Geotechnical Investigation

Proposed Addition and Civil Work
Earl of March School. 4 The Parkway, Ottawa, ON
OCDSB EXP SOA # 24-08n

Client:
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Executive Summary

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed addition and civil works for the Earl of March Secondary School, located at 4 The Parkway, Ottawa, Ontario (Figure 1). The terms and conditions of this assignment were outlined in EXP Services Inc. (EXP) proposal number: OTT-23012778-A0 dated December 27, 2023, and authorized by the Ottawa-Carleton District School Board (OCDSB) by PO 333240053061 dated January 17, 2024, as well as a subsequent proposal, dated August 8, 2024, and authorized by the Ottawa-Carleton District School Board (OCDSB) by PO 333240059155, dated August 15, 2024. This report supersedes the final geotechnical report submitted on July 22, 2024, and the updated draft geotechnical report submitted on September 17, 2024.

Drawing No. C04A, titled "Grading plan", dated July 19, 2024 (Issued for Construction), prepared by WSP, indicates that the proposed addition is to be a two-storey structure with an approximate area of 1,600 square metres (m^2) and will be constructed to the north of the existing building with a proposed Finished Floor Elevation (FFE) of Elevation 94.11 m. It is understood from emails from the OCDSB that the building will not have a basement. Drawing No. C04A indicates that additional surface parking and laneways will also be constructed as part of the development. The design Underside of Footing (USF) elevation is not known at the time of this report.

It is understood that the proposed civil works will include the installation of a new watermain and new storm and sanitary sewers. The services are proposed for both the school property and on The Parkway. Drawing Nos. C05A and C05B, titled "Site servicing plans", dated July 19, 2024 (Issued for Construction), prepared by WSP, indicate that the new watermain will be a 150 mm diameter polyvinyl chloride (PVC) pipe. The new storm and sanitary services will also be PVC pipes with diameters ranging from 200 mm to 375 mm as well as a 450 mm diameter concrete storm sewer. The provided storm and sanitary pipe inverts range from Elevation 92.43 m to Elevation 89.97 m; approximately 1.3 m to 3.3 m below the existing grade. The inverts for the proposed watermain were not included and it has been assumed that the watermain pipe inverts will be up to 2.4 m below the existing grade.

Asbuilt Drawings original school building by Helmer and Tutton (H&T), 1968, were also provided to EXP and indicate that, at the location of the proposed addition, the existing foundations are footings founded on the sound bedrock surface. The design top of footing is indicated as Elevation 91.7 m. The Asbuilt drawings also note that at five footing locations, the founding conditions were changed bedrock during construction from footings to end bearing piling extending to sound bedrock. This change may have been due to bedrock being deeper than the anticipated in the design. The locations where the Asbuilt plans indicate that the footings were changed to end bearing piles are shown as red squares on Figure 3a.

The fieldwork for the geotechnical investigation was undertaken in two (2) stages. The first stage was undertaken between January 8 and 9, 2024 and consists of the drilling of twelve (12) boreholes (Borehole Nos. 23-1 to 23-12) to auger refusal and termination depths ranging from 2.3 m to 7.5 m below the existing grade. Due to the variability of the bedrock conditions as well as the proposed civil works, a second stage was undertaken between August 28 and September 2, 2024, and consists of the drilling of ten (10) boreholes (Borehole Nos. 24-1 to 24-10) to auger refusal and termination depths ranging from 2.1 m to 4.8 m below the existing grade. Two (2) test pits (Test Pit Nos. 1 and 2) were also excavated at the northern extent of the existing building to determine the existing founding conditions and founding types. The test pits were excavated to depths of 3.0 m and 3.5 m below the existing grade, in Test Pit Nos. 1 and 2, respectively.

The borehole information indicates the subsurface conditions consist of a surficial layer (topsoil, asphaltic concrete and fill) underlain by native silty clay which extends to 1.4 m to 5.8 m depths (Elevation 93.4 m to Elevation 88.1 m). The silty clay is underlain by glacial till. Refusal to augers was met in all the boreholes at 1.7 m to 7.5 m depths (Elevation 93.1 m to Elevation 86.4 m) below the existing grade. DCPT cone refusal was encountered at 6.5 m depth (Elevation 87.5 m). The type and presence of bedrock was confirmed in six of the boreholes by washboring and core drilling techniques which indicates that diorite bedrock underlies the site. The groundwater table at the site was established to range from 1.6 m to 3.2 m depths (Elevation 93.0 m to Elevation 90.1 m).

The results of the test pit investigation indicates that at Test Pit No. 1 (Figure No. 4) the foundation wall is sitting on a grade beam at 2.2 m depth (Elevation 91.8 m). Excavation at this testpit location was terminated at 3.0 m depth (Elevation 91.0 m) and the testpit was extended by use of a Dynamic Cone Penetration Test (DCPT) adjacent to the borehole to the depth of DCPT cone refusal, 6.5 m depth (Elevation 87.5 m), approximately 3.7 m below the underside of the grade beam. It is therefore likely that at this location, the building is supported by a deep foundation (i.e. piles). This location corresponds to where the H&T plans indicate that a footing was switched to an end bearing pile. At Test Pit No. 2, the existing building is supported by a footing founded bedrock at 3.5 m depth (Elevation 90.5 m).

The results of the seismic shear wave survey conducted at the site are provided in the report attached in Appendix C. The survey indicates a shear wave velocity of >1,500 m/s. For footings placed on sound bedrock and caissons or micropiles with **caps less than 3 m** from the sound bedrock surface, Table 4.1.8.4.A of the 2012 Ontario Building Code (as amended January 2022) indicates a site classification for seismic response of **Class A.** For caissons or micropiles with **caps more than 3 m** from the sound bedrock surface, Table 4.1.8.4.A of the 2012 Ontario Building Code (as amended January 2022) indicates a site classification for seismic response of **Class C.**

Based on proposed Finished Floor Elevation (FFE) of Elevation 94.11 m the proposed addition of, a minor grade raise will be required at the proposed addition location. For preliminary design purposes, a grade raise of up to 0.5 m is considered to be permissible from a geotechnical point of view.

Based on the subsurface condition, it is considered that a combination of shallow foundation (footings) and deep foundation (piles, caisson, micropiles) will be required in the area of the proposed addition. Controlled Modulus Column (CMC) are also considered feasible in the area of deep bedrock, however a specialized contractor should be contacted to investigate the feasibility of this option.

At the location of Borehole Nos. 23-7, 23-8, 23-12, 24-7 to 24-10 and Testpit No. 24-2, strip and spread footings founded on the sound diorite bedrock are considered feasible. Footings founded on sound, competent and free of soil filled seams, may be designed for a factored geotechnical resistance at Ultimate Limit State (ULS) of 1,500 kPa.

At the location of Borehole Nos. 23-6, 23-9, 18-3 and Testpit 24-1, caissons (drilled piers) are considered feasible. Caissons should be a minimum of 760 mm in diameter with a socketed length equal to one (1) to three (3) times the socket diameter into the competent, sound bedrock. For these conditions caissons may be designed to carry the load based on sidewall (shaft) resistance between the concrete and bedrock, neglecting end bearing capacity, for a factored sidewall resistance at ultimate limit state (ULS) of 1,000 kPa. The SLS bearing pressure of the bedrock, required to produce 25 mm settlement of the structure will be much larger than the recommended value for factored geotechnical resistance at ULS. Therefore, the factored geotechnical resistance at ULS will govern the design for footings founded on bedrock. Micro piles are also feasible and can be discussed further if selected by the structural engineer.

The floor slab for the proposed building may be designed and constructed as a slab-on-grade placed on a 200 mm thick 19 mm sized clear stone bed placed on a minimum 300 mm thick engineered fill pad set on the approved native subgrade constructed in accordance with Section 9 of this report. The clear stone would minimize the capillary rise of moisture from the sub-soil to the floor slab. Alternatively, the floor slab may be cast on a 200 mm thick bed of OPSS Granular A overlain by a vapour barrier. Adequate saw cuts should be provided in the floor slabs to control cracking. A perimeter drainage system should be provided around the proposed addition. An underfloor drainage system will not be required for the proposed school building.

Excavations for the proposed addition and proposed services in the overburden may be undertaken by conventional heavy mechanical equipment and should comply with the most recent Occupational Health and Safety Act (OHSA), Ontario Regulations 213/91 (August 1, 1991). Excavation of side slopes in the sound diorite bedrock may be undertaken with near vertical sides subject to examination by a geotechnical engineer. Small quantities of the diorite bedrock may be excavated using a hoe ram however, this process is expected to be very slow. Where more significant excavation is required into the Diorite bedrock, such as for the proposed sanitary service in the vicinity of Boreholes Nos. 24-4 and 24-5. excavation can be undertaken by line drilling and blasting methods.

It is anticipated that excavations will extend up to 1.3 m below the recorded groundwater level and seepage of the surface and subsurface water into the excavations is anticipated. However, it should be possible to remove any water entering the excavation by collecting water in the perimeter of the excavation or pumping from sumps. In areas of high infiltration or in areas where more permeable soil layers may exist, a higher seepage rate should be anticipated and will require high-capacity pumps to keep the excavation dry.

It is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the proposed building and for trench backfill would have to be imported and should preferably conform to Ontario Provincial Standard Specification (OPSS) 1010 Granular B Type II and OPSS 1010 Select Subgrade Material (SSM) specifications.

Pavement structure for light duty traffic areas (parking lots, access pathways) should consist of 65 mm thick asphaltic concrete, 150 mm thick OPSS Granular A base and 450 mm thick OPSS Granular B Type II subbase. Pavement structure for heavy duty traffic areas (trucks and emergency vehicles) should consist of 110 mm thick asphaltic concrete, 150 mm thick OPSS Granular A base and 600 mm thick OPSS Granular B Type II subbase. The reinstatement of the pavement structure for The Parkway should consist of 140 mm thick asphaltic concrete, 150 mm thick OPSS Granular A base and 600 mm thick OPSS Granular B Type II subbase.

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

1. Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed addition and civil works for the Earl of March Secondary School, located at 4 The Parkway, Ottawa, Ontario (Figure 1). The terms and conditions of this assignment were outlined in EXP Services Inc. (EXP) proposal number: OTT-23012778-A0 dated December 27, 2023, and authorized by the Ottawa-Carleton District School Board (OCDSB) by PO 333240053061 dated January 17, 2024, as well as a subsequent proposal, dated August 8, 2024, and authorized by the Ottawa-Carleton District School Board (OCDSB) by PO 333240059155, dated August 15, 2024. This report supersedes the final geotechnical report submitted on July 22, 2024, and the updated draft geotechnical report submitted on September 17, 2024.

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The geotechnical investigation was undertaken to:

a) Establish the subsurface soil and groundwater conditions at (24) twelve boreholes and two (2) testpit locations,

b) Classify the site for seismic site response in accordance with the requirements of the 2012 Ontario Building Code (as amended January 1,2022) and assess the potential for liquefaction of the subsurface soils during a seismic event,

c) Comment on grade-raise restrictions and provide site grading requirements,

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 for the proposed building addition,

e) Comment on excavation conditions and de-watering requirements during construction of the proposed addition and new services, (watermain, sanitary service and storm sewer),

f) Provide pipe bedding requirements for the proposed new underground services;

g) Discuss backfilling requirements and suitability of on-site soils for backfilling purposes,

h) Recommend pavement structure thicknesses for access roads and parking lots and re-instatement of the roadway along the Parkway, and

i) Comment on the corrosion potential of subsurface soils to buried concrete and 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 Earl of March Secondary School is located in the area bounded by The Parkway to the North, Campeau Drive to the South and Teron Road to the east. Residences are present to the West of the school. The existing building consists of a two-storey structure with no basement, constructed in 1968 with an addition constructed to the south of the existing building in 2014. The Finished Floor Elevation (FFE) of the original structure has been indicated to be Elevation 94.09 m.

At the time of the January 2024 investigation the location of the proposed addition consisted of school portables situated on grass covered ground surrounded by asphaltic concrete walkways and fire access roads. At the time of the September 2024 investigation, the portables at the location of the proposed addition have been moved outside of the addition area.

The topography of the site slopes upwards to the west with borehole elevations ranging from Elevation 93.29 m to Elevation 94.80 m.

3. Background Information

3.1 Asbuilt Drawings (1968)

An Asbuilt drawing set for the original school building construction, Drawings S-1 to S-21, prepared by Helmer and Tutton Architects, dated December 1968 (H&T, 1968) were provided as background material.

Drawing S-01, Key Plan and General Notes indicates the following:

- Bearing capacity on sound bedrock is 958 kPa (20 ksf);
- Bearing capacity on overburden is 287 kPa (6 ksf);
- Unless otherwise noted, all piles and footings are to be founded on sound bedrock; and
- All piles are to be Franki piles unless otherwise noted;

Drawing S-18, Foundation and Ground Floor Plan and Details, indicates the following details along the north exterior wall, where the proposed addition is to be located:

- Foundations along the north wall were planned as footings extending to the sound bedrock.;
- The design top of the footings was indicated at Elevation 91.74 m (301'-0"). The exception to this is the footing at the north corner of the building with a top of footing at Elevation 92.0 m (302'-0");
- Five of the footings were noted as being changed to end bearing piles, extending to bedrock, during construction (as indicated by red squares on Figure 3a).
- It was also noted that all piles were 560 mm (22") Franki expanded base piles with a minimum capacity of 980 kN (100 tons).

3.2 Inspec-Sol Report (2014)

A geotechnical investigation was carried out by Inspec-Sol in 2014 for the building addition and additional parking areas to the south of the original school building. The results of the investigation were provided in the report titled, *Geotechnical Investigation Report, Earl of March Secondary School Proposed Addition, 4 The Parkway, Ottawa, Ontario,* Project Number T021165-A1, dated November 25, 2013, revised March 20, 2014.

The following were the relevant results of the investigation:

- Test pits were carried along the southeast wall of the existing school building. It was confirmed that the southern portion of the building is supported on piles.
- The top of the existing pile cap ranged from 0.9 m to 1.1 m depth below the existing grade (Elevation 93.1 m to Elevation 87.5 m). The pile caps were typically 0.5 m to 0.9 m thick.
- The depth of auger refusal ranged from 0.5 m to 10.5 m depth (Elevation 93.6 m to Elevation 83.4 m)
- The presence of bedrock was confirmed by coring at 5.3 m to 14.0 m depths (Elevation 88.6 m to Elevation 79.9 m)

3.3 EXP Geotechnical Report (2018)

EXP also completed a geotechnical investigation at the site in 2018 and the results of the geotechnical investigation are provided in the report titled, *Geotechnical Investigation - Proposed Hydrants, Earl of March Secondary School 4 The Parkway, Ottawa, Ontario,* dated May 30, 2018 (EXP Project No. OTT-00245378-C0). Borehole Nos. 18-2 and 18-3 from the 2018 geotechnical investigation are located within the bounds of the current investigation and their locations are shown on the Borehole Location Plans, Figures 2 and 3. The 2018 borehole logs are provided in Appendix A. Where referenced in this report, a prefix of 18- has been added to the borehole numbers from the EXP 2018 investigation.

4. Geology of the Site

4.1 Surficial Geology Map

The surficial geology map (Map 1506A, Surficial Geology Ottawa, Geological Survey of Canada, 1981) indicates the site is underlain by Precambrian bedrock with a deposit of clay and silt underlying erosional terraces in the general area. The surficial deposits are shown in Image 1 below.

Clay and silt underlying erosional terraces; upper part of marine deposits removed to variable depth by fluvial erosion. Includes sands and pockets of nonmarine silts.

Precambrian Bedrock

Image 1 – Surficial Geology

4.2 Bedrock Geology Map

The bedrock geology map (Map 1508A, Generalized Bedrock Geology, Ottawa-Hall, Geological Survey of Canada, 1985) indicates the site is underlain by various Precambrian bedrock types. The bedrock geology is shown in Image 2 below.

Paragneiss, pelitic and psammopelitic schists and

Diorite, gabbro, anorthosite and metagabbro

Quartzite, interlayered paragneiss; quartzose paragneiss

Image 2 – Bedrock Geology

5. Procedure

5.1 Test Hole Fieldwork

The fieldwork for the geotechnical investigation was undertaken in two (2) stages. The first stage was undertaken between January 8 and 9, 2024 and consists of the drilling of twelve (12) boreholes (Borehole Nos. 23-1 to 23-12) to auger refusal and termination depths ranging from 2.3 m to 7.5 m below the existing grade. Due to the variability of the bedrock conditions as well as the proposed civil works, a second stage was undertaken between August 28 and September 2, 2024, and consists of the drilling of ten (10) boreholes (Borehole Nos. 24-1 to 24-10) to auger refusal and termination depths ranging from 2.1 m to 4.8 m below the existing grade. Two (2) test pits (Test Pit Nos. 1 and 2) were also excavated at the northern extent of the existing building to determine the existing founding conditions and founding types. The test pits were excavated to depths of 3.0 m and 3.5 m below the existing grade, in Test Pit Nos. 1 and 2, respectively. A dynamic cone penetration test (DCPT) was conducted next to Test Pit Nos. 1 extending the test pit to the depth of DCPT cone refusal, 6.5 m below the existing grade. This DCPT was done in attempt to establish the depth of the bedrock at this location.

The borehole and test pit locations were cleared by a private utility locator retained by EXP. The fieldwork for all the phases were supervised on a full-time basis by a representative from EXP and the location and elevation of the test holes (Borehole and Test Pits) are shown on the testhole location plans, Figure 2, Figure 3a (Testhole Location Plan – Proposed Addition) and Figure 3b (Testhole Location Plan – Underground Services).

The boreholes were drilled using either a CME-55 or CME-75 truck-mounted drill rig equipped with continuous flight hollow-stem auger equipment and rock coring capabilities, operated by a drilling contractor subcontracted to EXP. Standard penetration tests (SPTs) were performed in all the boreholes at 0.8 m depth intervals and the soil samples were retrieved by the split-spoon sampler. The undrained shear strength of the clayey cohesive soils were measured by conducting in-situ vane tests and selected samples were also tested with a penetrometer. Six (6) boreholes were advanced beyond the depth of refusal by conventional coring techniques using the N-size core barrel. A field record of wash water return, colour of wash water and any sudden drops of the drill rods were kept during rock coring operations. The subsurface soil conditions in each borehole were logged with each soil sample placed in labelled plastic bags. Similarly, the rock cores were visually examined, placed in core boxes, identified, and logged.

Nineteen (19) mm diameter piezometers were installed in selected boreholes for long-term monitoring of the groundwater table. The piezometers were installed in accordance with EXP standard practice, and the installation configuration is documented on the respective borehole log. The boreholes were backfilled upon completion of drilling.

The test pits were excavated using a rubber tire backhoe. Samples of the soils exposed in the test pits were collected at selected depth intervals. The test pits were backfilled upon completion of excavating operations and the backfill was nominally packed in place using the backhoe bucket. The test pit logs, including photographs, are included as Figures 4 and 5.

5.2 Laboratory Testing Program

On completion of the borehole fieldwork, the soil and rock samples were transported to the EXP laboratory in Ottawa where they were examined by a geotechnical engineer and logs of boreholes prepared. All soil samples were classified in accordance with the Unified Soil Classification System (USCS) and the modified Burmister System (2006 Fourth Edition of the Canadian Foundation Engineering Manual (CFEM)).

The geotechnical engineer also assigned the laboratory testing program which is summarized in Table I.

Table I: Summary of Laboratory Testing Program	
Type of Test	Number of Tests Completed
Soil Samples	
Moisture Content Determination	58
Unit Weight Determination	15
Grain Size Analysis	4
Atterberg Limit Determination	4
Corrosion Analysis (pH, sulphate, chloride and resistivity)	4
Rock Samples	
Unconfined Compressive Strength and Unit Weight Determination	5

6. Subsurface Conditions and Groundwater Levels

A detailed description of the subsurface conditions and groundwater levels from the boreholes are given on the attached Borehole Logs, Figure 6 to 27. The borehole logs and related information depict subsurface conditions only at the specific locations and at the 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.

