GEOTECHNICAL INVESTIGATION

1 ST GEORGE STREET
NORTH, BOWMANVILLE, ON
L1C 2K5

REPORT NO.: 01
REFERENCE NO.: 7299-26-GA
REPORT DATE: SEPTEMBER 15, 2026

PREPARED FOR:

BBA

250 WATER STREET, S-201
WHITBY, ONTARIO
L1N 0G5

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REVISIONS LOG

Revision No.	Date

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1 Introduction

Toronto Inspection Ltd. was retained by BBA to conduct a geotechnical investigation at 1 St George Street North, Bowmanville, Ontario (hereinafter described as “the Site”) that is part of Bowmanville Health Centre, known with the address of 222 King Street east.

The purpose of the geotechnical investigation was to delineate the subsoil and groundwater conditions encountered at the borehole locations and provide our comments and recommendations for the design and construction of the proposed new 4 storey medical building with a basement. Geotechnical data was to be provided for:

- General founding conditions
- Foundation design for foundation
- Pavement Design and Construction
- Other Recommendations for Construction

The geotechnical investigation report is provided based on the above terms of reference and on an assumption that the design of structures will be in accordance with the applicable building codes and standards. If there are any changes in the design features relevant to the geotechnical analysis, our office should be consulted to review the design and to confirm the design parameters, comments and recommendations provided in the report.

A previous Geotechnical Investigation Report, Ref. No. 3157-11-5, prepared by V. A. Wood Associates Limited, dated July 16, 2015 (Revised), was provided to our office for reference. The log of Borehole No: 105, to the southwest of the proposed new 4 storey building, was referred to for preparation of the current report. The previous Geotechnical Investigation Report is attached in Appendix B.

2 Site Condition

The Site, approximately 580 m2 in area for the proposed new building, is located on the east side of St George Street North and at the east end of Church Street, in Bowmanville, Ontario.

At the time of the investigation, the area was an existing parking lot with grass and trees at the north boundary, located at the northwest corner of the medical plaza.

The existing site gradient was fairly flat.

3 Investigation Procedure

The field work for the investigation was carried out on August 20 and 21, 2026, and consisted of drilling two sampled boreholes (26BH-1 and 226H-2), extending to depths of 18.3m to 18.4m from grade, at the locations shown on the appended Borehole Location Plan (Figure No. 1).

The boreholes were advanced using a track mounted drill rig (Geoprobe), equipped with sampling rods and continuous solid stem augers, supplied and operated by a specialist drilling contractor, using a mud rotary method. Soil samples were taken from the boreholes at 0.76m intervals to depths of 3.0m below the existing ground level. Below the depth, the sampling frequency was increased to 1.5m. The samples were obtained using a split spoon sampler in conjunction with Standard Penetration Tests using a driving energy of 475 joules (350 ft-lbs.). The retrieved soil samples were identified and logged in the field and were carefully bagged and delivered to our laboratory for later visual identification and determination of in-situ moisture.

Groundwater observations were made in the open boreholes during and upon the completion of drilling. Both of the boreholes, 26BH-1 and 26BH-2, were completed as monitoring wells to determine the current static groundwater conditions. The symbol (MW), besides the borehole identification, indicated a monitoring well. The groundwater records are presented in the borehole logs.

The borehole locations, established at the Site by our field personnel, are shown on the appended Borehole Location Plan (Figure No. 1). The ground surface elevations, at the borehole locations, were established in the field using the “FFE of BULDING”, located to the south of the investigation area, as a temporary benchmark (TBM).

The geodetic elevation of 94.66m for the TBM was obtained from the Section of Foundations in the previous Geotechnical Investigation Report, Ref. No. 3157-11-5, prepared by V. A. Wood Associates Limited, dated July 16, 2015 (Revised), provided to our office.

4 Summarized Site & Subsurface Conditions

Reference is made to the Borehole Location Plan (Figure No. 1) and the appended Logs of Borehole sheets (Drawing Nos. 1 to 2, attached in Appendix A) for details of field work, including soil classification, inferred stratigraphy and groundwater observations carried out during and on completion of drilling of the boreholes.

The subsoil below the surficial topsoil, consisted of a layer of fill, overlying native clayey silt and silty sand deposits, underlain by a presumed limestone bedrock.

Brief descriptions of the subsoils, encountered at the borehole locations, are as follows:

4.1 Surface Course

Topsoil, approximately 50mm to 125mm in thickness, was contacted at the ground surface at all borehole locations.

4.2 Fill

Underlying the topsoil, a layer of fill was contacted at all borehole locations, extending to depths of 2.1m to 2.9m from grade.

The fill consisted of brown clayey silt, some sandy silt, trace to some gravel, with minor topsoil and rootlets.

4.3 Clayey Silt

Underlying the fill, a clayey silt deposit was contacted at all borehole locations at depths of 2.1m to 2.9m from grade. The clayey silt deposit was of low to medium plasticity and contained trace grave, trace silty clay, with occasional thin layers of silty sand. The clayey silt deposit extended to depths of 11.9m to 13.4m from grade.

Based on the Standard Penetration N-values of 1 to 10 blows per 0.3m penetration, the consistency of the clayey silt deposit was very soft to stiff, generally soft.

The in-situ moisture content of the soil samples retrieved from this deposit ranged from 11% to 41%, indicating moist to wet conditions.

4.4 Silty Sand

Underlying the clayey silt deposit, a silty sand deposit was contacted at all borehole locations at depths of 11.9m to 13.4m from grade. The silty sand deposit was fine to coarse grained and contained trace to some gravel or gravelly, some sandy silt, with occasional cobbles.

All boreholes, 26BH-1 to 26BH-2, were terminated in the silty sand deposit at depths of 18.3m to 18.4m from grade, due to auger refusal on presumed limestone bedrock.

A review of the previous Geotechnical Investigation Report, Ref. No. 3157-11-5, prepared by V. A. Wood Associates Limited, dated July 16, 2025 (Revised), indicated that “Coring of the rock carried out during the investigation for the existing building in 2005 showed that the bedrock is composed of weathered limestone.

Based on the Standard Penetration N-values of 25 to more than 100 blows per 0.3m penetration, the relative density of the silty sand deposit was compact to very dense.

The in-situ moisture content of the soil samples retrieved from this deposit ranged from 8% to 18%, indicating generally wet conditions.

4.5 Groundwater

Free water or cave-in could not be accurately recorded in the open boreholes due to using the mud rotary method.

On August 31, 2026, the groundwater levels, measured in the monitoring wells at Boreholes 26BH-1 and 26BH-2, were at depths of 2.24m and 2.00m from grade, respectively.

Table 4- 1 Groundwater Elevation Measurements

BH/Well ID	Ground Elevation	Well Depth	Groundwater Measured Depths/Elevations	
			Upon Completion	August 31, 2026
26BH-1 (MW)	94.08m	6.1m	-	2.24m / 91.84m
26BH-2 (MW)	94.28m	6.1m	-	2.00m / 92.28m

Based on the field records and the moisture content profiles of soil samples, as shown on the appended borehole logs, it is our opinion that the depths of the measured groundwater represent water in the wet clayey silt and silty sand deposits and perched water in the fill.

5 Recommendations

A review of a set of architectural drawings of Bowmanville Health Centre – CT & Radiology Clinic 4 Storey Building Expansion, prepared by BBA, dated May 7, 2026, indicated that the development of the Site will consist of a new 4 storey medical building, which may have a basement, is proposed at the northwest corner of this plaza.

At the time of preparation of this report, the finished floor elevation (FFE) and the slab-on-grade elevation of the basement for the 4 storey building were not known. We have assumed that the FFE will have similar elevation of 94.66m as the existing building to the south, and the slab-on-grade elevation of the basement at a depth of 3.0m below the FFE, to an elevation of 91.66m. The founding levels of the footings are assumed to be 0.5m lower than the proposed basement floor, at an elevation of 91.16m. However, the elevator and the surrounding foundations are anticipated to be approximately 2m deeper than the above assumed founding levels, at an elevation of 89.16m, at a depth of approximately 6.5m below the FFE.

Based on the subsoil data obtained at the borehole locations, our recommendations are as follows:

5.1 Foundation Design

The subsoil at and below the assumed founding elevations of 89.16m to 91.16m are anticipated to consist of soft clayey silt deposit, at Boreholes 26BH-1 and 26BH-2 locations.

