# GEOTECHNICAL INVESTIGATION PRELIMINARY REPORT
# PROPOSED DEVELOPMENT
# 159, CONFEDERATION STREET
# TOWN OF HALTON HILLS

**Prepared for**

**WESTON CONSULTING**

**Prepared by**

**SIRATI & PARTNERS CONSULTANTS LIMITED**

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Project: SP23-01265-00
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## 1. INTRODUCTION

Sirati & Partners Consultants Limited (SIRATI) was retained by Weston Consulting on behalf of Eden Oak (the Client), to undertake a preliminary geotechnical investigation for the proposed development (Figure 1) located at 159 Confederation Street in the Town of Halton Hills, Ontario.

**Figure 1 – 159 Confederation Street, Halton Hills, ON**




As per information provided by the Client, it is understood that the site will be developed into a series of thirteen (13) townhouse blocks and two (2) semi-detached dwellings for the subject lands addressed at 159 Confederation Street. As such, in support of the detailed design requirements, SIRATI was provided the following services:

1. Geotechnical investigation
2. Hydrogeological impact assessment
3. Environmental site assessment

This report deals with only the geotechnical aspects of the project. Report pertaining to hydrogeological and environmental conditions is provided under separate covers.

The following references were reviewed and utilized in preparation of the current study:

**[Ref. 1]:** J. D. BARNES Limited. Land Information Specialists, Plan of Survey of Part of Lot 26 Registrar's Complied Plan No.1555, Town of Halton Hills, Ontario, Ref. No. 14-30-651-00-A, Dated October 31, 2023.

**[Ref. 2]:** Concept Plan, Bayfield Georgetown, Town of Halton Hills, Ontario, Project. No. 23020, Dated September 27, 2023.

The purpose of the geotechnical investigation was to obtain information on the general subsurface soil and groundwater conditions at the site by means of borehole drilling, geotechnical laboratory test, and to provide recommendations for the foundations, excavation, backfilling, services and the roads within the property boundaries.

This report is provided based on the terms of reference indicated 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 current geotechnical analyses 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 affirmed.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and conform to accepted industry practice. 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 the Client and their designers. Third party use of this report without SIRATI consent is prohibited. The limitation conditions presented in **Appendix B** form an integral part of this report and they are to be considered in conjunction with this report.

## 2. SITE DESCRIPTION AND LOCAL GEOLOGY

The subject site located at 159 Confederation Street, town of Halton Hills, Ontario. The subject site is bounded by the river beside the Main St to the north, by the Bennett PI to the east, by the Confederation St to the south and Bishop Ct to the west. According to surveyed borehole locations and [Ref.1], the site is characterized by a combination of dense tree cover, open grass areas, and slopes with some flat terrain.

Based on the Map of Quaternary Geology of Ontario prepared by the Ontario Department of Northern Development and Mines and database maintained by the Ontario Geological Survey, the Site is located at glaciofluvial deposit composed of gravel and sand; includes proglacial river and deltaic deposits.

## 3. INVESTIGATION PROCEDURE

A total of four (4) boreholes, BH/MW-01 through BH/MW-04 (per Figure 1) were identified by the Client and drilled by SIRATI during the period of December 01 and 04, 2023. Boreholes advanced to depths ranging between 6.2 m and 10.8 m below existing ground surface (mbgs). The number, location and depth of the boreholes were communicated and approved by the Client.

Since the number of boreholes and their locations were determined prior to the development of the subdivision layout, additional confirmatory borehole investigation may be required at the footprints of the buildings.

The boreholes were drilled with solid stem continuous flight auger equipment (BH/MW-01 through BH/MW-04) by a drilling subcontractor under the direction and fulltime supervision of SIRATI personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropped 760 mm in accordance with the Standard Penetration Test (SPT) method. Soil samples were logged by field technicians and returned to SIRATI laboratory for detailed examination by the project engineer and for laboratory testing.

Allowance was made by the Client for installation of four (4) monitoring wells for groundwater monitoring purposes once groundwater conditions stabilized. The monitoring wells were constructed using a 50 mm diameter Schedule 40 polyvinyl chloride (PVC) pipe. The monitoring wells were constructed in accordance with O. Reg. 903 (as amended) by extending a bentonite seal and/or grout from above the well screen to the surface.

All soil samples were tested for moisture content and selected soil samples were tested for grain size analysis, hydrometer and Atterberg Limits tests.

The as drilled borehole/monitoring well locations and ground surface elevations were specified by SIRATI and confirmed by the Client. The borehole/monitoring well locations, ground surface elevation, termination depths and elevations are presented on the borehole records. The following table summarizes the borehole/monitoring well information:

**Table 1: Borehole/Monitoring Wells Summary**

| Borehole/Monitoring Well ID | Ground Elevation (m ASL*) | Bottom of Borehole/Monitoring Well | |
|---|---|---|---|
| | | (mbgs**) | (m ASL*) |
| BH/MW-01 | 254.2 | 6.4 | 247.8 |
| BH/MW-02 | 257.0 | 9.9 | 247.1 |
| BH/MW-03 | 253.3 | 6.2 | 247.1 |
| BH/MW-04 | 249.1 | 10.8 | 238.3 |

* m ASL = meter(s) above sea level

**mbgs = meter(s) below ground surface

## 4. SITE AND SUBSURFACE CONDITIONS

The borehole/monitoring well location plan is shown on Figure 1. Notes on soil descriptions are presented on Enclosure 1A. The subsurface conditions in the boreholes are presented in the individual borehole logs (Encl. 2 to 5).

The subsurface conditions in the boreholes are summarized in the following paragraphs.

The following presents the soil stratigraphy based on the observations of the boreholes drilled by SIRATI.

### *4.1 SOIL CONDITIONS*

**Topsoil:** A surficial layer of topsoil was encountered at the location of boreholes BH/MW-01 and BH-04 with thickness ranging between 150 mm to 200 mm.

It should be noted that the thickness of the topsoil explored at the borehole location may not be representative for the entire site and should not be relied on to calculate the amount of topsoil to be stripped at the site.

**Fill Material:**

A layer of fill material was found in all boreholes BH/MW-01 thorough BH/MW-04 beneath the topsoil layer or on the surface extended to depths ranging between 0.8 m and 1 m below the existing ground surface. This layer is generally brown in color and is consisted of gravelly sand, silty sand with different proportions, occasional trace cobbles, trace organics, occasional trace rootlets, occasional trace wood fragments.

The moisture content in fill layer was found to range from 5.0% to 24.0% indicating relatively moist to very moist conditions.

The measured SPT 'N' values in the fill layer ranged from 4 to 9 blows per 300 mm penetration, indicating a loose material.

**Cohesionless Soil Deposits:** Native cohesionless soil deposits were observed in all boreholes, underlying topsoil layer or fill flayer. This layer is generally reddish brown to brown and brown to grey in color and is comprised of sand and gravel, silty sand, sandy silt with different proportions, occasional trace cobbles, trace to some clay. The cohesionless soil stratum extended to depths ranging between 6.2 m and 10.8 m below the existing ground surface.

The moisture content in cohesionless soil deposit was found to range from 4.0% to 21.0% indicating moist to very moist conditions.

The measured SPT 'N' values in the cohesionless soil deposit ranged from 15 to more than 50 blows per 300 mm penetration, indicating a compact to very dense material.

Grain size and hydrometer analyses on five (5) representative soil samples of cohesionless soil deposit (BH/MW-01/SS2, BH/MW-02/SS6, BH/MW-02/SS10, BH/MW-03/SS4, BH/MW-04/SS5) were conducted and the results are presented in Figure 6 with the following fractions:

Clay: 3% to 8%
Silt: 18% to 52%

Sand: 33% to 59%
Gravel: 3% to 39%

Atterberg limits testing was completed on the soil sample BH/MW-04/SS5 that was non-plastic.

