Preliminary Geotechnical Investigation Report - 220 Bradford Street, Barrie, Ontario

2019-12-05

Prepared for:
Chayell Hotels Ltd.

 Reference No.: 9326-002

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Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 INTRODUCTION

Chayell Hotels Ltd. (Client) retained Cambium Inc. (Cambium) to complete a Preliminary Geotechnical Investigation in support of the design and construction of a 14-storey condominium apartment building (including 122 residential units) with four levels of above ground parking at 220 Bradford Street, Barrie, Ontario (Site). It is assumed that the building will be constructed as a slab-on-grade structure with no basement levels.

The Site is on the west side of Bradford Street, south of the intersection with Brock Street. The purpose of this geotechnical investigation was to obtain information about the subsurface conditions by means of a number of boreholes and based on the findings provide recommendations pertaining to the geotechnical design of the proposed high-rise building and parking structure.

It is understood that various environmental studies have previously been carried out at the Site by others. As part of Cambium's scope of work at the Site, a hydrogeological study and Phase One and Two Environmental Site Assessment (ESA) reports have been provided under separate covers.

This report presents the methodology and findings of the geotechnical investigation and addresses requirements and constraints for the design and construction of the proposed structure and facilities.

2.0 METHODOLOGY

2.1 Borehole Investigation

Cambium completed a geotechnical investigation at the Site between October 16 to 21, 2019. Four boreholes (BH301-19 through BH304-19) were advanced into the subsurface at predetermined locations throughout the Site. BH302-19 and BH303-19 were terminated at a depth of 30.9 m below ground surface (mbgs) and BH301-19 and BH304-19 were terminated at depth of 9.6 mbgs. The boreholes were mapped using a handheld GPS unit. Ground surface elevations at the boreholes were surveyed relative to a temporary bench mark (TBM), referenced to previously advanced boreholes BH207-19 and BH201-19. Borehole locations are shown on Figure 1.

Drilling and sampling was completed using a D-50 track-mounted drilling rig operated by Walker Drilling. The boreholes were advanced using continuous flight, hollow-stem augers. Given the encountered soil conditions, mud rotary techniques were utilized to stabilize boreholes BH302-19 and BH303-19.

Standard Penetration Test (SPT) N values were recorded for the sampled intervals as the number of blows required to drive a standard 50 mm outside diameter (O.D.) split-spoon sampler 305 mm into the soil, using a 63.5 kg drop hammer falling 750 mm, as per ASTM D1586 procedures. The SPT N values are used in this report to assess consistency of cohesive soils and relative density of non-cohesive materials.

Soil samples were collected at approximately 0.75 m intervals in the upper 3 m, 1.5 m intervals between 3 mbgs and 16 mbgs and 3 m intervals below 16 mbgs. The encountered soil units were logged in the field using visual and tactile methods, and samples were placed in labelled plastic bags for transport, future reference, possible laboratory testing, and storage.

Open boreholes were checked for groundwater and general stability prior to backfilling. Borehole BH301-19 was instrumented with a 50 mm diameter monitoring well to 5 mbgs. The top of casing elevation was surveyed relative to the TBM. All other boreholes were backfilled

and sealed consistent with R.R.O. 1990 Regulation 903 and the property was reinstated to pre-existing conditions.

Additional boreholes were advanced as part of an ESA Phase Two completed at the property by Cambium (BH201-19 to BH208-19), which is provided under separate cover. As part of previous investigations, it is understood that T. Harris Environmental Management (THEM) advanced ten boreholes (BH1 to BH10) in 2016 and Pinchin advanced four boreholes (BH101 to BH104) in 2018, the results of which are summarized in Cambium's ESA Phase Two report.

Pertinent soil and groundwater information obtained from Cambium's environmental boreholes were used to determine the geotechnical conditions at the site. Borehole logs are provided in Appendix A. Site soil and groundwater conditions are described and geotechnical recommendations are discussed in the following sections of this report.

2.2 Physical Laboratory Testing

Particle size distribution analyses (LS-702,705) was completed on four soil samples to confirm textural classification and to assess geotechnical parameters. Moisture content testing was completed on all soil samples. Testing results are presented in Appendix B and are discussed in Section 3.0.

3.0 SUBSURFACE CONDITIONS

The detailed soil profiles encountered in the boreholes are indicated on the attached borehole logs in Appendix A. Conditions indicated on the borehole logs are for specific locations only and can vary between and beyond the borehole locations. The soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change. In addition, the descriptions provided on the borehole logs are inferred from a variety of factors, including visual observations of the soil samples retrieved, laboratory testing, measurements prior to and after drilling, and the drilling process itself (drilling speed, shaking/grinding of the augers, etc.).

Based on the results of the borehole investigation, subsurface conditions at the Site generally consist of fill overlying native sand to silty sand/sandy silt glacial till soils, bedrock was not encountered during this geotechnical investigation.

3.1 Pavement Structure

The south and east quadrants of the Site are topped with an asphalt surface. Geotechnical boreholes BH302-19 and BH303-19 were advanced through a combination of both surficial asphalt and concrete. The surficial asphalt layer was ±50 mm in thickness. The underlying concrete layer was ±150 mm in thickness.

3.2 Fill

Based on information obtained from geotechnical boreholes BH301-19 to BH 304-19 and environmental boreholes BH201-19 to BH208-19, a layer of sand, trace to some gravel, trace silt fill was identified at the site. The fill contained organics and rubble (asphalt and brick) at some locations. Fill material N values ranged from 1 to 11 blows per 300 mm of penetration, which indicates a very loose to compact relative density. The natural moisture content of the upper layer of native sand varied from 7% to 13% by weight (moist).

Based on these observations, the fill layer appears to extend to 0.7 to 3.0 mbgs. The observed thickness of the general fill layer is summarized in Table 1 below.

Table 1 Fill Thickness Observations

Borehole	Ground Surface Elevation (masl)	Thickness of Fill Layer (m)	Elevation at Base of Fill Layer (masl)
BH301-19	224.9	0.7	224.2
BH302-19	223.3	1.5	221.8
BH303-19	222.8	1.5	221.3
BH304-19	225.1	0.7	224.4
BH201-19	223.0	2.0	221.0
BH202-19	224.0	1.8	222.2
BH203-19	224.1	1.8	222.3
BH204-19	222.5	3.0	219.5
BH205-19	222.8	1.7	221.1
BH206-19	222.1	-	-
BH207-19	224.3	-	-
BH208-19	222.5	3.0	219.5

masl – metres above sea level

A laboratory particle size distribution analysis was completed on one sample of the fill as shown in Table 2 to identify the soil texture based on the Unified Soil Classification System (USCS). Based on the particle size results, the soil is classified as sand, some silt, trace gravel, trace clay. The testing results are provided in Appendix B.

Table 2 Particle Size Distribution Analysis – Fill

Borehole	Depth (mbgs)	Soil	% Gravel	% Sand	% Silt	% Clay	% Moisture Content
BH301-19 SS1	0 – 0.6	Sand some silt, trace gravel, trace clay	5	77	13	4	13.2

3.3 Sand

A native sand deposit was identified underlying the fill layer. The native sand deposit contained trace to some silt and trace to some gravel (cobble sizes). Traces of organics were noted

within the upper sand soils. The sand layer was ranged in thickness from 4.6 m to 7.6 mbgs. SPT N values were 3 to 25 blows per 300 mm of penetration, indicating a very loose to compact relative density. From laboratory analysis the natural moisture content of the upper layer of native sand soils varied between 2% and 24% by weight (moist to wet) with an average 13% by weight.

A laboratory particle size distribution analysis was completed on one sample of the native sand as shown in Table 3 to identify the soil texture based on the USCS. Based on the particle size results, the soil is classified as Sand, some gravel, trace silt, trace clay. The testing results are provided in Appendix B.

