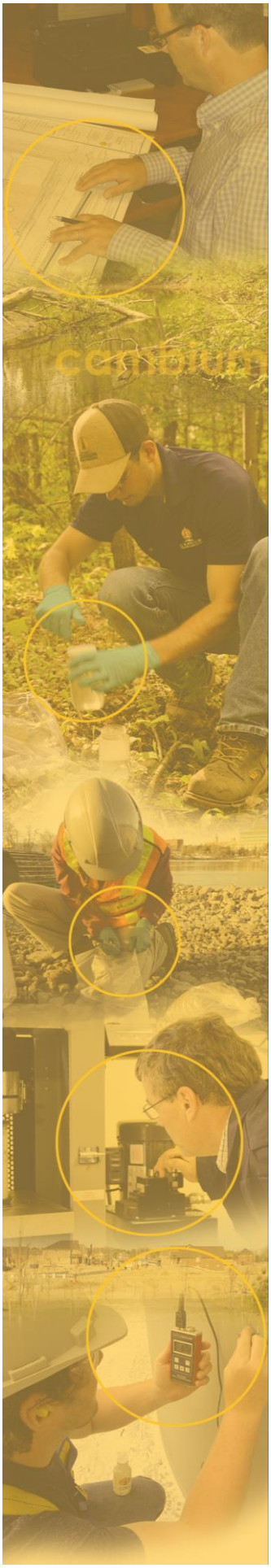


Preliminary Geotechnical Investigation Report

80 Big Bay Point Road & 315 Bayview Drive, Barrie, Ontario

Cambium Reference No.: 12689-001

July 20, 2021

Prepared for: Tonlu Holdings Limited

Cambium Inc.

135 Bayfield street, Suite 102
Barrie, Ontario, L4M 3B3

Telephone: (866) 217.7900
Facsimile: (705) 742.7907

cambium-inc.com

TABLE OF CONTENTS

LIST OF APPENDED FIGURES

LIST OF INSERTED TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

Cambium Inc. (Cambium) was retained by Tonlu Holdings Limited (Client) to complete a geotechnical investigation in support of the proposed industrial development located at 80 Big Bay Point Road & 315 Bayview Drive, Barrie, Ontario (Site).

The property is currently undeveloped and is characterized as a disturbed field with the exception of a few remaining forest blocks, it is noted that the majority of the property was previously treed. It is understood that substantial clearing works occurred at the property circa. 2010 which involved the removal of large caliper trees and grubbing. At the time of writing, it is understood that the proposed development will subdivide the property with up to 31 lots (manufacturing, processing, servicing, storage of goods and raw materials, industrial warehousing and similar uses), two new streets and 3 blocks (Environmental Protection Block, SWM block and Open Space block).

The geotechnical investigation was required to confirm the subsurface conditions at the Site in order to provide geotechnical design parameters as input into the design and construction of the proposed industrial development. A Site Plan, including borehole locations, is included as Figure 1 of this report.

This report presents the methodology and findings of the geotechnical investigation to determine the subsurface soil and groundwater conditions and provide design recommendations. Based on the results of this investigation, the report provides geotechnical engineering recommendations pertaining to the proposed development including soil bearing capacity, excavations, backfill and compaction, and groundwater elevations and dewatering.

As part of the scope of works, Cambium was also retained to complete a hydrogeological assessment which will be provided under a separate cover.

2.0 METHODOLOGY

2.1 BOREHOLE INVESTIGATION

A borehole investigation was completed on April 15, 2021 to assess subsurface conditions at the Site. A total of five boreholes, designated as BH201-21 through BH205-21, were advanced throughout the Site in locations agreed with the Client. All of the boreholes were terminated to a depth of 6.6 m below ground surface (mbgs).

The borehole locations and elevations were surveyed using a Sokkia RTK GPS system. The borehole elevations were tied to geodetic using a known benchmark. The benchmark is a tablet at the Rockwell International Building, set horizontally in the east face of the concrete foundation, 43.2 m west of centerline of Bayview Drive, 32 cm south of northeast corner of building, flush with grade, and with a known elevation of 274.328 meters above sea level (mASL). The borehole UTMs and elevations are provided on the borehole logs in Appendix A. Borehole locations are shown on Figure 1.

