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A REPORT TO
CROWN (BARRIE) DEVEOPMENTS INC.

A GEOTECHNICAL INVESTIGATION FOR PROPOSED MIXED-USE DEVELOPMENT

1012 YONGE STREET

CITY OF BARRIE

REFERENCE NO. 2002-S036

MARCH 2021
(REVISION OF REPORT DATED FEBRUARY 2021)

DISTRIBUTION

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TABLE OF CONTENTS

TABLES

ENCLOSURES

1.0 INTRODUCTION

In accordance with written authorization dated February 7, 2020, from Mr. Adam Taverna of Crown (Barrie) Developments Inc., a geotechnical investigation was carried out at the property located at 1012 Yonge Street in the City of Barrie.

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

2.0 SITE AND PROJECT DESCRIPTION

The City of Barrie is situated within the periphery of Lake Simcoe basin where the glacial till has been partly eroded, in places, by glacial Lake Algonquin. In places, the area has been filled with glaciolacustrine sand, silt, clay and reworked till.

The site of investigation, approximately 4.9 hectare in area, is located on the west side of Yonge Street, nearly 1.0 km south of Mapleview Drive East in the City of Barrie. At the time of investigation, the site was a farm field with farmhouses, barns and a driveway accessible from Yonge Street. The existing site gradient is slightly elevated from the road pavement on Yonge Street.

It is our understanding that site will be developed for 3-storey and 6-storey building blocks with an underground parking structure.

3.0 FIELD WORK

The field work, consisting of seven (7) sampled boreholes extending to a depth of 9.3 m, was performed between March 12 and 19, 2020, at the locations shown on the 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 non-cohesive 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 borehole drilling and soil sampling, four (4) monitoring wells were installed at the selected borehole locations, as instructed by Cole Engineering Group Ltd. to facilitate groundwater records. The depth and details of the monitoring wells are shown on the corresponding Boreholes Logs.

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

4.0 SUBSURFACE CONDITIONS

The site is a farm field with farmhouses, barns and a driveway at the centre portion. The boreholes are located in the farm field with topsoil and vegetation cover. Earth fill can be anticipated beyond the borehole locations in the vicinity of the farmhouses and barns.

The investigation has disclosed that beneath the topsoil and ploughed earth, the site is underlain by native sandy silt till and sand deposits. Detailed descriptions of the subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 7, 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 is approximately 25 to 45 cm in thickness, with ploughed earth extending to a depth of 0.5 to 0.6 m. Thicker topsoil may be contacted beyond the borehole locations.

4.2 **Sandy Silt Till** (Boreholes 1, 2, 3, 4 and 6)

The native sandy silt till deposit was encountered below the topsoil and ploughed earth at most of the borehole locations. Sample examinations disclosed that the till is slightly cemented, with a random mixture of particle sizes ranging from clay to gravel, with sand and silt exerting the dominant influence on the soil properties. The silt till extends to a depth of 2.4 to 3.4 m from grade.

The obtained 'N' values range from 8 to over 100 blows per 30 cm of penetration, with a median of 29 blows per 30 cm of penetration. The lower 'N' values recorded near the ground surface represent soil weathering. Below a depth of 2 m from grade, the till is generally dense or very dense in relative density. Hard resistance to augering was encountered in places, indicating the presence of cobbles and boulders.

The natural water content of the soil samples was determined and the results are plotted on the Borehole Logs. The values range from 7% to 15%, with a median of 10%, indicating damp to moist conditions.

The engineering properties of the silt till pertaining to the project are given below:

- Moderately frost susceptible.
- Relatively low water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec, a percolation rate of 60 min/cm, and runoff coefficients of:

Slope	
0% - 2%	0.15
2% - 6%	0.20
6% +	0.28

- The shear strength is primarily derived from internal friction and is augmented by cementation.
- In excavation, the silt till will be relative stable with a steep slope; however, under prolonged exposure, localized erosion in sand pockets and sheet collapse may occur.
- Fair pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of 8%.
- Moderately low corrosivity to buried metal, with an estimated electrical resistivity of 4500 ohm.cm.

4.3 **Sand** (All Boreholes)

The sand deposit is predominant in the stratigraphy. It is fine to medium grained, with silt, gravel and occasional cobbles. Grain size analyses were performed on 4 representative samples; the results are plotted on Figures 8 and 9.

The obtained 'N' values range from 6 to over 100 blows per 30 cm of penetration, showing the relative density of the deposit is loose to very dense. The lower 'N' values recorded near the ground surface represent soil weathering.

The natural water content values of the sand samples range from 2% to 22%, indicating dry to wet conditions. The samples are generally water bearing below El. 263 m to 264 m.

The engineering properties of the sand deposit are given below:

- Highly water erodible.
- Pervious, with an estimated coefficient of permeability of 10^{-2} to 10^{-3} cm/sec, a percolation rate of 5 to 10 min/cm, and runoff coefficients of:

Slope	
0% - 2%	0.04
2% - 6%	0.09
6% +	0.13

- The shear strength is primarily derived from internal friction and is density dependent.
- In excavation, the sand will slough and run with seepage. The bottom will boil with a piezometric head of about 0.3 m.
- Good pavement-supportive material, with an estimated CBR value of 16%.
- Moderately low corrosivity to buried metal, with an estimated electrical resistivity of 6000 ohm.cm.

5.0 GROUNDWATER CONDITIONS

Upon completion of the borehole drilling, groundwater or wet cave-in was recorded in the boreholes at a depth between 4.1 m and 9.1 m, or between El. 262.6 m and 264.4 m.

On March 24, 2020 and April 22, 2020, approximately 1 and 5 weeks after the drilling, free groundwater was recorded in the monitoring wells at El. 263.66 m to 264.96 m. Monitoring Well No. 2, however, remained dry at the time of record, indicating the groundwater can be beneath the bottom of well, below El. 265.1 m. The findings are summarized in Table 1.

Table 1 - Groundwater Levels

Borehole/ Monitoring Well No.	Ground Elevation (m)	Well Depth (m)	Groundwater/Cave-in* Level Upon Completion of Drilling		Groundwater Level in Monitoring Well			
					March 24, 2020		April 22, 2020	
			Depth (m)	El. (m)	Depth (m)	El. (m)	Depth (m)	El. (m)
1 (MW)	271.0	7.6	7.6	263.4	Dry	Below 263.4	7.34	263.66
2 (MW)	271.2	6.1	7.3	263.9	Dry	Below 265.1	Dry	Below 265.1
3	270.2	-	5.8/6.1*	264.4/264.1*	No Well			
4 (MW)	271.7	7.6	9.1	262.6	7.07	264.63	6.74	264.96
5 (MW)	268.8	6.1	4.7	264.1	4.73	264.07	4.61	264.19
6	269.9	-	6.4/6.7*	263.5/263.2*	No Well			
7	268.1	-	4.1/4.3*	264.0/263.8*	No Well			

Based on the records from the open boreholes and monitoring wells, with the consideration of the water content profiles of the soil samples, it is our opinion that the recorded groundwater represents the continuous aquifer in the sand stratum. The groundwater table is subject to seasonal fluctuation.

