TOWN OF CALEDON
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Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE 100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

A REPORT TO
2868577 ONTARIO INC.

A GEOTECHNICAL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

15544 MCLAUGHLIN ROAD

TOWN OF CALEDON

REFERENCE NO. 2301-S042

MARCH 2024

DISTRIBUTION

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ENCLOSURES

1.0 INTRODUCTION

In accordance with written authorization dated January 3, 2023, from Mr. Manoj Sharma of 2868577 Ontario Inc., a geotechnical investigation was carried out on a vacant area within 15544 McLaughlin Road in the Town of Caledon.

The purpose of this investigation was to reveal the subsurface conditions and determine the engineering properties of the disclosed soils for the design and construction of a proposed residential development. The geotechnical findings and resulting recommendations are presented in this Report.

2.0 SITE AND PROJECT DESCRIPTION

The Town of Caledon is situated on Halton-Peel till plain where the drift dominates the soil stratigraphy. In places, lacustrine sand, silt and clay, which has been reworked by the water action of Peel Ponding (glacial lake), have modified the drift stratigraphy.

The investigated area, being part of 15544 McLaughlin Road, is located approximately 200 m west of McLaughlin Road and approximately 470 m north of Old Base Line Road, at the terminus of Kaufman Road. The area is currently a vacant lot. The site gradient generally slopes towards east with a grade difference of almost 9 m.

Based on the preliminary development plan prepared by Candevcon Limited, the area will be developed into 13 single detached dwelling lots, an open space at Block 1A and a stormwater management (SWM) pond at Block 2. Access to the lots will be provided by extension of Kaufman Road, and will be connected to Victoria Street and McKenzie Street.

3.0 FIELD WORK

The field work, consisting of five (5) sampled boreholes extending to depths of 6.2 to 6.6 m, was performed on January 24, 2023. Upon the completion of borehole drilling and sampling, monitoring wells were installed in all boreholes to facilitate groundwater monitoring. Details of the monitoring wells are included in the corresponding borehole logs. The locations of the boreholes and monitoring wells are shown on the Borehole and Monitoring Well Location Plan, Drawing No. 1.

The boreholes were advanced at intervals to the sampling depths by a track-mounted machine using solid stem auger, and equipped with split spoon sampler for soil sampling. Split-spoon samples were recovered for soil classification and laboratory testing. Standard

Penetration Tests, using the procedures described on the enclosed “List of Abbreviations and Terms,” were performed at the sampling depths. The test results are recorded as the Standard Penetration Resistance (or ‘N’ values) of the subsoil. The relative density of the non-cohesive strata and the consistency of the cohesive strata are inferred from the ‘N’ values. The field work was supervised and the findings were recorded by a Geotechnical Technician.

The ground elevation at each borehole location was determined using a hand-held Global Navigation Satellite System (GNSS) equipment.

4.0 SUBSURFACE CONDITIONS

The investigation revealed that beneath a layer of topsoil veneer, and a layer of earth fill or weathered soil, the site is underlain by strata of silt, silty sand, sandy silt, silty sand till, sandy silt till and silty clay till. Weathered shale was observed in one of the boreholes at deeper elevation.

Detailed descriptions of the encountered subsurface conditions from the boreholes are presented on the Borehole Logs, comprising Figures 1 to 5, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing No. 2. The engineering properties of the disclosed soils are discussed herein.

4.1 **Topsoil** (All boreholes)

All boreholes were carried out on the vacant field where the ground surface is covered with a layer of topsoil, approximately 15 to 30 cm in thickness. Thicker topsoil may be encountered beyond the borehole locations.

4.2 **Earth Fill** (Boreholes 3, 4 and 5)

Beneath the topsoil layer, a layer of earth fill, consisting of a mixture of sand, silt and clay, was encountered in three of the boreholes, extending to depths of 1.5 to 2.2 m below the prevailing ground surface.

The obtained ‘N’ values of the earth fill range from 3 to 6 blows per 30 cm of penetration, indicating that the fill is loosely placed with nominal compaction.

The natural water content of the earth fill was determined at a range from 3% to 24%, with a median of 16%, indicating generally moist conditions.

4.3 **Silt, Sandy Silt and Silty Sand** (Boreholes 1, 2, 3 and 5)

The silt, sandy silt and silty sand deposits were contacted in Borehole 1, 2, 3 and 5. It is very fine grained in texture, and interbedded with occasional gravel and silty clay layers. Grain size analyses were performed on representative samples of the silt, sandy silt and silty sand, and the results are plotted on Figures 6, 7 and 8.

The natural water content of the samples ranged from 7% to 33%, with a median of 18%, showing that the soil samples are moist to wet, generally in wet conditions.

The obtained 'N' values range from 4 to over 100, with a median of 15 blows per 30 cm of penetration, indicating that the silt, sandy silt and silty sand are loose to very dense, generally compact in relative density.

The engineering properties of the deposits are given below:

- High frost susceptibility, with high soil-adfreezing potential.
- High water erodibility, the fine particles are susceptible to migration through small opening under seepage pressure.
- The soils have high capillarity and water retention capacity.
- The shear strength is density dependent. The wet soils are susceptible to impact disturbance, while will result in soil dilation and reduction in shear strength.
- In excavation, the sand and silt will slough and run slowly with seepage from the cut face. It will boil with a piezometric head of 0.4 m.

4.4 **Sand and Gravel** (Boreholes 4 and 5)

The sand and gravel deposit was contacted in Boreholes 4 and 5 in the eastern portion of the investigated area. Grain size analysis was performed on one representative sample of the sand and gravel, and the result is plotted on Figure 9.

The natural water contents of the samples ranged from 3% to 18%, with a median of 6%, indicating the sand and gravel deposit is generally in moist condition with a wet silt layer embedded in the deposit found on Borehole 4.

The obtained 'N' values range from 34 to 46 blows per 30 cm of penetration, indicating that the deposit is dense in relative density.

The engineering properties of the sand and gravel deposit are given below:

- Low frost to relatively high in susceptibility, depending on its silt content.
- High water erodibility.
- In steep cuts, the sand and gravel will slough to its angle of repose, run with water seepage, and boil with a piezometric head of 0.4 m.

4.5 **Sandy Silt Till/Silty Sand Till** (Boreholes 1, 2 and 4)

The sandy silt till and/or silty sand till were contacted at various depths in Boreholes 1, 2 and 4. It consists of a random mixture of particle sizes ranging from clay to gravel, with sand and silt being the dominant fraction.

The natural water contents of the samples ranged from 10% to 36%, with a median of 11%, indicating the till deposit is generally in moist conditions. The high moisture is contacted near ground surface, likely due to the presence of topsoil and other organic materials.

The obtained ‘N’ values range from 3 to over 100, with a median of 22 blows per 30 cm of penetration, indicating that the till deposit is very loose to very dense, generally compact in relative density. The low ‘N’ values are generally contacted near the ground surface, likely being disturbed/weakened from weathering.

The engineering properties of the till deposit are given below:

- High frost susceptibility and low water erodibility.
- The till will be relatively stable in steep excavation; however, the sand and silt seams or layers in the till deposit may slough after prolonged exposure.

4.6 **Silty Clay Till** (Boreholes 3, 4 and 5)

The silty clay till deposit was encountered at the lower stratigraphy in Boreholes 3, 4 and 5. It consists of a random mixture of particle sizes ranging from clay to gravel, with clay being the dominant fraction.

The natural water content of the clay samples ranged from 9% to 16%, with a median of 10%, indicating generally moist conditions.

The obtained ‘N’ values range from 45 to over 100 blows per 30 cm of penetration, indicating hard in consistency.

The engineering properties of the silty clay till are listed below:

- High frost susceptibility and high soil-adfreezing potential.
- Low water erodibility.
- In excavation, the clay till will generally be stable in relatively steep slope, but will slough under prolonged exposure.

4.7 Shale

Weathered shale was contacted near the termination depth of Borehole 5. Occasional shale fragments were also observed in the silty clay till deposit in Boreholes 3 and 4, showing the presence of shale bedrock may be at deeper depth in the borehole locations.

The contacted shale deposit was fragmented and clay-shale reversion was identified, showing that the shale is weathered near the interface.

4.8 Compaction Characteristics of the Revealed Soils

The obtainable degree of compaction is primarily dependent on the soil moisture and, to a lesser extent, on the type of compactor used and the effort applied. As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 1.

Table 1 - Estimated Water Content for Compaction

Soil Type	Determined Natural Water Content (%)	Water Content (%) for Standard Proctor Compaction	
		100% (optimum)	Range for 95% or +
Existing Earth Fill	3 to 24 (median 16)	10	8 to 12
Silt, Silty Sand and Sandy Silt	11 to 33 (median 18)	12	9 to 14
Sand and Gravel	3 to 18 (median 7)	6	4 to 9
Sandy Silt Till and Silty Sand Till	10 to 36 (median 11)	12	9 to 16
Silty Clay Till	9 to 16 (median 10)	17	15 to 20

The above values showed that the till deposits are suitable for structural compaction; the other subsoils were found on the wet side of the optimum and will require aeration prior to structural compaction. Aeration can be achieved by spreading them thinly on the ground in the dry and warm weather.

The existing earth fill should be subexcavated and inspected, sorted free of organics and other deleterious material, before reusing for structural backfill.

5.0 GROUNDWATER CONDITION

The boreholes were checked for the presence of groundwater on completion of drilling. The groundwater was recorded at 5.5 to 5.8 m, or at El. 275.9 m and El. 277.3 m, in Boreholes 2 and 3 respectively. The remaining boreholes were dry upon completion. The records are plotted on the Borehole Logs and summarized in Table 2.

Table 2 - Groundwater Levels (On Completion of Drilling)

Borehole No.	**Ground Elevation (m)**	**Borehole Depth (m)**	**Measured Groundwater Level Upon Completion**	
			Depth (m)	**El. (m)**
1	285.8	6.3	Dry	
2	281.7	6.4	5.8	275.9
3	282.8	6.2	5.5	277.3
4	277.2	6.6	Dry	
5	287.6	6.2	Dry	

Subsequently, the groundwater level was recorded in the monitoring wells and the data are summarized in Table 3 and included in the hydrogeological assessment under separate cover.

