GEI Consultants

Consulting Engineers and Scientists

Geotechnical Investigation

Proposed Hewitt's South Residential Subdivision

Barrie, Ontario

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1. Introduction

GEI Consultants Ltd. (GEI) was retained by Hansen Group Inc (Client) to complete a geotechnical investigation and report for the Proposed Hewitt's South Residential Subdivision in Barrie, Ontario. A site location plan is enclosed as Figure 1.

The southern portion of the Hewitt's Residential Subdivision is planned for construction. The area slated for development is just north of Lockhart Road. The site is currently undeveloped agricultural land. A mixed residential development is planned with several 6 to 8 storey buildings with a single level of underground parking, townhomes and single lots. A small commercial block is proposed in the southeast corner of the site. A large Storm Water Management (SWM) facility is planned of the western part of the site. A network of paved roads will connect the site and it is understood that the subdivision will have full municipal servicing. The concept plan is shown in Figure 2B and may undergo some revisions as the design progresses. An aerial image of the site is shown in Figure 2A.

A previous preliminary geotechnical report was prepared by others and provided for GEI's review. The relevant borehole information is appended for completeness.

The purpose of the geotechnical investigation was to assess the subsurface soil conditions at the site, and based on this information, provide geotechnical engineering recommendations in support of the proposed development. This report summarizes the borehole findings, provides design geotechnical engineering recommendations regarding available bearing capacities for foundations, site grading and earthworks, floor slabs, earth pressure coefficients for basements, drainage requirements, site servicing installation, SWM pond, infiltration and pavement design. Considerations for constructability such as soil excavation, compaction, on-site backfill suitability and temporary groundwater control are also provided.

It is noted that the recommendations provided in this report must be considered preliminary in nature due to the current uncertainty of the design for the project. As the design progresses further geotechnical review and input may be required which might necessitate the need for additional investigation and/or analysis.

2. Procedures and Methodology

It is noted that all elevations in this report are metric/geodetic and expressed in metres (m). All measurements are also in metric and expressed in millimetres (mm), metres (m) or kilometres (km).

Prior to the commencement of drilling activities, the borehole locations were staked in the field by GEI. Ground surface elevations of the boreholes and horizontal co-ordinates (referencing NAD 83 geodetic datum) were surveyed by GEI with a Topcon FC – 5000 GPS Survey unit.

Underground utilities including natural gas, electrical, telephone, water, etc. were marked out by public and private utility locating companies prior to drilling.

The fieldwork for the drilling program was carried out between November 2 and 8, 2023. Boreholes 1 to 29 were advanced to 6.6 m below existing grade (Elev. 245.2 to 257.1) across the site. Borehole logs are provided in Appendix A and the borehole locations are shown on Figures 2A and 2B.

The boreholes were advanced by a drilling subcontractor retained and supervised by GEI using a track-mounted drill rig, solid stem augers, and standard soil sampling equipment. Sampling was conducted using a 51 mm O.D. Split Spoon (SS) sampler. Standard Penetration Test (SPT) "N" Values (N values) were recorded for the sampled intervals as the number of blows required to drive an SS sampler 305 mm into the soil using a 63.5 kg drop hammer falling 750 mm, in accordance with ASTM D1586. In each borehole soil sampling was conducted at 0.75 m intervals for the upper 3.0 m and at 1.5 m intervals thereafter.

Monitoring wells were installed in Boreholes 1, 2, 5, 6, 9, and 11 to 21 by GEI to facilitate long-term groundwater monitoring, each consisting of 50 mm diameter PVC pipe with a 1.5 m long screen and protective casing. Monitoring well construction is shown on the borehole logs in Appendix A. Boreholes without wells were backfilled in accordance with O.Reg. 903.

The GEI field staff examined, and classified characteristics of the soils encountered in the boreholes, including the presence of fill materials, groundwater observations during and upon completion of the drilling, recorded observations of borehole construction, and processed the recovered samples. All recovered soil samples were logged in the field, carefully packaged, and transported to GEI's laboratory for more detailed examination and classification.

In GEI's laboratory, the samples were classified as to their visual and textural characteristics. A total of fourteen (14) representative samples of the major soil units were selected and submitted to our laboratory for grain size analysis. Three (3) of the samples were also submitted for Atterberg Limits tests. Laboratory results are provided in Appendix B.

3. Subsurface Conditions

3.1 General Overview

The detailed soil profiles encountered in the boreholes are indicated on the attached borehole logs in Appendix A, and the geotechnical laboratory results are included in Appendix B. The borehole locations are shown in Figures 2A and 2B.

It should be noted that the conditions indicated on the borehole logs are for specific locations only and can vary between and beyond the locations. It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change.

In addition, the descriptions provided in the borehole logs are inferred from a variety of factors, including: visual observations of the soil samples retrieved, laboratory testing, measurements prior to and after drilling, and the drilling process itself (speed of drilling, shaking/grinding of the augers, etc.). The passage of time also may result in changes in conditions interpreted to exist at locations where sampling was conducted.

3.2 Stratigraphy

3.2.1 Topsoil

A topsoil layer was at the ground surface in all boreholes ranging in thickness from 50 to 760 mm, typically 100 to 305 mm. Topsoil thickness may vary between boreholes and in other areas of the site.

3.2.2 Fill

A fill layer was encountered in most boreholes (Boreholes1, 2, 4 to 10, 12, 13, 15 to 17, 20, 24 to 27, and 29) below the topsoil and considered to be associated with the agricultural activities and disturbance of the in-situ soil over time. The fill was penetrated at 0.8 m depth, locally 1.5 m depth, (Elev. 251.0 to 262.9). The fill predominantly consisted of silty and or sand, with trace gravel, locally varying to clayey silt or sandy silt. Trace organics were observed in most boreholes. The fill was moist with moisture contents of 3 to 32%. The fill typically had N values of 10 or less revealing loose conditions, locally firm/stiff or compact.

3.2.3 Upper Sand/Silty Sand/Fine Sand/Gravelly Sand

Underlying the fill or topsoil, upper discontinuous layers of sand/silty sand/fine sand or gravelly sand were revealed in Boreholes 1, 2, 6, 8, 11, 14 to 21, 23, 24 and 27 to 29. The upper

cohesionless soil layers were penetrated at depths of 0.8 to 4.6 m (Elev. 252.5 to 260.5), typically 1.5 to 2.3 m depth. The N values in these layers ranged between 4 and 59 blows, indicating loose to very dense conditions, but typically being loose to compact. The layers were moist to wet with depth, with moisture contents ranging between 1 and 36%.

3.2.4 Silty Clay

A silty clay layer was revealed in Boreholes 3 to 7, 13, 17, 18, 20, 22 to 24, and 26. In Boreholes 3 to 7, 13, 17 and 22 to 24 the layer was typically thinner and was revealed in the upper part of the boreholes from 0.2 to 2.3 m depth (Elev. 250.3 to 256.1) and being penetrated at 1.5 to 4.6 m depth (Elev. 247.2 to 255.4). In Boreholes 18, 20 and 26, the silty clay layer was slightly thicker and was revealed at depth, from 4.6 m depth (Elev. 255.0 to 257.2) and extending to 6.1 m depth (Elev. 253.5 to 254.2) in Boreholes 18 and 26, and to the 6.6 m depth of exploration (Elev.255.2) in Borehole 20. Three (3) samples of the material were submitted for grain size analysis and the results are provided in Figure B1 in Appendix B. All three (3) samples were also submitted for Atterberg Limit tests and the results are presented on Figure B5 in Appendix B. Plastic limits of 20.4 to 23.8 and liquid limits of 45.1 to 50.3 were revealed from the lab testing. The soil was moist to wet with moisture contents of 15 to 45%. The consistency was firm to hard with blow counts of 5 to 30.

3.2.5 Clayey Silt

A local layer of clayey silt was underlying the fill in Boreholes 12 and 25 and extending to 1.5 m depth (Elev. 250.9 to 254.1). The unit had trace to some sand and trace gravel. The soil had a firm to stiff consistency with N values of 7 and 11. Moisture contents were 20 and 36%.

3.2.6 Sand and Silt/Silt and Sand

A unit of sand and silt/silt and sand was present in Boreholes 3 to 5, 7, 9, 10, 18 to 21, 26 and 28. The unit varied in thickness from 0.7 to 5.3 m and occurred from 0.6 to 3.0 m depth (Elev. 251.0 to 260.5) and terminated at 1.5 to 6.1 m depth (Elev. 249.2 to 257.5). Trace clay was noted in most samples. Two (2) samples of the material were submitted for grain size analysis and the results are provided in Figure B2 in Appendix B. The soil was moist to wet with depth and moisture contents were 2 to 36%. The soil was typical compact, locally loose or dense, with N values ranging from 6 to 34.

3.2.7 Glacial Till

A major glacial till deposit was encountered in all boreholes, except Boreholes 20, 21 and 27, below the upper soil layers. The till extended to the 6.6 m depth of exploration (Elev. 245.2 to 256.6) in Boreholes 4, 5, 7, 9, 10 to 12, 15 to 19, 22, 24, 26, 28 and 29. In Boreholes 1 to 3, 6, 8, 13, and 23, the till was penetrated at 4.6 to 6.1 m depth (Elev. 247.0 to 251.7). Locally in Boreholes 14 and 25 the till was interrupted between 3.0 and 4.6 m depth (Elev. 249.4 to 251.0)

by a sand layer and 4.6 to 5.0 m depth (Elev. 250.5 to 251.0) by a gravelly sand layer, respectively. The till matrix varied between a silty and sandy silt with trace to some clay and gravel. Cobbles and boulders should be expected based on augers grinding during advancement of the boreholes. Six (6) samples of the material were submitted for grain size analysis and the results are provided in Figures B3 in Appendix B. The glacial till was brown, locally grey at depth, and was typically moist to wet with depth with local wet seams. Moisture contents were 7 to 24%. N values in the glacial till ranged from 6 to more than 100 blows, indicating loose to very dense conditions, typically being compact.

3.2.8 Lower Sand/Gravelly Sand

Basal sand/gravelly sand deposits were noted at the base of Boreholes 1 to 3, 6, 8, 13, 14, 21, 23, 25 and 27 extending beyond the 6.6 m depth of the boreholes (Elev. 246.5 to 257.0). Locally in Boreholes 14 and 25, a sand or gravelly sand layer interrupted the till between 3.0 and 4.6 m depth (Elev. 249.4 to 251.0) and 4.6 to 5.0 m depth (Elev. 250.5 to 251.0), respectively. Two (2) samples of the material were submitted for grain size analysis and the results are provided in Figure B4 in Appendix B. The soil was typically wet with moisture contents of 8 to 21%. N values in the layers were 17 to more than 100, indicating compact to very dense soil, typically showing dense to very dense soil.

3.3 Groundwater

Unstabilized groundwater level measurements and cave measurements were taken upon the completion of drilling of each borehole as shown on the borehole logs in Appendix A. These measurements were taken to provide a rough estimate of the possible excavation and temporary groundwater control constructability considerations that may arise. Sixteen (16) boreholes were outfitted with a monitoring well with 50 mm diameter PVC standpipe and 1.5 m long screen. Monitoring well configuration and groundwater observations are noted on the borehole logs in Appendix A, and a summary is below.

Borehole	Depth of Cave (m) / Elev.	Unstabilized Groundwater Level Depth / Elev.	Depth / Elev. of Groundwater Table, Nov. 29, 2023
1	Open (6.6 / 249.8)	No Water	0.5 / 255.8
2	3.3 / 252.8	2.3 / 253.8	0.4 / 255.7
3	Open (6.6 / 248.8)	3.3 / 252.0	N/A
4	Open (6.6 / 245.2)	No Water	N/A
5	Open (6.6 / 251.1)	No Water	1.8 / 255.8
6	Open (6.6 / 248.7)	5.4 / 249.8	1.2 / 254.0
7	Open (6.6 / 249.1)	3.0 / 252.7	N/A
8	4.2 / 252.1	3.0 / 253.3	N/A

Borehole	Depth of Cave (m) / Elev.	Unstabilized Groundwater Level Depth / Elev.	Depth / Elev. of Groundwater Table, Nov. 29, 2023
9	2.0 / 256.0	1.9 / 256.1	1.3 / 256.7
10	4.0 / 255.8	1.8 / 258.0	N/A
11	Open (6.6 / 256.1)	No Water	3.9 / 258.7
12	Open (6.6 / 245.8)	2.4 / 250.0	Pipe Blocked
13	Open (6.6 / 246.5)	No Water	Pipe Blocked
14	4.5 / 249.5	3.5 / 250.5	1.2 / 252.8
15	5.8 / 249.8	5.1 / 250.5	2.1 / 253.5
16	Open (6.6 / 249.4)	No Water	2.1 / 253.9
17	Open (6.6 / 250.5)	5.8 / 251.3	3.0 / 254.1
18	4.0 / 255.6	3.0 / 256.6	2.0 / 257.6
19	4.4 / 254.9	1.2 / 258.1	1.7 / 257.6
20	3.0 / 258.1	4.5 / 257.3	3.4 / 258.4
21	3.0 / 260.6	4.8 / 258.8	5.4 / 258.2
22	Open (6.6 / 246.5)	No Water	N/A
23	4.8 / 250.1	2.7 / 252.2	N/A
24	Open (6.6 / 250.0)	5.8 / 250.8	N/A
25	4.1 / 251.5	1.8 / 253.8	N/A
26	3.6 / 256.7	3.3 / 257.0	N/A
27	3.3 / 258.6	3.3 / 258.6	N/A
28	4.1 / 259.1	3.8 / 259.4	N/A
29	5.3 /258.4	5.1 / 258.6	N/A

The stabilized groundwater levels in the monitoring wells are typically within about 2 m of the ground surface corresponding to Elev. 252.8 to 258.7. This is believed to reflect a combination of perched water in the upper soil units, wet seams or wet cohesionless layers in the till deposit and groundwater under sub-artesian pressure in the lower sand/gravelly sand unit below the till.

The silty clay and clayey silt are not permeable. The till, silt and sand/sand and silt and fine sand units are semi permeable. The sand, silty sand and gravelly sand are permeable.

Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing climate conditions.

4. Engineering Design Parameters & Analysis

The southern portion of the Hewitt's Residential Subdivision is planned for construction. The area slated for development is just north of Lockhart Road. The site is currently undeveloped agricultural land. A mixed residential development is planned with several 6 to 8 storey buildings with a single level of underground parking, townhomes and single lots. A small commercial block is proposed in the southeast corner of the site. A large Storm Water Management (SWM) facility is planned of the western part of the site. A network of paved roads will connect the site and it is understood that the subdivision will have full municipal servicing. The concept plan is shown in Figure 2B and may undergo some revisions as the design progresses. An aerial image of the site is shown in Figure 2A.

In general, the current preliminary design is feasible with geotechnical engineering recommendations to be confirmed once design details have been established. As the design progresses further geotechnical review and input may be required which might necessitate the need for additional investigation and/or analysis. GEI will be a part of the design team/process and review the various elements of the design for geotechnical requirements for detailed and site plan design. It is noted that the recommendations provided in this report must be considered preliminary in nature due to the current preliminary nature of the design for the project.

4.1 Site Grading

Grading plans for the site were being designed at the time of this report and it is understood that some site grading may be required to accommodate the project. When grading is established, it is understood that GEI will be a part of the process and will review the drawings for geotechnical requirements.

In general, where grades need to be raised under structures, the topsoil and fill and any localized areas of weak native soil directly below the fill/topsoil are unsuitable to support the buildings due to concern with settlement. In this regard, it is recommended to strip the topsoil and stockpile separately then sub-excavate the fill and any or upper weak native soil down to competent native soil (subject to geotechnical review during construction). The exposed competent native soil should be thoroughly compacted and then engineered fill placement can commence, to the desired grade. Footings and floor slabs would be supported by native soil and/or the engineered fill.

4.1.1 Engineered Fill

GEI defines "engineered fill" as material that will support foundations, and which is placed and compacted in a specified and controlled manner under full-time supervision of geotechnical engineering staff.

In any location where engineered fill will be placed to raise grades or replace poor/weak soil, the topsoil, vegetation, weathered/disturbed or existing earth fill must be fully removed down to competent native soil. The exposed subgrade soil must be proof-rolled and inspected by the geotechnical engineer to ensure all unsuitable material (e.g., organics, weak or soft soil, weathered / disturbed soil, deleterious materials, existing fill) is removed from the engineered fill footprint. Any unsuitable areas must be further sub-excavated and replaced with fill compacted to targeted 100% Standard Proctor Maximum Dry Density (SPmdd), minimum 98% SPmdd in building areas and 95% SPmdd in road and servicing areas.

Once the subgrade is approved, engineered fill can be placed. Engineered fill must be placed under the full-time supervision of a geotechnical engineer as required in the Ontario Building Code. The engineered fill may consist of excavated on-site inorganic cohesionless soils provided they have been moisture conditioned to a moisture content within 2% of optimum moisture content and do not contain organics, topsoil or deleterious material. It is recommended that any imported soil consist of Granular B (OPSS.MUNI 1010) and be first used in building areas, with suitable on-site soil used in landscaped or road areas. Engineered fill must be placed in loose lifts of 200 mm or less and compacted as noted above.

In wet subgrade areas, the first lift of engineered fill shall consist of 400 mm of Granular B Type II (OPSS.MUNI 1010). This will help to bridge the weaker subgrade and improve the ability to achieve the compaction specifications for subsequent engineered fill lifts.

The engineered fill must extend a minimum of 1 m out from all sides of the foundations and extend at a 1 horizontal to 1 vertical slope (1H:1V) down to the exposed subgrade. A typical detail for engineered fill pad dimensioning is included in Appendix C.

4.2 Foundation Design

4.2.1 Foundations on Native Soil

Grading plans for the site were being designed at the time of this report. The underground parking levels and residential basements are anticipated to extend about 3 to 4 m below the proposed grade.

Foundations at this site may be constructed as conventional spread and strip footing foundations that bear on the native, undisturbed soil in the upper 3 to 4 m of the existing ground surface as provided below. The geotechnical reaction at Serviceability Limit State (SLS) is for 25 mm or less of total settlement, and the factored geotechnical resistance at Ultimate Limit State ULS are provided in the table below for the corresponding depths and soil strata. The table below lists only the boreholes in building areas.

Borehole	Depth (m) / Elev. for Footings (At or Below)	Soil	Serviceability Limit State (SLS) (kPa)	Ultimate Limit State (ULS) (kPa)
1	2.3 / 254.0	Till	200	300
	3.0 / 253.3	Till	300	450
2	1.5 / 254.5	Till	150	225
	3.0 / 253.1	Till	250	375
5	0.8 / 256.9	Sand and Silt/Silty Clay/Till	100	150
6	0.8 / 233.1	Silty Sand/Silty Clay	100	150
	2.3 / 253.0	Till	200	300
11	0.8 261.8	Sand/Gravelly Sand	200	300
12	1.5 / 250.9	Till	150	225
	2.3 / 250.1	Till	300	450
13	2.3 / 250.8	Till	100	150
14	1.5 / 252.5	Till	200	300
	3.0 / 251.0	Sand	300	450
15	0.8 / 254.9	Silty Sand	100	150
	1.5 / 254.1	Till	150	225
	3.0 / 252.6	Till	300	340
16	0.8 / 255.2	Silty Sand	100	150
	2.3 / 253.7	Till	200	300
	3.0 / 253.0	Till	300	450
17	0.8 / 256.3	Silty Sand/Sand/Silty Clay	50	75
18	0.8 / 258.8	Fine Sand/Sand and Silt	150	225
19	0.8 / 258.8	Fine Sand/Sand and Silt	150	225
	3.0 / 256.3	Sand and Silt	300	450
20	0.8 / 261.0	Gravelly Sand	300	450
	2.3 / 259.5	Sand/Silt and Sand	200	300
21	1.5 / 252.1	Sand	150	225

Borehole	Depth (m) / Elev. for Footings (At or Below)	Soil	Serviceability Limit State (SLS) (kPa)	Ultimate Limit State (ULS) (kPa)
22	1.5 / 251.5	Till	150	225
	3.0 / 250.0	Till	300	450
23	1.5 / 253.4	Till	100	150
	3.0 / 251.9	Till	200	300
24	0.8 / 255.8	Fine Sand/Silty Clay	100	150
25	1.5 / 254.1	Till	100	150
	2.3 / 253.3	Till	300	450
26	1.5 / 259.5	Silt and Sand	100	150
27	0.8 / 261.1	Gravelly Sand/Sand	200	300
28	0.8 / 262.4	Sand	100	150
	1.5 / 261.7	Sand/Sand and Silt	200	300
29	0.8 / 262.9	Gravelly Sand/Sand	150	225

Locally higher bearing resistances are available or available at depth and can be provided upon request. Although, it is noted that greater groundwater control will be required during construction.

4.2.2 Foundations on Engineered Fill

If the foundations are supported on an engineered fill pad, constructed as discussed in Section 4.1.1, the spread or strip footings can be designed using the underlying native soil bearing capacity shown above, up to a maximum of 150 kPa at SLS and 225 kPa at ULS.

It is recommended that nominal reinforcing steel for stiffening of the foundation walls made on engineered fill be provided to help mitigate minor cracking due to minor differential settlement. The reinforcing steel in the poured concrete foundation walls may consist of 2-15M bars continuous at the top of the foundation wall, and 2-15M bars continuous at the bottom of the foundation walls. Typically, these bars are placed 100 to 200 mm from the top or bottom of the foundation wall, respectively. The reinforcing steel should extend a minimum of 3 m past any transition zones between engineered fill and native soil. A typical reinforcing steel detail for foundation walls placed on engineered fill is provided within Appendix C. The recommended nominal reinforcing steel should not be considered a structural design. The need for different or additional reinforcement should be reviewed by a structural engineer to ensure the original structural design intent of the structure is maintained.

4.2.3 General Foundation Considerations

All footings exposed to ambient air temperature throughout the year must be provided with a minimum of 1.2 m of earth cover or equivalent insulation for frost protection (25 mm of polystyrene insulation is equivalent to 300 mm of soil cover). The minimum strip and spread footing widths to be used shall be dictated as per the Ontario Building Code, regardless of loading considerations. Footings stepped from one level to another must be at a slope not exceeding 7V:10H.

The foundation design parameters provided above are predicated on the assumption that the foundation subgrade surface is undisturbed, and that all earth fill, deleterious, softened, disturbed, organic, and caved material is removed. The foundation excavation must be done in such a way that groundwater is controlled to prevent any disturbance to the foundation base. The groundwater table must be lowered at least 1 m below the founding elevation prior to excavation to prevent disturbance to the foundation subgrade from groundwater seepage.

The foundation subgrade must be reviewed prior to concrete placement to ensure the foundation design parameters provided are applicable, and to provide remedial recommendations if necessary. If the foundation excavation will be open for a prolonged period of time, the foundation subgrade should be protected with a skim coat of lean mix concrete (applied immediately after inspection by the geotechnical engineer), to ensure that no deterioration will occur due to weather effects.

