Proposed Development

Sky Property Group Inc.

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Preliminary Geotechnical Investigation

Project Location:
Neyagawa Boulevard
between Hwy 407 & Burnhamthorpe Road West, Oakville, Ontario

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1. Introduction

This report presents the findings of a preliminary geotechnical investigation conducted for the proposed development at a vacant lot located on the north side of Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West in Oakville, Ontario. The work was authorized by Mr. Marc J. Pourvahidi of Sky Property Group Inc.

The conceptual plan has not been developed at the time of this investigation. However, it is understood the proposed development will consist of four (4) high-rise towers averaging thirty (30) stories high with three (3) to four (4) levels of underground parking. The preliminary geotechnical investigation will address general site development.

The purpose of the preliminary geotechnical investigation was to determine the subsurface soil and groundwater conditions at the site by putting down a limited number of sampled boreholes and rock coring and, based on an assessment of the factual borehole and rock core data, to provide preliminary geotechnical engineering guidelines for the design and construction of proposed development.

Our Terms of Reference also included Phase One and Two Environmental Site Assessments (ESAs) and a preliminary hydrogeological investigation, the results of which will be presented under separate covers.

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

2. Site Description

The site is located at the east side of Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West in Oakville, Ontario. There is no municipal address for this site at the time of the investigation.

The site is irregular in shape and is currently a vacant parcel of land. An asphalt driveway provides access to the site at the southeast corner of the site. The site is bounded by Highway 407 to the north, Neyagawa Boulevard to the west, Burnhamthorpe Road West to the south and an agricultural land parcel to the east. The existing ground surface drops about 10 m from north to south.

3. Fieldwork

The fieldwork was carried out between November 6 and 10, 2023. Prior to drilling, the borehole locations were cleared of underground utilities by Ontario One Call contractors and a private locator. Five (5) sampled boreholes (designated Boreholes 1D, 2D, 3D, 4 and 5) and three (3) unsampled boreholes (Boreholes 1S, 2S and 3S) were advanced to depths of 7.8 to 18.3 m below existing grade at the approximate locations shown on the attached Borehole Location Plan (Drawing No. 1).

The boreholes were advanced using continuous flight solid stem augering and mud rotary drilling equipment owned and operated by a specialist drilling contractor. In each borehole, soil samples were recovered using conventional split spoon equipment following the standard penetration test method. To confirm bedrock and to determine its quality, Boreholes 1D, 2D and 3D were extended into the bedrock down to the termination depth of boreholes by coring in HQ size using diamond drilling equipment.

Water levels were observed in the boreholes during the course of the fieldwork and in monitoring wells installed in all completed boreholes to establish the short-term stabilized groundwater level at the site. The monitoring wells were installed in accordance with the Ontario Water Resources Act, R.R.O. 1990, Ontario Regulation (O. Reg.) 903 – Amended to O. Reg. 128/03.

The fieldwork was supervised by EXP geotechnical staff who monitored the drilling operations and logged the borings. The split spoon samples and recovered rock cores were transported to our laboratory for detailed examination.

The location and ground surface elevation of the boreholes were determined in the field by EXP Services Inc. Ground surface elevations at the borehole locations were determined from Can-Net Elevations with the use of a Trimble TSC3 Controller.

4. Laboratory Testing

The laboratory testing program comprised moisture content determination on all recovered soil samples, with results presented on the Log of Borehole sheets (Drawing Nos. 2 to 6).

5. Subsurface Conditions

5.1 Soil and Bedrock

The detailed soil and rock profile encountered in each borehole and the results of laboratory moisture content determinations are indicated on the attached borehole and rock core logs (Drawing Nos. 2 to 6). It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Notes on Sample Descriptions" preceding the borehole and rock core logs form an integral part of and should be read in conjunction with this report.

The stratigraphy, as revealed in the boreholes, comprised surficial topsoil underlain by fill overlying native deposits of sandy silt till, clayey silt till and silt till over shale bedrock. A brief description of the stratigraphy in order of depth follows.

Topsoil

Surficial topsoil approximately 100 to 180 mm thick was encountered in all boreholes and comprised dark brown sandy silt with rootlets and organics.

Fill

Fill was encountered below the topsoil in all boreholes, extending to depths of about 0.6 to 1.1 m below existing grade. The composition of the fill is generally sandy silt with trace amounts of gravel. Occasional rootlets were noted within the fill. Moisture contents of the moist fill ranged from 10 to 24%.

Sandy Silt Till

Sandy silt till was encountered below the fill in all boreholes and extended to depths of about 3.8 to 6.5 m below existing grade. The sandy silt till deposit was brown/red in colour, contained a trace to some clay and a trace of gravel. Some cobbles and boulders are also present in the till. The till existed in a compact to very dense state of compactness. Moisture contents ranged from 9 to 13%, indicating a moist condition.

Clayey Silt Till

A clayey silt deposit was encountered below the sandy silt till in all boreholes except Borehole 5. This deposit extended to depths of about 7.0 to 10.4 m below existing grade. The clayey silt till was reddish grey in colour and contained a trace of sand and gravel. It was stiff to very stiff in consistency. Moisture contents were about 12 to 15%, indicating a moist condition.

Silt Till

Below the clayey silt till in Boreholes 1D to 4 and the sandy silt till in Borehole 5, a silt till deposit was encountered. The reddish brown silt till contained trace to some clay and a trace of sand and gravel. It also contains some cobbles and boulders. The lower portion of the silt till became a shale/till complex in Boreholes 1D and 2D. It is dense at the surface, but otherwise generally very dense. Moisture contents ranged between 5 and 12%, indicating moist conditions. Boreholes 4 and 5 were terminated within the silt till while it extended to the surface of the bedrock at depths of about 8.8 to 15.3 m below existing grade in Boreholes 1D, 2D and 3D.

Shale Bedrock

In Boreholes 1D, 2D and 3D, weathered shale bedrock was encountered at about 8.8 to 15.3 m below existing grade. The surface level of the shale bedrock varied from approximate Elevation 175.0 m in Borehole 1D at the northern portion of the site to about Elevation 172.8 m in Borehole 3D at the southern portion of the site. It should be noted that the upper zone of the bedrock is generally completely to highly weathered. The distinction between completely weathered shale and the overlying strata, particularly if the latter contains abundant shale fragments, is not always clear and consequently, some of the soils resting on the surface of the bedrock might be very weak or completely weathered rock. As such, the contact elevations should not be interpreted as exact planes of bedrock since the auger will frequently penetrate some distance into the weathered rock before noticeable resistance is encountered.

Coring of rock was carried out by HQ size diamond core drilling to determine the quality of the bedrock. Based on the rock core samples and knowledge of the site area, the bedrock at this site is the Queenston Formation which consists of red to maroon noncalcareous to calcareous shale with subordinate amounts of green shale, siltstone and limestone. Typically, the hard limestone layers comprise about 15 to 20 percent of the unit but may comprise as much as 70 to 90 percent of the bedrock. The hard layers are usually less than about 100 to 150 mm thick but some are much thicker. The thicker layers have been observed to be as much as 750 to 900 mm at other sites. The layers are actually lenses and they can vary significantly in thickness over short distances.

Stress relief features such as folds and faults may be encountered in the Queenston Formation. In these features the rock is heavily fractured and sheared. It can also contain layers of shale rubble and clay. Due to the fracturing, these features may also be groundwater conduits, which could result in excessive water flow into excavation. Weathering is much deeper than the surrounding rock in sound unweathered bedrock overlying fractured and weathered bedrock. The stress relief features are usually in the order of 4 to 6 m wide, but in depth can vary from 4 to 5 m to in excess of 10 m.

In the three boreholes where rock cores were taken, the total recovery was 100%, and the RQD (Rock Quality Designation) varied from 18 to 93%, indicating very poor quality rock at the surface, changing to fair to excellent quality at depths. The shale was moderately to highly weathered at the surface, and slightly weathered to fresh below. The thickness of the moderately to highly weathered rock was about 0.8 to 1.8 m at BH 1 to BH 3. The depths of the bedrock surface and of the slightly weathered rock are summarized in the table below.

Table 1: Rock Depth & Elevation

Borehole	Ground Elev	Rock Surface		Slightly Weathered Rock	
		Depth (m)	Elev (m)	Depth (m)	Elev (m)
1D	190.26	15.3	175.0	17.1	173.2
2D	184.30	10.6	173.7	11.4	172.9
3D	181.59	8.8	172.8	9.7	171.9

5.2 Groundwater

Groundwater conditions were observed in the boreholes during the course of the fieldwork and groundwater monitoring wells were installed in all boreholes for subsequent readings. Short-term groundwater measurements are recorded in the attached borehole logs.

Upon completion of drilling, groundwater level was unable to be observed in all boreholes due to the use of drilling mud, water for rock coring or flushing. The subsequent short-term groundwater level readings are presented in Table 1 below.

Table 2: Short Term Groundwater Levels in Boreholes

Borehole No.	Ground Surface Elevation (m)	Depth of Monitoring Well (m)	Groundwater Depth / Elevation in Well (m)		
			November 15, 2023	November 17, 2023	November 29, 2023
BH 1D	190.26	18.29	6.48 / ~179.6	N/A (No reading)	6.64 / ~183.6
BH 1S	190.26	8.22	7.77 / ~173.3	7.71 / ~173.4	6.31 / ~183.9
BH 2D	184.30	16.0	1.86 / ~188.4	N/A (No reading)	1.92 / ~182.4
BH 2S	184.30	8.8	0.86 / ~189.4	1.10 / ~189.2	1.02 / ~183.3
BH 3D	181.59	16.03	4.47 / ~179.8	N/A (No reading)	4.47 / ~177.1
BH 3S	181.59	8.66	0.55 / ~183.8	0.66 / ~183.6	0.67 / ~180.9
BH 4	186.12	8.97	2.73 / ~178.9	2.84 / ~178.8	2.89 / ~183.2

Borehole No.	Ground Surface Elevation (m)	Depth of Monitoring Well (m)	Groundwater Depth / Elevation in Well (m)		
			November 15, 2023	November 17, 2023	November 29, 2023
BH 5	181.06	7.84	-0.64 / ~182.2	-0.49 / ~182.1	-0.44 / ~181.5

Based on the measured groundwater levels, there appears to be multiple groundwater systems at the site. A shallow groundwater table is measured between about 2.89 below grade to 0.44 m above grade, corresponding to Elevations 181.5 to 183.3 m. The tills in BH5 were under artesian pressure. A deeper groundwater table was measured at about 4.47 to 6.64 m below existing grade, corresponding to Elevations 177.1 to 183.9 m below existing grade. The groundwater elevations reflect conditions at the time of the investigation. Seasonal fluctuation of the groundwater levels at the site should be anticipated.