Conventional spread and strip footings, founded in the undisturbed clayey silt deposit, at elevations of 89.16m to 91.16m, at Boreholes 26BH-1 and 26BH-2 locations, can be designed using the following bearing pressures of:

- 50 kPa at Serviceability Limit State (SLS)
- 75 kPa at Factored Ultimate Limit State (ULS)

The limited bearing capacity of the native soft clayey silt deposit, with its underlying very soft to soft clayey silt deposit, is not adequate to support the proposed 4 storey building using conventional spread/strip footings. The building may have to be supported by deep foundations of caissons founded into the bedrock.

Cast-in-place caissons, founded a minimum of one diameter of caissons into the bedrock, can be designed using the bearing pressures of:

- 2500 kPa at SLS
- 3700 kPa at ULS

The bedrock depths are at depths of 18.4m and 18.3m from grade, at Boreholes 26BH-1 and 26BH-2, respectively.

The total and differential settlement of footings, with the designed bearing pressures as recommended above, will not exceed 25 mm and 20mm respectively.

The clayey silt deposit is generally very soft to soft in consistency and in a wet condition, and the silty sand deposit is in a wet condition. It will, therefore, be necessary to use temporary liners to prevent ingress of wet clayey sit, cave-in of silty sand and the groundwater into the caissons. The temporary liners should be withdrawn only after concrete of the caissons has been filled to the cut-off level.

All perimeter footings or any footings, which may be exposed to freezing conditions, should be placed below the frost penetration depth of 1.2m below the outside grade or be provided with an equivalent thermal protection.

It should be noted that the recommendations for the design and construction of footings have been analysed by ***Toronto Inspection Ltd***. from the information obtained at the borehole locations. The bearing material, the interpretation between the boreholes and the recommendations of this report must be checked through field inspection provided by ***Toronto Inspection Ltd.*** to validate the information for use during the construction stage.

5.2 Slab Construction

No basement - The additional load of the fill, the slab and the imposed loads could result in settlement of the slab, between the caissons. The slab will, therefore, have to be designed as a structural slab, supported on the caissons.

With basement - The total load on the slab-on-grade, if less than the weight of the excavated soil, the settlement of the slab will be minimal. However, there is probability of settlement, if there is a significant decrease in the groundwater conditions over the years. Therefore, the slab-on-grade should also be designed as a structural slab-on-grade, supported on caissons.

The anticipated slab-on-grade for one level of basement, will be below the existing static groundwater level. We recommend that provision should be made to install subfloor drains below the basement slab.

A minimum of 150 mm thick layer of 19mm OPSS Granular A, or equivalent, is recommended as a moisture barrier below the floor slab. The bedding should be compacted to at least 100% SPMDD. In our opinion, no underfloor drains will be required below the ground floor, if no basement is proposed.

5.3 Earthquake Consideration

The Ontario Building Code requires that all buildings be designed to resist earthquake forces.

A review of the previous Geotechnical Investigation Report, Ref. No. 3157-11-5, prepared by V. A. Wood Associates Limited, dated July 16, 2025 (Revised), indicated that “Based on the results of the shear wave velocity soundings by Geophysics GPR International Inc., as presented in their letter dated May 25, 2015, the seismic site classification is considered to be Site Class ‘C’”.

The acceleration and velocity-based site coefficients, Fa and Fv, should conform to Tables 4.1.8.4.B and 4.1.8.4.C. of the Ontario Building Code. These values should be reviewed by the Structural Engineer.

5.4 Excavation & Backfilling

All excavations should comply with the Ontario Occupational Health and Safety Act. Any excavation should be sloped back to a safe angle of around 45°. A flatter slope will be required for excavation in the saturated soils.

At locations where adequate space will not be available for an open cut excavation, temporary shoring will have to be used to support the vertical faces of the excavation. The temporary shoring will have to be designed by an experience shoring consultant. The loading from the neighbouring properties should be considered for the design of the temporary shoring system, using Earth

Pressure Coefficient at rest of Ko = 0.4.

No serious groundwater problems are anticipated for excavation up to depths of 2.0m from existing grade. Groundwater seepage from the fill and wet clayey silt deposit will be minor which can be handled by pumping from filtered sumps, as necessary.

The on-site excavated material, separated from topsoil and organics, can be reused for site grading and trench/foundation backfill. To achieve the specified degree of compaction, drying of the on-site material will be required, prior to placement and compaction. Therefore, it is recommended that the excavation and backfilling process should be conducted in the dry and frost-free seasons.

Any unsuitable fill, such as topsoil and other compressible fill, may be reused in landscape areas, subject to the approval of the landscape architect.

Backfill around catch basins, manholes and narrow trenches, if encountered, should consist of imported granular material, and should be compacted using a medium or light vibratory equipment.

5.5 Lateral Earth Pressure

Wherever subsurface walls will retain unbalanced earth loads, the lateral earth pressure in the overburden may be computed using the following expression:

$$p = K (\gamma H + q)$$

where p = lateral earth pressure	(kPa)
K = lateral earth pressure coefficient	0.4
γ = bulk unit weight of the soil	21.0 kN/m^3
H= depth of wall below the finished grade	(m)
q = surcharge loads adjacent to the basement walls	(kPa)

Wherever subsurface walls below the water table, additional lateral pressure should be added on the walls, computed using the following expression:

$$P_s = K (\gamma' H_s + q) + \gamma_w H_s$$

where P_s = lateral earth pressure below the water table	(kPa)
K = lateral earth pressure coefficient	0.4
γ' = Submerged unit weight of the soil	11.2 kN/m^3
H_s = depth of wall below the water table	(m)
γ_w = Unit weight of water	9.8 kN/m^3
q = surcharge loads adjacent to the basement walls	(kPa)

This expression assumes that a permanent free drainage system is provided to prevent a build-up of hydrostatic pressure next to the wall. A typical installation detail of the permanent perimeter drainage system for open cut excavation is shown in the appended **Figure No. 2**. In addition, the ground surface around the building should be sloped away from the building.

5.6 Pavement Design & Construction

The existing on-site material consists of clayey silt with sandy silt. These materials are normally moderate susceptible to frost. The following pavement design, if needed for new pavement, is recommended based on the assumption that perforated sub-drains will be installed to prevent buildup of water in the granular bases of the pavement:

		Light Duty LD Parking	**Heavy Duty Fire Route**
Asphaltic Concrete	OPSS HL3 or equivalent	65mm	40mm
	OPSS HL8 or equivalent	-	60mm
Base	OPSS Granular A or 20mm crusher-run	150mm	150mm
Sub-base	OPSS Granular B or 50mm crusher-run	200mm	300mm

The granular base and sub-base should be compacted to a minimum of 100% SPMDD. Asphaltic concrete should be compacted to at least 96% Marshall density.

The above pavement thicknesses are based on favourable site conditions and the construction being carried out during the drier time of the year, that the subgrade is stable, and not heaving under construction traffic. If the subgrade is wet and unstable, additional thickness of sub-base material will be required.

Following site grading, the subgrade of the entire pavement should be proof-rolled using a heavy vibratory roller. Any soft spots revealed by the proof-rolling should be sub-excavated and replaced with approved dry material and compacted to at least 95% of the Standard Proctor maximum dry density (SPMDD) to 300mm below the subgrade level. The upper 300mm of the subgrade should be compacted to 98% SPMDD.

Continuous perforated, OPSS 405, longitudinal drains, minimum diameter of 100mm, should be used as sub-drains, on both sides of the roadways. The sub-drains should be installed on a positive gradient towards the outlets (collecting into catch basins), at a minimum depth of 800mm below the pavement level, to allow for a free flow of water. The backfill above the drains should comprise of free draining Granular B or its equivalent and should be continuous with the granular sub-base of the pavement. This will help in draining the pavement structure and minimize the differential heave of the pavement.

The key-in for the transverse and longitudinal joints between the existing and the new pavements should consist of 300mm for the surface course and 150mm for the binder course, if encountered. These joints should be tack coated.

