



**FINAL**

# **Geotechnical Investigation – Proposed Hotel Development**

19 Lennox Drive (formerly 440 Dunlop Street West), Barrie,  
Ontario

Prepared for:

**Innisfil Beach Development Inc.**

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## **1.0 INTRODUCTION AND SCOPE**

Pinchin Ltd. (Pinchin) was retained by Innisfil Beach Development Inc. (Client) to conduct a Geotechnical Investigation and provide subsequent geotechnical design recommendations for the proposed hotel development to be located at 19 Lennox Drive (formerly 440 Dunlop Street West), Barrie, Ontario (Site). The Site location is shown on Figure 1.

Based on information provided by the Client, it is Pinchin's understanding that the development will consist of a six-storey slab-on-grade (i.e. no basement level) hotel building in the east portion of the Site and associated surface parking and driveways in the remainder of the Site.

Pinchin's geotechnical comments and recommendations are based on the results of the Geotechnical Investigation and our understanding of the project scope.

The purpose of the Geotechnical Investigation was to delineate the subsurface conditions and soil engineering characteristics by advancing a total of four (4) sampled boreholes (Boreholes MW301, MW302, BH303 and BH304), at the Site.

Based on a desktop review and the results of the Geotechnical Investigation, the following geotechnical data and engineering design recommendations are provided herein:

- A detailed description of the soil and groundwater conditions;
- Site preparation recommendations;
- Open cut excavations;
- Anticipated groundwater management;
- Site service trench design;
- Foundation design recommendations including soil bearing resistances at Ultimate Limit States (ULS) and Serviceability Limit States (SLS) design;
- Potential total and differential settlements;
- Foundation frost protection and engineered fill specifications and installation;
- Seismic Site classification for seismic Site response;
- Concrete floor slab-on-grade support recommendations;
- Asphaltic concrete pavement structure design for parking areas and access roadways; and,
- Potential construction concerns.

Abbreviations, terminology and principle symbols commonly used throughout the report, borehole logs and appendices are enclosed in Appendix I.



## **2.0 DESKTOP REVIEW**

### **2.1 Site Description and Geological Setting**

The subject Site considered for development is located on the southeast corner of the intersection of Lennox Drive and Ferndale Drive North in Barrie, Ontario. The north portion of 440 Dunlop Street West is considered for the planned development and is currently occupied by ball hockey courts, a gravel lot and asphalt areas. The Site is bordered by Ferndale Drive North to the west, Dunlop Street West to the south, Lennox Drive to the north, and adjacent commercial properties to the east. The Site is relatively flat with elevations at the borehole locations ranging from 235.5 to 236.1 metres above sea level (masl).

Data obtained from the Ontario Geological Survey Maps, as published by the Ontario Ministry of Energy, Northern Development and Mines, indicates that the Site is located primarily on coarse-grained glaciolacustrine deposits of sand, gravel, minor silt and clay (Ontario Geological Survey 2010, Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128-REV). The underlying bedrock at this Site is of the Simcoe Group (Verulam Formation) consisting of limestone and shale (Armstrong, D.K. and Dodge, J.E.P. 2007, Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 219). Based on drift thickness mapping (Gao, C., Shirota, J., Kelly, R. I., Brunton, F.R., van Haaften, S.; Ontario Geological Survey 2006, Bedrock topography and overburden thickness mapping, southern Ontario, Miscellaneous Release--Data 207.), the depth to bedrock in the general area is about 110 to 120 meters below ground surface (mbgs).

### **2.2 Previous Investigations Completed at the Site**

In 2021, Pinchin completed a geotechnical investigation at 440 Dunlop Street West and 125 Ferndale Drive North in Barrie, Ontario (Final Geotechnical Investigation – Proposed Commercial Development, Pinchin reference 295667.001, dated October 18, 2021). The fieldwork was completed on August 23 and 24, 2021 and included the advancement of nine (9) sampled boreholes (Boreholes MW101 to MW103, MW201 to MW203, and BH204 to BH206) to 5.2 mbgs. Six (6) of these boreholes (Boreholes MW201 to BH206) were advanced within the current subject Site (north portion of 440 Dunlop Street West). The soil conditions at these boreholes consisted of pavement structure and/or fill underlain by sand which in turn was underlain by clay deposits. The fill extended to depths of 0.8 to 3.1 mbgs and had a compact to very loose relative density. The sand contained trace to some silt and gravel was compact to loose (generally compact). The silty clay contained trace sand and gravel and was very stiff to soft (generally stiff to firm). Stabilized groundwater levels were collected on September 20, 2021 and ranged from 0.7 to 1.7 mbgs within the subject Site (Elevations 234.2 to 234.8 masl). The relevant borehole logs are included in Appendix II and the relevant borehole locations are shown on appended Figure 2.



### **2.3 Concurrent Investigation Completed at the Site**

Concurrently to the geotechnical investigation Pinchin is completing a Hydrogeological Assessment at the Site. The relevant information from the concurrent investigation has been incorporated into this report. The results of the Hydrogeological Assessment will be provided under separate cover.

### **3.0 GEOTECHNICAL FIELD INVESTIGATION AND METHODOLOGY**

Pinchin completed the field investigation at the Site on March 29 and 30, 2023 by advancing a total of four sampled boreholes (Boreholes MW301, MW302, BH303 and BH304) within the proposed building footprint. The sampled boreholes were advanced to depths of approximately 9.8 mbgs. Dynamic cone penetration tests were completed at Boreholes MW302 and MW303 extending from the bottom of the augered boreholes to 13.6 mbgs (Borehole MW302) and 15.8 mbgs (Borehole BH303). The approximate spatial locations of the boreholes advanced at the Site are shown on Figure 2.

The boreholes were advanced with the use of a Geoprobe 3230 DT direct push drill rig which was equipped with standard soil sampling equipment. Soil samples were collected at 0.75 and 1.5 m intervals using a 51 mm outside diameter (OD) split spoon barrel in conjunction with Standard Penetration Tests (SPT) "N" values (ASTM D1586). The SPT "N" values were used to assess the compactness condition of the non-cohesive soil. Approximate shear strengths of the cohesive deposits were measured using a shear vane as well as a handheld pocket penetrometer. The results of the pocket penetrometer testing are presented on the appended borehole logs and the results of the shear vane are discussed in the report text.

Monitoring wells were installed in Boreholes MW301 and MW302 to allow measurement of groundwater levels. The monitoring wells were constructed using flush-threaded 50 mm diameter Trilock pipe with 3.0 meter long 10-slot well screens, delivered to the Site in pre-cleaned individually sealed plastic bags. The screen and riser pipes were not allowed to come into contact with the ground or drilling equipment prior to installation.

A completed well record was submitted to the property owner and the Ministry of the Environment, Conservation and Parks for Ontario (MECP) as per Ontario Regulation 903, as amended. A licensed well technician must properly decommission the monitoring wells prior to construction according to Regulation 903 of the Ontario Water Resources Act.

Groundwater observations and measurements were obtained from the open boreholes during and upon completion of drilling. Groundwater levels were measured in the monitoring wells as part of the hydrogeological assessment between March 31 and May 5, 2023. The groundwater observations and measurements recorded are included on the appended borehole logs.



The borehole locations and ground surface elevations were located at the Site by Pinchin personnel. The ground surface elevation at each borehole location was referenced to the following temporary benchmark as shown on Figure 2:

- TBM: Ground Surface at previous Borehole BH205
- Elevation: 235.41 masl.

The field investigation was monitored by experienced Pinchin personnel. Pinchin logged the drilling operations and identified the soil samples as they were retrieved. The recovered soil samples were sealed into plastic bags and carefully transported to Pinchin's accredited materials testing laboratory for detailed analysis and testing. All soil samples were classified according to visual and index properties by the project engineer.

The field logging of the soil and groundwater conditions was performed to collect geotechnical engineering design information. The borehole logs include textural descriptions of the subsoil in accordance with a modified Unified Soil Classification System (USCS) and indicate the soil boundaries inferred from non-continuous sampling and observations made during the borehole advancement. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The modified USCS classification is explained in further detail in Appendix I. Details of the soil and groundwater conditions encountered within the boreholes are included on the Borehole Logs within Appendix II.

Select soil samples collected from the boreholes were submitted to Pinchin's material testing laboratory to determine the grain size distribution, Atterberg Limits, and moisture contents of the soil. A copy of the laboratory analytical reports is included in Appendix III. In addition, the collected samples were compared against previous geotechnical information from the area, for consistency and calibration of results.

#### **4.0 SUBSURFACE CONDITIONS**

In general, the soil stratigraphy contacted within the current boreholes advanced at the Site comprised pavement structure and/or fill / possible fill underlain by sand, which in turn was underlain by clay to the maximum borehole termination depths of approximately 9.8 mbgs. The appended borehole logs provide detailed soil descriptions and stratigraphies, results of SPT and pocket penetrometer testing, moisture content profiles, details of monitoring well installations, and groundwater measurements.

##### **4.1 Pavement Structure**

Borehole BH303 was advanced through the ball hockey court and Borehole BH304 was advanced through the gravel lot. The pavement structure contacted at Borehole BH303 consisted of 150 mm of asphaltic concrete underlain by 750 mm of sand and gravel fill. At Borehole BH304, a 50 mm skiff of surficial sand and gravel fill was underlain by 50 mm of asphaltic concrete.



#### 4.2 Topsoil Fill

Borehole MW301 was advanced through the grassed area adjacent to the gravel lot. The topsoil thickness was 150 mm. The topsoil consisted of sandy silt.

#### 4.3 Fill and Possible Fill

Fill was contacted at Boreholes MW301 (below topsoil fill), MW302 (at ground surface), and BH304 (below pavement structure) extending to depths of 2.1 to 3.4 mbgs. The fill generally ranged in composition from sandy silt to sand with variable silt content (trace silt to silty) and nil to trace gravel. Trace organics or topsoil inclusions were contacted within the fill at Borehole MW301 and BH304. Trace asphalt was contacted within the fill at MW302. At the time of sampling the fill was described as moist to wet. Laboratory determined moisture contents ranged from 10 to 28%. SPT N-values of 4 to 16 blows per 300 mm indicate a loose to compact relative density.

Possible fill was contacted at Borehole MW301 underlying the fill at 3.1 mbgs and extended to 3.6 mbgs. The possible fill consisted of sand with trace silt. The possible fill was described as wet. A laboratory moisture content of 20% was determined. Based on an SPT N-value of 4 blows per 300 mm the possible fill had a loose relative density.

#### 4.4 Sand

Sand with trace silt and nil to trace gravel was contacted at Boreholes BH303 and BH304 underlying the pavement structure and fill and extended to 2.5 and 3.8 mbgs, respectively. The sand was described as very moist to wet. Moisture contents of 14 to 20% were reported. SPT N-values 12 to 21 blows per 300 mm indicated a compact relative density.

The results of a particle size distribution analysis completed on one representative sample of the sand are provided in Appendix III and summarized in the table below:

| Borehole / Sample Number | Depth (mbgs) | Soil Type | Gravel (%) | Sand (%) | Silt and Clay (%) |
|--------------------------|--------------|-----------|------------|----------|-------------------|
| BH303 / SS3              | 1.5 to 2.1   | Sand      | 11         | 86       | 3                 |

#### 4.5 Clay

Silty clay with nil to trace sand and gravel was contacted at all borehole locations underlying the fill / possible fill or sand at depths of 2.5 to 3.8 mbgs and extended below the sampled borehole depths of 9.8 mbgs. At the time of fieldwork, the silty clay was About the Plastic Limit (APL) to Wetter Than the Plastic Limit (WTPL). Laboratory determined moisture contents ranged from 22 to 30%.

Approximate shear strengths of the cohesive deposits measured using an in-situ shear vane are summarized in the following table:

| Borehole Number | Depth (mbgs) | Initial (kPa) | Remold (kPa)        | Sensitivity |
|-----------------|--------------|---------------|---------------------|-------------|
| MW301           | 4.6          | 108           | 36                  | 3.0         |
| MW301           | 5.5          | 83            | 54                  | 1.5         |
| MW301           | 7.0          | 29            | 10                  | 2.7         |
| MW301           | 8.5          | 21            | 7                   | 3.0         |
| BH303           | 4.6          | 130           | 43                  | 3.0         |
| BH303           | 6.9          | 54            | 36                  | 1.5         |
| BH303           | 9.9          | 181           | Unable to turn vane | n/a         |
| BH304           | 6.2          | 72            | 29                  | 2.5         |
| BH304           | 6.9          | 72            | 31                  | 2.3         |

Based on the vane shear ratio of initial and remold, the clay deposit is estimated to have a low to medium sensitivity, generally medium sensitivity. The clay deposit was variable very stiff to soft, based on SPT N-values ranging from 2 to 19 blows per 300 mm and approximate shear strengths of 21 to 181 kPa as determined by hand held pocket penetrometer and field vane.

The results of a particle size distribution analysis and Atterberg Limits test completed on one representative sample of the clay deposit are provided in Appendix III and summarized in the tables below:

| Borehole / Sample Number | Depth (mbgs) | Soil Type | Gravel (%) | Sand (%) | Silt (%) | Clay (%) |
|--------------------------|--------------|-----------|------------|----------|----------|----------|
| BH303 / SS5              | 3.1 – 3.7    | Clay      | 0          | 5        | 54       | 41       |

| Borehole / Sample Number | Depth (mbgs) | Soil Type | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | Moisture Content (%) |
|--------------------------|--------------|-----------|------------------|-------------------|----------------------|----------------------|
| BH303 / SS5              | 3.1 – 3.7    | Clay      | 33               | 15                | 19                   | 22                   |

The Atterberg Limits test results indicated that the clay is of medium plasticity.

Dynamic cone penetration tests extending below the sampled borehole depths of boreholes BH302 and BH303, indicate relatively consistent as well as localized increased blow counts. These could be



indicative of intermittent coarse soil seams / layers or gravel content. A slight increase of blow counts may also be attributed to side friction on the drill rods.

#### **4.6 Groundwater Conditions**

Groundwater observations and measurements were obtained in the open boreholes at the completion of drilling and are summarized on the appended borehole logs. Stabilized groundwater levels were measured between March 31 and May 5, 2023 at the monitoring wells installed at the subject Site and the results are summarized in the following table:

| <b>Borehole No.</b> | <b>Ground Surface Elevation (masl)</b> | <b>Date</b>    | <b>Depth to Groundwater (mbgs)</b> | <b>Groundwater Elevation (masl)</b> |
|---------------------|----------------------------------------|----------------|------------------------------------|-------------------------------------|
| MW201               | 235.6                                  | March 31, 2023 | 1.1                                | 234.5                               |
|                     |                                        | April 12, 2023 | 1.0                                | 234.6                               |
|                     |                                        | May 5, 2023    | 0.9                                | 234.7                               |
| MW202               | 235.5                                  | March 31, 2023 | 0.3                                | 235.2                               |
|                     |                                        | April 12, 2023 | 0.4                                | 235.1                               |
|                     |                                        | May 5, 2023    | 0.3                                | 235.2                               |
| MW203               | 235.6                                  | March 31, 2023 | 1.3                                | 234.3                               |
|                     |                                        | April 12, 2023 | 1.4                                | 234.2                               |
|                     |                                        | May 5, 2023    | 1.3                                | 234.3                               |
| MW301               | 235.6                                  | March 31, 2023 | 0.7                                | 234.8                               |
|                     |                                        | April 12, 2023 | 0.7                                | 234.8                               |
|                     |                                        | May 5, 2023    | 0.7                                | 234.9                               |
| MW302               | 235.5                                  | March 31, 2023 | 0.5                                | 234.9                               |
|                     |                                        | April 12, 2023 | 0.6                                | 234.9                               |
|                     |                                        | May 5, 2023    | 0.5                                | 235.0                               |



Perched conditions should be expected within the fill/possible fill. Further, seasonal variations in the water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions.

Reference is made to Pinchin's hydrogeological assessment for additional details pertaining to the groundwater regime below the subject Site.

## **5.0 GEOTECHNICAL DESIGN RECOMMENDATIONS**

### **5.1 General Information**

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

It is understood that the proposed development will include six-storey slab-on-grade (i.e., no basement level) hotel building with associated asphalt pavement structures. The proposed hotel building is planned in the east portion of the Site. Surface parking and driveways are proposed in the remainder of the Site with driveway access to Lennox Drive, Ferndale Road, and Dunlop Street West. It is understood that the design finished floor elevation is Elevation 236.25 masl.

