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CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
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A REPORT TO

1334281 ONTARIO LIMITED.

A GEOTECHNICAL INVESTIGATION FOR PROPOSED MID-RISE RESIDENTIAL DEVELOPMENT

720 GRANITE COURT

CITY OF PICKERING

REFERENCE NO. 2111-S043

MARCH 2023

(REVISION FROM REPORT DATED JANUARY 2022)

DISTRIBUTION

1 Digital Copy – 1334281 Ontario Limited
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ENCLOSURES

1.0 INTRODUCTION

In accordance with the written authorization from Mr. Steve Margie of 1334281 Ontario Limited., dated November 1, 2021, a geotechnical investigation was carried out at the property at 720 Granite Court, in the City of Pickering.

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

2.0 SITE AND PROJECT DESCRIPTION

The City of Pickering is situated on Iroquois (glacial lake) plain where, in places, the glacial till stratigraphy has been partly eroded by the water action of the glacial lake and filled with lacustrine sand, silt, clay and reworked till.

The subject site is vacant, currently situated at the intersection of Granite Court and Whites Road South, in the City of Pickering. The site area is weed covered at the time of the investigation.

Based on the architectural drawings prepared by OneSpace Unlimited Inc. dated December 19, 2022, the proposed development will be a 12-storey building, adjoined with 2-level underground parking, on-grade parking and driveway at ground level.

3.0 FIELD WORK

The field work, consisting of four (4) sampled boreholes extending to a depth of 12.3 m, was performed between December 14 and 17, 2021, at the locations 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, continuous-flight power-auger machine equipped for soil sampling. 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 noncohesive strata and the consistency of the cohesive strata are inferred from the 'N' values. Split-spoon samples were recovered for soil classification and laboratory testing.

Upon completion of drilling and soil sampling, three (3) monitoring wells were installed at the selected borehole locations to facilitate the hydrogeological assessment. The depth and details of the monitoring wells are shown on the corresponding Boreholes Logs.

The ground elevation at each borehole location was evaluated using a hand-held Global Navigation Satellite System Surveying equipment (Trimble Geoexplorer 6000 Series)

4.0 SUBSURFACE CONDITIONS

The site is weed covered. The investigation has disclosed that beneath the topsoil, the site is underlain by a stratum of sandy silt till. Detailed descriptions of the subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 4, 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)

The revealed topsoil layer is approximately 20 to 25 cm in thickness. Thicker topsoil layer may be contacted beyond the borehole locations.

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

The native sandy silt till deposit was encountered below the topsoil and all boreholes were terminated within the sandy silt till. The till consists of a random mixture of particle sizes ranging from clay to gravel, with sand and silt exerting the dominant influence on the soil properties. Grain size analyses were performed on 3 representative samples and the results are plotted on Figure 5.

The obtained 'N' values range from 37 to over 100 blows per 30 cm of penetration, showing the till deposit is dense to very dense in relative density. Hard resistance to augering was encountered in places, indicating the presence of cobbles and boulder.

The natural water content of the soil samples was determined and the results are plotted on the Borehole Logs. The value ranges from 5% to 11%, with a median of 7%, indicating generally moist conditions.

The engineering properties of the sandy silt till are given below:

- High frost susceptibility and low water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-6} to 10^{-7} cm/sec, and a percolation time of more than 60 min/cm.
- The shear strength is primarily derived from internal friction and is augmented by cementation.
- The till will be relative stable in steep excavation; however, under prolonged exposure, localized erosion and sheet collapse may occur.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 4500 ohm.cm.

5.0 GROUNDWATER CONDITION

The boreholes were checked for the presence of groundwater upon completion of drilling. Free groundwater was recorded in the Boreholes 1 and 2, at a depth of 8.1 to 10.4 m from grade, upon the completion of drilling. The remaining boreholes remained dry.

On January 7, 2022, approximately 3 weeks after borehole drilling, groundwater was recorded in the monitoring wells (Boreholes 1, 2 and 4), at depths between 5.5 and 6.8 m, or between El. 97.6 m and 98.5 m. The groundwater findings are summarized in Table 1.

Table 1 - Groundwater Levels in Monitoring Wells

Borehole/ Monitoring Well No.	Well Depth (m)	Ground Elevation (m)	Ground Water Level on January 7, 2022	
			Depth (m)	Elevation (m)
1	9.0	104.5	6.5	98.0
2	9.0	104.4	6.8	97.6
4	9.0	104.0	5.5	98.5

It is our opinion that the recorded groundwater represents perched water trapped in the sand seams within the till deposit and is subject to seasonal fluctuation. Continuous groundwater is not anticipated within the depth of investigation.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation has disclosed that beneath the topsoil, the site is underlain by dense to very dense sandy silt till stratum.

Free groundwater was recorded in the boreholes 1 and 2, at a depth of 8.1 to 10.4 m from grade, upon the completion of drilling and the remaining boreholes remained dry. On January 7, 2022, approximately 3 weeks after borehole drilling, groundwater was recorded in the monitoring wells, at depths between 5.5 to 6.8 m, or between El. 97.6 m and 98.5 m, representing perched water condition in the sand seams within the till deposit. Continuous groundwater is not anticipated within the depth of investigation.

It is our understanding that the proposed development will be a 12-storey building, adjoined with 2-level underground parking, on-grade parking and driveway at ground level. The geotechnical findings which warrant special consideration are presented below:

1. The topsoil and vegetation should be removed for site development.
2. Bulk excavation of the 2-level underground parking will likely extend 6 to 7 m below grade. The building foundations are anticipated to extend into the very dense sandy silt till, suitable for supporting the proposed buildings on conventional footings.
3. Where slop excavation is not feasible, a brace shoring will be required.

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 Foundations

The proposed building can be supported on conventional footings founded on the sound native sandy silt till. The recommended bearing pressures for conventional footing design are provided:

- Maximum Soil Bearing Pressure, at Serviceability Limit State (SLS) = 600 kPa
- Factored Ultimate Bearing Pressure, at Ultimate Limit State (ULS) = 900 kPa

The total and differential settlements of foundation, designing for the recommended bearing pressures at SLS, are estimated to be 25 mm and 20 mm, respectively.

