Ottawa-Carleton District School Board (OCDSB)

Preliminary Geotechnical Investigation

Type of Document
Final

Project Name
Proposed Elementary School
Blackstone Residential Development
Cope Drive and Rouncey Road, Ottawa, ON

Project Number
OTT-00245378-K0

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Date Submitted
March 22, 2019

Ottawa-Carleton District School Board

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Executive Summary

A preliminary geotechnical investigation was undertaken on a parcel of land located in the southwest quadrant of the intersection of Cope Drive and Rouncey Road in the City of Ottawa, Ontario. This work was authorized by the Ottawa-Carleton District School Board under Standing Offer Agreement Number 18-007 and via PO Number 333190003289 dated February 19, 2019.

It is proposed to build a school on the site. Structural details, location of building on the parcel of land, proposed grade-raise, etc., were not available at the time of preparing this report.

The investigation comprised of drilling seven boreholes to refusal at 3.7 m in Borehole 2 and 13.1 m depth in Borehole 7, while all the other boreholes were terminated at 7.1 m to 9.2 m depth. In addition, a dynamic cone penetration test was performed beside Borehole 1 to refusal at 7.3 m depth and a dynamic cone penetration test was performed in the bottom of Borehole 7 to refusal at 18.8 m depth. The groundwater table was established at 1.9 m to 5.1 m depth in Boreholes 1 and 3 to 7, whereas Borehole 2 was dry. The groundwater table has not stabilized during the short-term interval over which the readings were made.

The investigation revealed that in the west part of the site (Boreholes 1 and 2) silty clay crust extends to 2.3 m depth in Borehole 1 and to 2.6 m depth in Borehole 2. The silty clay crust is underlain by compact to loose silty sand till. In the other boreholes, some fill and silty clay crust is underlain by firm to stiff silty clay, which extends to entire depth investigated in Boreholes 3 and 5 to 7 (i.e. 8.0 m to 9.2 m depth) and to 12.2 m depth in Borehole 4. Based on the dynamic cone test, it is inferred that the silty clay in Borehole 7 may extend to 18.2 m depth. The silty clay in Borehole 4 and 7 is expected to be underlain by silty sand till to refusal depth of 13.1 m in Borehole 4, and 18.8 m depth in Borehole 7.

The investigation has revealed that from a geotechnical perspective, the founding soils are better in the west part of the site compared to the rest of the site. If practical, consideration should therefore be given to the possibility of building the school in the west part of the block. In the remainder of the site, the firm to stiff silty clay has limited capacity to support loads. Therefore, Serviceability Limit State (SLS) and Ultimate Limit State (ULS) bearing pressure available for the design of the footings will be a function of the undisturbed shear strength of the silty clay, founding depth, proposed grade raise and post construction lowering of the groundwater table. Most of these parameters are currently not known. Therefore, the SLS and ULS bearing pressures that will likely be available for the design of footings 1 m to 3 m wide set at 1.5 m and 2.5 m depth below finished grade with grade raise of 1 m and 2 m respectively were computed and have been listed on Table 2 in the report. If initial analysis indicates that these bearing capacities are not sufficient to found the structure on spread and strip footings, piled foundations would be required.

Closed end pipe piles driven to practical refusal in the till or on bedrock are considered to be the most suitable type of foundations. The design loads that these piles can carry have been listed on Table 3 based on the assumption that the piles will meet refusal in the till. The depth at which these piles will meet refusal is expected to vary greatly, i.e. from about 4 m in the vicinity of Borehole 2 to 18.8 m depth in the vicinity of Borehole 7.

The floor slab of the proposed building may be considered as slab-on-grade provided it is set on a 200 mm thick, 19 mm clear crushed stone and the exterior grade is lower than the floor slab by at least 150 mm. The finished exterior grade should be sloped away from the structure.

The site has been classified as **Class D** for seismic site classification based on the shear-wave velocity measurements at the site. The silty clay soils are considered to be moderately susceptible to liquefaction during a seismic event.

Excavations at the site are expected to extend to a maximum depth of 2 m to 4 m below the existing ground surface. They are expected to be up to 2 m below the groundwater table. These excavations may be undertaken as open cut provided they are cut back at 45 degrees above the groundwater table and at an inclination of 3H:1V below the groundwater table. A 'base-heave' type of failure of the excavation is not anticipated. It should be possible to collect the surface and subsurface water entering the excavations in perimeter ditches and to remove by pumping.

The pavement structure for the proposed access roads may consist of 90 mm of asphaltic concrete underlain by 150 mm of crushed limestone Granular A base and 550 mm of OPSS Granular B subbase. Parking area pavements may consist of 65 mm of asphaltic concrete underlain by 150 mm of Granular A base and 400 mm of Granular B Type II subbase.

The above and other related considerations have been discussed in greater detail in the report.

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1 Introduction

EXP Services Inc. (EXP) is pleased to present the results of the preliminary geotechnical investigation completed for the proposed Elementary School to be located in the Blackstone Residential Development at the intersection of Cope Drive and Rouncey Road in the City of Ottawa, Ontario. This work was completed under EXP Standing Offer Agreement with the Ottawa-Carleton District School Board (OCDSB) No. 18-0-7; Purchase Order Number: 333190003289 dated February 19, 2018.

Details regarding the location of the structure on the site, structural loads and founding depth, design grades, etc., were not available at the time of preparing this preliminary geotechnical investigation report.

This preliminary geotechnical investigation was undertaken to:

a) Establish the subsurface soil, bedrock and groundwater conditions at the borehole locations;

b) Comment on the grade-raise restrictions;

c) Make recommendations regarding the most suitable type of foundations, founding depth and Serviceability Limit States (SLS) bearing pressures and Ultimate Limit States (ULS) factored geotechnical resistances and comment on anticipated settlements;

d) Discuss slab-on-grade construction and permanent drainage requirements;

e) Comment on the liquefaction potential of the subsurface soils during a seismic event and classify the site for seismic response in accordance with requirements of the 2012 Ontario Building Code (OBC);

f) Discuss excavation conditions and dewatering requirements;

g) Comment on backfilling requirements and suitability of the on-site soils for backfilling purposes;

h) Recommend pavement structures for the proposed access roads and parking areas; and

i) Comment on subsurface concrete requirement.

As indicated above, since the design details are not available at this time, the discussion and recommendations contained in this report are preliminary and subject to revision subsequent to a detailed geotechnical investigation, which must be undertaken once the design details are available**.**

2 Site Description

The site is located in the Blackstone Residential Development in the City of Ottawa, Ontario (Figure 1). It is comprised of a parcel of land 7.02 acres in area. The parcel of land is bordered by Cope Drive to the north, Rouncey Road to the east, Continental Avenue to the west and some residential development and vacant land to the south. The site is flat lying with the ground surface elevations at the borehole locations varying between elevation 99.36 m and 100.88 m. At the time of the investigation, the site was snow covered. In addition, stockpiles of topsoil and fill were noted throughout the site.

3 Procedure

The fieldwork for the preliminary geotechnical investigation was undertaken between February 21 and 25, 2019. It comprised of drilling seven boreholes (Boreholes 1 to 7) to 3.7 m to 13. 1 m depth at locations shown on the Borehole Location Plan, Figure 2. In addition, two dynamic cone penetration tests were also performed. One of the dynamic cone penetration tests was performed beside Borehole 1 to refusal at 7.0 m depth whereas the other dynamic cone penetration test was performed in the bottom of Borehole 7 to refusal at 18.8 m depth. The fieldwork was supervised by a geotechnician on a full-time basis.

The locations of the boreholes and their elevations were established by representatives of EXP. The elevations of the boreholes refer to the Geodetic datum. The borehole locations were cleared of private and public underground services prior to the start of the drilling operations.

The boreholes were drilled with a CME-55 track-mounted drill rig equipped with continuous flight hollow-stem auger equipment. Standard penetration tests (ASTM 1586) were performed in all the boreholes at regular depth intervals and soil samples retrieved by the split-barrel sampler. Relatively undisturbed thin-walled tub samples (Shelby tube samples) were retrieved at selected depth intervals within the clay. The undrained shear strength of the clay was measured by conducting penetrometer and in-situ vane tests at selected depth intervals.

Groundwater levels were measured in the open boreholes upon completion of drilling. In addition, 19 mm diameter slotted standpipe piezometers were installed in five boreholes for long-term monitoring of the groundwater levels. The standpipe piezometers were installed in accordance with EXP standard practice and their installation configuration is documented on the respective borehole logs.

On completion of the fieldwork, all the soil samples were transported to the EXP laboratory in the City of Ottawa. All the borehole samples were visually examined in the laboratory by a senior geotechnical engineer for textural classification, and borehole logs prepared. The engineer also assigned the laboratory testing, which consisted of performing the following tests on selected soil samples in accordance with the American Society for Testing and Materials (ASTM).

Tests on Selected Soil Samples:

Natural Moisture Content	56 tests
Natural Unit Weight	12 tests
Grain-size Analysis	4 tests
Atterberg Limits	3 tests
pH, Sulphate, Chloride and Electrical Resistivity Analyses	3 tests

4 Subsurface Soil and Groundwater Conditions

A detailed description of the subsurface soil and groundwater conditions determined from the boreholes is given on the attached borehole logs, Figures 3 to 9.

The borehole 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 may also result in changes in the conditions interpreted to exist at the locations where sampling was conducted. Boreholes were drilled 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. 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 “Notes on Sample Descriptions” preceding the borehole logs forms an integral part of this report and should be read in conjunction with this report.

A review of the borehole logs indicates the following soil stratigraphy with depth.

4.1 Topsoil

A 300 mm thick surficial topsoil layer was contacted in Boreholes 1, 3 and 6.

4.2 Fill

Surficial fill was encountered I Boreholes 2, 5 and 7 and extended to a depth of 0.75 m to 1.2 m (Elev. 99.4 m to 100.1 m) The fill consists of disturbed silty clay to mixture of silty clay and sand and gravel, to sand and gravel. It is loose. The natural moisture content of the fill varies from 23 to 29 percent.

4.3 Silty Clay Crust

The surficial soil in Borehole 4 is silty clay crust, which also underlies the fill in Boreholes 2, 5 and 7 and the topsoil in Boreholes 1, 3 and 6. The desiccated crust extends to 2.3 m to 3.2 m depth (Elev. 97.1 m to 98.3 m). The crust is stiff to very stiff as indicated by its shear strength, which varies from 96 kPa to 186 kPa. It has a unit weight of 16.9 to 19.4 kN/m^3 and moisture content of 23 to 52 percent.

A grain-size analysis performed on a sample of the silty clay crust yielded a composition of 31 percent clay, 65 percent silt and 4 percent sand (Figure 10). Its liquid limit is 34.2 percent and plastic limit is 17.9 percent. On this basis, the clay may be described as inorganic clay of medium plasticity.

4.4 Silty Clay

The silty clay crust in Boreholes 3 to 7 is underlain by firm to stiff silty clay, which extends to the entire depth investigated in Boreholes 3 and 5 to 7, i.e. 8.0 m to 9.2 m (Elev. 91.0 to 92.9 m) and to 12.2 m depth in Borehole 4 (Elev. 88.1 m). It is noted that a dynamic cone penetration test performed in the bottom of borehole 7 indicates that the silty clay likely extends to 18.1 m depth. In summary, the firm to stiff silty clay was not encountered in the west part of the site and its thickness increases progressively to the east part of the site. The undrained shear strength of the silty clay varies from 29 kPa to 62 kPa. Its moisture content is 30 to 50 percent.

Two grain-size analyses performed on this stratum indicated that it comprises of 52 to 60 percent clay, 38 to 46 percent silt and 2 percent sand (Figures 11 and 12). Its liquid limit is 23.6 to 32.1 percent and plastic limit 16.6 to 17.3 percent. On this basis, the silty clay may be defined as inorganic clay of low to medium plasticity.

4.5 Silty Sand Till

The silty clay crust in Boreholes 1 and 2 and the silty clay in Borehole 4 are underlain by silty sand till, which extends to the refusal depth of 3.7 m in Borehole 2 and termination depths of 7.1 m in Borehole 1 (Elev. 93.3 m) and 13.1 m depth in Borehole 4 (Elev. 87.2 m). The refusal in Borehole 2 is considered to have been met on cobbles/boulders in the till. In Borehole 7, the dynamic core test indicated that the till is located below 18.1 m depth.

The till is loose to very dense as indicated by ‘N’ values of 3 to 50 for 50 mm penetration of the split-barrel sampler. Its moisture content and unit weight are 6.1 to 10.5 percent and 23.3 kN/m^3 respectively. A grain-size analysis performed on the till indicated a composition of 17 percent clay, 23 percent silt, 51 percent sand and 9 percent gravel (Figure 13).

4.6 Groundwater

Water level observations were made in the boreholes during drilling and in standpipes installed in Boreholes 1, 2, 4, 6 and 7 subsequent to completion of drilling. The water level observations made have been summarized on Table 1.

Table 1: Groundwater Observations

Borehole No.	Elapsed Time	Depth to Groundwater (m)	Elapsed Time	Water Level Depth (m)	Water Level Elev. (m)
1	On completion	3.0	11 days	2.65	97.8
2	On completion	Dry	8 days	Dry	Dry
3	On completion	3.6	11 days	--	--
4	On completion	6.0	8 days	3.35	97.0
5	On completion	4.6	12 days	1.9	98.4
6	On completion	3.9	11 days	5.1	95.2
7	On completion	4.8	12 days	2.85	97.8

The groundwater table had not stabilized during the short-time interval over which the observations were made. The groundwater table is also subject to seasonal fluctuations and may be at a higher level during wet weather periods.

5 Grade Raise Restrictions

The investigation has revealed that the west part of the site (Boreholes 1 and 2) contains stiff to very stiff silty clay crust, which is underlain by glacial till. In the remaining boreholes, the silty clay crust is underlain by firm to stiff silty clay, which is inferred to extend up to 18.2 m depth based on the seven boreholes drilled at the site. The firm to stiff silty clay has limited capacity to support structural loads.

The capacity of the firm to stiff silty clay to support structural loads will be adversely affected by the grade raise and by post construction lowering of the groundwater table at the site. The Serviceability Limit State (SLS) and factored Ultimate Limit State (ULS) bearing pressures recorded in Section 6.0 are based on a grade raise of 1 m to 2 m respectively assuming that lowering of the post construction groundwater table will not take place.

6 Foundation Considerations

6.1 Spread and Strip Footings

The preliminary geotechnical investigation has revealed that the west part of the site (Boreholes 1 and 2) contains silty clay crust underlain by glacial till. In the remainder of the site, the silty clay crust is underlain by firm to stiff silty clay, which has a limited capacity to support structural loads. The thickness of the firm to stiff silty clay increases progressively toward the east part of the site, and it is inferred that in Borehole 7, this stratum extends up to 18.2 m depth.

