weight of Moisture:	3.38	3.89	4.01			
% Moisture:	66.0 %	69.6 %	74.3 %			
N:	35	25	14			



Liquid Limit @ 25 Blows: 69.8 %
Plastic Limit: 29.4 %
Plasticity Index, I_P: 40.5 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	21.39	20.92				
Weight of Dry Soils + Pan:	21.00	20.63				
Weight of Pan:	19.70	19.62				
Weight of Dry Soils:	1.30	1.01				
Weight of Moisture:	0.39	0.29				
% Moisture:	30.0 %	28.7 %				



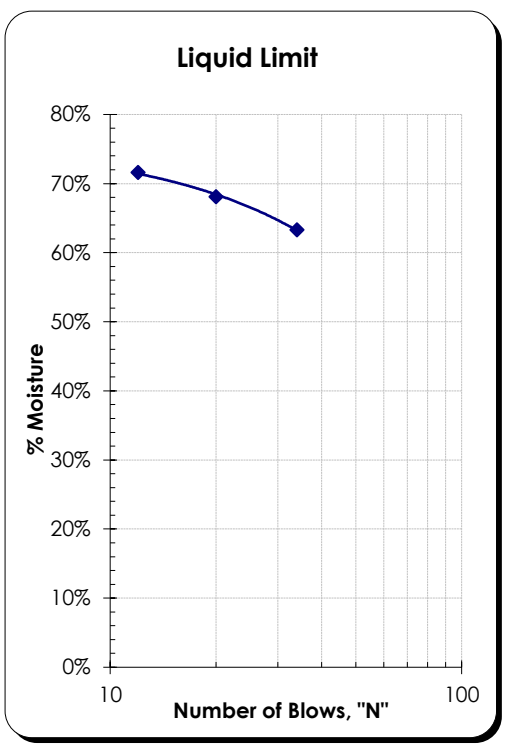
ATTERBERG LIMITS (ASTM D-4318)

Project: Geotechnical Investigation - Proposed New Avalon III Elementary
Project Location: Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa
Client CECCE
Borehole No. BH14 SS3 **Sample Depth** 1.5-2.1m

ASTM D-2487, Unified Soils Classification System
Clay of High Plasticity (CH)

Liquid Limit Determination

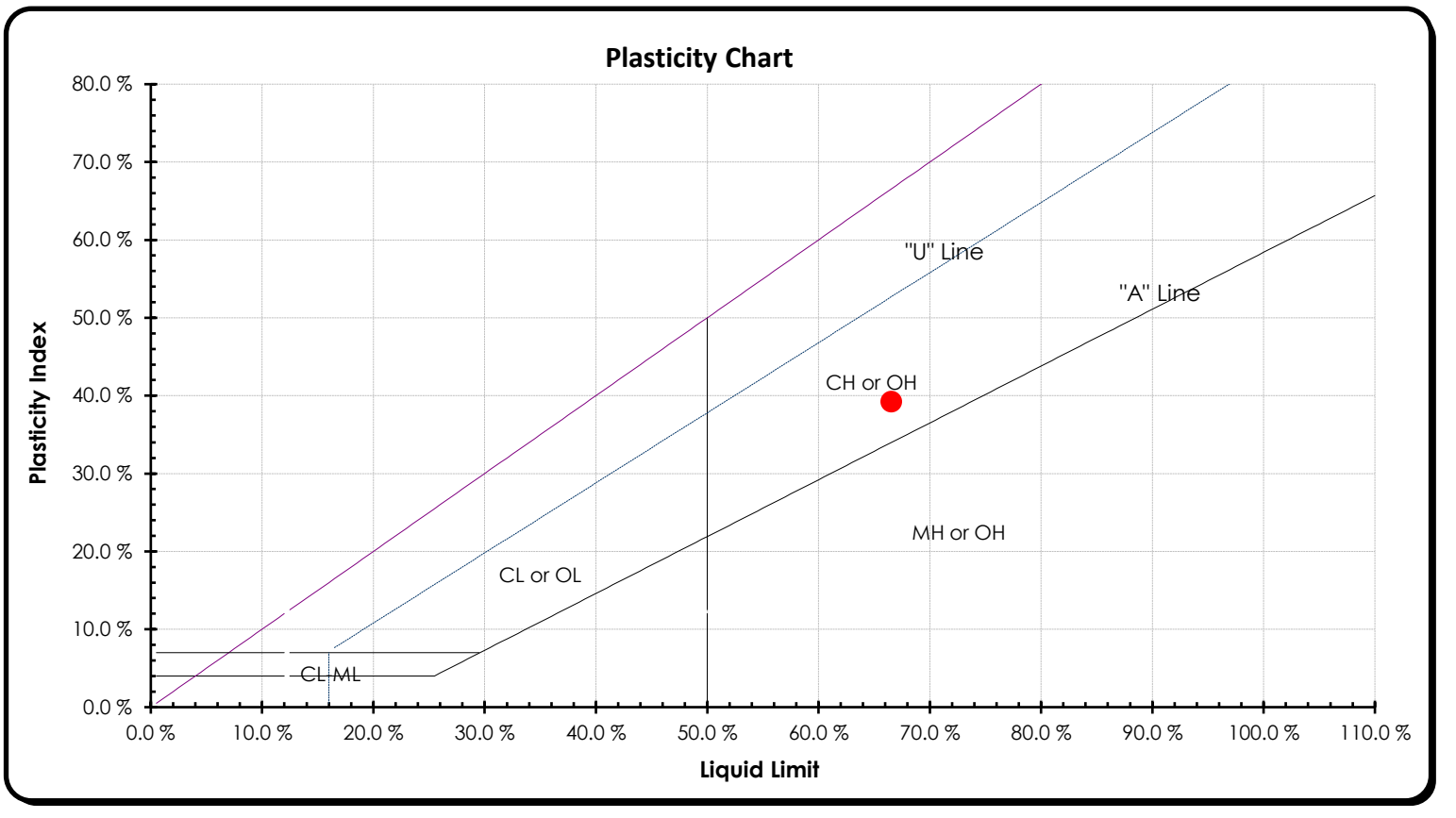
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	30.15	28.72	29.54			
Weight of Dry Soils + Pan:	26.11	24.94	25.50			
Weight of Pan:	19.73	19.39	19.86			
Weight of Dry Soils:	6.38	5.55	5.64			
Weight of Moisture:	4.04	3.78	4.04			
% Moisture:	63.3 %	68.1 %	71.6 %			
N:	34	20	12			



Liquid Limit @ 25 Blows: 66.6 %
Plastic Limit: 27.4 %
Plasticity Index, I_P: 39.2 %

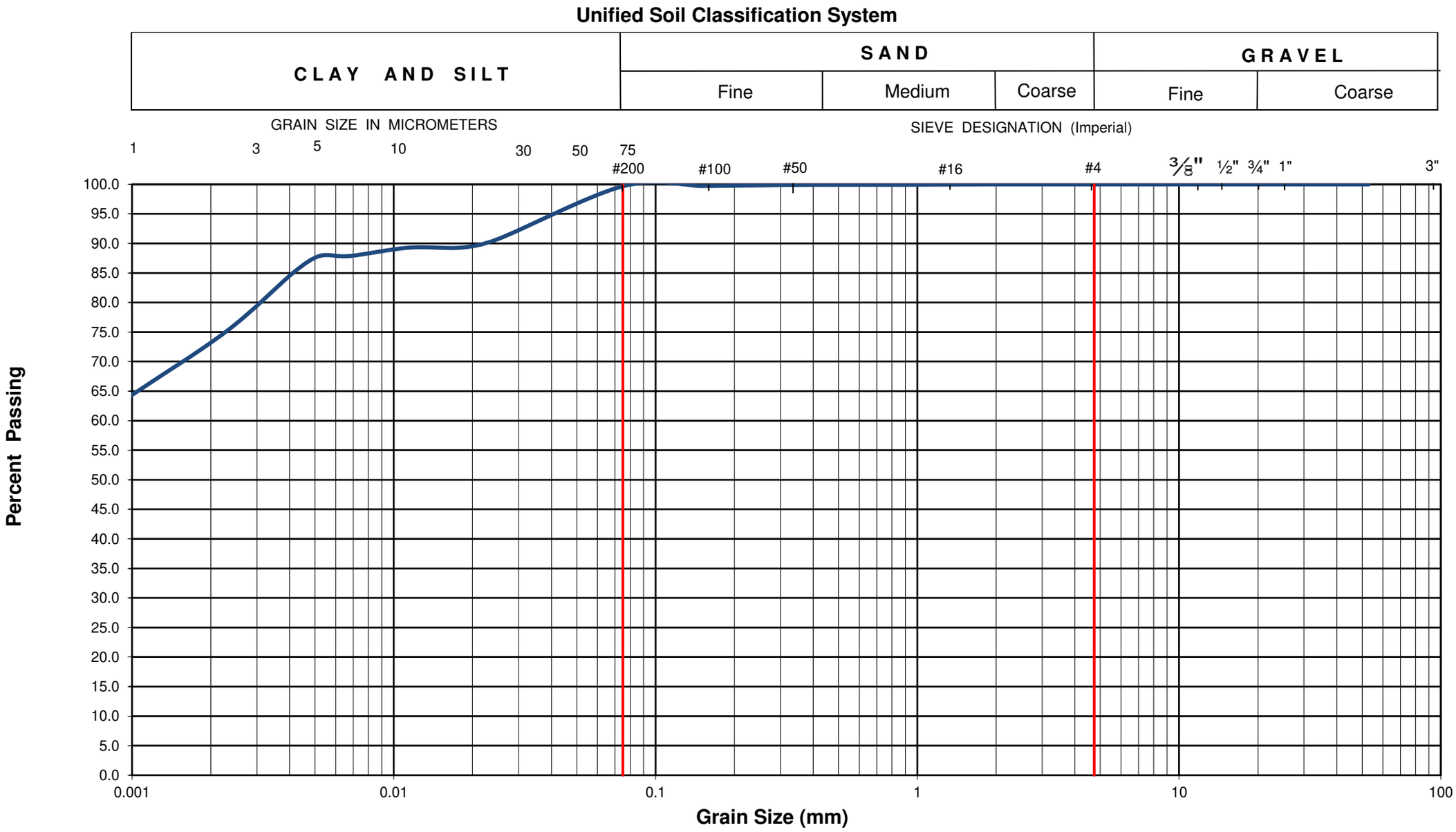
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	22.16	22.22				
Weight of Dry Soils + Pan:	21.60	21.65				
Weight of Pan:	19.54	19.58				
Weight of Dry Soils:	2.06	2.07				
Weight of Moisture:	0.56	0.57				
% Moisture:	27.2 %	27.5 %				



EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

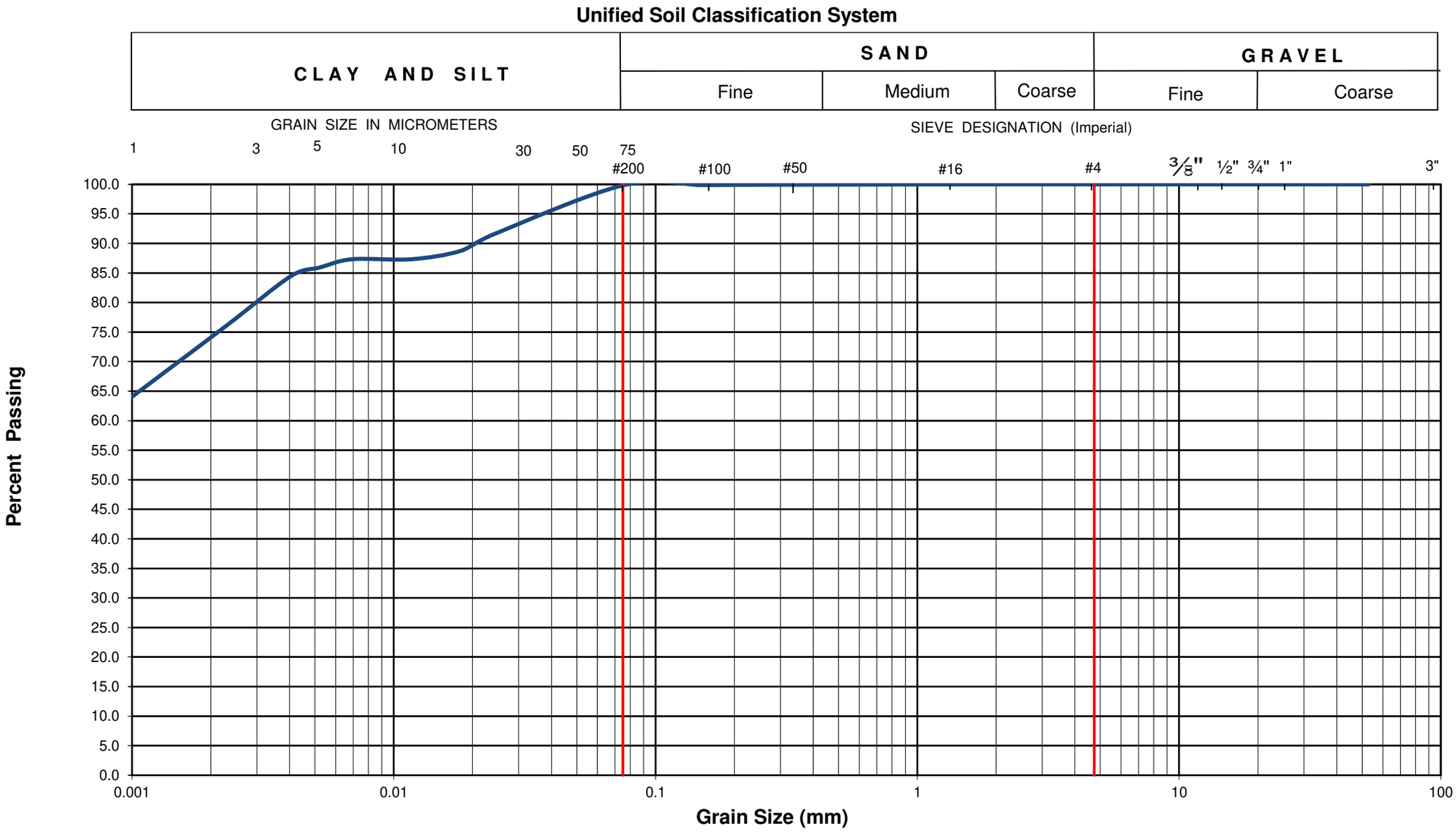
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22017859-A0**	**Project Name :**	**Proposed New Avalon III Elementary School**						
Client :	**CECCE**	**Project Location :**	**Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa**						
Date Sampled :	**December 15, 2023**	**Borehole No:**	**BH2**		**Sample No.:**	**SS8**		**Depth (m) :**	**7.6-8.2**
Sample Description :		**% Silt and Clay**	**100**	**% Sand**	**0**	**% Gravel**	**0**	**Figure :**	**41**
Sample Description :		**Clay of High Plasticity (CH)**							

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

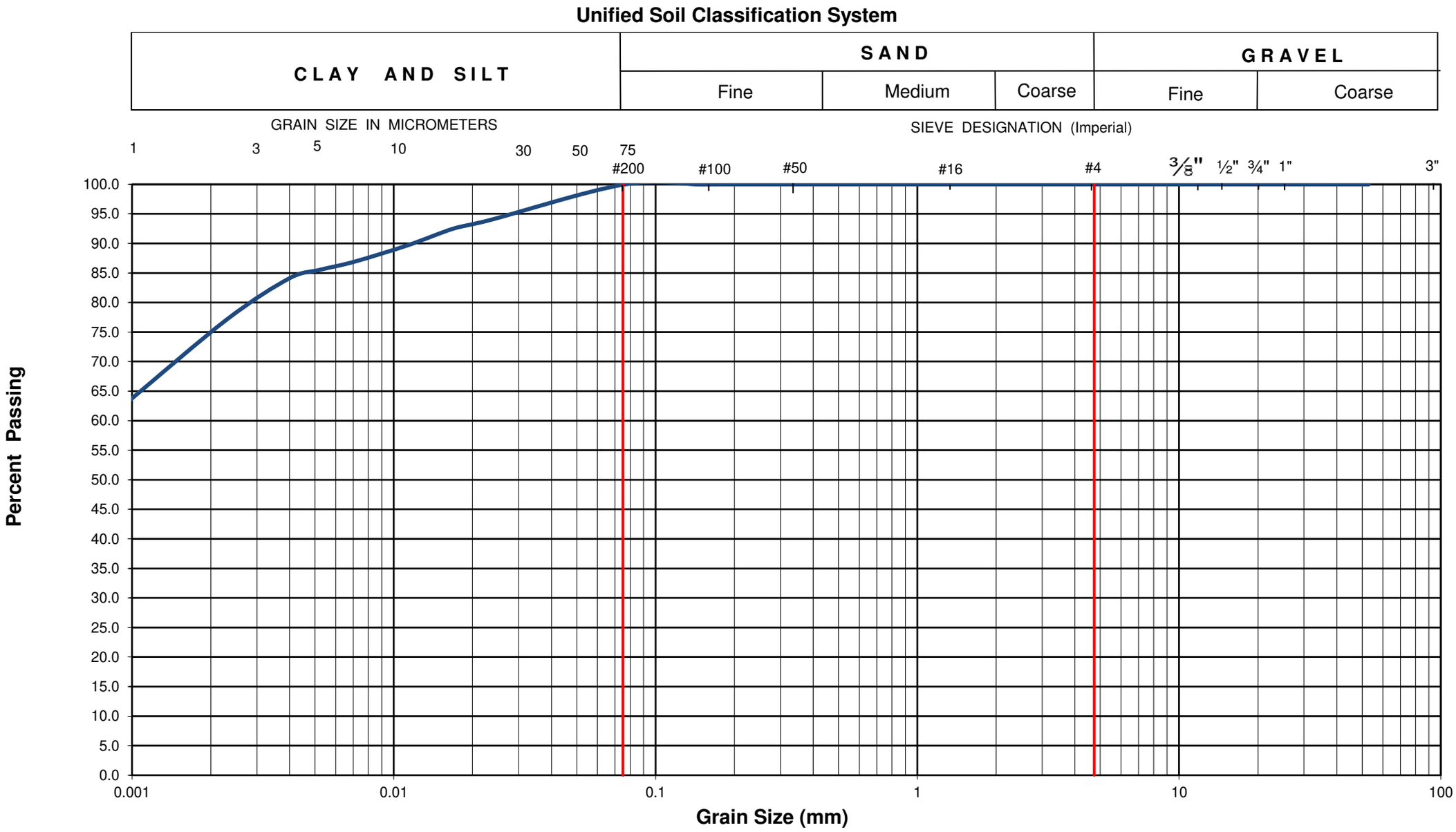
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22017859-A0**	**Project Name :**	**Proposed New Avalon III Elementary School**						
Client :	**CECCE**	**Project Location :**	**Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa**						
Date Sampled :	**December 15, 2023**	**Borehole No:**	**BH5**		**Sample No.:**	**SS7**		**Depth (m) :**	**6.1-6.7**
Sample Description :		**% Silt and Clay**	**100**	**% Sand**	**0**	**% Gravel**	**0**	**Figure :**	**42**
Sample Description :		**Clay of High Plasticity (CH)**							