Table 3 - Groundwater Levels in Monitoring Wells

Well No.	**Ground Elevation (m)**	**Well Depth (m)**	**January 31, 2023**		**March 2, 2023**		**April 3, 2023**	
			Depth (m)	**El. (m)**	**Depth (m)**	**El. (m)**	**Depth (m)**	**El. (m)**
1	285.81	6.1	3.04	282.77	2.14	283.67	1.13	284.68
2	281.75	6.1	3.52	278.23	2.20	279.55	0.66	281.09
3	282.83	6.2	3.56	279.27	2.78	280.05	2.11	280.72
4	277.25	6.1	4.93	272.32	4.17	273.08	3.42	273.83
5	287.64	6.2	2.07	276.57	1.39	277.25	0.93	277.71

Groundwater was recorded between 0.66 m and 4.93 m below the prevailing ground surface, or between El. 272.32 m and El. 284.68 m, representing the groundwater regime of the subject site and is subject to seasonal fluctuations. Detailed groundwater condition within the investigated area will be discussed in the hydrogeological assessment, under separate cover.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation revealed that beneath the topsoil, and a layer of earth fill or weathered soil, the site is underlain by strata of silt, silty sand, sandy silt, silty sand till, sandy silt till and silty clay till. Weathered shale was observed in one of the boreholes at deeper elevation.

Groundwater was recorded between 0.66 m and 4.93 m below the prevailing ground surface, or between El. 272.32 m and El. 284.68 m, representing the groundwater regime of the subject site and is subject to seasonal fluctuations.

Based on the preliminary development plan prepared by Candevcon Limited, the area will be developed into 13 single detached dwelling lots and an open space at Block 1A and a stormwater management (SWM) pond at Block 2. The geotechnical findings which warrant special consideration are presented below:

1. Prior to construction, all vegetation and topsoil must be removed for site development. They can only be reused for landscape purpose. Any surplus must be removed off site.
2. The existing earth fill is not suitable for supporting the proposed structure at its current state. The earth fill should be subexcavated, sorted free of organics and/or deleterious materials, prior to be reused for structural backfill or engineered fill constructions.
3. Where additional fill is required for site grading, the earth fill can be constructed in accordance with the engineering fill specifications for supporting the foundation, underground services, and pavement construction.
4. The proposed structures can be constructed on conventional spread and strip footings founded on the undisturbed native soils or on engineered fill below the frost penetration depth. The foundation subgrade must be inspected by the geotechnical engineer or a senior geotechnical technician to ensure that the revealed conditions are compatible with the foundation design requirements.

The recommendations appropriate for the project described in Section 2.0 are presented herein. One must be aware that the subsurface conditions may vary between boreholes. Should this become apparent during construction, a geotechnical engineer must be consulted to determine whether the following recommendations require revision.

6.1 **Site Preparation**

Where additional fill is required for site grading, the earth fill can be constructed in accordance with the engineering fill specifications for supporting the foundation, underground services, and pavement construction. The engineering requirements for a certifiable fill are presented below:

1. The topsoil and vegetation must be stripped. The existing earth fill and weathered soil should also be removed and examined. Any topsoil and deleterious material must be segregated and removed before reuse for structural backfill. The exposed soil subgrade must be inspected and proof-rolled prior to any fill placement. Any loose material identified during proof-rolling must be further subexcavated and backfilled with organic free material, compacted to engineered fill specifications.
2. Inorganic soils must be used for the engineered fill construction, and they must be uniformly compacted in lifts of 20 cm thick to at least 98% of their maximum Standard Proctor dry density (SPDD) with its moisture content controlled near its optimum. If the foundations are to be built soon after the fill placement, the densification process for the engineered fill must be increased to 100% SPDD.
3. If the engineered fill is compacted with the moisture content on the wet side of the optimum, the underground services and pavement construction should not begin until the pore pressure within the fill mantle has completely dissipated. This must be further assessed at the time of the engineered fill construction.
4. If imported fill is to be used, it should be inorganic soils, free of any deleterious material with environmental issue (contamination). Any potential imported earth fill from off-site must be reviewed for geotechnical and environmental quality by the appropriate personnel as authorized by the developer or agency, before it is hauled to the site.
5. The engineered fill must not be placed during the period where freezing ambient temperatures occur either persistently or intermittently. This is to ensure that the fill is free of frozen soils, ice and snow. If the fill is to be left over the winter months, adequate earth cover, or equivalent, must be provided for protection against frost action.
6. The fill operation must be supervised and inspected on a full-time basis by a geotechnical technician under the direction of a geotechnical engineer.
7. The engineered fill envelope and finished elevations must be clearly and accurately defined in the field, and they must be precisely documented.
8. Foundations founded on engineered fill must be properly reinforced. It should be designed by a structural engineer to allow distribution of stress induced by the abrupt differential settlement (about 20 mm) in engineered fill.

9. The footing, slab-on-grade and underground services subgrade must be inspected by the geotechnical consulting firm which supervised the engineered fill placement. This is to ensure that the foundations and service pipes are placed within the engineered fill envelope, and the integrity of the fill has not been compromised by interim construction, environmental degradation and/or disturbance by any excavation.
10. Any excavation carried out in certified engineered fill must be reported to the geotechnical consultant who supervised the fill placement in order to document the locations of excavation and/or to supervise reinstatement of the excavated areas to engineered fill status. If construction on the engineered fill does not commence within a period of 2 years from the date of certification, the condition of the engineered fill must be assessed for re-certification.

6.2 Foundations

The proposed structures can be supported on conventional spread and strip footings, founded on engineered fill or competent native soil, at a depth at least 1.2 m below the proposed finished grade. The recommended soil bearing pressures for the design of conventional footings are presented below:

- Maximum Soil Bearing Pressure, at Serviceability Limit State (SLS) = 150 kPa
- Factored Ultimate Bearing Pressure, at Ultimate Limit State (ULS) = 200 kPa

The total and differential settlements of the conventional spread and strip footings, designed for the bearing pressure at SLS, are estimated to be 25 mm and 20 mm, respectively.

The foundation subgrade must be inspected by either a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, to ensure that the revealed conditions are compatible with the design of the foundation.

It should be noted that if water seepage is encountered during footing excavations, or where the foundation subgrade is found to be wet, the subgrade should be protected by a concrete mud-slab immediately after exposure. This will prevent construction disturbance and costly rectification.

Footings exposed to weathering or in unheated areas should have at least 1.2 m of earth cover for protection against frost action.

The building foundation must meet the requirements specified in the latest Ontario Building Code. As a guide, the structure should be designed to resist an earthquake force using Site Classification ‘D’ (stiff soil).

6.3 **Basement Structure and Slab-On-Grade Construction**

For structures with a basement, the perimeter walls should be designed to sustain a lateral earth pressure calculated using the soil parameters stated in Section 6.7. Any applicable surcharge loads adjacent to the basement must also be considered in the wall design.

The basement structure should be damp-proofed and provided with a drainage system (Drawing No. 3) at the wall base. The subdrains should be encased in a fabric filter to protect them against blockage by silting.

The floor subgrade should consist of sound native soil or well compacted inorganic earth fill. It must be inspected and proof-rolled prior to the placement of granular bedding. Any weak spots must be subexcavated and replaced with inorganic earth fill compacted to at least 98% SPDD in lifts no more than 20 cm in thickness. The floor slab should be constructed on granular bedding, at least 15 cm thick, consisting of 19-mm Crusher-Run Limestone (CRL), or equivalent, compacted to 100% SPDD.

The existing grade around the building structure must be such that it directs runoff away from the structure.

6.4 **Underground Services**

The subgrade for the underground services should be found on sound native soils or properly compacted, inorganic earth fill. A Class ‘B’ bedding, consisting of compacted 19-mm CRL, or equivalent, is recommended for the underground service construction.

The pipe joints connecting into the manholes and catch basins must be leak-proof to prevent the migration of fines through the joints. Openings to subdrains and catch basins should be shielded with a fabric filter to prevent blockage by silting.

A soil cover having a thickness equal to the diameter of the pipe, should be in place at all times after pipe installation to prevent pipe floatation when the trench is deluged with water derived from precipitation.

The on-site soil is corrosive to ductile iron pipes and metal fittings; therefore, they should be protected against soil corrosion. For estimation for the anode weight requirements, the electrical resistivities of the disclosed soils can be used. The proposed anode weight must meet the minimum requirements as specified by the municipality standard.

6.5 Backfilling in Trenches and Excavated Areas

Some of the on-site inorganic soils are suitable for trench backfill; however, any wet soil will require aeration prior to its use as structural backfill. The backfill material should be inorganic soils, free of boulders or oversized rock pieces (over 15 cm in size), compacted to at least 95% SPDD in lifts no more than 20 cm in thickness, or the thickness should be determined by test strips.

In the zone within 1.0 m below the pavement subgrade or slab-on-grade, the backfill should be compacted to at least 98% SPDD, with the water content at 2% to 3% drier than the optimum.

The narrow trenches should be cut at 1 vertical:2 or + horizontal so that the backfill can be effectively compacted. Otherwise, soil arching will prevent the achievement of proper compaction.

In normal sewer construction practice, the problem areas of ground settlement largely occur adjacent to manholes, catch basins and services crossings, foundation walls and columns. In areas which are inaccessible to a heavy compactor, sand backfill should be used and compacted with lighter equipment.

6.6 Pavement Design

The recommended pavement design for local residential road is presented in Table 4.

Table 4 - Pavement Design for Local Road

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL3
Asphalt Binder	65	HL8
Granular Base	150	Granular ‘A’ or equivalent
Granular Sub-base	300	Granular ‘B’ or equivalent

In preparation of pavement subgrade, any topsoil and compressible material should be removed. The final subgrade must be proof-rolled and inspected. Any soft spot identified must be rectified by subexcavation and replacing with selected inorganic material. In zone within 1.0 m below the pavement subgrade must be compacted to at least 98% SPDD, with the water content at 2% to 3% drier than its optimum. All the granular bases should be compacted to 100% SPDD.

