Geotechnical Investigation Report
Proposed Residential Development
500 and 508 Edgeworth Avenue
Ottawa, Ontario

Client:
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Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed residential development to be located at 500 and 508 Edgeworth Avenue, Ottawa, Ontario (Figure 1). The terms of reference for this geotechnical investigation were provided in our proposal dated May 7, 2025 (Proposal No. OTT-23002437-A0). Authorization to proceed with this geotechnical investigation was provided by Edgeworth Development Lands Corp.

Phase One and Two Environmental Site Assessments (ESAs) by EXP were undertaken concurrently with this geotechnical investigation and are provided in separate reports.

Proposed Development

Site plans completed by RLA Architecture and dated January 2025 indicate the proposed development will consist of a twenty-four (24) storey residential apartment building with one (1) and four (4) storey podiums and a two (2) level underground parking garage. The underground parking garage will occupy the majority of the site. The site plans indicate that the average design elevation for the final exterior grade of the site will be Elevation 67.70 m, the ground floor will be at design Elevation 68.00 m and the lowest floor of the parking garage will be at design elevation ranging from Elevation 59.55 m to Elevation 60.30 m.

Fieldwork Program

The borehole fieldwork was conducted on June 19 and 20, 2025 and consists of six (6) boreholes (Borehole Nos. 25-01 to 25-06) advanced to termination and auger refusal depths ranging from 3.3 m to 9.2 m depths below existing grade. The fieldwork was supervised on a full-time basis by a representative from EXP. The locations and geodetic elevations of the boreholes were determined on site by EXP. A 50 mm diameter PVC monitoring well with screened section was installed in four (4) boreholes (Borehole Nos. 25-01, 25-02, 25-03, and 25-06) for long-term monitoring of groundwater levels and for sampling the groundwater as part of the Phase Two ESA. The monitoring wells were installed in accordance with EXP standard practice and the installation configurations are documented on the respective borehole logs. The boreholes were backfilled upon completion of drilling and installation of the monitoring wells.

Subsurface Conditions

The boreholes revealed that the subsurface conditions beneath a surficial topsoil layer are underlain by fill, a buried topsoil layer, very loose to very dense glacial till contacted at 0.8 m to 1.7 m depths (Elevation 66.9 m to Elevation 65.2 m). Auger refusal was met in the boreholes at 3.3 m to 5.1 m depths (Elevation 62.8 m to Elevation 61.7 m) on inferred cobbles, boulders within the glacial till or on bedrock. Shale bedrock with frequent limestone seams and layers was confirmed in Borehole No. 25-04 at a 5.1 m depth (Elevation 62.1 m). The groundwater level was at 1.5 m to 3.4 m depths (Elevation 64.69 m to Elevation 64.17 m).

Geotechnical Engineering Comments and Recommendations

Site Classification

Based on a review of the borehole information and the design elevation of the lowest floor in the underground parking garage of Elevation 59.55 m to Elevation 60.30 m, it is considered feasible to support the proposed twenty-four storey building with a two (2) level underground parking garage by strip and spread footings founded on the competent sound shale bedrock that is free of soil seams, weathered zones and loose material (soil and bedrock pieces).

For footings founded on sound shale bedrock and based on Table 4.1.8.4.-B of the 2024 Ontario Building Code (OBC), the site classification and designation for seismic design would be Site Class C and Site Designation X_C.

A higher site class and designation may be available if a seismic shear wave survey is conducted on the site and provided the underside of the footings recommended in this report to support the proposed building are founded on the sound shale bedrock.

Liquefaction Potential of Soils

Since the construction of the two (2) level underground parking garage would require the excavation and removal of all soils down to the bedrock, the determination as to whether or not the soils are liquefiable during a seismic event does not need to be considered in the design of the proposed development.

Site Grade Raise

The borehole information indicates that compressible clays do not exist at the site. Therefore, from a geotechnical perspective, there is no restriction to raising the grades at the site.

Foundation Considerations

Based on a review of the borehole information, the proposed apartment building may be supported by strip and spread footings founded directly on the shale bedrock below Elevation 60.30 m that is free of soil seams, weathered zones or loose material and designed for a factored geotechnical resistance at ultimate limit state (ULS) of 3000 kPa. The factored ULS value includes a geotechnical resistance factor of 0.5. The serviceability limit state (SLS) bearing pressure of the bedrock, required to produce 25 mm total 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.

The 2023 Fifth Edition Canadian Foundation Engineering Manual (CFEM) indicates the unfactored coefficient of friction at ULS between the concrete of the underside of the footing and clean sound rock is 0.70. A geotechnical resistance factor of 0.8 should be applied to the unfactored ULS to determine the factored ULS value of 0.56.

Floor Slab and Drainage Requirements

The lowest floor of the parking garage may be designed as a slab-on-grade set on the competent sound bedrock subgrade and may be constructed as a concrete slab-on-grade or as a paved surface. The concrete and asphalt pavement structures indicated in the attached report are for light duty traffic only (cars). EXP can provide concrete and asphalt pavement structures for heavy duty traffic (cars and trucks), if required. The exposed bedrock surface should be examined by a geotechnician and any weathered zones, soil seams or loose material (soil and bedrock pieces) should be excavated and removed from the exposed bedrock subgrade within the floor area.

The lowest floor level for the parking garage is anticipated to be located below the groundwater level. Therefore, underfloor and perimeter drainage systems will be required for the proposed below grade parking garage.

Excavations and Dewatering Requirements

Excavation of the soils may be undertaken using heavy equipment capable of removing cobbles, boulders and debris within the soils and existing subsurface concrete footings, foundation walls and floor slabs from the demolition of the existing buildings.

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

It is anticipated that due to the significant depth of the excavation for the proposed building and the proximity of the excavation to existing buildings, infrastructure and roadways, the excavations will likely have to be undertaken within the confines of a shoring system. The shoring system may consist of steel H soldier pile and timber lagging system, interlocking sheeting system and/or secant pile shoring system. The most appropriate type of showing will be best established once the final design plans are available.

The excavations are anticipated to extend into the bedrock. Excavations within the weathered zone of the bedrock and for shallow excavations into the competent sound bedrock may be excavated using a hoe ram for the removal of small quantities of the bedrock; however, this process is expected to be very slow. The excavation of the competent sound limestone bedrock to extensive depths below the bedrock surface will likely require line drilling and blasting techniques. Contractors bidding on this project should decide on their own the most preferred rock removal method; hoe ramming or line drilling and blasting.

The excavation side slopes in the weathered limestone bedrock may be cut back at a 1H:1V gradient from the bottom of the weathered bedrock zone. Excavations within the sound bedrock may be undertaken with near vertical sides subject to review by a geotechnical engineer. The rock face of the excavation may require support in the form of shotcreting, wire mesh and/or rock bolts. The need for and type of rock support is best determined during on-site examination of the bedrock during excavation operations.

Excavations above the groundwater may be dewatered by conventional sump pumping techniques. In excavations below the groundwater level and within the shored excavation, where seepage of water should still be anticipated, water may be removed by collecting the water at low points within the shored excavation and pumping from sumps. In areas of high infiltration, a higher seepage rate should be anticipated and high-capacity pumps may be required to keep the excavation dry.

Pipe Bedding Requirements

The pipe bedding including material specifications, thickness of cover material and compaction requirements should conform to the relevant OPSS or municipality 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). It is recommended that the pipe bedding be a minimum 150 mm thick and consist of OPSS Granular A. The bedding material should be placed along the sides and on top of the pipe to provide a minimum cover thickness of 300 mm.

Backfilling Requirements

It is anticipated that the majority of the material required for backfilling purposes would have to be imported and should preferably conform to the recommendation provided in the attached geotechnical report.

Tree Planting Restrictions

Since sensitive compressible clays were not encountered at the site, there are no restrictions to tree planting from a geotechnical perspective.

Additional Studies

Since the presence of bedrock was confirmed in only one (1) borehole (Borehole No. 25-04), it is recommended that additional boreholes be undertaken to confirm the depth (elevation) and quality of the bedrock across the site. Based on the findings from the additional boreholes, the comments provided in this geotechnical report may need to be updated.

It is recommended that a hydrogeological assessment (study) be completed at the site as part of the detail design to establish the quantity of water to be removed from the site for water taking permit requirements as well as to determine the potential impact on the neighboring properties as the results of the dewatering activities. Based on the findings from the hydrogeological assessment (study), the comments provided in this geotechnical report may need to be updated.

Closure

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

This executive summary is a brief synopsis of the report and should not be read in lieu of reading the attached geotechnical report in its entirety.

1. Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed residential development to be located at 500 and 508 Edgeworth Avenue, Ottawa, Ontario (Figure 1). The terms of reference for this geotechnical investigation were provided in our proposal dated May 7, 2025 (Proposal No. OTT-23002437-A0). Authorization to proceed with this geotechnical investigation was provided by Edgeworth Development Lands Corp.

Phase One and Two Environmental Site Assessments (ESAs) by EXP were undertaken concurrently with this geotechnical investigation and are provided in separate reports.

At the time of this geotechnical report the site was occupied by two (2) single-detached residential dwellings that will have to be demolished as part of the proposed new residential development.

Site plans completed by RLA Architecture and dated January 2025 indicate the proposed development will consist of a twenty-four (24) storey residential apartment building with one (1) and four (4) storey podiums and a two (2) level underground parking garage. The underground parking garage will occupy the majority of the site. The site plans indicate that the average design elevation for the final exterior grade of the site will be Elevation 67.70 m, the ground floor will be at design Elevation 68.00 m and the lowest floor of the parking garage will be at design elevation ranging from Elevation 59.55 m to Elevation 60.30 m.