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

Foundations exposed to weathering or in unheated areas, such as the exterior footings near ventilation shaft and the ramp-down driveway, should have at least 1.2 m of earth cover for protection against frost action. In unheated underground parking structure, if the entrance to the garage is kept closed most of the time, the earth cover for footings away from entrances and ventilation shaft can be reduced to 0.6 m for perimeter walls and 0.9 m for interior walls and columns.

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

6.2 Underground Structure

The perimeter walls of the conventional underground structure should be designed to sustain a lateral earth pressure calculated using the soil parameters given in Section 6.7. Any applicable surcharge loads adjacent to the underground structure must also be considered in the design of the foundation walls.

The perimeter walls of conventional underground structures should be dampproofed and provided with a perimeter subdrain system (Drawing No. 3). Backfill of open excavation should consist of free-draining granular material unless prefabricated drainage board is installed over the entire wall below grade, such as besides shoring walls (Drawing No. 4). The subdrains should be shielded by a fabric filter and covered with stone filter to prevent blockage by silting, installed on a positive gradient and discharge to a positive outlet.

The subgrade for slab-on-grade should consist of well compacted earth fill or native subsoil. The concrete slab should be constructed on a granular base, consisting of 19-mm Crusher-

Run Limestone (CRL), or equivalent, 20 cm in thickness, compacted to its maximum Standard Proctor dry density (SPDD).

The elevator pit, which normally extends a few metres below the floor level, should be designed as a submerged 'tank' structure with waterproofed pit walls and pit floor.

6.3 Sidewalk and Interlocking Stone Pavement

At the exterior, the concrete sidewalk should be designed to tolerate frost heave. The grading around the slab-on-grade must be such that it directs surface runoff away from the structure to minimize the frost heave phenomenon generally associated with the disclosed soils.

To prevent frost action induced by cold wintry drafts in areas where vertical ground movement cannot be tolerated, such as the building entrances, the concrete sidewalk can be constructed on free-draining, non-frost-susceptible granular material such as Granular 'B', extending to 1.2 m below the pavement level and be provided with positive drainage such as weeper subdrains connected to the storm sewer system. Alternatively, the sidewalk and pavement should be insulated with 50-mm Styrofoam, or equivalent.

6.4 Underground Services

The subgrade for underground services should consist of sound native soils or properly compacted earth fill, free of organics. In areas where the subgrade consists of loose or weathered soil, it should be subexcavated and replaced with bedding material, compacted to at least 98% SPDD.

A Class 'B' bedding, consisting of compacted 19-mm CRL or equivalent, is recommended for construction of the underground services. The pipe joints into the catch basins and manholes should be leak-proof, or wrapped with a waterproof membrane to prevent subgrade migration through leakage at joints resulting from inadvertent faulty installation.

Openings to subdrains and catch basins should be shielded with a fabric filter to prevent silting.

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

In-ground steel pipes and accessories should be protected against corrosion. For estimation of anode weight requirements, the estimated electrical resistivity of 4500 ohm.cm for the disclosed soils can be used. This, however, should be confirmed by testing the soils at the time of construction.

6.5 Backfilling in Trench and Excavated Area

The backfill in service trenches and excavated areas should consist of organic free material. It should be compacted to at least 95% SPDD and increase to 98% below the concrete floor slab.

In the zone within 1.0 m below the pavement subgrade, the backfill should be compacted with the water content 2% to 3% drier than the optimum, and the compaction should be increased to at least 98% SPDD. This is to provide the required stiffness for pavement and slab construction.

In normal construction practice, the problem areas of ground settlement largely occur adjacent to manholes, catch basins, services crossing, foundation walls and columns. In areas which are inaccessible to a heavy compactor, granular backfill should be used for compaction with a light equipment.

The lift of each backfill layer should either be limited to a thickness of 20 cm, or the thickness should be determined by test strips.

6.6 Pavement Design

Where the pavement is to be built on structural slabs such as the underground parking structure, sufficient granular base and adequate drainage must be provided to prevent frost heaving in the pavement. In addition, an impervious membrane must be placed above the structural slab of the underground structure to prevent water leakage as well as to protect the reinforcing steel bars in the structure against brine corrosion.

The recommended pavement to be placed above the underground structure is presented in Table 2.

Table 2 - Pavement Design on Roof of Underground Garage

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	50	HL-3
Asphalt Binder	50	HL-8
Granular Base	200	20-mm Crusher-Run Limestone or equivalent
Granular Sub-base	100	Free-Draining Sand Fill

For the on-grade parking and access driveway construction, the recommended pavement design is presented in Table 3.

Table 3 - Pavement on Grade

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	50	HL-3
Asphalt Binder		HL-8
Light Duty Parking	50	
Heavy Duty and Fire Route	60	
Granular Base	150	Granular 'A'
Granular Sub-base		Granular 'B'
Light Duty Parking	300	
Heavy Duty and Fire Route	450	

The final subgrade should be inspected and proof-rolled. Any soft spots should be subexcavated and replaced with compacted inorganic earth fill. New fill should consist of organic free material, compacted to 95% SPDD. In the zone within 1.0 m below the pavement subgrade, the backfill should be compacted to at least 98% SPDD, with the water content 2% to 3% drier than the optimum.

All the granular bases should be compacted to 100% of their maximum SPDD.

In order to prevent infiltrated precipitation from seeping into the granular bases, since this may inflict frost damage on the pavement, an intercept sundrain should be installed along the perimeter where surface runoff may drain onto the pavement. In paved areas, catch basins with stub drains in all four directions should be provided. The stub drains and subdrains should be connected into the catch basin through filter-sleeved weepers. The invert of the subdrains should be at least 0.3 m beneath the underside of the granular subbase and should be backfilled with free-draining granular material.

6.7 Soil Parameters

The recommended soil parameters for the project design are given in Table 4.

Table 4 - Soil Parameters

Unit Weight and Bulk Factor	**Bulk Unit Weight (kN/m^3)**	**Estimated Bulk Factor**	
		Loose	**Compacted**
Sandy Silt Till	22.5	1.25	1.05
Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_o**	**Passive K_p**
Sandy Silt Till	0.30	0.46	3.40
Coefficients of Friction			
Between Concrete and Granular Base			0.50
Between Concrete and Sound Natural Soils			0.35

6.8 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. The types of soils are classified in Table 5.

Table 5 - Classification of Soils for Excavation

Material	Type
Sandy Silt Till	2

Where sloped excavation is not feasible, a braced shoring will be required. The overburden and surcharge from any adjacent structures should be considered in the design of shoring. The recommendations for shoring design are attached in Appendix A.

