Geotechnical Investigation

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Executive Summary

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed mixed use building to be located at 2663 Innes Road, Ottawa, Ontario. Written authorization to proceed with this geotechnical investigation was provided by Caber Group of Companies on November 1, 2022.

It is our understanding that the proposed development will consist of a four- to five-story building with a basement. The ground floor of the proposed building will be at Elevation 74.60 m. The basement will be located 4.5 m below the finished floor elevation at approximate Elevation 70.1 m. The development will also include a surface parking lot with access roads and landscaped green space areas.

The borehole fieldwork for this investigation was undertaken on December 2,2022 and consists of two (2) boreholes (Borehole Nos. 1 and 2) advanced to termination depths of 6.4 m and 31.7 m below existing grade.

The borehole information indicates the subsurface conditions at the site consist of a surficial fill to a 3.0 m depth (Elevation 73.2 m and Elevation 73.4 m) underlain by a marine clay soil. The groundwater level is at a 2.6 m depth below existing grade (Elevation 71.8 m).

The site may be classified as **Class D** for seismic site response in accordance with the 2012 Ontario Building Code (as amended May 2, 2019). The subsurface soils are not considered to be liquefiable during a seismic event.

Based on a review of the borehole information, a maximum grade raise at the site of 0.5 m is considered to be acceptable from a geotechnical perspective and will accommodate the anticipated site grade raise of up to 0.2 m.

The basement floor slab will be located 4.5 m below the finished floor elevation (Elevation 74.60 m) at approximate Elevation 70.1 m. Based on a review of the borehole information, the floor slab and foundations of the proposed building will be founded on the grey firm to stiff clay. The proposed building may be supported by strip and spread footings or by a raft foundation designed to bear on the firm to stiff clay at an assumed founding depth of 0.6 m below the basement floor slab at a 5.1 m depth (Elevation 69.5 m).

Strip footings having a maximum width of 1.5 m and square pad footings having a maximum width and length of 3.0 m and founded 4.9 m below existing grade (Elevation 69.5 m) may be designed for a bearing pressure at serviceability limit state (SLS) of 60 kPa and factored geotechnical resistance at ultimate limit state (ULS) of 90 kPa. The factored geotechnical resistance value at ULS includes a resistance factor of 0.5. The total and differential settlements of well designed and constructed footings placed in accordance with the above recommendations are expected to be less than 25 mm and 19 mm respectively. The SLS and factored ULS values are valid provided the site grade raise to a maximum of 0.5 m is respected.

The bearing pressure at SLS for the raft foundation at the underside of the raft at 4.9 m below existing grade (Elevation 69.5 m) is based on the compensating weight of the excavated soil and the pressure in excess of the existing overburden pressure that can be safely supported by the foundation. At the raft founding depth of 4.9 m below existing grade (Elevation 69.5 m), the excavation of the subsurface soils to a 4.9 m depth will result in an unloading of the clay by approximately 50 kPa for the condition where the groundwater level is lowered from the 2.6 m (Elevation 71.8 m) measurement to the 4.9 m depth by the installation of perimeter and underfloor drainage systems for the proposed building. Therefore, the raft foundation may be designed for an SLS gross pressure of 50 kPa for the condition where the groundwater level lowered to a 4.9 m depth (Elevation 69. 5m). This would result in no net stress increase on the underlying clay and the total settlement will be negligible. If the weight of the building and raft will exceed the SLS gross pressures above, it is considered that the net stress increase on the clay at the founding depth of 4.9 m (Elevation 69.5 m) can be taken as 40 kPa. This value is for the case where the groundwater level is lowered to the 4.9 m depth (Elevation 69.5 m). Therefore, the total gross SLS bearing pressure under the raft may be taken as 90 kPa. The total gross SLS assumes the groundwater level is lowered to the underside of the raft foundation to a 4.9 m depth (Elevation 69.5 m). Total settlement will be in the order of 25 mm to 50 mm. The vertical modulus of subgrade reaction for the raft foundation founded on the grey firm to stiff clay at a of 4.9 m depth (Elevation 69.5 m) is estimated to be 8 MPa/m.

The founding clay material must be protected with a 50 mm thick concrete mud slab immediately following approval.

The floor slab of the proposed building may be designed as a slab-on-grade in accordance with recommendations made in the attached geotechnical report.

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 seepage and below the groundwater level, the excavation side slopes are expected to slough and eventually stabilize at 2H:1V to 3H:1V from the bottom of the excavation. Seepage of the surface and subsurface water into open cut and shored excavations is anticipated and it should be possible to collect water entering the excavations at low points and to remove it by conventional pumping techniques. In areas of high infiltration and below the groundwater level, a higher seepage rate should be anticipated and may require high-capacity pumps to keep the excavation dry.

It is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the proposed building, for service trench backfill and for parking lot and access road(s) construction would have to be imported and should preferably conform to the Ontario Provincial Standard Specifications (OPSS) for Granular A, Granular B Type II material and Select Subgrade Material (SSM).

For consideration and for project contract bidding purposes, it is recommended that test pits be undertaken in the proposed parking lot and access road areas to obtain additional information regarding the subsurface conditions in these areas; such as the depth of the topsoil, fill and native soils.

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

1. Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed mixed use building to be located at 2663 Innes Road, Ottawa, Ontario (Figure 1 Written authorization to proceed with this geotechnical investigation was provided by Caber Group of Companies on November 1, 2022.

It is our understanding that the proposed development will consist of a four- to five-story building with a basement. The ground floor of the proposed building will be at Elevation 74.60 m. The basement will be located 4.5 m below the finished floor elevation at approximate Elevation 70.1 m. The development will also include a surface parking lot with access roads and landscaped green space areas.

The geotechnical investigation was undertaken to:

a) Establish the subsurface soil and groundwater conditions at eight (8) boreholes located at the subject site,

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

c) Comment on grade-raise restrictions,

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

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

f) Provide lateral earth pressure coefficients (static and seismic conditions) for the proposed retaining wall,

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

h) Make recommendation regarding pipe bedding requirements,

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

j) Recommend pavement structure thicknesses for access roads and parking lot,

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

l) Tree planting restrictions.

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. Procedure

The borehole fieldwork for this investigation was undertaken on December 2,2022 and consists of two (2) boreholes (Borehole Nos. 1 and 2)to termination depths of 6.4 m and 31.7 m below existing grade. The fieldwork was supervised on a full-time basis by a representative from EXP.