Reference should be made to the hydrogeological investigation for details of the groundwater conditions at this site.

6. Engineering Discussion and Recommendations

6.1 General

A preliminary geotechnical investigation was conducted for the proposed development at a vacant lot located on the north side of Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West in Oakville, Ontario. The conceptual plan have not been developed at the time of this investigation. However, it is understood the proposed development will consist of four (4) high-rise towers averaging thirty (30) stories high with three (3) to four (4) levels of underground parking. The preliminary geotechnical investigation will address general site development.

Based on the information revealed in the limited number of boreholes drilled at the site, the site is considered generally suitable for the construction of the proposed structure with three (3) to four (4) levels of underground parking. However, some design and construction issues should be anticipated due to the relatively high groundwater level at the site.

The following subsections provide preliminary geotechnical engineering guidelines pertinent to the design and construction of proposed development. When the design has been finalized including building locations and number of underground parking, a more detailed investigation, including additional boreholes and rock coring, should be carried out to provide geotechnical parameters for final design and construction of the proposed development.

6.2 Site Grading

Considering the almost 10 m elevation difference between the north and the south ends of the site, some site grading works is expected. As artesian groundwater pressure was detected in BH 5, it is recommended that the finished grade at the south end of the site be raised, by 2 m or more if feasible. This will avoid encountering soft subgrades for internal roads and parking areas, and avoid the need to install deep subdrains under these areas.

6.3 Foundation Considerations

For the proposed structure with three (3) to four (4) levels of underground parking, it is anticipated the lowest basement floor will extend to depths of about 10 to 13 m below existing grade.

Based on the results of the investigation, two (2) foundation options were considered, namely:

1. Footing Foundations
2. Raft Foundations

The preferred foundation option will be based on design, construction and economics constraints.

6.3.1 Footings or Short Concrete Piers

Based on the results of the boreholes, the proposed structure may be supported on conventional spread and strip footings or concrete cast-in-place short piers founded on the native silt till or shale bedrock below all fill and loose soils. For preliminary design purposes, footings or short piers founded on the very dense silt till at the elevations given in ***Table 3*** or on the surface of the bedrock at the elevations shown in ***Table 1*** may be designed for a geotechnical reaction of 1,000 kPa at Serviceability Limit States (S.L.S.), subject to inspection during construction. The factored geotechnical resistance at Ultimate Limit States (U.L.S.) is 1,500 kPa. Footings or short piers founded on slightly weathered to fresh shale at the elevations given in ***Table 1***, may be designed for a geotechnical resistance of 2.5 MPa at U.L.S. The geotechnical reaction at S.L.S. for shale bedrock does not govern as it is an 'unyielding' soil. The depths (elevations) shown in ***Table 1*** must be confirmed by drilling more boreholes with rock coring.

Table 3: Highest Elevations Where 1,000 KPa (SLS) Is Available for Footings and Short Concrete Piers

Borehole No.	Approximate Ground Surface Elevation (m)	Highest Founding Elevation (m) (Depth below Existing Grade) (m)	Anticipated Founding Material
1D	190.26	~179.2 (11.0)	Very Dense Silt TIll
2D	184.30	~176.8 (7.5)	Very Dense Silt Till
3D	181.59	~173.5 (8.1)	Very Dense Silt Till

6.3.2 Raft Foundation

Consideration may also be given to supporting the structure on a raft slab foundation. The raft may be designed for a geotechnical reaction of 1,000 kPa at S.L.S or a factored geotechnical resistance of 2.5 MPa at U.L.S. at the founding elevations presented in the preceding section of this report. A modulus of subgrade reaction of 120 MPa/m may be used if a flexible design approach is considered. Once the loading contour is available, it is recommended a settlement analysis be carried out to determine the settlements of the raft foundation to verify they are within tolerable limits.

6.3.3 Foundation Subgrade Inspection

Prior to placement of concrete, all footings/short piers/raft bases should be inspected by geotechnical personnel from EXP Services Inc. to verify the competency of the founding material. It is recommended that following excavation to the footing foundation level, the subgrade should be covered with a 50 mm working mat of lean concrete following approval of the footing bases.

6.3.4 Foundations General

Footings, short piers or raft which are to be placed at different elevations on soils should be located such that the higher footing is set below a line drawn up at 10 horizontal to 7 vertical from the near edge of the lower footing.

All footings exposed to seasonal freezing conditions should be protected from frost action by at least 1.2 m of soil cover or equivalent insulation, depending on the final design requirements. However, for footings below 3 or 4 unheated levels of basement, unmonitored experience in recent years indicates shallow footing depths of 1.0 m for interior columns and 0.6 m for walls have been successful. Adjacent to air shafts and entrance and exit doors, a footing depth of 1.2 m below floor surface level is required, or alternatively, insulation protection must be provided.

It should be noted the recommended bearing value has been calculated by EXP from the borehole information for the development stage only. The investigation and comments are necessarily ongoing as new information (i.e. concept design and number of underground parking levels) becomes available. For example, it should be appreciated modification to bearing levels may be required if unforeseen subsurface conditions are encountered or if design decisions differ from those assumed in this report. For this reason, this office should be retained to review final foundation drawings and to provide field inspections during the construction stage.

6.4 Shoring Requirements

Shoring will be required for the basement excavation where it is necessary to limit the horizontal and vertical movements of adjacent properties, buried utilities and roadways. A shoring system consisting of tied-back soldier piles and lagging is expected to provide suitable support in areas where some movements are acceptable. In areas where movements are to be minimized, a continuous caisson wall supported by tiebacks may be required.

The shoring systems should be designed in accordance with the latest edition of the Canadian Foundation Engineering Manual (CFEM). Based on the manual, the following earth-pressure coefficients are recommended.

0.25	Where minor movements can be tolerated.
0.35	Where utilities, roads, sidewalks must be protected from significant movement or where vibration from traffic is a factor.
0.45	Where movements are to be minimized such as near adjacent building footings or movement sensitive services (i.e. gas and watermains).

Natural Unit Weight = 22.0 kN/m^3 (native soils)

Unit Weight of Groundwater = 9.8 kN/m^3

Bond resistance in native soils and highly weathered shale

= 50 kPa (higher values can be obtained if re-groutable anchors are used)

The shoring system should be designed by a specialist shoring contractor. All soldier pile and tieback holes, and caisson drill holes, should be temporary cased to minimize the risk of caving. During winter months, the shoring should be covered with thermal blankets to prevent frost penetration behind the shoring system which may result in unacceptable movements.

For preliminary estimation purposes, the bond stress between tie backs and the native soils below any fill, can be assumed to be 50 kPa. Higher values may be available with pressure grouting. The actual bond stress should be confirmed by a sufficient number of full scale pull-out tests ("performance test") in accordance with the Post-Tensioning Institute (PTI) guidelines. The design for the production anchors should then be modified based on the test results, where necessary. All remaining anchors must be installed using similar procedures and proof tested to 1.33 times the design load.

EXP should be retained to review the shoring design, to monitor installation and testing of the system, and to monitor the shoring movements during all phases of the excavation. Inclinometers should be installed at locations where buildings or sensitive services lie close to the excavation. Careful monitoring is needed in any shored excavation, especially when buildings are located in close proximity. This is necessary not only to anticipate when and if additional support is needed, but also to provide data to meet claims from adjacent property owners. In this regard, it is essential that detailed precondition surveys be made on adjacent structures.

6.5 Excavation and Groundwater Control

Excavation through the overburden soils should be relatively straightforward using conventional equipment. Excavation into shale bedrock will require heavy excavators and dozers equipped with special ripping teeth. Where limestone layers are encountered, a hoe-ram will be required. Excavation must be carried out in accordance with the Occupational Health and Safety Act and local regulations.

It should be noted obstructions and cobbles and boulders may be present within the fill and native till deposits, respectively. Consequently, provisions should be made in the contract documents to cover any delays caused by obstructions and cobbles and boulders.

Based on the groundwater conditions encountered, groundwater seepage through perched water in the fill, and pervious seams and layers in the till, should be anticipated for construction of three (3) to four (4) levels of underground parking extending to a depth of about 10 or 13 m below existing grade. It is anticipated that the rate of seepage should be slow to moderate. As such, it is in our opinion that it should be feasible to control the seepage using conventional construction dewatering techniques, such as pumping from deep sumps, or closely spaced well points. If a continuous caisson wall is used for shoring support, the rate of seepage into the basement excavation should be greatly reduced, and dewatering outside the excavation should not be needed.

It should be noted that any temporary construction dewatering that extracts more than 400,000 L per day would be subjected to a Permit To Take Water (PTTW), as regulated by the Ministry of Environment, Conservation and Parks (MECP). If the estimated rate will be more than 50,000 L per day but less than 400,000 L per day, the water taking can be regulated under the Environmental Activity and Sector Registry (EASR) as per MECP's new regulatory requirements.

For short and long-term groundwater control requirements, a Hydrogeological Study has been carried out to determine if a PTTW is required from the Ministry of the Environment, Conservation and Parks (MECP) and as part of the submission to the Town of Oakville.

6.6 Backfill Considerations

Backfill used to satisfy underfloor slab requirements, footings/grade beams and service trenches, etc., should be compactible fill, i.e., inorganic soil with its moisture content close to its optimum value determined in the standard Proctor maximum dry density test. The excavated materials will generally consist of fill and native sandy silt till, clayey silt till and silt till. Fill that is free of organics and otherwise deleterious materials are considered suitable for reuse as backfill. The native till deposits are also considered suitable for reuse as backfill material. However, portions of these material may require moisture adjustments (i.e. drying) for proper compaction. If the excavation is up to the property limits, there will be no room to stockpile soils within the excavation for backfilling purpose. As such, the use of imported granular B material is recommended.

