REPORT ON
PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT
MACVILLE COMMUNITY
IN CONNECTION WITH LOPA APPLICATION TO
ESTABLISH THE MACVILLE COMMUNITY
SECONDARY PLAN AREA
BOLTON, ONTARIO

PREPARED FOR:
Bolton Option 3 Landowners Group

Project No: 20-169-100
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1. INTRODUCTION

DS Consultants Ltd. (DS) was retained by Bolton Option 3 Landowners Group to prepare a preliminary geotechnical investigation report for the proposed development, Macville Community, in connection with a LOPA application to establish the Macville Community Secondary plan area, located at The Gore Road and King Street in Bolton, Ontario.

DS carried out the geotechnical investigation field work at the subject site during the period of July 27 to 31, 2020, consisting of sixteen (16) boreholes (BH 20-1 to BH 20-16) which were drilled to depths ranging from 6.70 to 11.30 m below the existing grade at the locations shown on the Borehole Location Plan, **Drawing 1**. The Borehole logs are attached in **Drawings 2 to 17** of this report

Monitoring wells were installed in all the boreholes (except Boreholes BH20-8, BH20-10 and BH20-13) to monitor long-term stabilized groundwater levels.

In addition, laboratory tests such as moisture content for all soil samples, grain size distribution (sieve and hydrometer analyses) and Atterberg Limit tests were carried out, by DS Consultants on selected samples.

The purpose of this geotechnical investigation was to obtain information about the subsurface conditions at boreholes locations and from the findings in the boreholes to make engineering recommendations pertaining to the geotechnical design of underground utilities, roads and to comment on the foundation conditions for the building construction.

This report is provided on the basis of the terms of reference presented above and, on the assumption, that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for Bolton Option 3 Landowners Group Corp and its architect and designers. Third party use of this report without DS consent is prohibited.

2. FIELD AND LABORATORY WORK

A total of sixteen (16) boreholes (BH20-1 through BH20-16, see Drawing 1 for borehole locations) were drilled by DS, to depths ranging from 6.70 to 11.30 m below the existing grade.

Boreholes were drilled with solid stem continuous flight augers equipment by a drilling sub-contractor under the direction and supervision of DS personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the DS laboratory for detailed examination by the project engineer and for laboratory testing.

As well as visual examination in the laboratory, all soil samples from geotechnical boreholes were tested for moisture contents. Grain size analyses of nine (9) selected soil samples were conducted and the results are presented in Drawing 19. Atterberg Limits testing was conducted on selected one (1) soil sample and results are presented on the respective borehole log.

Water level observations were made during and upon completion of drilling. Thirteen (13) monitoring wells of 50mm diameter were installed in all the boreholes, except Boreholes BH20-8, BH20-10 and BH20-13, for the long-term groundwater levels monitoring. The elevation surveying of the boreholes was undertaken by DS Consultants Ltd. personnel, using the differential GPS unit.

3. SUBSURFACE CONDITIONS

3.1 Soil Conditions

The borehole location plan is shown on Drawing 1. General notes on sample description are provided on Drawing 1A. The subsurface conditions in the boreholes by DS are presented in the individual borehole logs presented on **Drawings 2 to 17**. Generalized sub-surface profiles are presented on Drawing 18.

Topsoil and Fill Material/Disturbed Native Material:

A surficial layer of topsoil, ranging from 200 to 550 mm in thickness, was observed at the surface of all the boreholes, except BH20-4.

Fill/disturbed native material consisting of clayey silt and sandy silt soils were detected in all the boreholes below the topsoil layer and extended to approximate depth of 0.80 m below the existing ground surface. In the area of Borehole BH20-4, the fill layer was overlain by a concrete slab, approximately 300 mm in thickness. The fill was brown to dark brown in color and contained and trace of topsoil/organics, gravel and rootlets.

SPT 'N' values measured in fill/disturbed native materials ranged from 5 to 15 blows per 300mm penetration, indicating a firm to stiff consistency or loose to compact state. The moisture content of this moist to wet fill layer varied from 5 to 23%.

The type/quantity and extent of the existing fill and topsoil layers must be explored by further test pit investigation prior to/during excavation.

Clayey Silt/Silty Clay Till:

Clayey silt to silty till deposit was encountered below the fill layer in all the boreholes except Borehole BH20-4 and extended to approximate depths ranging from 1.50 to 7.70 m in Boreholes BH20-1 to BH20-3, BH20-5, BH20-8, BH20-9, BH20-11 to BH20-13 and BH20-16 and to the maximum explored depth of Boreholes BH20-6, BH20-7, BH20-10, BH20-14 and BH20-15. This, in general, moist to very moist (wet at the bottom of the boreholes at some locations) clayey till deposit was brown to grey in color and contained sand seams and some to trace of sand, gravel and cobbles. SPT 'N' values measured in the clayey till ranged from 8 to 72 blows per 300mm of penetration, indicating a stiff to hard consistency. The moisture content of this clayey till deposit varied from 7 to 26%.

Grain size analyses of nine (9) soil samples (BH20-5/SS8, BH20-7/SS4, BH20-8/SS4 and SS7, BH20-11/SS8, BH20-12/SS7 and BH20-16/SS4, SS6 and SS7) were conducted and the results are presented in Drawing 19, with the following fractions:

Clay:	2 to 29%
Silt:	10 to 94%
Sand:	1 to 64%
Gravel:	1 to 42%

Atterberg limits tests of above noted one (1) soil sample (BH20-7/SS4) were conducted. The results are shown on the borehole logs and are summarized as follows:

Liquid limit (W_L):	33%
Plastic limit (W_P):	26%
Plasticity index (PI):	7

Lower Cohesionless Soil silt to sandy Silt and Silty Sand Deposit:

Lower deposit of silt to sandy silt silty sand soils with some to trace of clay and gravel was encountered underlying clayey silt to silty clay till deposit in Boreholes BH20-1 to BH20- 3, BH20-5, BH20-8, BH20-9, BH20-11 to BH20-13 and BH20-16 and extending to the maximum explored depths of boreholes. SPT 'N' values measured within this sandy, silty layer varied from 7 to more than 50 blows per 300mm of penetration, indicating loose to very dense relative density. The moisture content of this moist to wet sand to silty sand layers varied from 8 to 23%.

This moist to wet deposit was brown to grey in color and also contained layers of sand and gravel/gravelly sand materials in the area of Borehole BH20-16 at different depths, between depths ranging from 1.50 and 6.20 m. SPT 'N' value measured within this gravelly sand to sand and gravel layers varied from 24 to 66 blows per 300mm of penetration, indicating compact to very dense relative density.

3.2 Groundwater Conditions

Upon completion of drilling, groundwater was observed at depths varying from 2.30 to 9.10 meters in all the boreholes except Boreholes BH20-10 which remained dry and BH20-14 was wet at the bottom.

Stabilized groundwater levels in the monitoring wells installed at thirteen (13) borehole locations (BH1 to BH7, BH9, BH 11, BH 12 and BH14 to BH 16) measured on August 6, 2020 are provided below on Table 1.

Table 1: Summary of Groundwater Level Measurements in Monitoring Wells

BH No.	Ground Surface Elevation (m)	Date of Drilling	Date of Observation	Depth of Groundwater (m)	Elevation of Groundwater (m)
BH 20- 1	279.8	July 27, 2020	Aug 6, 2020	4.1	275.7
BH 20-2	278.8	July 27, 2020	Aug 6, 2020	6.1	272.7
BH 20-3	278.6	July 27, 2020	Aug 6, 2020	6.0	272.6
BH 20-4	277.1	July 27, 2020	Aug 6, 2020	4.6	272.5
BH 20-5	273.0	July 29, 2020	Aug 6, 2020	2.8	270.2
BH 20-6	271.0	July 28, 2020	Aug 6, 2020	6.8	264.2
BH 20-7	261.7	July 31, 2020	Aug 6, 2020	Dry	Dry
BH 20-9	274.1	July 28, 2020	Aug 6, 2020	4.4	269.7
BH 20-11	270.1	July 29, 2020	Aug 6, 2020	3.4	266.7
BH 20-12	264.9	July 31, 2020	Aug 6, 2020	0.2	264.7
BH 20-14	267.7	July 30, 2020	Aug 6, 2020	3.3	264.4
BH 20-15	264.1	July 30, 2020	Aug 6, 2020	3.7	260.4
BH 20-16	265.5	July 31, 2020	Aug 6, 2020	2.1	263.4

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

4. DISCUSSION AND RECOMMENDATIONS

4.1 SITE GRADING & ENGINEERED FILL

Please note that "the Macville Community Secondary Plan, once approved through a Local Official Plan Amendment (LOPA), will serve as a framework for future development of the Subject Lands for the purposes of accommodating residential and mixed-use development with related complimentary uses, such as open spaces, parks, trails, commercial uses, the Bolton GO Station, the Natural Heritage System (NHS), and stormwater management facilities.'. This report must be updated when the site plan is approved. Recommendations for different components will be provided in the updated geotechnical report.