The pavement subgrade will suffer a strength regression if water is allowed to saturate the mantle. The following measures should, therefore, be incorporated in the construction procedures and pavement design:

- The subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained prior to pavement construction.
- Areas adjacent to the pavement should be properly graded to prevent water ponding. Otherwise, the water will seep into the subgrade mantle and induce a regression of the subgrade strength, with costly consequences for the pavement construction.
- Fabric filter-encased curb subdrains connecting to a positive outlet of catch basin, will be required at the edge of the pavement.
- If the pavement is to be constructed during wet seasons, wet or soft subgrade may occur and should be properly rectified. Alternatively, the granular sub-base can be thickened to compensate for the inadequate strength of the subgrade. This can be assessed during construction.

6.7 Stormwater Management Pond (Block 2)

A SWM pond is proposed at Block 2, located at the southeast portion of the subject site. Preliminary design of the SWM pond is provide and illustrated on Drawing No. 4.

It is noted that Borehole 4 was completed within the footprint of the SWM block, where the subsoil generally consists of sand and gravel. The highest groundwater was recorded at 3.42 m below grade or El. 273.83 m. With reference to the preliminary servicing plan, the bottom of the pond will be at El. 275.25 m, where bottom of the pond will be at least 1.4 m above the highest measured groundwater. Due to the pervious subgrade condition, a clay liner, having a minimum thickness of 1.0 m, will be required for water retention purpose.

For construction of the clay liner, inorganic material having at least 30% clay content must be considered. It should be placed in lifts no more than 20 cm in thickness, and compacted to at least 98% SPDD.

Where the source of clay is not available, geosynthetic clay liner (GCL) should be considered. To secure the GCL in place, a ballast having the same thickness as the clay liner will be required. The installation of the GCL and placement of the ballast should be completed in accordance to the manufacturer's specifications and guidelines.

The pond side slopes will be graded to 4H:1V and 3H:1V, which is generally considered geotechnically stable. All exposed slopes must be vegetated and/or sodded to prevent surface erosion.

The inlet, outlet and control structures should be designed in accordance with the recommendations in Section 6.2. The footings must be placed below the scouring depth or the frost depth, whichever is deeper. The inlet and outlet structures must be lined with gabion mats or rip rap for protection against scouring.

6.8 Soil Parameters

The recommended soil parameters for the project design are given in Table 5.

Table 5 - Soil Parameters

Unit Weight and Bulk Factor	**Unit Weight γ (kN/m^3)**		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Existing Earth Fill	20.5	10.5	12.5	1.00
Silt, Silty Sand, Sandy Silt	20.5	10.5	1.20	1.00
Sand and Gravel	20.0	10.0	1.20	0.98
Sandy Silt Till, Silty Sand Till	22.5	12.5	1.33	1.00
Silty Clay Till	22.0	12.0	1.30	1.03

Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_0**	**Passive K_p**
Compacted Earth Fill	0.36	0.53	2.77
Silt, Silty Sand, Sandy Silt	0.32	0.48	3.12
Sand and Gravel	0.29	0.46	3.39
Sandy Silt Till, Silty Sand Till, Silty Clay Till	0.33	0.50	3.00

Table 5 – Soil Parameters (cont’d)

Estimated Coefficient of Permeability (K) and Percolation Time (T)	**K (cm/sec)**	**T (min/cm)**
Silt, Silty Sand, Sandy Silt	10^{-4} to 10^{-5}	12 to 20
Sand and Gravel	10^{-3}	8
Sandy Silt Till, Silty Sand Till	10^{-5} to 10^{-6}	20 to 50
Silty Clay Till	10^{-7}	Over 80
Coefficients of Friction		
Between Concrete and Granular Base	0.50	
Between Concrete and Sound Native Soils	0.35	

6.9 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. The types of soils are classified in Table 6.

Table 6 - Classification of Soils for Excavation

Material	Type
Sound Till, Weathered Shale	2
Earth Fill/Drained Soils, Sand and Gravel	3
Saturated soils	4

Though shale bedrock is contacted in 1 borehole, the bedrock topography is not determined within the subject site. The thickness of the overburden appeared to vary greatly within the subject site. Based on the information provided, it is unlikely that any excavation within the development will extend to the shale bedrock.

Water seepage can be expected during excavation into the sand and silt deposits. Depending on the rate and quantity, extensive dewatering may be required. This should be confirmed with the hydrogeologist.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of 2868577 Ontario Inc., and for review by its designated consultants and government agencies. Use of this report is subject to the conditions and limitations of the contractual agreement.

The material in the report reflects the judgement of Poh Fung (Derek) Kwok, M.Sc., and Kin Fung Li, P.Eng., in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of such Third Parties. Soil Engineers Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

SOIL ENGINEERS LTD.

LICENSED PROFESSIONAL ENGINEER
March 5, 2024
K. F. LI
100169280
PROVINCE OF ONTARIO

Poh Fung (Derek) Kwok, M.Sc.
PFK/KFL

Kin Fung Li, P.Eng.

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS	Auger sample
CS	Chunk sample
DO	Drive open (split spoon)
DS	Denison type sample
FS	Foil sample
RC	Rock core (with size and percentage recovery)
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows per each 30 cm of penetration of a 51 mm diameter, 90° point cone driven by a 63.5 kg hammer falling from a height of 76 cm.

Plotted as '—●—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 63.5 kg hammer falling from a height of 76 cm required to advance a 51 mm outer diameter drive open sampler 30 cm into undisturbed soil, after an initial penetration of 15 cm.

Plotted as '○'

WH	Sampler advanced by static weight
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
NP	No penetration

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/30 cm)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

Cohesive Soils:

Undrained Shear Strength (kPa)	'N' (blows/30 cm)	Consistency
less than 12	less than 2	very soft
12 to 25	2 to 4	soft
25 to 50	4 to 8	firm
50 to 100	8 to 15	stiff
100 to 200	15 to 30	very stiff
over 200	over 30	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0	Field vane test in borehole; the number denotes the sensitivity to remoulding
△	Laboratory vane test

METRIC CONVERSION FACTORS

1 ft = 0.3048 m
1 inch = 25.4 mm
1 lb = 0.454 kg
1 ksf = 47.88 kPa

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LOG OF BOREHOLE: 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Residential Development

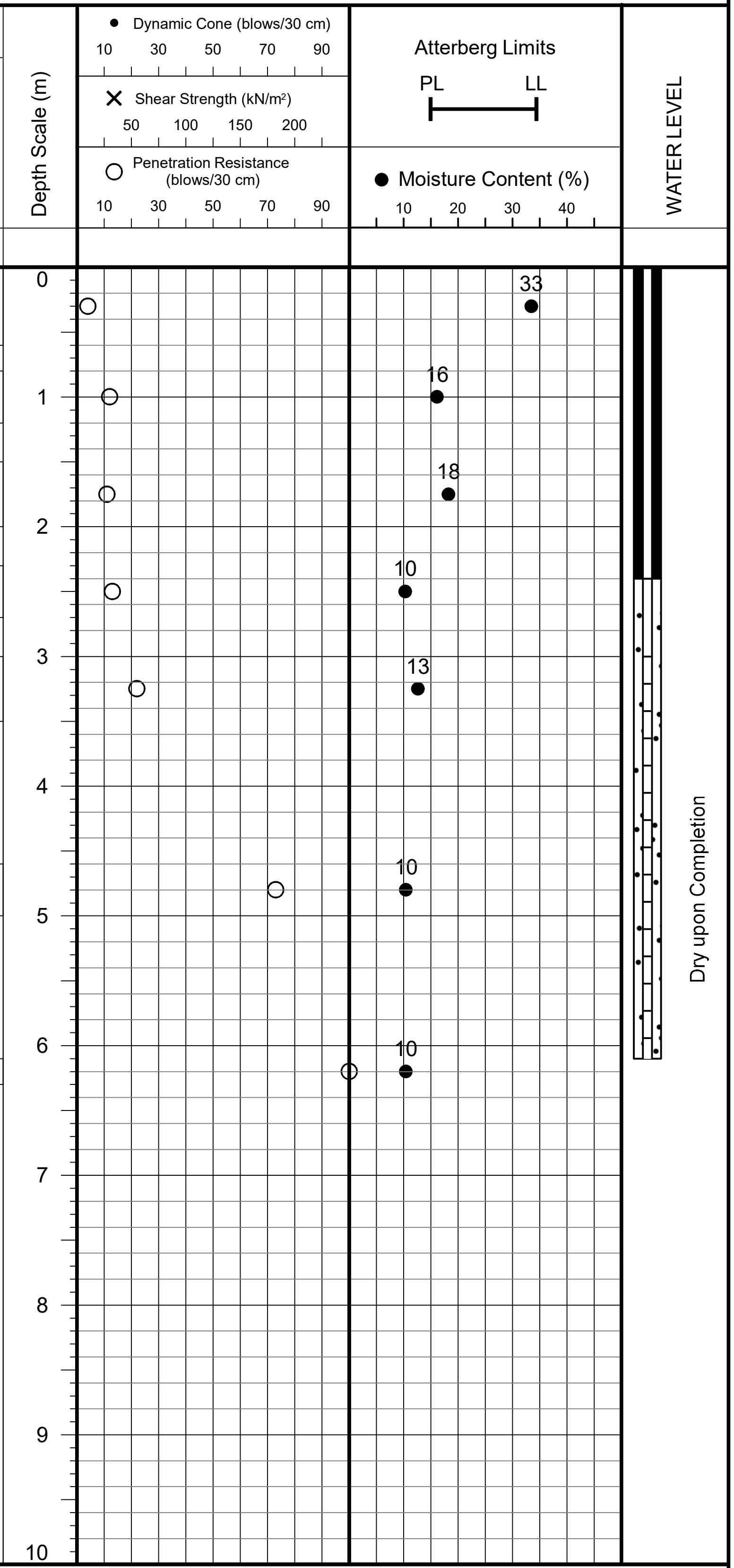
METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: 15544 McLaughlin Road, Town of Caledon

DRILLING DATE: Janaury 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
285.8	Ground Surface			
0.0	**30 cm Topsoil** Brown, loose to compact weathered **SANDY SILT** a trace of clay occ. gravel	1	DO	4
		2	DO	12
		3	DO	11
283.6 2.2	Brown, compact to very dense **SANDY SILT TILL / SILTY SAND TILL** a trace of clay some gravel to gravelly	4	DO	13
		5	DO	22
		6	DO	73
		7	DO	50/15
279.5 6.3	**END OF BOREHOLE**			