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 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 “Notes 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 borehole logs indicates the following subsurface conditions with depth and groundwater level measurements.

6.1 Topsoil

A 75 mm to 450 mm thick surficial topsoil layer was encountered in all the boreholes expect Borehole Nos. 23-8, 24-4, 24-5 and 24-7 to 24-10.

6.2 Asphaltic Concrete

A 60 mm to 140 mm thick asphaltic concrete layer was encountered in Borehole Nos. 23-8, 24-4, 24-5, 24-7 to 24-9.

6.3 Fill

The surficial topsoil, asphaltic concrete or the surface are underlain by fill in all the boreholes, except Borehole Nos. 23-6 and 18-2, and extends to 0.5 m to 2.2 m depths (Elevation 93.9 m to Elevation 91.1 m). The fill ranges in consistency from silty clay to silty sand with gravel and organics. Possible debris, cobbles or boulders are inferred from auger grinding within the fill layer in Borehole No. 23-3. The fill in a loose to very dense state based on standard penetration tests (SPT) N-values ranging from 6 to 62. The moisture content ranged from 2 to 37 percent.

6.4 Silty Clay

A silty clay layer was contacted below the fill or the topsoil all the boreholes except in Borehole Nos. 23-1, 23-3 and 24-4. The silty clay extended to 1.4 m to 5.8 m depths (Elevation 93.4 m to Elevation 88.1 m). Borehole No. 18-3 terminated within this layer at 3.9 m depth (Elevation 90.0 m). The undrained shear strength of the silty clay ranges from 34 kPa to 210 kPa indicating a firm to hard consistency. The natural moisture content and unit weights ranges from 21 percent to 54 percent and 17.0 kN/m^3 to 20.1 kN/m^3, respectively.

Results from grain-size analysis and Atterberg limit determination conducted on two (2) samples of the silty clay from the 2024 investigation and one (1) sample from the 2018 investigation are summarized in Table II. The grain-size distribution curves are shown in Figures 28 to 30.

Table II: Summary of Results from Grain-Size Analysis and Atterberg Limit Determination – Silty Clay									
Borehole No. (BH) – Sample No. (SS)	Depth (m)	Grain-Size Analysis (%) and Atterberg Limits							
		Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification (USCS)
23-5 -SS2	0.8-1.4	0	9	44	47	49	21	28	Silty Clay of Medium Plasticity (CI) - Trace Sand
23-6 -SS4	2.3-2.9	0	9	41	50	47	19	28	Silty Clay of Medium Plasticity (CI) - Trace Sand
18-3 -SS4	2.3-2.9	0	4	42	54	49	23	26	Silty Clay of Medium Plasticity (CI) - Trace Sand

Based on a review of the results of the grain-size analysis and Atterberg limits, the soil may be classified as a silty clay of medium plasticity (CI) with trace sand, in accordance with the Unified Soil Classification System (USCS).

6.5 Silty Sand Glacial Till

The fill or the silty clay are underlain by glacial till in all the boreholes except Borehole Nos. 23-2, 23-5, 24-8, 23-10 and 24-4 to 24-7. Borehole No. 18-3 terminated within the silty clay layer. The glacial till was encountered at 1.4 m to 5.8 m depths (Elevation 93.4 m to Elevation 88.1 m). The glacial till contain cobbles and boulders and is in a loose to very dense state as indicated by SPT "N" values of 4 to 69 blows. The natural moisture content and unit weight of the glacial till ranges from 6 percent to 42 percent and 18.3 kN/m^3 to 23.5 kN/m^3, respectively.

The results from the grain-size analysis conducted on two (2) samples of the glacial till from the 2024 investigation as well as (1) sample from the 2018 drilling investigation are summarized in Table III. The grain-size distribution curves are shown in Figures Nos. 31 to 33.

Table III: Summary of Results from Grain-Size Analysis and Atterberg Limit Determination – Glacial Till							
Borehole No. (BH) – Sample No. (SS)	Depth (m)	Grain-Size Analysis (%) and Atterberg Limits					
		Gravel	Sand	Silt	Clay	Plasticity Index	Soil Classification (USCS)
23-1 - SS4	2.3-2.9	17	47	27	9	Non-plastic	Silty Sand (SM) – Some Gravel, Trace Clay
23-11 - SS7	4.6-5.2	11	45	28	16	Non-plastic	Silty Sand (SM) – Some Gravel, Some Clay
18-2 - SS2	1.5-2.1	12	48	29	11	--	Silty Sand (SM) – Some Gravel, Some Clay

Based on a review of the laboratory test results, the glacial till may be classified as a silty sand (SM) with some gravel and trace to some clay in accordance with the USCS.

6.6 Auger Refusal and Bedrock

Auger refusal was met at 1.7 m to 7.5 m depths (Elevation 93.1 m to Elevation 86.4 m) in all the boreholes.

A summary of the auger refusal depths as well as the depth of bedrock confirmed by coring are shown in Table IV.

Table IV: Summary of Auger and Soil Sampler Refusal and Bedrock Depths (Elevations) in Boreholes

Borehole /TestPit No.	Ground Surface Elevation (m)	Refusal Depth (m) (Elevation(m))	Depth (Elevation) of Proven Bedrock (m)	Comment wrt to Depth (Elevation) of Bedrock Surface
BH23-1	94.61	3.3 (91.3)	--	Auger refusal at 3.3 m
BH23-2	93.89	1.8 (92.1)	1.8 (92.1)	3.2 m length of bedrock cored below 1.8 m depth
BH23-3	94.06	3.1 (91.0)	--	Auger refusal at 3.1 m
BH23-4	93.98	2.3 (91.7)	--	Auger refusal at 2.3 m
BH23-5	93.77	2.6 (91.2)	--	Auger refusal at 2.6 m
BH23-6	93.90	4.5 (89.4)	--	Auger refusal at 4.5 m
BH23-7	94.12	2.6 (91.5)	2.6 (91.5)	1.5 m length of bedrock cored below 2.6 m depth
BH23-8	94.05	2.9 (91.2)	2.9 (91.2)	2.7 m length of bedrock cored below 2.9 m depth
BH23-9	93.95	7.5 (86.5)	--	Auger refusal at 7.5 m
BH23-10	94.18	3.8 (90.4)	--	Auger refusal at 3.8 m
BH23-11	94.19	5.6 (88.6)	--	Auger refusal at 5.6 m
BH23-12	94.07	3.0 (91.1)	--	Auger refusal at 3.0 m
BH18-2	93.98	2.1 (91.9)	--	Auger refusal at 2.1 m
BH 18-3	93.85	>3.0 (<90.0)	--	Borehole terminated at 3.9 m depth (no refusal)
BH24-1	94.80	1.7 (93.1)	1.7 (93.1)	3.1 m length of bedrock cored below 1.7 m depth
BH24-2	93.82	3.9 (89.9)	--	Auger refusal at 3.9 m
BH24-3	93.77	4.2 (89.6)	--	Auger refusal at 4.2 m
BH24-4	93.52	2.1 (91.4)	2.1 (91.4)	2.7 m length of bedrock cored below 2.1 m depth
BH24-5	93.29	3.0 (90.3)	3.0 (90.3)	1.9 m length of bedrock cored below 3.0 m depth
BH24-6	93.82	3.0 (90.8)	--	Auger refusal at 3.0 m
BH24-7	94.02	3.4 (90.6)	--	Auger refusal at 3.4 m
BH24-8	93.99	3.3 (90.7)	--	Auger refusal at 3.3 m
BH24-9	93.99	2.7 (91.3)	--	Auger refusal at 2.7 m
BH24-10	94.07	2.1 (92.0)	--	Auger refusal at 2.1 m
TP-1	93.96	6.5 (87.5)	--	DCPT Refusal at 6.5 m
TP-2	93.96	3.5 (90.5)	3.5 (90.5)	Observed bedrock at 3.5 m depth

A review borehole logs Indicates that the total core recovery (TCR) ranges between 80 percent and 100 percent and the rock quality designation (RQD) ranges between 50 and 84 percent indicating a diorite bedrock of a fair to good quality. Photographs of the bedrock cores are included in Appendix B.

Unit weight determination and unconfined compressive strength tests were conducted on five (5) rock core samples. The test results are summarized in Table V.

Table V: Summary of Unconfined Compressive Strength Test Results – Bedrock Cores				
Borehole (BH) No. – Run No.	Depth (m)	Unit Weight (kN/m³)	Unconfined Compressive Strength (MPa)	Classification of Rock with respect to Strength
23-2 Run1	2.6 - 2.7	28.6	154	Very Strong R5
23-7 Run1	2.9 - 3.1	26.7	214	Very Strong R5
24-1 Run 2	3.3 - 3.5	28.0	142	Very Strong R5
24-4 Run 1	2.3 - 2.5	29.4	175	Very Strong R5
24-5 Run 1	3.0 - 3.1	29.1	220	Very Strong R5

A review of the test results in Table IV indicates the strength of the rock may be classified as very strong (R5) in accordance with the Canadian Foundation Engineering Manual (CFEM), Fifth Edition, 2023.

6.7 Groundwater Level Measurements

The groundwater level was measured in each borehole upon completion and ranges from 0.9 to 4.0 m depth (Elevation 92.6 m to 90.2 m).

A summary of the groundwater level measurements taken at time of completion and in the boreholes equipped with piezometers on February 15, 2024, and September 13, 2024, are shown in Table VI.

Table VI: Summary of Groundwater Level Measurements					
Borehole No. (BH)	Ground Surface Elevation (m)	February 15, 2024		September 13, 2024	
		Elapsed Time in Days from Date of Installation	Depth Below Ground Surface	Elapsed Time in Days from Date of Installation	Depth Below Ground Surface
23-1	94.61	38	1.6 (93.0 m)	Inaccessible	
23-2	93.98	38	2.2 (91.7 m)	Inaccessible	
23-8	94.12	Inaccessible		249	2.8 (91.3 m)
23-9	93.95	Inaccessible		Well not found	
24-1	94.80	--	--	11	3.1 (91.7 m)
24-5	93.29	--	--	11	3.2 (90.1 m)
24-9	93.99	--	--	14	2.7 (91.3 m)

The groundwater level ranges from 1.6 m to 3.2 m depths (Elevation 93.0 m to Elevation 91.0 m). It should be noted that the portables at the school were moved subsequent to the initial geotechnical investigation in January 2024 and portables have been moved over top of the piezometers at Borehole Nos. 23-1 and 23-2 and therefore the piezometers could not be measured in September 2024. The piezometer at Borehole Nos. 23-8 and 23-9 were not accessible in February 2024 due to ice accumulation. The piezometer at Borehole No. 23-9 was not found in September 2024 and the flush mount may have been removed.

The groundwater levels were determined in the boreholes at the time and under the condition stated in this report. 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.

It is recommended that another set of groundwater readings be collected before issuance of the final report.

7. Test Pit Investigation of Existing Founding Conditions

Two (2) test pits (Test Pit Nos. 1 and 2) were excavated at the northern extent of the existing building for the purpose of exposing the existing foundations and assessing the founding type and founding conditions. The findings of the testpit investigation are presented in Figures 4 and 5. The following observations were made:

Test Pit No. 1.

- The foundation wall is a poured concrete wall with a width of approximately 0.4 m.
- The foundation wall is sitting on a concrete beam, approximately 0.5 m in thickness, at 2.2 m depth (Elevation 91.8 m)
- A void of approximately 75 mm was observed between the foundation wall and the concrete beam
- The concrete beam is underlain by granular fill.
- A Dynamic Cone Penetration Test was carried out adjacent to the test pit and extended to a refusal depth of 6.5 m below the existing grade (Elevation 87.5 m) approximately 3.7 m below the underside of the grade beam.
- Water was observed at 3.0 m depth (Elevation 91.0 m)
- No perimeter drainage was noted
- The existing foundation wall was noted as not having any damp proofing or drainage board.

Test Pit No. 2.

- The foundation wall is a poured concrete wall with a width of approximately 0.8 m.
- The foundation wall extended to a depth of 2.5 m below the existing grade (Elevation 91.5 m) where a concrete footing was observed.
- The concrete footing has a width of 1.1 m in and was 1.0 m thick, founded on the bedrock surface at a depth of 3.5 m below the existing grade (Elevation 90.5 m)
- The subsurface conditions consisted of fill extending to 1.2 m depth underlain by silty clay extending the depth of the excavation
- Granular fill was observed adjacent to the existing foundation wall
- No perimeter drainage was noted
- The existing foundation wall was noted as not having any damp proofing or drainage board.
- The test pit was dry upon completion of excavation

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

8.1 Site Classification for Seismic Site Response

The results of the seismic shear wave survey conducted at the site are provided in the report attached in Appendix C. The survey indicates a shear wave velocity of >1,500 m/s. For footings placed on sound bedrock and caissons or micropiles with **caps less than 3 m** from the sound bedrock surface, Table 4.1.8.4.A of the 2012 Ontario Building Code (as amended January 2022) indicates a site classification for seismic response of **Class A.** For caissons or micropiles with **caps more than 3 m** from the sound bedrock surface, Table 4.1.8.4.A of the 2012 Ontario Building Code (as amended January 1, 2022) indicates a site classification for seismic response of **Class C.**

8.2 Liquefaction Potential of Soils

Based on a review of the borehole information, the subsurface soils are not considered to be susceptible to liquefaction during a seismic event.

9. Grade Raise Restrictions

It indicated in the provided drawings that the Finished Floor Elevation (FFE) of the addition will be Elevation 94.11 m. Based on the borehole elevations within the proposed building footprint, this will result in a minor regrading. For preliminary design purposes, a grade raise of up to 0.5 m is considered to be permissible from a geotechnical point of view.

10. Site Grading

Site grading within the **proposed building addition footprint** area should consist of the removal of all existing fill, surficial and buried topsoil (organic) layers and organic stained soils down to the undisturbed native silty clay or glacial till. The native subgrade should be examined and proofrolled if directed by a geotechnician. Any loose/soft areas identified during the subgrade examination should be excavated, removed and replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II material compacted to 98 percent standard Proctor maximum dry density (SPMDD). Once the subgrade has been approved, the grades may be raised to the design underside footing and floor slab elevation by the construction of an engineered fill pad constructed in accordance with Section 11.

Site grading within the footprint of the **parking area and laneways/access roads** should consist of the removal of the surficial topsoil layer and organic stained soils and the exposed soil proofrolled with a heavy vibratory roller the presence of a geotechnician. Any loose/soft areas identified during the proofrolling process should be excavated, removed and replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II or OPSS Select Subgrade Material (SSM) compacted to 95 percent standard Proctor maximum dry density (SPMDD).

11. Foundation Considerations

The H&T, 1968 Asbuilt Drawings indicate that the top of the existing footings were constructed at Elevation 91.7 m and the footings extended to the bedrock surface. The results of the test pit investigation indicates that at Test Pit No. 1 (Figure No. 4) the foundation wall is sitting on a grade beam at 2.2 m depth (Elevation 91.8 m). Excavation at this testpit location was terminated at 3.0 m depth (Elevation 91.0 m) and the testpit was extended by use of a Dynamic Cone Penetration Test (DCPT) adjacent to the borehole to the depth of DCPT cone refusal, 6.5 m depth (Elevation 87.5 m), approximately 3.7 m below the underside of the grade beam. It is therefore likely that at this location, the building is supported by a deep foundation (i.e. piles). This location corresponds to where the H&T p ns indicate that a footing was switched to an end bearing pile. At Test Pit No. 2, the existing building is supported by a footing found bedrock at 3.5 m depth (Elevation 90.5 m). The proposed addition is to have an FFE of Elevation 94.11 m.

A rev of logs for the boreholes located within the proposed building addition footprint indicates that the depth of auger refus was met at 2.1 m to 7.5 m depths (Elevation 92.0 m to Elevation 86.5 m) in all of the boreholes. The exception to this is Boreh e No. 18-3 which terminated within the silty clay layer at 3.9 m depth (Elevation 90.0 m). The presence of very strong diorit edrock was confirmed in Borehole Nos. BH23-7 and BH23-8 at 2.6 m and 2.9 depths (Elevation 91.5 m and Elevation 91.2 m), respectively.

It has been assumed that where auger/DCPT cone refusal or bedrock was encountered at a depth of 3.5 m or higher, the building will be founded on footings. This depth corresponds to the where the existing footing was founded in Test Pit No. 1. Where auger/DCPT cone refusal or bedrock was encountered at a depth below 3.5 m, it has been assumed that the building will be founded on caissons.

Based on the auger refusal or confirmed bedrock depths, the expected footing conditions are presented in Table VII below.

Table VII: Summary of Groundwater Level Measurements

Borehole /Test Pit No. (BH/TP)	Ground Surface Elevation (m)	Auger Refusal or Confirmed Bedrock Below Ground Surface (Elevation), m	Expected Founding Condition
BH23-6	93.90	4.5 (89.4)	Cassion Socketed in Bedrock
BH 23-7	94.10	2.6 (91.5)	Footing Founded on Bedrock
BH23-8	94.10	2.9 (91.2)	Footing Founded on Bedrock
BH23-9	94.00	7.5 (86.5)	Caisson Socketed into Bedrock
BH23-12	94.10	3.0 (91.1)	Footing Founded on Bedrock
BH18-3	94.10	>3.9 (<90.0)	Caisson Socketed into Bedrock
BH24-7	94.02	3.4 (90.6)	Footing Founded on Bedrock
BH24-8	93.99	3.3 (90.7)	Footing Founded on Bedrock
BH24-9	93.99	2.7 (91.3)	Footing Founded on Bedrock
BH24-10	94.07	2.1 (92.0)	Footing Founded on Bedrock
TP24-1	93.96	6.5 (87.5)	Caisson Socketed into Bedrock
TP24-2	93.96	3.5 (90.5)	Footing Founded on Bedrock

Each foundation option is discussed in the following sections of this report.

11.1 Footings – Borehole Nos. 23-7, 23-8, 23-12, 24-7 to 24-10 and Testpit No. 24-2

Strip and spread footings founded on the sound diorite bedrock, competent and free of soil filled seams, may be designed for a factored geotechnical resistance at Ultimate Limit State (ULS) of 1,500 kPa. The factored ULS values includes a resistance factor

of 0.5. The SLS bearing pressure of the bedrock, required to produce 25 mm settlement of the structure will be much larger than the recommended value for factored geotechnical resistance at ULS. Therefore, the factored geotechnical resistance at ULS will govern the design for footings founded on bedrock.

All footing beds should be examined by a geotechnical engineer/technician to ensure that the founding surfaces are capable of supporting the design bearing pressure at SLS and that the footing beds have been properly prepared.

11.2 Caissons- Borehole Nos. 23-6, 23-9, 18-3 and Testpit 24-1

The proposed addition may be supported by caissons (drilled piers) socketed into the sound diorite bedrock and designed to carry the load based on sidewall (shaft) resistance between the concrete and bedrock, neglecting end bearing capacity. The caisson should be a minimum 760 mm in diameter and typically have a socketed length equal to one (1) to three (3) times the socket diameter into the competent, sound bedrock. The caissons should be spaced at three (3) caisson diameters. For a caisson constructed using concrete with a compressive strength of 35 MPa, the rock socketed caissons may be designed for a factored sidewall resistance at ultimate limit state (ULS) of 1,000 kPa. The factored ULS values includes a resistance factor of 0.4 in accordance with the 2006 Canadian Foundation Engineering Manual, Fourth Edition (CFEM). The Serviceability Limit State (SLS) bearing pressure of the bedrock, required to produce 25 mm settlement of the foundation will be much larger than the recommended value for factored geotechnical resistance at ULS. Therefore, the factored geotechnical resistance at ULS will govern the design.