The soils contacted at the Site consisted of fill / possible fill in the upper 0.9 to 3.6 mbgs underlain by compact to loose sand, which in turn was underlain by clay over the sampled borehole depth of 9.8 mbgs. The clay was variable very stiff to soft with the shear strength of the clay generally decreasing with depth. The clay underlying the Site is considered highly compressible. Disturbance of the upper very stiff to stiff clay crust will cause reduction in shear strength of the underlying soils and potentially cause large settlements. Special considerations must be made during the excavation work to protect the clay subgrade as well as before any grade raise is planned for the Site. Overstressing of the underlying clay soils (i.e., from surcharge loading) may result in excessive settlement and punching failure.

Additionally, the thick fill deposits (0.8 to 3.6 mbgs) as well as high groundwater table at the Site will complicate the site preparation works. Dewatering will be required to lower the groundwater table and facilitate the removal and replacement of the fill materials, as well as the installation of new services and foundations. As such, in-situ soil improvement may be best suited for this Site and the planned development.



Under consideration of the soil conditions at the Site, the following foundations options are available:

- Conventional spread footings designed for lower than typical bearing pressures within the upper stiff to very stiff clays, compact sand, and / or engineered fill.
- Conventional spread footings designed for higher bearing pressures, supported by a Rammed Aggregate Pier system or Controlled Modulus Column system.

While blow counts from the dynamic cone testing increased at about 12 to 15 m below existing grade, a suitable bearing layer for concrete caissons or steel piles was not found over the sampled depths of the boreholes. Deeper sampled boreholes would be needed to confirm a suitable bearing stratum for piles / caissons. Collection of additional deeper borehole data is further recommended should a raft slab be considered for this Site. This additional data would be needed to confirm the bottom depth of the highly compressible clay deposit and collect Shelby tube samples for additional laboratory testing such as consolidation testing.

It is understood that following Pinchin's geotechnical fieldwork and the issuance of the first draft of this Geotechnical Report in May of 2023, additional investigation utilizing cone penetration testing (CPT) was carried out to provide additional geotechnical information to aid in design of a soil improvement system.

## 5.2 Site Preparation

Existing utilities not to be maintained should be removed and/or relocated. The existing pavement structures and fill materials are not suitable to remain below the proposed building and will need to be removed.

Due to the thickness of the fill materials, it may not be feasible to remove the full depth of fill in the parking/driveway areas. The existing inorganic fill is considered suitable to remain below the proposed parking lot and driveway areas subject to proof-roll inspection, any organic material encountered at the subgrade level including topsoil is removed and potential for future settlements, a reduced service life, and increased need for maintenance are accepted by the owner. Alternatively, a geogrid soil system could be used to minimize excavation of pre-existing fill material below pavement structures.

Pinchin recommends that any engineered fill required at the Site be compacted in accordance with the criteria stated in the following table:

| Type of Engineered Fill                                | Maximum Loose Lift Thickness (mm) | Compaction Requirements | Moisture Content (Percent of Optimum) |
|--------------------------------------------------------|-----------------------------------|-------------------------|---------------------------------------|
| Structural fill to support foundations and floor slabs | 200                               | 100% SPMDD              | Plus 2 to minus 4                     |
| Subgrade fill beneath parking lots and access roadways | 300                               | 98% SPMDD               | Plus 2 to minus 4                     |



Structural fill placed below foundations should extend horizontally 1 m beyond the edge of foundation. The structural fill pad should be sloped at an inclination of 1 horizontal to 1 vertical to the approved subgrade soil. It is recommended that engineered structural fill pads be overbuilt to at least 300 mm above the design underside of footing elevations.

Prior to placing any fill material at the Site, the subgrade should be inspected by a qualified geotechnical engineer, and loosened/soft pockets should be sub excavated and replaced with engineered fill.

Soils excavated from below the groundwater table are not considered suitable for reuse at the Site unless sufficiently dry, which may not be achievable at the Site. Limited amounts of inorganic on-site soils excavated from above the groundwater table may be available for re-use; however, this should be confirmed at the time of construction. It is therefore recommended that any fill required to raise grades below the proposed building addition comprise imported Ontario Provincial Standards and Specifications (OPSS) 1010 Granular 'B'. If the work is carried out during very dry weather, water may have to be added to the material to improve compaction.

A qualified geotechnical engineering technician should be on site to observe fill placement operations and perform field density tests at random locations throughout each lift, to indicate the specified compaction is being achieved.

It is again noted that any grade raises could result in long-term consolidation of the underlying clay soils. Additional investigation and analysis would be needed to assess any proposed grade raises.

### **5.3 Open Cut Excavations**

It is anticipated that the foundations will be constructed below conventional frost depths, at approximately 1.5 metres below finished floor elevation, and that services will be constructed at conventional depths, approximately 2 to 4 mbgs.

Based on the subsurface information obtained from within the boreholes, it is anticipated that the excavated material will predominately consist of fill / possible fill and sand in the upper 2 to 4 m and clay below. Groundwater was measured on May 5, 2023 at depths of 0.3 to 1.3 mbgs (Elevation 234.3 to 235.2 masl).

Where workers must enter trench excavations deeper than 1.2 m, the trench excavations should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act (OHSA), Ontario Regulation 213/91, Construction Projects, July 1, 2011, Part III - Excavations, Section 226.

Based on the OHSA, the Site soils above the groundwater table would be classified as Type 3 soil and temporary excavations in these soils must be sloped at an inclination of 1 horizontal to 1 vertical (H to V) from the base of the excavation. Excavations extending below the groundwater table would be classified as a Type 4 soil and temporary excavations will have to be sloped back at 3 H to 1 V from the base of the



excavation. Where more than one soil type is exposed in an excavation, the soil type with the higher number governs.

Alternatively, the excavation walls may be supported by either closed shoring, bracing, or trench boxes complying with sections 235 to 239 and 241 under O. Reg. 231/91, s. 234(1). The use of trench boxes can most likely be used for temporary support of vertical side walls. The appropriate trench should be designed/confirmed for use in this soil deposit.

In addition to compliance with the OHSA, the excavation procedures must also be in compliance to any potential other regulatory authorities, such as federal and municipal safety standards.

#### **5.4 Anticipated Groundwater Management**

Groundwater was measured on May 5, 2023 at depths of 0.3 to 1.3 mbgs (Elevation 234.3 to 235.2 masl). Excavations to remove the existing fill and place an engineered structural fill pad below the proposed building could be in the order of 4 mbgs.

Moderate to significant groundwater inflow through the native sand and fill material is expected. For excavations that extend below the groundwater table. It is believed that this groundwater inflow can be controlled using a gravity dewatering system with high capacity pumps installed in constructed sumps for excavations extending less than 0.3 m below the groundwater table.

For excavations extending more than 0.3 m below the stabilized groundwater table, a dewatering system installed by a specialist dewatering contractor may be required to lower the groundwater level prior to excavation. The design of the dewatering system should be left to the contractor's discretion, and the system should meet a performance specification to maintain and control the groundwater at least 0.30 m below the excavation base. It is recommended that Pinchin review the final grading plan to confirm this recommendation.

Seasonal variations in the water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions. If construction commences during wet periods (typically spring or fall), there is a greater potential that the groundwater elevation could be higher and/or perched groundwater may be present. Any potential inflow of perched groundwater should be able to be controlled from pumping from filtered sumps.

Prior to commencing excavations, it is critical that all existing surface water and potential surface water is controlled and diverted away from the Site to prevent infiltration and subgrade softening. At no time should excavations be left open for a period of time that will expose them to precipitation and cause subgrade softening.



All collected water is to discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures, such as a silt fence should be installed at the discharge point of the dewatering system. The utmost care should be taken to avoid any potential impacts on the environment.

It is the responsibility of the contractor to propose a suitable dewatering system based on the groundwater elevation at the time of construction. The method used should not adversely impact any nearby structures.

A Permit to Take Water or a submission to the Environmental Activity and Sector Registry (EASR) may be required for the dewatering activities and reference is made to the hydrogeological assessment report for further detail. It is the responsibility of the contractor to make this application if required.

As previously mentioned, above average seasonal variations in the groundwater table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions. As such, depending on the groundwater at the time of the excavation works, a more involved dewatering system may be required.

## **5.5 Site Servicing**

### **5.5.1 Pipe Bedding and Cover Materials for Flexible and Rigid Pipes**

Fill and possible fill materials were found to extend to depths of 0.8 mbgs to 3.6 mbgs. The pipe subgrade soils should be inspected at the time of excavations and any fill materials remaining below proposed pipe inverts should be removed and replaced with additional bedding material.

No support problems are anticipated for flexible or rigid pipes founded in the natural mineral soils. Any organic soils, or loose/soft material encountered below the pipe invert should be removed and replaced with additional bedding material.

Service pipes require an adequate base to ensure proper pipe connection and positive flow is maintained post construction. As such, pipe bedding should be placed to be of uniform thickness and compactness. The pipe bedding and cover material should conform to OPSD 802.010 and 802.013 specifications for flexible pipes and to OPSD 802.031 to 802.033 with Class "B" bedding for rigid pipes.

The pipe bedding material should consist of a minimum thickness of 150 mm Granular "A" (OPSS 1010) below the pipe and extend up the sides to the spring line. However, the bedding thickness may have to be increased depending on the pipe diameter or if wet or weak subgrade conditions are encountered. The pipe cover material from the spring line should consist of a Granular "B" Type I (OPSS 1010) and should extend to a minimum of 300 mm above the top of the pipe. All granular fill material is to be placed in maximum 200 mm thick loose lifts compacted to a minimum of 98% SPMDD.



The bedding material, pipe and cover material should be installed as soon as practically possible after the excavation subgrade is exposed. The longer the excavated subgrade soil remains open to weather conditions and groundwater seepage, the greater the chance for construction problems to occur.

Where it is difficult to stabilize the subgrade due to groundwater or the material is higher than the optimum moisture content, a Granular "B" Type II material may be required. Alternatively, if constant groundwater infiltration becomes an issue, then an approximate 150 mm granular pad consisting of 19 mm clear stone gravel (OPSS 1004) wrapped in a non-woven geotextile should be considered to maintain the integrity of the natural subgrade soils. The clear stone should contain a minimum of 50% crushed particles. Water collected within the stone should be controlled through sumps and filtered pumps.

#### **5.5.2 Trench Backfill**

Above the pipe cover material, the trench can be backfilled by re-using the inorganic soil free of deleterious content excavated from above the groundwater table, matching the materials exposed on the sides of the trenches. The material from below the groundwater table will be too wet for reuse. Additional trench backfill material may be required. The soil should be placed and compacted in maximum 200 mm thick lifts to 98% SPMDD within 4% of the optimum moisture content. Due to the elevated moisture content and groundwater level within the natural sand deposit it is recommended that excessive vibration be avoided during backfilling operations.

All stockpiled material should be protected from deleterious materials, additional moisture and be kept from freezing.

Quality control will be the utmost importance when selecting the material. The selection of the material should be done as early in the contract as possible to allow sufficient time for gradation and proctor testing on representative samples to ensure it meets the projects specifications.

Depending on weather and moisture conditions at the time of construction, an imported material may be required to achieve adequate compaction. If the imported material is not the same/similar to the soil observed on the side walls of the excavation, then a horizontal transition between the materials should be sloped as per frost heave taper OPSD 205.060. Any natural material is to be placed in maximum 200 mm thick lifts compacted to 98% SPMDD within plus 2% to minus 4% optimum moisture content. Imported material should consist of a Granular "A", Granular "B" Type I or Type II, or Select Subgrade Material (OPSS 1010). Heavy construction equipment and truck traffic should not cross any pipe until at least 1 m of compacted soil is placed above the top of the pipe.

Post compaction settlement of finer grained soil can be expected, even when placed to compaction specifications. As such, fill materials should be installed as far in advance as possible before finishing the roadway in order to mitigate post compaction settlements.



### **5.5.3 Seepage Collars**

Seepage collars should be considered where pipes are installed below the groundwater table to minimize the flow of groundwater through the granular bedding and backfill thereby possibly causing unwatering of the native soils. It is noted that any unwatering of the clay soils (especially over a longer term) may cause settlements within the clay deposit.

### **5.5.4 Frost Protection**

The frost penetration depth in Barrie, Ontario for these types of soil conditions is estimated to extend to approximately 1.5 mbgs in open roadways cleared of snow. As such, it is recommended to place water services at a minimum depth of 300 mm below this elevation with the top of the pipe located at 1.8 mbgs or lower as dictated by municipal/regional service requirements. If a minimum of 1.8 m of soil cover cannot be provided, then the pipe should be insulated with a rigid polystyrene insulation or a pre-insulated pipe be utilized.

The insulation design configuration may either consist of placing horizontal insulation to a specified design distance beyond the outside edge of the pipe or an inverted “U” surrounding the top and sides of the pipe. Any method chosen requires suitable design and installation in accordance with the manufacturer’s recommendations. To accommodate the placement of horizontal insulation a wider excavation trench may be required.

## **5.6 Foundation Design**

The following subsections of the report provide recommendations on the above noted soil improvement technique and foundation options that would be suitable for the proposed development.

### **5.6.1 Conventional Shallow Foundations**

Conventional foundations founded at a free-free depth of 1.5 mbgs on undisturbed native soil or engineered fill placed as described under Section 5.2 may be designed for a bearing resistance at Serviceability Limit States (SLS) of 75 kPa and a factored geotechnical bearing resistance of 120 kPa at Ultimate Limit States (ULS). A resistance factor of 0.5 was applied to the ULS.

As the actual service loads were not known at the time of this report, these should be reviewed by the project structural engineer to determine if SLS or ULS governs the footing design.

The associated total and differential settlements for these pressures are anticipated to be less than 25 mm and 19 mm, respectively for continuous foundations less than 1.0 m in width and spread (square) footings of up to 2.0 m.

Footings proposed at depth greater than 2.0 mbgs should be re-evaluated since the distance to the underlying weaker soils will be reduced and consolidation settlements may occur. Overstressing the



underlying clay soils must be avoided as this would lead to consolidation settlements. Re-evaluation will also be required for any footings wider than 2 m. Pinchin should review the foundation design (geometry, underside of footing elevation, and loading) to confirm that overstressing of the underlying weaker soils will not occur.

#### **5.6.2 Raft Slab Design**

It is noted that construction of a raft slab will require subexcavation of the existing fill materials and dewatering of the subgrade soils and may therefore not be considered feasible at the Site. Additional deeper boreholes including collection of samples for consolidation testing are recommended should a raft slab be considered at the Site.

For the general assessment of feasibility of a raft slab, preliminary raft slab bearing resistances are provided below. It was assumed that the underside of the raft slab will be at a frost-free depth of 1.5 mbgs on engineered fill and that existing site grades will generally be maintained (i.e., no additional surcharge loading from grade changes). Bedrock occurs at depths of greater than 100 m below the Site, as such the bottom of the compressible soils was assumed at twice the planned building width.

Assuming the foundation is made on engineered fill, a raft foundation founded at a depth of 1.5 mbgs can be designed using a preliminary factored bearing resistance of 150 kPa at ULS condition and a preliminary total geotechnical reaction of 20 to 40 kPa at SLS. The existing effective overburden stress at foundation bearing elevation is included in the provided bearing resistance. For an allowable bearing resistance of 20 to 40 kPa, the settlement is estimated to be approximately 50 mm. A resistance factor of 0.5 was used for the bearing resistance at ULS condition.

#### **5.6.3 In-Situ Soil Improvement Options**

In-situ soil improvement options such as Rammed Aggregate Piers (RAP), Controlled Modulus Columns (CMC), or other in-situ soil systems may be best suited for this Site. In-situ soil improvement options would limit the need for subexcavation of unsuitable soils and reduce the need for dewatering during construction. As previously mentioned, it is understood that CPT was completed to supplement the existing borehole data and assist in optimizing the design of the in-situ soil improvement system. There is potential that deeper boreholes would also be beneficial for considering soil improvement options.

