

TOWN OF CALEDON
PLANNING
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Preliminary Geotechnical Engineering Report 0 Dixie Road, Town of Caledon, ON

**Report #6765 – Gill Caledon
October 31, 2022**

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1.0 INTRODUCTION

1.1 Proposed Construction

Mr. Ken Gill, 2476998 Ontario Inc. (the client), retained the services of A & A Environmental Consultants Inc. (A&A) to conduct a preliminary geotechnical investigation for a proposed Transportation Depot (industrial development) located at 0 Dixie Road, Town of Caledon, Ontario. Nine (9) boreholes were to be advanced and sampled for this geotechnical investigation. The information obtained is used to provide recommendations that will allow for the design of foundations at the subject site. See Section 4.0 for additional details of the proposed development.

1.2 Purpose and Limitations of Report

The purpose of this study is to provide geotechnical information, recommendations, and comments for the design and construction of the proposed development. The number of boreholes has been selected to provide representative information sufficient to determine parameters needed for design, specifications, and construction of the proposed development. Conditions elsewhere near or beneath the footprint of the structures may be found to differ, during construction, from those at the borehole locations. Should this occur, the contractor should contact the design engineer for recommendations as how to best proceed and what changes if any, should be made.

The information in this report is intended for this specific proposed structure and has been prepared for the client, and their nominated engineers and designers. It is assumed that the designers will use all appropriate contemporary standards, governing regulations, and codes in the performance of their work. Third party use or reproduction, in part or in full, of this report is prohibited without written authorization from A&A. This report is also subject to the Statement of Limitations which form an integral part of this document.

1.3 Liaison during design and/or Construction

On-going liaison with A&A during the final design and construction phases of the project is recommended to confirm that they are in keeping with the intentions of this report.

2.0 SCOPE OF WORK

2.1 Proposed Scope of Work

The scope of work for the geotechnical investigation of the proposed development is as follows:

- Advanced nine (9) boreholes to sample for geotechnical analysis. All nine (9) boreholes were advanced to a maximum depth between 3.05 to 6.1 meters below the existing ground level (mbgl). Four (4) boreholes were converted into monitoring wells to monitor the groundwater, the remaining boreholes were backfilled upon completion as per current regulations.
- Submit select soil samples to a geotechnical laboratory to provide information for the soil samples recovered.
- Prepare a geotechnical report summarizing the results of the field investigation and laboratory testing program, to include discussion of specific concerns that need to be addressed during design and/or construction. Specifically, the report is to include:
 - Site plan showing locations of the boreholes.
 - Borehole records.
 - Recommendations for:
 - Site preparation.
 - Construction dewatering if required.
 - Earthworks.
 - Potential reuse of existing fill materials and/or native soils indicated in the boreholes.
 - Excavation requirements.
 - Geotechnical resistances for foundation designs at ULS and SLS conditions.
 - Lateral earth pressure coefficients for existing soils and typical imported materials.
 - Pavement structures

3.0 SITE DESCRIPTION

3.1 Current Land Use and Location

The site is a vacant land used for agricultural purposes and located at 0 Dixie Road, Town of Caledon, ON. The approximate location of the subject site is shown in **Figure 1**, (Appendix A). The approximate UTM coordinates of the site are Zone 17T; 596420 m Easting; 4847040 m Northing. The site inspected is rectangularly shaped with the municipal address of 0 Dixie Road, Town of Caledon, ON.

4.0 PROPOSED DEVELOPMENT

It is understood that the proposed Transportation Depot development will consist of the following:

- Proposed one storey industrial building include office and service/repair bays with a total area of 340 m² and no basement or underground parking.
- Loading area/space.
- 170 Truck/Trailer parking spaces, parking lot, roads, sewer, watermain, and maneuvering area.

The general arrangement of the proposed development is provided by the client and presented in **Appendix A** (Site Drawings – **Figure 2**).

5.0 METHOD OF INVESTIGATION

5.1 Field Investigation

A&A engaged a utility locating company to map locations of public and private underground utilities. A&A then scheduled the drilling of boreholes for sampling in accordance with the borehole drilling and sampling plan.

The geotechnical investigation for the planned development consisted of the following activities:

- In the month of October 3 and 5, 2022, A&A attended the site located at 0 Dixie Road, Town of Caledon, ON.
- Boreholes were advanced using a track mounted drill unit with 152.4 mm (6 inch) diameter continuous flight hollow stem auger at locations shown in **Figure 3**.
- Sampling of the overburden materials encountered in the boreholes was carried out at regular intervals using a drive open conventional spoon sampler in conjunction with

standard penetration testing (SPT) “N” values. The SPT were conducted following the standard method ASTM D1586 and the results of SPT, in terms of the number of blows per 0.3 m of split-spoon sampler penetration, were provided in borehole logs. **Table 1** shows the borehole advanced depth and location. **Figure 3** in Appendix A depicts the locations of the boreholes in relation to the proposed development. Samples submitted for analysis are to be representative of the boreholes and their locations within the proposed development.

Table 1 - Borehole Advanced Depths and Location

Borehole	UTM Coordinates – UTM 17T		Depth (m)
	Northing	Easting	
BH/MW-1	4847040	596420	6.1
BH/MW-2	4847182	596452	4.6
BH/MW-3	4847173	596659	6.1
BH/MW-4	4847281	596625	6.1
BH-5	4847052	596448	4.6
BH-6	4847133	596476	3.05
BH-7	4847166	596510	3.05
BH-8	4847257	596538	3.05
BH-9	4849232	596629	3.05

- Nine (9) boreholes (BH/MW-1, BH/MW-2, BH/MW-3, BH/MW-4, BH-5, BH-6, BH-7, BH-8, and BH-9) were used for the geotechnical investigation. BH/MW-1, BH/MW-2, BH/MW-3, and BH/MW-4 were converted to monitoring wells to monitor the groundwater. The remaining boreholes were backfilled upon completion as per current regulations. Four (4) soil samples were selected for soil gradation and index testing.

5.2 Sampling Procedures

Select samples recovered from the geotechnical investigation were submitted to Orbit Engineering Limited (Orbit), a CCIL certified geotechnical and materials testing laboratory. The scope of the geotechnical laboratory testing program includes the following:

- Water moisture content per ASTM D2216.

-
- Grain size analyses per ASTM D422 & D2217.
 - Atterberg Limits per ASTM 4318.

The results of the laboratory tests are discussed in the text of this report. The results of laboratory tests are presented in **Appendix C**.

6.0 LABORATORY TESTING AND RESULTS OF INVESTIGATION

6.1 Subsurface Conditions Overview

The borehole logs provided in **Appendix B** summarize the soil types observed during drilling. Explanation of the symbols and terms used to describe the borehole logs are also included in **Appendix B**.

Select bagged samples taken from the boreholes were analyzed at Orbit for natural moisture content, grain size analysis, and Atterberg limits.

It should be noted that the boundaries between the strata on the borehole records have been inferred from drilling observations and non-continuous sampling. The boundaries generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes.

All nine (9) boreholes were advanced to a maximum depth between 3.05 to 6.1 meters below the existing ground level (mbgl). The strength variations are detailed in the borehole logs in **Appendix B**.

The combination of lab results and standard penetration test N values were used to estimate geotechnical resistance values. This translation was based on generally accepted, recorded correlations from thousands of similar tests. Soil characteristics for each hole may be found in **Appendices B & C**.

6.2 Detailed Summary

All nine (9) boreholes revealed underlain the surface to be characterised as follows:

- **Topsoil:**
The thickness of the topsoil explored in boreholes is generally ranged from 50mm to 100mm. The data provided here pertaining to the topsoil thickness is confirmed at the borehole locations only and may vary between and beyond the borehole locations. This

information is not considered to be sufficient for estimating topsoil quantities and associated costs.

- **Native Soil:**

The surficial topsoil layer was underlain by the following layers of native soils. The native soil at borehole locations was encountered at depths ranging from 0.05 to 0.1 m below the original ground surface.

- **Weathered/Disturbed Soil:** The upper weathered zone to depths ranging from 0.05 m to 0.8 m below the existing grade was consisted of sandy silt trace to some clay and gravel, loose, grey, moist, trace topsoil inclusions, rootlets, no odour, and no organic.
- **Sandy Silt till to Sandy Clayey Silt:** Underneath the weathered/distributed layer, native soil deposits of sandy clayey silt, trace to some gravel. These deposits were greyish/grey to brown, firm to hard, no odour, moist to wet, trace gravel, occasionally cobbles are encountered at BH-3/MW, BH-2/MW, and BH-6, and auger refusals are observed at BH-2 and BH-5.

6.3 Summary of Subsurface Conditions to Anticipated Depths of Construction

In the following tables (Tables 2-4), the relevant properties of the various deposits are briefly described. For details of the subsurface conditions, reference should be made to the individual borehole logs. The "Notes on Sample Description" preceding the borehole logs are an integral part of and should be read in conjunction with this report.