### *4.2 GROUNDWATER CONDITIONS*

During and upon completion of drilling, the short term unstabilized groundwater level was observed in all boreholes/monitoring wells with the exception of BH/MW-01 that was dry.

The stabilized groundwater levels will be monitored at bi-weekly intervals on six occasions. The first reading was taken on December 12, 2023 in boreholes/monitoring wells BH/MW 23-01 through BH/MW-04 at depth ranging between 2.44 m to 8.32 mbgs, corresponding to elevations ranging between 240.78 m ASL to 252.57 m ASL. Table 2 provides a summary of all readings.

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

Recommendations in this section must be read in conjunction with the hydrogeology study. The hydrogeological study should be relied upon for accurate assessment of the groundwater conditions prevailing at the subject site.

**Table 2: Groundwater Levels Observed in Monitoring Wells**

| Monitoring Well ID | Date of Drilling | Date of Observation | Depth of Groundwater below Existing Ground (m) | Elevation of Groundwater (m) |
|---|---|---|---|---|
| BH/MW-01 | Dec 1, 2023 | Dec 12, 2023 | 6.07 | 248.13 |
| BH/MW-02 | Dec 4, 2023 | Dec 12, 2023 | 4.43 | 252.57 |
| BH/MW-03 | Dec 4, 2023 | Dec 12, 2023 | 2.44 | 250.86 |
| BH/MW-04 | Dec 1, 2023 | Dec 12, 2023 | 8.32 | 240.78 |

## 5. GEOTECHNICAL ENGINEERING RECOMMENDATIONS

It is understood that the proposed redevelopment at Site (addressed at addressed at 159 Confederation Street, in the Town of Halton Hills) will consist of thirteen (13) townhouse blocks and two (2) semi-detached dwellings.

The geotechnical recommendations made herein this report are based on the findings from the subsurface information at four (4) borehole locations, namely BH/MW-01 through BH/MW-04. The following recommendations should be considered as preliminary and will need to be re-assessed by SIRATI once the drawings regarding architectural, structural design and services are finalized and made available to SIRATI. Additional confirmatory geotechnical investigation is required to confirm the

findings in this report and the subsurface conditions prevailing at the footprints of the proposed buildings.

Where comments are made on construction, they are provided to highlight those aspects which could affect the design of the project and for which special provisions may be required during construction. Those requiring information on aspects of construction should make their own interpretation of the factual information, provided such interpretation may affect selections, proposed construction methods, scheduling and the like.

### *5.1 SHALLOW FOUNDATION CONDITIONS*

The borehole information revealed the subject Site is generally covered with topsoil/fill material (possible fill material) to a maximum depth of 1.0 mbgl, below which lies the native soil of dense to very dense sand and gravel proved to a maximum depth of 2.3 mbgl. Below the dense to very dense sand and gravel is the native silty sand Till/sand and silt Till, which extended to the base of the boreholes. At BH/MW 04 location, however, the sand and gravel are replaced by dense to very dense sandy silt.

The groundwater level varies from 2.44 mbgl (BH/MW 03) to 8.32 mbgl (BH/MW 04).

Based on above and provided that the shallow foundation soil is undisturbed during the construction, in general, allowable soil bearing values of 120 kPa at Serviceability Limit State (SLS) and 180 kPa at Ultimate Limit State (ULS) are feasible in the undisturbed inorganic natural sand and gravel and sandy silt soils, at or below the depths provided in Table 3.

**Table 3: Bearing Values and Founding Levels of Spread Footings**

| BH No. | Material | Bearing Capacity at SLS (kPa) | Factored Geotechnical Resistance at ULS (kPa) | Minimum Depth Below Existing Ground (m) | Founding Level at or Below Elevation (m) |
|---|---|---|---|---|---|
| BH/MW-01 | Sand and Gravel | 120 | 180 | 1.5 | 252.7 |
| BH/MW-02 | Sand and Gravel | 120 | 180 | 1.5 | 255.5 |
| BH/MW-03 | Sand and Gravel | 120 | 180 | 1.5 | 251.8 |
| BH/MW-04 | Sandy silt | 120 | 180 | 1.5 | 247.6 |

Given the subsurface groundwater conditions and the depth to founding stratum, groundwater is not anticipated to be encountered during construction and as such no dewatering is considered necessary. However, water ingress and seepages should be anticipated since relatively shallow groundwater was reported at parts of the site, in which case conventional sump pump is considered adequate for dewatering purposes. Should groundwater be encountered, then the groundwater table must be lowered to at least 1 m below the lowest founding level prior to bulk excavation.

Where the grade needs to be raised, the proposed structures can be supported by spread and strip footings founded on engineered fill for an allowable bearing pressure of 150 kPa. The engineered fill supporting footings should be constructed in accordance with the guidelines presented in Appendix A. Other requirements of engineered fill are given in Section 5.4.

Given the generally heterogenous nature of engineered fill, pockets of loose material may exist. All footings shall be inspected by SIRATI prior to pouring concrete.

Footings and foundation walls supported by the engineered fill should be adequately reinforced to tolerate potential differential settlements.

The bearing value would be suitable for the use of normal spread footings to support the proposed development. The foundations designed to the specified allowable bearing capacity at the serviceability limit state (SLS) are expected to settle less than 25 mm total and 19 mm differential.

All footing bases must be inspected by qualified geotechnical engineer prior to pouring concrete. The excavated foundation bases can be covered with 50 mm thick lean concrete slab immediately after inspection and cleaning, in order to avoid disturbance of the founding soil due to construction activity.

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.

### *5.2 FLOOR SLAB AND PERMANENT DRAINAGE*

All footings must have at least 1.2 m of frost cover.

The floor slab for the proposed elements can be supported on grade provided any disturbed native soils are removed and the base is thoroughly proof rolled. Any backfill required to raise the grade can consist of inorganic soil, placed in shallow lifts (less than 300 mm thick prior to compaction) and compacted to 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

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

Where the exposed subgrade consists of cohesive soils below the groundwater table, all openings including the subgrade must be covered or wrapped with filter fabric, typically a Class II non-woven geotextile with a filtration opening size (F.O.S.) of 50 to 100 µm.

The completed excavations for floor slabs should not be left open before pouring concrete for any period longer than 24 hours, in particular if the floor construction works are being completed during the winter months or wet weather periods. The base of any floor slab excavation that is left exposed longer than 24 hours should be suitably covered and protected from water ponding, and/or protected to prevent degradation of the exposed founding stratum. This can be accomplished with construction of a mud slab.

## *5.3 ROADS*

The investigation has shown that the predominant subgrade soil at the site, after stripping the topsoil and any other organic and otherwise unsuitable material will mainly consist of fill material extending 1.0 m depth.

Based on the above and the Town of Halton Hills Design Criteria Manual for Engineering Plans, the following minimum pavement thickness is recommended for light duty traffic:

**Light Duty Pavement Structure:**

40 mm compacted depth of HL3 Asphaltic Concrete
50 mm compacted depth of HL8 Asphaltic Concrete
150 mm compacted depth of Granular 'A'
300 mm compacted depth of Granular 'B' (Type 2)

The pavement structure recommended above assumes that the subgrade has sufficient bearing capacity to accommodate the applied pavement structure from local traffic. 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 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.

### *5.3.1 STRIPPING, SUB-EXCAVATION AND GRADING*

The site should be stripped of all topsoil and any organic or otherwise unsuitable fills to the full depth of the roads, in both cut and fill areas.

Following stripping, the site should be graded to the subgrade level and approved. The subgrade should then be proof-rolled using several passes of a heavy compactor having a rated capacity of at least 10 tonnes in the presence of the project geotechnical engineer. Any exposed soft spots 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 recompacted 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 drainage and to prevent the formation of local depressions in which water could accumulate.

Proper cambering and allowing the water to escape towards the roadsides is considered beneficial. 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 must be used.