6.0 DISCUSSION AND RECOMMENDATIONS

The site is a farm field with farmhouses, barns and a driveway at the centre portion. The boreholes located in the farmland has disclosed that beneath the topsoil and ploughed earth, the site is underlain by native sandy silt till and sand deposits, generally dense to very dense in relative density below a depth of 1.5 m to 2.5 m from grade. Earth fill can be anticipated beyond the borehole locations in the vicinity of the farmhouses and barns.

The recorded groundwater levels in the open boreholes and monitoring wells, ranging between El. 263.66 m and 264.96 m, represent the continuous aquifer in the sand stratum. The groundwater table is subject to seasonal fluctuation.

The site will be developed for 3-storey and 6-storey building blocks with an underground parking structure. It is anticipated that the maximum excavation depth for the underground structure to be 4.5 m below grade. The geotechnical findings which warrant special consideration are presented below:

1. The bulk excavation for the building foundation will extend through the silt till and into the sand stratum of dense to very dense in relative density, which is suitable for supporting the proposed structures on conventional footings.
2. In conventional construction of underground structures, damp-proofing of the perimeter walls and a subdrain system should be provided.
3. The walls of excavation will have to be sloped properly. Where sloped excavation is not feasible, a braced 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 blocks will consist of an underground parking. The bulk excavation for the building foundation will be approximately 4.6 m in depth, which will extend through the silt till and into the sand stratum of dense to very dense in relative density.

The building blocks, having the underground parking floor of at least 0.5 m above the highest groundwater level, can be constructed on conventional footings, with perimeter and underfloor subdrains to remove any water as collected at the bottom of the structure. The recommended bearing pressures for conventional footing design are provided:

- Maximum Soil Bearing Pressure, at SLS = 600 kPa
- Factored Ultimate Bearing Pressure, at ULS = 900 kPa

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

The foundation subgrade should 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. A concrete mud-slab should be placed on the bearing subsoil immediately after exposure and inspection, where seepage is evident. This will prevent construction disturbance and costly rectification.

Foundations exposed to weathering or in unheated areas, such as the exterior footings near ventilation shaft and ramp-down driveway, should have at least 1.5 m of earth cover for protection against frost action. For 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 0.8 m for perimeter walls and 1.0 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 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 and hydrostatic pressure must also be considered in the design of the underground structure.

In conventional design, the underground structure founded at a 1.0 m above the highest record of groundwater level should be provided with a perimeter subdrain and damp-proofing of the foundation wall (Drawing No. 3). Backfill of open excavation should consist of free-draining granular material. Prefabricated drainage board will be required on the blind side of foundation walls poured against the shoring (Drawing No. 4).

Underfloor weepers, at 5 m to 6 m spacing, should be considered below the concrete floor of the underground structure, where the highest record of groundwater level is less than 0.5 m below the floor of the underground structure (Drawing No. 5). A 10-mil polyethylene membrane should be provided between the bedding and the concrete slab where underfloor weepers are provided.

The perimeter drains and the underfloor weepers should be installed with a positive gradient, connecting into the frost-free sump in separate drain pipes. They should be shielded by geofabric filter and covered with stone filter to prevent blockage by silting. The water collected in the sump can be discharged into municipal sewer. If the discharge of water into the sewer is not allowed by the municipality, the water should be discharged into a cistern for

storage where the water can be used for irrigation of the landscaping areas or cleaning in the dry and warm season.

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

6.3 Slab-On-Grade Construction

The subgrade for underground parking slab should consist of well compacted earth fill or native subsoil. The slab floor should be constructed on a granular base, consisting of 20-mm Crusher-Run Limestone, or equivalent, not less than 20 cm in thickness, compacted to its maximum Standard Proctor dry density. In case underfloor weepers are required, the slab bedding should be increased to 30 cm in thickness.

At the underground parking entrances, the driveway subgrade should be properly insulated, or the subgrade material should be replaced with 1.5 m of non-frost-susceptible granular material and provided with subdrains. This will minimize frost action in this area where vertical ground movement cannot be tolerated. The interior floor next to the entrance and in areas next to the air shafts should also be insulated, and the insulation should extend 1.5 m internally. This measure is to prevent frost action induced by cold drafts.

At the exterior, the slab-on-grade or concrete sidewalk should be designed to tolerate frost heave. To prevent frost action induced by cold wintry drafts in areas where vertical ground movement cannot be tolerated, such as building entrances, the pavement or sidewalk must be constructed on free-draining, non-frost-susceptible granular material such as Granular 'B', with proper drainage below the frost depth of 1.5 m. Alternatively, the sidewalk can be insulated with 50-mm Styrofoam, or equivalent. The grading around structures must be such that it directs runoff away from the surface to minimize the frost heave phenomenon in the disclosed soils.

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 weathered soils, it should be subexcavated and replaced with bedding material compacted to at least 95% or + of its Standard Proctor compaction.

A Class 'B' bedding, consisting of compacted 20-mm Crusher-Run Limestone or equivalent, is recommended for construction of the underground services. In areas where seepage is evident in the pipe invert, a Class 'A' concrete bedding should be used or alternatively, the native sand invert is to be levelled for the pipe bedding.

The pipe joints into manholes and catch basins should be leak-proof. 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 equal to two times the diameter of the pipe should be in place at all times after completion of the pipe installation.

The metal 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 be compacted to at least 95% of its maximum Standard Proctor density (SPDD) and increase to 98% SPDD below the concrete floor slab or sidewalk. In the zone within 1.0 m below the parking lot and driveways, the backfill should be compacted with the water content at 2% to 3% drier than the optimum to at least 98% SPDD.

6.6 Pavement Design

Where the pavement is to be built above the structural slab of underground structure, sufficient granular base and adequate drainage must be provided to prevent frost damage to the pavement. An impervious waterproofing membrane must be placed above the structural slab to prevent water leakage as well as to protect the reinforcing steel bars against brine corrosion.

The recommended pavement structure to be placed on the underground garage rooftop is presented in Table 2.

