"BUILT ON THE ROCK"

# PRELIMINARY GEOTECHINCAL INVESTIGATION REPORT

# CHIPWOODS PARK, MELANCTHON, ONTARIO

**PROJECT NUMBER:** 24-057-01

**CLIENT:** 1000719578 Ontario Inc.

**ATTENTION:** Josh Blokhuis

**DATE:** May 29, 2025

**PREPARED BY:** Green Geotechnical Ltd.
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# 1.0 SITE AND PROJECT BACKGROUND

Green Geotechnical Ltd. (Green Geotechnical) was retained by 1000719578 Ontario Inc. to conduct a subsurface investigation and prepare a preliminary geotechnical design report for the proposed residential re-development in the Township of Melancthon, Ontario. The site is located on the west side of 3rd Line, between Dufferin County Road 17 and Side Road 5, in the Town of Melancthon. A site location plan is provided as Figure 1. The site is currently primarily used as camping grounds with trailers and permanent residences, as well as internal gravel-surfaced roadways, trails, treed areas, and is bound by 3rd Line to the east, and by existing residential and agricultural properties to its north, west and south.

While a conceptual site plan is not yet available, based on conversations with C.F. Crozier & Associates Inc. (Crozier), it is understood that the site will be developed to include the construction of mostly single-family dwellings. It is presumed that the re-development would be constructed to an urban standard with paved roads and full underground services connecting to existing infrastructure.

At the time of this investigation, no conceptual grading or servicing plans were available. It is presumed that site grades will generally be near or slightly above their current elevations. Any regrading within the influence zones of buildings, pavement structures, or settlement sensitive areas is anticipated to be done with the use of Engineered Fill.

It is recommended that once the conceptual site plan and/or civil drawings are available, Green Geotechnical should be contacted for to review and update this report accordingly from a geotechnical perspective.

This report encompasses the geotechnical investigation conducted for the Property to assess its geotechnical suitability for the proposed re-development. The field investigation consisted of advancing a total of eight (8) exploratory boreholes (Boreholes 1 to 8) at the Property. The objective of the geotechnical investigation was to determine the prevailing subsurface soil and groundwater conditions, in order to provide geotechnical engineering recommendations for the design of the proposed building foundations, basement/floor-slabs, lateral earth pressure and seismic design parameters, pavement design, pipe bedding, and stormwater management facility design. In addition, comments are also included on the pertinent project construction aspects including excavation, backfill and groundwater control.

# 2.0 INVESTIGATION PROCEDURES AND METHODOLOGY

The field investigation was conducted on July 4th and 5th, 2024, and consisted of drilling and sampling a total of eight (8) exploratory boreholes (Boreholes 1 to 8) extending to termination depths ranging from approximately 5.0m to 6.6m below existing ground surface.

The boreholes were staked out in the field by Green Geotechnical based on the proposed re-development and existing site features. The approximate borehole locations are shown on enclosed Borehole Location Plan as Figure 2.

Various utility locate agencies (including a private locate company) were contacted by Green Geotechnical to clear the borehole locations prior to the commencement of the field investigation.

Borehole elevations are provided relative to existing ground surface. The horizontal coordinates are reported relative to the Universal Transverse Mercator geographic coordinate system (UTM Zone 17T). During the topographical survey to be completed by others, the borehole locations should be included so that this report can be updated to include geodetic elevations. It should be noted that the depths provided on the Borehole Logs are approximate and provided only for the purpose of relating borehole soil stratigraphy and should not be used or relied on for other purposes.

The borings were drilled by a specialist drilling contractor using a track mounted drill rig power auger and sampled at regular intervals with a conventional 50mm diameter split barrel sampler when the Standard Penetration Test (SPT) was carried out (ASTM D 1586). The field work (drilling, sampling, and testing) was observed full time and recorded by Green Geotechnical field staff, who logged the boring and examined the samples as they were obtained.

All samples obtained during the investigation were sealed into plastic jars and transported to our geotechnical laboratory for detailed inspection and testing. The borehole samples were examined (tactile) in detail by a geotechnical engineer and classified according to visual and index properties. Geotechnical laboratory testing consisted of water content determination on all samples, and grain size analysis on two (2) selected soil sample. The measured natural water contents of individual samples and the results of the grain size analysis test are plotted on the enclosed borehole logs at respective sampling depths. The results of the grain size analyses are also summarized in Section 3.6 of this report and are appended in Appendix B.

Groundwater levels were observed in the open boreholes upon the completion of drilling. Monitoring wells were installed in six (6) boreholes to facilitate one (1) stabilized groundwater level reading, which was taken on July 12th, 2024. The results of the groundwater level readings are enclosed on the borehole logs and summarized in Section 3.5 of this report.

# 3.0 SUBSURFACE CONDITIONS

The specific soil conditions encountered at each borehole location are described in greater detail on the Borehole Logs, with a summary of the general subsurface soil conditions outlined below. This summary is intended to correlate this data to assist in the interpretation of the subsurface conditions at the site. The borehole logs are enclosed in Appendix A.

It should be noted that the subsurface conditions are confirmed at the borehole locations only and may vary between and beyond the borehole locations. The boundaries between the various strata as shown on the logs are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geologic change.

## 3.1 Topsoil

Surficial topsoil with a thickness of approximately 0.2m to 0.5m was encountered at the ground surface of all Boreholes except Borehole 1. The topsoil was dark brown in colour.

Topsoil thicknesses provided in this report were obtained at the individual borehole locations, as measured through the collar of the open borehole. Thicknesses may vary between and beyond borehole locations and should not be used/relied upon for costing purposes.

## 3.2 Earth Fill

Earth fill was encountered in all boreholes underlying the surficial topsoil and extended to depths of approximately 0.8m to 0.9m below grade, where it was underlain by native soils. The earth fill was comprised predominantly of a sand to sandy silt, with trace to some gravel, and trace clay.

The Standard Penetration Test results (N-Values) obtained from the earth fill zone ranged from 3 to over 50 blows per 300mm of penetration, indicating a generally very loose to very dense relative density.

The in-situ moisture content of the earth fill soil samples was between approximately 4 to 18 percent by weight, indicating a generally moist condition.

## 3.3 Sand to Gravelly Sand

Native deposits of a sand to gravelly sand with silt content ranging from trace silt to silty, and trace clay was encountered in all Boreholes underlying the earth fill layer and extending to the depths between 3m and borehole termination depth (5.0m - 6.6m) below existing grades.

The Standard Penetration Test results (N-Values) obtained from the sand to gravelly sand layer was between 15 to over 50 blows per 300mm of penetration, indicating a generally compact to very dense relative density.

The in-situ moisture content of the sand to gravelly sand soil samples were between 2 to 20 percent by weight, indicating a generally moist to wet condition.

### 3.4 Glacial Till

Native deposits of a glacial till, comprised of sand till, silt till and sandy silt till, with trace to some gravel, trace to some clay, and cobble to boulder inclusions, was encountered in all Boreholes except BH2. The glacial till extended to the depths ranged between 6.1m (BH4, BH6, BH8) and 6.6m (BH1, BH3, BH5, BH7, termination depth) below existing grades.

The Standard Penetration Test results (N-Values) obtained from the glacial till layer was over 50 blows per 150mm of penetration, indicating a very dense relative density.

The in-situ moisture contents of the glacial till soil samples ranged from 8 to 17 percent by weight, indicating a generally moist condition.

### 3.5 Groundwater

The depth of ground water and caving was measured in each of the boreholes immediately following the drilling. Water level measurements were made in the monitoring wells installed in Boreholes 1, 2, 3, 4, 6, and 8, on July 12th, 2024. The ground water observations of all the boreholes are summarized as follows:

| Borehole No. | Depth of Sampling (m) | Depth to Cave (m) | Unstabilized Water Level (Depth) (m) | Stabilized Water Level in well on July 12th, 2024 (Depth) (m) | Stabilized Water Level in well on July 26th, 2024 (by Crozier) (Depth) (m) | Stabilized Water Level in well on Sept. 20th, 2024 (by Crozier) (Depth) (m) |
|---|---|---|---|---|---|---|
| 1 | 6.6 | 5.8 | 5.5 | 4.7 | 4.8 | 5.1 |
| 2 | 5.0 | Open | 3.4 | 4.2 | 4.4 | 4.5 |
| 3 | 6.6 | 3.4 | 1.5 | 1.7 | 1.9 | 2.3 |
| 4 | 6.6 | 5.8 | 3.2 | 2.2 | 2.2 | 2.4 |
| 5 | 6.6 | 5.5 | 1.0 | N/A | N/A | N/A |
| 6 | 6.6 | 5.8 | Dry | 2.5 | 2.5 | 2.8 |
| 7 | 6.6 | Open | 0.9 | N/A | N/A | N/A |
| 8 | 6.6 | Open | 3.0 | (0.3) | (0.2) | 0.3 |

It should be noted that the ground water level reading at BH8 was observed with potentially artesian conditions including a stabilized reading of approximately 0.3m above grade on July 12, 2024. It is understood that Crozier is completing a Hydrogeological Assessment at the site which will provide additional water level readings and analysis. Additional water level measurements made by Crozier on July 26 and September 20, 2024 are also included for reference. Groundwater levels will fluctuate seasonally and depending on the amount of surface runoff and precipitation.

### 3.6 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of natural moisture content determination for all samples, while grain size analysis was conducted on two selected soil samples (Borehole 1, Sample 4 and Borehole 6, Sample 4). The test results are listed on the enclosed Borehole Logs at the respective sampling depth.

The results (graphs) of the grain size analyses are appended and a summary of the results are as follows:

| Borehole No.<br>Sample No. | Sampling Depth below Grade (m) | Percentage (by mass) | | | | Descriptions<br>(MIT System) |
|---|---|---|---|---|---|---|
| | | Gravel | Sand | Silt | Clay | |
| Borehole 1, Sample 4 | 2.3 – 2.7 | 3 | 78 | 16 | 3 | SAND, some silt, trace gravel, trace clay |
| Borehole 6, Sample 4 | 2.3 – 2.7 | 1 | 19 | 70 | 10 | SILT, some sand, trace clay, trace gravel |

## 4.0 GEOTECHNICAL ENGINEERING DESIGN

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for use by the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

This report is provided on the assumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards, and guidelines of practice. If there are any changes to the site re-development features or any additional information relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then

Green Geotechnical should be retained to review the implications of these changes with respect to the contents of this report.

While a conceptual site plan is not yet available, based on conversations with C.F. Crozier & Associates Inc., it is understood that the site will be developed to include the construction of mostly single family dwellings. It is presumed that the re-development would be constructed to an urban standard with paved roads and full underground services connecting to existing infrastructure.

At the time of this investigation, no conceptual grading or servicing plans were available. It is presumed that site grades will generally be near or slightly above their current elevations. Any regrading within the influence zones of buildings, pavement structures, or settlement sensitive areas is anticipated to be done with the use of Engineered Fill.

It is recommended that once the conceptual site plan and/or civil drawings are available, Green Geotechnical should be contacted for to review and update this report accordingly from a geotechnical perspective.

## 4.1 Foundation Design Parameters

Based on the field investigation at this site, at Boreholes 1 to 8, below the surficial topsoil, earth fill, and weathered/disturbed zone, the subsurface conditions generally consist of a compact to very dense native sand/gravelly sand to silty sand/silt glacial till with sand and silt seams present at various depths within the boreholes. The undisturbed native site soils are suitable for the support of conventional spread footings. Depending on the designed underside of footing elevations, dewatering may be necessary during construction, especially in areas with high groundwater conditions. The surficial topsoil, earth fill zones, weathered/disturbed native soils or high organic soil areas and/or any other deleterious materials are not suitable to support building foundations.

The compact to very dense native soil conditions encountered will allow structure foundations to be designed with maximum net geotechnical reactions (SLS) of 150 kPa and factored geotechnical resistances (ULS) of 225 kPa at minimum 0.3m into the undisturbed native soils, subject to foundation inspection confirmation by Green Geotechnical. Greater capacity can be available at greater depths if required for specific components and can be assessed by Green Geotechnical on a case-by-case basis.

A minimum soil cover of 1.6m or equivalent insulation is recommended for frost protection to footings in exterior or unheated areas. Construction during cold weather should also ensure temporary frost protection of footing bases.

Native soils tend to weather rapidly and deteriorate on exposure to the atmosphere and surface water. The time between foundation excavation and concrete placement should be minimized as much as possible.

The minimum footing widths to be used in conjunction with the above recommended soil bearing pressures should be 0.5m for continuous footings and 0.9m for individual footings placed on native soils. The above recommended bearing capacities are based on estimated maximum total settlement of 25mm and differential settlement of 19mm.

It should also be noted that due to the variable conditions in the upper approximately 1-2m of the site, some downward stepping of footings should be anticipated in order to extend to competent soils. Footings stepped from one level to another must be at a slope not exceeding 7 vertical to 10 horizontal, and with a grade change not exceeding 600mm.

Prior to placing foundation concrete, all excavated foundation subgrade soils should be cleaned of all deleterious materials such as topsoil, fill, softened or disturbed materials as well as any standing water. It is recommended that the foundations be inspected by Green Geotechnical in order to confirm the exposed soil conditions and recommended bearing capacities.

### 4.1.1 Foundations on Engineered Fill

The undisturbed native soils beneath the topsoil and earth fill are considered suitable for the support of Engineered Fill pads for supporting building foundations. The Engineered Fill pads should extend a minimum of 1m beyond the building footprint at underside of footing elevation and extend out at a 1:1 (horizontal to vertical) slope down to the native soil subgrade approved by Green Geotechnical. Unless the foundations are constructed immediately on the Engineered Fill pad, the Engineered Fill should be built up at least an additional 0.6m in elevation to serve as a protective cap of the Engineered Fill at underside of footing level from the effects of weathering.

All deleterious or otherwise unsuitable materials such as topsoil, fill, softened or disturbed materials, as well as any standing water must be removed prior to the placement of Engineered Fill. These materials do not constitute an adequate subgrade for support of Engineered Fill. After any unsuitable materials are removed, the exposed competent native soil subgrade must be inspected and approved by Green Geotechnical prior to placement of Engineered Fill. Engineered Fill must consist of clean earth, free from any organic/topsoil or deleterious matter and must be placed in maximum 150mm thick lifts and compacted to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD). Clean onsite excavated soils can be further examined/tested by Green Geotechnical for the suitability of re-use as Engineered Fill materials. Supplemental test pits prior to Engineered Fill construction are recommended to determine suitable subgrade elevations and to confirm the suitability of on-site soils for Engineered Fill reuse. Any Engineered Fill construction must be completed under full time supervision by Green Geotechnical to monitor extent, lift thickness, compaction, material quality and the like.

Where structures are placed on at least 0.5m of Engineered Fill constructed on a subgrade approved by Green Geotechnical, the recommended maximum net geotechnical reaction may be 150kPa (SLS) and the maximum factored geotechnical resistance at Ultimate Limit State (ULS) is 225kPa.

The gradation profile of imported fill and its corresponding self-consolidation period must be considered regarding Engineered Fill. This should also be taken into account during the construction scheduling and budgeting process, to avoid significant settlements in road and foundation areas. Green Geotechnical should be consulted during this time. Coarse grained soils have significantly faster self-consolidation periods than fine-grained soils. This is discussed in greater detail in Appendix E – Engineered Fill Specifications.

Prior to placing foundation concrete, the Engineered Fill should be cleaned of all deleterious materials such as softened or disturbed materials as well as any standing water. It is recommended that the foundations be inspected by Green Geotechnical in order to confirm the exposed soil conditions and recommended bearing capacities.

The minimum footing widths to be used in conjunction with the above recommended soil bearing pressures should be 0.6m for continuous footings and 1.0m for individual footings placed on Engineered Fill. The above recommended bearing capacities are based on estimated maximum total settlement of 25mm and differential settlement of 19mm.

It should be noted that for structures placed on Engineered Fill, nominal reinforcing steel (rebar) at a minimum be placed in the foundations comprising two (2) continuous 15M bars in the strip footings, and two (2) continuous 15M bars at the top and bottom of the foundation walls be provided. Any column footing will require 15M bars spaced at 0.3m on centre, in each direction of the column. The reinforcing steel requirements of the structure are to be reviewed by a structural engineer.

A copy of “Engineered Fill Earthworks Specifications” is enclosed in Appendix E of this report for reference purposes. These specifications should be included in the earthworks contract.

## 4.2 Slab-on-Grade or Basement Floor Design Parameters

Groundwater levels recorded at this site ranged between approximately ±0.3m above existing grade to ±4.7m below existing grade in July of 2024. It is understood that Crozier is completing a Hydrogeological Assessment at the site which will provide additional water level readings and analysis. **All finished floor surfaces are recommended to be at least 0.5m above the prevailing seasonally high groundwater level.**

All non-structural earth fill, topsoil, organics and any other deleterious or unsuitable materials must be removed prior to slab-on-grade/basement floor slab construction. These materials do not constitute an adequate subgrade for support of Engineered Fill. After any unsuitable materials are removed, the exposed soil subgrade must be inspected and approved by Green Geotechnical at the time of construction. All structural fill must be placed in maximum 150mm thick lifts and compacted to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD). Conventional lightly loaded concrete slab-on-grade or basement floors can be placed on the Engineered Fill. The vertical moduli of subgrade reaction for compacted fill soils at the site is 18,000 kPa/m.