Any fill required for 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 95% of its SPMDD. The degree of compaction should be increased to 98% within the top 1.0 m of the subgrade, as per Town Standards. The compaction of the new fill should be verified by frequent field density testing.

### *5.3.2 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 of 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 testing 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.

### *5.3.3 DRAINAGE*

The subdrains should be properly filtered to prevent clogging or the loss of soil fines.

All paved surfaces should be sloped to provide satisfactory drainage towards catch basins. As discussed in Section 5.3.1 any water trapped in the granular sub-base materials should be drained towards subdrains or other interceptors.

## *5.4 SITE GRADING AND ENGINEERED FILL*

In the areas where earth fill is required for site grading purposes, an engineered fill may be constructed below foundations, roads, boulevards, etc.

Prior to the construction of an engineered fill, all topsoil, fill material, weak weathered/ disturbed or deleterious must be removed in this area. After the removal of all unsuitable materials, the excavation base consisting of native soil deposits must be inspected and approved by a qualified geotechnical engineer prior to any placement of engineered fill. The base of the excavation should be compacted and proof rolled with heavy compactors (minimum 10,000 kg). During proof rolling, spongy, wet or soft/loose spots should be sub-excavated to stable subgrade and replaced with approved soil, compatible with subgrade conditions, as directed by the geotechnical engineer.

The material for engineered fill should consist of approved inorganic soil, compacted to 100 percent of Standard Proctor Maximum Dry Density (SPMDD). Recommendations regarding engineered fill placement are provided in **Appendix A** of this report.

To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential by SIRATI to certify the engineered fill.

Depending upon the amount of grading work required, there will be consolidation settlement of the underlying soils. Additionally, there will be settlement of the engineered fill under its own weight, approximately 0.5% of the fill height. A waiting period of 3 to 6 months may be required prior to the construction of any structures on engineered fill. This should be confirmed during the detail design stage, once the grading plans for the proposed development are available.

### *5.5 FROST PROTECTION*

The floor slab should be structurally independent of any load bearing structural elements and should tolerate expected foundation settlements as indicated above.

All footings exposed to seasonal freezing conditions must have at least 1.2 m of soil cover for frost protection.

It is also emphasized that underfloor drainage and/or an adequate free draining granular base is required to minimize the risk of floor dampness.

### *5.6 EXCAVATIONS AND BACKFILL*

The groundwater table observed in the monitoring wells installed in the cohesionless soils was at depths ranging between 2.44 m and 8.32 m below existing grade corresponding to elevation of 240.78 m ASL and 252.57 m ASL. Given the subsurface groundwater conditions and the depth to founding stratum, groundwater is not anticipated to be encountered during construction and as such no dewatering is considered necessary. However, water ingress and seepages should be anticipated since relatively shallow groundwater was reported at parts of the site, in which case conventional sump pump is considered adequate for dewatering purposes. The groundwater table must be lowered to at least 1m below the lowest excavation level, prior to bulk excavation.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA fill material can be classified as Type 3 soil above the groundwater table. Compact to very dense cohesionless soils can be classified as Type 2 Soil above the groundwater table and as Type 3 Soil when below the groundwater table.

The existing fill in the boreholes is generally not suitable for re-use as backfill. The native soils free from topsoil and organics can be used as general construction backfill, provided their moisture content is within 2 percent of optimum moisture content. Soils which are to be compacted should not exceed 200 mm layer thickness. Depending on the time of construction and weather conditions, some

excavated material may be too wet to compact and will require aeration prior to its use. Significant drying of the wet sandy soils will be required prior to their use as the backfill material.

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.

### *5.7 EARTH PRESSURES*

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 lateral earth and water pressure acting at any depth on the basement walls can be calculated by the following formula:

In soils above the groundwater table ($z < d_w$):

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

In soils below the groundwater table ($z \geq d_w$):

$$p = K \{\gamma d_w + \gamma_1 (z - d_w) + q\} + p_w$$

In which, $p_w = \gamma_w (z - d_w)$

| | | |
|---|---|---|
| where p | = | lateral earth and water pressure in kPa acting at a depth of z below ground surface |
| K | = | earth pressure coefficient |
| $\gamma$ | = | unit weight of soil above groundwater table |
| $\gamma_1$ | = | submerged unit weight of soil below groundwater table |
| $\gamma_w$ | = | unit weight of water, assuming $\gamma_w = 9.8$ kN/m$^3$ |
| z | = | depth below ground surface to point of interest, in metres |
| $d_w$ | = | depth of groundwater table below ground surface, in metres |
| q | = | value of surcharge in kPa |
| $p_w$ | = | hydrostatic water pressure in kPa |

When the basement wall is poured against the shoring caisson wall, the basement wall as well as the shoring caisson wall should be designed for hydrostatic pressure, even though a drainage board is provided between the basement wall and the caisson wall. For the design of the basement walls and shoring caisson wall, reference should be made to the variable groundwater elevations as indicated in Table 2.

The lateral earth pressure parameters are estimated and presented in **Table 4**:

**Table 4: Lateral Earth Pressure Parameters**

| Parameter | Sand and Gravel, Sand and Silt, Silty sand and Sandy silt |
|---|---|
| Unit Weight, $\gamma$, kN/m$^3$ | 21 |
| Submerged Unit Weight, $\gamma_1$, kN/m$^3$ | 11.2 |
| Friction Angle, $\phi$, degrees (for undrained conditions of temporary shoring system) | 30 |
| Undrained Shear Strength, $S_u$, kPa | 0 |
| Active Earth Pressure Coefficient, $K_a$ | 0.33 |
| Passive Earth Pressure Coefficient, $K_p$ | 3.0 |
| Earth Pressure at rest Coefficient, $K_0$ | 0.50 |
| Modulus of Subgrade Reaction, $K_s$, MN/m$^3$ | 5-10 |

### *5.8 SEISMIC SITE CLASSIFICATION*

Based on the borehole information and according to Table 4.1.8.4.A of OBC 2012, the subject site for the proposed development can be classified as “Class D” for seismic site response.

## 6. GENERAL COMMENTS ON REPORT

Sirati & Partners Consultants Limited (SIRATI) 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, SIRATI will assume no responsibility for interpretation of the recommendations in the report.

The proposed construction works as part of the proposed installation may cause ground movement and/or direct transmission of ground vibrations to adjoining structures. Considerations should be given to preparation of a preconstruction condition survey of the existing structures along with movement monitoring of existing structures.

The comments given in this report are intended only for the guidance of design engineers. Contractors bidding on or undertaking the works could conduct their own investigations and rely upon their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them during the construction process.

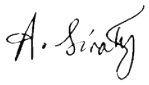
Limitation and conditions are presented in **Appendix B** and form an integral part of this report and must be considered in conjunction when reading this report.

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

**Yours truly,**
**SIRATI & PARTNERS CONSULTANTS LIMITED**



Javad Sadr, M.Sc., E.I.T
Geotechnical Engineer in Training



Archie Sirati, Ph.D., P.Eng.
Principal Geotechnical Engineer

# Drawings/Enclosures




Source: Google Earth Map

SIRATI & PARTNERS
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Markham, ON. L3R 9T9
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**North:**

**Legend:**

Borehole/ Monitoring well

**Project Title:**

Preliminary Geotechnical Investigation

**Site Location:**

159 Confederation Street,
Halton Hills, Ontario

**Figure Title:**

Borehole/ Monitoring well
Location Plan

| Scale: | Project Number: |
|---|---|
| As Shown | SP23-01265-00 |
| **Date:** | **Figure Number:** |
| December, 2023 | 1 |

# Enclosure 1A: Notes on Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by Sirati & Partners Consultants Limited also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has 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 | | |

| 0.002 | 0.006 | 0.02 | 0.06 | 0.2 | 0.6 | 2.0 | 6.0 | 20 | 60 | 200 |
|---|---|---|---|---|---|---|---|---|---|---|

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 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.