Table 2 - Typical Values of Moisture Content

BH # / Sample No.	Depth (m)	Soil Description	Water Content (%)
BH1-SS2	0.8-1.4	Sandy Silt, some Clay and, Gravel	11.0
BH4-SS2	0.8-1.4	Sandy Clayey Silt, trace Gravel	12.2
BH5-SS3	1.5-2.1	Sandy Clayey Silt, trace Gravel	12.3
BH1-SS5	3.1-3.7	Sandy Silt, some Clay and, Gravel	11.5

Table 3 - Typical Values of Atterberg Limits (%)

BH # / Sample No.	Depth (m)	Soil Description	Atterberg Limits		
			W _L	W _P	I _P
BH1-SS2	0.8-1.4	Sandy Silt, some Clay and, Gravel	21.4	13.2	8.2
BH4-SS2	0.8-1.4	Sandy Clayey Silt, trace Gravel	26.0	14.6	11.4
BH5-SS3	1.5-2.1	Sandy Clayey Silt, trace Gravel	12.3	26.2	14.8
BH1-SS5	3.1-3.7	Sandy Silt, some Clay and, Gravel	24.4	13.8	10.6

Table 4 - Sieve and Hydrometer Analysis

BH # / Sample No.	Depth (m)	Grain Size Content (%)				Soil Description
		Gravel	Sand	Silt	Clay	
BH1-SS2	0.8-1.4	14	34	38	14	Sandy Silt, some Clay and, Gravel
BH4-SS2	0.8-1.4	9	26	45	20	Sandy Clayey Silt, trace Gravel
BH5-SS3	1.5-2.1	4	27	48	21	Sandy Clayey Silt, trace Gravel
BH1-SS5	3.0-3.6	10	27	44	19	Sandy Silt, some Clay and, Gravel

As shown on **Table 2** and **Table 3**, the moisture content of clayey deposits in the boreholes is generally close to the plasticity limit which indicates that the clay deposits are consolidated

6.4 Groundwater Conditions

Ground water observations and measurements were obtained in the open boreholes at the completion of drilling and are summarized on the appended borehole logs. In addition, four (4) boreholes (BH/MW-1, BH/MW-2, BH/MW-3, and BH/MW4) were converted into monitoring wells to monitor the groundwater, the highest water level measured in monitoring wells during writing this report was at an approximate depth of 2.1 m below the existing ground surface. Perched groundwater may occur above these depths particularly following heavy rainfall or snowmelt. It should be noted that groundwater levels vary and are subjected to seasonal fluctuations and can respond to major precipitation events. The depth of groundwater table can also be influenced by the presence of underground features such as utility trenches. Refer to hydrogeological report for more details on groundwater conditions.

7.0 DESIGN DISCUSSION AND RECOMMENDATIONS

7.1 General Considerations

The recommendations presented in the following sections of this report are based on the information available regarding the proposed construction, the results obtained from the Preliminary Geotechnical Investigation, and A&A's experience with similar projects. Since the investigation only represents a portion of the subsurface conditions, it is possible that soil conditions may be encountered during construction that are substantially different than those encountered during the investigation. If these situations are encountered, adjustments to the design may be necessary. A qualified geotechnical engineer should be on-Site during the foundation preparation to ensure the subsurface conditions are the same/similar to what was observed during the investigation.

Contractors and/or subcontractors bidding on or undertaking the work should seek permission from owners to access the site for their own type of investigations, as well may make their own interpretations of the factual borehole results contained in this report. The following general comments are provided with respect to the conditions encountered and the intended scope of development.

It is A&A's understanding that the proposed development is to consist of Transportation Depot one-storey building without basement, complete with asphalt surface access roadway, truck and trailer parking area, watermain, sewer, and manoeuvring area.

7.2 Foundations

In accordance with the 2010 National Building Code of Canada (NBCC), the use of Limit States Design (LSD) is required for the design of buildings and their structural components including foundations. The limit states of LSD design are classified into two groups; the Ultimate Limit States (ULS) and the Serviceability Limit States (SLS). The recommended geotechnical resistances for the building foundations are presented for ULS and SLS conditions.

For foundation design this ultimate resistance value is reduced using a Geotechnical Resistance Factor, Φ , which is based on the reliability index of the geotechnical data used to determine the ultimate resistance for the foundation loading case. The resistance factor values presented on Table 5 should be used for foundation design.

Table 5 - Geotechnical Resistance Factors for Foundations

Geotechnical Case	Resistance Factors, Φ
SHALLOW FOUNDATION	
Vertical resistance by semi-empirical analysis and in-situ test data	0.5
Horizontal resistance against sliding (based on friction)	0.8
DEEP FOUNDATIONS (PILES)	
Vertical resistance by semi-empirical analysis and in-situ test data	0.4
Vertical resistance from analysis of dynamic monitoring results	0.5
Vertical resistance from analysis of static load test results	0.6
Uplift resistance by semi-empirical analysis and in-situ test data	0.3
Uplift resistance from analysis of static load test results	0.4
Lateral load resistance	0.5

The values given for SLS geotechnical resistances are based on settlement values of less than 25 mm. Total differential settlements within a building should also be less than 19 mm.

Relevant information for the final design purposes including proposed final grades, finished floor elevations, drainage system, and proposed underside of foundations were not available to A&A at the time of writing this report. Then, A&A's geotechnical engineers must review the recommendations options presented in the following sections of foundation design once such development parameters become available.

7.2.1 Foundations

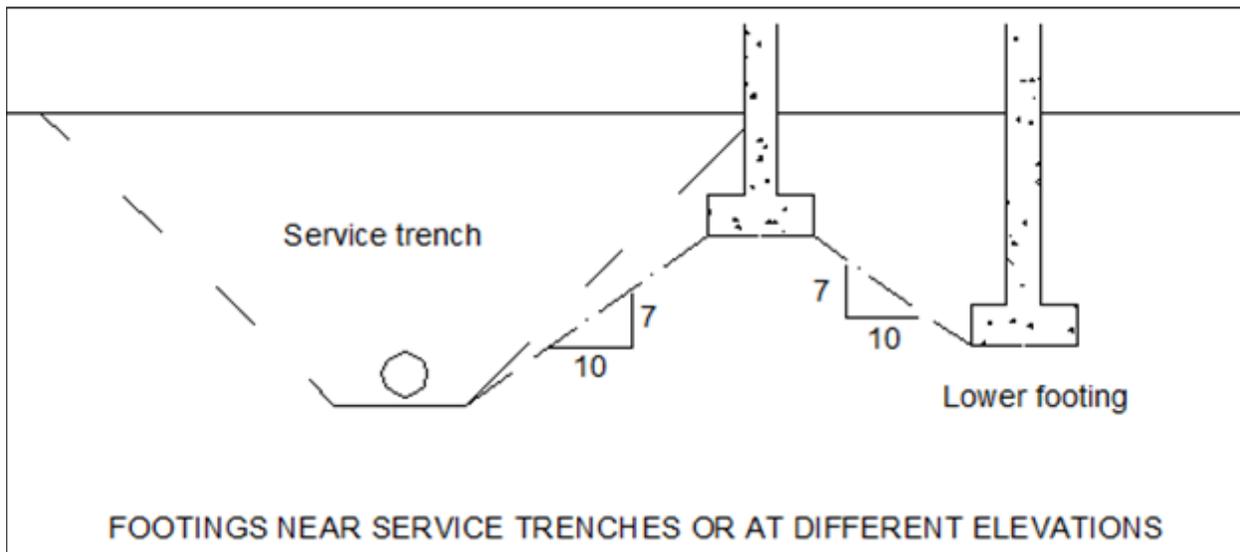
The proposed structures foundations can be supported on conventional spread and/or strip footings founded on the undisturbed native soil at or below depth of 1.5 m below the existing grades at BH locations for a geotechnical reaction of 150 kPa at the Serviceability Limit States (SLS) and a factored geotechnical resistance of 225 kPa at the Ultimate Limit State (ULS). The recommended founding levels and geotechnical resistance for the proposed building structure will need to be confirmed by A & A at the time of construction.

In the vicinity of the existing buried utilities, all footings must be lowered to undisturbed soils, or alternatively, the services must be structurally bridge. The footings should not be lowered to wet sandy deposits, if any.

If applicable, where the footing extends to the cohesionless soils, the base of footings can easily be disturbed by foot traffic and should be covered by 50mm of skim coat concrete immediately after cleaning and inspection.

During winter construction, foundations and slab on grade must not be poured on frozen soil. Foundations must always be adequately protected from cold weather and freezing conditions.

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. Should any excavation extend below the existing footing within the influence zone of imaginary 10 horizontal to 7 vertical line from the base of the existing footing, underpinning will be required.



The recommended bearing capacities and the corresponding founding elevations would need to be confirmed by the representative of A&A during construction. It should be noted that the recommended bearing capacities have been calculated by A&A 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 A&A to validate the information for use during the construction stage.

Backfilling of foundations shall be carried out with approved OPSS Granular B material provided. It can be placed in maximum 300 mm loose lifts and compacted to a minimum of 98% SPMDD. Filling should continue until the design subgrade elevations are obtained.

7.3 Frost Considerations

For any shallow structures, all exterior foundations and foundations in unheated areas must be provided with a minimum soil cover of 1.2 m or equivalent insulation for frost protection. The foundation depths recommended below are with respect to final grading levels. A perimeter drain tile, leading to an outward discharge, should be placed at the exterior face of the foundation wall where any high-water table can cause freeze thaw damage or unacceptable infiltration to the foundation.

7.4 Slab-On-Grade Floor Using Engineered Fill

Prior to construction of the floor slab, all topsoil, and surficial weak/softened native soil are removed and the base thoroughly proof rolled. The floor area should then be raised to within 200 mm underside of the floor slab using OPSS Granular B engineered fill or equivalent, placed in maximum 300 mm loose lifts and compacted to 98% SPMDD. To create a stable working surface and to distribute loadings, compacted OPSS Granular A or equivalent should be placed over the Granular B materials, below all floor slabs. The compacted OPSS Granular A or equivalent should be 200 mm thick at minimum, compacted to 100% SPMDD.

Floor slabs below unheated buildings or equipment should be provided with adequate insulation to prevent cracking from potential frost heave unless the compacted Granular A base is placed on clean limestone bedrock. A 100 mm thickness of high-density Styrofoam insulation, extending horizontally 1.8 m beyond the building/slab footprint, should be adequate to prevent frost heave where necessary.

The estimated modulus of subgrade reaction (k_s) equal to 25 MN/m^3 may be used for the design of slab-on-grade supported on native soils, provided that the construction is in accordance with the recommendations provided herein. If the engineered fill (Granular A or B Type II) having minimum thickness of 300 mm, this value can be increased to 30 MN/m^3 . The estimated value provided above may need to be adjusted based on the structure size and locations of detail design.