It is necessary that building floor slabs be provided with a capillary moisture barrier and drainage layer. This is accomplished by placing the slab on a minimum 200mm layer of 19mm clear stone (OPSS.MUNI 1004) compacted by vibration to a dense state. The upper 50mm of the 200mm drainage layer may be replaced with 50mm of Granular A (OPSS.MUNI 1010) to provide a trafficable surface. The 19mm clear stone can be replaced in its entirety with Granular 'A' so long as a minimum 10mil poly-vapour barrier is used below the slab base. However, these do not replace the floor manufacturers' specific requirement(s) for a moisture and vapour barrier. A suitable non-woven geotextile filter (Terrafix 360R or equivalent approved by Green Geotechnical) must be installed (with a minimum 900mm overlap) below the capillary moisture break to properly filter the slab base from the subgrade. Otherwise, this could result in the loss of ground supporting the slab and clogging of the slab base.

**All basement floors should be constructed at least 0.5m above the seasonally high water level.** Perimeter weeping drains (filtered) are recommended to be installed leading to positive outlets such as a sump pump in the basements. Normal basement damp proofing with Miradrain is recommended. Basement walls must be backfilled either with imported Granular "B" type backfill or drainage mediums as per the Ontario Building Code. The insitu soils are not considered to be suitable for reuse as backfill against basement walls unless damp proofing measures as specified in the Ontario Building Code are taken on foundation walls. Typical Basement Drainage Details are provided in the attached Appendix C.

**Where a basement level is within 1.0m of the water table, under-floor drains should be considered.** Under floor drainage tiles should consist of placing rows of 100mm diameter perforated drainage pipe leading to a positive sump or outlet. It is recommended that the under-floor drain invert be placed at least 300mm below the underside of the floor slab. Drainage tiles should be placed in parallel rows 3m on centre in each direction. The drainage tile must be surrounded with 100mm of rounded clear stone, completely wrapped in filter fabric. It is essential that the clear stone is separated from the subgrade by using an approved geotextile fabric material (effective opening size of less than 130 microns). Typical Basement Drainage Details are provided in the attached Appendix C.

The basement drainage system is a critical structural element since it keeps water pressure from acting on the basement floor slab or on the foundation walls, in addition to keeping moisture out of the basement. The size and arrangement of the pump system and battery backup system should be designed to be adequate to accommodate the anticipated groundwater and storm event flows. The subdrain system should be outlet to a suitable discharge point under gravity flow or connected to a sump located in the lowest level of the basement. The water from the sump must be pumped out to a suitable discharge point/positive outlet. The installation of the drains as well as the outlet must conform to the applicable plumbing code requirements.

Regardless of the approach to slab/basement floor construction, the floor slabs that are to have bonded floor finishes (such as tiles with adhesives) should be provided with a capillary moisture and vapour barrier and drainage layer. The floor manufacturers have specific requirements for moisture and vapour barrier, therefore, the floor designer/architect must ensure that a provision of appropriate moisture and vapour barrier conforming to specific floor finish product requirements is incorporated in the project specifications. Adequate testing must be carried out to ensure acceptable levels of moisture and relative humidity in the concrete slab prior to the installation of floor finish(es).

The under-slab vapour retarder specifications, selection and installation shall conform to ASTM E1745 and ASTM E1643. The moisture vapour measurement tests shall conform to RH: ASTM F2170, RH: ASTM F2420 and Calcium Chloride: ASTM F1869. The Surface Applied Moisture Vapour Barrier system shall meet the guidelines established in ASTM F3010-13.

## 4.3 Earthquake Design Parameters

The Ontario Building Code stipulates the methodology for earthquake design analysis. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

Under Ontario Regulation 88/19, the ministry amended Ontario’s Building Code (O. Reg 332/12) to further harmonize Ontario’s Building Code with the 2015 National Codes. These changes will help reduce red tape for businesses and remove barriers to interprovincial trade throughout the country. The amendments are based on code change proposals the ministry consulted in 2016 and 2017. The majority of the amendments came into effect on January 1, 2020, which includes structural sufficiency of buildings to withstand external forces and improve resilience.

Seismic hazard is defined in the Ontario Building Code (OBC) by uniform hazard spectra (UHS) at spectral coordinates of 0.2s, 0.5s, 1.0s and 2.0s and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g., shear wave velocity (vs), Standard Penetration Test (SPT) resistance, and undrained shear strength ($s_u$) in the top 30 meters of the site stratigraphy below the foundation level, as set out in the Ontario Building Code. There are 6 site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g., sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain peak ground acceleration (PGA), peak ground velocity (PGV) site coefficients Fa and Fv, respectively, used to modify the UHS to account for the effects of site-specific soil conditions.

Based on the above, it is recommended that the site designation for seismic analysis be **Site Class C**, as per the Ontario Building Code. It should be noted that the above site seismic designation is estimated on the basis of rational analysis of the average standard penetration strength information obtained from the boreholes advanced at the site only up to about 6.6m depth below grade. Consideration may be given to conducting a site-specific Multichannel Analysis of Surface Waves (MASW) at this site to confirm the average shear wave velocity in the top 30m of the site stratigraphy. MASW testing often determines higher seismic site class ratings than those able to be determined from SPT testing, resulting in potential project cost savings.

The values of the site coefficient for design spectral acceleration at period T, F(T), and of similar coefficients F(PGA) and F(PGV) shall conform to Tables 4.1.8.4.B. to 4.1.8.4.I. using linear interpolation for intermediate values of PGA.

## 4.4 Lateral Earth Pressure Design Parameters

The appropriate values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows:

| **Stratum/Parameter** | **$\gamma$** | **$\phi$** | **$K_a$** | **$K_o$** | **$K_p$** |
|---|---|---|---|---|---|
| Compact Granular Fill<br>Granular 'B' (OPSS.MUNI 1010) | 21 | 32 | 0.31 | 0.47 | 3.25 |
| Earth Fill | 18 | 28 | 0.36 | 0.53 | 2.76 |
| Glacial Till | 19 | 32 | 0.31 | 0.47 | 3.25 |
| Sand to Gravelly Sand | 20 | 32 | 0.31 | 0.47 | 3.25 |

where: $\gamma$ = bulk unit weight of soil (kN/$m^3$)

$\varphi$ = internal angle of friction (degrees)

$K_a$ = Rankine active earth pressure coefficient (dimensionless)

$K_o$ = Rankine at-rest earth pressure coefficient (dimensionless)

$K_p$ = Rankine passive earth pressure coefficient (dimensionless)

The above earth pressure parameters pertain to a horizontal grade condition behind a retaining structure. Values of earth pressure parameters for an inclined retained grade condition will vary.

Walls subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

$$P = K[\gamma(h - h_w) + \gamma' h_w + q] + \gamma_w h_w$$

where,

**P** = the horizontal pressure at depth, **h** (m)

**K** = the earth pressure coefficient

**$h_w$** = the depth below the groundwater level (m)

**γ** = the bulk unit weight of soil, (kN/m$^3$)

**γ'** = the submerged unit weight of the exterior soil, (γ - 9.8 kN/m$^3$)

**q** = the surcharge loading (kPa)

The above equation pertains to a horizontal grade condition behind a retaining structure. Values of earth pressure against retaining structures for an inclined retained grade condition will vary.

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall that would otherwise act in conjunction with the earth pressure, this equation can be simplified to:

$$P = K[\gamma h + q]$$

Resistance to sliding of retaining structures is developed by friction between the base of the footing and the soil. This friction **(R)** depends on the normal load on the soil contact **(N)** and the frictional resistance of the soil **(tan ϕ)** expressed as: **R = N tan ϕ**. This is an unfactored resistance. The factored resistance at ULS is **$R_f$ = 0.8 N tan ϕ**.

## 4.5 Pavement Design

The pavement subgrade is expected to comprise of native, undisturbed compact sand to silty sand glacial till with sand and silt seams, or clean earth fill compacted to a minimum of 98% of SPMDD. **The topsoil and non-structural earth fill should be removed from the pavement structure's zone of influence and the pavement structure should be built on a native soil subgrade approved by Green Geotechnical or Engineered Fill placed and compacted under Green Geotechnical's full-time supervision.** The exposed subgrade should be shaped and graded with a typical 3% cross-fall, directed towards continuous subdrains with inverts at least 0.3m below subgrade level.

All topsoil, earth fill, organic-rich, and otherwise deleterious material should be sub-excavated. The pavement subgrade should be assessed (proof rolled with a heavy rubber-tired vehicle, if deemed feasible by Green Geotechnical) and approved (no rutting or major deflections) by Green Geotechnical to ensure stability prior to the placement of the pavement granular courses. All unstable areas will require sub-excavation and re-compaction or increased thickness of granular subbase. It should be noted that the majority of the upper site soils are considered low to moderately frost susceptible, with pockets that have higher frost susceptibility. Therefore, adequate subgrade drainage is recommended.

Based on the soil conditions encountered during our investigation, we recommend the following pavement structure for light duty and heavy duty traffic areas:

| **Pavement Structural Layers** | **Min. Thickness (mm)** | | **Compaction Requirements** |
|---|---|---|---|
| | **Light Duty Traffic** | **Heavy Duty Traffic** | |
| Hot Mix Asphalt Surface Course, OPSS 1150 HL 3 | 40 | 50 | as per OPSS 310 |
| Hot Mix Asphalt Binder Course, OPSS 1150 HL 8 | 60 | 80 | |
| Base Course, OPSS.MUNI 1010, Granular A or 19mm Crushed Stone | 150 | 150 | 100 percent of Standard Proctor Maximum Dry Density (SPMDD) (ASTM D698) |
| Subbase Course, OPSS.MUNI 1010, Granular B 'Type II' or 50mm Crushed Stone | 300 | 450 | 98 percent of Standard Proctor Maximum Dry Density (SPMDD) (ASTM D698) |

The above design assumes that sub-drainage of the granular fill will be provided. This should consist of continuous subdrains leading to catch basins and/or open ditches.

The native subgrade soils are typically low to moderately frost susceptible, with pockets that have higher frost susceptibility. The subdrains are considered a valuable protection against frost heave damage and subgrade softening particularly impacting the long-term performance of the pavement.

An adequate granular working surface would be likely required in order to minimize subgrade disturbance and protect its integrity in wet periods. The fill material may consist of granular type material with a moisture content within ±2 percent of optimum moisture content. Fill materials placed to construct the pavement structure's subgrade should be placed and compacted to 98 percent of SPMDD.

The granular subbase and base fill materials should be compacted to a minimum of 98% and 100% of Standard Proctor Maximum Dry Density (SPMDD), respectively, placed in lifts of 150mm or less. Asphaltic concrete materials should be rolled and compacted as per OPSS 310 based on density testing. **Due to the site's groundwater conditions and the susceptibility of the site soils to disturbance, care should be taken that construction occurs in the driest summer periods. If this is not possible, the granular subbase may require additional thickness.**

Control of surface water is an important factor in achieving a good pavement life. The need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (preferably at a minimum grade of 3 percent) to provide effective drainage toward subgrade drains.

Grading adjacent to pavement areas should be designed to ensure that water is not allowed to pond adjacent to the outside edges of the pavement. Continuous pavement subdrains should be provided along both sides of the driveway and drained into respective catch basins or ditch lines to facilitate drainage of the subgrade and the granular materials. The subdrain inverts should be maintained at least 0.3m below subgrade level. Continuous subdrains should also be provided for pavement areas along any curb-lines/sidewalks. Two lengths of subdrain stubs (each minimum 3m long) should be installed at each catch basin (refer to Appendix D - Pavement Drainage Details).

Sidewalks and concrete walkways should be provided with a minimum granular base thickness of 150mm, consisting of 19mm Crusher Run Limestone conforming to OPSS 1010 Granular ‘A,’ compacted to 98% of SPMDD. The subgrade in the sidewalk and boulevard should be sloped to promote drainage to the nearest surface runoff drainage feature to help minimize concrete slab heaving.

For sidewalks which will minimize long term maintenance, consideration can also be given to supporting the concrete surface sidewalk on a minimum of 1.6m thick of non-frost susceptible material to help minimize frost heaving.

The above pavement design thicknesses are considered adequate for typical residential subdivision design traffic. However, if the pavement construction occurs in wet or inclement weather, it may be necessary to provide additional subgrade support for heavy construction traffic by increasing the thickness of the granular sub-base, base or both. Further, traffic areas for construction equipment may experience unstable subgrade conditions. These areas may be stabilized utilizing additional thickness of granular materials.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures must be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as possible when fill is placed, and the natural subgrade is not disturbed or weakened after it is exposed.

It should be noted that in addition to adherence of the above pavement design recommendations, a close control on the pavement construction process will also be required in order to obtain the desired pavement life. Therefore, it is required that regular inspection and testing by Green Geotechnical be conducted during the pavement construction to confirm material quality, stability, thickness, and to ensure adequate compaction.

## 4.6 Pipe Bedding

Trench bases are expected to consist primarily of native, undisturbed compact sand to gravelly sand or glacial till, or clean earth fill compacted to a minimum of 98% of SPMDD. Native undisturbed soils and Engineered Fill will generally be suitable for support of underground services with conventional Class ‘B’ granular bedding. **Non-structural earth fill should be removed from the pipe's zone of influence and the pipe bedding should be built on a native soil subgrade approved by Green Geotechnical or Engineered Fill placed and compacted under Green Geotechnical's full-time supervision.** Additional granular bedding may be necessary for stabilization of wet trench bases or particularly soft areas. The granular bedding should consist of a well graded material such as Granular 'A'. Excavation bases should be free of standing water prior to and during bedding and service placement.

Any soft, loose, or disturbed soils encountered as a result of groundwater seepage or construction traffic should be subexcavated and replaced with suitably compacted granular fill. Additionally, any loose or deleterious fill or organics encountered below proposed pipe inverts should be subexcavated and replaced with suitable compacted bedding material. Granular 'A' bedding material should be placed in thin lifts and compacted to a minimum of 95% of SPMDD. If HL8 coarse aggregate or 19mm clear stone is used this will require light tamping only. However, it should be cautioned that this HL8 aggregate or clear stone should not be used directly against native deposits unless a geotextile fabric is also considered as a complete wrap to prevent migration of fines into the bedding from the surrounding fine soil. Without proper filtering, this loss of ground could result in loss of support to the pipes and in possible future.

In areas where the soils become wet, unstable and dilatant (easily disturbed) such as saturated silts, clays and water bearing granular soils, careful construction techniques and dewatering should be followed. If the pipes are laid on disturbed, dilatant soil, significant post-construction settlements could occur after the trenches are backfilled. In such cases, disturbed soils must be removed. The bottom of wet trenches will have to be stabilized by dewatering. The placement of a thin layer of lean mix concrete or a 'mud slab' may be considered to prevent heaving of sensitive or easily disturbed sub-soils and prevent disturbance of sensitive sub-soils due to construction activity. If a 'mud slab' option is not used, then increasing the Class 'B' type bedding thickness in order to stabilize the subgrade soil is recommended.

## 4.7 Stormwater Management Facilities

Proposed side slopes associated with any SWMP should be finalized at 3:1 (horizontal to vertical) or flatter above the ground water level for overall stability and for maintenance. Slopes below the ground water levels and/or permanent pool level are recommended to be sloped to about 5:1 or flatter (horizontal to vertical). All bare surfaces should be covered with topsoil and seeded upon completion in order to minimize long term surface erosion.

Depending upon the ground water level at the time of SWMP construction, some difficulty may be encountered with the movement of construction equipment on the site, especially when the excavation approaches the base elevations. For this reason, the construction is recommended to be carried out during dry weather months (summer months).

It is recommended that the proposed SWMP be lined with a minimum thickness of 0.9m of clay soil to prevent interference with groundwater. The clay liner soil should be compacted to at least 95% of SPMDD, at ±3% optimum moisture content, in maximum 200mm thick lifts. The clay liner shall consist of at least 10% clay sizes, at least 35% silt sizes, and at most 40% sand sizes (by weight) and must be free of organics, topsoil inclusions, cobbles and boulders. The native soils at this site are not expected to meet this grain size profile specification based on the grain size analysis laboratory tests completed.

As an alternative option, a geosynthetic clay liner such as a Terrafix-Bentofix could be used. A specialist designer/manufacturer will need to be consulted in order to provide an appropriate geosynthetic design which will perform adequately under the variety of soil and groundwater conditions anticipated.

Where ground water enters the proposed pond through walls, additional slope protection/support may be required in the form of rip-rap placed on filter fabric. The pond designers should assess uplift/unbalanced hydrostatic forces created on geosynthetic SWMP liners at elevations below the groundwater table. These uplift/unbalances hydrostatic forces from the groundwater table require countermeasures, such as surcharge soil weight to resist these forces. The specialist designer/manufacturer will need to be consulted in order to provide an appropriate geosynthetic design which will perform adequately under the variety of soil and groundwater conditions anticipated.