4.3 Seismic Site Classification

Section 4.1.8.4 of the Ontario Building Code provides values of the acceleration and velocity-based site coefficients (F_a and F_v) for various time periods, associated with specific Site Classes. These Site Classes are based on the energy-corrected Average Standard Penetration Resistance values and undrained shear strength within the upper 30 m of soil underlying the grade beams or foundations of the proposed structure. As the boreholes were advanced less than this depth at the site, the site classification recommendation provided below assumes that the soil conditions are similar below the drilled depth.

Underneath the proposed foundations, the subsoil will consist of generally compact to dense cohesionless soils. The Site Classification for Seismic Site Response is "D" for this site.

4.4 Earth Pressure Design Parameters

Basement/underground parking levels or other retaining type walls must be designed to resist unbalanced lateral earth pressures imparted from the weight of adjacent soils. Lateral earth pressures are calculated using the following equation:

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

where, **P** = the horizontal pressure at depth, **h** (m)
K = the earth pressure coefficient (dimensionless)
h = depth below ground surface (m)
γ = the bulk unit weight of soil, (kN/m^3)
q = surcharge loading (kPa)

The above equation assumes that a drainage system is present which prevents the build-up of any hydrostatic pressure behind the structure subjected to the unbalanced lateral earth pressures. If this is not the case, the equation must be revised to also incorporate the submerged unit weight of the soil multiplied by the earth pressure coefficient, in addition to the water pressure itself.

The values for use in the design of the walls subjected to unbalanced lateral earth pressures in the upper 3 to 4 m of the site are as follows:

Soil Type	γ - Bulk Unit Weight (kN/m^3)	φ - Friction Angle (degrees)	Earth Pressure Coefficient (dimensionless)		
			K_a - Active	K_o – At-Rest	K_p - Passive
Granular 'B' (OPSS 1010)	21.0	32	0.31	0.47	3.25
Compact to Very Dense Native Soil	20.0	30	0.33	0.50	3.00
Fill/Loose Native soil	19.0	28	0.36	0.53	2.77

The calculation of the earth pressure coefficients is based on Rankine theory, which provides a conservative estimate as no friction between the soil and the structure is accounted for. The earth pressure coefficients provided above are applicable for flat ground surfaces beyond the structure and must be revised for sloping ground surfaces.

The earth pressure coefficients referenced within the above table are a function of the friction angle of the adjacent soil, and both the degree and direction of movement of the structure subjected to unbalanced lateral earth pressures. For structures that are restrained at the top (such as basement walls), the at-rest earth pressure coefficient will apply. For structures that allow for 0.1 to 1% of movement away from the soil (such as unrestrained retaining walls), the

full active earth pressure coefficient will apply. For structures that allow for 1 to 10% of movement into the soil, the full passive earth pressure coefficient will apply. The percentage movement is based on the height of the structure.

Other types of structures such as shoring walls with multiple rows of tiebacks and soil nail walls are subject to different loading conditions and must be analyzed separately.

4.5 Floor Slabs

The native soils or engineered fill are suitable to support the parking garage floor slabs or basement slabs for residences.

The engineered fill pad or exposed native soil may have been loosened/disturbed and the floor slab subgrade must be proof-rolled and inspected by the geotechnical engineer. If any soft or weak subgrade areas are identified, or if there are areas containing excessive amounts of deleterious/organic material, they must be locally sub-excavated and backfilled with Granular B Type I (OPSS.MUNI 1010) placed in maximum 200 mm thick loose lifts and compacted to a minimum of 98% SPmdd within 2% optimum moisture content.

All building floor slabs must be provided with a capillary moisture barrier and drainage layer. This is made by placing the concrete slab on a minimum 200 mm layer of 19 mm clear stone (OPSS.MUNI 1004) compacted by vibration to a dense state. The upper 50 mm of clear stone can be replaced with 19 mm crusher run limestone for a working surface. The clear stone and a cohesionless subgrade must be separated by a geotextile such as Terrafix 270R (or approved equivalent) to prevent the migration of fines into the clear stone layer which could result in loss of support for the slab. Alternatively, Granular A (OPSS.MUNI 1010) can used, compacted to 100% SPmdd, without geotextile.

4.6 Drainage

For underground parking, all foundation walls must be provided with damp-proofing provisions in conformance to the Ontario Building Code. Backfill along the foundation wall must consist of Granular B Type I (OPSS.MUNI 1010) for a minimum lateral distance of 600 mm out from the foundation wall. Alternatively, if a filtered cellular drainage media is provided adjacent to the foundation wall, the backfill may consist of common earth fill.

For underground structures, a perimeter drainage system must be installed that will remove any water that infiltrates into the building backfill, to ensure that any water does not infiltrate into the basement. The perimeter drains must consist of minimum 100 mm diameter perforated pipes wrapped in filter socks, sufficiently covered on all sides by 19 mm clear stone. Perimeter drains should be directed to the sump underneath the basement floor in solid pipes so as not to surcharge the underfloor drainage layer with water. It is recommended that basements be established a minimum of 1.0 m above the groundwater level. Where basements are less than

1.0 m but 0.5 m or more above the groundwater perforated subfloor drainage pipes at 5 m centres, surrounded by 19 mm clear stone, surrounded by a geotextile such as Terrafix 270R (or approved equivalent) to prevent the migration of fines, and trenched into the subgrade is also recommended for the buildings along the short axis of the buildings. All sump pumps should be on emergency power for redundancy in case of a power outage. A typical basement drainage detail is included in Appendix C.

For new structures that will be slab-on-grade with no basement levels, perimeter and under-slab drainage at the foundation level is not required, provided that the underside of concrete slab is at least 200 mm above the prevailing grade of the site and the surrounding surfaces slope away from the building at a gradient of at least 2% to promote surface water run-off and to reduce groundwater infiltration adjacent to foundations. To minimize infiltration of surface water, the upper 150 mm of backfill could consist of less permeable, compacted soil such as clayey silt at the site.

4.7 Site Servicing

It is expected that the proposed development will be serviced with municipal water, sanitary and storm sewers. Inverts were assumed to extend as deep as 3 to 4 m below the existing grade for the purposes of this report.

4.7.1 Bedding

The type of material and depth of granular bedding below the pipe will, to some extent, depend on the method of construction used by the contractor. Pipe bedding for flexible pipes should follow the requirements in Ontario Provincial Standard Drawing 802.010 or applicable municipal standards. Pipe bedding for rigid pipes should follow the requirements in Ontario Provincial Standard Drawings 802.030 to 802.032 or applicable municipal standards.

A subgrade consisting of the native soil or engineered fill will provide adequate support for pipes with the bedding requirements as laid out in the above referenced OPS drawings. Where disturbance of the trench base has occurred from groundwater seepage, construction traffic, etc., or if in-situ fill is present at the invert level, the material should be sub-excavated and replaced with suitably compacted granular fill. If weak zones are encountered, additional bedding materials and differing construction practices may be required and should be determined during construction. Any zones of organic soil should be sub-excavated and replaced with approved earth fill or imported granular material compacted to 95% SPmdd. Details on temporary groundwater control are provided in Section 5.2.

Regardless of whether flexible or rigid pipes are implemented, granular bedding and cover material should consist of a well graded, free draining material, such as Granular "A" (OPSS.MUNI 1010). All granular bedding must be compacted to a minimum of 95% SPmdd.

4.7.2 Backfill

Excavated native inorganic cohesionless soil may be re-used as backfill in trenches, provided it is moisture conditioned so that the moisture content is within 2% of optimum. Additional soil compaction details are provided in Section 5.3. The backfill should be compacted to a minimum of 95% SPmdd. In confined areas the layer thickness will have to be reduced to utilize smaller compaction equipment efficiently or by using granular material instead of locally sourced fill. Any backfill that is frozen, contains a high percentage of organic material (topsoil, peat, etc.) or moisture, or has otherwise unsuitable deleterious inclusion should not be used as backfill. The maximum cobble or boulder size should not exceed half of the loose lift thickness (i.e., all particles with a diameter greater than 100 mm should be removed). Where cohesive soils are utilized as backfill a sheepsfoot compactor will be required. In general, excavated clayey soil from the site is not recommended for re-use as backfill because these soils have moisture contents above optimum. Reducing moisture in the cohesive soil is not practical and the compaction specifications cannot be achieved.

Where trenches are within the traveled portions of a roadway, backfill within the frost penetration depth of 1.2 m should consist of native, non-organic, excavated material consistent with the soils surrounding the trench. If this technique is not undertaken, then frequently problems arise with yearly differential frost heave movements between the trench backfill and the adjacent native soil. This would occur, for example, if imported granular material is used to backfill trenches which is less susceptible to frost effects compared to the native soils on site. Alternatively, if different soil is used as the backfill due to issues with achieving compaction, a frost taper of 10H:1V can be implemented to help mitigate the potential for differential settlement and frost heave.

4.8 Pavement Design

The proposed development will have a network of roads as shown on the concept plan in Figure 2B.

4.8.1 Subgrade Preparation

For purposes of this report, the road grade is assumed to be at or just above the existing grade. Based on this the subgrade for the road is assumed to comprise engineered fill or the near surface soil noted in the boreholes, which range from low to high frost susceptibility.

The subgrade must be inspected and approved by the geotechnical engineer at the time of construction. If the subgrade does not comprise engineered fill, the exposed pavement subgrade should be compacted to a minimum 95% SPmdd. If any soft or weak subgrade areas are identified, or if there are areas containing excessive amounts of moisture or deleterious/organic material, they must be locally sub-excavated and backfilled with approved clean earth fill or imported granular material and compacted to a minimum of 95% SPmdd.

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.

4.8.2 Drainage

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 (at a minimum grade of 2 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 roadways and around the perimeter of parking areas and drained into respective catchbasins to facilitate drainage of the subgrade and the granular materials. The subdrain invert should be maintained at least 0.3 m below subgrade level. To minimize the problems of differential movement between the pavement and catchbasins/manholes due to frost action, the backfill around the structures should consist of free-draining OPSS Granular B. Typical pavement drainage details are provided in Appendix C.

4.8.3 Pavement Structure

The two different types of pavements for this project are defined below:

- Light duty: Includes parking lots which will not see frequent heavy traffic loads such as buses, delivery or fire trucks, etc., and will mostly service small vehicles such as cars or pickup trucks. In this case this design should be used for the parking lot used by the cars
- Heavy Duty: Includes access and driveways which are designated fire truck routes, or will see frequent heavy traffic loads such as school buses, delivery or garbage trucks, etc. In this case this design should be used for the driveway used by trucks and loading aprons.

The industry pavement design methods are based on a design life of 15 to 20 years for typical weather conditions depending on actual traffic volumes. The following pavement thickness designs are provided on the above noted considerations and conservatively based on the highly frost susceptible native soil. When the subgrade is confirmed, the designs can be finalized.

Pavement Layer	Compaction Requirements	Minimum Component Thickness	
		Light-Duty	Heavy-Duty
Surface Course Asphaltic Concrete: HL3 (OPSS 1150) with PG 58-28 Asphalt Cement (OPSS.MUNI 1101)	OPSS 310	40 mm	40 mm
Binder Course Asphaltic Concrete: HL8 (OPSS 1150) with PG 58-28 Asphalt Cement (OPSS.MUNI 1101)	OPSS 310	50 mm	80 mm
Base Course: Granular A (OPSS.MUNI 1010)	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm	150 mm
Subbase Course: Granular B Type I or II (OPSS.MUNI 1010)	100% Standard Proctor Maximum Dry Density (ASTM- D698)	450 mm	600 mm

The granular materials should be placed in lifts 200 mm thick or less and be compacted to a minimum of 100% SPmdd for both granular base and subbase. Asphalt materials should be rolled and compacted as per OPSS 310. The granular and asphalt pavement materials and their placement should conform to OPSS 310, 501, 1010 and 1150.

If the pavement construction occurs in wet, winter or inclement weather, it may be necessary to provide additional subgrade support for heavy construction traffic by increasing the thickness of the granular subbase, 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 or geogrid materials.

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 recommended that regular inspection and testing should be conducted during the pavement construction to confirm material quality, thickness, and to ensure adequate compaction.

Frost tapers of 10H:1V should be implemented between areas of differing pavement thickness and tie-in areas to existing pavement.

Smooth transitions are required in all areas where the new pavement meets the existing asphalt surface (existing roads). Asphalt joints shall follow OPSS.MUNI 310. Longitudinal asphalt joints should be milled into the existing asphalt a minimum of 0.5 m for each lift. Transvers joint shall be milled into the existing asphalt a minimum 0.5 m for each lift. Successive joints should be staggered.

4.9 Stormwater Management Pond

A large SWM pond is currently proposed along the west edge of the development. The details of the pond have not yet been fully established and are in the design phase.

Boreholes 3 and 4 were drilled in the area of the proposed SWM pond. Below the surficial topsoil and local fill, a sand and silt unit was revealed to 1.5 to 2.3 m depth (Elev. 250.3 to 253.0). A silty clay unit was below the silt and sand unit with variable thickness (0.7 to 3.1 m) extending to 3.0 to 4.6 m depth (Elev. 247.2 to 253.3). The silty clay was underlain by the major till deposit, extending to the 6.6 m depth of exploration in Borehole 4 (Elev. 245.2) and to 6.1 m depth (Elev. 2492.) in Borehole 3. A basal sand layer was below the till in Borehole 3 to the 6.6 m depth of the borehole (Elev. 248.8).

4.9.1 General Construction Considerations

Excavation and temporary ground water control construction considerations are provided with Section 5.1 of this report and apply to the construction of the SWM pond.

The steepest recommended interior pond slope inclination is 5H:1V. The steepest recommended exterior berm slope inclination is 3H:1V. The pond design should follow the design guidelines of the City of Barrie.

It is recommended that any piping or trenching in the area of the pond should be provided with seepage cut-off collars (clay plugs, concrete plugs, or other barriers) to protect against water seepage through the pipe bedding and backfill.

Pond berms above grade will have to be constructed as engineered fill, constructed as described earlier in the report.

4.9.2 Pond Slope Surface Treatment

The final slope surface and all bare or exposed areas (where applicable) should be provided with suitable vegetation cover or erosion protection. The sloped surface should be provided with a layer of topsoil (minimum 100 mm thick) and should be hydro-seeded with a grass mixture and mulch. If seeded, during the first 2 to 3 years, the surface cover of topsoil and seeding may require periodic maintenance until the vegetation becomes well established. It is recommended that erosion netting/erosion control blankets be staked on the slope surface for erosion protection (including the inside slope above the water level).

4.9.3 Liner Considerations

Depending on the type of SWM pond that is planned, a liner may be required if a permanent pool is proposed. The liner should be placed along the entire pond bottom and extend a minimum of 1.0 m above the permanent pool elevation. The liner may consist of a natural soil

material (such as clay), a synthetic membrane liner (such as a High-Density Polyethylene, Geo-synthetic Clay Liner, or PVC), a concrete liner, or a combination thereof. Details can be provided when the design has progressed.

The liner system must be designed to withstand uplift pressure due to hydrostatic head at the base of the liner for the worse-case condition when the pond is emptied for cleaning and maintenance activities. Uplift pressure can be assessed and reviewed when design details are established. A gravel/rip rap protection layer should also be considered for the liner when the pond is cleaned out in the future.

4.10 Infiltration Considerations

The predominant soil type(s) encountered on-site are summarized below with the interpreted unfactored infiltration rates:

Soil Type	Unfactored Infiltration Rate (mm/hr)
Sand/ Gravelly Sand	150 to 300
Silty Sand/Sand and Silt/Silt and Sand	50 to 75
Till	30
Silty Clay/Clayey Silt	Less than 10

Typical design of infiltration facilities has the base of the feature a minimum of 1 above the groundwater table. The infiltration rate provided below is not applicable below the groundwater table. As such, infiltration may not be practical/possible at some locations.

Appendix C of *"Low Impact Development Stormwater Management and Planning Design Guide"* (Version 1.0, 2010, by CVC and TRCA) suggests safety factors to be applied to infiltration rates. The safety factor applicable to the site is expected to be 2.5 but must be confirmed once the final location and elevation of LID measures are known.

Once LID plans are available, GEI recommends conducting Guelph Permeameter testing in the proposed footprints and infiltration elevations for the LID measures to determine the in-situ infiltration rates of the soil.

5. Constructability Considerations

5.1 Excavations

At this time, excavations for the project site are anticipated to be about 3.0 to 4.0 m below existing grade to account for SWM ponds, buildings and servicing. Below the surficial topsoil and fill, excavations are anticipated to encounter the upper cohesionless units, clayey silt, silty clay, sand and silt/silt and sand, the glacial till and lower gravelly sand/sand. Harder digging can be expected in the dense to very dense soils. Cobbles and boulders can be expected in the glacial till.

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, Section 222 through 242. Where workers must enter a trench or excavation the soil must be suitably sloped and/or braced in accordance with the OHSA. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety. If more than one soil type is encountered in an excavation, the most conservative soil type must be followed for sloping the sidewalls of the excavation. Excavations for the site should be completed considering a Type 3 soil geometry, 1H:1V from the base of the excavation, assuming that the soils are dewatered prior to excavation.

Excavation sidewalls will need to be continuously reviewed for evidence of instability and ground water seepage, particularly following periods of heavy rain or thawing. When required, remedial action must be taken to ensure the continued stability of excavation slopes and the safety of the workers.

Minimum support system requirements for steeper excavations are stipulated in Sections 235 through 238 and 241 of the OHSA and include provisions for timbering, shoring and moveable trench boxes. To reduce the potential for instability of the trench excavations, materials excavated from the service trenches and/or other fill materials or heavy equipment should not be placed near the crest of the trench excavations.

It is important to note that soil encountered in the construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in the boreholes advanced on site. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, we recommend that GEI be contacted immediately to evaluate the conditions encountered.

5.2 Temporary Construction Groundwater Control

As noted above, excavation is envisioned to extend to about 3.0 to 4.0 m depth below existing grades for the project.

The stabilized groundwater levels in the monitoring wells are typically within about 2 m of the ground surface corresponding to Elev. 252.8 to 258.7. This is believed to reflect a combination of perched water in the upper soil units, wet seams or wet cohesionless layer in the till deposit and groundwater under sub-artesian pressure in the lower sand unit below the till.

The exact scenario where certain groundwater control techniques will work are directly correlated to how coarse/fine the native soils are in an excavation, and both the lateral and vertical extent of the wet cohesionless deposits encountered as noted above. If the groundwater table is not controlled during construction, the base of the excavations will be unstable, leading to difficulties in excavating and placement of pipes, footings or engineered fill, and providing safety for the workers.

Conventional sump pumping should suffice to control groundwater seepage for excavations that extend about 1.0 to 2.0 m below existing grade. Locally in sandier zones several sumps or keg wells may be required.

Deeper excavation will require pumping from multiple keg wells or dewatering, including depressurization of the lower sub-artesian pressurized sand and gravelly sand deposits.

It is recommended to carry out the work during the dry time of the year when the ground water table is lowest, to mitigate groundwater control measures. Also reducing the size of the excavation that is open at any one time will aid in reducing groundwater control requirements.

Based on the above, a Permit-to-Take-Water (PTTW) may be required depending on the design. Registry on the Environmental Activity and Sector Registry (EASR) system is considered to be required as a minimum.

A hydrogeological study is recommended for the site when the design details have been established to assess water taking analysis, regulatory requirements, impact assessments and monitoring plans, etc.

5.3 Compaction Specifications

SPmdd is the specification to indicate the degree to which soil or aggregate is compacted. To achieve the specified SPmdd as indicated in this report, all soils or aggregates must be placed in lift thicknesses no greater than 200 mm. If this is not the case, only the upper portion of the lift will be adequately compacted, and the lower portion of the lift has a high probability of not meeting compaction specifications. In addition, industry standard equipment used to determine

the degree of compaction consists of nuclear densometers. These devices have an inherent limitation in that they cannot test beyond 300 mm in depth, and so the degree of compaction beyond this depth cannot be quantitatively determined.

Along with lift thickness, ensuring that the soil or aggregate is within 2% of its optimum moisture content ensures that the specified compaction can be reached. If the soil or aggregate is too dry/wet, it is either very difficult or impossible to reach the specified compaction. This is especially true for when higher compaction specifications such as 98% and 100% SPmdd are required.

Based on our review of the soil types encountered in the boreholes with associated moisture contents, the soils at this site above the groundwater table are near optimum and the soil below the ground water table is wet of optimum.

Moisture can be increased by adding water and mixing the soil prior to re-use, blending the soil with wetter material, or by importing soil to the site that is at optimum and can be readily compacted.

Moisture can be reduced by tilling or spreading out the soil to dry or blending it with drier material. In-situ moisture contents can change based on the season and local groundwater levels and can also change for stockpiled material due to precipitation. Zones of the fine-grained soil beneath the site have very high moisture contents and moisture conditioning may be difficult to accomplish.

Excavated clayey soil from the site should not be re-used as engineered fill or common backfill because these soils have moisture contents well above optimum. Reducing moisture in the cohesive soil is likely not practical and the compaction specifications will not be achieved.

In addition to the above compaction specifications, in any areas where compacted fill will be placed over the exposed native soil subgrade, any loose, soft, wet, organic or unstable areas should be sub-excavated, and backfilled with clean earth fill or Granular 'B' (OPSS.MUNI 1010) compacted to a minimum of 95% SPmdd. This recommendation applies to site servicing and pavement subgrades. Where structures/buildings require upfilling beneath the structure the fill should be compacted to 100% SPmdd.

5.4 Quality Verification Services

On-site quality verification services are an integral part of the geotechnical design function, and for foundations, engineered fill and retaining walls, are required under the Ontario Building Code. Quality verification services are used to confirm that construction is being conducted in general conformance with the requirements as outlined in the drawings, reports and specifications prepared for the proposed development.

GEI Consultants can provide all the on-site quality verification services outlined below:

- The subgrade for shallow foundations for buildings must be field reviewed by the geotechnical engineer as required by the municipal regulating authority.
- Installation of retaining structures over 1.0 m high and related backfilling operations must be field reviewed on a continuous basis by the geotechnical engineer as required in the OBC.
- Full-time monitoring, testing and inspection of engineered fill placement is required by the geotechnical engineer per the OBC.
- Part-time monitoring of the subgrade support capabilities, material quality, lift thickness, moisture content, degree of compaction, etc. is recommended for the following areas to ensure the recommendations within this report are followed and they perform adequately in the long-term;
  - Slab-on-grades;
  - Pavement structure (granular and asphalt); and
  - Bedding/backfilling of site servicing.
- Testing of the concrete (compressive strength, slump, air content, etc.) and testing of the asphalt (asphalt content and gradation) are recommended to ensure that the quality of the materials being brought to site meet the requirements of the project.