For the residential subdivision with residential lots/buildings, underground services, roads and driveways, it is recommended that all fill to be placed for grading purposes be constructed as engineered fill to provide competent subgrade below house foundations, roads, boulevards, etc.

Prior to placement of engineered fill, all existing surficial organic material/topsoil, fill materials and weathered/disturbed native soils containing topsoil/organics should be stripped to expose the inorganic native subgrade. The exposed subgrade should then be proof rolled with a heavy sheepsfoot roller to identify weak areas. Any weak or excessively wet zones identified during proof-rolling should be sub-excavated and replaced with compacted competent material to establish stable and uniform conditions. Prior to placement of engineered fill, the subgrade should be inspected and approved by a geotechnical engineer.

General guidelines for the placement and preparation of engineered fill are presented on **Appendix A**. Bearing capacity values of 150 kPa at SLS and 225 kPa at ULS can be used on engineered fill, provided that all requirements on **Appendix A** are adhered to. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential.

The following is a recommended procedure for an engineered fill:

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and DS. Without this confirmation no responsibility for the performance of the structure can be accepted by DS. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a DS engineer prior to placement of fill.

5. The approved engineered fill must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Granular Fill preferred. Engineered fill should not be placed (where it will support footings) during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur.

6. Full-time geotechnical inspection by DS during placement of engineered fill is required. Work cannot commence or continue without the presence of the DS representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. Bearing capacity values of 150 kPa at SLS and 225 kPa at ULS may be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings should be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

10. After completion of the pad a second contractor may be selected to install footings. All excavations must be backfilled under full time supervision by DS to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of DS.

11. After completion of compaction, the surface of the pad must be protected from disturbance from traffic, rain and frost.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

The native soils and existing fill materials free from organics/topsoil and organics to be excavated from cut-areas are considered suitable for re-use as engineered fill, provided that their moisture contents at the time of construction are at or near optimum. Clayey tills are likely to be excavated in cohesive chunks or blocks and will be difficult to compact. They should be pulverized and placed in thin layers not exceeding 200 mm and compacted using heavy equipment suitable for these types of soils (e.g. heavy sheepsfoot compactors).

4.2 ROADS/PAVEMENTS

The investigation has shown that the predominant subgrade soil, after stripping the topsoil and any other organic and otherwise unsuitable subsoil, will generally consist of clayey silt/silty clay and silt to sandy silt soils.

Based on the above and assuming that traffic usage will be residential, the following minimum pavement thickness is recommended for the roads to be constructed within the development.

For Minor Local or local roads

40 mm HL3 Asphaltic Concrete
65 mm HL8 Asphaltic Concrete
150 mm Granular ‘A’
300 mm Granular ‘B’

For collector roads

40 mm HL3 Asphaltic Concrete
90 mm HL8 Asphaltic Concrete
150 mm Granular ‘A’
450 mm Granular ‘B’

Roads and driveway pavements/aprons should be constructed as per the Town of Bolton standards.

The site subgrade and weather conditions (i.e. if wet) at the time of construction may necessitate the placement of thicker granular sub-base layer and/or geogrid in order to facilitate the construction. Furthermore, heavy construction equipment may have to be kept off the newly constructed roads before the placement of asphalt and/or immediately thereafter, to avoid damaging the weak subgrade by heavy truck traffic.

4.2.1 STRIPPING, SUB-EXCAVATION AND GRADING

The site should be stripped of all organic soil/topsoil, fill materials and weathered/disturbed soils containing topsoil/organics or otherwise unsuitable soils to the full depth of the roads, both in cut and fill areas. Following stripping, the site should be graded to the subgrade level and approved. The subgrade should then be proof rolled, in the presence of the Geotechnical Engineer, by at least several passes of a heavy compactor having a rated capacity of at least 8 tonnes. Any soft spots thus exposed should be removed and replaced by select fill material, similar to the existing subgrade soil and approved by the Geotechnical Engineer. The subgrade should then be re-compacted from the surface to at least 98% of its Standard Proctor Maximum Dry Density (SPMDD). The final subgrade should be cambered or otherwise shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate.

Owing to the clayey (i.e. impervious) nature of some subsoils at the site, proper cambering and allowing the water to escape towards the sides (where it can be removed by means of subdrains) is considered to be beneficial for this project. Otherwise, any water collected in the granular sub-base materials could be trapped thus causing problems due to softened subgrade, differential frost heave, etc. For the same reason damaging the subgrade during and after placement of the granular materials by heavy construction traffic should be avoided. If the moisture content of the local material cannot be maintained at ±2% of the optimum moisture content, imported granular material may need to be used.

Any fill required for re-grading the site or backfill should be select, clean material, free of topsoil, organic or other foreign and unsuitable matter. The fill should be placed in thin layers and compacted to at least 98% of its SPMDD. The compaction of the new fill should be checked by frequent field density tests.

4.2.2 CONSTRUCTION

Once the subgrade has been inspected and approved, the granular base and sub-base course materials should be placed in layers not exceeding 200 mm (uncompacted thickness) and should be compacted to at least 100% of their respective SPMDD. The grading of the material should conform to current OPS Specifications.

The placing, spreading and rolling of the asphalt should be in accordance with OPS Specifications or, as required by the local authorities.

Frequent field density tests should be carried out on both the asphalt and granular base and sub-base materials to ensure that the required degree of compaction is achieved.

4.2.3 DRAINAGE

The installation of full-length subdrains on all roads is recommended. The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines.

All paved surfaces should be sloped to provide satisfactory drainage towards catch-basins. As discussed in Section 4.2.1, by means of good planning any water trapped in the granular sub-base materials should be drained rapidly towards subdrains or other interceptors.

4.2.4 WATERMAIN/SEWERS

As a part of the site development, a network of new watermains, storm and sanitary sewers will be constructed. It is assumed that the trenches will generally be within 4 to 5 m below the existing grade.

The type of material for the pipes to be used for watermains or sewers will be the choice of civil engineer.

4.2.5 TRENCHING

The boreholes show that below the existing topsoil and fill, the trenches will be predominantly dug through the silty clay till, sand and gravel and sandy silt to silt soils. Groundwater seepage within the silty clay till and till is expected to be slow to moderate and manageable by gravity drainage and pumping from filtered sumps. However, dewatering will be required for excavations in cohesionless soils (sand, gravel, silt, sandy silt to silty sand) below groundwater table.

Excavations in fill and native soils can be carried out with heavy hydraulic backhoe.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, fill material and weathered/disturbed native soils can be classified as Type 3 Soil above groundwater and Type 4 Soil below groundwater table or in perched water condition. The very stiff to hard silty clay can be classified as Type 2 Soil above groundwater and Type 3 Soil below groundwater. Cohesionless soils (sand, gravel, silt, sandy silt to silty sand) can be classified as Type 3 soil above groundwater and as Type 4 below groundwater.

The sides of excavations in the natural strata can be expected to be temporarily stable at relatively steep side slopes for short periods of time but they should be cut back at slopes no steeper than 1V:1.5H in fill material and 1V:1H in silty clay till in order to comply with the safety regulations. The OHSA stipulates that any excavation deeper than 1.2m must be shored or cut back at a slope of 1V:1H or flatter, depending on the soil type.

It should be noted that the till is a non-sorted sediment and therefore contain cobble and boulders. Possible large obstructions such as buried concrete pieces are also anticipated in the fill material. Provisions must be made in the excavation contract for the removal of possible boulders in the till and obstructions in the fill material.

4.2.6 BEDDING

Subject to design grades, the sewer pipes will predominantly be laid within the native soils and/or engineered fill which will provide adequate support for the sewer pipes and allow the use of normal Class B type bedding. The bedding should conform to the current Ontario Provincial Standard specifications (OPSS 401/OPSD 802) and/or standards set by the local municipality.

The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, have to be increased depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions or fill materials are encountered at the trench base level. The bedding material should consist of well graded granular material such as Granular 'A' or equivalent.

After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as set out by the local Authority, should be placed.

To avoid the loss of soil fines from the subgrade, uniformly graded clear stone should not be used unless, below the granular bedding material, a suitable, approved filter fabric (geotextile) is placed. The geotextile should extend along the sides of the trench and should be wrapped all around the poorly graded bedding material.

4.2.7 BACKFILLING OF TRENCHES

Based on visual and tactile examination, the on-site excavated inorganic native soils are considered to be suitable for re-use as backfill in the service trenches provided their moisture contents at the time of construction are within 2 percent of their optimum moisture content. Significant aeration of the wet excavated soils will be required prior to their use as backfill material.

The clayey deposits especially when its consistency is hard is likely to be excavated in cohesive chunks or blocks and will be difficult to compact in confined areas. For use as backfill, the clayey material will have to pulverized and placed in thin layers. The clayey soils will have to be compacted using heavy equipment suitable for these soils which may be difficult to operate in the narrow confines of the trenches. Unless the clayey materials are properly pulverized and compacted in sufficiently thin lifts post-construction settlements could occur. Their use in narrow trenches such as laterals (where heavy compaction equipment cannot be operated) may not be feasible.