Depending on proposed pond base elevations, it is possible that ground water seepage could occur during the sub-excavation process. Sloughing of soils may occur during the sub-excavation works. Contractors should be prepared to meet the possibility of ground water constraints and disturbed subgrade soils. Depending on design elevations and the location of any proposed SWMP relative to potential artesian groundwater conditions, dewatering may be required during construction.

The native site soils may have moisture constraints with regard to re-use and moisture conditioning may be required to achieve the recommended compactive effort. General berm fills should be placed in lifts not exceeding 150mm in thickness, compacted to 98% of SPMDD at ±2% optimum moisture content.

Granular materials and crusher run limestone materials scheduled for use on maintenance access roads are recommended to be compacted to 100% and 98% of SPMDD for base and subbase layers respectively.

Clay trench pug/anti-seepage collars can be used to minimize the amount of seepage from pipes/pipe connections where deemed required by the designer in relatively pervious (sand, gravel) site soil conditions. Proposed clay trench plug/anti-seepage collars should be at least 1.0m thick, measured along the pipe, and should completely replace any granular bedding and relatively pervious (sand, granular) backfill. The clay plug must be compacted to a minimum of 95% of SPMDD.

The clay plug material should have a coefficient of permeability less than $10^{-6}$ cm/s and must include a minimum of 15 percent clay (finer than 0.002mm) and 30 percent silt sized (finer than 0.06mm) particles. The backfill material must not include particles greater than 100mm in diameter, greater than 15 percent of the material larger than 4.8mm size (No. 4 sieve), and greater than 5 percent organic content by weight, as well as visible roots or topsoil.

Alternatively, seepage cut off collars can be installed around the pipe barrel to achieve the same effect. Collars should not be placed closer than 1.0m to a pipe joint and precautions should be taken to ensure that a minimum of 95% of SPMDD is achieved around the collars. Watertight connections are required between the collar and pipe wall.

Some maintenance of slopes may be required in the first years until a strong vegetative growth of ground cover is established.

## 4.8 Soil Permeability

Laboratory testing was conducted on two select soil samples at various depths (BH1 SS4, and BH6 SS4) to determine estimated coefficients of permeability. The results of the soil gradation are appended and estimated Hydraulic Conductivities, Percolation Rates (T-Times), and Infiltration Rates are summarized below:

| Testing Location | Soil Description (MIT System) | Sampling Depth<br>Below Grade (m) | Estimated Hydraulic Conductivity (cm/sec) | Estimated Percolation Rate (T-Time) (mins/cm) | Estimated Infiltration Rate (mm/hr) |
|---|---|---|---|---|---|
| BH1 SS4 | SAND, some silt, trace gravel, trace clay | 2.3 – 2.7 | 1.0 x$10^{-4}$ | 12 | 50 |
| BH6 SS4 | SILT, some sand, trace clay, trace gravel | 2.3 – 2.7 | $10^{-5}$ to <$10^{-6}$ | 40 to >50 | <12 – 20 |

**Note: Based on geotechnical laboratory grain size analysis, the T-Times and infiltration rates are estimated as per Table C1 'Approximate relationships between hydraulic conductivity, percolation time and infiltration rate' of the Low Impact Development Stormwater Management Planning and Design Guide.**

It should be noted that the hydraulic conductivities, soil permeabilities, and infiltration rates as noted above are estimated based on the composition of the soil samples tested. It should also be noted that the soil conditions may vary between and beyond the boreholes and there can also be variation within the soil layers. The above infiltration rates do not include any factors of safety. The application or non-application of factors of safety are to be determined by the design engineer. Designs must be conducted by a qualified professional engineer with due regard to site-specific conditions and other design considerations.

# 5.0 CONSTRUCTION CONSIDERATIONS

## 5.1 Excavation and Backfill

Excavations must be carried out in accordance with the Occupational Health and Safety Act, Ontario Regulation 213/91 (as amended), Construction Projects, Part III – Excavations, Sections 222 through 242. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety. For practical purposes, the site soils are considered Type 3 soils above, and Type 4 soils below the prevailing groundwater table.

Where workers must enter excavations advanced deeper than 1.2 m, the trench walls should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The regulation stipulates safe slopes of excavation by soil type as follows:

| Soil Type | Base of Slope | Steepest Slope Inclination |
|---|---|---|
| 1 | within 1.2 metres of bottom of trench | 1 horizontal to 1 vertical |
| 2 | within 1.2 metres of bottom of trench | 1 horizontal to 1 vertical |
| 3 | from bottom of trench | 1 horizontal to 1 vertical |
| 4 | from bottom of trench | 3 horizontal to 1 vertical |

Minimum support system requirements for steeper excavations are stipulated in the Occupational Health and Safety Act and Regulations for Construction Projects, and include provisions for timbering, shoring and moveable trench boxes.

The subsurface soils can be removed by conventional excavation equipment. Cobble/boulder obstructions are expected. Larger size particles (cobbles and boulders) that are not specifically identified in the boreholes may be present in the native soils. The size and distribution of cobbles/boulders/obstructions cannot be predicted with boreholes, as the sampler size is insufficient to secure representative particles of this size. The risk and responsibility for the removal and disposal of cobbles/boulders/obstructions and appropriate use of equipment must be addressed in the contract documents for foundations, excavations and shoring contractors.

The surficial topsoil, earth fill, and native soil layers with amounts of organics should not be reused as backfill in settlement sensitive areas (building footprints, trench backfill and pavement areas). However, these materials may be stockpiled and reused for landscaping purposes.

Unsaturated native soils (free of organics, boulders, and deleterious inclusions) encountered within excavations above the water table are considered to be suitable for reuse as trench backfill. It should be noted that native soils excavated from below the prevailing groundwater level (if encountered) will likely be too wet to compact to required compaction specification.

The moisture content of the backfill soils should be within 2 percent of their optimum moisture content. Any soil material with in-situ moisture content higher than 2 percent of its optimum moisture content could be put aside to dry or be tilled to reduce the moisture content so that it can be effectively compacted. Alternatively, materials of higher moisture content could be wasted and replaced with imported material which can be readily compacted.

In settlement sensitive areas, the backfill should consist of clean earth and should be placed in lifts of 150mm thicknesses or less, and heavily compacted to a minimum of 95 percent SPMDD at a water content close to optimum. The soils encountered on the site, and imported granular type fill will be best compacted with a heavy smooth drum type roller.

It should be noted that the site soils are generally moderately to highly permeable and will be difficult to handle and compact should they become wetter as a result of inclement weather or seepage. Hence, it can be expected that earthworks will be difficult during the wet periods (i.e., spring and fall) of the year and may result in increased earthwork costs.

It is recommended that inspection and testing be carried out by Green Geotechnical during construction to confirm trench backfill quality, lift thickness, and to ensure adequate compaction.

## 5.2 Groundwater Control

Groundwater levels recorded at this site ranged between approximately ±0.3m above existing grade to ±4.7m below existing grade in July of 2024. However, long term monitoring was beyond the scope of this investigation and the seasonal water table may fluctuate. It is understood that Crozier is completing a Hydrogeological Assessment at the site which will provide additional water level readings and analysis. Seepage above the groundwater levels should be handled adequately using filtered sump pumps placed at the base of the excavations for most of the site. More significant dewatering efforts will be required near or below the groundwater levels, and particularly in sandy/gravelly soil pockets.

Moderately to highly permeable soils were encountered in the boreholes. These soils may yield moderate to high amounts of groundwater seepage into the excavation depending upon the type of soil and the depth of excavation. The amount of water seepage is expected to increase with the depth of excavation. Groundwater control will be required for excavations extending into/or below the prevailing groundwater level, prior to and during the subsurface construction. Without positive groundwater control, the subgrade in wet permeable soils will become weak/disturbed and lose its integrity to support.

Consideration should be given to install a skim coat of lean concrete (mud-slab) to preserve the subgrade integrity in these areas, and to provide a working platform, as deemed appropriate by the project geotechnical engineer during construction.

All finished floor surfaces are recommended to be at least 0.5m above the prevailing seasonally high groundwater level.

It should be noted that excavations carried through and below the water bearing soils will likely experience loosening and sloughing of the base and sides unless the groundwater level is lowered first to at least 1.0m below the bottom of the excavation.

## 5.3 Quality Control

The foundation installations must be reviewed in the field by Green Geotechnical, the geotechnical engineer, as they are constructed. The on-site review of the condition of the foundation subgrade as the foundations are constructed is an integral part of the geotechnical design function. If Green Geotechnical is not retained to carry out foundation evaluations during construction, then Green Geotechnical accepts no responsibility for the performance or non-performance of the foundations, even if they are ostensibly constructed in accordance with the conceptual design advice contained in this report.

The long-term performance of the pavement is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as practically possible. The design advice in this report is based on an assessment of the subgrade support capabilities as indicated by the boreholes. These conditions may vary across the site depending on the final design grades and therefore, the preparation of the subgrade and the compaction of all fill should be monitored by Green Geotechnical at the time of construction to confirm material quality, thickness, and to ensure adequate compaction.

The requirements for fill placement on this project have been stipulated relative to Standard Proctor Maximum Dry Density (SPMDD). In situ determinations of density during fill placement on site are required to demonstrate that the specified placement density is achieved. Green Geotechnical can provide sampling and testing services for the project as necessary, with our qualified technical staff.

Concrete will be specified in accordance with the requirements of CAN3 - CSA A23.1. Green Geotechnical maintains a concrete laboratory and can provide concrete sampling and testing services for the project as necessary.

# 6.0 LIMITATIONS AND REPORT USE

## 6.1 Procedures

This subsurface investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Green Geotechnical and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained by Green Geotechnical.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Green Geotechnical has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Green Geotechnical has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling. Contractors bidding on or undertaking work on the project should be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, cognizant of the risks implicit in the subsurface investigation activities so that they may draw their own conclusions as to how the subsurface conditions may affect them.

## 6.2 Changes in Site and Scope

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Groundwater levels are particularly susceptible to seasonal fluctuations.

The discussion and recommendations are based on the factual data obtained from this investigation made at the site by Green Geotechnical and are intended for use by the owner and its retained designers in the design phase of the project. If there are changes to the project scope and re-development features, the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructability issues and quality control may not be relevant or complete for the revised project. Green Geotechnical should be retained to review the implications of such changes with respect to the contents of this report.

This report was prepared for the express use of 1000719578 Ontario Inc. and their retained design consultants and is not for use by others. This report is copyright of Green Geotechnical Inc., and no part of this report may be reproduced by any means, in any form, without the prior written permission of Green Geotechnical and 1000719578 Ontario Inc., who are the authorized users.

It is recognized that the regulatory agencies in their capacities as the planning and building authorities under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

We trust the foregoing information will satisfy your present requirements. If you should have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Sincerely,

**Green Geotechnical Ltd.**

TAKuchar

**Li Chang, P.Eng.**
Project Manager

**Tristan Kuchar, B.A.Sc., E.I.T.**
Project Manager

Steven Green

**Steven Green, P.Eng.**
President

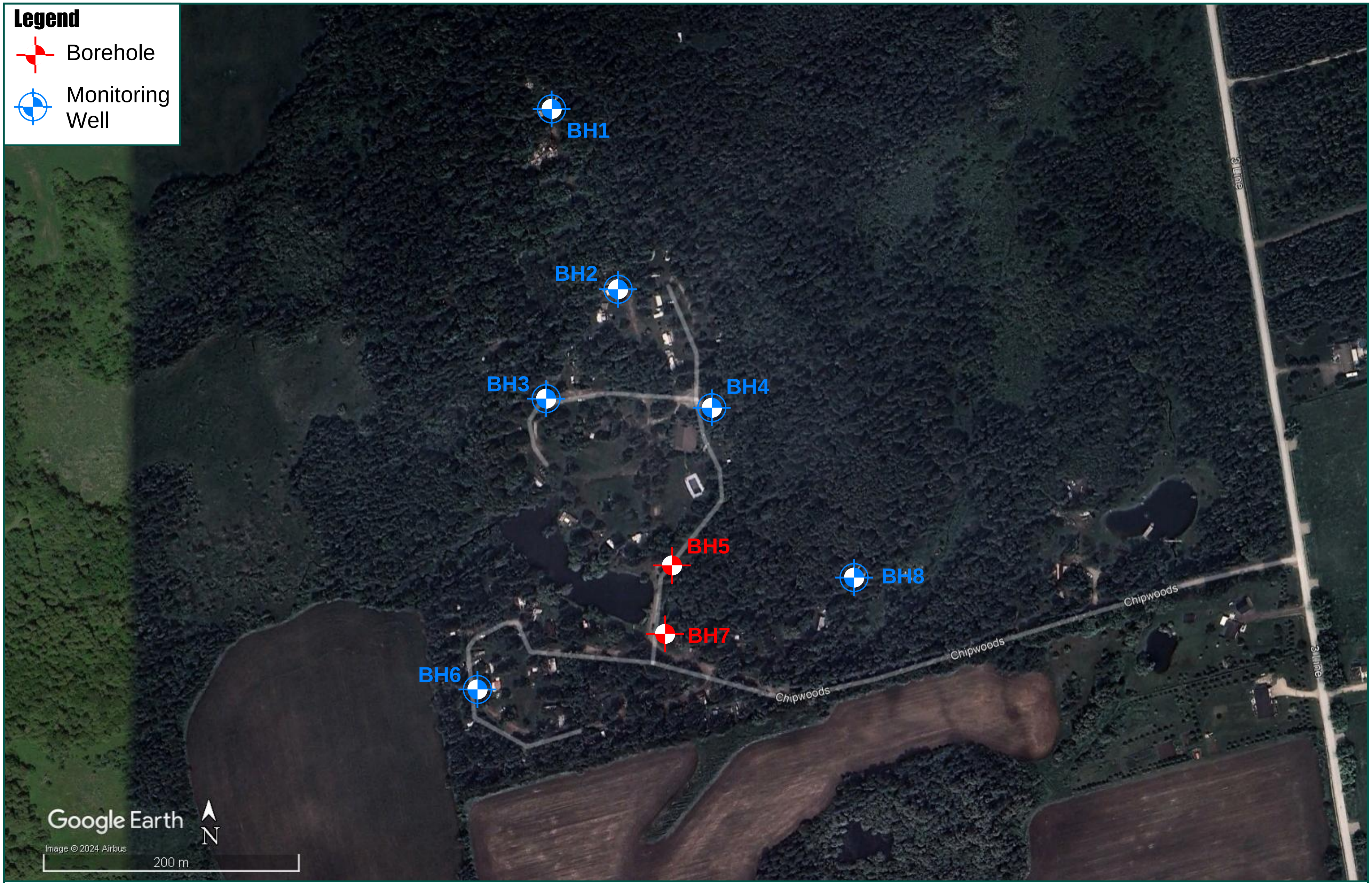
LICENSED PROFESSIONAL ENGINEER
S. C. GREEN
100175284
May 29, 2025
PROVINCE OF ONTARIO

# FIGURES

Title:

# FIGURE 1: SITE LOCATION PLAN

| | | | |
|---|---|---|---|
| Project:<br>**Chipwoods Park, Melancthon, Ontario** | Drawn By:<br>**LC** | Project Number:<br>**24-057-01** | **GREEN GEOTECHNICAL** |
| Reference:<br>**Map Data © 2024 Google Maps** | Reviewed By:<br>**TK** | Date:<br>**July 2024** | **576 Bryne Drive, Unit 'O', Barrie, ON**<br>**705-503-9626**<br>**info@greengeo.ca** |



Title:

# FIGURE 2: APPROXIMATE BOREHOLE LAYOUT PLAN

| | | |
|---|---|---|
| Project:<br>**Chipwoods Park, Melancthon, Ontario** | Drawn By:<br>**LC** | Project Number:<br>**24-057-01** |
| Reference:<br>**Map Data © 2024 Google Maps** | Reviewed By:<br>**TK** | Date:<br>**July 2024** |

GREEN GEOTECHNICAL

576 Bryne Drive, Unit 'O', Barrie, ON
705-503-9626
info@greengeo.ca

# APPENDICIES

# APPENDIX A

# SYMBOLS and ABBREVIATIONS USED ON BOREHOLE LOGS

## PROPORTIONAL TERMS

| Term | Proportion |
|---|---|
| trace | 0 to 10% |
| some | 10 to 20% |
| -y or -ey | 20 to 35% |
| and | >35% |

## MOISTURE DESCRIPTION

| Term | Description |
|---|---|
| dry | No observable pore moisture |
| moist | Inferred pore moisture, no observable free water |
| wet | Weakened by moisture, free water on hands when handling |

## CONSISTENCY of COARSE-GRAINED SOILS

| Consistency | Blow Count N |
|---|---|
| very loose | < 4 |
| loose | 4 to 10 |
| compact | 10 to 30 |
| dense | 30 to 50 |
| very dense | > 50 |