Table 3 Particle Size Distribution Analysis – Sand

Borehole	Depth (mbgs)	Soil	% Gravel	% Sand	% Silt	% Clay	% Moisture Content
BH303-19 SS3	1.5 – 2.0	Sand, some gravel, trace silt, trace clay	10	83	5	2	16.4

3.4 Silty Sand to Sandy Silt

A silty sand to sandy silt glacial till deposit was identified below the native sand. The glacial till contained trace to some gravel, trace clay. SPT N values were generally from 4 to over 50 blows per 0.3 metres of penetration, indicating a loose to very dense relative density. The glacial till deposit increased relative density with depth. From laboratory analysis the natural moisture content of the lower portion of native silty sand to sandy silt till varied between 15 % and 31 % by weight.

A laboratory particle size distribution analysis was completed on one sample of the silty sand/sandy silt glacial till deposit as shown in

Table 4 to identify the soil texture based on the USCS. Based on the particle size results, the soil is classified as silt, trace sand, trace clay. The testing results are provided in Appendix B.

Table 4 Particle Size Distribution Analysis – Silty Sand/Sandy Silt

Borehole	Depth (mbgs)	Soil	% Gravel	% Sand	% Silt	% Clay	% Moisture Content
BH302-19 SS20	25.9 – 26.4	Silt, trace sand, trace clay	0	7	88	5	21.3
BH304-19 SS9	9.3 – 9.6	Silty Sand, trace gravel, trace clay	1	67	26	6	19.1

3.5 Bedrock

Bedrock was not encountered to the maximum depth (30.9 mbgs) of this geotechnical investigation.

3.6 Groundwater

Groundwater seepage was present in all of the boreholes upon completion. The water levels were measured on completion of drilling and prior to backfill. During drilling of boreholes BH301-19 to BH304-19, the short-term groundwater table was found at depths of 1.6 to 4.0 mbgs as listed in Table 5. Given the geotechnical boreholes were stabilized with drilling mud, the groundwater levels observed during the drilling investigation may not be representative of the actual groundwater table. In addition, no significant sloughing (caving) was noted upon terminating the stabilized boreholes; however, sloughing was noted from 3.0 to 5.6 mbgs in the boreholes that were not stabilized with drilling mud.

The stabilized groundwater levels measured monitoring wells from August 2019 to November 2019 ranged from 0.8 mbgs (MW208-19) to 4.0 mbgs (BH304-19), corresponding to elevations from 220.6 masl to 222.2 masl, as listed in Table 5. Groundwater levels at the Site may fluctuate seasonally and in response to climatic events.

Cambium will be recording monthly groundwater measurements from the monitoring wells over a 12 month period. The recorded groundwater levels (and elevations) will be provided to the Client under separate cover.

Table 5 Groundwater Levels Observed in Boreholes

Borehole	Date of Observation	Depth of Groundwater (mbgs)	Elevation of Groundwater (masl)	Notes
MW201-19	Aug 29, 2019 Oct 3, 2019 Nov 19, 2019	2.09 2.09 1.95	220.93 220.93 221.07	Monitoring Well
MW202-19	Aug 29, 2019 Oct 3, 2019 Nov 19, 2019	2.07** 3.07 2.92	221.90** 220.89 221.04	Monitoring Well
MW203-19	Aug 29, 2019 Oct 3, 2019 Nov 19, 2019	3.04 3.05 2.90	221.07 221.05 221.20	Monitoring Well
MW204-19	Aug 29, 2019 Oct 3, 2019 Nov 19, 2019	1.72 1.71 1.58	220.74 220.75 220.88	Monitoring Well
MW205-19	Aug 29, 2019 Oct 3, 2019 Nov 19, 2019	1.85 1.82 1.67	220.95 220.98 221.13	Monitoring Well
MW206-19	Aug 29, 2019 Oct 3, 2019 Nov 19, 2019	1.18 1.07 1.01	220.88 220.98 221.04	Monitoring Well
MW207-19	Aug 29, 2019 Oct 3, 2019 Nov 19, 2019	2.03** 3.05 2.89	222.23** 221.21 221.37	Monitoring Well
MW208-19	Aug 29, 2019 Oct 3, 2019 Nov 19, 2019	1.91 0.81 1.34	220.62 221.71 221.18	Monitoring Well
BH301-19	Oct 24, 2019 Nov 19, 2019	3.44 3.27	221.47 221.64	Monitoring Well
BH302-19	Oct 21, 2019	1.6*	221.7*	During Drilling
BH303-19	Oct 17, 2019	7.8*	215.0*	During Drilling
BH304-19	Oct 21, 2019	4.0	221.1	During drilling

**Boreholes stabilized with drilling mud*

***Possible erroneous result*

4.0 GEOTECHNICAL CONSIDERATIONS

The following recommendations are based on the borehole information and are intended to assist designers. Recommendations should not be construed as providing instructions to contractors, who should form their own opinions about site conditions. It is possible that subsurface conditions beyond the borehole locations may vary from those observed. If significant variations are found before or during construction, Cambium should be contacted so that we can reassess our findings, if necessary.

4.1 General Site Preparation

Any existing fill material and organic materials encountered should be excavated and removed from beneath the proposed building footprint; additionally, this material should be excavated and removed to a minimum distance of 3 m around the building footprint. The fill material may potentially be left in place beneath any proposed non-structural or landscaped areas, the fill material includes, but is not limited to the fill materials identified in this report, any topsoil and materials with significant quantities of organics and deleterious materials (i.e., construction debris, asphalt etc.) are not appropriate for use as fill below parking and driving areas.

The exposed subgrade should be proof-rolled and inspected by a qualified geotechnical engineer prior to placement of any granular fill. Any loose/soft soils identified at the time of proof-rolling that are unable to uniformly be compacted should be sub-excavated and removed. The excavations created through the removal of these materials should be backfilled with approved engineered fill consistent with the recommendations provided below.

The near surface sand and silty sand soils can be very unstable if they are wet or saturated. Such conditions are common in the spring and late fall. Under these conditions, temporary use of granular fill, and possible reinforcing geotextiles, may be required to prevent severe rutting on construction access routes.

4.2 Excavations

It is assumed that the building will be constructed as a slab-on-grade structure with no basement levels. Cambium should be contacted for additional recommendations if basement levels are added as the design progresses.

Excavations will extend through surficial shallow fill materials, native sand and sandy/silty deposits. The stabilized groundwater elevations in the monitoring wells from August 2019 to November 2019 ranged from 220.62 masl to 221.71 masl, as listed in Table 5.

Temporary excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA). The soils above the groundwater levels at this site would generally be classified as Type 3 soils in accordance with OHSA, with unsupported side slopes no steeper than 1H:1V to the bottom of the excavation. Soils encountered below the groundwater levels should be considered a Type 4 soil and may be excavated with unsupported side slopes no steeper than 3H:1V. It is recommended that temporary shoring be constructed to support the open excavations at this property below groundwater levels.

Excavation side slopes should be protected from exposure to precipitation and associated ground surface runoff and should be inspected regularly for signs of instability. If localized instability is noted during excavations or if wet conditions are encountered, the side slopes should be flattened as required to maintain safe working conditions. If required, the excavation sidewalls should be fully supported (shored). The excavation support system should be designed to resist the lateral earth pressures of the soils, hydrostatic pressures and any surcharges while limiting ground movements to tolerable levels. It is a common practice for a specialist contractor to design and install the excavation support system. Since the proposed design founding elevations and the need for a shoring have not been determined at the time this report was prepared, the geotechnical parameters to be used in the shoring design, if required, should be determined during the detailed design stage once the excavation schemes are known.

