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A REPORT TO
AVENIA CONSTRUCTION
c/o ARMLAND GROUP

A GEOTECHNICAL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

NORTHEAST OF LISGAR DRIVE AND DOUG LEAVENS BOULEVARD

CITY OF MISSISSAUGA

REFERENCE NO. 2302-S052

MAY 2023

DISTRIBUTION

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1.0 INTRODUCTION

In accordance with written authorization dated April 25, 2022, from Ms. Lisa La Civita of a Avenia Construction Inc. a geotechnical investigation was carried out at the captioned property to the northeast of Lisgar Drive and Doug Leavens Boulevard in the City of Mississauga.

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 development. The geotechnical findings and resulting recommendations are presented in this Report.

2.0 SITE AND PROJECT DESCRIPTION

The City of Mississauga is situated on Halton till plain. In places, the drift has been partly eroded by Peel Ponding (glacial lake) and filled with lacustrine sand, silt and clay.

The subject site is located to the northeast of Lisgar Drive and Doug Leavens Boulevard in the City of Mississauga. At the time of investigation, the site is an empty lot with grass cover. The existing site gradient is relatively flat with minor undulations.

Based on the conceptual plan provided by the client, it is understood that the site will be developed with low-rise residential units, with municipal services and paved roadways meeting urban standards. In addition, the northern portion of the site will be used for Lisgar Fields Community Park expansion. An underground storm water tank is also proposed at the southeast corner of the site.

3.0 FIELD WORK

The field work, consisting of six (6) sampled boreholes extending to a depth of 5.2 m to 6.6 m, was performed on February 24, 2023. The locations of the boreholes are shown on Drawing No. 1, enclosed.

The boreholes were advanced at intervals to the sampling depths by a track-mounted machine equipped with solid-stem augers and 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 field work was supervised and the findings were recorded by a Geotechnical Technician. 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 of each borehole and monitoring well location was determined using hand-held Global Navigation Satellite System survey equipment.

4.0 SUBSURFACE CONDITIONS

The boreholes were performed on the grass cover vacant field, where a topsoil veneer was contacted at the ground surface in the boreholes. Beneath a topsoil layer, the site is underlain by a layer of earth fill, approximately 1.6 to 3.3 m thick, overlying silty clay till and sandy silt till.

Detailed descriptions of the encountered subsurface conditions from the boreholes are presented on the Borehole Logs, comprising Figures 1 to 6, 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)

A layer of topsoil, 8 to 13 cm in thickness, was encountered at the ground surface. Thicker topsoil may be encountered beyond the borehole locations.

4.2 **Earth Fill** (All Boreholes)

A review of our previous documents indicates that the existing earth fill was placed in an engineered manner in majority of the area, which was certified by Soil Engineers Ltd. (SEL) in 1998. The earth fill layer was contacted beneath the topsoil layer and extends to depths of 1.6 to 3.3 m below the prevailing ground surface. It consists of silty clay with occasional rootlets and wood fragments.

The obtained 'N' values of the earth fill range from 4 to 29, with a median of 9 blows per 30 cm of penetration, indicating that the existing earth fill has potentially been weakened by weathering in various areas and is no longer suitable to support any structure.

The natural water content of the earth fill was determined at a range from 12% to 28%, with a median of 18%, indicating generally moist conditions.

4.3 **Silty Clay Till** (All Boreholes)

The silty clay till stratum was contacted beneath the earth fill in the boreholes and extends to a depth of 4.0 m below the prevailing ground surface. Its structure is heterogeneous, consisting of a random mixture of soil particles ranging from clay to gravel, with the clay and silt fraction exerting the dominant influence on the soil properties. Grain size analysis was performed on a representative sample; the result is plotted on Figure 7.

Atterberg Limits was also performed on a representative sample and the result is plotted in the respective borehole log. The resulting Liquid Limit and Plastic Limit are 24% and 16%, respectively, indicating that the clay till is low in plasticity.

The obtained ‘N’ values of the clay till range from 9 to 71, with a median of 20 blows per 30 cm of penetration, indicating that the clay till is stiff to hard, being generally very stiff in consistency.

The natural water content of the silty clay till samples was determined; the results range from 11% to 25%, with a median of 13%, indicating generally moist conditions.

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

- Moderately high frost susceptibility and low water erodibility.
- The silty clay till will be relatively stable in steep excavation; however, prolonged exposure will allow the sand seams within the till to slough.

4.4 **Sandy Silt Till** (All Boreholes)

The sandy silt till deposit was contacted beneath the silty clay till deposit in the boreholes. The boreholes were terminated in the sandy silt till deposit at depths of 5.2 m to 6.6 m from grade; the lower limit of the stratum was not established. The sandy silt till consists of a random mixture of particle sizes ranging from clay to gravel, with silt and sand being the dominant fraction. Sample examinations have disclosed that the till deposit was slightly cemented and displayed some cohesion when remoulded.

High resistance in borehole drilling was detected, indicating probable cobbles or boulders in the till mantle. The obtained 'N' values range from 27 to over 100, with a median of 94 blows per 30 cm penetration, indicating that the sandy silt till is compact to very dense, being generally very dense in relative density.

The natural water content values of the sandy silt till samples range from 8% to 11%, with a median of 9%, indicating generally moist conditions.

The engineering properties of the sandy silt till deposit are listed below:

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

4.5 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	12 to 28 (median 18)	18	15 to 22
Silty Clay Till	11 to 25 (median 13)	17	14 to 20
Sandy Silt Till	8 to 11 (median 9)	10	8 to 13

The above values show that on-site soils are generally suitable for structural backfill. Any wet soil will require aeration prior to structural compaction. Aeration can be achieved by spreading them thinly on the ground in the dry and warm weather. Any boulders larger than 15 cm in size must be sorted and removed from the backfill.

In addition, 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 and cave-in upon completion of drilling. Groundwater was recorded in Borehole 1 at a depth of 5.8 m, or at El. 189.3 m, and cave-in was recorded in Borehole 3 at a depth of 5.9 m, or at El. 188.6 m, upon completion of drilling. The remaining boreholes were dry and open upon completion of drilling.

As such, continuous groundwater is not anticipated in the boreholes within the depth of investigation. Any encountered water seepage may be perched in the sand seams within the till mantle. The recorded water level is subject to seasonal fluctuations.

6.0 DISCUSSION AND RECOMMENDATIONS

The boreholes were performed on the grass cover, where a topsoil veneer was contacted at the ground surface in the boreholes. Beneath a topsoil layer, the site is underlain by a layer of earth fill, approximately 1.6 to 3.3 m thick, overlying silty clay till and sandy silt till.

Groundwater was recorded in Borehole 1 at a depth of 5.8 m, or at El. 189.3 m, and cave-in was recorded in Borehole 3 at a depth of 5.9 m, or at El. 188.6 m, upon completion of drilling.

It is understood that the site will be developed with low-rise residential units, with municipal services and paved roadways meeting urban standards. The geotechnical findings which warrant special consideration are presented below:

1. The topsoil must be removed from the area of construction. It can be stockpiled and reused in landscaping areas only. Any surplus will have to be disposed off-site.
2. The existing earth fill, at its present state, cannot be used to support any structure sensitive to movement. Upon review of the geotechnical and chemical properties of the earth fill, it can be reused for engineered fill construction.
3. Where additional fill is required for site grading, the earth fill can be constructed in an engineered manner for foundations, underground services and pavement construction.
4. The proposed structures can be supported on conventional spread and strip footings, founded on engineered fill or sound native soil.
5. Where the proposed structures have a basement, the perimeter walls should be damp-proofed and provided with a perimeter drainage system. The subdrain must be encased

in a fabric filter to protect them against blockage by silting and connected into a positive outlet.