The floor slabs should not be tied to any load-bearing walls or columns unless they have been designed accordingly. Contraction/expansion joints should be provided for the slabs as required by the structural engineer.

It should be noted that permanent, fail-safe drainage should be designed around any depressed areas such as below grade pits, as well as behind retaining walls (if applicable).

7.5 Earthquake Design Parameters

Based on the borehole information and according to Table 4.1.8.4.A of OBC 2012, the subject site for the proposed structure can be classified as Class 'D' for seismic site response. Accordingly, the foundation factors F_a can be obtained from Table 4.1.8.4.B and F_v from Table 4.1.8.4.C for the design of the proposed structure.

Consideration may be given to conduct an earthquake site assessment with the use of in-situ testing of the seismic characteristics (i.e., Geophysical testing) which may lead to an improved site classification, if required.

7.6 Lateral Earth Pressure on Walls

The structures should be designed to withstand lateral earth pressure using the following equation:

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

Where p is lateral earth pressure, k is coefficient of lateral earth pressure assumed to be 0.5 for at-rest condition, γ is backfill unit weight assumed to be 20 kN/m^3 , h is depth from the ground surface and q is surcharge at ground surface adjacent to the wall. The above expression assumes that backfill consisting of free-draining granular material with a drainage system to prevent the build-up of hydrostatic pressure behind the wall. The granular backfill should be compacted to at least 98% SPMDD, placed in maximum 200 mm lifts.

7.7 Groundwater Control

For foundation excavations extending below the groundwater level, it will be necessary to lower and maintain the groundwater level one meter below the excavation base. Seepage at the interface of weathered/disturbed native soils and undisturbed native soil should be expected but in all likelihood water seepage should be controllable using conventional pumping from collection sumps and ditches for most excavations. As the groundwater at the site may fluctuate seasonally it can be expected to be even higher in response to major precipitation events, no impact to the development is expected.

The magnitude of the hydrostatic uplift may be calculated using the following formula:

$$P = \gamma_w d$$

Where:

P = hydrostatic uplift pressure acting on the base of the structure (kPa)

γ_w = unit weight of water ($9.8 kN/m^3$)

d = depth of base of structure below the design high water level (m)

The resistance of gross uplift of the structure can be increased by simply increasing the mass of the structure.

7.8 Foundation Drainage

A conventional, perforated corrugated polyethylene drainage pipe (100 mm minimum), pre-wrapped with geotextile knitted sock conforming to OPSS 1840 should be embedded in a 300 mm layer of 19 mm clear crushed stone, and set adjacent to the perimeter footings. The drainage pipe should be connected positively to a suitable outlet, such as a sump pit or storm sewer.

In order to minimize ponding of water adjacent to the foundation walls, roof water should be controlled by a roof drainage system that directs water away from the building to prevent ponding of water adjacent to the foundation wall. The exterior grade should be sloped away from the building to promote water drainage away from the foundation walls.

7.9 Site Grading and Engineered Fill Construction

Site grading operations involving "cut and fill" procedures in the order of ± 1 m are expected through the site. It is recommended to construct engineered fill in areas to be raised in order to suitably support the future fire route, infrastructure servicing and lightly loaded building structures.

It is noted that topsoil stripping operations should be conducted when the ground is not wet and will support large scale construction equipment. Over-stripping can result when the ground conditions are wet and unstable.

Any shortfall of fill material required for site grading operations may be made with similarly graded imported soils for the various purposes described above. It is recommended that any proposed imported source materials be tested prior to importing, in order to ensure that the environmental quality of the imported fill meets all environmental approval criteria and to ensure that the natural moisture content of the fill is suitable for compaction.

It is recommended that engineered fill construction be conducted during the summer and early fall months when drier warmer weather conditions typically exist as the onsite soils are sensitive

to moisture and will become difficult to handle and compact to the specified degree of compaction when wet.

The onsite deposits are frost-susceptible. Constructing engineered fill, backfilling footings, foundation walls and service trenches using these finer grained soils during the winter months is not advisable, unless suitable weather conditions prevail, the soils are at suitable moisture content, and strict procedures are followed and monitored on a full-time basis by the geotechnical engineer.

The onsite soils are susceptible to softening and deformation when exposed to excessive moisture and construction traffic. As a result, it is imperative that the grading/filling operations are planned and maintained to direct surface water run-off to low points and then be positively drained by suitable means. During periods of wet weather, construction traffic should be directed along the designated construction routes so as not to disturb and rut the exposed subgrade soil. Temporary construction roads consisting of clear crushed material (such as crushed stone or recycled concrete) may be required during poor weather conditions such as a wet spring or fall.

7.10 Site Servicing

7.10.1 Excavation Conditions

It is anticipated that municipal watermain and sewer servicing will generally be in the range of 2 to 4 m below final design grades. Excavation side slopes should comply with the current "Regulations for Construction Projects under the Ontario Occupational Health and Safety Act". Firm to stiff clayey silt or compact sandy silt till or silt can be generally classified as Type 3 soils. The native soil consisting of very stiff to hard clayey silt or dense to very dense sandy silt till and silt can be classified as Type 2 soils above water table. As a general rule, the excavations in Type 2 soils can be carried out without support using side slopes 1H:1V, while the bottom 1.2 m of the excavation can be cut vertically and could retain the wall for a short period of time. The excavation in Type 3 soil can be carried out maintaining the side slopes not steeper than 1H:1V. The excavation side slopes should be suitably protected from erosion processes. For the conventional excavation depth, it is not anticipated to encounter major water flow into the excavation. Should unstable and/or wet conditions be encountered, side slopes are to be flattened to a stable configuration. The geotechnical engineer should be retained to examine and inspect cut slopes to ensure construction safety.

The on-site native very stiff to hard clayey soils will excavate in blocks or chunks, which should be adequately pulverized prior to placement in the trenches. Heavy sheep's foot compactors

would be best suited for these soils, but such heavy equipment may be difficult to operate within the narrow confines of the trenches. These soils may therefore present some difficulty in compacting. If such soils are not adequately pulverized, placed in thin lifts and carefully compacted then excessive post construction settlements at the ground surface could occur.

7.10.2 Pipe Bedding

The native and re-compacted fill soil will generally provide suitable subgrade support to sewer and watermain servicing provided that the integrity of the base of the trench excavations can be maintained during construction. Any unsuitable soils exposed at the pipe subgrade should be sub-excavated and replaced with a minimum 150 mm bedding thickness of OPSS Granular A, compacted to at least 98% SPMDD. The bedding requirements for the services should be in accordance with Ontario Provincial Standard Drawings (OPSD) standards and the town Standards. Granular "A" should be used to backfill around the pipe to at least 150 mm above the top of the pipe. From the springline to 300 mm above the obvert of the pipe, sand cover shall be used. Particular attention should be given to ensure material placed beneath the haunches of the pipe is adequately compacted.

7.10.3 Trench Backfill

Excavated inorganic materials are considered suitable for reuse as trench backfill. If necessary, potential mixing of drier and wetter excavated soils in proper ratios can be done to produce a suitable mixture at or near the optimum water content for compaction in order to achieve the required compaction specification. Conversely, judicious addition of water may be required if the soils are significantly drier than their optimum moisture content in order to facilitate suitable compaction.

Backfilling of service trenches under proposed pavement areas shall be carried out using approved imported soils or imported OPSS approved Granular B materials provided it can be placed in maximum 300 mm lifts and compacted to a minimum of 98% SPMDD. The onsite fill materials, if any, may not meet compaction requirements or may contain substantial amounts of silt or clay and therefore, are not considered suitable to be used as backfill. It is expected that most material will have to be imported. Materials such as organic soils, overly wet soils, boulders and frozen materials (if work is carried out in the winter months) should not be used for backfilling. Backfilling operations should follow closely after excavation so that only a minimal length of trench slope is exposed at any one time to minimize potential problems. This will potentially minimize over-wetting of the subgrade material. Particular attention should be given to make sure frozen material is not used as backfill should construction extend into the winter season.

Proctor compaction tests must show that the soil is capable of being compacted to a satisfactory density; results submitted to A&A for approval and then be delivered on site within 2% of its optimum moisture content. Materials that have been imported and approved for use that are stored onsite should be maintained within 2% of their optimum moisture content. They should also be protected from the weather with tarps.

7.10.4 Pavement Structures

It is our understanding from the proposed development that there are 170 truck/trailer parking spaces and new roadways/driveways/parking area will be constructed for this project. Detailed traffic loads not been provided at the time of writing this report, the following recommendations for pavement structure based on experience with similar projects.

The recommended pavement structure is outlined in Table 6, based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples. Consequently, the recommended pavement structures should be considered for preliminary design purposes only. A functional design life of 8 to 10 years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. If required, a more refined pavement structure design can be performed based on specific traffic data and design life requirements and will involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific data input from the client. Regular maintenance will be required due to the nature of the underlying fill material.

Table 6: Recommended Pavement Structure Thickness

Pavement Layer	Compaction Requirements	Light Duty Parking (Cars)	Heavy-Duty Parking Area
Asphaltic Concrete (wearing course)	92 to 96.5% SPMDD*	40mm OPSS HL3	40mm OPSS HL3
Asphaltic Concrete (binder course)		40mm OPSS HL8	80mm OPSS HL8
OPSS Granular A Base (or 20mm Crushed Limestone)	100% SPMDD*	150mm	150mm
OPSS Granular B Subbase (or 50mm Crusher Run Limestone)	100% SPMDD*	250mm	350mm
* Standard Proctor Maximum Dry Density, ASTM-D698			

Alternatively, consideration should be given to the use of rigid Portland Cement Concrete pavement where there is intense truck use, parking and turning of vehicles. Table 7 provides the minimum recommended rigid pavement structure.