Installation of the caisson will require the use of at least one liner to minimize soil loss. The liner should be driven to the diorite bedrock. It may be necessary to loosen the overburden material by augering through to the bedrock. The liner may then be advanced through the soil slurry to the bedrock. It is noted that the caissons will require dewatering operations since the groundwater level upon completion of the boreholes within the building footprint ranges from 2.4 to 3.4 m depth (Elevation 92.0 m to 90.6 m). The stabilized groundwater level in Borehole No. 24-9 was 2.7 m depths (Elevation 91.3 m). If the caissons cannot be dewatered, concrete may have to be placed by ‘tremie’ technique. This should be allowed for by the caisson installation contractor.

It is imperative that the sidewalls of the portion of the caisson socketed into the bedrock be cleaned of any soil smearing, to ensure the concrete is in contact with clean bedrock.

All caissons installation must be reviewed by a geotechnician working under the supervision of a geotechnical engineer to confirm the factored geotechnical resistance value at ULS of the founding rock and to ensure that the caissons have been prepared satisfactorily and properly cleaned.

The caisson 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 cover in areas where the snow will not be removed. Alternatively, frost protection may be provided by rigid insulation or a combination of earth cover and rigid insulation.

Alternatively, the caissons can be replaced with either Control Modulus Columns (CMC’s) or micropiles, as discussed below.

11.3 Control Modulus Columns

Controlled Modulus Columns (CMCs) are concrete columns placed in a grid network that effectively spreads the applied high loads from the structure to the ground and the grid of CMCs. The installation process will result in stiffened soils capable of supporting shallow footings and slab-on-grade construction.

CMCs may be able to be used in place of caissons in areas of deep bedrock. A specialized contractor should be contacted to investigate the feasibility of this option.

11.4 Micropiles

Micropiles are small diameter piles (typically 75 mm to 200 mm in diameter) drilled through overburden soils and socketed into the underlying sound bedrock. The loading on the micropiles is carried by the bond between the grout and the sound bedrock. The micropiles are connected to a micropile cap which can support conventional shallow foundations.

The installation of micropiles avoids large excavations to the bedrock surface and excavations below the groundwater level.

Micropiles may be able to be used in place of caissons in areas of deep bedrock. A specialized contractor should be contacted to investigate the feasibility of this option.

11.5 General Comments

For footings of a heated structure where all the footings are founded on the sound bedrock, it is recommended the soil cover be 1.2 m to protect the footings from frost damage. For footings of an unheated structure founded on sound bedrock, the soil cover should be 1.5 m. Alternatively, frost protection may be provided by rigid insulation or by a combination of rigid insulation and earth cover.

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.

12. Floor Slab and Drainage Requirements

The floor slab for the proposed building may be designed and constructed as a slab-on-grade placed on a 200 mm thick 19 mm sized clear stone bed placed on a minimum 300 mm thick engineered fill pad set on the approved native subgrade constructed in accordance with Section 9 of this report. The clear stone would minimize the capillary rise of moisture from the sub-soil to the floor slab. Alternatively, the floor slab may be cast on a 200 mm thick bed of OPSS Granular A overlain by a vapour barrier. Adequate saw cuts should be provided in the floor slabs to control cracking.

It is recommended that a perimeter drainage system should be provided around the proposed addition. Based on the presumed finished floor elevation of Elevation 94.09 m, no basement, and the groundwater level at Elevation 93.0 m to Elevation 91.7 m, an underfloor drainage system will not be required for the proposed school building.

The floor slab should be set at a minimum of 150 mm higher than the surrounding final exterior grade.

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

13. Excavation and De-Watering Requirements

13.1 Excess Soil Management

Ontario Regulation 406/19 specifies protocols that are required for the management and disposal of excess soils. As set forth in the regulation, specific analytical testing protocols need to be implemented and followed based on the volume of soil to be managed and the requirements of the receiving site. 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. EXP would be pleased to assist with the implementation of a soil management and testing program that would satisfy the requirements of Ontario Regulation 406/19.

13.2 Excavations

This section of the report discusses excavation requirements for the construction of the building addition and the construction of the underground services.

13.2.1 Foundation Excavations

It has been anticipated that depth of excavation for foundations will be approximately 3.5 m depth (Elevation 90.5 m) below the existing grade, extending through the surficial layers (asphaltic concrete, topsoil and fill), the silty clay, glacial till and weathered bedrock to the sound diorite bedrock.

It is anticipated that the excavation may be up to 1.0 m below the recorded groundwater level.

13.2.2 Underground Services Excavation

It is understood that the proposed underground services will have pipe inverts ranging from Elevation 92.43 m to Elevation 89.97 m; approximately 1.3 m to 3.3 m below existing grade. A review of the nearest borehole log at each provided invert elevation indicates that generally it is expected that excavations will extend through the surficial layers (asphaltic concrete, topsoil and fill) to either the silty clay or glacial till. Near Borehole Nos.24-4 and 24-5 the proposed invert depths are below the bedrock depth, proven by coring, by up to 0.6 m and it is expected that excavations will extend into the diorite bedrock. It should noted that bedrock depths are variable and it should be expected that excavation into the bedrock surface will occur at various locations along the alignment of the proposed services.

It is anticipated that the excavation may be up to 1.3 m below the recorded groundwater levels.

13.2.3 Overburden (Soil) Excavation

Excavations in overburden soil may be undertaken by conventional heavy mechanical equipment capable of removing cobbles and boulders within the glacial till.

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 above the water table at the site are classified as Type 3 soil and sidewalls of open cut excavations 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 the required side slopes for open cut excavations cannot be achieved due to space restrictions, dewatered excavations for the installation of underground services may be undertaken within the confines of a prefabricated support system (trench box) designed and installed in accordance with OHSA.

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.

13.2.4 Bedrock Excavations

It is anticipated that excavations will extend to the sound diorite bedrock for footings and into the sound diorite bedrock for underground services installation. The excavation of side slopes in the sound diorite bedrock may be undertaken with near vertical sides subject to examination by a geotechnical engineer. Weathered or highly fractured zones of the diorite bedrock should be cut back at near vertical slope.

Small quantities of the diorite bedrock may be excavated using a hoe ram however, this process is expected to be very slow. Where more significant excavation is required into the sound very strong diorite bedrock, excavation can be undertaken by line drilling and blasting methods. Should blasting not be permitted, the excavation of the diorite bedrock would have to be undertaken by line drilling and removal of rock pieces by heavy equipment. Specialized contractors bidding on this project should decide on their own the most preferred rock removal method, hoe ramming or line drilling and blasting.

13.2.5 Preconstruction Survey and Vibration Monitoring

It is recommended that a pre-construction condition survey of the existing school and surrounding infrastructure located within the construction zone of influence be undertaken prior to any earth (soil) and rock excavation work as well as vibration monitoring during excavation, blasting and construction operations. A pre-blast survey and a blasting report indicating that there will be no impact to adjacent buildings, City owned infrastructure, or other infrastructure in accordance with City Standard F-1201 is required to be submitted to the City.

Prior to the commencement of blasting, a detailed blast methodology should be submitted by the Contractor. The vibration limits for blasting should be in accordance with City of Ottawa Special Provisions (SP No. 1201).

Vibration monitors should be installed in critical areas adjacent building and infrastructure located within the construction zone of influence to monitor the vibration levels and set up to provide automated “alert” and “stop work” notifications if the permissible vibration levels are exceeded.

13.2.6 Excavations - General

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.

13.3 Dewatering

It is anticipated that excavations will extend up to 1.3 m below the recorded groundwater level and seepage of the surface and subsurface water into the excavations is anticipated. However, it should be possible to remove any water entering the excavation by collecting water in the perimeter of the excavation or pumping from sumps. In areas of high infiltration or in areas where more permeable soil layers may exist, a higher seepage rate should be anticipated and will require high-capacity pumps to keep the excavation dry.

For construction dewatering, an Environmental Activity and Sector Registry (EASR) approval may be obtained for water takings greater than 50 m^3 and less than 400 m^3 per day. If more than 400 m^3 per day of groundwater are generated for dewatering purposes, then a Category 3 Permit to Take Water (PTTW) must be obtained from the Ministry of the Environment, Conservation and Parks (MECP). A Category 3 PTTW would require a complete hydrogeological assessment and would take at least 90 days for the MECP to process once the application is submitted.

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.

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

The on-site soils to be excavated are fill, silty clay and glacial till.

It is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the proposed building, trench backfill and parking lot subgrade would have to be imported and should preferably conform to the following specifications:

- Engineered fill under the floor slab of the proposed addition - OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 98 percent SPMDD,
- Backfill material for footing trenches and against foundation walls located outside the proposed school building – OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 95 percent SPMDD,
- Backfill in exterior services trenches (above the bedding and cover) where paved surfaces will be located– Existing onsite material (silty clay and glacial till) from above the water table, placed so that the trench backfill matches the existing material exposed along the trench walls, placed in 300 mm thick lifts compacted to 95 percent SPMDD. The suitability of the onsite material should be assessed early in the construction process.
- Trench backfill and subgrade fill for the parking lots/roadways should consist of OPSS 1010 Select Subgrade Material (SSM) for the parking lot placed in 300 mm thick lifts and each lift compacted to 95 percent SPMDD; and
- Fill for landscaped areas should be clean fill free of debris, topsoil (organic soil), cobbles and boulders placed in 300 mm thick lifts and each lift compacted to 92 percent SPMDD.

15. Pipe Bedding Requirements

It is anticipated that the subgrade for the proposed underground services will consist of native silty clay, glacial till or the diorite bedrock.

The pipe bedding including material specifications, thickness of cover material and compaction requirements should conform to City of Ottawa specifications, drawings and special provisions. The bedding and cover material should be compacted to a minimum of 95 percent standard Proctor maximum dry density (SPMDD).

The bedding thickness may be increased in areas where the subgrade is subject to disturbance. If this is the case, trench base stabilization techniques, such as the removal of loose material, placement of sub-bedding, consisting of OPSS Granular B Type II completely wrapped in a non-woven geotextile, may be used.

For paved surfaces that will be located over service trenches, it is recommended that the trench backfill material within the 1.8 m frost zone, should match the existing material exposed along the trench walls 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. Alternatively, frost tapers may be used.

If the backfill for the service trenches will consist of granular fill, clay seals should be installed in the service trenches at select intervals (spacing) as per City of Ottawa Drawing No. S8. The seals should be 1 m wide, extend over the entire trench width and 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.

To minimize the potential for bending stresses within the pipe, a transition zone treatment should be provided in areas where the pipe subgrade changes from overburden to bedrock and vice versa. In areas where the surface of the bedrock slopes at a steeper gradient than 3H:1V, the bedrock should be excavated and additional bedding material placed to create a 3H:1V transition zone.

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

16. Access Roads and Parking Lots

The subgrade for the pavement structures is anticipated to consist of the existing fill and native silty clay. Pavement structure thicknesses required for the access roads and parking lots and The Parkway reinstatement on the anticipated approved subgrade materials were computed and are shown in Table VIII. The pavement structures assume a functional design life of 15 to 20 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	Computed Pavement Structures		
		Light Duty Traffic (Cars Only)	Heavy Duty Traffic (Fire Truck Access)	Reinstatement of The Parkway
Asphaltic Concrete	92 percent to 97 percent MRD	65 mm HL3/SP12.5 mm Cat. B (PG 58-34)	50 mm HL3/SP12.5 mm Cat. B (PG 58-34) 60 mm HL8/SP 19 mm Cat. B (PG 58-34)	60 mm HL3/SP12.5 mm Cat. D (PG 64-34) 80 mm HL8/SP 19 mm Cat. D (PG 64-34)
OPSS 1010 Granular A Base (crushed diorite)	100% percent SPMDD	150 mm	150 mm	150 mm
OPSS 1010 Granular B Type II Sub-base	100% percent SPMDD	450 mm	600 mm	600 mm

Notes:

1. SPMDD denotes standard Proctor maximum dry density, ASTM, D-698-12e2.
2. MRD denotes Maximum Relative Density, ASTM D2041.
3. The upper 300 mm of the subgrade fill must be compacted to 98% SPMDD.

The approved subgrade should be covered with a woven geotextile prior to placement of granular sub-base of the pavement structure.

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 may be required in addition to the woven geotextile indicated in Table VIII.

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

1. As part of the subgrade preparation, the areas of the proposed parking area and access roads should be stripped of all existing fill, surficial and buried topsoil (organic) layers and organic stained soils down to the subgrade level The subgrade should be properly shaped, crowned, then proofrolled 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 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, temporary construction roadways, etc., may be required, especially if construction is carried out during unfavorable weather.
4. 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.
5. 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.
6. 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.

17. Corrosion Potential

Chemical tests limited to pH, sulphate, chloride and resistivity were undertaken on four (4) soil samples. A summary of the results is shown in Table IX. The laboratory certificate of analysis is shown in Appendix D.

Table IX: Corrosion Test Results on Soil Samples

Borehole – Sample No.	Depth (m)	Soil Type	pH	Sulphate (%)	Chloride (%)	Resistivity (ohm-cm)
23-6 SS4	2.3 – 2.9	Silty Clay	7.94	0.020	0.0398	870
23-11 SS4	2.3 – 2.9	Silty Clay	7.90	0.007	0.0078	3,800
24-2 SS4	2.3 – 2.9	Silty Clay	8.67	0.003	0.0120	2,390
24-3 SS5	3.0 – 3.6	Glacial Till	8.99	0.002	0.0009	3,970

The results indicate the silty clay and the glacial till have a negligible 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 tested soils are mildly corrosive to moderately corrosive to corrosive to bare steel as per the National Association of Corrosion Engineers (NACE). Appropriate measures should be taken to protect the buried bare steel from corrosion.

18. Tree Planting Restrictions

The guidelines indicate that for street trees in the road right-of-way, where sensitive marine clays have been identified, the trees are to have a setback equal to or greater than the full mature height of the tree. This setback can be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium (mature tree height 7.5m to 14.0 m) sized trees if a total of six conditions are met. Two of the six requirements, listed below, require comment from a geotechnical perspective.

- The modified plasticity index of the soil between the underside of footing (USF) and a depth of 3.5m generally does not exceed 40%. This corresponds to soils with low/medium potential for soil volume change.
- The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall) to provide ductility as described in the Geotechnical Report

The silty clay is considered to have a medium potential for soil volume change based on the modified plasticity index values ranging from 24 percent to 26 percent. For foundations walls which are reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall), the geotechnical conditions for a reduced setback have been met.

It should be noted that the following conditions below must also be met in order for the reduced setback to apply:

- The USF is 2.1m or greater below the lowest finished grade. Note: this footing level must be satisfied for footings within 10m of the tree, as measured from the centre of the tree trunk, and verified by means of the Grading Plan as indicated in the Procedural Changes below.
- A small size tree must be provided with a minimum of 25m3 of available soil volume, as determined by a Landscape Architect. A medium size tree must be provided with a minimum of 30m3 of available soil volume, as determined by a Landscape Architect. The developer will ensure the soil is generally uncompacted when backfilling in street tree planting locations.
- The tree species must be small to medium size, as confirmed by a Landscape Architect in the Landscape Plan
- Grading surrounding the tree must promote draining to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

Therefore, a reduced setback is applicable at this site for small size tree with a minimum of 25 m^3 of available soil volume and medium size trees with a minimum of 30 m^3 of available soil volume, as determined by a Landscape Architect.

19. Additional Comments

All earthwork activities from subgrade preparation to placement and compaction of engineered fill, fill in service trenches, placement and compaction of granular materials and asphaltic concrete, should be inspected by qualified geotechnicians to ensure that construction proceeds according to the project specifications.

All the footing beds should be examined by a geotechnical engineer to ensure that the founding surfaces are capable of supporting the design bearing pressure and that the footing beds have been properly prepared.

20. 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 test hole 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.

Sincerely

Daniel Wall, M. Eng., P.Eng.
Geotechnical Engineer
Earth & Environment

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

Figures

0 150m 300m 600m

HORIZONTAL 1:15,000

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GEOTECHNICAL INVESTIGATION
EARL OF MARCH SECONDARY SCHOOL ADDITION
4 THE PARKWAY, KANATA, ONTARIO

SITE LOCATION PLAN

SCALE 1:15,000

SKETCH NO FIG 1

Filename: \\exp\data\OTT\OTT-23012778-B0\60 Execution\65 Drawings\OTT-23012778-B0_Geo-2024.dwg
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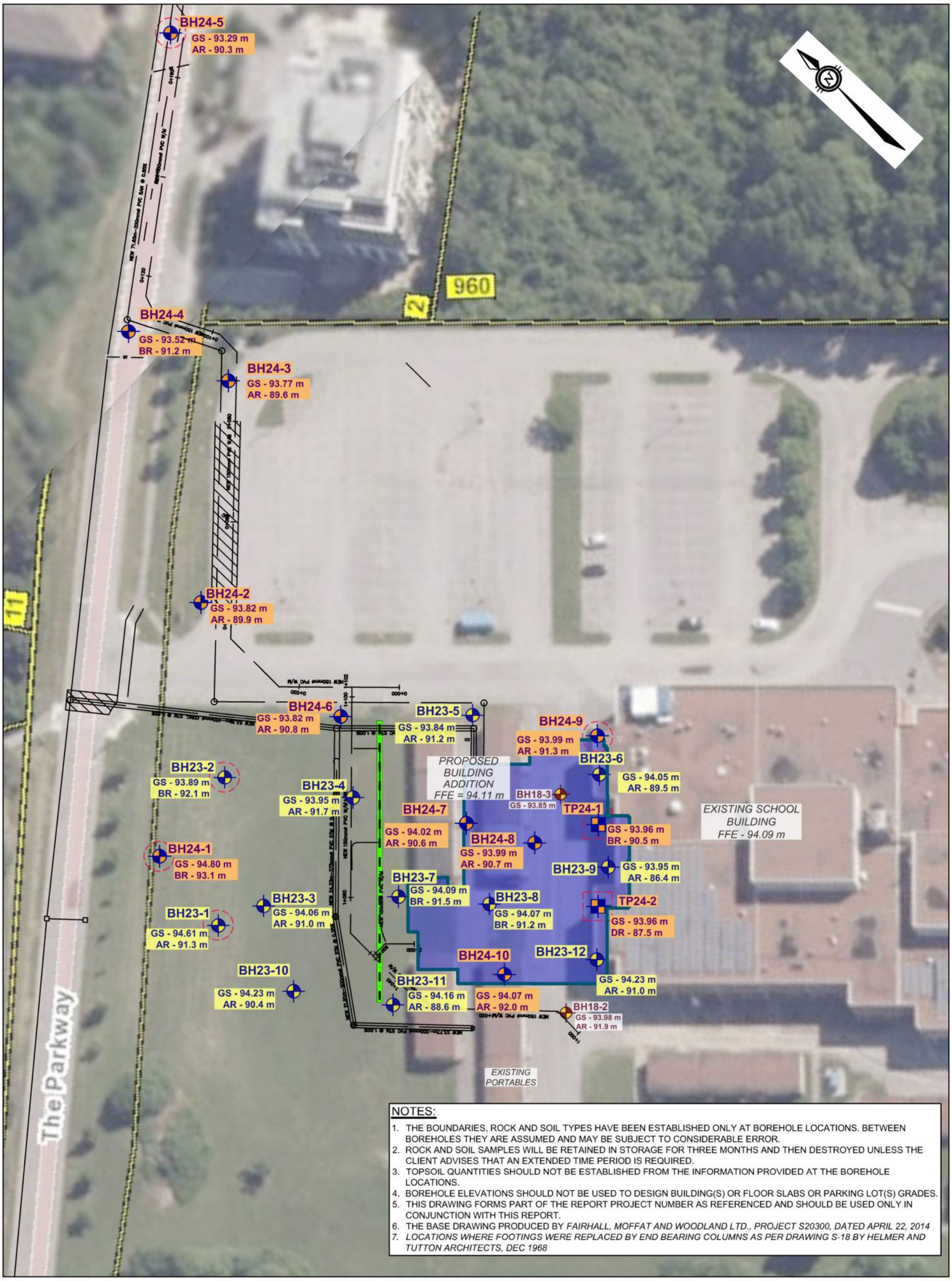