4.3 Dewatering

As discussed in Section 3.6, the stabilized groundwater elevations in the monitoring wells from August 2019 to November 2019 ranged from 220.62 masl to 221.71 masl. It is noted that the groundwater table is influenced by seasonal fluctuations and climatic events.

Based on the groundwater conditions measured in the monitoring wells and the anticipated founding elevations, depending on the time of year, the foundation excavations may be below the local groundwater table and within the sandy/silty deposits. The sandy/silty deposits encountered in the boreholes are highly susceptible to disturbance by groundwater seepage. In this regard, depending on the time of year the construction takes place, localized pro-active dewatering of the groundwater levels to at least 1 m below the foundation excavation elevations using a well-point system may be required to maintain the integrity of the excavation. If possible, it is recommended that construction excavations during the wet/spring seasons be avoided to reduce the need for pro-active dewatering.

Overall, it is anticipated that groundwater seepage is likely to occur where excavations are made below the groundwater level, it should be possible to handle the groundwater inflow from this deposit by pumping from well filtered sumps in the floor of the excavation, using suitably sized pumps (within the top 300 mm of the groundwater table. A dewatering system such as well-points will likely be required to depress the groundwater level below deeper excavation bases. If a well-point dewatering system is used, registration on the Environmental Activity and Sector Registry (EASR) or a Permit to Take Water (PTTW) may be required from the Ministry of the Environment Conservation and Parks (MOECP) as pumping could exceed 50 m^3/day or 400 m^3/day respectively.

A Hydrogeological Assessment Report is being completed concurrently with this geotechnical assessment report. Please refer to the Hydrogeological Assessment Report for additional recommendations.

4.4 Foundation Design

It is our understanding that the proposed development at the Site will consist of a 14-storey condominium apartment building with four above ground parking levels. It is assumed that the building will be constructed as a slab-on-grade structure with no basement levels.

The structure may be supported by conventional strip/spread footing sitting on undisturbed, dewatered native sandy / silty sand deposits. Footings situated on these deposits at or below depths of 1.5 m below the final adjacent grade may be designed for geotechnical resistance at Ultimate Limit States (ULS) of 150 kPa and a geotechnical resistance at Serviceability Limit States (SLS) of 100 kPa (assuming 25 mm total and 19 mm differential settlement). If a higher allowable bearing capacity than that outlined above is required, it may be achievable at a greater depth. The recommended allowable bearing capacities at the borehole locations are summarized in Table 6.

Table 6 Allowable Bearing Pressures at Required Depths

Borehole	Depth (mbgs)	Elevation (masl)	Maximum Geotechnical Reaction SLS (kPa)	Maximum Geotechnical Reaction ULS (kPa)	Soil Type
BH303-19	1.5 - 9 Below 9	221.3 – 213.8 Below 213.8	100 275	150 350	Sand Till
BH302-19	1.5 – 11 Below 11	221.8 – 212.3 Below 212.3	100 275	150 350	Sand Till
BH301-19	1.5 – 9.6	223.4 – 215.3	100	150	Sand to Till
BH304-19	1.5 – 9.6	223.6 –215.5	100	150	Sand to Till

The existing sand and silty sand deposits at shallow depths may be considered unsuitable for supporting conventional strip/spread footings for the condominium building. It is recommended that Driven Friction Piles seated within the very dense silty/sandy material is a feasible and practical foundations system for the proposed multi storey condominium building.

4.4.1 Driven Steel Piles

Both thick-walled concrete filled pipe piles and high capacity steel H-piles could be considered for this project. Foundation loads may be carried on pile frictions. It is recommended that the

resistance of the pile base/tip to be neglected. Table 7 provides parameters for calculating the unfactored geotechnical shaft skin friction at ULS.

Table 7 Designed Skin Friction for Driven Pile

Soil Strata	Depth (mbgs)	Maximum Skin Friction (kPa)
Loose to compact sand	(1.5 m – 11 m)	15
Dense to very dense silty sand or sandy silt	(11 m – 28 m)	75

The length of pile required to support the design load can be estimated using skin friction for a specific pile type with a known cross section. For the installation of driven piles, the criteria of pile driving termination will be dependent on the pile driving equipment and length of pile. Therefore, the criteria should be established at the time of construction when the piling equipment is known. The criteria must also be selected to ensure that the piles are not overdriven to avoid possible damage to the piles. Piling operations should be inspected on a full-time basis by geotechnical personnel.

For lateral soil-pile interaction analysis, the horizontal subgrade reaction (lateral spring parameters) and ultimate lateral resistance may be calculated from the following expression if the soil is primarily cohesionless at the site:

$$ks = nh(z/d)$$

$$Pult = 3\gamma' z\, KP$$

Where ks = Coefficient of horizontal subgrade reaction (kPa/m);

nh = Constant of horizontal subgrade reaction (kPa/m);

d = Pile width (m); and

z = Depth (m)

γ' = effective unit weight (kN/m^3)

Table 8 summarizes the values of nh for the soil encountered during the borehole investigation.

Table 8 Design Parameters for Lateral Resistance

Soil Strata	Depth (mbgs)	Bulk Unit Weight (kN/m^3)	Passive Earth Pressure Coefficient	n_h (kPa/m)
Loose to compact sand	(1.5 m – 11 m)	19.0	2.8	3,000
Dense to very dense silty sand	(11 m – 28 m)	20.0	3.2	10,000

Group action for lateral loading should be considered when the pile spacing in the direction of loading is less than 8d. Group action can be evaluated by reducing the coefficient of horizontal subgrade reaction in the direction of loading using a reduction factor, R, as shown in Table 9.

Table 9 Reduction Factor Due to Pile Spacing

Pile Spacing d = Pile Diameter or Width	Subgrade Reaction Reduction Factor, R
8d	1.00
4d	0.75
2d	0.40
d	0.25

4.5 Slope Stability

On November 21, 2019, a Cambium geotechnical analyst conducted a visual inspection of the slope at the southern property line of the site based on the Ontario Ministry of Natural Resources ‘Table 8.1 – Geotechnical Principles for Stable Slopes’ (MNR, 1998).

The stability of the slope and the table land slope were assessed on-site following MNR (1998) principles. As per the appended Slope Stability Rating Chart, the total rating values sum to 20 for the overall slope, indicating the slope has a low potential for instability.

1. Slope Inclination – The slope angle is generally 18° to 26°, giving a rating of 6 for the overall slope based on the steepest sections.

2. Soil Stratigraphy – Based on the stratigraphy, for the purposes of Table 8.1, the slope is considered to consist of native sand soil, giving a rating of 6.
3. Seepage from Slope Face – At the time of the investigation no seepage from the slope face was observed, giving a best-case rating of 0.
4. Slope Height – The height for the steepest section of slope is between 2.1 m and 5.0 m providing a rating value of 2.
5. Vegetation Cover on Slope Face – Based on observations during the site visit, the slope is lightly vegetated primarily with weeds and wild grasses, giving a rating value of 4 for the slope.
6. Table Land Drainage – The table land exhibits minor drainage over the slope with no active erosion, resulting in a value of 2.
7. Proximity of Watercourse to Slope Toe – Hotchkiss Creek is generally greater than 15 m from the toe of the slope giving a rating value of 0.
8. Previous Landslide Activity – No apparent previous landslide activity was seen at the time of the investigation, giving a best case rating of 0.

Based on the above, the overall Slope Instability Rating for the slope is 20, which indicates a low potential for instability (MNR, 1998).

No boreholes were advanced at the base of the slope, as it was outside of the scope of this investigation.