The backfill should be placed in lifts not more than 300 mm thick in the loose state with each lift being compacted to at least 98% standard Proctor maximum dry density (SPMDD) before subsequent lifts are placed. The degree of compaction achieved in the field should be checked by in-place density tests.

The on-site soils are not free draining and therefore should not be used where this characteristic is required or in confined areas where smaller compaction equipment is required. Imported granular material such as OPSS Granular 'B' would also be suitable for these purposes.

6.7 Floor Slab Construction and Permanent Drainage

It is anticipated the lowest basement floor slab will be constructed on the very dense silt till or shale bedrock. Following excavation to the proposed basement subgrade level, the exposed subgrade should be thoroughly inspected by geotechnical personnel. Any soft or loose soil areas or highly weathered or loose rock areas identified during the inspection should be subexcavated and replaced with approved material compacted in the manner described in the "Backfill Considerations" subsection of the report.

A moisture barrier, consisting of a 200 mm thick layer of 19 mm clear crushed stone should be placed directly under the floor slab.

Perimeter drainage is required to remove any water adjacent to the exterior foundation walls. In order to prevent the build-up of water adjacent to the basement walls, it would be prudent to incorporate an exterior vertical drainage sheet attached to the backside of the basement wall connected to frost free outlets inside the building. The exterior vertical drainage sheet may consist of a prefabricated system, such a SITEDRAIN HQ240 or equivalent, covering the entire basement wall in order to reduce the risk of water penetration. The wall drain panels should be outletted through the basement wall into the basement. A solid pipe should be installed to within 1 m of the exterior wall to collect seepage for the wall drains.

In addition, installation of an under-floor drain system is also recommended below the basement slab. For preliminary guidance, the underfloor drain system should consist of a 300 mm thick layer of clear stone, with 100 mm diameter perforated drain pipes installed at the base of the drainage stone, at 3 to 6 m intervals. The final spacing of the underground drains should be determined by a hydrological study. The pipes and the stone must be completely wrapped in a non-woven geotextile having a filtering opening size (FOS) of 60 microns. These drain pipes must be provided with a frost-free positive discharge (i.e. sump pits). Adequate clean-out ports should be installed for each line of drainage pipes to faciliate future cleaning of the pipes.

The perimeter and sub-floor drainage systems should be independent of any stormwater piping, such as rainwater leaders. Backflow prevention should be provided between the sumps and the drain headers.

The Town of Oakville requires a detailed Hydrogeological Study be carried out for each site to determine the short-term (during construction) and long-term (post construction) flow rates. The hydrogeological report will be reviewed by the Town to determine if the groundwater is allowed to be discharged into their sewer system based on the quantity and quality of the water. If the groundwater collected from perimeter and underfloor drainage system are not allowed to be discharged into the Town sewers, the basement and floor will need to be designed as a watertight structure. In this case, the walls and floor must be designed to resist the hydrostatic pressures exerted by the recorded groundwater levels.

6.8 Earth Pressure on Subsurface Walls

The lateral earth pressure acting on basement walls may be calculated from the following equation:

$$p = k(\gamma h + q)$$

where: p = the pressure in kPa acting against any subsurface wall at depth, h, below the ground surface;

k = the earth pressure coefficient considered to be appropriate for the subsurface walls, for this case, 0.4;

ɣ = the bulk unit weight of the retained soil; use 22 kN/m^3;

h = the depth in m below the ground surface at which the pressure, p, is to be computed; and

q = the value of any adjacent surcharge in kPa which may be acting close to the wall.

The above expression assumes an effective perimeter drainage system will be incorporated to prevent the build-up of hydrostatic pressure behind the subsurface wall. The subsurface walls should be properly waterproofed. If both the subsurface walls and floor are to be designed as a watertight structure, they should be designed to resist full hydrostatic pressures and uplift.

If water is retained, submerged unit weight can be used for the retained soil below the groundwater table and full hydrostatic pressure should be added to the above equation. Accordingly, for a waterproofed basement, the lateral earth pressures acting on basement walls below groundwater table may be calculated from the following expression:

$$P = K(\gamma h_1 + \gamma' h_2 + q) + \gamma_w h_2$$

Where:

p = lateral earth pressure in kPa acting at depth h
K = earth pressure coefficient, assumed to be (0.4) for vertical walls and horizontal backfill
γ = unit weight of soil, a value of 22 kN/m^3 may be assumed
h_1 = groundwater table depth, meters
γ' = effective unit weight of soil, a value of 12 $kN/\ m^3$ may be assumed
γ_w = unit weight of water (10 $kN/\ m^3$)
h_2 = depth in metres below the water table
q = equivalent value of surcharge on the ground surface in kPa

6.9 Earthquake Considerations

The recommendations for the geotechnical aspects to determine the earthquake loading are presented below.

6.9.1 Subsoil Conditions

The subsoil information at this site has been examined in relation to Section 4.1.8.4 of OBC 2012. The subsoil consisted of fill overlying native sandy silt till, clayey silt till and silt till. The proposed structure will be supported on footings, short piers or raft founded on the silt till or shale bedrock.

There have been no shear wave velocity measurements carried out at this site.

6.9.2 Depth of Boreholes

Table 4.1.8.4.A Site Classification for Seismic Site Response in OBC 2012 indicated that to determine the site classification, the average properties in the top 30 m are to be used. The boreholes were advanced to depths of about 7.8 to 18.3 m below existing grade. Bedrock was encountered at about 8.8 to 15.3 m below existing grade.

6.9.3 Site Classification

Based on the known soil conditions, the Site Class for this site is “C” as per Table 4.1.8.4.A, Site Classification for Seismic Site Response, OBC 2012.

7. General Comments

A geotechnical engineer should be retained for a general review of the final design and specifications to verify the recommendations in this report address all relevant geotechnical parameters regarding the design and construction of the proposed development.

The comments given in this report are intended only for the guidance of design and structural engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for 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.

More specific information with respect to the conditions between samples or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent; should this occur, a geotechnical engineer should be contacted to assess the situation and additional testing and reporting may be required. EXP has qualified personnel to provide assistance in regard to future geotechnical issues related to this property.

We trust this report is satisfactory for your purposes. Should you have any questions or comments, please do not hesitate to contact this office.

Yours truly,
EXP Services Inc.

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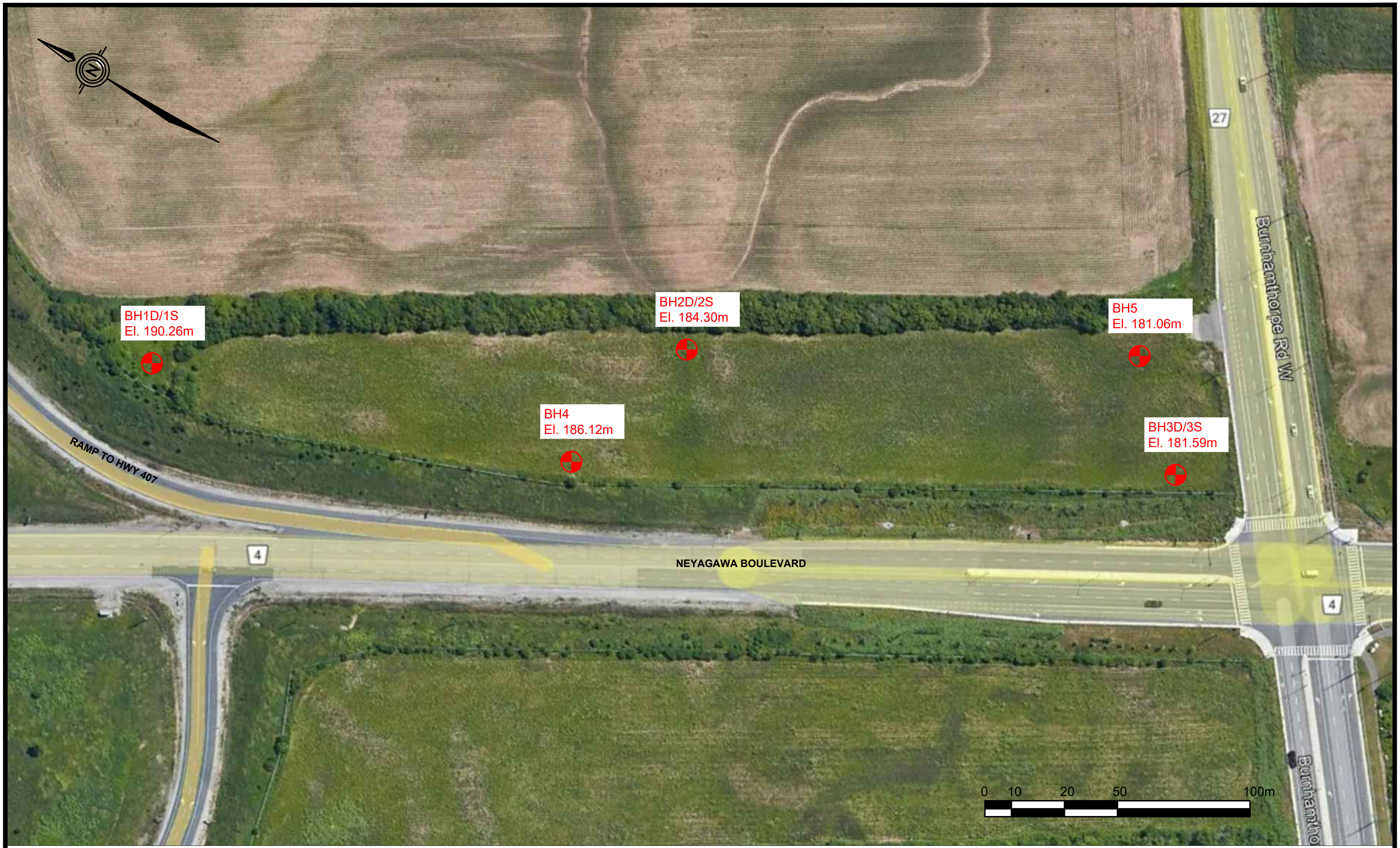
Infrastructure Projects
Geotechnical Division

Drawings

Borehole Location Plan
Borehole Logs



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 AND ROCK SAMPLES WILL BE RETAINED IN STORAGE FOR 1 MONTH AND THEN DESTROYED UNLESS CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. BOREHOLE ELEVATIONS SHOULD NOT BE USED FOR BUILDING GRADES.