Drilling and sampling was completed using a track-mounted drill rig, under the supervision of a Cambium Geotechnical Analyst. The boreholes were advanced to the pre-determined depths by means of continuous flight hollow stem augers with 50 mm O.D. split spoon samplers. Standard Penetration Test (SPT) N values were recorded for the sampled intervals as the number of blows required to drive a split spoon (SS) sampler 305 mm into the soil using a 63.5 kg drop hammer falling 750 mm, as per ASTM D1586 procedures. Soil samples were collected at 0.75 m intervals from 0 to 3 m and at 1.5 m intervals after 3 m. 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, laboratory testing, and storage. Open boreholes were checked for groundwater and general stability prior to backfilling.

Three boreholes BH203-21, BH204-21 and BH205-21 were outfitted as monitoring wells in order to determine the static groundwater elevation 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

Physical laboratory testing, including five sieve and hydrometer analyses (LS-702, 705), was completed on selected soil samples to confirm textural classification and to assess geotechnical parameters. Natural moisture content testing (LS-701) was completed on all retrieved soil samples. Results are presented in Appendix B and are discussed in Section 3.0.

3.0 SUBSURFACE CONDITIONS

Based on the results of the borehole investigation, the subsurface conditions at the site consist of a surficial layer of topsoil overlying brown sand material, which overlies a brown sandy clayey silt to silty clay layer in some of the borehole locations to the termination depths of 6.6 mbgs. The boreholes were terminated in native soils and bedrock was not encountered within the investigation depths.

The borehole locations are shown on Figure 1 and the individual soil units are described in detail below and provided in detail on the borehole logs in Appendix A.

3.1 TOPSOIL

A layer of ±100 mm thick brown topsoil with some organics including fibrous mulch was observed at the surface of all boreholes throughout the Site. This layer was moist at the time of the investigation with a natural moisture content ranging from 12% to 26% based on laboratory testing. Each individual topsoil thickness can be found in the borehole logs in Appendix A.

Assessments of organic matter content or other topsoil quality tests were beyond the scope of this study.

3.2 SAND

Beneath the topsoil in all borehole locations, a layer of sand material was encountered. The sand was brown in colour and contained trace to some amounts of silt and gravel. This sand layer extends to depths of 4.9 mbgs, 6.6 mbgs (termination depth), 6.6 mbgs (termination depth), 4.6 mbgs and 4.6 mbgs in boreholes BH201-21, BH202-21, BH203-21, BH204-21 and BH205-21 respectively. Based on the SPT “N” values between 6 and 29, the sand relative density is generally considered to be loose to compact. The sand material in borehole BH203-21 has SPT “N” values of up to 37 (ranging between 15 and 37), indicating a compact to dense relative density. The natural moisture content of the sand ranges between 4% and 22% based on laboratory testing and was described as moist to wet at the time of the investigation.

Laboratory particle size distribution analysis was completed for three samples of the sand in order to identify the soil texture. The testing results are provided in Appendix B and are summarized in Table 1 based on the Unified Soils Classification System (USCS).

Table 1 Particle Size Distribution – Sand

Borehole	Depth (mbgs)	Description	% Gravel	% Sand	% Silt & Clay	% Moisture content
BH202-21 SS3	1.5 – 2.0	Sand trace Silt trace Gravel	1	95	4	4.3
BH203-21 SS3	1.5 – 2.0	Sand trace Gravel trace Silt	6	90	4	4.9
BH205-21 SS2	0.8 – 1.2	Sand some Gravel some Silt	11	78	11	17.8

3.3 CLAYEY SILT TO SILTY CLAY

A cohesive layer of brown sandy clayey silt to silty clay was encountered beneath the sand soils in boreholes BH201-21, BH204-21 and BH205-21, all extending to a depth of 6.6 mbgs (termination depth). This brown to grey clayey silt to silty clay layer contained trace gravel, various amounts of sand and was described as wetter than plastic limit (WTPL) with natural moisture content ranging from 11% to 47% based on laboratory testing. The SPT N values of the clayey silt to silty clay ranged from 10 to 22, indicating a stiff to very stiff consistency.

Laboratory particle size distribution analysis was completed for two samples of the clayey silt to silty clay in order to identify the soil texture. The testing results are provided in Appendix B and are summarized in Table 2 based on the USCS.

Table 2 Particle Size Distribution – Clayey Silt to Silty Clay

Borehole	Depth (mbgs)	Description	% Gravel	% Sand	% Silt	% Clay	% Moisture content
BH201-21 SS7	6.1 – 6.6	Silty Clay trace Sand trace Gravel	1	9	23	67	41.0
BH204-21 SS6	4.6 – 5.0	Sandy Clayey Silt	0	31	40	29	23.2

3.4 BEDROCK

Bedrock was not confirmed within the investigation depths, all of the boreholes were terminated in native soils at the pre-determined depth of 6.6 mbgs. The elevation of each boreholes and the respective termination depths are provided in Table 3 below.