Table 2 - Pavement Design on Underground Structure

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL-3
Asphalt Binder	50	HL-8
Granular Base	200	OPSS Granular 'A' or equivalent
Granular Sub-base	100	Free-Draining Sand Fill

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

Table 3 - Pavement Design on Grade

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL-3
Asphalt Binder Light Duty Parking Heavy Duty and Fire Route	 45 60	HL-8
Granular Base	150	OPSS Granular 'A' or equivalent
Granular Sub-base Light Duty Parking Heavy Duty and Fire Route	 200 300	OPSS Granular 'B' or equivalent

In preparation of the pavement subgrade, topsoil and organic earth fill must be removed. The final subgrade should be inspected and proof-rolled. Any soft spots should be subexcavated and replaced with compacted inorganic earth fill.

The 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 at 2% to 3% drier than the 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 into the construction procedures and pavement design:

- If the pavement construction does not immediately follow the trench backfilling, the subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained.
- Areas adjacent to the pavement should be properly graded to prevent accumulating of large amounts of water during the interim construction period.
- 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.
- Subdrains will be required around catch basins at the lower spots to remove any percolated water from the pavement structure into the catch basins, unless the pavement subgrade is consisting of free draining material. The subdrains should be at least 0.3 m below the subgrade level with granular backfill. They should consist of filter-sleeved weepers to prevent blockage by silting.

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**
Topsoil/Ploughed Earth	16.0	1.25	-
Sand	21.0	1.20	1.00
Sandy Silt Till	22.5	1.30	1.05
Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_0**	**Passive K_p**
Compacted Earth Fill	0.35	0.50	3.00
Native Sandy Silt Till/Sand	0.25	0.40	4.00
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
Sound Till	2
Earth Fill, Drained Sand	3
Saturated Soil	4

Where sloped excavation is not feasible, a braced shoring structure will be required. The overburden and surcharge from any adjacent roads should be considered in the design of shoring.

During the excavation, the yield of groundwater from the till stratum will be limited in quantity and slow in rate. If any excavation will be extended into the saturated soil strata below El. 264 or 265 m, dewatering from well points and/or deep wells should be considered.

It is recommended that close monitoring of the excavation is necessary. Any movement of the shoring wall should be recorded and frequent site inspections be conducted to ensure that the excavation does not adversely affect the structural stability of roads and underground utilities in close proximity of the excavation. A pre-construction survey of the adjacent properties must be carried out prior to the commencement of the excavation.

7.0 LIMITATIONS OF REPORT

This report was prepared for the account of Crown (Barrie) Development Inc. 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 Weida (Daric) Yang, B.A.Sc. and Bennett Sun, 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, are the responsibility of such Third Parties. Soil Engineers Ltd. accepts no responsibility for

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SOIL ENGINEERS LTD.

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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

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 12, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	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
271.0	Ground Surface							
0.3	**25 cm TOPSOIL**	1	DO	6	0		21	
	ploughed Brown, compact to very dense							
	SANDY SILT TILL traces of clay and gravel occ. sand seams and layers, cobbles and boulders	2	DO	11	1		15	
		3	DO	50/15			7	
					2			
		4	DO	91/24			7	
					3			
267.6		5	DO	87/24			12	
3.4	Brown, very dense **SAND** fine to medium grained occ. silt seams and gravel				4			
		6	DO	50/12			4	
					5			
					6			
		7	DO	70/28			3	
					7			
		8	DO	50/10			17	
					8			
261.7		9	DO	50/12	9		16	
9.3	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 7.6 m completed with 3.1 m screen Sand backfill from 2.9 m to 7.6 m Bentonite seal from 0.0 m to 2.9 m Provided with a momument steel casing				10			
					11			
					12			

W.L. @ El. of 263.4 m upon completion of drilling.

Well was dry on March 25, 2020
W.L @ El. of 263.66 m on April 22, 2020.

Soil Engineers Ltd.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 12, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	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
271.2	Ground Surface							
0.3	**30 cm TOPSOIL**	1	DO	6	0		27	
	ploughed Brown, compact to dense							
	SANDY SILT TILL traces of clay and gravel occ. sand seams and layers, cobbles and boulders	2	DO	19	1		9	
		3	DO	44	2		9	
268.8 2.4	Brown, very dense	4	DO	50/8			7	
	SAND medium grained occ. silt seams and gravel	5	DO	67	3		8	
		6	DO	50/12	4		5	
		7	DO	50/12	5		7	
		8	DO	50/10	6		17	
261.9 9.3	**END OF BOREHOLE**	9	DO	50/12	7		20	
	Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 m to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a momument steel casing				8 9 10 11 12			

W.L. @ El. of 263.9 m upon completion of drilling.

Well was dry on March 25, 2020 and April 22, 2020

Soil Engineers Ltd.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 12, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	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
270.2	Ground Surface							
0.3	**25 cm TOPSOIL**	1	DO	8	0		16	
	Brown, loose to very dense							
	SANDY SILT TILL traces of clay and gravel occ. sand seams and layers, cobbles and boulders	2	DO	8	1		13	
		3	DO	20	2		11	
		4	DO	73/25			8	
267.4 2.8					3			
	Brown, very dense	5	DO	78/23			7	
	SAND fine to medium grained occ. cobbles and boulders				4			
		6	DO	50/8			3	
					5			
		7	DO	50/15	6		10	
					7			
		8	DO	50/15			15	
					8			
260.9		9	DO	50/15	9		18	
9.3	**END OF BOREHOLE**				10			
					11			
					12			

W.L. @ El. of 264.4m upon completion of drilling.
Cave-in @ El. of 264.1 m upon completion of drilling.

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JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 12, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	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
271.7	Ground Surface							
	33 cm TOPSOIL	1	DO	4	0		40	
0.3	ploughed Brown, loose to very dense **SANDY SILT TILL** traces of clay and gravel occ. sand seams and layers, cobbles and boulders	2	DO	9	1		11	
		3	DO	29	2		8	
		4	DO	67			7	
268.8					3			
2.9	Brown, very dense **SAND** fine to medium grained traces of silt and gravel occ. cobbles and boulders	5	DO	50/12			3	
		6	DO	50/10	4		4	
		7	DO	50/15	5		3	
		8	DO	50/10	6		12	
262.4		9	DO	50/15	7		15	
9.3	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 7.6 m completed with 3.1 m screen Sand backfill from 2.9 m to 7.6 m Bentonite seal from 0.0 m to 2.9 m Provided with a momument steel casing				8			
					9			
					10			
					11			
					12			

W.L. @ El. of 262.6 m upon completion of drilling.
W.L @ El. of 264.63 m on March 24, 2020.
W.L @ El. of 264.96 m on April 22, 2020.