SIRATI & PARTNERS

# LOG OF BOREHOLE BH/MW 01



PROJECT: Geotechnical and Hydrogeological Investigations and Excess Soil
CLIENT: Eden Oak
PROJECT LOCATION: 159 Confederation Street, Town of Halton Hills
DATUM: Geodetic
BH LOCATION: N 4836219 E 586124

**DRILLING DATA**
Method: Solid Stem Auger
Diameter: 150 mm
Date: Dec-01-2023

REF. NO.: SP23-01265-00
ENCL NO.: 2

| ELEV / DEPTH (m) | DESCRIPTION | NUMBER | TYPE | BLOWS 0.3 m "N" | ELEVATION | GR | SA | SI | CL |
|---|---|---|---|---|---|---|---|---|---|
| 254.2 | | | | | | | | | |
| 254.0 0.2 | **TOPSOIL:** 150 mm thick | | | | | | | | |
| | **FILL:** silty sand, trace cobbles, trace gravel, trace organics, brown, very moist, loose | 1 | SS | 4 | 254 | | | | |
| 253.5 0.8 | **SAND AND GRAVEL:** some silt, trace cobbles, trace clay, brown, moist, compact | 2 | SS | 25 | 253 | 39 | 39 | 18 | 4 |
| | | 3 | SS | 23 | | | | | |
| | dense | 4 | SS | 34 | 252 | | | | |
| | | 5 | SS | 30 | 251 | | | | |
| 249.6 4.6 | **SANDY SILT:** trace to some clay, trace gravel, brown, moist, very dense | 6 | SS | 50/ 150mm | 250 | | | | |
| 247.8 6.4 | grey, very moist | 7 | SS | 50/ 150mm | 249 | | | | |
| | **END OF BOREHOLE:** | | | | | | | | |

1. Borehole was open and dry upon completion of drilling.
2. Nested monitoring well was installed (Deep well).
3. Monitoring well observations for long-term stabilized groundwater levels:

| Date | Depth (mbgs) |
|---|---|
| Dec 12, 2023 | 6.07m |

W. L. 248.1 m
Dec 12, 2023

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)

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP23-01265-00.GPJ SPCL.GDT 23-12-13

SIRATI & PARTNERS

# LOG OF BOREHOLE BH/MW 02



PROJECT: Geotechnical and Hydrogeological Investigations and Excess Soil
CLIENT: Eden Oak
PROJECT LOCATION: 159 Confederation Street, Town of Halton Hills
DATUM: Geodetic
BH LOCATION: N 4836417 E 585897

**DRILLING DATA**
Method: Solid Stem Auger
Diameter: 150 mm
Date: Dec-04-2023

REF. NO.: SP23-01265-00
ENCL NO.: 3

| (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) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 257.0 | | | | | | | | | | | | |
| 0.0 / 256.2 | **POSSIBLE FILL:** gravelly sand, trace silt, trace rootlets, brown, moist, loose | | 1 | SS | 9 | | | | ○ | | | |
| 0.8 / 254.7 | **SAND AND GRAVEL:** trace to some silt, trace cobbles, trace clay, brown, moist, dense | | 2 | SS | 31 | | 256 | | ○ | | | |
| | very dense | | 3 | SS | 50/ 100mm | | 255 | | ○ | | | |
| 2.3 / 252.4 | **SILTY SAND TILL:** trace cobbles, trace gravel, brown, moist, very dense | | 4 | SS | 50/ 140mm | | 254 | | ○ | | | |
| | | | 5 | SS | 50/ 50mm | | 253 | | ○ | | | |
| 4.6 | **SAND AND SILT TILL:**trace cobbles, trace gravel, trace clay, brown, moist, very dense | | 6 | SS | 50/ 130mm | W. L. 252.6 m Dec 12, 2023 | 252 | | ○ | | | 3 41 50 6 |
| | | | 7 | SS | 50/ 140mm | | 251 | | ○ | | | |
| | | | 8 | SS | 50/ 100mm | | 250 | | ○ | | | |
| | | | | | | | 249 | | | | | |
| | very moist | | 9 | SS | 50/ 140mm | | 248 | | ○ | | | |
| 247.1 | | | 10 | SS | 50/ 150mm | | | | ○ | | | 9 41 46 4 |
| 9.9 | **END OF BOREHOLE:** | | | | | | | | | | | |

1. Borehole was open upon completion of drilling.
2. Groundwater was encountered at 9.1 mbgs upon completion of drilling.
3. Nested monitoring well was installed (Deep well).
4. Monitoring well observations for long-term stabilized groundwater levels:

| Date | Depth (mbgs) |
|---|---|
| Dec 12, 2023 | 4.43m |

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

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $\varepsilon_f$=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP23-01265-00.GPJ SPCL.GDT 23-12-13

SIRATI & PARTNERS

# LOG OF BOREHOLE BH/MW 03



PROJECT: Geotechnical and Hydrogeological Investigations and Excess Soil
CLIENT: Eden Oak
PROJECT LOCATION: 159 Confederation Street, Town of Halton Hills
DATUM: Geodetic
BH LOCATION: N 4836294 E 585981

**DRILLING DATA**
Method: Solid Stem Auger
Diameter: 150 mm
Date: Dec-04-2023

REF. NO.: SP23-01265-00
ENCL NO.: 4

| (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) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 253.3 | | | | | | | | | | | | |
| 0.0 / 252.6 | **POSSIBLE FILL:** gravelly sand, trace silt, trace rootlets, trace wood fragments, brown, moist, loose | | 1 | SS | 7 | | 253 | | | | | |
| 0.8 / 251.0 | **SAND AND GRAVEL:** trace to some silt, trace cobbles, trace clay, brown, moist, dense | | 2 | SS | 40 | | | | | | | |
| | | | 3 | SS | 46 | | 252 | | | | | |
| 2.3 / 250.3 | **SILTY SAND TILL:** trace cobbles, trace gravel, trace clay, brown, moist, dense | | 4 | SS | 31 | ▽ | 251 | | | | | 8 59 30 3 |
| 3.1 | **SAND AND SILT TILL:** trace gravel, trace clay, reddish brown, very moist, compact | | 5 | SS | 18 | | 250 | | | | | |
| | very dense | | 6 | SS | 50/ 100mm | | 249 | | | | | |
| 247.1 | | | | | | | 248 | | | | | |
| 6.2 | **END OF BOREHOLE:** | | 7 | SS | 50/ 140mm | | | | | | | |

W. L. 250.9 m
Dec 12, 2023

1. Borehole was open upon completion of drilling.
2. Groundwater was encountered at 3.0 mbgs upon completion of drilling.
3. Nested monitoring well was installed (Deep well).
4. Monitoring well observations for long-term stabilized groundwater levels:

| Date | Depth (mbgs) |
|---|---|
| Dec 12, 2023 | 2.44m |

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

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

SPCL SOIL LOG /DRAFT SP23-01265-00.GPJ SPCL.GDT 23-12-13

SIRATI & PARTNERS

# LOG OF BOREHOLE BH/MW 04



PROJECT: Geotechnical and Hydrogeological Investigations and Excess Soil
CLIENT: Eden Oak
PROJECT LOCATION: 159 Confederation Street, Town of Halton Hills
DATUM: Geodetic
BH LOCATION: N 4836331 E 586190