Table 3 Borehole Termination Depth – Elevations

Borehole	Borehole Elevation (mASL)	Borehole Termination Depth (mbgs)	Borehole Termination Elevation (mASL)
BH201-21	272.19	6.6	265.59
BH202-21	271.99	6.6	265.39
BH203-21	271.51	6.6	264.91
BH204-21	270.97	6.6	264.37
BH205-21	270.02	6.6	263.42

3.5 GROUNDWATER

Groundwater (free water) and caving (sloughing) were noted in the boreholes BH201-21 and BH202-21 during the investigation. Monitoring wells were installed in boreholes BH203-21, BH204-21 and BH205-21 and groundwater was recorded in each of the monitoring wells on April 23, 2021. The groundwater and caving observations are summarized in Table 4.

The moisture content of the soils generally ranged from 4% to 47%. It should be noted that soil moisture and groundwater levels at the Site may fluctuate seasonally and in response to climatic events.

Table 4 Groundwater and Caving Observations

Date	Borehole ID	Borehole Elevation (m)	Depth to Groundwater (mbgs)	Groundwater Elevation (mASL)	Caving Depth (mbgs)
April 15th , 2021 (Date of Drilling)	BH201-21	272.19	2.4	269.79	5.2
	BH202-21	271.99	2.4	269.59	4.9
	BH203-21	271.51	-	-	Open
	BH204-21	270.97	-	-	Open
	BH205-21	270.02	-	-	Open
April 23rd, 2021	BH203-21	271.51	**2.16**	**269.36**	-
	BH204-21	270.97	**2.03**	**268.94**	-
	BH205-21	270.02	**0.54**	**269.47**	-
	MW101*	272.19	**2.26**	**269.94**	-
	MW102*	270.93	**1.06**	**269.86**	-
	MW103*	273.11	**3.77**	**269.34**	-
	MW104*	273.76	4.30	269.47	-
	P1*	271.51	Dry	-	-
	P2*	271.14	**1.29**	**269.85**	-
	P3*	269.92	**4.13**	**265.79**	-
	P4*	271.70	Dry	-	-
May 26th, 2021	BH203-21	271.51	2.19	269.33	-
	BH204-21	270.97	2.10	268.87	-
	BH205-21	270.02	0.75	269.26	-
	MW101*	272.19	2.27	269.93	-
	MW102*	270.93	1.28	269.64	-
	MW103*	273.11	4.29	268.82	-
	MW104*	273.76	**4.29**	**269.48**	-
	P1*	271.51	Dry	-	-
	P2*	271.14	1.41	269.73	-
	P3*	269.92	4.15	265.77	-
	P4*	271.70	Dry	-	-

*Monitoring Wells (*MW101, MW102, MW103, and MW104) and Piezometers (*P1, P2, P3 and P4) were installed by others.*

***Bold** text indicates the high groundwater measurements observed during the monitoring period*

Based on the measured water levels, the static groundwater level at the Site is between 265.77 mASL and 269.94 mASL. However, grey soils, indicating constant saturation, were observed at deeper depths than the measured water levels, indicating that the water table measured in April may be seasonally high. Cambium would urge caution with relying on the groundwater information from Piezometer P3 given the groundwater elevation difference compared with adjacent instruments (±3.5 m).

4.0 GEOTECHNICAL CONSIDERATIONS

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

This report is based on the assumption that the design features relevant to the geotechnical analysis will be completed in accordance with applicable codes, standards, and guidelines of practice. If there are changes to the site development features, or there is any significant variations in the subsurface conditions that are found before or during construction, Cambium should be retained to review the implications of these changes with respect to the contents of this report.

It is assumed that all the proposed lots will be developed with slab on grade single storey structures and municipally serviced. A detailed geotechnical investigation, including additional boreholes across the site is required once more design details are provided.

Based on site observations the existing elevations of the surrounding roadways and boreholes, significant grade raise is not anticipated at this site. Site grading recommendations can be provided depending on need and upon request.