Soil Engineers Ltd.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 5

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 17, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
268.8	Ground Surface				
	36 cm TOPSOIL	1	DO	2	0
0.4	ploughed Brown, loose very dense				
	SAND fine to medium grained a trace of silt occ. gravel	2	DO	24	1
		3	DO	57	2
		4	DO	72	
		5	DO	91/28	3
		6	DO	50/15	4
		7	DO	50/8	5
		8	DO	50/15	6
					7
					8
259.5		9	DO	50/15	9
9.3	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 m to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a momument steel casing				10
					11
					12

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. @ El. of 264.1 m upon completion of drilling.

W.L @ El. of 264.07 m on March 24, 2020.
W.L @ El. of 264.19 m on April 22, 2020.

Soil Engineers Ltd.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 6

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 19, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	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
269.9	Ground Surface							
	36 cm TOPSOIL	1	DO	4	0		16	
0.4	ploughed Brown, loose to compact							
	SAND fine grained a trace of silt	2	DO	15	1		4	
		3	DO	15	2		11	
267.8								
2.1	Brown, compact to very dense							
	SANDY SILT TILL traces of clay and gravel occ. sand seams and layers, cobbles and boulders	4	DO	29	3		9	
266.5		5	DO	67			7	
3.4	Brown, very dense				4			
	SAND fine grained occ. silt seams and gravel	6	DO	57	5		5	
		7	DO	50/12	6		8	
		8	DO	50/8	7		18	
					8			
260.6		9	DO	50/10	9		22	
9.3	**END OF BOREHOLE**				10			
					11			
					12			

W.L. @ El. of 263.5 m upon completion of drilling.
Cave-in @ El. of 263.2 m upon completion of drilling.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 7

FIGURE NO.: 7

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 18, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	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
268.1	Ground Surface							
	45 cm TOPSOIL	1	DO	2	0		14	W.L. @ El. of 264.0 m upon completion of drilling. Cave-in @ El. of 263.8 m upon completion of drilling.
0.5	Brown, loose to very dense ~~— — —~~ ploughed							
	SAND fine to medium grained traces of silt and gravel occ. cobbles and boulders	2	DO	6	1		14	
		3	DO	41	2		4	
		4	DO	45			2	
		5	DO	65	3		3	
		6	DO	50/12	4		12	
		7	DO	50/28	5		16	
		8	DO	50/8	6		18	
		9	DO	50/12	7		18	
258.8					8			
9.3	**END OF BOREHOLE**				9			
					10			
					11			
					12			

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GRAIN SIZE DISTRIBUTION

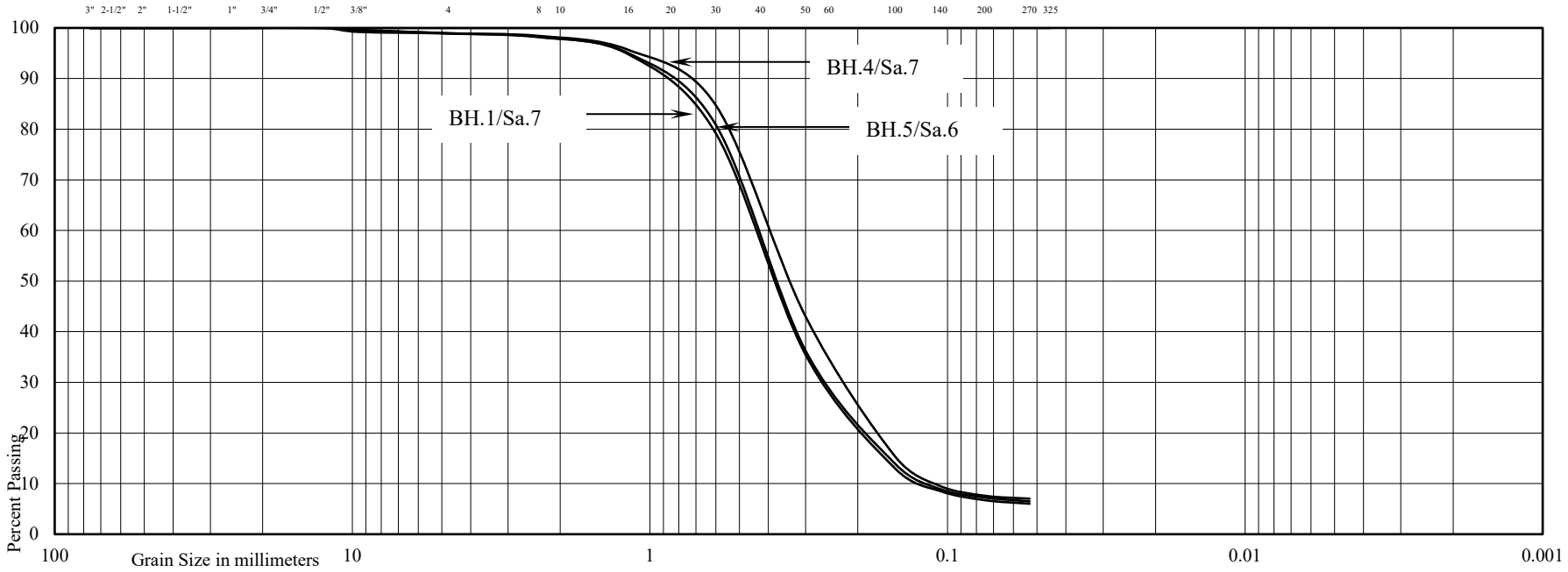
Reference No: 2002-S036

U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL		SAND				SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: Proposed Residential Development

Location: 1012 Yonge Street, City of Barrie

Borehole No:	1	4	5
Sample No:	7	7	6
Depth (m):	6.1	6.14	4.6
Elevation (m):	264.9	265.6	264.2

BH./Sa.	1/7	4/7	5/6
Liquid Limit (%) =	-	-	-
Plastic Limit (%) =	-	-	-
Plasticity Index (%) =	-	-	-
Moisture Content (%) =	3	3	14
Estimated Permeability (cm./sec.) =	10^{-2}	10^{-2}	10^{-2}

Classification of Sample [& Group Symbol]: FINE TO MEDIUM SAND, traces of silt and gravel