The geotechnical investigation was undertaken to:

a) Establish the subsurface soil and groundwater conditions at six (6) boreholes located on the site,

b) Provide the site classification and designation for seismic design in accordance with the requirements of the 2024 Ontario Building Code (OBC) and assess the potential for liquefaction of the subsurface soils during a seismic event,

c) Comment on grade-raise restrictions,

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

e) Comment on slab-on-grade construction and the requirement for perimeter and underfloor drainage systems,

f) Provide lateral earth pressure parameters (static and seismic states) for the design of the subsurface basement walls,

g) Comment on excavation conditions and de-watering requirements during construction,

h) Provide pipe bedding requirements,

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

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

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

2. Site Description

The site is located within a residential area of the city of Ottawa. The site is bounded by Edgeworth Avenue to the east, the City of Ottawa landscaped parkland and pathway to the west and residential properties to the north and south. The site is currently occupied by two (2) detached residential dwellings.

Based on the ground surface elevations indicated on a plan in the Surveyor's Real Property Report titled, Topographic Details Part 1 Showing Part of Lots 108 and 109 Registered Plan 305 City of Ottawa dated October 16, 2023 and prepared by J.D. Barnes Limited, the existing ground surface slopes gradually downwards from east to west with ground surface elevations ranging from Elevation 67.92 m at the southeast corner to Elevation 65.97 m at the northwest corner of the site. A concrete retaining wall exists along the south property line to separate an elevation change of approximately 0.5 m to 0.8 m where the subject site is at lower elevation.

3. Geology of the Site

3.1 Surficial Geology Map

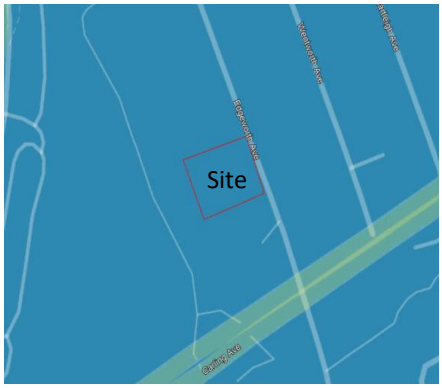
The surficial geology was reviewed via the Google Earth application using the map published by the Ontario Ministry of Energy, Northern Development and Mines available via www.mndm.gov.on.ca/en/mines-and-minerals/applications/ogsearth/surficial-geology and was last modified on May 23, 2017. The map indicates the site is underlain by stone-poor, sandy silt to silty sand-textured glacial till on Paleozoic terrain. The surficial deposits are shown in Image 1 below.

Stone-poor, sandy silt to silty sand-textured glacial till on Paleozoic terrain

Image 1 – Surficial Geology

3.2 Bedrock Geology Map

The bedrock geology was reviewed via the Google Earth application using the map published by the Ontario Ministry of Energy, Northern Development and Mines available via http://www.geologyontario.mndm.gov.on.ca/mines/data/google/MRD219/geology/doc.kml and published in 2007. The map indicates the site is underlain by sandstone, shale, limestone and dolostone of the Rockcliffe formation. The bedrock geology is shown in Image 2 below.



Sandstone, shale, limestone and dolostone of the Rockcliffe formation

Image 2 – Bedrock Geology

4. Procedure

The borehole fieldwork was conducted on June 19 and 20, 2025 and consists of six (6) boreholes (Borehole Nos. 25-01 to 25-06) advanced to termination and auger refusal depths ranging from 3.3 m to 9.2 m depths below existing grade. The fieldwork was supervised on a full-time basis by a representative from EXP.

The locations and geodetic elevations of the boreholes were determined on site by EXP and are shown on the Borehole Location Plan, Figure 2.

The borehole locations were cleared of private and public underground services prior to the start of the fieldwork.

The boreholes were advanced using a CME-55 LC rubber track mounted drill rig equipped with continuous flight hollow stem augers and conventional rock coring equipment. Standard penetration tests (SPTs) were performed in all the boreholes at 0.75 m depth intervals and soil samples retrieved by the split-barrel sampler. The bedrock was cored in one (1) borehole using the N-size core barrel and conventional rock coring techniques. A field record of wash water return, colour of wash water and any sudden drops of the core barrel were kept during the rock coring operations.

A 50 mm diameter PVC monitoring well with screened section was installed in four (4) boreholes (Borehole Nos. 25-01, 25-02, 25-03, and 25-06) for long-term monitoring of groundwater levels and for sampling the groundwater as part of the Phase Two ESA. The monitoring wells were installed in accordance with EXP standard practice and the installation configurations are documented on the respective borehole logs. The boreholes were backfilled upon completion of drilling and installation of the monitoring wells.

On completion of the borehole fieldwork, the soil samples and rock cores were transported to the EXP laboratory in Ottawa. The samples were reviewed by a geotechnical engineer and borehole logs prepared. The soils are classified by their main constituents in accordance with the Unified Soil Classification System (USCS) using the soil group name and symbol and by the modified Burmister soil classification method for the classification of the minor constituents of the soil using adjectives and modifiers such as trace and some.

The rock cores were visually examined by the geotechnical engineer and logged in general accordance with the 2023 Canadian Foundation Engineering Manual (CFEM) Fifth Edition. Photographs were taken of the bedrock cores.

The geotechnical laboratory testing program for the soil samples and rock cores is summarized in Table I.

Table I: Summary of Laboratory Testing Program

Type of Test	Number of Tests Completed
Soil Samples	
Natural Moisture Content Determination	39
Grain Size Analysis	3
Corrosion Analysis (pH, sulphate, chloride and resistivity)	1
Rock Cores	
Unconfined Compressive Strength and Natural Unit Weight Determination	3

5. 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 Nos. 3 to 8. The borehole logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time 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. Reference is made to the EXP Phase One and Two ESA reports regarding the environmental aspects of the soil and groundwater.

It should be noted that the soil and bedrock boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling operations. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "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.

5.1 Topsoil

A surficial topsoil layer was encountered in all boreholes with a thickness ranging from 75 mm to 124 mm thick.

5.2 Fill

Fill was encountered beneath the topsoil layer in all boreholes and extends to depths of 0.8 m to 1.5 m (Elevation 66.9 m to Elevation 65.2 m). The fill consists of sand and gravel to silty sand and gravel and contains brick fragments, topsoil inclusions, possible cobbles and boulders or large debris. The standard penetration test (SPT) N-values range from 3 to 23 indicating the fill is in a very loose to compact state. The moisture content of the fill ranges from 6 percent to 22 percent.

5.3 Buried Topsoil Layer

The fill layer in Borehole No. 25-04 is underlain by a 180 mm thick buried topsoil layer contacted at 1.5 m depth (Elevation 65.7 m).

5.4 Glacial Till

The topsoil and fill are underlain by glacial till in all boreholes and extends to a 5.1 m depth (Elevation 62.1 m) in Borehole No. 25-04. The glacial till consists of sandy silt with gravel and trace clay to silty sand with gravel and possible cobbles and boulders. The SPT N-values of the glacial till range from 2 to 92 indicating the glacial till is in a very loose to very dense state. The glacial till has localized zones of high SPT N-values for low sampler penetration depth likely resulting from the sampler contacting a cobble or boulder within the glacial till. The natural moisture content of the glacial till is 4 percent to 23 percent.

The results from the grain-size analysis conducted on three (3) samples of the glacial till is summarized in Table II. The grain-size distribution curves are shown in Figures 9 to 11.

Table II: Summary of Results from Grain-Size Analysis – Glacial Till						
Borehole No. (BH) – Sample No. (SS)	Depth (m)	Grain-Size Analysis (%)				
		Gravel	Sand	Silt	Clay	Soil Classification
BH25-01 – SS2	0.8 – 1.4	27	36	26	11	Silty Sand (SM): Gravelly, Some Clay
BH25-01 – SS6	3.8 – 4.2	31	48	16	5	Silty Sand (SM): Gravelly, Trace Clay
BH25-06 – SS3	1.5 – 2.1	12	42	34	12	Silty Sand (SM): Some Gravel and Clay

The results of the grain size analysis indicates the glacial till may be classified as a silty sand (SM) that is gravelly to containing some gravel trace to some clay.

5.5 Inferred Boulders or Bedrock

Auger refusal was met in all boreholes except Borehole No. 25-04 at 3.3 m to 5.1 m depths (Elevation 62.8 m to 61.7 m) on inferred cobbles or boulders within the glacial till or on inferred bedrock.

5.6 Shale Bedrock

Shale bedrock was contacted in Borehole No. 25-04 at a 5.1 m depth (Elevation 62.1 m). Photographs of the bedrock cores are shown in Figures 12 and 13.

Based on examination of the retrieved bedrock cores, the total core recovery (TCR) was determined to be 100 percent and the rock quality designation (RQD) was determined to be 63 percent to 97 percent indicating the bedrock has a fair to excellent quality.

Based on visual examination of the bedrock cores, the bedrock is considered to be shale bedrock with frequent limestone seams and layers. As previously indicated, the shale bedrock is of the Rockcliffe formation as indicated by the available bedrock geology maps including Generalized Bedrock Geology Ottawa - Hull, Ontario and Quebec; Geological Survey of Canada, Map 1508A (1979), and the online map published by the Ontario Ministry of Energy, Northern Development and Mines available via http://www.geologyontario.mndm.gov.on.ca/mines/data/google/MRD219/ geology/doc.kml and published in 2007.

The unconfined compressive strength and natural unit weight of the shale bedrock was determined and the results are given in Table III below.

Table III: Summary of Unconfined Compressive Strength and Unit Weight of Bedrock			
Borehole No. (BH) – Run No.	Depth (Elevation, m)	Unconfined Compressive Strength (MPa)	Natural Unit Weight (kN/m^3)
BH25-04 - Run 1	5.6 (61.59)	109.0	27.1
BH25-04 - Run 2	6.3 (60.89)	112.0	25.8
BH25-04 – Run 3	8.0 (59.19)	54.0	26.0

The bedrock is considered to be strong (R4) to very strong (R5) according to the 2023 Fifth Edition Canadian Foundation Engineering Manual.