4.1 SITE PREPARATION

The existing topsoil/organic material and any deleterious material (i.e. construction debris, fibrous material, etc.) encountered should be excavated and removed beneath the proposed development area; additionally this material should be excavated and removed to a minimum distance of 3 m around the building footprint(s). Given a substantial amount of large caliper trees have already been removed from the property, Cambium recommends contractors make an allowance for encountering potential deep root systems within the native soils during construction which may lead to over-excavation works.

The exposed subgrade should be proof-rolled and inspected by a qualified geotechnical engineer prior to placement of any granular fill or foundations. 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 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 FROST PENETRATION

Based on climate data and design charts, the maximum frost penetration depth below the surface at the site is estimated at 1.5 mbgs.

Exterior footings for the proposed structures should be situated at or below this depth for frost penetration or should be appropriately protected.

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

4.3 EXCAVATIONS AND SHORING

All excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA). The generally loose to dense sand may be classified as Type 3 soils above the groundwater table in accordance with OHSA. Type 3 soils may be excavated with unsupported side slopes no steeper than 1H:1V. If the groundwater table is encountered during construction, below the groundwater table the soils may be classified as Type 4 soils and may be excavated with unsupported side slopes no steeper than 3H:1V.

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 excavation or if wet conditions are encountered, the side slopes should be flattened as required to maintain safe working conditions or the excavation sidewalls must be fully supported (shored). In the event that shoring is required, soldier piles and lagging is likely the most cost-effective method.

4.4 DEWATERING

The groundwater table was encountered across the site and appeared to vary in depth as measured in the monitoring wells. The groundwater measurements from the monitoring wells and piezometers are provided in Table 4 and indicate that the groundwater table ranged between 265.77 mASL and 269.94 mASL at the time of measurement. It is noted that the elevation of the groundwater table will vary due to seasonal conditions and in response to heavy precipitation events, further, perched groundwater conditions may exist during seasonal wet periods.

It is anticipated that most of the excavations will be above the groundwater elevation based on the groundwater measurements during our investigation. It should be noted that the shallow groundwater levels (BH205-21 – installed by Cambium, and MW102 and P3 – installed by others) were recorded within the location of the proposed SWM block in the northeast corner of the site where ground elevation was lower.

Overall, it is anticipated that some groundwater seepage is likely to occur, depending on the construction season and locations of the excavations, however 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. If significant groundwater is encountered at the time of construction at the proposed excavation depths, 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. 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 50,000 L/day or 400,000 L/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

4.5 BACKFILL AND COMPACTION

Excavated topsoil or organic soil from the Site is not appropriate for use as fill below grading areas. Excavated sand soils not containing organics may be appropriate for use as fill below grading 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 upon seasonal conditions.

Foundation wall and any buried utility backfill material should consist of free-draining imported granular material. This should be accomplished using well graded Granular B Type 1 material complying with OPSS 1010. The fill should be placed in maximum 300 mm thick lifts and should be compacted to 98% of SPMDD within the foundation walls, and 95% of SPMDD on the exterior of the foundation.

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

Geotechnical inspections and testing of engineered fill are required to confirm acceptable quality.

4.5.1 ENGINEERED FILL

Any engineered fill below foundations should be placed in lifts appropriate to the type of compaction equipment used, and be compacted to a minimum of 100% of standard Proctor maximum dry density (SPMDD), as confirmed

by nuclear densometer testing. If native soils from the site are not used as engineered fill, imported material for engineered fill should consist of clean, non-organic soils, free of chemical contamination or deleterious material. The moisture content of the engineered fill will need to be close enough to optimum at the time of placement to allow for adequate compaction. Consideration could be given to using a material meeting the specifications of OPSS 1010 Granular B Type II material near the water table

When the fill is treated as an engineered fill to support structural elements such as foundations and/or floor slabs the following is recommended for the construction of engineered fill:

I. Remove any and all existing vegetation, surficial topsoil/ organics, organic fills or fills and any loose soils to a competent subgrade for a suitable envelope;

II. As a minimum, the area of the engineered fill should extend horizontally 1 m beyond the outside edge of the foundations then extend downward at a 1H:1V slope to the competent native soil;

III. The subgrade or base of the engineered fill area must be approved by Cambium prior to placement of any new fill, to ensure that suitability of subgrade condition;

IV. Place approved OPSS 1010 Granular ‘B’ Type I or Granular B Type II material at a moisture content at or near optimum moisture in suitable maximum 200 mm thick lifts, compacted to 100% of SPMDD. Any frost penetration into the fill material must be removed prior to placement of subsequent lifts of fill and reviewed by Cambium;

V. Full time testing and inspection of the engineered fill will be required for it to be used as a founding material, as outlined in Section 4.2.2.2 of the Ontario Building Code.