Figure: 8

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

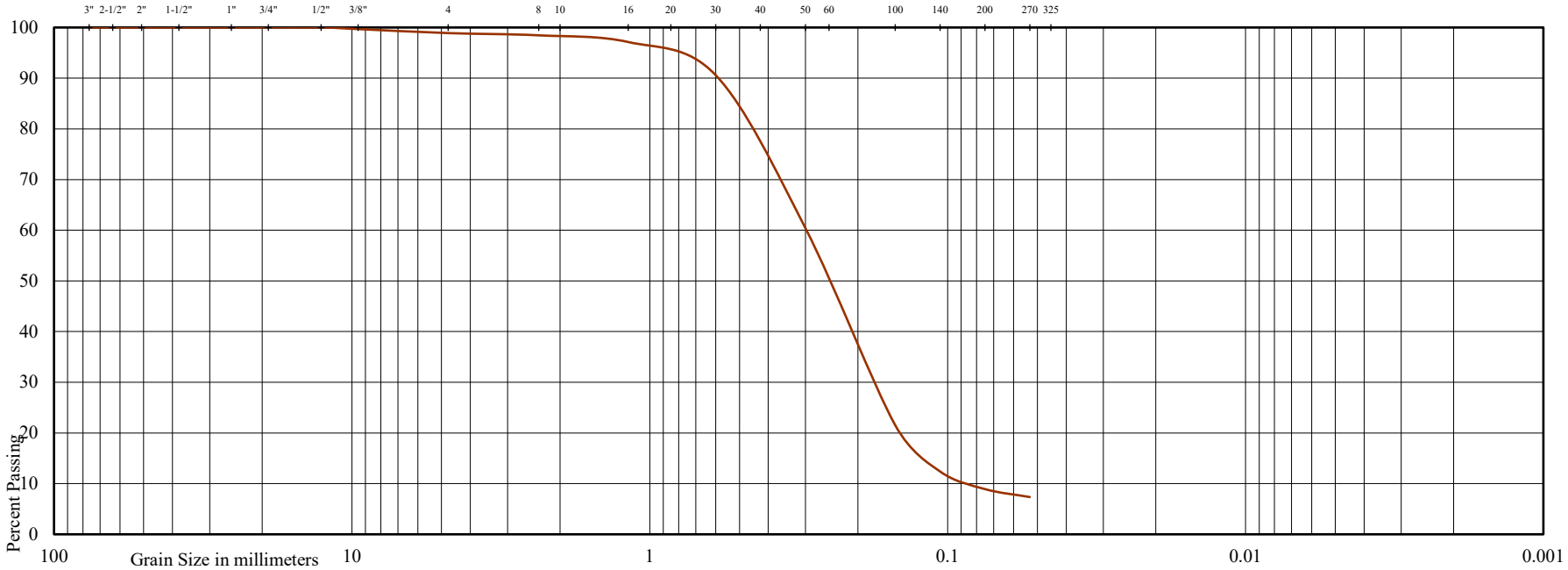
Reference No: 2002-S036

U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL		SAND				SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: Proposed Residential Development

Location: 1012 Yonge Street, City of Barrie

Borehole No: 2

Sample No: 6

Depth (m): 4.6

Elevation (m): 266.6

Liquid Limit (%) = -

Plastic Limit (%) = -

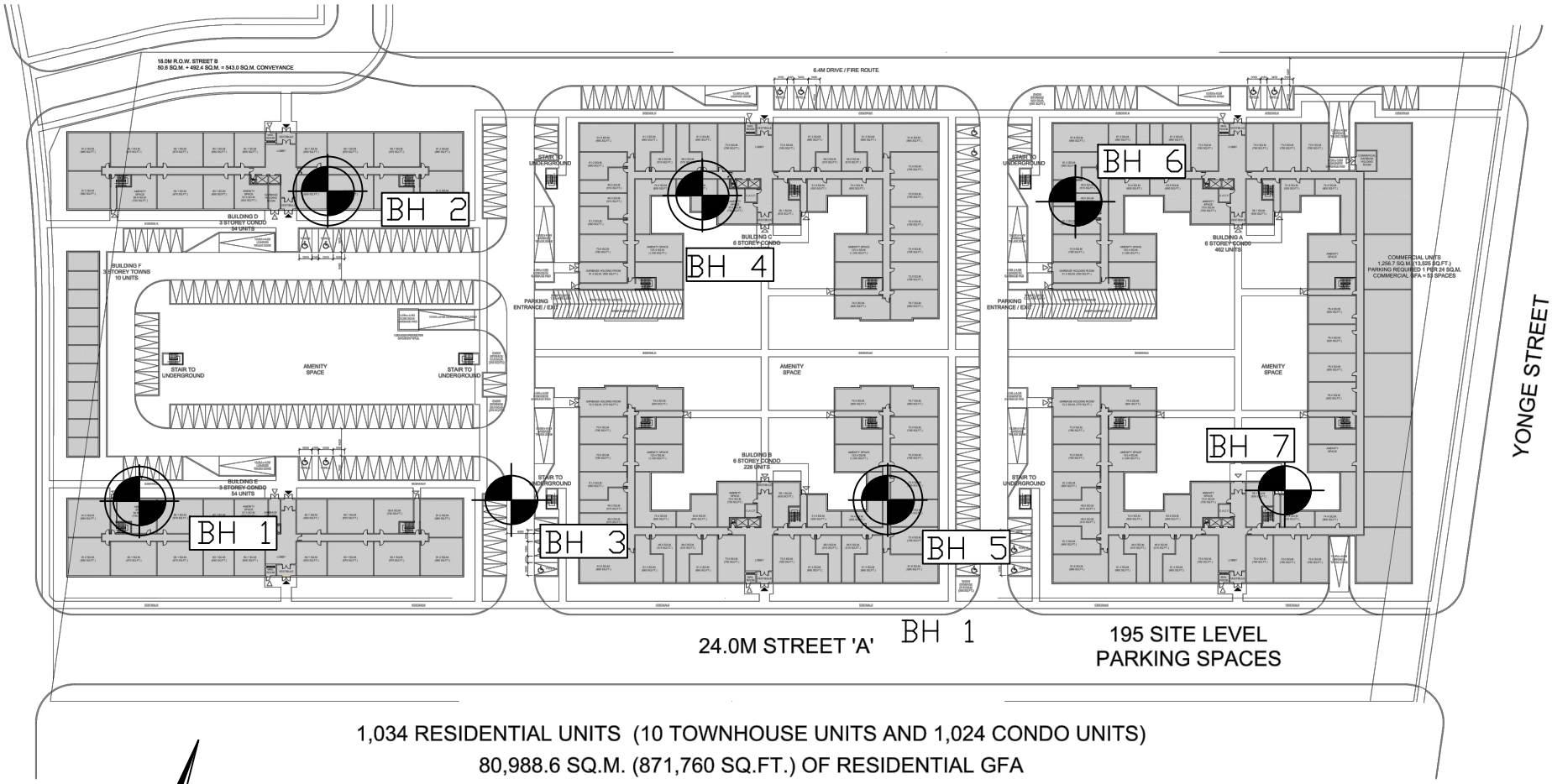
Plasticity Index (%) = -

Moisture Content (%) = 5

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

Classification of Sample [& Group Symbol]: FINE TO MEDIUM SAND, traces of silt and gravel