Feasibility of founding the proposed structure on spread and strip footings is a function of the following factors:

1.) Structural loads;
2.) Founding level of the footings below finished grade and size of footings;
3.) Location of the structure on the block;
4.) Grade raise at the site; and
5.) Post construction groundwater lowering.

It is noted that information regarding the above factors is not available at this stage. For preliminary assessment of the feasibility of founding the proposed structure on spread and strip footings, the SLS and ULS bearing pressures listed on Table 2 may be taken into consideration. Once the above factors can be quantified, a detailed geotechnical investigation should be undertaken on the site so that specific recommendations can be provided for the design of the footings.

Table 2: Recommended Founding Depth, SLS and Factored ULS Bearing Pressures for Design of Footings

Borehole No.	Grade Raise	Founding Depth Below Finished Grade	SLS and ULS Bearing Pressure for Footing Width Indicated		
			Footing Width	SLS (kPa)	ULS (kPa)
1 & 2	1 m	1.5 m	1 m – 3 m	150	225
		2.5 m	1 m – 3 m	120	180
	2 m	1.5 m	1 m – 3 m	96	144
		2.5 m	1 m – 3 m	76	114
3, 4, 5, 6 and 7	1 m	1.5 m	1 m	120	180
			2 m	90	135
			3 m	67	100
		2.5	1 m	115	172
			2 m	70	105
			3 m	55	83
	2 m	1.5 m below finished grade	1 m	96	144
			2 m	50	75
			3 m	40	60
		2.5 m below finished grade	1 m	76	114
			2 m	43	65
			3 m	32	48

A review of Table 2 indicates the SLS and ULS bearing pressures that would most likely be available for the design of the footings based on location, grade raise, footing depth, and size of the footings indicated.

It is also noted that the firm to stiff clay was not encountered in the vicinity of Boreholes 1 and 2. Therefore, from a geotechnical perspective, there would be potential savings in the construction costs if the structure can be located on the west part of the site.

The settlements of the footings under the above listed SLS bearing pressures are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential movements.

The use of spread and strip footings would require that the existing fill on the site is removed from the building areas as it is not suitable for carrying structural loads. In building areas, it would be necessary to replace this fill with engineered fill, which should be continued up to the underside of the floor slab. The engineered fill should consist of crusher-run limestone conforming to Ontario Provincial Standard

Specifications for Granular B, Type II. It should be compacted to 100 percent Standard Proctor Maximum Dry Density (SPMDD) up to the founding level and to 95 percent of SPMDD from the founding level to the 200 mm below the underside of the floor slab.

On-site supervision and testing would be required by geotechnical personnel during placement and compaction of the fill.

It would be necessary to protect the footings against frost damage. This would necessitate providing an earth cover of 1.5 m to all the exterior footings of a heated structure. Footings of unheated structure would require an earth cover of 2.1 m if snow will not be removed from their vicinity, and 2.4 m of earth cover if snow will be removed from the vicinity of the structure.

All the footing beds would require review by geotechnical personnel to assure that the design bearing pressure is available at the proposed founding level and that the footing beds have been adequately prepared.

Placement of 50 mm mud slab is recommended on the surface of the silty clay in areas where engineered fill is not required to protect the surface from disturbance due to movement of equipment and workers and due to precipitation.

The recommended bearing pressure at SLS and 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.

6.2 Pile Foundations

It is noted that if the SLS and ULS bearing pressures listed on Table 2 are not sufficient to enable design of spread and strip footing, consideration may have to be given to pile foundations. Closed end pipe piles are expected to be the most suitable type of driven piles. The piles are expected to meet practical refusal in the till and SLS load carrying capacity of the piles will govern the design.

Precise information regarding the refusal depth of the piles cannot be established based on the present limited investigation. However, indications are that the piles may meet refusal at varying depths, e.g. at a depth of 7.5 m approximately (Borehole 1) to 18.5 m depth (Borehole 7). The SLS an ULS load carrying capacity of the piles has been given on Table 3.

If fill is placed on the site to raise the grade, the piles will be subjected to negative skin friction due to consolidation of the silty clay and the overlying fill. The negative skin friction would have to be subtracted for the SLS and ULS load carrying capacity to arrive at the design loads that the piles can carry. Additional recommendations regarding the negative skin friction can be provided subsequent to detailed geotechnical investigation at the site.

Table 3: Serviceability Limit State and Factored Ultimate Limit State (ULS) Load Carrying Capacity of Steel Pipe Piles Driven to Refusal in Silty Sand Till

Type of Pile	Size	SLS Load Carrying Capacity (kN)	Factored Geotechnical Resistance at ULS (kN)
Steel Pipe	245 mm O.D. by 9 mm wall thickness	529	635
	245 mm O.D. by 12 mm wall thickness	700	845
	324 mm O.D. by 12 mm wall thickness	990	1190

The SLS and factored ULS loads listed on Table 3 are based on steel piles with a yield strength of 350 MPa and concrete compressive strength of 35 MPa. It has been assumed that the piles will meet refusal in the till.

Settlements induced by the above recommended pile loads are expected to be less than normally tolerated limits of 25 mm total and 19 mm differential movements.

An additional investigation will be required at the site to establish the depth to the silty sand till and bedrock throughout the site if piled foundation is to be used.

7 Floor Slab and Drainage Requirements

The lowest level floor slab of the proposed building may be constructed as a slab-on-grade provided it is cast on a bed of well-compacted 19 mm clear stone at least 200 mm thick placed on engineered fill or on natural undisturbed silty clay.

The need for perimeter and underfloor drainage systems for the proposed school building will have to be assessed based on the design elevation of the ground floor relative to the prevailing groundwater elevation established during the detailed geotechnical investigation.

The finished floor slab, however, should be set at least 150 mm higher than the finished exterior grade. The finished exterior grade of the building should be sloped away from the building at an inclination of at least two percent to prevent surface ponding of water close to the exterior walls.

8 Seismic Site Classification and Liquefaction Potential of On-Site Soils

The investigation has revealed that the west part of the site contains silty clay crust underlain by glacial till. The remainder of the site contains some localized fill underlain by silty clay crust and silty clay, which likely extends up to 18.3 m depth. The silty clay is underlain by glacial till.

Geophysics GPR International Inc. was commissioned to carry out seismic shear-wave surveys on the site. Based on the results of the survey, the average shear-wave velocity to 30 m depth (V_{s30}) was established by GPR as 268.8 m/s. On this basis, the site has been classified as Class D in accordance with Table 4.1.8.4A of the Ontario Building Code, 2012.

Three Atterberg Limit tests were performed on the silty clay samples from the site. The results have been plotted on Bray et al. (2004) chart to assess the liquefaction potential of the silty clay during a seismic event. The results indicate that the silty clay at the site is moderately susceptible to liquefaction during a seismic event (Figure 14).

9 Excavations and De-Watering Requirements

9.1 Excavations

The geotechnical conditions at the site consist of some localized surficial fill beneath which silty clay extends to 18.2 m depth. The exception to this is in the west part of the site (Boreholes 1 and 2), where silty clay crust is underlain by silty sand till below 2.3 m to 2.6 m depth. The groundwater level was measured at 1.9 m to 5.1 m depth below existing grade. However, it is likely that the groundwater table had not stabilized over the short time period over which rea readings were collected. Large stockpile of topsoil and fill placed at the site would require to be removed and dispose off-site.

Details regarding the location, lateral extent and depth of the excavations were not available at the time of this preliminary geotechnical investigation. It is assumed that excavations will extend to a depth of 2 m approximately below the existing ground surface and will be above or slightly below the groundwater table. A base-heave type of failure of the excavation is not anticipated in the glacial till and the silty clay.

Excavation of the overburden soil may be undertaken with conventional mechanical equipment.

All excavations at the site should comply with the most recent edition of Occupational Health and Safety Act (OHSA), Ontario Regulations 213/91 (August 1, 1991). The excavations in the soils above the groundwater table are considered to be Type 3 soil as defined by OHSA and as such must be cut back at 1H:1V from the base of the excavation. Excavations below the groundwater table are expected to slough and are anticipated to stabilize at a slope of 2H:1V to 3H:1V.

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.

9.2 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 may exist, higher water seepage should be anticipated. Therefore, the need of high capacity pumps to keep the excavation dry should not be overlooked.

It is noteworthy 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 and Climate Change (MOECC) 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 MOECC 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. 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. EXP can provide assistance during the EASR/PTTW process, if required.

Although this investigation has estimated the groundwater levels at the time of the field work, and commented on de-watering and general construction problems, conditions may be present that are difficult to establish from standard boring and excavating techniques. These conditions may affect the type and nature of de-watering procedures used by the contractor. 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 de-watering systems.

9 Backfilling Requirements and Suitability of On- Site Soils for Backfilling Purposes

The on-site soils to be excavated are the existing fill and silty clay. The fill is random and contains organics. It is not suitable for backfilling. However, it may be used for landscaping purposes.

- Existing fill free of boulders, debris may be used as fill in landscaped areas only.
- The desiccated silty clay crust may be compactable. Its compactability would have to be assessed during final geotechnical investigation. If the silty clay crust is compactable, it may be used to backfill service trenches and as subgrade fill in paved areas provided its moisture content is maintained between 2 and 3 percent of the optimum value. If it is determined to be not compactible, it may be used for landscaping purposes.

Therefore, it is anticipated that the majority of the material required for backfilling in the interior and exterior of the building, in service trenches, for subgrade and for site grading purposes would have to be imported and should preferably conform to the following specifications:

- Engineered Fill under footings - OPSS 1010 Granular B, Type II, compacted to 100 percent of the SPMDD;
- Engineered Fill under building slab, inclusive of any services trenches in the interior of the building - OPSS 1010 Granular B, Type II, compacted to 98 percent of the SPMDD;
- Backfill of service trenches exterior to the building – OPSS 1010 Granular B Type I OR II above the groundwater table and OPSS 1010 Granular B Type II below the groundwater table, compacted to 95 percent of the SPMDD; and
- Trench backfill and subgrade fill in parking areas, access roadways – OPSS 1010 Select Subgrade Material (SSM), OR on-site dry silty clay material (if approved and as noted above) and compacted to 95 percent of the SPMDD.

10 Access Roads and Parking Areas

Subgrade for the proposed parking areas, access roadways and other hard surfaces at the site will comprise of native clay or select subgrade material used to raise the grades to the proposed subgrade levels following the removal of all the existing fill placed at the site.

Pavement structure thicknesses required for the light duty and heavy-duty roadways (fire route) were computed and are shown on Table 4. The thicknesses are based upon an estimate of the subgrade soil properties determined from visual examination, textural classification of the soil samples and functional design life of 15 to 18 years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table 4: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Light Duty (Cars and Parking)	Heavy Duty (Fire Route)
Asphaltic Concrete (PG 58-34)	92 - 97% MRD	65 mm HL3 or SP12.5 Cat B	40 mm HL3 or SP12.5 Cat B 50 mm HL8 or SP19 Cat B
OPSS 1010 Granular 'A' Base (crushed limestone)	100% SPMDD*	150 mm	150 mm
OPSS 1010 Granular 'B' Sub-base, Type II	100% SPMDD*	400 mm	550 mm

Notes:

MRD denotes Maximum Relative Density – ASTM D-2041, SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698-12e2, Asphaltic Concrete in accordance with OPSS 1150 (Marshall Mixes) or OPSS 1151 (Superpave Mixes).

The foregoing design assumes that construction is carried out during dry periods and that the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather, and heaving or rolling of the subgrade is experienced, additional thickness of granular material and/or geotextile may be required.

Additional comments on the construction of parking area are as follows:

1. As part of the subgrade preparation, the proposed parking area and access roadways should be stripped of topsoil, existing fill down to native silty clay. The subgrade should be proof rolled by 10 tons vibratory roller in the presence of a geotechnician and approved before placement of the granular materials for the pavement structure (or granular materials for the grade raise)
2. Fill required to raise the grades to design elevations should conform to requirement as per Section 9 which should be placed and compacted to 95 percent of the SPMDD. 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

subexcavated and properly replaced with suitable approved backfill compacted to 98% SPMDD (ASTM D698-12e2).

3. 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. Sub-drains must be installed on both sides of the access roads, in the proposed parking areas. The sub-drains should be installed at low points and should be continuous between catch basins 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 requirement and location and extent of subdrainage required within the paved areas will have to be established once the grades at the site are finalized.
4. To minimize the problems of differential movement between the pavement and catchbasins/ manholes due to frost action, the backfill around the structures should consist of free-draining granular preferably conforming to OPSS 1010 Granular B, Type II material. Weep holes should be provided in the catchbasins/manholes to facilitate drainage of the granular fill.
5. 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, etc., may be required, especially if construction is carried out during unfavorable weather.
6. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum cross fall of 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.
7. Relatively weaker subgrade may develop over service trenches at subgrade level if wet soils is used to backfill of the service trenches. Therefore, only dry and compactible material should be used to backfill service trenches as recommended in Section 12 of the report.
8. The granular materials used for pavement structure should conform to OPSS 1010 for Granular A and Granular B Type II and should be compacted to 100 percent of the SPMDD.
9. The asphaltic concrete used, and its placement should meet OPSS 1150 or 1151 requirements. It should be compacted to 92 to 97 percent of the Marshall Relative Density (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 that they are consistent with the recommendations of this report.

11 Subsurface Concrete Requirements and Corrosion Potential of Subsurface Soil to Buried Steel

Chemical tests limited to pH, sulphate, chloride and electrical resistivity were undertaken on two (2) selected soil samples and the results are shown in Table 5. The laboratory certificate of analysis for the chemical tests is shown in Appendix A.

Table 5: Results of pH, Chloride, Sulphate and Resistivity Tests on Selected Soil Samples

Borehole No. - Sample No.	**Soil**	**Depth (m)**	**pH**	**Sulphate (%)**	**Chloride (%)**	**Resistivity (ohm.cm)**
Threshold Values			**<5**	**>0.1**	**>0.04**	**<1500 ohm.cm Corrosive**
1 – SS2	Silty Clay Crust	0.76 – 1.4	7.8	0.00040	0.0013	3690
5 – SS3	Silty Clay Crust	1.5 – 2.1	7.94	0.0039	0.0012	4740
6 – SS4	Silty Clay Crust	2.3 – 2.9	8.09	0.0014	0.0009	5880

The results indicate a soil with sulphate and chloride content of less than 0.1 percent and 0.04 percent respectively. These concentrations of sulphate and chloride would have a negligible potential of sulphate and chloride attack on subsurface concrete. The concrete should be in accordance with Table Nos. 3 and 6 of CSA A.23.1-14. However, the concrete should be dense, well compacted and cured.

The results of the resistivity tests indicate that the soil is mildly corrosive to underground bare steel structures. A corrosion expert should be contacted to provide corrosion protection recommendations if steel is to be buried on the site.