Table 7: Minimum Rigid Concrete Pavement Structure

Pavement Layer	Compaction Requirements	Heavy Duty Pavement
Portland Cement Concrete (CAN3-CSA A23.1) - Class C-2	CAN3-CSA A23.1	225mm
Base Course: Granular A (OPSS 1010) or 19 mm Crusher Run Limestone	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150mm

It must be noted that this structure does not provide full protection of the subgrade from frost penetration; therefore, the pavement slabs must be separated from the building structure.

Concrete should be proportioned, mixed, placed and cured in accordance with the requirements of CSA Standard CAN/CSA-A23.1-14 for class C-2 exposure, with the following key requirements:

- Minimum 28-day compressive strength: 32 MPa
- Air entrainment (14-20mm): 5 to 8 %
- Maximum water/cementing material ratio: 0.45

Concrete should be placed and spread in a manner which avoids segregation. It should be consolidated with a vibratory screed or internal vibrators. Consolidation close to form edges must be given special consideration.

Concrete should be finished to a thickness tolerance of 0 to plus 10mm. Concrete must be cured adequately to provide durability and strength. Curing can be accomplished by wet blankets, sprinkling, plastic sheets and curing compounds. Curing should begin immediately after the loss of bleed water.

Concrete pavement should be provided with joints to control stresses and prevent the formation of irregular cracks. Recommended joint spacing is 24 to 30 times slab thickness to a maximum dimension of about 4.0m. We would also recommend that load transfer dowels be placed at 50 mm spacing at the joints.

Sawed joints should be cut before random cracking occurs in the slab, usually within 6 to 18 hours after concrete placement. The maximum thickness (aperture) of control joints should be 6mm, while the depth of control joints should be about 1/4th of the slab thickness.

The pavement should be closed to traffic until a minimum flexural strength of 2MPa is attained or an approximate compressive strength of 20MPa. This minimum strength is generally reached when the concrete can be saw cut without ravelling.

Additional comments on the construction of parking areas and access roadways are as follows:

- As part of the subgrade preparation, proposed parking areas and access roadways should be stripped of all topsoil, loose to very loose fill and/or native soil materials within a minimum depth of 0.6m below the underside of the designed subbase and then thoroughly proof rolled by using a loaded truck or a roller with a minimum rated capacity of 20 tons, under the full-time supervision of this office. Any localized soft or unstable areas detected must be further sub-excavated and bridged by using clean fill materials like adjacent areas placed in shallow lifts (maximum 200mm thick and at or near “±2%” optimum moisture contents) and compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD). Similarly, the fill required to raise the grade should consist of inorganic soil, placed in the shallow lifts, and compacted to the aforementioned SPMDD requirements.
- The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved. In addition, the need for adequate drainage cannot be over-emphasized. The finished pavement surface and underlying subgrade should be free of depressions and should be sloped (preferably at a minimum grade of two percent) to provide effective surface drainage toward catch basins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas. Continuous pavement subdrains should be provided along both sides of the driveway/access routes and drained into respective catch basins to facilitate drainage of the subgrade and granular materials. This is particularly important in heavy-duty pavement areas. The subdrain invert should be maintained at least 0.3m below subgrade level. Subdrains should also be provided at all catch basins within the parking area.
- The locations and extent of sub-drainage required within the paved areas should be reviewed by this office in conjunction with the proposed lot grading. Assuming that satisfactory crossfalls in the order of two percent have been provided, subdrains

extending from and between catch basins may be satisfactory. If shallower crossfalls are considered, a more extensive system of sub-drainage may be necessary and should be reviewed by this office.

- The above pavement structure considers that construction will be carried out during the dry period of the year. If the subgrade becomes excessively wet or rutted during construction activities, additional sub-base material or placement of geogrids may be required. The need for additional sub-base material and/or placement of geogrids including filter fabric to stabilize the base is best determined during construction. It is recommended that the existing subgrade be heavily proof-rolled prior to placement and any areas showing excessive deflection be replaced prior to placing the granular sub-base material.
- The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted access lanes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavourable weather.
- It is recommended that A&A be retained to review the final pavement structure designs and drainage plans prior to construction to ensure that they are consistent with the recommendations.

8.0 LIMITATIONS OF REPORT

This report has been prepared for Mr. Ken Gill, 2476998 Ontario Inc. (the client), who retained the services of A&A to conduct a preliminary geotechnical investigation for a proposed industrial development located at 0 Dixie Road, Town of Caledon, Ontario. Further dissemination of this report is not permitted without A&A's prior written approval. A&A has carefully assessed all information provided to them during this investigation but makes no guarantees or warranties as to the accuracy or completeness of this provided information.

The comments given in this report are intended only for the guidance of design engineers and architects. Contractors bidding on or undertaking the work, should in this light, decide that further field investigations, and interpretations of the factual borehole results are necessary to draw their own conclusions as to how the subsurface conditions may affect them. Should soil conditions during excavation for the foundations prove to be different than what have been described in this report, the author of this report should be notified as soon as possible. No liability or claims may be made by owners or third parties against A&A for factors outside (A&A's) control. An independent quality control firm must be made available for all concrete and

compaction testing associated with construction. All testing results should be made available to the owner, designers, consultant and general contractor.

The site investigation and recommendations follow generally accepted practice for Geotechnical Consultants in Ontario. Materials testing has been completed in accordance with ASTM or CSA Standards or modifications of these standards that have become standard practice.

For and on behalf of A&A Environmental Consultants Inc.



Thomas Demers, BAsC. (Hons. Env.), EIT
Project Manager

Reviewed by:



Aly Ahmed, Ph. D., P.Eng., QP_{ESA}

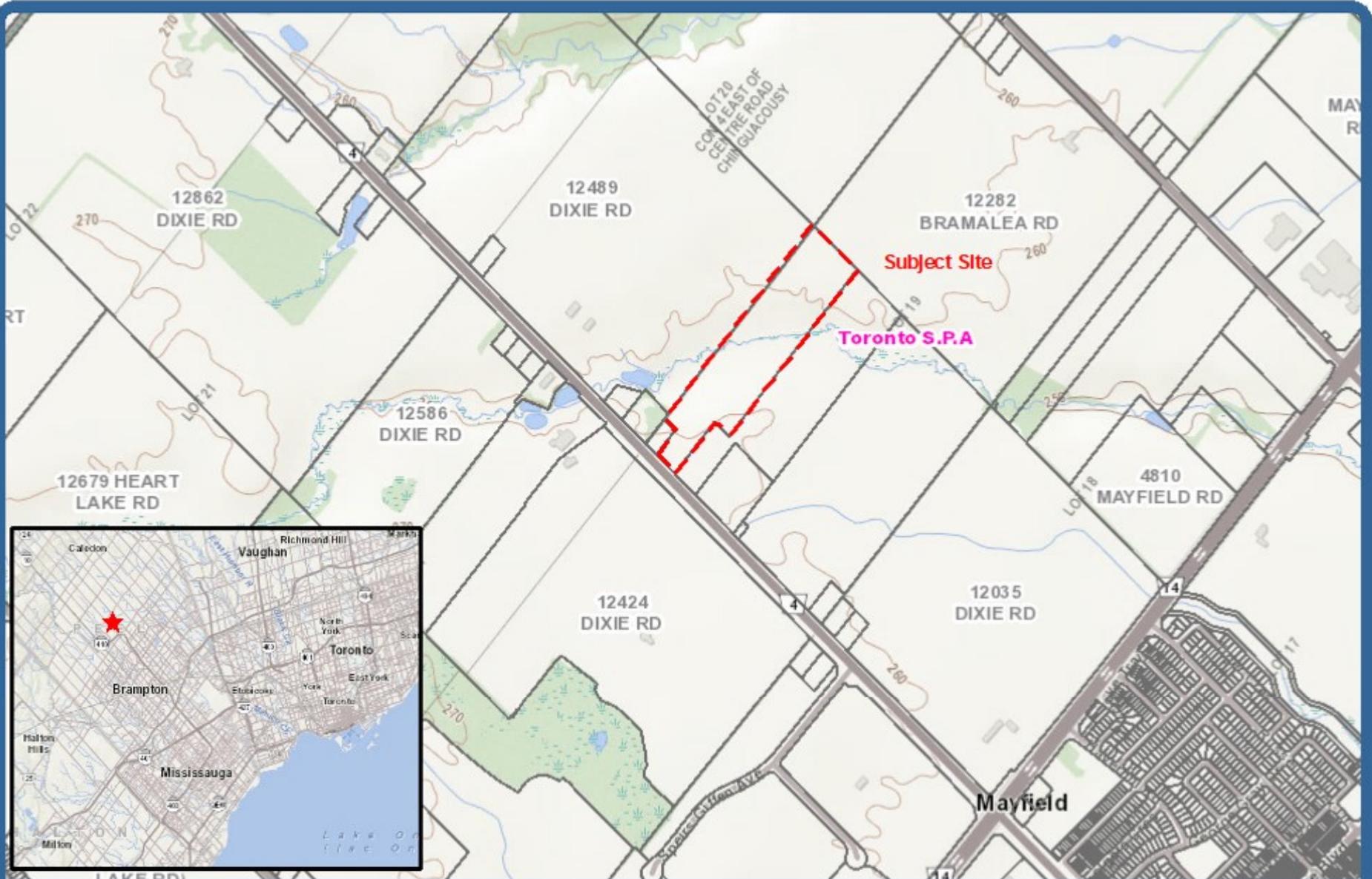


9.0 REFERENCES

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- Canadian foundation engineering manual. 4th Edition.* (2006). Richmond, B.C : Canadian Geotechnical Society.
- Sowers, G. (1979). *Introductory Soil Mechanics and Foundations: Geotechnical Engineering*. New York: MacMillan.
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APPENDIX A – Site Drawings