Figure: 9



1,034 RESIDENTIAL UNITS (10 TOWNHOUSE UNITS AND 1,024 CONDO UNITS)

80,988.6 SQ.M. (871,760 SQ.FT.) OF RESIDENTIAL GFA

1,256.7 SQ.M. (13,525 SQ.FT.) OF COMMERCIAL GFA

1 A100 SITE PLAN
SCALE: 1:400

	TYPE	AREA	UNITS
PARKING	UNDERGROUND GARAGE	35,439.5 SQ.M. (381,360 SQ.FT.)	1,049 SPACES
	SITE LEVEL PARKING		195 SPACES
	TOTAL PARKING (53 COMMERCIAL SPACES REQUIRED)		1,244 SPACES
	PARKING RATIO OF 1.15 SPACES PER UNIT		

SITE STATISTICS:

SITE AREA	39,806.3 SQ.M. (428,530 SQ.FT.)
BUILDING COVERAGE	10,857.1 SQ.M. (168,535 SQ.FT.) OR 39.50%
FSI	2.08 (INCLUDING COMMERCIAL)
	2.04 (EXCLUDING COMMERCIAL)

LEGEND

Borehole

Borehole with Monitoring Well

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Borehole and Monitoring Well Location Plan

SITE: 1012 Yonge Street, City of Barrie

DESIGNED BY: D.Y.	CHECKED BY: B.S.	DWG NO.: 1	
SCALE: 1:1500	REF. NO.: 2002-S036	DATE: February 2021	REV 2

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SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 2002-S036

REPORT DATE: March 2021

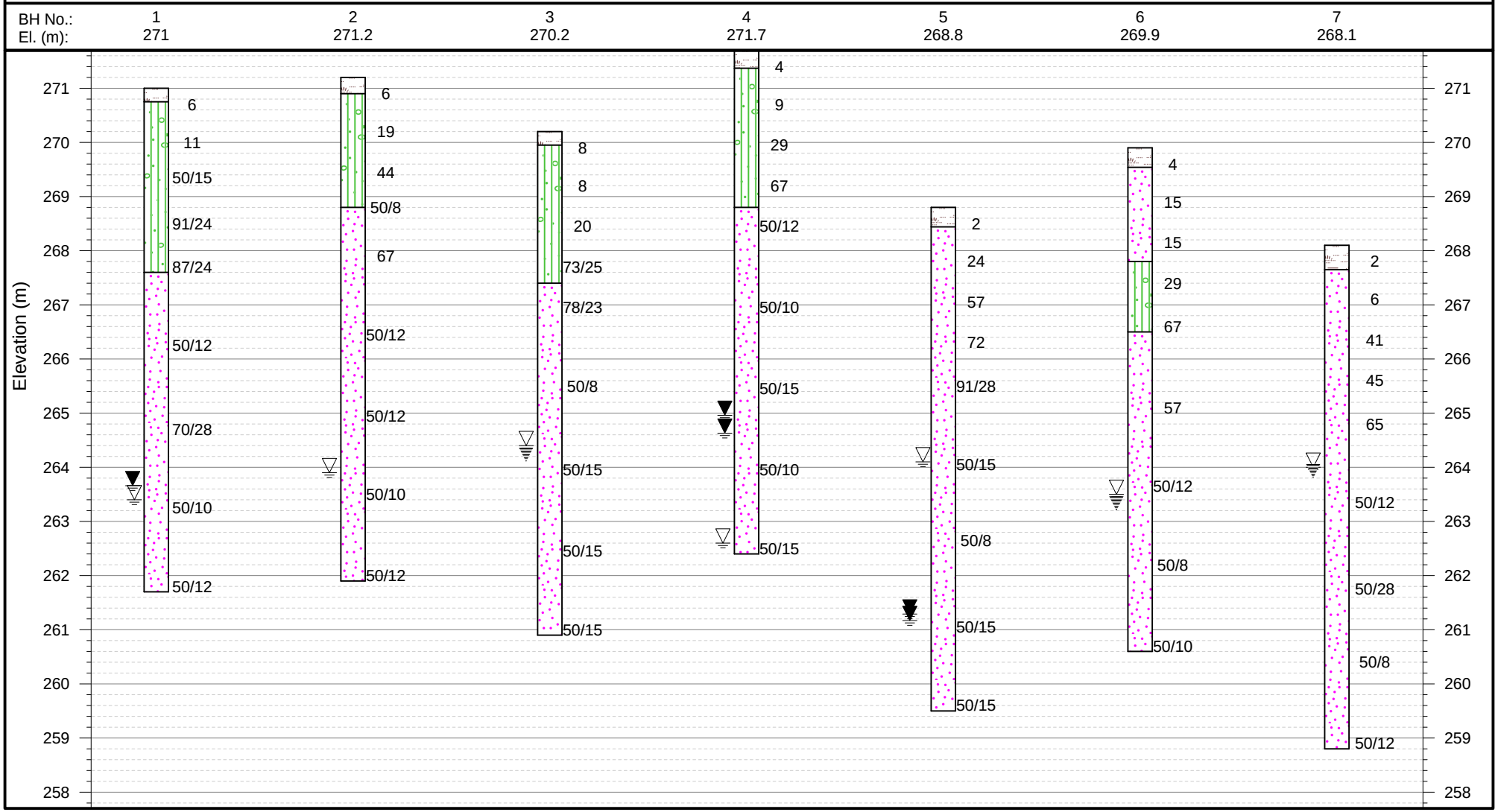
PROJECT DESCRIPTION: Proposed Residential Development