4.6 Seismic Site Classification

The structures should be designed to withstand forces caused by seismic activity in accordance with the Ontario Building Code (OBC). To determine a site classification, it was assumed that soils as encountered in the samples retrieved in the boreholes would remain continuous to a minimum depth of 30 m below the bottom of any foundations. In addition, average ‘N60’ values for soils were assumed for the site. Based on these assumptions, in combination with the known local geological conditions, the site class for the proposed building

is “D” as per Table 4.1.8.4.A, Site Classification for Seismic Site Response, OBC 2012. These earthquake/seismic design parameters should be reviewed in detail by the structural engineer and incorporated into the design as required.

Peak ground acceleration and spectral acceleration (period of 0.2 seconds) for the site are calculated to be 0.064g and 0.108g respectively using the 2015 National Building Code Seismic Hazard Calculation. A detailed report of the calculation and its results can be found in Appendix C.

4.7 Frost Penetration

Based on Ontario Provincial Standard Drawing (OPSD) 3090.101, the typical frost penetration depth for the proposed structure is expected to be approximately 1.5 mbgs. Footings for the proposed structure should be situated at or below this depth for frost penetration or should be protected. If construction is carried out during the winter months, all footing locations where excavated soils become exposed to potential frost penetration should be poured within the same day to prevent potential future settlements. If the footings cannot be poured within the same day the soils are excavated, the surface should be covered with thermal insulation equivalent to 1.5 m of soil cover to prevent potential freezing of the frost susceptible soils at the Site.

It is assumed that any pavement structure thickness will be less than 1.5 m; therefore, grading and drainage are important for good pavement performance and life expectancy. Any utilities should be located below this depth or be appropriately insulated.

4.8 Floor Slabs & Subdrains

For both shallow footings and piled foundation options, it is considered that conventional construction may be used for the building floor slabs. Any soft, loose, wet, and disturbed material should be removed and replaced with approved granular material compacted to 100% of its standard proctor maximum dry density (SPMDD).

The following guidelines assume that a “drained” foundation system will be provided. These guidelines should be revisited if it is decided that the construction of any elevator pits or basements will be watertight.

Perimeter and under floor drainage systems will be also required for the proposed building. The perforated pipes should discharge to a positive outlet such as a storm water sewer or a sump from which the water is pumped. Floor slabs and foundation walls should also be waterproofed.

4.9 Backfill and Compaction

Excavated non-organic fill and native sand soils from the site may be appropriate for use as fill below grading and parking areas, provided that the actual or adjusted moisture content at the time of construction is within a range that permits compaction to required densities. Some moisture content adjustments may be required depending on seasonal conditions. Geotechnical inspections and testing of engineered fill are required to confirm acceptable quality.

Engineered fill for foundations should consist of free-draining granular material meeting the specifications of OPSS 1010 Granular B or an approved equivalent, and should be placed in maximum 200 mm thick lifts compacted to a minimum of 100% SPMDD as confirmed by full time nuclear densometer testing and inspection. Foundation wall backfill should consist of imported free-draining granular material meeting the specifications for OPSS Granular B, or an approved equivalent, compacted to 95% SPMDD, taking care to keep heavy compaction equipment from damaging the walls.

The backfill material, if any, in the upper 300 mm below the pavement subgrade elevation should be compacted to 100% SPMDD in all areas.

4.10 Buried Utilities

Trench excavations should generally consider Type 3 soil conditions which require side slopes no steeper than 1H:1V to the bottom of the excavation. Where very loose or very soft to soft soils are encountered during excavations, trench slopes should generally consider Type 4 soil

conditions which require side slopes no steeper than 3H:1V to the bottom of the excavation. The bedding and cover material for any buried utilities should consist of OPSS 1010 Granular A or B Type II, placed in accordance with pertinent Ontario Provincial Standard Drawings (OPSD 802.013). The bedding and cover material shall be placed in maximum 200 mm thick lifts and should be compacted to at least 98% of SPMDD. The cover material shall be a minimum of 300 mm over the top of the pipe and compacted to 98% SPMDD, taking care not to damage the utility pipes during compaction.

If wet or saturated conditions exist within any utility excavation, consideration should be given to using 19 mm diameter crushed clear stone wrapped in a geotextile filter fabric as pipe bedding.

4.11 Preliminary Pavement Design

The performance of the pavement is dependent upon proper subgrade preparation. All topsoil and organic materials should be removed down to native material and backfilled with approved engineered fill or native material, compacted to 98% SPMDD. The subgrade should be compacted, proof rolled, and inspected by a Geotechnical Engineer. Any areas where rutting or appreciable deflection is noted should be sub-excavated and replaced with suitable fill. The fill should be compacted to at least 98% of SPMDD.

The recommended minimum pavement structure design has been developed for two traffic loading scenario; light duty and heavy duty. The heavy duty design is appropriate for areas where heavy trucks and maintenance vehicles are anticipated to drive while the light duty design is appropriate for areas where no heavy traffic is anticipated. The recommended minimum pavement structure is provided in Table 10.

Table** 10 **Recommended Pavement Structure

Pavement Layer	Compaction Requirements	Heavy Duty (access road)	Light Duty (parking lot)
Surface Course Asphalt	OPSS 310	40 mm HL3 or HL4	40 mm HL3 or HL4
Binder Course Asphalt	OPSS 310	90 mm HL8 (2 lifts)	50 mm HL8
Granular Base	100% SPMDD (ASTM-D698)	150 mm OPSS 1010 Granular A	150 mm OPSS 1010 Granular A
Granular Subbase	98% SPMDD (ASTM-D698)	400 mm OPSS 1010 Granular B	300 mm OPSS 1010 Granular B

Material and thickness substitutions must be approved by the Design Engineer. The thickness of the subbase layer could be increased at the discretion of the Engineer, to accommodate site conditions at the time of construction, including soft or weak subgrade soil replacement.

Compaction of the subgrade should be verified by the Engineer prior to placing the granular fill. Granular layers should be placed in 200 mm maximum loose lifts and compacted to at least 98% SPMDD (ASTM D698) standard. The granular materials specified should conform to OPSS standards, as confirmed by appropriate materials testing. The final asphalt surface should be sloped at a minimum of 2% to promote runoff.

4.12 Design Review and Inspections

Cambium should be contacted to review and approve design drawings, prior to tendering or commencing construction, to ensure that all pertinent geotechnical-related factors have been addressed.

Further, Cambium should be retained to complete testing and inspections during construction operations to examine and approve subgrade conditions, placement and compaction of fill materials, granular base courses, and asphaltic concrete.

5.0 CLOSING

Please note that this report is governed by the attached qualifications and limitations. If you have questions or comments regarding this document, please do not hesitate to contact the undersigned at (705) 719-0700.

Cambium Inc.

Sean O'Mara, P.Geo.
Project Manager

Rob Gethin, P.Eng.
Senior Project Manager

Qualifications and Limitations

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer and, on that basis; Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

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Figures

GEOTECHNICAL INVESTIGATION

CHAYELL HOTELS LTD

220 Bradford Street,
Barrie, Ontario

LEGEND

- Borehole Location
- Infiltration Test Location
- Borehole With Monitoring Well
- Subject Property (approximate)

Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources and Forestry or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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BOREHOLE LOCATION PLAN

Project No.:	9326-002	Date:	November 2019
		Rev.:	
Scale:	1:750	Projection:	NAD 1983 UTM Zone 17N
Created by:	TLC	Checked by:	RG
Figure:	1		

O:\GIS\project_MXDs\9300-9399\9326-002 Chayell Hotels Ltd. - Geotech & Hydro-G - 220 Bradford Street, Barrie\2019-11-22 FIG 1 Borehole Location Plan.mxd