12 General Closure

Design details for the proposed school development were not available at the time of this preliminary geotechnical investigation. Therefore, comments and recommendations provided in this report are considered preliminary in nature and must be verified by a more detailed geotechnical investigation once design details are available.

The information contained in this report in no way reflects on the environmental aspects of the soils. Should specific information be required, additional testing may be necessary.

We trust this report is satisfactory for your purposes. If you have any questions regarding our submission, please do not hesitate to contact this office.

FIGURES

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scale N.T.S	CLIENT: OTTAWA CARLETON DISTRICT SCHOOL BOARD	project no. OTT-00245378-K0
date FEB, 2019	TITLE: PROPOSED ELEMENTARY SCHOOL,COPE DRIVE & ROUNCEY ROAD, OTTAWA, ON SITE LOCATION PLAN	FIG 1
drawn by A.O.		

Filename: p:\projects\geotechnical\240000\245000\245378 k0- geo inv scvhool blackstone ocdsbk - drawings\civil\19098-civil_metric.dwg
Last Saved: 3/11/2019 1:43:17 PM
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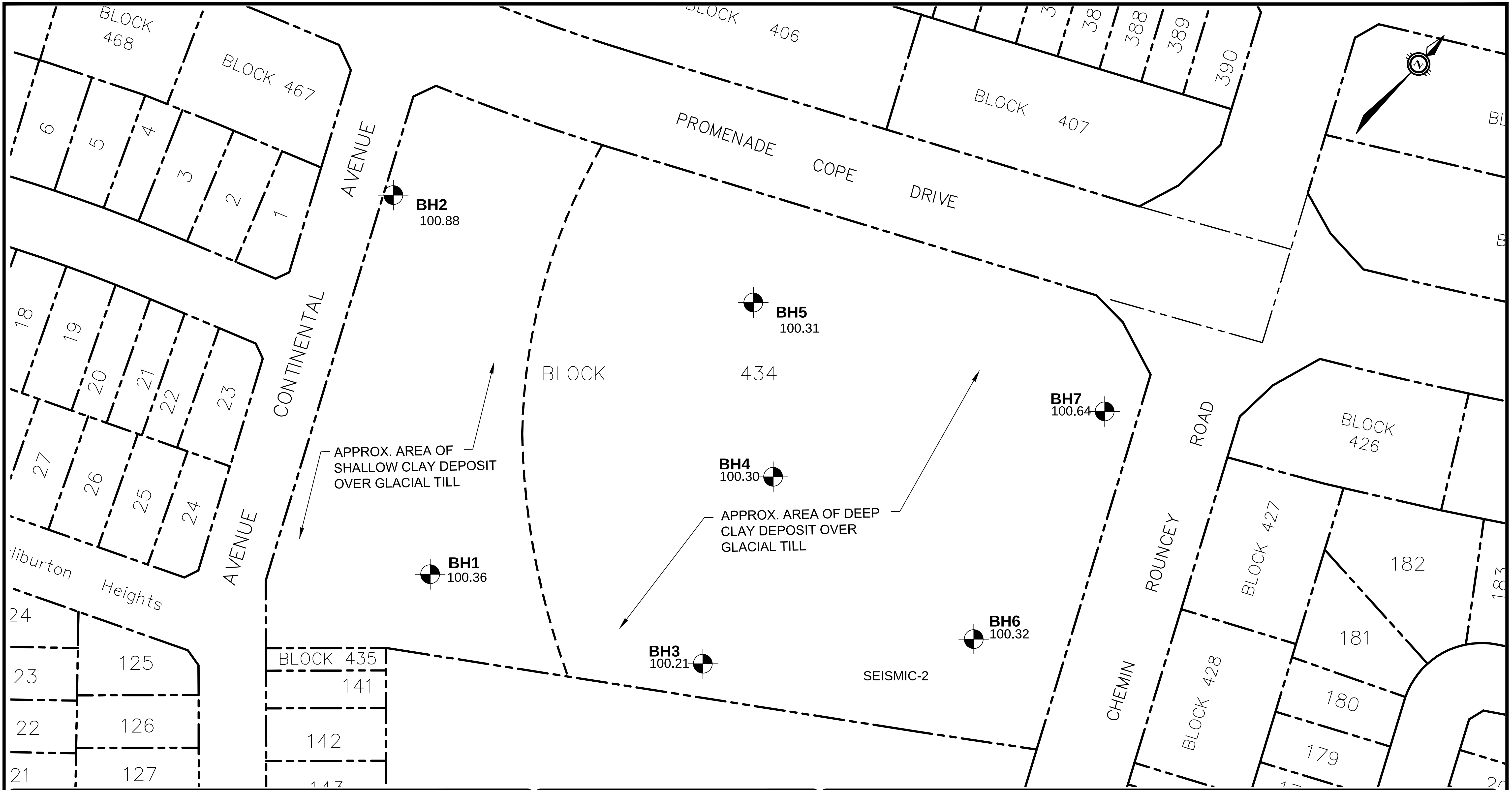

NOTES:
1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. TOPSOIL QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION PROVIDED AT THE BOREHOLE LOCATIONS.
4. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
6. BASE PLAN OBTAINED FROM AOV, PROJECT 19098, DATED SEPTEMBER 20, 2018.

LEGEND

⊕ **BH1** 98.00 — BOREHOLE NUMBER, LOCATION AND ELEVATION

— - - — PROPERTY BOUNDARY

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scale: N.T.S
date: FEB, 2019
drawn by: A.O
CLIENT: OTTAWA-CARLETON DISTRICT SCHOOL BOARD
TITLE: BOREHOLE LOCATION PLAN
COPE DRIVE & ROUNCEY ROAD, OTTAWA, ON
project no. OTT-00245378-K0
FIG 2

Filename: p:\projects\geotechnical\240000\245000\245378 k0- geo inv scvhool blackstone ocdsblk - drawings\245378-k0 fig 2 bh plan.dwg
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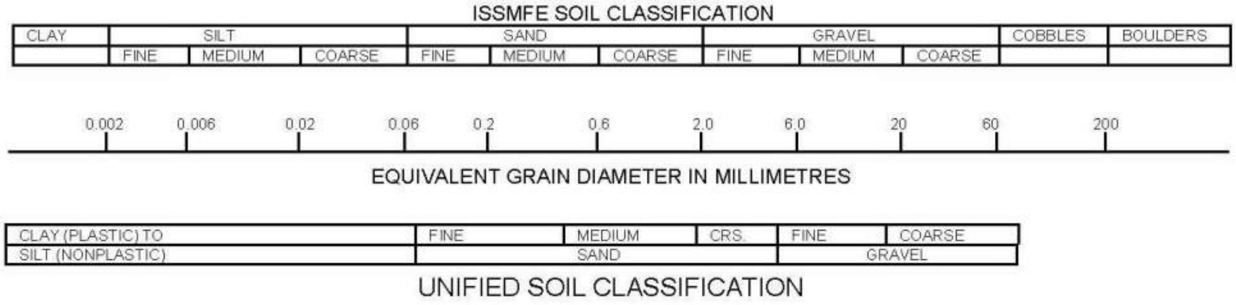
Notes On Sample Descriptions

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.



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-1

Project No: OTT-00245378-K0

Project: Preliminary Geotechnical Investigation - Proposed Blackstone Elementary

Location: School. Cope Drive and Riouncey Drive, City of Ottawa, Ontario

Figure No. 3

Page. 1 of 1

Date Drilled: 'February 22, 2019

Drill Type:

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	◫	Natural Moisture Content	×
SPT (N) Value	○	Atterberg Limits	├─○
Dynamic Cone Test	──	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

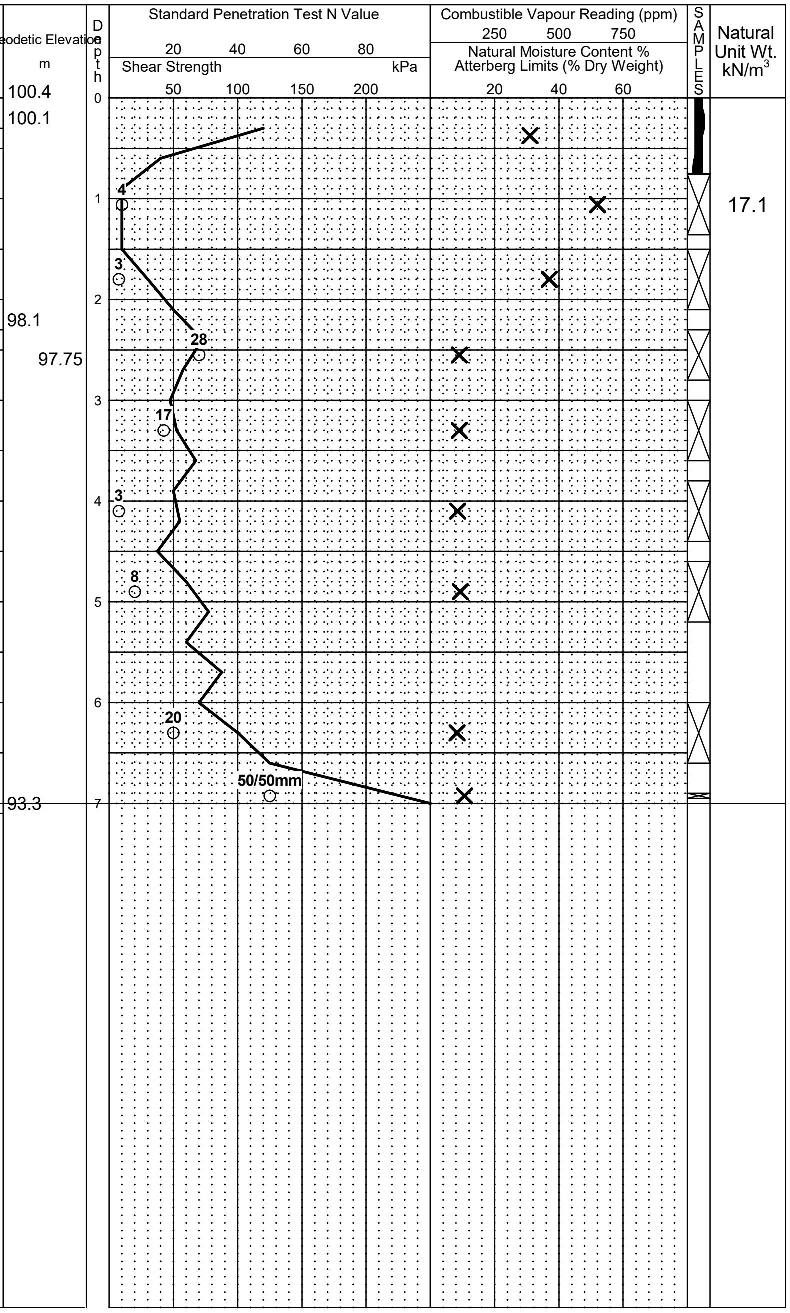
GWL | SYMBOL | SOIL DESCRIPTION

TOPSOIL ~ 300 mm

SILTY CLAY CRUST
Oxidized silt pocktes, brown to grey, moist to very moist (very stiff to stiff)

SILTY SAND TILL
Trace to some clay, scattered gravel and cobbles, occasional sand seams or layers, grey, moist to wet (compact to loose to very dense)

Borehole Terminated at 7.1 m Depth



NOTES

1.0 Drove Dynamic Cone beside the borehole from ground surface to refusal at 7.0 m depth.

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
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-00245378-K0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	3.0	
11 days	2.7	

CORE DRILLING RECORD

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

Log of Borehole BH-2

Project No: OTT-00245378-K0

Project: Preliminary Geotechnical Investigation - Proposed Blackstone Elementary

Location: School. Cope Drive and Riouncey Drive, City of Ottawa, Ontario

Figure No. 4

Page. 1 of 1

Date Drilled: 'February 25, 2019

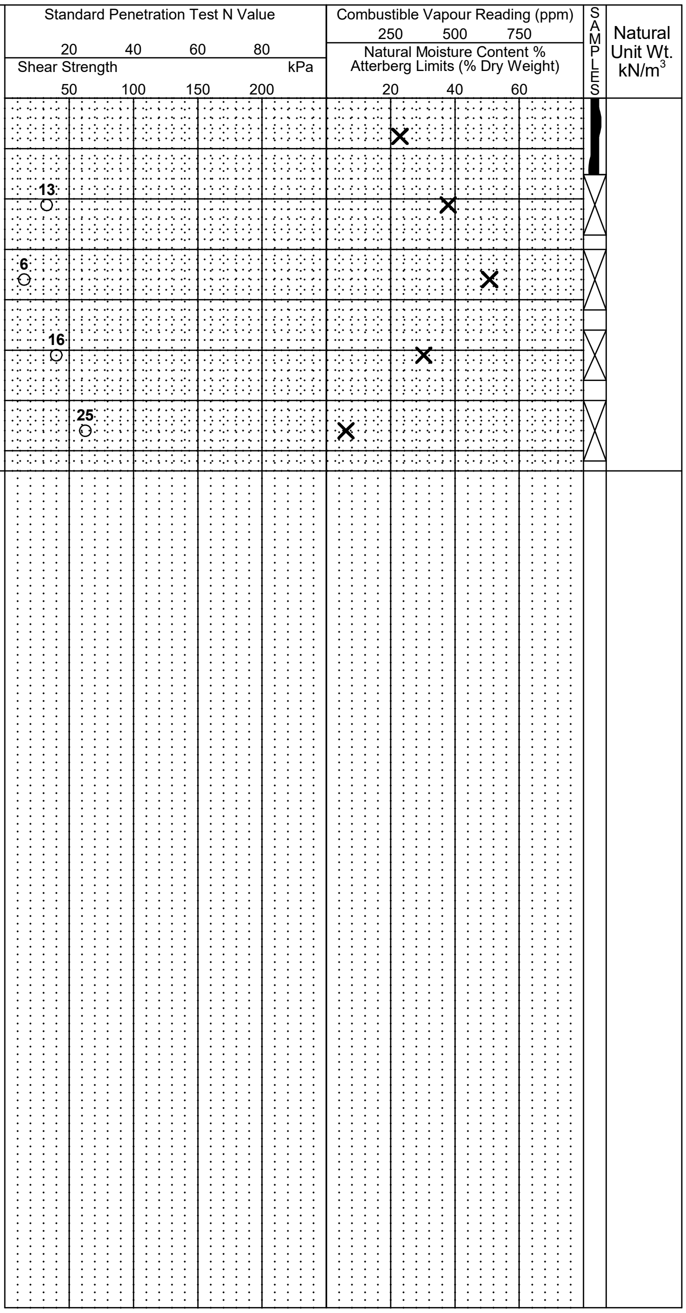
Drill Type:

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◨	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	├─○
Dynamic Cone Test	───	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