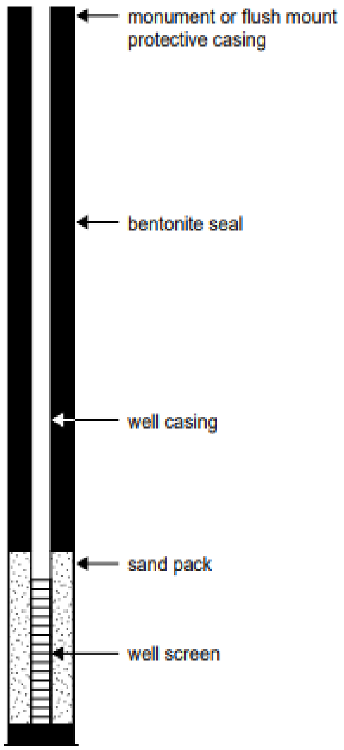
*Notes: SPT/DCPT 'N' values are 'raw' field blow counts, measured for 300 mm (12 inch) of penetration.*

## CONSISTENCY of FINE-GRAINED SOILS

| Consistency | Blow Count N | Undrained Shear Strength Su (kPa) | |
|---|---|---|---|
| very soft | < 2 | < 12 | Easily exudes between fingers when squeezed |
| soft | 2 to 4 | 12 to 25 | Easily intended by fingers |
| firm | 4 to 8 | 25 to 50 | Can be intended by strong finger or thumb pressure |
| stiff | 8 to 16 | 50 to 100 | Cannot be intended by thumb pressure |
| very stiff | 16 to 30 | 100 to 200 | Can be intended by thumb nail |
| hard | > 30 | > 200 | Difficult to intend by thumb nail |

| ASTM STANDARDS |
|---|
| **ASTM D1568 Standard Penetration Test (SPT) -** Driving a 51 mm O.D. split-barrel sampler ("split spoon") into soil with a 63.5 kg weight free falling 760mm. The blows required to drive the split spoon 300mm ("bpf") after an initial penetration of 150 mm is referred to as the N-Value. |
| **ASTM D1568 Cone Penetration Test (CPT) -** Pushing an internal still rod with a outer hollow rod ("sleeve") tipped with a cone with an apex angle of 60° and a cross-sectional area of 1000 mm$^2$<br>Into soil. The resistance is measured in the sleeve and at the tip to determine the skin friction and the tip resistance. |
| **ASTM D2573 Field Vane Test (FVT) -**<br>Pushing a four blade vane into soil and rotating it from the surface to determine the torque required to shear a cylindrical surface with the vane. The<br>torque is converted to the shear strength of the soil using a limit equilibrium analysis. |
| **ASTM D1587 Shelby Tubes (ST) -**<br>Pushing a thin-walled metal tube into the in-situ soil at the bottom of a borehole, removing the tube and sealing the ends to prevent soil movement or changes in moisture content for the purposes of extracting a relatively undisturbed sample. |

## WELL LEGEND

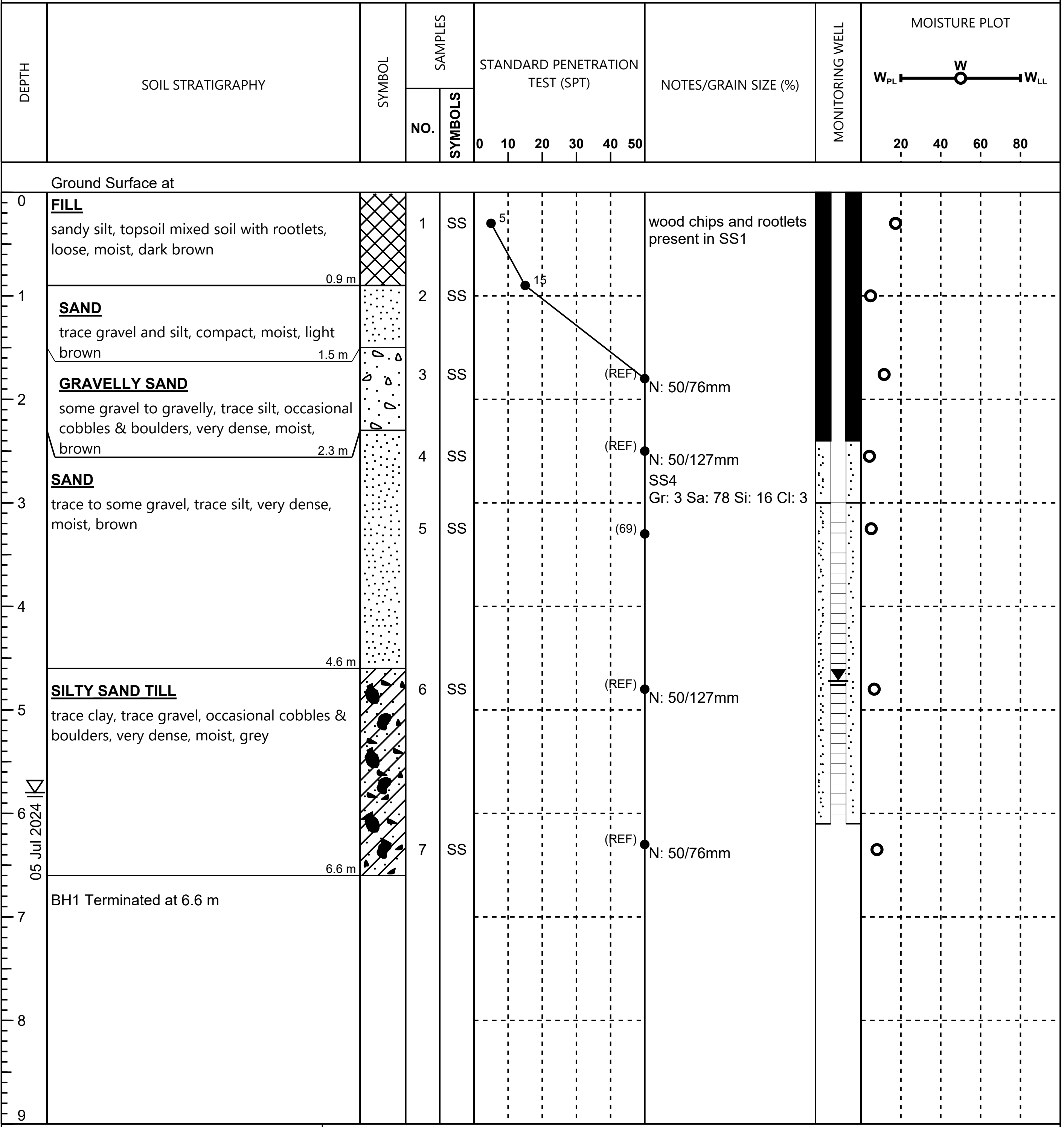


| SYMBOL | Description |
|---|---|
| AS | Auger Sample |
| CC | Continuous Core Sample |
| DC | Drill Cuttings |
| GS | Grab Sample |
| SS | SPT Spoon Sample |
| TS | Thin-walled / Shelby Sample |
| WS | Water Sample |

| SYMBOL | Description |
|---|---|
| ▼ | Measured in a piezometer or well |
| ▽ | Inferred water level based on observations during investigation |

# BOREHOLE LOG: BH1

| | | |
|---|---|---|
| Project: Chipwoods Park | | Project No.: 24-057-01 |
| Site Address: Melancthon | | Client: 1000719578 Ontario Inc |
| Easting: 562371 | Northing: 4885436 | Elevation: |
| Logged By: SO | Reviewed By: LC | Investigation Date: 2024-07-04 |



Ground Surface at

**FILL**
sandy silt, topsoil mixed soil with rootlets, loose, moist, dark brown
0.9 m

**SAND**
trace gravel and silt, compact, moist, light brown
1.5 m

**GRAVELLY SAND**
some gravel to gravelly, trace silt, occasional cobbles & boulders, very dense, moist, brown
2.3 m

**SAND**
trace to some gravel, trace silt, very dense, moist, brown
4.6 m

**SILTY SAND TILL**
trace clay, trace gravel, occasional cobbles & boulders, very dense, moist, grey
6.6 m

BH1 Terminated at 6.6 m

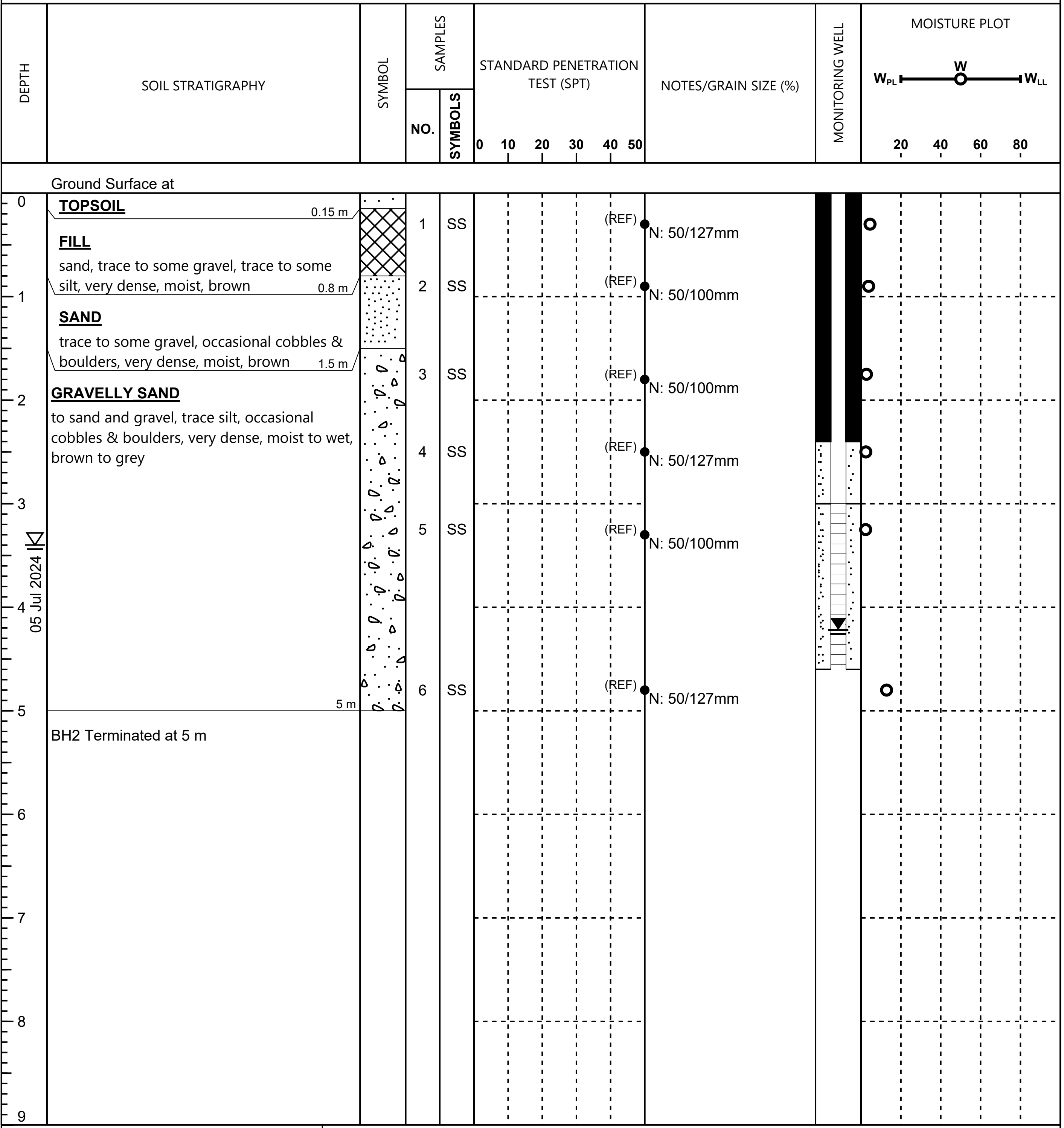
| NO. | SYMBOLS | STANDARD PENETRATION TEST (SPT) | NOTES/GRAIN SIZE (%) |
|---|---|---|---|
| 1 | SS | 5 | wood chips and rootlets present in SS1 |
| 2 | SS | 15 | |
| 3 | SS | (REF) | N: 50/76mm |
| 4 | SS | (REF) | N: 50/127mm<br>SS4<br>Gr: 3 Sa: 78 Si: 16 Cl: 3 |
| 5 | SS | (69) | |
| 6 | SS | (REF) | N: 50/127mm |
| 7 | SS | (REF) | N: 50/76mm |

RSLog / (No CPT) Soil Log with Piezometer (Letter) / green-geotechnical-ltd. / admin / August 06, 2024 09:37 AM

Notes:
Un-stabilized water level measured at 5.5 mbg.
Borehole caved to 5.8 mbg upon completion of drilling.
Water Level Reading at 4.7 mbg on 07-12-24.

# BOREHOLE LOG: BH2

Project: Chipwoods Park
Project No.: 24-057-01
Site Address: Melancthon
Client: 1000719578 Ontario Inc
Easting: 562419
Northing: 4885321
Elevation:
Logged By: SO
Reviewed By: LC
Investigation Date: 2024-07-04



Ground Surface at

| Depth | Soil Stratigraphy |
|---|---|
| 0.15 m | **TOPSOIL** |
| 0.8 m | **FILL**<br>sand, trace to some gravel, trace to some silt, very dense, moist, brown |
| 1.5 m | **SAND**<br>trace to some gravel, occasional cobbles & boulders, very dense, moist, brown |
| 5 m | **GRAVELLY SAND**<br>to sand and gravel, trace silt, occasional cobbles & boulders, very dense, moist to wet, brown to grey |

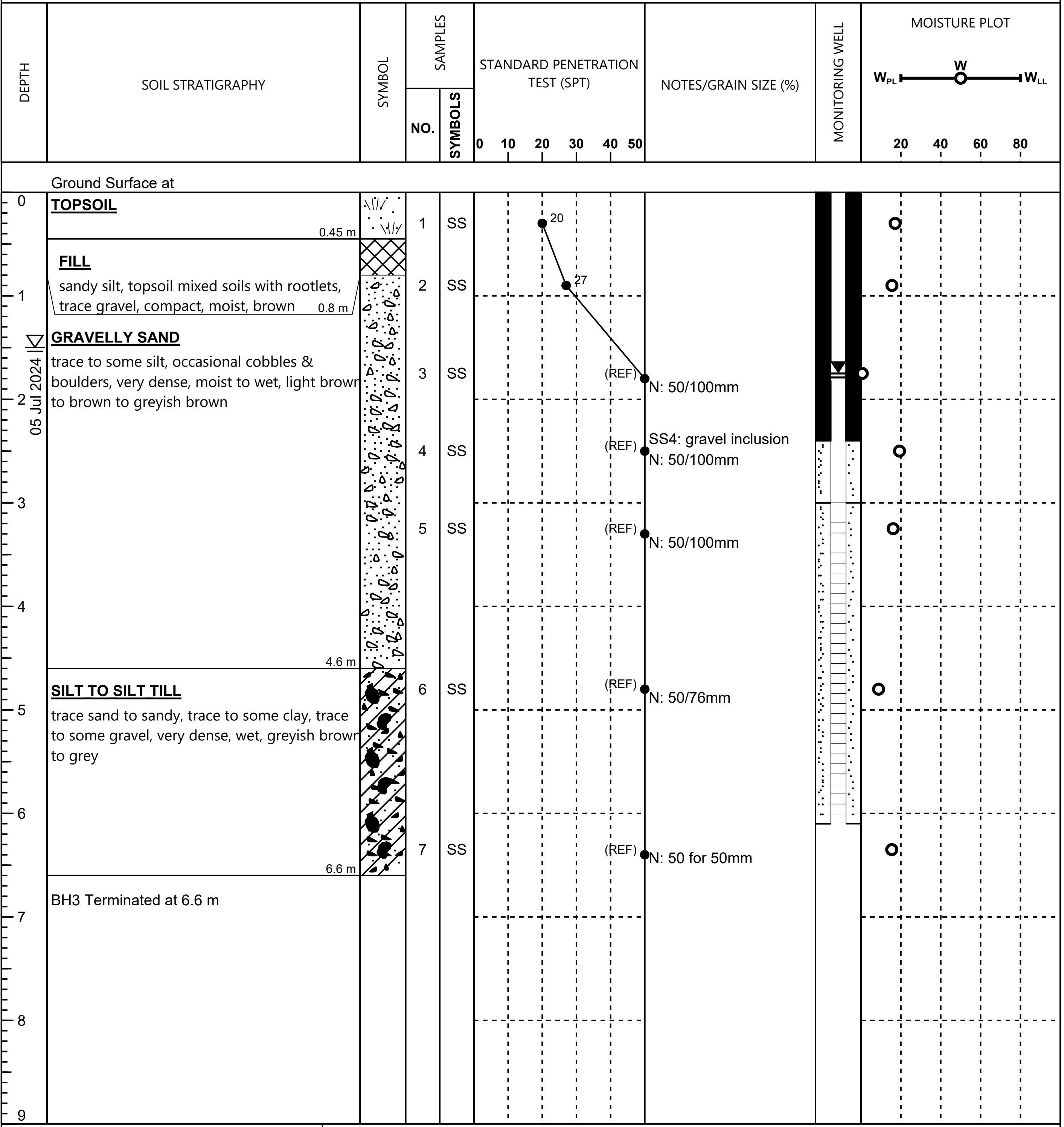
BH2 Terminated at 5 m

| No. | Symbols | SPT | Notes |
|---|---|---|---|
| 1 | SS | (REF) | N: 50/127mm |
| 2 | SS | (REF) | N: 50/100mm |
| 3 | SS | (REF) | N: 50/100mm |
| 4 | SS | (REF) | N: 50/127mm |
| 5 | SS | (REF) | N: 50/100mm |
| 6 | SS | (REF) | N: 50/127mm |

Notes:
Un-stabilized water level measured at 3.4 mbg.
Borehole was open upon completion of drilling.
Water Level Reading at 4.2 mbg on 07-12-24.