Appendix A

Borehole Logs

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Log of Borehole: BH301-19

Client: Chayell Hotels Ltd.
Project Name: Geotech Investigation - 220 Bradford St.
Project No.: 9326-002
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: October 21, 2019
Location: 220 Bradford Street, Barrie ON
UTM: 17T 604094, 4914446
Elevation: 224.91 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
0		Sand: Brown sand, with organics, trace gravel, trace clay, moist, very loose, FILL	1	SS	40	1			Cap; Grout; Bentonite Plug; PVC Standpipe	Top of Standpipe (TOS) Elevation : 226.10 mASL Groundwater measured at 3.27 mbgs (221.64 mASL) on November 19th, 2019 GSA SS1: 5% Gravel 77% Sand 13% Silt 4% Clay
224 — 1		Sand: Brown sand, some gravel, trace organics, moist, loose	2	SS	50	5				
		Compact	3	SS	70	13				
223 — 2										
			4	SS	80	17			Sand Pack; PVC Screen	
222 — 3										
			5	SS	80	12				
221 — 4										
		Saturated								
			6	SS	80	12				
220 — 5										
219 — 6										
		Sandy Silt: Grey sandy silt, trace gravel, trace clay, saturated, compact	7	SS	90	13			Cap	

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Log of Borehole: BH301-19

Client: Chayell Hotels Ltd. **Project Name:** Geotech Investigation - 220 Bradford St. **Project No.:** 9326-002

Contractor: Walker Drilling **Method:** Hollow Stem Augers **Date Completed:** October 21, 2019

Location: 220 Bradford Street, Barrie ON **UTM:** 17T 604094, 4914446 **Elevation:** 224.91 mASL

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
218 / 7										
217 / 8		Loose	8	SS	90	8				
216 / 9		Compact	9	SS	100	15				
215 / 10		Borehole terminated at 9.6 mbgs								Groundwater first observed at 2.3 mbgs.

Logged By: BW **Input By:** CM

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Log of Borehole: BH302-19

Client: Chayell Hotels Ltd.
Project Name: Geotech Investigation - 220 Bradford St.
Project No.: 9326-002
Contractor: Walker Drilling
Method: Hollow Stem Augers + Mud Rotary
Date Completed: October 17-18, 21, 2019
Location: 220 Bradford Street, Barrie ON
UTM: 17T 604119, 4914426
Elevation: 223.27 mASL

Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
223	0		Asphalt: (50 mm)								
			Concrete: (150 mm)								
			Sand: Brown sand, trace gravel, trace silt, moist, compact, FILL	2	SS	60	11				
222	1										
			Sand: Brown sand, some silt, trace gravel, saturated, compact	3	SS	60	14				
221	2										
				4	SS	70	14				
	3										
220				5	SS	70	12				
	4										
219											
	5			6	SS	70	13				
218											
	6										
217			Sandy Silt: Grey sandy silt, trace clay, saturated, loose	7	SS	40	7				Switched drilling method to mud rotary at 6.1 mbgs

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Log of Borehole: BH302-19

Client: Chayell Hotels Ltd. **Project Name:** Geotech Investigation - 220 Bradford St. **Project No.:** 9326-002

Contractor: Walker Drilling **Method:** Hollow Stem Augers + Mud Rotary **Date Completed:** October 17-18, 21, 2019

Location: 220 Bradford Street, Barrie ON **UTM:** 17T 604119, 4914426 **Elevation:** 223.27 mASL

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
7 / 216										
		Compact	8	SS	50	22				
8 / 215										
9 / 214		With clay, firm, wet	9	SS	100	5				
10 / 213										
11 / 212		Trace clay, trace gravel, saturated, very dense	10	SS	90	50/ 140 mm				
12 / 211		Dense	11	SS	60	46				
13 / 210										

Logged By: BW **Input By:** CM

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Log of Borehole: BH302-19

Client: Chayell Hotels Ltd. **Project Name:** Geotech Investigation - 220 Bradford St. **Project No.:** 9326-002

Contractor: Walker Drilling **Method:** Hollow Stem Augers + Mud Rotary **Date Completed:** October 17-18, 21, 2019

Location: 220 Bradford Street, Barrie ON **UTM:** 17T 604119, 4914426 **Elevation:** 223.27 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
14 / 209										
			12	SS	70	42				
15 / 208		Some gravel, very dense	13	SS	40	50/ 280 mm				
16 / 207										
17 / 206			14	SS	50	50/ 290 mm				
18 / 205		Trace gravel	15	SS	60	50/ 230 mm				
19 / 204										
20 / 203			16	SS	60	50/ 300 mm				

Logged By: BW **Input By:** CM

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Log of Borehole: BH302-19

Client: Chayell Hotels Ltd.
Project Name: Geotech Investigation - 220 Bradford St.
Project No.: 9326-002
Contractor: Walker Drilling
Method: Hollow Stem Augers + Mud Rotary
Date Completed: October 17-18, 21, 2019
Location: 220 Bradford Street, Barrie ON
UTM: 17T 604119, 4914426
Elevation: 223.27 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
202 / 21										
			17	SS	70	50/ 240 mm				
201 / 22										
200 / 23		Silty Sand: Grey silty sand, trace clay, saturated, dense	18	SS	90	47				
199 / 24										
		Dense	19	SS	70	44				
198 / 25										
197 / 26		Silt: Grey silt, trace sand, trace clay, very dense	20	SS	80	50/ 255 mm				GSA SS20: 0% Gravel 7% Sand 88% Silt 5% Clay
27										

Logged By: BW
Input By: CM

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Log of Borehole: BH302-19

Client: Chayell Hotels Ltd.
Project Name: Geotech Investigation - 220 Bradford St.
Project No.: 9326-002
Contractor: Walker Drilling
Method: Hollow Stem Augers + Mud Rotary
Date Completed: October 17-18, 21, 2019
Location: 220 Bradford Street, Barrie ON
UTM: 17T 604119, 4914426
Elevation: 223.27 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
196 / 28		Dense	21	SS	60	43				
195 / 29		Compact	22	SS	50	28				
194 / 30										
193 / 31		Very dense	23	SS	40	50/ 255 mm				
192 / 32		Borehole terminated at 30.9 mbgs								Borehole caving at 5.6 mbgs upon completion.

Logged By: BW
Input By: CM

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Log of Borehole: BH303-19

Client: Chayell Hotels Ltd.
Project Name: Geotech Investigation - 220 Bradford St.
Project No.: 9326-002
Contractor: Walker Drilling
Method: Hollow Stem Augers + Mud Rotary
Date Completed: October 16-17, 2019
Location: 220 Bradford Street, Barrie ON
UTM: 17T 604143, 4914448
Elevation: 222.82 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
0 / 222		Asphalt: (50 mm)								
		Concrete: (150 mm)								
		Sand: Brown sand, some gravel, trace silt, moist, very loose FILL	2	SS	80	3				
1 / 221		Sand: Brown sand, some gravel, trace silt, trace clay, occasional cobble, moist, very loose	3	SS	70	3				GSA SS3: 10% Gravel 83% Sand 5% Silt 2% Clay
2 / 220			4	SS	70	12				
3 / 219			5	SS	50	8				
4 / 218		Silty Sand: Grey silty sand, some gravel, trace clay moist, very loose	6	SS	80	6				
5 / 217			7	SS	80	4				Switched drilling method to mud rotary at 6.1 mbgs
6										

Logged By: CM
Input By: SB

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Log of Borehole: BH303-19

Client: Chayell Hotels Ltd. **Project Name:** Geotech Investigation - 220 Bradford St. **Project No.:** 9326-002

Contractor: Walker Drilling **Method:** Hollow Stem Augers + Mud Rotary **Date Completed:** October 16-17, 2019

Location: 220 Bradford Street, Barrie ON **UTM:** 17T 604143, 4914448 **Elevation:** 222.82 mASL