Selected inorganic fill and the native soils free from topsoil and organics can be used as general construction backfill where it can be compacted with sheep's foot type compactors. Loose lifts of soil, which are to be compacted, should not exceed 200 mm. Depending on the time of construction and weather, some excavated material may be too wet to compact and will require aeration prior to its use.

Imported granular fill, which can be compacted with handheld equipment, should be used in confined areas.

The excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as OPSS Granular B should be used.

The backfill should be placed in maximum 200 mm thick layers at or near (±2%) their optimum moisture content and each layer should be compacted to at least 95% SPMDD. In the upper 1.5 m of the subgrade, underneath the road base, the compaction should be increased to 98% SPMDD.

Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling.

The on-site excavated soils and especially the clayey soils should not be used in confined areas (e.g. around catch-basins and laterals under roadways) where heavy compaction equipment cannot be operated. The use of imported granular fill together with an appropriate frost taper would be preferable in confined areas and around structures, such as catch-basins.

It should be noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should be compacted at the surface or be covered with tarpaulins to minimize moisture uptake.

The topsoil encountered at the site can be used for landscaping fill area to raise the grades. Topsoil cannot be reused as foundation or trench backfill material.

4.2.8 ANTI SEEPAGE COLLARS/TRENCH PLUGS

For pipes installed under the groundwater table, seepage between the trench backfill material and the trench wall may cause erosion of the backfill materials. it is recommended that nominal anti-seepage collars (maximum spacing 50m) be provided to prevent erosion of the backfill materials. Anti seepage collar should not be located at pipe joint.

The anti-seepage collar may consist of a clay plug surrounding the sewer pipe. A typical clay plug will be about 1 m thick and extends laterally to a minimum distance of 0.5 m from the pipe circumference with a minimum of 0.3 m embedment into the shale or native sub-grade. Typical (not to scale) anti-seepage collar conceptual detail is provided on Drawing 21.

The on-site native clayey soils may be suitable for such purpose subject to additional sampling and testing.

4.2.9 THRUST BLOCKS AND JOINT RESTRAINTS

An allowable (or SLS) bearing resistance of 150 kPa and factored ULS bearing resistance of 225 kPa can be used in the design of thrust blocks constructed on undisturbed native soils or engineered fill.

4.3 FOUNDATION CONDITIONS

4.3.1 PROPOSED HOUSES

Please note that “the Macville Community Secondary Plan, once approved through a Local Official Plan Amendment (LOPA), will serve as a framework for future development of the Subject Lands for the purposes of accommodating residential and mixed-use development with related complimentary uses, such as open spaces, parks, trails, commercial uses, the Bolton GO Station, the Natural Heritage System (NHS), and stormwater management facilities.’. This report must be updated when the site plan is approved. Recommendations for different components will be provided in the updated geotechnical report.

For the proposed , it is understood that the proposed subdivision will consist of single-family homes (detached, townhomes, back-to-backs, and stacked) with one level of basement.

The native soils encountered in the boreholes are competent to support the proposed houses on conventional footings.

The spread and strip footings founded on the undisturbed native soils can be designed for a bearing capacity of 150 kPa at SLS (Serviceability Limit State), and for a factored geotechnical resistance of 225 kPa at ULS (Ultimate Limit State).

Subject to design grades, footing founding elevations, in the area of Borehole BH 20-12, must be confirmed on site due to variable soil conditions. The footings might be lowered, or less bearing capacity be used.

In addition, the locally encountered sandy silt to silty sand at the base of footings can be easily disturbed by construction activities. A concrete skim coat, about 50 mm in thickness, on the founding subgrade immediately after its approval might be required, on a case by case basis, to prevent its disturbance by construction activities.

Due to the difference in ground elevations and subject to design grades, should the proposed footings be founded above the competent native soils, then the proposed houses can also be supported by spread and strip footings founded on engineered fill for a bearing capacity of 150 kPa at the serviceability limit states (SLS) and for a factored geotechnical resistance of 225 kPa at the ultimate limit states (ULS), provided all requirements on **Appendix A** are adhered to.

4.3.2 PROPOSED LOW TO MID-RISE RESIDENTIAL BUILDINGS

It is understood that low to mid-rise residential buildings (varying from 4 to 6 storey and up to probably 15 storey) are proposed to be erected in the vicinity of the GO station, the areas of boreholes BH20-10, BH20-11, BH20-14 and BH20-15. The proposed buildings will also include underground parking.

The design grades and number of floors/underground parking levels are not known at this stage. Therefore, our recommendations should be considered preliminary and will be revised when the proposed Site/Foundation plan becomes available.

However, due to the variable soil conditions and the presence of less competent soils (see borehole BH20-10 and BH20-15), further borehole investigation will be required to investigate the subsurface soil conditions and the need to utilize deep foundation alternative (if required), confirm the soil bearing capacities, subject to design loads.

In addition, settlement analyses will be required when the foundation plan/design loads areas available to evaluate/quantify the total and differential settlements.

Subject to design grades/loads, number of floors/levels of underground parking and based on the information from the above-mentioned boreholes, the following soil bearing capacities, as presented in Table 2, are available (which must be confirmed by further borehole investigation).

Table 2: Bearing Values and Founding Levels of conventional Strip/Spread Footings in Native Soils

BH No.	Surface Elevation At Borehole (m)	Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth below Existing Ground (m)	Founding Level At or Below Elevation (m)
BH20-10	268.3	200/150	300/225	2.0/5.0	266.3/263.3
BH20-11	270.1	250	375	3.0	267.1
BH20-14	267.7	250	375	2.5	265.2
BH20-15	264.1	200/150	300/225	2.0/5.0	262.1/259.1

4.3.3 GENERAL FOUNDATION NOTES

Foundations designed to the specified bearing capacities at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential.

All footings exposed to seasonal freezing conditions must have at least 1.4 metres of soil cover for frost protection.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

It should be noted that the recommended bearing capacities have been calculated by DS from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by DS to validate the information for use during the construction stage.

4.4 FLOOR SLAB

The floor slab can be supported on grade provided all organic materials/topsoil, fill, and surficial softened/disturbed native soils are removed and the base thoroughly proof rolled. The fill required to raise the grade can consist of inorganic soil, approved by this office, placed in shallow lifts and compacted to 98 percent of Standard Proctor Maximum Dry Density (SPMDD). Where engineered fill is used to support the foundations, the floor slab can also be supported by engineered fill.

A moisture barrier consisting of at least 200 mm of 19 mm clear crushed stone should be installed under the floor slab.

A perimeter and underfloor drainage system will be required around the exterior basement walls, as shown on **Drawing 20**.

4.5 EARTH PRESSURES

The lateral earth pressures acting on retaining walls or underground structures may be calculated from the following expression:

$$p = k(\gamma h + q)$$

where, p = Lateral earth pressure in kPa acting at depth h

K = Earth pressure coefficient, assumed to be 0.40 for vertical walls and horizontal backfill for permanent construction

γ = Unit weight of backfill, a value of 21 kN/m3 may be assumed

h = Depth to point of interest in metres

q = Equivalent value of surcharge on the ground surface in kPa

The above expression assumes that the perimeter drainage system prevents the build up of any hydrostatic pressure behind the wall.

4.6 STORMWATER MANAGEMENT PONDS

The proposed stormwater management ponds which will be located at the southeast and central south portions of the subject site.

The pond design grades are not available at this stage. Due to the variable soil conditions and the presence of different types of soils at different depths, recommendations will be provided at later stage including the clay liner recommendations, if required, when design information are available.

Based on the subsurface conditions encountered in boreholes BH20-12 and BH20-16 and subject to design grades, the soils at the pond sides and base after removing the existing fill materials will consist of silty clay till, sand and gravel and sandy silt to silt. The groundwater levels measured in the monitoring wells within the pond areas ranged from 0.2 (BH20-12) to 1.5m below the existing grade, corresponding to Elevations 264.70 and 263.40m, in Boreholes BH20-12 and BH20-16, respectively.

Dewatering system will be required for excavations below groundwater levels, subject to depth of excavations and type of soils encountered, to be confirmed during design stage.

Anti-seepage collars should be considered for outlet works that direct flow out of the SWM pond as these outlet works are subject to hydraulic heads directly from the pond. The provision of anti-seepage collars would increase the seepage path along the outlet works and therefore reduce the quantity of potential seepage.

5. GENERAL COMMENTS AND LIMITATIONS OF REPORT

DS Consultants Ltd. (DS) should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, DS will assume no responsibility for interpretation of the recommendations in the report.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to DS at the time of preparation. Unless otherwise agreed in writing by DS, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial organic soil/topsoil or fill layers may vary markedly and unpredictably.