The borehole locations were established on site by EXP and are shown on the Borehole Location Plan, Figure 2. The ground surface elevations of the boreholes were estimated from a topographic plan and therefore, should be considered approximate.

The borehole locations were cleared of any private and public underground services, prior to the start of drilling operations. The boreholes were drilled using a CME-45 track-mounted drill-rig equipped with continuous flight hollow stem augers and soil sampling capabilities. Standard penetration tests (SPTs) were performed in all the boreholes at depth intervals ranging from 0.75 m to 2.0 m depth interval with soil samples retrieved by the split-barrel sampler. The undrained shear strength of the cohesive soil was measured by conducting penetrometer and in-situ vane tests. In Borehole No. 2, a dynamic cone penetration test (DCPT) was conducted from a 15.8 m depth to a 31.7 m borehole termination depth.

A 19 mm diameter standpipe was installed in Borehole No. 2 for long-term monitoring of groundwater levels. The standpipe was installed in accordance with EXP standard practice, and the installation configuration is documented on the respective borehole log. The boreholes were backfilled upon completion of drilling and the installation of the standpipe.

Upon completion of the borehole fieldwork, the soil samples were transported to the EXP Ottawa laboratory where they were visually examined in the laboratory by a geotechnical engineer. The soil samples were classified in accordance with the Unified Soil Classification System (USCS) and the modified Burmeister System (as per the 2006 Fourth Edition Canadian Foundation Engineering Manual (CFEM)). The laboratory testing program on the soil samples consisted of moisture content determination on all recovered soil samples with unit weight determination Atterberg limits and corrosion analysis (pH, sulphate, chloride and resistivity) conducted on selected soil samples.

3. 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 and 4. 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.

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

3.1 Fill

A surficial fill was contacted on both boreholes and extends to 1.0 and 1.2 m depths (Elevation 73.2 m and Elevation 73.4 m). The fill consists of silty sand to sand with gravel. The fill contains topsoil inclusions. The fill in Borehole No. 2 contains a 125 mm thick topsoil layer at a 0.7 m depth (Elevation 73.7 m). Based on the standard penetration test (SPT) N-values of 11 and 14, the fill is in a compact state. The moisture content of the fill ranges from 3 percent to 22 percent.

3.2 Clay

In both boreholes, the fill is underlain by a marine clay contacted at 1.0 m and 1.2 m depths (Elevation 73.2 m and Elevation 73.4 m). The clay consists of an upper weathered desiccated brown clay crust that exhibits good strength underlain by a weaker non-desiccated grey clay.

3.2.1 Upper Brown Desiccated Clay Crust

The upper brown desiccated clay crust extends to an approximate depth of 3.0 m (Elevation 71.4 m). The undrained shear strength of the clay ranges from 156 kPa to 216 kPa indicating the clay has a very stiff to hard consistency. The natural moisture content of the brown clay ranges from 32 percent to 50 percent. The natural unit weight of the clay is 18.0 kN/m^3 to 19.5 kN/m^3.

The results from the Atterberg limit determination conducted on one (1) selected sample of the upper brown clay is summarized in Table I.

Table I: Summary of Results from Atterberg Limit Determination
Brown Clay Sample

Borehole No. (BH) – Sample No. (SS)	Depth (m)	Atterberg Limits (%)			
		Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification (USCS)
BH 2– SS3	1.5-2.1	63	29	34	Clay of High Plasticity (CH)

Based on a review of the results of the Atterberg limits, the upper brown clay may be classified as a clay of high plasticity (CH) in accordance with the Unified Soil Classification System (USCS).

3.2.2 Grey Clay

The grey clay was contacted beneath the brown clay at a 3.0 m depth (Elevation 71.4 m). The undrained shear strength of the grey clay ranges from 38 kPa to 96 kPa indicating a firm to very stiff consistency. The natural moisture of the grey clay is 44 percent to 80 percent.

The results from the Atterberg limit determination conducted on two (2) selected samples of the grey clay are summarized in Table II.

Table II: Summary of Results from Grain-Size Analysis and Atterberg Limit Determination Grey Clay Samples

Borehole No. (BH) – Sample No. (SS)	Depth (m)	Atterberg Limits (%)			
		Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification (USCS)
BH 2 -SS5	3.8-4.3	55	27	28	Clay of High Plasticity (CH)
BH 2 – SS7	7.6 – 8.2	58	28	30	Clay of High Plasticity (CH)

Based on a review of the results of the Atterberg limits, the grey clay may be classified as a clay of high plasticity (CH) in accordance with USCS.

3.3 Groundwater Level Measurements

The groundwater level in Borehole No. 2, measured twelve (12) days following the completion of drilling, is 2.6 m (Elevation 71.8 m).

Groundwater levels were determined in the boreholes at the times and under the conditions stated in the scope of services. 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.

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

4.1 Site Classification for Seismic Site Response

The subsurface conditions identified in the boreholes were examined in relation to Table 4.1.8.4.A of the 2012 Ontario Building Code (OBC) as amended May 2, 2019. Based on the borehole information, the site classification for seismic site response is considered to be **Site Class D**.

4.2 Liquefaction Potential of Soils

The subsurface soils are not considered to be liquefiable during a seismic event.

5. Grade Raise Restrictions

The design elevation for the ground floor slab of the proposed building will be Elevation 74.60 m. The ground surface elevations at the boreholes located are approximately Elevation 74.42 m and Elevation 74.44 m. Therefore, the site grade raise in the vicinity of the proposed building will be approximately 0.2 m.

Based on a review of the borehole information, a maximum grade raise at the site of 0.5 m is considered to be acceptable from a geotechnical perspective and will accommodate the anticipated site grade raise of up to 0.2 m.

If the design grade raise exceeds the maximum permissible grade raise of 0.5 m, EXP should be contacted to review the acceptability of the proposed new grade raise and to provide updated bearing pressure at serviceability limit state (SLS) and factored geotechnical resistance at ultimate limit state (ULS) for the building foundations.

6. Foundation Considerations

The basement floor slab will be located 4.5 m below the finished floor elevation (Elevation 74.60 m) at approximate Elevation 70.1 m. Based on a review of the borehole information, the floor slab and foundations of the proposed building will be founded on the grey firm to stiff clay. The proposed building may be supported by strip and spread footings or by a raft foundation designed to bear on the firm to stiff clay at an assumed founding depth of 0.6 m below the basement floor slab at a 5.1 m depth below the finished floor slab at Elevation 69.5 m. Each foundation alternative is discussed in the following sections of this report.