Figure 1 – Approximate Site Location Map for 0 Dixie Road, Town of Caledon, ON



**A&A
ENVIRONMENTAL
CONSULTANTS INC.**
16 Young St,
Woodstock, ON, N4S 3L4
Tel: 519 266-4680

Site Location at '0' Dixie Road, Caledon Ontario

0 m  300 m

Project #: 6765
October 2022

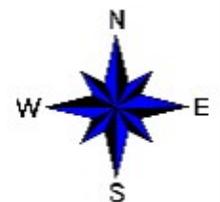
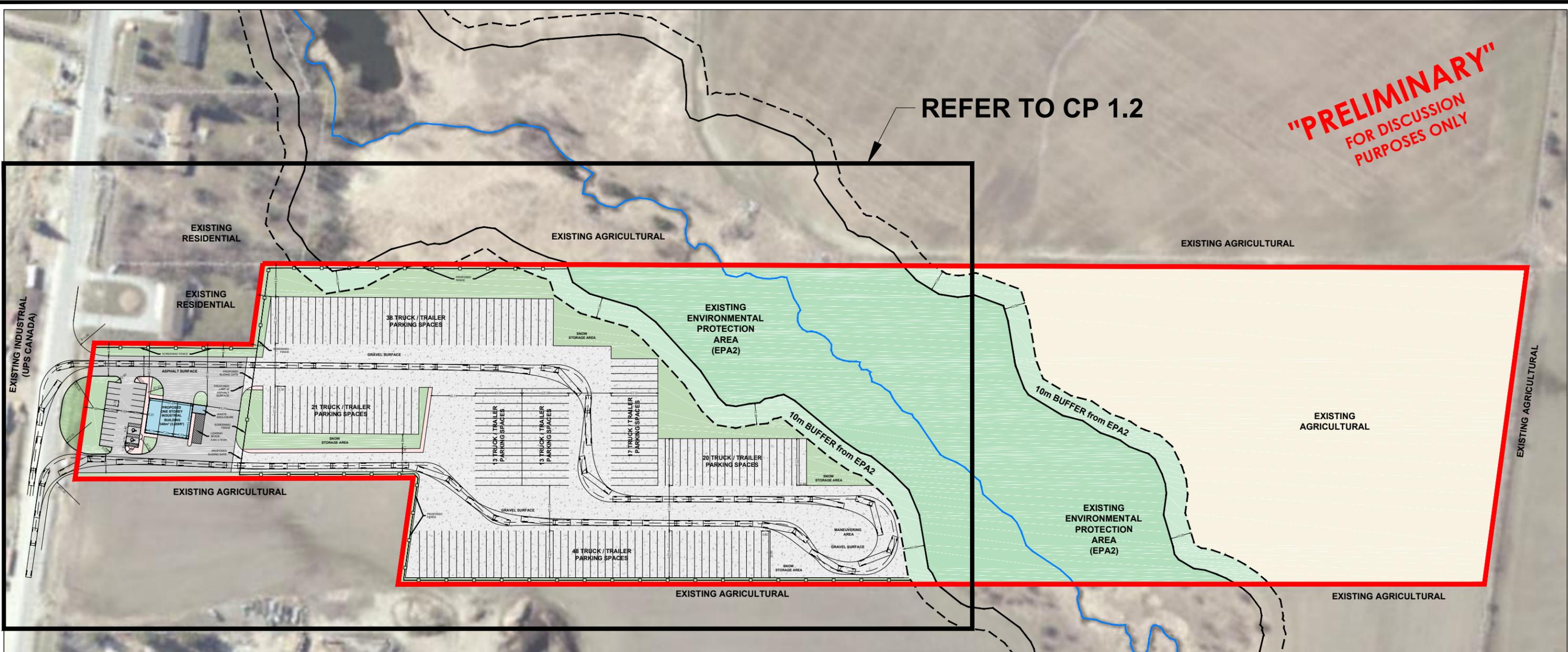


Figure 2 - Conceptual Site Plan Provided by the Client

"PRELIMINARY"
FOR DISCUSSION
PURPOSES ONLY

REFER TO CP 1.2



TOTAL SITE AREA:	9.15ha (22.62ac)	PROPOSED OFFICE & REPAIR BUILDING	PARKING REQUIRED:
TRANSPORTATION DEPOT:	3.61ha (8.93ac)	OFFICE: 100m ² (1,076ft ²)	OFFICE: 4 SPACES
ENVIRONMENTAL PROTECTION AREA (EPA2):	2.07ha (5.12ac)	SERVICE / REPAIR BAYS: 240m ² (2,583ft ²)	SERVICE / REPAIR BAYS: 6 SPACES
10m BUFFER from EPA2:	0.55ha (1.36ac)	GROSS FLOOR AREA: 340m ² (3,659ft ²)	PARKING PROVIDED:
AGRICULTURAL:	2.92ha (7.21ac)		AUTOMOBILE : 20 SPACES (2 HC)
TOTAL	9.15ha (22.62ac)		TRUCK / TRAILER: 170 SPACES
			TOTAL: 190 SPACES

**CONCEPTUAL SITE PLAN
PROPOSED TRANSPORTATION DEPOT
'0' DIXIE ROAD
TOWN of CALEDON
REGION of PEEL**

LEGEND		
SUBJECT SITE	LANDSCAPING	PROPOSED SLIDING GATE
AGRICULTURAL	WALKWAY / SIDEWALK	
ENVIRONMENTAL PROTECTION AREA (EPA2)	ASPHALT PAVING	
10m BUFFER from EPA2	GRAVEL SURFACE	
BUILDING	PROPOSED FENCE	

P.N.: 20.2744	Date: November 17, 2020	CP1.1
Scale: N.T.S	Revised:	
Drawn By: D.S.	File No.: PN 2744_ Concept Plans	
	21 Queen Street East Suite 500 Brampton, ON L6W 3P1 P (905) 796 - 5790	Gagnon Walker Domes PROFESSIONAL PLANNERS Toll Free 1 (855) 771-7266 www.gwdplanners.com
	3601 Highway 7 East Suite 310 Markham, ON L3R 0M3 P (905) 477 - 6556	

Figure 3 – Approximate Geotechnical Borehole Location Plan



Legend

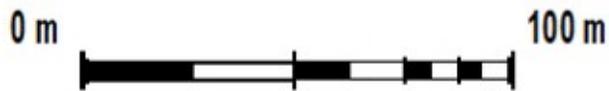
-  Borehole
-  Monitoring Well
-  Subject Site



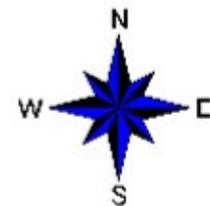
**A&A
ENVIRONMENTAL
CONSULTANTS INC.**

16 Young St,
Woodstock, ON, N4S 3L4
Tel: 519 266-4680

Satellite Image Indicating the Borehole Locations at '0' Dixie Road, Caledon, Ontario



Project 6765
October 2022



APPENDIX B – Borehole Logs and Explanation of Terms and Symbols

Explanation of Terms and Symbols

The terms and symbols used on the borehole logs to summarize the results of field investigation and subsequent laboratory testing are described in these pages.

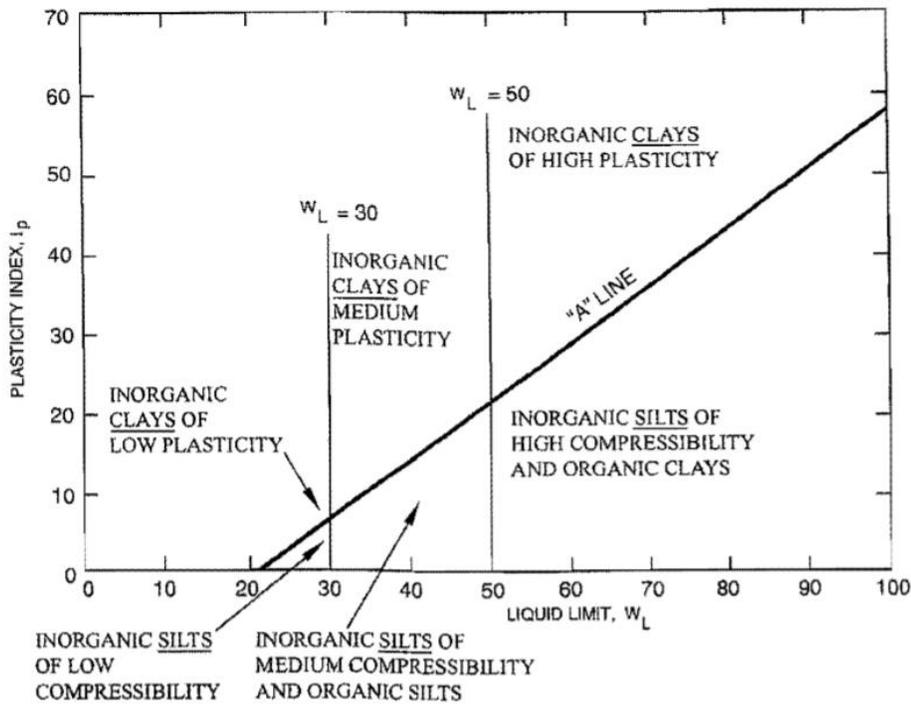
Abbreviations, graphic symbols and relevant test method designations are as follows:

w	Water Content
w_L, LL	Liquid Limit
w_p, PL	Plastic Limit
I_p	Plasticity Index
γ	Soil unit weight
K	Coefficient of Lateral earth pressure
K_s	Module of vertical subgrade reaction
P	Lateral earth pressure
Q	Surcharge load
H	Depth from the ground surface
B	Width of rectangular footing
P	Hydrostatic uplift pressure
d	Depth of structure's base below the design water level
γ_w	Unit weight of water
Φ	Geotechnical resistance factor
φ	Internal friction angle of soil
c	Cohesion
c_u, S_u	Undrained shear strength
V_s	Shear wave velocity
SPT-N	Penetration resistance
SPMMD	Standard Proctor Maximum Dry Density
MRD	Marshal Maximum Relative Density

Soils are classified and described according to their engineering properties and behaviours.