6 General Statement of Limitation

The comments and recommendations presented in this report are based on the subsoil and ground water conditions encountered at the borehole locations, indicated in the borehole location plan, and are intended for the guidance of the design engineer. Although we consider this report to be representative of the subsurface conditions at the subject property, the soil and the ground water conditions between and beyond the borehole locations may differ from those encountered at the time of our investigation and may become apparent during construction. Any contractor bidding on, or undertaking the works, should decide on their own investigation and interpretations of the groundwater and the soil conditions between the borehole locations.

Any use and/or the interpretation of the data presented in this report, and any decisions made on it by the third party are responsibility of the third parties. The responsibility of Toronto Inspection Ltd. is limited to the accurate interpretation of the soil and ground water conditions prevailing in the locations investigated and accepts no responsibility for the loss of time and damages, if any, suffered by the third party as a result of decisions or actions based on this report.

Any legal actions arising directly or indirectly from this work and/or Toronto Inspection Ltd.'s performance of the services shall be filed no longer than two years from the date of Toronto Inspection Ltd.'s substantial completion of the services. Toronto Inspection Ltd. shall not be responsible to the client for lost revenues, loss of profits, cost of content, claims of customers, or other special indirect, consequential or punitive damages.

To the fullest extent permitted by law, the client's maximum aggregate recovery against Toronto Inspection Ltd., its directors, employees, sub-contractors and representatives, for any and all claims by clients for all causes including, but not limited to, claims of breach of contract, breach of warranty and /or negligence, shall be the amount of the fee paid to Toronto Inspection Ltd. for its professional services rendered under the agreement with respect to the particular site which is the subject of the claim by the client.

Yours truly,

Toronto Inspection Ltd.

S. WANG
100131918
Sept. 15, 2026

V. WOOD
Sept. 15, 2026

David S. Wang

David S. Wang, P.Eng.

Senior Engineer

Victor A. Wood, P.Eng.

Principal Engineer

FIGURES

Source: Clarington Public Map Gallery (2024)

LEGEND:

⊕ Borehole and Monitoring Well Location

NOT TO SCALE

Toronto Inspection LTD.
GEO-ENVIRONMENTAL CONSULTANTS

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Unit 16
Markham, Ontario
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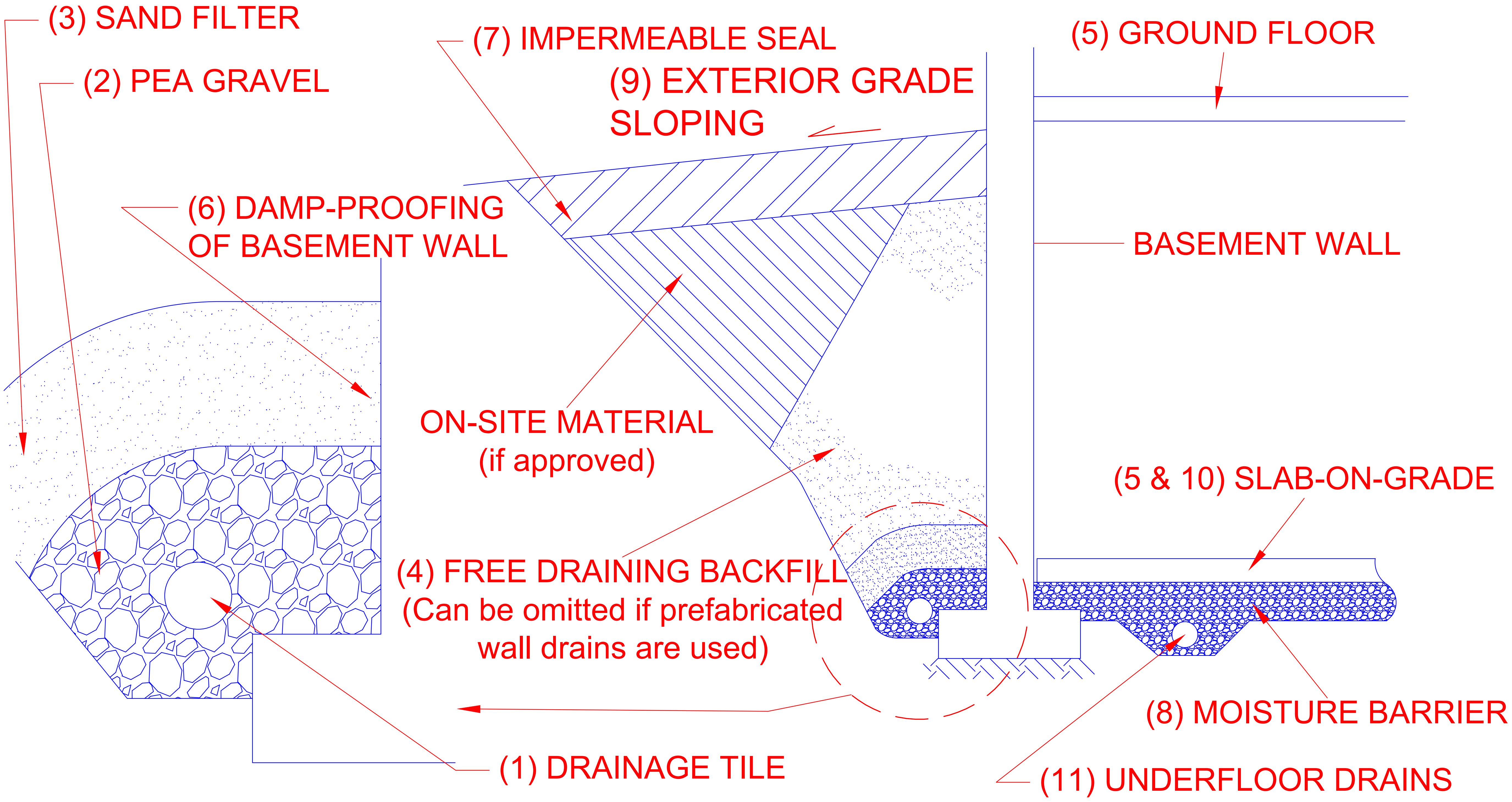
Tel: 905-940 8509 Fax: 905-940 8192 Email : TIL@torontoinspection.com

TITLE:	Borehole and Monitoring Well Location Plan
LOCATION:	1 St. George Street North, Bowmanville, Ontario

PROJECT NO.	DATE :	FIGURE NO.
7299-26-GA	August 2026	1



Notes:

1. **Drainage tile**: consist of 100mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. invert to be at minimum of 150mm (6") below underside of basement floor level.
2. **Pea gravel**: at 150mm (6") on the top and sides of drain. If drain is not placed on footing, provide 100mm (4") of pea gravel below drain. The pea gravel may be replaced by 20mm clear stone provided that the drain is covered by a porous geotextile membrane of Terrafix 270 R or equivalent.
3. **Filter material**: consists of C.S.A. fine concrete aggregate. A minimum of 300mm (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 93 to 95% (maximum) Standard Proctor Density. Do not ocmpact closer than 1.8m (6ft.) from wall with heavy equipment. This may be replaced by on site material if prefabicated 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. **Damp-proofing** of the basement wall is requred 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**: consists of 20mm clear stone or compacted OPSS Granular A, or equivalent. The thickness of this layer to be 150mm (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 6-8m (20-25 ft.) centre, on 100mm (4") of pea gravel with 150mm (6") of pea gravel on top and sides. The invert should be at least 300mm (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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TITLE:
Suggested Backfill and Drainage System for Open Cut Excavation

110 Konrad Cresent, Unit 16, Markham, Ontario L3R 9X2
Tel: 905-940 8509 Fax: 905-940 8192 Email: TIL@torontoinspection.com

FIGURE NO.
2

APPENDIX A

Borehole Logs

Project No. 7299-26-GA

Log of Borehole 26BH-1(MW)

Dwg No. 1

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 1 St. George Street North, Bowmanville, Ontario