5.7 Groundwater Level Measurements

A summary of the groundwater level measurements taken in the boreholes equipped with monitoring wells on July 4, 2025 is shown in Table IV.

Table IV: Summary of Groundwater Level Measurements

Borehole (BH)/ Monitoring Well (MW) No.	Ground Surface Elevation (m)	Date of Measurement (Elapsed Time in Days from Date of Installation)	Groundwater Depth Below Ground Surface (Elevation), m
BH/MW 25-01	67.61	July 4, 2025 (14 days)	3.0 (64.6)
BH/MW 25-02	67.69	July 4, 2025 (14 days)	3.0 (64.7)
BH/MW 25-03	67.57	July 4, 2025 (15 days)	3.4 (64.2)
BH/MW 25-06	66.11	July 4, 2025 (15 days)	1.5 (64.6)

Based on the July 4, 2025 set of measurements, the groundwater level is at 1.5 m to 3.4 m depths (Elevation 64.7 m to 64.2m).

The groundwater levels were determined in the boreholes at the time and under the conditions stated in the 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.

6. Site Classification and Designation and Liquefaction Potential of Soils for Seismic Design

6.1 Site Classification

Based on a review of the borehole information and the design elevation of the lowest floor in the underground parking garage of Elevation 59.55 m to Elevation 60.30 m, it is considered feasible to support the proposed twenty-four storey building with a two (2) level underground parking garage by strip and spread footings founded on the competent sound shale bedrock that is free of soil seams, weathered zones and loose material (soil and bedrock pieces).

For footings founded on sound shale bedrock and based on Table 4.1.8.4.-B of the 2024 Ontario Building Code (OBC), the site classification and designation for seismic design would be Site Class C and Site Designation X_C.

A higher site class and designation may be available if a seismic shear wave survey is conducted on the site and provided the underside of the footings recommended in this report to support the proposed building are founded on the sound shale bedrock.

6.2 Liquefaction Potential of Subsurface Soils

Since the construction of the two (2) level underground parking garage would require the excavation and removal of all soils down to the bedrock, the determination as to whether or not the soils are liquefiable during a seismic event does not need to be considered in the design of the proposed development.

7. Grade Raise Restrictions

The borehole information indicates that compressible clays do not exist at the site. Therefore, from a geotechnical perspective, there is no restriction to raising the grades at the site.

8. Foundation Considerations

The set of drawings, Drawing Nos. SP-1 dated January 13, 2025 and D301 to D303, dated January 8, 2025 and prepared by RLA Architecture indicate the proposed development will consist of a twenty-four (24) storey apartment building with two (2) levels of underground parking with the lowest basement level being at Elevation 59.55 m to Elevation 60.30 m. Design elevations for the final exterior grade of the site will be at Elevation 66.80 m on the west side and Elevation 67.80 m on the east side and the finished floor elevation will be Elevation 68.00 m throughout.

Based on a review of the borehole information, the proposed apartment building may be supported by strip and spread footings founded directly on the shale bedrock below Elevation 60.30 m.

The proposed building may be supported by strip and spread footings founded on the competent sound shale bedrock that is free of soil seams, weathered zones or loose material and designed for a factored geotechnical resistance at ultimate limit state (ULS) of 3000 kPa. The factored ULS value includes a geotechnical resistance factor of 0.5. The serviceability limit state (SLS) bearing pressure of the bedrock, required to produce 25 mm total 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.

Since the presence of bedrock was confirmed in one (1) borehole only (Borehole No. 25-04), it is recommended that additional boreholes be undertaken at the site to confirm the depth (elevation) and quality of the bedrock across the site. Based on the findings from the additional boreholes, the comments provided in this geotechnical report may need to be updated.

Footings founded at different elevations in the competent sound bedrock should be located such that the higher footing is located behind a line drawn up at 6V:1H from the bottom of the limit of the footing excavation of the lower footing.

The exposed bedrock subgrade for footings should be examined by a geotechnician to ensure the exposed bedrock subgrade is capable of supporting the recommended factored ULS value and that the footing beds have been properly prepared. Where weathered zones of the bedrock, soil seams and loose material (soil and bedrock pieces) are encountered at the founding surface of the exposed bedrock, these materials will require sub-excavation and removal down to the underlying competent sound bedrock. As previously indicated, the footing may be stepped down to the competent sound bedrock in these areas or the sub-excavated area may be backfilled using 20 MPa concrete (or compressive strength specified by the structural engineer) placed on the competent sound bedrock and backfilled to the design underside of footing elevation.

Footings founded on the competent sound shale bedrock below weathered zones, soft soil/rock seams and loose material do not require frost protection.

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

8.1 Sliding Resistance for Footings

The 2023 Fifth Edition Canadian Foundation Engineering Manual (CFEM) indicates the unfactored coefficient of friction at ULS between the concrete of the underside of the footing and clean sound rock is 0.70. A geotechnical resistance factor of 0.8 should be applied to the unfactored ULS to determine the factored ULS value of 0.56.

9. Floor Slab and Drainage Requirements

The lowest floor of the parking garage may be designed as a slab-on-grade set on the competent sound bedrock subgrade and may be constructed as a concrete slab-on-grade or as a paved surface. The concrete and asphalt pavement structures indicated below are for light duty traffic only (cars). EXP can provide concrete and asphalt pavement structures for heavy duty traffic (cars and trucks), if required. The exposed bedrock surface should be examined by a geotechnician and any weathered zones, soil seams or loose material (soil and bedrock pieces) should be excavated and removed from the exposed bedrock subgrade within the floor area.

The lowest floor level for the parking garage is anticipated to be located below the groundwater level. Therefore, underfloor and perimeter drainage systems will be required for the proposed below grade parking garage.

The underfloor drainage system may consist of 100 mm diameter perforated pipe or equivalent placed in parallel rows at 5 m to 6 m centres and at least 300 mm below the underside of the floor slab. The drains should be set on 100 mm thick bed of 19 mm sized clear stone covered on top and sides with 150 mm thick clear stone that is fully wrapped with an approved porous geotextile membrane, such as Terrafix 270R or equivalent. The perimeter drains may also consist of 100 mm diameter perforated pipe set on the footings and surrounded with 150 mm thick clear stone fully wrapped with a geotextile membrane. The perimeter and underfloor drains should be connected to separate sumps equipped with backup pumps and generators in case of mechanical failure and/or power outage, so that at least one system would be operational should the other fail.

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

9.1 Lowest Floor Level as a Concrete Surface

The subgrade is anticipated to consist of shale bedrock. The shale bedrock should be examined by EXP and any loose/soft zones of the bedrock should be excavated and removed.

Following approval of the bedrock subgrade, the concrete slab for light duty traffic (cars only) may be constructed as follows:

- 150 mm thick concrete with 32 MPa compressive strength and air content of 5 percent to 8 percent; over
- 150 mm thick layer of Ontario Provincial Standard Specification (OPSS) 1010 Granular A compacted to 100 percent standard Proctor maximum dry density (SPMDD); over
- 300 mm minimum thick layer of OPSS 1010 Granular B Type II compacted to 100 percent SMPDD.

The concrete slab should be reinforced and adequate saw cuts should be provided in the floor slab to control cracking. Once the final design elevation of the lowest floor level is available, the above comments may need to be updated.

9.2 Lowest Floor Level as a Paved Surface

The subgrade is anticipated to consist of shale bedrock. The shale bedrock should be examined by EXP and any loose/soft zones of the bedrock should be excavated and removed.

Following approval of the bedrock subgrade, the asphalt pavement structure for light duty traffic (cars only) may be constructed on the bedrock subgrade as follow:

- 65 mm thick layer of asphaltic concrete consisting of HL3/SP12.5 – The asphaltic concrete should be placed and compacted as per OPSS 310 and 313 and should be designed in accordance with OPSS 1150/1151; over
- 150 mm thick layer of OPSS Granular A compacted to 100 percent SPMDD; over
- 450 mm thick layer of OPSS Granular B Type II compacted to 100 percent SPMDD.

10. Lateral Earth Pressure Against Subsurface Walls

The subsurface basement walls of the proposed building will be subjected to lateral static earth pressure as well as lateral dynamic earth pressure during a seismic event. The lateral static earth pressure that the subsurface walls would be subjected to may be computed from equations (i) and (ii) and the lateral seismic (dynamic) earth force from equation (iii) given below. It is recommended that the basement walls be backfilled with free-draining material such as Ontario Provincial Standard Specification (OPSS) Granular B Type II material compacted to 95 percent standard Proctor maximum dry density (SPMDD) and the basement walls be equipped with a permanent perimeter drainage system.

The equations given below assume that the backfill against the subsurface walls will be free-draining granular material and that subsurface drains (perimeter drainage system) will be provided to prevent build-up of hydrostatic pressure behind the wall. Equation (i) will be applicable to the portion of the subsurface wall located within the overburden (soil). Equation (ii) will be applicable to the portion of the subsurface wall located in the bedrock where the earth pressure will be considerably reduced due to the narrow backfill between the subsurface wall and the rock face resulting in an arching effect (Spangler & Handy, 1984).