##### **5.6.3.1 Rammed Aggregate Piers**

Rammed Aggregate Pier® (RAP) soil reinforcing elements are installed by drilling a cavity and ramming thin lifts of well graded aggregate within the cavity to form very stiff, high-density aggregate piers. The lengths of the piers will be site specific. The first lift of aggregate forms a bulb below the bottoms of the piers, thereby pre-stressing and pre-straining the soils to a depth equal to at least one pier diameter below the base of the drill cavity. Subsequent lifts are typically about 300 mm in thickness. Ramming



takes place with a high-energy bevelled tamper that both densifies the aggregate and forces the aggregate laterally into the sidewalls of the drill cavity. This action increases the lateral stress in surrounding soil; thereby further stiffening the stabilized composite soil mass.

The result of the RAP installation is a significant strengthening and stiffening of subsurface soils that then support high bearing capacity footings.

Rammed aggregate piers are a proprietary design and will require input from specialized contractors and engineers. The installation of the rammed aggregate piers should be monitored on a full-time basis by a qualified geotechnical consultant.

#### **5.6.3.2 Controlled Modulus Column**

The Controlled Modulus Column (CMC) method utilizes a specialized & patented, high torque, displacement drill system capable of displacing in-situ soils during penetration and installing a controlled structural grout element during withdrawal. The displacement drill system produces virtually no vibrations or excess soils and is suitable for construction adjacent to existing structures.

The installed CMC elements are then overlain with a structural/engineered fill pad known as a Load Transfer Platform (LTP). The LTP is typically designed as 150-300 mm of compacted granular placed between the CMC element tops and the underside of footing which distributes the imposed footing loads evenly over the CMC treatment area. The CMC / LTP system allows for the design of high-capacity strip / spread footings and relatively thin, lightly reinforced floor slabs.

The design of the CMC and recommendations will be conducted by a third party for the proposed structure.

#### **5.6.4 Ancillary Foundation Recommendations**

It is noted that there is a potential for weaker subgrade soil to be encountered between the investigation locations. Pinchin presumes that any areas of weaker subgrade soil will consist of small pockets of soft/loose natural soil which can be compacted to match the density of the remainder of the Site. As such, the material must be compacted to a minimum of 100% Standard Proctor Maximum Dry Density (SPMDD) prior to installing the concrete formwork. Any soft/loose areas which are not able to achieve the recommended 100% SPMDD are to be removed and replaced with a low strength concrete.

Pinchin notes that a qualified geotechnical engineering consultant should be on-Site during the proof roll and foundation preparation activities to verify the recommended level of compaction is achieved and to verify the design assumptions and recommendations. This is especially critical with respect to the recommended soil bearing pressures. If variations occur in the soil conditions between the borehole locations, site verification and site review by Pinchin is recommended to provide appropriate recommendations at that time.

The natural subgrade soil is sensitive to change in moisture content and can become loose/soft if subjected to additional water or precipitation. As well, it could be easily disturbed if travelled on during construction. Once it becomes disturbed it is no longer considered adequate to support the recommended design bearing pressures. It is recommended that a working slab of lean concrete (mud slab) be placed in the footing areas immediately after excavation and inspection to protect the founding soils during placement of formwork and reinforcing steel.

In addition, to ensure and protect the integrity of the subgrade soil during construction operations, the following is recommended:

- Prior to commencing excavations, it is critical that all existing surface water, potential surface water and perched groundwater are controlled and diverted away from the work Site to prevent infiltration and subgrade softening. At no time should excavations be left open for a period of time that will expose them to inclement weather conditions and cause subgrade softening;
- The subgrade should be sloped to a sump outside the excavation to promote surface drainage and the collected water pumped out of the excavation. Any potential precipitation or seepage entering the excavations should be pumped away immediately (not allowed to pond);
- The footing areas should be cleaned of all deleterious materials such as topsoil, organics, fill, disturbed, or caved materials;
- Any potential large cobbles or boulders (i.e. greater than 200 mm in diameter) within the subgrade material are to be removed and replaced with a similar soil type not containing particles greater than 200 mm in diameter. It is critical that particles greater than 200 mm in diameter are not in contact with the foundation to prevent point loading and overstressing; and
- If the excavated subgrade soil remains open to weather conditions and groundwater seepage, sidewall stability and suitability of the subgrade soil will need to be verified prior to construction.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided and maintained above freezing at all times.

#### *5.6.5 Site Classification for Seismic Site Response & Soil Behaviour*

The following information has been provided to assist the building designer from a geotechnical perspective only. These geotechnical seismic design parameters should be reviewed in detail by the structural engineer and be incorporated into the design as required.



The seismic site classification has been based on the 2012 OBC. The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A of the OBC. The site classification is based on the average shear wave velocity in the top 30 m of the site stratigraphy. If the average shear wave velocity is not known, the site class can be estimated from energy corrected Standard Penetration Resistance (N<sub>60</sub>) and/or the average undrained shear strength of the soil in the top 30 m.

The sampled boreholes advanced at this Site extended to depths of 9.8 mbgs. Dynamic cone penetration tests extended to 13.6 mbgs and 15.8 mbgs. SPT “N” values within the native soil deposits ranged from 2 to 21 blows per 300 mm. Shear strengths in the clay deposit varied from 21 to 181 kPa, generally decreasing with depth. As such, based on Table 4.1.8.4.A of the OBC, this Site has been classified as Class E. A Site Class E has an average shear wave velocity (V<sub>s</sub>) of less than 180 m/s.

In order to obtain a higher Site Class, shear wave velocity soundings in the top 30 m of the Site stratigraphy would have to be performed, through testing methods such as multi-channel analysis of surface waves (MASW).

#### *5.6.6 Foundation Transition Zones*

Excessive differential settlements can occur where the subgrade support material types differ below the underside of continuous strip footings. As such, where strip footings transition from one material to another the transition between the materials should be suitably sloped or benched to mitigate differential settlements.

Pinchin also recommends the following transition precautions to mitigate/accommodate potential differential settlements:

- For strip footings, the transition zones should be adequately reinforced with additional reinforced steel lap lengths or widened footings;
- Steel reinforced poured concrete foundation walls; and
- Control joints throughout the transition zone(s).

The above recommendations should be reviewed by the structural engineer and incorporated into the design as necessary.

Where strip footings are founded at different elevations, the subgrade soil is to have a maximum slope of 2 H to 1 V, with the concrete footing having a maximum rise of 600 mm and a minimum run of 600 mm between each step, as detailed in the 2012 Ontario Building Code (OBC). The lower footing should be installed first to mitigate the risk of undermining the upper footing.



Individual spread footings are to be spaced a minimum distance of one and a half times the largest footing width apart from each other to avoid stress bulb interaction between footings. This assumes the footings are at the same elevation.

Foundations may be placed at a higher elevation relative to one another provided that the slope between the outside face of the foundations are separated at a minimum slope of 2 H to 1 V with an imaginary line drawn from the underside of the foundations. The lower footing should be installed first to mitigate the risk of undermining the upper footing.

#### *5.6.7 Estimated Settlement*

All individual spread footings should be founded on uniform subgrade soils, reviewed and approved by a licensed geotechnical engineer.

All foundations are to be designed and constructed to the minimum widths as detailed in the 2012 OBC.

#### *5.6.8 Building Drainage*

To assist in maintaining the building dry from surface water seepage, it is recommended that exterior grades around the buildings be sloped away at a 2% gradient or more, for a distance of at least 2.0 m. Roof drains should discharge a minimum of 1.5 m away from the structure to a drainage swale or appropriate storm drainage system.

Exterior perimeter foundations drains are not required, where the finished floor elevation is established a minimum of 150 mm above the exterior final grades or that the exterior gradient is properly sloped to divert surface water away from the building.

#### *5.6.9 Shallow Foundations Frost Protection & Foundation Backfill*

In the Barrie, Ontario area, exterior perimeter foundations for heated buildings require a minimum of 1.5 m of soil cover above the underside of the footing to provide soil cover for frost protection.

Where the foundations for heated buildings do not have the minimum 1.5 m of soil cover frost protection, they should be protected from frost with a combination of soil cover and rigid polystyrene insulation, such as Dow Styrofoam or equivalent product. If required, Pinchin can provide appropriate foundation frost protection recommendations as part of the design review.

To minimize potential frost movements from soil frost adhesion, the perimeter foundation backfill should consist of a free draining granular material, such as a Granular 'B' Type I (OPSS 1010) or an approved sand fill, extending a minimum lateral distance of 600 mm beyond the foundation. The existing sand material is too wet for reuse and not considered suitable for reuse as foundation wall backfill. The backfill material must be brought up evenly on both sides of walls not designed to resist lateral earth pressure. All granular material is to be placed in maximum 300 mm thick lifts compacted to a minimum of 100%



SPMDD below the interior of building and exterior hard landscaping areas; and, 95% SPMDD below exterior soft landscaping areas. It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure compaction requirements are achieved.

## 5.7 Floor Slabs

Prior to the installation of the engineered fill material, all fill materials and any soils containing organics (if contacted) should be removed to the underlying organic free in-situ soil. The natural subgrade soil is to be proof roll compacted with a minimum 10 tonne non-vibratory steel drum roller to observe for weak/soft spots.

The engineered fill placed as part of the site preparation will be suitable to support the proposed concrete floor slab, provided the subgrade is prepared following the recommendations within Section 5.2.

Once the subgrade soil is exposed it is to be inspected and approved by a qualified geotechnical engineering consultant to ensure that the material conforms to the soil type and consistency observed during the subsurface investigation work. Any soft area(s) encountered during proof rolling should be excavated and replaced with a similar soil type.

Based on the in-situ soil conditions, it is recommended to establish the concrete floor slab on a minimum 300 mm thick layer of Granular “A” (OPSS 1010) compacted to 100% SPMDD. Alternatively, consideration may also be given to using a 200 mm thick layer of uniformly compacted 19 mm clear stone placed over the approved subgrade. Any required up fill should consist of a Granular “B” Type I or Type II (OPSS 1010).

The following table provides the unfactored modulus of subgrade reaction values:

| Material Type                    | Modulus of Subgrade Reaction (kN/m <sup>3</sup> ) |
|----------------------------------|---------------------------------------------------|
| Granular A (OPSS 1010)           | 85,000                                            |
| Granular “B” Type I (OPSS 1010)  | 75,000                                            |
| Granular “B” Type II (OPSS 1010) | 85,000                                            |
| Engineered Fill and Native Sand  | 20,000                                            |

The values in the table above are for loaded areas of 0.3 m by 0.3 m.

Where in-situ soil improvements are completed the design engineer of the soil improvement technique will provide the applicable modulus of subgrade reaction for the floor slab design.



## **5.8 Asphaltic Concrete Pavement Structure Design for Parking Lot and Driveways**

### **5.8.1 Discussion**

Surface parking and driveways are proposed in the west portion of the Site and driveway access is planned to Lennox Drive, Ferndale Road, and Dunlop Street West. It is assumed that proposed grades will be close to existing grades. Due to the thickness of the fill material (0.8 to 3.6 mbgs), it may not be feasible to remove the full depth of fill in the parking/driveway areas. The composition of the subgrade soils will depend on if import materials are used on-site. For the purposes of this report, Pinchin assumes that soils with similar characteristic to the onsite soils or OPSS 1010 Granular B Type I will be imported to the Site.

The existing inorganic fill is considered suitable to remain below the proposed parking lot and driveway areas subject to proof-roll inspection, any organic material encountered at the subgrade level including topsoil is removed and potential for future settlements, reduced service life, and increased maintenance are accepted by the owner. Where required, grades should be raised with engineered fill compacted to 98% SPMDD. Alternatively, the use of a geogrid-soil system could be considered below pavement structures to minimize the excavation of fill materials. Due to the shallow groundwater table below proposed grades, the installation and maintenance of pavement subdrains will be critical for the performance of the pavement structures. It is further recommended that a combination of geotextile and geogrid is considered for support of the pavement structure where seasonal groundwater is expected to extend to the bottom of the granular subbase of the pavement structure. The geotextile and geogrid will aid in distributing traffic loads better across the pavement structure in wet subsoil conditions thereby reducing the potential for decreased pavement structure performance.

### **5.8.2 Pavement Structure**

Light duty (i.e., parking area) as well as heavy duty (i.e., fire route, weekly garbage pick-up) asphalt pavements are being considered for the Site. No traffic design details were available at the time of this report. It is recommended that Pinchin review the provided pavement design recommendations once additional traffic design detail becomes available.

It is understood that pavement subdrains are likely to not be allowed as finished grades will be close to the groundwater table, and subdrains would create a condition of permanent dewatering, which is not allowed at this Site.



The following table presents the minimum specifications for a flexible asphaltic concrete pavement structure, considering that the base and subbase may be below the groundwater table:

| <b>Pavement Layer</b>                              | <b>Compaction Requirements</b>                        | <b>Parking Areas</b> | <b>Driveways</b> |
|----------------------------------------------------|-------------------------------------------------------|----------------------|------------------|
| Surface Course Asphaltic Concrete HL-3 (OPSS 1150) | 92% MRD as per OPSS 310                               | 35 mm                | 35 mm            |
| Binder Course Asphaltic Concrete HL-8 (OPSS 1150)  | 92 % MRD as per OPSS 310                              | 55 mm                | 75 mm            |
| Base Course: Granular “A” (OPSS 1010)              | 100% Standard Proctor Maximum Dry Density (ASTM-D698) | 150 mm               | 150 mm           |
| Subbase Course: Granular “B” Type I (OPSS 1010)    | 100% Standard Proctor Maximum Dry Density (ASTM D698) | 300 mm               | 400 mm           |
| Woven Geotextile (Terrafix 200W or equivalent)     | N/A                                                   | N/A                  | N/A              |

Notes:

- I. Prior to placing the pavement structure, the subgrade soil is to be proof rolled with a smooth drum roller without vibration to observe weak spots and the deflection of the soil; and
- II. The recommended pavement structure may have to be adjusted according to the City of Barrie standards. Also, if construction takes place during times of substantial precipitation and the subgrade soil becomes wet and disturbed, the granular thickness may have to be increased to compensate for the weaker subgrade soil. In addition, the granular fill material thickness may have to be temporarily increased to allow heavy construction equipment access the Site, in order to avoid the subgrade from “pumping” up into the granular material.

Performance grade PG 58-28 asphaltic concrete should be specified for Marshall mixes.

### *5.8.3 Pavement Structure Subgrade Preparation and Granular up Fill*

The proper placement of base and subbase fill materials becomes very important in addressing the proper load distribution to provide a durable pavement structure.

The pavement subgrade materials should be thoroughly proof-rolled prior to placement of the Granular ‘B’ subbase course. If any unstable areas are noted, then the Granular ‘B’ thickness may need to be increased to support pavement construction traffic. This should be left as a field decision by a qualified geotechnical engineer at the time of construction, but it is recommended that additional Granular ‘B’ be carried as a provisional item under the construction contract.

Where fill material is required to increase the grade to the underside of the pavement structure it should consist of Granular ‘B’ Type I (OPSS 1010). The up fill material is to be placed in maximum 300 mm thick lifts compacted to 98% SPMDD within 4% of the optimum moisture content.

Samples of both the Granular ‘A’ and Granular ‘B’ Type I aggregates should be tested for conformance to OPSS 1010 prior to utilization on Site and during construction. All stockpiled material should be protected from deleterious materials, additional moisture and be kept from freezing.



Post compaction settlement of fine grained soil can be expected, even when placed to compaction specifications. As such, fill material should be installed as far in advance as possible before finishing the parking lot and access roadways for best grade integrity.

Where the subgrade material types differ below the underside of the pavement structure, the transition between the materials should be sloped as per frost heave taper OPSD 205.60.

## **6.0 SITE SUPERVISION & QUALITY CONTROL**

It is recommended that all geotechnical aspects of the project be reviewed and confirmed under the appropriate geotechnical supervision, to routinely check such items. This includes but is not limited to inspection and confirmation of the undisturbed natural subgrade material prior to subgrade preparation, pouring any foundations or footings, backfilling, or engineered fill installation to ensure that the actual conditions are not markedly different than what was observed at the borehole locations and geotechnical components are constructed as per Pinchin's recommendations. Compaction quality control of engineered fill material (full-time monitoring) is recommended as standard practice, as well as regular sampling and testing of aggregates and concrete, to ensure that physical characteristics of materials for compliance during installation and satisfies all specifications presented within this report.