6. Class 'B' bedding, consisting of compacted 19-mm Crusher Run Limestone (CRL), or equivalent, is recommended for the construction of the underground utilities.

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

The topsoil must be removed from the area of construction. It can be stockpiled and reused in landscaping areas only. Any surplus will have to be disposed off-site.

As stated previously, the existing earth fill cannot be used to support any structure sensitive to movement. Upon review of the geotechnical and chemical properties of the earth fill, it can be reused for engineered fill construction. Where additional fill is required for site grading, the earth fill can be placed in an engineered manner for conventional footing construction, site services support and road construction. The engineering requirements for a certifiable fill are presented below:

1. After removal of the topsoil, the existing earth fill should be subexcavated, sorted free of topsoil inclusions and deleterious materials, if any, aerated and properly compacted in layers. The exposed subgrade must be inspected and proof-rolled prior to any fill placement.
2. Inorganic soils must be used for the fill, and they must be uniformly compacted in lifts of 20 cm thick to at least 98% Standard Proctor Dry Density (SPDD) up to the proposed finished grade. The soil moisture must be properly controlled near the 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 deleterious or any material with environmental issue or 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 being hauled to the site.

5. The fill operation must be inspected on a full-time basis by a technician under direction of a geotechnical engineer.
6. The engineered fill should not be placed during period when 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 engineered fill is to be left over the winter months, adequate earth cover, or equivalent, must be provided for protection against frost action.
7. The engineered fill must extend over the entire graded area; the engineered fill envelope and finished elevations must be clearly and accurately defined in the field, and they must be precisely documented by qualified surveyors.
8. The foundations and underground services subgrade must be inspected by the geotechnical consulting firm that inspected the engineered fill placement. This is to ensure that the foundations 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 the footing excavation.
9. Despite stringent control in the placement of the engineered fill, variations in soil type and density may occur in the engineered fill. Therefore, the foundations must be properly reinforced, or be designed by the structural engineer for the project. The total and differential settlements of 25 mm and 20 mm, respectively, should be considered in the design of the foundation founded on engineered fill.
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 the 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 <u>Foundations</u>

The development will consist of low-rise residential dwellings. These structures can be supported on conventional footings, founded on engineered fill or sound native soil. The recommended 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) = 240 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.

Foundations exposed to weathering, or in unheated areas, should have at least 1.2 m of earth cover for protection against frost action, or must be properly insulated.

The foundation subgrade should be inspected by the geotechnical engineer or a senior geotechnical technician to ensure that the revealed conditions are compatible with the foundation design requirements.

Where water seepage is encountered during footing excavations, if any, or where the subgrade of the foundations 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.

The foundations should meet the requirements specified in the latest Ontario Building Code, and the structure should be designed to resist an earthquake force using Site Classification 'D' (stiff soil).

6.3 **Basement Structure**

In conventional design, the perimeter walls of basement structures should be damp-proofed and provided with perimeter subdrain at the wall base as illustrated on Drawing No. 3. The subdrains should be encased in fabric filter to protect them against blockage by silting and connected into a positive outlet.

The subgrade for conventional basement floor should consist of sound native soil or properly compacted inorganic earth fill. The slab should be constructed on a granular base, minimum 15 cm thick, consisting of 19-mm CRL, or equivalent, compacted to 100% SPDD.

The exterior ground surface must be graded to direct water away from the structures.

6.4 **Underground Services**

The subgrade for underground services should consist of sound native soils or engineered fill. Where soft or wet soil is encountered in the subgrade, it should be subexcavated and replaced with compacted earth fill or bedding material, compacted to at least 98% SPDD.

A Class 'B' bedding, consisting of compacted 19-mm CRL, or equivalent, is recommended for the construction of the underground services.

The pipe joints connecting into manholes and catch basins should be leak-proof, or wrapped with an appropriate waterproof membrane. Openings to subdrains and catch basins should be shielded with a fabric filter to prevent blockage by silting.

In order to prevent pipe floatation when the sewer trench is deluged with water, a soil cover having a thickness equal to the diameter of the pipe should be in place at all times after completion of the pipe installation.

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 City of Mississauga standard.

6.5 Backfilling in Trenches and Excavated Areas

The backfill in service trenches should be compacted at least 95% SPDD. In the zone within 1.0 m below the pavement subgrade or below the slab-on-grade, the material should be compacted to 98% SPDD, with the water content controlled at 2% or 3% drier than the optimum. The lift of each backfill layer should be limited to a thickness of 20 cm, or the thickness should be determined by test strips at the time of compaction.

In normal construction practice, the problem areas of pavement settlement largely occur adjacent to manholes, catch basins, service crossings, foundation walls and columns. These trenches should be cut at 1 vertical:2 horizontal so that the backfill in the trenches can be effectively compacted. Otherwise, soil arching in the trenches will prevent achievement of the proper compaction. In confined areas which are inaccessible to a heavy compactor, sand backfill should be used and compacted using a light duty compactor.

One must be aware of the possible consequences during trench backfilling and exercise caution as described below:

- It is often difficult to achieve uniform compaction of the backfill in the lower vertical section of a trench which is an open cut or is stabilized by a trench box, particularly in the sector close to the trench walls or the sides of the box. These sectors must be backfilled with sand and the compaction must be carried out diligently prior to the placement of the backfill above this sector, i.e., in the upper sloped trench section. This measure is necessary in order to prevent consolidation of inadvertent voids and loose backfill which will compromise the compaction of the backfill in the upper section.

- When construction is carried out in freezing weather, frozen soil layers may inadvertently be mixed with the structural trench backfill. Should the in situ soils have a water content on the dry side of the optimum, it would be impossible to wet the soils due to the freezing condition, rendering difficulties in obtaining uniform and proper compaction. Furthermore, the freezing condition will prevent wetting of the backfill or when it is required, such as when the trench box is removed. The above will invariably cause backfill settlement in the next few years.
- In areas where the underground services construction is carried out during the winter months, prolonged exposure of the trench walls will result in frost heave within the soil mantle of the walls. This may result in some settlement as the frost recedes, and repair costs will be incurred prior to final surfacing of the new pavement and the slab-on-grade.

6.6 Pavement Design

According to the Pavement and Road Base Design Requirement prepared by the City of Mississauga, the recommended pavement structure for residential local roads is presented in Table 2.

Table 2 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL3
Asphalt Binder	100	HL8
Granular Base	200	Granular ‘A’ or equivalent
Granular Sub-base	250	Granular ‘B’ or equivalent

In preparation of pavement subgrade, any compressible material should be removed, and the subgrade surface must be proof-rolled and inspected. Any soft spot identified must be rectified by subexcavation to competent ground and replacing with inorganic soil, compacted to at least 98% SPDD with water content controlled within 2% of the optimum. All granular bases should be compacted to 100% SPDD.