For design purposes, the lateral static earth pressure against the subsurface wall above the bedrock may be computed from the following equation:

$p = K_o(\gamma h + q)$ ---------- (i)

where p = lateral static earth pressure, kPa
K_0 = lateral earth pressure coefficient for 'at rest' condition = 0.50
γ = unit weight of free draining granular backfill; Granular B Type II = 22 kN/m^3
h = depth of point of interest below top of backfill, m
q = any surcharge acting at ground surface, kPa

Lateral static earth pressure (σ_n) at depth z from the top of the bedrock surface, due to narrow earth backfill between subsurface wall and rock at depth z, may be computed from the following equation:

$$\sigma_n = \frac{\gamma B}{2\tan\delta}\left(1 - e^{-2Ko\frac{z}{B}\tan\delta}\right) + K_o q$$ ---------- (ii)

where σ_n = lateral static earth pressure, kPa
γ = unit weight of free draining granular backfill; Granular B Type II = 22 kN/m^3
B = Backfill width (m)
z = depth from top of bedrock surface (m)
δ = friction angle between the backfill and wall and bedrock (assumed to be equal) = 17 degrees
K_0 = lateral earth pressure coefficient for 'at rest' condition = 0.50
q = surcharge pressure including pressures from overburden soil, traffic load at ground surface and foundations from existing adjacent buildings (kPa)

The lateral dynamic thrust may be computed from the equation given below:

$$\Delta_{Pe} = \gamma H^2 \frac{a_h}{g} F_b$$ ---------- (iii)

where Δ_{Pe} = dynamic thrust in kN/m of wall
H = height of wall, m
γ = unit weight of backfill material = 22 kN/m^3
$\frac{a_h}{g}$ = seismic coefficient = 0.342g (2020 National Building Code of Canada Seismic Hazard Tool)
F_b = thrust factor = 1.0

The dynamic thrust does not take into account the surcharge load. The resultant force of the dynamic thrust acts approximately at 0.63H above the base of the wall.

For basement walls cast directly against the bedrock, a vertical drainage membrane or board such as Terradrain 200 or equivalent should be installed on the face of the bedrock that leads to a solid discharge pipe connecting to a sump inside the building. The top of the drainage board should be covered with a fabric filter to prevent the loss of the overlying soil into the drainage board.

All subsurface walls should be properly waterproofed.

11. Excavation and De-Watering Requirements

11.1 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.

Reference is made to the EXP Phase One and Two ESAs for additional comments regarding the environmental aspects of the soils.

11.2 Overburden Soil Excavation

Excavations for the construction of the footings for the proposed building are anticipated to extend to depths of 7 m to 9 m below existing grade. These excavations will be undertaken through the existing topsoil, fill, glacial till, and into the shale bedrock. The excavations will extend below the groundwater table.

Excavation of the soils may be undertaken using heavy equipment capable of removing cobbles, boulders and debris within the soils and existing subsurface concrete footings, foundation walls and floor slabs from the demolition of the existing buildings.

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

It is anticipated that due to the significant depth of the excavation for the proposed building and the proximity of the excavation to existing buildings, infrastructure and roadways, the excavations will likely have to be undertaken within the confines of a shoring system. The shoring system may consist of steel H soldier pile and timber lagging system, interlocking sheeting system and/or secant pile shoring system. The most appropriate type of showing will be best established once the final design plans are available.

The type of shoring system required would depend on a number of factors including:

- Proximity of the excavation to existing structures and infrastructure,
- Type and location of foundations of the existing adjacent buildings and the difference in founding levels between the foundations of new buildings and existing adjacent buildings; and
- The subsurface soil, bedrock and groundwater conditions.

A conventional shoring system consisting of soldier pile and timber lagging is more flexible compared to the interlocking steel sheeting system and the secant pile shoring system. In areas where there is concern for lateral yielding of the soils and the potential of settlement of nearby structures and infrastructure, the use of a steel interlocking sheeting system or secant pile system can be considered. The shoring system will require lateral restraint provided by tiebacks consisting of rock anchors. Due to the presence of cobbles and boulders in the glacial till, pre-drilling may be required for the installation of the soldier piles. The presence of cobbles and boulders in the subsurface soils should also be taken into consideration for other contemplated shoring systems.

The need for a shoring system, the most appropriate type of shoring system and the design and installation of the shoring system should be determined by the contractors bidding on this project. The design of the shoring system should be undertaken by a professional engineer experienced in shoring design and the installation of the shoring system should be undertaken by a contractor experienced in the installation of shoring systems. The shoring system should be designed and installed in accordance with OHSA and the 2023 Fifth Edition CFEM (Canadian Foundation Engineering Manual).

Soldier Pile and Timber Lagging System

A conventional steel H soldier pile and timber lagging shoring system must be designed to support the lateral earth pressure given by the expression below:

P = k (γh + q)

where P = the pressure, at any depth, h, below the ground surface

k = applicable earth pressure coefficient; active lateral earth pressure coefficient = 0.33

'at rest' lateral earth pressure coefficient = 0.50

γ = unit weight of soil to be retained, estimated at 22 kN/m^3

h = the depth, in metres, at which pressure, P, is being computed

q = the equivalent surcharge acting on the ground surface adjacent to the shoring system

The pressure distribution assumes that drainage is permitted between the lagging boards and that no build-up of hydrostatic pressure may occur behind the shoring system.

The shoring should be designed using appropriate 'k' values depending on the location of any settlement-sensitive infrastructure (roadways and underground services) and building structures. The traffic loads on the streets should be considered as surcharge. Soldier piles will need to extend into the sound bedrock below the soils. For guidance, if there is room to permit at least a 1.0 m of rock ledge around the perimeter of the excavation, the soldier piles could be toed into the upper levels of the rock provided that a rock bolt and plate arrangement is installed on the rock face to support the toe. The rock bolt should be designed to take the full toe pressure.

The shoring system as well as adjacent settlement sensitive structures and infrastructure should be monitored for movement (deflection) on a periodic basis during construction operations. The shoring system will require lateral restraint by tiebacks in the form of grouted rock anchors.

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.

Secant Pile Shoring System

The secant pile shoring system should be designed to resist 'at rest' lateral earth thrust in addition to the hydrostatic thrust as given by the expression below:

$$P_0 = K_O\, q\, (h_1 + h_2) + \frac{1}{2} K_0\, \gamma\, h_1^2 + K_0\, \gamma\, h_1 h_2 + \frac{1}{2} K_0\, \gamma'\, h_2^2 + \frac{1}{2} \gamma_w\, {h_2}^2$$

where:

P_0 = at rest' earth and water thrusts acting against secant pile wall (kN/m)

K_0 = 'at rest' lateral earth pressure coefficient = 0.50

q = surcharge acting adjacent to the excavation (kPa)

h_1 = height of shoring from the ground surface to groundwater table (m)

h_2 = height of shoring from groundwater table to the bottom of excavation (m)

γ = unit weight of the soil = 22 kN/m^3

γ' = submerged unit weight of soil = 11.2 kN/m^3

γ_w = unit weight of water = 9.8 kN/m^3

Secant pile walls consist of overlapping concrete piles that form a strong watertight barrier. They can be constructed with conventional drilling methods. Secant pile walls typically include both reinforced primary and un-reinforced secondary piles. The

primary piles overlap the secondary piles, with secondary piles essentially acting as concrete lagging. The reinforcement in the primary piles generally consists of steel reinforcing bar cages or steel beams. The result is a continuous intersecting line of concrete piles that are placed before any excavation is performed.

The shoring system selected should be tied back by rock anchors grouted into the sound bedrock. The factored ULS grout to rock bond of 700 kPa may be used for design of the anchors and includes a geotechnical resistance factor of 0.3. This value assumes a grout with a minimum strength of 30 MPa is used and that the sides of the drilled holes are cleaned prior to the grouting operation. It is anticipated that the bedrock may contain near vertical seams and some horizontal fractures and therefore some grout loss when grouting anchors in the bedrock should be anticipated. The grout loss is expected to be higher in the fractured bedrock and lower in the sound bedrock.

If the rock anchors extend into adjacent properties, permission will be required from the adjacent property owners for the installation of the tiebacks. If permission is not granted, the shoring system may be braced by cross bracing or the use of rakers on the inside of the shored excavation.

Design anchors should be load tested to two times the design capacity. All anchors should be proof tested to 1.33 times the working load. The anchor should be locked off at working load plus an allowance for relaxation (usually 10 percent). When installing tie backs, casing would be required to advance through the fill and the native soil. The deflection of the shoring system should be carefully monitored during construction.

The shoring system as well as adjacent settlement sensitive structures and infrastructure should be monitored for movement (deflection) on a periodic basis during construction operations.

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.

11.3 Bedrock Excavation

The excavations are anticipated to extend into the bedrock. Excavations within the weathered zone of the bedrock and for shallow excavations into the competent sound bedrock may be excavated using a hoe ram for the removal of small quantities of the bedrock; however, this process is expected to be very slow. The excavation of the competent sound limestone bedrock to extensive depths below the bedrock surface will likely require line drilling and blasting techniques. Contractors bidding on this project should decide on their own the most preferred rock removal method; hoe ramming or line drilling and blasting.

The excavation side slopes in the weathered limestone bedrock may be cut back at a 1H:1V gradient from the bottom of the weathered bedrock zone.

Excavations within the sound bedrock may be undertaken with near vertical sides subject to review by a geotechnical engineer. The rock face of the excavation may require support in the form of shotcreting, wire mesh and/or rock bolts. The need for and type of rock support is best determined during on-site examination of the bedrock during excavation operations.

It is recommended that a pre-construction condition survey of the nearby buildings and the 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. Prior to the commencement of blasting, a detailed blast methodology should be submitted by the Contractor.

Vibration monitors should be installed in critical areas of adjacent buildings 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. The vibration limits should comply with City of Ottawa Special Provisions No. F-1201 (Use of Explosives) requirements.

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

11.4 De-Watering Requirements

Excavations above the groundwater may be dewatered by conventional sump pumping techniques. In excavations below the groundwater level and within the shored excavation, where seepage of water should still be anticipated, water may be removed by collecting the water at low points within the shored excavation and pumping from sumps. In areas of high infiltration, a higher seepage rate should be anticipated and high-capacity pumps may be required to keep the excavation dry.

It is recommended that a hydrogeological assessment (study) be completed at the site as part of the detail design to establish the quantity of water to be removed from the site for water taking permit requirements as well as to determine the potential impact on the neighboring properties as the results of the dewatering activities. Based on the findings from the hydrogeological assessment (study), the comments provided in this geotechnical report may need to be updated.

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.