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3 m PVC slotted screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument casing



JOB NO.: 2301-S042

LOG OF BOREHOLE: 2

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

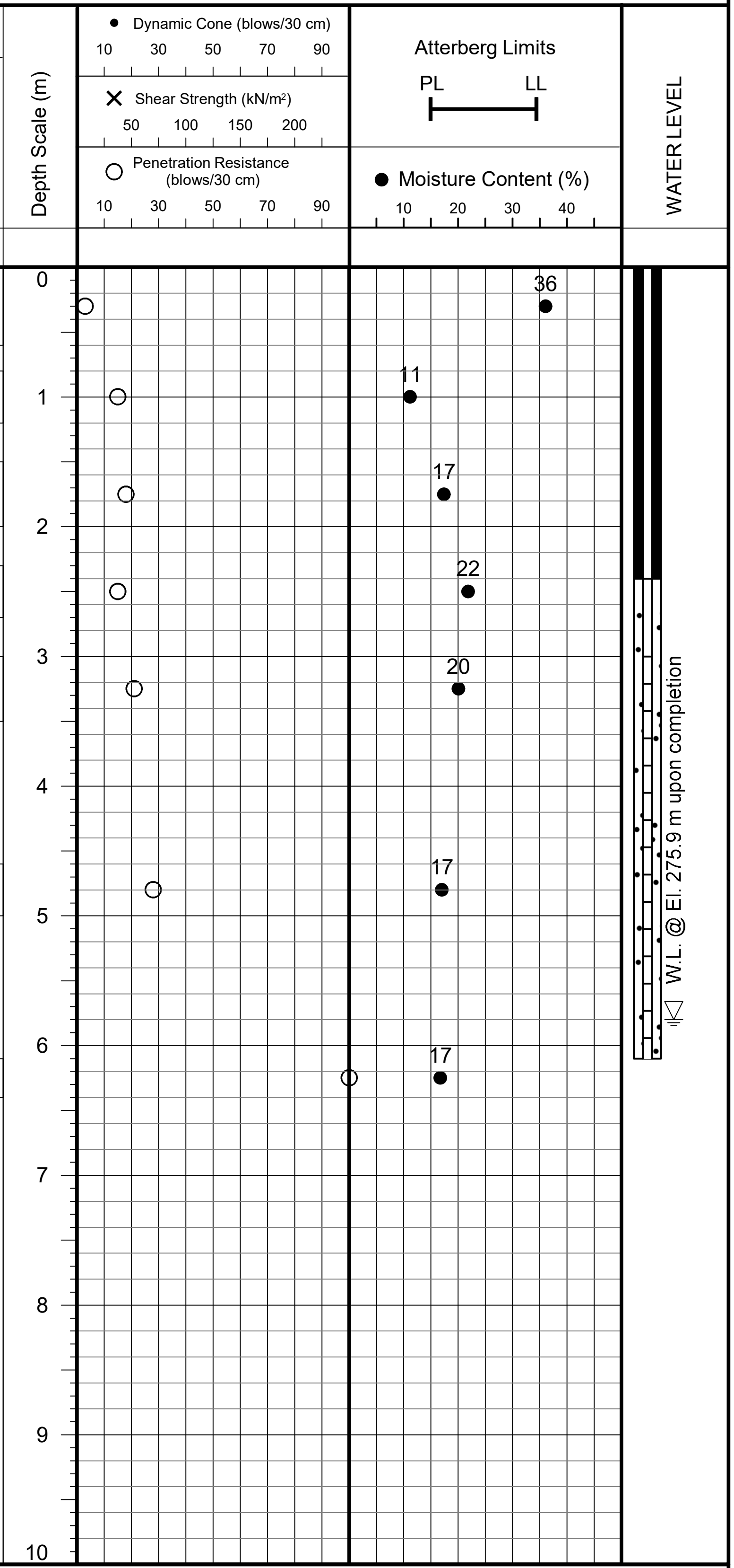
METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: 15544 McLaughlin Road, Town of Caledon

DRILLING DATE: Janaury 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
281.7	Ground Surface			
0.0	**25 cm Topsoil**	1	DO	3
	Brown, very loose to compact **SANDY SILT TILL** traces of clay and gravel weathered	2	DO	15
		3	DO	18
280.0 1.7	Brown, compact to very dense **SILT** very moist to wet a trace to some sand	4	DO	15
		5	DO	21
		6	DO	28
	occ. cobbles a trace of gravel	7	DO	50/15
275.3 6.4	**END OF BOREHOLE**			

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3 m PVC slotted screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument casing



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JOB NO.: 2301-S042

LOG OF BOREHOLE: 3

FIGURE NO.: 3

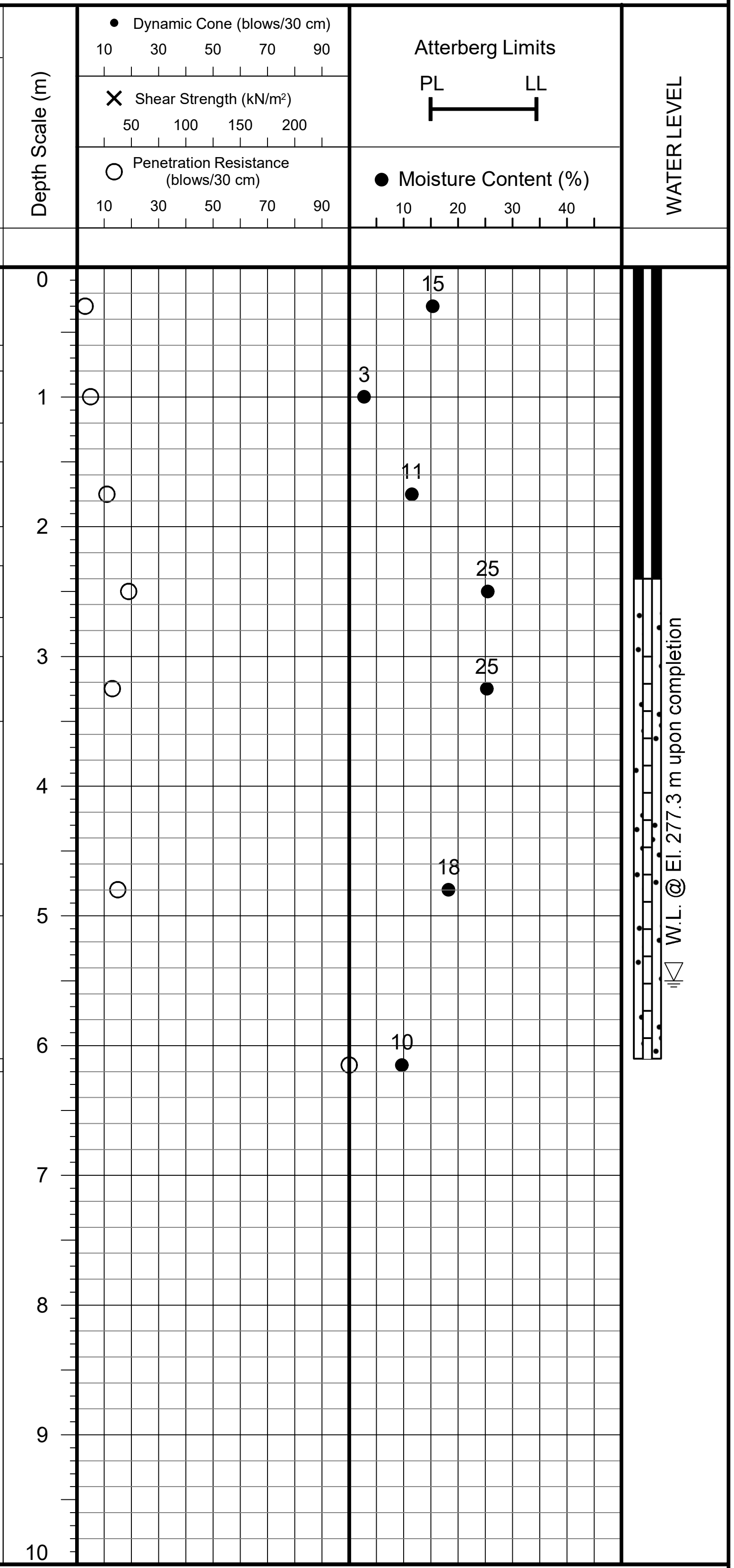
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: 15544 McLaughlin Road, Town of Caledon

DRILLING DATE: Janaury 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
282.8	Ground Surface			
0.0	**20 cm Topsoil**	1	DO	3
	Dark brown **EARTH FILL** sand, some silt occ. topsoil inclusion occ. organics and rootlets	2	DO	5
281.3 1.5	Brown, compact **SILTY SAND** occ. silty clay layers	3	DO	11
280.5 2.3	Brown, compact, wet **SILT** traces of clay and gravel	4	DO	19
		5	DO	13
278.8 4.0	Brown, compact **SANDY SILT** a trace of clay occ. gravel	6	DO	15
277.2 5.6	Brown, hard **SILTY CLAY TILL** occ. shale fragments	7	DO	50/3
276.6 6.2	**END OF BOREHOLE**			



Installed 50 mm Ø monitoring well to 6.1 m
completed with 3 m PVC slotted screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument casing

Soil Engineers Ltd.