**DRILLING DATA**
Method: Solid Stem Auger
Diameter: 150 mm
Date: Dec-01-2023

REF. NO.: SP23-01265-00
ENCL NO.: 5

| (m) ELEV / DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | BLOWS "N" 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) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 249.1 | | | | | | | | | | | | |
| 249.0 | **TOPSOIL:** 200mm | | | | | | | | | | | |
| 0.2 | **POSSIBLE FILL:** silty sand, trace cobbles, trace gravel, trace organics, brown, very moist, loose | | 1 | SS | 6 | | | | | | | |
| 248.0 | | | 2 | SS | 23 | | 248 | | | | | |
| 1.0 | **SANDY SILT:** trace to some clay, trace gravel, brown, very moist, compact | | 3 | SS | 15 | | | | | | | |
| | dense | | 4 | SS | 38 | | 247 | | | | | |
| | oxidated | | 5 | SS | 36 | | 246 | | | | | Non-plastic 7 33 52 8 |
| 244.5 | | | | | | | 245 | | | | | |
| 4.6 | **SAND:** trace to some silt, trace gravel, brown, moist, dense | | 6 | SS | 37 | | 244 | | | | | |
| | very dense | | 7 | SS | 50/ 130mm | | 243 | | | | | |
| | | | 8 | SS | 85 | | 242 | | | | | |
| 239.9 | | | | | | | 241 | | | | | |
| 9.1 | **SANDY SILT:** trace to some clay, trace gravel, brown, very moist, very dense | | 9 | SS | 50/ 150mm | | 240 | | | | | |
| 238.3 | | | | | | | 239 | | | | | |
| 10.8 | reddish brown **END OF BOREHOLE:** | | 10 | SS | 50/ 100mm | | | | | | | |

W. L. 240.7 m
Dec 12, 2023

1. Borehole was open upon completion of drilling.
2. Nested monitoring well was installed (Deep well).
3. Monitoring well observations for long-term stabilized groundwater levels:

| Date | Depth (mbgs) |
|---|---|
| Dec 12, 2023 | 8.32m |

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

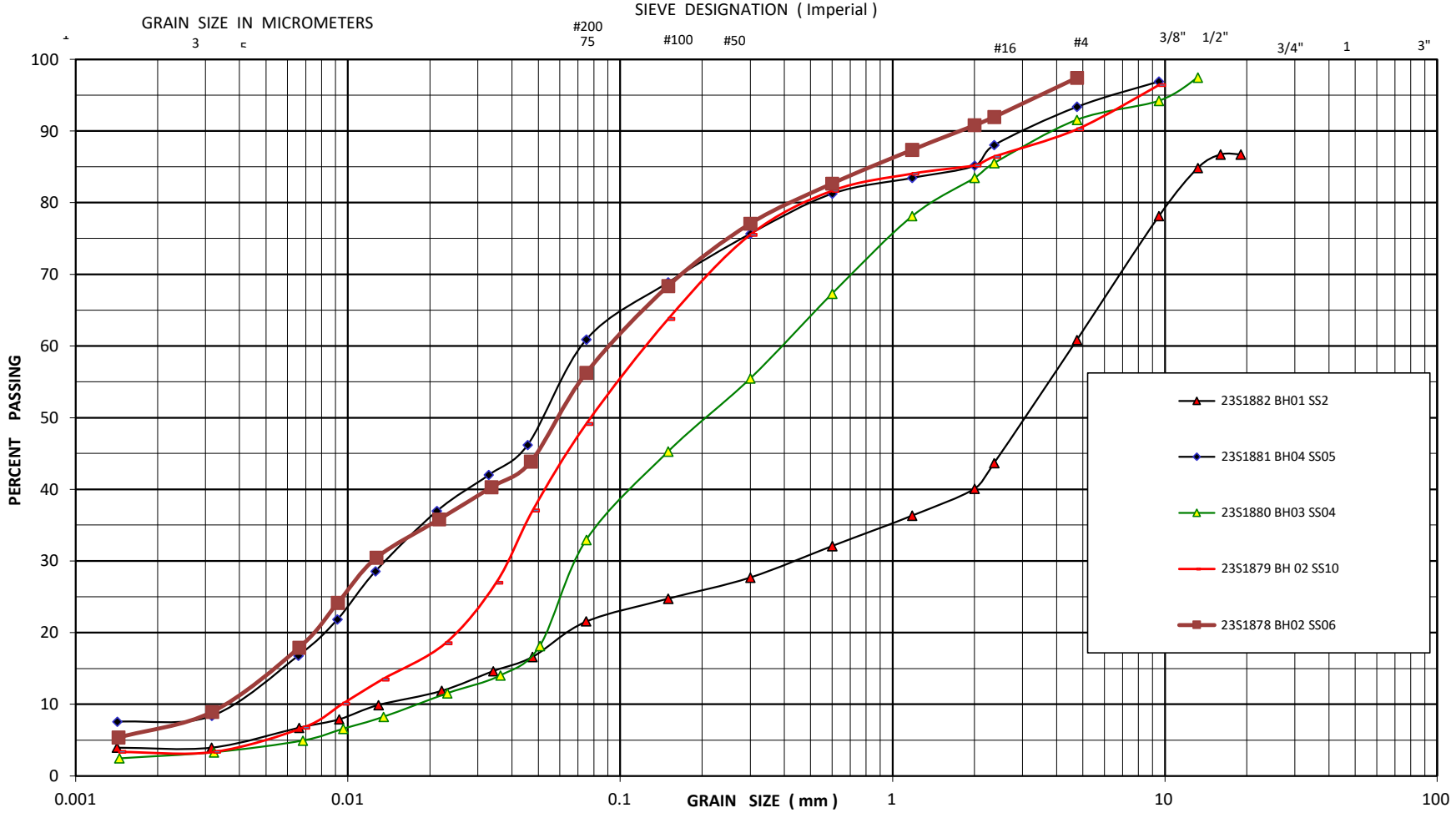
SPCL SOIL LOG /DRAFT SP23-01265-00.GPJ SPCL.GDT 23-12-13

SIRATI & PARTNERS

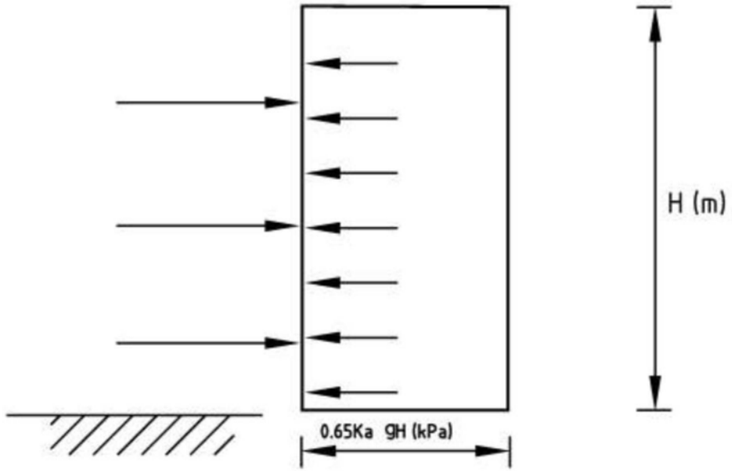
# GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY AND SILT | SAND | | | GRAVEL | |
|---|---|---|---|---|---|
| | Fine | Medium | Coarse | Fine | Coarse |




| | | |
|---|---|---|
| **Project No.** | : | SP23-01265-00 |
| **Date** | : | 08 December 2023 |
| **Figure No.** | : | 6 |

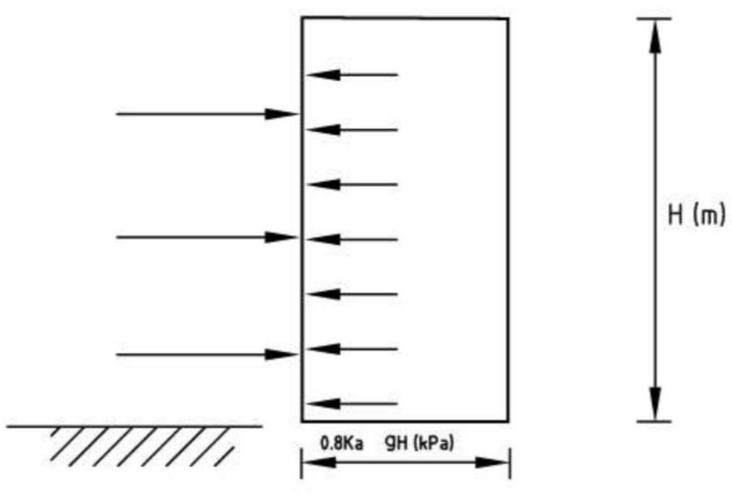



g = unit weight of soil = 21.0 kN/m$^3$

g' = submerged unit weight of soil (i.e. below ground water level)= 11.2 kN/m$^3$