12. Pipe Bedding Requirements

It is anticipated that the subgrade for the proposed underground services will consist of fill, glacial till and shale bedrock.

The pipe bedding including material specifications, thickness of cover material and compaction requirements should conform to the relevant OPSS or municipality 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). It is recommended that the pipe bedding be a minimum 150 mm thick and consist of OPSS Granular A. The bedding material should be placed along the sides and on top of the pipe to provide a minimum cover thickness of 300 mm.

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

In areas where the subgrade consists of weathered bedrock with slabs or pieces of rock that may contain voids, it is recommended that the voids be filled with OPSS Granular A material and the surface of the filled in bedrock be covered with a separation membrane, such as Terrafix 270 R or equivalent, prior to the placement of the pipe bedding material.

To minimize the potential for bedding 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.

In areas where paved surfaces 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.

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

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

The on-site soils to be excavated are anticipated to consist of surficial and buried topsoil, fill, glacial till, and shale bedrock with limestone seams and layers. Portions of the existing fill (free of debris, topsoil, cobbles and boulders) and native glacial till (free of cobbles and boulders) from above the groundwater table may be re-used as service trench backfill material or to raise the grades in areas away from the footprint of the proposed building subject to further geotechnical examination and testing during construction. These soils are susceptible to moisture absorption due to precipitation and therefore should be protected from the elements if stockpiled on site. The shale bedrock is not suitable for reuse as backfill material and should be discarded.

Subject to additional geotechnical examination and testing during construction, portions of the soils (free of debris, cobbles and boulders) below the groundwater level, may also be reused in areas away from the footprint of the proposed building as backfill in service trenches and subgrade fill in paved and landscaped areas, but they will likely require air-drying to reduce the moisture content to compact the materials to the specified degree of compaction. Air-drying may be problematic due to space restrictions on site and since air-drying is weather dependent, may take time and the soils are subject to moisture absorption from precipitation and must be protected at all times from the elements.

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

- Engineered fill under the floor slab, including backfilling of service trenches inside the building - OPSS Granular B Type II placed in maximum 300 mm thick lifts and each lift compacted to 98 percent SPMDD,
- Backfill material against exterior side of foundation walls – OPSS Granular B Type II placed in 300 mm thick lifts and each lift compacted to 95 percent SPMDD,
- Trench backfill and subgrade fill should consist of OPSS Select Subgrade Material (SSM) for the driveways and access roads, 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.

14. Subsurface Concrete and Steel Requirements

Chemical tests limited to pH, sulphate, chloride and resistivity were undertaken on one (1) selected soil sample. A summary of the results is shown in Table V. The laboratory certificate of analysis report is shown in Appendix A.

Table V: Corrosion Test Results on Soil Samples

Borehole No. (BH) – Sample No. (SS)	Depth (m)	Soil Type	pH	Sulphate (%)	Chloride (%)	Resistivity (ohm-cm)
BH25-01 – SS5	3.0 - 3.6	Glacial Till	8.67	0.0167	0.0019	3300

Based on a review of the lab test results, the concentration of sulphate in the glacial till would have a negligible potential of sulphate attack on subsurface concrete. The concrete should be designed in accordance with CSA A23.1:24/CSA A23.2:24.

The resistivity test result indicates that the glacial till is mildly corrosive to bare steel as per the National Association of Corrosion Engineers (NACE). Appropriate measures should be taken to protect the bare buried steel from corrosion.

15. Tree Planting Restrictions

Since sensitive compressible clays were not encountered at the site, there are no restrictions to tree planting from a geotechnical perspective.

16. Additional Investigation and Assessment (Study)

Since the presence of bedrock was confirmed in only one (1) borehole (Borehole No. 25-04), it is recommended that additional boreholes be undertaken to confirm the depth (elevation) and quality of the bedrock across the site. Based on the findings from the additional boreholes, the comments provided in this geotechnical report may need to be updated.

It is recommended that a hydrogeological assessment (study) be completed at the site as part of the detail design to establish the quantity of water to be removed from the site for water taking permit requirements as well as to determine the potential impact on the neighboring properties as the results of the dewatering activities. Based on the findings from the hydrogeological assessment (study), the comments provided in this geotechnical report may need to be updated.

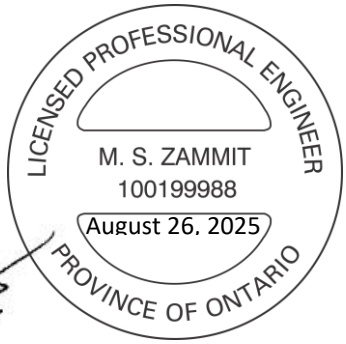
17. General Comments

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

The information contained in this report is not intended to reflect on environmental aspects of the soils. Reference is made to the EXP Phase One and Two ESA reports regarding environmental aspects of the soils and groundwater.

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,



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Figures

LEGEND

APPROXIMATE PROPERTY BOUNDARY

0 50m 100m 200m

HORIZONTAL 1:5,000

EXP Services Inc. www.exp.com

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2650 Queensview Drive, Suite 100

Ottawa, ON K2B 8H6, Canada

DATE: JULY 2025	PROJECT: GEOTECHNICAL INVESTIGATION 500 & 508 EDGEWORTH AVENUE, OTTAWA, ONTARIO		project no. OTT-23002437-B0
DESIGN: MZ / CHECKED: IT			scale 1:5,000
DRAWN BY: AS	TITLE: SITE LOCATION PLAN		FIG 1

Filename: E:\OTT\OTT-23002437-B0\60 Execution\65 Drawings\Geotechnical\OTT-23002437-B0_Geo_July-2025.dwg
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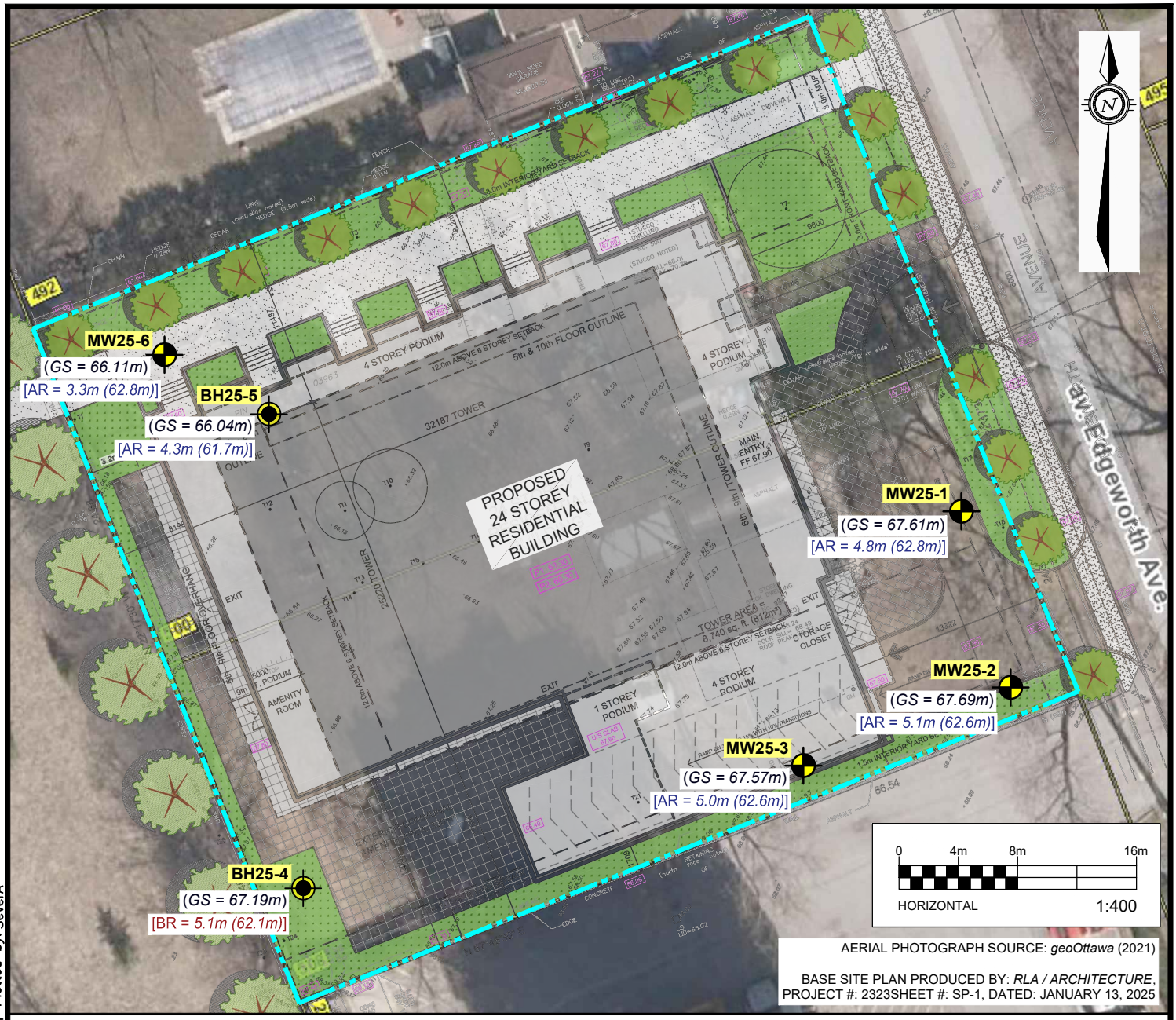

AERIAL PHOTOGRAPH SOURCE: *geoOttawa* (2021)

BASE SITE PLAN PRODUCED BY: *RLA / ARCHITECTURE*, PROJECT #: 2323SHEET #: SP-1, DATED: JANUARY 13, 2025

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- MW25-1 — MONITORING WELL NUMBER AND LOCATION (2025)
- BH25-5 — BOREHOLE NUMBER AND LOCATION (2025)
- (GS = 67.61m) — GROUND SURFACE ELEVATION (m)
- [BR = 5.1m] — BEDROCK DEPTH (ELEVATION) (m)
- [AR = 4.8m] — AUGER REFUSAL DEPTH (ELEVATION) (m) ON INFERRED COBBLES, BOULDERS OR ROCK
- PROPOSED DESIGN ELEVATIONS (m)

GENERAL 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. SOIL SAMPLES AND ROCK CORES 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.