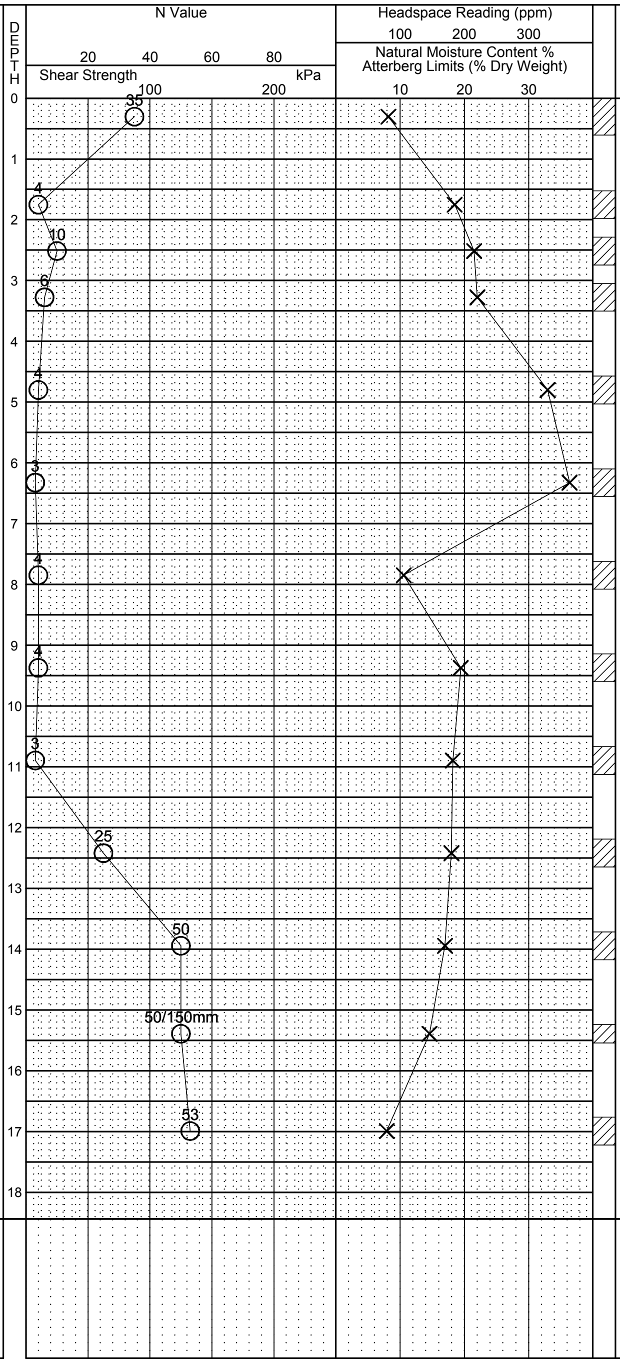
Date Drilled: 20/08/26

Drill Type: Geoprobe

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	✕
Dynamic Cone Test	―	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

GWL	SYMBOL	Soil Description	ELEV. m
		Ground Surface	94.08
		TOPSOIL	93.95
		FILL - brown clayey silt - minor topsoil - some sandy silt, trace gravel - moist to very moist	91.95
		CLAYEY SILT - soft to stiff - brown, grey below 4.5m - low to medium plasticity - trace gravel, trace silty clay - moist to wet	91.84 82.19
		SILTY SAND - compact to very dense - grey - fine to coarse grained - trace to some gravel, or gravelly - some sandy silt, occasional cobbles - wet	75.64
		END OF BOREHOLE **NOTES:** Upon completion of drilling - (using mud rotary) - Auger refusal at 18.4m on presumed Limestone Bedrock.	



Natural Unit Weight kN/m3

LGBE3 7299-26-GA.GPJ 15/09/26

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Aug. 31, 2026	2.24m	

Project No. 7299-26-GA

Log of Borehole 26BH-2(MW)

Dwg No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 1 St. George Street North, Bowmanville, Ontario

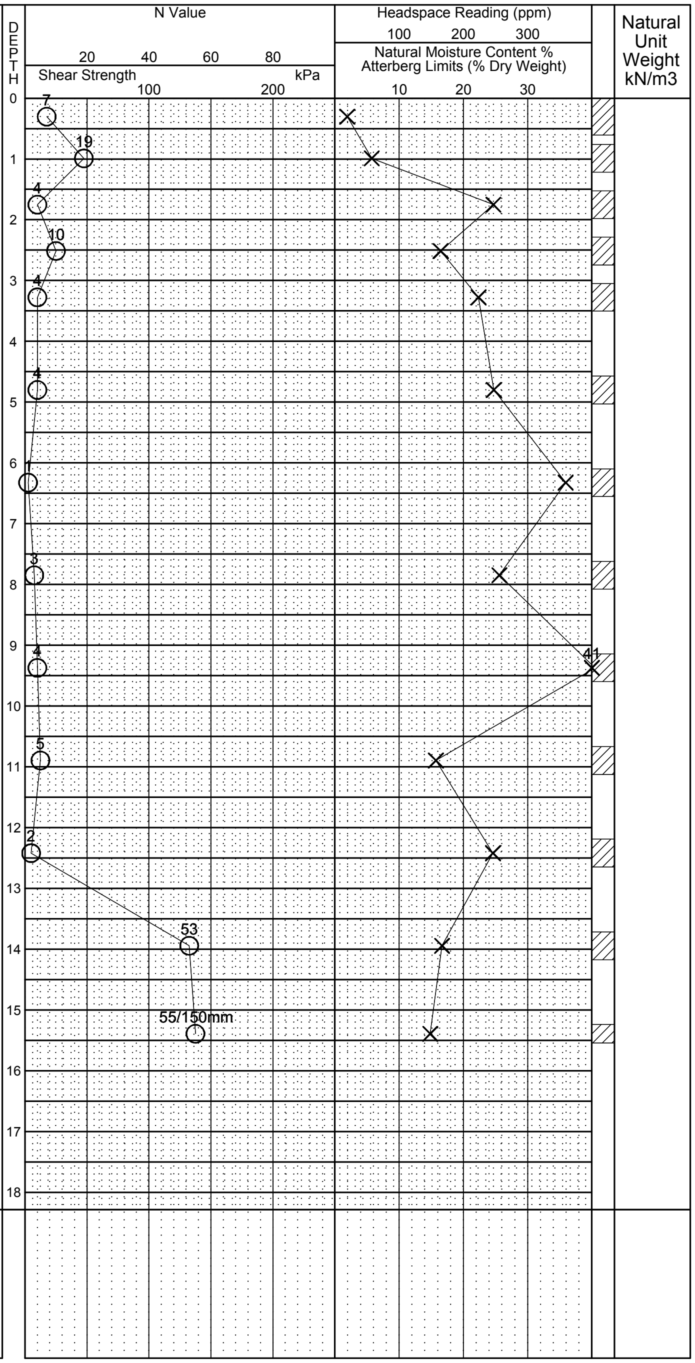
Date Drilled: 20/08/26

Drill Type: Geoprobe

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

Soil Description	ELEV. m
Ground Surface	94.28
TOPSOIL	94.23
FILL - brown clayey silt - minor topsoil, minor rootlets - some sandy silt, trace to some gravel - moist to very moist	92.28
CLAYEY SILT - very soft to firm - brown, grey below 4.5m - low to medium plasticity - trace gravel, trace silty clay - some silty sand at 12.0m - very moist to wet	91.39
SILTY SAND - very dense - grey - fine to coarse grained - some gravel or gravelly - some sandy silt - wet	80.87
END OF BOREHOLE	75.99



NOTES:
Upon completion of drilling
- (using mud rotary)
- Auger refusal at 18.3m on presumed Limestone Bedrock.

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Aug. 31, 2026	2.00m	

APPENDIX B

Previous Geotechnical Investigation Report

V. A. WOOD ASSOCIATES LIMITED
CONSULTING GEOTECHNICAL ENGINEERS
1080 TAPSCOTT ROAD, UNIT 24, SCARBOROUGH, ONTARIO M1X 1E7
TELEPHONE: (416) 292-2868 • FAX No: (416) 292-5375

July 16, 2015 (Revised)

Bowmanville Professional Building Ltd.
c/o J. R. Freethy Architect
5 Silver Street
Bowmanville, Ontario
L1C 3C2

RE: Ref. No. 3157-11-5
Geotechnical Investigation
Proposed Expansion
Bowmanville Professional Building
222 King Street East
Bowmanville, Ontario

Dear Sir:

We have revised the geotechnical investigation report based on the new design. The recommendations for the foundation design in the original report were based on the understanding that there was to be a full basement with a floor level at about the same grade as the basements of house numbers 5 & 7 St. George St. N. It is now understood that the proposed structure will not have a basement and that the two houses within the building area have been demolished.