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
216 / 7										
215 / 8		Some clay, wet, loose	8	SS	100	4				
214 / 9		Dense	9	SS	90	36				
213 / 10										
212 / 11		Trace clay, saturated	10	SS	80	31				
211 / 12										
210 / 13			11	SS	100	30				

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Log of Borehole: BH303-19

Client: Chayell Hotels Ltd.
Project Name: Geotech Investigation - 220 Bradford St.
Project No.: 9326-002
Contractor: Walker Drilling
Method: Hollow Stem Augers + Mud Rotary
Date Completed: October 16-17, 2019
Location: 220 Bradford Street, Barrie ON
UTM: 17T 604143, 4914448
Elevation: 222.82 mASL

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
209 / 14			12	SS	70	31				
208 / 15										
			13	SS	50	33				
207 / 16										
206 / 17			14	SS	90	34				
205 / 18										
		Very dense	15	SS	80	50/ 200 mm				
204 / 19										
203 / 20		Dense	16	SS	80	41				

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Input By: SB

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Log of Borehole: BH303-19

Client: Chayell Hotels Ltd. **Project Name:** Geotech Investigation - 220 Bradford St. **Project No.:** 9326-002

Contractor: Walker Drilling **Method:** Hollow Stem Augers + Mud Rotary **Date Completed:** October 16-17, 2019

Location: 220 Bradford Street, Barrie ON **UTM:** 17T 604143, 4914448 **Elevation:** 222.82 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
202 / 21										
			17	SS	60	48				
201 / 22										
			18	SS	60	44				
200 / 23										
			19	SS	50	50/200 mm				
199 / 24		Very dense								
198 / 25										
			20	SS	50	50/200 mm				
197 / 26										
196 / 27										

Logged By: CM **Input By:** SB

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Log of Borehole: BH303-19

Client: Chayell Hotels Ltd.
Project Name: Geotech Investigation - 220 Bradford St.
Project No.: 9326-002
Contractor: Walker Drilling
Method: Hollow Stem Augers + Mud Rotary
Date Completed: October 16-17, 2019
Location: 220 Bradford Street, Barrie ON
UTM: 17T 604143, 4914448
Elevation: 222.82 mASL

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
195 / 28										
			21	SS	60	50/280 mm				
194 / 29		Dense								
			22	SS	40	30				
193 / 30										
		Compact	23	SS	50	22				
192 / 31										
		Borehole terminated at 30.9 mbgs								Borehole caving at 3.0 mbgs upon completion.
191 / 32										

Logged By: CM
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Log of Borehole: BH304-19

Client: Chayell Hotels Ltd.
Project Name: Geotech Investigation - 220 Bradford St.
Project No.: 9326-002
Contractor: Walker Drilling
Method: Hollow Stem Augers
Date Completed: October 21, 2019
Location: 220 Bradford Street, Barrie ON
UTM: 17T 604093, 4914460
Elevation: 225.10 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
225 — 0		Sand: Brown sand, with organics, some gravel, moist, very loose, FILL	1	SS	10	3				
		Sand: Brown sand, some gravel, trace organics, moist, loose	2	SS	40	8				
224 — 1		Trace silt	3	SS	40	8				
223 — 2		Some silt, less organics, compact	4	SS	50	20				
222 — 3			5	SS	60	25				
221 — 4		Saturated	6	SS	60	20				
220 — 5			7	SS	90	17				
219 — 6										

Logged By: BW
Input By: CM

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Log of Borehole: BH304-19

Client:	Chayell Hotels Ltd.	**Project Name:**	Geotech Investigation - 220 Bradford St.	**Project No.:**	9326-002
Contractor:	Walker Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	October 21, 2019
Location:	220 Bradford Street, Barrie ON	**UTM:**	17T 604093, 4914460	**Elevation:**	225.10 mASL

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
218 / 7										
		Silty Sand: Grey silty sand, trace gravel, saturated, loose	8	SS	90	9				
217 / 8										
216 / 9			9	SS	90	15				GSA SS9: 1% Gravel 67% Sand 26% Silt 6% Clay
215 / 10		Borehole terminated at 9.6 mbgs								Caving at 4.6 mbgs and water level at 4.0 mbgs upon completion

Logged By: BW **Input By:** CM

Appendix B

Physical Laboratory Testing Results

Grain Size Distribution Chart

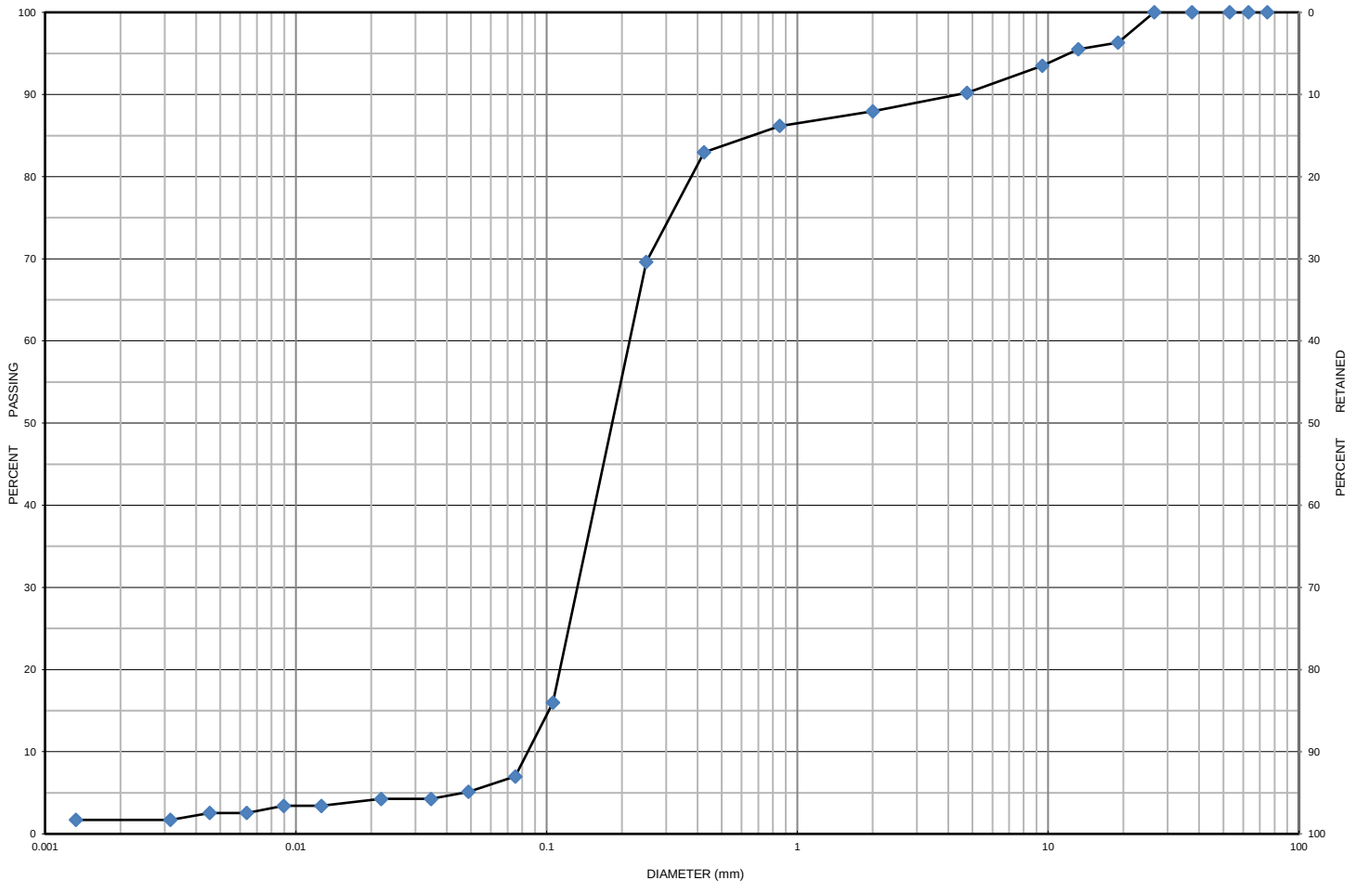
Project Number: *9326-002* **Client:** *ChayHotels Ltd.*