5.5 Site Work

The soils found at this site may become weakened when subjected to traffic, particularly when wet. If there is site work carried out during periods of wet weather, then it can be expected that the subgrade will be disturbed unless an adequate granular working surface is provided to protect the integrity of the subgrade soils from construction traffic. Subgrade preparation works cannot be adequately accomplished during wet weather and the project must be scheduled accordingly. The disturbance caused by the traffic can result in the removal of disturbed soil and use of granular fill material for site restoration or underfloor fill that is not intrinsic to the project requirements.

The most severe loading conditions on the subgrade may occur during construction. Consequently, special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during paving and other work may be required, especially if construction is carried out during unfavourable weather.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the founding subgrade and concrete must be provided. The soil at this site is susceptible to frost damage. Consideration must be given to frost effects, such as heave or softening, on exposed soil surfaces in the context of this particular project development.

6. Limitations and Conclusions

6.1 Limitations

The recommendations and comments provided are necessarily on-going as new information of underground conditions becomes available. More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, conditions not observed during this investigation may become apparent. Should this occur, GEI should be contacted to assess the situation and additional testing and reporting may be required.

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

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as 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.

This report was authorized by, and prepared by GEI for, the account of Hansen Group Inc. (as provided in the signed Standard Professional Services Agreement). 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. GEI accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

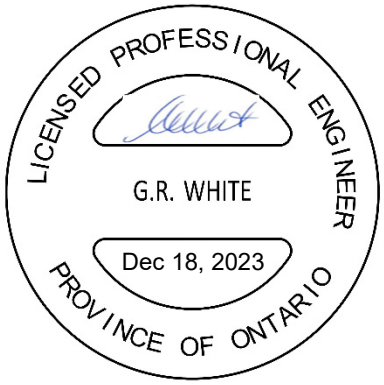
6.2 Conclusion

It is recognized that municipal/regional governing bodies, in their capacity as the planning and building authority under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both as are expressed and implied.

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to contact our office.

Yours Truly,

GEI Consultants

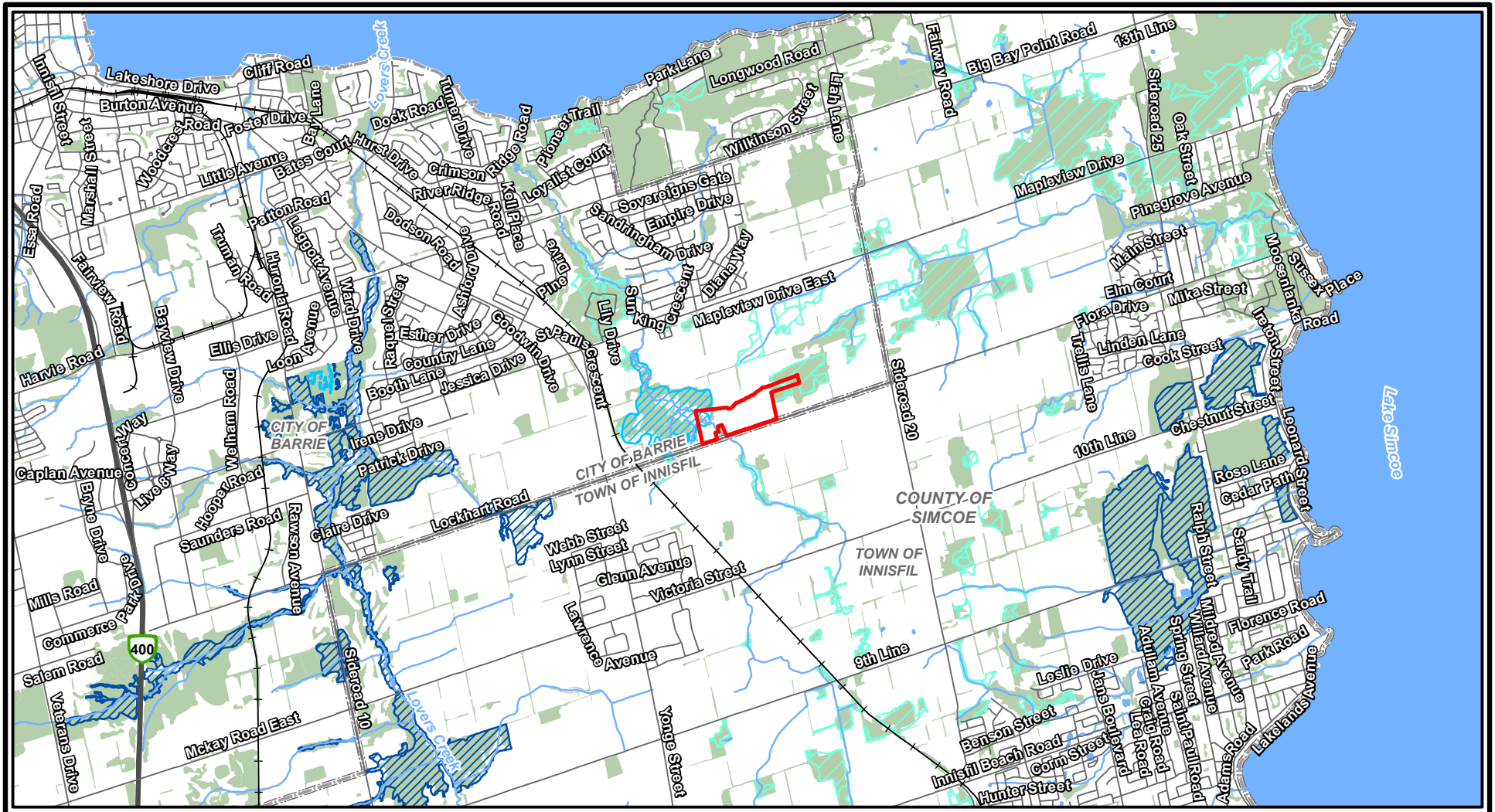


Geoffrey R. White, P.Eng.
Geotechnical Practice Lead

Figures

Site Location Plan

Borehole Location Plans



Legend

- Approx. Site Boundary
- Railway
- Highway
- Road
- Watercourse
- Waterbody
- Wooded Area
- Provincially Significant Wetland
- Locally/Other Significant Wetland
- Wetland not Evaluated per OWES

NOTES:

1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2023.

0 500 1,000 m

1:60,000

N

Geotechnical Investigation
Hewitt's South Subdivision
894 Lockhart Road, Barrie, ON

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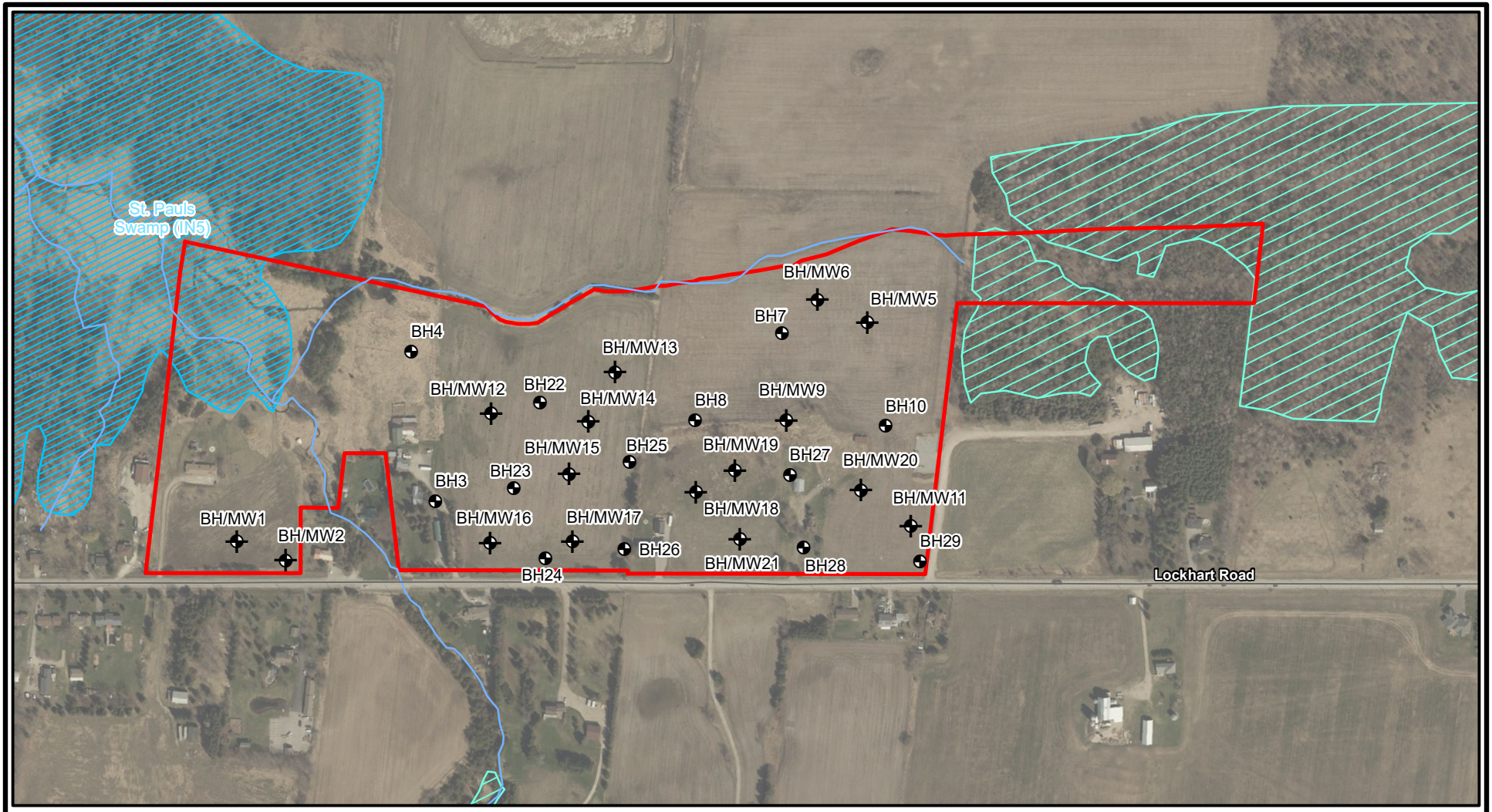
Project Area Location Plan

Project 2304675 | December 2023 | Fig. 1



Legend

- Approx. Site Boundary
- Road
- Watercourse
- Locally/Other Significant Wetland
- Wetland not Evaluated per OWES
- Waterbody
- Approx. Borehole/Monitroing Well Location
- Approx. Borehole Location

NOTES:

1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2023.
3. Orthoimagery © First Base Solutions, 2023. Imagery taken in 2022.

0 50 100 m

1:6,000

N

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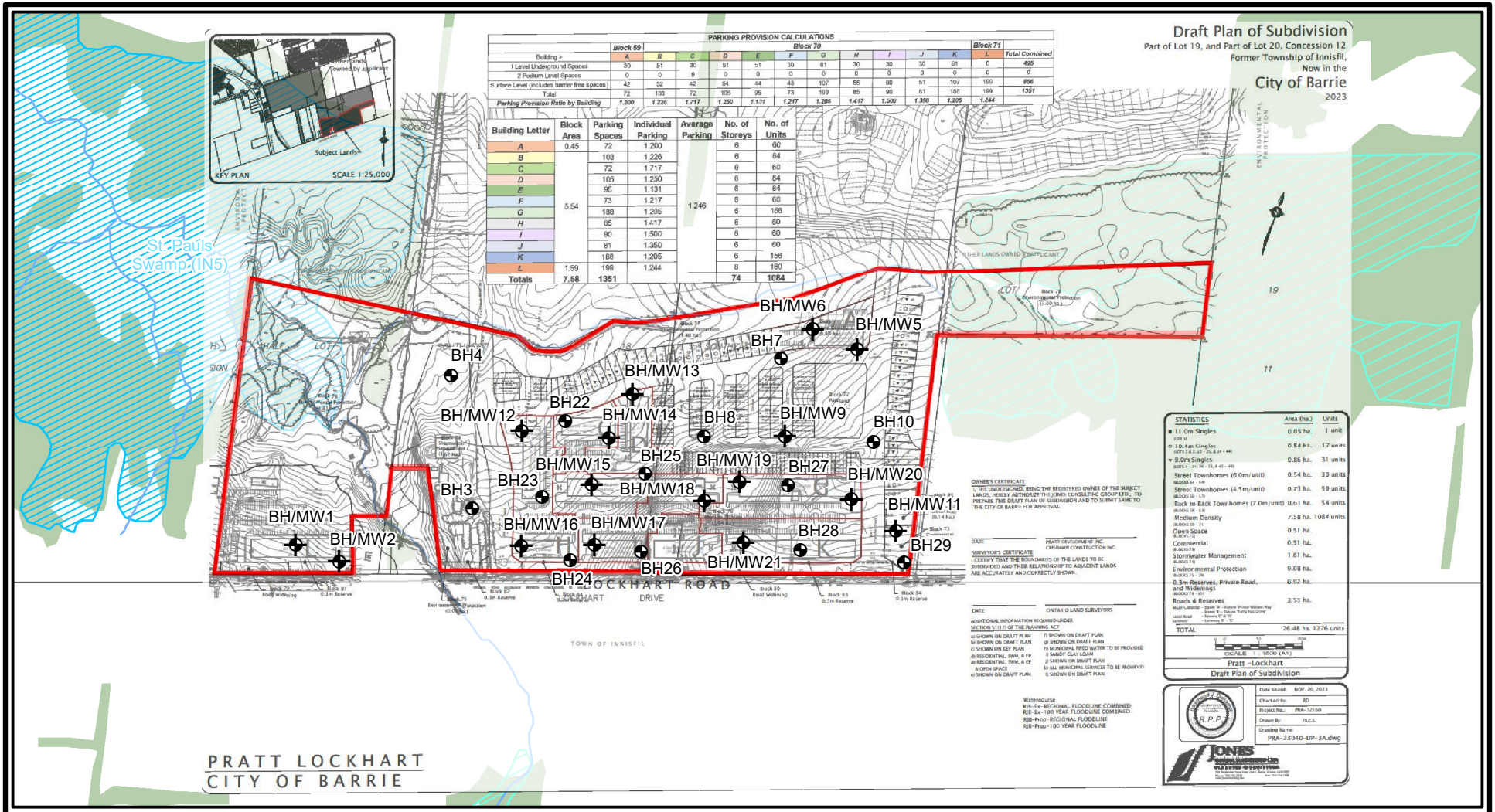
BOREHOLE LOCATION PLAN (AERIAL)

Project 2304675 | December 2023 | Fig. 2A



Legend

- Approx. Site Boundary
- Highway
- Road
- Watercourse
- Locally/Other Significant Wetland
- Wetland not Evaluated per OWES
- Approx. Borehole/Monitroing Well Location
- Approx. Borehole Location

NOTES:

1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2023.

0 50 100 m

1:6,750

N

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Project 2304675

BOREHOLE LOCATION PLAN (SITE PLAN)

December 2023 Fig. 2B

Appendix A

Borehole Logs

RECORD OF BOREHOLE No. 1

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910627** Date Started: **Nov 2/23**
Reviewed By: **GW** Easting: **610864** Date Completed: **Nov 2/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING (Shear Strength Testing (kPa); Penetration Testing SPT/DCPT)	LAB TESTING (Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); Atterberg Limits PL/LL; Water Content (%))	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
	0.0 256.3					0								
	0.2 256.2 TOPSOIL: 180 mm													
	FILL: Silty sand, trace clay, trace gravel, loose, brown, moist 0.8 255.5	SS	1	100	4		255	4	18					
	SILTY SAND: Trace gravel, loose, brown, wet 1.5 254.8	SS	2	100	6	1.5		6	16					
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, loose to dense, brown, moist to wet	SS	3	100	6		253.5	6	13					
		SS	4	100	19	3		19	9					
	- - - Wet seam - - -	SS	5	100	42		252	42	9		First Water Strike SS5			
	4.6 251.7					4.5								
	GRAVELLY SILTY SAND: Trace clay, dense, brown, wet 6.1 250.2	SS	6	100	33		250.5	33	16		31	46	20	3
	SAND: Some silt, trace gravel, dense, brown, wet 6.6 249.8	SS	7	100	39	6		39	19					
	Borehole Terminated at 6.6 m													

GEI CONSULTANTS
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Groundwater depth encountered on completion of drilling: Dry
Groundwater depth observed on: Nov 29/23 at depth of: 0.5 m.
Cave depth after auger removal: Open
Groundwater Elevation: 255.8 m

RECORD OF BOREHOLE No. 2

GEI Consultants

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910625** Date Started: **Nov 2/23**
Reviewed By: **GW** Easting: **610918** Date Completed: **Nov 2/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 256.1					0	
	0.2 TOPSOIL: 180 mm 255.9						
	FILL: Silty sand, trace clay, trace gravel, loose, brown, moist	SS	1	40	4		
	0.8 255.3						
	SILTY SAND: Trace clay, trace gravel, loose, brown, moist to wet	SS	2	100	4		255
	1.5 254.5					1.5	
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to dense, brown, moist to wet	SS	3	100	13		
		SS	4	60	17		253.5
		SS	5	100	23	3	
							252
		SS	6	100	36	4.5	
	6.1 250.0						250.5
	SAND: Trace silt, very dense, brown, wet	SS	7	100	58	6	
	6.6 249.5						
	Borehole Terminated at 6.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL ○ LL
Water Content (%)
10 20 30 40

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

First Water Strike SS4

GR	SA	SI	CL
7	46	37	10

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Groundwater depth encountered on completion of drilling: 2.3 m. Cave depth after auger removal: 3.3 m.
Groundwater depth observed on: Nov 29/23 at depth of: 0.4 m. Groundwater Elevation: 255.7 m

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :75**
Page: **1 of 1**

RECORD OF BOREHOLE No. 3

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910732** Date Started: **Nov 2/23**
Reviewed By: **GW** Easting: **611039** Date Completed: **Nov 2/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING (Shear Strength Testing (kPa); Penetration Testing: SPT ○, DCPT ●)	LAB TESTING (Combustible Organic Vapour (ppm) △, Combustible Organic Vapour (%LEL) ▲, Total Organic Vapour (ppm) ◇; Atterberg Limits PL–LL; Water Content (%) ○)	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
	0.0 255.3													
	TOPSOIL: 610 mm	SS	1	75	5	0	255	5	15					
	0.6 254.7													
	SAND AND SILT: Compact, brown, moist	SS	2	100	26			26	12					
	- - - Wet - - -	SS	3	100	18	1.5	253.5	18	21		First Water Strike SS3			
	2.3 253.0													
	SILTY CLAY: Trace sand, trace gravel, stiff, grey, moist	SS	4	100	14			14	45					
	3.0 252.3													
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to dense, brown, moist to wet	SS	5	100	21	3	252	21	10		8	45	36	11
		SS	6	100	40	4.5	250.5	40	9					
	6.1 249.2													
	SAND: Trace to some gravel, trace silt, dense, grey, wet	SS	7	100	65	6	249	65 →	8					
	6.6 248.8													
	Borehole Terminated at 6.6 m													

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Groundwater depth encountered on completion of drilling: 3.3 m. Cave depth after auger removal: Open
Groundwater depth observed on: Groundwater Elevation:

Scale: **1 :75**

RECORD OF BOREHOLE No. 4

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910870** Date Started: **Nov 6/23**
Reviewed By: **GW** Easting: **610971** Date Completed: **Nov 6/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 251.8					0	
	0.2 TOPSOIL: 150 mm 251.6						
	FILL: Sandy silt, trace gravel, trace organics, loose, brown, moist 0.8 251.0	AS	1				
	SAND AND SILT: Trace clay, loose, brown, moist to wet 1.5 250.3	SS	2	100	8	1.5	250.5
	SILTY CLAY: Trace sand, stiff, grey, moist to wet	SS	3	100	9		
		SS	4	100	8	3	249
		SS	5	100	9		
	4.6 247.2					4.5	247.5
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to dense, brown, moist to wet with wet seams	SS	6	100	16		
	6.6 245.2	SS	7	100	31	6	246
	Borehole Terminated at 6.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL ○ Water Content (%) LL
10 20 30 40

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	2	30	68

First Water Strike SS6

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Groundwater depth encountered on completion of drilling: Dry
Groundwater depth observed on:
Cave depth after auger removal: Open
Groundwater Elevation:

RECORD OF BOREHOLE No. 5

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4911048** Date Started: **Nov 8/23**
Reviewed By: **GW** Easting: **611407** Date Completed: **Nov 8/23**

Depth (m)	Description	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Elevation (m)
0.0						257.6
0.2	TOPSOIL: 150 mm					257.5
0.8	FILL: Sand, trace silt, trace organics, loose, brown, moist to wet	AS	1			256.9
1.5	SAND AND SILT: Compact, brown, wet	SS	2	100	15	256.1
2.3	SILTY CLAY: Trace sand, very stiff, grey, moist	SS	3	100	16	255.4
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to very dense, brown, moist to wet	SS	4	100	11	
		SS	5	100	10	
		SS	6	100	39	
6.6		SS	7	100	56	251.1
	Borehole Terminated at 6.6 m					

FIELD TESTING: Shear Strength Testing (kPa) — Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded); 40 80 120 160. Penetration Testing: SPT, DCPT; 10 20 30 40.

LAB TESTING: Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); 100 200 300 400. Atterberg Limits: PL, LL. Water Content (%); 10 20 30 40.