The 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 road 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 ponding of large amounts of water. 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 should be provided on both sides of roadways, as required by the City of Mississauga.
- If the pavement is to be constructed during wet seasons and extensively soft subgrade occurs, the granular sub-base should be thickened in order to compensate for the inadequate strength of the subgrade. This can be assessed during construction.

6.7 Underground Stormwater Tank

It is understood that an underground stormwater tank is proposed at the southeast corner of the subject site. Details of the tank, however, are not available for review at the time of this report preparation. A review should be carried out once the design is available at the detailed design stage.

6.8 Soil Parameters

The recommended soil parameters for the project design are given in Table 3.

Table 3 - Soil Parameters

Unit Weight and Bulk Factor	**Bulk Unit Weight**	**Estimated Bulk Factor**	
	γ (kN/m^3)	**Loose**	**Compacted**
Earth Fill	20.5	1.20	0.95
Silty Clay Till/Sandy Silt Till	22.0	1.30	1.03

Lateral Earth Pressure Coefficients	**Active**	**At Rest**	**Passive**
	K_a	**K_0**	**K_p**
Compacted Earth Fill	0.40	0.55	2.50
Silty Clay Till/Sandy Silt Till	0.32	0.48	3.15

Estimated Coefficient of Permeability (K) and Percolation Time (T)	**K (cm/sec)**	**T (min/cm)**
Silty Clay Till	10^{-7}	80+
Sandy Silt Till	10^{-5} to 10^{-6}	20 to 50

Estimated Electrical Resistivity	**(ohm·cm)**
Silty Clay Till	3500
Sandy Silt Till	4500

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 4.

Table 4 - Classification of Soils for Excavation

Material	Type
Silty Clay Till and Sandy Silt Till	2
Earth Fill	3

Continuous groundwater is not anticipated in the boreholes within the depth of investigation. The yield of perched groundwater within the till stratum is expected to be limited in quantity in open excavation. It can be removed by conventional pumping from sumps where necessary.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Avenia Construction 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 Cedric Ramos, B.A.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.

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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 for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—•—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

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/ft)	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 (ksf)	'N' (blows/ft)	Consistency
less than 0.25	0 to 2	very soft
0.25 to 0.50	2 to 4	soft
0.50 to 1.0	4 to 8	firm
1.0 to 2.0	8 to 16	stiff
2.0 to 4.0	16 to 32	very stiff
over 4.0	over 32	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
☐	Compression test in laboratory

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

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

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JOB NO.: 2302-S052

LOG OF BOREHOLE: 1

FIGURE NO.: 1

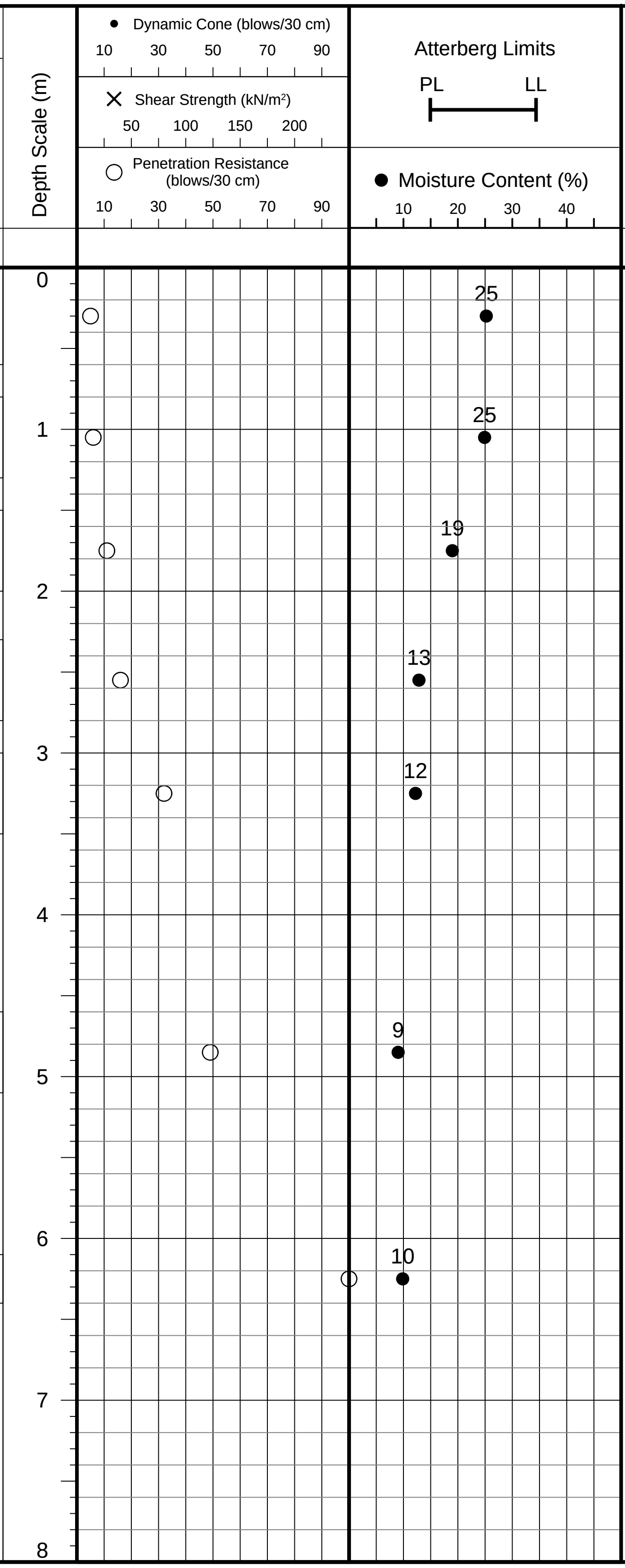
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: North of Lisgar Drive and Doug Leavens Boulevard, City of Mississauga

DRILLING DATE: February 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
195.1	Ground Surface			
0.0	**8 cm of Topsoil** **EARTH FILL** Brown Silty Clay traces of gravel and sand occ. rootlets and wood fragments	1	DO	5
		2	DO	6
		3	DO	11
192.9 2.1	Brown, very stiff to hard **SILTY CLAY TILL** some sand to sandy, a trace of gravel	4	DO	16
		5	DO	32
191.0 4.0	Brown, dense to very dense **SANDY SILT TILL** traces of gravel and clay	6	DO	49
		7	DO	50/13
188.7 6.4	**END OF BOREHOLE**			



WATER LEVEL

▽W.L. @ El. 189.3 m upon completion

Soil Engineers Ltd.