Investigation and Findings

The investigation consisted of six boreholes at the approximate locations shown on Enclosure 1 and was carried out between May 11 and 19, 2011. The boreholes were advanced to the sampling depths using a track mounted continuous hollow stem power auger equipment.

Full details of the soils encountered in the boreholes are shown on the Borehole Logs, Enclosures 2 to 7 inclusive, and the following notes are intended to summarize this data.

Borehole 101 encountered a pavement consisting of 75 mm thick paving stone underlain by 150 mm thick granular base. The remaining boreholes encountered a surficial layer of topsoil 250 mm to 300 mm thick. The pavement and topsoil were underlain by 0.6 to 1 m of fill, followed by 9.7 to 10.2 m of generally firm to stiff clay and silty clay till, then compact to very dense silty sand till and gravelly till. Auger refusal was encountered in inferred limestone bedrock at a depth of between 16.9 and 18 9 m.

Coring of the rock carried out during the investigation for the existing building in 2005 showed that the bedrock is composed of weathered limestone.

A free water surface was encountered in the boreholes at a depth of between 4 and 5 m below grade. An examination of the native soil samples revealed that they were moist to wet and a change in colour from brown to grey was observed at a depth of about 5 m. Based on the findings, the permanent ground water level is considered to be located at a depth of at least 4 m below grade. However, perched water conditions are expected on top of the impervious clay deposit.

Assessment and Recommendations

Foundations

It is understood that the proposed building will now be a four storey structure with a slab on grade having a finished elevation of 94.66 m. The proposed footings are to extend to a depth of at least 1.2 m (Elev. 93.26) and are designed to a bearing pressure in SLS of 125 kPa (190 kPa in ULS). These bearing pressures may be sustained by the stiff silty clay, which was encountered in the boreholes as follows:

Borehole No.	Ground Elevation	Location of Stiff Silt Clay	
		Depth	Elevation
BH1	94.05	1.3 m	92.75
BH2	93.67	1.3 m	92.37
BH3	93.83	1.5 m	92.33

BH4	*94.05*	*1.3 m*	*92.75*
BH5	*94.13*	*1.5 m*	*92.63*
BH6	*94.12*	*1.3 m*	*92.82*

All of the boreholes encountered topsoil, paving stone and/or loose fill (clayey silt with topsoil and organic stains) to a depth of 1.3± m. These materials are liable to consolidate and should be removed from within the building area and replaced with engineered fill. All of the foundations and any unsuitable material within the two demolished homes should also be removed and replaced with engineered fill.

The engineered fill construction should be carried out using the following procedure:

1. *Total removal of all organics, topsoil, loose fill, old foundations, unsuitable fill, and soft clay from beneath the proposed building envelope.*
2. *The exposed subgrade should be inspected by geotechnical personnel from V A Wood Associates prior to placement of fill. Any wet or loose zones identified should be removed and replaced with approved on-site or imported granular material and compacted to at least 100% of its Standard Proctor maximum dry density (SPMDD).*
3. *The area should then be brought up to the final subgrade level with granular 'A' material placed in typically 200 mm thick loose lifts and compacted to at least 100% SPMDD.*
4. *The engineered fill should extend at least 0.6 m laterally beyond the footprint of the building at the foundation level and at least a distance equal to the depths of the fill pad at the level of the approved subgrade. The fill in the basement area should extend laterally to the native clay.*
5. *The engineered fill should be in place at least one week prior to foundation construction to minimize settlement.*

The engineered fill could be brought up to the underside of the granular floor bases and the footings could then be trenched into the engineered fill and designed to the design bearing pressure of 125 kPa SL(190 kPa ULS). The total differential settlement of these foundations will be less than 25 mm and 20 mm, respectively, which should be acceptable for this type of structure.

We do not consider the placement of the engineered fill within a trench excavation to be adequate for supporting foundations for the structures since the required degree of compaction is difficult to attain within the narrow confines of a trench. In this case, the settlement of the fill may result in the cracking of the foundation walls.

The placement of engineered fill should be supervised on a full time basis by personnel from V A Wood Associates to ensure that approved materials are used and that suitable compaction of the fill is attained.

The engineered fill will provide a suitable subgrade for the proposed floor slab. A layer of well-graded free-draining granular material, at least 150 mm thick and compacted to 100% SPMDD should be placed under the floor slab to provide a uniform bearing surface and to act as a vapour barrier. For the design of the floor slab, a modulus of subgrade reaction (Ks) of 40 MN/m^3 *(150 lb/in*^{3}*) may be assumed for engineered fill.*

It is recommended that footings which are located closer than 1.5 m edge to edge be combined where possible. It is understood that this can be done for the columns to the north of the elevator and for the northern two thirds of the east wall. The elevator foundation pad is wider than 2.4 m but the contact pressure is much lower than 125 kPa and this is acceptable.

All exterior footings or footings in unheated areas should be located at least 1.2 m below finished grade for adequate frost protection.

It is noted that structures founded on spread footings and those in caissons will respond differently during an earthquake, and this should be considered in the design of the link between the existing and new building.

Seismic Site Classification

Based on OBC 2012, the seismic site classification should be based on the average soil properties of the top 30 m of the soil profile. The deepest borehole was only 19 m deep and encountered soft to stiff clay and silty clay till, and dense to very dense silty sand till, then auger refusal on presumed limestone bedrock. Very soft clay or liquefiable sand was not encountered. Based on the results of the shear wave velocity soundings by Geophysics GPR International Inc., as presented in their letter dated May 25, 2015, the seismic site classification is considered to be Site Class 'C'.

Service Trenches

It is anticipated that the service trenches will generally be less than 2± m below finished grade. Reference to the Borehole Logs indicates that the subgrade will likely be composed of stiff clay, which will generally provide adequate support for the pipes and allow the use of normal Class 'B' bedding using Granular 'A' material.
Clear crushed stone should not be used as bedding otherwise the fines from the surrounding clayey subsoil may migrate into the voids of the stone and cause undesirable settlements. If there is local softening of the trench grade, then the bedding thickness may have to be increased. The backfill around manholes should consist of well compacted granular materials.

Excavation and Groundwater Control

No major problems due to ground water are expected for the anticipated excavation depths of generally less than 2 m. Provision should, however, be made for the control of surface water or perched water seepages by pumping from local sumps, as and where required.

Excavations of more than 1.2 m in depth should be cut back to a side slope of 1:1. Alternatively, the excavation should be supported using adequately braced sheeting. To minimize potential problems, backfilling operations should follow closely after excavation so that only a minimal length of trench slope is exposed.

The Statement of Limitations presented on Appendix 'A' is an integral part of this report

If you have any questions or concerns regarding this report, please contact this office.

Yours very truly,

V.A. WOOD ASSOCIATES LIMITED

Rene Quiambao, P. Eng.
Reviewed by:

V. Wood, M.Eng., P.Eng.,
RQ/VW
Encl.

V. WOOD

STATEMENT OF LIMITATIONS

The conclusions and recommendations in this report are based on information determined at the borehole locations and on geological data of a general nature which may be available for the area investigated. Soil and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations and conditions may become apparent during construction which would not be detected or anticipated at the time of the soil investigation.