Continuous groundwater is not anticipated within the depth of investigation. In excavation, the groundwater yield within the till, if any, will be limited in quantity and slow in rate. It can be drained into sump pits and removed by conventional pumping.

In order to optimize the effect of the dewatering system, we recommend that any installation of soldier piles and caisson walls for the shoring system should be carefully monitored to record the contact elevation of the water-bearing sand layers and the static water levels. This information should be reviewed by the dewatering contractor and Soil Engineers Ltd. in order to determine the extent of the dewatering system on site.

6.9 **Monitoring of Performance**

It is recommended that close monitoring of vertical and lateral movement of the shoring wall should be carried out and frequent site inspections be conducted to ensure that the excavation does not adversely affect the structural stability of the adjacent buildings and the existing underground utilities. Extra bracing or support may be required if any movement is found excessive. The contractor should maintain the shoring to ensure any movement is within the design limit.

Vibration control and pre-construction survey is strongly recommended for the adjacent properties and structures prior to any excavation activities at the site. Our office can provide further advice or undertaking the vibration control and pre-construction survey as necessary.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of 133428 Ontario Limited. and for review by the designated consultants and government agencies. Use of the report is subject to the conditions and limitations of the contractual agreement.

The material in the report reflects the judgement of Poh Fung Kwok, M.Sc., and Kin Fung Li, P.Eng., in light of the information available to it at the time of preparation. Any uses which a Third Party makes of this report, or any reliance on decisions to be made based on it, are 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.

Poh Fung Kwok, M.Sc.

LICENSED PROFESSIONAL ENGINEER
March 7, 2023
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Kin Fung Li, P.Eng.
PFK/KFL

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	1 inch = 25.4 mm
1lb = 0.454 kg	1ksf = 47.88 kPa

JOB NO.: 2111-S043

LOG OF BOREHOLE: 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Mid-Rise Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 720 Granite Court, City of Pickering

DRILLING DATE: December 16, 2021

Legend: ● Dynamic Cone (blows/30 cm) 10 30 50 70 90; × Shear Strength (kN/m²) 50 100 150 200; ○ Penetration Resistance (blows/30 cm) 10 30 50 70 90; Atterberg Limits PL LL; ● Moisture Content (%) 10 20 30 40; WATER LEVEL

El. (m) / Depth (m)	SOIL DESCRIPTION	Sample Number	Type	N-Value	Depth Scale (m)	Moisture Content (%)
104.5	Ground Surface					
0.0	**23 cm TOPSOIL**	1	DO	2	0	17
	Very dense **SANDY SILT TILL** a trace of gravel occ. silty clay layers, cobbles and boulders (weathered)	2	DO	56	1	11
		3	DO	50/4		7
		4	DO	50/4	2	6
		5	DO	50/4	3	7
	brown / grey	6	DO	50/5	4	5
		7	DO	50/6	6	7
		8	DO	50/3	7	7
		9	DO	50/1	9	6
		10	DO	50/3	10	7
92.2 / 12.3	**END OF BOREHOLE**	11	DO	50/3	12	7

END OF BOREHOLE
Installed 50 mm Ø monitoring well to 9.0 m
completed with 3.1 m screen
Sand backfill from 5.5 to 9.0 m
Bentonite seal from 0.0 m to 5.5 m
Provided with a momument steel casing

W.L @ El of 98.0 m on January 7, 2022

W.L. @ El. 94.1 m on completion

Cave-in @ El. 92.8 m m on completion

Soil Engineers Ltd.

JOB NO.: 2111-S043

LOG OF BOREHOLE: 2

FIGURE NO.: 2

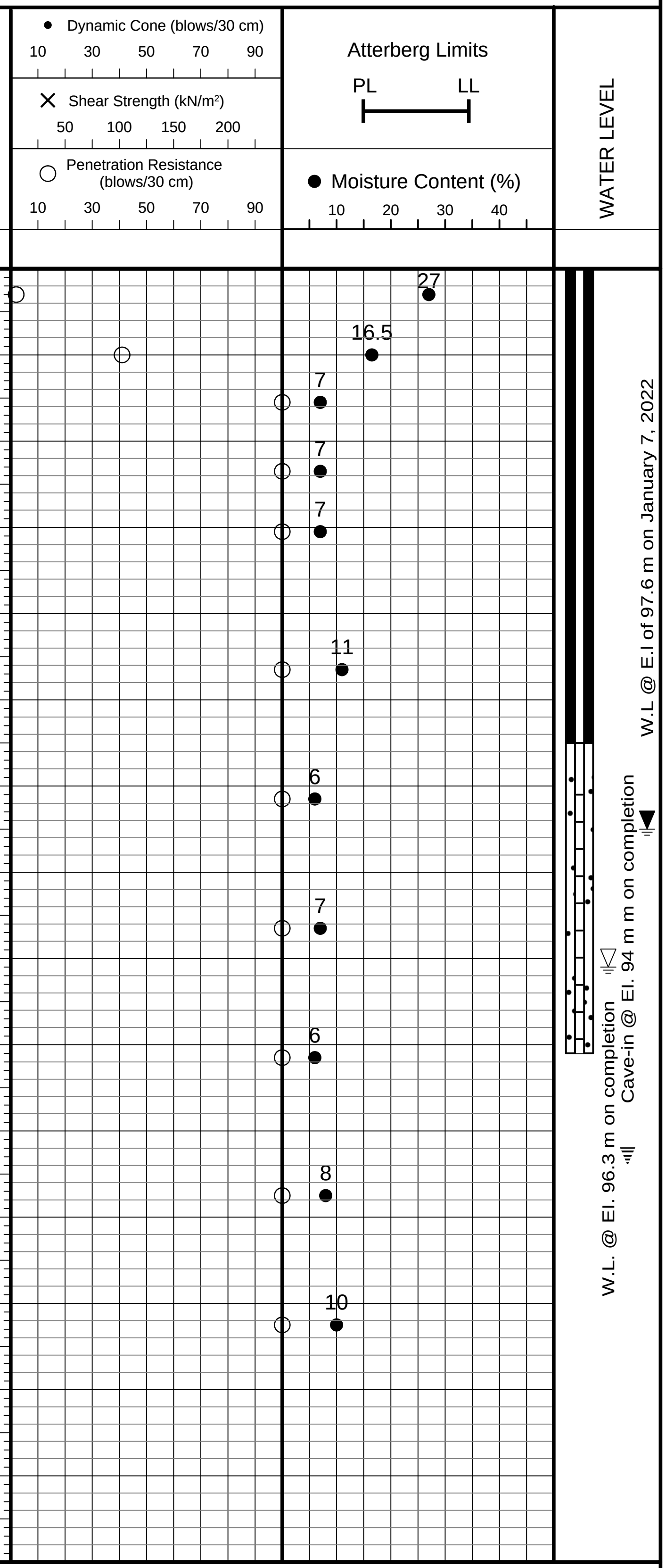
PROJECT DESCRIPTION: Proposed Mid-Rise Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 720 Granite Court, City of Pickering