## **7.0 TERMS AND LIMITATIONS**

This Geotechnical Investigation was performed for the exclusive use of Innisfil Beach Development Inc. (Client) in order to evaluate the subsurface conditions at 19 Lennox Drive (formerly 440 Dunlop Street West), Barrie, Ontario. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practises in the field of geotechnical engineering for the Site. Classification and identification of soil, and geologic units have been based upon commonly accepted methods employed in professional geotechnical practice. No warranty or other conditions, expressed or implied, should be understood. Conclusions derived are specific to the immediate area of study and cannot be extrapolated extensively away from sample locations.

Performance of this Geotechnical Investigation to the standards established by Pinchin is intended to reduce, but not eliminate, uncertainty regarding the subgrade soil at the Site, and recognizes reasonable limits on time and cost.

Regardless how exhaustive a Geotechnical Investigation is performed, the investigation cannot identify all the subsurface conditions. Therefore, no warranty is expressed or implied that the entire Site is representative of the subsurface information obtained at the specific locations of our investigation. If during construction, subsurface conditions differ from then what was encountered within our test location and the additional subsurface information provided to us, Pinchin should be contacted to review our recommendations. This report does not alleviate the contractor, owner, or any other parties of their respective responsibilities.



This report has been prepared for the exclusive use of the Client and their authorized agents. 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 the third parties. If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice.

The liability of Pinchin or our officers, directors, shareholders or staff will be limited to the lesser of the fees paid or actual damages incurred by the Client. Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage if the Client has failed, within a period of two years following the date upon which the claim is discovered (Claim Period), to commence legal proceedings against Pinchin to recover such losses or damage unless the laws of the jurisdiction which governs the Claim Period which is applicable to such claim provides that the applicable Claim Period is greater than two years and cannot be abridged by the contract between the Client and Pinchin, in which case the Claim Period shall be deemed to be extended by the shortest additional period which results in this provision being legally enforceable.

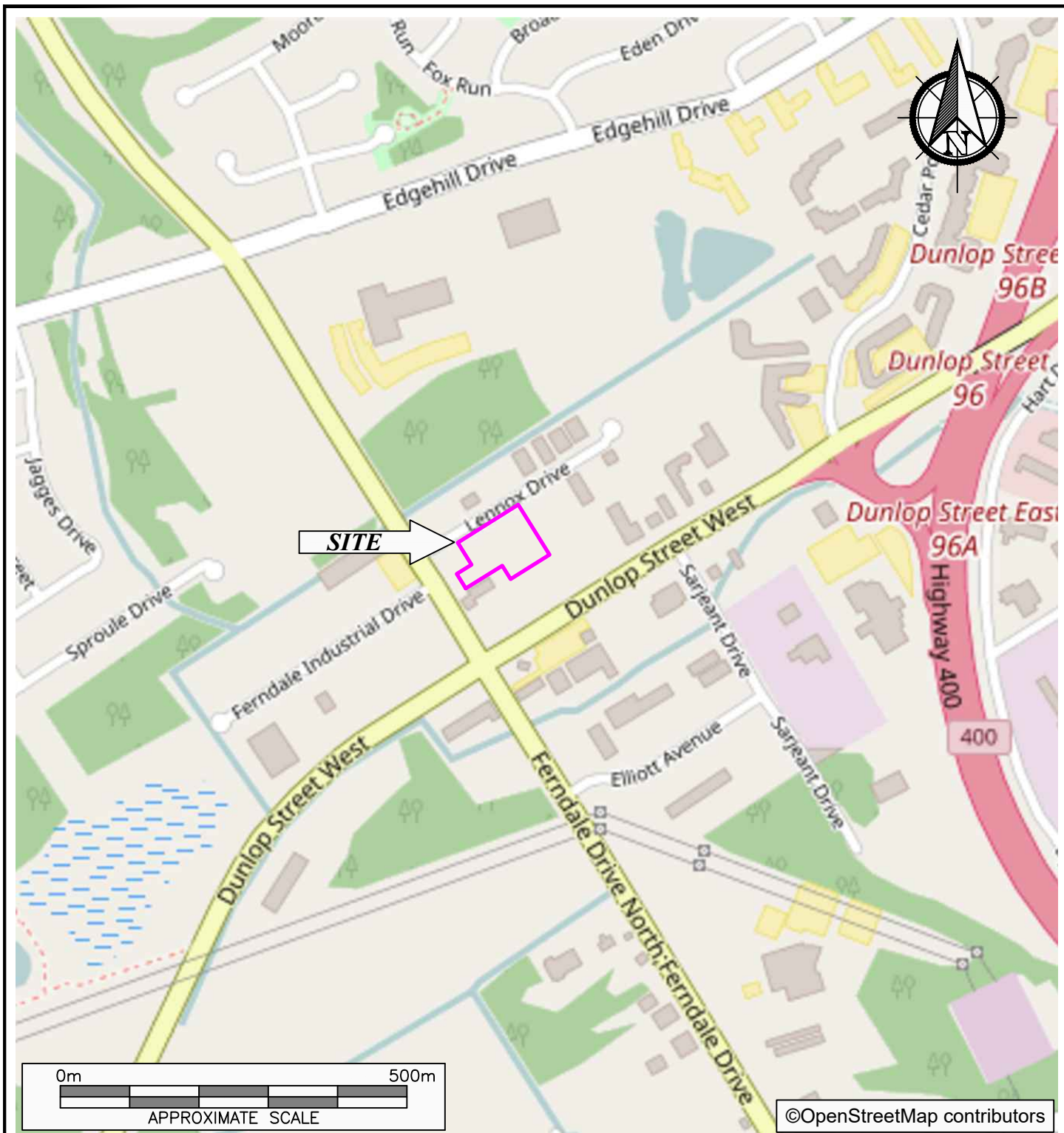
Pinchin makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and these interpretations may change over time. Please refer to Appendix IV, Report Limitations and Guidelines for Use, which pertains to this report.

Specific limitations related to the legal and financial and limitations to the scope of the current work are outlined in our proposal, the attached Methodology and the Authorization to Proceed, Limitation of Liability and Terms of Engagement which accompanied the proposal.

Information provided by Pinchin is intended for Client use only. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law. Any use by a third party of reports or documents authored by Pinchin or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.

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Template: Master Geotechnical Investigation Report – Ontario, GEO, September 2, 2021

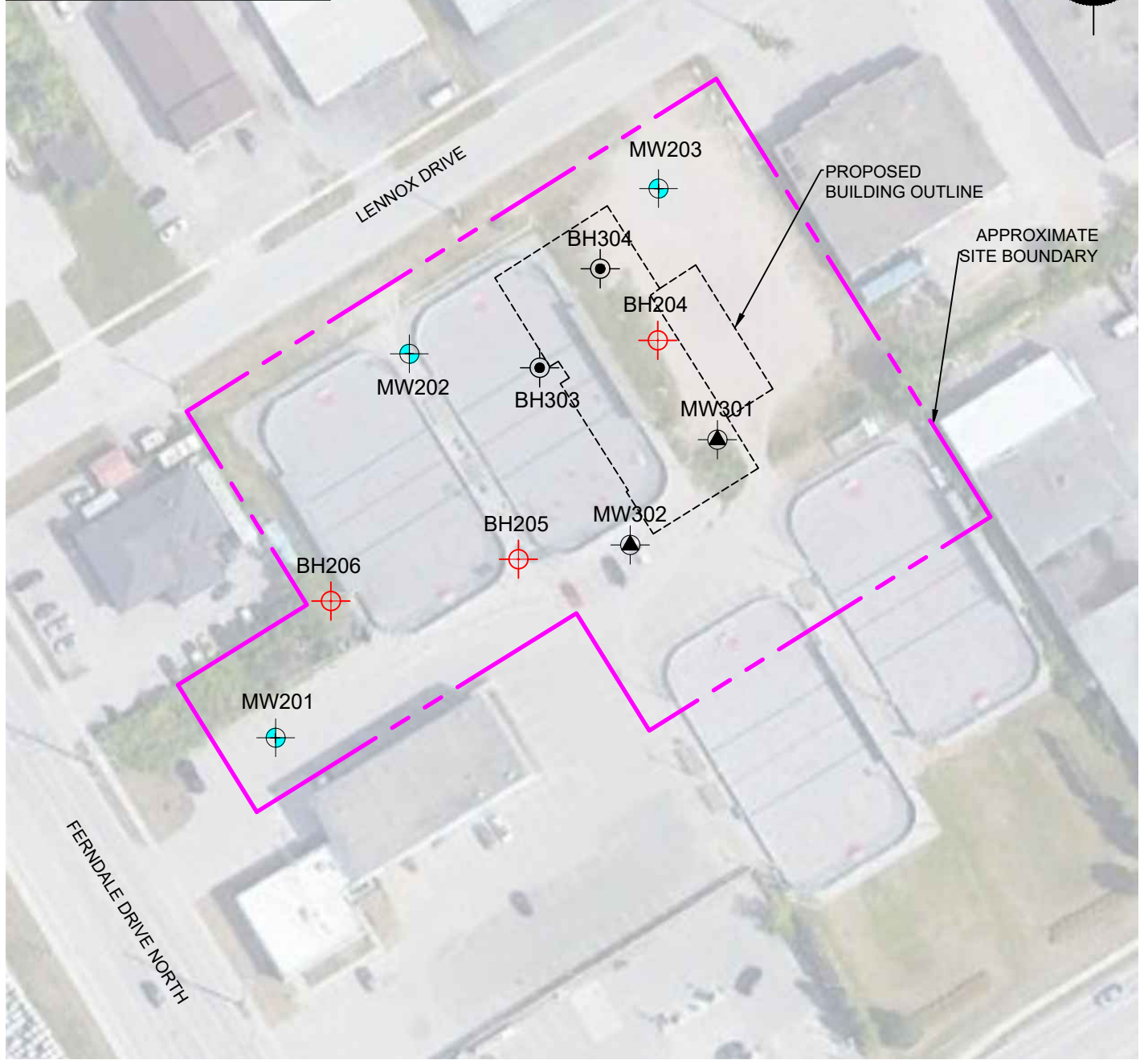
## FIGURES



|                                                             |             |          |            |
|-------------------------------------------------------------|-------------|----------|------------|
| PROJECT NAME                                                |             |          |            |
| GEOTECHNICAL INVESTIGATION                                  |             |          |            |
| CLIENT NAME                                                 |             |          |            |
| INNISFIL BEACH DEVELOPMENT INC.                             |             |          |            |
| PROJECT LOCATION                                            |             |          |            |
| 19 LENNOX DRIVE (FORMERLY 440 DUNLOP STREET W.), BARRIE, ON |             |          |            |
| FIGURE NAME                                                 |             |          | FIGURE NO. |
| KEY MAP                                                     |             |          |            |
| APPROXIMATE SCALE                                           | PROJECT NO. | DATE     |            |
| AS SHOWN                                                    | 295667.007  | MAY 2023 |            |
|                                                             |             |          | 1          |

# LEGEND

- BOREHOLE (PINCHIN, 2021)
- MONITORING WELL (PINCHIN, 2021)
- BOREHOLE (PINCHIN, 2023)
- MONITORING WELL (PINCHIN, 2023)



|                                                             |             |          |            |
|-------------------------------------------------------------|-------------|----------|------------|
| PROJECT NAME                                                |             |          |            |
| GEOTECHNICAL INVESTIGATION                                  |             |          |            |
| CLIENT NAME                                                 |             |          |            |
| INNISFIL BEACH DEVELOPMENT INC.                             |             |          |            |
| PROJECT LOCATION                                            |             |          |            |
| 19 LENNOX DRIVE (FORMERLY 440 DUNLOP STREET W.), BARRIE, ON |             |          |            |
| FIGURE NAME                                                 |             |          | FIGURE NO. |
| BOREHOLE AND MONITORING WELL LOCATION PLAN                  |             |          |            |
| APPROXIMATE SCALE                                           | PROJECT NO. | DATE     |            |
| AS SHOWN                                                    | 295667.007  | MAY 2023 |            |
|                                                             |             |          | 2          |

**APPENDIX I**  
**Abbreviations, Terminology and Principle Symbols used in Report and**  
**Borehole Logs**



## ABBREVIATIONS, TERMINOLOGY & PRINCIPAL SYMBOLS USED

### Sampling Method

|           |                         |           |                           |
|-----------|-------------------------|-----------|---------------------------|
| <b>AS</b> | Auger Sample            | <b>w</b>  | Washed Sample             |
| <b>SS</b> | Split Spoon Sample      | <b>HQ</b> | Rock Core (63.5 mm diam.) |
| <b>ST</b> | Thin Walled Shelby Tube | <b>NQ</b> | Rock Core (47.5 mm diam.) |
| <b>BS</b> | Block Sample            | <b>BQ</b> | Rock Core (36.5 mm diam.) |

### In-Situ Soil Testing

**Standard Penetration Test (SPT)**, “N” value is the number of blows required to drive a 51 mm outside diameter split spoon barrel sampler into the soil a distance of 300 mm with a 63.5 kg weight free falling a distance of 760 mm after an initial penetration of 150 mm has been achieved. The SPT, “N” value is a qualitative term used to interpret the compactness condition of cohesionless soils and is used only as a very approximation to estimate the consistency and undrained shear strength of cohesive soils.

**Dynamic Cone Penetration Test (DCPT)** is the number of blows required to drive a cone with a 60-degree apex attached to “A” size drill rods continuously into the soil for each 300 mm penetration with a 63.5 kg weight free falling a distance of 760 mm.

**Cone Penetration Test (CPT)** is an electronic cone point with a 10 cm<sup>2</sup> base area with a 60 degree apex pushed through the soil at a penetration rate of 2 cm/s.

**Field Vane Test (FVT)** consists of a vane blade, a set of rods and torque measuring apparatus used to determine the undrained shear strength of cohesive soils.

### Soil Descriptions

The soil descriptions and classifications are based on an expanded Unified Soil Classification System (USCS). The USCS classifies soils on the basis of engineering properties. The system divides soils into three major categories; coarse grained, fine grained and highly organic soils. The soil is then subdivided based on either gradation or plasticity characteristics. The classification excludes particles larger than 75 mm. To aid in quantifying material amounts by weight within the respective grain size fractions the following terms have been included to expand the USCS:

| Soil Classification |                  | Terminology               | Proportion |
|---------------------|------------------|---------------------------|------------|
| Clay                | < 0.002 mm       |                           |            |
| Silt                | 0.002 to 0.06 mm | “trace”, trace sand, etc. | 1 to 10%   |
| Sand                | 0.075 to 4.75 mm | “some”, some sand, etc.   | 10 to 20%  |



| Soil Classification |               | Terminology                      | Proportion             |
|---------------------|---------------|----------------------------------|------------------------|
| Gravel              | 4.75 to 75 mm | Adjective, sandy, gravelly, etc. | 20 to 35%              |
| Cobbles             | 75 to 200 mm  | And, and gravel, and silt, etc.  | >35%                   |
| Boulders            | >200 mm       | Noun, Sand, Gravel, Silt, etc.   | >35% and main fraction |

Notes:

- Soil properties, such as strength, gradation, plasticity, structure, dictate the soils engineering behaviour over grain size fractions; and
- With the exception of soil samples tested for grain size distribution or plasticity, all soil samples have been classified based on visual and tactile observations. The accuracy of visual and tactile observation is not sufficient to differentiate between changes in soil classification or precise grain size and is therefore an approximate description.

The following table outlines the qualitative terms used to describe the compactness condition of cohesionless soil:

| Cohesionless Soil     |                                |
|-----------------------|--------------------------------|
| Compactness Condition | SPT N-Index (blows per 300 mm) |
| Very Loose            | 0 to 4                         |
| Loose                 | 4 to 10                        |
| Compact               | 10 to 30                       |
| Dense                 | 30 to 50                       |
| Very Dense            | > 50                           |

The following table outlines the qualitative terms used to describe the consistency of cohesive soils related to undrained shear strength and SPT, N-Index:

| Cohesive Soil |                                |                                |
|---------------|--------------------------------|--------------------------------|
| Consistency   | Undrained Shear Strength (kPa) | SPT N-Index (blows per 300 mm) |
| Very Soft     | <12                            | <2                             |
| Soft          | 12 to 25                       | 2 to 4                         |
| Firm          | 25 to 50                       | 4 to 8                         |
| Stiff         | 50 to 100                      | 8 to 15                        |
| Very Stiff    | 100 to 200                     | 15 to 30                       |
| Hard          | >200                           | >30                            |



**Note:** Utilizing the SPT, N-Index value to correlate the consistency and undrained shear strength of cohesive soils is only very approximate and needs to be used with caution.