SOIL DESCRIPTION	Geodetic Elevation m	Depth
	100.9	0
FILL Silty sand mixed with some silty clay, some roots, brownish grey, moist to very moist (loose)		
SILTY CLAY CRUST Weathered in upper levels, dessicated silt pockets, brown, moist to very moist (very stiff to stiff)	100.1	1 2
SILTY SAND TILL Trace to some clay, scattered gravel, grey, moist (compact)	98.3	3
	97.2	
Refusal to Augers at 3.7 m Depth		



NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
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-00245378-K0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	dry	
8 days	dry	

CORE DRILLING RECORD

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

Log of Borehole BH-3

Project No: OTT-00245378-K0

Figure No. 5

Project: Preliminary Geotechnical Investigation - Proposed Blackstone Elementary

Page. 1 of 1

Location: School. Cope Drive and Riouncey Drive, City of Ottawa, Ontario

Date Drilled: 'February 22, 2019

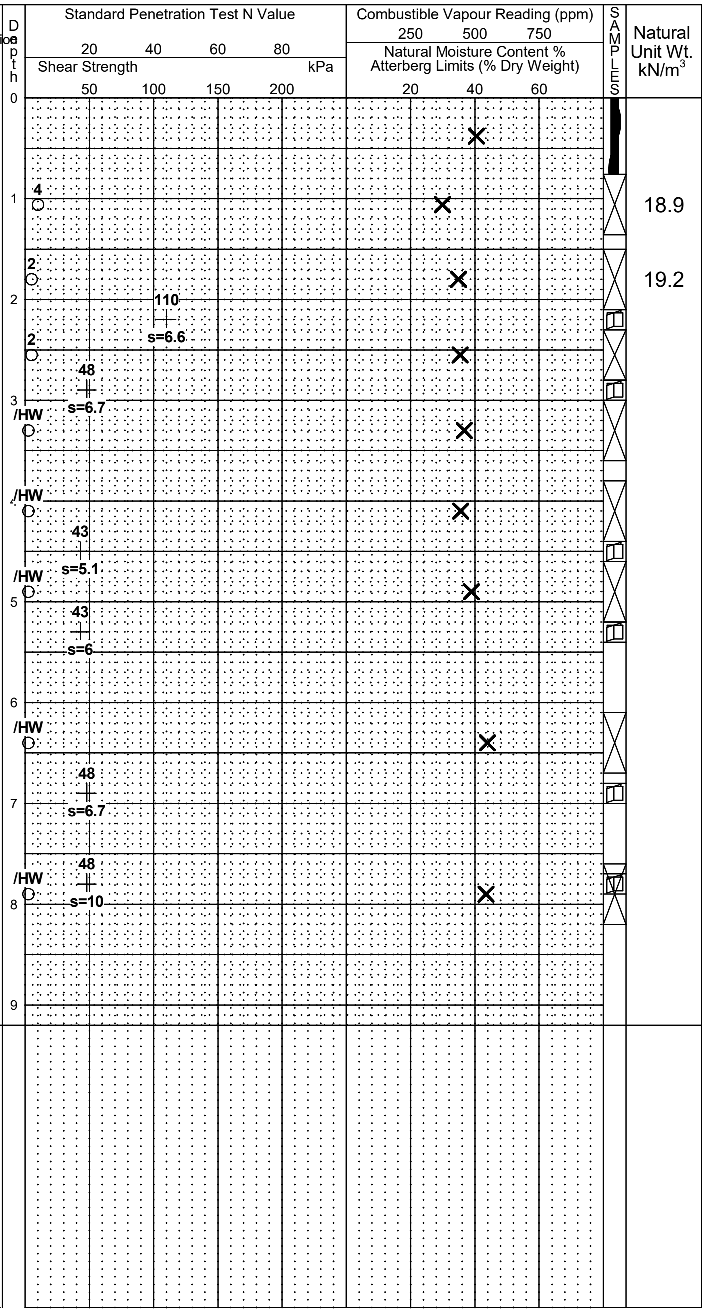
Drill Type:

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	▥	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	⊢○
Dynamic Cone Test	—	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■		
Shear Strength by Vane Test	+ S	Shear Strength by Penetrometer Test	▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m
			100.2
		TOPSOIL ~300 mm	99.9
		SILTY CLAY CRUST Dessicated silt pockets, brown to grey, moist to wet (very stiff to stiff)	97.4
		SILTY CLAY Grey to dark grey, very moist o wet (firm)	91.0
		Borehole Terminated at 9.2 m Depth	



NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Borehole backfilled upon completion of drilling.
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-00245378-K0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	3.6	

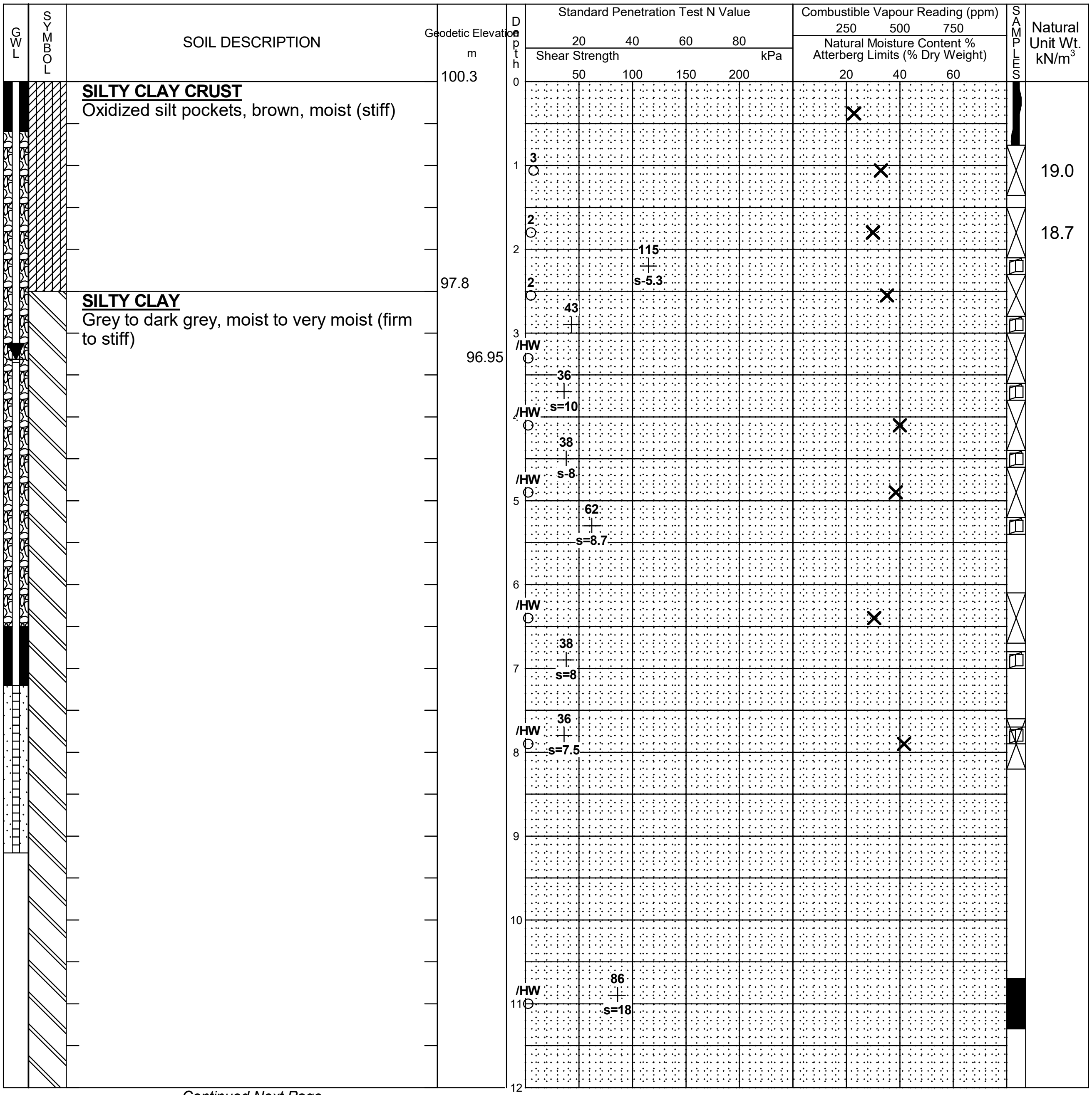
CORE DRILLING RECORD

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

Log of Borehole BH-4

Project No:	OTT-00245378-K0	Figure No.	6
Project:	Preliminary Geotechnical Investigation - Proposed Blackstone Elementary	Page.	1 of 2
Location:	School. Cope Drive and Riouncey Drive, City of Ottawa, Ontario		
Date Drilled:	'February 25, 2019		
Drill Type:			
Datum:	Geodetic		
Logged by:	AN	Checked by:	SKA

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◨	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	⊢○
Dynamic Cone Test	—	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■		
Shear Strength by Vane Test	+ S	Shear Strength by Penetrometer Test	▲



SILTY CLAY CRUST
Oxidized silt pockets, brown, moist (stiff)

SILTY CLAY
Grey to dark grey, moist to very moist (firm to stiff)

Continued Next Page

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
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-00245378-K0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	6.0	
8 days	3.4	

CORE DRILLING RECORD

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

Log of Borehole BH-4

Project No: OTT-00245378-K0

Project: Preliminary Geotechnical Investigation - Proposed Blackstone Elementary

Figure No. 6

Page. 2 of 2

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation 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	SAMPLES	Natural Unit Wt. kN/m³
			88.3	12				
			88.1					
		SILTY SAND TILL Frequent gravel and cobbels, grey						
			87.2	13				
		Refusal to Augers at 13.1 m Depth						

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
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-00245378-K0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	6.0	
8 days	3.4	

CORE DRILLING RECORD

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

Log of Borehole BH-5

Project No: OTT-00245378-K0

Project: Preliminary Geotechnical Investigation - Proposed Blackstone Elementary

Location: School. Cope Drive and Riouncey Drive, City of Ottawa, Ontario

Figure No. 7

Page. 1 of 1

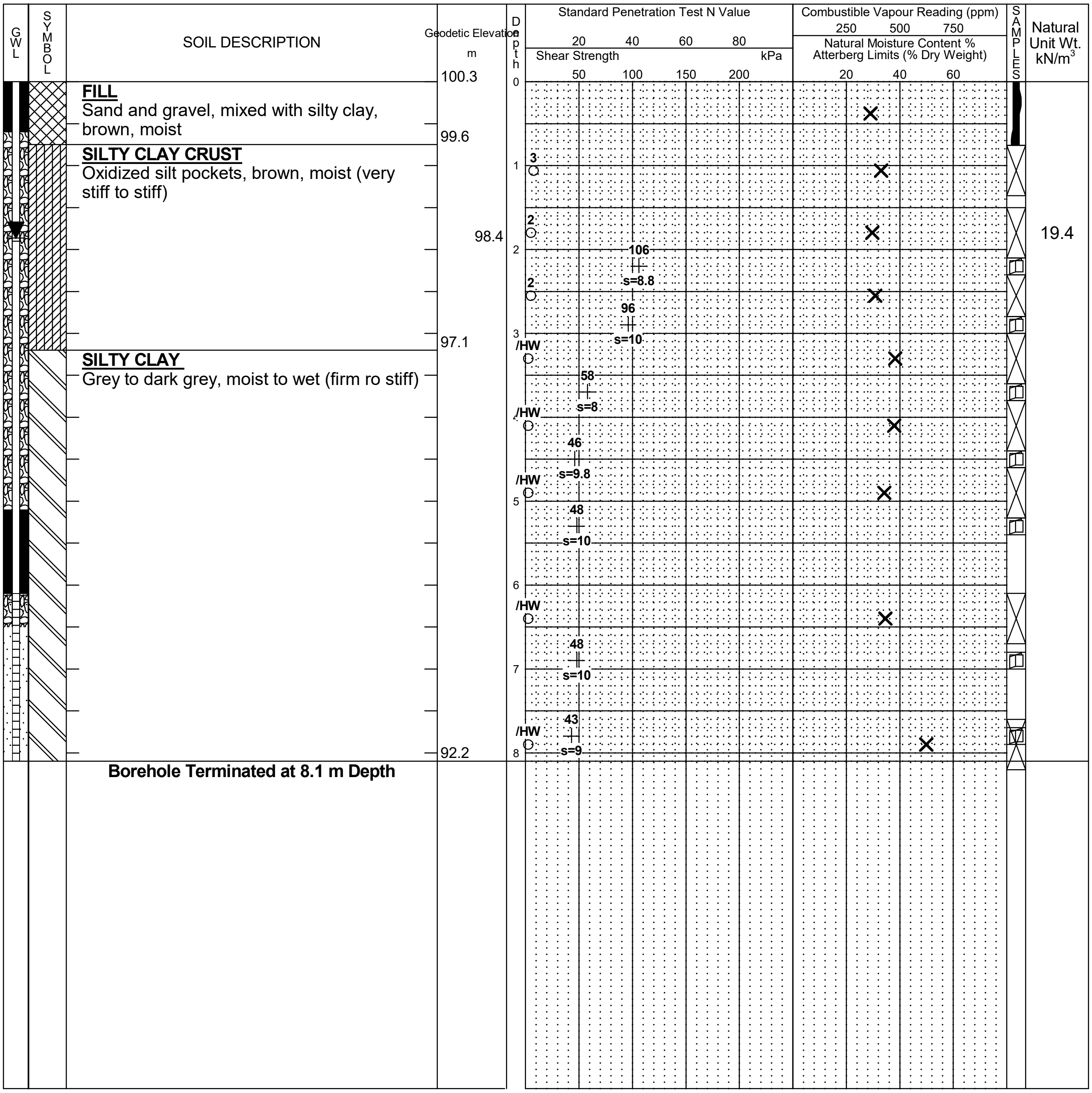
Date Drilled: 'February 21, 2019

Drill Type:

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◨	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	├──○
Dynamic Cone Test	──	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	┼ S		



Geodetic Elevation (m)	SOIL DESCRIPTION
100.3	**FILL** Sand and gravel, mixed with silty clay, brown, moist
99.6	**SILTY CLAY CRUST** Oxidized silt pockets, brown, moist (very stiff to stiff)
98.4	
97.1	**SILTY CLAY** Grey to dark grey, moist to wet (firm ro stiff)
92.2	

Borehole Terminated at 8.1 m Depth

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Borehole backfilled upon completion of drilling.
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-00245378-K0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	4.6	
11 days	1.9	