DRILLING DATE: December 16, 2021

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Moisture Content (%)
104.4	Ground Surface					
0.0	**23 cm TOPOSIL**	1	DO	2	0	27
	Dense to very dense **SANDY SILT TILL** a trace of gravel occ. silty clay layers, cobbles and boulders (weathered)	2	DO	41	1	16.5
		3	DO	50/3		7
		4	DO	50/5	2	7
		5	DO	50/6	3	7
	brown / grey				4	
		6	DO	50/5		11
		7	DO	50/5	6	6
		8	DO	50/4	7	7
		9	DO	90/11	9	6
		10	DO	50/4	10	8
92.1 / 12.3	**END OF BOREHOLE**	11	DO	50/2	12	10



END OF BOREHOLE

Installed 50 mm Ø monitoring well to 9.0 m completed with 3.1 m screen
Sand backfill from 5.5 to 9.0 m
Bentonite seal from 0.0 m to 5.5 m
Provided with a momument steel casing

Soil Engineers Ltd.

JOB NO.: 2111-S043

LOG OF BOREHOLE: 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Mid-Rise Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 720 Granite Court, City of Pickering

DRILLING DATE: December 17, 2021

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Moisture Content (%)	WATER LEVEL
104.9	Ground Surface					
0.0	**20 cm TOPSOIL**	1	DO	1	30	Dry upon completion
	Dense to very dense **SANDY SILT TILL** a trace of gravel occ. silty clay layers, cobbles and boulders (weathered)	2	DO	37	8	
		3	DO	50/5	7	
		4	DO	50/5	7	
		5	DO	50/3	7	
	brown / grey					
		6	DO	50/5	7	
		7	DO	50/6	7	
		8	DO	50/3	9	
		9	DO	50/4	9	
		10	DO	50/3	5	
92.6 / 12.3	**END OF BOREHOLE**	11	DO	50/3	6	

Depth Scale (m): 0–15

● Dynamic Cone (blows/30 cm): 10 30 50 70 90

× Shear Strength (kN/m²): 50 100 150 200

○ Penetration Resistance (blows/30 cm): 10 30 50 70 90

Atterberg Limits: PL LL

● Moisture Content (%): 10 20 30 40

Soil Engineers Ltd.

JOB NO.: 2111-S043

LOG OF BOREHOLE: 4

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Mid-Rise Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 720 Granite Court, City of Pickering

DRILLING DATE: December 14, 2021

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Moisture Content (%)
104.0	Ground Surface				
0.0	25 cm TOPSOIL	1	DO	12	21
	Very dense **SANDY SILT TILL** a trace of gravel occ. silty clay layers, cobbles and boulders (weathered)	2	DO	79/8	10
		3	DO	50/4	7
		4	DO	50/4	7
		5	DO	50/4	6
	brown / grey	6	DO	50/3	6
		7	DO	50/3	5
		8	DO	50/2	6
		9	DO	50/2	5
		10	DO	50/4	6
91.7 / 12.3		11	DO	50/4	5

END OF BOREHOEL

Installed 50 mm Ø monitoring well to 9.0 m
completed with 3.1 m screen
Sand backfill from 5.5 to 9.0 m
Bentonite seal from 0.0 m to 5.5 m
Provided with a momument steel casing

Depth Scale (m): 0 – 15

Dynamic Cone (blows/30 cm): 10 30 50 70 90
Shear Strength (kN/m²): 50 100 150 200
Penetration Resistance (blows/30 cm): 10 30 50 70 90
Atterberg Limits: PL LL
Moisture Content (%): 10 20 30 40