NOTES:

1. THE BOUNDARIES, ROCK AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. ROCK AND 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. THE BASE DRAWING PRODUCED BY *FAIRHALL, MOFFAT AND WOODLAND LTD., PROJECT S20300, DATED APRIL 22, 2014*
7. *LOCATIONS WHERE FOOTINGS WERE REPLACED BY END BEARING COLUMNS AS PER DRAWING S-18 BY HELMER AND TUTTON ARCHITECTS, DEC 1968*

LEGEND

BH23-1 GS - 94.61 m BR - 91.3 m — BOREHOLE LOCATION & NUMBER - *EXP* 2023 INVESTIGATION

BH18-2 GS - 93.98 m AR - 91.9 m — BOREHOLE LOCATION & NUMBER - *EXP* 2018 INVESTIGATION

BH24-10 GS - 93.98 m AR - 91.9 m — BOREHOLE LOCATION & NUMBER - *EXP* 2024 INVESTIGATION

TP-1 GS - 93.96 m BR - 90.6 m — TESTPIT LOCATION & NUMBER - *EXP* 2024 INVESTIGATION

MONITORING WELL

GS = Ground Surface Elevation
BR = Bedrock Elevation
AR = Auger Refusal Elevation
DR = DCPT Refusal Elevation

APPROXIMATE MASW STUDY AREA

PROPOSED NEW ADDITION

PROPOSED UNDERGROUND SERVICE

0 5m 10m 30m

HORIZONTAL 1:750

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GEOTECHNICAL INVESTIGATION
EARL OF MARCH SECONDARY SCHOOL ADDITION
4 THE PARKWAY, KANATA, ONTARIO

TESTHOLE LOCATION PLAN

SCALE 1:750

SKETCH NO FIG 2

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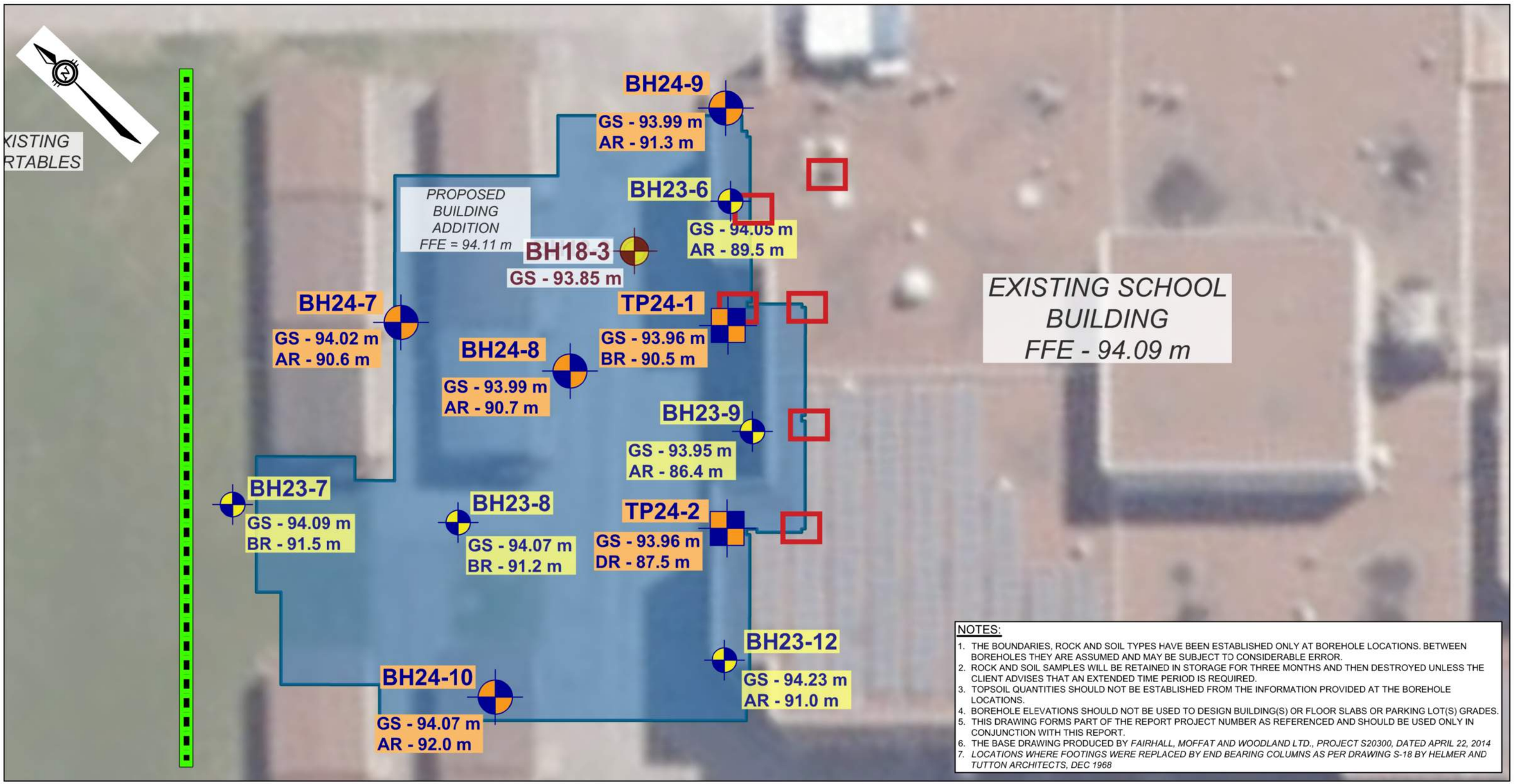

NOTES:

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7. *LOCATIONS WHERE FOOTINGS WERE REPLACED BY END BEARING COLUMNS AS PER DRAWING S-18 BY HELMER AND TUTTON ARCHITECTS, DEC 1968*

LEGEND

- BH23-1 (GS - 94.61 m, BR - 91.3 m) — BOREHOLE LOCATION & NUMBER - *EXP* 2023 INVESTIGATION
- BH18-2 (GS - 93.98 m, AR - 91.9 m) — BOREHOLE LOCATION & NUMBER - *EXP* 2018 INVESTIGATION
- TP-1 (GS - 93.96 m, BR - 90.6 m) — TESTPIT LOCATION & NUMBER - *EXP* 2024 INVESTIGATION
- BH24-10 (GS - 93.98 m, AR - 91.9 m) — BOREHOLE LOCATION & NUMBER - *EXP* 2024 INVESTIGATION

GS = Ground Surface Elevation
BR = Bedrock Elevation
AR = Auger Refusal Elevation
DR = DCPT Refusal Elevation

- PROPOSED NEW ADDITION
- FOOTINGS REPLACED WITH END BEARING PILES TO BEDROCK (APPROXIMATE LOCATIONS)
- APPROXIMATE MASW STUDY AREA

0 3m 6m 12m
HORIZONTAL 1:300

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GEOTECHNICAL INVESTIGATION
EARL OF MARCH SECONDARY SCHOOL ADDITION
4 THE PARKWAY, KANATA, ONTARIO

TESTHOLE LOCATION PLAN
Proposed Addition

SCALE 1:500
SKETCH NO **Fig 3a**

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BH24-5
GS - 93.29 m
AR - 90.3 m

BH24-4
GS - 93.52 m
BR - 91.2 m

BH24-3
GS - 93.77 m
AR - 89.6 m

BH24-2
GS - 93.82 m
AR - 89.9 m

BH24-6
GS - 93.82 m
AR - 90.8 m

BH23-5
GS - 93.84 m
AR - 91.2 m

BH23-2
GS - 93.89 m
BR - 92.1 m

BH23-4
GS - 93.95 m
AR - 91.7 m

BH24-1
GS - 94.80 m
BR - 93.1 m

BH23-3
GS - 94.06 m
AR - 91.0 m

BH23-1
GS - 94.61 m
AR - 91.3 m

BH23-10
GS - 94.23 m
AR - 90.4 m

BH23-11
GS - 94.16 m
AR - 88.6 m

BH18-2
GS - 93.98 m
AR - 91.9 m

960

11

2

The Parkway

EXISTING PORTABLES

PROPOSED BUILDING ADDITION
FFE = 94.11 m

EXISTING SCHOOL BUILDING
FFE - 94.09 m

EXISTING PORTABLES

EXISTING PORTABLES

LEGEND

BH23-1
GS - 94.61 m
BR - 91.3 m
BOREHOLE LOCATION & NUMBER - *EXP* 2023 INVESTIGATION

BH18-2
GS - 93.98 m
AR - 91.9 m
BOREHOLE LOCATION & NUMBER - *EXP* 2018 INVESTIGATION

BH24-10
GS - 93.98 m
AR - 91.9 m
BOREHOLE LOCATION & NUMBER - *EXP* 2024 INVESTIGATION

GS = Ground Surface Elevation
BR = Bedrock Elevation
AR = Auger Refusal Elevation
DR = DCPT Refusal Elevation

0 5m 10m 30m
HORIZONTAL 1:750

NOTES:

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7. *LOCATIONS WHERE FOOTINGS WERE REPLACED BY END BEARING COLUMNS AS PER DRAWING S-18 BY HELMER AND TUTTON ARCHITECTS, DEC 1968*

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GEOTECHNICAL INVESTIGATION
EARL OF MARCH SECONDARY SCHOOL ADDITION
4 THE PARKWAY, KANATA, ONTARIO

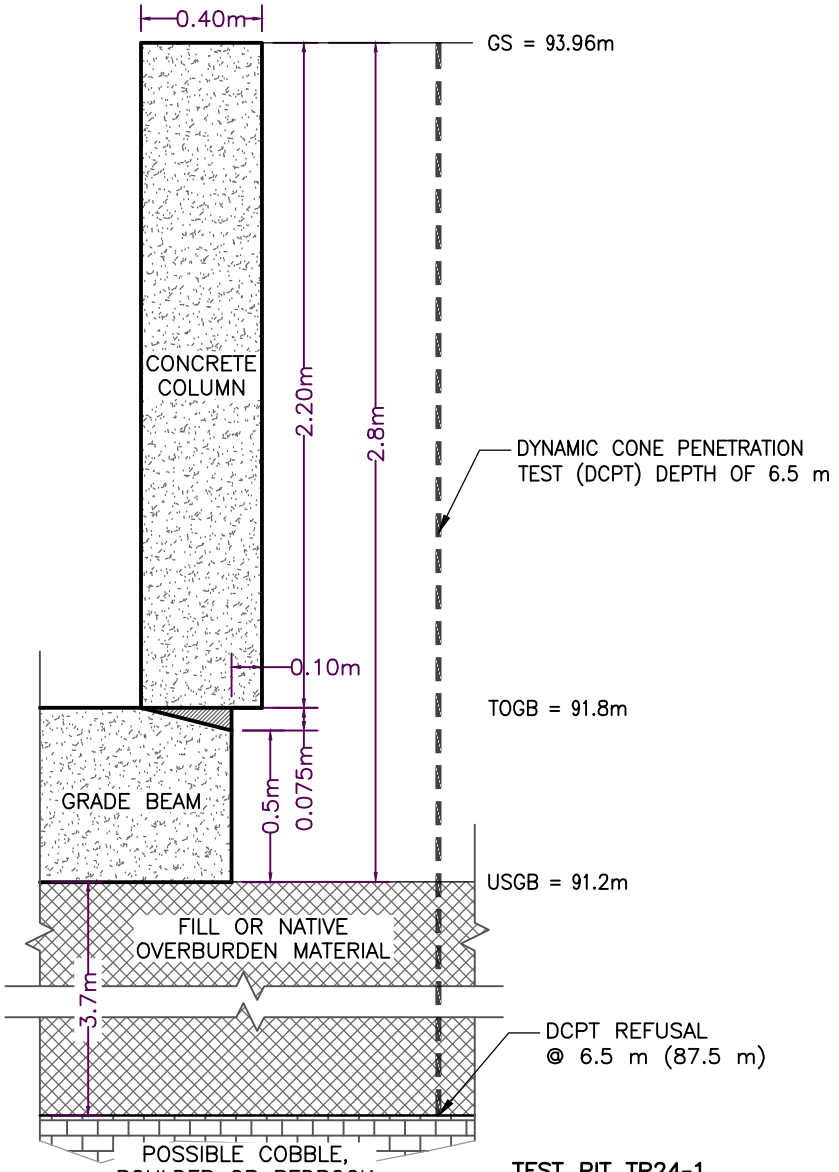
TESTHOLE LOCATION PLAN
Underground Services

SCALE 1:750
SKETCH NO
Fig 3b

Filename: \\exp\data\OTT\OTT-23012778-B0\60 Execution\65 Drawings\OTT-23012778-B0_Geo_Sept-2024.dwg
Last Saved: Sep 19, 2024 12:34 PM Last Plotted: Sep 19, 2024 1:34 PM Plotted by: WallD

NOTES:
1) NO PERIMETER DRAINAGE SYSTEM (WEEPING TILE) PRESENT IN TEST PIT
2) NO DAMPPROOFING AND NO DRAINAGE BOARD ON VERTICAL FACE OF FOUNDATION WALL
3) GROUNDWATER WAS ENCOUNTERED BELOW GROUND SURFACE AT ELEVATION 91.0m IN THE TEST PIT UPON COMPLETION OF EXCAVATION
4) TEST PIT BACKFILLED UPON COMPLETION WITH BACKFILL NOMINALLY PACKED IN PLACE WITH BACKHOE BUCKET

TEST PIT TP24-1
PHOTOGRAPH



FRONT VIEW

TEST PIT TP24-1
PROFILE / CROSS-SECTION
(SCALE – 1:25)

LEGEND/DEFINITION:
TOGB = Top of Grade Beam
USGB = Underside of Grade Beam
FFE = Finished Floor Elevation

ORIGINAL SHEET SIZE = 11"x8.5"
0 0.2m 0.4m 1m
HORIZONTAL 1:25

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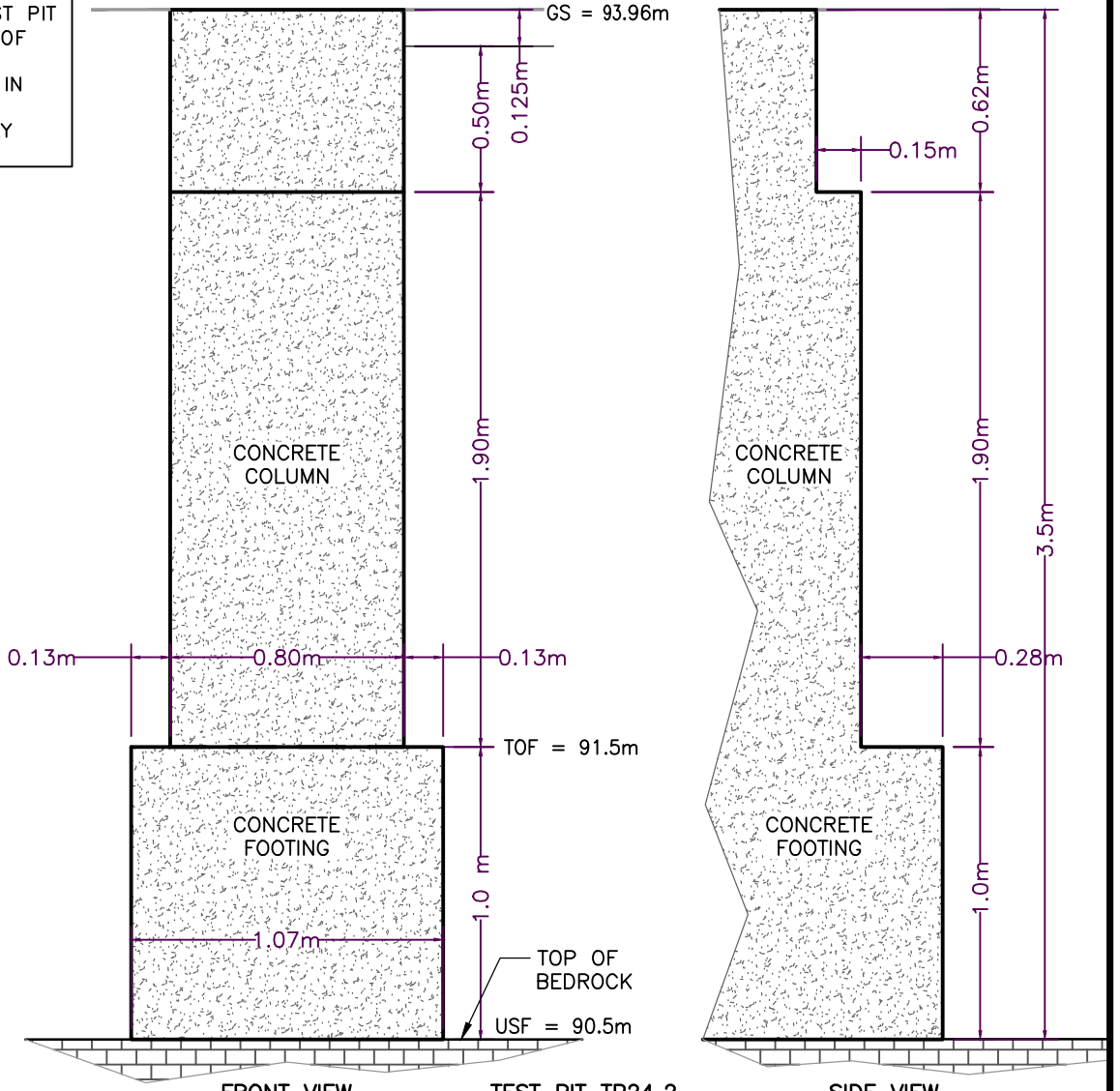
GEOTECHNICAL INVESTIGATION
EARL OF MARCH SECONDARY SCHOOL ADDITION
4 THE PARKWAY, KANATA, ONTARIO

TEST PIT TP24-1 PROFILE OF EXISTING FOOTING

SCALE 1:25
SKETCH NO FIG 4

NOTES:
1) NO PERIMETER DRAINAGE SYSTEM (WEEPING TILE) PRESENT IN TEST PIT
2) NO DAMPPROOFING AND NO DRAINAGE BOARD ON VERTICAL FACE OF FOUNDATION WALL
3) GROUNDWATER WAS NOT ENCOUNTERED BELOW GROUND SURFACE IN THE TEST PIT UPON COMPLETION OF EXCAVATION
4) TEST PIT BACKFILLED UPON COMPLETION WITH BACKFILL NOMINALLY PACKED IN PLACE WITH BACKHOE BUCKET

TEST PIT TP24-2
PHOTOGRAPH



TEST PIT TP24-2
PROFILE / CROSS-SECTION
(SCALE - 1:25)

LEGEND/DEFINITION:
TOF = Top of Footing
USF = Underside of Footing

ORIGINAL SHEET SIZE = 11"x8.5"
0 0.2m 0.4m 1m
HORIZONTAL 1:25

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GEOTECHNICAL INVESTIGATION
EARL OF MARCH SECONDARY SCHOOL ADDITION
4 THE PARKWAY, KANATA, ONTARIO

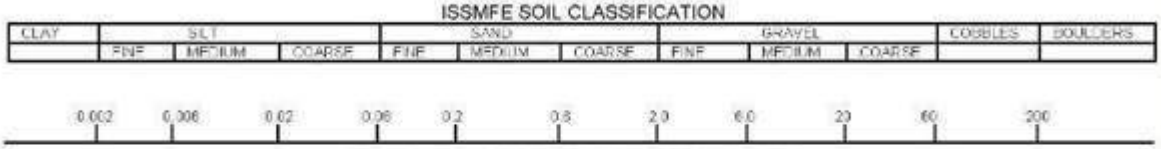
TEST PIT TP24-2
PROFILE OF EXISTING FOOTING