6.1 Footings

For the footings, it is assumed the groundwater level is lowered from the 2.6 m (Elevation 71.8 m) measurement to the 4.9 m depth (Elevation 69.5 m) by the installation of perimeter and underfloor drainage systems for the proposed building (refer to section 7 of this report). Strip footings having a maximum width of 1.5 m and square pad footings having a maximum width and length of 3.0 m and founded 4.9 m below existing grade at Elevation 69.5 m may be designed for a bearing pressure at serviceability limit state (SLS) of 60 kPa and factored geotechnical resistance at ultimate limit state (ULS) of 90 kPa. The factored geotechnical resistance value at ULS includes a resistance factor of 0.5. The total and differential settlements of well designed and constructed footings placed in accordance with the above recommendations are expected to be less than 25 mm and 19 mm respectively. The SLS and factored ULS values are valid provided the site grade raise to a maximum of 0.5 m is respected.

6.2 Raft Foundation

The bearing pressure at SLS for the raft foundation at the underside of the raft at 4.9 m below existing grade (Elevation 69.5 m) is based on the compensating weight of the excavated soil and the pressure in excess of the existing overburden pressure that can be safely supported by the founding clay soil. At the raft founding depth of 4.9 m below existing grade (Elevation 69.5 m), the excavation of the subsurface soils to a 4.9 m depth will result in an unloading of the clay by approximately 50 kPa for the condition where the groundwater level is lowered from the 2.6 m (Elevation 71.8 m) measurement to the 4.9 m depth (Elevation 69.5 m) by the installation of perimeter and underfloor drainage systems for the proposed building (refer to section 7 of this report). Therefore, the raft foundation may be designed for an SLS gross pressure of 50 kPa for the condition where the groundwater level is lowered to a 4.9 m depth (Elevation 69. 5m). This would result in no net stress increase on the underlying clay and the total settlement will be negligible.

If the weight of the building and raft will exceed the SLS gross pressure of 50 kPa, it is considered that the net stress increase on the clay at the founding depth of 4.9 m (Elevation 69.5 m) may be taken as 40 kPa. This value is for the case where the groundwater level is lowered to the 4.9 m depth (Elevation 69.5 m). Therefore, the total gross SLS bearing pressure under the raft may be taken as 90 kPa. The total gross SLS assumes the groundwater level is lowered to the underside of the raft foundation to a 4.9 m depth (Elevation 69.5 m). The total settlement will be in the order of 25 mm to 50 mm.

The SLS and factored ULS values are valid provided the site grade raise to a maximum of 0.5 m is respected.

The vertical modulus of subgrade reaction for the raft foundation founded on the grey firm to stiff clay at a 4.9 m depth below existing grade (Elevation 69.5 m) is estimated to be 8 MPa/m.

6.3 Additional Comments for Foundations

If the founding depth for the proposed footings or raft foundation for the proposed building will be at a higher or deeper depth than indicated above, EXP should be contacted to provide updated SLS and factored ULS values for the footings or raft foundation.

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

For footings or raft founded directly on the native undisturbed grey clay and to prevent disturbance to the subgrade, the footing beds or raft subgrade must be protected by covering the subgrade with a 50 mm thick concrete mud slab following examination and approval of the founding soil subgrade.

A minimum of 1.5 m of earth cover should be provided to the footings to protect them from damage due to frost penetration. The frost cover should be increased to 2.1 m for unheated structures if snow will not be removed from their vicinity.

If snow will be removed from the vicinity of the unheated structures, the frost cover should be increased to 2.4 m. Rigid insulation thermally equivalent to the required soil cover may be used instead of the soil cover. Alternatively, a combination of rigid insulation and soil cover may be used to achieve the required frost protection for the footings.

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

7. Floor Slab and Drainage Requirements

Based on the design elevation of the basement floor slab 4.5 m below the finished floor elevation (Elevation 74.60 m) at an approximate Elevation 70.1 m, the floor slab will be founded on the firm to stiff clay. The floor slab for the proposed building may be designed and constructed as a slab-on-grade placed on a 200 mm thick 19 mm sized clear stone bed placed on a minimum 300 mm thick engineered fill pad set on the approved native clay subgrade. The engineered fill pad should consist of Ontario Provincial Standard Specification (OPSS) Granular B Type II material compacted to 98 percent standard Proctor maximum dry density (SPMDD). The clear stone would minimize the capillary rise of moisture from the sub-soil to the floor slab. Alternatively, the floor slab may be cast on a 200 mm thick bed of OPSS Granular A overlain by a vapour barrier. Adequate saw cuts should be provided in the floor slabs to control cracking.

Since the groundwater level is at a 2.6 m depth (Elevation 71.8 m) and the basement floor will be located below the groundwater level at Elevation 70.1 m, a perimeter drainage system and underfloor drainage system are recommended for the proposed building. The perimeter drainage system may consist of 100 mm diameter perforated pipe set on the footings or next to the raft foundation and surrounded with 150 mm thick 19 mm sized clear stone that is fully wrapped or covered with an approved porous geotextile membrane, such as Terrafix 270R or equivalent. 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 a 100 mm thick bed of 19 mm sized clear stone and covered on top and sides with 150 mm thick clear stone that is fully wrapped or covered with an approved porous geotextile membrane, such as Terrafix 270R or equivalent.

The perimeter and underfloor drains should be connected to separate sumps equipped with backup (redundant) 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 floor slab should be set at least 150 mm higher than the finished exterior grade.

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

8. Lateral Earth Pressure Against Subsurface Basement Walls

The subsurface basement walls of the building should be backfilled with free draining material, such as OPSS Granular B Type II compacted to 95 percent SPMDD and equipped with a perimeter drainage system to prevent the buildup of hydrostatic pressure behind the walls. The walls will be subjected to lateral static and dynamic (seismic) earth forces. The expressions below assume free draining backfill material, a perimeter drainage system, level backfill surface behind the wall and vertical face on the back side of the wall.