# BOREHOLE LOG: BH3

Project: Chipwoods Park
Project No.: 24-057-01
Site Address: Melancthon
Client: 1000719578 Ontario Inc
Easting: 562356
Northing: 4885224
Elevation:
Logged By: SO
Reviewed By: LC
Investigation Date: 2024-07-04



Ground Surface at

**TOPSOIL** 0.45 m

**FILL**
sandy silt, topsoil mixed soils with rootlets, trace gravel, compact, moist, brown 0.8 m

**GRAVELLY SAND**
trace to some silt, occasional cobbles & boulders, very dense, moist to wet, light brown to brown to greyish brown 4.6 m

**SILT TO SILT TILL**
trace sand to sandy, trace to some clay, trace to some gravel, very dense, wet, greyish brown to grey 6.6 m

BH3 Terminated at 6.6 m

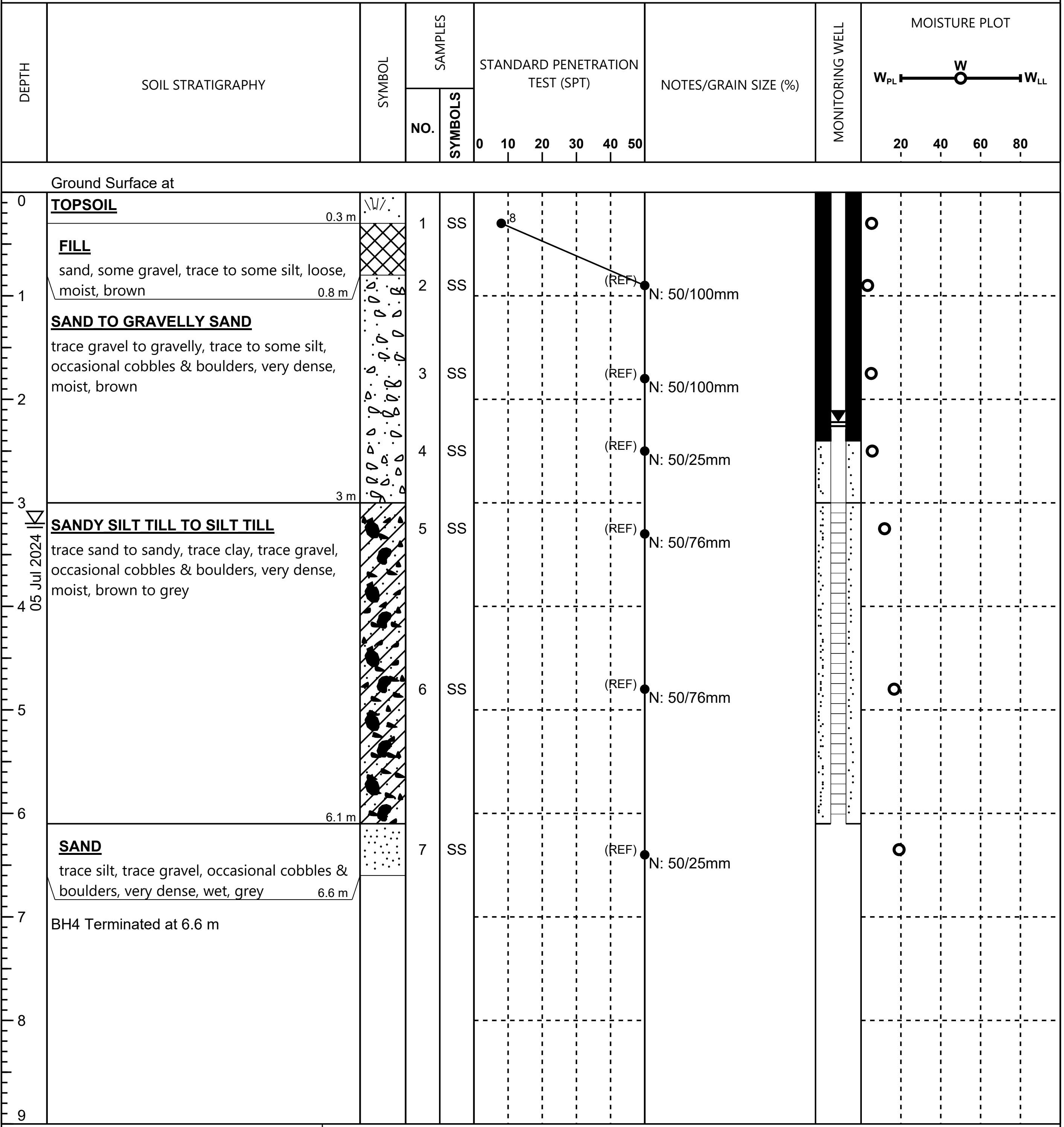
| NO. | SYMBOLS | STANDARD PENETRATION TEST (SPT) | NOTES/GRAIN SIZE (%) |
|---|---|---|---|
| 1 | SS | 20 | |
| 2 | SS | 27 | |
| 3 | SS | (REF) | N: 50/100mm |
| 4 | SS | (REF) | SS4: gravel inclusion<br>N: 50/100mm |
| 5 | SS | (REF) | N: 50/100mm |
| 6 | SS | (REF) | N: 50/76mm |
| 7 | SS | (REF) | N: 50 for 50mm |

GREEN GEOTECHNICAL

Notes:
Un-stabilized water level measured at 1.5 mbg.
Borehole caved to 3.4 mbg upon completion of drilling.
Water Level Reading at 1.8 mbg on 07-12-24.

# BOREHOLE LOG: BH4

Project: Chipwoods Park
Project No.: 24-057-01
Site Address: Melancthon
Client: 1000719578 Ontario Inc
Easting: 562490
Northing: 4885204
Elevation:
Logged By: SO
Reviewed By: LC
Investigation Date: 2024-07-04



| Depth | Soil Stratigraphy | Sample No. | Symbol | SPT |
|---|---|---|---|---|
| 0–0.3 m | **TOPSOIL** | 1 | SS | 8 |
| 0.3–0.8 m | **FILL**<br>sand, some gravel, trace to some silt, loose, moist, brown | 2 | SS | (REF) N: 50/100mm |
| 0.8–3 m | **SAND TO GRAVELLY SAND**<br>trace gravel to gravelly, trace to some silt, occasional cobbles & boulders, very dense, moist, brown | 3 | SS | (REF) N: 50/100mm |
| | | 4 | SS | (REF) N: 50/25mm |
| 3–6.1 m | **SANDY SILT TILL TO SILT TILL**<br>trace sand to sandy, trace clay, trace gravel, occasional cobbles & boulders, very dense, moist, brown to grey | 5 | SS | (REF) N: 50/76mm |
| | | 6 | SS | (REF) N: 50/76mm |
| 6.1–6.6 m | **SAND**<br>trace silt, trace gravel, occasional cobbles & boulders, very dense, wet, grey | 7 | SS | (REF) N: 50/25mm |

BH4 Terminated at 6.6 m

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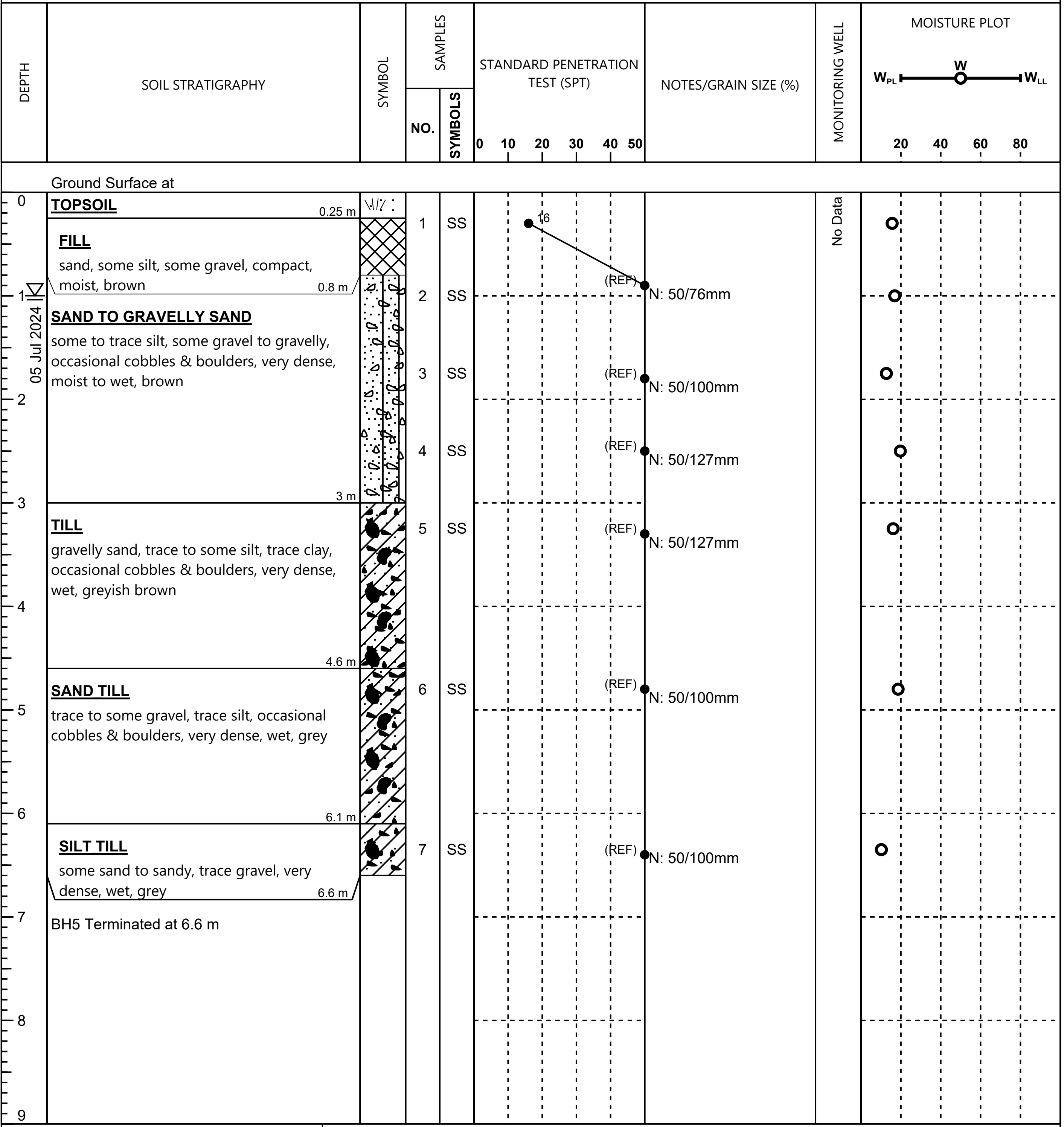
Notes:
Un-stabilized water level measured at 3.2 mbg.
Borehole caved to 5.8 mbg upon completion of drilling.
Water Level Reading at 2.2 mbg on 07-12-24.

# BOREHOLE LOG: BH5

Project: Chipwoods Park
Project No.: 24-057-01
Site Address: Melancthon
Client: 1000719578 Ontario Inc
Easting:
Northing:
Elevation:
Logged By: SO
Reviewed By: LC
Investigation Date: 2024-07-04



Ground Surface at

| Depth to base | Soil Stratigraphy |
|---|---|
| 0.25 m | **TOPSOIL** |
| 0.8 m | **FILL**<br>sand, some silt, some gravel, compact, moist, brown |
| 3 m | **SAND TO GRAVELLY SAND**<br>some to trace silt, some gravel to gravelly, occasional cobbles & boulders, very dense, moist to wet, brown |
| 4.6 m | **TILL**<br>gravelly sand, trace to some silt, trace clay, occasional cobbles & boulders, very dense, wet, greyish brown |
| 6.1 m | **SAND TILL**<br>trace to some gravel, trace silt, occasional cobbles & boulders, very dense, wet, grey |
| 6.6 m | **SILT TILL**<br>some sand to sandy, trace gravel, very dense, wet, grey |

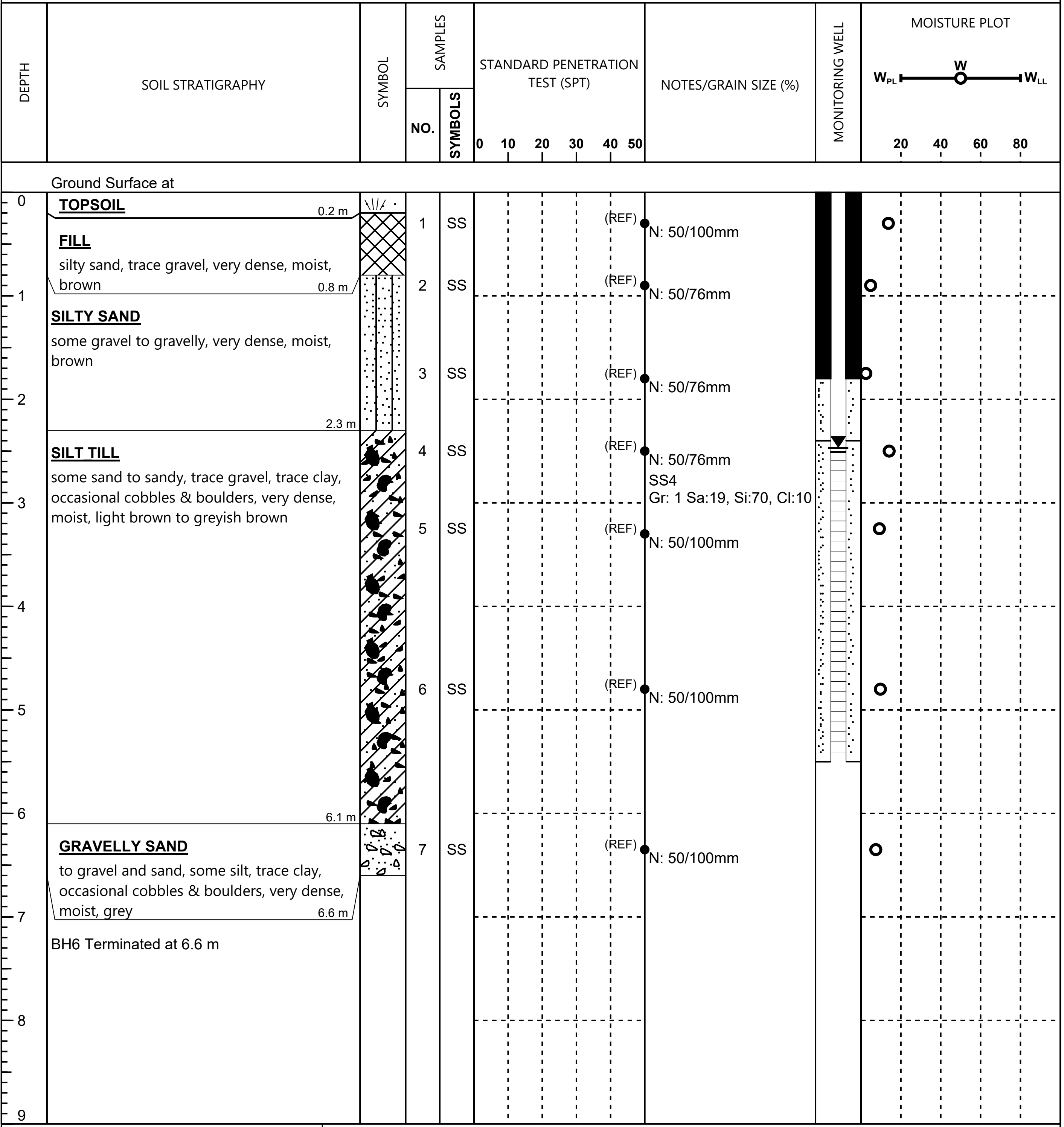
BH5 Terminated at 6.6 m

| NO. | SYMBOLS | STANDARD PENETRATION TEST (SPT) | NOTES/GRAIN SIZE (%) |
|---|---|---|---|
| 1 | SS | 16 | |
| 2 | SS | (REF) | N: 50/76mm |
| 3 | SS | (REF) | N: 50/100mm |
| 4 | SS | (REF) | N: 50/127mm |
| 5 | SS | (REF) | N: 50/127mm |
| 6 | SS | (REF) | N: 50/100mm |
| 7 | SS | (REF) | N: 50/100mm |

Notes:
Unstabilized water level measured at 1.0 mbg.
Borehole caved to 5.5 mbg upon completion of drilling.