SCALE 1:25
SKETCH NO FIG 5

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



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

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 BH23-1

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'January 08, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T

Figure No. 6

Page. 1 of 1

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	94.61	0				
		FILL Clayey silty sand with silty clay and topsoil inclusions, brown, moist, (loose)	94.41		9		SS1	
				1	7		SS2	
			93.21					
		GLACIAL TILL Silty sand to sandy silt, some gravel, trace to some clay, possible cobbles and boulders, brown, wet, (loose to compact)	93.01		4		SS3	
				2				
					16		SS4	22.6
		Wet below 3.0 m depth		3	5,50/100mm		SS5	
			91.31					
		Auger Refusal at 3.3 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter piezometer 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-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	3.0	3.3
02/15/2024	1.6	

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH23-2

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'January 08, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T

Figure No. 7

Page. 1 of 1

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	93.89	0	13		SS1	
		FILL Silty clay with rootlets and organics, brown, moist. (compact)	93.79					
		SILTY CLAY Brown, moist, (very stiff)	93.09	1	11 — 192 kPa		SS2	18.4
					3, 50/50mm		SS3	18.4
		DIORITE BEDROCK Fine to coarse grained, bluish grey with some red minerals, with iron staining, good to fair quality bedrock, (very strong)	92.09	2			RUN1	
			91.69	3			RUN2	
				4			RUN3	
		Borehole Terminated at 5.0 m Depth	88.89	5				

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter piezometer 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-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
02/15/2024	2.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.8 - 2.8	80	68
2	2.8 - 4.3	97	84
3	4.3 - 5	100	50

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH23-3

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'January 08, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T

Figure No. 8

Page. 1 of 1

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 ~ 150 mm thick	94.06	0	16	×	SS1	
		FILL Silty sand to silty clay wth occasional gravel and rootlets, possible debris or cobbles, brown, moist, (compact)	93.91					
		Augers grinding below 0.9 m m depth		1	25	×	SS2	
			92.66					
		GLACIAL TILL Silty sand with gravel, possible cobbles and boulders, brown, wet, (compact)			11	×	SS3	23.5
▼			91.36	2	10	×	SS4	
			90.96	3				
		Auger Refusal at 3.1 m Depth						

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Completion	2.7	3.1

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

Log of Borehole BH23-4

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'January 08, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T

Figure No. 9

Page. 1 of 1

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 ~ 450 mm thick	93.95	0	6		SS1	
		FILL Silty sand with rootlets, dark brown, moist	93.50					
		SILTY CLAY Brown, moist, (stiff)	93.25	1	10		SS2	18.9
		GLACIAL TILL Silty sand with gravel and clay, possible cobbles and boulders, brown, wet, (loose)	92.55		5		SS3	
▼			91.85	2	50 for 75mm		SS4	
		Auger Refusal at 2.3 m Depth	91.65					

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. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	2.1	2.3

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH23-5

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 10

Page. 1 of 1

Date Drilled: 'January 08, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N 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 I—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~100 mm thick	93.84	0
		FILL	93.74	
		Silty clay, dark brown, moist, (compact)	93.39	
		SILTY CLAY		
		Low plasticity, trace sand, brown, moist, (very stiff)		1
▼				2
		93 then 50 for 75mm	91.24	
		Auger Refusal at 2.6 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

21 (SS1)
8 (SS2)
5, 196 (SS3)

SAMPLES	Natural Unit Wt. kN/m³
SS1	
SS2	18.5
SS3	
SS4	19.3

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	2.4	2.6

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH23-6

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'January 09, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T

Figure No. 11

Page. 1 of 1

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 ~150 mm thick	94.05	0
		SILTY CLAY Low plasticity, brown, moist to wet, (very stiff)	93.90	
▼			91.05	3
		GLACIAL TILL Silty sand with gravel and clay, possible cobbles and boulders, brown grey, wet, (compact)	90.75	
			89.55	4
		Auger Refusal at 4.5 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	Notes
SS1		12
SS2	18.7	7, 192 kPa
SS3	18.0	8, 192 kPa
SS4		2, 192 kPa, 160 kPa, s=3
SS5		7
SS6		13

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	3.0	

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH23-7

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 12

Page. 1 of 1

Date Drilled: 'January 09, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N 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	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 ~300 mm thick	94.09	0				
		FILL Silty sand to silty clay, with gravel, grey to brown, moist, (compact)	93.79		11		SS1	
				1	12		SS2	
		SILTY CLAY Brown grey, moist	92.69		8		SS3	18.3
		GLACIAL TILL Silty sand with gravel and clay, possible cobbles and boulders, grey, wet, (compact)	92.09	2				
▼			91.6		10 then 50 for 75mm		SS4	
		DIORITE BEDROCK Fine to coarse grained, bluish grey with some red minerals, with iron staining, good quality bedrock, (very strong)	91.49	3			RUN1	
			89.99	4				
		Borehole Terminated at 4.1 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	2.4	2.6

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.6 - 4.1	90	84

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH23-8

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'January 09, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T

Figure No. 13

Page. 1 of 1

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
		ASPHALT	94.07	0				
		FILL Silty sand, with gravel, grey, wet	93.97				AS1	
		SILTY CLAY with silty sand seams, brown, moist, (very stiff to hard)	93.27	1	8 ○ 192 kPa ▲	×	SS2	19.1
					7 ○ 144 kPa ▲	×	SS3	
				2	210 kPa + s=4			
					5 ○ 144 kPa ▲	×	SS4	17.8
		DIORITE BEDROCK Fine to coarse grained, bluish grey with some red minerals, with iron staining, fair to poor quality bedrock, (very strong)	91.17 91.27	3			RUN1	
				4				
				5			RUN2	
			88.47					
		Borehole Terminated at 5.6 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter piezometer 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-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	2.4	
9/13/2024	2.8	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.9 - 4.1	87	56
2	4.1 - 5.6	90	50

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH23-9

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'January 08, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T

Figure No. 14

Page. 1 of 1

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 ~250 mm thick	93.89	0
		FILL Sand and gravel, brown, moist, (compact)	93.64	
		SILTY CLAY Brown, moist, (very stiff)	93.09	1
				2
		SILTY CLAY Grey, wet, (firm to stiff)	90.89	3
				4
				5
		GLACIAL TILL Silty sand with gravel and clay, possible cobbles and boulders, grey, wet, (loose)	88.09	6
			86.39	7
		Auger Refusal at 7.5 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
SS1	
SS2	
SS3	19.0
SS4	
SS5	18.0
SS6	
SS7	
SS8	

12 | 6 | 7 | 3 | >120 kPa | 2 | 96 kPa | 82 kPa s=6 | 1 | 48 kPa s=5 | Hammer Weight | 34 kPa s=7 | 5

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter piezometer 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-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	3.0	7.5

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH23-10

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'January 08, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T

Figure No. 15

Page. 1 of 1

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 ~300 mm thick	94.23	0	7		SS1	
		FILL Sand and gravel, brown, moist, (loose)	93.93					
			93.13	1	9		SS2	
		SILTY CLAY Brown, moist, (very stiff)			6	192 kPa	SS3	
				2	6		SS4	
		Brown grey below 3.0 m depth		3	8		SS5	
			90.43					
		Auger Refusal at 3.8 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH23-11

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'January 09, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T

Figure No. 16

Page. 1 of 1

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 ~150 mm thick	94.16 / 94.01	0	11		SS1	
		FILL Sand and gravel, brown, moist, (compact)						
			93.06	1	9		SS2	19.0
		SILTY CLAY Brown, moist, (very stiff)						
				2	11		SS3	
					9		SS4	17.9
				3	180 kPa, s=5			
					4		SS5	
			90.56		72 kPa, s=6			
		SILTY CLAY Grey, wet, (stiff)		4	4		SS6	
			89.86					
		GLACIAL TILL Silty sand, some clay, some gravel, possible cobbles and boulders, dark grey, wet, (compact)						
▼				5	10		SS7	
			88.56 / 88.56					
		Auger Refusal at 5.6 m Depth						

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Completion	4.0	5.6

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

Log of Borehole BH23-12

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'January 08, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T

Figure No. 17

Page. 1 of 1

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 (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
		TOPSOIL ~100 mm thick	93.97	0				
		FILL Sand to silty clay, with gravel, brown, moist, (compact)	93.87		10		SS1	
			93.27					
		SILTY CLAY Grey brown, moist, (firm)		1	7		SS2	
				2	7		SS3	
			91.77					
		GLACIAL TILL Silty sand, some gravel, possible cobbles and boulders, grey, moist, (very dense)			69		SS4	
			90.97	3				
		Auger Refusal at 3 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

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

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH24-1

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 18

Page. 1 of 1

Date Drilled: 'September 04, 2024

Drill Type: CME-75 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: D.W.

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 ~100 mm thick	94.8	0
		FILL Sand with silt and gravel, brown, moist, (compact)	94.70	
		SILTY CLAY Brown, moist, (very stiff)	93.90	1
		GLACIAL TILL Silty sand with clay and gravel, possible cobbles and boulders, brown, moist	93.40	
		DIORITE BEDROCK Fine to coarse grained, bluish grey with some red minerals, fair quality bedrock, (very strong)	93.10	2
▽			91.7	3
		Borehole Terminated at 4.8 m Depth	90.00	4

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

10 | 16 | >192 kPa | 14, then 50/75 mm

SAMPLES	Natural Unit Wt. kN/m³
SS1	
SS2	
SS3	
RUN1	
RUN2	

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter piezometer 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-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	2.7	
9/13/2024	3.1	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.7 - 3.3	100	62
2	3.3 - 4.8	100	76

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH24-2

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Date Drilled: 'August 30, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: D.W.

Figure No. 19

Page. 1 of 1

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 ~100 mm thick	93.82	0
		FILL Silty sand with gravel, brown, moist, (loose)	93.72	
			93.22	
		SILTY CLAY Brown, moist, (stiff to very stiff)		1
				2
				3
▼		**GLACIAL TILL** Silty sand with clay and gravel, possible cobbles and boulders, brown, moist, (loose)	90.62	
			90.42	
		Auger Refusal at 3.9 m Depth	89.92	

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	Standard Penetration Test N Value	Shear Strength kPa	Combustible Vapour Reading (ppm)	Natural Moisture Content % Atterberg Limits (% Dry Weight)
SS1		8			×
SS2	18.9	14	168 kPa ▲		×
SS3		7	132 kPa ▲		×
SS4		7	96 kPa +S s=7		×
SS5		7			

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	3.4	3.9

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH24-3

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 20

Page. 1 of 1

Date Drilled: 'August 30, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: D.W.

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	93.77	0				
		FILL Silty sand with gravel, brown, moist, (compact)	93.67		15		SS1	
▼			92.87					
		SILTY CLAY Brown, moist, (very stiff)	92.67	1	15 — 192 kPa		SS2	17.7
				2	10 — 168 kPa		SS3	
					8		SS4	
		GLACIAL TILL Silty sand with clay and gravel, possible cobbles and boulders, brown, moist	90.57	3	15		SS5	
				4	4, then 50/75 mm		SS6	
			89.57					
		Auger Refusal at 3.9 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	0.9	4.2

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH24-4

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 21

Page. 1 of 1

Date Drilled: 'September 02, 2024

Drill Type: CME-75 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: D.W.

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
		ASPHALTIC CONCRETE~140 mm thick	93.52	0
		GRANULAR FILL Sand and gravel with silt, brown, moist, (very dense)	93.38	
			92.62	1
		FILL Sand and gravel with silt and concrete fragments, brown, moist, (compact to dense)		
			91.42	2
▼		**DIORITE BEDROCK** Fine to coarse grained, bluish grey with some red minerals, good quality bedrock, (very strong)	91.12	3
			88.72	4
		Borehole Terminated at 4.8 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: SS1 (N = 62), SS2 (N = 20), SS3 (N = 48), RUN1, RUN2

Natural Unit Wt. kN/m³

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	2.4	4.8

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.1 - 3.3	100	81
2	3.3 - 4.8	97	72

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH24-5

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 22

Page. 1 of 1

Date Drilled: 'September 02, 2024

Drill Type: CME-75 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: D.W.

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
		ASPHALTIC CONCRETE~100 mm thick	93.29 / 93.19	0
		GRANULAR FILL Sand and gravel with silt, brown, moist, (loose)	92.59	
		FILL Sand with gravel and shale fragments, occasional clay inclusion, brown, moist, (loose)		1
			91.09	2
		SILTY CLAY Brown, moist, (very stiff)	90.29	
▼		**DIORITE BEDROCK** Fine to coarse grained, bluish grey with some red minerals, fair to good quality bedrock, (very strong)	90.09	3
			88.59	4
		Borehole Terminated at 4.7 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

9 | 6 | 6 | 108 kPa

SAMPLES	Natural Unit Wt. kN/m³
GS1	
SS2	
SS3	
SS4	
RUN1	
RUN2	

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter piezometer 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-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion		4.7
9/13/2024	3.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	3 - 4.2	100	78
2	4.2 - 4.7	98	83

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH24-6

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 23

Page. 1 of 1

Date Drilled: 'August 30, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: D.W.

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 ~75 mm thick	93.82	0				
		FILL Silty clay, trace sand, brown, moist	93.75		12		SS1	
			93.12					
		SILTY CLAY Brown, moist, (very stiff)		1	14 144 kPa		SS2	
					7 192 kPa		SS3	18.5
				2				
					5 >120 kPa		SS4	
		Auger Refusal at 3.0 m Depth	90.82	3				

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Completion		3.0

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH24-7

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 24

Page. 1 of 1

Date Drilled: 'August 30, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: D.W.

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
		ASPHALTIC CONCRETE~60 mm thick	94.02	0				
		GRANULAR FILL Sand and gravel with silt, brown, moist	93.96				AS1	
		SILTY CLAY Brown, moist, (stiff to very stiff)	93.22	1	9 ○ 144 kPa ▲	×	SS2	
					9 ○ 120 Kpa ▲	×	SS3	
				2	2 ○ 60 kPa ▲	×	SS4	
					91 kPa +S s=7			
		With sand below 3.0 m depth		3	5 ○	×	SS5	
			90.62					
		Auger Refusal at 3.4 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	3.3	3.4

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH24-8

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 25

Page. 1 of 1

Date Drilled: 'August 30, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: D.W.

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
		ASPHALTIC CONCRETE~75 mm thick	93.99	0				
		GRANULAR FILL Sand and gravel with silt, brown, moist	93.92				GS1	
			93.19					
		SILTY CLAY Brown, moist, (stiff to very stiff)		1	11		SS2	
					6	168 kPa	SS3	
				2	91 kPa s=8			
		Wet and firm below 2.3 m depth			3		SS4	
					43 kPa			
			90.89	3	3, then 50/75 mm		SS5	
		GLACIAL TILL Silty sand with clay and gravel, possible cobbles and boulders, grey, moist	90.69					
		Auger Refusal at 3.3 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion		3.4

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH24-9

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 26

Page. 1 of 1

Date Drilled: 'August 30, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: D.W.

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
		ASPHALTIC CONCRETE~75 mm thick	93.99	0				
		GRANULAR FILL Sand and gravel with silt, brown, moist	93.92				AS1	
			93.19					
		SILTY CLAY Brown to grey, moist, (very stiff)		1	7 ○ 144 kPa ▲	×	SS2	
					5 ○ 120 kPa ▲	×	SS3	
				2	180 kPa + s=9			
			91.59		7, and 50 for 75mm ○	×	SS4	
		GLACIAL TILL Silty sand with clay and gravel, possible cobbles and boulders, grey, moist	91.29					
		Auger Refusal at 2.7 m Depth	91.29					

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-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
9/13/2024	2.7	

CORE DRILLING RECORD

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

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

Log of Borehole BH24-10

Project No: OTT-23012778-B0

Project: Geotchnical Investegation Earl of March Secondary School Addition

Location: 4 The Parkway, Ottawa, Ontario

Figure No. 27

Page. 1 of 1

Date Drilled: 'August 30, 2024

Drill Type: CME-55 Truck-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N Checked by: D.W.

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, dark brown, moist, (compact)	94.07	0	15 ○	×	SS1	
			93.27					
		SILTY CLAY Brown grey, moist, (very stiff)		1	13 ○ + 132 kPa	×	SS2	
					11 ○	×	SS3	
▼		**GLACIAL TILL** Silty sand with clay and gravel, possible cobbles, grey, wet	92.07 91.97	2				
		Auger Refusal at 2.1 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. Borehole was backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion		2.1

CORE DRILLING RECORD

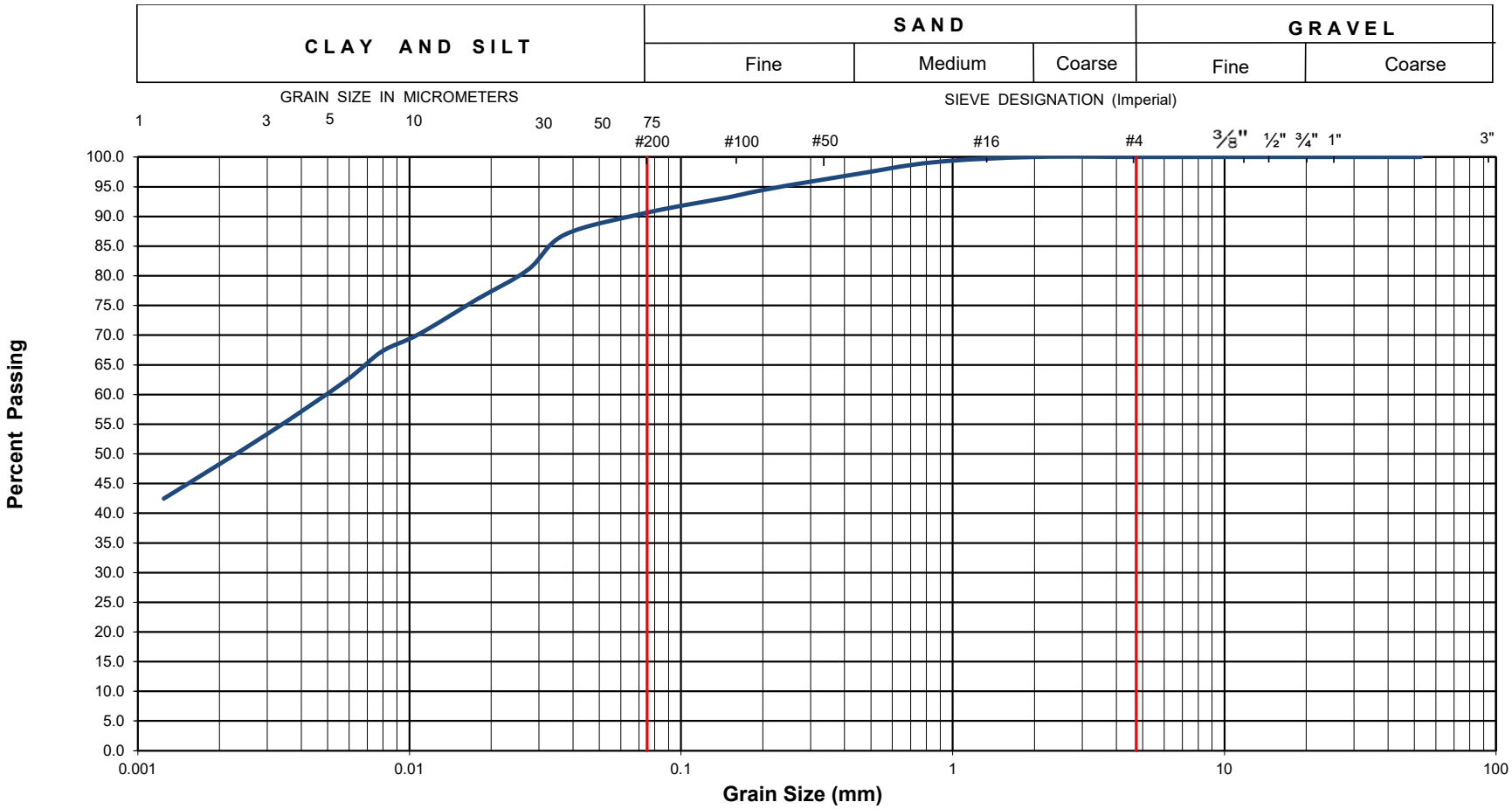
Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE 4 THE PARKWAY , KANATA, OTTAWA.GPJ TROW OTTAWA.GDT 9/17/24