LEGEND:

⊕ BOREHOLE LOCATION

EXP Services Inc.
t: +1.905.695.3217 | f: +1.905.695.0169
220 COMMERCE VALLEY DR., SUITE 110
MARKHAM, ON L3T 0A8
Canada

www.exp.com

exp.
The new identity of Trow

PROJECT TITLE AND LOCATION:
PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT
NEYAGAWA BOULEVARD BETWEEN HWY 407
AND BURNHAMTHORPE ROAD WEST
OAKVILLE, ONTARIO

DRAWING TITLE:
BOREHOLE LOCATION PLAN

PROJECT#: BRM-23012833-D0
DWN.: LC
SCALE: AS PER SCALE
CHKD.: PC
DATE: NOVEMBER 2023
DWG. No.: 1

Notes on Sample Descriptions

1. All sample descriptions included in this report follow the International Society for Soil Mechanics and Foundation Engineering (ISSMFE), as outlined in the Canadian Foundation Engineering Manual. Note, however, that behavioral properties (i.e. plasticity, permeability) take precedence over particle gradation when classifying soil. 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.

UNIFIED SOIL CLASSIFICATION

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

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

ISSMFE SOIL CLASSIFICATION

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

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 (75 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.

Notes On Soil Descriptions

4. The following table gives a description of the soil based on particle sizes. With the exception of those samples where grain size analyses have been performed, all samples are classified visually. The accuracy of visual examination is not sufficient to differentiate between this classification system or exact grain size.

Soil Classification		Terminology	Proportion
Clay and Silt	<0.060 mm	“trace” (e.g. Trace sand)	1% to 10%
Sand	0.060 to 2.0 mm	“some” (e.g. Some sand)	10% to 20%
Gravel	2.0 to 75 mm	adjective (e.g. sandy, silty)	20% to 35%
Cobbles	75 to 200 mm	“and” (e.g. and sand)	35% to 50%
Boulders	>200 mm		

The compactness of Cohesionless soils and the consistency of the cohesive soils are defined by the following:

Cohesionless Soil		Cohesive Soil		
Compactness	**Standard Penetration Resistance “N” Blows / 0.3 m**	**Consistency**	**Undrained Shear Strength (kPa)**	**Standard Penetration Resistance “N” Blows / 0.3 m**
Very Loose	0 to 4	Very soft	<12	<2
Loose	4 to 10	Soft	12 to 25	2 to 4
Compact	10 to 30	Firm	25 to 50	4 to 8
Dense	30 to 50	Stiff	50 to 100	8 to 15
Very Dense	Over 50	Very Stiff	100 to 200	15 to 30
		Hard	>200	>30

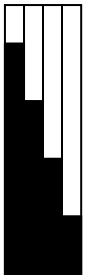
5. **ROCK CORING**

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundless of the rock mass. It is obtained from the rock cores by summing the length of the core covered, counting only those pieces of sound core that are 100 mm or more length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

RQD Classification	RQD (%)
Very Poor Quality	<25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

$$\text{Recovery Designation \% Recovery} = \frac{\text{Length of Core Per Run}}{\text{Total Length of Run}} \times 100$$

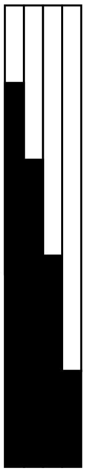
Explanatory Sheet To Core Log

Column No.	**Description**
1	Elevation of Geotechnical Boundary
2	Depth of Geotechnical Boundary in Borehole
3	Geological Symbol for Rock or Soil Material
4	General Description of Geotechnical Unit: Quantitative description including rock type (s), percentage of rock types, frequency and sizes of interbeds, colour, texture, weathering, strength and general joint spacing
5-11	Joint (Discontinuity) Characteristics
5	Number of Joints in Set: A rock mass can be intersected by a number of joint sets of varying orientations
6	Joint Type: B = Bedding Joint F = Fault C = Cross Joint S = Shear Plane
7	Orientation: Only variations in dip can be identified in core; dip direction is obtained from field mapping or orientated core F = Flat = 0 - 20° D = Dipping = 20 - 50° V = Vertical = 50 - 90°
8	Joint Spacing: This is an approximate measure of spacing between joints in specific joint sets VW = Very Wide = >3 m W = Wide = 1 to 3 m M = Moderate = 30 cm to 1 m C = Close = 5 to 30 cm VC = Very Close = <5 cm
9	Roughness RU = Rough Undulating RP = Rough Planar SU = Smooth Undulating SP = Smooth Planar LU = Slickensided Undulating LP = Slickensided Planar
10	Filling: Approximate ϕ_r T = Tight, hard, non softening 25° - 35° O = Oxidation, surface staining only 25° - 30° SA = Slightly altered; clay free 25° - 30° S = Sandy particles; clay free 25° - 35° Si = Sandy and silty' minor clay 20° - 25° NC = Non softening clays (<5 mm) 16° - 24° SO = Softening clays (<5 mm) 12° - 16° SC = Swelling clay fillings (<5 mm) 6° - 12°
11	Aperture: Estimated size of joint opening
12	Degree of Weathering of Rock Material  Unweathered = no signs of discolouration or oxidation Slightly weathered = partial discolouration; fractures (joints) typically oxidized Moderately weathered = total discolouration Highly weathered = total discolouration; typically friable & pitted Completely weathered = resembles soil; rock structure usually preserved

Explanatory Sheet To Core Log

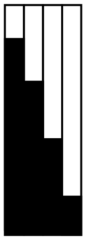
Column No. **Description**

13 Strength of Rock Material



		Approx.Uniaxial Compressive Strength
Very High strength	= specimen can only be chipped by geological hammer	>200 MPa
High strength	= specimen requires a number of blows to fracture it: cannot be scrapped with a pocket knife	50 – 200 MPa
Medium strength	= specimen can be fractured by a single blow of geological hammer; can be scrapped with pocket knife, not peeled	15 – 50 MPa
Low strength	= shallow indentations made with a firm blow of geological hammer; can be peeled by pocket knife with difficulty	4 – 15 MPa
Very low strength	= crumbles under firm blow with point of geological hammer; can be peeled by pocket knife	1 – 4 MPa

14 Fracture Frequency: Number of natural joints occurring over a metre length of core. All natural joints are counted irrespective of the number of joint sets.



Fracture Frequency		Joint Spacing	
<0.3/m	=	Very wide	= 3 m
0.3 – 1/m	=	Wide	= 1 – 3 m
1 – 3/m	=	Moderate	= 30 cm – 1 m
3 – 20/m	=	Close	= 5 – 30 cm
>20/m	=	Very Close	= <5 cm

15 Run Number: Drill run number

16 Core Recovery: Core recovery is the total length of core pieces, irrespective of their individual lengths, obtained in a core run and expressed as a percentage of the length of that core run.

17 Rock Quality Designation (RQD): The total length of those pieces of sound core which are 10 cm or greater in length in a core run expressed as a percentage of the total length of that core run. Sound pieces of rack are those pieces separated by natural breaks and not machine breaks or subsequent artificial breaks.

RQD	Rock Mass Classification (After Deere)
0 - 25%	very poor
25 – 50%	poor
50 – 75%	fair
75 – 90%	good
90 – 100%	excellent

18 Water Recovery: The estimated water returning out of the casing

19 Water Colour: The colour of the water returning out of the casing

Log of Borehole 1D

Project No.	BRM-23012833-D0	Drawing No.	2
Project:	Preliminary Geotechnical Investigation - Proposed Development	Sheet No.	1 of 1
Location:	Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West, Oakville, Ontario		

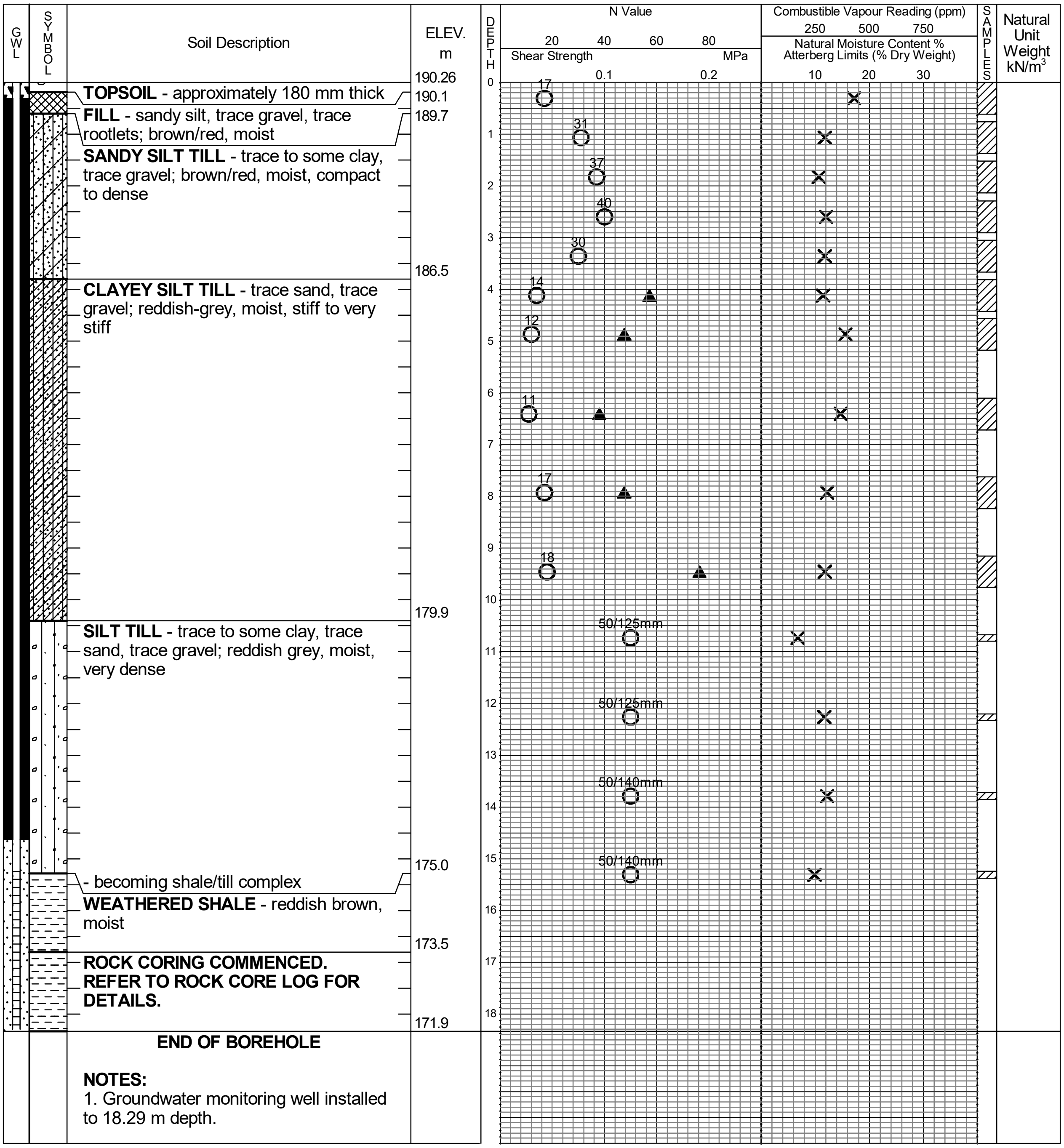
Date Drilled: November 7-8, 2023

Drill Type: CME75 Track Mount

Datum: Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	⊢—○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲

Soil Description	ELEV. m
	190.26
TOPSOIL - approximately 180 mm thick	190.1
FILL - sandy silt, trace gravel, trace rootlets; brown/red, moist	189.7
SANDY SILT TILL - trace to some clay, trace gravel; brown/red, moist, compact to dense	186.5
CLAYEY SILT TILL - trace sand, trace gravel; reddish-grey, moist, stiff to very stiff	179.9
SILT TILL - trace to some clay, trace sand, trace gravel; reddish grey, moist, very dense	175.0
- becoming shale/till complex **WEATHERED SHALE** - reddish brown, moist	173.5
ROCK CORING COMMENCED. REFER TO ROCK CORE LOG FOR DETAILS.	171.9



END OF BOREHOLE

NOTES:
1. Groundwater monitoring well installed to 18.29 m depth.

LAGWGL02 BRM-23012833-D0 - NEYAGAWA.GPJ NEW.GDT 12/6/23

exp.

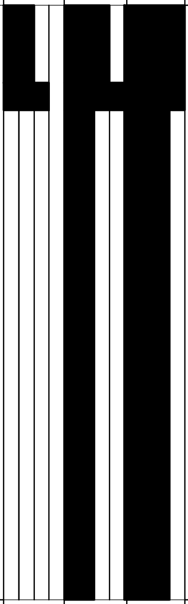
Time	Water Level (m)	Depth to Cave (m)
On completion	N/A	Well
November 15, 2023	6.48	Well
November 29, 2023	6.64	Well

ROCK CORE LOG

BH 1D

PROJECT Preliminary Geotechnical Investigation - Proposed Development	**ORIENTATION** Vertical	**ELEVATION (m)** 190.3	**DATUM** Geodetic	**PROJECT NUMBER** BRM-23012833-D0
LOCATION Neyagawa Blvd btwn Hwy 407 & Burnhamthorpe Rd W, Oakville	**DATE STARTED** 11/08/23	**COMPLETED** 11/08/23	**LOGGED BY** RY	**DRAWING NUMBER** 2
CLIENT Sky Property Group Inc.	**DRILLER** 3D Drilling	**DRILL TYPE** CME 75 Track	**CORE BARREL** HQ	**SHEET** 1 of 1

				JOINT CHARACTERISTICS														
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
173.5	17		**QUEENSTON FORMATION** Brick red to maroon noncalcareous to calcareous shale with subordinate amounts of green shale, siltstone and limestone **RUN 1 :** Moderately weathered (W3) to unweathered (W1), weak (R2) to medium strong (R3), reddish brown, hematitic, sandy, bedded / laminated, calcareous SHALE and SILTSTONE (100%) Highly Weathered Zone (W1): 17.01 - 17.08 m (70mm) Fracture Zones: 16.81 - 17.08 m (270mm) 17.48 - 17.53 m (50mm) Vertical Fracture: 17.08 - 17.18 m (100mm) Solid Core Recovery: 72%		B C B	F V F		SP RU RP	T T T									
					B	F		RU	S	1				1	100	65		
					B	F		SP	S	1								
	18				B	F		SP	S	1								
					B	F		SP	Si	10								
171.9			End of Borehole at 18.3 m															
	19																	
	20																	



Log of Borehole 1S

Project No.	BRM-23012833-D0	Drawing No.	2A
Project:	Preliminary Geotechnical Investigation - Proposed Development	Sheet No.	1 of 1
Location:	Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West, Oakville, Ontario		

Date Drilled: November 8, 2023
Drill Type: CME75 Track Mount
Datum: Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├—○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 / Shear Strength MPa 0.1 0.2	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Natural Unit Weight kN/m³
		NO SAMPLING. BOREHOLE DRILLED FOR THE PURPOSE OF GROUNDWATER MONITORING WELL INSTALLATION.	190.26	0 1 2 3 4 5 6 7 8				
		END OF BOREHOLE **NOTES:** 1. Groundwater monitoring well installed to 8.22 m depth.	182.0					

exp.

Time	Water Level (m)	Depth to Cave (m)
On completion	N/A	Well
November 15, 2023	7.77	Well
November 17, 2023	7.71	Well
November 29, 2023	6.31	Well

Log of Borehole 2D

Project No. BRM-23012833-D0

Drawing No. 3

Project: Preliminary Geotechnical Investigation - Proposed Development

Sheet No. 1 of 1

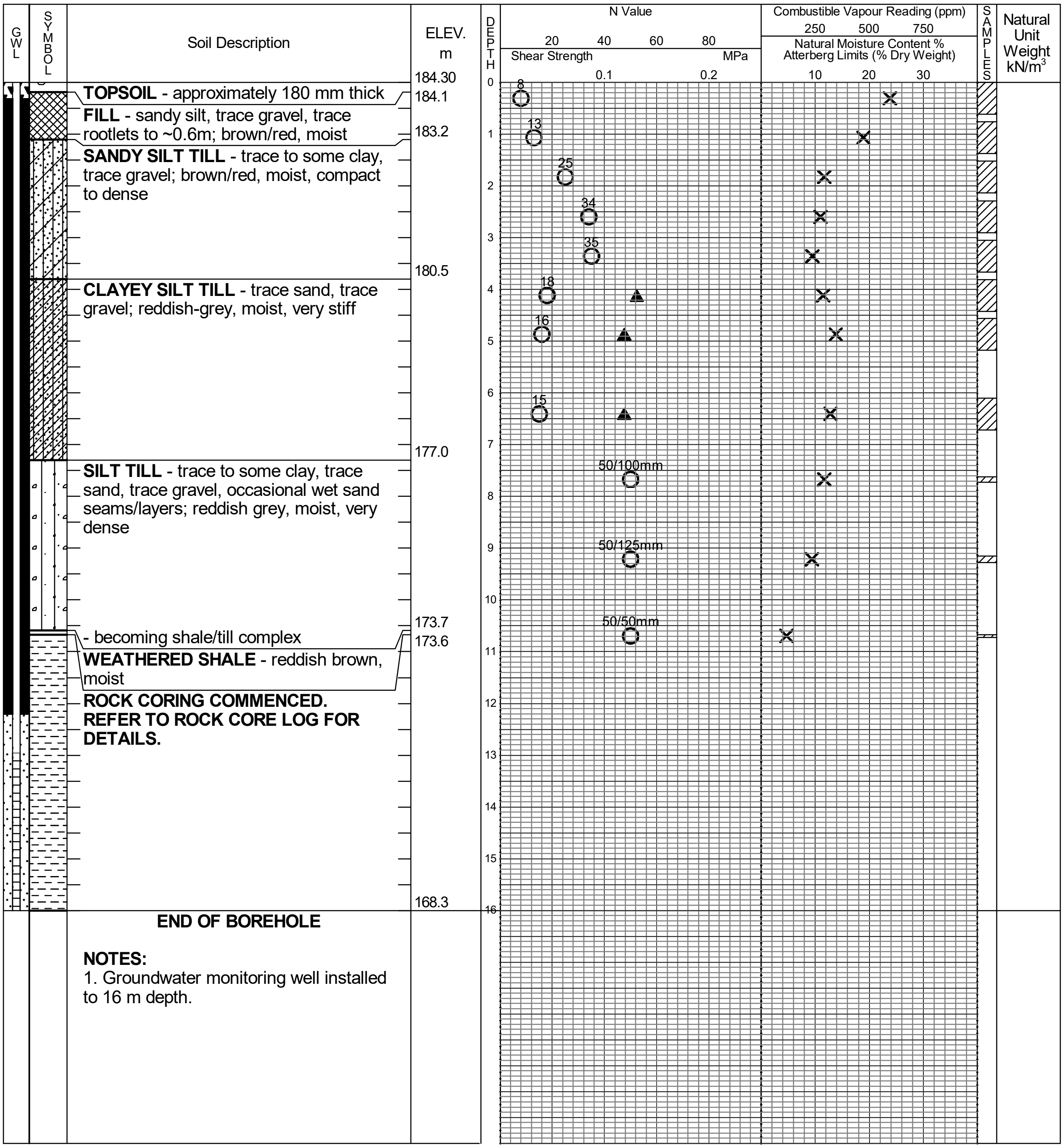
Location: Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West, Oakville, Ontario

Date Drilled: November 8-9, 2023

Drill Type: CME75 Track Mount

Datum: Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	⊢—○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲



TOPSOIL - approximately 180 mm thick

FILL - sandy silt, trace gravel, trace rootlets to ~0.6m; brown/red, moist

SANDY SILT TILL - trace to some clay, trace gravel; brown/red, moist, compact to dense

CLAYEY SILT TILL - trace sand, trace gravel; reddish-grey, moist, very stiff

SILT TILL - trace to some clay, trace sand, trace gravel, occasional wet sand seams/layers; reddish grey, moist, very dense

- becoming shale/till complex

WEATHERED SHALE - reddish brown, moist

ROCK CORING COMMENCED. REFER TO ROCK CORE LOG FOR DETAILS.