## **Soil & Rock Physical Properties**

### **General**

|                                  |                                                              |
|----------------------------------|--------------------------------------------------------------|
| <b>W</b>                         | Natural water content or moisture content within soil sample |
| <b><math>\gamma</math></b>       | Unit weight                                                  |
| <b><math>\gamma'</math></b>      | Effective unit weight                                        |
| <b><math>\gamma_d</math></b>     | Dry unit weight                                              |
| <b><math>\gamma_{sat}</math></b> | Saturated unit weight                                        |
| <b><math>\rho</math></b>         | Density                                                      |
| <b><math>\rho_s</math></b>       | Density of solid particles                                   |
| <b><math>\rho_w</math></b>       | Density of Water                                             |
| <b><math>\rho_d</math></b>       | Dry density                                                  |
| <b><math>\rho_{sat}</math></b>   | Saturated density                                            |
| <b>e</b>                         | Void ratio                                                   |
| <b>n</b>                         | Porosity                                                     |
| <b><math>S_r</math></b>          | Degree of saturation                                         |
| <b><math>E_{50}</math></b>       | Strain at 50% maximum stress (cohesive soil)                 |

### **Consistency**

|                             |                             |
|-----------------------------|-----------------------------|
| <b><math>W_L</math></b>     | Liquid limit                |
| <b><math>W_P</math></b>     | Plastic Limit               |
| <b><math>I_P</math></b>     | Plasticity Index            |
| <b><math>W_S</math></b>     | Shrinkage Limit             |
| <b><math>I_L</math></b>     | Liquidity Index             |
| <b><math>I_c</math></b>     | Consistency Index           |
| <b><math>e_{max}</math></b> | Void ratio in loosest state |
| <b><math>e_{min}</math></b> | Void ratio in densest state |



**I<sub>D</sub>** Density Index (formerly relative density)

### Shear Strength

**C<sub>u</sub>, S<sub>u</sub>** Undrained shear strength parameter (total stress)

**C'<sub>d</sub>** Drained shear strength parameter (effective stress)

**r** Remolded shear strength

**τ<sub>p</sub>** Peak residual shear strength

**τ<sub>r</sub>** Residual shear strength

**ø'** Angle of interface friction, coefficient of friction =  $\tan \phi'$

### Consolidation (One Dimensional)

**C<sub>c</sub>** Compression index (normally consolidated range)

**C<sub>r</sub>** Recompression index (over consolidated range)

**C<sub>s</sub>** Swelling index

**m<sub>v</sub>** Coefficient of volume change

**c<sub>v</sub>** Coefficient of consolidation

**T<sub>v</sub>** Time factor (vertical direction)

**U** Degree of consolidation

**σ'<sub>o</sub>** Overburden pressure

**σ'<sub>p</sub>** Preconsolidation pressure (most probable)

**OCR** Overconsolidation ratio

### Permeability

The following table outlines the terms used to describe the degree of permeability of soil and common soil types associated with the permeability rates:

| Permeability (k cm/s)  | Degree of Permeability | Common Associated Soil Type       |
|------------------------|------------------------|-----------------------------------|
| $> 10^{-1}$            | Very High              | Clean gravel                      |
| $10^{-1}$ to $10^{-3}$ | High                   | Clean sand, Clean sand and gravel |
| $10^{-3}$ to $10^{-5}$ | Medium                 | Fine sand to silty sand           |



| Permeability (k cm/s)  | Degree of Permeability  | Common Associated Soil Type            |
|------------------------|-------------------------|----------------------------------------|
| $10^{-5}$ to $10^{-7}$ | Low                     | Silt and clayey silt (low plasticity)  |
| $>10^{-7}$             | Practically Impermeable | Silty clay (medium to high plasticity) |

## Rock Coring

**Rock Quality Designation (RQD)** is an indirect measure of the number of fractures within a rock mass, Deere et al. (1967). It is the sum of sound pieces of rock core equal to or greater than 100 mm recovered from the core run, divided by the total length of the core run, expressed as a percentage. If the core section is broken due to mechanical or handling, the pieces are fitted together and if 100 mm or greater included in the total sum.

**RQD is calculated as follows:**

$$\text{RQD (\%)} = \frac{\sum \text{Length of core pieces} > 100 \text{ mm} \times 100}{\text{Total length of core run}}$$

The following is the Classification of Rock with Respect to RQD Value:

| RQD Classification | RQD Value (%) |
|--------------------|---------------|
| Very poor quality  | <25           |
| Poor quality       | 25 to 50      |
| Fair quality       | 50 to 75      |
| Good quality       | 75 to 90      |
| Excellent quality  | 90 to 100     |

\\PIN-HAM-FS02\job\295000s\0295667.000 TRAMDevelopments,440DunlopStWBar,SA1\0295667.007 DunlopFerndale,440DunlopStWBar,HydroGeo\Deliverables\Geo\REV-DRAFT\Appendix I - Abbreviations Terminolgy and Principal Symbols.docx

Template: Appendix I – Abbreviations Terminology & Principal Symbols, GEO, February 19, 2024

## **APPENDIX II**

### **Pinchin's Borehole Logs**



# Log of Borehole: MW201

Project #: 295667.001

Logged By: BM

Project: Geotechnical Investigation

Client: Cassandra Projects Inc.

Location: 125 Ferndale Dr. North and 440 Dunlop St. West, Barrie, Ontario

Drill Date: August 24, 2021

Project Manager: KRD

| SUBSURFACE PROFILE |        |                                                                   |               |                         | SAMPLE      |           |              |             |                                                                                  |                                                                                     |                                                                                 |
|--------------------|--------|-------------------------------------------------------------------|---------------|-------------------------|-------------|-----------|--------------|-------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Depth (m)          | Symbol | Description                                                       | Elevation (m) | Monitoring Well Details | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value                                                     | Shear Strength                                                                      | Water Content                                                                   |
|                    |        |                                                                   |               |                         |             |           |              |             | <div> <div>□</div> <div>20</div> <div>40</div> <div>60</div> <div>□</div> </div> | <div> <div>△</div> <div>kPa</div> <div>100</div> <div>200</div> <div>△</div> </div> | <div> <div>●</div> <div>%</div> <div>10</div> <div>20</div> <div>●</div> </div> |
| 0                  |        | Ground Surface                                                    | 235.59        |                         |             |           |              |             |                                                                                  |                                                                                     |                                                                                 |
|                    |        | <b>Asphaltic Concrete</b><br>(50 mm)                              |               |                         | SS          | 1         | 50           | 18          |                                                                                  |                                                                                     |                                                                                 |
|                    |        | <b>Fill</b><br>Brown sand and gravel, compact, moist              | 234.83        |                         |             |           |              |             |                                                                                  |                                                                                     |                                                                                 |
| 1                  |        | Loose                                                             |               |                         | SS          | 2         | 21           | 6           |                                                                                  |                                                                                     |                                                                                 |
|                    |        |                                                                   | 234.07        |                         |             |           |              |             |                                                                                  |                                                                                     |                                                                                 |
| 2                  |        | <b>Sand</b><br>Brown sand, trace silt, compact, wet to saturated  |               |                         | SS          | 3         | 92           | 13          |                                                                                  |                                                                                     |                                                                                 |
|                    |        |                                                                   | 233.31        |                         |             |           |              |             |                                                                                  |                                                                                     |                                                                                 |
|                    |        | Trace gravel, saturated                                           |               |                         | SS          | 4         | 83           | 20          |                                                                                  |                                                                                     |                                                                                 |
|                    |        |                                                                   | 232.54        |                         |             |           |              |             |                                                                                  |                                                                                     |                                                                                 |
| 3                  |        | Trace to some gravel                                              |               |                         | SS          | 5         | 100          | 11          |                                                                                  |                                                                                     |                                                                                 |
|                    |        |                                                                   | 231.68        |                         |             |           |              |             |                                                                                  |                                                                                     |                                                                                 |
| 4                  |        | <b>Clay</b><br>Grey silty clay, trace sand and gravel, soft, WTPL |               |                         | SS          | 6         | 92           | 3           |                                                                                  |                                                                                     |                                                                                 |
|                    |        |                                                                   | 231.02        |                         |             |           |              |             |                                                                                  |                                                                                     |                                                                                 |
|                    |        | Firm to stiff                                                     |               |                         | SS          | 7         | 67           | 8           |                                                                                  |                                                                                     |                                                                                 |
| 5                  |        |                                                                   | 230.41        |                         |             |           |              |             |                                                                                  |                                                                                     |                                                                                 |
|                    |        | End of Borehole<br>Borehole terminated at 5.2 mbgs.               |               |                         |             |           |              |             |                                                                                  |                                                                                     |                                                                                 |
| 6                  |        |                                                                   |               |                         |             |           |              |             |                                                                                  |                                                                                     |                                                                                 |

Contractor: Pontil Drilling

Grade Elevation: 235.59 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: 235.54 masl

Well Casing Size: 51 mm

Sheet: 1 of 1



# Log of Borehole: MW202

Project #: 295667.001

Logged By: BM

Project: Geotechnical Investigation

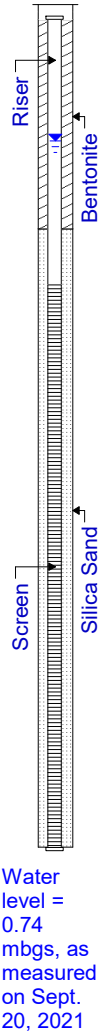
Client: Cassandra Projects Inc.

Location: 125 Ferndale Dr. North and 440 Dunlop St. West, Barrie, Ontario

Drill Date: August 24, 2021

Project Manager: KRD

| SUBSURFACE PROFILE |        |                                                                             |               |                         | SAMPLE      |           |              |             |                                              |                                      |                                 |
|--------------------|--------|-----------------------------------------------------------------------------|---------------|-------------------------|-------------|-----------|--------------|-------------|----------------------------------------------|--------------------------------------|---------------------------------|
| Depth (m)          | Symbol | Description                                                                 | Elevation (m) | Monitoring Well Details | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value<br>□ 20 40 60 □ | Shear Strength<br>△ kPa △<br>100 200 | Water Content<br>• % •<br>10 20 |
| 0                  |        | Ground Surface                                                              | 235.48        |                         |             |           |              |             |                                              |                                      |                                 |
|                    |        | <b>Asphaltic Concrete</b><br>(50 mm)                                        |               |                         | SS          | 1         | 58           | 17          |                                              |                                      |                                 |
|                    |        | <b>Fill</b><br>Brown sand and gravel, compact, damp                         | 234.72        |                         |             |           |              |             |                                              |                                      |                                 |
| 1                  |        | <b>Sand</b><br>Brown sand, trace silt, clay, and gravel, compact, saturated |               |                         | SS          | 2         | 58           | 22          |                                              |                                      |                                 |
| 2                  |        |                                                                             |               |                         | SS          | 3         | 67           | 10          |                                              |                                      |                                 |
|                    |        | Loose                                                                       | 233.19        |                         |             |           |              |             |                                              |                                      |                                 |
| 3                  |        |                                                                             | 232.43        |                         | SS          | 4         | 24           | 9           |                                              |                                      |                                 |
|                    |        | <b>Clay</b><br>Grey silty clay, trace sand and gravel, stiff, APL to WTPL   |               |                         | SS          | 5         | 75           | 9           |                                              |                                      |                                 |
| 4                  |        |                                                                             |               |                         | SS          | 6         | 100          | 8           |                                              |                                      |                                 |
| 5                  |        |                                                                             | 230.30        |                         | SS          | 7         | 100          | 11          |                                              |                                      |                                 |
|                    |        | End of Borehole<br>Borehole terminated at 5.2 mbgs.                         |               |                         |             |           |              |             |                                              |                                      |                                 |
| 6                  |        |                                                                             |               |                         |             |           |              |             |                                              |                                      |                                 |



Contractor: Pontil Drilling

Grade Elevation: 235.48 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: 235.39 masl

Well Casing Size: 51 mm

Sheet: 1 of 1



# Log of Borehole: MW203

Project #: 295667.001

Logged By: BM

Project: Geotechnical Investigation

Client: Cassandra Projects Inc.

Location: 125 Ferndale Dr. North and 440 Dunlop St. West, Barrie, Ontario

Drill Date: August 24, 2021

Project Manager: KRD

| SUBSURFACE PROFILE |             |                                                            |               |                                                        | SAMPLE      |           |              |             |                                              |                                      |                                 |
|--------------------|-------------|------------------------------------------------------------|---------------|--------------------------------------------------------|-------------|-----------|--------------|-------------|----------------------------------------------|--------------------------------------|---------------------------------|
| Depth (m)          | Symbol      | Description                                                | Elevation (m) | Monitoring Well Details                                | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value<br>□ 20 40 60 □ | Shear Strength<br>△ kPa △<br>100 200 | Water Content<br>• % •<br>10 20 |
| 0                  |             | Ground Surface                                             | 236.43        |                                                        |             |           |              |             |                                              |                                      |                                 |
|                    | <b>Fill</b> | Brown sand and gravel, compact, moist                      |               |                                                        | SS          | 1         | 8            | 16          |                                              |                                      |                                 |
|                    |             |                                                            | 235.67        |                                                        |             |           |              |             |                                              |                                      |                                 |
| 1                  |             | Light brown sand with black staining, some silt, loose     |               |                                                        | SS          | 2         | 33           | 7           |                                              |                                      |                                 |
|                    |             |                                                            | 234.90        |                                                        |             |           |              |             |                                              |                                      |                                 |
| 2                  |             | Brown to grey with black staining, compact                 |               |                                                        | SS          | 3         | 50           | 13          |                                              |                                      |                                 |
|                    |             |                                                            | 234.14        |                                                        |             |           |              |             |                                              |                                      |                                 |
|                    |             | Grey sand and gravel, dense, moist                         |               |                                                        | SS          | 4         | 38           | 30          |                                              |                                      |                                 |
|                    |             |                                                            | 233.38        |                                                        |             |           |              |             |                                              |                                      |                                 |
| 3                  | <b>Sand</b> | Brown sand, some silt, compact, saturated                  |               |                                                        | SS          | 5         | 50           | 20          |                                              |                                      |                                 |
|                    |             |                                                            | 232.62        |                                                        |             |           |              |             |                                              |                                      |                                 |
| 4                  | <b>Clay</b> | Grey silty clay, trace sand and gravel, stiff, APL to WTPL |               |                                                        | SS          | 6         | 50           | 12          |                                              |                                      |                                 |
|                    |             |                                                            |               |                                                        |             |           |              |             |                                              |                                      |                                 |
| 5                  |             |                                                            | 231.25        |                                                        | SS          | 7         | 100          | 12          |                                              |                                      |                                 |
|                    |             |                                                            |               |                                                        |             |           |              |             |                                              |                                      |                                 |
|                    |             | End of Borehole<br>Borehole terminated at 5.2 mbgs.        |               | Water level = 1.68 mbgs, as measured on Sept. 20, 2021 |             |           |              |             |                                              |                                      |                                 |
| 6                  |             |                                                            |               |                                                        |             |           |              |             |                                              |                                      |                                 |

Contractor: Pontil Drilling

Grade Elevation: 236.43 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: 236.39 masl

Well Casing Size: 51 mm

Sheet: 1 of 1



# Log of Borehole: BH204

Project #: 295667.001

Logged By: BM

Project: Geotechnical Investigation

Client: Cassandra Projects Inc.