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

First Water Strike SS2

GR	SA	SI	CL
0	7	32	61

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Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Nov 29/23 at depth of: 1.8 m.
Groundwater Elevation: 255.8 m

Scale: **1 :75**

RECORD OF BOREHOLE No. 6

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Project Number:	2304675				
Project Client:	Hansen Group Inc.				
Project Name:	Hewitt's South Residential Subdivision	Drilling Method:	Solid Stem Augers	Drilling Machine:	Track Mount
Project Location:	Lockhart Road, Barrie, ON	Logged By:	BH	Northing: 4911054	Date Started: Nov 8/23
Drilling Location:	See Borehole Location Plan	Reviewed By:	GW	Easting: 611351	Date Completed: Nov 8/23
Local Benchmark:					

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 255.2					0	255
	TOPSOIL: 100 mm FILL: Silty sand, trace clay, trace gravel, loose, brown, moist	AS	1				
	0.8 254.5						
	SILTY SAND: Compact, brown, wet	SS	2	100	14		
	1.5 253.7					1.5	253.5
	SILTY CLAY: Trace sand, stiff, grey, moist	SS	3	100	10		
	2.3 253.0						
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact, brown, moist to wet	SS	4	100	22		
						3	252
		SS	5	100	24		
						4.5	250.5
		SS	6	100	24		
	6.1 249.1					6	249
	SAND: Some silt, trace gravel, dense, grey, wet	SS	7	100	35		
	6.6 248.7						
	Borehole Terminated at 6.6 m						

FIELD TESTING

Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160

Penetration Testing
○ SPT ● DCPT
10 20 30 40

14, 10, 22, 24, 24, 35

LAB TESTING

△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400

Atterberg Limits
PL ——— LL

○ Water Content (%)
10 20 30 40

15, 20, 26, 9, 8, 7, 11

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

First Water Strike SS2

Second Water Strike SS6

GR	SA	SI	CL
9	45	35	11

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Groundwater depth encountered on completion of drilling: 5.4 m. Cave depth after auger removal: Open

Groundwater depth observed on: Nov 29/23 at depth of: 1.2 m. Groundwater Elevation: 254.0 m

Scale: **1 :75**

RECORD OF BOREHOLE No. 7

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4911010** Date Started: **Nov 8/23**
Reviewed By: **GW** Easting: **611327** Date Completed: **Nov 8/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 255.7					0	255
	0.2 TOPSOIL: 150 mm 255.5						
	FILL: Sand, some silt, trace organics, loose, brown, moist	AS	1				
	0.8 254.9					1.5	253.5
	SAND AND SILT: Compact, brown, wet	SS	2	100	10		
	1.5 254.1					3	252
	SILTY CLAY: Some sand, very stiff, grey, moist to wet	SS	3	100	16		
	2.3 253.4					4.5	250.5
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to very dense, brown, moist to wet	SS	4	100	18		
		SS	5	100	24	6	
		SS	6	100	50		
		SS	7	100	30		
	6.6 249.1						
	Borehole Terminated at 6.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

First Water Strike SS2

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Groundwater depth encountered on completion of drilling: 3.0 m. Cave depth after auger removal: Open
Groundwater depth observed on: Groundwater Elevation:

RECORD OF BOREHOLE No. 8

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910896** Date Started: **Nov 8/23**
Reviewed By: **GW** Easting: **611271** Date Completed: **Nov 8/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 256.3					0	
	0.2 TOPSOIL: 205 mm 256.1						
	FILL: Silty sand, trace clay, trace gravel, loose, brown, moist	AS	1				
	0.8 255.5					1.5	255
	SAND: Trace silt, brown, compact, moist to wet	SS	2	100	10		
	1.5 254.8						
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to dense, brown, moist to wet	SS	3	100	17		
		SS	4	100	26	3	253.5
		SS	5	100	31		252
	4.6 251.7					4.5	
	SAND: Trace silt, trace gravel, compact to dense, grey, wet	SS	6	100	26		
		SS	7	100	34	6	250.5
	6.6 249.8						
	Borehole Terminated at 6.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

First Water Strike SS2

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Groundwater depth encountered on completion of drilling: 3.0 m. Cave depth after auger removal: 4.2 m.
Groundwater depth observed on: Groundwater Elevation:

RECORD OF BOREHOLE No. 9

Project Number:	**2304675**						
Project Client:	**Hansen Group Inc.**						
Project Name:	**Hewitt's South Residential Subdivision**	Drilling Method:	**Solid Stem Augers**	Drilling Machine:	**Track Mount**		
Project Location:	**Lockhart Road, Barrie, ON**	Logged By:	**BH**	Northing:	**4910926**	Date Started:	**Nov 8/23**
Drilling Location:	**See Borehole Location Plan**	Reviewed By:	**GW**	Easting:	**611360**	Date Completed:	**Nov 8/23**
Local Benchmark:							

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0					0	258
	TOPSOIL: 760 mm	AS	1				
	0.8						257.3
	SILT AND SAND: Compact, brown, moist to wet	SS	2	100	14		
						1.5	256.5
		SS	3	100	10		
		SS	4	100	11		
	3.0						255.0
	SILT CLAY: Trace sand, stiff, brown, moist	SS	5	100	13	3	255
	4.6						253.4
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, dense to very dense, brown, moist to wet	SS	6	100	34	4.5	253.5
						6	252
	6.6	SS	7	65	100+		251.5
	Borehole Terminated at 6.6 m						

FIELD TESTING

Shear Strength Testing (kPa)

× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)

40 80 120 160

Penetration Testing

○ SPT ● DCPT

10 20 30 40

SPT values: 14, 10, 11, 13, 34, 100+

LAB TESTING

△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)

100 200 300 400

Atterberg Limits

PL ○ LL

Water Content (%)

10 20 30 40

Water Content values: 110, 20, 22, 21, 25, 7, 8

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

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Groundwater depth encountered on completion of drilling: 1.9 m. Cave depth after auger removal: 0.1 m.

Groundwater depth observed on: Nov 29/23 at depth of: 1.3 m. Groundwater Elevation: 256.7 m

Scale: **1 :75**

RECORD OF BOREHOLE No. 10

GEI Consultants

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910953** Date Started: **Nov 8/23**
Reviewed By: **GW** Easting: **611458** Date Completed: **Nov 8/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	0.0 259.8							Shear Strength Testing (kPa): × Other Test; + Pocket Penetrometer; ▲ Field Vane (Intact); △ Field Vane (Remolded); 40 80 120 160. Penetration Testing: ○ SPT ● DCPT; 10 20 30 40	△ Combustible Organic Vapour (ppm); ▲ Combustible Organic Vapour (%LEL); ◇ Total Organic Vapour (ppm); 100 200 300 400. Atterberg Limits: PL — LL. ○ Water Content (%); 10 20 30 40		GR SA SI CL
	TOPSOIL: 100 mm FILL: Sand, trace silt, trace organics, loose, brown, moist	AS	1			0	259.5				
	0.8 259.0										
	SILT AND SAND: Trace clay, compact, brown, moist to wet	SS	2	100	16			16	18		First Water Strike SS2
						1.5	258				
		SS	3	100	14			14	23		
		SS	4	100	14			14	21		
		SS	5	100	22	3	256.5	22	18		
						4.5	255				
		SS	6	100	27			27	18		
	6.1 253.7					6	253.5				
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact, brown, moist to wet	SS	7	100	17			17	24		
	6.6 253.2 Borehole Terminated at 6.6 m										

Groundwater depth encountered on completion of drilling: 1.8 m. Cave depth after auger removal: 4.0 m.
Groundwater depth observed on: Groundwater Elevation:

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Scale: **1 :75**

RECORD OF BOREHOLE No. 11

GEI Consultants

Project Number:	2304675				
Project Client:	Hansen Group Inc.				
Project Name:	Hewitt's South Residential Subdivision	Drilling Method:	Solid Stem Augers	Drilling Machine:	Track Mount
Project Location:	Lockhart Road, Barrie, ON	Logged By:	BH	Northing: 4910864	Date Started: Nov 7/23
Drilling Location:	See Borehole Location Plan	Reviewed By:	GW	Easting: 611516	Date Completed: Nov 7/23
Local Benchmark:					

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 262.6					0	262.5
	TOPSOIL: 100 mm SAND: Some gravel, trace silt, trace organics, loose to compact, brown, moist	AS	1				
		SS	2	100	29		
	1.5 261.1					1.5	261
	GRAVELLY SAND: Trace silt, dense, brown, moist	SS	3	100	44		
	2.3 260.4						
	SAND: Trace silt, trace gravel, compact, brown, moist to wet	SS	4	100	22		
		SS	5	100	20	3	259.5
		SS	6	100	16	4.5	258
	6.1 256.6					6	256.5
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact, brown, moist to wet	SS	7	100	25		
	6.6 256.1 Borehole Terminated at 6.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL ○ LL
Water Content (%)
10 20 30 40

Instrumentation Installation: First Water Strike SS4

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

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Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Nov 29/23 at depth of: 3.9 m.
Groundwater Elevation: 258.7 m

RECORD OF BOREHOLE No. 12

GEI Consultants

Project Number:	2304675				
Project Client:	Hansen Group Inc.				
Project Name:	Hewitt's South Residential Subdivision	Drilling Method:	Solid Stem Augers	Drilling Machine:	Track Mount
Project Location:	Lockhart Road, Barrie, ON	Logged By:	BH	Northing: 4910835	Date Started: Nov 6/23
Drilling Location:	See Borehole Location Plan	Reviewed By:	GW	Easting: 611070	Date Completed: Nov 6/23
Local Benchmark:					

Depth (m)	Elevation (m)	Description	Sample Type	Sample Number	Recovery (%)	SPT "N" Value
0.0	252.4					
0.2	252.2	TOPSOIL: 150 mm				
		FILL: Clayey silt, trace organics, trace sand, stiff, brown, wet	SS	1	75	9
0.8	251.6					
		CLAYEY SILT: Some sand, stiff, brown, moist	SS	2	100	11
1.5	250.9					
		SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, loose, brown, moist to wet	SS	3	100	16
			SS	4	100	42
			SS	5	100	32
		- - - Wet sand and gravel layer - - -				
			SS	6	100	41
		- - - Some to gravelly, very dense, moist to wet - - -	SS	7	100	57
6.6	245.8	Borehole Terminated at 6.6 m				

Field Testing: Shear Strength Testing (kPa) — Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded); Penetration Testing: SPT, DCPT

Lab Testing: Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); Atterberg Limits (PL, LL); Water Content (%)

Instrumentation Installation: First Water Strike SS5

Comments & Grain Size Distribution (%): GR, SA, SI, CL

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Groundwater depth encountered on completion of drilling: 2.4 m. Cave depth after auger removal: Open

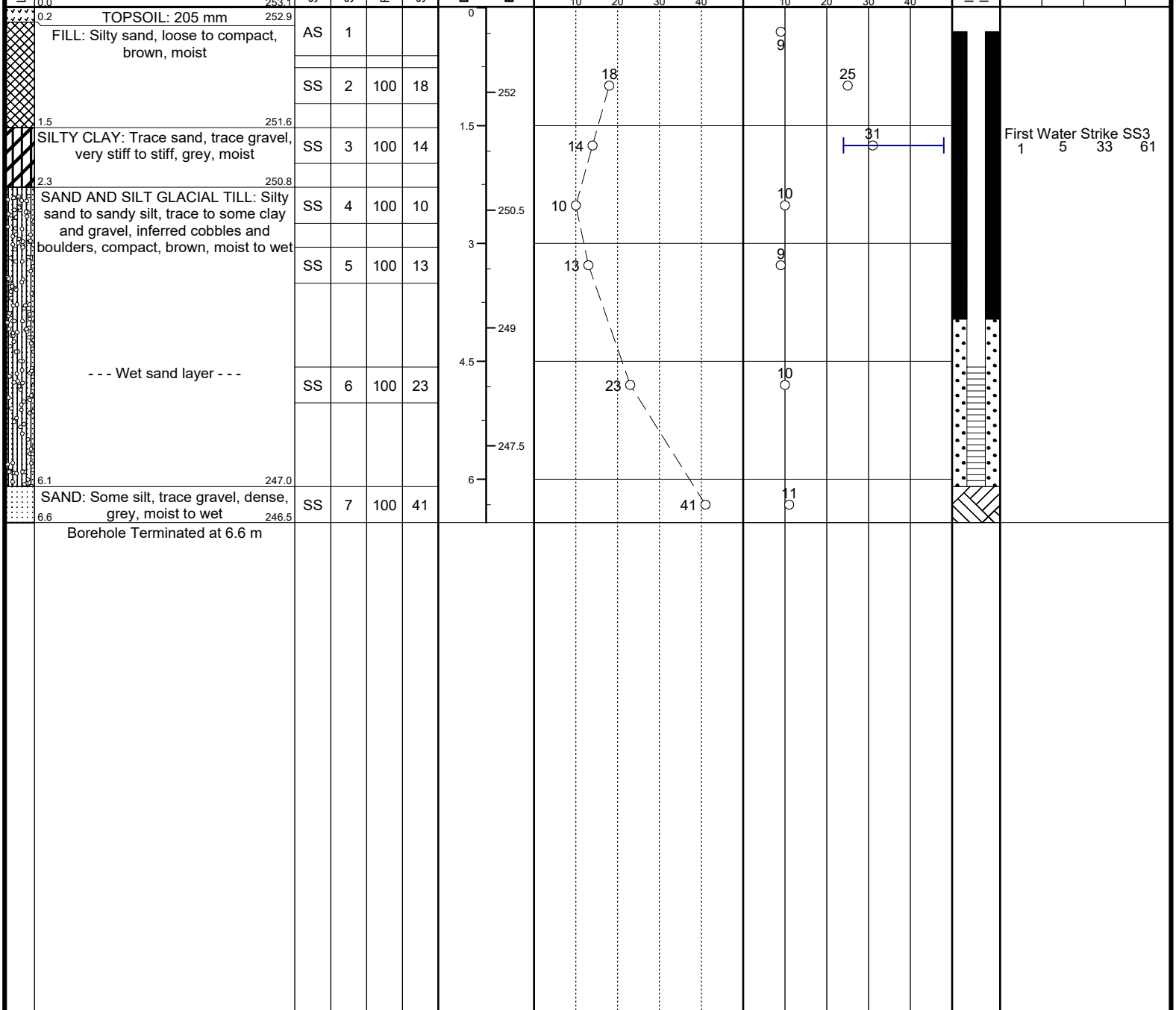
Groundwater depth observed on: Nov 29/23 at depth of: Blocked Groundwater Elevation:

RECORD OF BOREHOLE No. 13

GEI Consultants

Project Number:	2304675				
Project Client:	Hansen Group Inc.				
Project Name:	Hewitt's South Residential Subdivision	Drilling Method:	Solid Stem Augers	Drilling Machine:	Track Mount
Project Location:	Lockhart Road, Barrie, ON	Logged By:	BH	Northing: 4910916	Date Started: Nov 6/23
Drilling Location:	See Borehole Location Plan	Reviewed By:	GW	Easting: 611177	Date Completed: Nov 6/23
Local Benchmark:					

Depth (m)	Elevation (m)	Description	Sample Type	Sample Number	Recovery (%)	SPT "N" Value
0.0	253.1					
0.2	252.9	TOPSOIL: 205 mm				
		FILL: Silty sand, loose to compact, brown, moist	AS	1		
			SS	2	100	18
1.5	251.6					
		SILTY CLAY: Trace sand, trace gravel, very stiff to stiff, grey, moist	SS	3	100	14
2.3	250.8					
		SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact, brown, moist to wet	SS	4	100	10
			SS	5	100	13
		- - - Wet sand layer - - -	SS	6	100	23
6.1	247.0					
		SAND: Some silt, trace gravel, dense, grey, moist to wet	SS	7	100	41
6.6	246.5					
		Borehole Terminated at 6.6 m				



COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

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Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Nov 29/23 at depth of: Blocked
Groundwater Elevation:

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: 1 :75
Page: 1 of 1

RECORD OF BOREHOLE No. 14

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910860** Date Started: **Nov 6/23**
Reviewed By: **GW** Easting: **611167** Date Completed: **Nov 6/23**

Depth (m)	Description	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Elevation (m)
0.0						254.0
0.2	TOPSOIL: 150 mm					253.9
	SILTY SAND: Trace clay, trace gravel, loose, brown, moist to wet	AS	1			
		SS	2	100	7	
1.5						252.5
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact, brown, moist to wet	SS	3	100	17	
		SS	4	100	22	
3.0						251.0
	SAND: Trace silt, trace gravel, very dense, brown, wet	SS	5	100	62	
4.6						249.4
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to very dense, brown, moist to wet	SS	6	100	21	
		SS	7	65	100+	
6.6						247.5
	Borehole Terminated at 6.6 m					

Shear Strength Testing (kPa): Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded)
Penetration Testing: SPT; DCPT
Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm)
Atterberg Limits: PL; LL; Water Content (%)
Instrumentation Installation: First Water Strike SS5

Groundwater depth encountered on completion of drilling: 3.5 m. Cave depth after auger removal: 4.5 m.
Groundwater depth observed on: Nov 29/23 at depth of: 1.2 m. Groundwater Elevation: 252.8 m

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Scale: **1 :75**

RECORD OF BOREHOLE No. 15

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Project Number:	2304675				
Project Client:	Hansen Group Inc.				
Project Name:	Hewitt's South Residential Subdivision	Drilling Method:	Solid Stem Augers	Drilling Machine:	Track Mount
Project Location:	Lockhart Road, Barrie, ON	Logged By:	BH	Northing: 4910802	Date Started: Nov 3/23
Drilling Location:	See Borehole Location Plan	Reviewed By:	GW	Easting: 611165	Date Completed: Nov 3/23
Local Benchmark:					

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 255.6						
	TOPSOIL: 305 mm 0.3 255.3	SS	1	45	5	0	255
	FILL: Silty sand, trace organics, loose, brown, moist 0.8 254.9	SS	2	100	10	1.5	253.5
	SILTY SAND: Trace gravel, trace clay, compact, brown, moist 1.5 254.1	SS	3	35	14	3	252
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to dense, brown, moist to wet	SS	4	100	27	4.5	250.5
		SS	5	100	42	6	
		SS	6	30	30		
	6.6 249.1	SS	7	100	41		
	Borehole Terminated at 6.6 m						

FIELD TESTING

Shear Strength Testing (kPa)

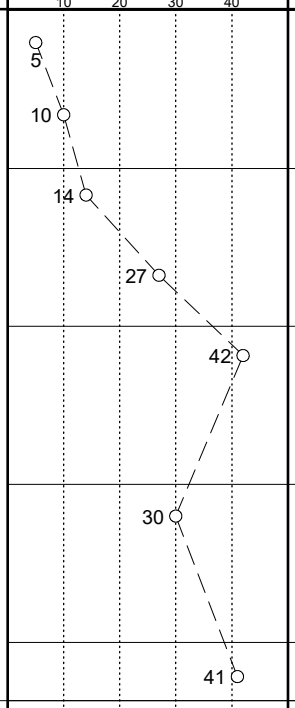
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)

40 80 120 160

Penetration Testing

○ SPT ● DCPT

10 20 30 40



LAB TESTING

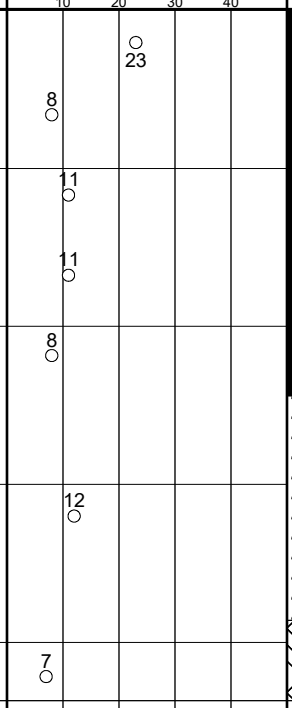
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)

100 200 300 400

Atterberg Limits

PL ○ Water Content (%) LL

10 20 30 40



COMMENTS & GRAIN SIZE DISTRIBUTION (%)

First Water Strike SS5

GR	SA	SI	CL
4	54	33	9

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Groundwater depth encountered on completion of drilling: 5.1 m. Cave depth after auger removal: 5.8 m.

Groundwater depth observed on: Nov 29/23 at depth of: 2.1 m. Groundwater Elevation: 253.5 m

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :75**

RECORD OF BOREHOLE No. 16

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910709** Date Started: **Nov 2/23**
Reviewed By: **GW** Easting: **611111** Date Completed: **Nov 2/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	GR	SA	SI	CL
	0.0 / 256.0										
	TOPSOIL: 330 mm (0.3 / 255.7)	SS	1	100	6	0					
	FILL: Silty sand, trace organics, loose, brown, moist (0.8 / 255.2)						255				
	SILTY SAND: Trace gravel, trace clay, loose to compact, brown, moist to wet	SS	2	100	9	1.5					
		SS	3	100	13		253.5				
	(2.3 / 253.7) SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to dense, brown, moist to wet	SS	4	100	19	3					
		SS	5	100	34		252				
	- - - Grey - - -	SS	6	100	28	4.5		10	45	32	13
	(6.6 / 249.4)	SS	7	100	21	6	250.5				
	Borehole Terminated at 6.6 m										

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40
Values: 6, 9, 13, 19, 34, 28, 21

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40
Values: 21, 11, 11, 10, 10, 10, 9

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

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Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Nov 29/23 at depth of: 2.1 m.
Groundwater Elevation: 253.9 m

RECORD OF BOREHOLE No. 17

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Project Number:	2304675						
Project Client:	Hansen Group Inc.						
Project Name:	Hewitt's South Residential Subdivision	Drilling Method:	Solid Stem Augers	Drilling Machine:	Track Mount		
Project Location:	Lockhart Road, Barrie, ON	Logged By:	MH	Northing:	4910737	Date Started:	Nov 3/23
Drilling Location:	See Borehole Location Plan	Reviewed By:	GW	Easting:	611191	Date Completed:	Nov 3/23
Local Benchmark:							

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	0.0 257.1							Shear Strength Testing (kPa): Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded)	Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm)		GR SA SI CL
	0.2 256.9 TOPSOIL: 150 mm					0	256.5	40 80 120 160	100 200 300 400		
	FILL: Silty sand, trace organics, loose, brown, moist	SS	1	100	10			Penetration Testing: SPT ○ DCPT ●	Atterberg Limits: PL ○ LL; Water Content (%)		
	0.8 256.3							10 20 30 40	10 20 30 40		
	SILTY SAND: Compact, brown, moist	SS	2	100	20	1.5	255				
	1.5 255.5										
	SAND: Trace silt, loose, brown, wet	SS	3	100	5						First Water Strike SS3
	2.0 255.1										
	SILTY CLAY: Stiff, grey, moist										
	- - - Organics seam - - -	SS	4	100	8						
	- - - Trace sand - - -	SS	5	100	9	3	253.5				
	4.6 252.5										
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact, brown, moist to wet	SS	6	100	18	4.5	252				
	6.6 250.5	SS	7	100	10	6					
	Borehole Terminated at 6.6 m										

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Groundwater depth encountered on completion of drilling: 5.8 m. Cave depth after auger removal: Open

Groundwater depth observed on: Nov 29/23 at depth of: 3.0 m. Groundwater Elevation: 254.1 m

RECORD OF BOREHOLE No. 18

Project Number:	**2304675**						
Project Client:	**Hansen Group Inc.**						
Project Name:	**Hewitt's South Residential Subdivision**	Drilling Method:	**Solid Stem Augers**	Drilling Machine:	**Track Mount**		
Project Location:	**Lockhart Road, Barrie, ON**	Logged By:	**BH**	Northing:	**4910826**	Date Started:	**Nov 7/23**
Drilling Location:	**See Borehole Location Plan**	Reviewed By:	**GW**	Easting:	**611295**	Date Completed:	**Nov 7/23**
Local Benchmark:							

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 259.6						
	TOPSOIL: 100 mm FINE SAND: Trace silt, compact, brown, moist to wet	AS	1			0	259.5
		SS	2	100	20		
	1.5 258.0					1.5	258
	SAND AND SILT: Trace clay, compact, brown, moist	SS	3	100	17		
		SS	4	100	15		
		SS	5	100	20	3	256.5
	4.6 255.0						
	SILTY CLAY: Some sand, trace gravel, hard, brown, moist	SS	6	100	30	4.5	255
	6.1 253.5					6	253.5
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, very dense, brown, moist to wet	SS	7	65	100+		
	6.6 253.0						
	Borehole Terminated at 6.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL ○ LL
Water Content (%)
10 20 30 40

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	52	45	3

First Water Strike SS2

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Groundwater depth encountered on completion of drilling: 3.0 m. Cave depth after auger removal: 4.0 m.