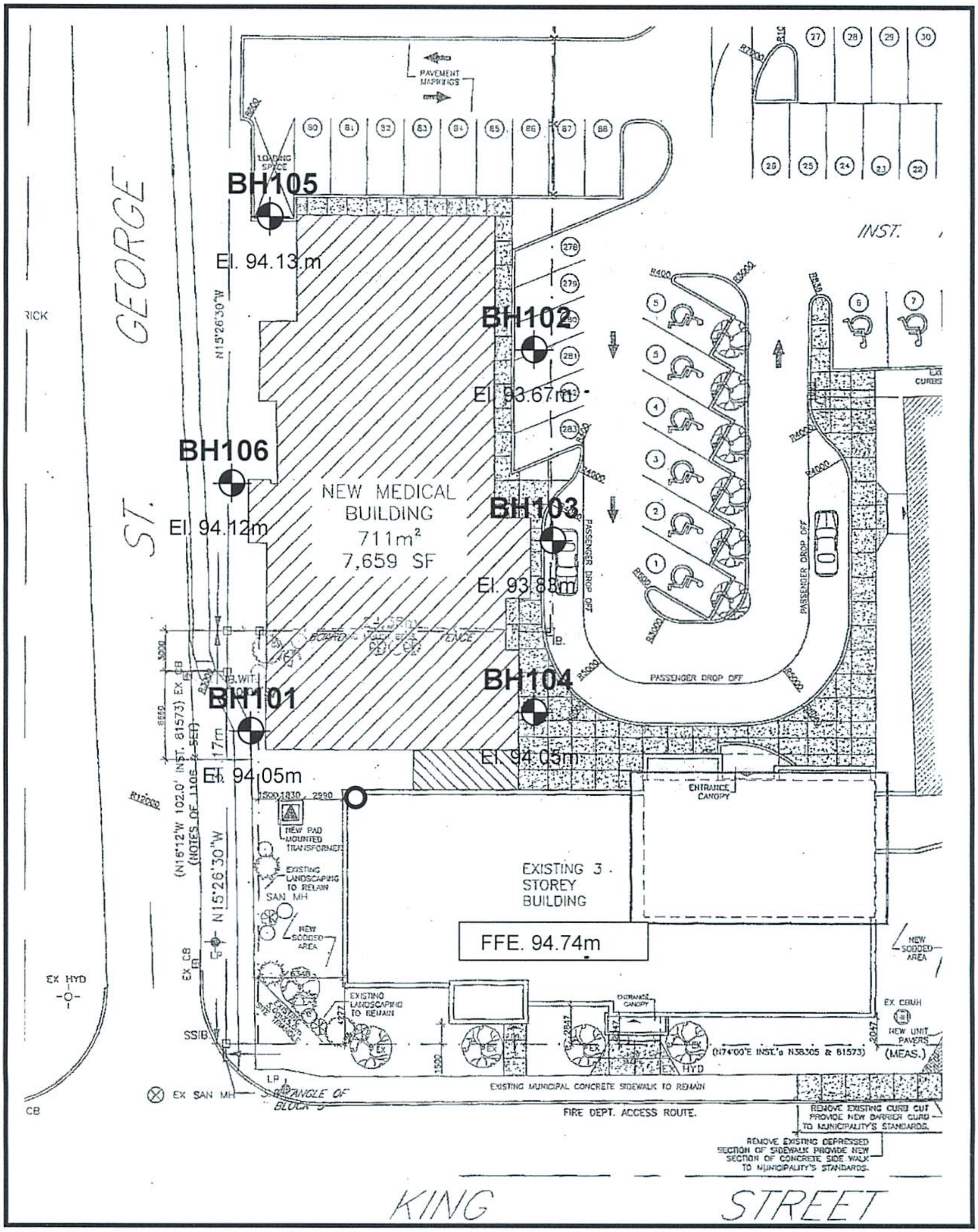
We recommend that we be retained to ensure that all necessary stripping, subgrade preparation and compaction requirements are met, and to confirm that the soil conditions do not deviate materially from those encountered in the boreholes. In cases where this recommendation is not followed, the company's responsibility is limited to interpreting accurately the information encountered at the borehole locations.

This report is applicable only to the project described in the introduction, constructed substantially in accordance with details of alignment and elevations quoted in the text.

ENCLOSURES

Ref. No. 3157-11-5

Enclosure 1



BOREHOLE LOCATION PLAN

Reference No : 3157-11-5

Borehole No : 101

Enclosure No : 2

Client : Bowmanville Professional Building Ltd

Project : Proposed Expansion

Method : Auger

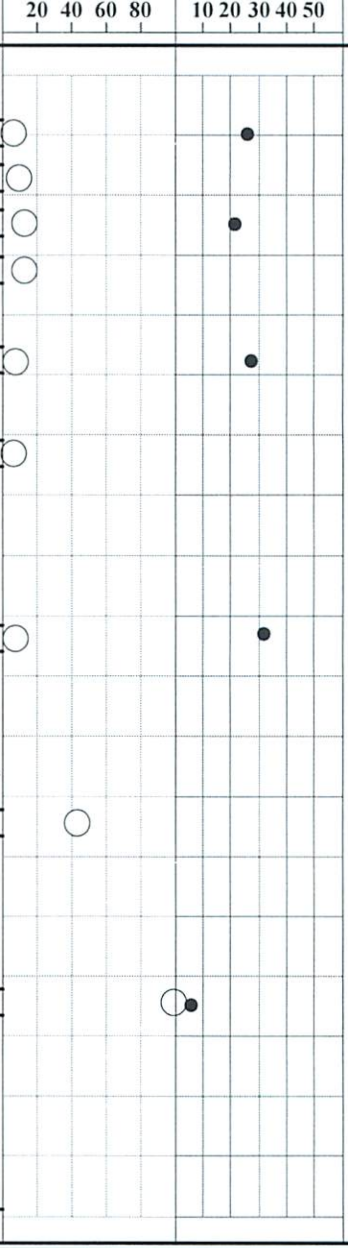
Location : 22 King St. East, Bowmanville, ON

Diameter : 110mm

Datum Elevation : Geodetic

Date : May 11, 2011

SUBSURFACE PROFILE					SAMPLE				
Elevation m	Depth m	Description	Symbol	Water	Number	Type	N-value	Standard Penetration Test blows/300mm 20 40 60 80	Moisture Content, % 10 20 30 40 50	Remarks
94.05	0	Ground Surface								
93.25	1 2	Paving Stone 75mm thick Granular Base 150mm thick FILL Mixed sand, silt and clay with topsoil and cinders			1 2	SS SS	7 10			
86.45	3 4 5 6 7	***CLAY*** Firm to stiff, some seams of silt, varved structure below 3m depth, brown then grey, moist to wet brown grey			3 4 5 6	SS SS SS SS	13 13 8 7			
83.05	8 9 10 11	***SILTY CLAY TILL*** Soft to firm, trace gravel, grey, wet			7	SS	8			
81.05	12 13	***SILTY SAND TILL*** Dense, some gravel, grey, saturated			8	SS	44			
78.4	14 15	***GRAVELLY TILL*** Very dense, mixed sand and gravel, grey, moist			9	SS	100+			
75.15	16 17 18 19	Augering in Gravelly Till Auger refusal at 18.9m on presumed Limestone Bedrock								Logged from auger cuttings