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-22017859-A0**	**Project Name :**	**Proposed New Avalon III Elementary School**						
Client :	**CECCE**	**Project Location :**	**Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa**						
Date Sampled :	**December 22, 2023**	**Borehole No:**	**BH8**		**Sample No.:**	**SS4**		**Depth (m) :**	**3.8-4.4**
Sample Description :		**% Silt and Clay**	**100**	**% Sand**	**0**	**% Gravel**	**0**	**Figure :**	**43**
Sample Description :		**Clay of High Plasticity (CH)**							

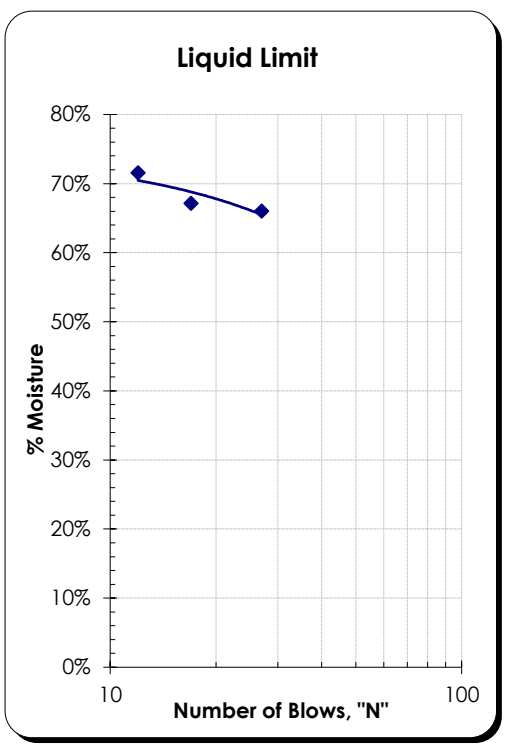
ATTERBERG LIMITS (ASTM D-4318)

Project: Geotechnical Investigation - Proposed New Avalon III Elementary
Project Location: Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa
Client CECCE
Borehole No. BH2 SS8 **Sample Depth** 7.6-8.2m

ASTM D-2487, Unified Soils Classification System
Clay of High Plasticity (CH)

Liquid Limit Determination

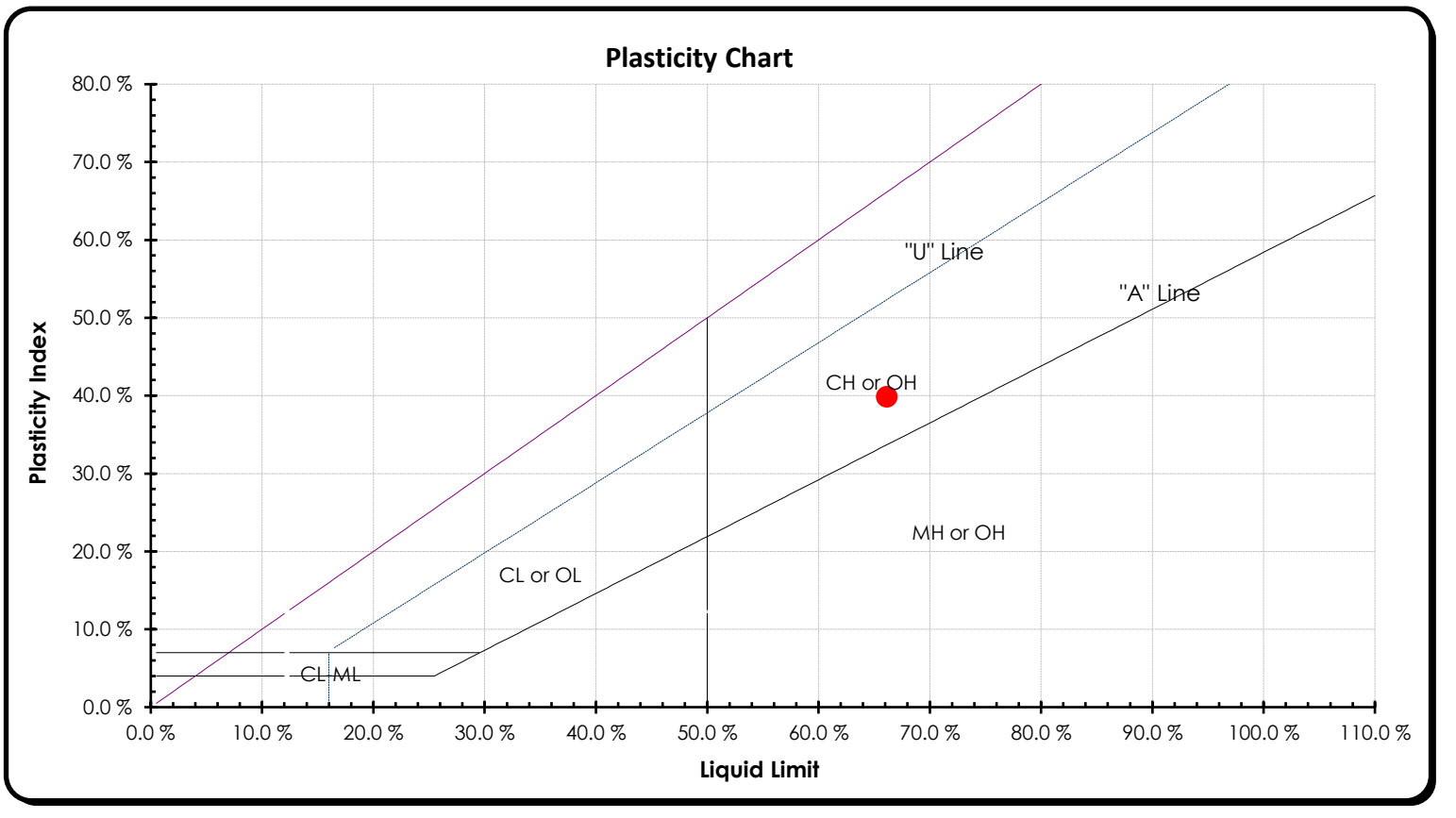
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	30.02	31.73	28.40			
Weight of Dry Soils + Pan:	25.90	26.74	24.83			
Weight of Pan:	19.66	19.31	19.84			
Weight of Dry Soils:	6.24	7.43	4.99			
Weight of Moisture:	4.12	4.99	3.57			
% Moisture:	66.0 %	67.2 %	71.5 %			
N:	27	17	12			



Liquid Limit @ 25 Blows: 66.1 %
Plastic Limit: 26.3 %
Plasticity Index, I_P: 39.8 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	21.38	21.31				
Weight of Dry Soils + Pan:	20.99	20.97				
Weight of Pan:	19.54	19.65				
Weight of Dry Soils:	1.45	1.32				
Weight of Moisture:	0.39	0.34				
% Moisture:	26.9 %	25.8 %				



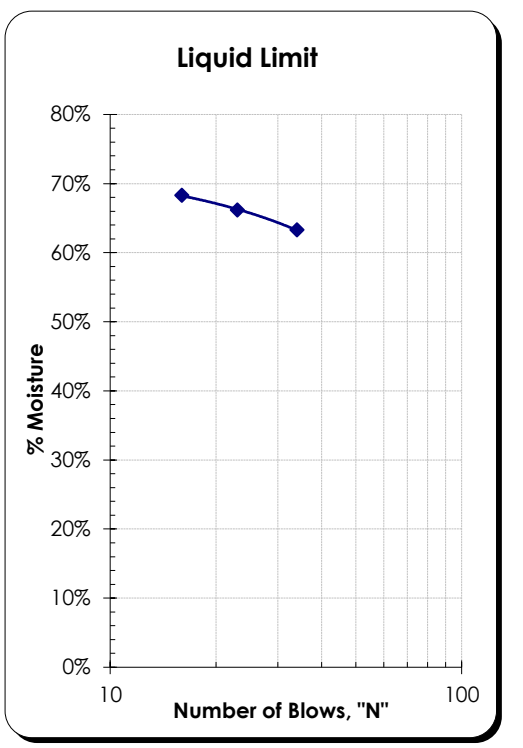
ATTERBERG LIMITS (ASTM D-4318)