Groundwater depth observed on: Nov 29/23 at depth of: 2.0 m. Groundwater Elevation: 257.6 m

RECORD OF BOREHOLE No. 19

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Project Number:	2304675				
Project Client:	Hansen Group Inc.				
Project Name:	Hewitt's South Residential Subdivision	Drilling Method:	Solid Stem Augers	Drilling Machine:	Track Mount
Project Location:	Lockhart Road, Barrie, ON	Logged By:	BH	Northing: 491860	Date Started: Nov 8/23
Drilling Location:	See Borehole Location Plan	Reviewed By:	GW	Easting: 611326	Date Completed: Nov 8/23
Local Benchmark:					

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 259.3					0	
	TOPSOIL: 50 mm FINE SAND: Trace to some silt, compact to dense, brown, moist to wet	AS	1				
		SS	2	100	19		258
	1.5 257.8					1.5	
	SAND AND SILT: Trace clay, compact, brown, moist	SS	3	100	20		
		SS	4	100	20		256.5
		SS	5	100	34	3	
	4.6 254.7						255
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, dense to very dense, brown, moist to wet	SS	6	100	35	4.5	
		SS	7	20	100+	6	253.5
	6.6 252.7						
	Borehole Terminated at 6.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

First Water Strike SS2

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Groundwater depth encountered on completion of drilling: 1.2 m. Cave depth after auger removal: 4.4 m.

Groundwater depth observed on: Nov 29/23 at depth of: 1.7 m. Groundwater Elevation: 257.6 m

RECORD OF BOREHOLE No. 20

Project Number:	**2304675**						
Project Client:	**Hansen Group Inc.**						
Project Name:	**Hewitt's South Residential Subdivision**	Drilling Method:	**Solid Stem Augers**	Drilling Machine:	**Track Mount**		
Project Location:	**Lockhart Road, Barrie, ON**	Logged By:	**BH**	Northing:	**4910882**	Date Started:	**Nov 7/23**
Drilling Location:	**See Borehole Location Plan**	Reviewed By:	**GW**	Easting:	**611455**	Date Completed:	**Nov 7/23**
Local Benchmark:							

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	0.0 / 261.8							Shear Strength Testing (kPa): Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded) — 40 80 120 160. Penetration Testing: SPT, DCPT — 10 20 30 40	Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm) — 100 200 300 400. Atterberg Limits: PL, LL. Water Content (%) — 10 20 30 40		GR / SA / SI / CL
	TOPSOIL: 100 mm FILL: Sand, some gravel, trace silt, loose, brown, moist	AS	1			0			3		
	0.8 / 261.0						261				
	GRAVELLY SAND: Trace silt, dense, brown, moist	SS	2	100	41			41	7		
						1.5					
		SS	3	100	49			49	3		
	2.3 / 259.5						259.5				
	SAND: Trace gravel, trace silt, compact, brown, wet	SS	4	100	23			23	11		First Water Strike SS4
	3.0 / 258.7					3					
	SILT AND SAND: Compact, brown, wet	SS	5	100	18			18	21		
							258				
	4.6 / 257.2					4.5					
	SILTY CLAY: Some sand, trace gravel, stiff, brown, moist	SS	6	100	14			14	21		
							256.5				
	- - - Grey - - -					6					
	6.6 / 255.2	SS	7	100	13			13	20		
	Borehole Terminated at 6.6 m										

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Groundwater depth encountered on completion of drilling: 3.0 m. Cave depth after auger removal: 4.5 m.

Groundwater depth observed on: Nov 29/23 at depth of: 3.4 m. Groundwater Elevation: 258.4 m

RECORD OF BOREHOLE No. 21

GEI Consultants

Project Number:	2304675				
Project Client:	Hansen Group Inc.				
Project Name:	Hewitt's South Residential Subdivision	Drilling Method:	Solid Stem Augers	Drilling Machine:	Track Mount
Project Location:	Lockhart Road, Barrie, ON	Logged By:	BH	Northing: 4910795	Date Started: Nov 7/23
Drilling Location:	See Borehole Location Plan	Reviewed By:	GW	Easting: 611353	Date Completed: Nov 7/23
Local Benchmark:					

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 263.6						
	TOPSOIL: 100 mm SAND: Trace silt, trace gravel, compact, brown, moist	AS	1			0	
		SS	2	100	12	1.5	262.5
		SS	3	100	16		
		SS	4	100	20	3	261
	3.0 260.5						
	SILT AND SAND: Trace clay, compact, brown, wet	SS	5	100	17	4.5	259.5
		SS	6	100	26	6	258
	6.1 257.5						
	SAND: Trace silt, very dense, brown, wet	SS	7	15	100+		
	6.6 257.0						
	Borehole Terminated at 6.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40
12 16 20 17 26 100+

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40
4 4 2 2 2

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
6	89	0	0
0	39	59	2

First Water Strike SS6

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Groundwater depth encountered on completion of drilling: 4.8 m. Cave depth after auger removal: 3.0 m.

Groundwater depth observed on: Nov 29/23 at depth of: 5.4 m. Groundwater Elevation: 258.2 m

Scale: **1 :75**

RECORD OF BOREHOLE No. 22

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910862** Date Started: **Nov 6/23**
Reviewed By: **GW** Easting: **611114** Date Completed: **Nov 6/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING (Shear Strength Testing (kPa); Penetration Testing SPT/DCPT)	LAB TESTING (Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); Atterberg Limits PL/LL; Water Content (%))	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	253.0										
0.2	TOPSOIL: 205 mm 252.9										
	SILTY CLAY: Trace sand, trace gravel, firm to stiff, brown, moist	AS	1			0	252		20, 20		
		SS	2	100	12			12			
1.5	251.5					1.5	250.5				
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to dense, brown, moist to wet	SS	3	100	15			15	15		
		SS	4	100	23			23	9		
		SS	5	100	28	3	249	28	14		
	- - - Wet sand layer - - -	SS	6	100	31	4.5	247.5	31	8		First Water Strike SS6
6.6	246.5	SS	7	100	40	6		40	10		
	Borehole Terminated at 6.6 m										

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Groundwater depth encountered on completion of drilling: Dry
Groundwater depth observed on:
Cave depth after auger removal: Open
Groundwater Elevation:

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :75**
Page: **1 of 1**

RECORD OF BOREHOLE No. 23

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910770** Date Started: **Nov 3/23**
Reviewed By: **GW** Easting: **611116** Date Completed: **Nov 3/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING (Shear Strength Testing (kPa); Penetration Testing SPT ○ DCPT ●)	LAB TESTING (Combustible Organic Vapour (ppm) △; Combustible Organic Vapour (%LEL) ▲; Total Organic Vapour (ppm) ◇; Atterberg Limits PL–LL; Water Content (%) ○)	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
	0.0 254.9													
	0.2 TOPSOIL: 205 mm 254.8					0								
	SILTY SAND: Loose, brown, moist	SS	1	100	8			8	18					
	0.8 254.2													
	SILTY CLAY: Trace gravel, trace sand, firm, brown, moist	SS	2	100	7			7	32					
	1.5 253.4					1.5	253.5							
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, loose to compact, brown, moist to wet	SS	3	100	9			9	11					
		SS	4	100	10			10	10					
						3	252							
		SS	5	100	17			17	8					
	4.6 250.4										First Water Strike SS5			
	SAND: Some silt, trace gravel, trace clay, compact to very dense, grey, moist	SS	6	100	27	4.5	250.5	27	8		9	74	15	2
		SS	7	100	55	6	249	55 →	7					
	6.6 248.4													
	Borehole Terminated at 6.6 m													

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Groundwater depth encountered on completion of drilling: 2.7 m. Cave depth after auger removal: 4.8 m.
Groundwater depth observed on: Groundwater Elevation:

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :75**
Page: **1 of 1**

RECORD OF BOREHOLE No. 24

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910712** Date Started: **Nov 2/23**
Reviewed By: **GW** Easting: **611170** Date Completed: **Nov 2/23**

Depth (m)	Description	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Elevation (m)
0.0						256.6
0.2	TOPSOIL: 150 mm					256.4
	FILL: Fine sand, trace organics, compact, brown, moist	SS	1	100	11	
0.8						255.8
	FINE SAND: Trace silt, compact, brown, moist to wet	SS	2	100	15	
1.5						255.0
	SILTY CLAY: Trace gravel, trace sand, stiff to firm, grey, moist	SS	3	100	8	
		SS	4	100	9	
		SS	5	100	5	
4.6						252.0
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact, brown, moist to wet	SS	6	100	16	
6.6		SS	7	100	19	250.0
	Borehole Terminated at 6.6 m					

FIELD TESTING: Shear Strength Testing (kPa) — Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded); 40 80 120 160. Penetration Testing — SPT; DCPT; 10 20 30 40.

LAB TESTING: Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); 100 200 300 400. Atterberg Limits — PL; LL; Water Content (%); 10 20 30 40.

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

First Water Strike SS2

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Groundwater depth encountered on completion of drilling: 5.8 m. Cave depth after auger removal: Open
Groundwater depth observed on: Groundwater Elevation:

RECORD OF BOREHOLE No. 25

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910834** Date Started: **Nov 3/23**
Reviewed By: **GW** Easting: **611220** Date Completed: **Nov 3/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
	0.0 255.6											
	0.2 TOPSOIL: 150 mm 255.4											
	FILL: Clayey silt, trace organics, firm, brown, moist	SS	1	80	7							
	0.8 254.8											
	CLAYEY SILT: Trace sand, trace gravel, firm, brown, moist	SS	2	100	7							
	1.5 254.1					1.5	254.1					
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact to very dense, brown, moist to wet	SS	3	100	12		253.5					
		SS	4	100	50+							
		SS	5	100	43	3	252		First Water Strike SS5			
	4.6 251.0											
	GRAVELLY SAND: Trace silt, very dense, brown, wet	SS	6	65	100+	4.5	250.5					
	6.1 249.5											
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact, brown, moist to wet	SS	7	100	78	6						
	6.6 249.0 Borehole Terminated at 6.6 m											

FIELD TESTING: Shear Strength Testing (kPa) — Other Test; Pocket Penetrometer; Field Vane (Intact); Field Vane (Remolded); 40 80 120 160. Penetration Testing — SPT; DCPT; 10 20 30 40.

LAB TESTING: Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); 100 200 300 400. Atterberg Limits — PL; LL. Water Content (%); 10 20 30 40.

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Groundwater depth encountered on completion of drilling: 1.8 m. Cave depth after auger removal: 4.1 m.
Groundwater depth observed on: Groundwater Elevation:

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :75**
Page: **1 of 1**

RECORD OF BOREHOLE No. 26

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Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910747** Date Started: **Nov 3/23**
Reviewed By: **GW** Easting: **611244** Date Completed: **Nov 3/23**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)				
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	Shear Strength Testing (kPa): Other Test, Pocket Penetrometer, Field Vane (Intact), Field Vane (Remolded); Penetration Testing: SPT, DCPT	Combustible Organic Vapour (ppm), Combustible Organic Vapour (%LEL), Total Organic Vapour (ppm); Atterberg Limits; Water Content (%)	Instrumentation Installation		GR	SA	SI	CL
	0.0 260.3					0	260.3								
	TOPSOIL: 100 mm FILL: Sand, trace organics, trace silt, loose, brown, moist	SS	1	80	5			5	11						
	0.8 259.5						259.5								
	SILT AND SAND: Trace clay, loose to compact, brown, wet	SS	2	100	6			6	36						
						1.5									
		SS	3	100	19			19	19		First Water Strike SS3				
							258								
		SS	4	55	11			11	25			0	44	53	3
						3									
		SS	5	100	16			16	22						
	4.6 255.7						256.5								
	SILTY CLAY: Trace gravel, trace sand, stiff, brown, moist	SS	6	100	11	4.5		11	31						
	6.1 254.2						255								
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, loose, brown, moist to wet	SS	7	100	7	6		7	10						
	6.6 253.7														
	Borehole Terminated at 6.6 m														

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Groundwater depth encountered on completion of drilling: 3.3 m. Cave depth after auger removal: 3.6 m.
Groundwater depth observed on: Groundwater Elevation:

Scale: **1 :75**

RECORD OF BOREHOLE No. 27

Project Number: **2304675**
Project Client: **Hansen Group Inc.**
Project Name: **Hewitt's South Residential Subdivision**
Project Location: **Lockhart Road, Barrie, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4910874** Date Started: **Nov 7/23**
Reviewed By: **GW** Easting: **611381** Date Completed: **Nov 7/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 261.9					0	261
	0.2 TOPSOIL: 205 mm 261.7						
	FILL: Sand, trace gravel, trace organics, trace silt, loose, brown, moist 0.8 261.1	AS	1				
	GRAVELLY SAND: Trace silt, compact to very dense, brown, moist	SS	2	100	22	1.5	259.5
		SS	3	100	59		
		SS	4	35	55	3	258
	3.0 258.8						
	SAND: Some silt, trace gravel, compact, brown, moist to wet	SS	5	100	22	4.5	256.5
		SS	6	100	26	6	
	6.6 255.3	SS	7	100	17		
	Borehole Terminated at 6.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

First Water Strike SS5

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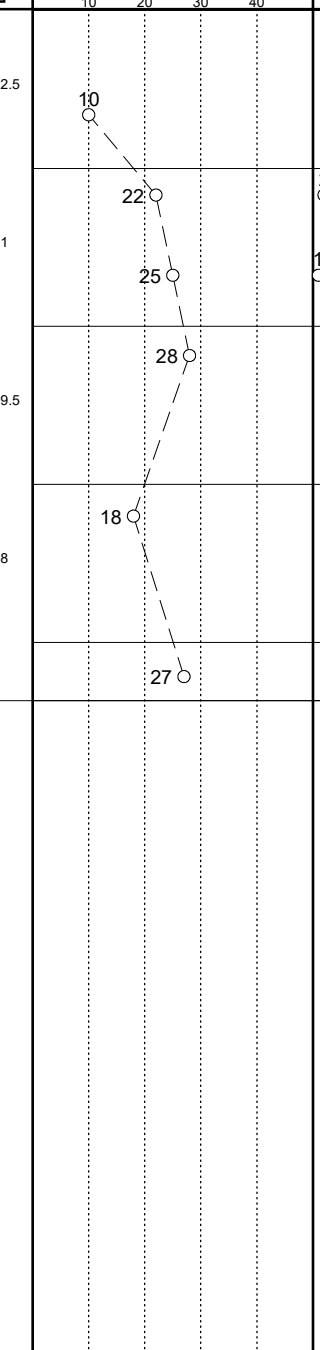
Groundwater depth encountered on completion of drilling: 3.3 m. Cave depth after auger removal: 3.3 m.
Groundwater depth observed on: Groundwater Elevation:

RECORD OF BOREHOLE No. 28

Project Number:	**2304675**						
Project Client:	**Hansen Group Inc.**						
Project Name:	**Hewitt's South Residential Subdivision**	Drilling Method:	**Solid Stem Augers**	Drilling Machine:	**Track Mount**		
Project Location:	**Lockhart Road, Barrie, ON**	Logged By:	**BH**	Northing:	**4910807**	Date Started:	**Nov 7/23**
Drilling Location:	**See Borehole Location Plan**	Reviewed By:	**GW**	Easting:	**611418**	Date Completed:	**Nov 7/23**
Local Benchmark:							

Depth (m)	Description	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Elevation (m)
0.0	TOPSOIL: 125 mm SAND: Some gravel, trace silt, compact, brown, moist	AS	1			263.2
		SS	2	100	10	
		SS	3	100	22	
		SS	4	100	25	
3.0	SAND AND SILT: Trace clay, compact, brown, wet	SS	5	100	28	260.1
		SS	6	100	18	
6.1	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact, brown, moist to wet	SS	7	100	27	257.1
6.6	Borehole Terminated at 6.6 m					256.6



First Water Strike SS5

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Groundwater depth encountered on completion of drilling: 3.8 m. Cave depth after auger removal: 4.1 m.

Groundwater depth observed on: Groundwater Elevation:

Scale: **1 :75**

RECORD OF BOREHOLE No. 29

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Project Number:	2304675				
Project Client:	Hansen Group Inc.				
Project Name:	Hewitt's South Residential Subdivision	Drilling Method:	Solid Stem Augers	Drilling Machine:	Track Mount
Project Location:	Lockhart Road, Barrie, ON	Logged By:	BH	Northing: 4910832	Date Started: Nov 7/23
Drilling Location:	See Borehole Location Plan	Reviewed By:	GW	Easting: 611537	Date Completed: Nov 7/23
Local Benchmark:					

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 263.7					0	
	TOPSOIL: 100 mm FILL: Sand, trace silt, trace gravel, trace organics, loose, brown, moist	AS	1				
	0.8 262.9						
	GRAVELLY SAND: Trace silt, compact, brown, moist	SS	2	100	16		262.5
	1.5 262.1					1.5	
	SAND: Trace gravel, trace silt, compact, brown, moist to wet	SS	3	100	11		
		SS	4	100	18		261
		SS	5	100	30	3	
	4.6 259.1						259.5
	SAND AND SILT GLACIAL TILL: Silty sand to sandy silt, trace to some clay and gravel, inferred cobbles and boulders, compact, brown, moist to wet	SS	6	100	15	4.5	
							258
	6.6 257.1	SS	7	100	20	6	
	Borehole Terminated at 6.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40
16
11
18
30
15
20

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40
5
4
5
9
8
8
10

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

First Water Strike SS6

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Groundwater depth encountered on completion of drilling: 5.1 m. Cave depth after auger removal: 5.3 m.

Groundwater depth observed on: Groundwater Elevation:

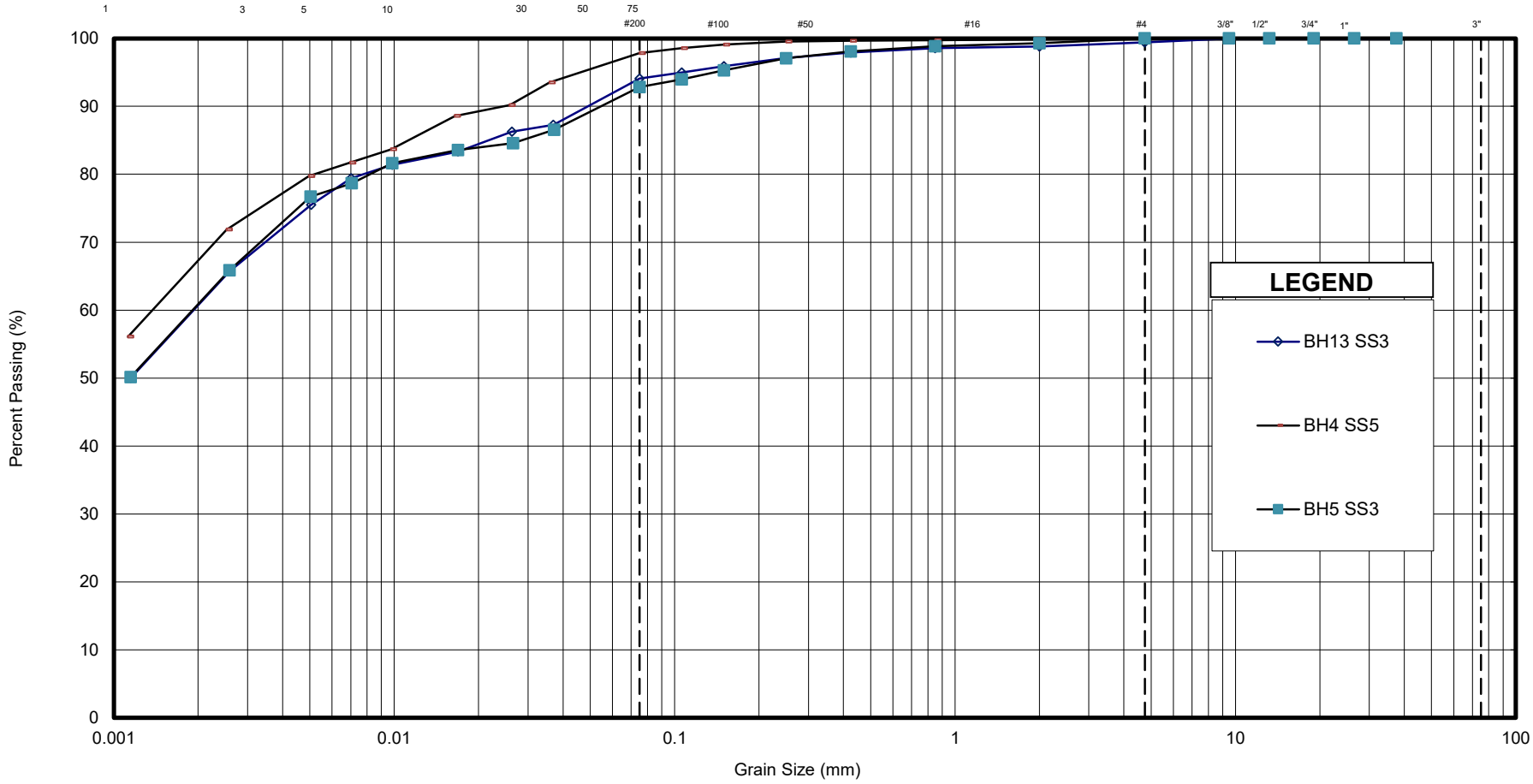
Appendix B

Geotechnical Laboratory Testing

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse

GRAIN SIZE IN MICROMETERS — SIEVE DESIGNATION (IMPERIAL)



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH13 SS3	SILTY CLAY, Trace Sand, Trace Gravel	1	5	33	61	-	-	0.002	-	-
BH4 SS5	SILTY CLAY, Trace Sand	0	2	30	68	-	-	0.001	-	-
BH5 SS3	SILTY CLAY, Trace Sand	0	7	32	61	-	-	0.002	-	-

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GRAIN SIZE DISTRIBUTION - Hewitt's Gate South