Location: 125 Ferndale Dr. North and 440 Dunlop St. West, Barrie, Ontario

Drill Date: August 24, 2021

Project Manager: KRD

| SUBSURFACE PROFILE |        |                                                                                                    |               |                              | SAMPLE      |           |              |             |                              |    |    |                |   |   |               |   |   |   |
|--------------------|--------|----------------------------------------------------------------------------------------------------|---------------|------------------------------|-------------|-----------|--------------|-------------|------------------------------|----|----|----------------|---|---|---------------|---|---|---|
| Depth (m)          | Symbol | Description                                                                                        | Elevation (m) | Monitoring Well Details      | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value |    |    | Shear Strength |   |   | Water Content |   |   |   |
|                    |        |                                                                                                    |               |                              |             |           |              |             | □                            | 20 | 40 | 60             | □ | △ | kPa           | △ | • | % |
|                    |        | Ground Surface                                                                                     | 235.57        | No Monitoring Well Installed |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |
| 0                  |        | <b>Fill</b><br>Light brown silty sand (topsoil)<br>Sand and gravel, compact, moist                 |               |                              | SS          | 1         | 58           | 12          |                              |    |    |                |   |   |               |   |   |   |
|                    |        |                                                                                                    | 234.81        |                              |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |
| 1                  |        | Very loose                                                                                         |               |                              | SS          | 2         | 46           | 2           |                              |    |    |                |   |   |               |   |   |   |
|                    |        |                                                                                                    | 234.05        |                              |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |
| 2                  |        | Grey to brown sand, some gravel, wet                                                               |               |                              | SS          | 3         | 75           | 11          |                              |    |    |                |   |   |               |   |   |   |
|                    |        |                                                                                                    | 233.29        |                              |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |
| 3                  |        | <b>Sand</b><br>Brown sand, some gravel, trace silt, compact, wet to saturated                      |               |                              | SS          | 4         | 100          | 12          |                              |    |    |                |   |   |               |   |   |   |
|                    |        |                                                                                                    | 232.22        |                              |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |
| 4                  |        | <b>Clay</b><br>Grey silty clay, trace sand and gravel, stiff, APL                                  |               |                              | SS          | 5         | 100          | 13          |                              |    |    |                |   |   |               |   |   |   |
|                    |        |                                                                                                    |               |                              |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |
|                    |        |                                                                                                    |               |                              | 231.00      |           |              |             |                              |    |    |                |   |   |               |   |   |   |
| 5                  |        | Firm, WTPL                                                                                         |               |                              |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |
|                    |        |                                                                                                    | 230.39        |                              |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |
|                    |        | End of Borehole                                                                                    |               |                              |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |
|                    |        | Borehole terminated at 5.2 mbgs. At drilling completion, the water level was measured at 1.4 mbgs. |               |                              |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |
| 6                  |        |                                                                                                    |               |                              |             |           |              |             |                              |    |    |                |   |   |               |   |   |   |

Contractor: Pontil Drilling

Grade Elevation: 235.57 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: NA

Well Casing Size: NA

Sheet: 1 of 1



# Log of Borehole: BH205

Project #: 295667.001

Logged By: BM

Project: Geotechnical Investigation

Client: Cassandra Projects Inc.

Location: 125 Ferndale Dr. North and 440 Dunlop St. West, Barrie, Ontario

Drill Date: August 24, 2021

Project Manager: KRD

| SUBSURFACE PROFILE |        |                                                                                               |               |                              | SAMPLE      |           |              |             |                                              |                                      |                                 |
|--------------------|--------|-----------------------------------------------------------------------------------------------|---------------|------------------------------|-------------|-----------|--------------|-------------|----------------------------------------------|--------------------------------------|---------------------------------|
| Depth (m)          | Symbol | Description                                                                                   | Elevation (m) | Monitoring Well Details      | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value<br>□ 20 40 60 □ | Shear Strength<br>△ kPa △<br>100 200 | Water Content<br>● % ●<br>10 20 |
| 0                  |        | Ground Surface                                                                                | 235.41        | No Monitoring Well Installed |             |           |              |             |                                              |                                      |                                 |
|                    |        | <b>Asphaltic Concrete</b><br>(50 mm)                                                          |               |                              | SS          | 1         | 33           | 10          |                                              |                                      |                                 |
|                    |        | <b>Fill</b><br>Brown sand and gravel, compact, moist                                          | 234.50        |                              |             |           |              |             |                                              |                                      |                                 |
| 1                  |        | <b>Sand</b><br>Brown sand, some gravel, compact, damp                                         | 233.89        |                              | SS          | 2         | 50           | 27          |                                              |                                      |                                 |
|                    |        | Saturated                                                                                     |               |                              |             |           |              |             |                                              |                                      |                                 |
| 2                  |        |                                                                                               |               |                              | SS          | 3         | 63           | 15          |                                              |                                      |                                 |
|                    |        |                                                                                               |               |                              | SS          | 4         | 25           | 16          |                                              |                                      |                                 |
| 3                  |        | <b>Clay</b><br>Grey silty clay, trace sand and gravel, stiff, APL                             | 232.36        | No Monitoring Well Installed | SS          | 5         | 100          | 14          |                                              |                                      |                                 |
|                    |        |                                                                                               | 231.60        |                              |             |           |              |             |                                              |                                      |                                 |
| 4                  |        | Firm, WTPL                                                                                    |               |                              | SS          | 6         | 100          | 4           |                                              |                                      |                                 |
|                    |        |                                                                                               |               |                              |             |           |              |             |                                              |                                      |                                 |
| 5                  |        |                                                                                               | 230.23        | No Monitoring Well Installed | SS          | 7         | 100          | 7           |                                              |                                      |                                 |
|                    |        | End of Borehole                                                                               |               |                              |             |           |              |             |                                              |                                      |                                 |
|                    |        | Borehole terminated at 5.2 mbgs. At drilling completion, a dry cave was measured at 1.0 mbgs. |               |                              |             |           |              |             |                                              |                                      |                                 |
| 6                  |        |                                                                                               |               |                              |             |           |              |             |                                              |                                      |                                 |

Contractor: Pontil Drilling

Grade Elevation: 235.41 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: NA

Well Casing Size: NA

Sheet: 1 of 1



# Log of Borehole: BH206

Project #: 295667.001

Logged By: BM

Project: Geotechnical Investigation

Client: Cassandra Projects Inc.

Location: 125 Ferndale Dr. North and 440 Dunlop St. West, Barrie, Ontario

Drill Date: August 24, 2021

Project Manager: KRD

| SUBSURFACE PROFILE |                                                                                                 |                                                                                                                       |               |                              | SAMPLE      |           |              |             |                                              |                                      |                                 |
|--------------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|---------------|------------------------------|-------------|-----------|--------------|-------------|----------------------------------------------|--------------------------------------|---------------------------------|
| Depth (m)          | Symbol                                                                                          | Description                                                                                                           | Elevation (m) | Monitoring Well Details      | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value<br>□ 20 40 60 □ | Shear Strength<br>△ kPa △<br>100 200 | Water Content<br>• % •<br>10 20 |
| 0                  |                                                                                                 | Ground Surface                                                                                                        | 235.37        | No Monitoring Well Installed |             |           |              |             |                                              |                                      |                                 |
|                    | <b>Fill</b><br>Dark brown sand, some gravel and rootlets, trace brick fragments, compact, moist |                                                                                                                       | 234.61        |                              | SS          | 1         | 25           | 12          |                                              |                                      |                                 |
| 1                  | <b>Sand</b><br>Brown sand, trace to some gravel and silt, compact, moist                        |                                                                                                                       |               |                              | SS          | 2         | 83           | 21          |                                              |                                      |                                 |
|                    |                                                                                                 |                                                                                                                       | 233.44        |                              |             |           |              |             |                                              |                                      |                                 |
| 2                  | <b>Clay</b><br>Grey silty clay, trace sand and gravel, very stiff, APL<br>Stiff                 |                                                                                                                       | 233.08        |                              | SS          | 3         | 92           | 16          |                                              |                                      |                                 |
|                    |                                                                                                 |                                                                                                                       |               |                              | SS          | 4         | 100          | 10          |                                              |                                      |                                 |
| 3                  |                                                                                                 |                                                                                                                       |               |                              |             |           |              |             |                                              |                                      |                                 |
|                    |                                                                                                 |                                                                                                                       | 231.56        |                              | SS          | 5         | 92           | 13          |                                              |                                      |                                 |
| 4                  | Firm, WTPL                                                                                      |                                                                                                                       |               |                              | SS          | 6         | 100          | 6           |                                              |                                      |                                 |
|                    |                                                                                                 |                                                                                                                       |               |                              |             |           |              |             |                                              |                                      |                                 |
| 5                  |                                                                                                 |                                                                                                                       | 230.19        |                              | SS          | 7         | 100          | 7           |                                              |                                      |                                 |
|                    |                                                                                                 | End of Borehole<br>Borehole terminated at 5.2 mbgs. At drilling completion, the water level was measured at 1.1 mbgs. |               |                              |             |           |              |             |                                              |                                      |                                 |
| 6                  |                                                                                                 |                                                                                                                       |               |                              |             |           |              |             |                                              |                                      |                                 |

Contractor: Pontil Drilling

Grade Elevation: 235.37 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: NA

Well Casing Size: NA

Sheet: 1 of 1



# Log of Borehole: MW301

Project #: 295667

Logged By: CP, JA, MG

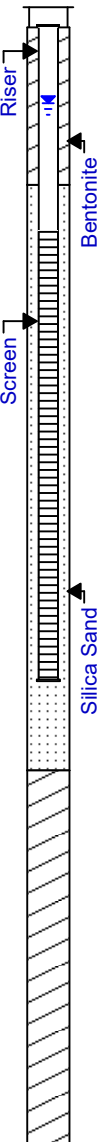
Project: Hydrogeological and Geotechnical Assessments

Client: Innisfil Beach Development Inc.

Location: 19 Lennox Dr (formerly 440 Dunlop St W), Barrie

Drill Date: March 29, 2023

Project Manager: JD

| SUBSURFACE PROFILE |        |                                                                        |               |                                                                                    | SAMPLE      |           |              |             |                                                                                       |                                      |                                       |
|--------------------|--------|------------------------------------------------------------------------|---------------|------------------------------------------------------------------------------------|-------------|-----------|--------------|-------------|---------------------------------------------------------------------------------------|--------------------------------------|---------------------------------------|
| Depth (m)          | Symbol | Description                                                            | Elevation (m) | Monitoring Well Details                                                            | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value<br>□ 20 40 60 □                                          | Shear Strength<br>△ kPa △<br>100 200 | Water Content<br>● % ●<br>10 20 30 40 |
| 0                  |        | Ground Surface                                                         | 235.55        |  |             |           |              |             |                                                                                       |                                      |                                       |
|                    |        | <b>Topsoil Fill</b><br>150 mm sandy silt                               | 235.40        |                                                                                    | SS          | 1         | 100          | 8           |   |                                      |                                       |
|                    |        | <b>Fill</b><br>Brown silty sand, trace gravel, loose, very moist       | 234.79        |                                                                                    | SS          | 2         | 100          | 5           |   |                                      |                                       |
| 1                  |        | Brown sand, trace silt and gravel, loose, wet                          | 234.03        |                                                                                    | SS          | 3         | 100          | 4           |   |                                      |                                       |
|                    |        | Trace organics                                                         | 233.42        |                                                                                    | SS          | 4         | 100          | 5           |  |                                      |                                       |
|                    |        | Grey sand, loose, wet                                                  | 233.26        |                                                                                    | SS          | 5         | 100          | 4           |  |                                      |                                       |
|                    |        | Trace silt                                                             | 232.50        |                                                                                    | SS          | 6         | 100          | 10          |  |                                      |                                       |
| 3                  |        | <b>Possible Fill</b><br>Grey sand, trace silt and organics, loose, wet | 231.89        |                                                                                    | SS          | 7         | 100          | 4           |  |                                      |                                       |
|                    |        | <b>Clay</b><br>Grey silty clay, WTPL                                   | 231.74        |                                                                                    | SS          | 8         | 100          | 2           |  |                                      |                                       |
|                    |        | Grey silty clay, trace sand and gravel, stiff to very stiff, WTPL      | 230.98        |                                                                                    |             |           |              |             |                                                                                       |                                      |                                       |
| 5                  |        | Stiff to firm                                                          |               |                                                                                    |             |           |              |             |                                                                                       |                                      |                                       |
| 6                  |        | Firm to soft                                                           | 229.45        |                                                                                    |             |           |              |             |                                                                                       |                                      |                                       |
| 7                  |        |                                                                        | 227.93        |                                                                                    |             |           |              |             |                                                                                       |                                      |                                       |

Contractor: Strata

Grade Elevation: 235.55

Drilling Method: SPT

Top of Casing Elevation: 236.50

Well Casing Size: 50 mm

Sheet: 1 of 2



## Log of Borehole: MW301

Project #: 295667

Logged By: CP, JA, MG

Project: Hydrogeological and Geotechnical Assessments

Client: Innisfil Beach Development Inc.

Location: 19 Lennox Dr (formerly 440 Dunlop St W), Barrie

Drill Date: March 29, 2023

Project Manager: JD

| SUBSURFACE PROFILE |                                                                                   |                                                                                                         |               |                                                                                             | SAMPLE      |           |              |             |                                                                                     |    |    |    |                |                                                                                     |               |   |     |     |                                                                                     |   |
|--------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------|-------------|-----------|--------------|-------------|-------------------------------------------------------------------------------------|----|----|----|----------------|-------------------------------------------------------------------------------------|---------------|---|-----|-----|-------------------------------------------------------------------------------------|---|
| Depth (m)          | Symbol                                                                            | Description                                                                                             | Elevation (m) | Monitoring Well Details                                                                     | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value                                                        |    |    |    | Shear Strength |                                                                                     | Water Content |   |     |     |                                                                                     |   |
|                    |                                                                                   |                                                                                                         |               |                                                                                             |             |           |              |             | □                                                                                   | 20 | 40 | 60 | □              | △                                                                                   | kPa           | △ | 100 | 200 | ●                                                                                   | % |
| 8                  |  | Soft                                                                                                    | 225.80        |  Bentonite | SS          | 9         | 100          | 4           |  |    |    |    |                |  |               |   |     |     |  |   |
|                    |                                                                                   |                                                                                                         |               |                                                                                             |             |           |              |             |                                                                                     |    |    |    |                |                                                                                     |               |   |     |     |                                                                                     |   |
| 9                  |                                                                                   |                                                                                                         |               |                                                                                             |             |           |              |             |                                                                                     |    |    |    |                |                                                                                     |               |   |     |     |                                                                                     |   |
| 10                 |                                                                                   | End of Borehole<br>Borehole terminated at 9.8 mbgs.                                                     |               |                                                                                             | SS          | 10        | 100          | 2           |  |    |    |    |                |                                                                                     |               |   |     |     |  |   |
| 11                 |                                                                                   |                                                                                                         |               |                                                                                             |             |           |              |             |                                                                                     |    |    |    |                |                                                                                     |               |   |     |     |                                                                                     |   |
| 12                 |                                                                                   | Water levels:<br>0.71 mbgs on March 31, 2023<br>0.74 mbgs on April 12, 2023<br>0.66 mbgs on May 5, 2023 |               |                                                                                             |             |           |              |             |                                                                                     |    |    |    |                |                                                                                     |               |   |     |     |                                                                                     |   |
| 13                 |                                                                                   |                                                                                                         |               |                                                                                             |             |           |              |             |                                                                                     |    |    |    |                |                                                                                     |               |   |     |     |                                                                                     |   |
| 14                 |                                                                                   |                                                                                                         |               |                                                                                             |             |           |              |             |                                                                                     |    |    |    |                |                                                                                     |               |   |     |     |                                                                                     |   |
| 15                 |                                                                                   |                                                                                                         |               |                                                                                             |             |           |              |             |                                                                                     |    |    |    |                |                                                                                     |               |   |     |     |                                                                                     |   |

Contractor: Strata

Grade Elevation: 235.55

Drilling Method: SPT

Top of Casing Elevation: 236.50

Well Casing Size: 50 mm

Sheet: 2 of 2



# Log of Borehole: MW302

Project #: 295667

Logged By: MG, CP

Project: Hydrogeological and Geotechnical Assessments

Client: Innisfil Beach Development Inc.