For design purposes, the lateral static earth thrust against the subsurface walls may be computed from the following equation:

$$P = K_0 h (\tfrac{1}{2} \gamma h + q)$$

where
- P = lateral earth thrust acting on the subsurface wall, kN/m
- K_0 = lateral earth pressure at rest coefficient, assumed to be 0.5 for Granular B Type II backfill material
- 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 = surcharge load stress, kPa

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

$$\Delta_{Pe} = \gamma H^2 \frac{a_h}{g} F_b$$

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
- $\frac{a_h}{g}$ = earth pressure coefficient = 0.32 for Ottawa area
- F_b = thrust factor = 1.0

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

All subsurface walls should be properly waterproofed.

9. Excavation and De-Watering Requirements

9.1 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.

9.2 Excavation

Excavations for the construction of the foundations for the proposed building and the installation of underground services are anticipated to extend to a maximum depth of 4.9 m below the existing grade and are anticipated to extend through the fill and into the native clay and are anticipated to be approximately 2.3m below the groundwater level.

Excavations maybe undertaken by conventional heavy equipment.

Open cut excavation within the subsurface soils should comply with the most recent Occupational Health and Safety Act (OHSA), Ontario Regulations 213/91 (August 1, 1991). Based on the definitions contained in OHSA, the subsurface soils at the site are classified as Type 3 soil and as such the excavation sidewalls must be cut back at 1H:1V from the bottom of the excavation. Below the groundwater table, the excavation side slopes are expected to slough and will eventually stabilize at a slope of 2H:1V to 3H:1V.

If side slopes noted above for the construction of the proposed building and retaining wall cannot be achieved due to space restrictions on site, such as the proximity of open cut excavations to the property limits or existing infrastructure, the excavation for the new building and retaining wall construction would have to be undertaken within the confines of an engineered support system (shoring system). If space restrictions prevent open cut excavations, the underground services may be installed within the confines of a prefabricated support system (trench box) which is designed and installed in accordance with the above-noted regulations.

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 latest edition of Ontario Regulation 213/91 under the OHSA and the 2006 Fourth Edition of the Canadian Foundation Engineering Manual (CFEM). The shoring system as well as adjacent settlement sensitive structures (buildings) and infrastructure should be monitored for movement (deflection) on a periodic basis during construction operations.

Excavations that extend to a maximum 5.0 m depth below existing grade and terminate within the grey clay are not expected to experience a base-heave type failure. If the excavation depth will be deeper than 5.0 m, EXP should be contacted to review and provide comment regarding the potential for base-heave type failure.

The native clay is susceptible to disturbance due to movement of construction equipment and personnel on its surface. It is therefore recommended that the excavation at the site should be undertaken by construction equipment that does not travel on the excavated surface, such as a gradall or mechanical shovel.

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

9.3 De-Watering Requirements

Seepage of the surface and subsurface water into the excavations is anticipated. However, it should be possible to collect any water entering the excavations in perimeter ditches and to remove it by pumping from sumps. In areas of high infiltration or in areas where more permeable soil layers may exist, a higher seepage rate should be anticipated and will require high-capacity pumps to keep the excavation dry.

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

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

10. Pipe Bedding Requirements

The depth at which municipal services will be installed is anticipated to be a maximum of 4.9 m depth below existing grade. Based on this, the subgrade for the underground service pipes is expected to be the grey clay.

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

It is recommended that the pipe bedding be 300 mm thick and consist of OPSS Granular A. The bedding material should be placed along the sides and on top of the pipe to provide a minimum cover of 300 mm. The bedding should be compacted to at least 98 percent of the SPMDD.

The bedding thickness may be further increased in areas where the subgrade becomes disturbed. Trench base stabilization techniques, such as the removal of loose/soft material, placement of additional sub-bedding, consisting of Ontario Provincial Standard Specification (OPSS) Granular B Type II completely wrapped in a non-woven geotextile, may be used if trench base disturbance becomes a problem in wet or soft/loose areas.

To minimize settlement of the pavement structure over services trenches, the trench backfill material within the frost zone, to 1.8 m depth below final grade, should match the existing material along the trench walls to minimize differential frost heaving of the subgrade soil, provided this material is compactible. Otherwise, frost tapers may be required.

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

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

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

The on-site soils to be excavated are fill, brown and grey clay. From a geotechnical perspective, portions of the existing fill and the native brown clay from above the groundwater level may be re-used as fill material to raise the grades at the site to the design subgrade level in areas in the proposed parking lot, access roads and landscaped areas, subject to additional 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 native grey clay below the groundwater table is expected to be too wet for re-use and for adequate compaction and should be discarded. The grey clay may, however, be used for general grading purposes in the landscape areas if left in the sun to dry or mixed with drier material. The existing topsoil (surficial and buried) is not considered suitable for use as backfill material.

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

- Engineered fill and service trench backfill under the floor slab of the proposed building - OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 98 percent SPMDD,
- Backfill material for footing trenches and against foundation walls located outside the proposed building and for the retaining wall – OPSS 1010 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 parking lot 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, cobbles and boulders placed in 300 mm thick lifts and each lift compacted to 92 percent SPMDD.

12. Access Roads and Parking Lot

The subgrade for the pavement structures is anticipated to consist of the existing fill, clay, OPSS Granular B Type II material, OPSS Select Subgrade material (SSM) or approved on-site material. Pavement structure thicknesses required for the access roads and parking lots set on the anticipated approved subgrade materials were computed and are shown in Table III. The pavement structures assume a functional design life of 15 to 20 years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table III: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Computed Pavement Structure	
		Light Duty Traffic (Parking Lots - Cars Only)	Heavy Duty (Parking Lots and Access Roads – Garbage/Fire Trucks)
Asphaltic Concrete (PG 58-34)	92 percent to 97 percent MRD	65 mm HL3/SP12.5 mm/ Category B	40 mm HL3/SP12.5 Category B 50 mm HL8/SP 19 Category B
OPSS 1010 Granular A Base (crushed limestone)	100 percent SPMDD	150 mm	150 mm
OPSS 1010 Granular B Type II Sub-base	100 percent SPMDD	450 mm	600 mm

Notes:

1. SPMDD denotes standard Proctor maximum dry density, ASTM, D-698-12e2.
2. MRD denotes Maximum Relative Density, ASTM D2041.

The upper 300 mm of the subgrade fill must be compacted to 98 percent SPMDD.