SILTY CLAY

FIGURE No. B1

REF. No. 2304675

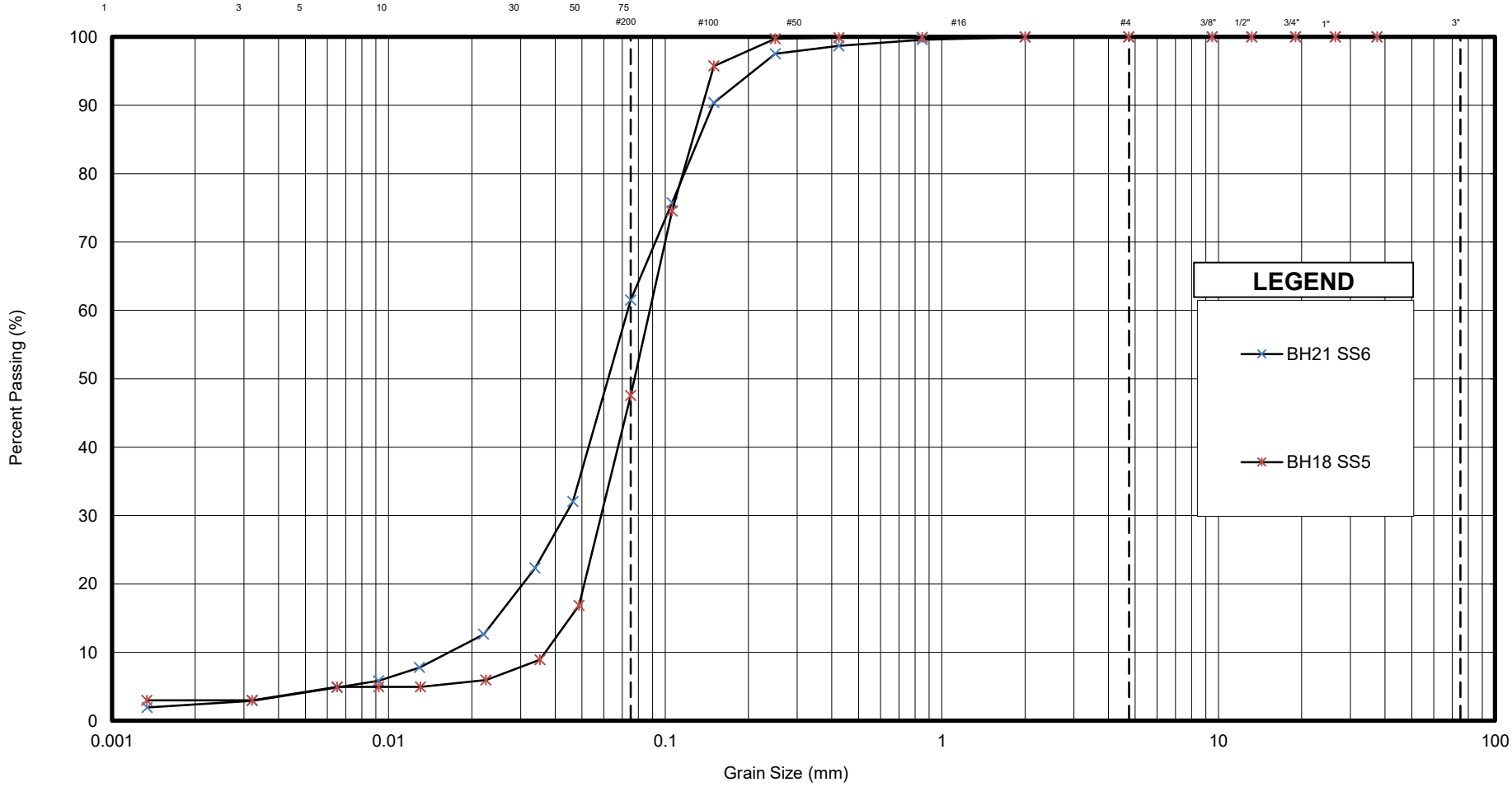
DATE December 2023

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse

GRAIN SIZE IN MICROMETERS

SIEVE DESIGNATION (IMPERIAL)



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH21 SS6	SILT AND SAND, Trace Clay	0	39	59	2	0.017	0.043	0.073	4.4	1.6
BH18 SS5	SAND AND SILT, Trace Clay	0	52	45	3	0.037	0.059	0.088	2.4	1.1

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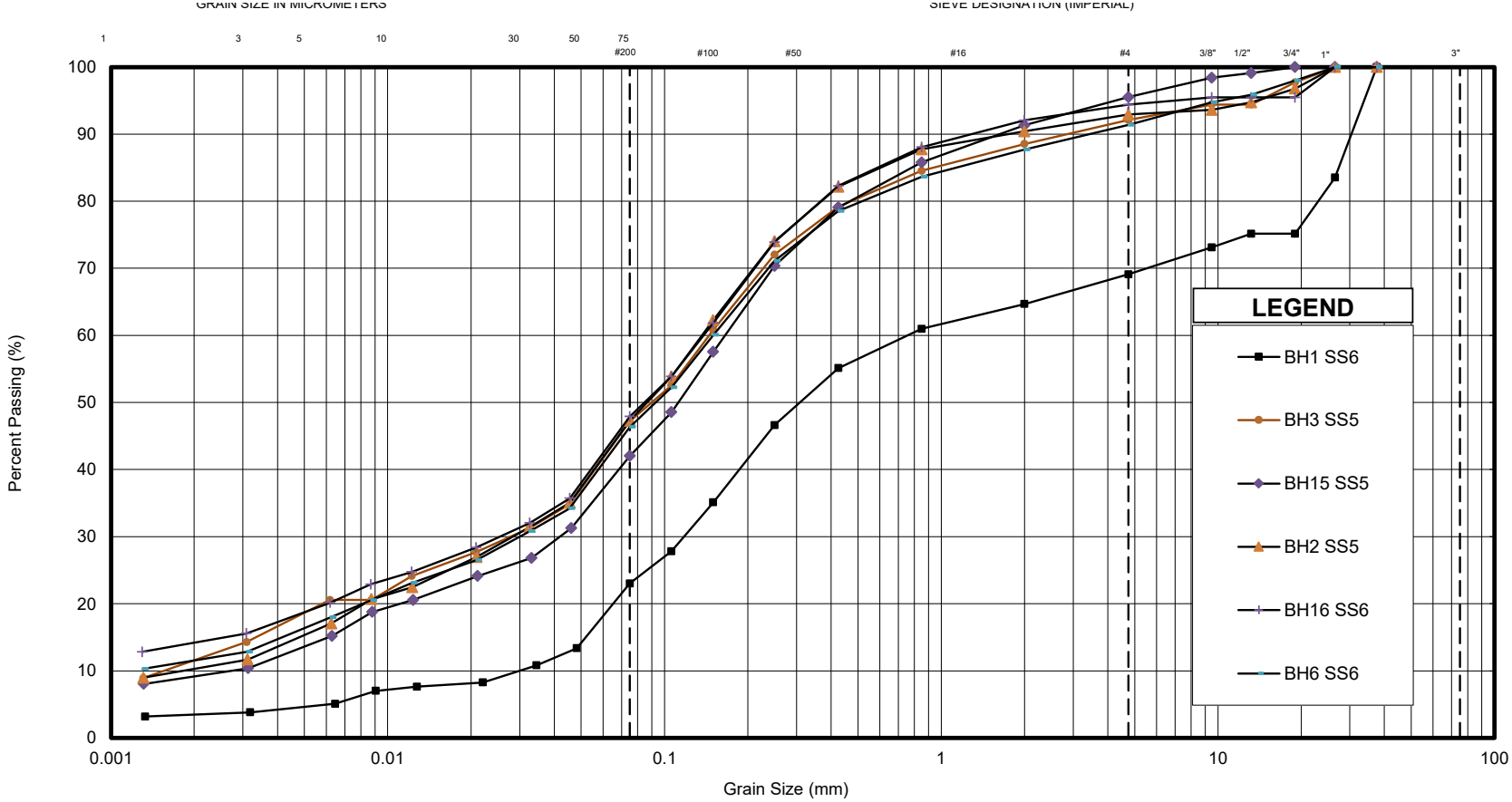
GRAIN SIZE DISTRIBUTION - Hewitt's Gate South

SILT AND SAND / SAND AND SILT

FIGURE No.	B2
REF. No.	2304675
DATE	December 2023

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH1 SS6	GRAVELLY SILTY SAND, Trace Clay	31	46	20	3	0.030	0.118	0.756	25.3	0.6
BH3 SS5	SAND AND SILT, Some Clay, Trace Gravel	8	45	36	11	0.002	0.028	0.145	93.2	3.4
BH15 SS5	SILTY SAND, Trace Clay, Trace Gravel	4	54	33	9	0.003	0.042	0.166	60.6	3.9
BH2 SS5	SAND AND SILT, Some Clay, Trace Gravel	7	46	37	10	0.002	0.028	0.137	75.1	3.2
BH16 SS6	SILTY SAND, Some Clay, Some Gravel	10	45	32	13	-	0.032	0.164	-	-
BH6 SS6	SAND AND SILT, Some Clay, Trace Gravel	9	45	35	11	-	0.030	0.150	-	-

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GRAIN SIZE DISTRIBUTION - Hewitt's Gate South

GLACIAL TILL

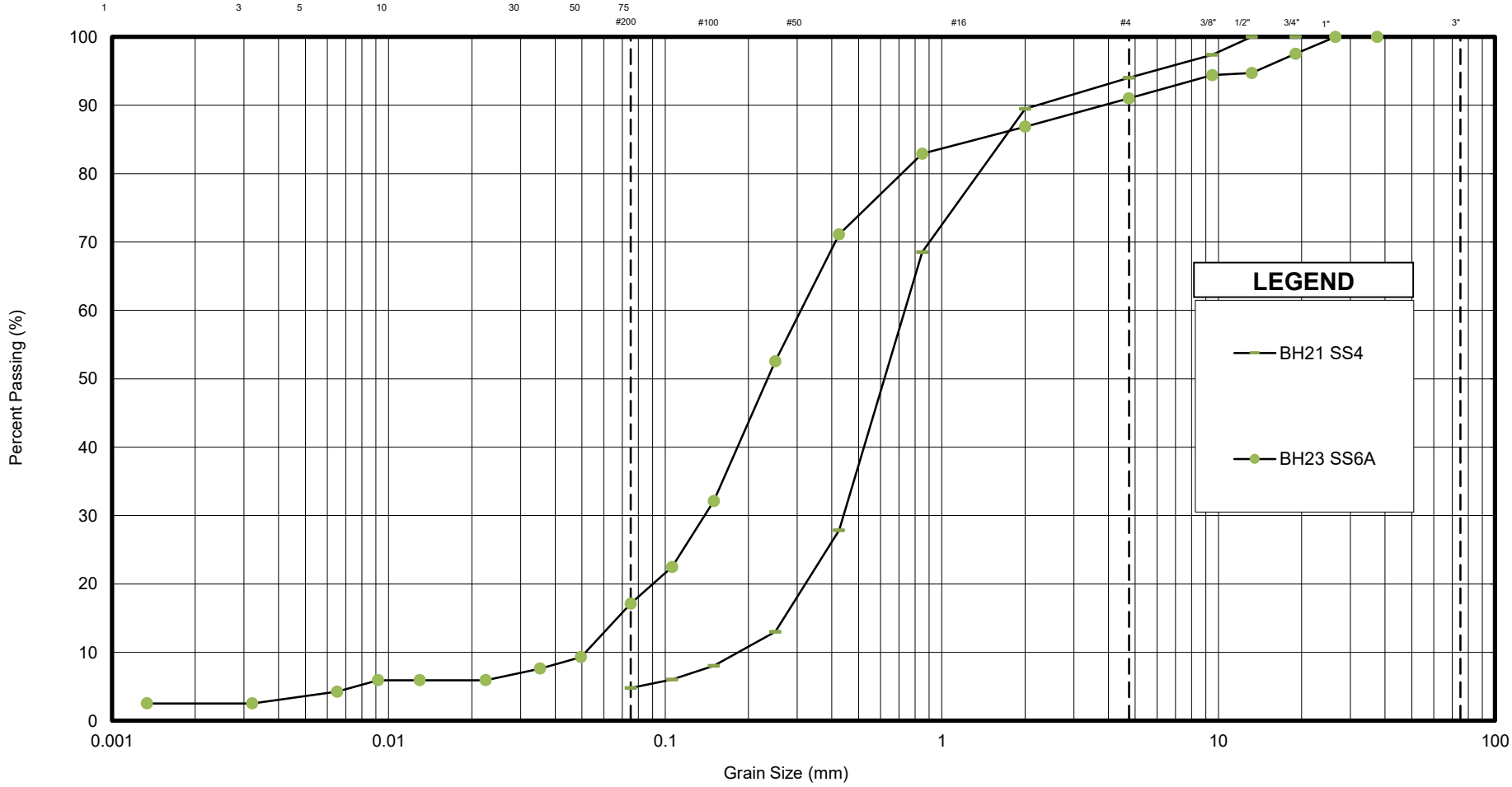
FIGURE No.	B3
REF. No.	2304675
DATE	December 2023

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse

GRAIN SIZE IN MICROMETERS

SIEVE DESIGNATION (IMPERIAL)



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH21 SS4	SAND, Trace Gravel	6	89	-	-	0.184	0.441	0.735	4.0	1.4
BH23 SS6A	SAND, Some Silt, Trace Gravel, Trace Clay	9	74	15	2	0.051	0.139	0.309	6.0	1.2

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GRAIN SIZE DISTRIBUTION - Hewitt's Gate South

SAND

FIGURE No.	B4
REF. No.	2304675
DATE	December 2023

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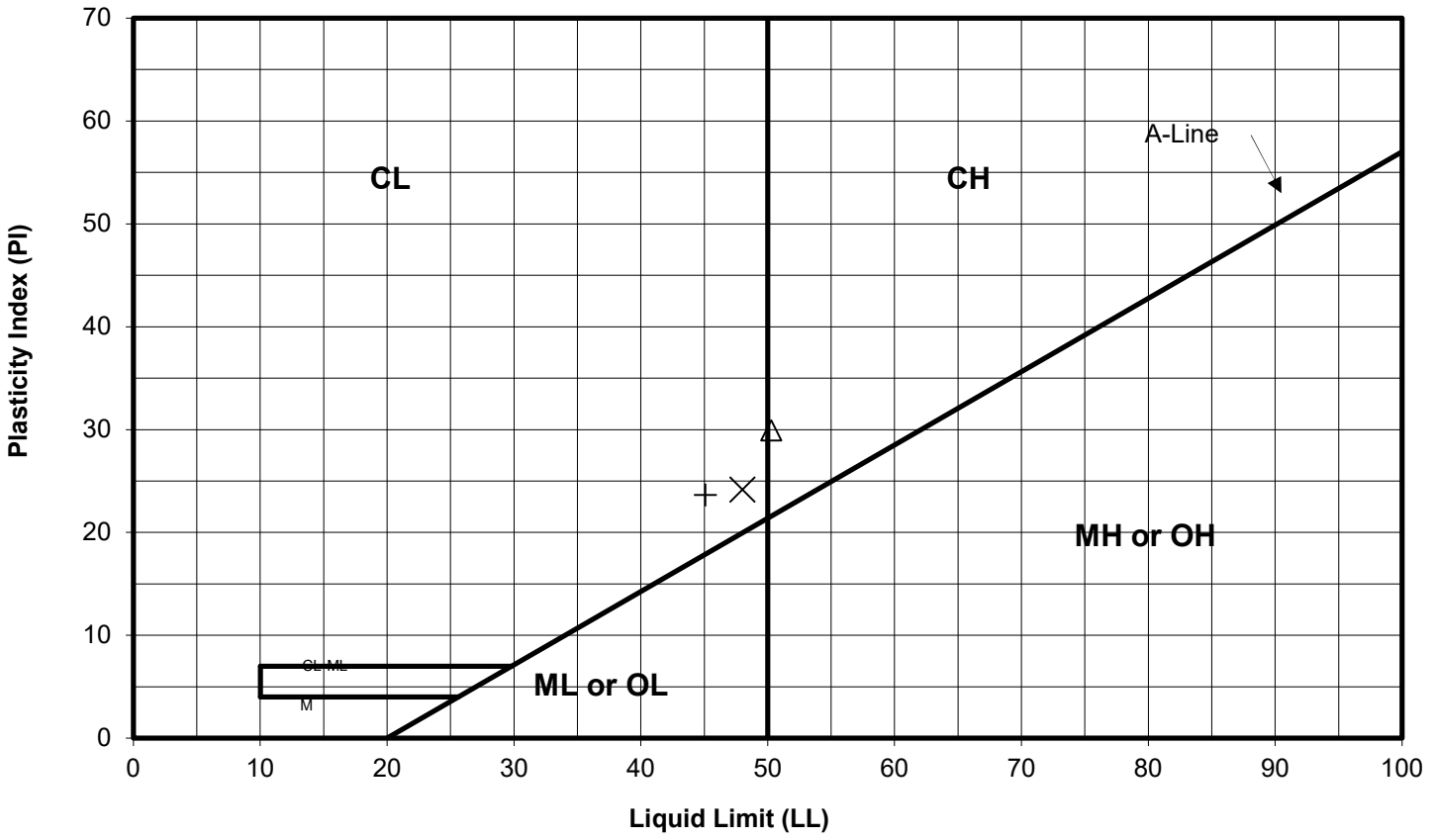
Atterberg Limits Report

Project Name: Pratt Hansen Phase 3
Project No.: 2304675
Client:

Figure No.: B5
Date Tested: December 12, 2023
Date Sampled: December 1, 2023

SAMPLE INFORMATION								
SAMPLE ID	BH13, SS3	LIQUID LIMIT (LL):	48	PLASTIC LIMIT (PL)	23.8	PLASTIC INDEX (PI)	24.2	X
SAMPLE ID	BH4, SS5	LIQUID LIMIT (LL):	50.3	PLASTIC LIMIT (PL)	20.4	PLASTIC INDEX (PI)	29.9	▲
SAMPLE ID	BH5, SS3	LIQUID LIMIT (LL):	45.1	PLASTIC LIMIT (PL)	21.5	PLASTIC INDEX (PI)	23.6	+

Plasticity Chart



DISTRIBUTION:	Prepared By: X.Guo	Checked By:

Report No. _____

Appendix C

Previous Borehole Information

KEY PLAN
BARRIE, ONTARIO

LEGEND:

BH 101
EL. 251.50
▼ 252.30
BOREHOLE 101 (MONITORING WELL)
SURFACE ELEVATION
GROUNDWATER ELEVATION

BH 109
EL. 255.15
BOREHOLE 109
SURFACE ELEVATION

REFERENCE:
BASE PLAN PRODUCED USING GOOGLE MAPS

0m 20 40 60 80 100
SCALE

BOREHOLE/MONITORING WELL LOCATION PLAN

PROPOSED HEWITT'S GATE EAST RESIDENTIAL DEVELOPMENT
PHASE 3
BARRIE, ONTARIO

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	FF	DATE	SCALE	PML REF.	DRAWING NO.
CHECKED	NG	APR. 2022	AS SHOWN	21BF052	2-1
APPROVED	FM				

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: - The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	TW	Thinwall Open
WS	Washed Sample	TP	Thinwall Piston
SB	Scraper Bucket Sample	OS	Oesterberg Sample
AS	Auger Sample	FS	Foil Sample
CS	Chunk Sample	RC	Rock Core
ST	Slotted Tube Sample		

PH	Sample Advanced Hydraulically
PM	Sample Advanced Manually

SOIL TESTS

Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 101

17T 610974E 4910966N

PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 — **PML REF.** 21BF052

LOCATION Barrie, Ontario — **BORING DATE** December 13, 2022 — **ENGINEER** FM

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** FF

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 251.50					
0.30 / 251.20	TOPSOIL: Black, sandy silt, trace gravel, trace organics, moist		1	SS	9	251
	SAND: Loose to compact, brown, sand, some silt, trace gravel, moist to wet		2	SS	10	
1.4 / 250.1	CLAY AND SILT: Firm to stiff, grey, clay and silt, some sand, trace gravel, APL		3[1]	SS	10	250
			4	SS	9	249
			5	SS	7	248
4.0 / 247.5	TILL: Loose to very dense, grey, silty sand, some clay, trace to some gravel, cobbles and possible boulders, wet to moist		6	SS	6	247
			7	SS	44	246
8.1 / 243.4	BOREHOLE TERMINATED AT 8.1 m		8	SS	50/130 mm	245
						244

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Upon completion of augering
Water at 4.6 m
No cave

Water Level Readings:

Date	Depth	Elev.
2022-01-04	FROZEN	252.3
2022-06-08	-0.8	252.3

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 102

17T 611000E 4910907N

PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 ***PML REF.*** 21BF052

LOCATION Barrie, Ontario ***BORING DATE*** December 13, 2022 ***ENGINEER*** FM

BORING METHOD Continuous Flight Hollow Stem Augers ***TECHNICIAN*** FF

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 251.85					
0.30 / 251.55	TOPSOIL: Black, sandy silt, trace gravel, trace organics, moist		1	SS	9	
0.70 / 251.15	SAND: Loose, brown, sand, trace silt, moist					
	CLAY AND SILT: Stiff, grey, clay and silt, some sand, trace gravel, APL		2	SS	14	251
			3[1]	SS	13	250
			4	SS	15	
2.9 / 249.0	TILL: Compact to dense, grey, silty sand, some clay, some gravel, cobbles and possible boulders, moist		5	SS	16	249
			6	SS	17	248
			7	SS	20	247
7.8	becoming wet		8	SS	33	246
8.1 / 243.8	BOREHOLE TERMINATED AT 8.1 m					245, 244

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Stick up casing
Concrete
0 12 40 48
Bentonite seal
First water strike at 4.6 m
50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 7.5 m
No cave
Water Level Readings:

Date	Depth	Elev.
2022-01-04	FROZEN	252.7
2022-06-08	-0.8	252.7

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 103

17T 611406E 4911170N

PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 ***PML REF.*** 21BF052

LOCATION Barrie, Ontario ***BORING DATE*** December 14, 2022 ***ENGINEER*** FM

BORING METHOD Continuous Flight Hollow Stem Augers ***TECHNICIAN*** FF

DEPTH (m)	ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 256.35					
0.0	256.35						256
0.20	256.15	TOPSOIL: Black, sandy silt, trace gravel, trace organics, moist		1	SS	5	
0.70	255.65	SAND: Loose, brown, sand, trace silt, trace gravel, moist					
1.0		CLAY AND SILT: Stiff, brown, clay and silt, trace sand, trace gravel, APL		2	SS	9	255
1.4	255.0	TILL: Loose to dense, grey, silty sand, some clay, some gravel, cobbles and possible boulders, moist		3[1]	SS	12	
2.0				4	SS	8	254
3.0				5	SS	10	253
4.0							252
5.0				6	SS	17	
6.0							251
7.0				7	SS	31	250
7.1	249.3	SAND: Compact, grey, sand, trace gravel, wet					
8.0				8	SS	24	249
8.1	248.3	BOREHOLE TERMINATED AT 8.1 m					
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Stick up casing
Concrete
Bentonite seal
First water strike at 6.7 m
50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 2.4 m
No cave
Water Level Readings:

Date	Depth	Elev.
2022-01-04	0.9	255.5
2022-06-08	0.3	256.1

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 104

17T 611415E 4911123N

PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 ***PML REF.*** 21BF052

LOCATION Barrie, Ontario ***BORING DATE*** December 14, 2022 ***ENGINEER*** FM

BORING METHOD Continuous Flight Hollow Stem Augers ***TECHNICIAN*** FF

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	256.50	SURFACE ELEVATION 256.50					
0.0	256.50						256
0.30	256.20	TOPSOIL: Black, sandy silt, trace gravel, trace organics, moist		1	SS	8	
		SAND: Compact, brown, sand, trace silt, very moist		2	SS	17	
1.0							
1.4	255.1	TILL: Loose to compact, grey, sandy silt, some clay to clayey, some gravel, cobbles and possible boulders, moist to very moist		3[1]	SS	10	255
2.0							
				4	SS	10	254
3.0							
				5	SS	7	253
4.0	252.5	becoming dense, silty sand, some clay, trace to some gravel					
				6	SS	19	252
5.0							
							251
6.0				7	SS	20	
							250
7.0							
							249
8.0	248.4	BOREHOLE TERMINATED AT 8.1 m		8	SS	35	
8.1							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Stick up casing
Concrete
Bentonite seal
50 mm slotted pipe
Filter sand
First water strike at 4.0 m

15 39 34 12

Upon completion of augering
Water at 3.9 m
No cave

Water Level Readings:

Date	Depth	Elev.
2022-01-04	1.1	255.4
2022-06-08	0.8	255.7

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 105

17T 611249E 4910979N

PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 ***PML REF.*** 21BF052

LOCATION Barrie, Ontario ***BORING DATE*** December 13, 2022 ***ENGINEER*** FM

BORING METHOD Continuous Flight Hollow Stem Augers ***TECHNICIAN*** FF

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	"N" VALUES
		SURFACE ELEVATION 254.80				
0.0	254.50	TOPSOIL: Black, silty sand, trace gravel, trace organics, moist		1	SS	5
0.30		SAND: Compact, brown, sand, some silt, trace gravel, moist		2	SS	10
1.4	253.4	TILL: Compact to dense, grey, silty sand, some clay, some gravel, cobbles and possible boulders, moist		3[1]	SS	10
				4	SS	13
				5	SS	20
				6	SS	28
6.5	248.3	BOREHOLE TERMINATED AT 6.5 m		7	SS	39

ELEVATION SCALE: 254, 253, 252, 251, 250, 249

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Upon completion of augering
Water at 6.0 m
No cave
Water Level Readings:

Date	Depth	Elev.
2022-01-04	0.5	254.3
2022-06-08	0.6	254.2

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 106

17T 611104E 4910699N

PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 — **PML REF.** 21BF052

LOCATION Barrie, Ontario — **BORING DATE** December 13, 2022 — **ENGINEER** FM

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** FF

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 256.20				
0.30 / 255.90	TOPSOIL: Black, silty sand, trace organics, moist		1	SS	11
0.70 / 255.50	SILTY CLAY: Stiff, brown to grey, silty clay, trace sand, moist				
	TILL: Loose to compact, brown to grey, silty sand, some clay, trace gravel, moist		2	SS	9
			3[1]	SS	9
			4	SS	27
			5	SS	25
4.0 / 252.2	CLAY AND SILT: Stiff, grey, clay and silt, some sand, APL		6	SS	14
5.6 / 250.6	TILL: Compact to dense, grey, silty sand, some clay, some gravel, cobbles and possible boulders, very moist to wet		7	SS	22
			8	SS	34
			9	SS	32
10.0 / 246.2	BOREHOLE TERMINATED AT 10.0 m				

ELEVATION SCALE: 256, 255, 254, 253, 252, 251, 250, 249, 248, 247

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200

DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

9 45 34 12

Stick up casing
Concrete
Bentonite seal
First water strike at 4.6 m
50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 4.6 m
No cave
Water Level Readings:

Date	Depth	Elev.
2022-01-04	1.5	254.7
2022-06-08	1.6	254.6

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 107

17T 611311E 4910770N

PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 — **PML REF.** 21BF052

LOCATION Barrie, Ontario — **BORING DATE** December 14, 2022 — **ENGINEER** FM

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** FF

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 263.50				
0.0	263.50					
0.20	263.30	TOPSOIL: Black, silty sand, trace gravel, trace organics, moist		1	SS	6
		SAND: Loose to compact, brown, sand, trace to some silt, trace gravel, moist		2	SS	7
1.5	262.0	Becoming till-like with cobbles and possible boulders		3[1]	SS	28
				4	SS	25
				5	SS	26
4.6	258.9	Becoming grey, wet		6	SS	28
6.5	257.0	BOREHOLE TERMINATED AT 6.5 m		7	SS	14

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 263, 262, 261, 260, 259, 258, 257

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Stick up casing
Concrete
Bentonite seal
First water strike at 4.6 m
50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 4.6 m
No cave
Water Level Readings:

Date	Depth	Elev.
2022-01-04	2.4	261.1
2022-06-08	4.4	259.1

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 108

17T 611496E 4910822N

PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 — **PML REF.** 21BF052

LOCATION Barrie, Ontario — **BORING DATE** December 14, 2022 — **ENGINEER** FM

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** FF

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
0.0		SURFACE ELEVATION 263.75					263
0.30	263.45	TOPSOIL: Black, sand, trace gravel, trace organics, moist		1	SS	7	
		SAND: Loose to compact, brown, sand, trace gravel, moist to very moist		2	SS	8	
1.5	262.3	becoming gravelly and till-like		3[1]	SS	5	262
				4	SS	24	
				5	SS	24	261
4.0	259.8	CLAY AND SILT: Very stiff, grey, clay and silt, some sand, trace gravel, APL		6	SS	17	260
5.6	258.2	TILL: Compact, grey, silty sand, some clay, some gravel, cobbles and possible boulders, moist		7	SS	25	259
6.5	257.3	BOREHOLE TERMINATED AT 6.5 m					258

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ● Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Stick up casing
Concrete
Bentonite seal
First water strike at 4.6 m
50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 4.6 m
No Cave
Water Level Readings:

Date	Depth	Elev.
2022-01-04	3.3	260.5
2022-06-08	3.8	260.0

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 109

17T 610867E 4910652N

PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 ***PML REF.*** 21BF052

LOCATION Barrie, Ontario ***BORING DATE*** December 15, 2022 ***ENGINEER*** FM

BORING METHOD Continuous Flight Hollow Stem Augers ***TECHNICIAN*** FF

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 255.15					
0.30	254.85	TOPSOIL: Black, sandy silt, trace gravel, trace organics, moist		1	SS	8	255
		CLAY AND SILT: Firm, brown, clay and silt, some sand, APL		2	SS	7	254
1.7	253.5	TILL: Compact to dense, grey, silty sand, some clay, trace to some gravel, cobbles and possible boulders, moist		3[1]	SS	6	253
				4	SS	19	
				5	SS	18	252
				6	SS	44	251
5.6	249.6	SAND: Dense, grey, sand, some silt, trace to some gravel, wet					250
6.5	248.7	BOREHOLE TERMINATED AT 6.5 m ARTESIAN CONDITIONS HIT		7	SS	32	249

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ● Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

First water strike at 6.1 m

Upon completion of augering Artesian conditions encountered

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 110

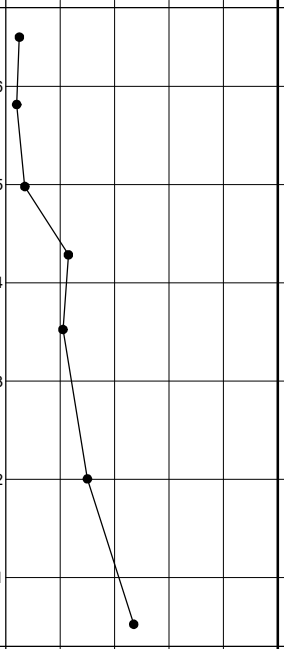
17T 610819E 4910610N

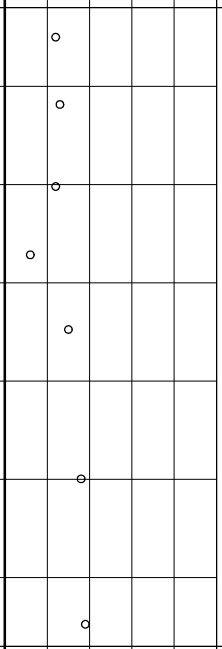
PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 — **PML REF.** 21BF052

LOCATION Barrie, Ontario — **BORING DATE** December 15, 2022 — **ENGINEER** FM

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** FF

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 256.80					
0.0	256.80	TOPSOIL: Black, sandy silt, trace gravel, trace organics, moist		1	SS	5	256
0.30	256.50	TILL: Loose, brown, sandy silt, some clay to clayey, trace gravel, very moist		2	SS	4	
1.0				3[1]	SS	7	255
2.1	254.7	becoming compact, grey, silty sand, some clay, some gravel, cobbles and possible boulders		4	SS	23	
2.0				5	SS	21	254
3.0							
4.0	252.8	SAND: Dense, brown, sand, trace to some silt, trace gravel, wet		6	SS	30	253
5.0							252
6.0				7	SS	47	251
6.5	250.3	BOREHOLE TERMINATED AT 6.5 m					
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							





UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Upon completion of augering
Water at 3.0 m
No cave
Water Level Readings:

Date	Depth	Elev.
2022-01-04	1.0	255.8
2022-06-08	-0.6	257.4

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 111

17T 610968E 4910803N

PROJECT Proposed Hewitt's Gate East Residential Development - Phase 3 — **PML REF.** 21BF052

LOCATION Barrie, Ontario — **BORING DATE** December 15, 2022 — **ENGINEER** FM

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** FF

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	253.80	SURFACE ELEVATION 253.80					
0.0	253.50	TOPSOIL: Black, sandy silt, trace gravel, trace organics, moist		1	SS	7	253
0.30		SAND: Loose to compact, brown, sand, trace to some gravel, trace silt, moist to wet		2	SS	13	
1.0							
1.5	252.3	Becoming gravelly		3[1]	SS	15	252
2.0	251.7	CLAY AND SILT: Firm, grey, clay and silt, trace sand, APL		4	SS	7	
2.1							251
3.0				5	SS	7	
4.0	249.8	TILL: Compact, grey, silty sand, some clay, some gravel, cobbles and possible boulders, moist		6	SS	24	250
4.0							249
5.0							
6.0				7	SS	24	248
6.5	247.3	BOREHOLE TERMINATED AT 6.5 m					
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ● Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

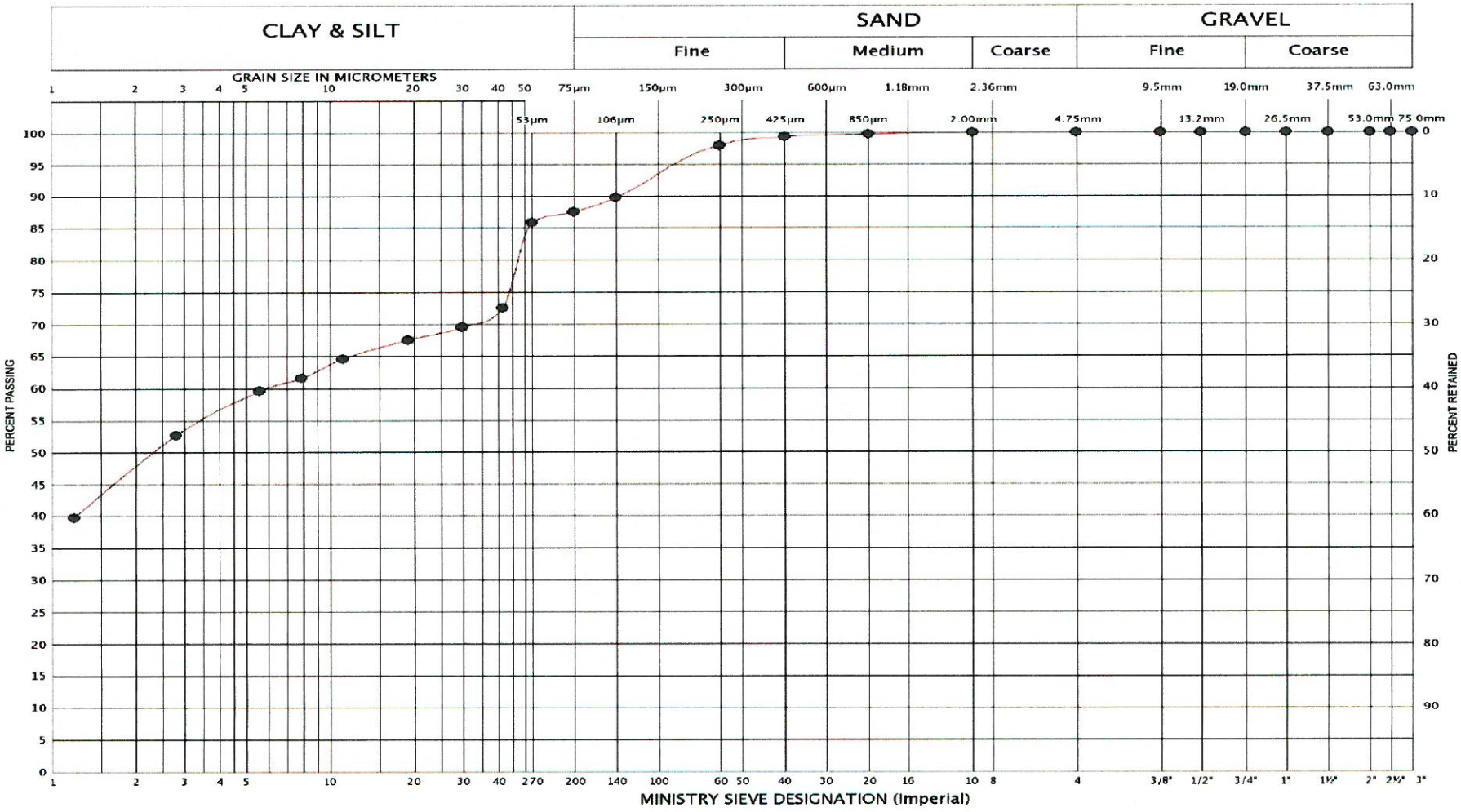
Stick up casing
Concrete
Bentonite seal
First water strike at 2.3 m
50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 2.2 m
No cave
Water Level Readings:

Date	Depth	Elev.
2022-01-04	1.2	252.6
2022-06-08	0.9	252.9

NOTES 1. Sample submitted for chemical testing

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
	BH	102
	SAMPLE	3
	SYMBOL	●

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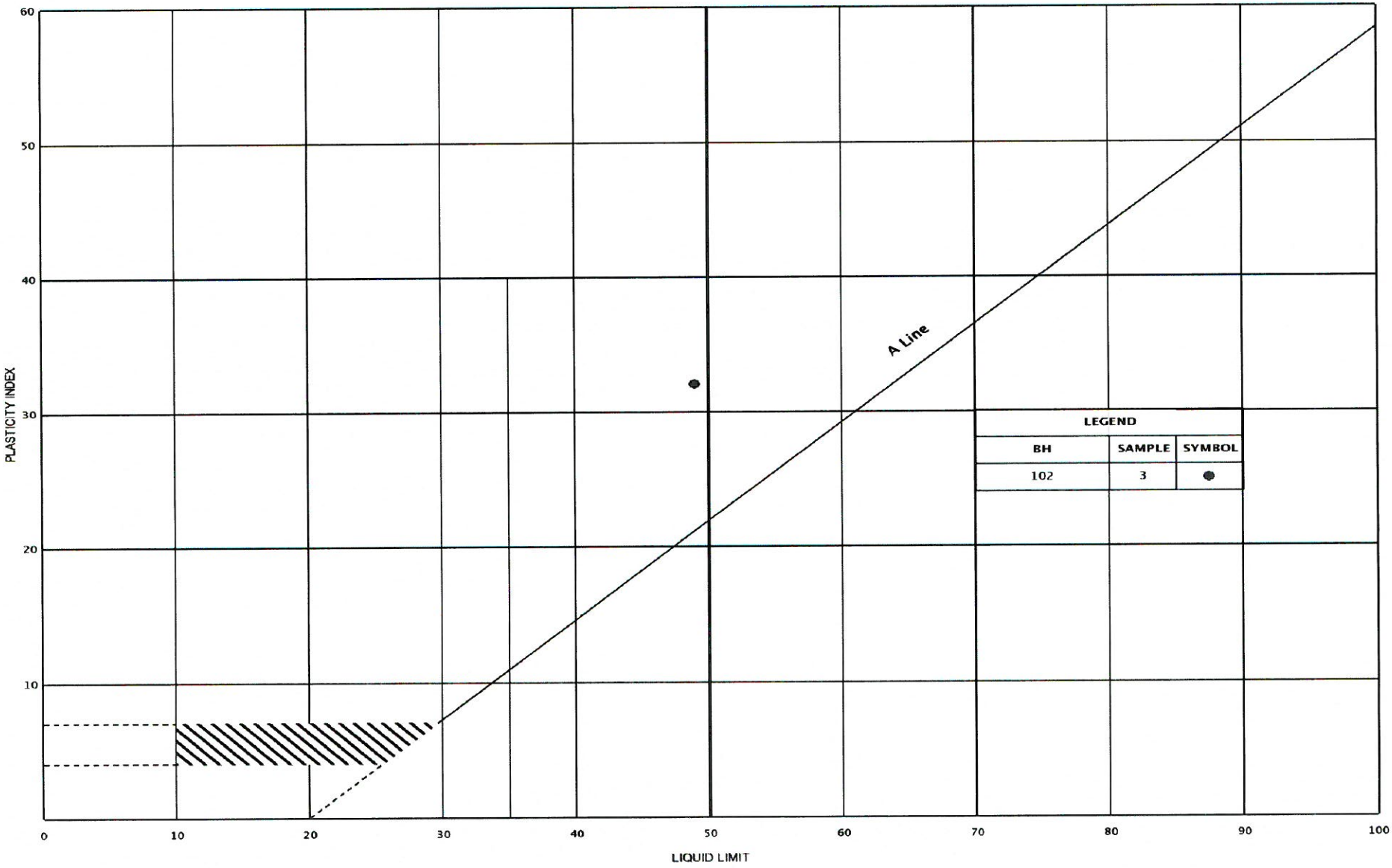
GRAIN SIZE DISTRIBUTION

CLAY AND SILT, Some Sand

FIG No.: 2-1

Project No.: 21BF052



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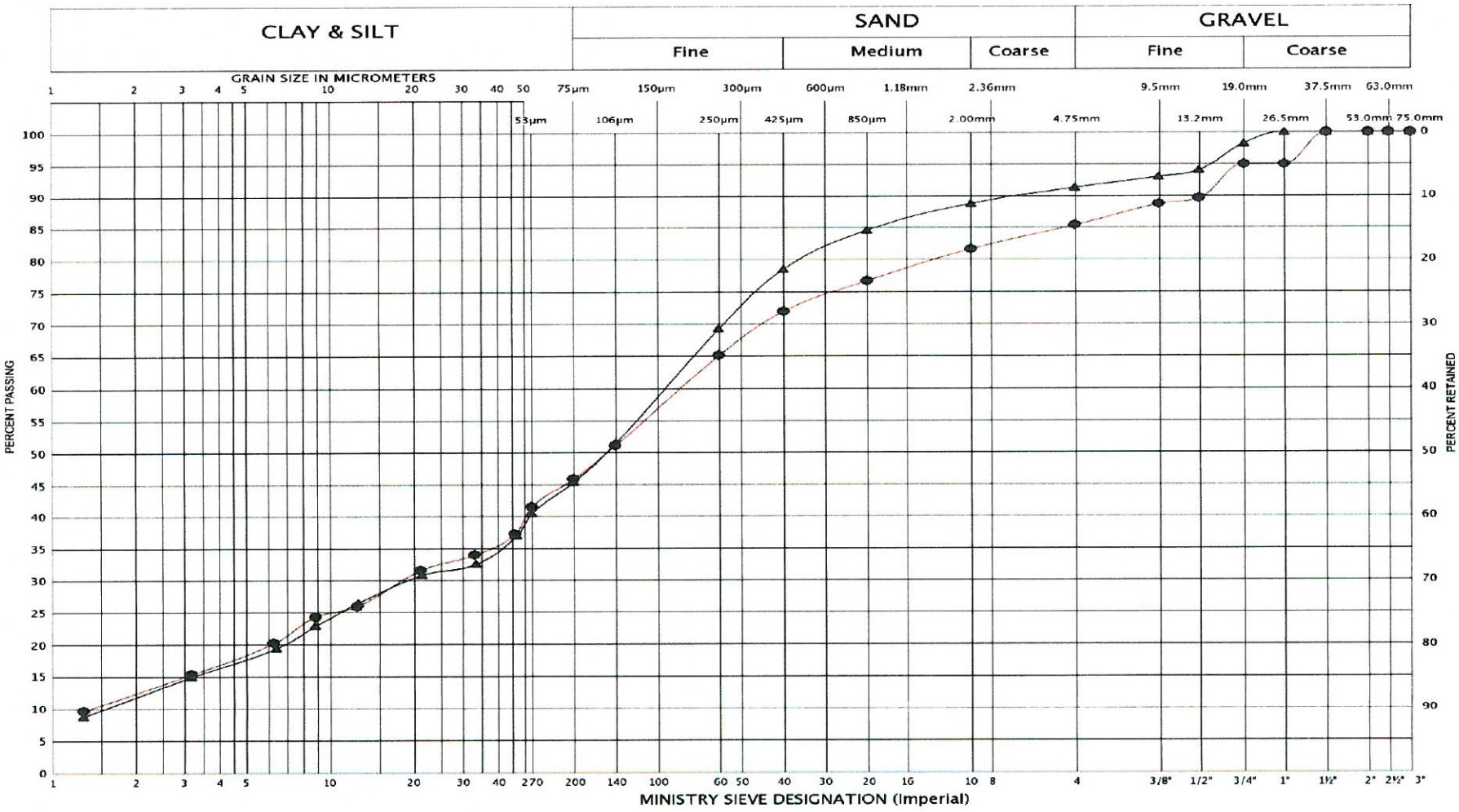
PLASTICITY CHART

CLAY AND SILT, Some Sand

FIG No.:	2-2
HWY.:	
Proj No.	21BF052

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	104	106
	SAMPLE	6	3
	SYMBOL	●	▲