WATER LEVEL

W.L @ E.l of 98.5 m on January 7, 2022

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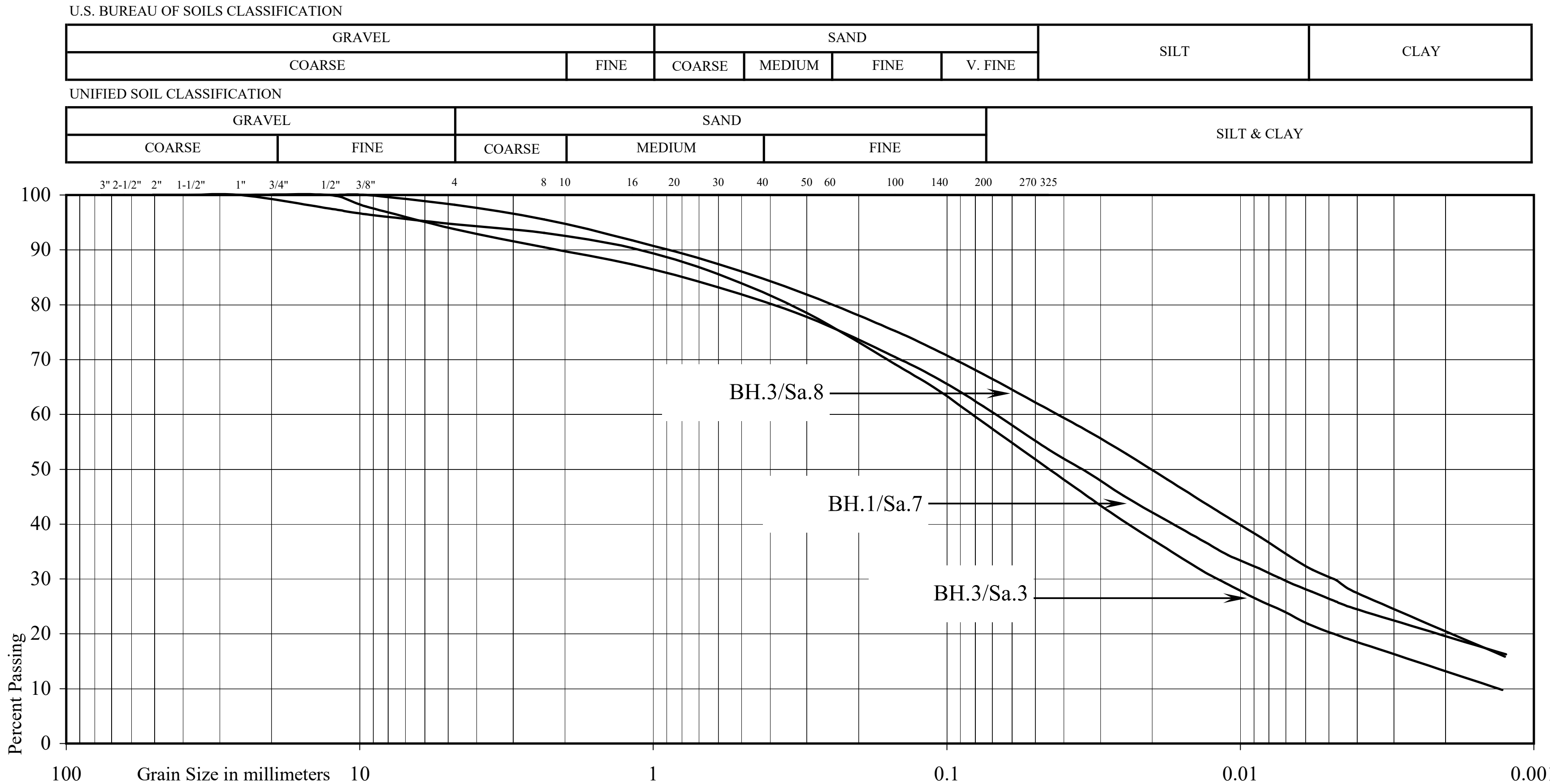
GRAIN SIZE DISTRIBUTION

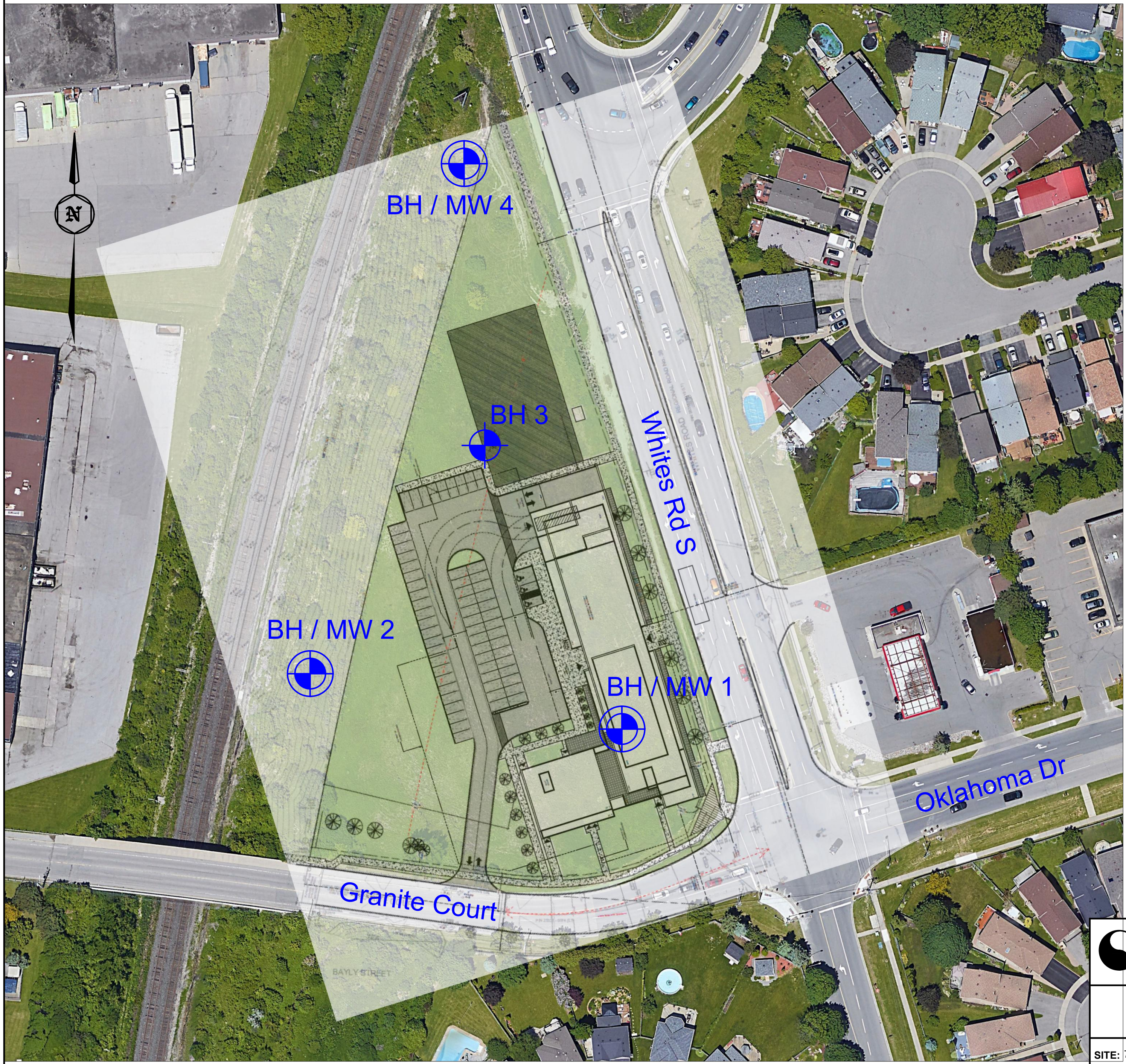
Reference No: 2111-S043



Project:	Proposed Mid-Rise Residential Development				BH./Sa.	1/7	3/3	3/8
Location:	720 Granite Court, City of Pickering				Liquid Limit (%) =	-	-	-
					Plastic Limit (%) =	-	-	-
Borehole No:	1	3	3		Plasticity Index (%) =	-	-	-
Sample No:	7	3	8		Moisture Content (%) =	7	7	9
Depth (m):	6.1	1.5	7.6		Estimated Permeability			
Elevation (m):	98.4	103.4	97.3		(cm./sec.) =	10^{-7}	10^{-6}	10^{-7}