CORE DRILLING RECORD

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

Log of Borehole BH-6

Project No: OTT-00245378-K0

Project: Preliminary Geotechnical Investigation - Proposed Blackstone Elementary

Location: School. Cope Drive and Riouncey Drive, City of Ottawa, Ontario

Figure No. 8

Page. 1 of 1

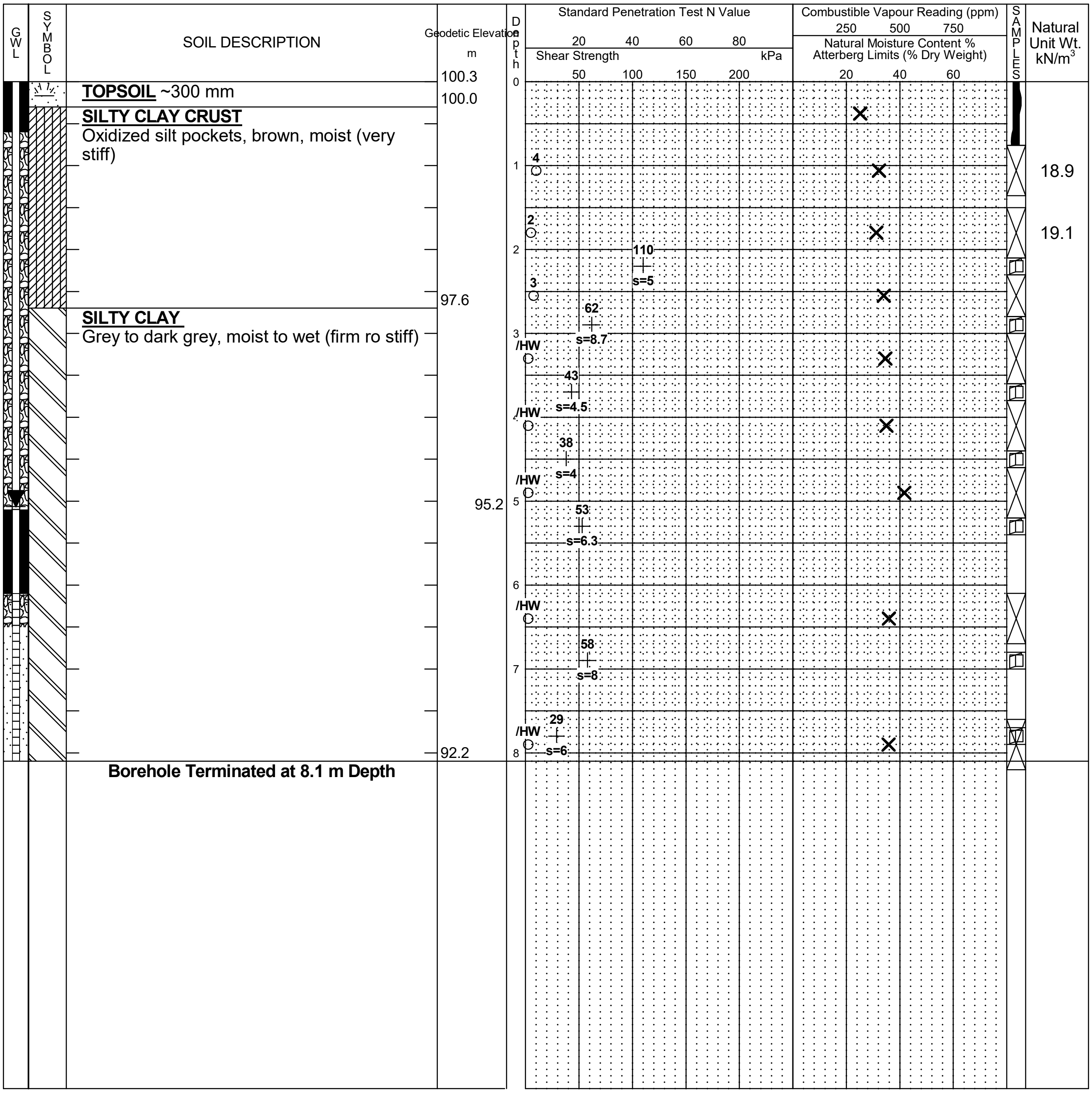
Date Drilled: 'February 22, 2019

Drill Type:

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◫	Natural Moisture Content	×
SPT (N) Value	○	Atterberg Limits	├─○
Dynamic Cone Test	──	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■		
Shear Strength by Vane Test	┼ S	Shear Strength by Penetrometer Test	▲



TOPSOIL ~300 mm

SILTY CLAY CRUST

Oxidized silt pockets, brown, moist (very stiff)

SILTY CLAY

Grey to dark grey, moist to wet (firm ro stiff)

Borehole Terminated at 8.1 m Depth

NOTES:

1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
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-00245378-K0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	3.9	
12 days	5.1	

CORE DRILLING RECORD

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

Log of Borehole BH-7

Project No: OTT-00245378-K0

Project: Preliminary Geotechnical Investigation - Proposed Blackstone Elementary

Location: School. Cope Drive and Riouncey Drive, City of Ottawa, Ontario

Figure No. 9

Page. 1 of 2

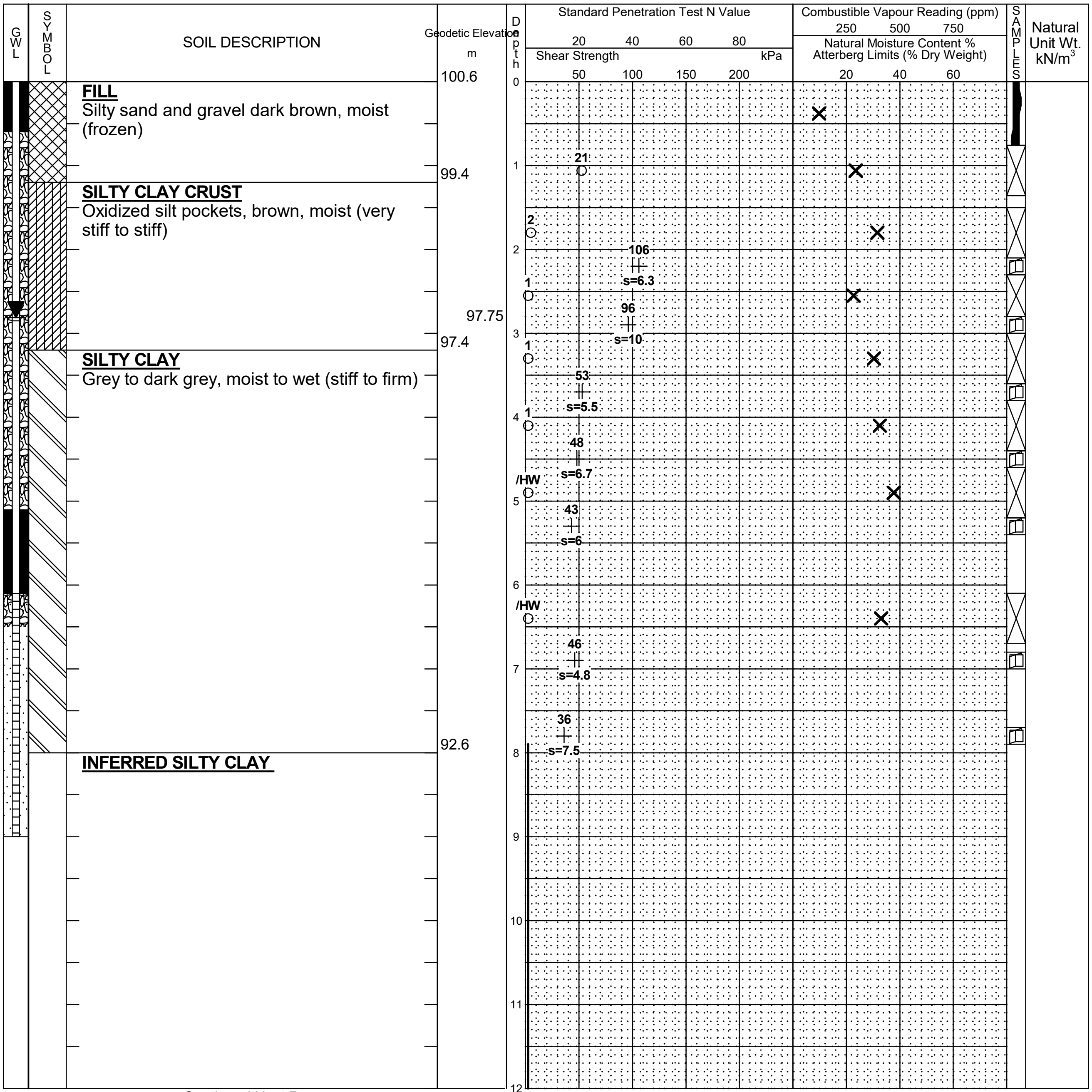
Date Drilled: 'February 21, 2019

Drill Type:

Datum: Geodetic

Logged by: AN   Checked by: SKA

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◫	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	⊢○
Dynamic Cone Test	—	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		



100.6
FILL
Silty sand and gravel dark brown, moist (frozen)

99.4
SILTY CLAY CRUST
Oxidized silt pockets, brown, moist (very stiff to stiff)

97.4
SILTY CLAY
Grey to dark grey, moist to wet (stiff to firm)

92.6
INFERRED SILTY CLAY

Continued Next Page

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
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-00245378-K0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	4.8	
12 days	2.9	

CORE DRILLING RECORD

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

Log of Borehole BH-7

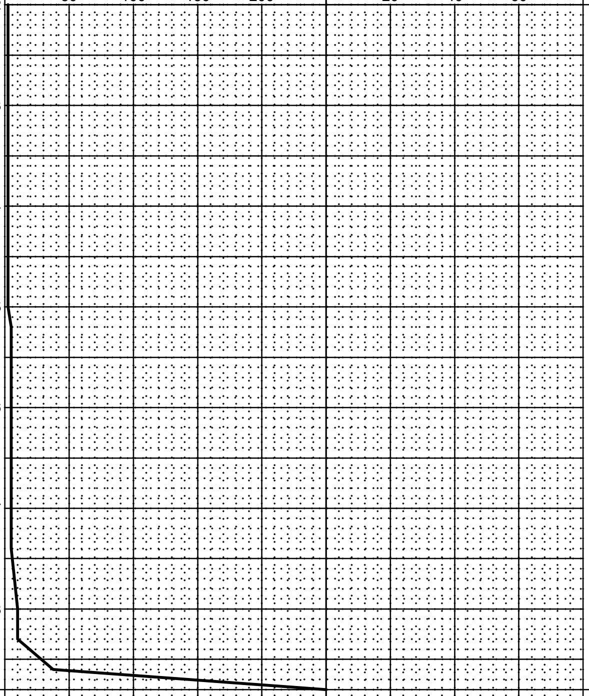
Project No: OTT-00245378-K0

Project: Preliminary Geotechnical Investigation - Proposed Blackstone Elementary

Figure No. 9

Page. 2 of 2

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation 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	SAMPLES	Natural Unit Wt. kN/m³
		INFERRED SILTY CLAY *(continued)*	88.6	12				
				13				
				14				
				15				
				16				
				17				
			82.4	18				
		INFERRED GLACIAL TILL	81.8					
		Cone Refusal at 18.8 m Depth						



LOG OF BOREHOLE BH LOGS - 245378-K0.GPJ TROW OTTAWA.GDT 3/11/19

NOTES:

1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
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-00245378-K0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	4.8	
12 days	2.9	