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

DATE: JULY 2025	PROJECT: GEOTECHNICAL INVESTIGATION 500 & 508 EDGEWORTH AVENUE, OTTAWA, ONTARIO	project no.: OTT-23002437-B0
DESIGN: SP / MZ; CHECKED: IT		scale: 1:400
DRAWN BY: AS	TITLE: BOREHOLE LOCATION PLAN	FIG 2

Filename: E:\OTT\OTT-23002437-B0\60 Execution\65 Drawings\Geotechnical\OTT-23002437-B0_Geo_July-2025.dwg
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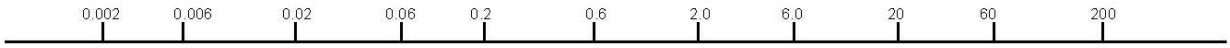
Notes On Sample Descriptions

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

ISSMFE SOIL CLASSIFICATION

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



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

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

UNIFIED SOIL CLASSIFICATION

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

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

Log of Borehole BH25-01

Project No: OTT-23002437-B0

Project: Proposed Residential Development

Location: 500 and 508 Edgeworth Avenue, Ottawa, Ontario

Figure No. 3

Page. 1 of 1

Date Drilled: 'June 20, 2025

Drill Type: CME 55 LC - Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: JE Checked by: MZ

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 ~ 125 mm thick	67.61	0				
		FILL	67.5					
		Sand and gravel, brown, damp, no odours, no stains, (compact)	66.8					
		GLACIAL TILL						
		Silty sand, gravelly, trace to some clay, cobbles and boulders, brown to grey, moist, no odours, no stains (compact to very dense)		1	11		SS1	
					34		SS2	
				2	15		SS3	
					4, 12, 50 / 75 mm		SS4	
▽			64.61	3				
		grey below 3.3 m depth			49		SS5	
				4	18, 42, 50 / 125 mm		SS6	
			62.8		27, 50 / 50 mm		SS7	
		Auger Refusal at 4.8 m Depth						

LOG OF BOREHOLE 500 EDGEWORTH LOGS - JULY 17, 2025.GPJ TROW OTTAWA.GDT 7/21/25

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-23002437-B0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
July 4, 2025	3.0	

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

Log of Borehole BH25-02

Project No: OTT-23002437-B0

Project: Proposed Residential Development

Location: 500 and 508 Edgeworth Avenue, Ottawa, Ontario

Figure No. 4

Page. 1 of 1

Date Drilled: 'June 20, 2025

Drill Type: CME 55 LC - Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: JE Checked by: MZ

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 ~ 125 mm thick	67.69	0				
		FILL	67.6					
		Sand and gravel, brown, damp, no odours, no stains, (compact)	66.9					
		GLACIAL TILL						
		Silty sand with gravel, cobbles and boulders, brown to grey, moist to wet, no odours, no stains (compact to very dense)		1	10		SS1	
					17		SS2	
				2	18		SS3	
					29		SS4	
			64.69	3	51		SS5	
		grey below 3.3 m depth						
				4	24, 50, 50 / 75 mm		SS6	
					11, 31, 50 / 100 mm		SS7	
			62.6	5				
		Auger Refusal at 5.1 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 50 mm diameter monitoring well was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23002437-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
July 4, 2025	3.0	

CORE DRILLING RECORD

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

LOG OF BOREHOLE 500 EDGEWORTH LOGS - JULY 17, 2025.GPJ TROW OTTAWA.GDT 7/21/25

Log of Borehole BH25-03

Project No: OTT-23002437-B0

Project: Proposed Residential Development

Location: 500 and 508 Edgeworth Avenue, Ottawa, Ontario

Figure No. 5

Page. 1 of 1

Date Drilled: 'June 19, 2025

Drill Type: CME 55 LC - Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: JE Checked by: MZ

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	67.57	0				
		FILL Silty sand and gravel, with topsoil inclusions, possible cobbles and boulders or large debris, brown, damp, no odours, no stains, (loose to compact)	67.5		7	×	SS1	
				1	18	×	SS2	
		GLACIAL TILL Sandy silt, trace clay, with gravel, brown, moist to wet, no odours, no stains (very loose to loose)	66.1		7	×	SS3	
				2	2	×	SS4	
▽		**GLACIAL TILL** Silty sand with gravel, possible cobbles and boulders, grey, moist, no odours, no stains, (very dense)	64.6	3	51	×	SS5	
			64.17	4	92	×	SS6	
					29, 50 / 75 mm	×	SS7	
		Auger Refusal at 5.0 m Depth	62.6	5				

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-23002437-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
July 4, 2025	3.4	

CORE DRILLING RECORD

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

LOG OF BOREHOLE 500 EDGEWORTH LOGS - JULY 17, 2025.GPJ TROW OTTAWA.GDT 7/21/25

Log of Borehole BH25-04

Project No: OTT-23002437-B0

Project: Proposed Residential Development

Location: 500 and 508 Edgeworth Avenue, Ottawa, Ontario

Figure No. 6

Page. 1 of 1

Date Drilled: 'June 19, 2025

Drill Type: CME 55 LC - Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: JE Checked by: MZ

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	67.19	0				
		FILL Sand and gravel, brown, moist, no odours, no stains, (compact)	67.1		23	×	SS1	
				1	12	×	SS2	
			65.7					
		TOPSOIL ~ 180 mm thick	65.5					
		GLACIAL TILL Sandy silt, trace clay, with gravel, brown, moist to wet, no odours, no stains (loose)	64.9	2	7	×	SS3	
		GLACIAL TILL Silty sand with gravel, possible cobbles and boulders, brown to grey, moist, no odours, no stains, (dense to very dense)		3	15	×	SS4	
		grey below 3 m depth			57	×	SS5	
				4	43	×	SS6	
					7, 25, 50 / 125 mm	×	SS7	
			62.1	5				
		SHALE BEDROCK With frequent limestone seams and layers, greenish grey, (fair to excellent quality)		6			Run 1	27.1
				7			Run 2	25.8
				8			Run 3	26.0
			58.0	9				
		Borehole Terminated at 9.2 m Depth						

LOG OF BOREHOLE 500 EDGEWORTH LOGS - JULY 17, 2025.GPJ TROW OTTAWA.GDT 7/21/25

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23002437-B0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	5.1 - 6.2	100	63
2	6.2 - 7.7	100	66
3	7.7 - 9.2	100	97

Log of Borehole BH25-05

Project No: OTT-23002437-B0

Project: Proposed Residential Development

Location: 500 and 508 Edgeworth Avenue, Ottawa, Ontario

Figure No. 7

Page. 1 of 1

Date Drilled: 'June 19, 2025

Drill Type: CME 55 LC - Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: JE Checked by: MZ

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
			66.04	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		TOPSOIL ~ 100 mm thick	65.9					
		FILL Silty sand and gravel, brown, damp, no odours, no stains, (compact)	65.2		13	×	SS1	
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown to grey, moist to wet, no odours, no stains (loose to very dense)		1	13	×	SS2	
				2	5	×	SS3	
		grey below 2.3 m depth			60	×	SS4	
				3	25, 24, 50 / 125 mm	×	SS5	
				4	28, 50 / 75 mm	×	SS6	
			61.7					
		Auger Refusal at 4.3 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23002437-B0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF BOREHOLE 500 EDGEWORTH LOGS - JULY 17, 2025.GPJ TROW OTTAWA.GDT 7/21/25

Log of Borehole BH25-06

Project No: OTT-23002437-B0

Project: Proposed Residential Development

Location: 500 and 508 Edgeworth Avenue, Ottawa, Ontario

Figure No. 8

Page. 1 of 1

Date Drilled: 'June 19, 2025

Drill Type: CME 55 LC - Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: JE Checked by: MZ

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	66.11	0	3		SS1	
		FILL Sand and gravel, with brick fragments, brown, moist, no odours, no stains, (very loose)	66.0 / 65.3					
		GLACIAL TILL Silty sand, some gravel and clay, cobbles and boulders, brown to grey, moist to wet, no odours, no stains (loose to very dense)	64.61	1	10		SS2	
				2	8		SS3	
		grey below 2.3 m depth			39		SS4	
				3	16, 50 / 125 mm		SS5	
		Auger Refusal at 3.3 m Depth	62.8					

Standard Penetration Test N Value: 20 40 60 80

Shear Strength kPa: 50 100 150 200

Combustible Vapour Reading (ppm): 250 500 750

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

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 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-23002437-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
July 4, 2025	1.5	