JOB NO.: 2302-S052

LOG OF BOREHOLE: 2

FIGURE NO.: 2

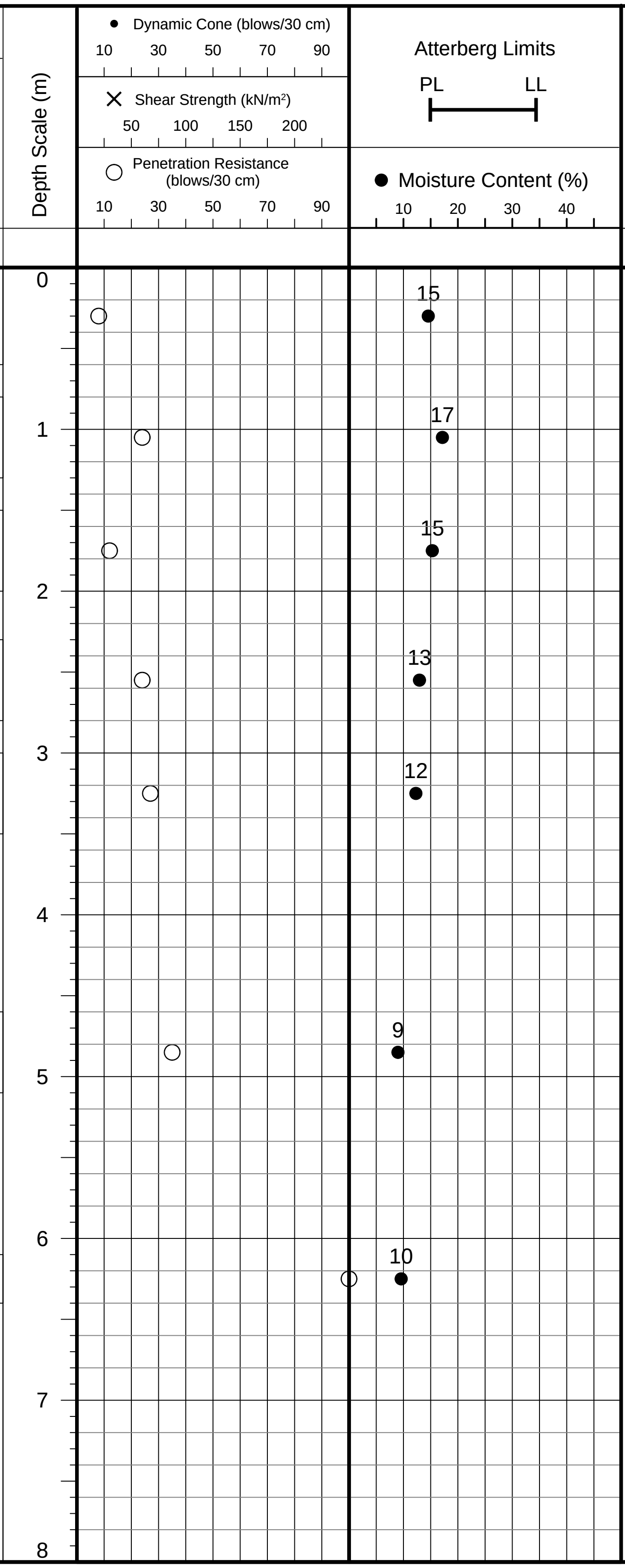
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger
(Solid Stem)

PROJECT LOCATION: North of Lisgar Drive and Doug Leavens Boulevard,
City of Mississauga

DRILLING DATE: February 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
194.6	Ground Surface				
0.0	**10 cm of Topsoil**				
	EARTH FILL Brown Silty Clay traces of gravel and sand occ. rootlets and wood fragments	1	DO	8	
		2	DO	24	
193.0 1.6	Brown, stiff to very stiff **SILTY CLAY TILL** some sand to sandy, a trace of gravel	3	DO	12	
		4	DO	24	
		5	DO	27	
190.5 4.0	Brown, dense to very dense **SANDY SILT TILL** traces of gravel and clay	6	DO	35	Dry upon Completion
		7	DO	50/13	
188.2 6.4	**END OF BOREHOLE**				



Soil Engineers Ltd.

JOB NO.: 2302-S052

LOG OF BOREHOLE: 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

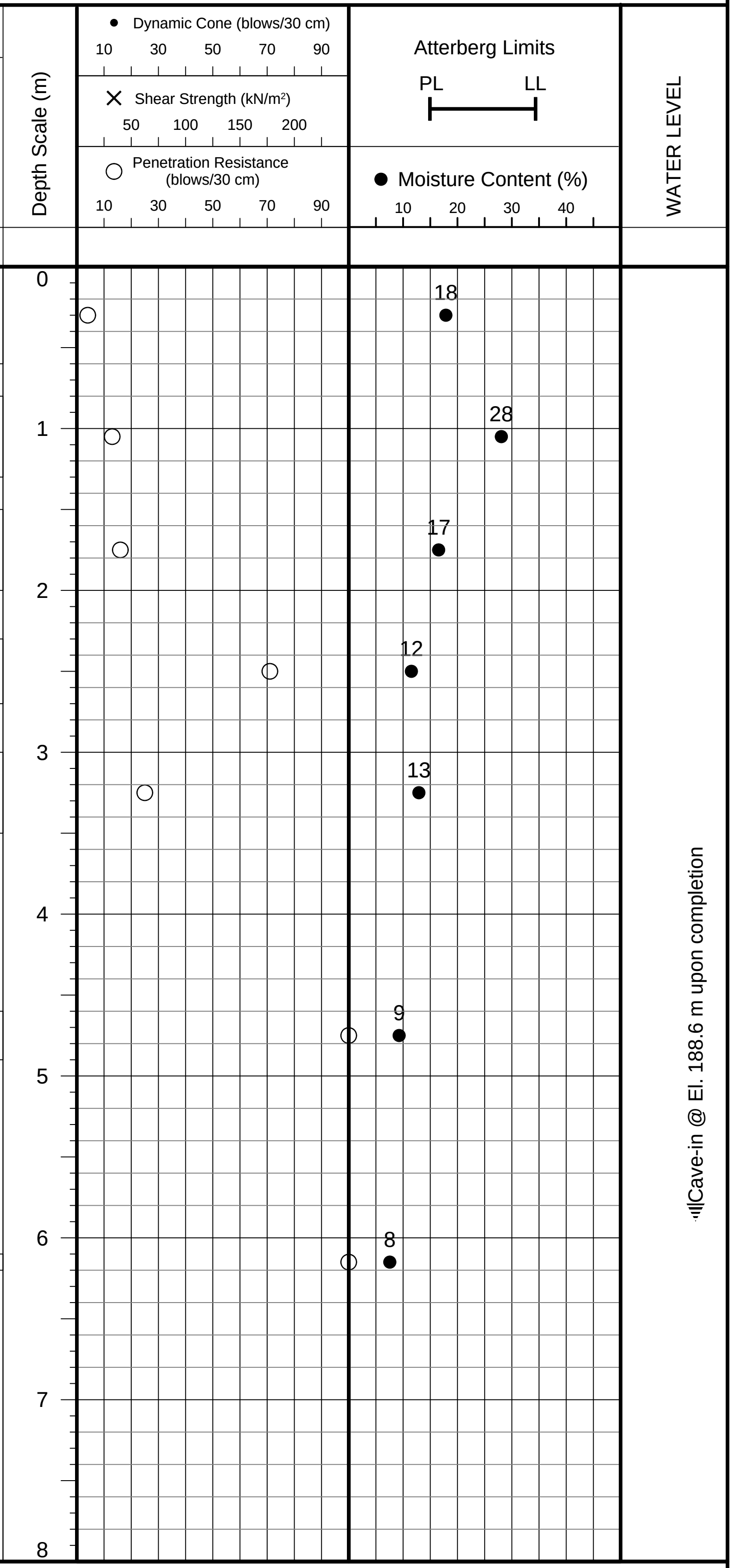
METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: North of Lisgar Drive and Doug Leavens Boulevard, City of Mississauga

DRILLING DATE: February 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION
194.5	Ground Surface
0.0	**10 cm of Topsoil** **EARTH FILL** Brown Silty Clay traces of gravel and sand occ. rootlets and wood fragments
192.7 1.8	Brown, very stiff to hard **SILTY CLAY TILL** some sand to sandy, a trace of gravel
190.4 4.0	Very dense **SANDY SILT TILL** traces of gravel and clay brown / grey
188.3 6.2	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1	DO	4
2	DO	13
3	DO	16
4	DO	71
5	DO	25
6	DO	50/15
7	DO	50/13



Soil Engineers Ltd.