JOB NO.: 2301-S042

LOG OF BOREHOLE: 4

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Residential Development

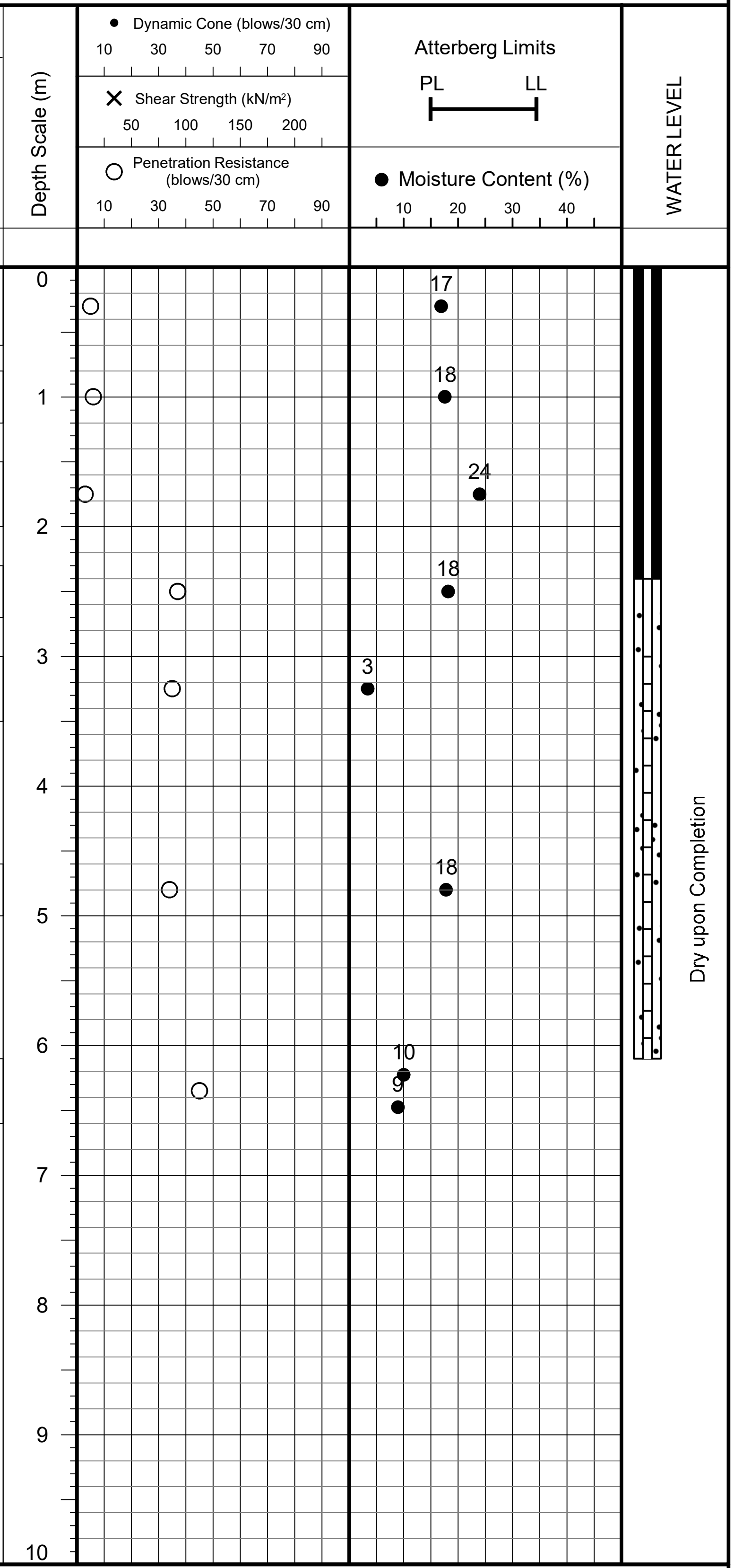
METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: 15544 McLaughlin Road, Town of Caledon

DRILLING DATE: Janaury 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
277.2	Ground Surface			
0.0	**20 cm Topsoil**			
	Dark brown **EARTH FILL** mixture of sand, silt and clay a trace of gravel occ. topsoil inclusion occ. organics and rootlets	1	DO	5
		2	DO	6
		3	DO	3
275.0 2.2	Brown, dense — — — silty **SAND AND GRAVEL** a trace to some silt	4	DO	37
		5	DO	35
272.4 4.8	Brown, dense **SANDY SILT TILL** traces of clay and gravel	6	DO	34
		7A	DO	45
270.9 6.3	Brown, hard **SILTY CLAY TILL**	7B		
270.6 6.6	**END OF BOREHOLE**			

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3 m PVC slotted screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument casing



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JOB NO.: 2301-S042

LOG OF BOREHOLE: 5

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

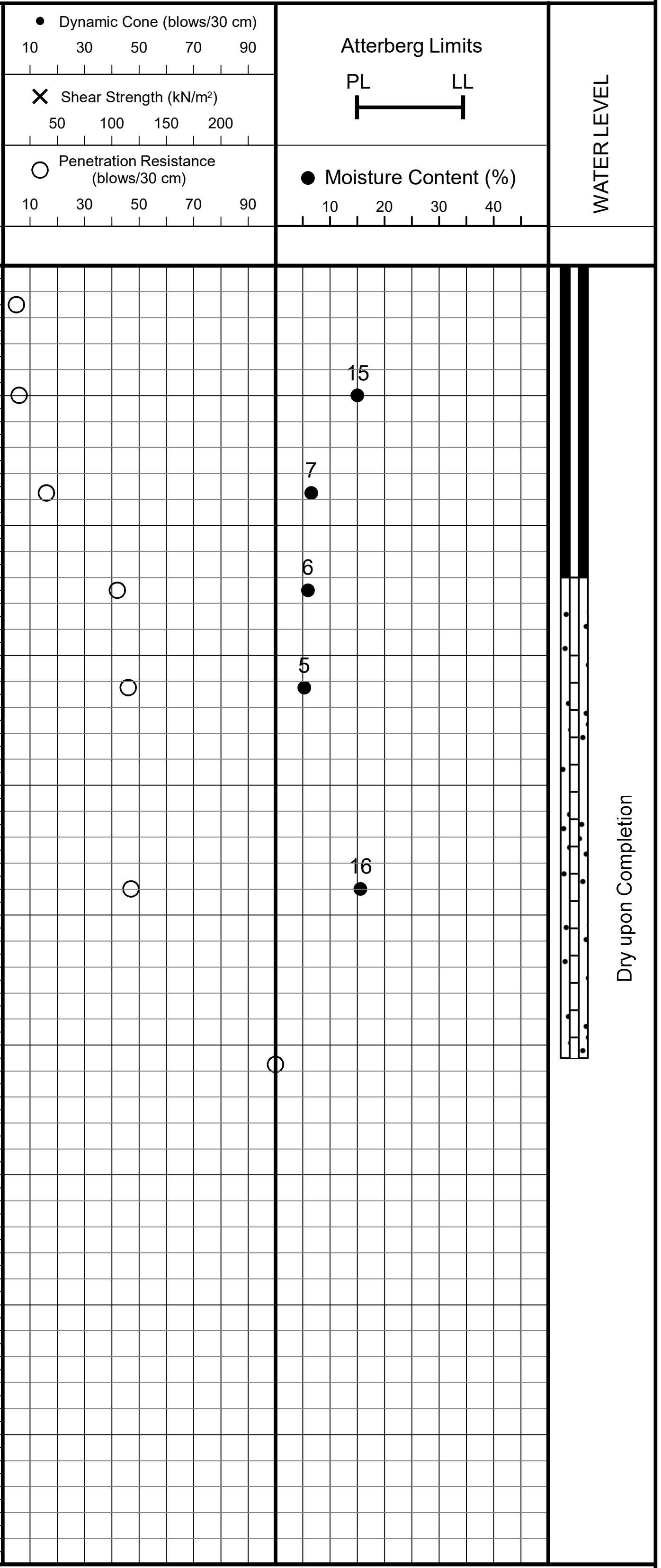
METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: 15544 McLaughlin Road, Town of Caledon

DRILLING DATE: Janaury 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
278.6	Ground Surface				
0.0	**15 cm Topsoil**				0
	Dark brown **EARTH FILL** sand, some silt to silty occ. topsoil inclusion occ. organics and rootlets	1	DO	5	
		2	DO	6	1
277.1 1.5	Brown, compact **SILTY SAND** a trace of clay	3	DO	16	2
276.3 1.5	Brown, dense **SAND AND GRAVEL** a trace to some silt	4	DO	42	
		5	DO	46	3
274.6 4.0	Brown, hard **SILTY CLAY TILL** a trace of gravel	6	DO	47	4 5
272.9 5.7	Grey, weathered **SHALE** water seepage	7	DO	50/3	6
272.4 6.2	**END OF BOREHOLE**				7 8 9 10

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3 m PVC slotted screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument casing



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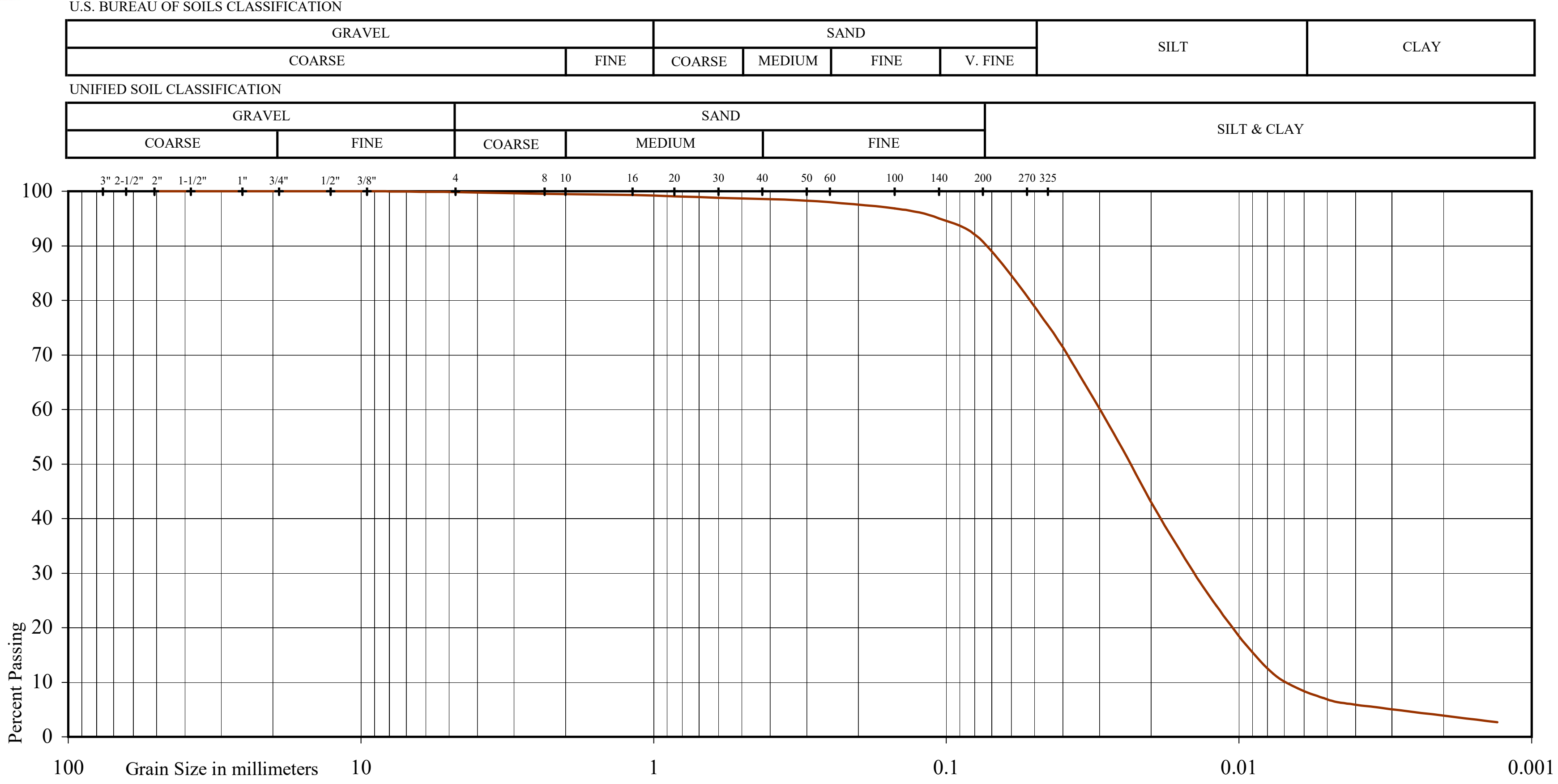
GRAIN SIZE DISTRIBUTION