# BOREHOLE LOG: BH6

Project: Chipwoods Park
Project No.: 24-057-01
Site Address: Melancthon
Client: 1000719578 Ontario Inc
Easting: 562306
Northing: 4885002
Elevation:
Logged By: SO
Reviewed By: LC
Investigation Date: 2024-07-04



Ground Surface at

**TOPSOIL** 0.2 m

**FILL**
silty sand, trace gravel, very dense, moist, brown 0.8 m

**SILTY SAND**
some gravel to gravelly, very dense, moist, brown 2.3 m

**SILT TILL**
some sand to sandy, trace gravel, trace clay, occasional cobbles & boulders, very dense, moist, light brown to greyish brown 6.1 m

**GRAVELLY SAND**
to gravel and sand, some silt, trace clay, occasional cobbles & boulders, very dense, moist, grey 6.6 m

BH6 Terminated at 6.6 m

| NO. | SYMBOLS | SPT | NOTES/GRAIN SIZE (%) |
|---|---|---|---|
| 1 | SS | (REF) | N: 50/100mm |
| 2 | SS | (REF) | N: 50/76mm |
| 3 | SS | (REF) | N: 50/76mm |
| 4 | SS | (REF) | N: 50/76mm<br>SS4<br>Gr: 1 Sa:19, Si:70, Cl:10 |
| 5 | SS | (REF) | N: 50/100mm |
| 6 | SS | (REF) | N: 50/100mm |
| 7 | SS | (REF) | N: 50/100mm |

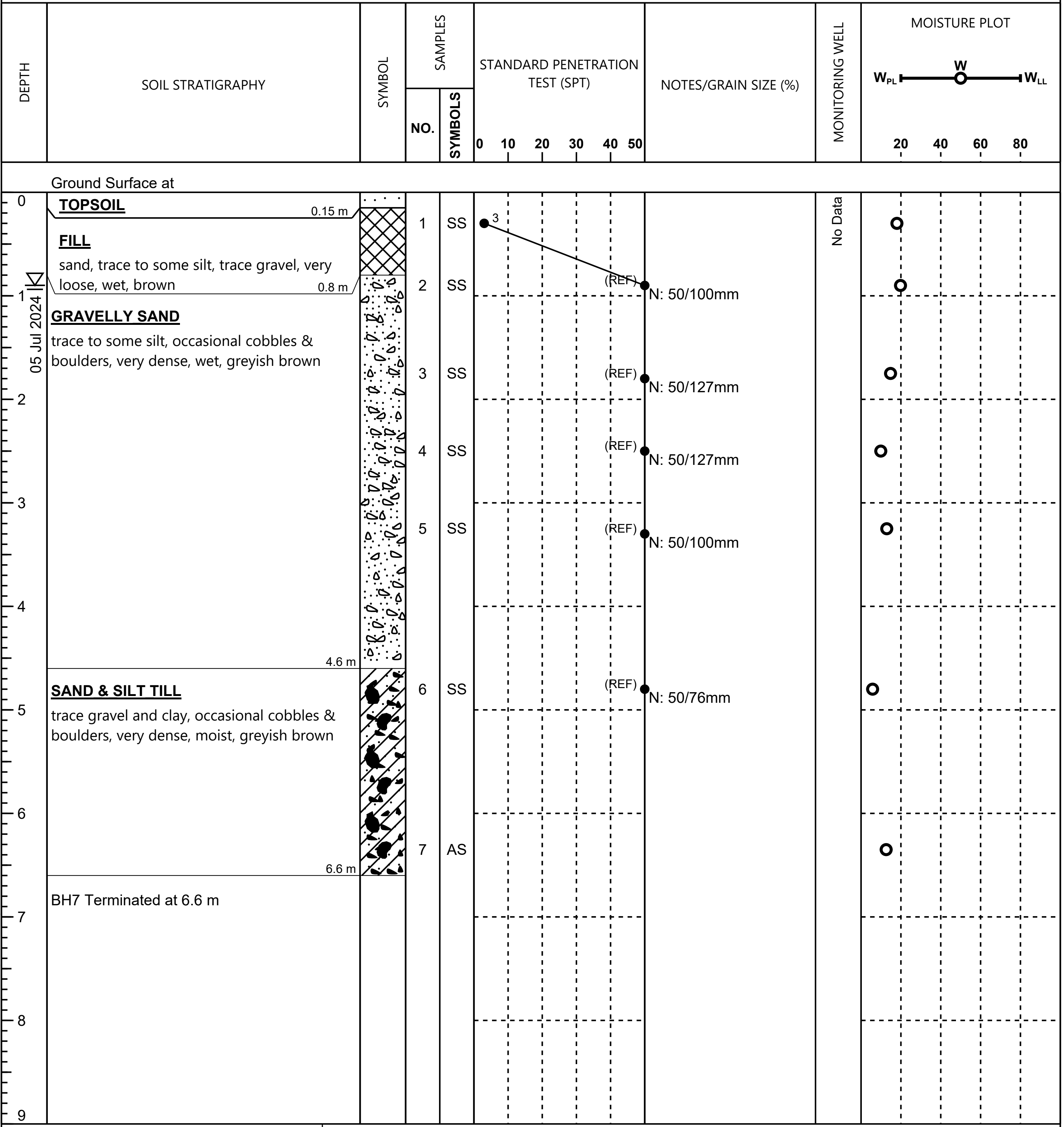
Notes:
Borehole was dry and caved to 5.8 mbg upon completion of drilling.

# BOREHOLE LOG: BH7

Project: Chipwoods Park
Site Address: Melancthon
Easting:
Logged By: SO

Northing:
Reviewed By: LC

Project No.: 24-057-01
Client: 1000719578 Ontario Inc
Elevation:
Investigation Date: 2024-07-04



Ground Surface at

**TOPSOIL** 0.15 m

**FILL**

sand, trace to some silt, trace gravel, very loose, wet, brown 0.8 m

**GRAVELLY SAND**

trace to some silt, occasional cobbles & boulders, very dense, wet, greyish brown 4.6 m

**SAND & SILT TILL**

trace gravel and clay, occasional cobbles & boulders, very dense, moist, greyish brown 6.6 m

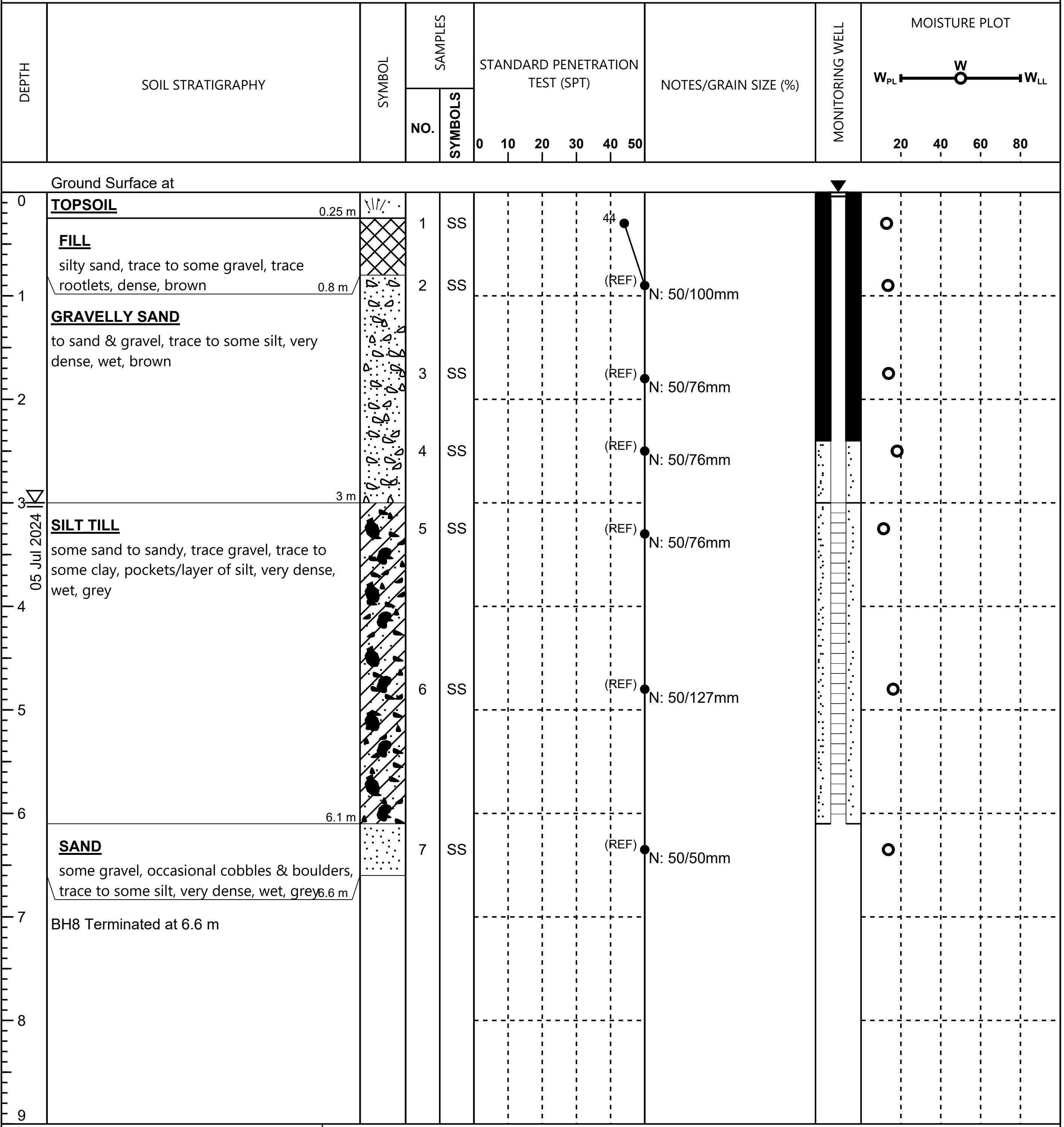
BH7 Terminated at 6.6 m

| NO. | SYMBOLS | STANDARD PENETRATION TEST (SPT) | NOTES/GRAIN SIZE (%) |
|---|---|---|---|
| 1 | SS | 3 | |
| 2 | SS | (REF) | N: 50/100mm |
| 3 | SS | (REF) | N: 50/127mm |
| 4 | SS | (REF) | N: 50/127mm |
| 5 | SS | (REF) | N: 50/100mm |
| 6 | SS | (REF) | N: 50/76mm |
| 7 | AS | | |

Notes:
Un-stabilized water level measured at 0.9 mbg.
Borehole was open upon completion of drilling.

# BOREHOLE LOG: BH8

Project: Chipwoods Park
Project No.: 24-057-01
Site Address: Melancthon
Client: 1000719578 Ontario Inc
Easting: 562642
Northing: 4885129
Elevation:
Logged By: SO
Reviewed By: LC
Investigation Date: 2024-07-04



Ground Surface at

**TOPSOIL** 0.25 m

**FILL**
silty sand, trace to some gravel, trace rootlets, dense, brown 0.8 m

**GRAVELLY SAND**
to sand & gravel, trace to some silt, very dense, wet, brown 3 m

**SILT TILL**
some sand to sandy, trace gravel, trace to some clay, pockets/layer of silt, very dense, wet, grey 6.1 m

**SAND**
some gravel, occasional cobbles & boulders, trace to some silt, very dense, wet, grey 6.6 m

BH8 Terminated at 6.6 m

| NO. | SYMBOLS | NOTES/GRAIN SIZE (%) |
|---|---|---|
| 1 | SS | |
| 2 | SS | N: 50/100mm |
| 3 | SS | N: 50/76mm |
| 4 | SS | N: 50/76mm |
| 5 | SS | N: 50/76mm |
| 6 | SS | N: 50/127mm |
| 7 | SS | N: 50/50mm |

Notes:
Unstabilized water level measured at 3.0 mbg.
Borehole was open upon completion of drilling.
Water Level Reading at 0.3m above grade on 07-12-24.

# APPENDIX B

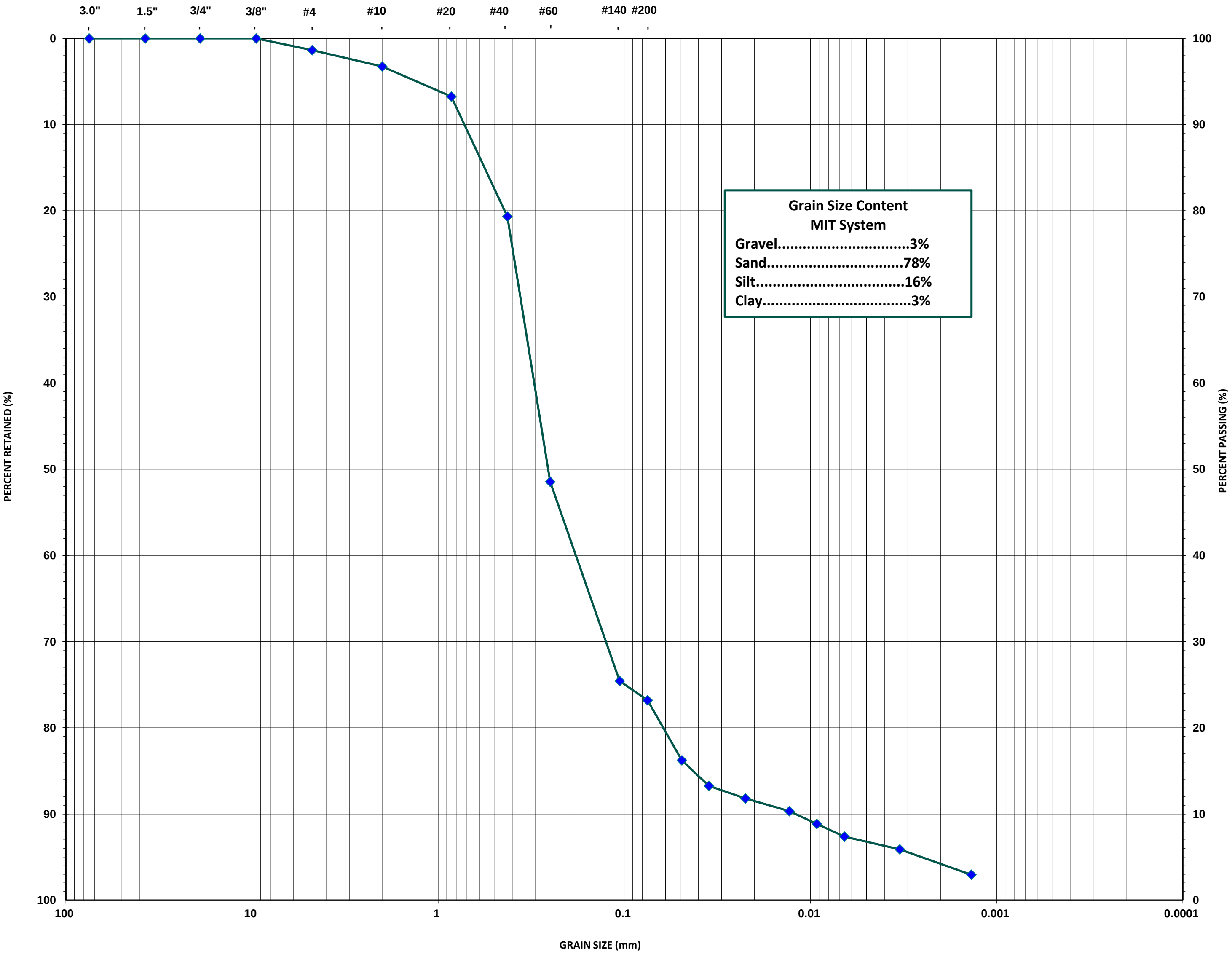
576 Bryne Drive, Unit 'O'
Barrie, ON
L4N 9P6

# Hydrometer Analysis Form

| | | | | | |
|---|---|---|---|---|---|
| **Project Number:** | 24-057-01 | **Location:** | Melancthon, ON | **Project Name:** | Chipwood Park |
| **Sample Date:** | July 4, 2024 | **Test Date:** | July 17, 2024 | **Client Name:** | 1000719578 Ontario Inc. |
| **Sample Description:** | Sand, some silt, trace gravel, trace | **Lab Number:** | 376 | **Tested By:** | J. Duguid |
| **Borehole No.:** | 1 | **Sample Depth:** | 2.3m - 2.7m | **Sampled By:** | SO |
| **Sample Location:** | Melancthon, ON | **Sample Number:** | 4 | | |
| **Estimated Septic T-Time:** | | N/A | | Unified Soil Classification | SM |