CORE DRILLING RECORD

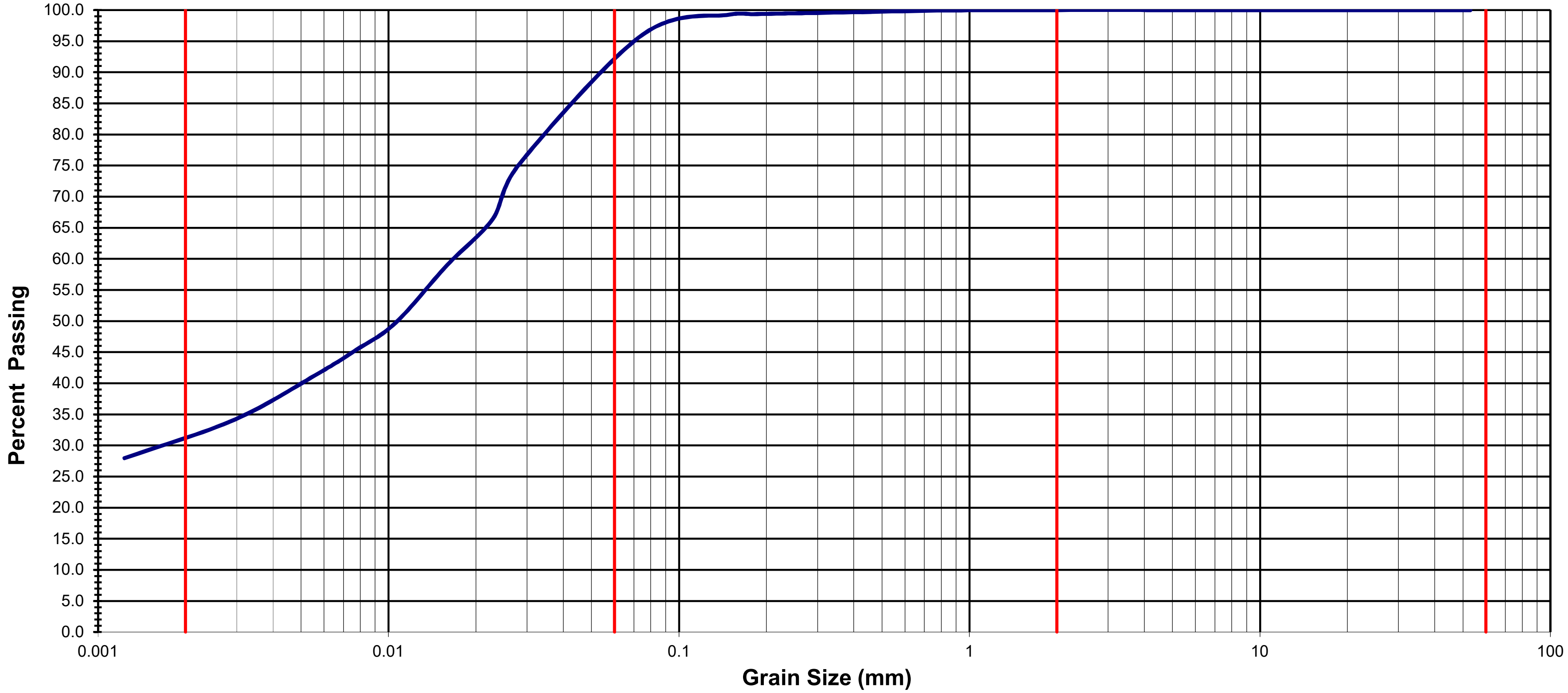
Run No.	Depth (m)	% Rec.	RQD %

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 D-422

Modified M.I.T. Classification

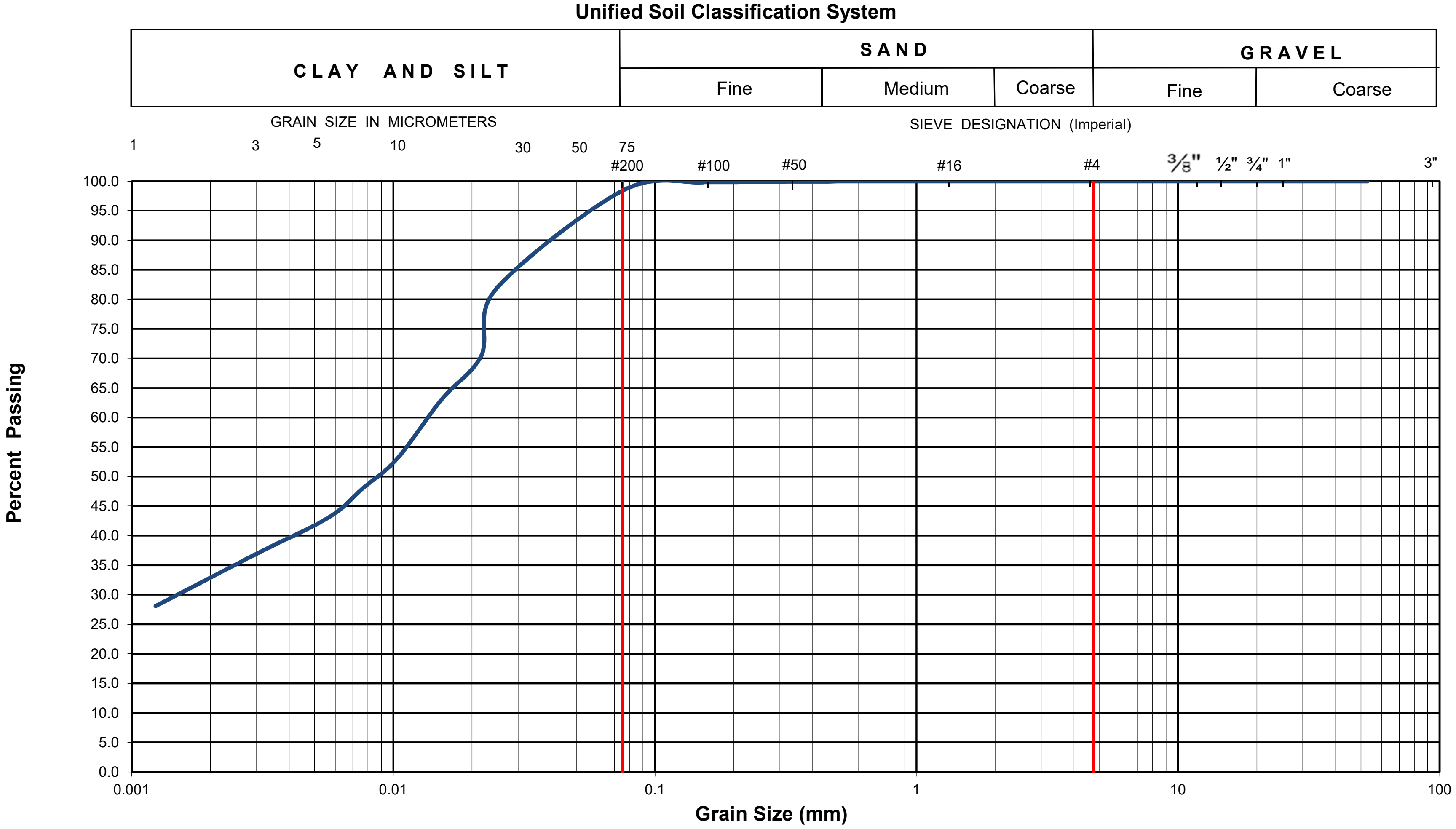
CLAY	SILT			SAND			GRAVEL			
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	



EXP Project No.:	OTT-00245378-K0			Project Name :	Prelim. Geo. Inv. of Proposed Elementary School Blackstone Development						
Client :	OCDSB SOA #18-007			Project Location :	Cope Drive & Rouncey Road, Ottawa, ON						
Date Sampled :	February 25, 2019			Borehole No:	4	Sample No.:	SS3			Depth (m) :	1.5-2.0
Sample Composition:		% Clay:	32	% Silt:	61	% Sand:	7	% Gravel:	0	Figure :	10
Sample Description :	Inorganic Clay of Low to Medium Plasticity (CL)										

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

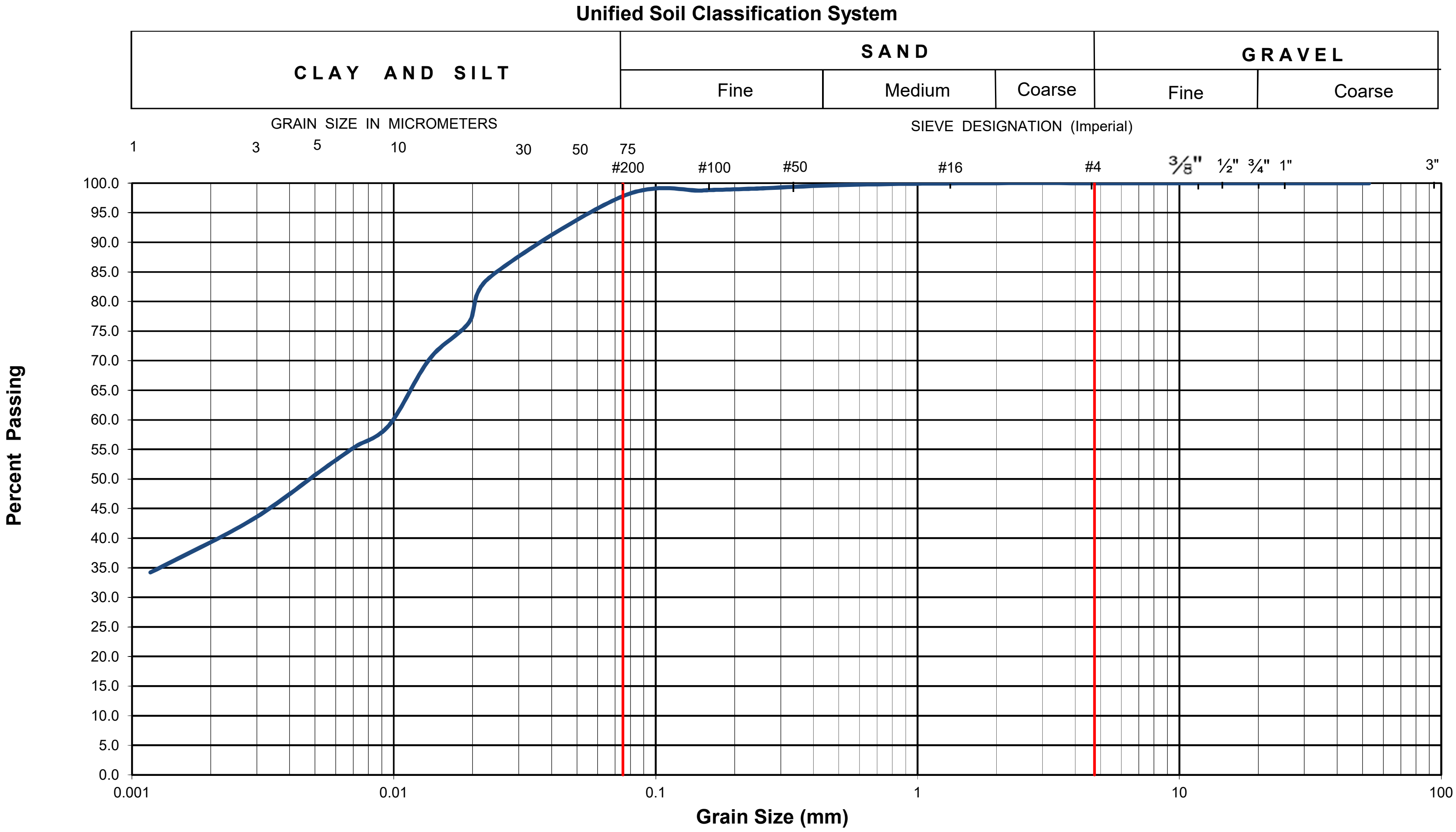
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	OTT-00245378-K0	Project Name :	Prelim. Geo. Inv. of Proposed Elementary School Blackstone Development						
Client :	OCDSB SOA #18-007	Project Location :	Cope Drive & Rouncey Road, Ottawa, ON						
Date Sampled :	February 25, 2019	Borehole No:	4	Sample No.:	SS6	Depth (m) :	3.8-4.3		
Sample Description :		% Silt and Clay	98	% Sand	2	% Gravel	0	Figure :	11
Sample Description :	Inorganic Clay of Low to Medium Plasticity (CL)								

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

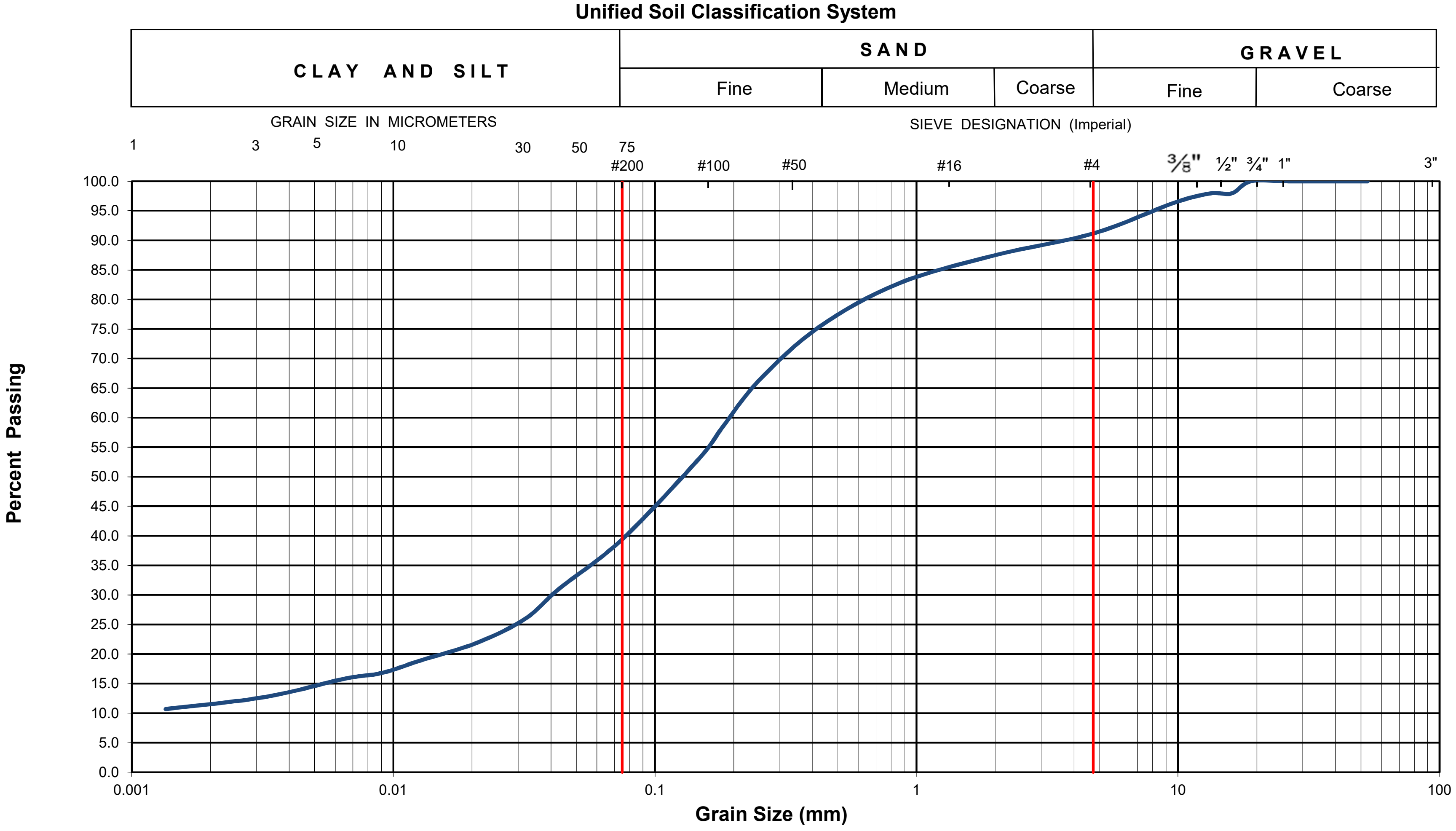
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



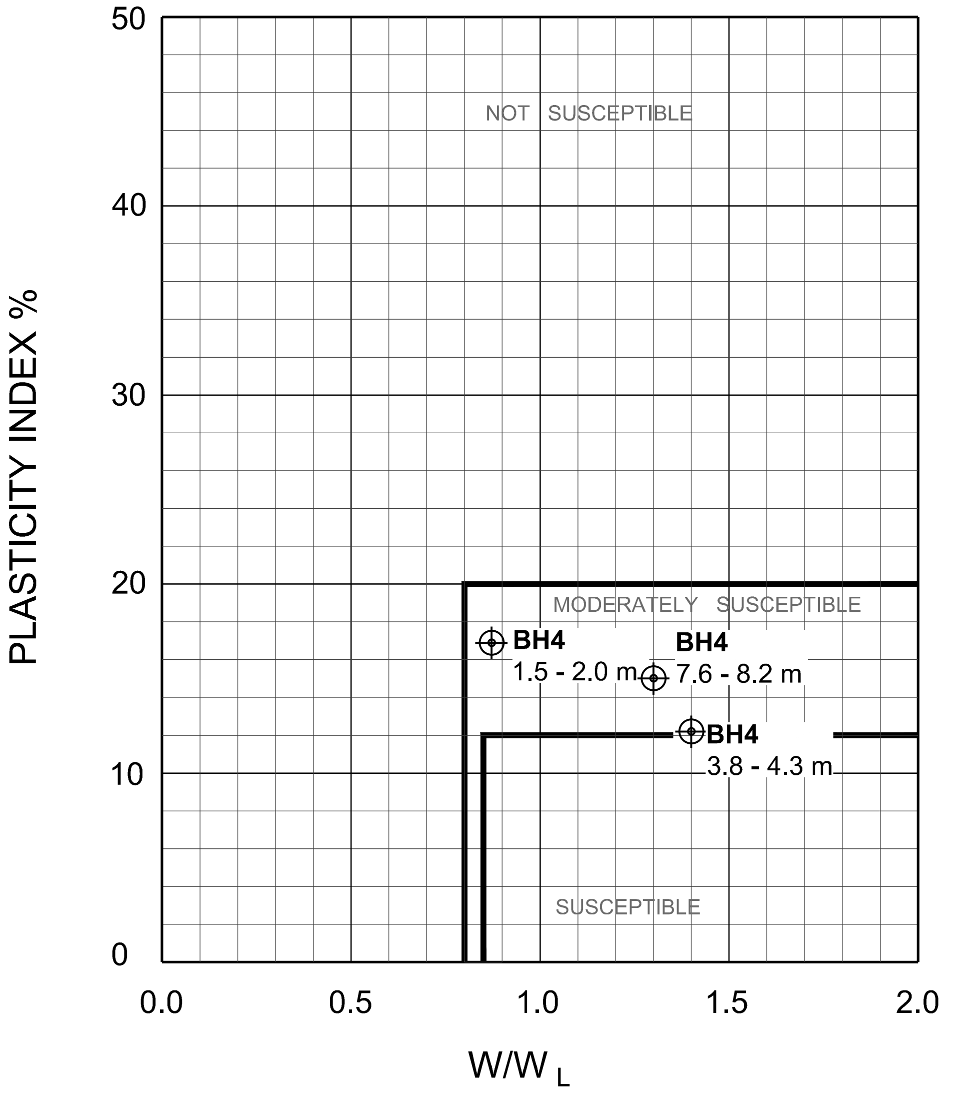
EXP Project No.:	OTT-00245378-K0	**Project Name :**	Prelim. Geo. Inv. of Proposed Elementary School Blackstone Development				
Client :	OCDSB SOA #18-007	**Project Location :**	Cope Drive & Rouncey Road, Ottawa, ON				
Date Sampled :	February 25, 2019	**Borehole No:**	4	**Sample No.:**	SS9	**Depth (m) :**	7.6-8.2
Sample Description :		**% Silt and Clay**	97	**% Sand**	3	**% Gravel**	0
Sample Description :	Inorganic Clay of low to Medium Plasticity (CL)					**Figure :**	12