VI. To account for varying founding soils, the footings and foundation walls should be suitably reinforced to mitigate potential settlement cracking.

4.6 FOUNDATION DESIGN

Design and construction recommendations for potential foundation systems are outlined below. It is understood that the site may be regraded and our foundation recommendations may change depending upon the final grades. Cambium should be contacted to review the final grading plan and provide any necessary changes to our foundation recommendations.

It is noted that the foundation recommendations have been developed based on the proposed industrial development, if additional structures are to be constructed at the site in different locations Cambium should be contacted for further foundation recommendations.

If the site is prepared as outlined above, the structures can be supported on standard strip and spread footings placed at frost depth (1.5 m depth) or below, founded on the generally compact sand material, prepared as outlined

in Section 4.1. Footings may be designed for an allowable bearing capacity of 130 kPa at serviceability limit state (SLS) and 175 kPa at ultimate limit state (ULS). If the footings are to extend to different depths, Cambium should be contacted to provide revised recommendations. Settlement potential at the SLS loading is less than 25 mm and differential settlement should be less than 10 mm.

Given the loose to compact nature of the native soils in some locations, if loose soil is encountered at footing depths it is recommended that trenches for the footings be subexcavated a minimum of 600 mm and widened 600 mm, taking care to remain above the groundwater table, and backfilled with engineer fill per the recommendations in Section 4.5.1.

The quality of the subgrade should be inspected by Cambium during construction, prior to constructing the footings, to confirm bearing capacity estimates.

4.7 LATERAL EARTH PRESSURE

The appropriate values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows in Table 5:

Table 5 Earth Pressure Design Values

Stratum/Parameter	γ	φ	Ka	Ko	Kp
Native Sand	19	32	0.31	0.47	3.26
Native Silty Clay to Clayey Silt	19	28	0.36	0.53	2.77
Granular Backfill	22	35	0.27	0.42	3.70

Where: γ = bulk unit weight of soil (kN/m^3)

φ = internal angle of friction (degrees)

K_a = Rankine active earth pressure coefficient (dimensionless)

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

K_p = Rankine passive earth pressure coefficient (dimensionless)

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

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

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

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

K = the earth pressure coefficient

hw = the depth below the ground water level (m)

γ = the bulk unit weight of soil, (kN/m3)

γ' = the submerged unit weight of the exterior soil, (γ - 9.8 kN/m3)

q = the complete surcharge loading (kPa)

The wall backfill must be drained effectively to eliminate hydrostatic pressures on the wall that would otherwise act in conjunction with the earth pressure. In this case, the above equation is simplified to:

$$\boldsymbol{P = K[\gamma h + q]}$$

The factored geotechnical resistance to sliding of foundation elements is developed by friction between the base of the footing and the soil. This friction (**R**) depends on the normal load at the soil contact (**N**) and the frictional resistance of the soil (**tan φ**) expressed as $\boldsymbol{R_f = N\, tan\varphi}$, which is the unfactored resistance. The factored geotechnical resistance at ULS is $\boldsymbol{R_f = 0.8\, N\, tan\varphi}$.

4.8 SLAB ON GRADE DESIGN PARAMETERS

All organic material and deleterious material must be removed prior to constructing the slab on grade. These materials do not constitute an adequate subgrade for support of a slab on grade. Compacted engineered fill, native sands or silty clay to clayey silts are suitable for the support of a conventional slab on grade provided they are approved by Cambium.

The moduli of subgrade reaction appropriate for slab on grade design on the soils at the site are as follows:

- Engineered Fill: 20,000 kPa/m
- Native, undisturbed sand soils: 20,000 kPa/m
- Native, undisturbed silty clays: 15,000 kPa/m

The subgrade for the slab must be cut-neat, proof rolled, and inspected by Cambium, prior to the placement of an aggregate base. The subgrade should be proof rolled using a static smooth drum roller. If any soft or weak subgrade areas are identified, or if there are areas containing excessive amounts of deleterious/organic material or moisture, they must be locally sub-excavated and backfilled with approved clean earth fill or Engineered Fill such as OPSS Granular B (Type I or II) and compacted to a minimum of 98% of SPMDD.

It is necessary that the slab be provided with a capillary moisture barrier and drainage layer. This is made by placing the slab on a minimum 200 mm layer of 19 mm diameter clear stone underlain by a geotextile (Terrafix 270R or

equivalent) and nominally compacted by vibration to a dense state. The upper 50 mm of clear stone may be replaced with 50 mm of OPSS Granular A to create a working surface.