Project: Geotechnical Investigation - Proposed New Avalon III Elementary
Project Location: Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa
Client CECCE
Borehole No. BH5 SS7 **Sample Depth** 6.1-6.7m

ASTM D-2487, Unified Soils Classification System
Clay of High Plasticity (CH)

Liquid Limit Determination

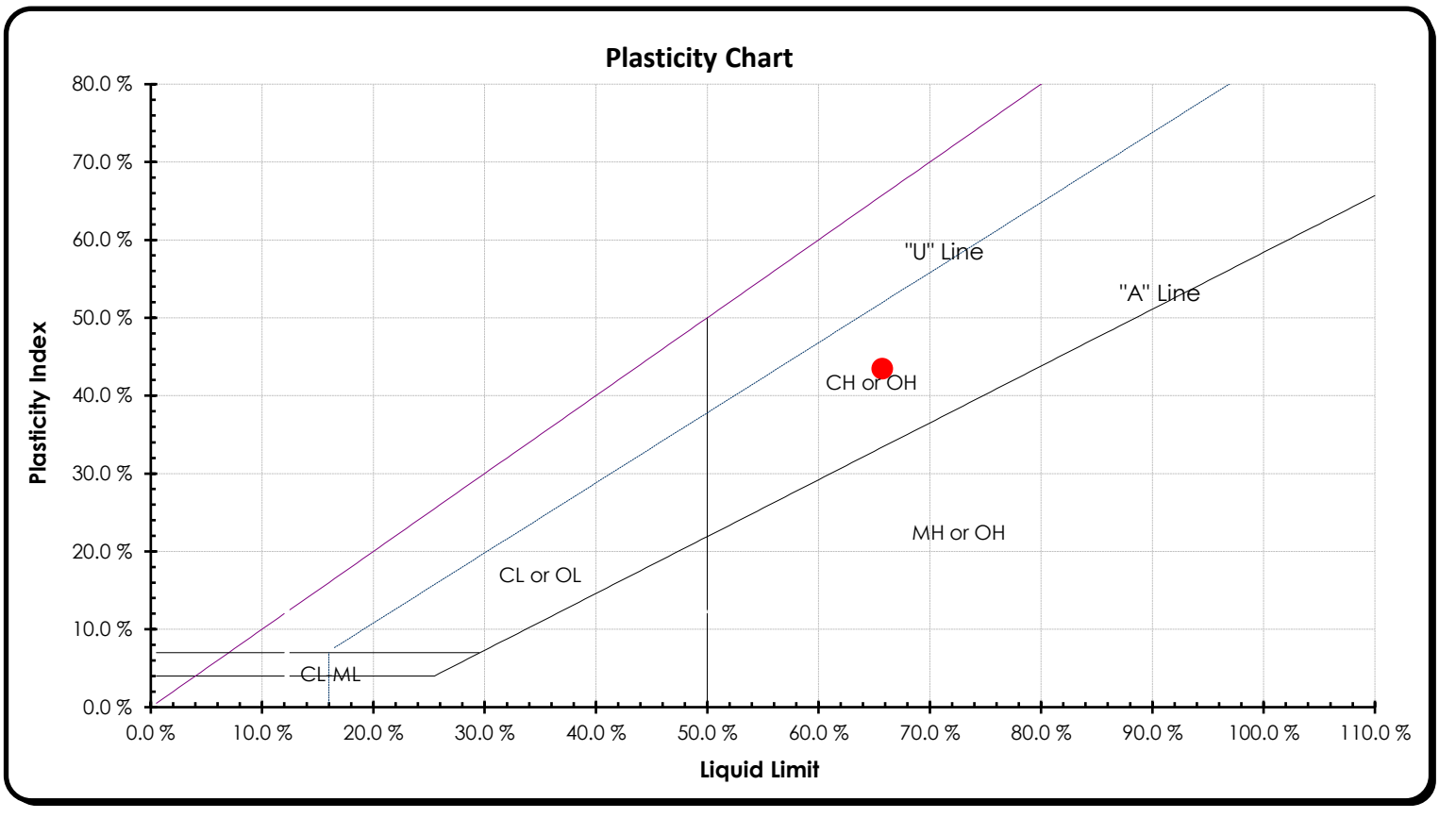
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.35	29.15	29.64			
Weight of Dry Soils + Pan:	25.54	25.26	25.46			
Weight of Pan:	19.52	19.38	19.34			
Weight of Dry Soils:	6.02	5.88	6.12			
Weight of Moisture:	3.81	3.89	4.18			
% Moisture:	63.3 %	66.2 %	68.3 %			
N:	34	23	16			



Liquid Limit @ 25 Blows: 65.7 %
Plastic Limit: 22.3 %
Plasticity Index, I_P: 43.5 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	20.54	20.36				
Weight of Dry Soils + Pan:	20.38	20.23				
Weight of Pan:	19.68	19.63				
Weight of Dry Soils:	0.70	0.60				
Weight of Moisture:	0.16	0.13				
% Moisture:	22.9 %	21.7 %				



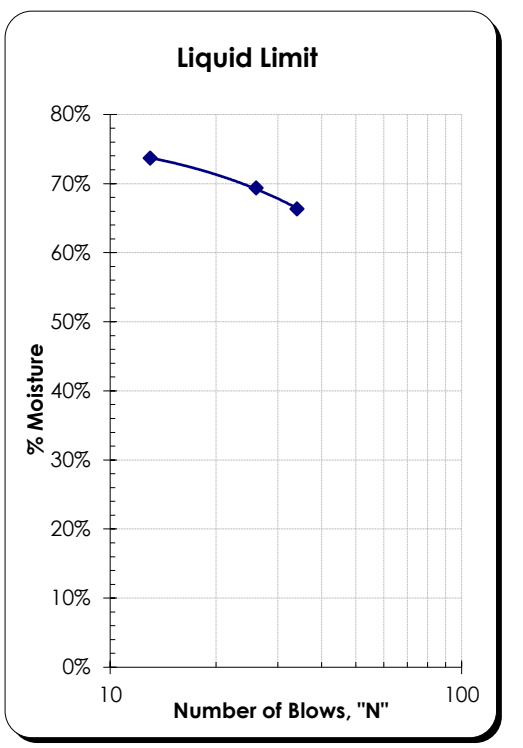
ATTERBERG LIMITS (ASTM D-4318)

Project: Geotechnical Investigation - Proposed New Avalon III Elementary
Project Location: Sweet Valley Drive between Mer Bleu & Tenth Line Rd, Ottawa
Client CECCE
Borehole No. BH8 SS4 **Sample Depth** 3.8-4.4m

ASTM D-2487, Unified Soils Classification System
Clay of High Plasticity (CH)

Liquid Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.83	30.69	31.82			
Weight of Dry Soils + Pan:	25.77	26.05	26.75			
Weight of Pan:	19.65	19.36	19.87			
Weight of Dry Soils:	6.12	6.69	6.88			
Weight of Moisture:	4.06	4.64	5.07			
% Moisture:	66.3 %	69.4 %	73.7 %			
N:	34	26	13			



Liquid Limit @ 25 Blows: 69.6 %
Plastic Limit: 27.0 %
Plasticity Index, I_P: 42.6 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	21.36	21.53				
Weight of Dry Soils + Pan:	20.97	21.13				
Weight of Pan:	19.53	19.64				
Weight of Dry Soils:	1.44	1.49				
Weight of Moisture:	0.39	0.40				
% Moisture:	27.1 %	26.9 %				