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

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

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

4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, temporary construction roadways, etc., may be required, especially if construction is carried out during unfavorable weather.
5. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum cross fall of 2 percent) to provide effective surface drainage towards catch basins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.
6. Relatively weaker subgrade may develop over service trenches at subgrade level. These areas may require the use of thicker/coarser sub-base material and the use of a geotextile at the subgrade level. If this is the case, it is recommended that additional 150 mm of granular sub-base, OPSS Granular B Type II, should be provided in these areas, in addition to the use of a geotextile at the subgrade level.
7. The granular materials used for pavement construction should conform to Ontario Provincial Standard Specifications (OPSS 1010) for Granular A and Granular B Type II and should be compacted to 100 percent of the SPMDD.

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

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

Consideration should be given to excavate additional test pits in the proposed pavement areas to obtain additional data on the depths of topsoil, fill and native soils, which can be used by contractors bidding on this project.

13. Corrosion Potential

Soil samples were submitted for chemical tests limited to pH, sulphate, chloride and resistivity. The test results will be reported in a separate letter when they become available.

14. Tree Planting Restriction

The site is underlain by marine clay. The test results of the native upper brown and lower grey clay of the marine clay deposit was compared with the document titled, *Tree Planting in Sensitive Marine Clay Soils – 2017 City of Ottawa Guidelines (2017 Guidelines)* and indicate the upper brown clay and the lower grey clay have a low/medium potential for soil volume change. For soils that have a low/medium potential for soil volume change, the 2017 Guidelines indicate that the tree to foundation setback distance and tree planting restrictions should be in accordance with the 2017 guidelines.

A landscape architect should be consulted to ensure the setbacks and tree planting restrictions are in accordance with the 2017 Guidelines.

15. Additional Geotechnical Investigation

For consideration and for project contract bidding purposes, it is recommended that test pits be undertaken in the proposed parking lot and access road areas to obtain additional information regarding the subsurface conditions in these areas; such as the depth of the topsoil, fill and native soils.

16. General Comments

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

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

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

Sincerely,

EXP Services Inc.

Susan M. Potyondy, P.Eng.
Senior Project Manager
Earth & Environment

LICENSED PROFESSIONAL ENGINEER
December 20, 2022
S.M. POTYONDY
37232568
PROVINCE OF ONTARIO

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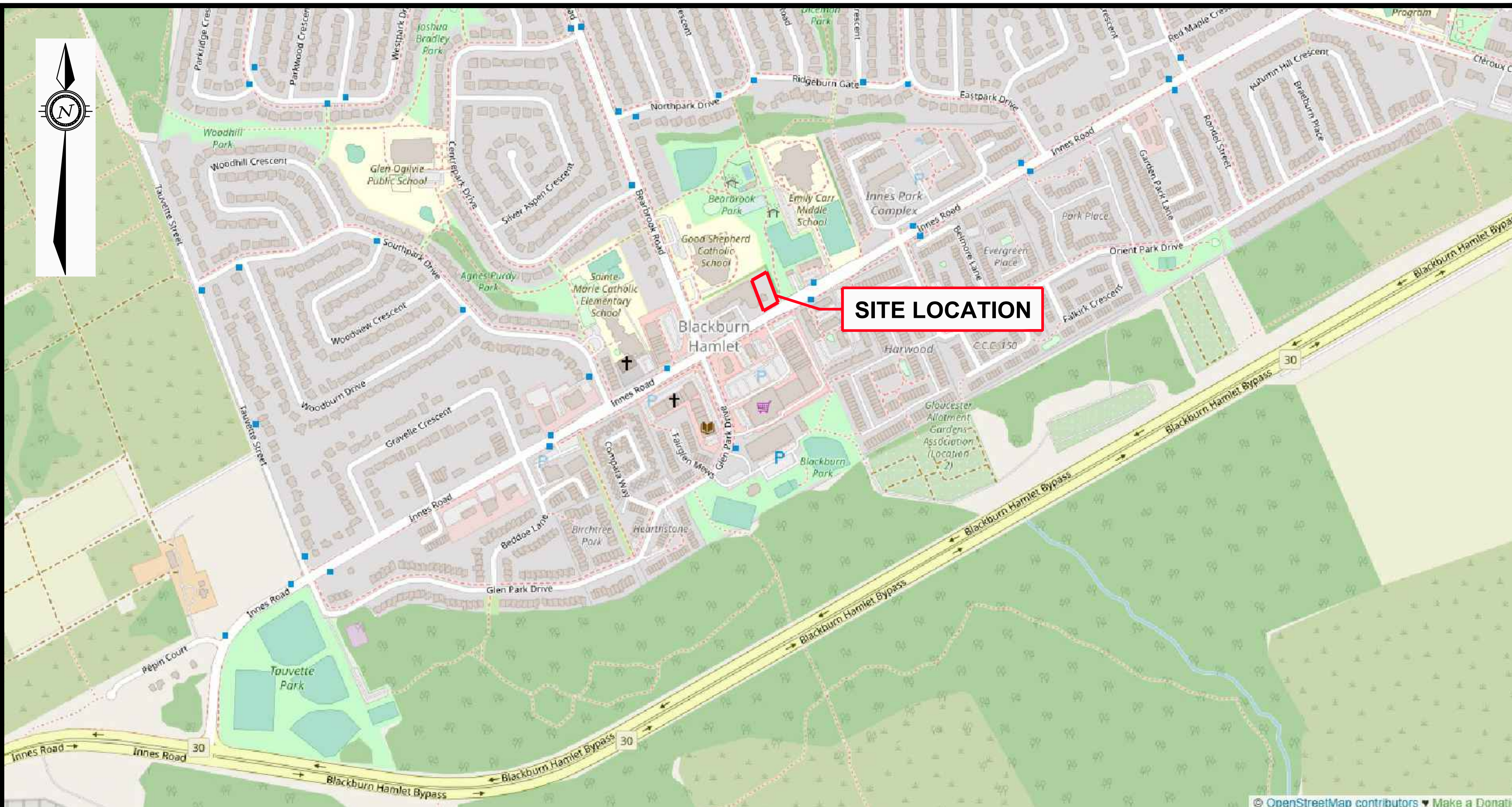
Senior Manager
Earth & Environment
Eastern Region