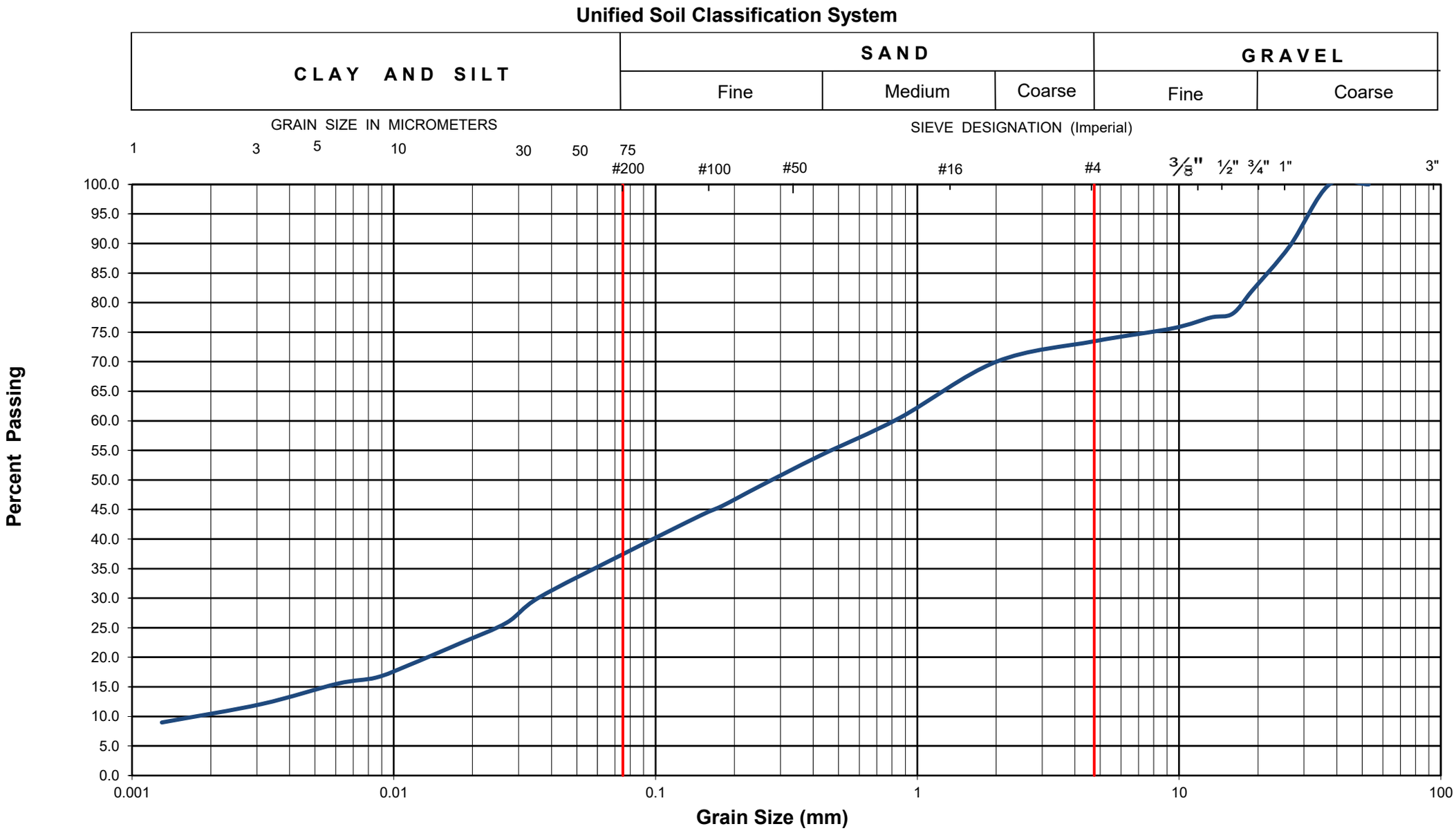
CORE DRILLING RECORD

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

LOG OF BOREHOLE 500 EDGEWORTH LOGS - JULY 17, 2025.GPJ TROW OTTAWA.GDT 7/21/25

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

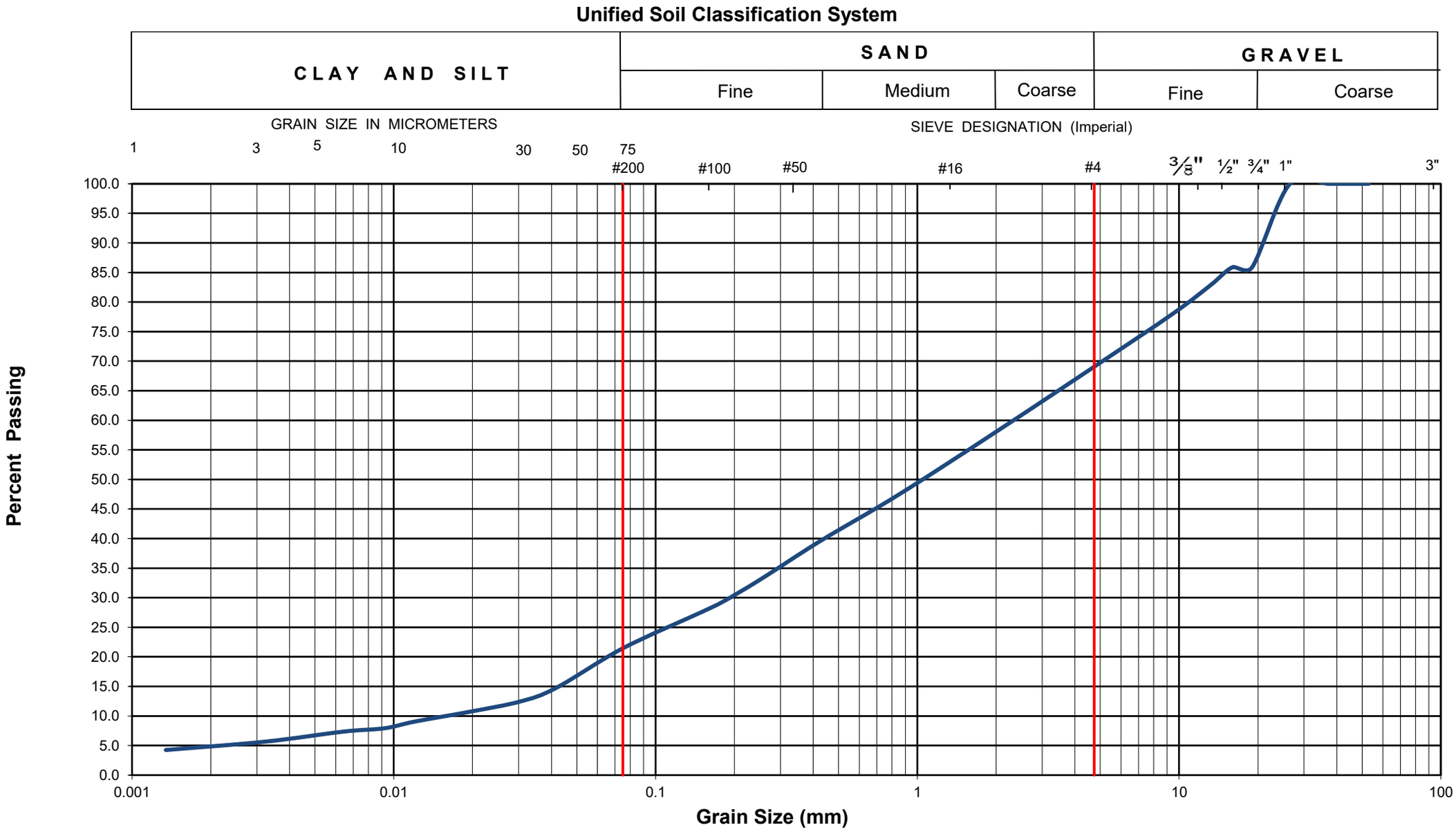
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-23002437-B0**	**Project Name :**	**Proposed Residential Development**						
Client :	**Edgeworth Development Lands Corp.**	**Project Location :**	**500 and 508 Edgeworth Avenue, Ottawa, Ontario**						
Date Sampled :	**June 20, 2025**	**Borehole No:**	**BH25-1**		**Sample No.:**	**SS2**		**Depth (m) :**	**0.8 - 1.4**
Sample Description :		**% Silt and Clay**	**37**	**% Sand**	**36**	**% Gravel**	**27**	**Figure :**	**9**
Sample Description :	**GLACIAL TILL: Silty Sand (SM), Gravelly, Some Clay**								

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

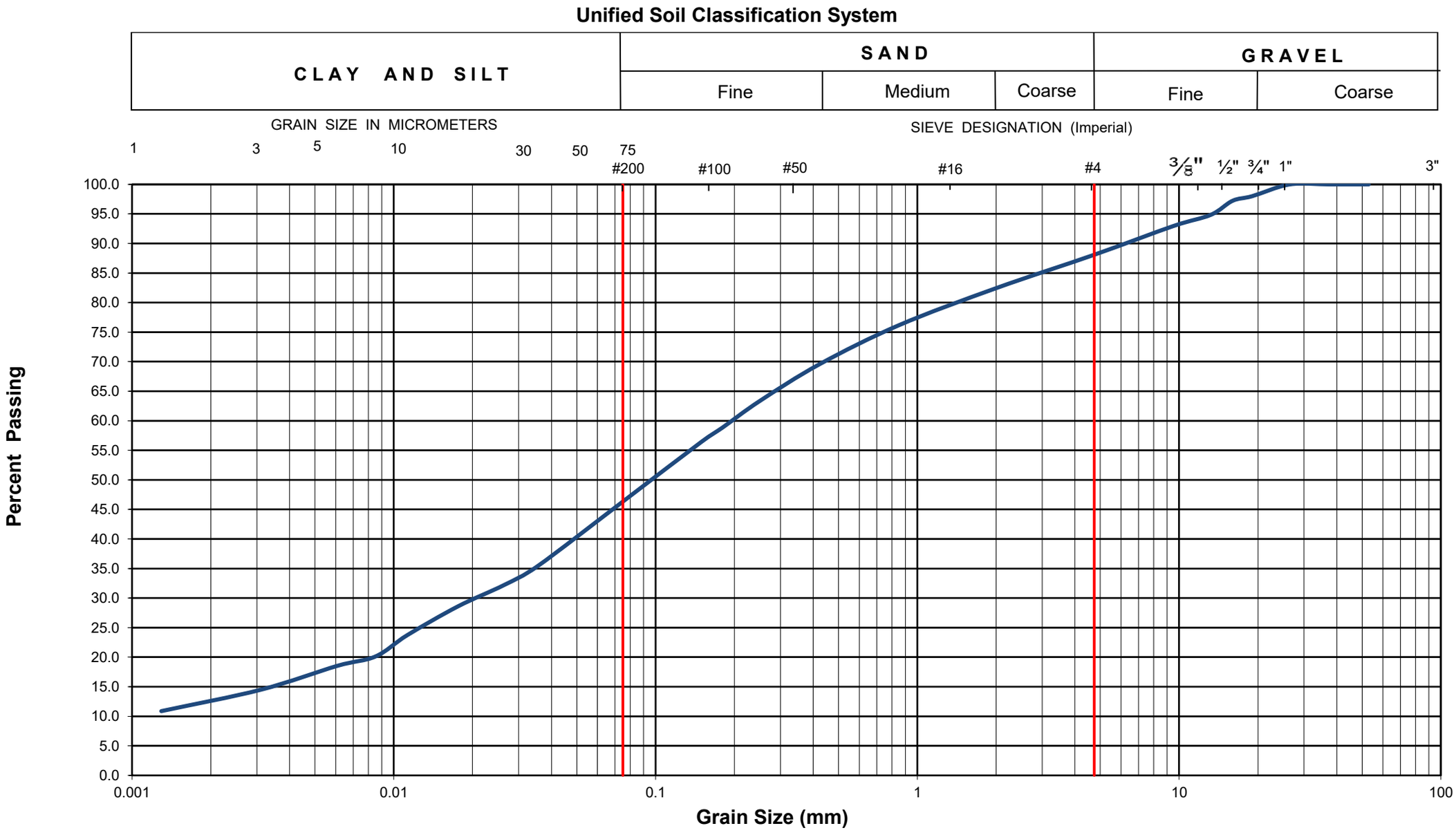
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-23002437-B0**	**Project Name :**	**Proposed Residential Development**						
Client :	**Edgeworth Development Lands Corp.**	**Project Location :**	**500 and 508 Edgeworth Avenue, Ottawa, Ontario**						
Date Sampled :	**June 20, 2025**	**Borehole No:**	**BH25-1**		**Sample No.:**	**SS6**		**Depth (m) :**	**3.8 - 4.2**
Sample Description :		**% Silt and Clay**	**21**	**% Sand**	**48**	**% Gravel**	**31**	**Figure :**	**10**
Sample Description :	**GLACIAL TILL: Silty Sand (SM), Gravelly, Trace Clay**								