4.9 SUBDRAINAGE

Given the close proximity to the groundwater table, geotextile wrapped sub drains set in a trench of clear stone and connected to a sump or other frost-free positive outlet are recommended around the perimeter of all building footings. Foundation walls should also be waterproofed.

4.10 SEISMIC SITE CLASSIFICATION

The Ontario Building Code (OBC) specifies that the structures should be designed to withstand forces due to earthquakes. For the purpose of earthquake design, geotechnical information shall be used to determine the "Site Class". The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4A of the OBC (2012). The classification is based on the determination of the average shear wave velocity in the top 30 metres of the site stratigraphy, where shear wave velocity (v_s) measurements have been taken. Alternatively, the classification is estimated on the basis of rational analysis of undrained shear strength (s_u) or penetration resistances (N_{60} values). Based on the explored soil properties and in accordance with Table 4.1.8.4.A, it is recommended that Site Class "E" (soft soil) be applied for structural design at the Site.

Peak ground acceleration and spectral acceleration (period of 0.2 seconds) for the site are calculated to be 0.064g and 0.109g 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.

Consideration could be given to carrying out shear wave velocity testing ("MASW") to evaluate whether an improved seismic site class can be obtained. Additionally, deeper boreholes may also provide more accurate results. Further details regarding shear wave velocity testing could be provided upon request.

4.11 BURIED UTILITIES

Trench excavations above the groundwater table should generally consider Type 3 soil conditions, which require side slopes no steeper than 1H:1V, otherwise shoring would be required. Any excavations below the water table should generally consider Type 4 soil conditions which require side slopes of 3H:1V or flatter. All utilities should be placed at a minimum depths of 1.6 mbgs to prevent damage due to frost, or be adequately insulated.

Bedding and cover material for any services 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% of SPMDD, taking care not

to damage the utility pipes during compaction. If bedding is being placed in wet conditions consideration should be given to using 19 mm crushed clear stone underlain by a geotextile (Terrafix 270R or similar).

4.12 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% of SPMDD. The subgrade should be proof rolled and inspected by a Geotechnical Engineer. Any areas where boulders, rutting, or appreciable deflection is noted should be subexcavated 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 scenarios; light duty and heavy duty. The light duty design is appropriate for areas where no truck traffic is anticipated. The heavy duty design should meet the City of Barrie Transportation Design Manual (2020) requirements and as a minimum, consist of the pavement layers identified in Table 6. The heavy duty pavement structure recommended below assumes that the annual average daily traffic (AADT) is less than 2,500, and is appropriate for areas where heavy traffic or heavy loads are anticipated. If the predicted AADT is higher than that assumed, Cambium should be contacted to reassess this recommendation.

Table 6 Recommended Minimum Pavement Structure

Pavement Layer	Light Duty	Heavy Duty (City of Barrie Designated Routes or Fire Truck Routes)
Surface Course Asphalt	40 mm HL3 or HL4	40 mm HL3 or SP 12.5
Binder Course Asphalt	50 mm HL8	70 mm HL8 or SP 19
Granular Base	150 mm OPSS 1010 Granular A	150 mm OPSS 1010 Granular A
Granular Subbase	300 mm OPSS 1010 Granular B	450 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.

Granular layers should be placed in 200 mm thick maximum loose lifts and compacted to at least 98% of SPMDD (ASTM D698) standard. The granular materials specified should conform to OPSS standards, as confirmed by appropriate materials testing.

Subdrains are recommended beneath the pavement structure, connecting to the storm sewer or an alternate frost-free outlet as outlined above, to extend the lifespan of the structure.

The final asphalt surface should be sloped at a minimum of 2% to shed runoff. Abutting pavements should be saw cut to provide clean vertical joints with new pavement areas.

4.13 DESIGN REVIEW AND INSPECTIONS

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.

We 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. It is important that onsite geotechnical supervision be provided at this site for excavation and backfill procedures, deleterious soil removal, subgrade inspections and compaction testing.

5.0 CLOSING

We trust that the information contained in this report meets your current requirements. If you have questions or comments regarding this document, please do not hesitate to contact the undersigned at (705) 719-0700.

Respectfully submitted,

CAMBIUM INC.