JOB NO.: 2302-S052

LOG OF BOREHOLE: 4

FIGURE NO.: 4

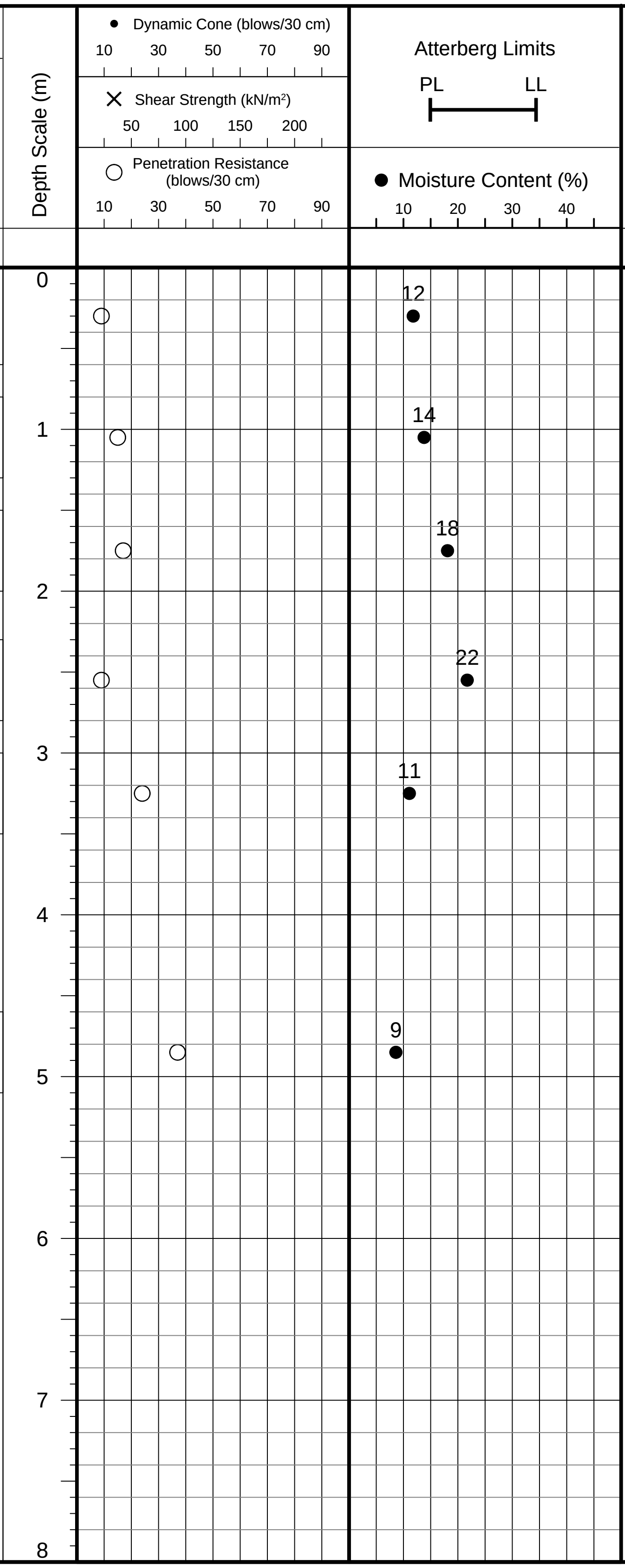
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: North of Lisgar Drive and Doug Leavens Boulevard, City of Mississauga

DRILLING DATE: February 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
193.8	Ground Surface			
0.0	**10 cm of Topsoil** **EARTH FILL** Brown Silty Clay traces of gravel and sand occ. rootlets and wood fragments	1	DO	9
		2	DO	15
		3	DO	17
191.7 2.1	Brown, stiff to very stiff **SILTY CLAY TILL** some sand to sandy, a trace of gravel	4	DO	9
		5	DO	24
189.8 4.0	Grey, dense **SANDY SILT TILL** traces of gravel and clay	6	DO	37
188.6 5.2	**END OF BOREHOLE DUE TO AUGER REFUSAL ON PROBABLE BOULDER OR BEDROCK**			



WATER LEVEL

Dry upon Completion

Soil Engineers Ltd.

JOB NO.: 2302-S052

LOG OF BOREHOLE: 5

FIGURE NO.: 5

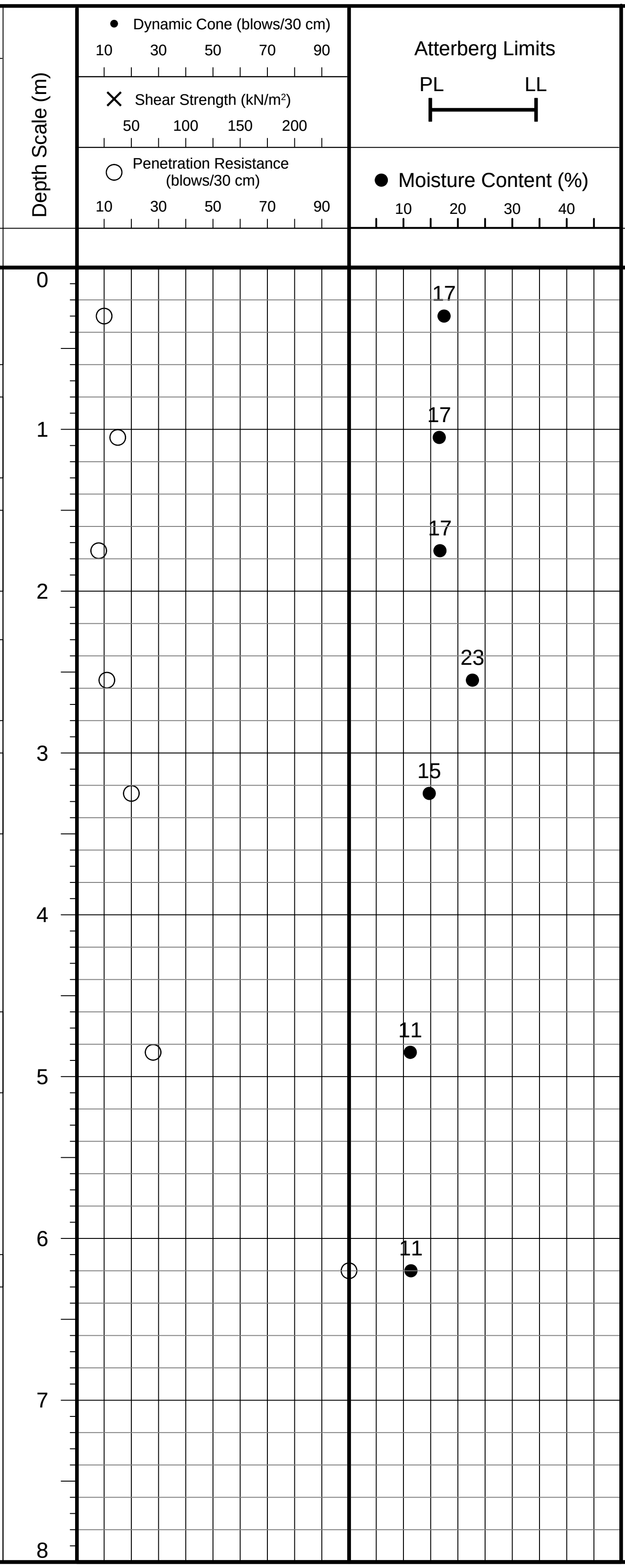
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger
(Solid Stem)