Reference No: 2301-S042



Project: Proposed Residential Development

Location: 15544 McLaughlin Road, Town of Caledon

Borehole No: 2

Sample No: 5

Depth (m): 3.3

Elevation (m): 278.5

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 20

Estimated Permeability

(cm./sec.) = 10^{-4}

Classification of Sample [& Group Symbol]: SILT

traces of clay and sand

Figure: 6

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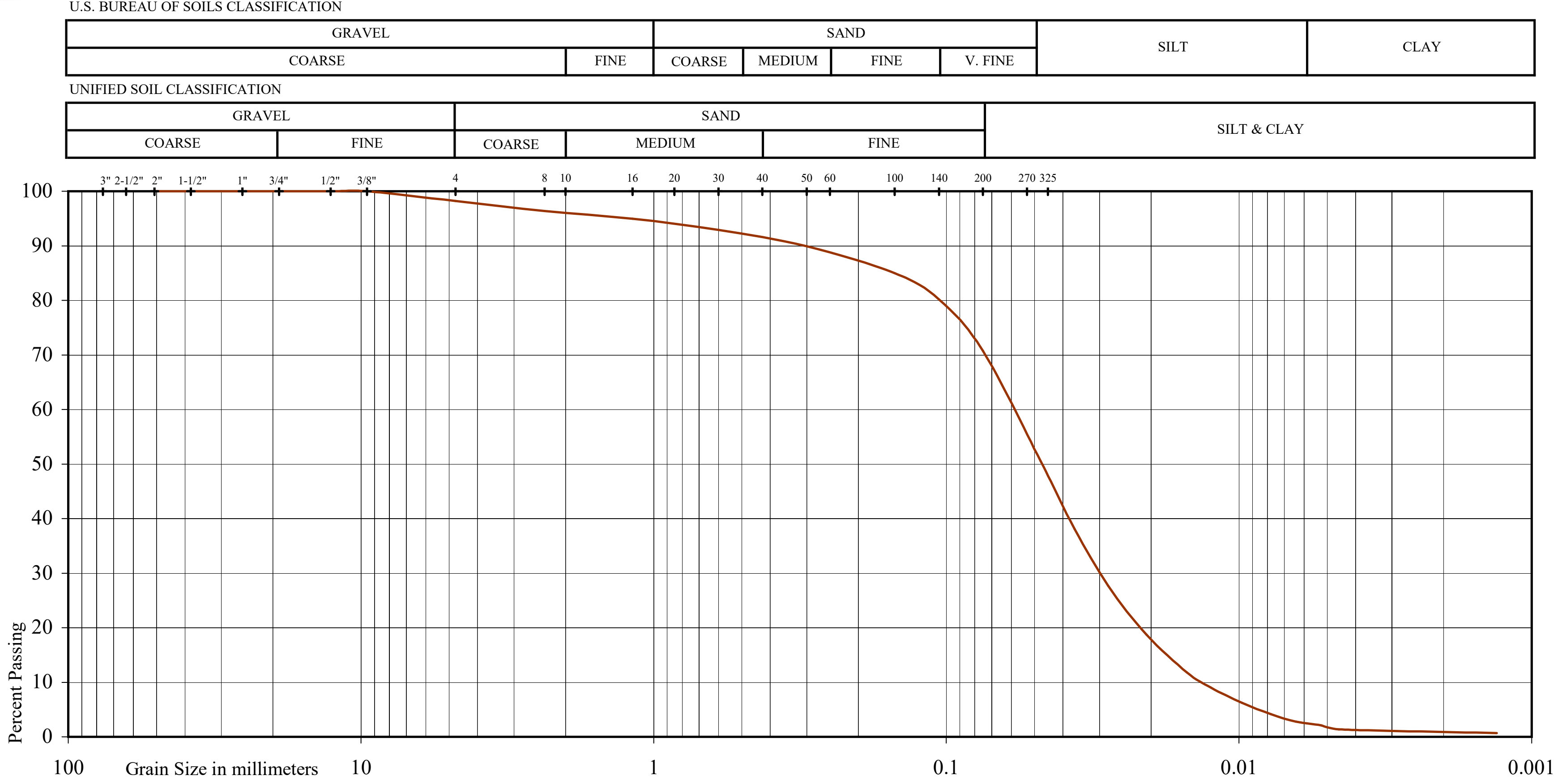
GRAIN SIZE DISTRIBUTION

Reference No: 2301-S042



Project: Proposed Residential Development

Location: 15544 McLaughlin Road, Town of Caledon

Borehole No: 3

Sample No: 6

Depth (m): 4.8

Elevation (m): 278.0

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 18

Estimated Permeability (cm./sec.) = 10^{-4}

Classification of Sample [& Group Symbol]: SANDY SILT

a trace of clay and occ. gravel

Figure: 7

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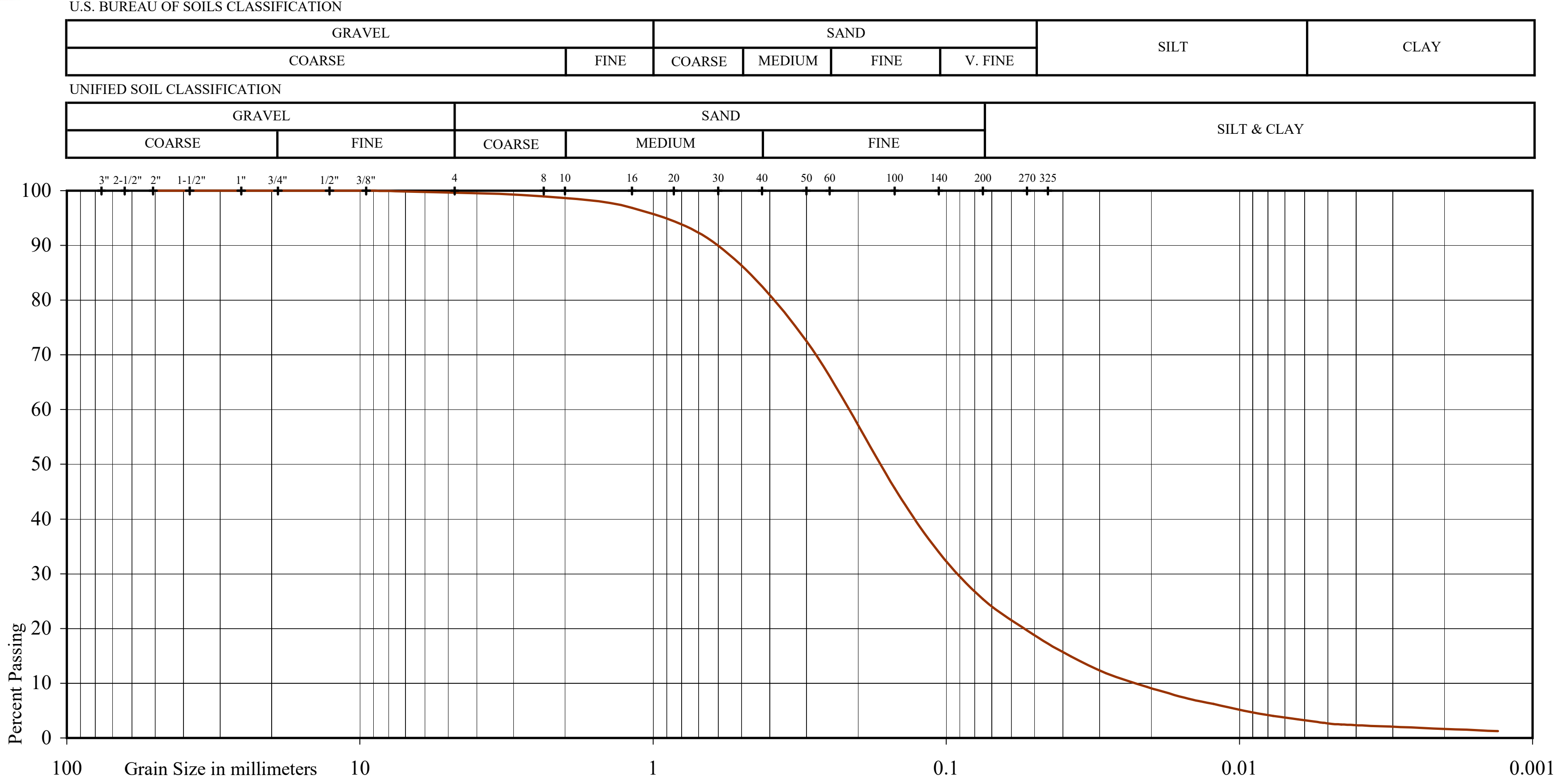
GRAIN SIZE DISTRIBUTION