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

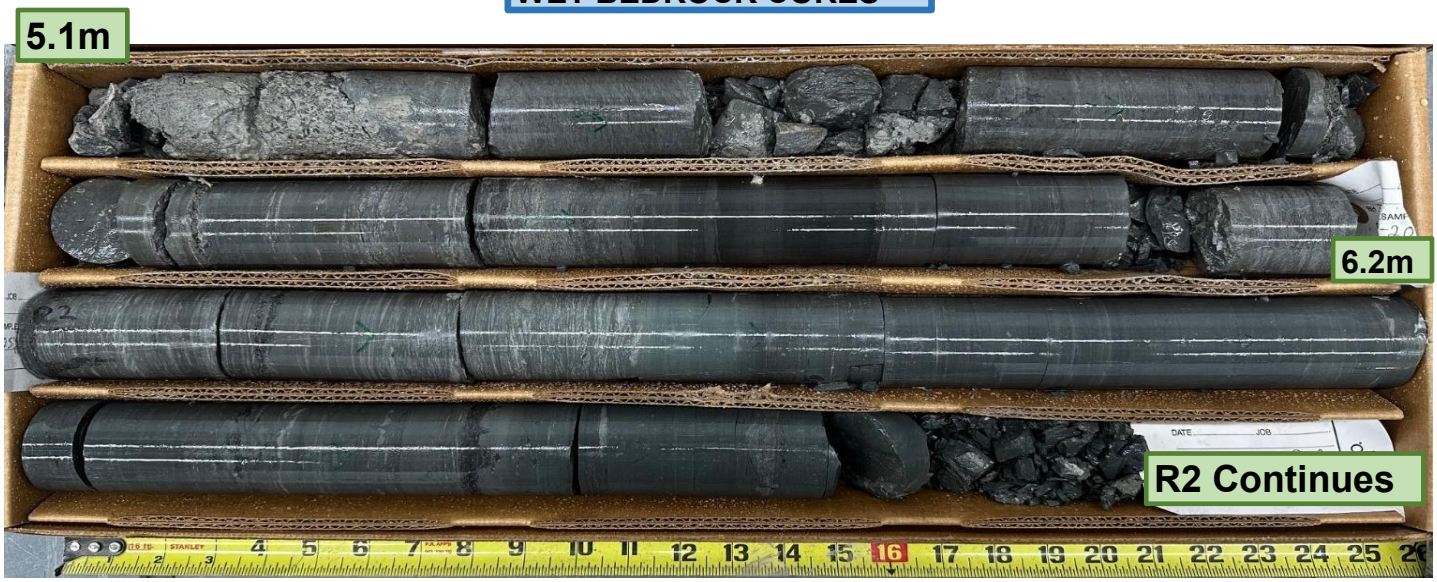
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-23002437-B0**	**Project Name :**	**Proposed Residential Development**						
Client :	**Edgeworth Development Lands Corp.**	**Project Location :**	**500 and 508 Edgeworth Avenue, Ottawa, Ontario**						
Date Sampled :	**June 19, 2025**	**Borehole No:**	**BH25-6**		**Sample No.:**	**SS3**		**Depth (m) :**	**1.5 - 2.1**
Sample Description :		**% Silt and Clay**	**46**	**% Sand**	**42**	**% Gravel**	**12**	**Figure :**	**11**
Sample Description :	**GLACIAL TILL: Silty Sand (SM), Some Gravel, Some Clay**								

DRY BEDROCK CORES

WET BEDROCK CORES



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borehole no.	core runs	PROJECT		project no.
BH25-4	Run 1: 5.1m - 6.2m Run 2: 6.2m - 7.7m		Proposed Residential Development 500 and 508 Edgeworth Avenue, Ottawa, Ontario	OTT-23002437-B0
date cored Jun 19, 2025			ROCK CORE PHOTOGRAPHS	FIG 12

DRY BEDROCK CORES

WET BEDROCK CORES

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borehole no.	core runs	PROJECT		project no.
BH25-4	Run 2: 6.2m - 7.7m Run 3: 7.7m - 9.2m End of Borehole		Proposed Residential Development 500 and 508 Edgeworth Avenue, Ottawa, Ontario	OTT-23002437-B0
date cored Jun 19, 2025			ROCK CORE PHOTOGRAPHS	FIG 13

Appendix A – Laboratory Certificate of Analysis Report by AGAT

AGAT Laboratories

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

CLIENT NAME: EXP SERVICES INC
2650 QUEENSVIEW DRIVE, UNIT 100
OTTAWA, ON K2B8H6
(613) 688-1899
ATTENTION TO: Matthew Zammit
PROJECT: OTT-23002437-B0
AGAT WORK ORDER: 25Z317035
SOIL ANALYSIS REVIEWED BY: Sukhwinder Randhawa, Inorganic Team Lead
DATE REPORTED: Jul 09, 2025
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 is available on request from AGAT Laboratories, in accordance with ISO/IEC 17025:2017, ISO/IEC 17025:2005 (Quebec), DR-12-PALA and/or NELAP Standards.*
- *This document is signed by an authorized signatory who meets the requirements of the MELCCFP, CALA, CCN and NELAP.*
- *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
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 25Z317035

PROJECT: OTT-23002437-B0

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Matthew Zammit

SAMPLING SITE:508 Edgeworth

SAMPLED BY:EXP

(Soil) Inorganic Chemistry

DATE RECEIVED: 2025-07-02 **DATE REPORTED: 2025-07-09**

			SAMPLE DESCRIPTION:	BH25-1 SS5 10'-12'
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2025-06-20
Parameter	Unit	G / S	RDL	6862756
Chloride (2:1)	µg/g		2	19
Sulphate (2:1)	µg/g		2	167
pH (2:1)	pH Units		NA	8.67
Resistivity (2:1) (Calculated)	ohm.cm		1	3300

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

6862756 EC, 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.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.

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

PROJECT: OTT-23002437-B0

SAMPLING SITE:508 Edgeworth

AGAT WORK ORDER: 25Z317035

ATTENTION TO: Matthew Zammit

SAMPLED BY:EXP

Soil Analysis

RPT Date: Jul 09, 2025			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)	6861810		404	409	1.2%	< 2	98%	70%	130%	98%	80%	120%	95%	70%	130%
Sulphate (2:1)	6861810		37	38	2.7%	< 2	93%	70%	130%	98%	80%	120%	97%	70%	130%
pH (2:1)	6864745		8.46	8.18	3.4%	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.

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

Certified By:

AGAT Laboratories

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

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 25Z317035

PROJECT: OTT-23002437-B0

ATTENTION TO: Matthew Zammit

SAMPLING SITE:508 Edgeworth

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

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 Services Inc
Contact: Matthew Zammit
Address: 2650 Queensview Drive, Suite 100
Ottawa, Ontario, K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: matthew.zammit@exp.com
2. Email: ryan.digiuseppe@exp.com

Project Information:

Project: OTT-23002437-B0
Site Location: 508 Edgeworth
Sampled By: EXP
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 #: 25Z317035

Cooler Quantity: N/A
Arrival Temperatures: 29.9 | 30.0 | 29.6
~~Depot~~ Temperatures: MISS: 8.0 | | |
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: B 17

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	Sulphates	Chlorides	Resistivity			Potentially Hazardous or High Concentration (Y/N)
1. BH25-1 SS5 10'-12'	June 20	AM/PM	1															☑	☑	☑	☑			
2.		AM/PM																						
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. Griffith	07/02/25	14h55
CC. to Pick	07/03/25	15h00			

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N°:

Pink Copy - Client 1 Yellow Copy - AGAT 1 White Copy- AGAT

Date Issued: Jan 18, 2024

Legal Notification

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