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-00245378-K0	**Project Name :**	Prelim. Geo. Inv. of Proposed Elementary School Blackstone Development						
Client :	OCDSB SOA #18-007	**Project Location :**	Cope Drive & Rouncey Road, Ottawa, ON						
Date Sampled :	February 22, 2019	**Borehole No:**	1	**Sample No.:**	SS6			**Depth (m) :**	3.8-4.3
Sample Description :		**% Silt and Clay**	40	**% Sand**	52	**% Gravel**	8	**Figure :**	13
Sample Description :	Silty Sand (SC)								



BRAY ET AL. (2004) CRITERIA FOR LIQUEFACTION ASSESSMENT OF FINE-GRAINED SOILS

LEGEND

⊕ **BH3**	BOREHOLE NO.
2.3 - 2.9 m	SAMPLE DEPTH (m)

exp Services Inc.
t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6
Canada

www.exp.com

• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

scale N.T.S.	CLIENT: OCDSB		project no. OTT-00245378-K0
date MARCH 2019	TITLE: LIQUEFACTION ASSESSMENT CHART		
drawn by M.N.	PROPOSED ELEMENTARY SCHOOL COPE DRIVE & ROUNCEY ROAD, OTTAWA, ON		FIG 14

Filename: p:\projects\geotechnical\240000\245000\245378 k0- geo inv scvhool blackstone ocdsb\k - drawings\fig 14 liquefaction assessment.dwg
Last Saved: 3/12/2019 8:50:19 AM
Last Plotted: 3/12/2019 8:55:00 AM Plotted by: nugentm Pen Table:: trow standard, july 01, 2004.ctb

APPENDIX A: Shear-wave Velocity Measurements

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

March 4th, 2019

Transmitted by email: ismail.taki@exp.com
Our Ref.: GPR-19-01194

Mr. Ismail M. Taki, M.Eng., P.Eng.
Manager, Geotechnical Services
exp Services inc.
100 - 2650 Queensview Drive
Ottawa (ON) K2B 8H6

Subject: **Shear Wave Velocity Sounding for Site Class Determination**
Cope Drive and Rouncey Road, Ottawa (ON)
[Project: OTT-00245378-K0]

Dear Sir,

Geophysics GPR International Inc. has been requested by **exp** Services Inc. to carry out seismic shear wave surveys over a field under development located in Stittsville, off Cope Drive, cornered by Terry Fox Drive and Fernbank Road, Ottawa (ON). The geophysical investigations used the Multi-channel Analysis of Surface Waves (MASW), the Extended SPatial AutoCorrelation (ESPAC), and the seismic refraction methods. From the subsequent results, the seismic shear wave velocities values were calculated for the soil and the rock.

The surveys were carried out, on February 11th, by Mr. Marc Rousseau, phys. and Mr. Kenny Gardner. Figure 1 shows the regional location of the site and Figure 2 illustrates the location of the seismic spreads. Both figures are presented in the Appendix.

The following paragraphs briefly describe the survey design, the principles of the test methods, and the results in graphic and table format.

METHODS PRINCIPLES

MASW Survey

The *Multi-channel Analysis of Surface Waves* (MASW) and the *Extended SPatial AutoCorrelation* (ESPAC 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 waves ("ground roll"). 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 ESPAC is considered a "passive" method, using the low frequency "noises" produced far away. The method can also be used with "active" seismic source records. The dispersion properties are expressed as a change of phase velocities with 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/ESPAC records, the corresponding spectrogram analysis and resulting 1D V_S model. The ESPAC method allows deeper V_S soundings, but generally with a lower resolution for the surface portion. Its dispersion curve can then be merged with the higher frequency one from the MASW to calculate a more complete inversion.

Seismic Refraction Survey

The method consists in measuring the propagation delays of the direct and refracted seismic waves (P and/or S) produced by an artificial source in the axis of a seismic linear spread. The seismic velocities of the materials can be directly calculated, then the refractors depths.

INTERPRETATION METHODS

MASW Surveys

The main processing sequence involved data inspection and edition when required; spectral analysis ("phase shift" for MASW, and "cross-correlation" for ESPAC); picking the fundamental mode; and 1D inversion of the MASW and ESPAC 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 of the order of 15% or better.

Seismic Refraction surveys

The considered seismic wave's arrival times were identified for each geophone. The General Reciprocal Method was used, with signal sources at both ends of the seismic spreads, to consider seismic wave propagation for two opposite directions. The measurements were realised to calculate the rock depth, and its seismic velocity (using P waves). The rock seismic velocities (V_S) were calculated using two methods: the reduced travel-times (the Hobson and Overton method) and the opposite apparent velocities. The first one allows independence from the surface and rock topography effect, as well as the overburden lateral variation of its seismic velocity, but remains limited to common geophones. Its application remains however limited to shallow to intermediate depths refractors. The second one can use longer segments of opposite directions signals, improving the linear regressions accuracy, but remains affected by the surface and rock topography effect, as well as the overburden lateral variation of the seismic velocity. Conversely to the MASW method, the seismic rock velocity calculated by seismic refraction is only representative of its superior part, due to the evanescent nature of the refracted wave.

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 located in a field under development, south of the intersection of Cope Drive and Rouncey Road. The geophone spacing for the main spread was of 3 metres, using 24 geophones. A shorter seismic spread, with geophone spacing of 1 metre, was dedicated to the near surface materials.

The seismic records counted 4096 data, sampled at 1000 µs for the MASW surveys, and 50 µs for the seismic refraction. The records included a pre-trig portion of 10 ms. A stacking procedure was also used to improve the Signal / Noise ratio for the seismic records.

Unlike the refraction method, which allows producing a result point beneath each geophone, 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. The seismic records were made with a seismograph Terraloc MK6 (from ABEM Instrument), and the geophones were 4.5 Hz. A 9 kg sledgehammer was used as the energy source with impacts being recorded off both ends of the seismic spreads.

RESULTS

From seismic refraction survey, the rock was calculated approximately 17.5 metres deep (± 10%). Its seismic velocity was calculated by seismic refraction between 2030 and 2130 m/s for its upper portion (cf. Figure 5). These results were used as initial parameters for the basic geophysical model, prior to the MASW dispersion curves inversions.

The MASW calculated V_S results are illustrated at Figure 6 and they are also presented at Table 1. Some high seismic velocities were calculated from the surface to approximately 1 metre deep. As it could be associated to frozen ground, they were replaced by the next lower layer velocities for a more realistic $\overline{V}_{S30}$ calculation.

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 up to 30 metres. This value represents an equivalent homogeneous single layer response.

The calculated $\overline{V}_{S30}$ value is 268.8 m/s (cf. Table 1), corresponding to the Site Class "D". However, some low seismic velocities were calculated from 1 to approximately 13 metres deep.

CONCLUSION

Geophysical surveys were carried out in a field under development, south of Cope Drive and Rouncey Road, in Ottawa (ON). The seismic surveys used the MASW, ESPAC analysis methods, seismic refraction, as well as the complementary borehole log information, to calculate the $\overline{V}_{S30}$ value for the Site Class determination. The $\overline{V}_{S30}$ calculation is presented in Table 1.

The calculated $\overline{V}_{S30}$ value of the actual site is 269 m/s corresponding to the Site Class "D" ($180 < \overline{V}_{S30} \leq 360$ m/s), as determined through the MASW, ESPAC and seismic refraction methods, Table 4.1.8.4.A of the NBC, and the Building Code, O. Reg. 332/12. It must be noted that some low seismic velocities were calculated for the unconsolidated materials between 1 metre and approximately 13 metres deep. A geotechnical assessment related to these materials should be realized.

It must be noted that other geotechnical information gleaned on site; including the presence of liquefiable soils, soft clays, high moisture content etc. 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.

P.Eng.

Jean-Luc Arsenault, P.Eng., M.A.Sc.
Project Manager

LICENSED PROFESSIONAL ENGINEER
J.-L. ARSENAULT
100148122
PROVINCE OF ONTARIO
2019-03-04

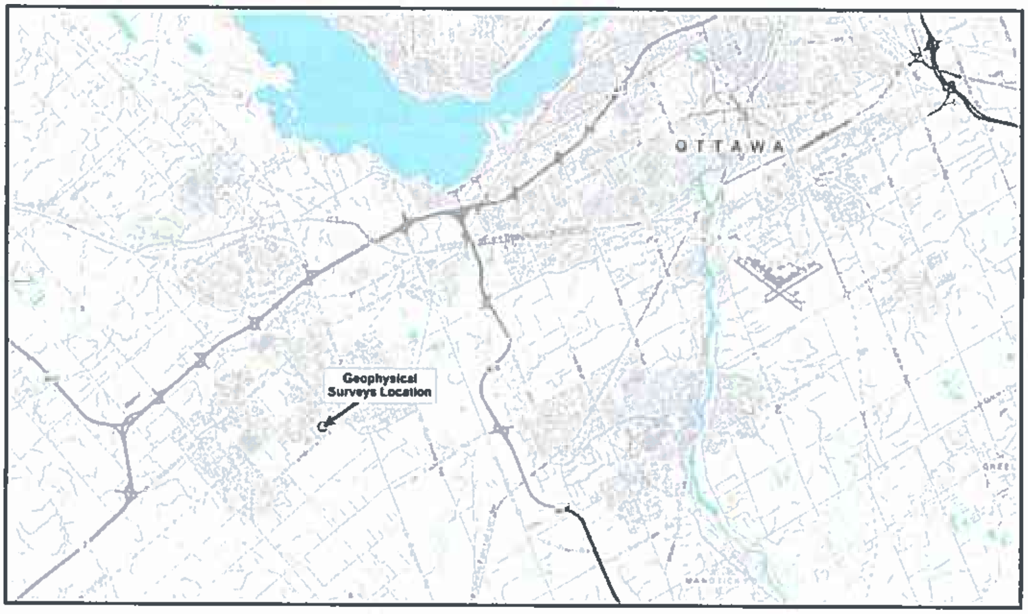


Figure 1: Regional location of the Site

(source: *GeoOttawa*)

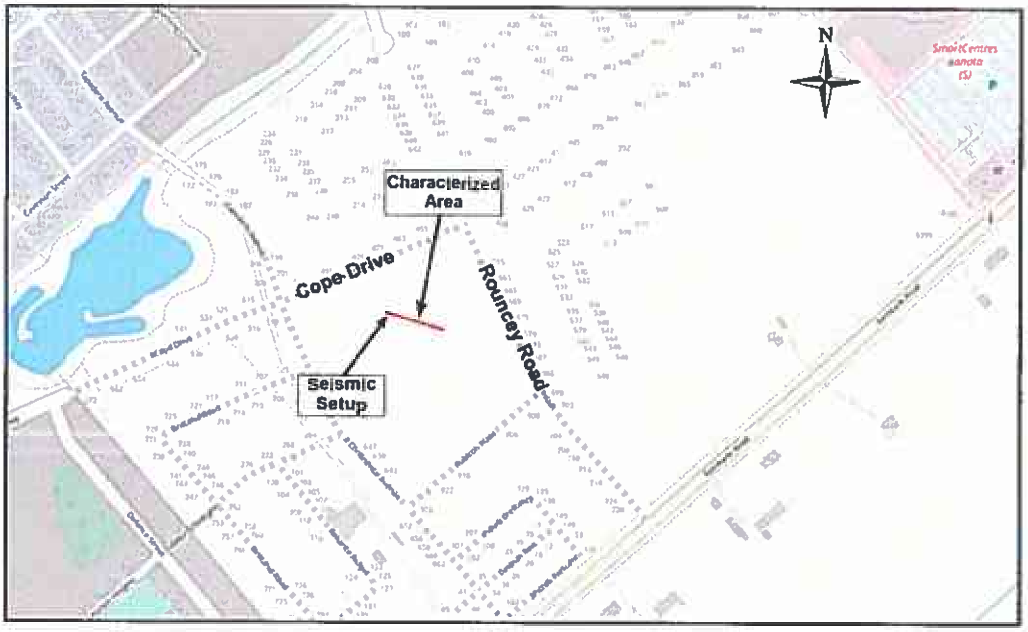


Figure 2: Location of the seismic spreads

(source: *OpenStreetMap©*)