The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as

to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. DS accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

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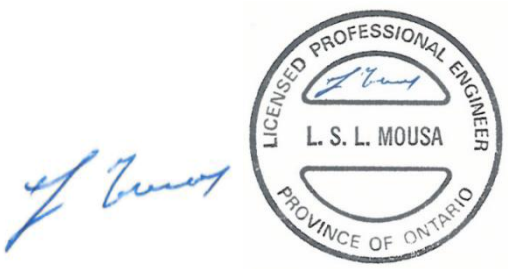
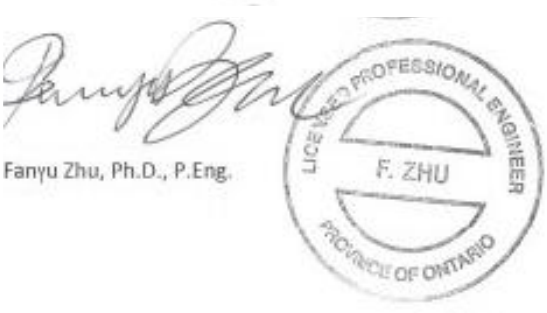


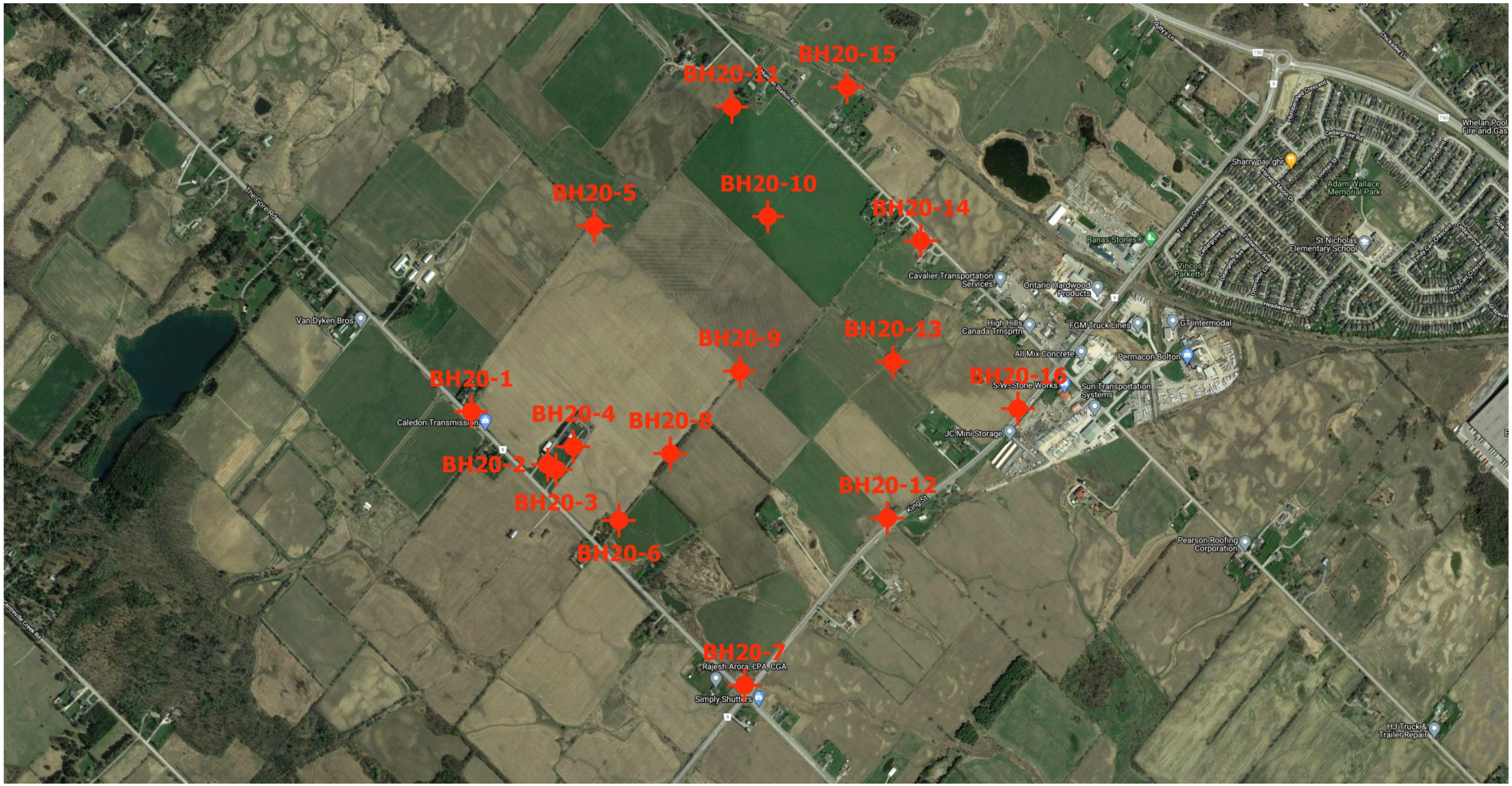
Labib Mousa, P.Eng.

Alka Sangar, M.Eng., P.Eng.



Fanyu Zhu, Ph.D., P.Eng.

Drawings



Legend

Borehole Location

DS CONSULTANTS LTD.
6221 Highway 7, UNIT 16
Vaughan, Ontario L4H 0K8
Telephone: (905) 264-9393
www.dsconsultants.ca

Project: Geotechnical Investigation - Bolton Option 3 Lands, Caledon, Ontario

Title: **Borehole Location Plan**

N

Client: Bolton Option 3 Landowners Group

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	LM	MM	August, 2020
Rev: 0	Scale: As Shown	Project No.: 20-169-100	Figure No.: 1

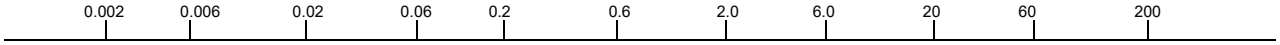
Image/Map Source: *Google Satellite Image*

Drawing 1A: Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by DSCL also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

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Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

LOG OF BOREHOLE BH20-1

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857815.92 E 597082.44

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/27/2020

REF. NO.: 20-169-100
ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
279.8							
0.0 / 279.8	**TOPSOIL:** 300mm		1	SS	6		
0.3 / 279.5	**FILL:** sandy silt, trace gravel, dark brown, moist, loose						
279.0							279
0.8	**CLAYEY SILT TILL:** sandy, trace gravel, sand seams, brown, moist, very stiff to hard		2	SS	19		
			3	SS	36		278
	trace cobble below 2.3m		4	SS	55		
							Bentonite
			5	SS	32		
							276
						W. L. 275.7 m Aug 06, 2020	
275.3							
4.5	**SILTY CLAY:** trace sand, grey, very moist, very stiff		6	SS	17		275
273.8							274
6.0	**SILT:** trace clay, grey, wet, compact		7	SS	12		
							Filter Pack
							Slotted Pipe
			8	SS	20		272
271.6							
8.2	**END OF BOREHOLE:**						

Notes:
1) Water level at 4.5m below grade during drilling.
2) 50mm dia. monitoring well installed upon completion.
3) Water level Reading:

Date:	Water Level (mbgl):
Aug 6, 2020	4.1

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

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LOG OF BOREHOLE BH20-2

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857663.29 E 597311.06

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/27/2020

REF. NO.: 20-169-100
ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
278.8							
278.6	**TOPSOIL:** 200mm						
0.2	**FILL:** sandy silt, trace gravel, brown, moist, loose		1	SS	8		
278.0							278
0.8	**CLAYEY SILT TILL:** sandy, trace gravel, sand seams, brown, moist, very stiff		2	SS	16		
			3	SS	19		277
276.5						Bentonite	
2.3	**SANDY SILT:** trace clay, brown, moist to very moist, very dense		4	SS	58		276
			5	SS	58		
							275
			6	SS	66		274
	wet below 6m					Filter Pack Slotted Pipe W. L. 272.7 m Aug 06, 2020	
			7	SS	51		
							272
			8	SS	52		271
270.6							
8.2	**END OF BOREHOLE:**						

Notes:
1) Water level at 6.1m below grade during drilling.
2) 50mm dia. monitoring well installed upon completion.
3) Water level Reading:

Date:	Water Level (mbgl):
Aug 6, 2020	6.1

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

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LOG OF BOREHOLE BH20-3

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857648.82 E 597335.94

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/27/2020

REF. NO.: 20-169-100
ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
278.6							
0.0 / 278.3	**TOPSOIL:** 300mm						
0.3 / 277.8	**FILL:** sandy silt, trace gravel, brown, moist, compact		1	SS	10		278
1 0.8	**SILTY CLAY TILL:** sandy, trace gravel, sand seams, brown, moist, stiff		2	SS	13		
			3	SS	10		277
2 / 276.3							
2.3	**SILTY SAND:** trace clay, grey, moist, compact to very dense		4	SS	15		276
3							
			5	SS	35		275
4							
	wet below 4.5m		6	SS	65		273
5							
6							
271.9			7	SS	49		272
6.7	**END OF BOREHOLE:**						

Bentonite
Filter Pack
Slotted Pipe
W. L. 272.6 m
Aug 06, 2020

Notes:
1) Water level at 4.5m below grade during drilling.
2) 50mm dia. monitoring well installed upon completion.
3) Water level Reading:

Date:	Water Level (mbgl):
Aug 6, 2020	6.0

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

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LOG OF BOREHOLE BH20-4

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857717.02 E 597386.34

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/27/2020

REF. NO.: 20-169-100
ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
277.1						
0.0 / 276.8	**CONCRETE:** 300mm					
0.3 / 276.3	**FILL:** clayey silt, trace gravel, grey to brown, moist, stiff	1	SS	8		
0.8	**SANDY SILT:** trace clay, brown, moist, compact to very dense	2	SS	21		276
		3	SS	42		275
		4	SS	62		274
	wet below 4.5m	5	SS	56		273
		6	SS	46		272
271.1						
6.0 / 270.4	**SANDY SILT:** trace silt, brown, wet, compact	7	SS	28		271
6.7	**END OF BOREHOLE:**					

Bentonite
Filter Pack
Slotted Pipe
W. L. 272.5 m
Aug 06, 2020

Notes:
1) Water level at 4.5m below grade during drilling.
2) 50mm dia. monitoring well installed upon completion.
3) Water level Reading:

Date:	Water Level (mbgl):
Aug 6, 2020	4.6

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

DS CONSULTANTS LTD.
Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

LOG OF BOREHOLE BH20-5

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4858369.55 E 597438.77

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/29/2020

REF. NO.: 20-169-100
ENCL NO.: 6

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
273.0												
272.9	**TOPSOIL:** 250mm											
272.7												
0.3	**FILL:** sandy silt, trace topsoil/ organics, trace gravel, trace rootlets, brown, moist, compact		1	SS	15							
272.2												
0.8	**SILTY CLAY TILL:** sandy, trace gravel, frequent sand seams, brown, moist, hard		2	SS	35		272					
			3	SS	31		271					
			4	SS	39	▽						
270.0							W. L. 270.2 m Aug 06, 2020					
3.0	**CLAYEY SILT TILL:** sandy, trace gravel, interbed of sandy silt layers, greyish brown, moist to very moist, hard		5	SS	35		Bentonite					
	grey below 4.5m		6	SS	37		269					
							268					
	sand seams below 6m		7	SS	46		267					
							266					
265.5												
7.5	**SILTY SAND:** trace clay, grey, moist, very dense		8	SS	74/ 280mm		Filter Pack Slotted Pipe					0 51 47 2
	very moist at 9m		9	SS	59		264					
263.3												
9.7	**END OF BOREHOLE:**											

Notes:
1) Water level at 9.1m below grade during drilling.
2) 50mm dia. monitoring well installed upon completion.
3) Water level Reading:

Date:	Water Level (mbgl):
Aug 6, 2020	2.8

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

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LOG OF BOREHOLE BH20-6

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857501.44 E 597524.2

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/28/2020

REF. NO.: 20-169-100
ENCL NO.: 7

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
271.0 / 0.0	**TOPSOIL:** 250mm				
270.7 / 0.3	**FILL:** sandy silt, trace topsoil/ organics, trace gravel, trace rootlets, dark brown, moist, loose	1	SS	8	
270.2 / 0.8	**CLAYEY SILT TILL:** sandy, trace gravel, sand seams, brown, moist, stiff to hard	2	SS	12	270
		3	SS	21	269
	hard below 2.3m	4	SS	59	
					Bentonite
		5	SS	58	268
					267
	grey below 4.5m	6	SS	31	266
					265
		7	SS	39	Filter Pack
					W. L. 264.2 m Aug 06, 2020
262.8 / 8.2	**END OF BOREHOLE:** Notes: 1) Borehole dry during drilling. 2) 50mm dia. monitoring well installed upon completion. 3) Water level Reading: Date: Aug 6, 2020 Water Level (mbgl): 6.8	8	SS	25	263

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)
SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

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LOG OF BOREHOLE BH20-7

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857020.81 E 597903.58

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/31/2020

REF. NO.: 20-169-100
ENCL NO.: 8

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
261.7 / 0.0	**TOPSOIL:** 500mm	1	SS	8	261
261.2 / 0.5	**FILL:** clayey silt, trace topsoil/ organics, trace gravel, trace rootlets, dark brown, moist, stiff	2	SS	10	
260.9 / 0.8	**CLAYEY SILT TILL:** some sand, trace gravel, brownish grey, very moist, stiff with silt and sand seams at 1.5m	3	SS	13	260
259.4 / 2.3	**SILTY CLAY TILL:** some sand, some gravel, greyish brown, moist, very stiff to hard	4	SS	39	
	grey, very moist to wet below 3m	5	SS	28	258
		6	SS	21	257
		7	SS	19	256
		8	SS	25	254
		9	SS	16	253
		10	SS	24	252
250.4 / 11.3	**END OF BOREHOLE:**				251

Notes:
1) Borehole dry during drilling.
2) 50mm dia. monitoring well installed upon completion.
3) Water level Reading:

Date:	Water Level (mbgl):
Aug 6, 2020	Dry

Bentonite
Filter Pack
Slotted Pipe
Bentonite: Bottom of hole

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
15	18	38	29

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

DS CONSULTANTS LTD.
Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

LOG OF BOREHOLE BH20-8

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857701.02 E 597673.81

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/28/2020

REF. NO.: 20-169-100
ENCL NO.: 9

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
277.2								
0.0 / 276.8	**TOPSOIL:** 340mm		1	SS	8		277	
0.4 / 276.4	**FILL:** sandy silt, trace topsoil/ organics, trace gravel, brown, moist, loose							
1 0.8 / 275.7	**CLAYEY SILT TILL:** sandy, trace gravel, brown, moist, compact		2	SS	10		276	
1.5	**SILT:** some clay, trace sand, trace gravel, brown, very moist, compact to very dense		3	SS	19			
2			4	SS	58		275	2 2 85 11
3			5	SS	92/ 255mm		274	
4							273	
5			6	SS	74		272	
271.2								
6.0	**SANDY SILT:** trace clay, brown, wet, very dense		7	SS	62		271	0 27 67 6
7							270	
8 / 269.0			8	SS	54		269	
8.2	**END OF BOREHOLE:** Notes: 1) Water at depth of 6.1m during drilling.							

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

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LOG OF BOREHOLE BH20-9

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857946.64 E 597876.44

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/28/2020

REF. NO.: 20-169-100
ENCL NO.: 10

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
274.1							
0.0 / 273.6	**TOPSOIL:** 550mm		1	SS	5		274
0.6 / 273.3	**FILL:** sandy silt, trace topsoil/ organics, trace clay, trace gravel, trace organics, trace rootlets, dark brown, moist, loose		2	SS	16		273
0.8	**SILTY CLAY TILL:** some sand, trace gravel, brown, moist, very stiff to hard		3	SS	25		272
	sand seams below 2.3m		4	SS	38	Bentonite	271
	grey below 4.5m		5	SS	72	W. L. 269.7 m Aug 06, 2020	270
	trace cobble, very moist below 6m		6	SS	45		269
			7	SS	24	Filter Pack, Slotted Pipe	268
266.6 / 7.5	**SANDY SILT:** trace clay, grey, wet, compact		8	SS	29		267
265.9 / 8.2	**END OF BOREHOLE:**						266

Notes:
1) Water level at 7.6m below grade during drilling.
2) 50mm dia. monitoring well installed upon completion.
3) Water level Reading:

Date:	Water Level (mbgl):
Aug 6, 2020	4.4

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

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LOG OF BOREHOLE BH20-10

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4858404.6 E 597955.26

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/29/2020

REF. NO.: 20-169-100
ENCL NO.: 11

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
268.3							
0.0 / 268.0	**TOPSOIL:** 300mm						
0.3 / 267.5	**FILL:** sandy silt, trace topsoil/ organics, trace gravel, trace rootlets, brown, moist, compact		1	SS	15		268
0.8	**SILTY CLAY TILL:** some sand, trace gravel, sand seams, brown, moist to very moist, very stiff		2	SS	21		267
			3	SS	25		
			4	SS	25		266
	grey below 3m		5	SS	16		265
			6	SS	20		264
			7	SS	17		263
			8	SS	15		262
260.1							261
8.2	**END OF BOREHOLE:** Notes: 1) Borehole dry and open upon completion.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

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LOG OF BOREHOLE BH20-11

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4858726.5 E 597841.19

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/29/2020

REF. NO.: 20-169-100
ENCL NO.: 12

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
270.1 / 0.0	**TOPSOIL:** 300mm				
269.8 / 0.3	**FILL:** sandy silt, trace topsoil/ organics, trace gravel, trace rootlets, brown, moist, compact	1	SS	12	270
269.3 / 0.8	**SILTY CLAY TILL:** sandy, trace gravel, sand seams, brown, moist, very stiff to hard	2	SS	19	269
		3	SS	22	
		4	SS	28	268
		5	SS	44	267
	grey below 4.5m	6	SS	24	266
		7	SS	21	265
262.4 / 7.7	**SILT:** some sand, trace clay, trace gravel, grey, wet, compact	8	SS	28	264
		9	SS	27	263
260.4 / 9.7	**END OF BOREHOLE:**				261

Notes:
1) Water level at 9.1m below grade during drilling.
2) 50mm dia. monitoring well installed upon completion.
3) Water level Reading:

Date:	Water Level (mbgl):
Aug 6, 2020	3.4

W. L. 266.7 m
Aug 06, 2020

Filter Pack
Slotted Pipe

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
1	11	80	8

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

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LOG OF BOREHOLE BH20-12

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857520.15 E 598321.99

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/31/2020

REF. NO.: 20-169-100
ENCL NO.: 13

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
264.9												
0.0 / 264.5	**TOPSOIL:** 400mm		1	SS	8		W. L. 264.7 m Aug 06, 2020					
0.4 / 264.1	**FILL:** clayey silt, trace topsoil/ organics, trace gravel, sand seams, trace rootlets, dark brown, moist, stiff		2	SS	8		264					
1 0.8	**SILTY CLAY TILL:** some sand, trace gravel, sand seams, brown, moist to very moist, stiff		3	SS	9		263					
2	grey below 2.3m		4	SS	10		Bentonite					
3 261.9							262					
3.0	**SANDY SILT TO SILT:** trace clay, grey, very moist, dense		5	SS	32							
4	wet below 4.5m		6	SS	36		261					
5							260					
6 258.9							259					
6.0	**SILT:** trace clay, trace sand, grey, very moist, compact to loose		7	SS	25		Filter Pack					0 1 94 5
7							Slotted Pipe					
8 256.7			8	SS	7		257					
8.2	**END OF BOREHOLE:** Notes: 1) Water level at 3.1m below grade during drilling 2) 50mm dia. monitoring well installed upon completion. 3) Water level Reading: Date: Aug 6, 2020 Water Level (mbgl): 0.2											

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

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LOG OF BOREHOLE BH20-13

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857981.07 E 598332.09

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/30/2020

REF. NO.: 20-169-100
ENCL NO.: 14

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
268.1 / 0.0	**TOPSOIL:** 200mm						268
0.2 / 267.3	**FILL:** clayey silt, trace topsoil/ organics, trace gravel, trace rootlets, dark brown, moist, stiff		1	SS	12		
0.8	**SILTY CLAY TILL:** some sand, trace gravel, sand seams, brownish grey, moist, stiff to very stiff		2	SS	19		267
			3	SS	20		
			4	SS	26		266
			5	SS	14		265
	grey below 4.5m		6	SS	9		264
			7	SS	19		263
260.6 / 7.5	**SANDY SILT TO SILT:** trace clay, trace gravel, grey, wet, very dense		8	SS	94/ 255mm		262
259.9 / 8.2	**END OF BOREHOLE:** Notes: 1) Water at 7.6m below grade during drilling						261
							260

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

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LOG OF BOREHOLE BH20-14

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4858339.89 E 598409.18

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/30/2020

REF. NO.: 20-169-100
ENCL NO.: 15

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
267.7						
0.0 / 267.3	**TOPSOIL:** 400mm	1	SS	7		267
0.4 / 266.9	**FILL:** clayey silt, trace topsoil/ organics, trace gravel, trace sand, trace rootlets, brown, moist, firm					
0.8	**SILTY CLAY TILL:** some sand, trace gravel, frequent sand seams, brown, moist, stiff to hard	2	SS	14		
		3	SS	13		266
		4	SS	27		265
		5	SS	28	▽ W. L. 264.4 m Aug 06, 2020	
					Bentonite	263
		6	SS	24		
	grey below 6m					262
		7	SS	18		
						261
		8	SS	29		260
						259
		9	SS	22	Filter Pack / Slotted Pipe	
	interbed of clayey silt and sany silt layers, wet below 10.5m					257
		10	SS	35		
256.4						
11.3	**END OF BOREHOLE:**					

Notes:
1) 50mm dia. monitoring well installed upon completion.
2) Water level Reading:

Date:	Water Level (mbgl):
Aug 6, 2020	3.3

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

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LOG OF BOREHOLE BH20-15

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4858789.95 E 598183.97

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/30/2020

REF. NO.: 20-169-100
ENCL NO.: 16

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
264.1							
0.0 / 263.8	**TOPSOIL:** 350mm		1	SS	12		264
0.4 / 263.3	**FILL:** clayey silt, trace topsoil/ organics, trace gravel, trace sand, trace rootlets, brown, moist, stiff						
1 0.8	**CLAYEY SILT TILL:** some sand, trace gravel, sand seams, brown, moist, stiff to very stiff		2	SS	18		263
			3	SS	22		
2			4	SS	27		262
3			5	SS	27		261
4						Bentonite W. L. 260.4 m Aug 06, 2020	
	grey below 4.5m		6	SS	17		259
5							
6			7	SS	14		258
7							257
8			8	SS	16	Filter Pack Slotted Pipe	
9	wet below 9m		9	SS	12		255
254.4							
9.7	**END OF BOREHOLE:**						

Notes:
1) Water level at 9.1m below grade during drilling.
2) 50mm dia. monitoring well installed upon completion.
3) Water level Reading:

Date:	Water Level (mbgl):
Aug 6, 2020	3.7

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21

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LOG OF BOREHOLE BH20-16

PROJECT: Geotechnical Investigation
CLIENT: Bolton Option 3 Landowners Group
PROJECT LOCATION: Bolton Option 3 Lands, Caledon, Ontario
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1 N 4857848.7 E 598703.75

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jul/31/2020

REF. NO.: 20-169-100
ENCL NO.: 17

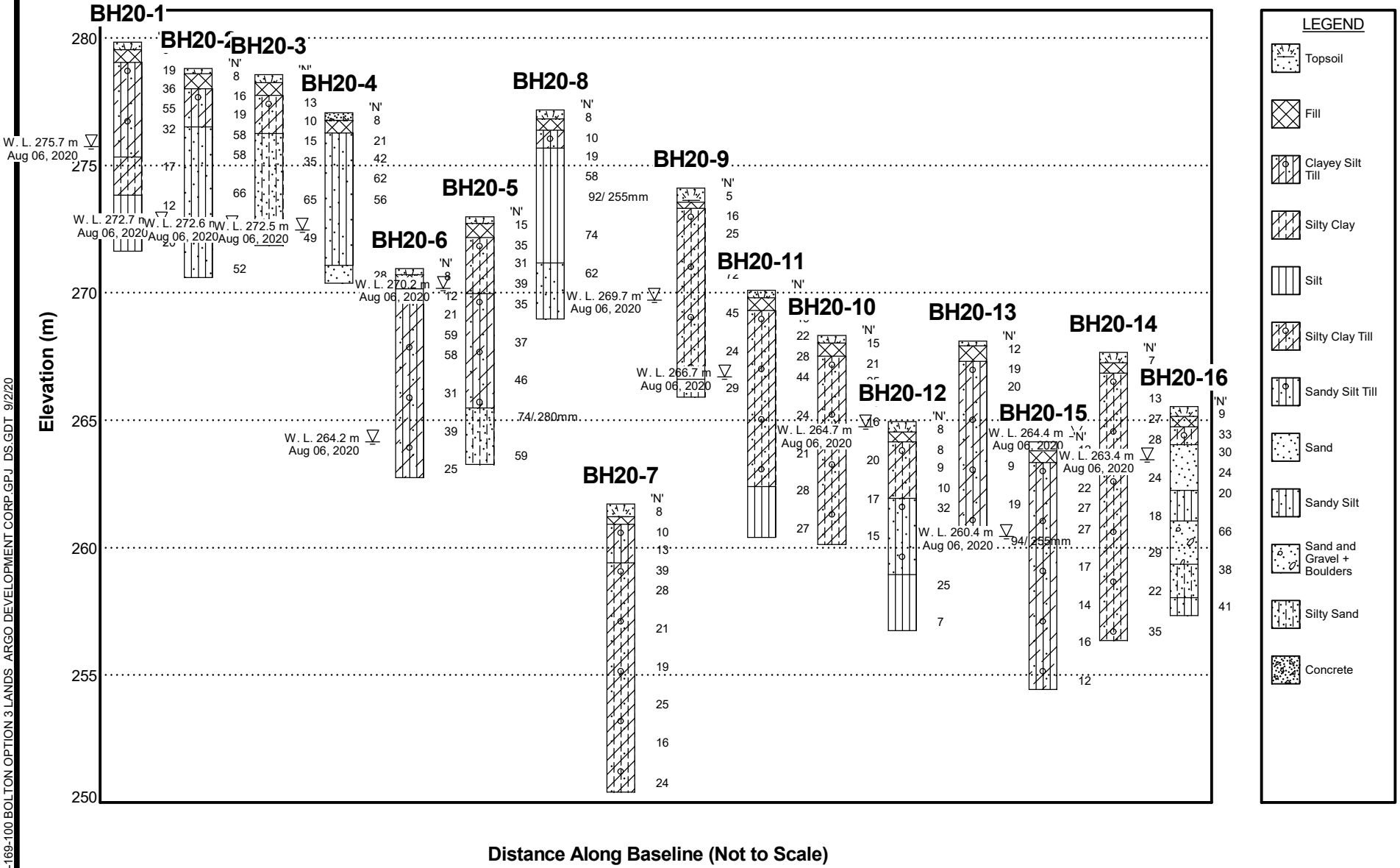
(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
265.5							
0.0 / 265.1	**TOPSOIL:** 400mm	1	SS	9		265	
0.4 / 264.7	**FILL:** clayey silt, trace topsoil/ organics, trace gravel, trace rootlets, brown, moist, stiff						
0.8 / 264.0	**SILTY CLAY TILL:** some sand, trace gravel, sand seams, brown, moist, stiff to hard	2	SS	33		264	
1.5	**GRAVELLY SAND:** some silt, trace clay, brown, very moist to wet, compact to dense	3	SS	30	▽ W. L. 263.4 m Aug 06, 2020		
262.2		4	SS	24	Bentonite	263	22 64 10 4
3.3 / 261.0	**SANDY SILT:** trace clay, brown, wet, compact	5	SS	20		262	
4.5 / 259.3	**SAND AND GRAVEI:** some silt, trace clay, brownish grey, wet, very dense	6	SS	66		261	42 37 15 6
6.2 / 258.0	**SILTY SAND:** some clay, trace gravel, greyish brown, wet, dense	7	SS	38	Filter Pack Slotted Pipe	260	3 61 26 10
7.5 / 257.3	**SANDY SILT:** trace clay, grey, wet, dense	8	SS	41		259	
8.2	**END OF BOREHOLE:** Notes: 1) Water level at 2.3m below grade during drilling. 2) 50mm dia. monitoring well installed upon completion. 3) Water level Reading: Date: Aug 6, 2020 Water Level (mbgl): 2.1					258	