Rob Gethin, P.Eng.
Group Manager – Geotechnical Services

Stuart Baird, M.Eng., P.Eng.
Director – Geotechnical & Construction Quality Verification Services

SEB/RLG/jm/fj

Appended Figures

GEOTECHNICAL INVESTIGATION

RINOMATO GROUP OF COMPANIES

80 Big Bay Point Road & 315 Bayview Drive
Barrie, Ontario

LEGEND

- Borehole (Cambium Inc.)
- Monitoring Well (Cambium Inc.)
- Monitoring Well (installed by others)
- Piezometer (installed by others)

Notes:
- Overlay obtained from Innovative Planning Solutions, Draft Plan of Subdivision, Dated December 2, 2020.
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources 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

CAMBIUM

P.O. Box 325, 52 Hunter Street East
Peterborough, Ontario, K9H 1G5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

BOREHOLE LOCATION PLAN

Project No.: 12689-001		Date: April 2021 Rev.:	
Scale: 1:3,000		Projection: NAD 1983 UTM Zone 17N	
Created by: TLC	Checked by: RG	Figure:	1

O:\GIS\MXDs\12600-12699\12689-001 Rinomato Group - 80 Big Bay Point Road & 315 Bayview Drive\2021-04-21 FIG 1 - Borehole Location Plan.mxd

Appendix A
Borehole Logs

Peterborough
Barrie
Oshawa
Kingston
T: 866-217-7900
www.cambium-inc.com

Log of Borehole: BH201-21

Client:	Tonlu Holdings Limited	**Project Name:**	80 Big Bay Point Rd & 315 Bayview Dr	**Project No.:**	12689-001
Contractor:	Landshark Drilling	**Method:**	Solid Stem Augers	**Date Completed:**	April 15, 2021
Location:	80 Big Bay Point Rd & 315 Bayview Dr, Barrie ON	**UTM:**	17T, 605562 m E, 4911969 m N	**Elevation:**	271.73 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
271 / 0		Topsoil: Black topsoil, some organics, very loose, moist	1A	SS	60	2				
		Sand: Brown sand, trace gravel, very loose, moist	1B							
		-loose	2	SS	100	6				
270 / 2		Sand: Brown sand, some gravel, trace silt, loose, moist	3	SS	65	8				
		-compact, wet	4	SS	100	11			▼	
269 / 3			5	SS	100	11				
268 / 4										
267 / 5			6A	SS	100	16				
		Silty Clay: Brown silty clay, trace sand, trace gravel, stiff, wetter than plastic limit	6B							GSA SS7: 1% Gravel 9% Sand 23% Silt 67% Clay
266 / 6		-grey	7	SS	90	10				
265 / 7		Borehole terminated at 6.6 mbgs								Caving measured at 5.2 mbgs, groundwater observed at 2.4 mbgs upon completion

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

Peterborough
Barrie
Oshawa
Kingston
T: 866-217-7900
www.cambium-inc.com

Log of Borehole: BH202-21

Client:	Tonlu Holdings Limited	**Project Name:**	80 Big Bay Point Rd & 315 Bayview Dr	**Project No.:**	12689-001
Contractor:	Landshark Drilling	**Method:**	Solid Stem Augers	**Date Completed:**	April 15, 2021
Location:	80 Big Bay Point Rd & 315 Bayview Dr, Barrie ON	**UTM:**	17T, 605392 m E, 4911905 m N	**Elevation:**	271.99 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
0 / 271		Topsoil: Black topsoil, some organics, loose, moist	1A							
		Sand: Brown sand, trace gravel, trace silt, loose, moist	1B	SS	60	7				
1			2	SS	60	10				
270			3	SS	70	6				GSA SS3: 1% Gravel 95% Sand 4% Silt and Clay
2		-wet	4	SS	45	7			▼	
269										
3		-compact	5	SS	75	10				
268										
4			6	SS	100	12				
267										
5										
266		-grey, some silt, some clay, compact	7	SS	100	29				
6										
265		Borehole terminated at 6.6 mbgs								Caving measured at 4.9 mbgs, groundwater observed at 2.4 mbgs upon completion
7										

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

Peterborough
Barrie
Oshawa
Kingston
T: 866-217-7900
www.cambium-inc.com

Log of Borehole: MW203-21

Client:	Tonlu Holdings Limited	**Project Name:**	80 Big Bay Point Rd & 315 Bayview Dr	**Project No.:**	12689-001
Contractor:	Landshark Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	April 15, 2021
Location:	80 Big Bay Point Rd & 315 Bayview Dr, Barrie ON	**UTM:**	17T, 605531 m E, 4911753 m N	**Elevation:**	271.51 mASL