Location: 19 Lennox Dr (formerly 440 Dunlop St W), Barrie

Drill Date: March 30, 2023

Project Manager: JD

| SUBSURFACE PROFILE |        |                                                    |               |                         | SAMPLE      |           |              |             |                                              |                                      |                                       |
|--------------------|--------|----------------------------------------------------|---------------|-------------------------|-------------|-----------|--------------|-------------|----------------------------------------------|--------------------------------------|---------------------------------------|
| Depth (m)          | Symbol | Description                                        | Elevation (m) | Monitoring Well Details | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value<br>□ 20 40 60 □ | Shear Strength<br>△ kPa △<br>100 200 | Water Content<br>● % ●<br>10 20 30 40 |
| 0                  |        | Ground Surface                                     | 235.45        |                         |             |           |              |             |                                              |                                      |                                       |
|                    |        | <b>Fill</b><br>Brown sandy silt, loose, very moist |               |                         | SS          | 1         | 100          | 5           |                                              |                                      |                                       |
|                    |        |                                                    | 234.69        |                         |             |           |              |             |                                              |                                      |                                       |
| 1                  |        | Grey sand, nil to trace gravel, compact, wet       |               |                         | SS          | 2         | 100          | 11          |                                              |                                      |                                       |
|                    |        |                                                    | 233.62        |                         |             |           |              |             |                                              |                                      |                                       |
| 2                  |        | gravel / asphalt seam at 1.8 mbgs                  |               |                         | SS          | 3         | 100          | 11          |                                              |                                      |                                       |
|                    |        |                                                    | 232.05        |                         |             |           |              |             |                                              |                                      |                                       |
| 3                  |        |                                                    |               |                         | SS          | 4         | 100          | 9           |                                              |                                      |                                       |
|                    |        | <b>Clay</b><br>Grey silty clay, stiff, WTPL        |               |                         |             |           |              |             |                                              |                                      |                                       |
| 4                  |        |                                                    | 230.88        |                         |             |           |              |             |                                              |                                      |                                       |
| 5                  |        | Firm to stiff                                      |               |                         | SS          | 5         | 100          | 8           |                                              |                                      |                                       |
|                    |        |                                                    |               |                         |             |           |              |             |                                              |                                      |                                       |
| 6                  |        |                                                    |               |                         | SS          | 6         | 100          | 5           |                                              |                                      |                                       |
|                    |        |                                                    |               |                         |             |           |              |             |                                              |                                      |                                       |
| 7                  |        |                                                    |               |                         |             |           |              |             |                                              |                                      |                                       |
|                    |        |                                                    | 227.83        |                         |             |           |              |             |                                              |                                      |                                       |

Contractor: Strata

Grade Elevation: 235.45

Drilling Method: SPT

Top of Casing Elevation: 236.48

Well Casing Size: 50 mm

Sheet: 1 of 2



# Log of Borehole: MW302

Project #: 295667

Logged By: MG, CP

Project: Hydrogeological and Geotechnical Assessments

Client: Innisfil Beach Development Inc.

Location: 19 Lennox Dr (formerly 440 Dunlop St W), Barrie

Drill Date: March 30, 2023

Project Manager: JD

| SUBSURFACE PROFILE |        |                                                                                                         |               |                         | SAMPLE      |           |              |             |                                              |                                      |                                       |
|--------------------|--------|---------------------------------------------------------------------------------------------------------|---------------|-------------------------|-------------|-----------|--------------|-------------|----------------------------------------------|--------------------------------------|---------------------------------------|
| Depth (m)          | Symbol | Description                                                                                             | Elevation (m) | Monitoring Well Details | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value<br>□ 20 40 60 □ | Shear Strength<br>△ kPa △<br>100 200 | Water Content<br>• % •<br>10 20 30 40 |
| 8                  |        | Soft                                                                                                    |               | Bentonite<br>↓          | SS          | 7         | 100          | 4           |                                              |                                      |                                       |
| 9                  |        |                                                                                                         |               |                         |             |           |              |             |                                              |                                      |                                       |
| 10                 |        | Unsampled<br>DCP testing continued                                                                      | 225.70        |                         | SS          | 8         | 100          | 3           |                                              |                                      |                                       |
| 11                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 6           |                                              |                                      |                                       |
| 12                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 7           |                                              |                                      |                                       |
| 13                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 25          |                                              |                                      |                                       |
| 14                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 25          |                                              |                                      |                                       |
| 15                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 21          |                                              |                                      |                                       |
| 16                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 24          |                                              |                                      |                                       |
| 17                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 17          |                                              |                                      |                                       |
| 18                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 16          |                                              |                                      |                                       |
| 19                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 15          |                                              |                                      |                                       |
| 20                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 28          |                                              |                                      |                                       |
| 21                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 23          |                                              |                                      |                                       |
| 22                 |        |                                                                                                         |               |                         | DCP         | NA        | NA           | 64          |                                              |                                      |                                       |
| 23                 |        | End of Borehole<br>Borehole terminated at 13.6 mbgs.                                                    | 221.89        |                         |             |           |              |             |                                              |                                      |                                       |
| 24                 |        | Water Levels:<br>0.51 mbgs on March 31, 2023<br>0.56 mbgs on April 12, 2023<br>0.47 mbgs on May 5, 2023 |               |                         |             |           |              |             |                                              |                                      |                                       |

Contractor: Strata

Grade Elevation: 235.45

Drilling Method: SPT

Top of Casing Elevation: 236.48

Well Casing Size: 50 mm

Sheet: 2 of 2

## Log of Borehole: BH303

**Project #:** 295667

**Logged By:** MG, CP

**Project:** Hydrogeological and Geotechnical Assessments

**Client:** Innisfil Beach Development Inc.

**Location:** 19 Lennox Dr (formerly 440 Dunlop St W), Barrie

**Drill Date:** March 30, 2023

**Project Manager:** JD

| SUBSURFACE PROFILE |                                                                                |                                                                     |               |                              | SAMPLE      |           |              |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
|--------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------|------------------------------|-------------|-----------|--------------|-------------|------------------------------|----|------|-------|----------------|-------|-----|----|---------------|----|------|--|--|
| Depth (m)          | Symbol                                                                         | Description                                                         | Elevation (m) | Monitoring Well Details      | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value |    |      |       | Shear Strength |       |     |    | Water Content |    |      |  |  |
|                    |                                                                                |                                                                     |               |                              |             |           |              |             | □ 20                         | 40 | 60 □ | △ kPa | 100            | 200 △ | ● % | 10 | 20            | 30 | 40 ● |  |  |
| 0                  |                                                                                | Ground Surface                                                      | 235.59        | No Monitoring Well Installed | SS          | 1         | 100          | 12          |                              |    |      |       |                |       |     |    |               |    |      |  |  |
|                    | <b>Pavement Structure</b><br>150 mm Asphaltic concrete                         |                                                                     |               |                              |             |           |              |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
|                    | <b>Granular Fill</b><br>Brown sand and gravel, some silt, compact moist to wet | 234.69                                                              | SS            |                              | 2           | 100       | 18           |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
| 1                  |                                                                                |                                                                     |               |                              |             |           |              |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
|                    | <b>Sand</b><br>Brown/grey sand, trace silt, compact, very moist                | 234.07                                                              | SS            |                              | 3           | 100       | 19           |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
| 2                  |                                                                                | Brown/grey sand, trace gravel and silt, coarse, compact, very moist | 233.30        |                              |             |           |              |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
|                    | Brown/grey coarse sand and gravel, trace silt, compact, moist                  | 233.07                                                              | SS            |                              | 4           | 100       | 13           |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
| 3                  |                                                                                | <b>Clay</b><br>Grey silty clay, very stiff, APL, WTPL at bottom     | 232.54        |                              | SS          | 5         | 100          | 12          |                              |    |      |       |                |       |     |    |               |    |      |  |  |
|                    | WTPL                                                                           |                                                                     |               |                              |             |           |              |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
| 4                  |                                                                                |                                                                     | 231.02        |                              | SS          | 6         | 100          | 10          |                              |    |      |       |                |       |     |    |               |    |      |  |  |
| 5                  |                                                                                | very stiff to stiff                                                 |               |                              | SS          | 7         | 100          | 8           |                              |    |      |       |                |       |     |    |               |    |      |  |  |
| 6                  |                                                                                |                                                                     | 229.49        |                              |             |           |              |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
|                    |                                                                                | Stiff to firm                                                       |               | SS                           | 8           | 100       | 4            |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
| 7                  |                                                                                |                                                                     |               |                              |             |           |              |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
| 8                  |                                                                                |                                                                     |               | SS                           | 9           | 100       | 3            |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |
| 9                  |                                                                                |                                                                     |               |                              |             |           |              |             |                              |    |      |       |                |       |     |    |               |    |      |  |  |

**Contractor:** Strata

**Grade Elevation:** 235.59

**Drilling Method:** SPT

**Top of Casing Elevation:** NA

**Well Casing Size:** NA

**Sheet:** 1 of 2



# Log of Borehole: BH303

Project #: 295667

Logged By: MG, CP

Project: Hydrogeological and Geotechnical Assessments

Client: Innisfil Beach Development Inc.

Location: 19 Lennox Dr (formerly 440 Dunlop St W), Barrie

Drill Date: March 30, 2023

Project Manager: JD

| SUBSURFACE PROFILE |        |                                                                                                                   |               | SAMPLE                  |             |           |              |             |                                              |                                      |                                       |
|--------------------|--------|-------------------------------------------------------------------------------------------------------------------|---------------|-------------------------|-------------|-----------|--------------|-------------|----------------------------------------------|--------------------------------------|---------------------------------------|
| Depth (m)          | Symbol | Description                                                                                                       | Elevation (m) | Monitoring Well Details | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value<br>□ 20 40 60 □ | Shear Strength<br>△ kPa △<br>100 200 | Water Content<br>• % •<br>10 20 30 40 |
| 10                 |        | <b>Unsampled</b><br>DCP testing continued                                                                         | 225.84        |                         | SS          | 10        | 100          | 2           |                                              |                                      |                                       |
| 11                 |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 12          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 15          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 17          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 14          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 16          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 14          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 20          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 45          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 24          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 38          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 18          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 52          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 56          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 35          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 46          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 70          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 57          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 45          |                                              |                                      |                                       |
|                    |        |                                                                                                                   |               |                         | DCP         | NA        | NA           | 31          |                                              |                                      |                                       |
| 16                 |        | End of Borehole                                                                                                   | 219.74        |                         |             |           |              |             |                                              |                                      |                                       |
| 17                 |        | Borehole terminated at 15.8 mbgs.<br>At completion, boreholes open to<br>1.7 mbgs and water level at 0.9<br>mbgs. |               |                         |             |           |              |             |                                              |                                      |                                       |
| 18                 |        |                                                                                                                   |               |                         |             |           |              |             |                                              |                                      |                                       |

Contractor: Strata

Grade Elevation: 235.59

Drilling Method: SPT

Top of Casing Elevation: NA

Well Casing Size: NA

Sheet: 2 of 2



# Log of Borehole: BH304

Project #: 295667

Logged By: CP, MG

Project: Hydrogeological and Geotechnical Assessments

Client: Innisfil Beach Development Inc.

Location: 19 Lennox Dr (formerly 440 Dunlop St W), Barrie

Drill Date: March 29, 2023

Project Manager: JD

| SUBSURFACE PROFILE |        |                                                                                           |               |                              | SAMPLE      |           |              |             |                                              |                                      |                                       |
|--------------------|--------|-------------------------------------------------------------------------------------------|---------------|------------------------------|-------------|-----------|--------------|-------------|----------------------------------------------|--------------------------------------|---------------------------------------|
| Depth (m)          | Symbol | Description                                                                               | Elevation (m) | Monitoring Well Details      | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value<br>□ 20 40 60 □ | Shear Strength<br>△ kPa △<br>100 200 | Water Content<br>• % •<br>10 20 30 40 |
| 0                  |        | Ground Surface                                                                            | 236.08        | No Monitoring Well Installed |             |           |              |             |                                              |                                      |                                       |
|                    |        | <b>Pavement Structure</b><br>Brown sand and gravel, 50 mm buried asphaltic concrete       |               |                              | SS          | 1         | 100          | 9           |                                              |                                      |                                       |
|                    |        | <b>Fill</b><br>Brown silty sand, trace gravel, loose, moist                               | 235.32        |                              |             |           |              |             |                                              |                                      |                                       |
| 1                  |        |                                                                                           | 235.01        |                              | SS          | 2         | 100          | 8           |                                              |                                      |                                       |
|                    |        | Brown/grey occasional topsoil inclusions, loose, moist                                    | 234.56        |                              |             |           |              |             |                                              |                                      |                                       |
|                    |        | Brown sand, trace silt, loose, moist                                                      |               |                              | SS          | 3         | 100          | 16          |                                              |                                      |                                       |
| 2                  |        | Brown/grey sand, trace silt and gravel, occasional small topsoil inclusions, compact, wet | 233.98        |                              |             |           |              |             |                                              |                                      |                                       |
|                    |        | <b>Sand</b><br>Brown/grey sand, compact, wet, gravel seam                                 |               |                              | SS          | 4         | 100          | 21          |                                              |                                      |                                       |
| 3                  |        |                                                                                           |               |                              |             |           |              |             |                                              |                                      |                                       |
|                    |        |                                                                                           | 232.27        |                              | SS          | 5         | 100          | 12          |                                              |                                      |                                       |
| 4                  |        | <b>Clay</b><br>Brown silty clay, very stiff, WTPL                                         |               | No Monitoring Well Installed | SS          | 6         | 100          | 19          |                                              |                                      |                                       |
|                    |        |                                                                                           | 231.51        |                              |             |           |              |             |                                              |                                      |                                       |
|                    |        | Brownish grey silty clay, stiff, WTPL                                                     |               |                              | SS          | 7         | 100          | 14          |                                              |                                      |                                       |
| 5                  |        |                                                                                           | 230.75        |                              |             |           |              |             |                                              |                                      |                                       |
|                    |        | Grey silty clay, stiff                                                                    |               |                              | SS          | 8         | 100          | 4           |                                              |                                      |                                       |
| 6                  |        |                                                                                           |               | No Monitoring Well Installed |             |           |              |             |                                              |                                      |                                       |
|                    |        |                                                                                           |               |                              | SS          | 9         | 100          | 4           |                                              |                                      |                                       |
| 7                  |        |                                                                                           |               | No Monitoring Well Installed |             |           |              |             |                                              |                                      |                                       |
|                    |        |                                                                                           | 228.46        |                              |             |           |              |             |                                              |                                      |                                       |

Contractor: Strata

Grade Elevation: 236.08

Drilling Method: SPT

Top of Casing Elevation: NA

Well Casing Size: NA

Sheet: 1 of 2



## Log of Borehole: BH304

Project #: 295667

Logged By: CP, MG

Project: Hydrogeological and Geotechnical Assessments

Client: Innisfil Beach Development Inc.