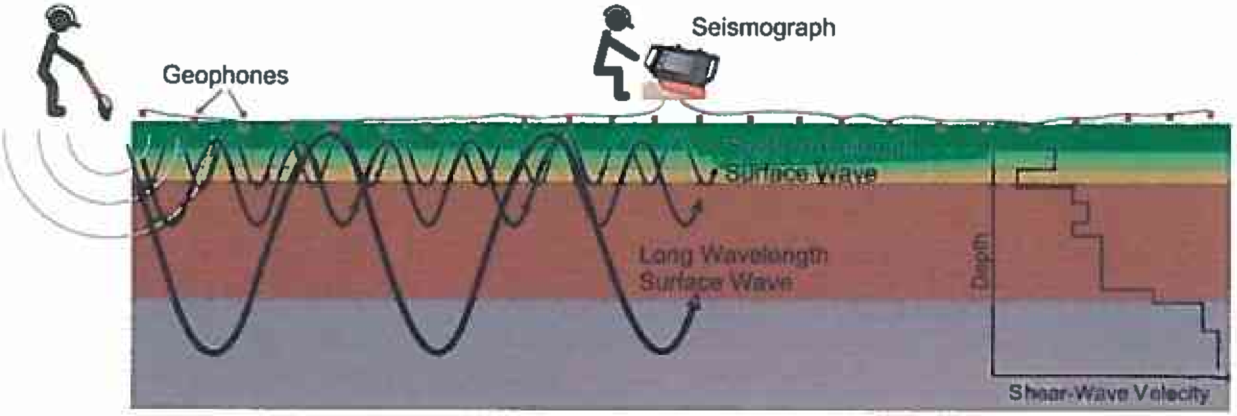
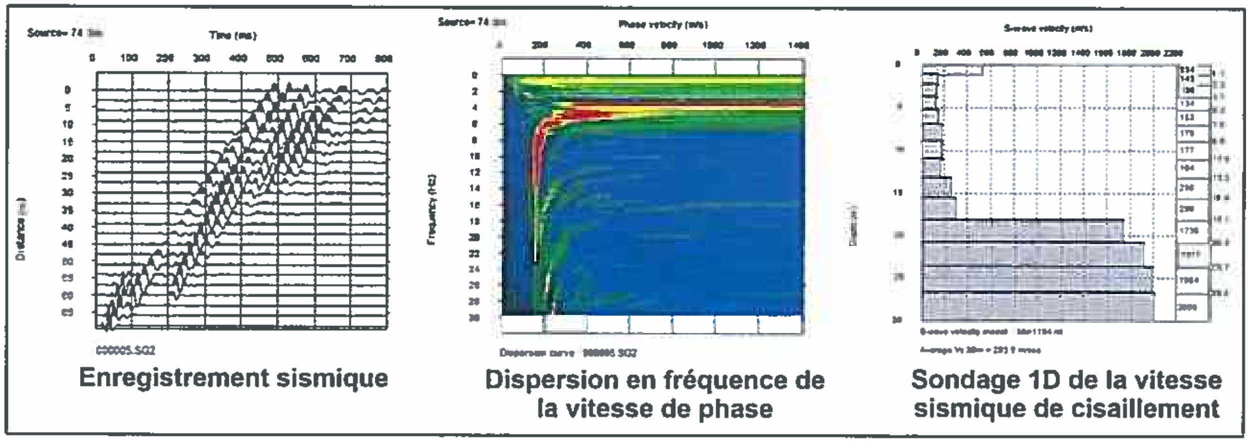


Figure 3: MASW Operating Principle



Enregistrement sismique

Dispersion en fréquence de la vitesse de phase

Sondage 1D de la vitesse sismique de cisaillement

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

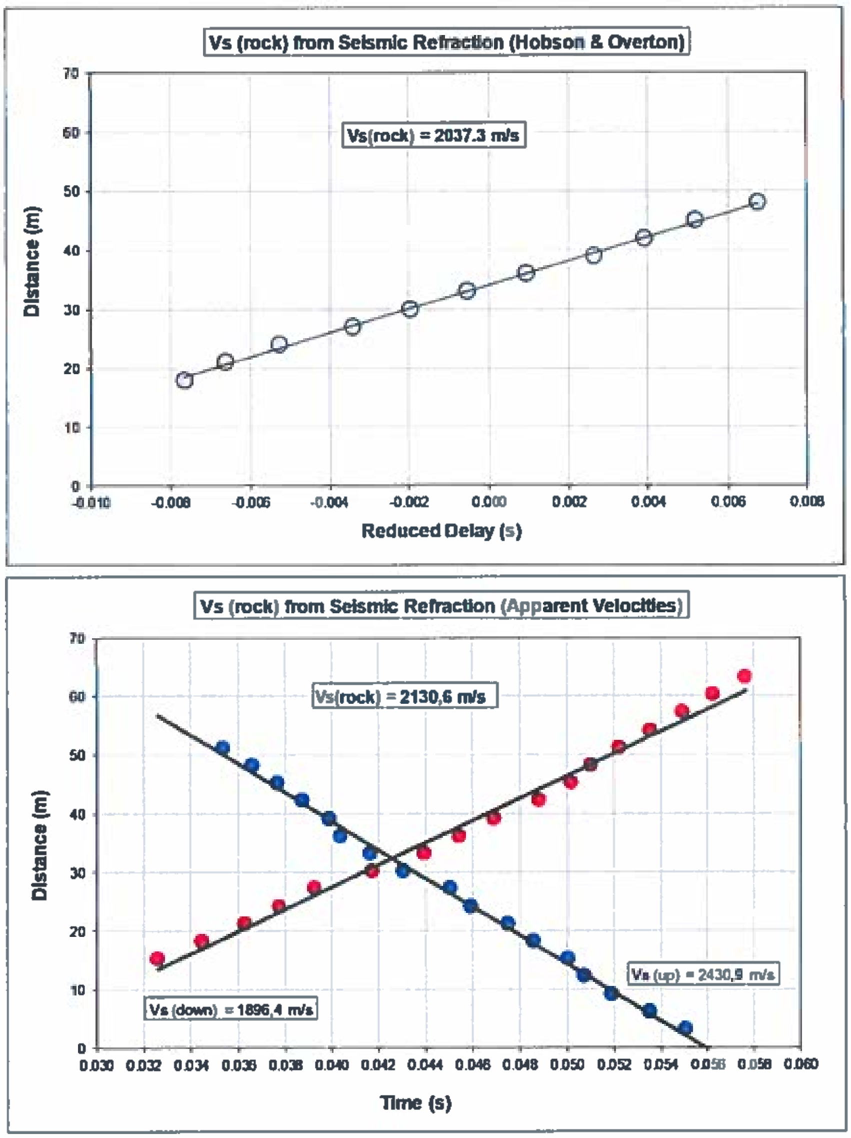


Figure 5: Rock V_S from Seismic Refraction

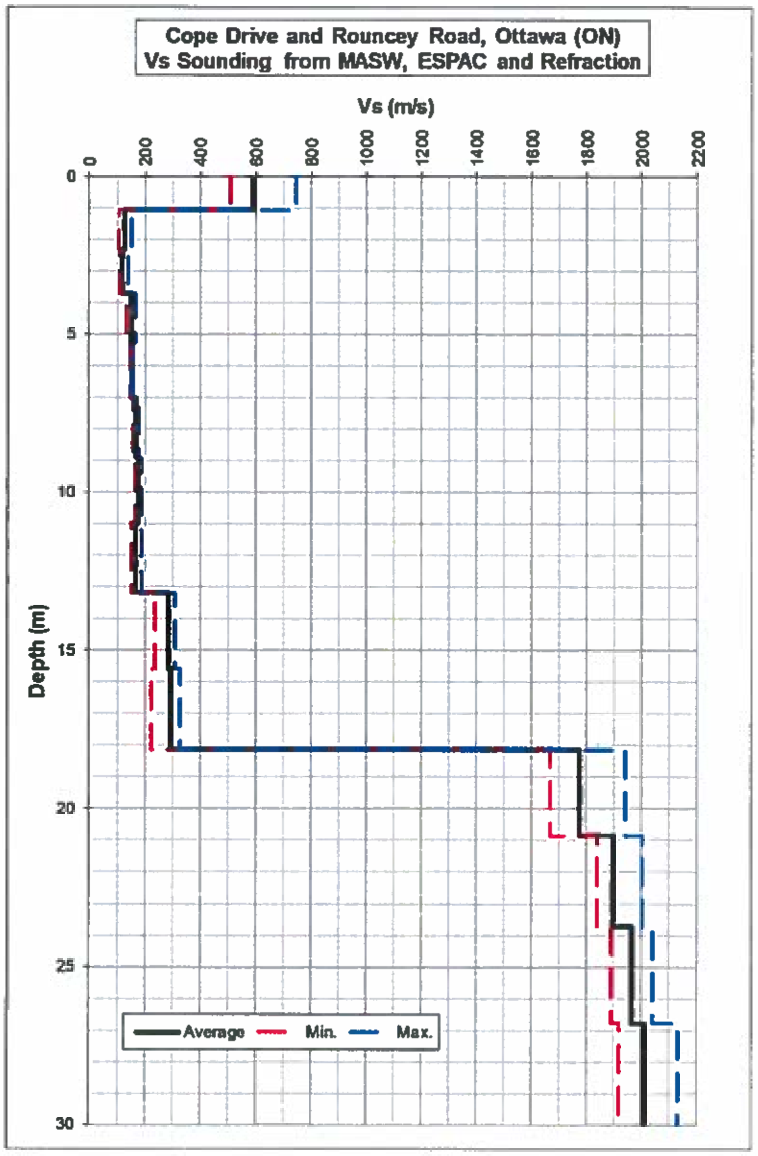


Figure 6: MASW Shear-Wave Velocities Sounding

TABLE 1

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

Depth	Vs			Thickness	Cumulative Thickness	Delay for Avg. Vs	Cumulative Delay	Vs at given Depth
	Min.	Average	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	***106.4***	***125.7***	***151.1***					
1.07	**106.4**	**125.7**	**151.1**	1.07	1.07	0.008523	0.008523	125.7
2.31	**111.5**	**118.6**	**136.3**	1.24	2.31	0.009834	0.018357	125.7
3.71	**134.4**	**148.7**	**163.6**	1.40	3.71	0.011813	0.030169	122.9
5.27	**146.3**	**152.3**	**155.9**	1.57	5.27	0.010532	0.040702	129.6
7.01	**155.6**	**166.4**	**178.8**	1.73	7.01	0.011364	0.052065	134.6
8.90	**166.2**	**175.9**	187.2	1.90	8.90	0.011393	0.063458	140.3
10.96	**151.6**	**170.0**	190.3	2.06	10.96	0.011714	0.075171	145.8
13.19	239.2	284.2	311.8	2.23	13.19	0.013090	0.088261	149.4
15.58	225.7	293.0	328.6	2.39	15.58	0.008410	0.096671	161.1
18.13	1668.2	1775.3	1941.2	2.55	18.13	0.008720	0.105392	172.0
20.85	1840.2	1894.2	2000.7	2.72	20.85	0.001532	0.106924	195.0
23.74	1891.5	1963.9	2037.3	2.88	23.74	0.001523	0.108447	218.9
26.79	1915.7	2008.7	2130.6	3.05	26.79	0.001553	0.110000	243.5
30				3.21	30.00	0.001600	0.111600	268.8

V_{S30} (m/s)	**268.8**
Site Class	**D** (1)

(1): conditional to geotechnical assessment of the low seismic velocities materials, from the surface to approximately 13 metres deep (potential of liquefaction and degree of clay sensitivity).

APPENDIX B: AGAT Laboratories Certificate of Analysis

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: **SURINDER AGGARWAL**

PROJECT: **OTT-245378-KO**

AGAT WORK ORDER: **19Z442152**

SOIL ANALYSIS REVIEWED BY: **Yris Verastegui, Report Reviewer**

DATE REPORTED: **Mar 07, 2019**

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

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 19Z442152
PROJECT: OTT-245378-KO

CLIENT NAME: EXP SERVICES INC
SAMPLING SITE:Cope Drive

ATTENTION TO: SURINDER AGGARWAL
SAMPLED BY:exp

Inorganic Chemistry (Soil)

DATE RECEIVED: 2019-02-28

DATE REPORTED: 2019-03-07

			SAMPLE DESCRIPTION:	BH1 SS2 2. 5'-4.5'	BH5 SS3 5'-6.5'	BH6 SS4 7.5'-9'
			SAMPLE TYPE:	Soil	Soil	Soil
			DATE SAMPLED:	2019-02-22	2019-02-22	2019-02-22
Parameter	**Unit**	**G / S**	**RDL**	**9933770**	**9933771**	**9933772**
pH (2:1)	pH Units		N/A	7.80	7.94	8.09
Electrical Conductivity (2:1)	mS/cm		0.005	0.271	0.211	0.170
Chloride (2:1)	µg/g		2	13	12	9
Sulphate (2:1)	µg/g		2	40	39	14

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

Certified By: Iris Verástegui

Quality Assurance

CLIENT NAME: EXP SERVICES INC
PROJECT: OTT-245378-KO
SAMPLING SITE:Cope Drive

AGAT WORK ORDER: 19Z442152
ATTENTION TO: SURINDER AGGARWAL
SAMPLED BY:exp

Soil Analysis

RPT Date: Mar 07, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Soil)															
pH (2:1)	9933659		7.50	7.53	0.4%	NA	101%	90%	110%						
Electrical Conductivity (2:1)	9940089		1.50	1.52	1.3%	< 0.005	100%	90%	110%						
Chloride (2:1)	9934976		13	14	8.0%	< 2	102%	70%	130%	103%	70%	130%	102%	70%	130%
Sulphate (2:1)	9934976		13	12	9.5%	< 2	106%	70%	130%	93%	70%	130%	99%	70%	130%

Comments: NA signifies Not Applicable.

Certified By: Iris Verástegui

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 19Z442152

PROJECT: OTT-245378-KO

ATTENTION TO: SURINDER AGGARWAL

SAMPLING SITE:Cope Drive

SAMPLED BY:exp

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH

AGAT Laboratories

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

Laboratory Use Only

Work Order #: 19T442152

Cooler Quantity: one

Arrival Temperatures: 12.1 | 12.0 | 12.5
4.6 | 4.2 | 3.9

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes: no ice

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 Services
Contact: Surinder Aggarwal
Address: 2650 Queensview Drive Suite 100
Ottawa ON K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: Surinder.Aggarwal@exp.com
2. Email:

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

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

☐Sewer Use
☐Sanitary
☐Storm
Region ______ *Indicate One*
☐MISA

☐Regulation 558
☐CCME
☐Prov. Water Quality Objectives (PWQO)
☐Other
______ *Indicate One*

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply): ______

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

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

Project Information:

Project: OTT-245378-KO
Site Location: Cope drive
Sampled By: exp
AGAT Quote #: ______ PO: ______
Please note: If quotation number is not provided, client will be billed full price for analysis.

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

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

Invoice Information:

Bill To Same: Yes ☐ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

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

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI Y / N	O. Reg 153: Metals and Inorganics	☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)	ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr^{6+} ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	ph	Sulphates	chlorides	Electro Conductivity
BH 1 SS 2 2.5'-4.5'	Feb22/19																				✓	✓	✓	✓
BH 5 SS 3 5'-6.5'	Feb21/19																				✓	✓	✓	✓
BH 6 SS 4 7.5'-9'	Feb22/19																				✓	✓	✓	✓

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Ryan DiGiuseppe	Feb 28/19	4:45		19-02-28	16h22
	19-03-01	16h00	Sima	19/3/2	11:24

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Nº: T 078134 ✓

List of Distribution

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