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

Unified Soil Classification System



EXP Project No.:	**OTT-23012778-B0**	**Project Name :**	**Proposed Addition - Earl of March Secondary School**						
Client :	**OCDSB**	**Project Location :**	**4 The Parkway, Ottawa, Ontario**						
Date Sampled :	**January 8, 2024**	**Borehole No:**	**BH23-5**		**Sample No.:**	**SS2**		**Depth (m) :**	**0.8-1.4**
Sample Description :		**% Silt and Clay**	**91**	**% Sand**	**9**	**% Gravel**	**0**	**Figure :**	**28**
Sample Description :		**Sily Clay of Medium Plasticity (CL), trace sand**							

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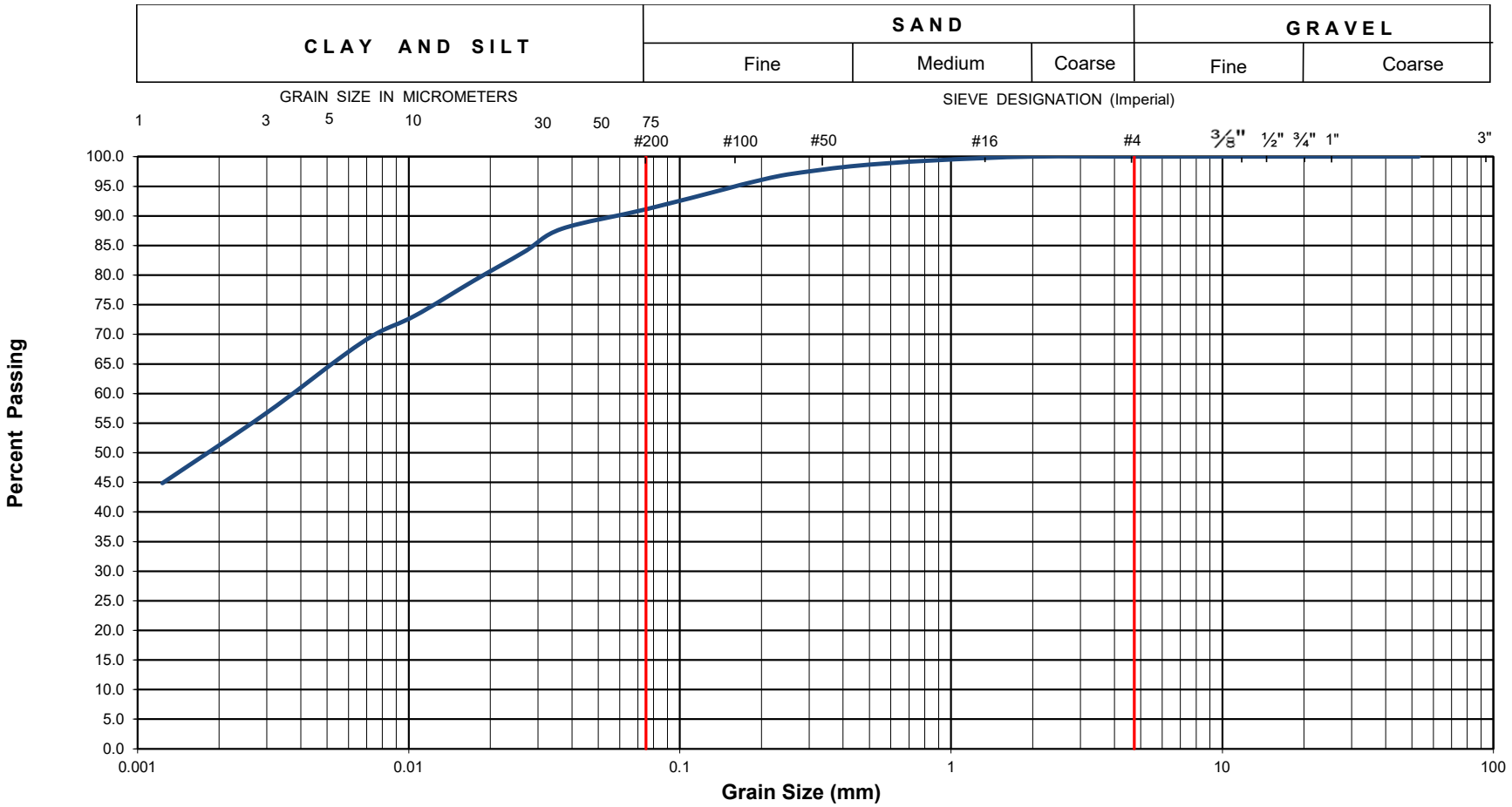
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System



EXP Project No.:	**OTT-23012778-B0**	**Project Name :**	**Proposed Addition - Earl of March Secondary School**						
Client :	**OCDSB**	**Project Location :**	**4 The Parkway, Ottawa, Ontario**						
Date Sampled :	**January 9, 2024**	**Borehole No:**	**BH23-6**	**Sample No.:**	**SS4**	**Depth (m) :**	**2.3-2.9**		
Sample Description :		**% Silt and Clay**	**91**	**% Sand**	**9**	**% Gravel**	**0**	**Figure :**	**29**
Sample Description :		**Sily Clay of Medium Plasticity (CL), trace sand**							

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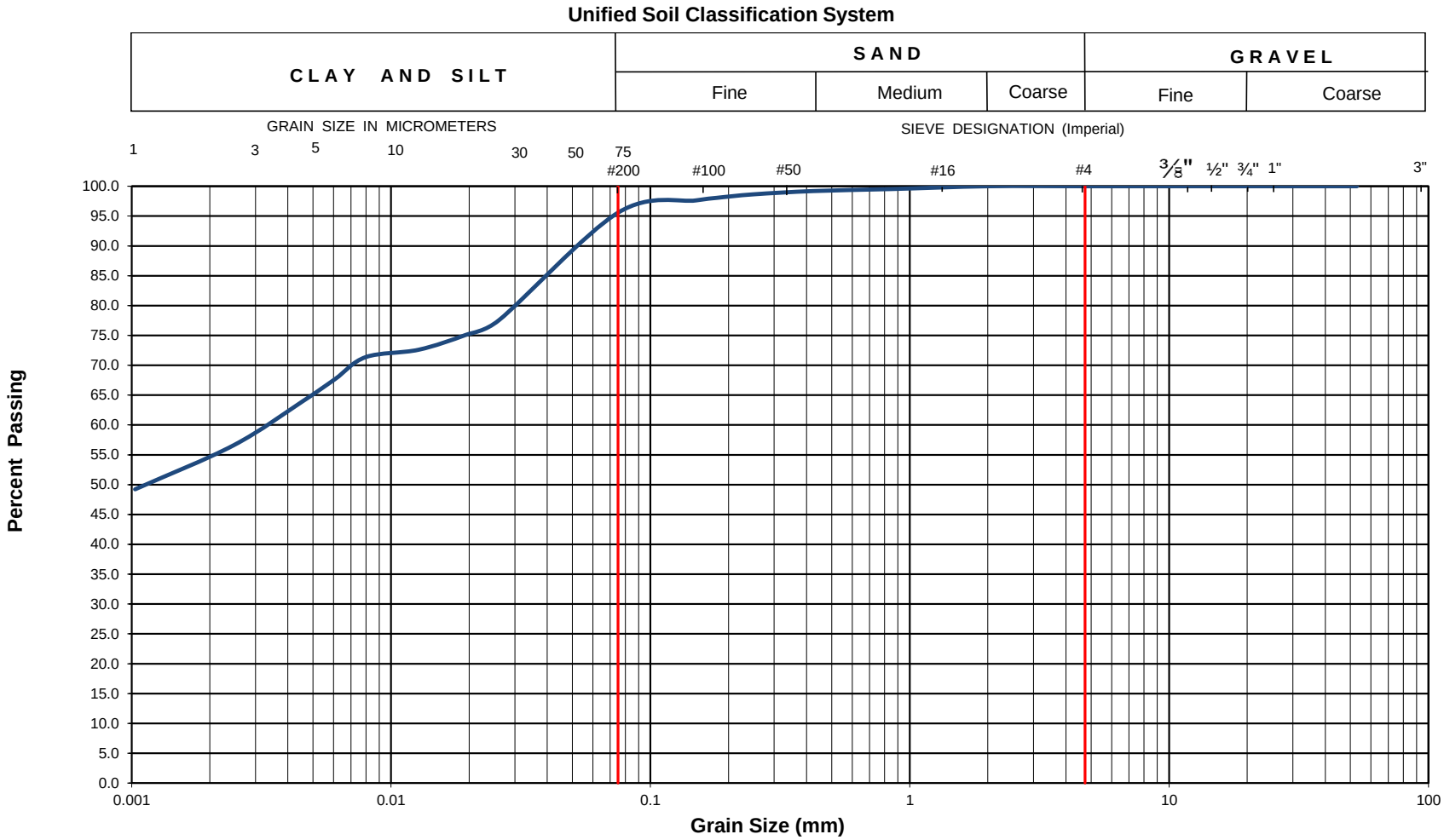
Ottawa, ON K2B 8H6

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

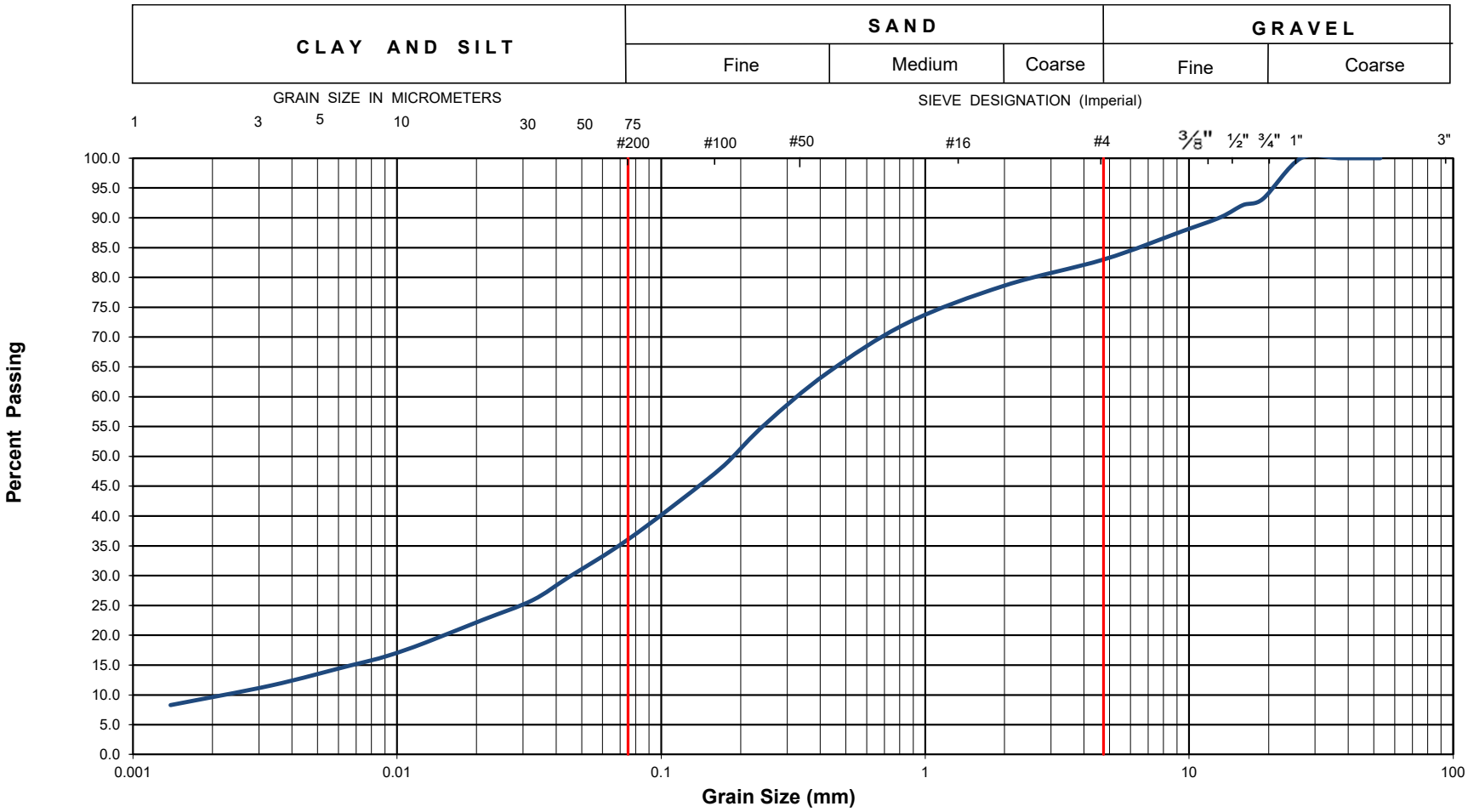


EXP Project No.:	**OTT-23012778-B0**	**Project Name :**	**Proposed Addition - Earl of March Secondary School**						
Client :	**OCDSB**	**Project Location :**	**4 The Parkway, Ottawa, ON**						
Date Sampled :	**April 20, 2018**	**Borehole No:**	**BH18-3**		**Sample No**	**SS4**	**Depth (m) :**	**2.3-2.9**	
Sample Description :		**% Silt and Clay**	**96**	**% Sand**	**4**	**% Gravel**	**0**	**Figure :**	**30**
Sample Description :	Silty Clay of Medium Plasticity (CI), trace sand								

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

Unified Soil Classification System



EXP Project No.:	**OTT-23012778-B0**	**Project Name :**	**Proposed Addition - Earl of March Secondary School**						
Client :	**OCDSB**	**Project Location :**	**4 The Parkway, Kanata, Ontario**						
Date Sampled :	**January 8, 2024**	**Borehole No:**	**BH23-1**	**Sample No.:**	**SS4**	**Depth (m) :**	**2.3-2.9**		
Sample Description :		**% Silt and Clay**	**36**	**% Sand**	**47**	**% Gravel**	**17**	**Figure :**	**31**
Sample Description :	**Glacial Till: Silty Sand (SM) - Some Gravel, Trace Clay**								

EXP Services Inc.
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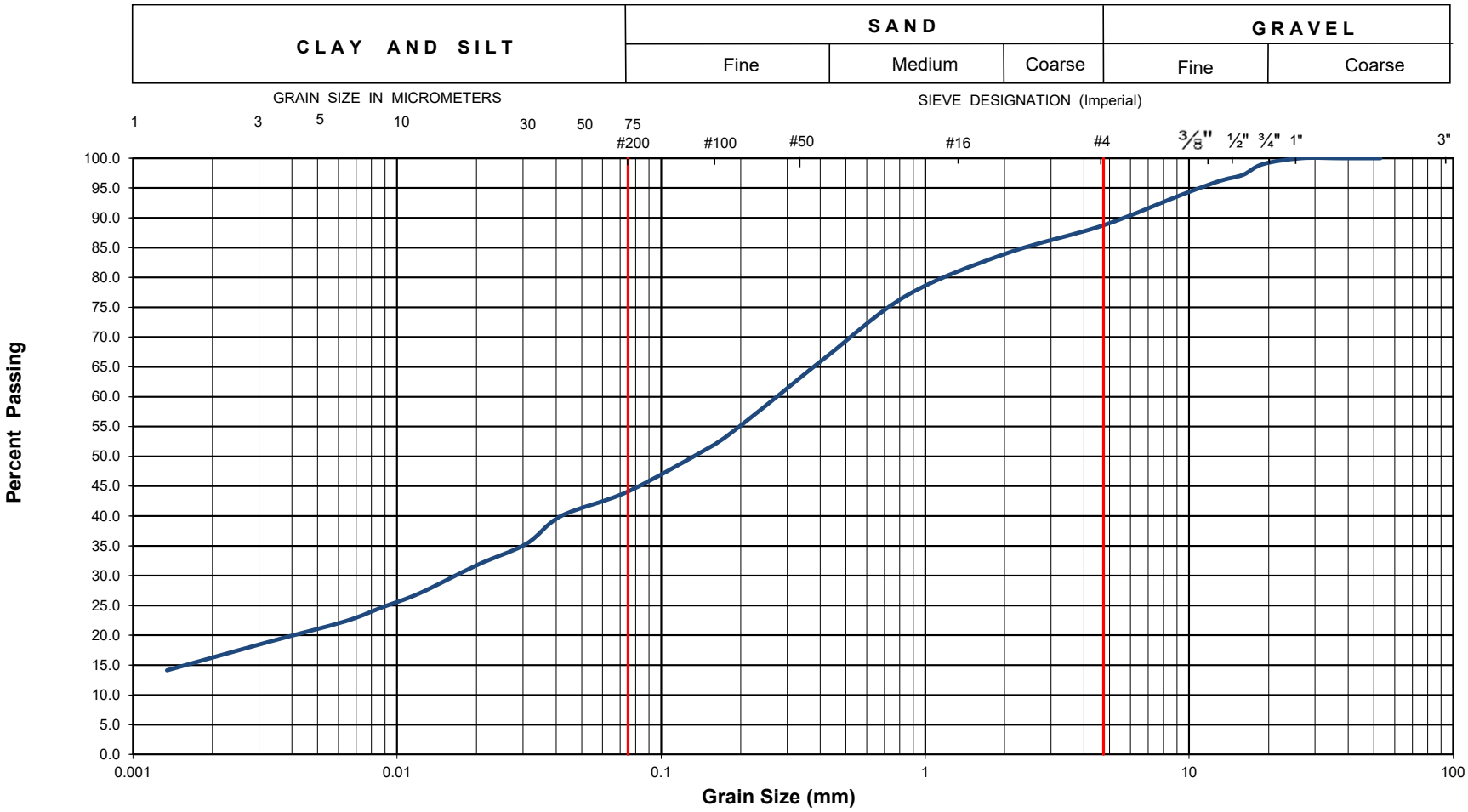
Ottawa, ON K2B 8H6

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

Unified Soil Classification System



EXP Project No.:	**OTT-23012778-B0**	**Project Name :**	**Proposed Addition - Earl of March Secondary School**						
Client :	**OCDSB**	**Project Location :**	**4 The Parkway, Kanata, Ontario**						
Date Sampled :	**January 9, 2024**	**Borehole No:**	**BH23-11**	**Sample No.:**	**SS7**	**Depth (m) :**	**4.6-5.2**		
Sample Description :		**% Silt and Clay**	**44**	**% Sand**	**45**	**% Gravel**	**11**	**Figure :**	**32**
Sample Description :		**Glacial Till: Silty Sand (SM) - Some Gravel, Some Clay**							