END OF BOREHOLE

NOTES:
1. Groundwater monitoring well installed to 16 m depth.

Time	Water Level (m)	Depth to Cave (m)
On completion	N/A	Well
November 15, 2023	1.86	Well
November 29, 2023	1.92	Well

LAGWGL02 BRM-23012833-D0 - NEYAGAWA.GPJ NEW.GDT 12/6/23

ROCK CORE LOG

BH 2D

PROJECT Preliminary Geotechnical Investigation - Proposed Development	**ORIENTATION** Vertical	**ELEVATION (m)** 184.3	**DATUM** Geodetic	**PROJECT NUMBER** BRM-23012833-D0
LOCATION Neyagawa Blvd btwn Hwy 407 & Burnhamthorpe Rd W, Oakville	**DATE STARTED** 11/09/23	**COMPLETED** 11/09/23	**LOGGED BY** RY	**DRAWING NUMBER** 3
CLIENT Sky Property Group Inc.	**DRILLER** 3D Drilling	**DRILL TYPE** CME 75 Track	**CORE BARREL** HQ	**SHEET** 1 of 2

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
173.8			**GRAVEL**															
173.7			**QUEENSTON FORMATION** Brick red to maroon noncalcareous to calcareous shale with subordinate amounts of green shale, siltstone and limestone		B	F		SP	T									
			RUN 1 : Moderately weathered (W3) to slightly weathered (W2), weak (R2) to medium strong (R3), reddish brown to greenish grey, hematitic, sandy, bedded / laminated, calcareous SHALE and SILTSTONE (100%)		B	F		SP	T					1	100	18		
	11		Fracture Zones: 10.59 - 10.79 m (200mm) 10.99 - 11.31 m (320mm)															
			Solid Core Recovery: 31%															
			RUN 2 : Slightly Weathered (W2) to unweathered (W1), medium strong (R3), reddish brown to greenish grey, hematitic, sandy, bedded / laminated, calcareous SHALE and SILTSTONE (100%)		B	F		RP	T									
					B	F		SP	T									
			Fracture Zones: 11.54 - 11.62 m (80mm)															
			Solid Core Recovery: 96%		B	F		SP	T									
	12																	
					B	F		RU	T					2	100	94		
					B	F		SP	T									
					B	F		RP	T									
	13		**RUN 3 :** Slightly Weathered (W2) to unweathered (W1), medium strong (R3), reddish brown to greenish grey, hematitic, sandy, bedded / laminated, calcareous SHALE and SILTSTONE (100%)		B	F		SP	T									
					B	F		RP	T									
			Highly Weathered Zone (W4): 13.21 - 13.34 m (130mm)															
			Fracture Zones: 13.07 - 13.13 m (60mm)		B	F		RU	T									
			Solid Core Recovery: 96%															
														3	100	96		

ROCK CORE LOG

BH 2D

PROJECT Preliminary Geotechnical Investigation - Proposed Development	**ORIENTATION** Vertical	**ELEVATION (m)** 184.3	**DATUM** Geodetic	**PROJECT NUMBER** BRM-23012833-D0
LOCATION Neyagawa Blvd btwn Hwy 407 & Burnhamthorpe Rd W, Oakville	**DATE STARTED** 11/09/23	**COMPLETED** 11/09/23	**LOGGED BY** RY	**DRAWING NUMBER** 3
CLIENT Sky Property Group Inc.	**DRILLER** 3D Drilling	**DRILL TYPE** CME 75 Track	**CORE BARREL** HQ	**SHEET** 2 of 2

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	14		**RUN 4 :** Slightly Weathered (W2) to unweathered (W1), medium strong (R3), reddish brown to greenish grey, hematitic, sandy, bedded / laminated, calcareous SHALE and SILTSTONE (100%) dissolution features: 15.18 - 15.31 m (130mm) Solid Core Recovery: 96%											4	100	86		
					B	F		RP	S	1								
					B	F		RP	T									
	15				B	F		SP	T									
					B	F		SP	T									
					B	F		SP	T									
					B	F		SP	T									
					B	F		RP	T									
					B	F		SP	T									
168.3	16		End of Borehole at 16.0 m															
	17																	

Log of Borehole 2S

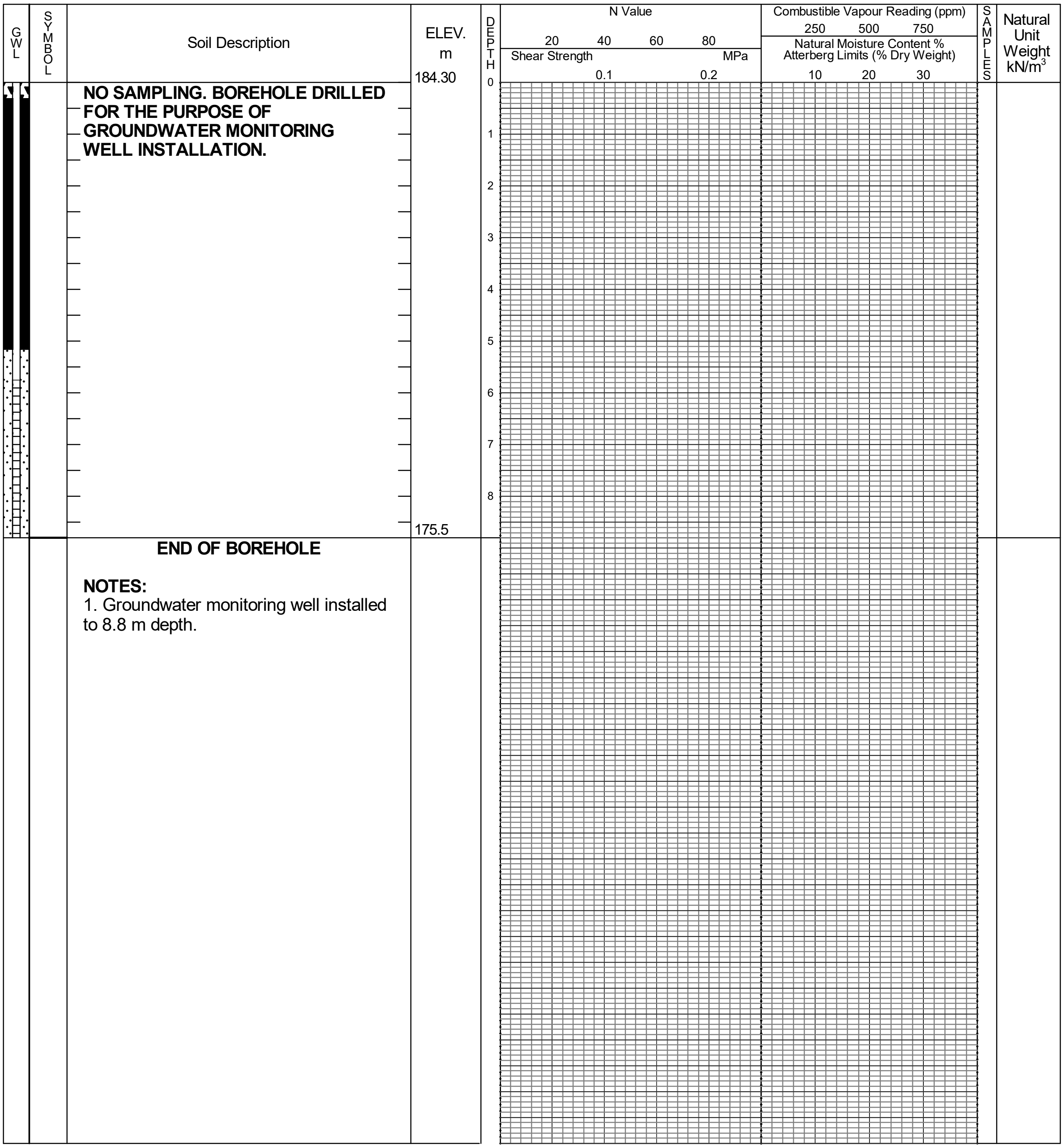
Project No.	BRM-23012833-D0	Drawing No.	3A
Project:	Preliminary Geotechnical Investigation - Proposed Development	Sheet No.	1 of 1
Location:	Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West, Oakville, Ontario		

Date Drilled: November 9, 2023

Drill Type: CME75 Track Mount

Datum: Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	✕
Dynamic Cone Test	—	Plastic and Liquid Limit	├─○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲



184.30

NO SAMPLING. BOREHOLE DRILLED FOR THE PURPOSE OF GROUNDWATER MONITORING WELL INSTALLATION.

175.5

END OF BOREHOLE

NOTES:

1. Groundwater monitoring well installed to 8.8 m depth.

LAGWGL02 BRM-23012833-D0 - NEYAGAWA.GPJ NEW.GDT 12/6/23

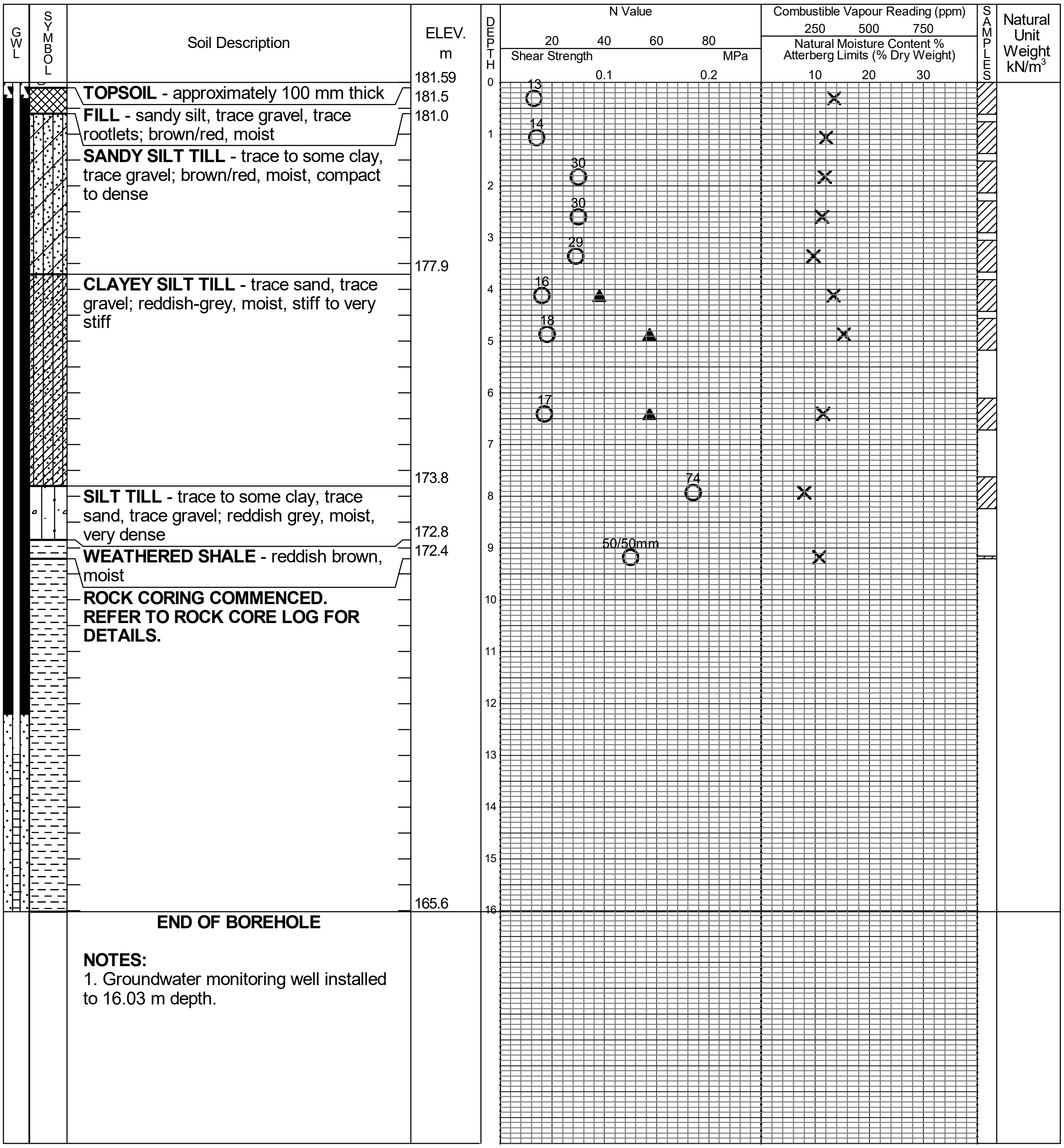
Time	Water Level (m)	Depth to Cave (m)
On completion	N/A	Well
November 15, 2023	0.86	Well
November 17, 2023	1.10	Well
November 29, 2023	1.02	Well

Log of Borehole 3D

Project No.	BRM-23012833-D0	Drawing No.	4
Project:	Preliminary Geotechnical Investigation - Proposed Development	Sheet No.	1 of 1
Location:	Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West, Oakville, Ontario		

Date Drilled:	November 6 and 10, 2023
Drill Type:	CME75 Track Mount
Datum:	Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲



ELEV. m	Soil Description
181.59	
181.5	**TOPSOIL** - approximately 100 mm thick
181.0	**FILL** - sandy silt, trace gravel, trace rootlets; brown/red, moist
	SANDY SILT TILL - trace to some clay, trace gravel; brown/red, moist, compact to dense
177.9	**CLAYEY SILT TILL** - trace sand, trace gravel; reddish-grey, moist, stiff to very stiff
173.8	**SILT TILL** - trace to some clay, trace sand, trace gravel; reddish grey, moist, very dense
172.8	**WEATHERED SHALE** - reddish brown, moist
172.4	**ROCK CORING COMMENCED. REFER TO ROCK CORE LOG FOR DETAILS.**
165.6	**END OF BOREHOLE**

NOTES:
1. Groundwater monitoring well installed to 16.03 m depth.

exp.

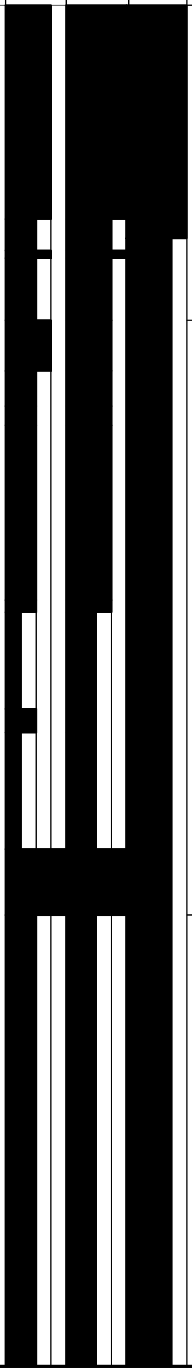
Time	Water Level (m)	Depth to Cave (m)
On completion	N/A	Well
November 15, 2023	4.47	Well
November 29, 2023	4.47	Well

ROCK CORE LOG

BH 3D

PROJECT	ORIENTATION	ELEVATION (m)	DATUM	PROJECT NUMBER
Preliminary Geotechnical Investigation - Proposed Development	Vertical	181.6	Geodetic	BRM-23012833-D0
LOCATION	**DATE STARTED**	**COMPLETED**	**LOGGED BY**	**DRAWING NUMBER**
Neyagawa Blvd btwn Hwy 407 & Burnhamthorpe Rd W, Oakville	11/10/23	11/10/23	RY	4
CLIENT	**DRILLER**	**DRILL TYPE**	**CORE BARREL**	**SHEET**
Sky Property Group Inc.	3D Drilling	CME 75 Track	HQ	1 of 2

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
172.5			**QUEENSTON FORMATION** Brick red to maroon noncalcareous to calcareous shale with subordinate amounts of green shale, siltstone and limestone															
			RUN 1 : Moderately weathered (W3) to slightly weathered (W2), very weak (R1) to weak (R2), reddish brown to greenish grey, hematitic, sandy, bedded / laminated, calcareous SHALE and SILTSTONE (100%)											1	100	28		
			Fracture Zones: 9.12 - 9.67 m (550mm)															
			Solid Core Recovery: 36%		B	F		RP	T									
					B	F		SP	T									
	10		**RUN 2 :** Moderately weathered (W3) to unweathered (W1), weak (R2) to medium strong (R3), reddish brown to greenish grey, hematitic, sandy, bedded / laminated, calcareous SHALE and SILTSTONE (100%)		B	F		SP	T									
			Highly Weathered Zone (W4): 11.29 - 11.46 m (170mm)															
			Fracture Zones: 9.94 - 10.06 m (120mm) 10.15 - 10.2 m (50mm) 10.65 - 10.68 m (30mm) 10.93 - 10.99 m (50mm)		B	F		SP	T									
					B	F		RP	T									
			Solid Core Recovery: 81%											2	100	70		
					B	F		SP	O									
					B	F		SP	S	4								
	11				B	F		RU	S	4								
					B	F		RP	T									
			RUN 3 : Moderately weathered (W3) to slightly weathered (W2), weak (R2) to medium strong (R3), reddish brown to greenish grey, hematitic, sandy, bedded / laminated, calcareous SHALE and SILTSTONE (100%)		B	F		RU	S	1								
			Solid Core Recovery: 96%		B	F		RU	S	1								
	12													3	100	92		

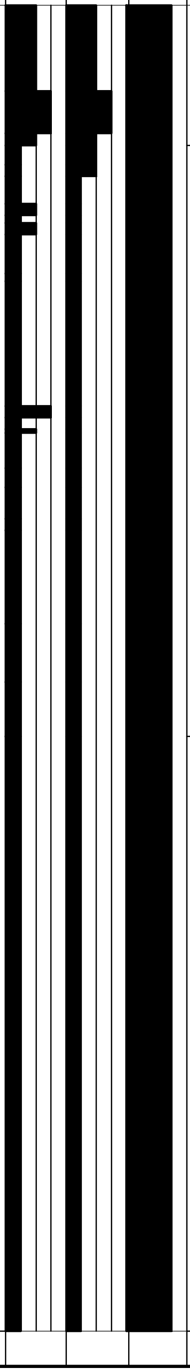


ROCK CORE LOG

BH 3D

PROJECT	ORIENTATION	ELEVATION (m)	DATUM	PROJECT NUMBER
Preliminary Geotechnical Investigation - Proposed Development	Vertical	181.6	Geodetic	BRM-23012833-D0
LOCATION	**DATE STARTED**	**COMPLETED**	**LOGGED BY**	**DRAWING NUMBER**
Neyagawa Blvd btwn Hwy 407 & Burnhamthorpe Rd W, Oakville	11/10/23	11/10/23	RY	4
CLIENT	**DRILLER**	**DRILL TYPE**	**CORE BARREL**	**SHEET**
Sky Property Group Inc.	3D Drilling	CME 75 Track	HQ	2 of 2

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	JOINT CHARACTERISTICS NO. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE (mm)	WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NUMBER	RECOVERY (%)	RQD	WATER RECOVERY (%)	WATER COLOUR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
					B	F		SP	T									
					B	F		RU	T									
					B	F		SP	T									
	13		**RUN 4 :** Unweathered (W1), medium strong (R3), reddish brown to greenish grey, hematitic, sandy, bedded / laminated, calcareous SHALE and SILTSTONE (100%) Fracture Zones: 13.59 - 13.61 m (20mm) Solid Core Recovery: 98%		B	F		SP	T									
					B	F		SU	S	1								
					B	F		SP	T									
					B	F		SP	T									
					B	F		SU	S	1								
					B	F		SP	T									
					B	F		RP	T									
					B	F		RP	T									
														4	100	93		
					B	F		SP	T									
	14																	
					B	F		SP	T									
			RUN 5 : Unweathered (W1), weak (R2) to medium strong (R3), reddish brown to greenish grey, hematitic, sandy, bedded / laminated, calcareous SHALE and SILTSTONE (100%) Solid Core Recovery: 99%		B	F		SU	T									
					B	F		RP	T									
					B	F		RP	T									
					B	F		RP	T									
					B	F		SP	Si	3								
					B	F		RP	T									
	15																	
					B	F		SP	Si	2								
														5	100	85		
					B	F		SP	T									
					B	F		SP	T									
165.6	16																	
			End of Borehole at 16.0 m															



Log of Borehole 3S

Project No. BRM-23012833-D0

Drawing No. 4A

Project: Preliminary Geotechnical Investigation - Proposed Development

Sheet No. 1 of 1

Location: Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West, Oakville, Ontario

Date Drilled: November 6, 2023

Drill Type: CME75 Track Mount

Datum: Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value 20 40 60 80 Shear Strength MPa 0.1 0.2	Combustible Vapour Reading (ppm) 250 500 750 Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	SAMPLES	Natural Unit Weight kN/m³
		**NO SAMPLING. BOREHOLE DRILLED FOR THE PURPOSE OF GROUNDWATER MONITORING WELL INSTALLATION.**	181.59 172.9	0 1 2 3 4 5 6 7 8				
		END OF BOREHOLE **NOTES:** 1. Groundwater monitoring well installed to 8.66 m depth.						