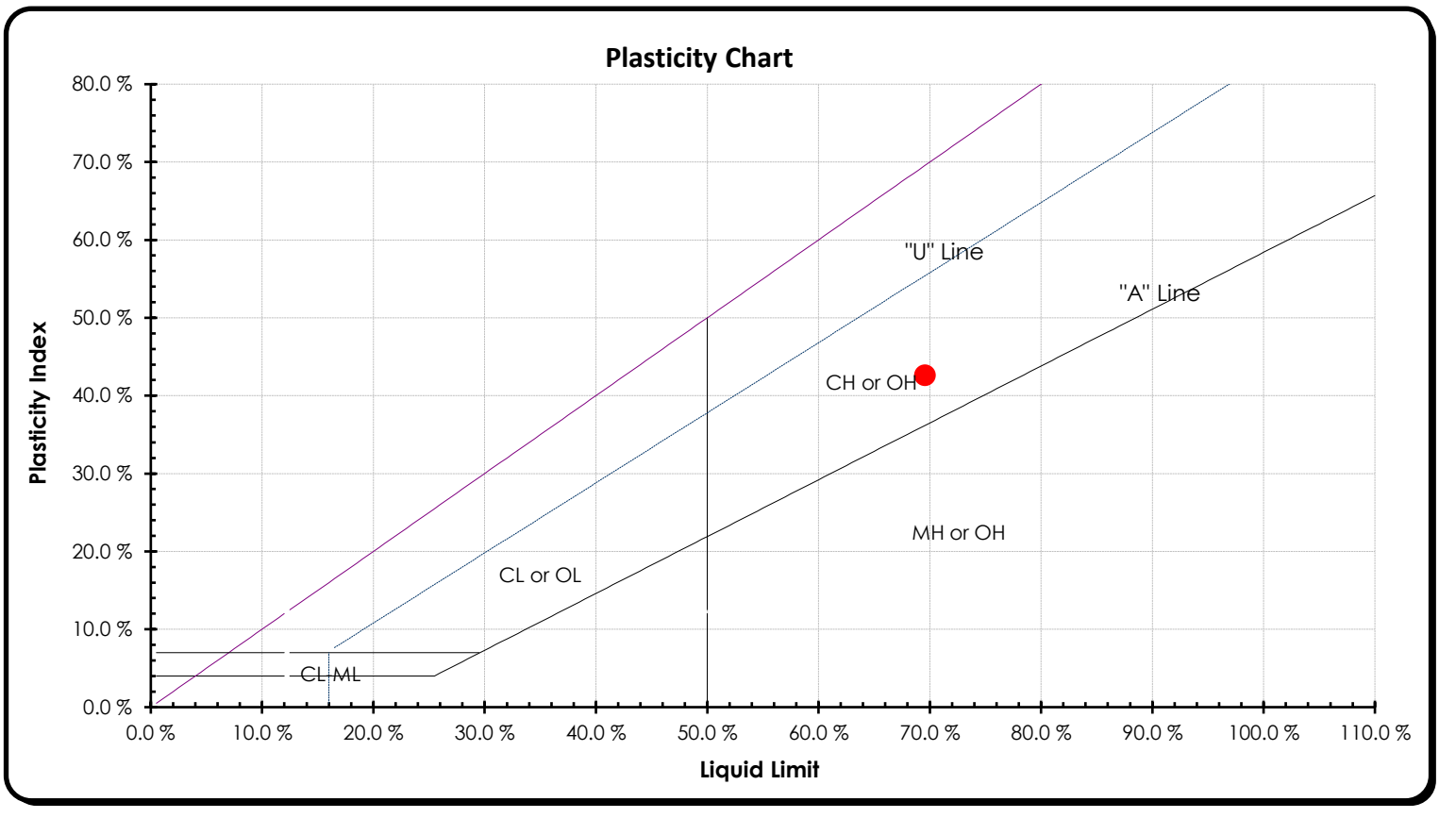
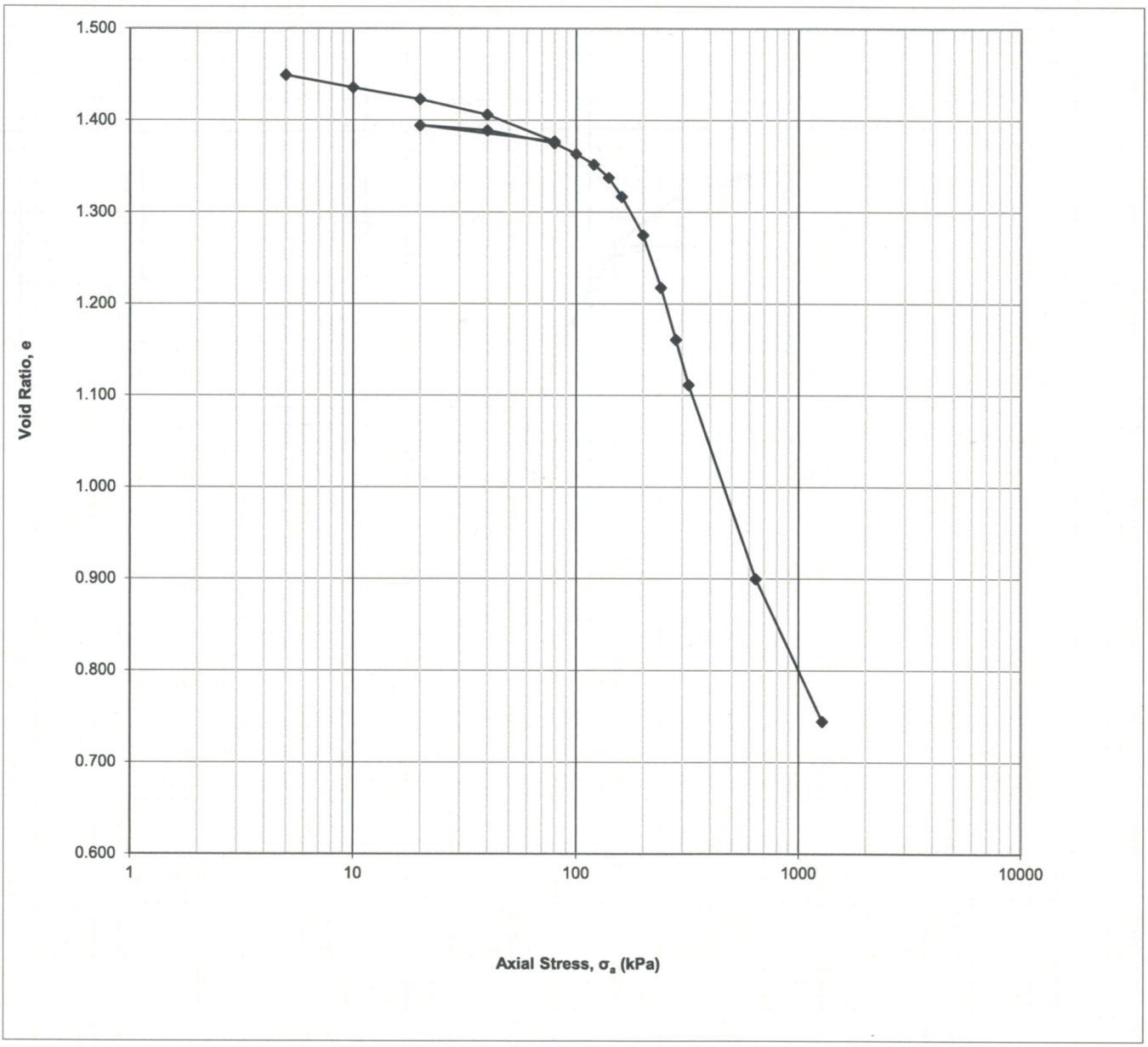


Figure 47

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Project	**Proposed CECCE Avalon III School, Exp# OTT-0022017859-A0**
Project No.	**121623683**
Borehole No.	**BH 5**
Sample No.	**ST 5**
Sample Depth	**10-12 ft**



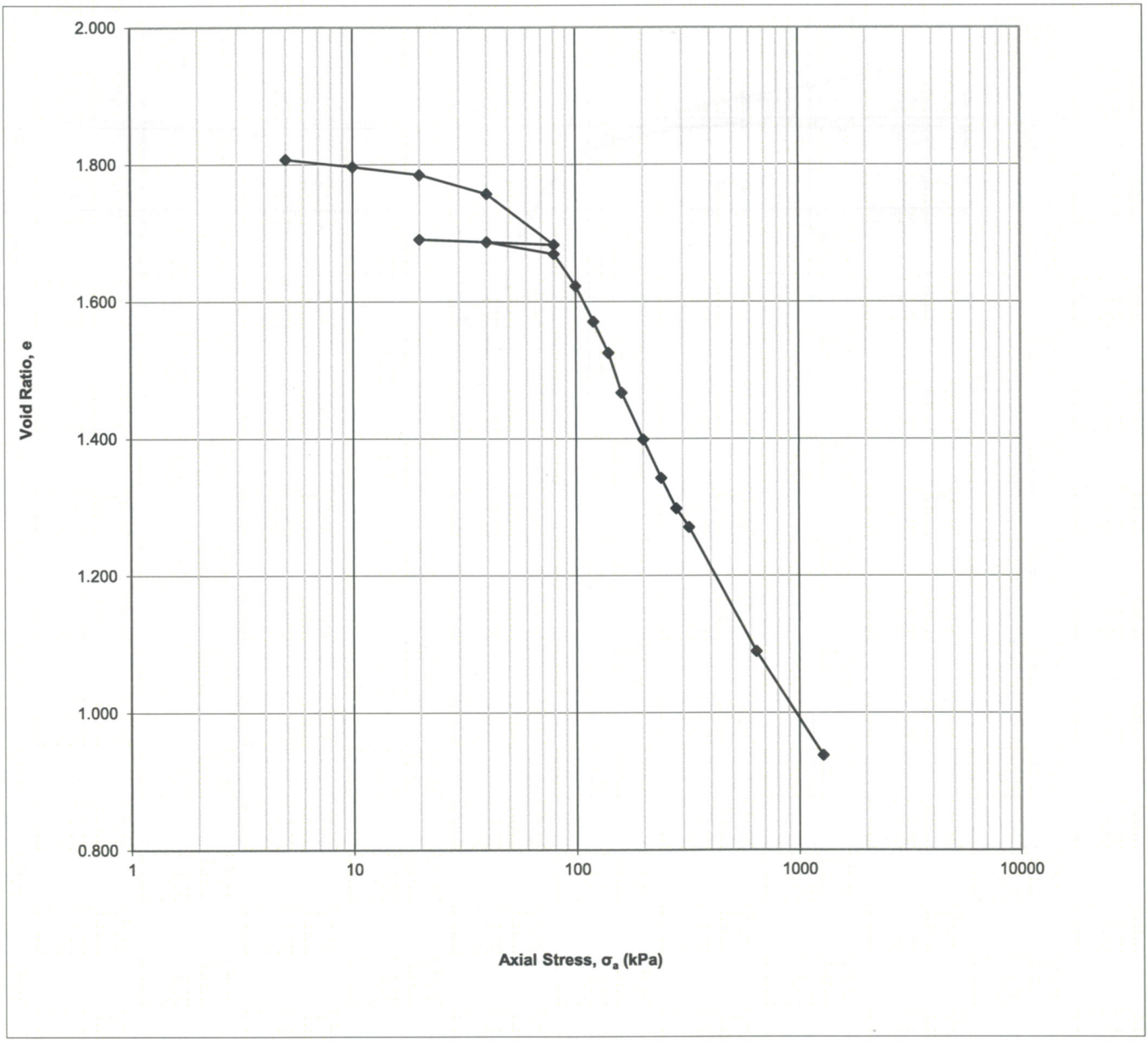
Results:

σ'_p = 115 kPa	σ'_{v0} = 59.0 kPa	e_0 = 1.462
c_c = 0.551	w_c = 53.03 %	OCR = 1.95
c_r = 0.046	γ = 16.76 kN/m^3	

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Project	**Proposed CECCE Avalon III School, Exp# OTT-0022017859-A0**
Project No.	**121623683**
Borehole No.	**BH 3**
Sample No.	**ST 7**
Sample Depth	**20-22 ft**



Results:

σ'_p = 65 kPa	σ'_{v0} = 73.8 kPa	e_0 = 1.812
c_c = 0.457	w_c = 65.66 %	OCR = 0.88*
c_r = 0.033	γ = 15.9 kN/m^3	

Appendix A – Multi-channel Analysis of Surface Waves (MASW) Survey Report

GEOPHYSICS GPR INTERNATIONAL INC.

100 – 2545 Delorimier Street
Longueuil (Québec)
Canada J4K 3P7

Tel. : (450) 679-2400
Fax : (514) 521-4128
info@geophysicsgpr.com
www.geophysicsgpr.com

January 10th, 2023

Transmitted by email: Ismail.Taki@exp.com
Our Ref.: GPR-22-04246

Mr. Ismail Taki, M.Eng., P.Eng.
Senior Manager, Earth & Environment, Eastern Region
exp Services inc.
100 – 2650 Queensview Drive
Ottawa ON K2B 8H6

Shear Wave Velocity Sounding for the Site Class Identification
Tenth Line Road, Ottawa (ON)

[Project: OTT-22017859]

Dear Sir,

Geophysics GPR International inc. has been mandated by **exp** Services inc. to carry out a seismic shear wave survey at the intersection of Sweet Valley Drive and Tenth Line Road, in Ottawa (ON). The geophysical investigation used the Multi-channel Analysis of Surface Waves (MASW), the Spatial AutoCorrelation (SPAC), and the seismic reflexion methods. From the subsequent results, the seismic shear wave velocity values were calculated for the soil to determine the Site Class.

The surveys were carried out on November 24th, 2022, by Mr. Timothy Ward, geophysics technician, and Mr. Ewen Pasdeloup, intern. Figure 1 shows the regional location of the site and Figure 2 illustrates the location of the seismic spread. Both figures are presented in the Appendix.

The following paragraphs briefly describe the survey design, the principles of the testing methods, and the results presented in table and graph.

MASW PRINCIPLE

The *Multi-channel Analysis of Surface Waves* (MASW) and the *SPatial AutoCorrelation* (SPAC or MAM for *Microtremors Array Method*) are seismic methods used to evaluate the shear wave velocities of subsurface materials through the analysis of the dispersion properties of the Rayleigh surface wave. The MASW is considered an "active" method, as the seismic signal is induced at known location and time in the geophones' spread axis. Conversely, the SPAC is considered a "passive" method, using the low frequency "signals" produced far away. The method can also be used with "active" seismic source records. The SPAC method generally allows deeper Vs soundings. Its dispersion curve can then be merged with the one of higher frequency from the MASW to calculate a more complete inversion. The dispersion properties are expressed as a change of velocities with respect to frequencies. 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. The inversion of the Rayleigh wave dispersion curve yields a shear wave (V_S) velocity depth profile (sounding).

Figure 3 schematically outlines the basic operating procedure for the MASW method. Figure 4 illustrates an example of one of the MASW/SPAC records, the corresponding spectrogram analysis and resulting 1D V_S model.

INTERPRETATION

The main processing sequence involved data inspection and edition when required; spectral analysis ("phase shift" for MASW, and "cross-correlation" for SPAC); picking the fundamental mode; and 1D inversion of the MASW and SPAC shot records using the SeisImagerSW™ software. The data inversions used a nonlinear least squares algorithm.

In theory, all the shot records for a given seismic spread should produce a similar shear-wave velocity profile. In practice, however, differences can arise due to energy dissipation, local surface seismic velocities variations, and/or dipping of overburden layers or rock. In general, the precision of the calculated seismic shear wave velocities (V_S) is close to 15% or better.

More detailed descriptions of these methods are presented in *Shear Wave Velocity Measurement Guidelines for Canadian Seismic Site Characterization in Soil and Rock*, Hunter, J.A., Crow, H.L., et al., Geological Surveys of Canada, General Information Product 110, 2015.

SURVEY DESIGN

The seismic acquisition spreads were laid perpendicular to the Tenth Line Road (Figure 2). The geophone spacing was of 3.0 metres for the main spread and 1.0 metre dedicated to the near surface materials. The seismic records were produced with a seismograph Terraloc Pro 2 (from ABEM Instrument), and the geophones were 4.5 Hz. The seismic records counted 4096 data, sampled at 1000 µs for the MASW surveys, and 40 µs for the seismic refraction. The records included a pre-trigged portion of 10 ms. An 8 kg sledgehammer was used as the energy source with impacts being recorded off both ends of the seismic spreads. A stacking procedure was also used to improve the Signal / Noise ratio for the seismic records.

The shear wave depth sounding can be considered as the average of the bulk area within the geophone spread, especially for its central half-length.

RESULTS

The MASW calculated V_S results are illustrated at Figure 5.

By seismic reflection, the bedrock depth was calculated between 36 and 38.6 meters.

The $\overline{V}_{S30}$ value results from the harmonic mean of the shear wave velocities, from the surface to 30 metres deep. It is calculated by dividing the total depth of interest (30 metres) by the sum of the time spent in each velocity layer from the surface down to 30 metres, as:

$$\overline{V}_{S30} = \frac{\sum_{i=1}^{N} H_i}{\sum_{i=1}^{N} {H_i}/{V_i}} \quad | \quad \sum_{i=1}^{N} H_i = 30 \text{ m}$$

(N: number of layers; H_i : thickness of layer "i" ; V_i : V_S of layer "i")

Thus, the $\overline{V}_{S30}$ value represents the seismic shear wave velocity of an equivalent homogeneous single layer response, between the surface and 30 meters deep.

The calculated $\overline{V}_{S30}$ value of the actual site is 128,1 m/s (Table 1), corresponding to the Site Class "E". It must be noted that very low and low seismic velocities were calculated for the clayey materials, from the surface to approximately 27 meters deep.

CONCLUSION

Geophysical surveys were conducted to identify the Site Class at the intersection of Sweet Valley Drive and Tenth Line Road, in Ottawa (ON). The seismic surveys used the MASW and the SPAC analysis, and the seismic reflection to calculate the $\overline{V}_{S30}$ value. Its calculation is presented at Table 1.

The $\overline{V}_{S30}$ value of the actual site is 128 m/s, corresponding to the Site Class "E" ($\overline{V}_{S30}$ < 180 m/s), as determined through the MASW and SPAC methods, Table 4.1.8.4.-A of the NBC, and the Building Code, O. Reg. 332/12. It must be noted that very low and low seismic velocities were calculated from the surface to approximately 27 meters deep. A geotechnical assessment of the corresponding materials should be produced for the potential of liquefaction, the clay degree of sensitivity, and possibly other critical parameters.

It must also be noted that other geotechnical information gleaned on site; including the presence of liquefiable soils, very soft clays, high moisture content etc. (cf. Table 4.1.8.4.-A of the NBC) can supersede the Site classification provided in this report based on the $\overline{V}_{S30}$ value.

The V_S values calculated are representative of the in-situ materials and are not corrected for the total and effective stresses.