EXP Services Inc.
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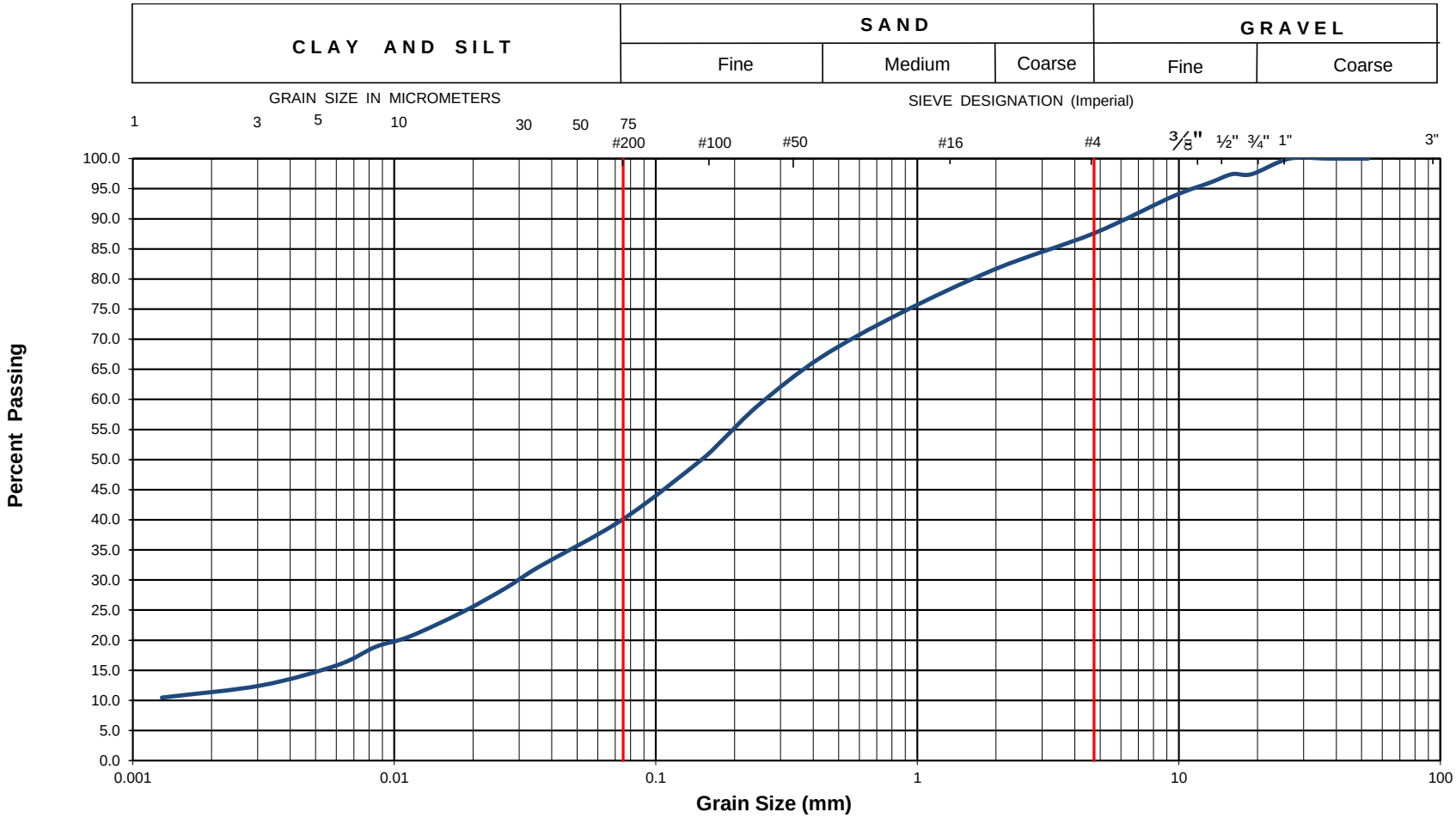
Ottawa, ON K2B 8H6

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

Unified Soil Classification System



EXP Project No.:	**OTT-23012778-B0**	**Project Name :**	**Proposed Addition - Earl of March Secondary School**						
Client :	**OCDSB**	**Project Location :**	**4 The Parkway, Ottawa, ON**						
Date Sampled :	**April 20, 2018**	**Borehole No:**	**BH18-2**		**Sample No**	**SS3**		**Depth (m) :**	**1.5-2.1**
Sample Description :		**% Silt and Clay**	**40**	**% Sand**	**48**	**% Gravel**	**12**	**Figure :**	**33**
Sample Description :	**Glacial Till: Silty Sand (SM) - Some Gravel, Trace Clay**								

Appendix A – EXP 2018 Borehole Logs

Log of Borehole BH2

Project No: OTT-00245378-C0

Project: Geotechnical Investigation - Proposed Hydrants - Earl of March Secondary School

Location: 4 The Parkway, City of Ottawa, Ontario

Figure No. 4

Page. 1 of 1

Date Drilled: 'April 19, 2018

Drill Type: CME-55 Truckmount

Datum: Geodetic

Logged by: M.L. 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	Geodetic 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	93.98	0				
		SILTY CLAY (CL) Brown, moist, (very stiff)	93.8		9 ○	×		20.1
				1	8 ○ ; 132 ▲	×		18.2
		SILTY SAND TILL (SM) With clay and gravel, brown, moist to wet, (compact)	92.5					
				2	11 ○	×		
			91.9					
		Auger Refusal at 2.1 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. Borehole backfilled with cuttings 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-00245378-C0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	dry	1.5

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 245378-C0 - EARL OF MARCH.GPJ TROW OTTAWA.GDT 4/30/18

Log of Borehole BH3

Project No: OTT-00245378-C0

Project: Geotechnical Investigation - Proposed Hydrants - Earl of March Secondary School

Location: 4 The Parkway, City of Ottawa, Ontario

Figure No. 5

Page. 1 of 1

Date Drilled: 'April 19, 2018

Drill Type: CME-55 Truckmount

Datum: Geodetic

Logged by: M.L. 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	Geodetic 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	93.85	0				
		FILL Sand with gravel, scattered aluminum debris, brown, moist, (compact)	93.7		16			
		SILTY CLAY (CL) Medium plasticity, sensitive, grey, moist to wet, (very stiff to stiff)	93.2	1	6; 120			17.9
			92.45	2	5; 132; 115 S = 5.3			17.0
				3	1; 96 S = 8.0; Hammer Weight; 72 S = 6.7			
		Borehole Terminated at 3.9 m Depth	90.0					

LOG OF BOREHOLE BH LOGS - 245378-C0 - EARL OF MARCH.GPJ TROW OTTAWA.GDT 4/30/18

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. 19 mm piezometer installed 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-00245378-C0

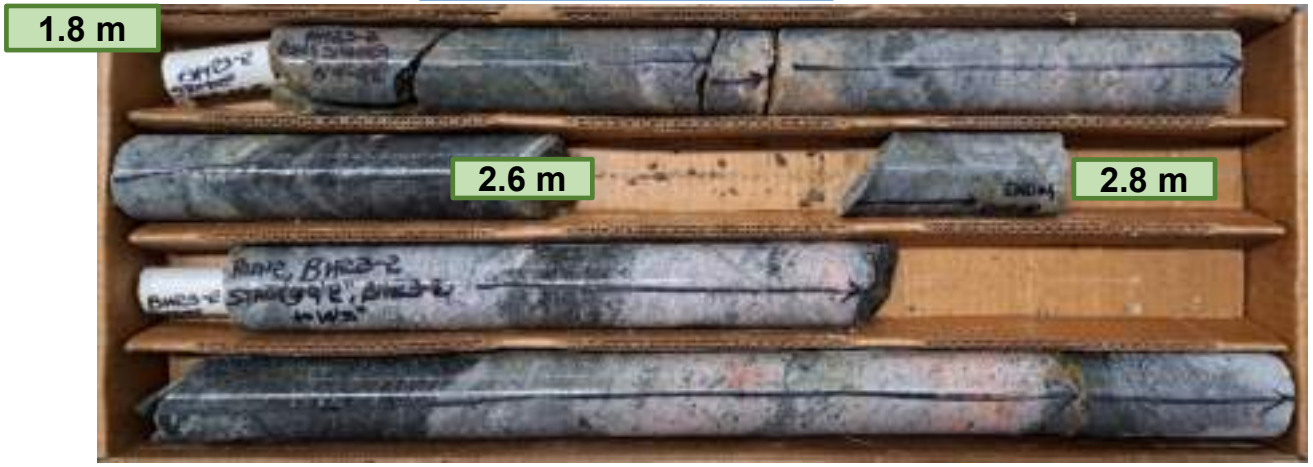
WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	1.7	3.0
8 days	1.4	

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

Appendix B – Bedrock Core Photographs

DRY BEDROCK CORES

WET BEDROCK CORES



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

Borehole No:	Core Runs	project	Project N0:
BH23-2	Run 1: 1.8 m - 2.8 m Run 2: 2.8 m - 4.3 m	Geotechnical Investigation Earl of March Secondary School Addition	OTT-23012778-B0
Date Cored January 8, 2024		Rock Core Photographs	B-1

DRY BEDROCK CORES

4.3 m

5.0 m

WET BEDROCK CORES

4.3 m

5.0 m

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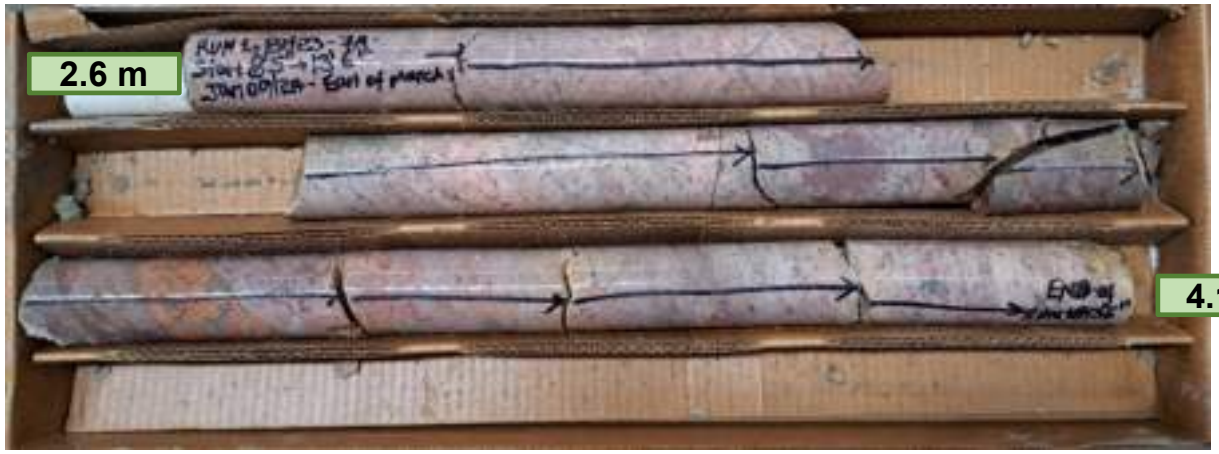
Ottawa, ON K2B 8H6, Canada

Borehole No:	Core Runs	project	Project N0:
BH23-2	Run 2: 2.8 m - 4.3 m Run 3: 4.3 m - 5.0 m	Geotechnical Investigation Earl of March Secondary School Addition	OTT-23012778-B0
Date Cored January 8, 2024		Rock Core Photographs	B-2

DRY BEDROCK CORES

WET BEDROCK CORES



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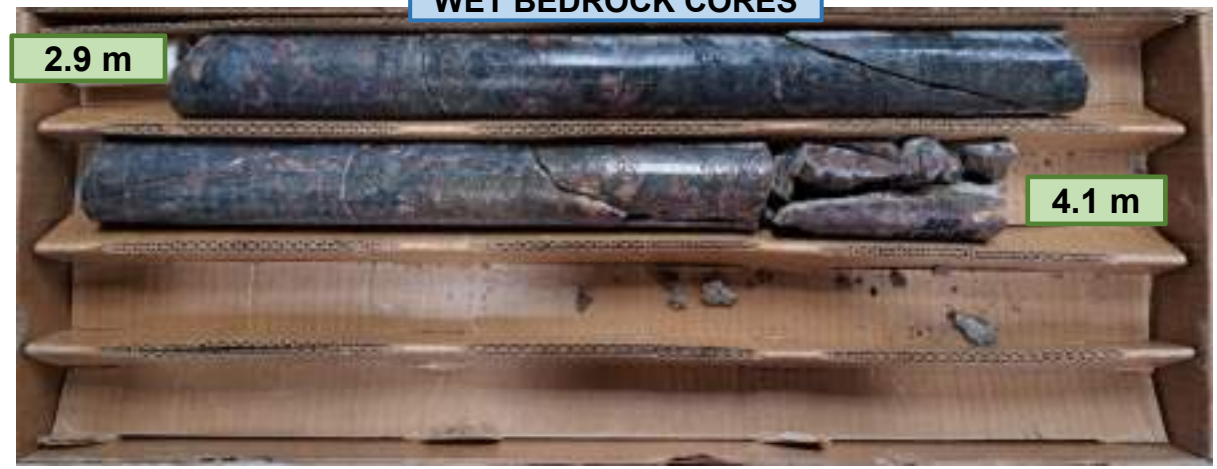
Ottawa, ON K2B 8H6, Canada

Borehole No:	Core Runs	project	Project N0:
BH23-7	Run 1: 2.6 m - 4.1 m	Geotechnical Investigation Earl of March Secondary School Addition	OTT-23012778-B0
Date Cored January 09, 2024		Rock Core Photographs	B-3

DRY BEDROCK CORES

WET BEDROCK CORES



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Ottawa, ON K2B 8H6, Canada

Borehole No:	Core Runs	project	Project N0:
BH23-8	Run 1: 2.9 m - 4.1 m	Geotechnical Investigation Earl of March Secondary School Addition	OTT-23012778-B0
Date Cored January 09, 2024		Rock Core Photographs	B-4

DRY BEDROCK CORES

WET BEDROCK CORES

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Ottawa, ON K2B 8H6, Canada

Borehole No:	Core Runs	project	Project N0:
BH23-8	Run 2: 4.1 m - 5.6 m	Geotechnical Investigation Earl of March Secondary School Addition	OTT-23012778-B0
Date Cored January 8, 2024		Rock Core Photographs	B-5

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WET BEDROCK CORES

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Ottawa, ON K2B 8H6, Canada

Borehole No:	Core Runs	project	Project N0:
BH24-1	Run 1: 1.7 m - 3.3 m	Geotechnical Investigation Earl of March Secondary School Addition	OTT-23012778-B0
Date Cored September 2, 2024		Rock Core Photographs	B-6

DRY BEDROCK CORES

WET BEDROCK CORES

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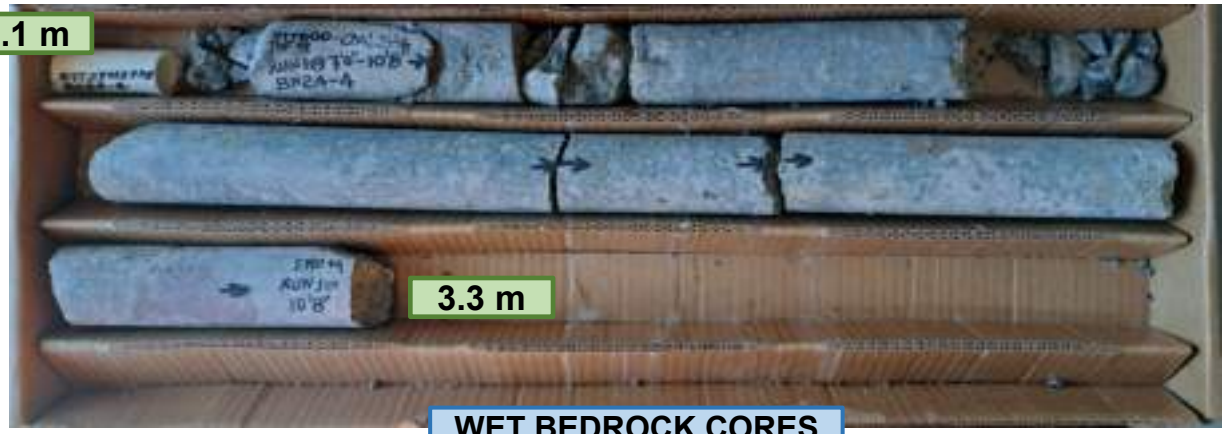
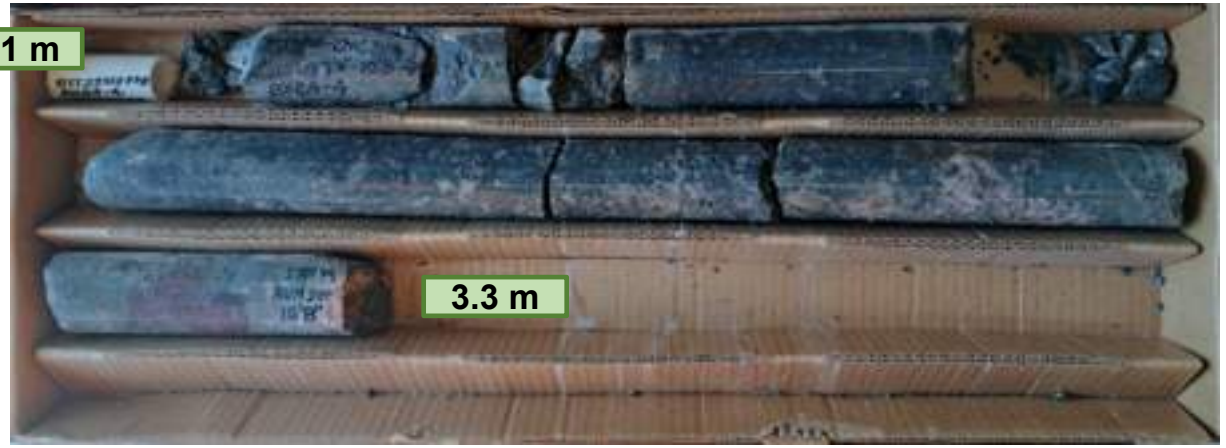
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

Borehole No:	Core Runs	project	Project N0:
BH24-1	Run 2: 3.3 m - 4.8 m	Geotechnical Investigation Earl of March Secondary School Addition	OTT-23012778-B0
Date Cored September 2, 2024		Rock Core Photographs	B-7

DRY BEDROCK CORES



WET BEDROCK CORES



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

Borehole No:	Core Runs	project	Project N0:
BH24-4	Run 1: 2.1 m - 3.3 m	Geotechnical Investigation Earl of March Secondary School Addition	OTT-23012778-B0
Date Cored September 2, 2024		Rock Core Photographs	B-8

DRY BEDROCK CORES

WET BEDROCK CORES

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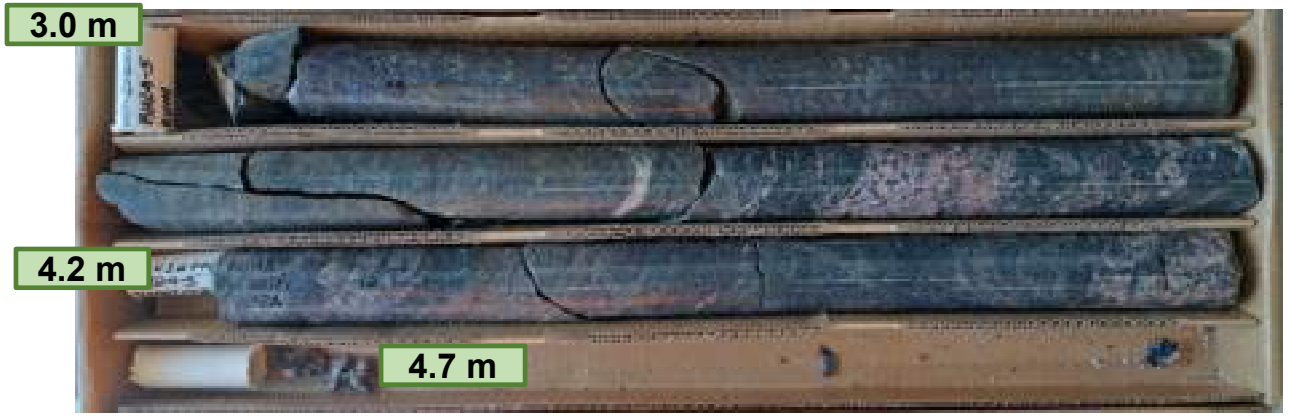
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

Borehole No:	Core Runs	project	Project N0:
BH24-4	Run 2: 3.3 m - 4.8 m	Geotechnical Investigation Earl of March Secondary School Addition	OTT-23012778-B0
Date Cored September 2, 2024		Rock Core Photographs	B-9

DRY BEDROCK CORES

WET BEDROCK CORES



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

Borehole No:	Core Runs	project	Project N0:
BH24-5	Run 1: 3.0 m - 4.2 m Run 2: 4.2 m - 4.7 m	Geotechnical Investigation Earl of March Secondary School Addition	OTT-23012778-B0
Date Cored September 2, 2024		Rock Core Photographs	B-10

Appendix C – MASW Seismic Survey

GEOPHYSICS GPR INTERNATIONAL INC.