Project Name: *Geotech & Hydro-G - 220 Bradford Street, Barrie, ON*

Sample Date: *October 16-18 & 21, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 301-19 SS 3* **Depth:** *1.5 m to 2 m* **Lab Sample No:** *S-19-0932*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 301-19	SS 3	1.5 m to 2 m	10	83	7		16.4

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand some Gravel trace Silt trace Clay	SP	0.2200	0.1400	0.0840	2.62	1.06

Issued By: _____ *Date Issued:* *November 11, 2019*

(Senior Project Manager)

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Grain Size Distribution Chart

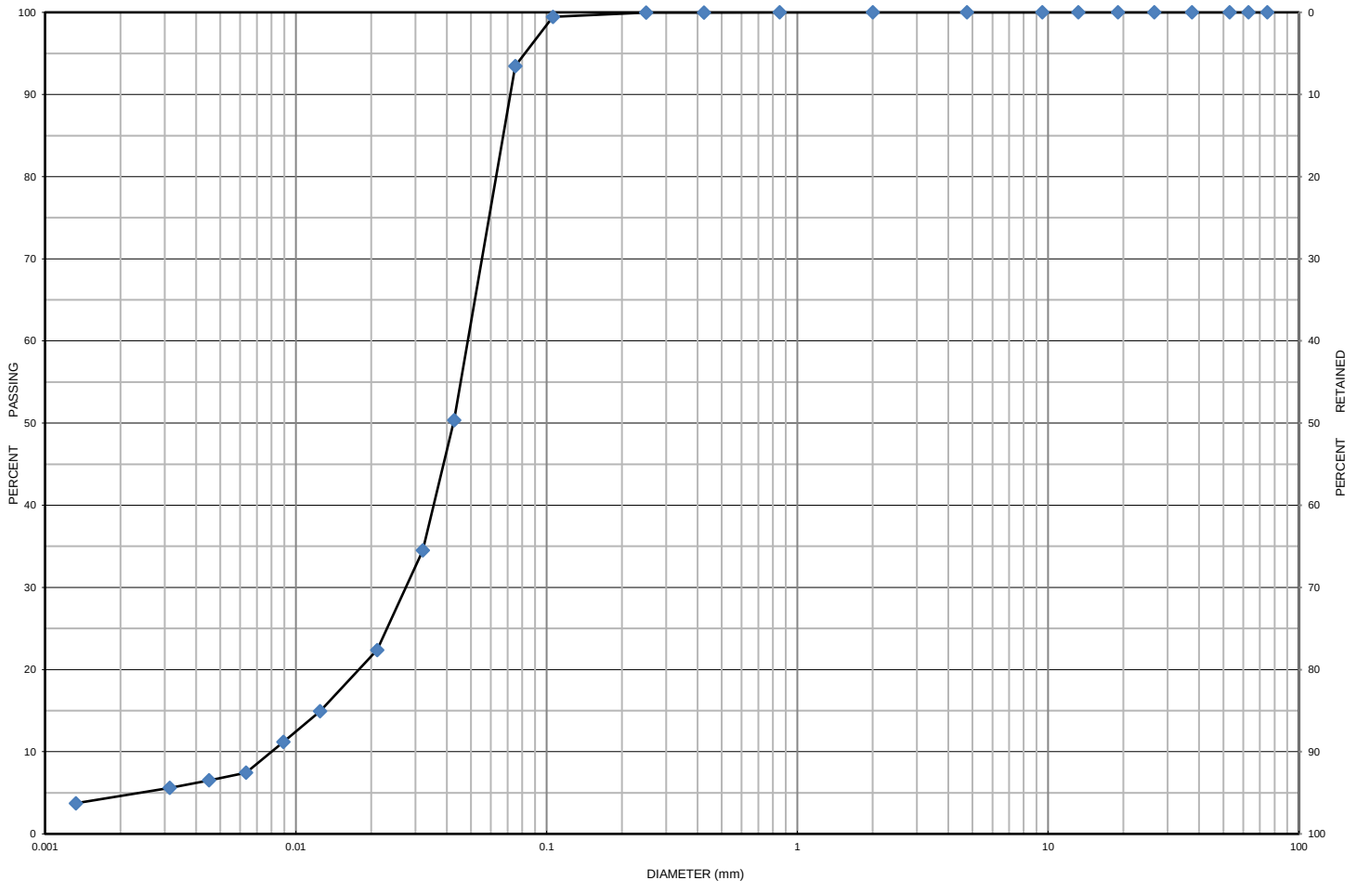
Project Number: *9326-002* **Client:** *ChayHotels Ltd.*

Project Name: *Geotech & Hydro-G - 220 Bradford Street, Barrie, ON*

Sample Date: *October 16-18 & 21, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 302-19 SS 20* **Depth:** *25.9 m to 26.4 m* **Lab Sample No:** *S-19-0929*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 302-19	SS 20	25.9 m to 26.4 m	0	7	93		21.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silt trace Sand trace Clay	ML	0.0490	0.0275	0.0025	19.60	6.17

Issued By: _____ *Date Issued:* *November 11, 2019*

(Senior Project Manager)

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Grain Size Distribution Chart

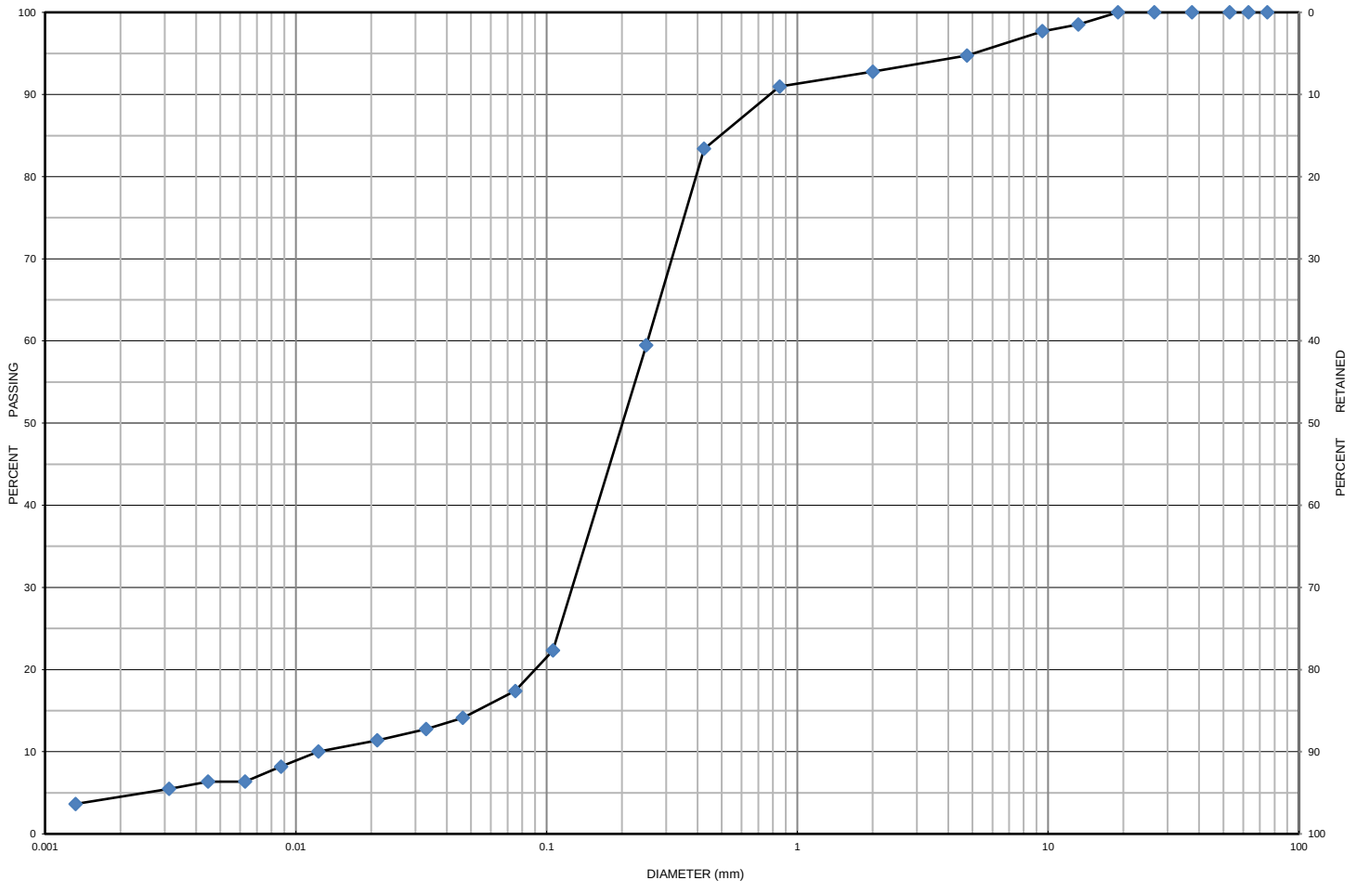
Project Number: *9326-002* **Client:** *ChayHotels Ltd.*