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Sheet : 1 of 1

Reference No : 3157-11-5

Borehole No : 102

Enclosure No : 3

Client : Bowmanville Professional Building Ltd

Project : Proposed Expansion

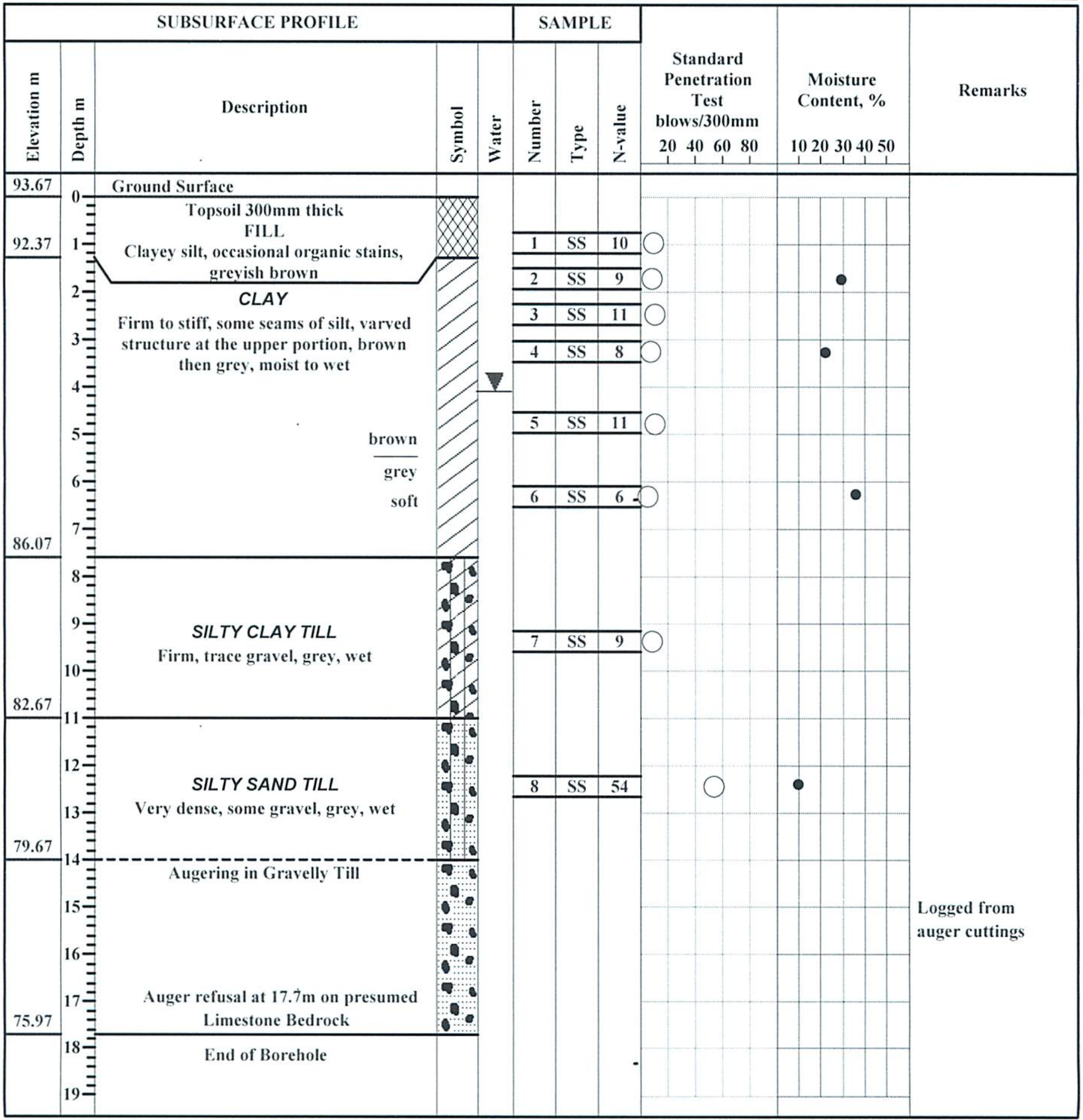
Method : Auger

Location : 222 King St. East, Bowmanville, ON

Diameter : 110mm

Datum Elevation : Geodetic

Date : May 12, 2011



Elevation m	Description	Remarks
93.67	Ground Surface	
92.37	Topsoil 300mm thick FILL Clayey silt, occasional organic stains, greyish brown	
86.07	*CLAY* Firm to stiff, some seams of silt, varved structure at the upper portion, brown then grey, moist to wet brown grey soft	
82.67	*SILTY CLAY TILL* Firm, trace gravel, grey, wet	
79.67	*SILTY SAND TILL* Very dense, some gravel, grey, wet	
75.97	Augering in Gravelly Till Auger refusal at 17.7m on presumed Limestone Bedrock	Logged from auger cuttings
	End of Borehole	

Number	Type	N-value
1	SS	10
2	SS	9
3	SS	11
4	SS	8
5	SS	11
6	SS	6
7	SS	9
8	SS	54

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Reference No : 3157-11-5

Borehole No : 103

Enclosure No : 4

Client : Bowmanville Professional Building Ltd

Project : Proposed Expansion

Method : Auger

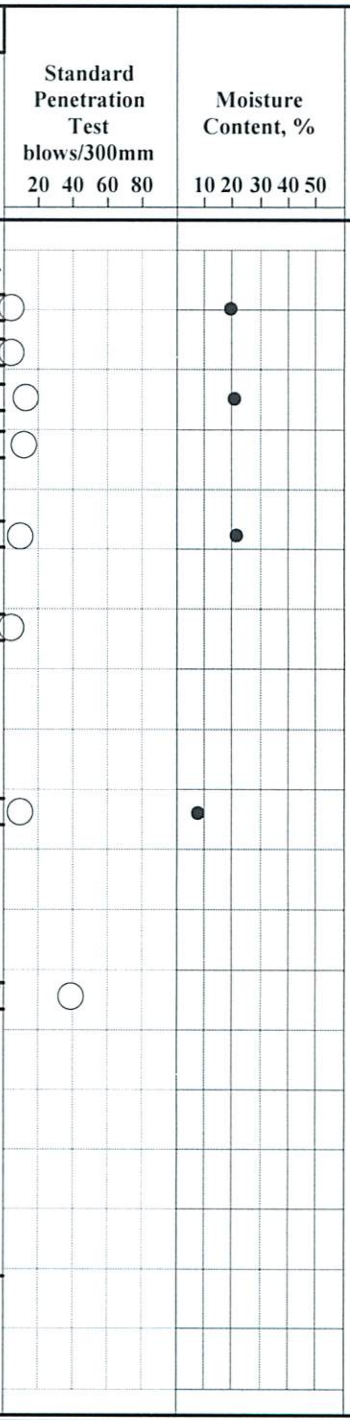
Location : 222 King St. East, Bowmanville, ON

Diameter : 110mm

Datum Elevation : Geodetic

Date : May 13, 2011

SUBSURFACE PROFILE				SAMPLE			
Elevation m	Depth m	Description	Water	Number	Type	N-value	Remarks
93.83	0	Ground Surface					
92.53	1	Topsoil 300mm thick FILL Clayey silt, trace topsoil, occasional organic stains, greyish brown		1	SS	5	
	2	***CLAY*** Firm to stiff, some seams of silt, varved structure observed, brown then grey, moist to wet		2	SS	5	
	3			3	SS	13	
				4	SS	12	
	4		▼				
	5	brown grey		5	SS	10	
86.23	6	soft		6	SS	5	
	7						
82.83	8	***SILTY CLAY TILL*** Stiff, trace gravel, grey, wet		7	SS	10	
79.83	11	***SILTY SAND TILL*** Dense, some gravel, grey, wet		8	SS	40	
76.73	14	Augering in Gravelly Till Auger refusal at 17.1m on presumed Limestone Bedrock					Logged from auger cuttings
	17	End of Borehole					



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Reference No : 3157-11-5

Borehole No : 104

Enclosure No : 5

Client : Bowmanville Professional Building Ltd

Project : Proposed Expansion

Method : Auger

Location : 222 King St. East, Bowmanville, ON

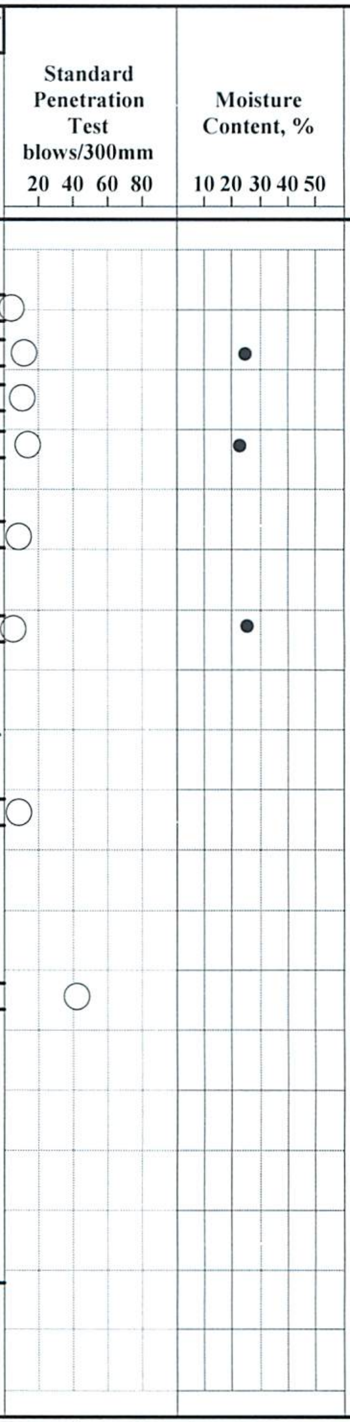
Diameter : 110mm

Datum Elevation : Geodetic

Date : May 16, 2011

SUBSURFACE PROFILE				SAMPLE			
Elevation m	Description	Symbol	Water	Number	Type	N-value	Remarks
94.05	Ground Surface						
92.75	Topsoil 300mm thick FILL Topsoil with some clayey silt, dark grey	▨		1	SS	5	
86.45	***CLAY*** Firm to stiff, some seams of silt, varved structure obesrved, brown then grey, moist to wet brown grey soft	▨	▼	2 3 4 5 6	SS SS SS SS SS	12 11 14 9 6	
83.05	***SILTY CLAY TILL*** Stiff, trace gravel, grey, wet	▨		7	SS	9	
80.05	***SILTY SAND TILL*** Dense; some gravel, grey, wet	▨		8	NR	43	No sample recovere Logged from auger cuttings
76.85	Augering in Gravelly Till Auger refusal at 17.2m on presumed Limestone Bedrock	▨					Auger cuttings
	End of Borehole						