PROJECT LOCATION: North of Lisgar Drive and Doug Leavens Boulevard,
City of Mississauga

DRILLING DATE: February 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
194.5	Ground Surface				
0.0	**13 cm of Topsoil** **EARTH FILL** Reddish Brown to Brown Silty Clay traces of gravel and sand occ. rootlets and wood fragments	1	DO	10	
		2	DO	15	
		3	DO	8	
		4	DO	11	
		5	DO	20	
191.2 3.3	Brown, very stiff **SILTY CLAY TILL** some sand to sandy, a trace of gravel				
190.4 4.0	Brown, compact to very dense **SANDY SILT TILL** traces of gravel and clay	6	DO	28	Dry upon Completion
		7	DO	50/15	
188.2 6.3	**END OF BOREHOLE**				



Soil Engineers Ltd.

JOB NO.: 2302-S052

LOG OF BOREHOLE: 6

FIGURE NO.: 6

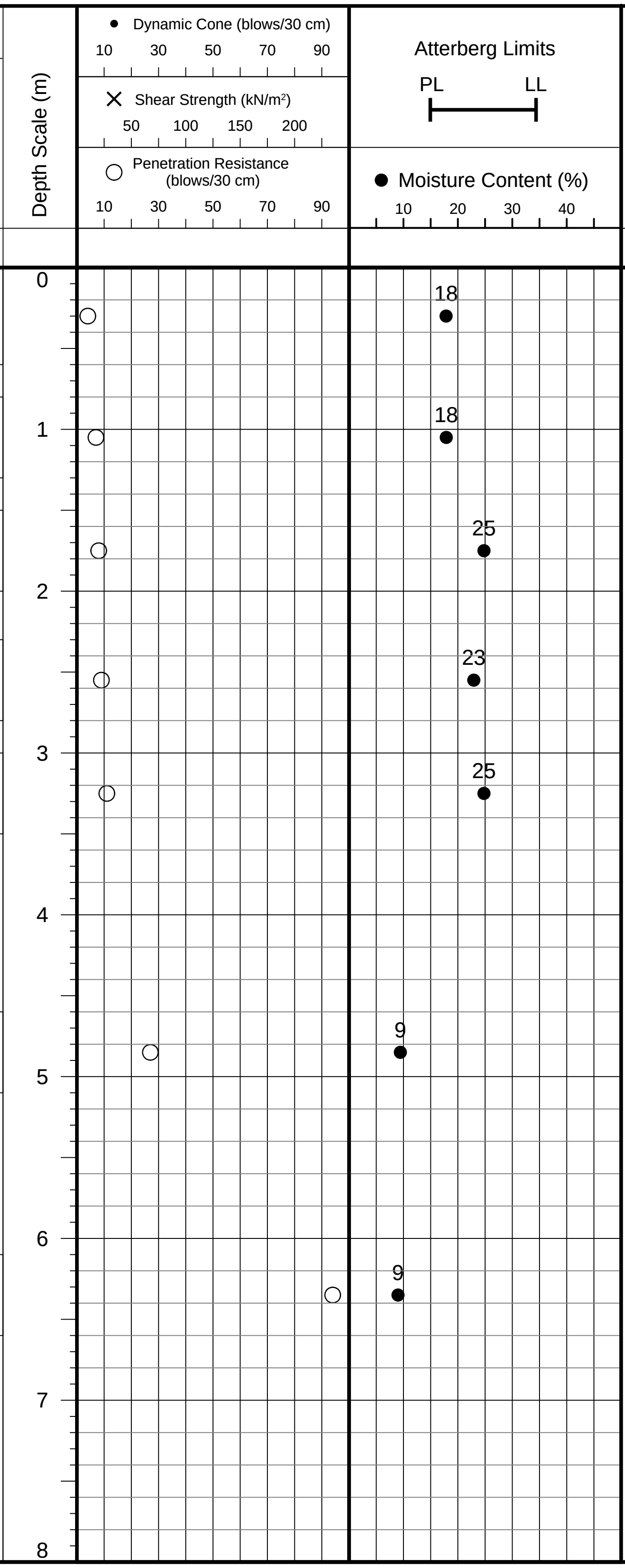
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: North of Lisgar Drive and Doug Leavens Boulevard, City of Mississauga

DRILLING DATE: February 24, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Moisture Content (%)
194.1	Ground Surface				
0.0	**10 cm of Topsoil** **EARTH FILL** Brown Silty Clay traces of gravel and sand occ. rootlets and wood fragments	1	DO	4	18
		2	DO	7	18
		3	DO	8	25
191.9 2.1	Brown, stiff **SILTY CLAY TILL** some sand to sandy, a trace of gravel	4	DO	9	23
		5	DO	11	25
190.0 4.0	Brown, compact to very dense **SANDY SILT TILL** traces of gravel and clay	6	DO	27	9
		7	DO	94	9
187.5 6.6	**END OF BOREHOLE**				