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)
SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 20-169-100 BOLTON OPTION 3 LANDS_ARGO DEVELOPMENT CORP.GPJ DS.GDT 1/5/21



Distance Along Baseline (Not to Scale)

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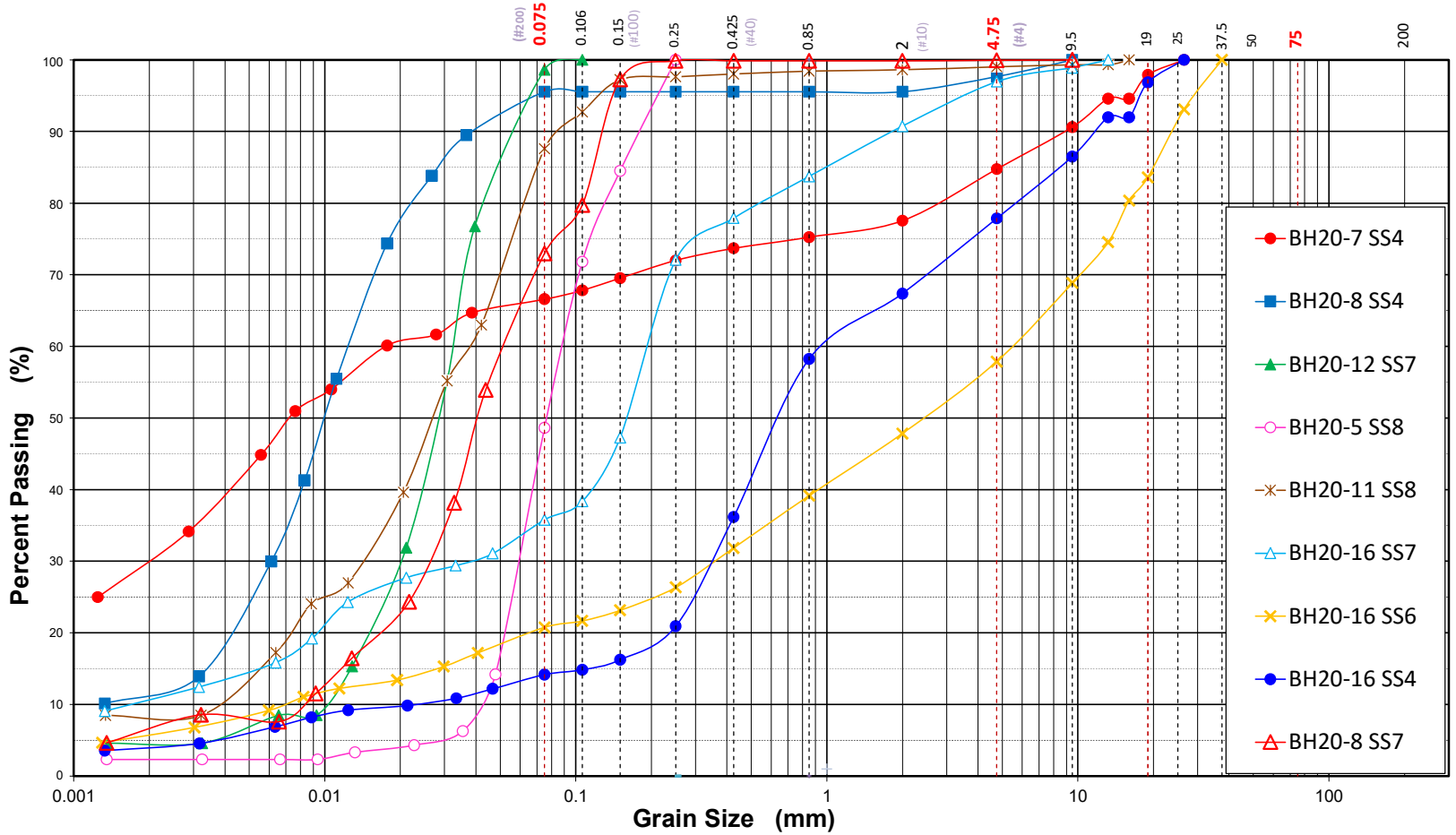
Generalized Sub-surface Profile

DRAWING NO.	18
JOB NO.	20-169-100
DATE	Sep 02, 2020

DS FENCE (M) 20-169-100 BOLTON OPTION 3 LANDS ARGO DEVELOPMENT CORP.GPJ DS.GDT 9/2/20

Particle Size Distribution (ASTM-D421/D422)



Silt and Clay		Sand			Gravel		Cobble +
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	

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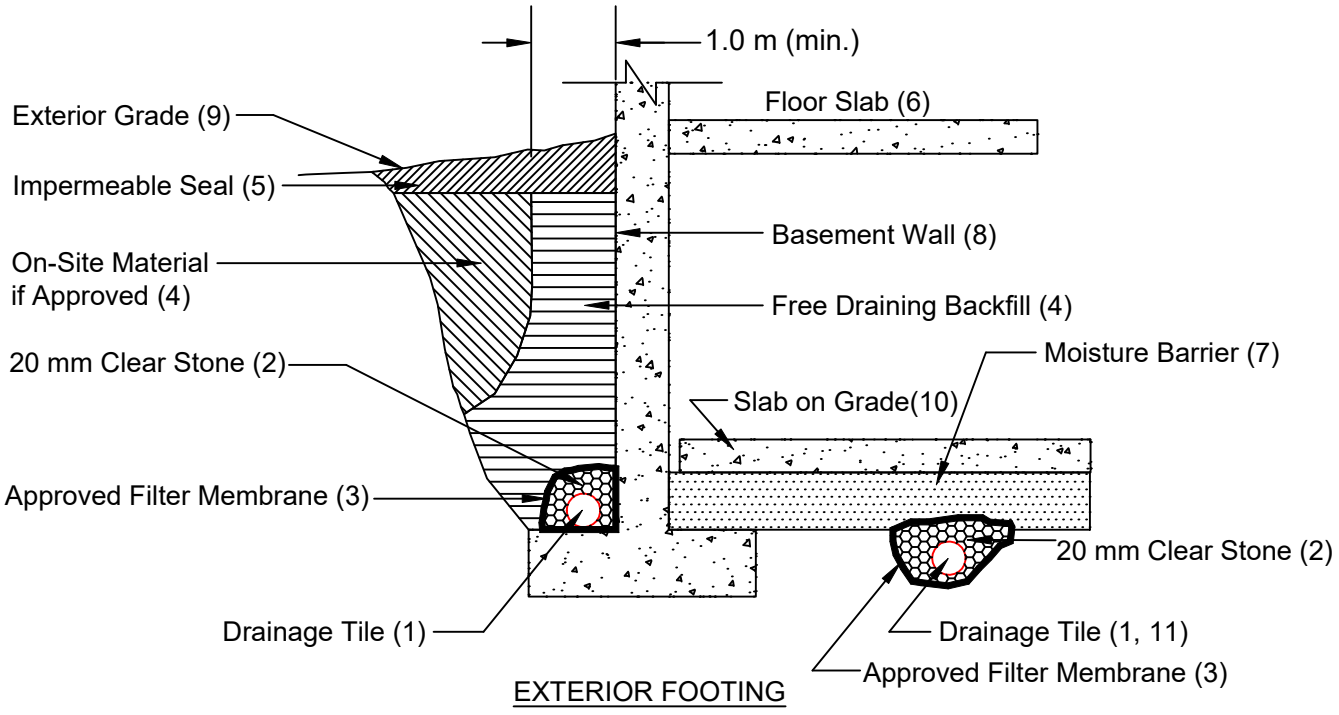
Project	**Bolton Option 3 Lands**	Project No	**20-169-100**
Location	**Caledon, Ontario**	Date	**Aug/21/2020**
Client	**Bolton Option 3 Landowners Group**	Figure No	19