Noun	gravel, sand, silt, clay	> 35 % and main fraction
"and"	and gravel, and silt, etc.	>35 %
Adjective	gravelly, sandy, silty, clayey, etc.	20 to 35 %
"some"	some sand, some silt, etc.	10 to 20%
"trace"	trace sand, trace silt, etc.	1 to 10 %

The plasticity chart (after Casagrande, 1948):



Correlation of soil parameters with uncorrected SPT values for: a) cohesionless soils and b) cohesive soil

Compactness Condition	SPT N-INDEX (blows per 0.3 m)
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

(a)

Consistency	Undrained Shear Strength (kPa)	SPT N-INDEX (blows per 0.3 m)
Very soft	< 12	0 to 2
Soft	12 - 25	2 to 4
Firm	25-50	4 to 8
Stiff	50 - 100	8 to 15
Very stiff	100 - 200	15 to 30
Hard	>200	>30

(b)

- Standard Penetration Tests (SPT); followed the methods described in ASTM Standard D1586-08a. The number of blows by a 63.5 kg (140 lb) hammer dropped from 760 mm (30 in.) is recorded for a depth of 460 mm (18"). The last two 150 mm distances (total = 300 mm) are used to calculate the SPT-N index.

LOG OF BOREHOLE BH-1/MW

PROJECT: Geotechnical Investigation CLIENT: Gill Caledon DATUM: PROJECT LOCATION: 0 Dixie Road, Caledon, ON BH LOCATION: Refer to Figure 2 - Approximate Boreholes Location Plan N 4847040 E 596420	DRILLING DATA Method: Hollow Stem Auger Diameter: 200mm Date: Oct-03-2022 REF. NO.: 6764 ENCL NO.: 2
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									WATER CONTENT (%)		
0.0	Topsoil: 100mm	1	SS	8															
0.1	Sandy Silt: some clay, trace to some gravel, loose to compact, grey, moist, no odour	2	SS	16							○					14	34	38	14
0.8	Sandy Silt Till: trace to some clay and gravel, compact, moist	3	SS	20															
3.1	Sandy Clayey Silt: trace gravel, very stiff	4	SS	28															
3.1	Sandy Clayey Silt: trace gravel, very stiff	5	SS	25							○					10	27	44	19
4.5	wet below 4.5m	6	SS	32															
4.5		7	SS	18															
4.5		8	SS	33															
6.1	End of Borehole: Notes: Water Level (i) During Drilling: 4.5m (ii) 50 mm MW was installed at completion																		

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH-2/MW

PROJECT: Geotechnical Investigation CLIENT: Gill Caledon DATUM: PROJECT LOCATION: 0 Dixie Road, Caledon, ON BH LOCATION: Refer to Figure 2 - Approximate Boreholes Location Plan N 4847182 E 596452	DRILLING DATA Method: Hollow Stem Auger Diameter: 200mm Date: Oct-03-2022 REF. NO.: 6764 ENCL NO.: 3
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)										WATER CONTENT (%)
0.0 0.1	TopSoil: 50mm Sandy Silt: some clay, trace to some gravel, loose to compact, grey, moist, no odour	1	SS	6	1	SS	6											
0.8	Sandy clayey Silt Till: trace to some gravel, stiff to very stiff, moist, greyish to brown, no odour	2	SS	17	2	SS	17											
1.5	Brown	3	SS	16	3	SS	16											
2.0		4	SS	21	4	SS	21											
3.0		5	SS	24	5	SS	24											
4.0	hard below 4 m	6	SS	28	6	SS	28											
4.6	End of Borehole: Notes: Water Level (i) 50 mm MW was installed at completion (ii) Wet at bottom (iii) Auger refusal																	

GROUNDWATER ELEVATIONS
 Measurement

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

LOG OF BOREHOLE BH-3/MW

PROJECT: Geotechnical Investigation CLIENT: Gill Caledon DATUM: PROJECT LOCATION: 0 Dixie Road, Caledon, ON BH LOCATION: Refer to Figure 2 - Approximate Boreholes Location Plan N 48947173 E 596659	DRILLING DATA Method: Hollow Stem Auger Diameter: 200mm Date: Oct-05-2022 REF. NO.: 6764 ENCL NO.: 5
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)										WATER CONTENT (%)		
0.0	Topsoil: 100mm	1	1	SS	4															
0.1	Sandy Silt: some clay, trace to some gravel, loose to very dense, grey, moist, no odour	2	2	SS	>50 / 15 cm															
0.8	Sandy Silt Till: some clay and gravel, compact to dense, moist, grey to brown, no odour	3	3	SS	25															
1		4	4	SS	26															
2		5	5	SS	28															
3	Sandy Clayey Silt: trace gravel, siff to very stiff, brown, no odour, moist	6	6	SS	27															
3.1		7	7	SS	21															
4		8	8	SS	24															
5																				
6																				
6.1	End of Borehole: Notes: Water Level (i) 50 mm MW was installed at completion (ii) Wet at bottom																			

GROUNDWATER ELEVATIONS
 Measurement ^{1st} ^{2nd} ^{3rd} ^{4th}

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

LOG OF BOREHOLE BH-4/MW

PROJECT: Geotechnical Investigation CLIENT: Gill Caledon DATUM: PROJECT LOCATION: 0 Dixie Road, Caledon, ON BH LOCATION: Refer to Figure 2 - Approximate Boreholes Location Plan N 48447281 E 596625	DRILLING DATA Method: Hollow Stem Auger Diameter: 200mm Date: Oct-05-2022 REF. NO.: 6764 ENCL NO.: 4
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									WATER CONTENT (%)		
0.0	Topsoil: 50mm Sandy Silt: some to trace clay and gravel, loose to compact, grey, moist, no odour	1	SS	4															
0.8	Sandy Clayey Silt: trace to some gravel, firm to stiff, moist to wet, grey to brown, no odour	2	SS	17						○						9	26	45	20
3.1	Sandy Silt Till: trace gravel, compact to very dense, brown, no odour, moist to wet	3	SS	30															
5.3	wet below 5.0 m	4	SS	18															
5.3		5	SS	17															
5.3		6	SS	19															
5.3		7	SS	22															
5.3		8	SS	21															
6.1	End of Borehole: Notes: Water Level (i) 50 mm MW was installed at completion (ii) During Drilling: 5.0 m																		

W. L. 5.0 mBGL
During Drilling

GROUNDWATER ELEVATIONS
 Measurement

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

LOG OF BOREHOLE BH-5

PROJECT: Geotechnical Investigation CLIENT: Gill Caledon DATUM: PROJECT LOCATION: 0 Dixie Road, Caledon, ON BH LOCATION: Refer to Figure 2 - Approximate Boreholes Location Plan N 4847052 E 596448	DRILLING DATA Method: Hollow Stem Auger Diameter: 200mm Date: Oct-03-2022 REF. NO.: 6764 ENCL NO.: 5
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									
0.0	Topsoil: 70mm	1	SS	6													
0.1	Sandy Silt: some clay, trace to some gravel, loose to compact, grey, moist, no odour	2	SS	19													
0.8	Sandy Silt Till: trace to some clay and gravel, loose to compact, moist	3	SS	23							○					4 27 48 21	
1.5	Sandy Clayey Silt: trace gravel, firm to hard, moist, brown, no odour	4	SS	38													
5		5	SS	64													
4.0	wet below 4 m	6	SS	27	▽	4.0 mBGL	After completion										
4.6	End of Borehole: Notes: Water Level (i) At completion: 4 m																

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH-6

PROJECT: Geotechnical Investigation CLIENT: Gill Caledon DATUM: PROJECT LOCATION: 0 Dixie Road, Caledon, ON BH LOCATION: Refer to Figure 2 - Approximate Boreholes Location Plan N 4847133 E 596476	DRILLING DATA Method: Hollow Stem Auger Diameter: 200mm Date: Oct-03-2022 REF. NO.: 6764 ENCL NO.: 6
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)										WATER CONTENT (%)	
0.0 0.1	Topsoil: 50mm Sandy Silt: some clay, trace to some gravel, loose to compact, grey, moist, no odour	[Strata Plot]	1	SS	4														
0.8	Sandy Clayey Silt: trace gravel, firm to hard, damp to moist, light brown, no odour	[Strata Plot]	2	SS	19														
1.5	very stiff below 1.5 m	[Strata Plot]	3	SS	23														
3.1	End of Borehole: Notes: Water Level (i) Wet at bottom	[Strata Plot]																	

GROUNDWATER ELEVATIONS
 Measurement ^{1st} ^{2nd} ^{3rd} ^{4th}

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

LOG OF BOREHOLE BH-7

PROJECT: Geotechnical Investigation CLIENT: Gill Caledon DATUM: PROJECT LOCATION: 0 Dixie Road, Caledon, ON BH LOCATION: Refer to Figure 2 - Approximate Boreholes Location Plan N 4847166 E 596510	DRILLING DATA Method: Hollow Stem Auger Diameter: 200mm Date: Oct-05-2022 REF. NO.: 6764 ENCL NO.: 7
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									
0.0	Topsoil: 80mm	[Symbol]															
0.1	Sandy Silt: some clay, trace to some gravel, loose to compact, grey, no odour	[Symbol]	1	SS	4												
0.8	Sandy Clayey Silt: trace to some gravel, firm to stiff, moist, grey to brown, no odour	[Symbol]	2	SS	16												
1		[Symbol]	3	SS	18												
2		[Symbol]	4	SS	18												
3		[Symbol]															
3.1	End of Borehole: Notes: Water Level (i) Wet at bottom																