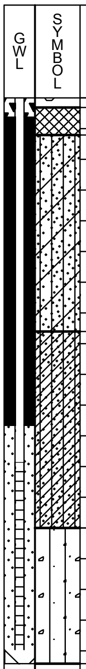
Time	Water Level (m)	Depth to Cave (m)
On completion	N/A	Well
November 15, 2023	0.55	Well
November 17, 2023	0.66	Well
November 29, 2023	0.67	Well

Log of Borehole 4

Project No.	BRM-23012833-D0	Drawing No.	5
Project:	Preliminary Geotechnical Investigation - Proposed Development	Sheet No.	1 of 1
Location:	Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West, Oakville, Ontario		

Date Drilled: November 7, 2023
Drill Type: CME75 Track Mount
Datum: Geodetic

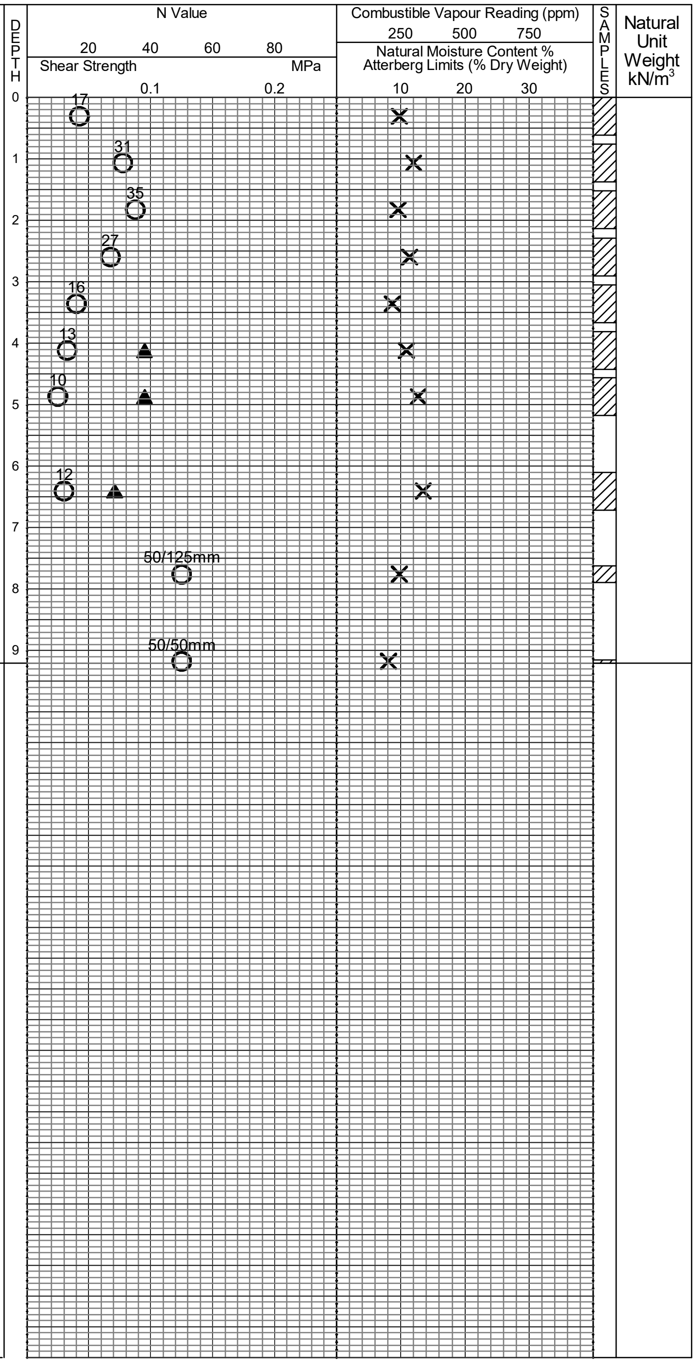
Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	✕
Dynamic Cone Test	—	Plastic and Liquid Limit	⊢—○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲



Soil Description	ELEV. m
	186.12
TOPSOIL - approximately 150 mm thick	186.0
FILL - sandy silt, trace gravel, trace rootlets; brown/red, moist	185.5
SANDY SILT TILL - trace to some clay, trace gravel; brown/red, moist, compact to dense	182.3
CLAYEY SILT TILL - trace sand, trace gravel; reddish-grey, moist, stiff	179.1
SILT TILL - trace to some clay, trace sand, trace gravel; reddish grey, moist, very dense	176.9

END OF BOREHOLE

NOTES:
1. Groundwater monitoring well installed to 8.97 m depth.



Time	Water Level (m)	Depth to Cave (m)
On completion	N/A	Well
November 15, 2023	2.73	Well
November 17, 2023	2.84	Well
November 29, 2023	2.89	Well

Log of Borehole 5

Project No. BRM-23012833-D0

Drawing No. 6

Project: Preliminary Geotechnical Investigation - Proposed Development

Sheet No. 1 of 1

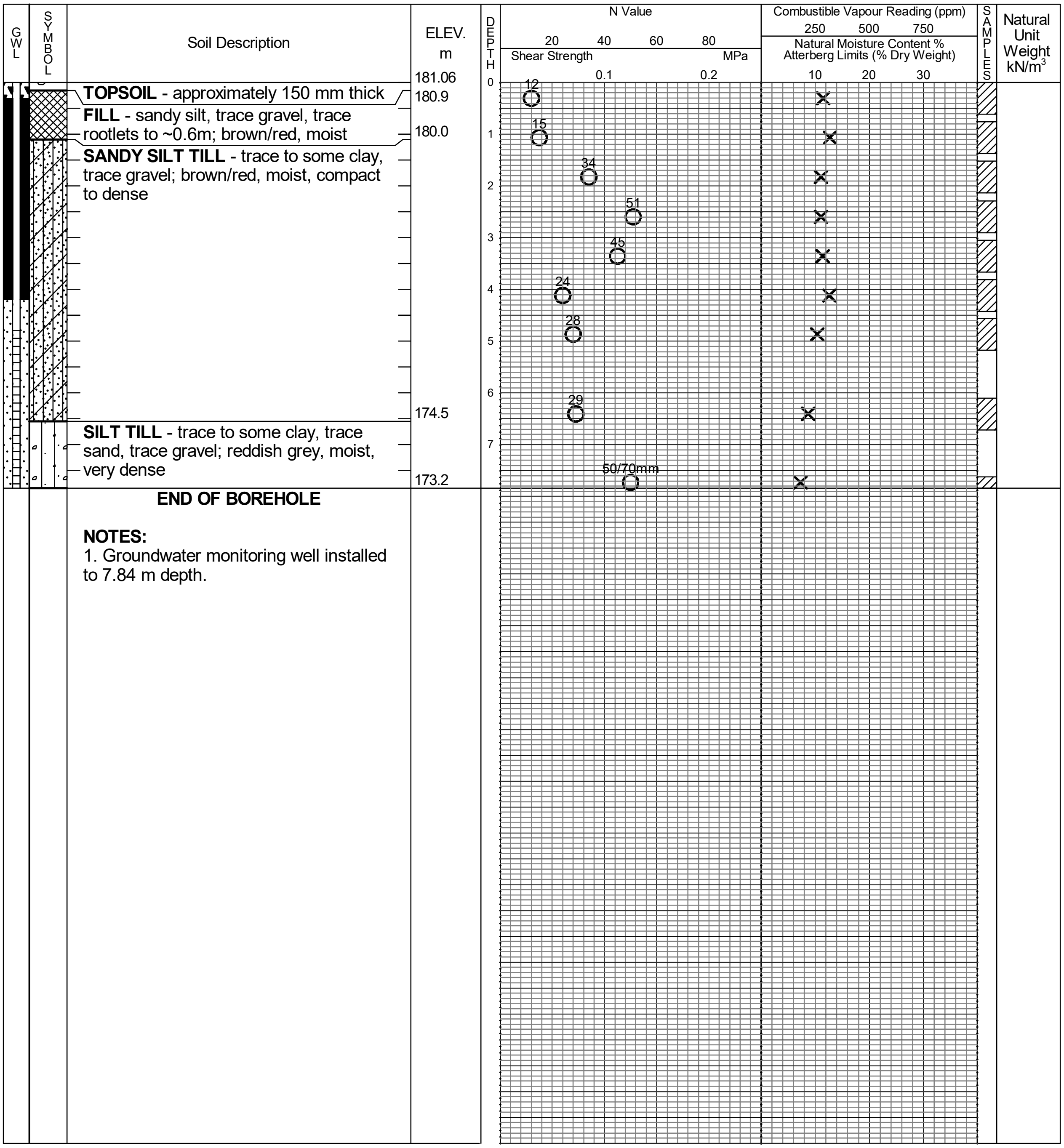
Location: Neyagawa Boulevard between Hwy 407 & Burnhamthorpe Road West, Oakville, Ontario

Date Drilled: November 6, 2023

Drill Type: CME75 Track Mount

Datum: Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲



TOPSOIL - approximately 150 mm thick

FILL - sandy silt, trace gravel, trace rootlets to ~0.6m; brown/red, moist

SANDY SILT TILL - trace to some clay, trace gravel; brown/red, moist, compact to dense

SILT TILL - trace to some clay, trace sand, trace gravel; reddish grey, moist, very dense

END OF BOREHOLE

NOTES:

1. Groundwater monitoring well installed to 7.84 m depth.

Time	Water Level (m)	Depth to Cave (m)
On completion	N/A	Well
November 15, 2023	-0.64	Well
November 17, 2023	-0.49	Well
November 29, 2023	-0.44	Well