Hoping the whole to your satisfaction, we remain yours truly,

Alexis Marchand, Eng.
Project Manager
(OIQ Number : 6008271)

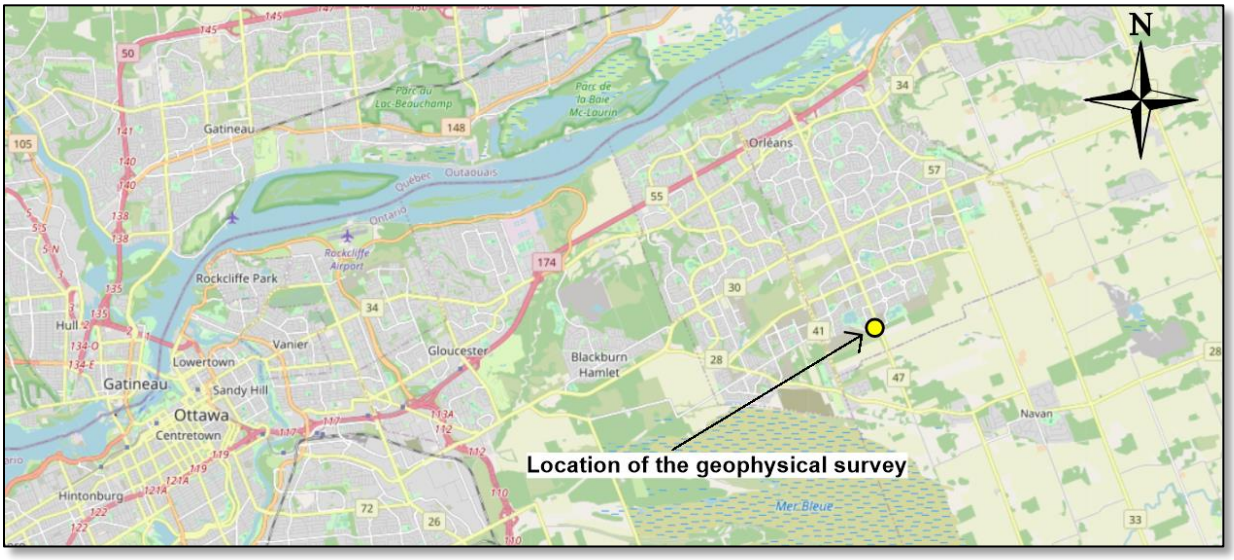


Figure 1: Regional location of the Site
(**Source:** ***OpenStreetMap©***)

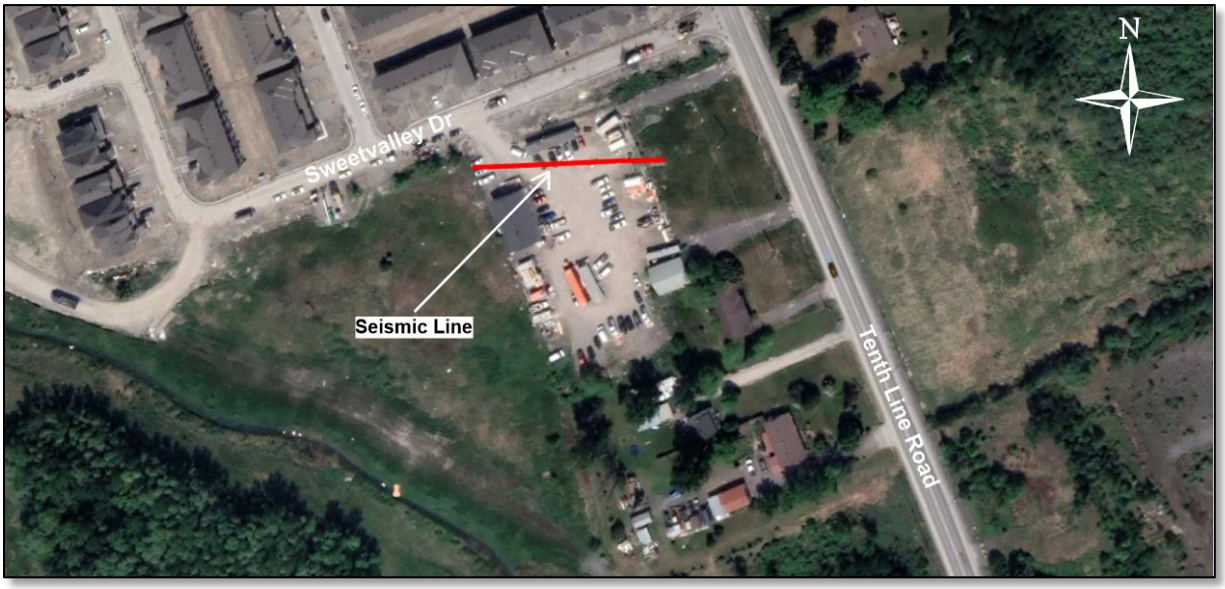


Figure 2: Location of the seismic spread
(**Source:** ***Google Earth***)

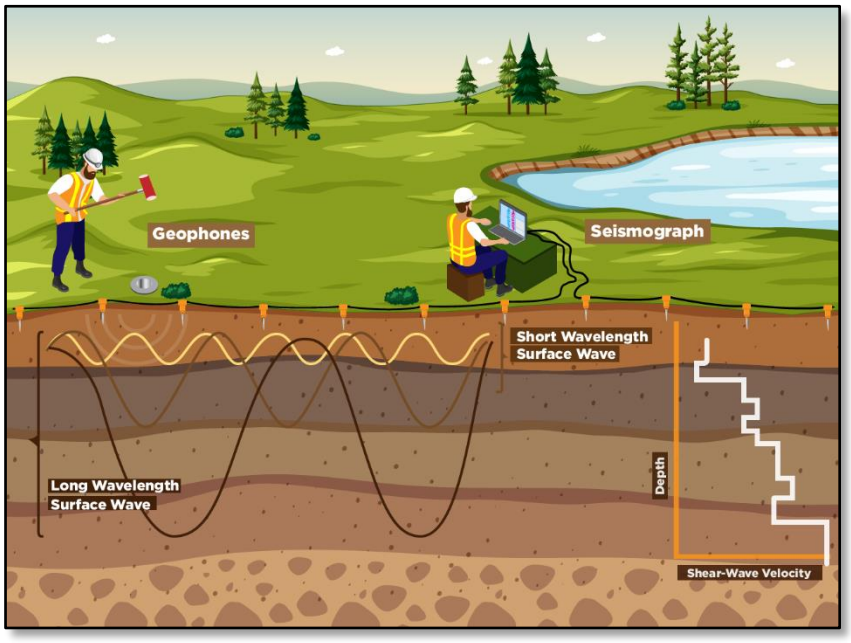


Figure 3: MASW Operating Principle

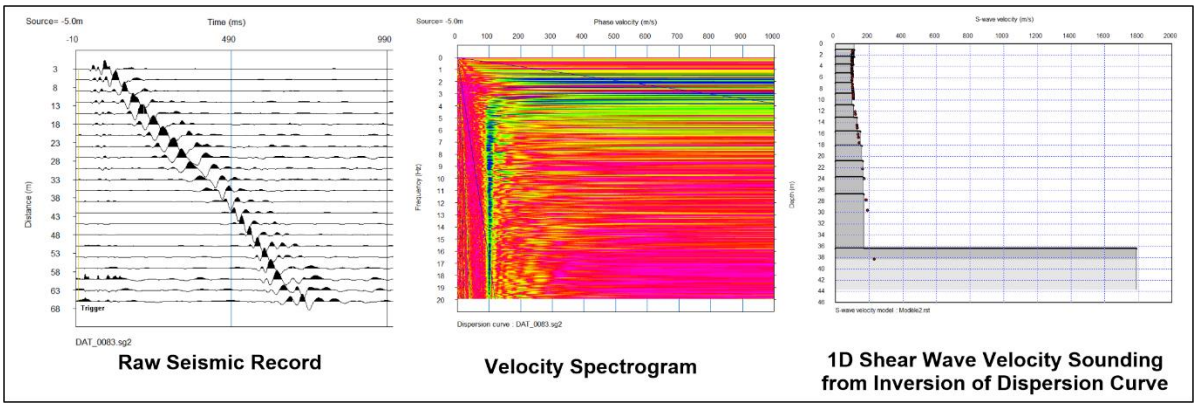


Figure 4: Example of a MASW/SPAC record, Phase Velocity - Frequency curve of the Rayleigh wave and resulting 1D Shear Wave Velocity Model