GROUNDWATER ELEVATIONS
 Measurement ^{1st} ^{2nd} ^{3rd} ^{4th}

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

LOG OF BOREHOLE BH-8

PROJECT: Geotechnical Investigation CLIENT: Gill Caledon DATUM: PROJECT LOCATION: 0 Dixie Road, Caledon, ON BH LOCATION: Refer to Figure 2 - Approximate Boreholes Location Plan N 4847257 E 596538	DRILLING DATA Method: Hollow Stem Auger Diameter: 200mm Date: Oct-05-2022 REF. NO.: 6764 ENCL NO.: 8
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)										WATER CONTENT (%)	
0.0 0.1	Topsoil: 50mm Sandy Silt: some clay, trace to some gravel, loose to compact, grey, no odour	[Hatched Pattern]	1	SS	5														
0.8 1	Sandy Clayey Silt: trace to some gravel, firm to very stiff, moist, grey to brown, no odour	[Hatched Pattern]	2	SS	16														
1		[Hatched Pattern]	3	SS	21														
2		[Hatched Pattern]	4	SS	18														
3		[Hatched Pattern]																	
3.1	End of Borehole: Notes: Water Level (i) During Drilling: Wet at bottom	[Hatched Pattern]																	

GROUNDWATER ELEVATIONS
 Measurement
 1st
 2nd
 3rd
 4th

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

LOG OF BOREHOLE BH-9

PROJECT: Geotechnical Investigation CLIENT: Gill Caledon DATUM: PROJECT LOCATION: 0 Dixie Road, Caledon, ON BH LOCATION: Refer to Figure 2 - Approximate Boreholes Location Plan N 4849232 E 596629	DRILLING DATA Method: Hollow Stem Auger Diameter: 200mm Date: Oct-05-2022 REF. NO.: 6764 ENCL NO.: 9
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)										WATER CONTENT (%)	
0.0	Topsoil: 100mm	1	SS	5															
0.1	Sandy Silt: some clay, trace to some gravel, loose to compact, grey, no odour	2	SS	21															
0.8	Sandy Clayey Silt: trace to some gravel, firm to stiff, moist, grey to brown, no odour	3	SS	19															
2.3	hard below 2.3 m	4	SS	34															
3.1	End of Borehole: Notes: Water level (i) Wet at bottom																		

GROUNDWATER ELEVATIONS
 Measurement

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

APPENDIX C – Grain Size Distribution and Test Results

GEOTECHNICAL TESTING REPORT DATA

6764– Gill Caledon

Prepared for:

A & A Environmental Consultants Inc.

By:

Orbit Engineering Limited

Project No. OE201046AG

October 24, 2022

October 24, 2022

A&A Environmental Consultants
16 Young Street
Woodstock, Ontario
N4S 3L4
Email: mheidari@aaenvironmental.ca

Attention: Dr. Ali A. Rasoul Ph.D, EP, P.Geo, QP - Principle

RE: LABORATORY TEST RESULTS - Project: 6764 – Gill Caledon

Dear Mr. Rasoul,

Orbit Engineering Limited (Orbit) is pleased to provide the Final LABORATORY TESTING REPORT DATA for the above-mentioned project. The report presents the results of laboratory testing carried out on soil samples received at Orbit Laboratory on October 07th, 2022.

The laboratory testing included the following:

1. Water Moisture Content - ASTM D2216
2. Particle Size Analysis (Hydrometer) - ASTM D422 - D2217
3. Atterberg Limits - ASTM 4318

The results of the testing are summarized in the attached Table 1 and details of testing results are shown in Appendix A.

We trust that this information meets your present requirements. If we can be of additional assistance in this regard, please contact this office.

For and on behalf of Orbit Engineering Limited,



Aly Ahmed, Ph D, P.Eng.,
Lab Supervisor



Hafiz Muneeb Ahmad, M.Sc., P.Eng.,
Principal Engineer
Professional Supervising Engineer

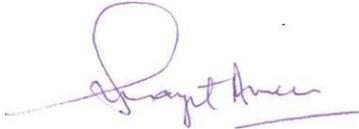
Table 1: Summary of Laboratory Testing Results (A & A Project: 6764 – Gill Caledon)

Sample No.	Depth (ft)	Water Content (%)	Atterberg Limits (%)			Soil Compositions (%)				Soil Description
			LL	PL	PI	Gravel	Sand	Silt	Clay	
BH-1	2.5-4.5	11.0	21.4	13.2	8.2	14	34	38	14	Sandy Silt, some Clay and, Gravel
BH-1	10-12	11.5	24.4	13.8	10.6	10	27	44	19	Sandy Silt, some Clay and, Gravel
BH-4	2.5-4.5	12.2	26.0	14.6	11.4	9	26	45	20	Sandy Clayey Silt, trace Gravel
BH-5	5-7	12.3	26.2	14.8	11.4	4	27	48	21	Sandy Clayey Silt, trace Gravel

CLOSURE

We trust that this information is satisfactory for your present requirements. Should you have any questions or require additional information, please do not hesitate to contact this office.

For and Behalf of Orbit Engineering Limited,



Ameer Rizvi, B.Sc.
Lab Technician

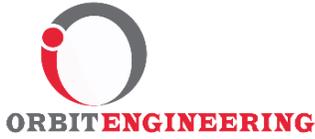


Aly Ahmed, Ph D., P.Eng.
Lab Supervisor

Reviewed by:



Hafiz Muneeb Ahmad, M.Sc.,P.Eng.
Principal Engineer
Professional Supervising Engineer



NATURAL MOISTURE CONTENT

LABORATORY SERVICES

LS - 703

Project No.: OE201046AG

Borehole No. BH1,BH4&BH5.

Lab Technician: Ameer Rizvi

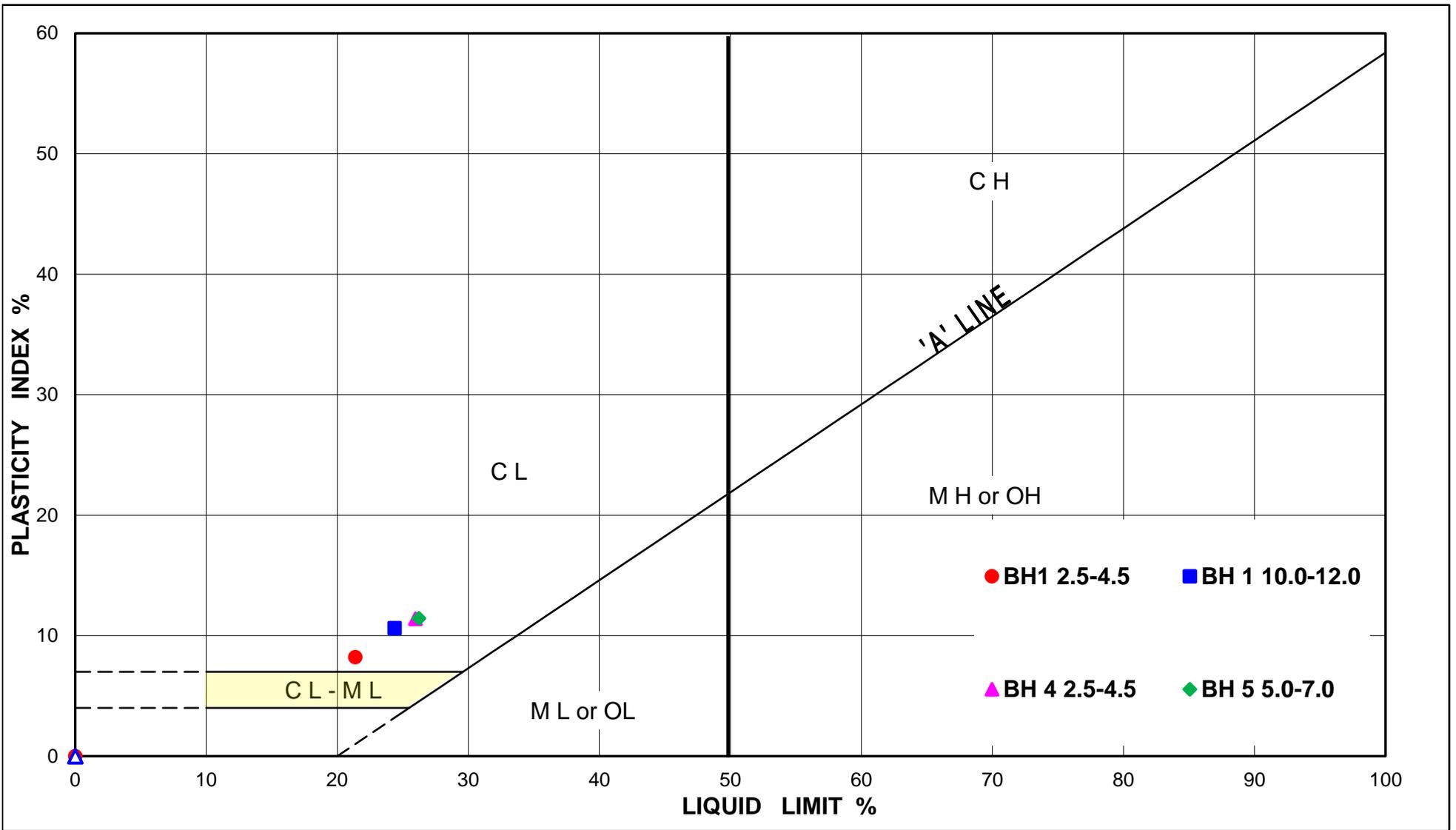
Date 17-Oct-22

NATURAL MOISTURE CONTENT				
Sample No.	Weight of tare (g)	Weight of tare + soil (g)	Weight of tare + soil (dry) (g)	Moisture content (%)
BH1 @ 2.5-4.5	6.45	400.08	361.18	11.0
BH1 @ 10-12	6.65	399.76	359.17	11.5
BH4 @ 2.5-4.5	6.49	399.62	356.74	12.2
BH5 @ 5-7	6.46	400.38	357.09	12.3

Aly Ahmed

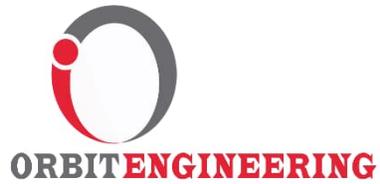
Aly Ahmed, Ph D., P Eng

Lab Supervisor



PLASTICITY CHART

Project No:	OE201046AG
Drawing No.	B15
Date:	24-Oct-22



ATTERBERG LIMITS
LABORATORY SERVICES

(LS-703, 704/D4318)