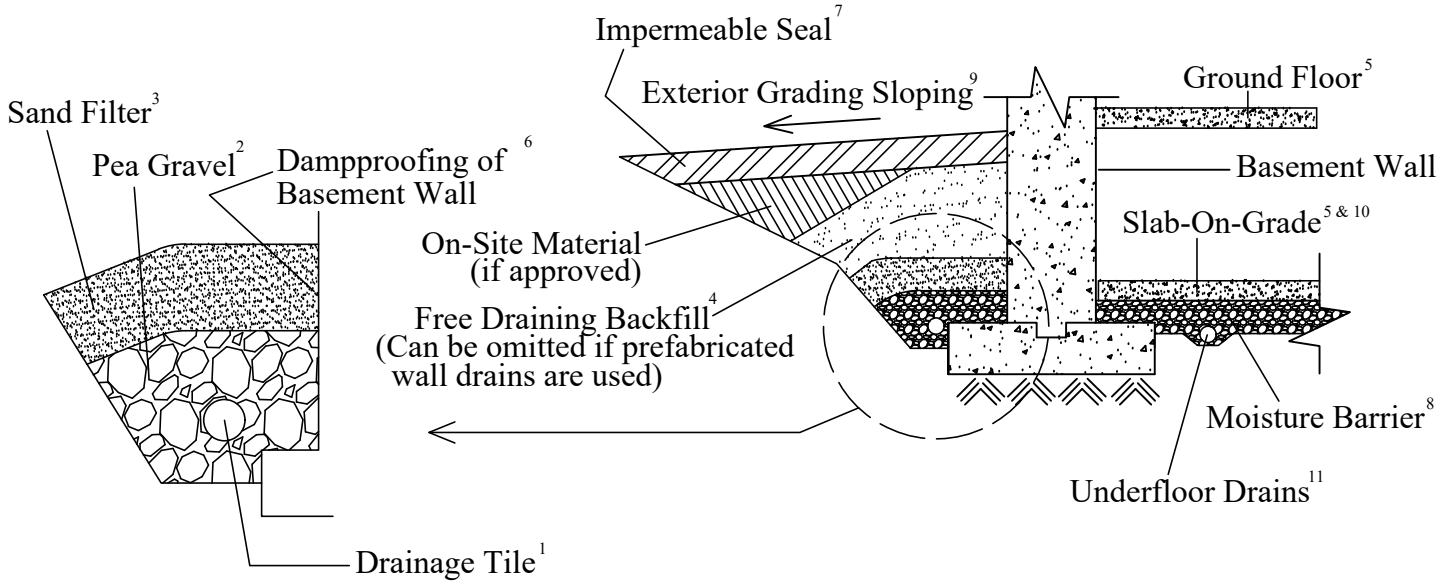
PROJECT LOCATION: 1012 Yonge Street, City of Barrie

LEGEND

TOPSOIL | SAND | SANDY SILT TILL

WATER LEVEL (END OF DRILLING) | CAVE-IN | WATER LEVEL (STABILIZED)





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 level.

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 adquate 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**: 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.

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 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.

* Underfloor drains can be deleted where not required.

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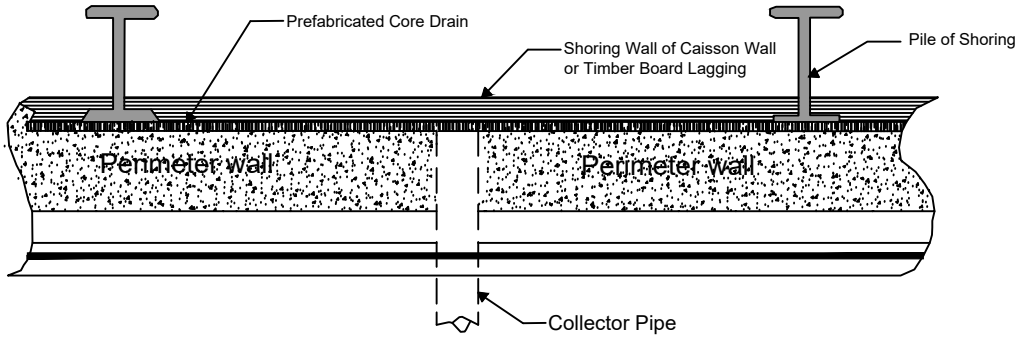
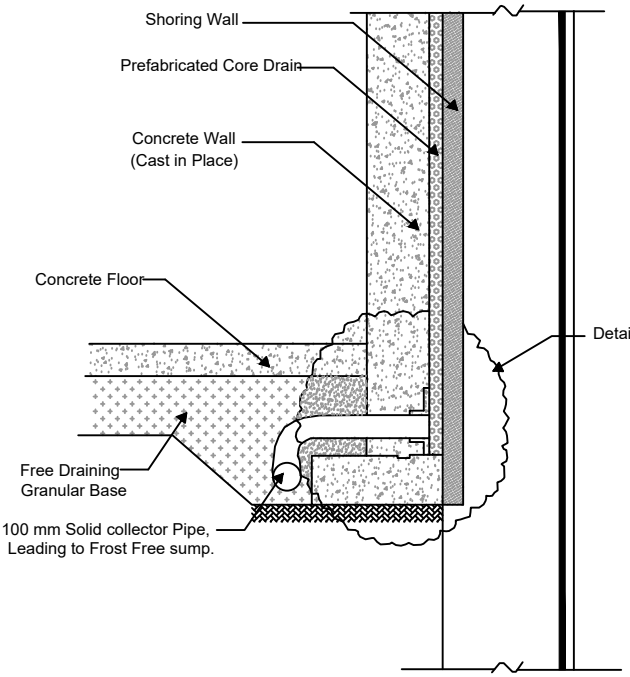
Details of Permanment Perimeter Drainage System

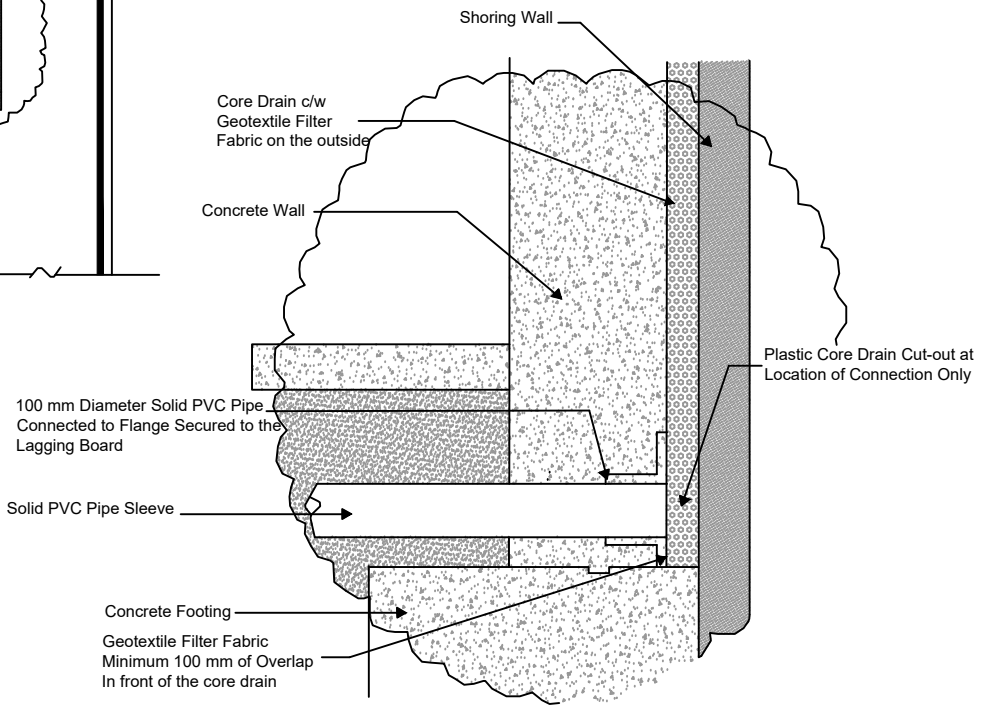
SITE 1012 Yonge Steet, City of Barrie			
DESIGNED BY D.Y.	**CHECKED BY** B.S.	**DWG NO.** 3	
SCALE N.T.S.	**REF. NO.** 2002-S036	**DATE** July 2020	**REV** -