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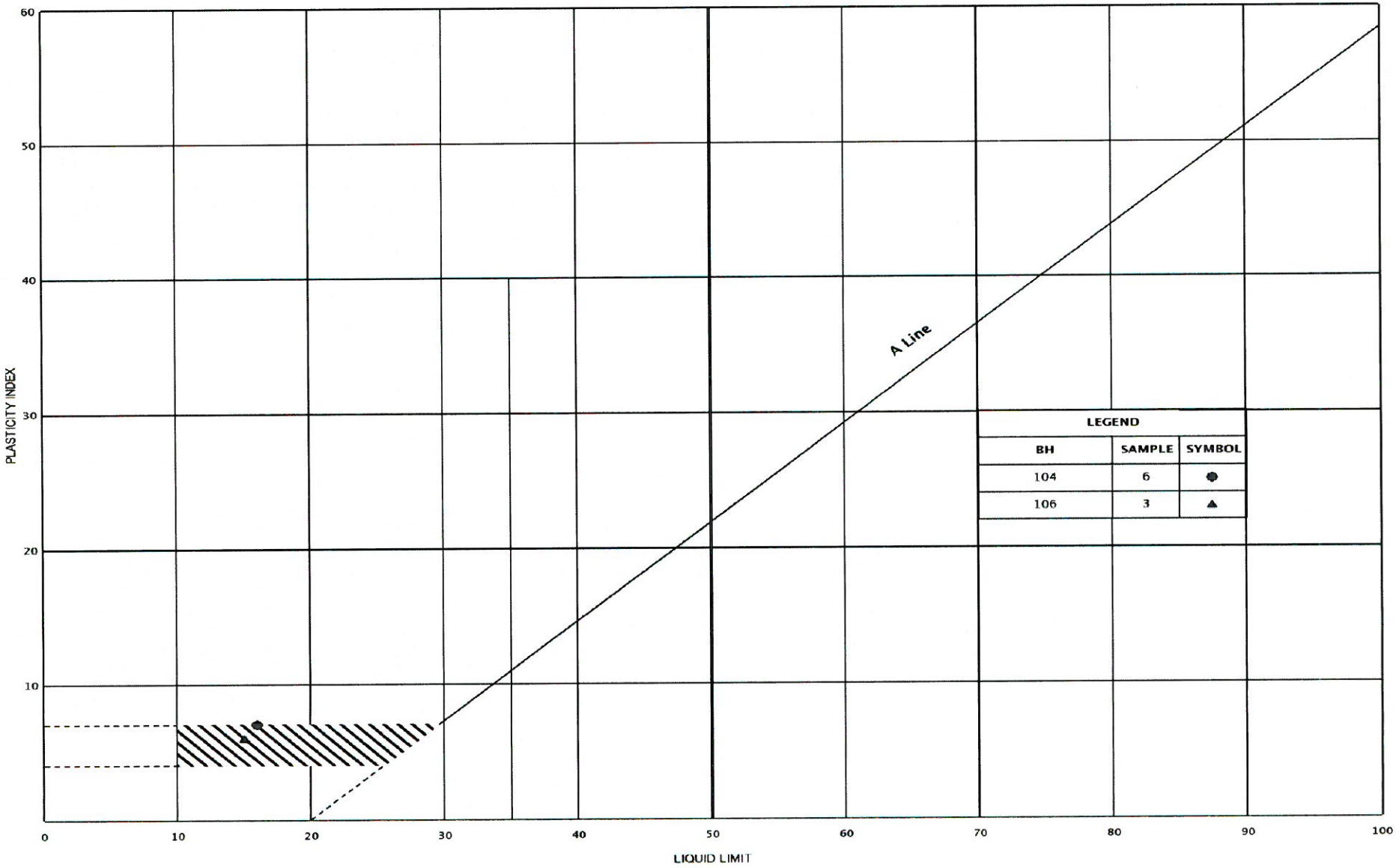
GRAIN SIZE DISTRIBUTION

TILL: Silty Sand, Some Clay, Trace To Some Gravel

FIG No.: 2-3

Project No.: 21BF052



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PLASTICITY CHART

TILL: Silty Sand, Some Clay, Trace To Some Gravel

FIG No.: 2-4

HWY.:

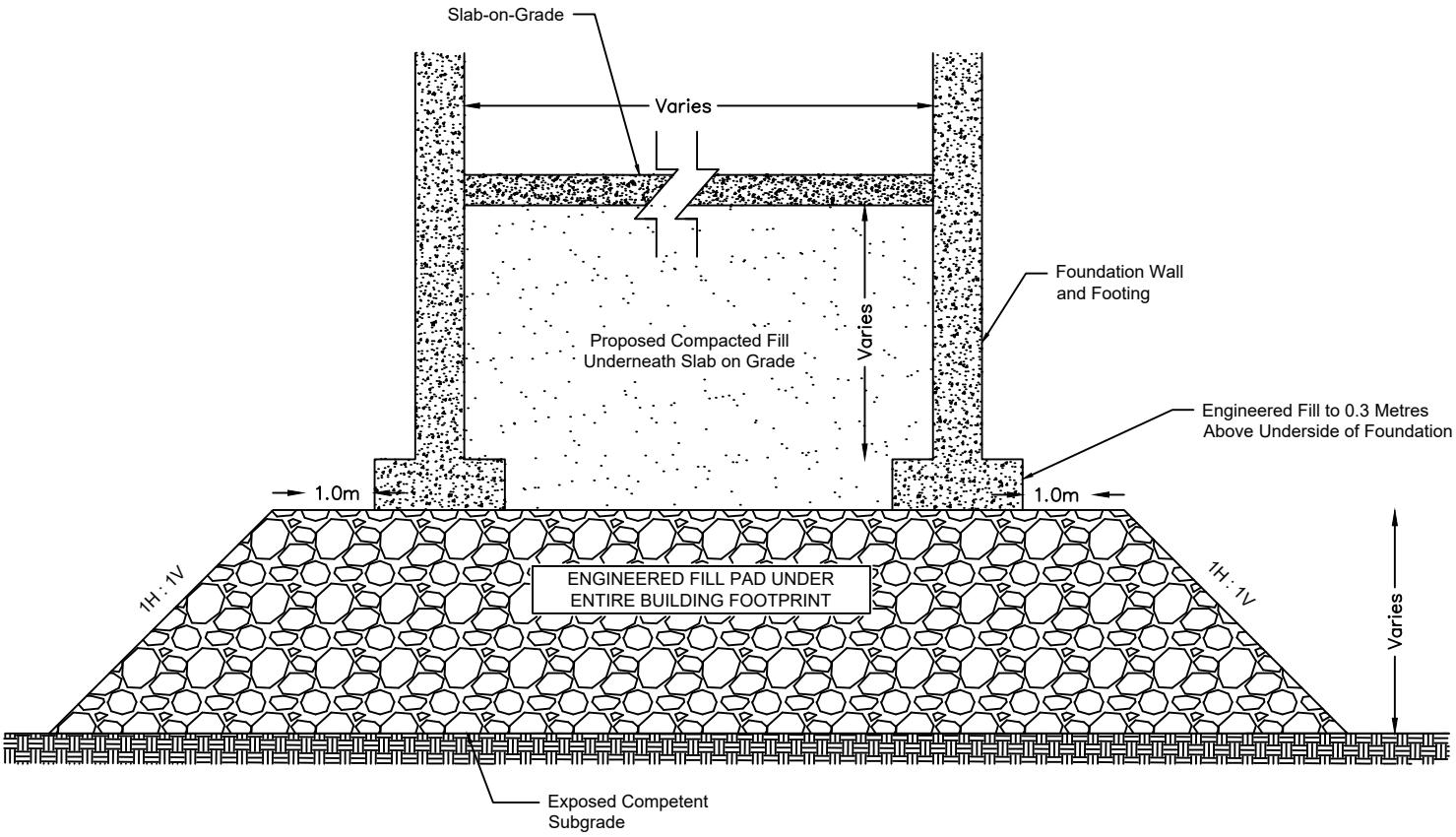
Proj No. 21BF052

Appendix D

Typical Details

Notes:

1. Engineered Fill compacted to 100% Standard Proctor Maximum Dry Density (SPMDD) and inspected under the full time supervision of GEI.
2. Engineered fill must be placed in loose lifts of 200 mm or less and then compacted as noted above.
3. Interior non-structural compacted fill compacted to 98% SPMDD with recommended part-time inspection.



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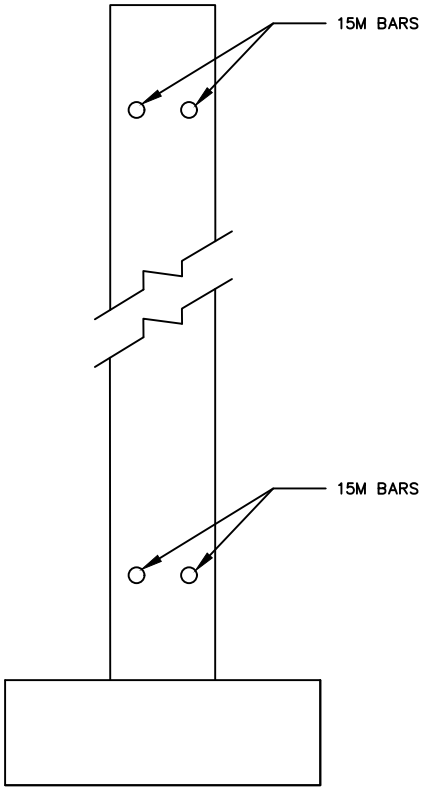
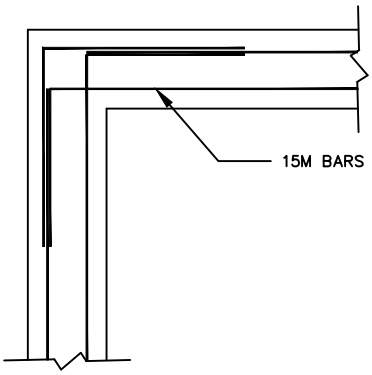
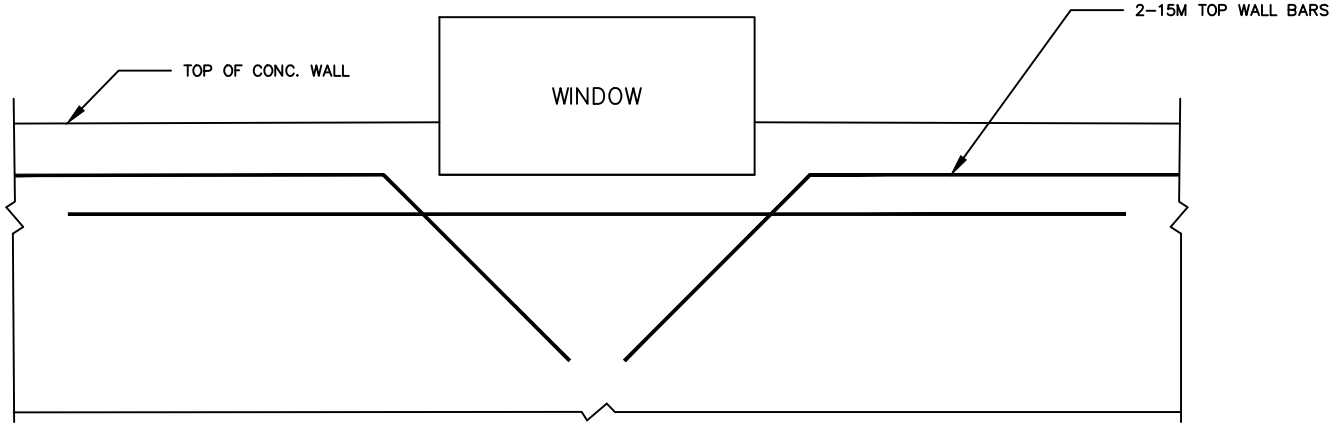
ENGINEERED FILL PAD DIMENSIONING TYPICAL DETAIL



TYPICAL REINFORCED WALL



TYPICAL SPLICING AT CORNERS



TYPICAL WINDOW REINFORCING

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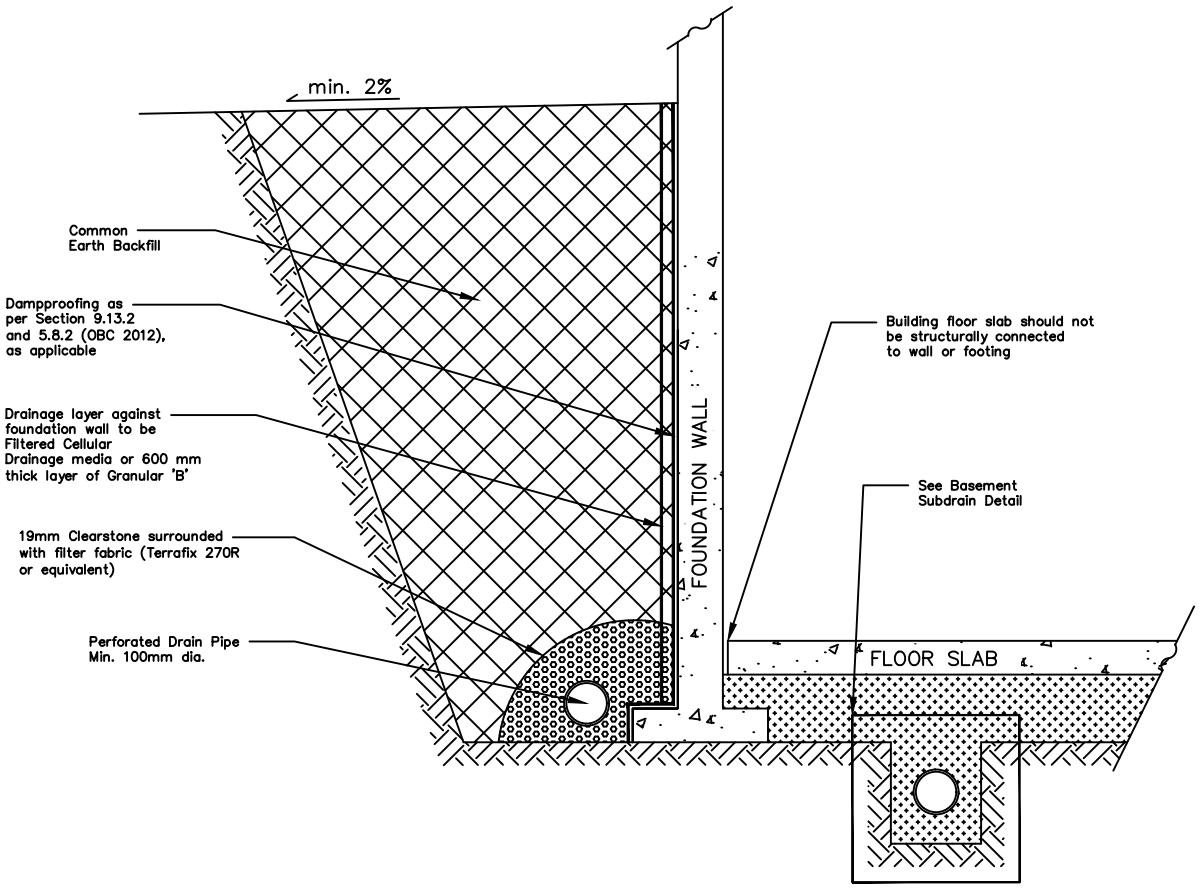
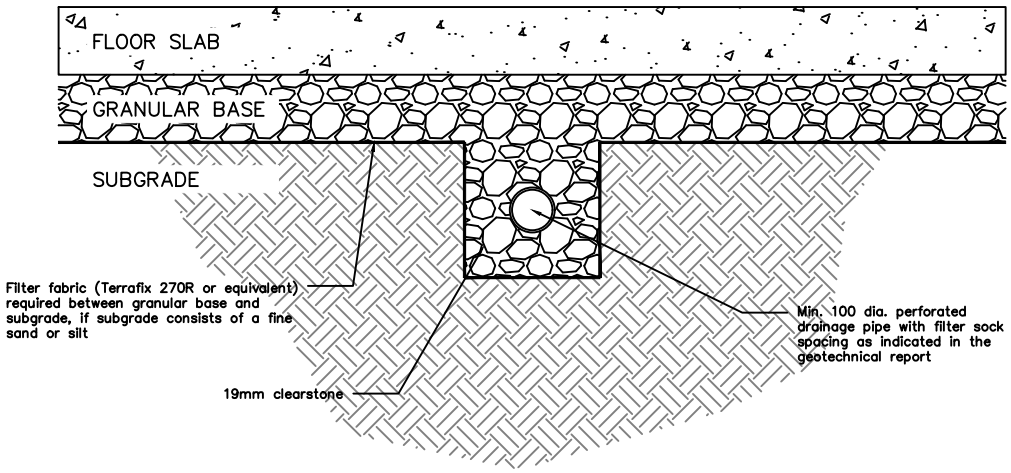
FOUNDATION WALL REINFORCING ON ENGINEERED FILL TYPICAL DETAIL





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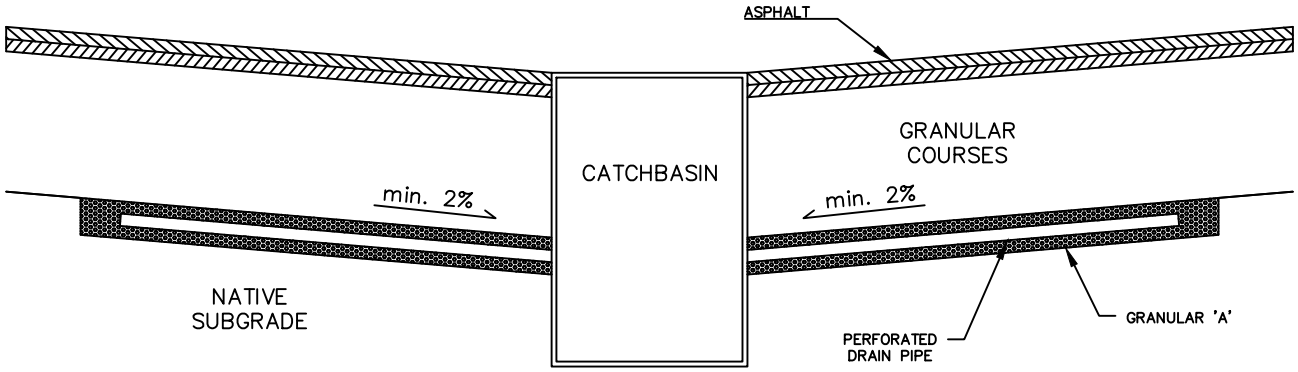
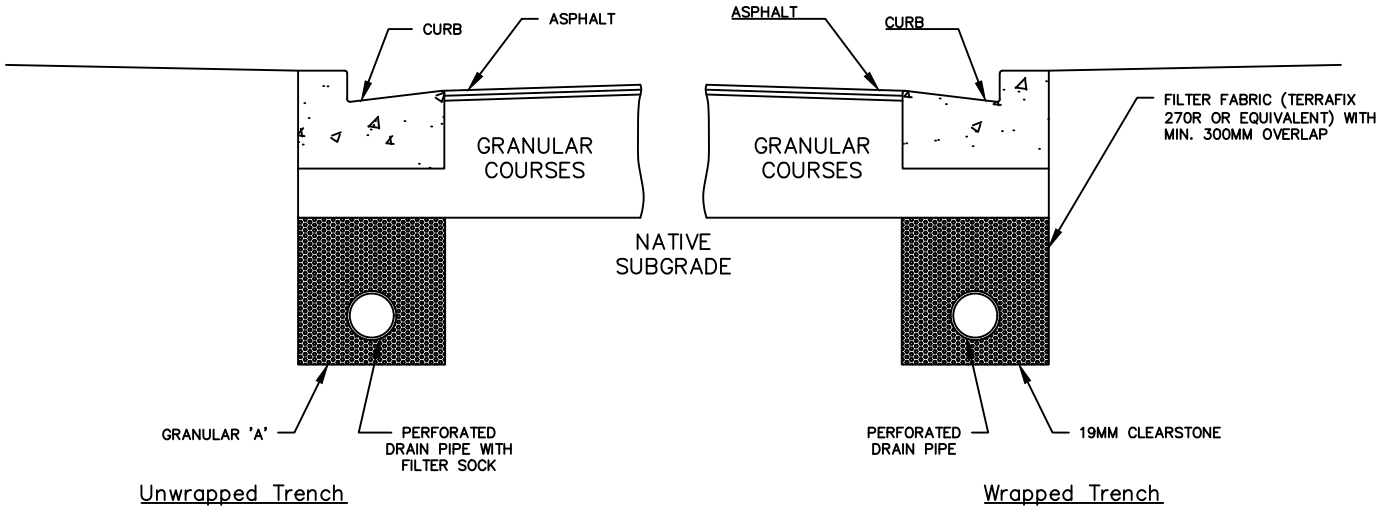
BASEMENT FOUNDATION WALL & SUBFLOOR DRAINAGE TYPICAL DETAIL

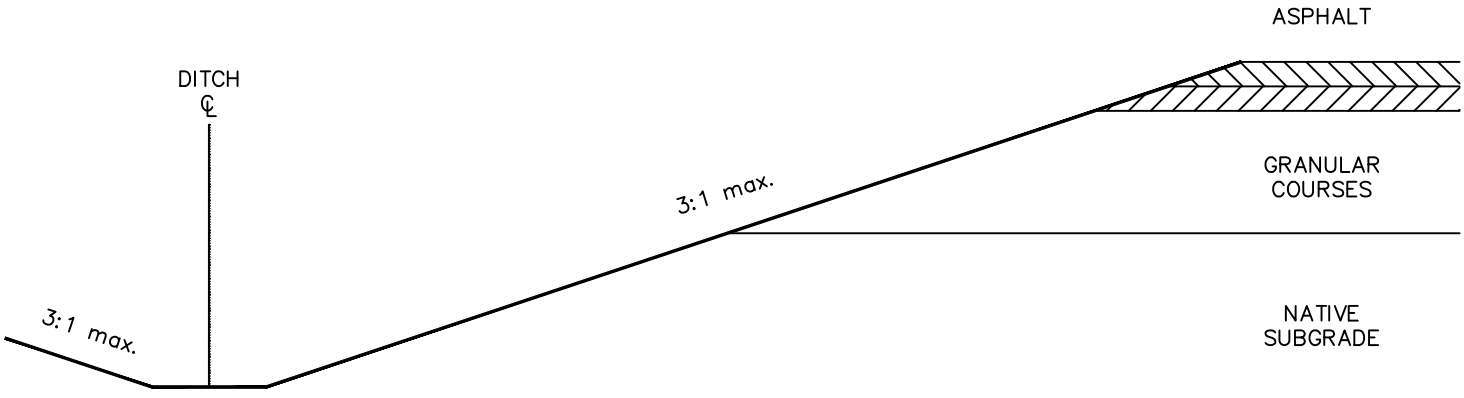




Unwrapped Trench

Wrapped Trench

Urban Cross Sections



Rural Cross Section

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PAVEMENT DRAINAGE ALTERNATIVES TYPICAL DETAILS