PLASTICITY CHART WORKSHEET								
Date :	24-Oct-22			Lab Number :	1374			
Project Number :	OE201046AG			Figure Number :	A0			
Drawing Number :	B3							
Soil Description :								
Borehole Number	Sample Type	Sample Number	Natural MC (%)	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index (%)
BH 1	CL	BH1-S1	11.00	2.5-4.5	21.40	13.20	8.20	-0.27
BH 1	CL	BH1-S2	11.50	10-12	24.40	13.80	10.60	-0.22
BH 4	CL	BH4-S3	12.20	2.5-4.5	26.00	14.60	11.40	-0.21
BH 5	CL	BH5-S4	12.30	5-7	26.20	14.80	11.40	-0.22

Aly Ahmed

Aly Ahmed, Ph D., P Eng
Lab Supervisor



ATTERBERG LIMITS

LABORATORY SERVICES

(LS-703, 704/D4318)

Project No.: OE201046AG
 Operator Ameer Rizvi

Borehole No BH1
 Date 24-Oct-22

LIQUID LIMIT									
SAMPLE NO.	2.5-4.5								
NO OF BLOWS	30	25	18						
DISH NO	1	2	3						
DISH + WET SOIL	35.46	34.45	34.45						
DISH + DRY SOIL	33	32.13	32.04						
MOISTURE	2.46	2.32	2.41						
DISH	21.2	21.32	21.2						
DRY SOIL	11.8	10.81	10.84						
% MOISTURE	20.85	21.46	22.23						
PLASTIC LIMIT									
DISH NO	4	5							
DISH + WET SOIL	29.51	29.56							
DISH + DRY SOIL	28.54	28.59							
MOISTURE	0.97	0.97							
DISH	21.26	21.15							
DRY SOIL	7.28	7.44							
% MOISTURE	13.32	13.04							
PLASTIC LIMIT %	13.2								
LIQUID LIMIT %	21.4								
PLASTICITY INDEX	8.2								

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 Lab Supervisor



ATTERBERG LIMITS

LABORATORY SERVICES

(LS-703, 704/D4318)

Project No.: OE201046AG
 Operator Ameer Rizvi

Borehole No. BH 1
 Date 24-Oct-22

LIQUID LIMIT									
SAMPLE NO.	10.0-12.0								
NO OF BLOWS	35	25	17						
DISH NO	6	7	8						
DISH + WET SOIL	33.84	34.04	34.6						
DISH + DRY SOIL	31.47	31.5	31.89						
MOISTURE	2.37	2.54	2.71						
DISH	21.24	21.24	21.2						
DRY SOIL	10.23	10.26	10.69						
% MOISTURE	23.17	24.76	25.35						
PLASTIC LIMIT									
DISH NO	9	10							
DISH + WET SOIL	30.09	28.75							
DISH + DRY SOIL	29	27.82							
MOISTURE	1.09	0.93							
DISH	21.09	21.05							
DRY SOIL	7.91	6.77							
% MOISTURE	13.78	13.74							
PLASTIC LIMIT %	13.8								
LIQUID LIMIT %	24.4								
PLASTICITY INDEX	10.6								

Aly Ahmed

Aly Ahmed, Ph D., P Eng
 Lab Supervisor



ATTERBERG LIMITS

LABORATORY SERVICES

(LS-703, 704/D4318)

Project No.: OE201046AG
 Operator Ameer Rizvi

Borehole No BH 4
 Date 24-Oct-22

LIQUID LIMIT									
SAMPLE NO.	2.5-4.5								
NO OF BLOWS	35	24	18						
DISH NO	11	12	13						
DISH + WET SOIL	34.08	33.51	34.39						
DISH + DRY SOIL	31.49	30.95	31.62						
MOISTURE	2.59	2.56	2.77						
DISH	21.1	21.19	21.29						
DRY SOIL	10.39	9.76	10.33						
% MOISTURE	24.93	26.23	26.82						
PLASTIC LIMIT									
DISH NO	14	15							
DISH + WET SOIL	26.06	25.47							
DISH + DRY SOIL	25.44	24.9							
MOISTURE	0.62	0.57							
DISH	21.16	21.01							
DRY SOIL	4.28	3.89							
% MOISTURE	14.49	14.65							
PLASTIC LIMIT %	14.6								
LIQUID LIMIT %	26.0								
PLASTICITY INDEX	11.4								

Aly Ahmed

Aly Ahmed, Ph D., P Eng
 Lab Supervisor



ATTERBERG LIMITS

LABORATORY SERVICES

(LS-703, 704/D4318)

Project No.: OE201046AG
 Operator Ameer Rizvi

Borehole No BH 5
 Date 24-Oct-22

LIQUID LIMIT									
SAMPLE NO.	5.0-7.0								
NO OF BLOWS	34	27	19						
DISH NO	16	17	18						
DISH + WET SOIL	34.13	34.6	35.18						
DISH + DRY SOIL	31.53	31.78	32.21						
MOISTURE	2.6	2.82	2.97						
DISH	21.11	21.08	21.21						
DRY SOIL	10.42	10.7	11						
% MOISTURE	24.95	26.36	27.00						
PLASTIC LIMIT									
DISH NO	19	20							
DISH + WET SOIL	29.12	30.06							
DISH + DRY SOIL	28.1	28.9							
MOISTURE	1.02	1.16							
DISH	21.25	21.01							
DRY SOIL	6.85	7.89							
% MOISTURE	14.89	14.70							
PLASTIC LIMIT %				14.8					
LIQUID LIMIT %				26.2					
PLASTICITY INDEX				11.4					

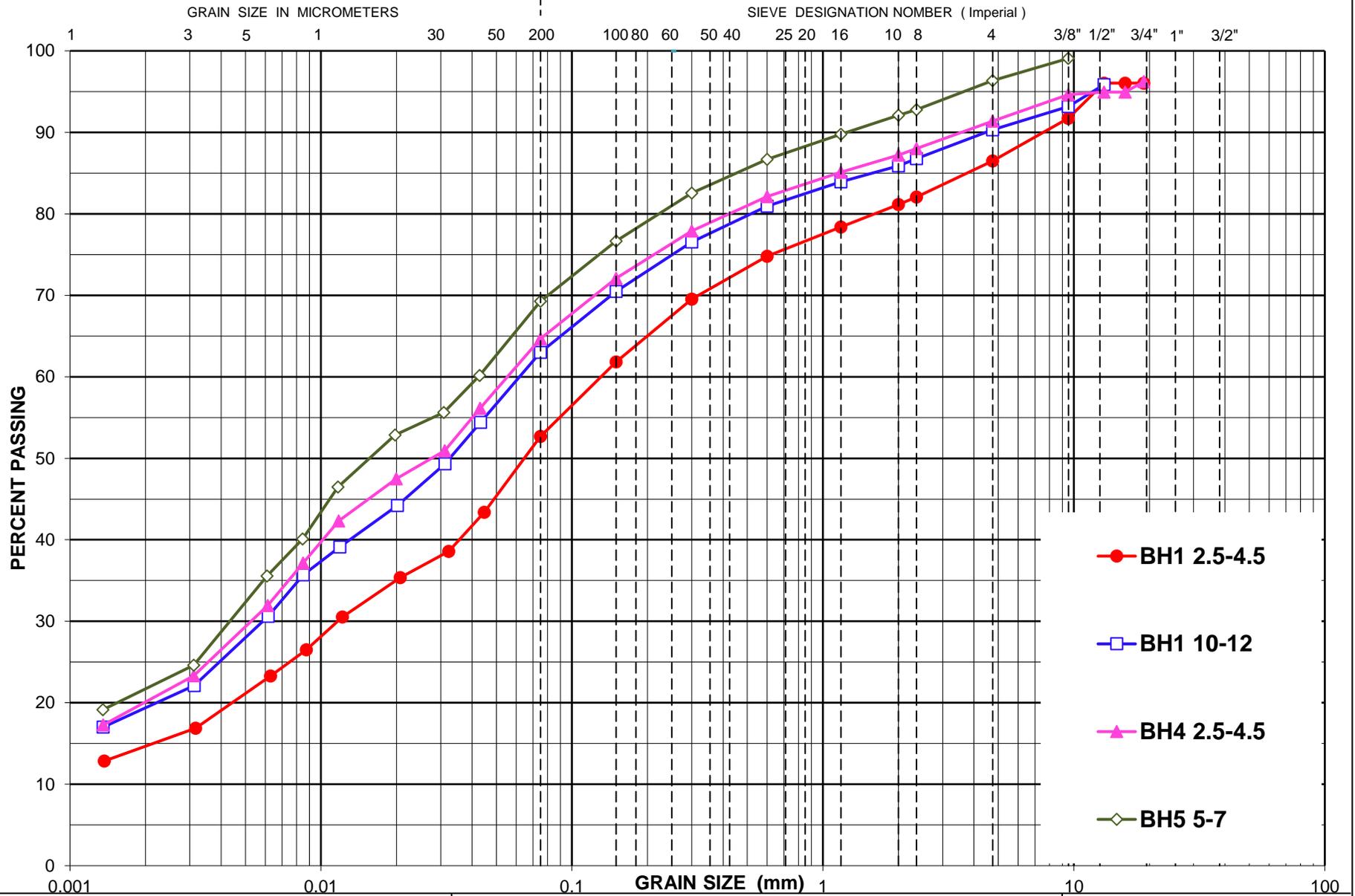
Aly Ahmed

Aly Ahmed, Ph D., P Eng
 Lab Supervisor

UNIFIED SOIL CLASSIFICATION SYSTEM

LS 702/D 422

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



GRAIN SIZE DISTRIBUTION

Figure No.:	B1
PROJECT No.:	OE201046AG
DATE:	Oct. 17, 2022