Ka = 0.3

**IN COMPACT TO VERY DENSE NON-COHESIVE SOILS (SANDS AND SILTS)**

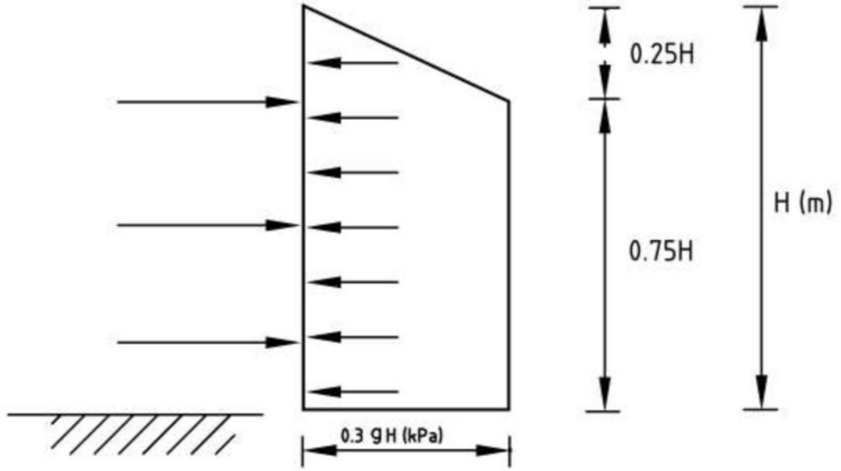



g = unit weight of soil = 19.0 kN/m$^3$

g' = submerged unit weight of soil (i.e. below ground water level)= 9.2 kN/m$^3$

Ka = 0.36

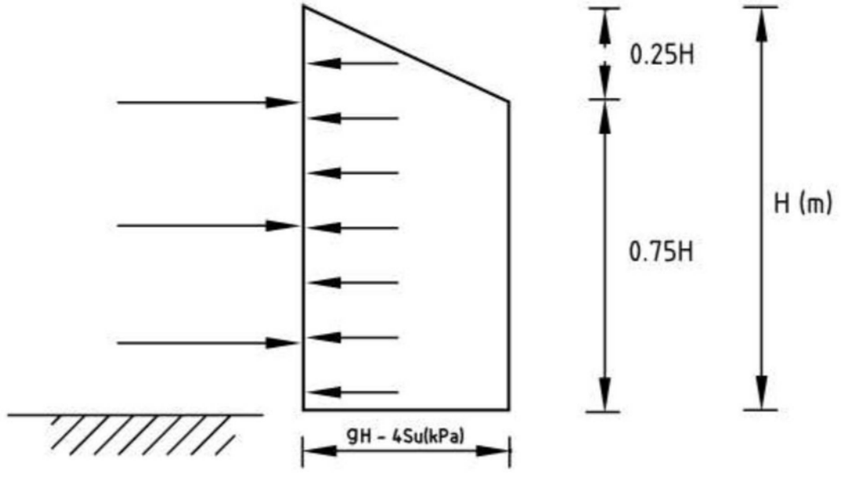
**IN LOOSE OR DISTURBED NON-COHESIVE SOILS (SANDS AND SILTS)**




g = unit weight of soil = 21.5 kN/m$^3$

g' = submerged unit weight of soil (i.e. below ground water level)= 11.7 kN/m$^3$

**IN COHESIVE CLAYS OR CLAYEY SOILS**




g = unit weight of soil = 19.0 kN/m$^3$

g' = submerged unit weight of soil (i.e. below ground water level)= 9.2 kN/m$^3$

Su = 10 KPa

**IN VERY SOFT TO FIRM COHESIVE CLAYS OR CLAYEY SOILS**

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Geotechnical Hydrogeological & Environmental Solutions

North:

**Notes:**

1. Check system for partial excavation condition.

2. If the free water level is above the base of the excavation, the hydrostatic pressure must be added to the above pressure distribution.

3. If surcharge loadings are present near the excavation, these must be included in the lateral pressure calculation.

**Project Title :**

Geotechnical Investigation Report

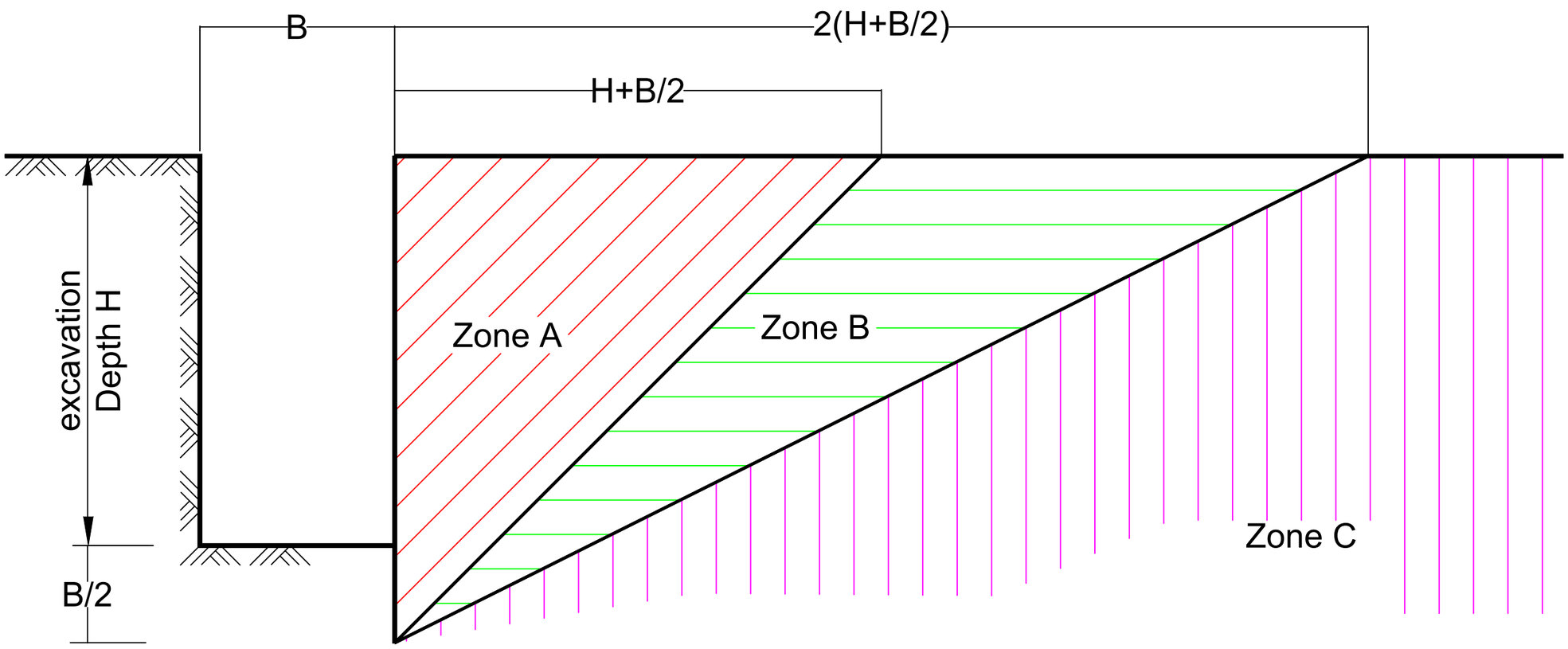
**Site Location:**

159 Confederation Street, Halton Hills, Ontario

**Figure Title:**

Earth Pressure Distribution on Braced Excavations

| Scale: | Project Number: |
|---|---|
| As Shown | SP23-01265-00 |
| **Date:** | **Figure Number:** |
| December 2023 | 7 |




RISK ZONES (after Howe et al., 1980): Zone A is zone of long term risk,Zone B is zone of intermediate risk,Zone C is zone of no risk.

SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions

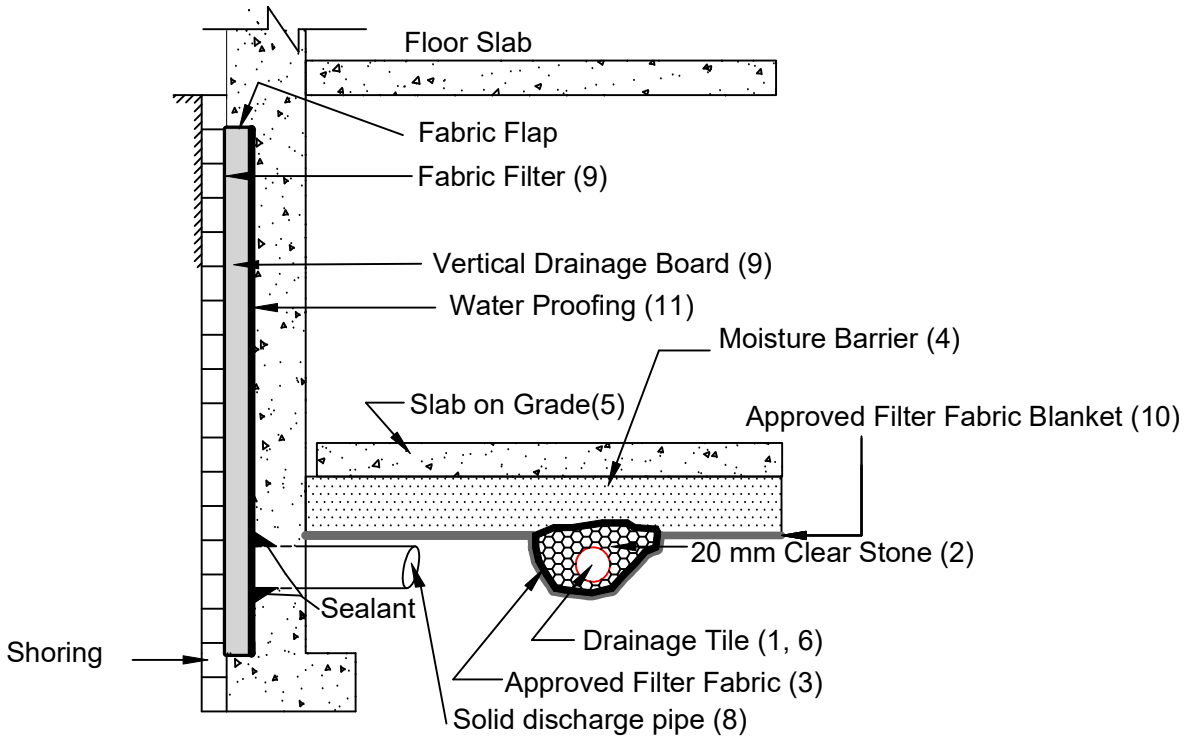
North:

**Project Title:**
Geotechnical Investigation Report

**Site Location:**
159 Confederation Street,
Halton Hills, Ontario

**Figure Title:**
Excavation Risk Zone

| Scale: | Project Number: |
|---|---|
| As Shown | SP23-01265-00 |
| Date: December 2023 | Figure Number: 8 |

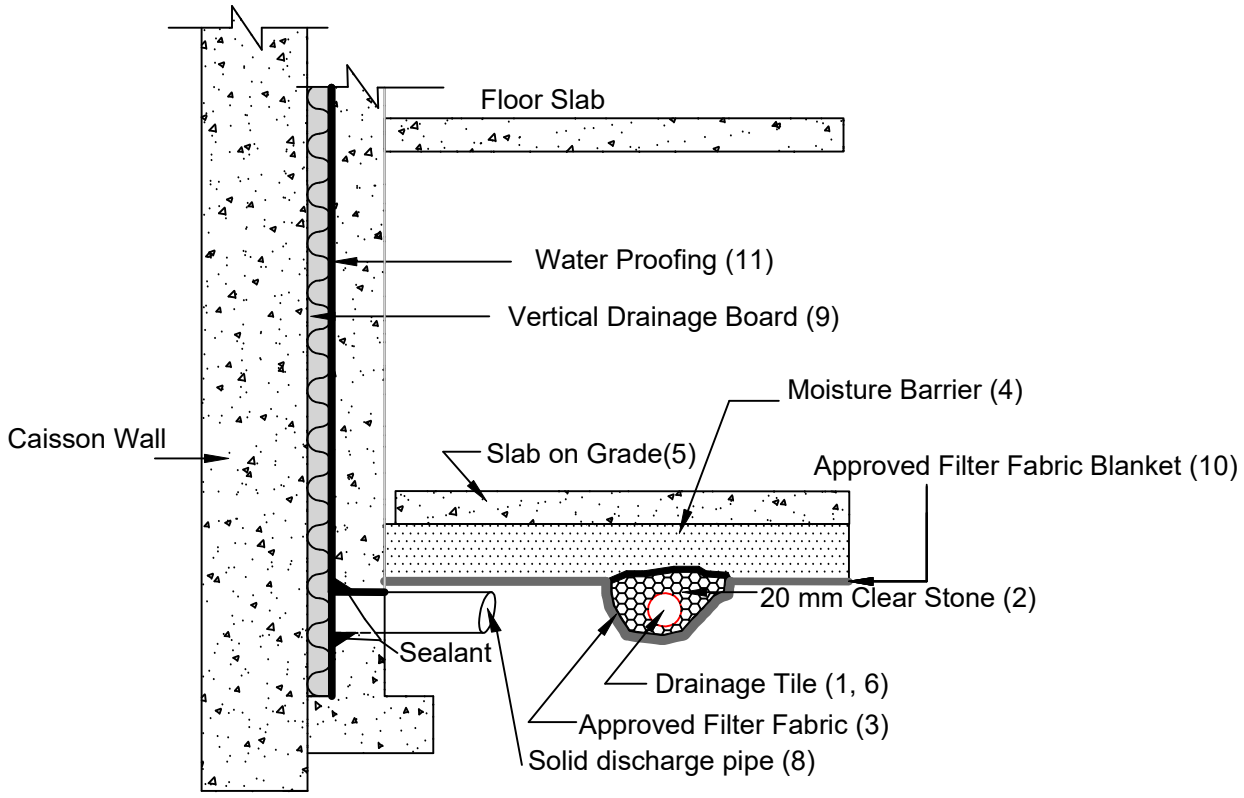



EXTERIOR FOOTING

**Notes**

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
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. 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.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. 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).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board with filter cloth should be kept a minium of 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls should be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