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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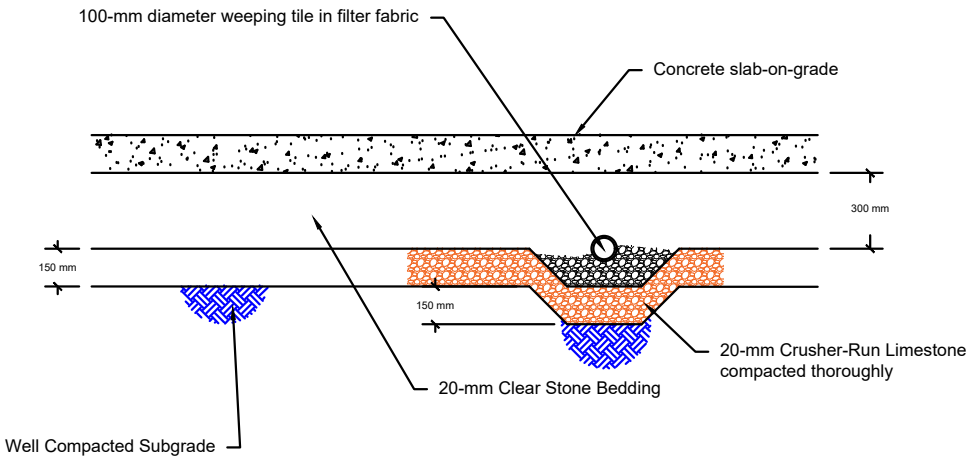
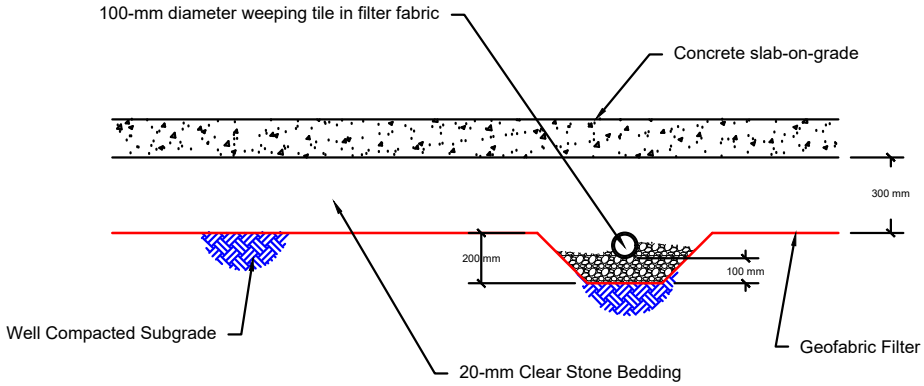
Permanent Perimeter Drainage System

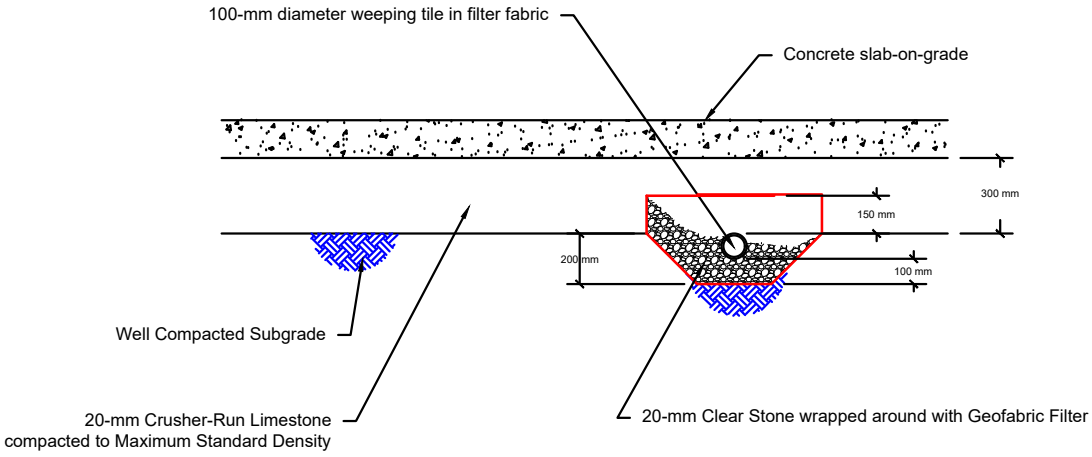
SITE: 1012 Yonge Street, City of Barrie			
DESIGNED BY: D.Y.	**CHECKED BY:** B.S.	**DWG NO.:** 4	
SCALE: N.T.S.	**REF. NO.:** 2002-S036	**DATE:** July 2020	**REV** -



Option 'A'



Option 'B'



Option 'C'

Note:

1. Weepers should be placed in 6 m grids, draining in a positive gradient towards an outlet or a sump pit for removal by pumping.
2. A 10-mil polyethylene sheet should be specified between the gravel bedding and concrete slab.

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100 NUGGET AVENUE, TORONTO, ONTARIO M1S 3A7 · TEL: (416) 754-8515 · FAX: (416) 754-8516

Underfloor Subdrain Details

SITE: 2012 Yonge Street, City of Barrie			
DESIGNED BY: D.Y.	**CHECKED BY:** B.S.	**DWG NO.:** 5	
SCALE: N.T.S.	**REF. NO.:** 2002-S036	**DATE:** February 2021	**REV** -