Classification of Sample [& Group Symbol]: SANDY SILT TILL, some clay, a trace of gravel

Figure: 5



KEY PLAN
1:25,000

Soil Engineers Ltd.
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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: 720 Granite Court, City of Pickering

DESIGNED BY: D.K.	**CHECKED BY:** K.L.	**DWG NO.:** 1

SCALE: 1 : 1,500	**REF. NO.:** 2111-S043	**DATE:** March 2023	**REV** A

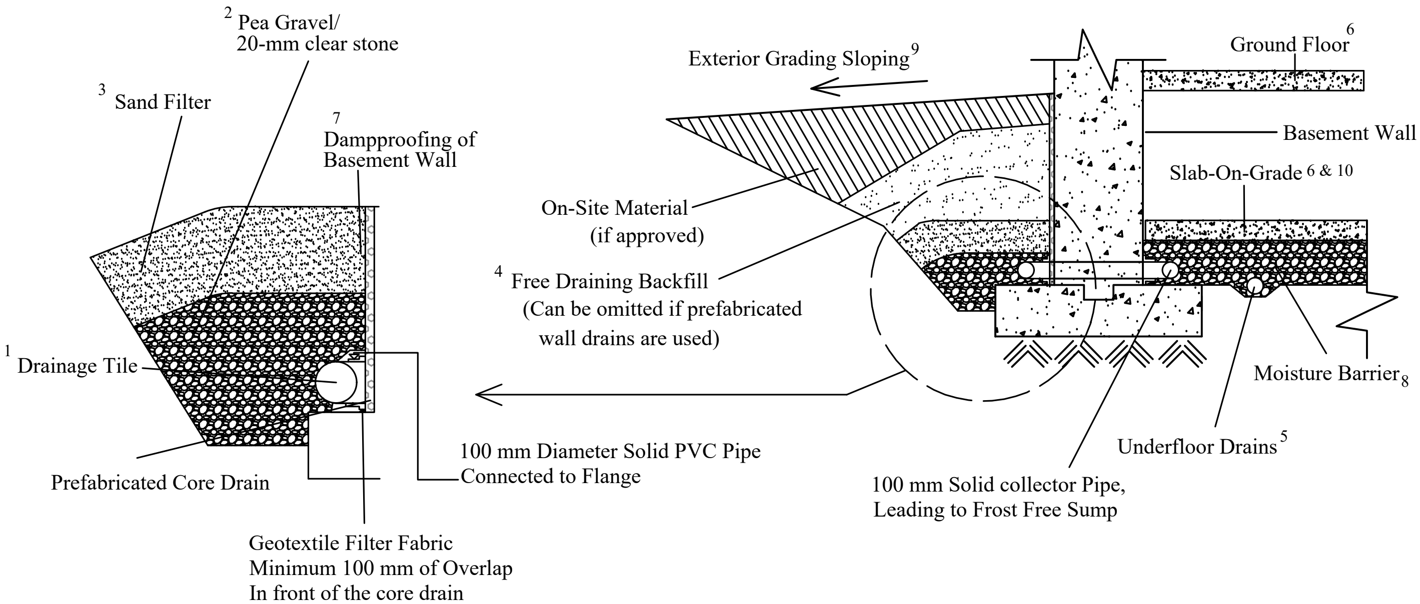
Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE

SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 2111-S043
REPORT DATE: January 2022
PROJECT DESCRIPTION: Proposed Mid-Rise Residential Development
PROJECT LOCATION: 720 Granite Court, City of Pickering

LEGEND
SANDY SILT TILL
TOPSOIL
CAVE-IN
WATER LEVEL (END OF BOREHOLE)
WATER LEVEL (STABILIZED)

BH No.:	1	2	3	4
El. (m):	104.5	104.4	104.9	104



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. **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 invert should be at least 300 mm (12") below the underside of the floor slab. The drains should be connected to positive sumps or outlets. Do not connect the underfloor drains to the perimeter drains.

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

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

8. **Moisture barrier**: 20-mm clear stone 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. Surface can be sodded immediately after construction.

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

* Underfloor drains can be deleted where not required.

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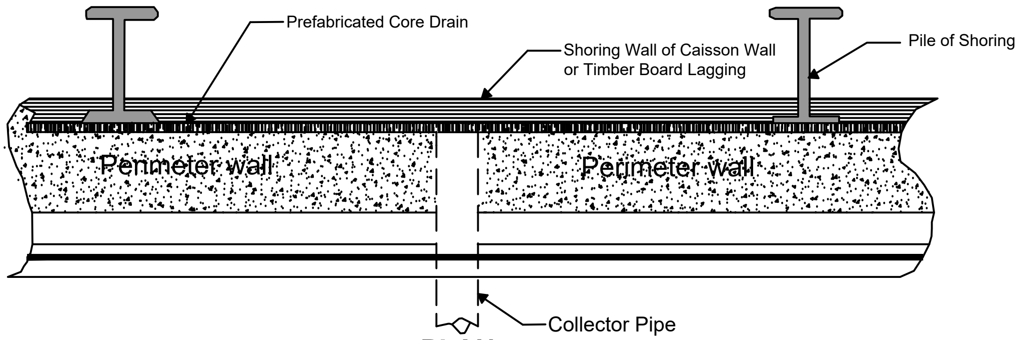
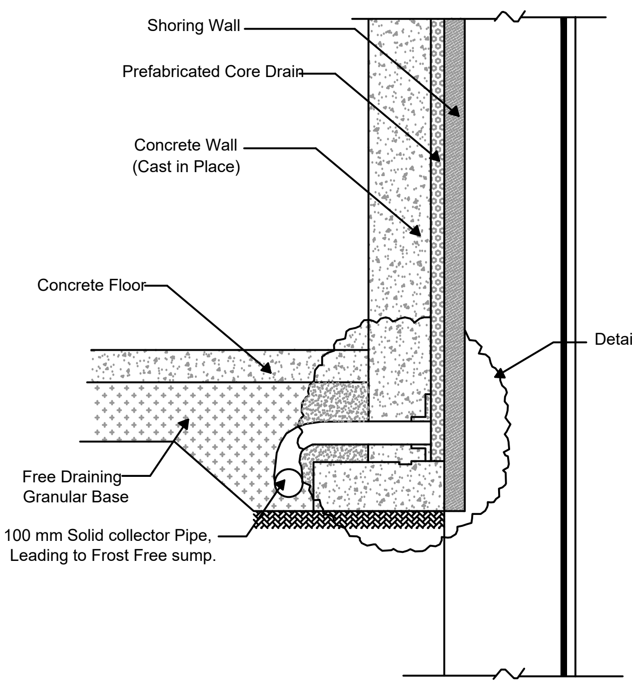
Details of Permanment Perimeter Drainage System