Reference No: 2301-S042



Project: Proposed Residential Development

Location: 15544 McLaughlin Road, Town of Caledon

Borehole No: 5

Sample No: 3

Depth (m): 1.8

Elevation (m): 276.9

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 7

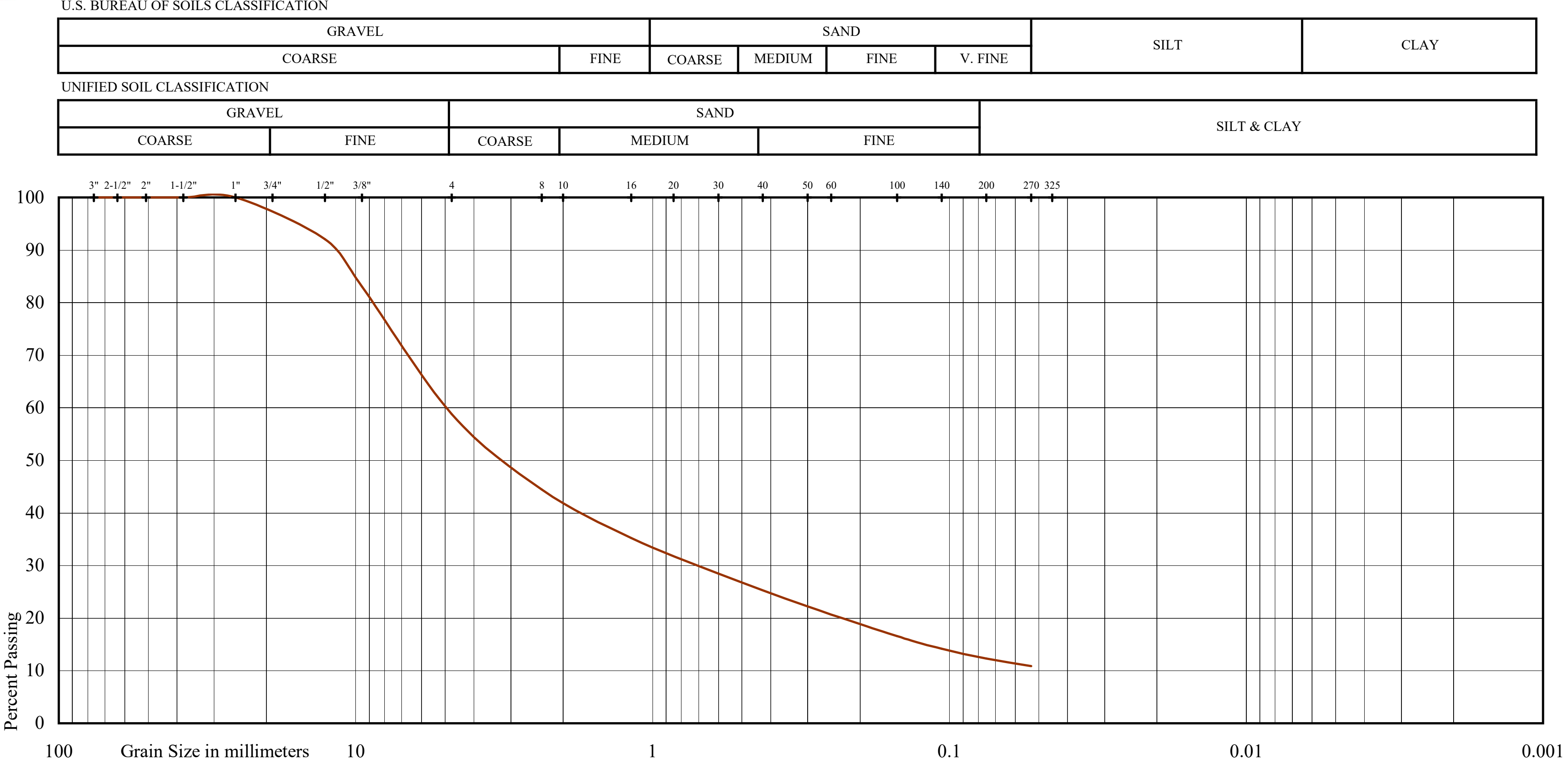
Estimated Permeability (cm./sec.) = 10^{-3}

Classification of Sample [& Group Symbol]: SILTY SAND
a trace of clay

Figure: 8

GRAIN SIZE DISTRIBUTION

Reference No: 2301-S042



Project: Proposed Residential Development

Location: 15544 McLaughlin Road, Town of Caledon

Liquid Limit (%) = -

Plastic Limit (%) = -

Borehole No: 4

Plasticity Index (%) = -

Sample No: 5

Moisture Content (%) = 3

Depth (m): 3.3

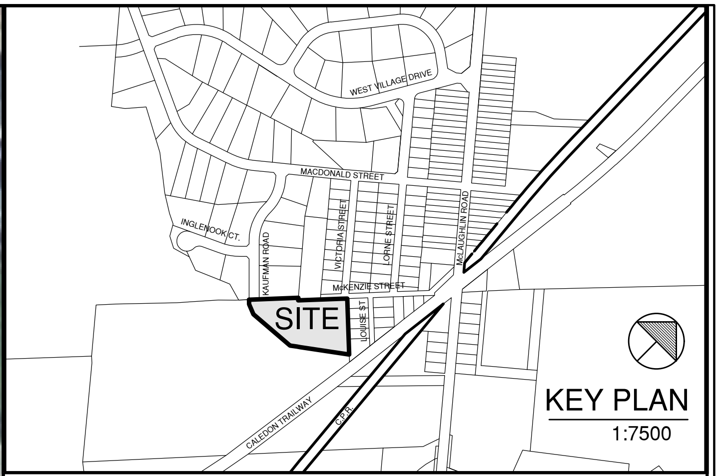
Estimated Permeability

Elevation (m): 274.0

(cm./sec.) = 10^{-3}

Classification of Sample [& Group Symbol]: SAND AND GRAVEL
some silt

Figure: 9



KEY PLAN
1:7500

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CONSULTING ENGINEERS
GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

Borehole and Monitoring Well Location Plan

SITE: 15544 McLaughlin Road, Town of Caledon

DESIGNED BY: P.K.	**CHECKED BY:** K.L.	**DWG NO.:** 1	
SCALE: 1:1000	**REF. NO.:** 2301-S042	**DATE:** February 2024	**REV** A

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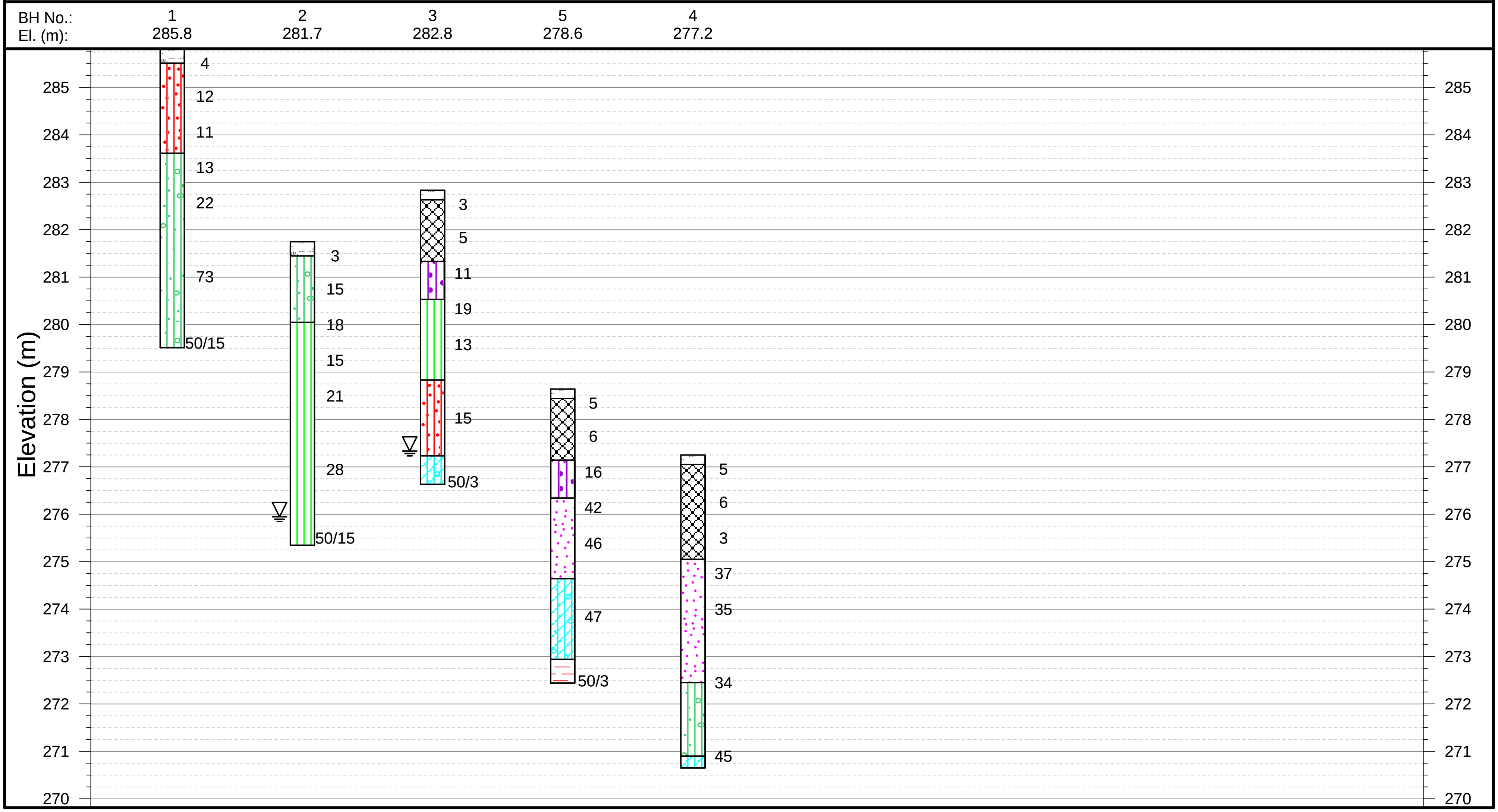
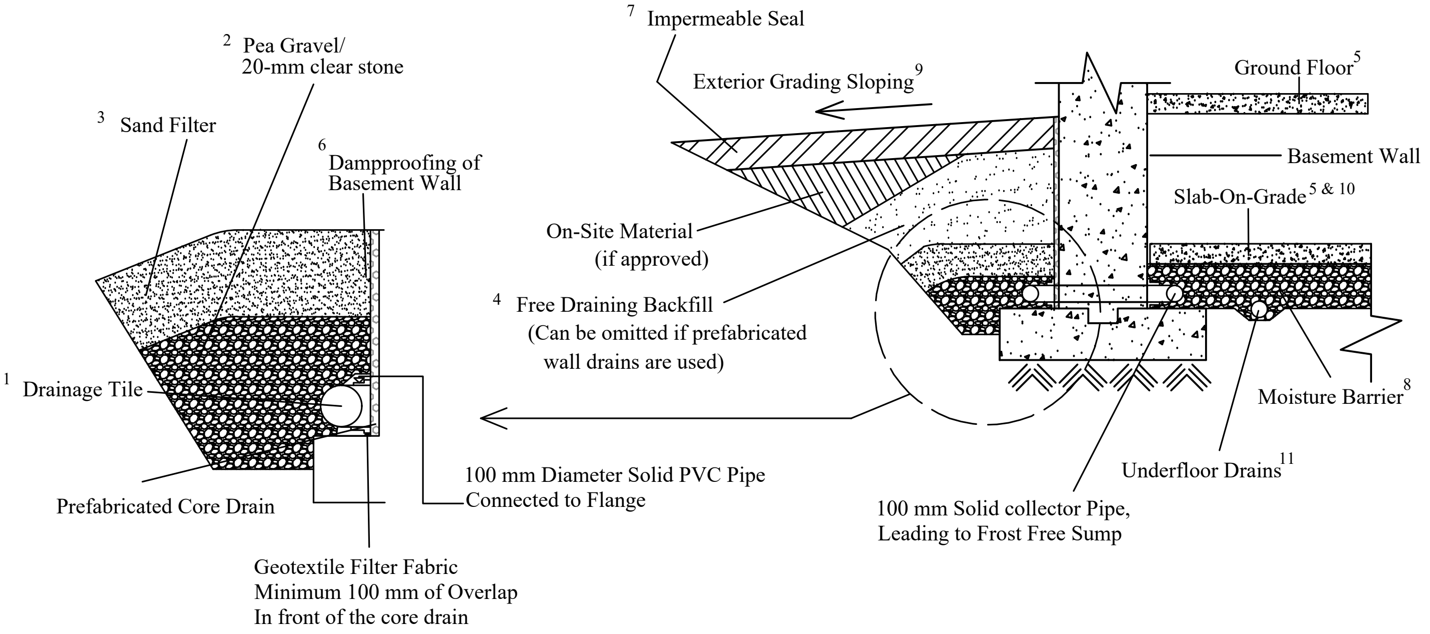
SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 2301-S042
REPORT DATE: March 2023
PROJECT DESCRIPTION: Proposed Residential Development
PROJECT LOCATION: 15544 McLaughlin Road, Town of Caledon