EXTERIOR FOOTING

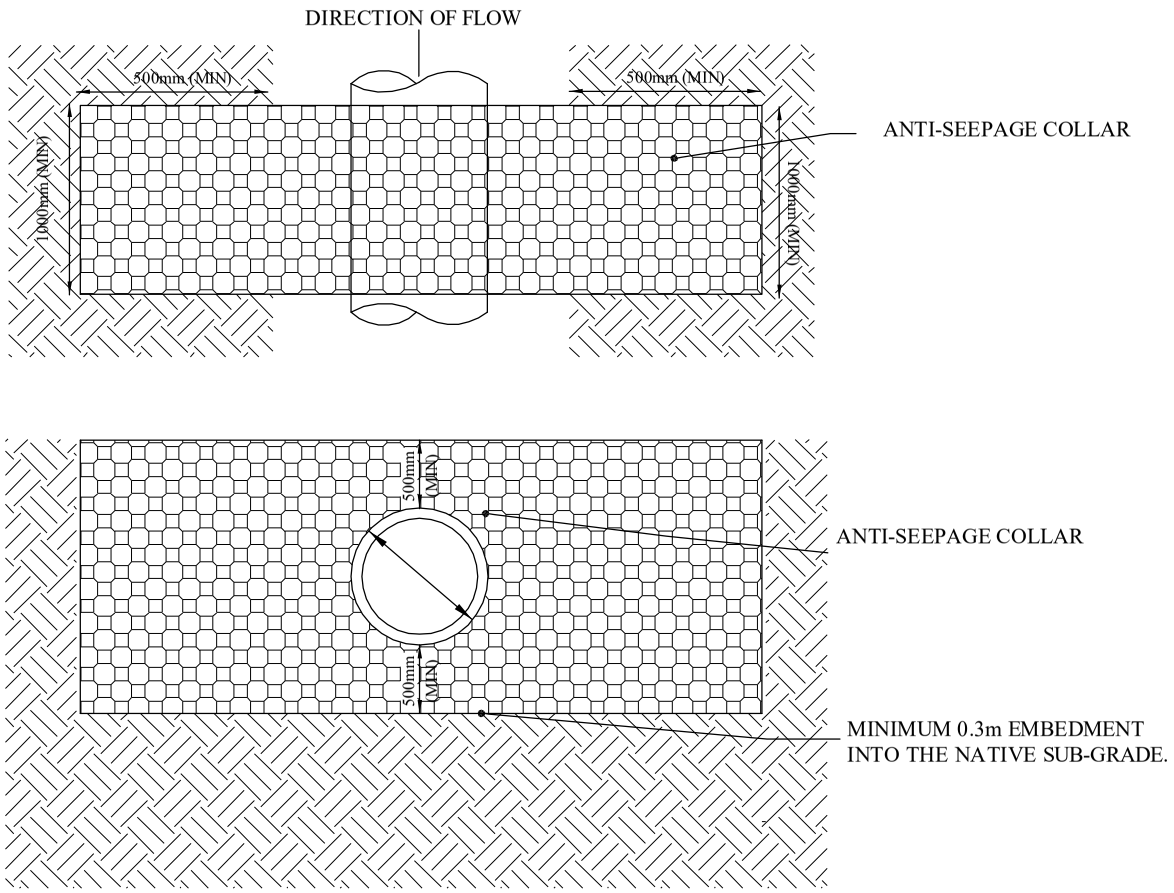
Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Free Draining backfill - OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
8. Basement wall to be damp proofed /water proofed.
9. Exterior grade to slope away from building.
10. Slab on grade should not be structurally connected to the wall or footing.
11. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
12. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
13. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
14. Do not connect the underfloor drains to perimeter drains.
15. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage

(not to scale)

DRAWING NO. 21: TYPICAL TRENCH PLUG INSTALLATION



ANTI-SEEPAGE COLLAR DETAIL

SCALE: N.T.S.

DRAFT

- All Units In Metric Unless Otherwise Noted.
- Base Information Obtained From Various Sources And Is Approximate.
- Schedule / Plan Information Is Conceptual And Requires Verification by Appropriate Agency.

GERRARD DESIGN

MACVILLE | Caledon, Ontario

PRELIMINARY BLOCK PLAN

NOV 19, 2020

PROJECT 1420

SCALE 1:8000

Appendix A
Engineered Fill Guidelines

GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, we recommend use of OPSS Granular 'B' sand and gravel fill material.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill cannot be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year.

The location of the foundations on the engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Excavations within the engineered fill pad must be backfilled with the same conditions and quality control as the original pad.

To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows; however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained from and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and DS Consultants Ltd (DSCL). Without this confirmation no responsibility for the performance of the structure can be accepted by DSCL. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a DSCL engineer prior to placement of fill.

5. The approved engineered fill material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Engineered fill should not be placed during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.

6. Full-time geotechnical inspection by DSCL during placement of engineered fill is required. Work cannot commence or continue without the presence of the DSCL representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. A bearing capacity of 150 kPa at SLS (225 kPa at ULS) can be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

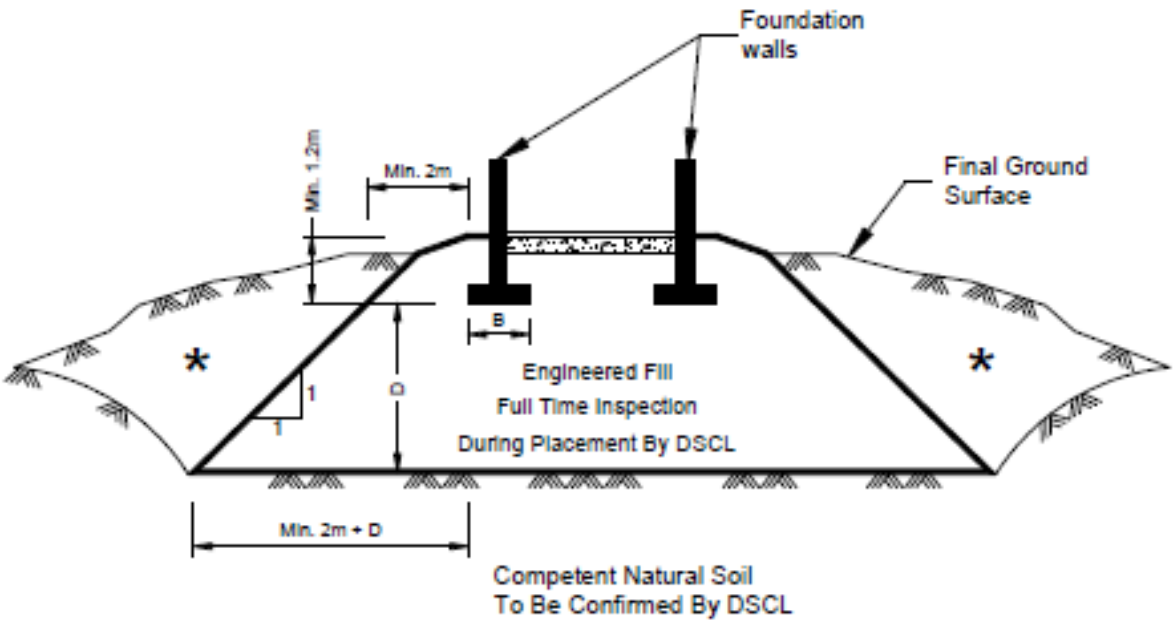
10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from DSCL prior to footing concrete placements. All excavations must be backfilled under full time supervision by DSCL to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of DSCL.

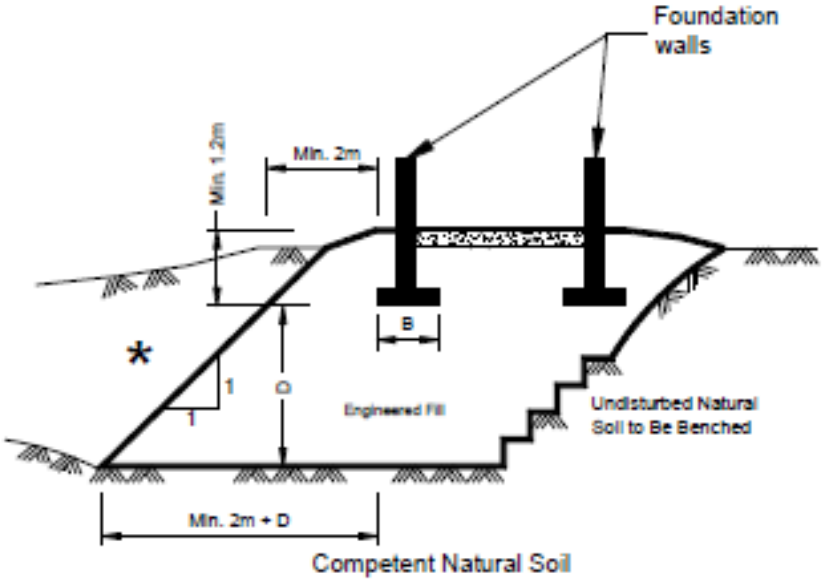
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with DS Consultants Ltd report attached.





* Backfill in this area to be as per the DSCL report.