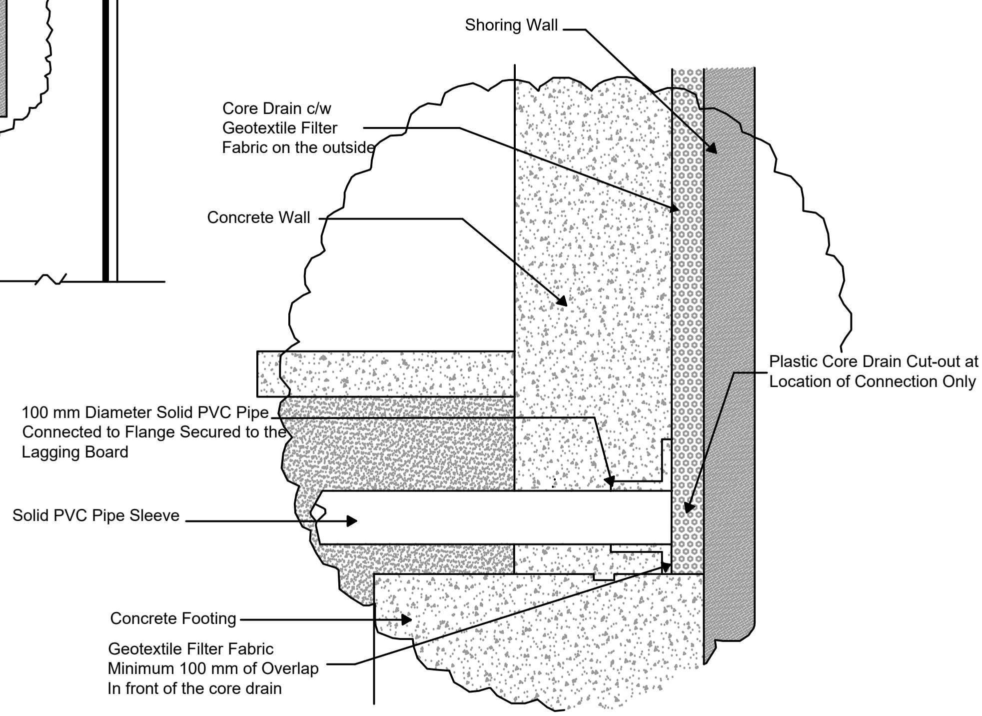
SITE 720 Granite Court, City of Pickering		
DESIGNED BY S.N	**CHECKED BY** B.L	**DWG NO.** 3
SCALE N.T.S.	**REF. NO.** 2111-S043	**DATE** january 2022
REV -		



PLAN



TYPICAL SECTION



DETAIL A

NOTES:

1. A continuous blanket of prefabricated drainage system, Miradrain 6000 or equivalent, should extend continuously from the top of footings to the ground surface.

2. All joints of the Miradrain should be taped. All openings above the concrete footing must be covered with filter fabric to prevent intrusion of fresh concrete into the core of the drain.

3. Backfill behind the lagging board must be free draining. Filter fabric or straw should be used to prevent loss of fines behind the lagging.

4. The perimeter drainage and any subfloor drainage systems must be kept separate.

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Permanent Perimeter Drainage System

SITE: 720 Granite Court, City of Pickering			
DESIGNED BY: S.N	**CHECKED BY:** B.L	**DWG NO.:** 4	
SCALE: N.T.S.	**REF. NO.:** 2111-S043	**DATE:** January 2022	**REV** -

APPENDIX A

SHORING DESIGN

REFERENCE NO. 2111-S043

SHORING SYSTEM

Shoring will be required in an excavation to limit the horizontal and vertical movements of adjacent properties.

A shoring system consisting of soldier piles and lagging boards can be used in an excavation where slight movement in the adjacent properties is tolerable. In an area with close proximity of adjacent structure and the excavation will be extending below the foundation level where any movement in the adjacent properties is a concern, or in an excavation embedding into saturated sand or silt deposit, an interlocking caisson wall is more appropriate.

The design and construction of the shoring system should be carried out by a specialist designer and contractor experienced in this type of construction. All specifications for the design of the shoring system should be in accordance with the latest edition of the Canadian Foundation Engineering Manual (CFEM).

LATERAL EARTH PRESSURE

For single and multiple level supporting systems, the lateral earth pressure distributions on the shoring walls are shown on Drawing A1. The design soil parameters are provided in the geotechnical report.

The lateral earth pressure expressions do not include hydrostatic pressure buildup behind the shoring. If the wall is designed to be watertight or undrained, such as a caisson wall, the anticipated hydrostatic pressure must be included behind the structure.

PILE PENETRATION

The depth of pile support should be calculated from the following expressions:

$$R = 1.5\, D\, K_p\, L^2\, \gamma$$

where	R	= Ultimate load to be restrained	kN
	D	= Diameter of concrete filled hole	m
	K_p	= Passive resistance of soils below the level of excavation	
	L	= Embedment depth of the pile	m
	γ	= Unit weight of the soil	kN/m^3

The shoring system should be designed for a factor of safety of $F = 2$.

For anchor supported shoring system, the global factor of safety against sliding and overturning of the anchored block of soil must also be considered.

The steel soldier piles in the shoring system must be installed in pre-augured holes. The lower portion will have to be filled with 20 MPa (3000 psi) concrete to the excavation level. The upper portion of the pile within the excavation depth should be filled with lean mix concrete or non-shrinkable cementitious filler (U-fill).