## DRAINAGE RECOMMENDATIONS
## Shored Basement wall with Underfloor Drainage System
(not to scale)




EXTERIOR FOOTING

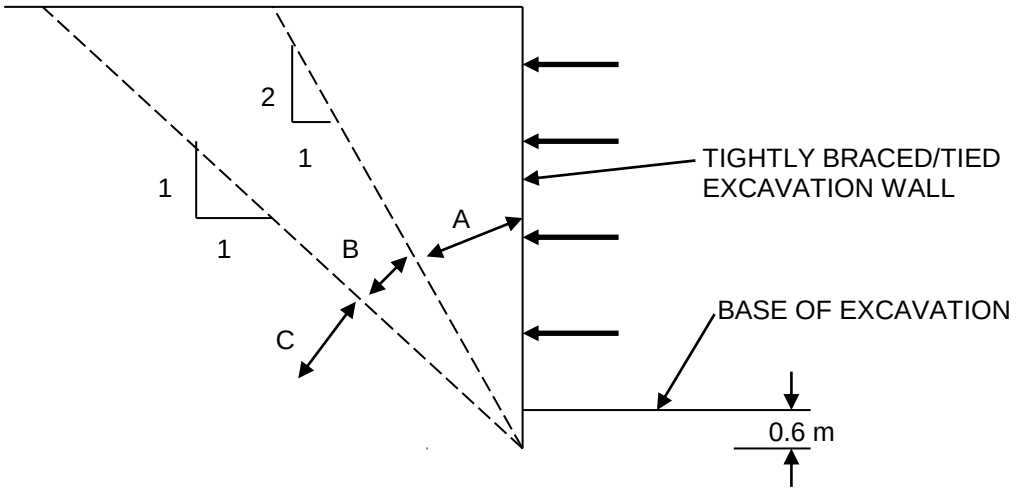
**Notes**

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
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. 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.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. 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).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board mira-drain 6000 or eqivalent with filter cloth should be continous from bottom to 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls must be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

## DRAINAGE RECOMMENDATIONS
## Shored Basement wall with Underfloor Drainage System
(not to scale)

## Guidelines for Underpinning in Soil and Excavation Support

Existing foundations located within Zone A normally require underpinning, especially for heavy structures. For some foundations in Zone A, it may be possible to eliminate underpinning and control foundation movement by tightly braced excavation walls, such as caisson walls.




Zone A Foundations located within this zone normally require underpinning. Horizontal and vertical pressures on the excavation wall of non underpinned foundations must be considered

Zone B Foundations located within this zone normally do not require underpinning. Horizontal and vertical pressures on the excavation wall of non underpinned foundations must be considered

Zone C Underpinning to structures is normally founded in this zone. Lateral pressure from underpinning is not normally considered

(Reference: Figure 26.27 from Canadian Foundation Engineering Manual, 4th Edition)

# Appendix A:
# Guidelines For Engineered Fill

## 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 Sirati & Partners Consultants Limited. Without this confirmation, no responsibility for the performance of the structure can be accepted by Sirati & Partners Consultants Limited (SIRATI). 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 SIRA -TI 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 SIRATI during placement of engineered fill is required. Workcannot commence or continue without the presence of the SIRATI 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.

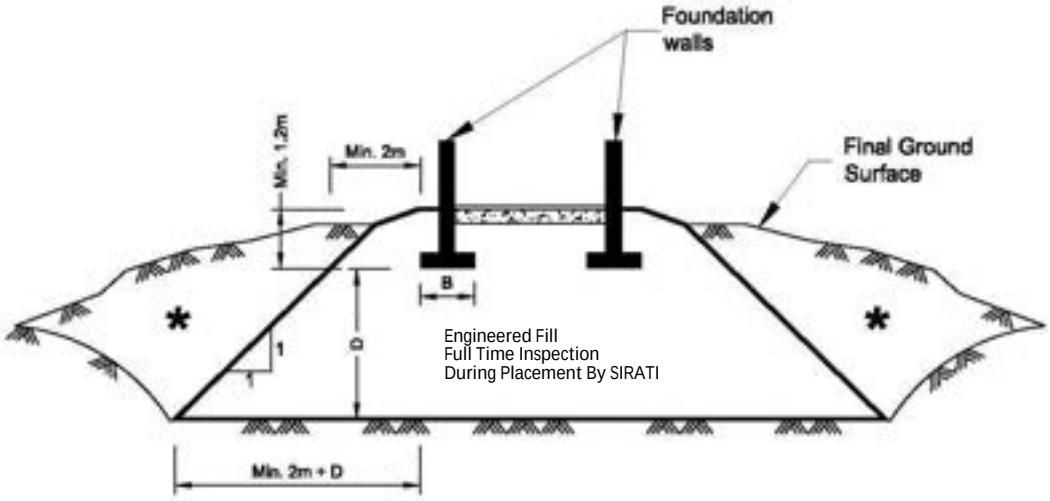
10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from SIRATI prior tofooting concrete placements. All excavations must be backfilled under full time supervision bySIRATI to the same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

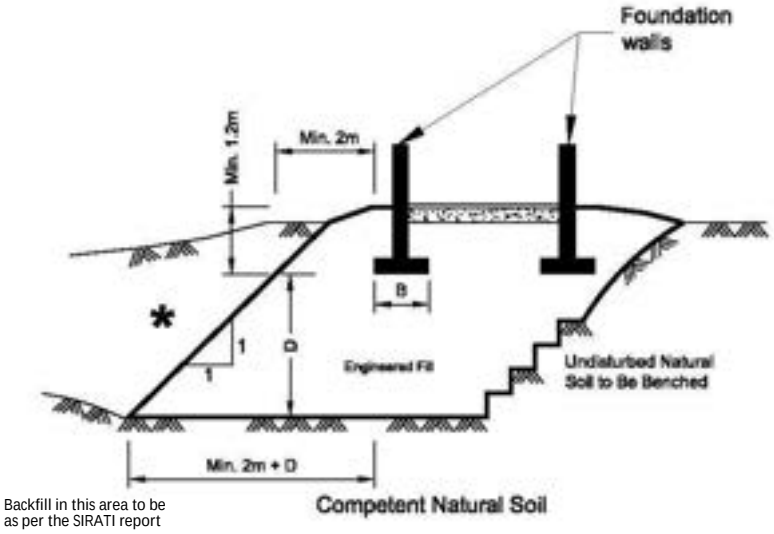
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any 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 Sirati & Partners Consultants Limited (SIRA TI) report attached.


Foundation walls
Final Ground Surface
Min. 1.2m
Min. 2m
B
D
1
1
Engineered Fill
Full Time Inspection
During Placement By SIRATI
Min. 2m + D
Competent Natural Soil To Be Confirmed By SIRATI


Foundation walls
Min. 1.2m
Min. 2m
B
D
1
1
Engineered Fill
Undisturbed Natural Soil to Be Benched
Min. 2m + D
Backfill in this area to be as per the SIRATI report
Competent Natural Soil

# Appendix B: Limitation and Use of 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 Sirati & Partners Consultants Limited (SIRATI) at the time of preparation. Unless otherwise agreed in writing by SIRATI, 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 borehole 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 boreholes may differ from those encountered at the borehole 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 borehole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc. Professional judgement was exercised in gathering and analyzing data and formulation of recommendations using current industry guidelines and standards. Similar to all professional persons rendering advice, SIRATI cannot act as absolute insurer of the conclusion we have reached. No additional warranty or representation, expressed or implied, is included or intended in this report other than stated herein the report.

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 boreholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial 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. SIRATI 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. Any user of this report specifically denies any right to claims against the Consultant, Sub-Consultants, their officers, agents and employees in excess of the fee paid for professional services.

SIRATI engagement hereunder is subject to and condition upon, that SIRATI not being required by the Client, or any other third party to provide evidence or testimony in any legal proceedings pertaining to this finding of this report or providing litigations support services which may arise to be required in respect of the work produced herein by SIRATI. It is prohibited to publish, release or disclose to any third party the report produced by SIRATI pursuant to this engagement and such report is produced solely for the Client own internal purposes and which shall remain the confidential proprietary property of SIRATI for use by the Client, within the context of the work agreement. The Client will and does hereby remise and forever absolutely release SIRATI, its directors, officers, agents and shareholders of and from any and all claims, obligations, liabilities, expenses, costs, charges or other demands or requirements of any nature pertaining to the report produced by SIRATI hereunder. The Client will not commence any claims against any Person who may make a claim against SIRATI in respect of work produced under this engagement.