Figures



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

DATE: DECEMBER 2022		PROJECT: GEOTECHNICAL SITE INVESTIGATION 2663 INNES ROAD, OTTAWA, ONTARIO	project no.: OTT-22024457-A0
DESIGN: MZ	CHECKED: IT	TITLE: SITE LOCATION PLAN	scale: 1:10,000
DRAWN BY: AS			FIG 1

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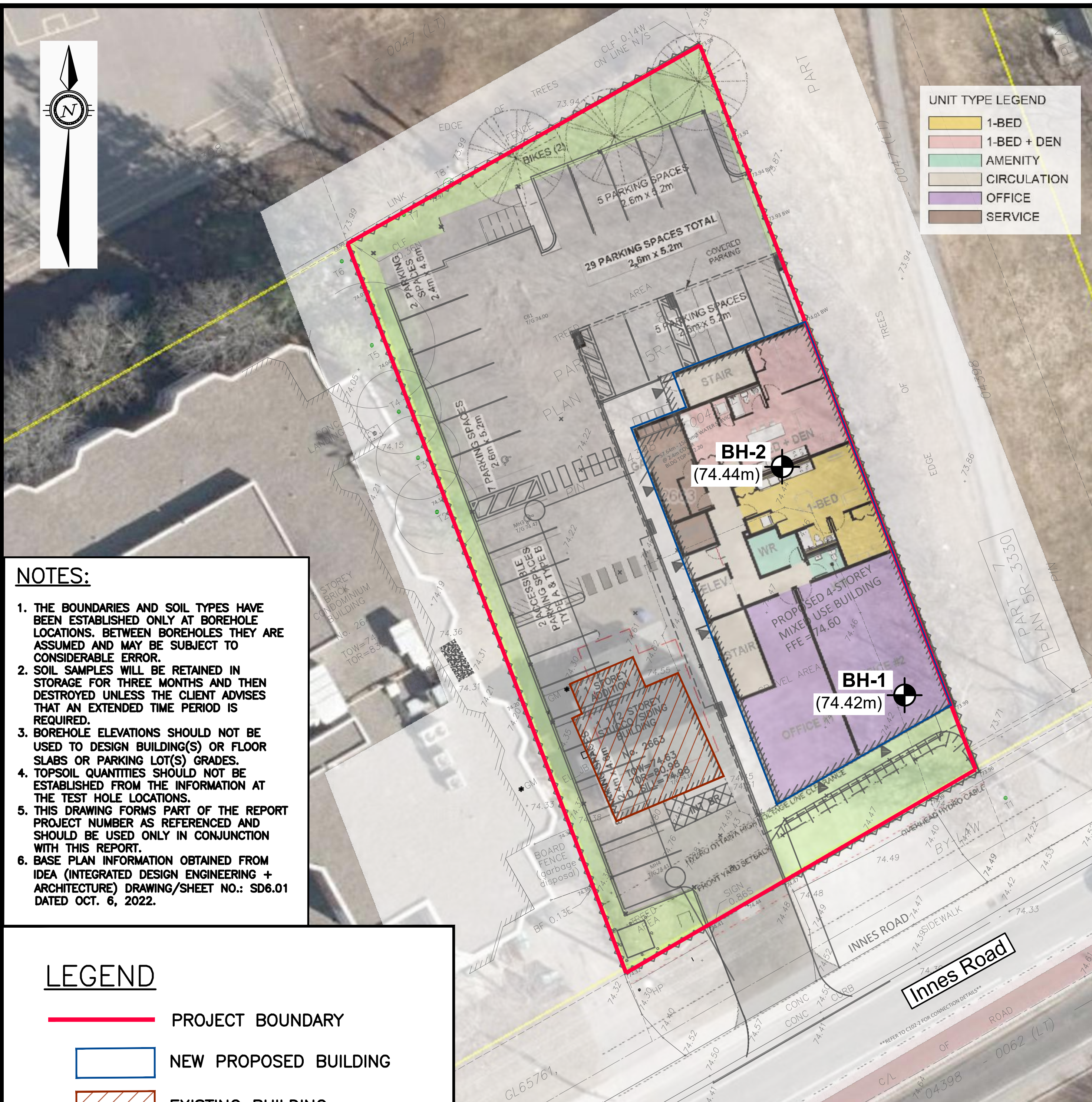

NOTES:

1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
4. TOPSOIL QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION AT THE TEST HOLE LOCATIONS.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
6. BASE PLAN INFORMATION OBTAINED FROM IDEA (INTEGRATED DESIGN ENGINEERING + ARCHITECTURE) DRAWING/SHEET NO.: SD6.01 DATED OCT. 6, 2022.

LEGEND

PROJECT BOUNDARY

NEW PROPOSED BUILDING

EXISTING BUILDING

BH-1 (74.42m) — BOREHOLE NO. & LOCATION, GROUND SURFACE ELEVATION

0 4m 8m 16m

HORIZONTAL 1:400

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Ottawa, ON K2B 8H6, Canada

DATE: DECEMBER 2022		PROJECT: GEOTECHNICAL SITE INVESTIGATION 2663 INNES ROAD, OTTAWA, ONTARIO	project no. OTT-22024457-A0
DESIGN: MZ	CHECKED: IT		scale 1:400
DRAWN BY: AS		TITLE: BOREHOLE LOCATION PLAN	FIG 2

Filename: E:\OTT\OTT-22024457-A0\60 Execution\65 Drawings\22024457-A0_Geo.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		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

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.

Logs of Borehole BH-01

Project No:	OTT-22024457-A0
Project:	Proposed Mixed Use Building
Location:	2663 Innes Road, Ottawa, Ontario
Date Drilled:	'December 2, 2022
Drill Type:	CME-45 Track-Mounted Drill RIg
Datum:	Approximate Elevation
Logged by:	M.Z.
Checked by:	D.W.