LEGEND

- ▩ FILL
- ▥ SANDY SILT TILL
- ▥ SILT
- ▥ SILTY SAND
- ▨ SAND
- ▤ SHALE
- ▨ SILTY CLAY TILL
- ▤ TOPSOIL
- ▥ SANDY SILT
- ∇ WATER LEVEL (END OF DRILLING)





NOTES:

1. **Drainage tile**: consists of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Invert to be at minimum of 150 mm (6") below underside of basement floor slab.

2. **Pea gravel**: at 150 mm (6") on the top and sides of drain. If drain is not placed on concrete footing, provide 100 mm (4") of pea gravel below drain. The pea gravel may be replaced by 20 mm clear stone provided that the drain is covered by a porous geotextile membrane of Terrafix 270R or equivalent.

3. **Filter material**: consists of C.S.A. fine concrete aggregate. A minimum of 300 mm (12") on the top and sides of gravel. This may be replaced by an approved porous geotextile membrane of Terrafix 270R or equivalent.

4. **Free-draining backfill**: OPSS Granular 'B' or equivalent, compacted to 95% to 98% (maximum) Standard Proctor dry density. Do not compact closer than 1.8 m (6') from wall with heavy equipment. This may be replaced by on-site material if prefabricated wall drains (Miradrain) extending from the finished grade to the bottom of the basement wall are used.

5. **Do not backfill** until the wall is supported by the basement floor slab and ground floor framing, or adequate bracing.

6. **Dampproofing** of the basement wall is required before backfilling

7. **Impermeable backfill seal** of compacted clay, clayey silt or equivalent. If the original soil in the vicinity is a free-draining sand, the seal may be omitted.

8. **Moisture barrier**: 19-mm CRL or compacted OPSS Granular 'A', or equivalent. The thickness of this layer should be 150 mm (6") minimum.

9. **Exterior Grade**: slope away from basement wall on all the sides of the building.

10. **Slab-On-Grade** should not be structurally connected to walls or foundations.

11. **Underfloor drains*** should be placed in parallel rows at 6 to 8 m (20'-25') centre, on 100 mm (4") of pea gravel with 150 mm (6") of pea gravel on top and sides. The spacing should be at least 300 mm (12") between the underside of the floor slab and the top of the pipe. The drains should be connected to positive sumps or outlets. Do not connect the underfloor drains to the perimeter drains.

*Underfloor drains can be deleted where not required.

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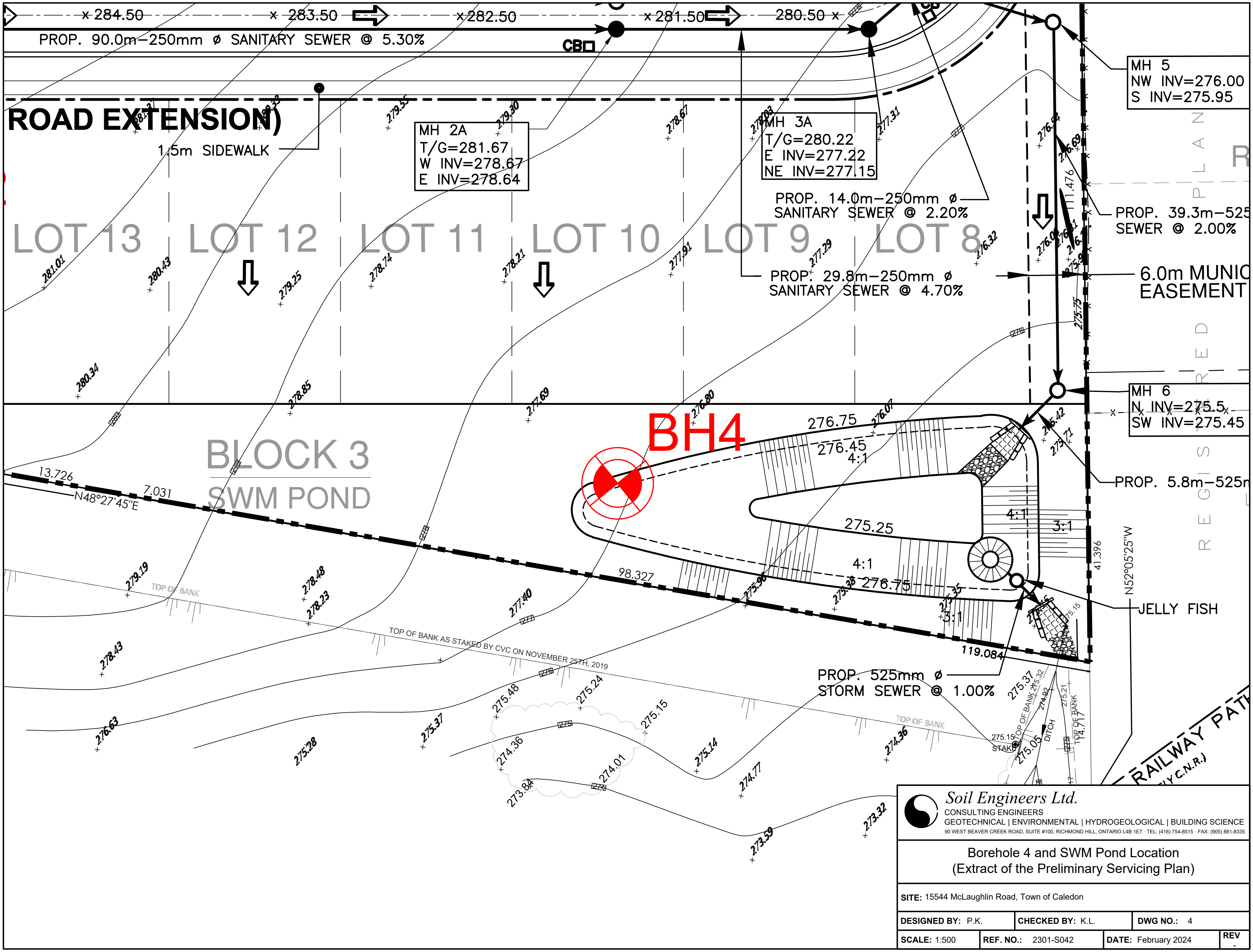
Details of Perimeter Drainage System

SITE: 15544 McLaughlin Road, Town of Caledon

DESIGNED BY: K.L.
CHECKED BY: B.L.
DWG NO.: 3
SCALE: N.T.S.
REF. NO.: 2301-S042
DATE: March 2023
REV -



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Borehole 4 and SWM Pond Location
(Extract of the Preliminary Servicing Plan)

SITE: 15544 McLaughlin Road, Town of Caledon

DESIGNED BY: P.K.
CHECKED BY: K.L.
DWG NO.: 4
SCALE: 1:500
REF. NO.: 2301-S042
DATE: February 2024
REV -