WATER LEVEL

Dry upon Completion

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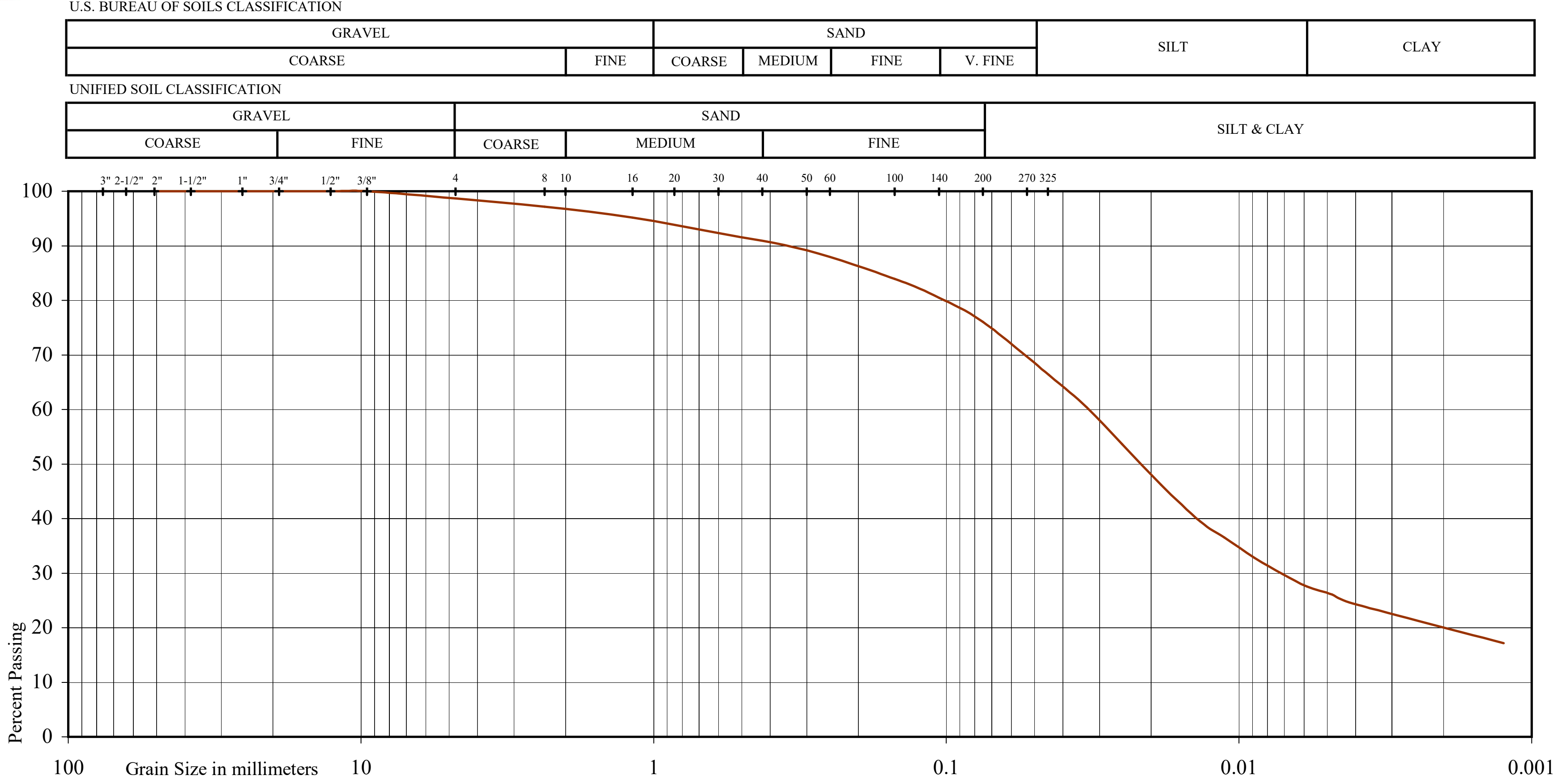
GRAIN SIZE DISTRIBUTION

Reference No: 2302-S052



Project: Proposed Residential Development

Location: North of Lisgar Drive and Doug Leavens Boulevard, City of Mississauga

Borehole No: 4

Sample No: 4

Depth (m): 2.3

Elevation (m): 191.5

Liquid Limit (%) = 24

Plastic Limit (%) = 16

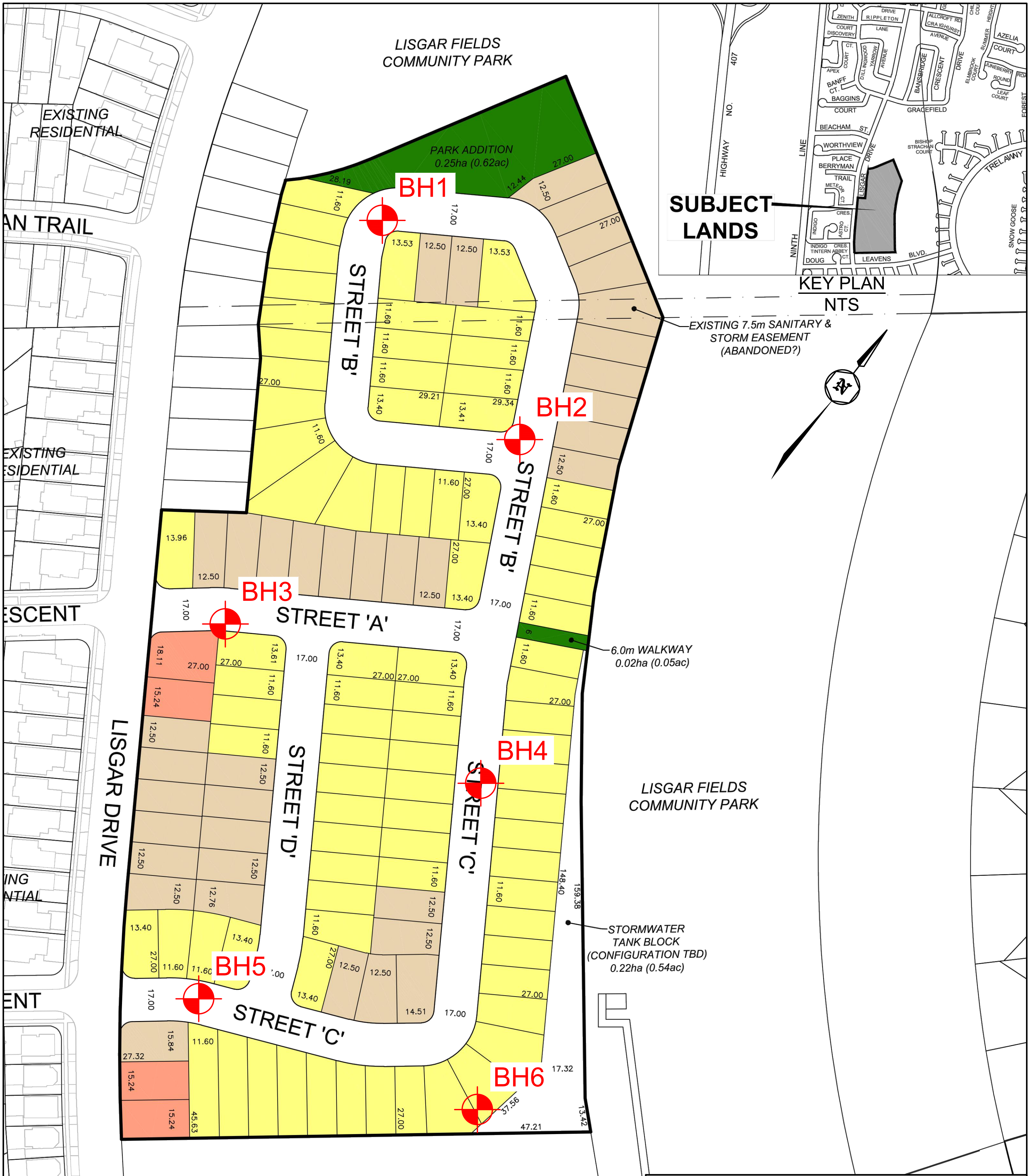
Plasticity Index (%) = 8

Moisture Content (%) = 22

Estimated Permeability (cm./sec.) = 10^{-7}

Classification of Sample [& Group Symbol]: SILTY CLAY TILL
sandy, a trace of gravel

Figure: 7



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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 Location Plan

SITE: North of Lisgar Drive and Doug Leavens Boulevard, City of Mississauga

DESIGNED BY: C.R.
CHECKED BY: K.F.L.
DWG NO.: 1
SCALE: 1:2000
REF. NO.: 2302-S052
DATE: April 2023
REV -

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SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