Figure No. 3

Page. 1 of 1

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

GWL	SYMBOL	SOIL DESCRIPTION	Approximate Elevation m	Depth (m)	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand with gravel and topsoil inclusions to silty clay fill, brown, moist, (loose to compact)	74.42	0	14			SS1
		CLAY Brown, moist, (very stiff)	73.4	1	9			SS2
					10; 156 kPa			SS3 19.5
				2				
					4			SS4 18.0
		CLAY Grey, wet (firm to stiff)	71.4	3	90 kPa s=6			
				4	4			SS5
				5				
					Hammer Weight			SS6
			68.0	6	48 kPa s=20			

Borehole Terminated at 6.4 m Depth

NOTES:

Notes

1. Borehole data requires interpretation before use by others
2. Borehole Backfilled up[on completion

4. See Notes on Sample Descriptions

5. Log to be read with EXP Report No. OTT-22024457-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Dry	6.0

CORE DRILLING RECORD

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

Logs of Borehole BH-02

Project No: OTT-22024457-A0

Project: Proposed Mixed Use Building

Location: 2663 Innes Road, Ottawa, Ontario

Figure No. 4

Date Drilled: 'December 2, 2022

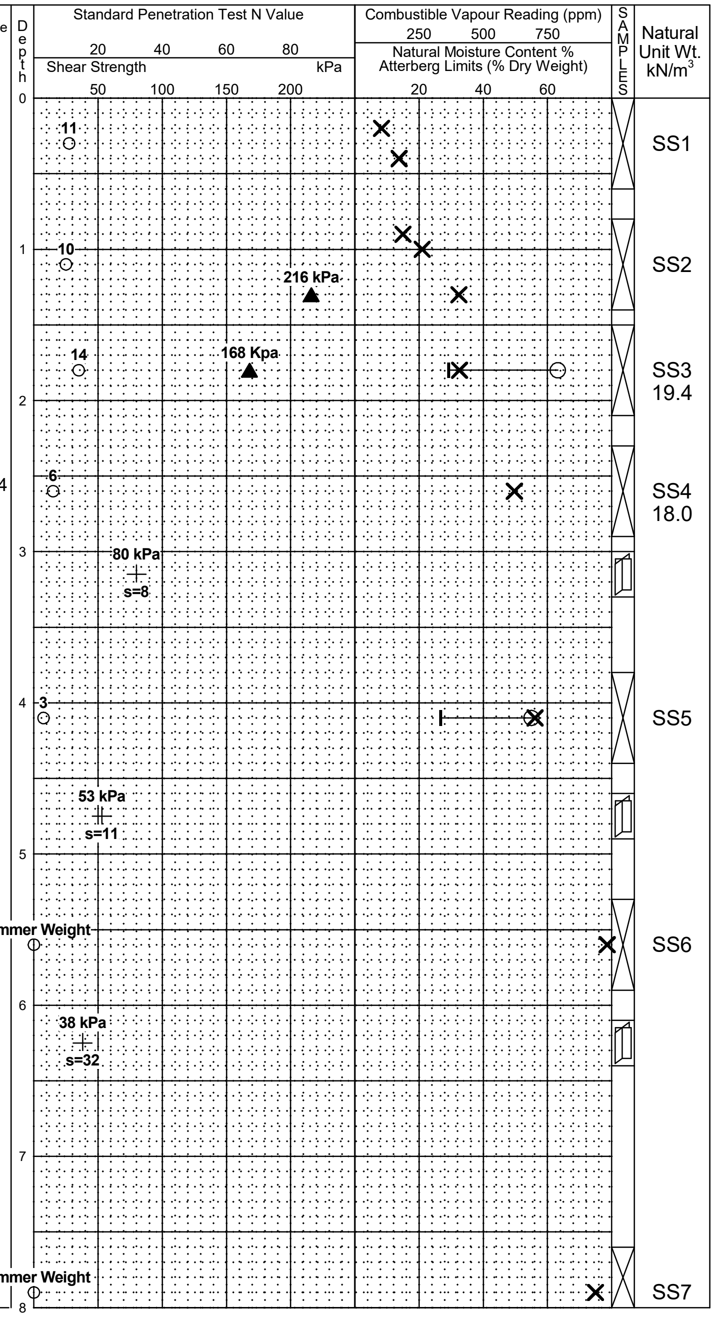
Drill Type: CME-45 Track-Mounted Drill RIg

Datum: Approximate Elevation

Logged by: M.Z. Checked by: D.W.

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

Approximate Elevation (m)	Depth (m)	Soil Description	Samples	Natural Unit Wt. kN/m³
74.44	0	**FILL** Silty sand to sand with gravel and topsoil inclusions, brown, moist, (compact)	SS1	
73.7		**TOPSOIL** ~125 mm thick		
73.5		**FILL** Silty sand, brown, moist, (compact)	SS2	
73.2		**CLAY** High plasticity, brown, moist, (very stiff)	SS3	19.4
71.84 (water level)			SS4	18.0
71.4	3	**CLAY** High plasticity, grey, wet (firm to stiff)	SS5, SS6, SS7	



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Notes
1. Borehole data requires interpretation before use by others
2. 19 mm slotted standpipe was installed in the borehole
3. Field work was supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report No. OTT-22024457-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Dry	13.1
'Dec 14, 2022	2.6	

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-22024457-A0 2663 INNES.GPJ TROW OTTAWA.GDT 12/19/22