Location: 19 Lennox Dr (formerly 440 Dunlop St W), Barrie

Drill Date: March 29, 2023

Project Manager: JD

| SUBSURFACE PROFILE |        |                                                                                                        |               |                         | SAMPLE      |           |              |             |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
|--------------------|--------|--------------------------------------------------------------------------------------------------------|---------------|-------------------------|-------------|-----------|--------------|-------------|------------------------------|----|----|----|----------------|---|-----|---|---------------|-----|---|---|---|----|----|----|----|--|--|--|
| Depth (m)          | Symbol | Description                                                                                            | Elevation (m) | Monitoring Well Details | Sample Type | Sampler # | Recovery (%) | SPT N-Value | Standard Penetration N-Value |    |    |    | Shear Strength |   |     |   | Water Content |     |   |   |   |    |    |    |    |  |  |  |
|                    |        |                                                                                                        |               |                         |             |           |              |             | □                            | 20 | 40 | 60 | □              | △ | kPa | △ | 100           | 200 | ● | % | ● | 10 | 20 | 30 | 40 |  |  |  |
| 8                  |        | Brownish silty clay, soft, WTPL                                                                        |               |                         | SS          | 10        | 100          | 4           |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
|                    |        |                                                                                                        |               |                         |             |           |              |             |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
| 9                  |        |                                                                                                        |               |                         |             |           |              |             |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
|                    |        |                                                                                                        | 226.33        |                         | SS          | 11        | 100          | 3           |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
| 10                 |        | End of Borehole                                                                                        |               |                         |             |           |              |             |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
|                    |        | Borehole terminated at 9.8 mbgs. At completion, borehole open to 1.7 mbgs and water level at 1.4 mbgs. |               |                         |             |           |              |             |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
| 11                 |        |                                                                                                        |               |                         |             |           |              |             |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
| 12                 |        |                                                                                                        |               |                         |             |           |              |             |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
| 13                 |        |                                                                                                        |               |                         |             |           |              |             |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
| 14                 |        |                                                                                                        |               |                         |             |           |              |             |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |
| 15                 |        |                                                                                                        |               |                         |             |           |              |             |                              |    |    |    |                |   |     |   |               |     |   |   |   |    |    |    |    |  |  |  |

Contractor: Strata

Grade Elevation: 236.08

Drilling Method: SPT

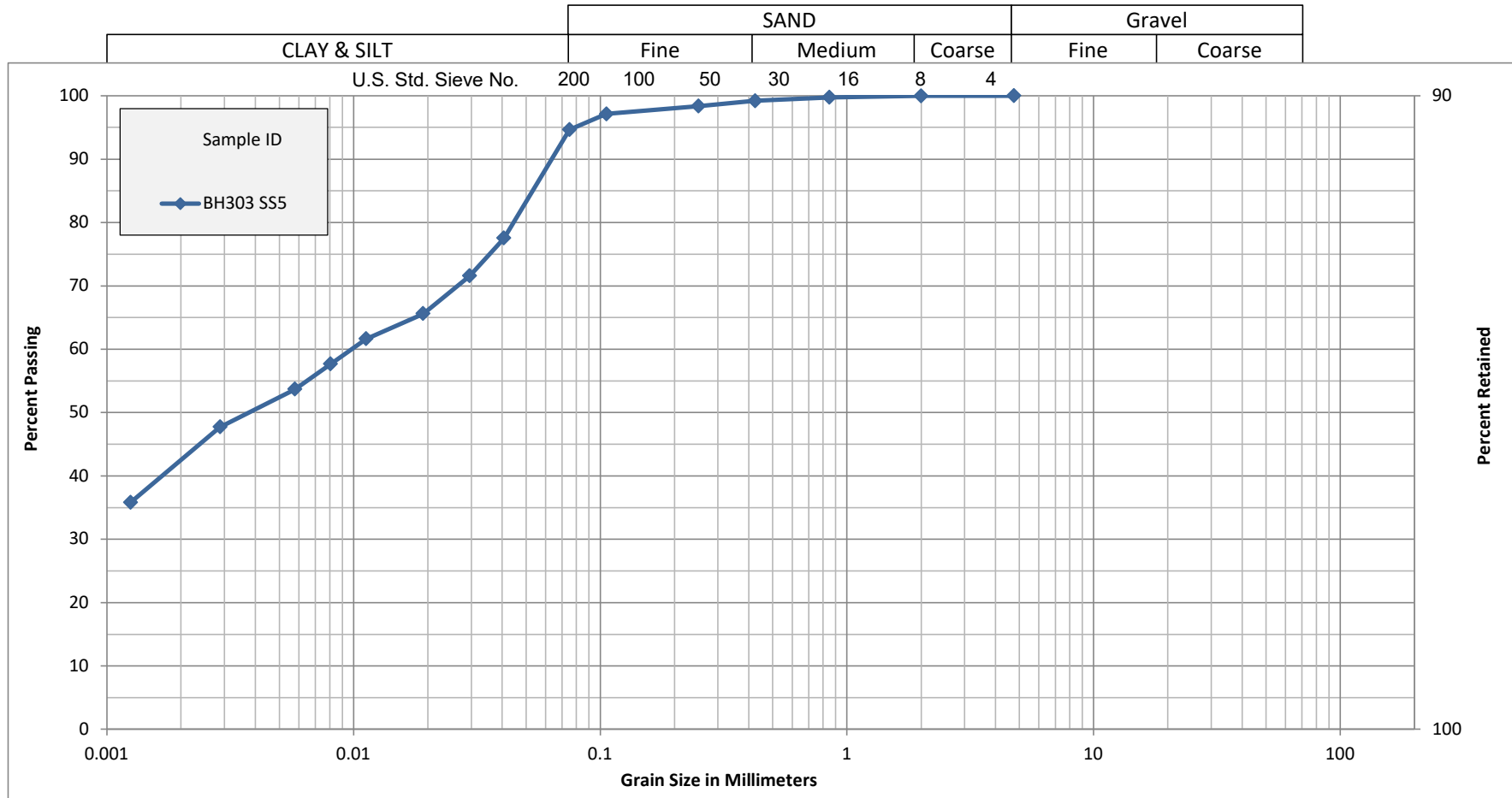
Top of Casing Elevation: NA

Well Casing Size: NA

Sheet: 2 of 2

**APPENDIX III**  
**Laboratory Testing Reports for Soil Samples**

# Unified Soil Classification System



| Sample ID | Depth (ft) | % Gravel | % Sand | % Silt | % Clay |
|-----------|------------|----------|--------|--------|--------|
| BH303 SS5 | 10.0-12.0  | 0.0      | 5.4    | 53.6   | 41.0   |
|           |            |          |        |        |        |
|           |            |          |        |        |        |
|           |            |          |        |        |        |
|           |            |          |        |        |        |



Pinchin Waterloo - 225 Labrador Drive, Unit 1, Waterloo, Ontario N2K 4M8

## PARTICLE SIZE DISTRIBUTION ANALYSIS

Proposed Hotel Building - 19 Lennox Dr (formerly 440 Dunlop St W),  
Barrie, ON  
Innisfil Beach Development Inc.

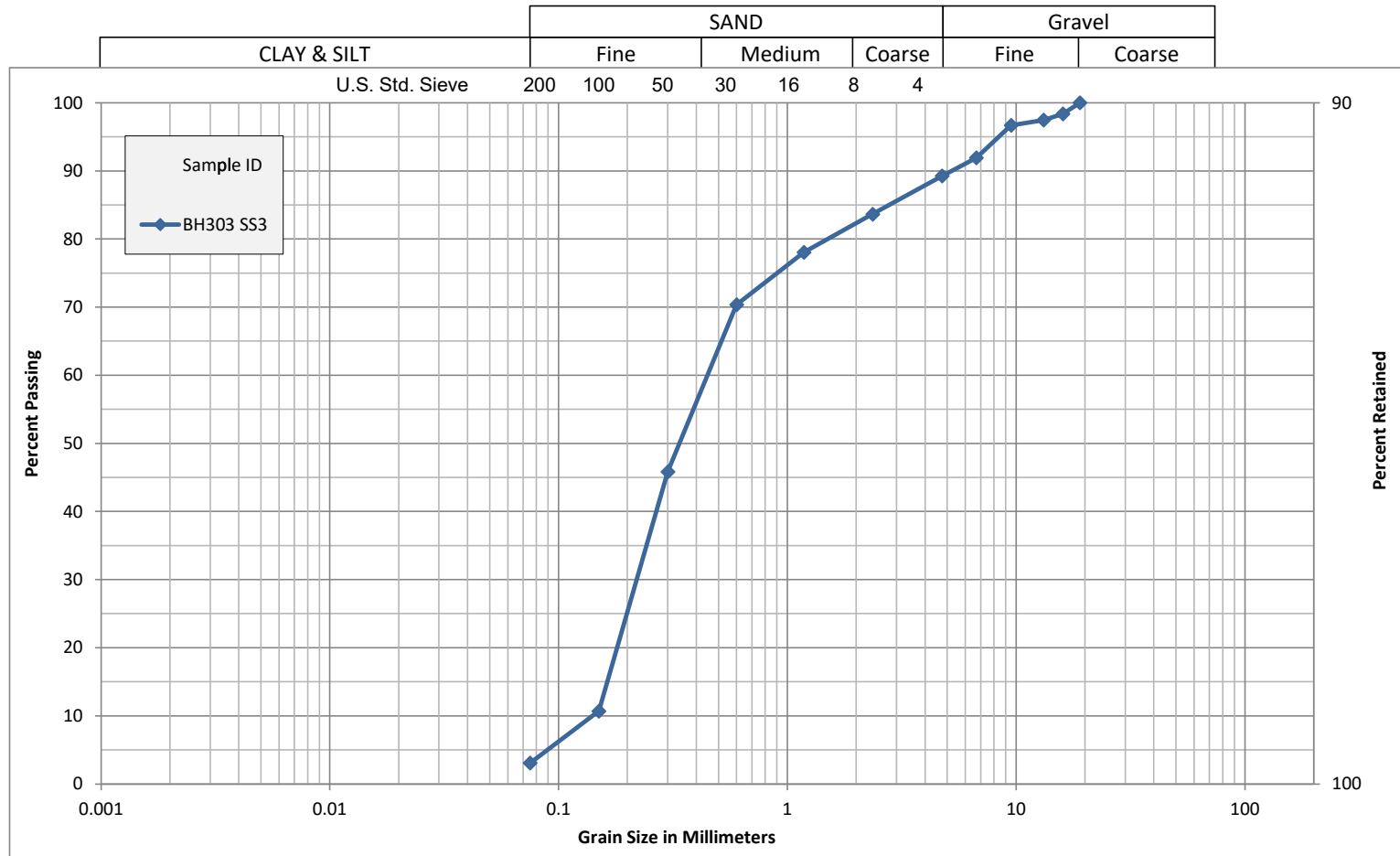
Figure No. 1

**295667.007**

Reviewed By:

More information available upon request

# Unified Soil Classification System



| Sample ID | Depth (ft) | % Gravel | % Sand | % Silt and Clay |
|-----------|------------|----------|--------|-----------------|
| BH303 SS3 | 5.0-7.0    | 10.7     | 86.2   | 3.1             |
|           |            |          |        |                 |
|           |            |          |        |                 |
|           |            |          |        |                 |
|           |            |          |        |                 |



Pinchin Waterloo - 225 Labrador Drive,  
Unit 1, Waterloo, Ontario N2K 4M8

## PARTICLE SIZE DISTRIBUTION ANALYSIS

Proposed Hotel Building - 19 Lennox Dr (formerly 440 Dunlop St W),  
Barrie, ON  
Innisfil Beach Development Inc.

Figure No. 1

**295667.007**

Reviewed By:

More information available upon request



# Atterberg Limits

LS 703&704 / ASTM D4318

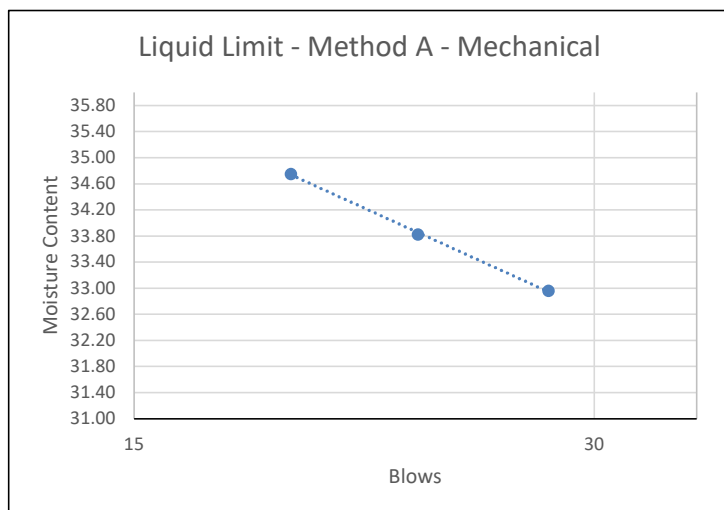
**Project Name:** Proposed Hotel Building  
**Project No.** 295667.007  
**Client:** Innisfil Beach Development Inc.  
**Location:** 19 Lennox Dr (formerly 440 Dunlop St W),  
 Barrie, ON  
**Material:** Soil  
**Sample:** BH303 SS5 10.0-12.0

**Test Date:** April 13, 2023  
**Tested By:** B Frank  
**Sample Date:** March 30, 2023  
**Sampled By:** CP  
**Reviewed By:** V Marshall

| Liquid Limit - Method A - Mechanical |       |       |       |  |  |  |
|--------------------------------------|-------|-------|-------|--|--|--|
| Pot Number                           | 1     | 2     | 3     |  |  |  |
| Number of blows                      | 28    | 23    | 19    |  |  |  |
| Wet mass + pot                       | 32.05 | 34.59 | 30.83 |  |  |  |
| Dry mass + pot                       | 27.93 | 29.78 | 26.83 |  |  |  |
| Tare                                 | 15.43 | 15.56 | 15.32 |  |  |  |
| Water content %                      | 32.96 | 33.83 | 34.75 |  |  |  |

| Plastic Limit - Hand Rolled |       |       |  |
|-----------------------------|-------|-------|--|
| Pot Number                  | 1     | 2     |  |
| Wet mass + pot              | 24.41 | 25.60 |  |
| Dry mass + pot              | 23.27 | 24.32 |  |
| Tare                        | 15.53 | 15.63 |  |
| Water content %             | 14.7  | 14.7  |  |

| PI = LL - PL    |           |
|-----------------|-----------|
| Liquid Limit %  | <b>33</b> |
| Plastic Limit % | <b>15</b> |
| Plastic Index   | <b>19</b> |
| Non Plastic     |           |



\* More information available upon request

**APPENDIX IV**  
**Report Limitations and Guidelines for Use**



## **REPORT LIMITATIONS & GUIDELINES FOR USE**

This information has been provided to help manage risks with respect to the use of this report.

### **GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS**

This report was prepared for the exclusive use of the Client and their authorized agents, subject to the conditions and limitations contained within the duly authorized work plan. 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 the third parties. If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice.

### **SUBSURFACE CONDITIONS CAN CHANGE**

This geotechnical report is based on the existing conditions at the time the study was performed, and Pinchin's opinion of soil conditions are strictly based on soil samples collected at specific test hole locations. The findings and conclusions of Pinchin's reports may be affected by the passage of time, by manmade events such as construction on or adjacent to the Site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations.

### **LIMITATIONS TO PROFESSIONAL OPINIONS**

Interpretations of subsurface conditions are based on field observations from test holes that were spaced to capture a 'representative' snap shot of subsurface conditions. Site exploration identifies subsurface conditions only at points of sampling. Pinchin reviews field and laboratory data and then applies professional judgment to formulate an opinion of subsurface conditions throughout the Site. Actual subsurface conditions may differ, between sampling locations, from those indicated in this report.

### **LIMITATIONS OF RECOMMENDATIONS**

Subsurface soil conditions should be verified by a qualified geotechnical engineer during construction. Pinchin should be notified if any discrepancies to this report or unusual conditions are found during construction.

Sufficient monitoring, testing and consultation should be provided by Pinchin during construction and/or excavation activities, to confirm that the conditions encountered are consistent with those indicated by the test hole investigation, and to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated. In addition, monitoring, testing and consultation by Pinchin should be completed to evaluate whether or not earthwork activities are completed in



accordance with our recommendations. Retaining Pinchin for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions. However, please be advised that any construction/excavation observations by Pinchin is over and above the mandate of this geotechnical evaluation and therefore, additional fees would apply.

### **MISINTERPRETATION OF GEOTECHNICAL ENGINEERING REPORT**

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having Pinchin confer with appropriate members of the design team after submitting the report. Also retain Pinchin to review pertinent elements of the design team's plans and specifications.

Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having Pinchin participate in pre-bid and preconstruction conferences, and by providing construction observation. Please be advised that retaining Pinchin to participation in any 'other' activities associated with this project is over and above the mandate of this geotechnical investigation and therefore, additional fees would apply.

### **CONTRACTORS RESPONSIBILITY FOR SITE SAFETY**

This geotechnical report is not intended to direct the contractor's procedures, methods, schedule or management of the work Site. The contractor is solely responsible for job Site safety and for managing construction operations to minimize risks to on-Site personnel and to adjacent properties. It is ultimately the contractor's responsibility that the appropriate Provincial Health and Safety Act is adhered to, and Site conditions satisfy all 'other' acts, regulations and/or legislation that may be mandated by federal, provincial and/or municipal authorities.

### **SUBSURFACE SOIL AND/OR GROUNDWATER CONTAMINATION**

This report is geotechnical in nature and was not performed in accordance with any environmental guidelines. As such, any environmental comments are very preliminary in nature and based solely on field observations. Accordingly, the scope of services do not include any interpretations, recommendations, findings, or conclusions regarding the, assessment, prevention or abatement of contaminants, and no conclusions or inferences should be drawn regarding contamination, as they may relate to this project.

The term "contamination" includes, but is not limited to, molds, fungi, spores, bacteria, viruses, PCBs, petroleum hydrocarbons, inorganics, pesticides/insecticides, volatile organic compounds, polycyclic aromatic hydrocarbons and/or any of their by-products.

Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be held liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage



if the Client has failed, within a period of two years following the date upon which the claim is discovered within the meaning of the *Limitations Act*, 2002 (Ontario), to commence legal proceedings against Pinchin to recover such losses or damage.

\\PIN-HAM-FS02\job\295000s\0295667.000 TRAMDevelopments,440DunlopStWBar,SA1\0295667.007 DunlopFerndale,440DunlopStWBar,HydroGeo\Deliverables\Geo\REV-DRAFT\Appendix IV - Report Limitations Guidelines for Use.docx

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