Project Name: *Geotech & Hydro-G - 220 Bradford Street, Barrie, ON*

Sample Date: *October 16-18 & 21, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 303-19 SS 1* **Depth:** *0 m to 0.6 m* **Lab Sample No:** *S-19-0931*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 303-19	SS 1	0 m to 0.6 m	5	77	17		13.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand some Silt trace Gravel trace Clay	SM	0.2600	0.1400	0.0130	20.00	5.80

Issued By: _____ *Date Issued:* *November 11, 2019*

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Grain Size Distribution Chart

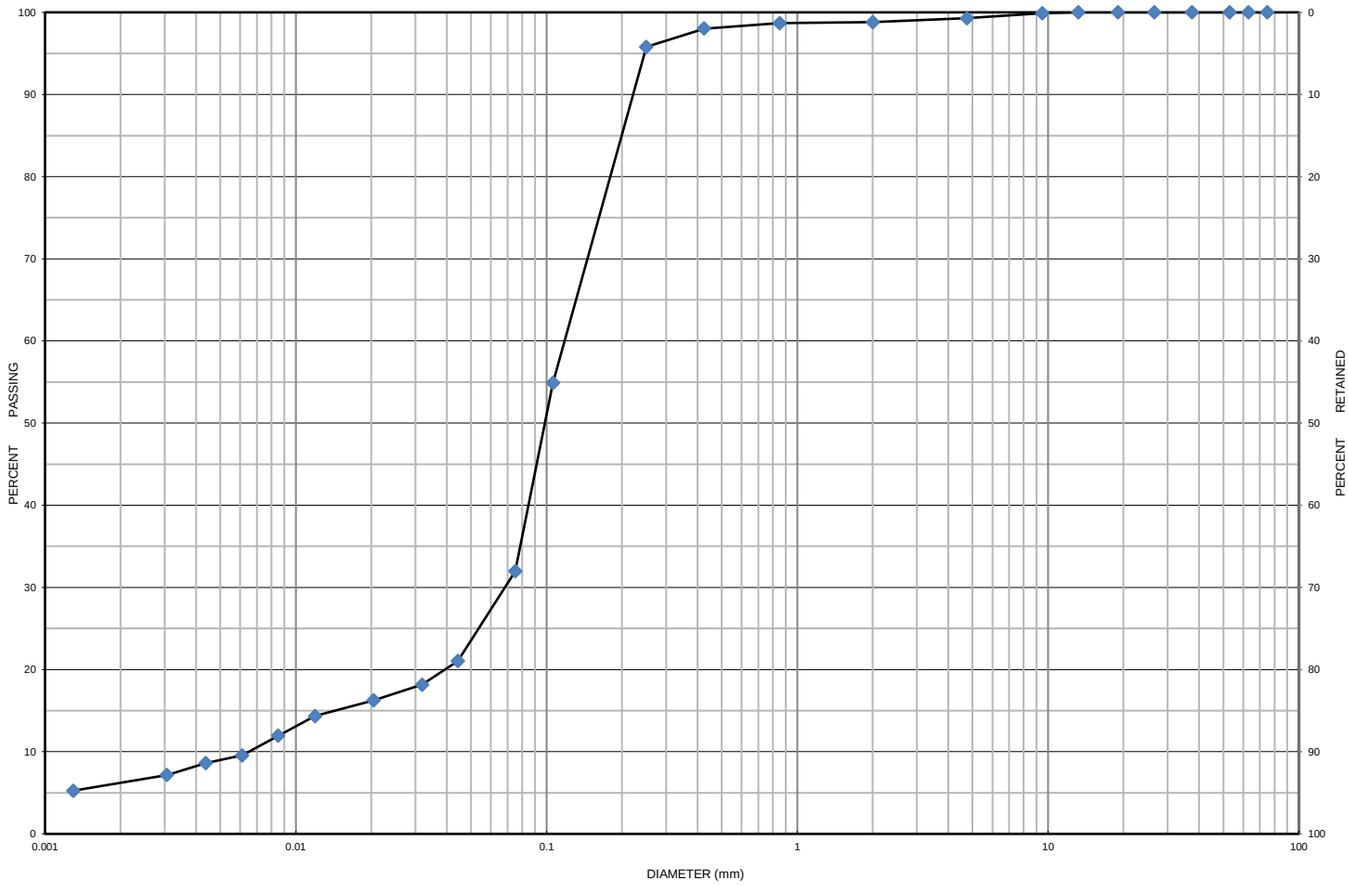
Project Number: *9326-002* **Client:** *ChayHotels Ltd.*

Project Name: *Geotech & Hydro-G - 220 Bradford Street, Barrie, ON*

Sample Date: *October 16-18 & 21, 2019* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 304-19 SS 9* **Depth:** *9.5 m to 9.6 m* **Lab Sample No:** *S-19-0930*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 304-19	SS 9	9.5 m to 9.6 m	1	67	32		19.1

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand trace Gravel trace Clay	SM	0.1250	0.0690	0.0065	19.23	5.86

Issued By: _____ *Date Issued:* *November 11, 2019*

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Appendix C

2015 National Building Code Seismic Hazard Values

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 44.376N 79.693W **User File Reference:** 220 Bradford Street, Barrie 2019-11-22 19:56 UT

Requested by: Cambium Inc.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.081	0.050	0.032	0.011
Sa (0.1)	0.111	0.072	0.048	0.017
Sa (0.2)	0.108	0.072	0.049	0.019
Sa (0.3)	0.093	0.063	0.043	0.017
Sa (0.5)	0.077	0.052	0.036	0.013
Sa (1.0)	0.047	0.031	0.021	0.006
Sa (2.0)	0.025	0.016	0.010	0.003
Sa (5.0)	0.006	0.004	0.002	0.001
Sa (10.0)	0.003	0.002	0.001	0.000
PGA (g)	0.064	0.041	0.027	0.009
PGV (m/s)	0.064	0.040	0.026	0.008

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information