## Grain Size Distribution

*U.S. Standard Sieve Sizes*



Grain Size Content
MIT System
Gravel...............................3%
Sand................................78%
Silt..................................16%
Clay..................................3%

| | | | | | | |
|---|---|---|---|---|---|---|
| MIT System | Gravel | Coarse<br>Sand | Medium<br>Sand | Fine<br>Sand | Silt | Clay |

| | | | | | | |
|---|---|---|---|---|---|---|
| Unified System | Coarse<br>Gravel | Fine<br>Gravel | Coarse<br>Sand | Medium<br>Sand | Fine<br>Sand | Silt and Clay |

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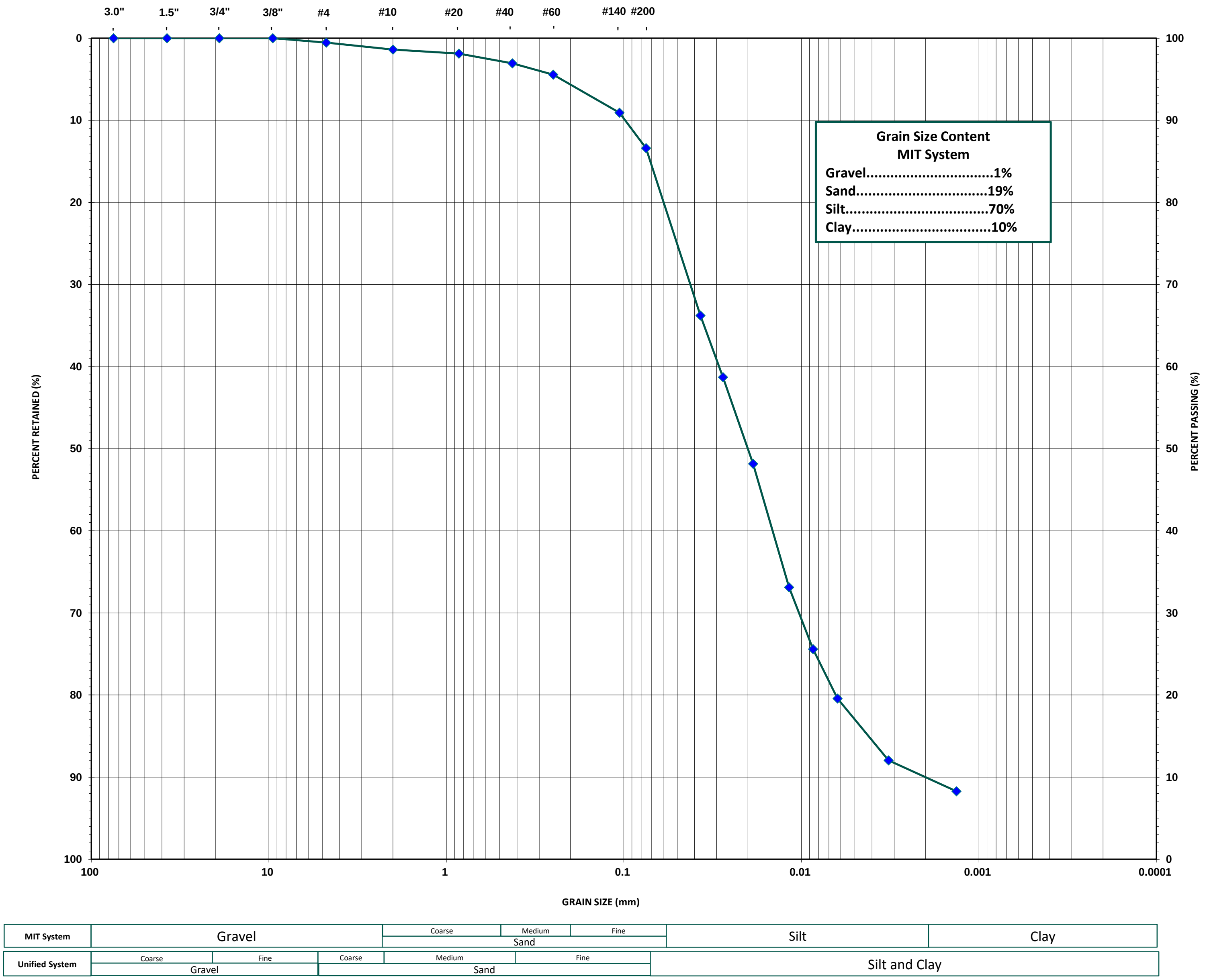
576 Bryne Drive, Unit 'O'
Barrie, ON
L4N 9P6

# Hydrometer Analysis Form

| | | | | | |
|---|---|---|---|---|---|
| **Project Number:** | 24-057-01 | **Location:** | Melancthon, ON | **Project Name:** | Chipwood Park |
| **Sample Date:** | July 4, 2024 | **Test Date:** | July 17, 2024 | **Client Name:** | 1000719578 Ontario Inc. |
| **Sample Description:** | Silt, Some sand, trace clay, trace gravel | **Lab Number:** | 377 | **Tested By:** | J. Duguid |
| **Borehole No.:** | 6 | **Sample Depth:** | 2.3m - 2.7m | **Sampled By:** | SO |
| **Sample Location:** | Melancthon, ON | **Sample Number:** | 4 | | |
| **Estimated Septic T-Time:** | N/A | | | Unified Soil Classification | ML |

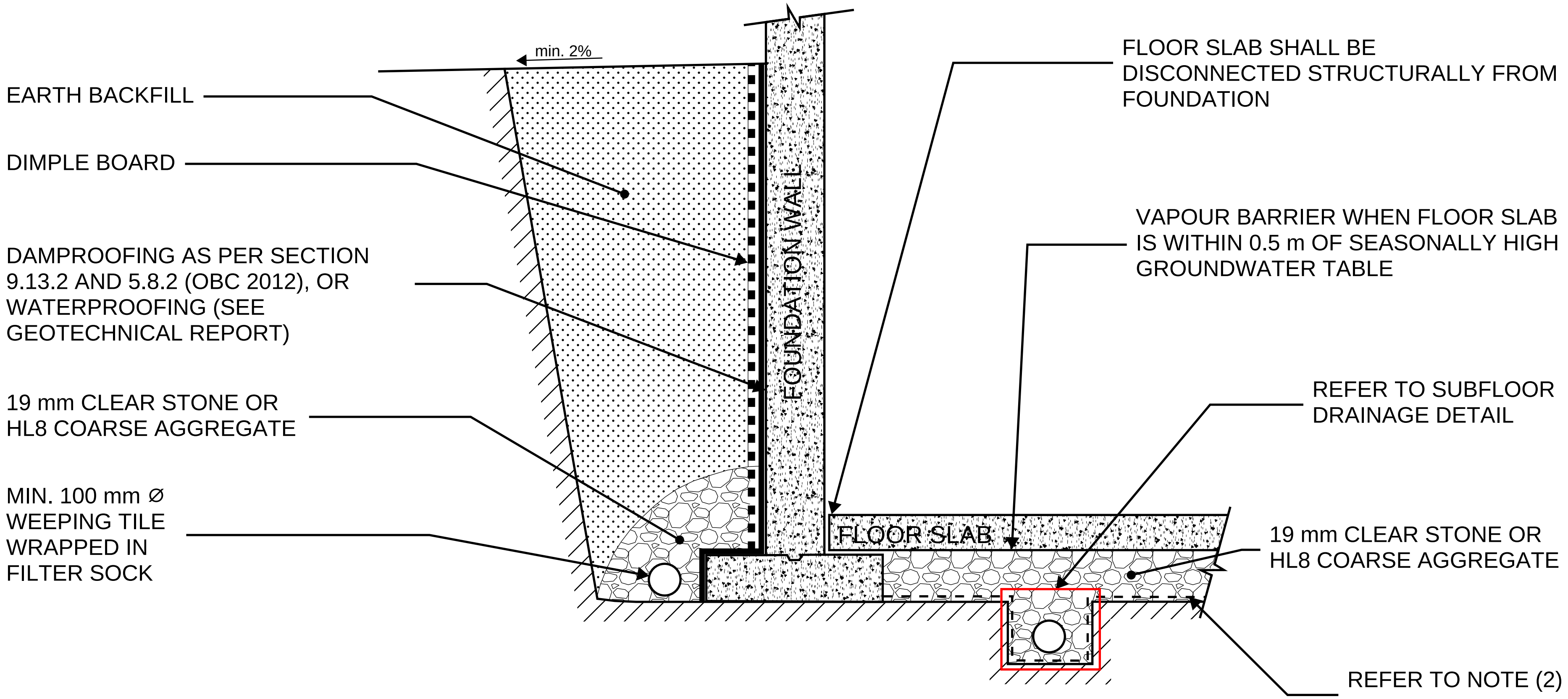
## Grain Size Distribution

*U.S. Standard Sieve Sizes*



Grain Size Content
MIT System
Gravel................................1%
Sand.................................19%
Silt...................................70%
Clay..................................10%

# APPENDIX C



NOTES:
1. TYPICAL SCHEMATIC ONLY. MUST BE READ IN CONJUNCTION WITH GEOTECHNICAL REPORT.
2. WHEN THE SUBGRADE CONSISTS OF COHESIONLESS SOIL, IT MUST BE SEPARATED FROM THE SUBFLOOR DRAINAGE LAYER USING A NON-WOVEN GEOTEXTILE (TERRAFIX 360R OR EQUIVALENT)
3. NOT TO SCALE

Title:

# TYPICAL BASEMENT DRAINAGE SCHEMATIC (OPEN EXCAVATION)

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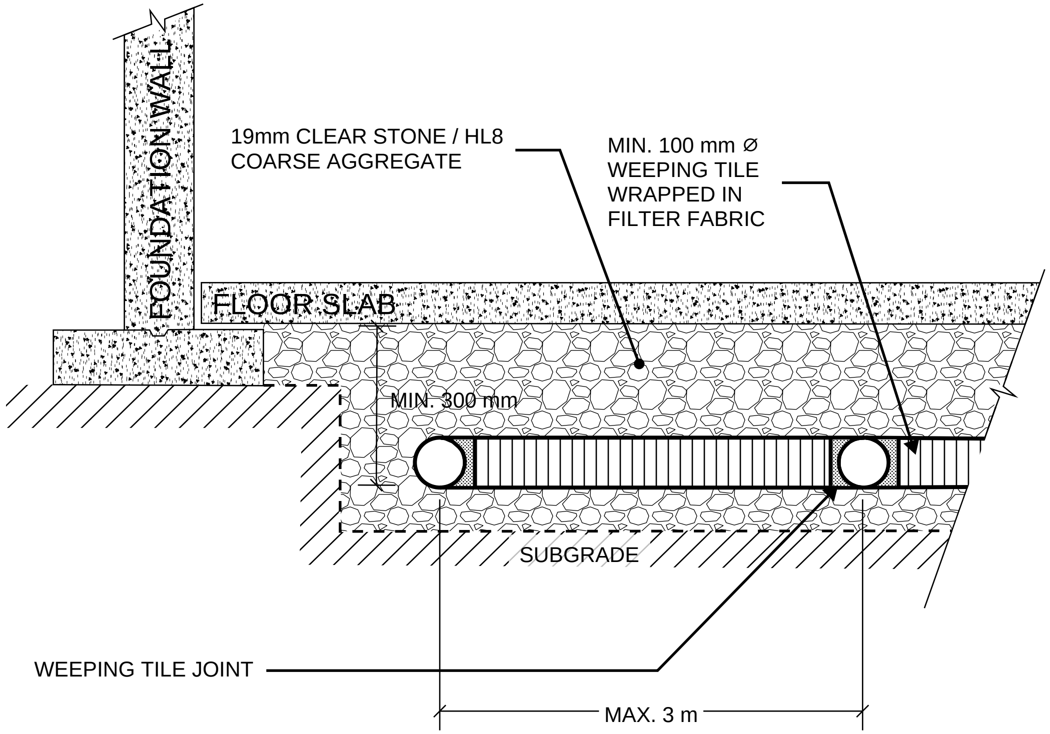
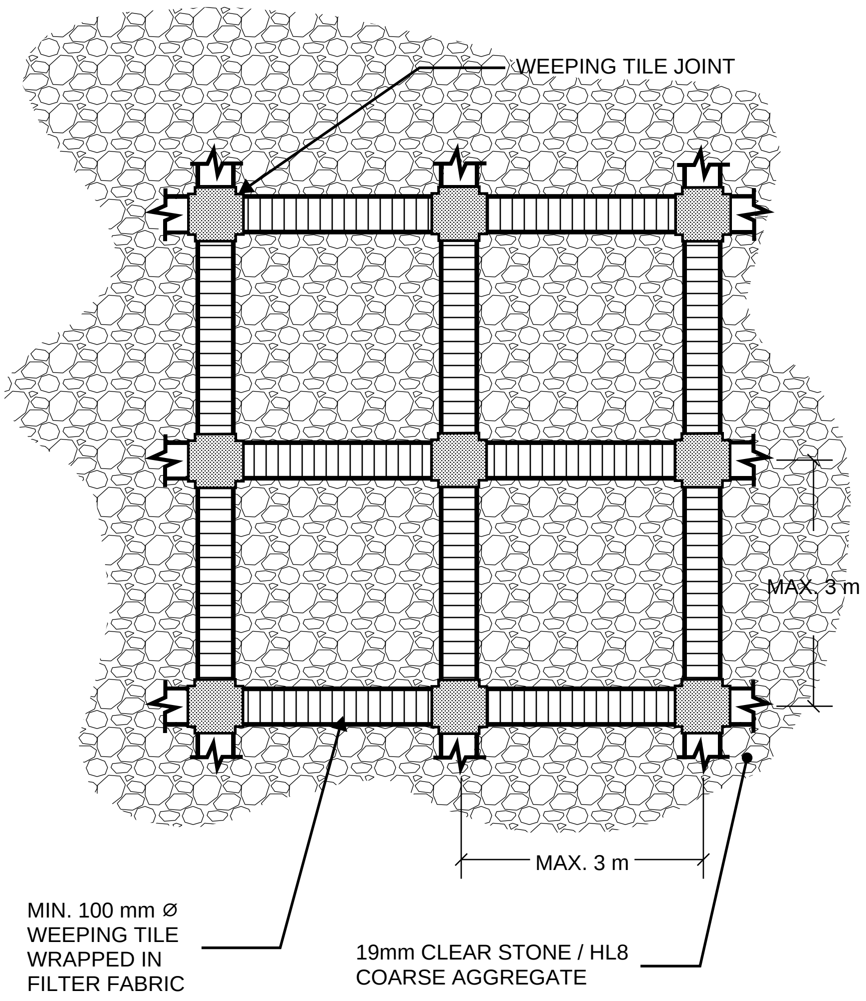
576 Bryne Drive, Unit 'O', Barrie, ON
705-503-9626
info@greengeo.ca





NOTES:

1. TYPICAL SCHEMATIC ONLY. MUST BE READ IN CONJUNCTION WITH GEOTECHNICAL REPORT.
2. WHEN THE SUBGRADE CONSISTS OF COHESIONLESS SOIL, IT MUST BE SEPARATED FROM THE SUBFLOOR DRAINAGE LAYER USING A NON-WOVEN GEOTEXTILE (TERRAFIX 360R OR EQUIVALENT)
3. UNDERFLOOR DRAINAGE SHOULD OUTLET TO PERIMETER DRAINAGE SYSTEM AND/OR SUMP PUMP
4. NOT TO SCALE

Title:

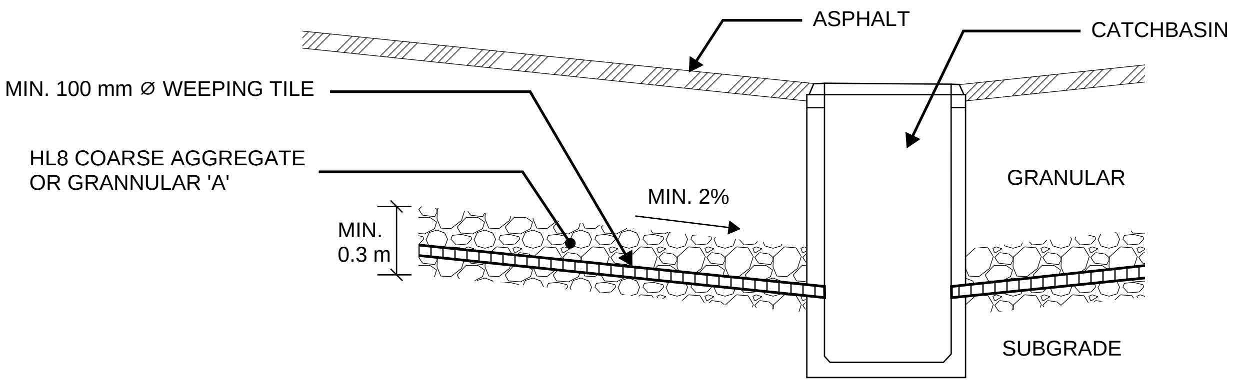
**UNDERFLOOR DRAINAGE (SLAB WITHIN 1m OF SEASONALLY HIGH GWT)**