February 15th, 2024

Transmitted by email : Ismail.Taki@exp.com
c.c. : Daniel.Wall@exp.com

Our ref : GPR24-05206-b

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

Subject: **Shear Wave Velocity Sounding for the Site Class Determination**
4 The Parkway, Kanata, Ottawa (ON)

[Project: OTT-23012778-B0]

Dear Mr. Taki,

Geophysics GPR International inc. has been mandated by **exp** Services inc. to carry out seismic surveys at the Earl of March Secondary School, located at 4 The Parkway, Kanata, in Ottawa (ON). The geophysical investigation used the Multi-channel Analysis of Surface Waves (MASW), the Spatial AutoCorrelation (SPAC), and the seismic refraction method. From the subsequent results, the seismic shear wave velocity values were calculated for the soils, to determine the Site Class.

The surveys were conducted on January 1st, 2023, by Mrs. Karyne Faguy, B.Sc. geophysics and Mr. Timothy Ward, tech. 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 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 (from MASW and 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 around 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 spreads were laid out north-west of the actual building (Figure 2). The geophone spacing was 3.0 metres for the main spread, using 24 geophones. Two shorter seismic spreads, with geophone spacing of 0.5 and 1.0 metre, were dedicated to the near surface materials. The seismic records were produced with a seismograph Terraloc Pro2 (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 at 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

From seismic refraction, the rock depth was calculated at 4.5 metres (± 1 metre), and its seismic velocity was calculated at 1910 m/s for the surface portion. The MASW calculated V_S results are illustrated at Figure 5.

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:

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

(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 metres deep.

The calculated $\overline{V}_{S30}$ value of the actual site is 1138.1 m/s (Table 1), corresponding to the Site Class "B". However, the Site Classes A and B are not to be used if there is 3 metres or more between the rock surface and the bottom of the foundation. In the case there would be 2.7 metres or less of soils, the $\overline{V}_{S30}$* value would be greater than 1500 m/s, corresponding to the Site Class A (Table 2).

CONCLUSION

Geophysical surveys were carried out to identify the Site Class at the Earl of March Secondary School, Kanata, in Ottawa (ON). The seismic surveys used the MASW and the SPAC analysis, and the seismic refraction to calculate the $\overline{V}_{S30}$ value. Its calculation is presented at Table 1.

The $\overline{V}_{S30}$ value of the actual site is 1138 m/s, corresponding to the Site Class "B" ($760 < \overline{V}_{S30} \leq 1500$ m/s), as determined through the MASW and SPAC results, Table 4.1.8.4.-A of the NBC (2015), and the Building Code, O. Reg. 332/12. It must be noted that the Site Classes A and B are not to be used if there is 3 metres or more of unconsolidated materials between the rock surface and the bottom of the spread footing or the mat foundation.

In the case there would be 2.7 metres or less of unconsolidated materials, the $\overline{V}_{S30}$* value would be greater than 1500 m/s, corresponding to the Site Class A.

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 2015) 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,

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

LICENSED PROFESSIONAL ENGINEER
J.-L. ARSENAULT
100148122
PROVINCE OF ONTARIO
2024-02-15

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

Figure 2: Location of the seismic spreads
(source: *Google Earth™*)

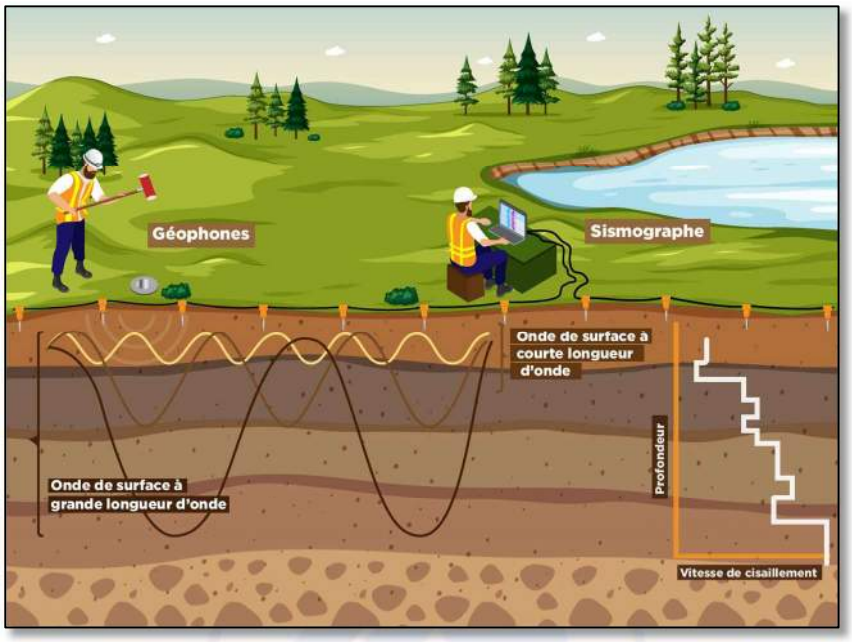

Figure 3: MASW Operating Principle

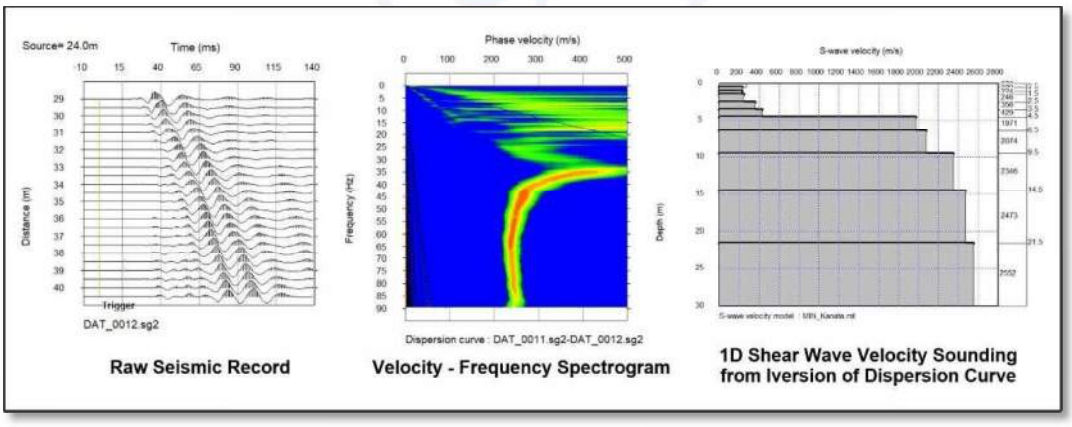

Figure 4: Example of a MASW/SPAC record, Phase Velocity - Frequency curve of the Rayleigh wave and resulting 1D Shear Wave Velocity Model

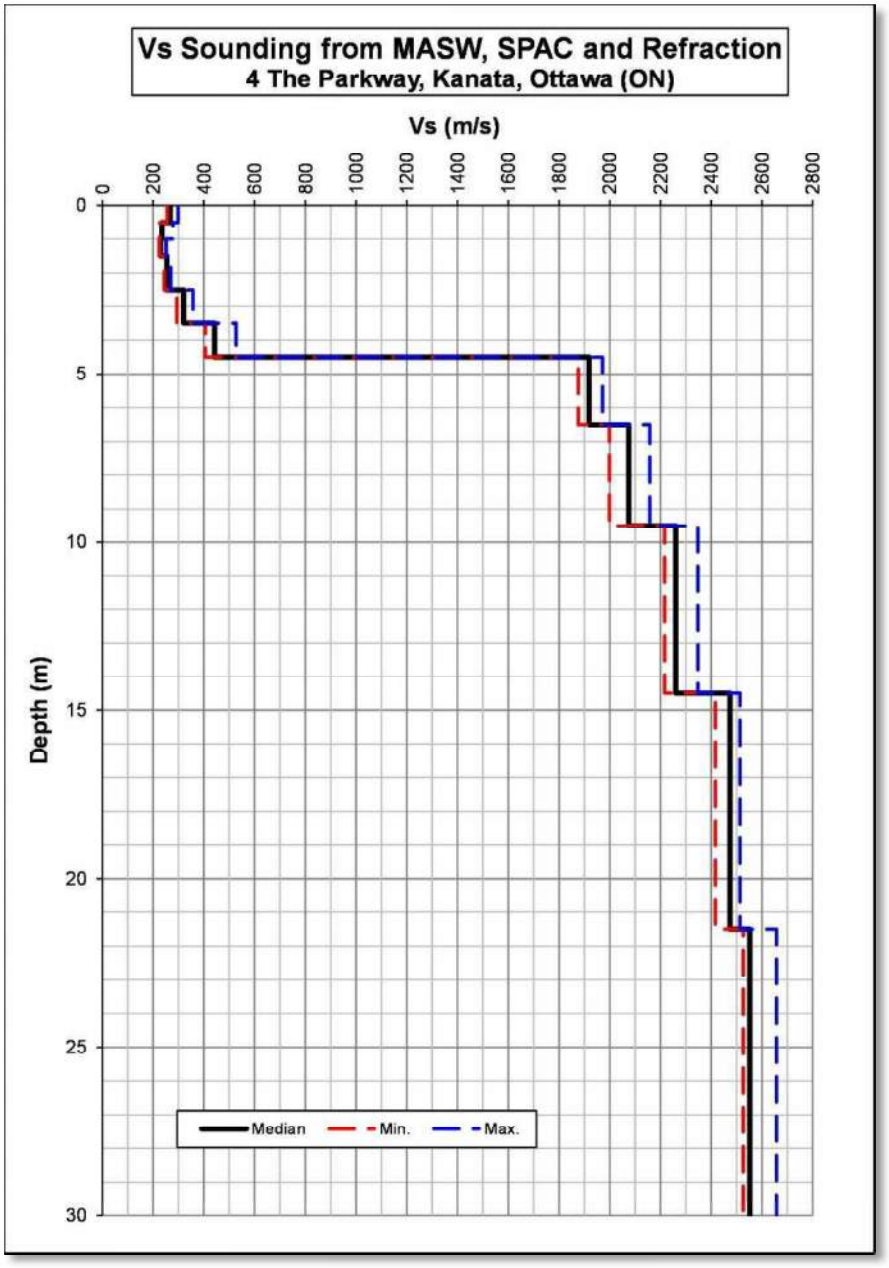

Figure 5: MASW Shear-Wave Velocity Sounding

TABLE 1

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

Depth	Vs			Thickness	Cumulative Thickness	Delay for med. Vs	Cumulative Delay	Vs at given Depth
	Min.	Median	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	255.4	267.2	298.7	Grade Level (February 1st, 2024)				
0.5	226.1	235.5	278.6	0.50	0.50	0.001871	0.001871	267.2
1.0	224.5	229.2	251.0	0.50	1.00	0.002123	0.003994	250.4
1.5	243.3	253.5	270.2	0.50	1.50	0.002182	0.006176	242.9
2.5	293.7	320.7	357.0	1.00	2.50	0.003945	0.010121	247.0
3.5	406.3	442.3	527.2	1.00	3.50	0.003118	0.013239	264.4
4.5	1876.3	1919.3	1971.7	1.00	4.50	0.002261	0.015499	290.3
6.5	1998.6	2074.5	2158.0	2.00	6.50	0.001042	0.016541	393.0
9.5	2216.5	2260.1	2347.2	3.00	9.50	0.001446	0.017988	528.1
14.5	2416.0	2473.4	2513.2	5.00	14.50	0.002212	0.020200	717.8
21.5	2525.9	2552.1	2657.4	7.00	21.50	0.002830	0.023030	933.6
30				8.50	30.00	0.003331	0.026361	1138.1

V_{S30} (m/s)	**1138.1**
Class	**B (1)**

(1) The Site Classes A and B are not to be used if there is 3 metres or more of unconsolidated materials between the rock surface and the bottom of the spread footing or the mat foundation.

TABLE 2

V_{S30} * Calculation for the Site Class A

Depth	Vs			Thickness	Cumulative Thickness	Delay for med. Vs	Cumulative Delay	Vs at given Depth
	Min.	Median	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	255.4	267.2	298.7	Limit for the Site Class A (2.7 metres of soils)				
0.5	226.1	235.5	278.6					
1.0	224.5	229.2	251.0					
1.5	243.3	253.5	270.2					
1.8	243.3	253.5	270.2					
2.5	293.7	320.7	357.0	0.70	0.70	0.002761	0.002761	253.5
3.5	406.3	442.3	527.2	1.00	1.70	0.003118	0.005879	289.1
4.5	1876.3	1919.3	1971.7	1.00	2.70	0.002261	0.008140	331.7
6.5	1998.6	2074.5	2158.0	2.00	4.70	0.001042	0.009182	511.9
9.5	2216.5	2260.1	2347.2	3.00	7.70	0.001446	0.010628	724.5
14.5	2416.0	2473.4	2513.2	5.00	12.70	0.002212	0.012841	989.0
21.5	2525.9	2552.1	2657.4	7.00	19.70	0.002830	0.015671	1257.1
31.8				10.30	30.00	0.004036	0.019707	1522.3

V_{S30} *	**1522.3**
Class	**A**

Appendix D – Laboratory Certificate of Analysis Report

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: Ismail M. Taki
PROJECT: OTT-23012778-B0
AGAT WORK ORDER: 24Z113379
SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganic Team Lead
DATE REPORTED: Jan 26, 2024
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.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*
- *For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.*

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 24Z113379

PROJECT: OTT-23012778-B0

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:Earl of March Secondary School, Kanata

SAMPLED BY:EXP

Inorganic Chemistry (Soil)

DATE RECEIVED: 2024-01-19

DATE REPORTED: 2024-01-26

				BH 6 SS4 7.	BH 11 SS4 7.
		SAMPLE DESCRIPTION:		5'-9.5'	5'-9.5'
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2024-01-09	2024-01-09
Parameter	Unit	G / S	RDL	5596376	5596377
Chloride (2:1)	µg/g		2	398	78
Sulphate (2:1)	µg/g		2	200	72
pH (2:1)	pH Units		NA	7.94	7.90
Resistivity (2:1) (Calculated)	ohm.cm		1	870	3800

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

5596376-5596377 pH, Chloride, 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

5835 COOPERS AVENUE
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: 24Z113379

PROJECT: OTT-23012778-B0

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:Earl of March Secondary School, Kanata

SAMPLED BY:EXP

Soil Analysis

RPT Date: Jan 26, 2024			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
Inorganic Chemistry (Soil)															
Chloride (2:1)	5598651		70	71	1.4%	< 2	93%	70%	130%	99%	80%	120%	99%	70%	130%
Sulphate (2:1)	5598651		119	119	0.0%	< 2	108%	70%	130%	101%	80%	120%	97%	70%	130%
pH (2:1)	5597793		8.04	8.02	0.2%	NA	93%	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.

Certified By:

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: 24Z113379

PROJECT: OTT-23012778-B0

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:Earl of March Secondary School, Kanata

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

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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: Daniel Wall
PROJECT: Earl or March SS
AGAT WORK ORDER: 24Z194528
SOIL ANALYSIS REVIEWED BY: Sukhwinder Randhawa, Inorganic Team Lead
DATE REPORTED: Sep 16, 2024
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

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: 24Z194528

PROJECT: Earl or March SS

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Daniel Wall

SAMPLING SITE:

SAMPLED BY:

(Soil) Inorganic Chemistry

DATE RECEIVED: 2024-09-09

DATE REPORTED: 2024-09-16

				SAMPLE DESCRIPTION:	BH2 SS4 7.5-9.5'	BH3 SS5 10-12'
				SAMPLE TYPE:	Soil	Soil
				DATE SAMPLED:	2024-08-30	2024-08-30
Parameter	Unit	G / S	RDL		6129317	6129324
Chloride (2:1)	µg/g		2		120	109
Sulphate (2:1)	µg/g		2		33	20
pH (2:1)	pH Units		NA		8.67	8.99
Resistivity (2:1) (Calculated)	ohm.cm		1		2390	3970

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

6129317-6129324 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

5835 COOPERS AVENUE
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: 24Z194528

PROJECT: Earl or March SS

ATTENTION TO: Daniel Wall

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Sep 16, 2024			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)	6127766		220	220	0.2%	< 2	95%	70%	130%	99%	80%	120%	90%	70%	130%
Sulphate (2:1)	6127766		51	51	0.4%	< 2	101%	70%	130%	101%	80%	120%	102%	70%	130%
pH (2:1)	6131363		10.4	10.1	2.6%	NA	97%	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.

Certified By:

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

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24Z194528

PROJECT: Earl or March SS

ATTENTION TO: Daniel Wall

SAMPLING SITE:

SAMPLED BY:

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

Have feedback? Scan here for a quick survey!

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: DANIEL WALL
Address: 2650 QUEENSVIEW
Phone: Fax:
Reports to be sent to:
1. Email: DANIEL.WALL@EXP.COM
2. Email:

Project Information:

Project: EARL OF MARCH SS
Site Location: 4 THE PARKWAY
Sampled By:
AGAT Quote #: 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

☐ Regulation 406
Table _____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

☐ 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 (RSC)? ☐ Yes ☐ No

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

Legal Sample ☐

Sample Matrix Legend

GW	Ground Water	**SD**	Sediment
O	Oil	**SW**	Surface Water
P	Paint	**R**	Rock/Shale
S	Soil		

Laboratory Use Only

Work Order #: 24Z194528
Cooler Quantity: n/a - no ice/pack
Arrival Temperatures: 14.3 | 14.6 | 14.4
~~Depot~~ Temperatures: 5.9 | 6.5 | 6.3
Custody Seal Intact: ☐ Yes ☐ No ☑ N/A
Notes: BI

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 CSR

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	VOC	PAHs	PCBs: Arocolors ☐	O. Reg 406: Regulation 406 Characterization Package pH, Metals, BTEX, F1-F4	O. Reg 406: EC, SAR	O. Reg 406: Regulation 406 SPLP Rainwater Leach mSPLP: ☐ Metals ☐ VOCs ☐ SVOCs ☐ OC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs TCLP:	Corrosivity: ☐ Moisture ☐ Sulphide	pH	Sulphate	Resistivity	Chloride			Potentially Hazardous or High Concentration (Y/N)
1. BH2 SS4 7.5-9.5'	AUG30/24	AM/PM	1	SOIL														✓	✓	✓	✓			
2. BH3 SS5 10'-12'	AUG30/24	AM/PM	1	SOIL														✓	✓	✓	✓			
3.		AM/PM																						
4.		AM/PM																						
5.		AM/PM																						
6.		AM/PM																						
7.		AM/PM																						
8.		AM/PM																						
9.		AM/PM																						
10.		AM/PM																						
11.		AM/PM																						

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
			C. Griffiths	09/09/24	14h10
C. to Pure	09/09/24	15h00	T. Tiffin	Sept 10	9:10Hr

Page _____ of _____

N°: T-157249

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

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