LAGGING

The following thicknesses of lagging boards have been recommended in CFEM:

Thickness of Lagging	Maximum Spacing of Soldier Piles
50 mm (2 in)	1.5 m (5 ft)
75 mm (3 in)	2.5 m (8 ft)
100 mm (4 in)	3.0 m (10 ft)

Local experience has indicated that the lagging board thickness of 75 mm has been adequate for soldier pile spacing of 3 m for soil conditions similar to those encountered at the subject site. However, it is important to consider all local conditions, such as the duration of excavation, the weather likely to be encountered through the construction period, seasonal variations in the ground water and ice lensing causing frost heave and softening of soils in determining the lagging thickness. 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.

During construction of shoring, all the spaces behind the lagging board must be filled with free-draining granular fill. If wet conditions are encountered, the space between the boards should be packed with a geotextile filter fabric or straw to prevent the loss of fine particles.

TIEBACK ANCHORS

The minimum spacing and the depths of the soil anchors should be as recommended in the CFEM.

All drilled holes for tieback anchors should be temporarily cased or lined to minimize the risk of caving. Systems involving high grout pressures should be avoided if working near other basements or buried services.

The tieback anchor lengths can be estimated using an adhesion values of 50 kPa. Full scale load tests should be carried out on the tieback anchors in each type of soils and at each level of anchor support at the site to confirm the design parameters and the adhesion values. The test anchors should be loaded in a pattern as described in CFEM, to 200% of the design load or until there is a significant increase in the pullout rate. In the latter case, the design load must be limited to 50% of the maximum load at which the pullout increases. Based on the results of the pullout test, it may be necessary to modify the anchor design of the production anchors.

Each tieback anchor must be proof-loaded to 133% of the design load, and the anchor must be capable of sustaining this load for a minimum of 10 minutes without creep. The load may then be relaxed to 100% of the design and locked in. The higher the lock-in loads, the less will be the outward movement on the shoring wall after excavation.

RAKERS

An alternative to tieback anchor support of the shoring is to use raker footings. Rakers inclining at an angle of 45º, founded in the native soil deposit below the bottom of excavation should be designed for the allowable bearing pressure of 300 kPa (6.0 k.s.f.).

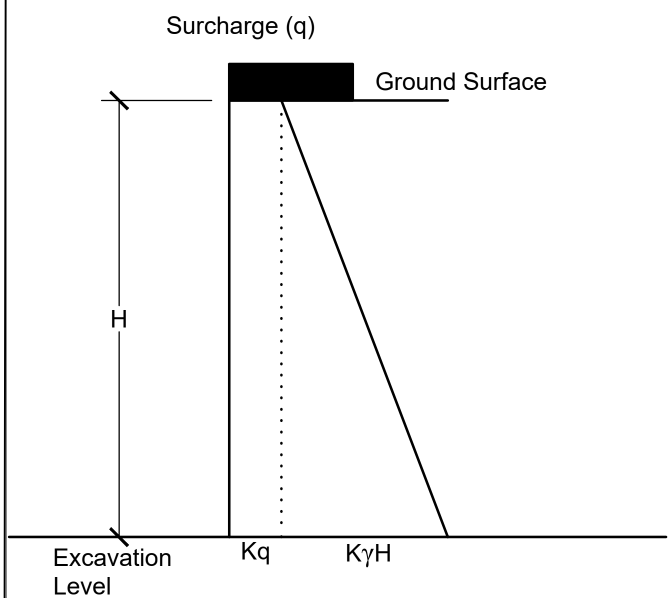
The raker footings should be located outside the zone of influence of the buried portion of the soldier piles at a distance of not less than 1.5 of the length of embedment of the soldier pile.

To prevent undermining of the raker footing, no excavation should be made within two times the width of raker footing on the opposite side of the raker.

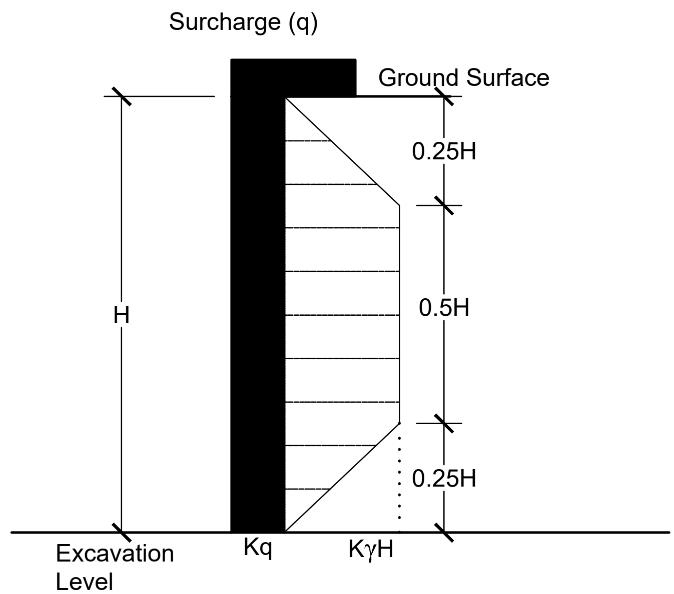
MONITORING OF PERFORMANCE

Close monitoring of the vertical and lateral movement of the shoring system, by inclinometers or by survey on targets, should be carried out at the site. Extra bracing or support may be required if any movement is found excessive. The contractor should maintain the shoring to ensure any movement is within the design limit.

TEMPORARY SHORING
Lateral Earth Pressures



Single Support System



Multiple Support System

Lateral Pressure $P = K(\gamma H + q)$

Where

H = Height of Shoring	m
γ = Unit Weight of Retained Soil	21 kN/m^3
q = Surcharge	kPa
K = Earth Pressure Coefficient	

- If moderate ground and shoring movements are permissible then:
  $K = K_a$ = Active Earth Pressure Coefficient

- if there are building foundations within a distance of 0.5 H behind the shoring then:
  $K = K_o$ = Earth Pressure at rest

- If there are building foundations within a distance of between 0.5 H and H behind the shoring then:
  $K = 0.5 (K_a + K_o)$

Note:

1. The lateral pressure expression assumes effective drainage from behind the temporary shoring.
2. The earth pressure coefficients are specified in the geotechnical report.

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Temporary Shoring

SITE: 720 Granite Court, City of Pickering			
DESIGNED BY: S.N	**CHECKED BY:** K.L	**DWG NO.:** A1	
SCALE: N.T.S.	**REF. NO.:** 2111-S043	**DATE:** January 2022	**REV** -