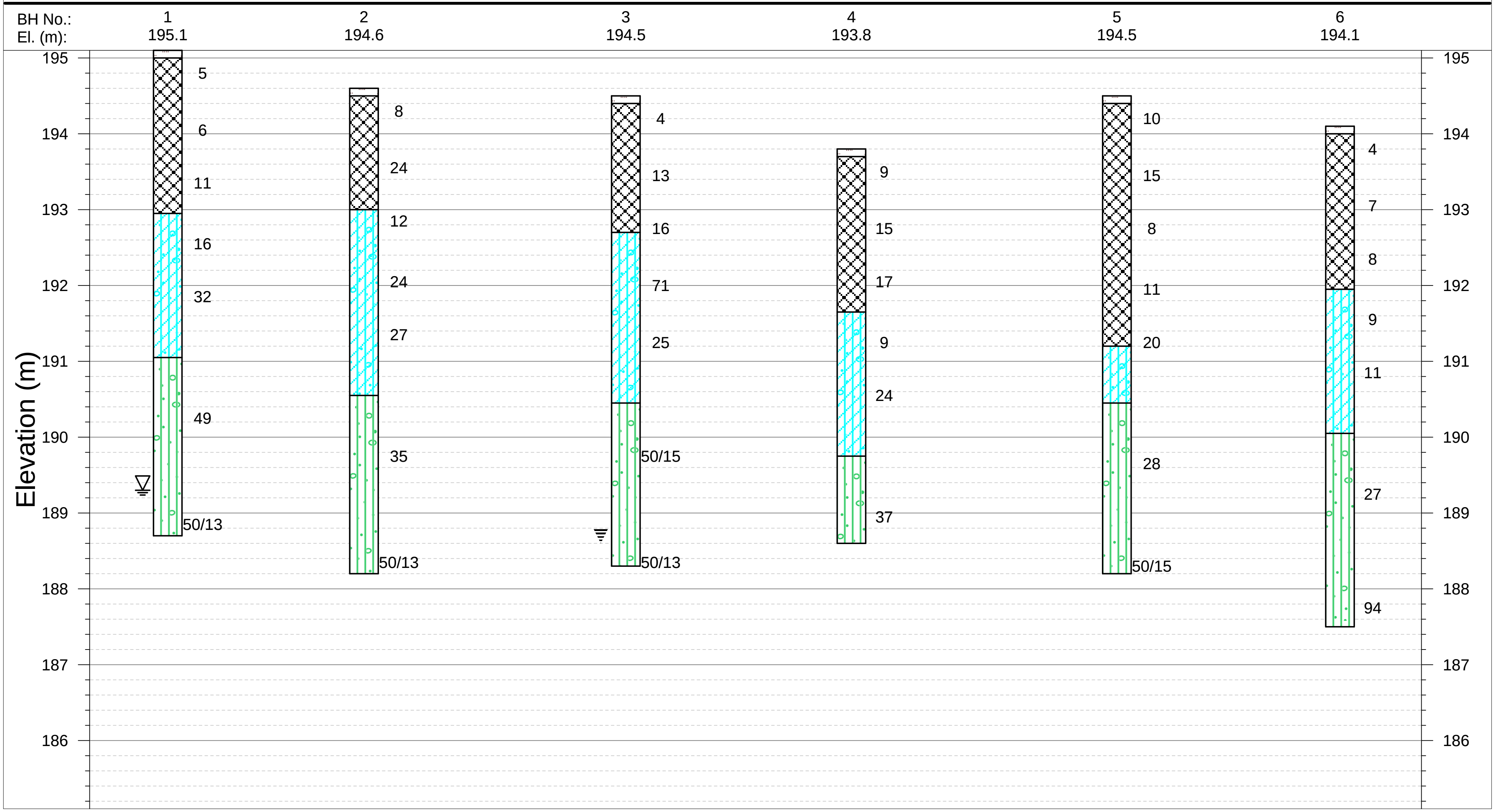
JOB NO.: 2302-S052
REPORT DATE: May 2023
PROJECT DESCRIPTION: Proposed Residential Development

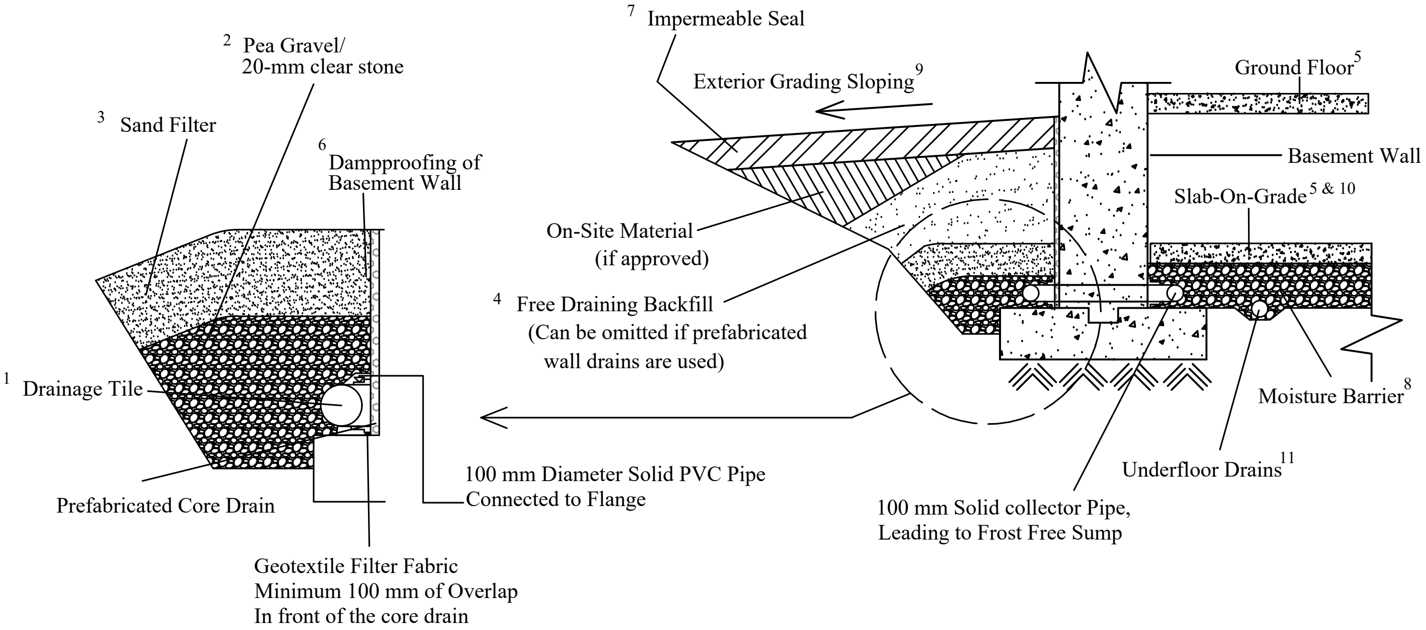
PROJECT LOCATION: North of Lisgar Drive and Doug Leavens Boulevard,
City of Mississauga

LEGEND

▩ FILL ▥ SANDY SILT TILL ▨ SILTY CLAY TILL ▤ TOPSOIL

≡ CAVE-IN ▽ 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.

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* Underfloor drains can be deleted where not required.

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Permanent Perimeter Drainage System
(Without Shoring)

SITE: North of Lisgar Drive and Doug Leavens Boulevard, City of Mississauga

DESIGNED BY: K.L. **CHECKED BY:** B.L. **DWG NO.:** 3

SCALE: N.T.S. **REF. NO.:** 2302-S052 **DATE:** May 2023 **REV** -