GREEN GEOTECHNICAL

576 Bryne Drive, Unit 'O', Barrie, ON
705-503-9626
info@greengeo.ca

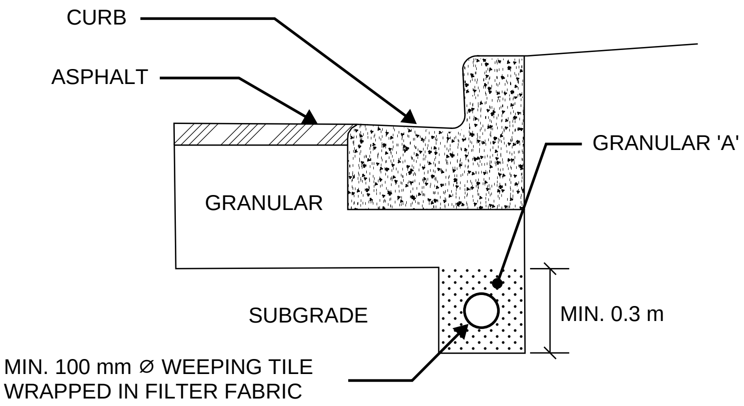
# APPENDIX D

## LONGITUDINAL SUBDRAIN CONNECTION TO CATCHBASIN

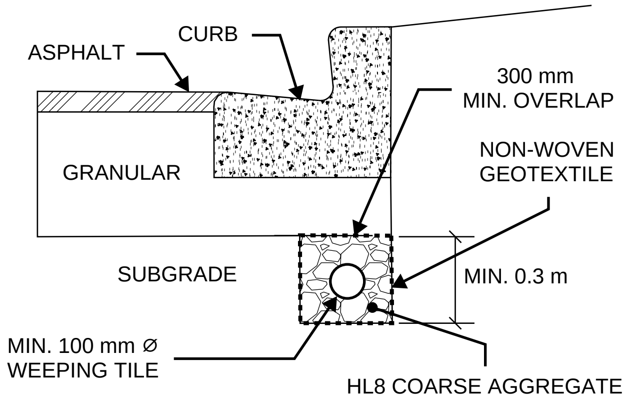


## URBAN CROSS SECTIONS

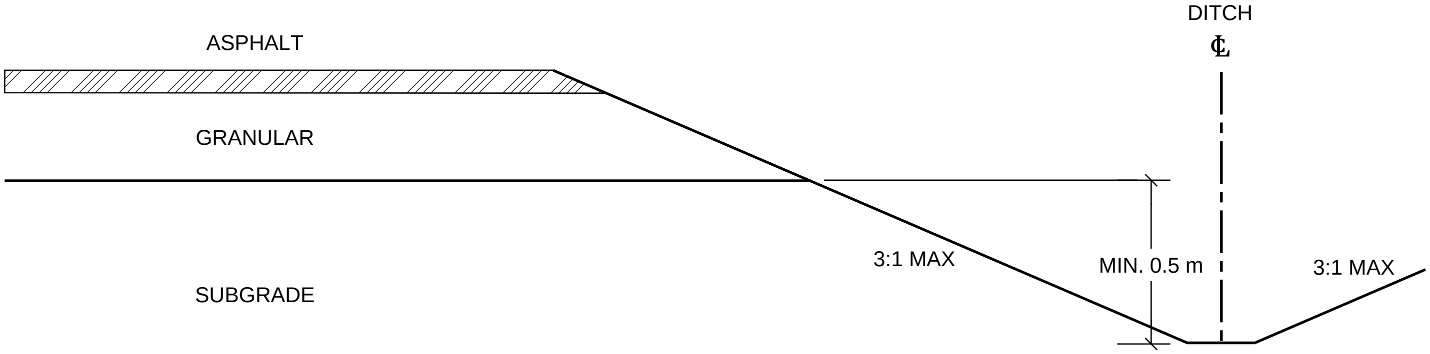
WEEPING TILE WITH FILTER FABRIC



WEEPING TILE WITHOUT FILTER FABRIC



## RURAL CROSS SECTIONS



Title:

# PAVEMENT DRAINAGE ALTERNATIVES

GREEN GEOTECHNICAL
576 Bryne Drive, Unit 'O', Barrie, ON
705-503-9626
info@greengeo.ca

# APPENDIX E

# ENGINEERED FILL SPECIFICATIONS

## Overview

- Engineered Fill is a pre-approved material which has been placed under the full-time supervision of Green Geotechnical, including testing and inspection during construction to ensure subgrade stability, material quality, proper lift thickness, and adequate compaction have all been maintained.
- Engineered Fill is used to accommodate structural loads (such as for foundations, slabs, etc.) where site grades are being altered, or in order to accommodate structural design loads.
- Prior to concrete placement for footings and poured walls on Engineered Fill, Green Geotechnical must inspect the foundation subgrade soils, and reinforcing steel respectively.

## Design

- Engineered fill material must be free of organic inclusions, construction debris, and any other deleterious material.
- Ideally, granular type soils, with less than 8% fines, such as OPSS 1010 Granular ‘B,’ are used.
- In sites where a high groundwater table or where wet conditions exist, (even with dewatering operations), in order to achieve stable layers and the specified compaction on the first one to two lifts, OPSS 1010 Granular ‘B’ Type II or 50 mm crusher run limestone may be advisable.
- The determination of whether the site soils are suitable for reuse as Engineered Fill, or if an imported material is to be used, is at the discretion of the opinion of the Geotechnical Engineer.
- Post construction settlement of the Engineered Fill is to be expected. The timeframe that this occurs varies based on the type of material used. Typically, time intervals of the following can be used:

| | **Self-Consolidation Settlement** | | **Foundation Loading Settlement** | |
|---|---|---|---|---|
| **Material** | **Settlement Rate** | **Time Rate** | **Settlement Rate** | **Time Rate** |
| **Granular ‘B’ or Coarser** | Minimal (0.2% D) | Immediate | Minor (0.5”, 12mm) | Immediate |
| **Fine Sand** | Minimal (0.5% D) | 1-50 hours | Minor (0.75”, 19mm) | 1-50 hours |
| **Sandy Silt** | Minor (0.75% D) | 2-30 days | Minor (1”, 25mm) | 2-30 days |
| **Clayey Silt** | Moderate (1% D) | 3-6 months | Moderate (1.25”, 31mm) | 3-6 months |
| **Silty Clay** | Major (1.5% D) | 6-7 years | Major (1.5”, 37mm) | 6-7 years |

*D is the depth of the Engineered Fill*

- It is imperative for avoiding excessive settlements that the construction of foundations take into account the post-construction settlement period.
- Engineered Fill is to extend a minimum of 1m beyond the base of any structure’s foundations, and project down to the subgrade at a slope with a maximum steepness of 1H:1V.
- An allowable design bearing capacity of 150 kPa (SLS) can usually be used for Engineered Fill constructed on a stable, approved subgrade.
    - This is unless a different bearing capacity for the Engineered Fill has been recommended by the Geotechnical Engineer, based on the properties of the site soils.
- The Engineered Fill is to extend at least 1m above the highest foundation base elevation to provide the Engineered Fill at founding level(s) protection from frost, precipitation, runoff, wind, and weathering.
- Poured concrete footings are to be a minimum width of 0.6m for strip footings and 1.0m for individual footings.

- Reinforcing steel comprised of two (2) continuous 15M bars at the top and bottom of foundation walls, and 15M bars spaced at 0.3m in column pad footings, are required in all poured concrete foundations.

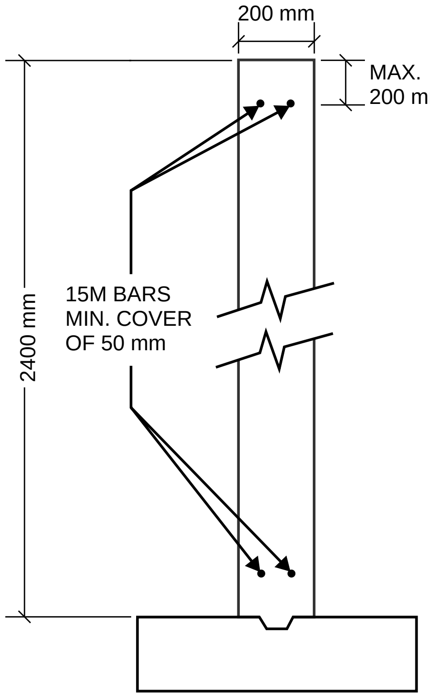
## Construction

- Surveying should be done by the earthworks contractor or the surveying contractor to ensure that Engineered fill elevations and footprint are accurate and meet the specifications outlined in this document.
- The elevations should be provided to Green Geotechnical by the earthworks contractor or the surveying contractor at each placed lift of material, for recording compaction levels by elevation, and to ensure proper lift thickness.
- Topsoil and uncontrolled fill/deleterious material are to be excavated, leaving a stable, dry, native subgrade.
- Dewatering may be required, depending on the groundwater conditions at the site.
- Prior to the placement of any Engineered Fill, Green Geotechnical must approve the stability of the exposed native subgrade for Engineered Fill placement.
- Depending on the groundwater conditions and soil type at the site, a proof-roll with a heavy compaction roller or rubber-tire front-end loader with a full bucket may be required on the subgrade. Any noted unstable areas will have to be sub-excavated and brought back up with the placement of Engineered Fill.
- As previously mentioned, if wet conditions exist at the site, for the first one to two lifts of the Engineered Fill, the use of OPSS 101 Granular ‘B’ Type II or 50 mm crusher run limestone may be advisable.
- All material must be compacted to at least 98% SPMDD (Standard Proctor Maximum Dry Density) within 2% of OMC (Optimum Moisture Content).
- Green Geotechnical will take a sample of the Engineered Fill material to determine its SPMDD, OMC, and gradation.
- Green Geotechnical must test the compaction of the placed Engineered Fill at each lift.
- In wet site conditions, it is typically advisable that the first lift be static rolled, and that all subsequent lifts be compacted with vibration. In dry site conditions, compaction by vibration can occur at all lifts.
- Engineered Fill material shall be placed in maximum 150mm loose lifts.
    - The only exception to this is in the first one to two lifts placed in wet site conditions. Here, loose lifts shall be a maximum of 300mm-450mm.
- Engineered Fill should not be placed during months where freezing temperatures occur.

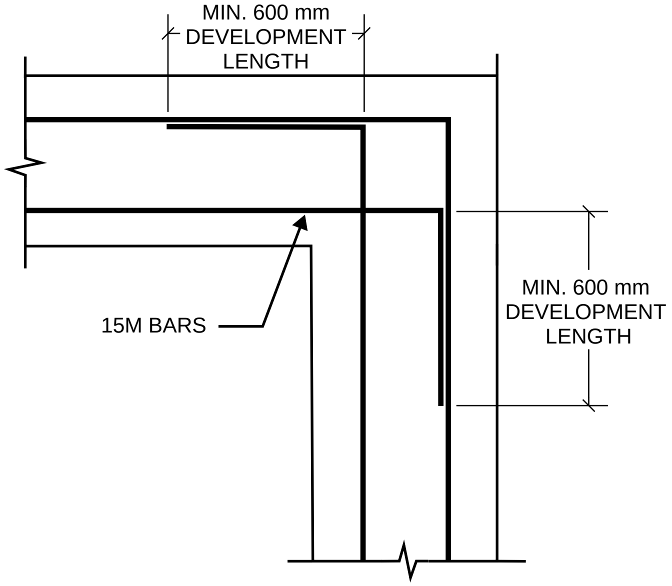
## Certification

- Green Geotechnical must be present during Engineered Fill construction to approve the native subgrade, approve of and take a sample of the material, as well as record compaction and lift thickness at every lift.
    - Following this, a letter signed and sealed by a P.Eng. will be submitted certifying the Engineered Fill as being properly constructed, and displaying the field records.
- Green Geotechnical must inspect the foundation subgrade immediately prior to the placement of concrete for footings.
    - Following this, a letter signed and sealed by a P.Eng. will be submitted certifying the Engineered Fill foundation subgrade as being adequate to support the design bearing capacity.
- Green Geotechnical must inspect the reinforcing steel in the foundation walls prior to the placement of concrete. See the attached Typical Reinforced Wall Detail for more information.
    - Following this, a letter signed and sealed by a P.Eng. will be submitted certifying the reinforcing steel as being placed in accordance with the design.

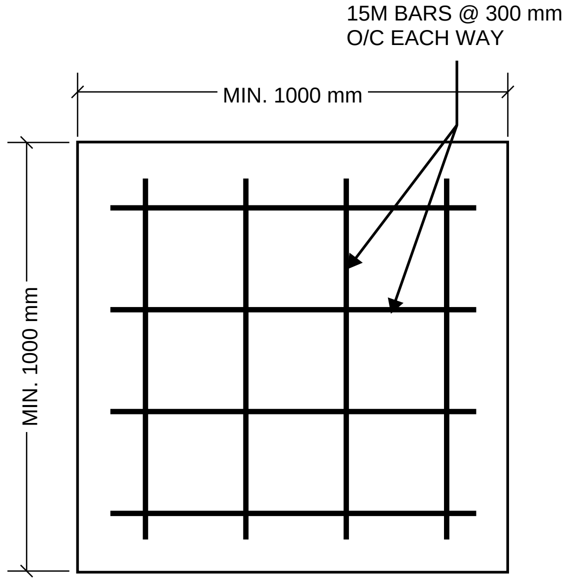
## TYPICAL REINFORCED WALL



## TYPICAL SPLICING AT CORNERS

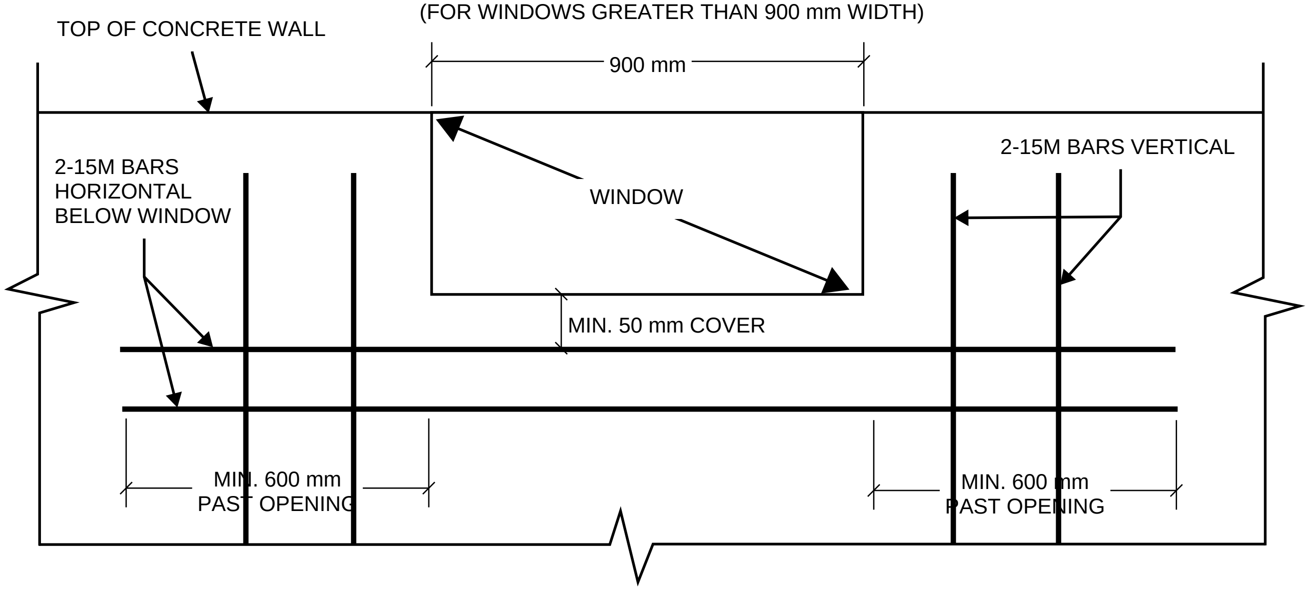


## TYPICAL REINFORCEMENT OF COLUMN FOOTINGS



## TYPICAL WINDOW REINFORCING

(FOR WINDOWS GREATER THAN 900 mm WIDTH)



NOTES:

1. REINFORCING STEEL C.S.A G30.18-09 GRADE 400
2. CONCRETE MINIMUM 28 DAY STRENGTH 20 MPa
3. BASE OF ALL FOOTING EXCAVATIONG TO BE INSPECTED AND APPROVED PRIOR TO PLACING FORMWORK
4. TO BE USED IN CONJUNCTION WITH STRUCTURAL REPORT
5. DRAWINGS ARE NOT TO SCALE

Title:

**TYPICAL REINFORCED WALL DETAILS FOR HOUSES ON ENGINEERED FILL**

GREEN GEOTECHNICAL

576 Bryne Drive, Unit 'O', Barrie, ON
705-503-9626
info@greengeo.ca