Depth m: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19



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Reference No : 3157-11-5

Borehole No : 105

Enclosure No : 6

Client : Bowmanville Professional Building Ltd

Project : Proposed Expansion

Method : Auger

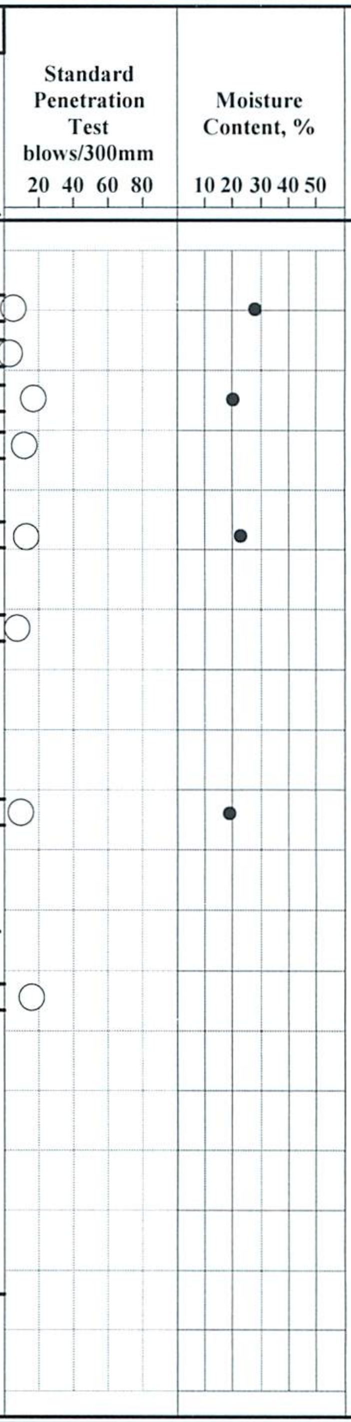
Location : 222 King St. East, Bowmanville, ON

Diameter : 110mm

Datum Elevation : Geodetic

Date : May 19, 2011

SUBSURFACE PROFILE			SAMPLE			
Elevation m	Depth m	Description	Number	Type	N-value	Remarks
94.13	0	Ground Surface				
92.83		Topsoil 250mm thick FILL Mixed topsoil and clayey silt, dark grey, loose	1	SS	6	
86.53		*CLAY* Firm to stiff, some seams of silt, varved structure observed, brown, moist to wet	2 3 4 5 6	SS SS SS SS SS	4 17 12 13 8	
83.13		*SILTY CLAY TILL* Stiff, trace gravel,.grey, wet	7	SS	10	
80.13		*SILTY SAND TILL* Compact, some gravel, grey, wet	8	SS	16	
76.73		Augering in Gravelly Till Auger refusal at 17.4m on presumed Limestone Bedrock				Logged from auger cuttings
		End of Borehole				



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Reference No : 3157-11-5

Borehole No : 106

Enclosure No : 7

Client : Bowmanville Professional Building Ltd

Project : Proposed Expansion

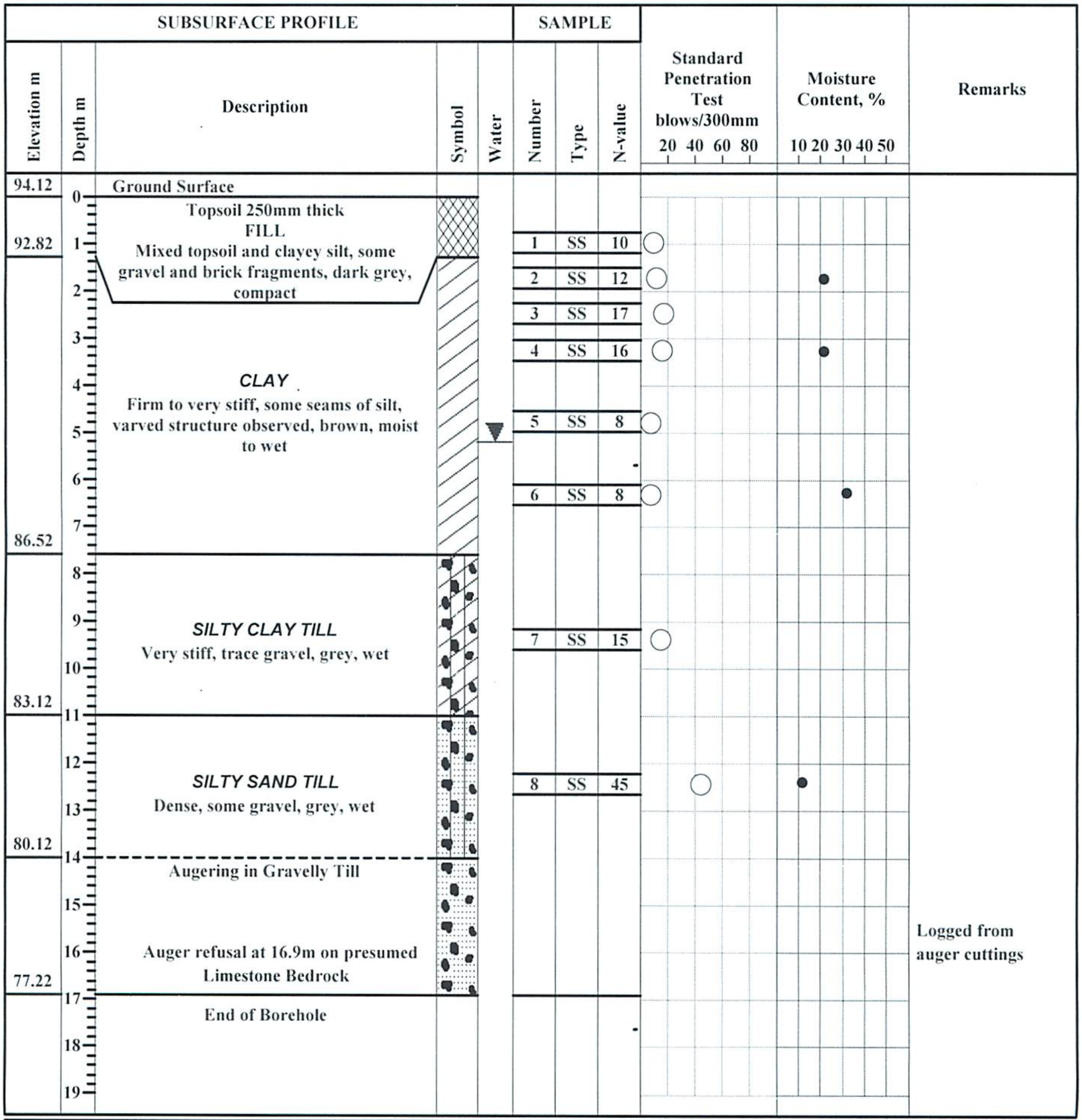
Method : Auger

Location : 222 King St. East, Bowmanville, ON

Diameter : 110mm

Datum Elevation : Geodetic

Date : May 19, 2011



Elevation m	Description	Water	Number	Type	N-value	Remarks
94.12	Ground Surface					
92.82	Topsoil 250mm thick FILL Mixed topsoil and clayey silt, some gravel and brick fragments, dark grey, compact		1 2	SS SS	10 12	
86.52	***CLAY*** Firm to very stiff, some seams of silt, varved structure observed, brown, moist to wet	▼	3 4 5 6	SS SS SS SS	17 16 8 8	
83.12	***SILTY CLAY TILL*** Very stiff, trace gravel, grey, wet		7	SS	15	
80.12	***SILTY SAND TILL*** Dense, some gravel, grey, wet		8	SS	45	
77.22	Augering in Gravelly Till Auger refusal at 16.9m on presumed Limestone Bedrock					Logged from auger cuttings
	End of Borehole					

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