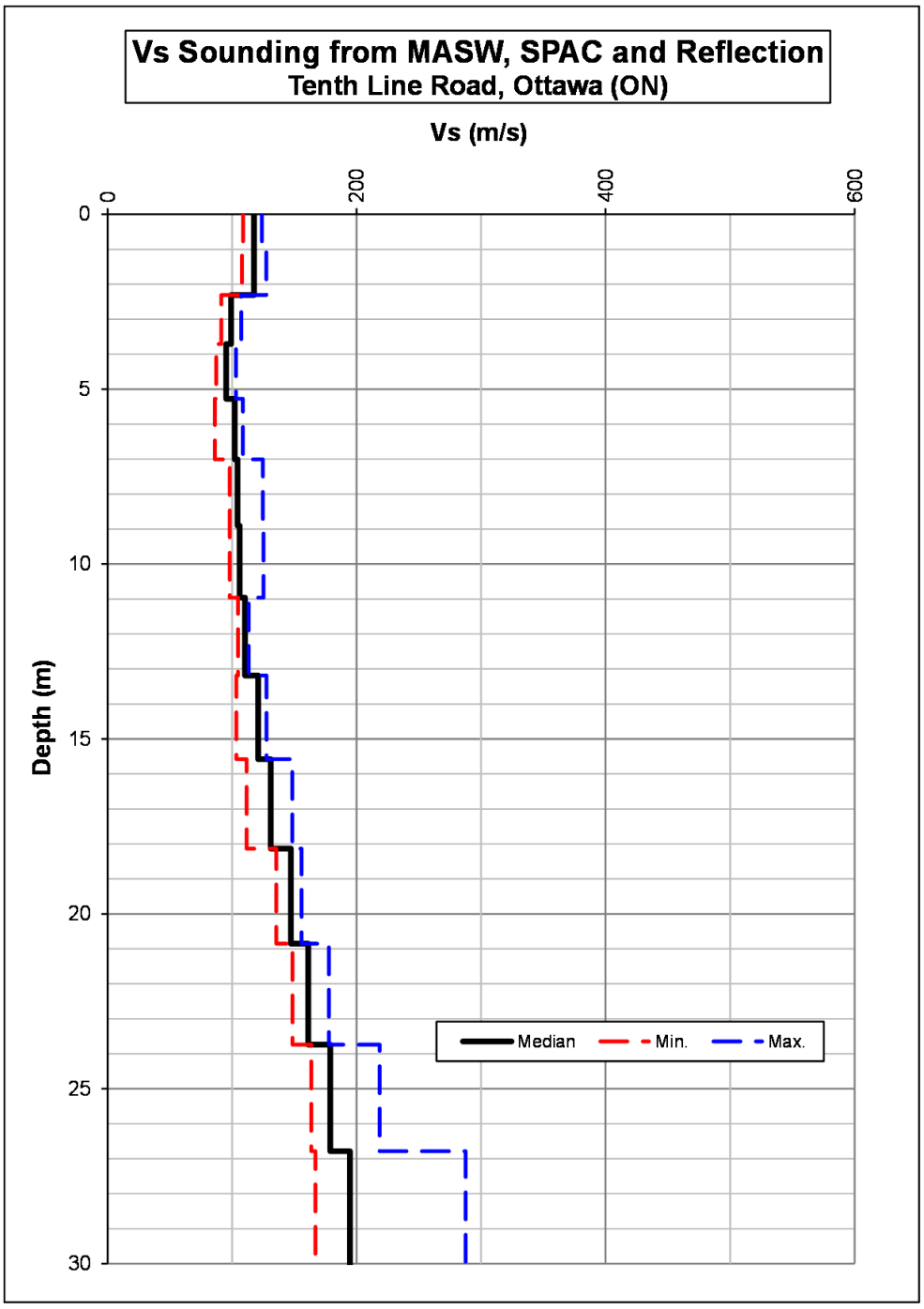


Figure 5: MASW Shear-Wave Velocity Sounding

TABLE 1
V_{S30} Calculation for the Site Class (actual site)

Depth	Vs			Thickness	Cumulative Thickness	Delay for Median Vs	Cumulative Delay	Vs at given Depth
	Min.	Median	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	**108.8**	**117.6**	**123.9**	**Ground level while survey (November 24th, 2022)**				
1.07	**108.0**	**117.6**	**127.6**	1.07	1.07	0.009113	0.009113	117.6
2.31	**91.4**	**99.1**	**107.4**	1.24	2.31	0.010511	0.019624	117.6
3.71	**87.2**	**95.2**	**103.2**	1.40	3.71	0.014137	0.033761	109.9
5.27	**86.1**	**102.2**	**108.6**	1.57	5.27	0.016450	0.050211	105.1
7.01	**98.1**	**104.4**	**124.6**	1.73	7.01	0.016933	0.067144	104.3
8.90	**98.1**	**106.0**	**125.3**	1.90	8.90	0.018154	0.085298	104.4
10.96	**104.7**	**110.3**	**113.3**	2.06	10.96	0.019429	0.104727	104.7
13.19	**103.5**	**120.9**	**127.6**	2.23	13.19	0.020169	0.124896	105.6
15.58	**111.7**	**131.0**	**148.4**	2.39	15.58	0.019768	0.144664	107.7
18.13	**135.4**	**147.1**	**155.8**	2.55	18.13	0.019509	0.164173	110.4
20.85	**148.5**	**161.1**	**177.8**	2.72	20.85	0.018487	0.182660	114.2
23.74	**163.7**	**178.8**	218.5	2.88	23.74	0.017907	0.200568	118.3
26.79	**167.0**	194.6	287.6	3.05	26.79	0.017052	0.217620	123.1
30				3.21	30.00	0.016515	0.234135	128.1

V_{S30} (m/s)	**128.1**
Site Class	**E** (1)

(1) Conditional to geotechnical assessment results of the materials associated with the very low to low seismic velocity values, for the potential of liquefaction, the clay degree of sensitivity, and/or other critical parameters.

Appendix B – Laboratory Certificate of Analysis

AGAT Laboratories

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

CLIENT NAME: **EXP SERVICES INC**
2650 QUEENSVIEW DRIVE, UNIT 100
OTTAWA, ON K2B8H6
(613) 688-1899
ATTENTION TO: **Matthew Zammit**
PROJECT: **OTT-22017859-AO**
AGAT WORK ORDER: **23Z986235**
SOIL ANALYSIS REVIEWED BY: **Nivine Basily, Inorganics Report Writer**
DATE REPORTED: **Jan 13, 2023**
PAGES (INCLUDING COVER): **5**
VERSION*: **1**

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

Notes

Disclaimer:

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

AGAT Laboratories

5835 COOPERS AVENUE
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TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 23Z986235

PROJECT: OTT-22017859-AO

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Matthew Zammit

SAMPLING SITE:2666 Tenth Line Rd., Ottawa

SAMPLED BY:EXP

(Soil) Inorganic Chemistry

DATE RECEIVED: 2023-01-09 **DATE REPORTED: 2023-01-13**

		SAMPLE DESCRIPTION:		BH1 SS5 10'-12'	BH6 SS3 5'-7'	BH7 SS8 25'-27'
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2022-12-19	2022-12-14	2022-12-14
Parameter	Unit	G / S	RDL	4669537	4669539	4669540
Chloride (2:1)	µg/g		2	456	22	1500
Sulphate (2:1)	µg/g		2	108	89	84
pH (2:1)	pH Units		NA	9.24	8.19	9.43
Resistivity (2:1) (Calculated)	ohm.cm		1	1040	5050	256

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

4669537-4669540 pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

AGAT Laboratories

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

Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 23Z986235

PROJECT: OTT-22017859-AO

ATTENTION TO: Matthew Zammit

SAMPLING SITE:2666 Tenth Line Rd., Ottawa

SAMPLED BY:EXP

Soil Analysis

RPT Date: Jan 13, 2023			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(Soil) Inorganic Chemistry															
Chloride (2:1)	4663797		35	35	0.0%	< 2	93%	70%	130%	97%	80%	120%	96%	70%	130%
Sulphate (2:1)	4663797		257	255	0.8%	< 2	97%	70%	130%	100%	80%	120%	NA	70%	130%
pH (2:1)	4671172		10.3	10.3	0.0%	NA	94%	80%	120%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.

Certified By:

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
NIVINE BASILY
CHEMIST

AGAT Laboratories

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

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 23Z986235

PROJECT: OTT-22017859-AO

ATTENTION TO: Matthew Zammit

SAMPLING SITE:2666 Tenth Line Rd., Ottawa

SAMPLED BY:EXP

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

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

Report Information:

Company: EXP
Contact: Matthew Zammit
Address: 2650 Queensview dr Suite 100
Ottawa, ON, K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: Matthew.Zammit@exp.com
2. Email:

Project Information:

Project: OTT-22017859-A0
Site Location: 2666 Tenth Line Rd, Ottawa
Sampled By: Exp
AGAT ID #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐
Company:
Contact:
Address:
Email:

Regulatory Requirements:

(Please check all applicable boxes)

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

☐ Excess Soils R406
Table _____ *Indicate One*
☐ Regulation 558
☐ CCME

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

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Sample Matrix Legend

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

Laboratory Use Only

Work Order #: 2329860235
Cooler Quantity: n/a - bag - no ice packs
Arrival Temperatures: 19.2 | 19.1 | 19.1
LT 6.0 | 6.2 | 6.3
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes:

Turnaround Time (TAT) Required:

Regular TAT (Most Analysis) ☒ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day
OR Date Required (Rush Surcharges May Apply):
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*
For 'Same Day' analysis, please contact your AGAT CPM

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC Y/N	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs Analyze F4G if required ☐ Yes ☐ No	O. Reg 153: PAHs	O. Reg 153: Total PCBs ☐ Aroclor	O. Reg 153: VOC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	O. Reg 406: Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	O. Reg 406: Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR	pH	Sulphates	Chlorides	Resistivity				Potentially Hazardous or High Concentration (Y/N)
BH 1 SS5 10'-12'	Dec 19	AM PM	1														✓	✓	✓	✓				
BH 6 SS3 5'-7'	Dec 14	AM PM	1														✓	✓	✓	✓				
BH 7 SS8 25'-27'	Dec 14	AM PM	1														✓	✓	✓	✓				
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign): C. Griffith	JAN 09 2023 Date	Time 10h25
Samples Relinquished By (Print Name and Sign): C. Cuto Pino	JAN 09 2023 Date	Time 16h00	Samples Received By (Print Name and Sign): M. GRASIC	Date Jan 10	Time 9:10
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page _____ of _____
N°: T 122988

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