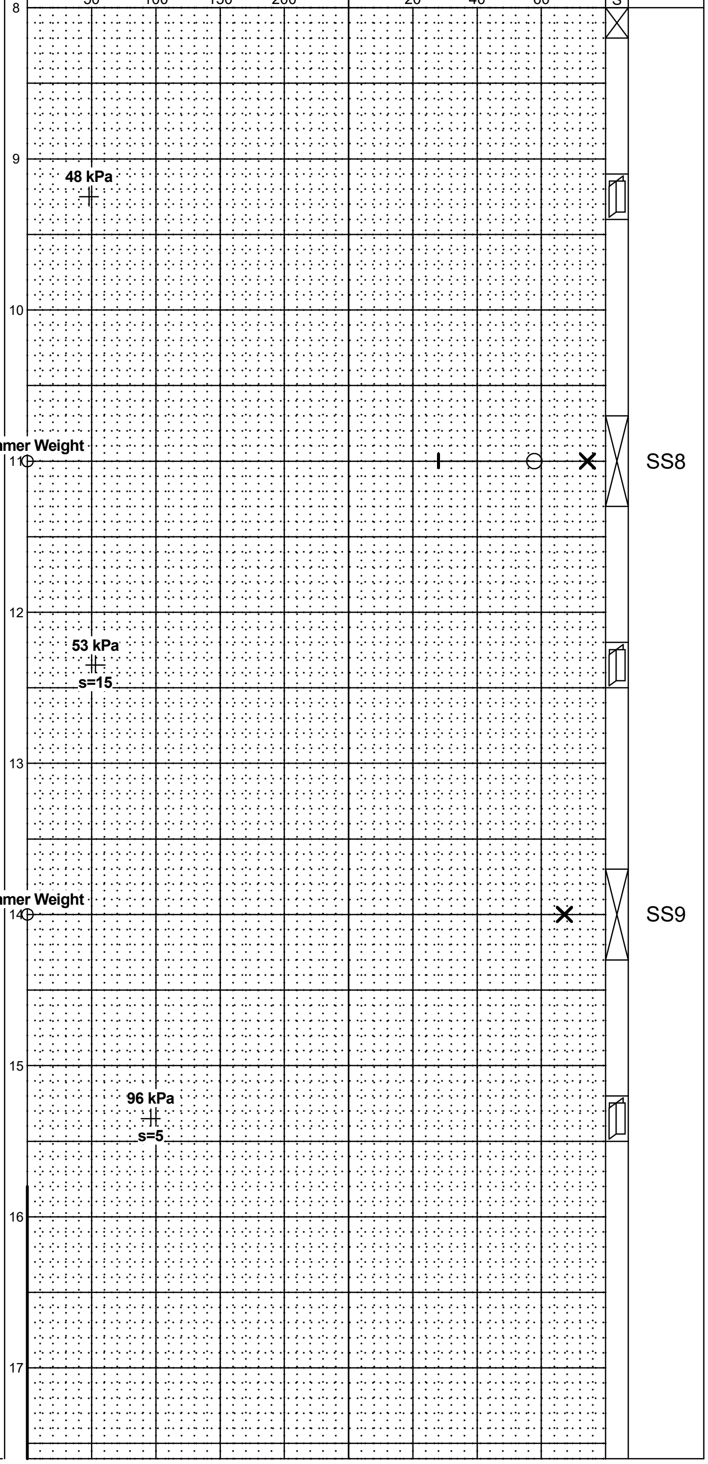
Logs of Borehole BH-02

Project No: OTT-22024457-A0

Project: Proposed Mixed Use Building

Figure No. 4

GWL	SYMBOL	SOIL DESCRIPTION	Approximate Elevation m	Depth	Standard Penetration Test N Value (20, 40, 60, 80) / Shear Strength kPa (50, 100, 150, 200)	Combustible Vapour Reading (ppm) (250, 500, 750) / Natural Moisture Content % / Atterberg Limits (% Dry Weight) (20, 40, 60)	SAMPLES	Natural Unit Wt. kN/m³
		CLAY High plasticity, grey, wet (firm to stiff) *(continued)*	66.44	8				
				9	48 kPa			
				10				
				11	Hammer Weight			SS8
				12	53 kPa, s=15			
				13				
				14	Hammer Weight			SS9
				15	96 kPa, s=5			
		Dynamic Cone Penetration Dynamic Cone penetration (DCPT) conducted from 15.8 m to termination depth at 31.7 m	58.6	16				
				17				



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Notes
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4. See Notes on Sample Descriptions
5. Log to be read with EXP Report No. OTT-22024457-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Dry	13.1
'Dec 14, 2022	2.6	

CORE DRILLING RECORD

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

Logs of Borehole BH-02

Project No: OTT-22024457-A0

Project: Proposed Mixed Use Building

Figure No. 4

GWL	SYMBOL	SOIL DESCRIPTION	Approximate Elevation m	Depth	Standard Penetration Test N Value (20, 40, 60, 80) / Shear Strength kPa (50, 100, 150, 200)	Combustible Vapour Reading (ppm) (250, 500, 750) / Natural Moisture Content % / Atterberg Limits (% Dry Weight) (20, 40, 60)	SAMPLES	Natural Unit Wt. kN/m³
		Dynamic Cone Penetration Dynamic Cone penetration (DCPT) conducted from 15.8 m to termination depth at 31.7 m *(continued)*	56.84	18–27				

Continued Next Page

Notes
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5. Log to be read with EXP Report No. OTT-22024457-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Dry	13.1
'Dec 14, 2022	2.6	

CORE DRILLING RECORD

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

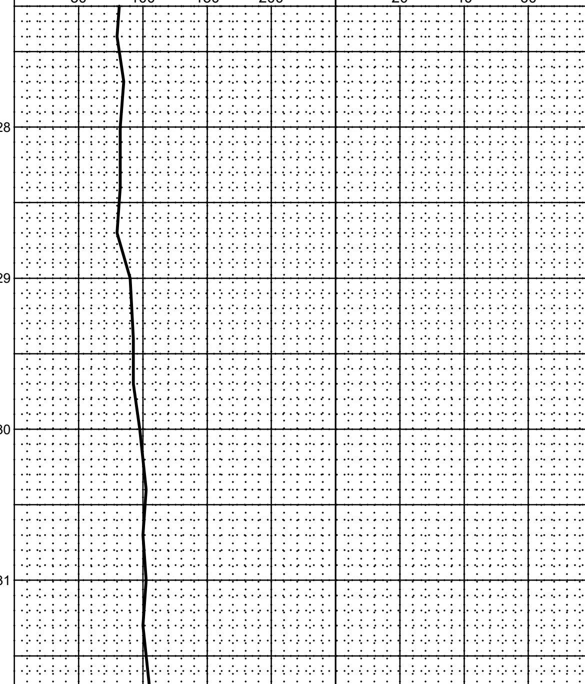
Logs of Borehole BH-02

Project No: OTT-22024457-A0

Project: Proposed Mixed Use Building

Figure No. 4

GWL	SYMBOL	SOIL DESCRIPTION	Approximate Elevation m	Depth	Standard Penetration Test N Value (20, 40, 60, 80) / Shear Strength kPa (50, 100, 150, 200)	Combustible Vapour Reading (ppm) (250, 500, 750) / Natural Moisture Content % / Atterberg Limits (% Dry Weight) (20, 40, 60)	SAMPLES	Natural Unit Wt. kN/m³
		Dynamic Cone Penetration Dynamic Cone penetration (DCPT) conducted from 15.8 m to termination depth at 31.7 m *(continued)*	47.24	28 29 30 31				
			42.7					
		Borehole Terminated at 31.7 m Depth						



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4. See Notes on Sample Descriptions
5. Log to be read with EXP Report No. OTT-22024457-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Dry	13.1
'Dec 14, 2022	2.6	

CORE DRILLING RECORD

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

Legal Notification

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