Elevation (m) / Depth	Description	Number	Type	% Recovery	SPT (N)	Well Installation	Remarks
271 / 0	Topsoil: Black topsoil, some organics, loose, moist	1A				Monument	Top of Standpipe (TOS) elevation: 272.58 mASL. Groundwater measured at 2.16 mbgs (269.36 mASL) on April 23, 2021
	Sand: Brown sand, trace gravel, loose, moist	1B	SS	100	7	Cap	
270 / 1	Sand: Brown sand, trace gravel, trace silt, dense, moist	2	SS	70	32	Bentonite Plug	
		3	SS	75	37	PVC Standpipe	GSA SS3: 6% Gravel 90% Sand 4% Silt and Clay
269 / 2	-compact, wet	4	SS	100	28		
268 / 3		5	SS	100	15		
267 / 4						Sand Pack	
		6	SS	100	26	PVC Screen	
266 / 5							
265 / 6	-grey, some silt, trace clay	7	SS	90	27	Cap	
264 / 7	Borehole terminated at 6.6 mbgs						

% Moisture: 25 50 75

SPT (N): 10 20 30 40

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

Peterborough
Barrie
Oshawa
Kingston
T: 866-217-7900
www.cambium-inc.com

Log of Borehole: MW204-21

Client:	Tonlu Holdings Limited	**Project Name:**	80 Big Bay Point Rd & 315 Bayview Dr	**Project No.:**	12689-001
Contractor:	Landshark Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	April 15, 2021
Location:	80 Big Bay Point Rd & 315 Bayview Dr, Barrie ON	**UTM:**	17T, 605334 m E, 4912052 m N	**Elevation:**	270.97 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
0 / 270		Topsoil: Black topsoil, some organics, loose, moist	1A	SS	80	5			Monument; Cap	Top of Standpipe (TOS) elevation: 272.03 mASL. Groundwater measured at 2.03 mbgs (268.94 mASL) on April 23, 2021
1		Sand: Brown sand, trace gravel, loose, moist	1B							
			2	SS	80	7			Bentonite Plug; PVC Standpipe	
2 / 269		Sand: Brown sand, some gravel, trace silt, compact, moist	3	SS	75	13				
		-wet	4	SS	70	11				
3 / 268			5	SS	95	12				
4 / 267									Sand Pack; PVC Screen	
5 / 266		Clayey Silt: Brown sandy clayey silt, stiff, wetter than plastic limit	6	SS	100	13				GSA SS6: 0% Gravel 31% Sand 40% Silt 29% Clay
6 / 265		-grey, very stiff	7	SS	100	19			Cap	
7 / 264		Borehole terminated at 6.6 mbgs								

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

Peterborough
Barrie
Oshawa
Kingston
T: 866-217-7900
www.cambium-inc.com

Log of Borehole: MW205-21

Client:	Tonlu Holdings Limited	**Project Name:**	80 Big Bay Point Rd & 315 Bayview Dr	**Project No.:**	12689-001
Contractor:	Landshark Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	April 15, 2021
Location:	80 Big Bay Point Rd & 315 Bayview Dr, Barrie ON	**UTM:**	17T, 605503 m E, 4912109 m N	**Elevation:**	270.02 mASL

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N)	Well Installation	Remarks
270	0	Topsoil: Black topsoil, some organics, loose, moist	1A				Monument	Top of Standpipe (TOS) elevation: 271.07 mASL. Groundwater measured at 0.542 mbgs (269.47 mASL) on April 23, 2021
		Sand: Brown sand, trace gravel, loose, moist	1B	SS	90	6	Cap	
269	1	Sand: Brown sand, some gravel, some silt, compact, wet	2	SS	40	14	Bentonite Plug	
			3	SS	100	13	PVC Standpipe	GSA SS2: 11% Gravel 78% Sand 11% Silt and Clay
268	2		4	SS	30	22		
267	3		5	SS	80	12		
266	4						Sand Pack	
		Silty Clay: Brown to grey silty clay, trace sand, very stiff, wetter than plastic limit	6	SS	95	16	PVC Screen	
265	5							
264	6		7	SS	80	22	Cap	
263	7	Borehole terminated at 6.6 mbgs						

% Moisture: 25 50 75

SPT (N): 10 20 30 40

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

Appendix B

Physical Laboratory Testing Results

Grain Size Distribution Chart

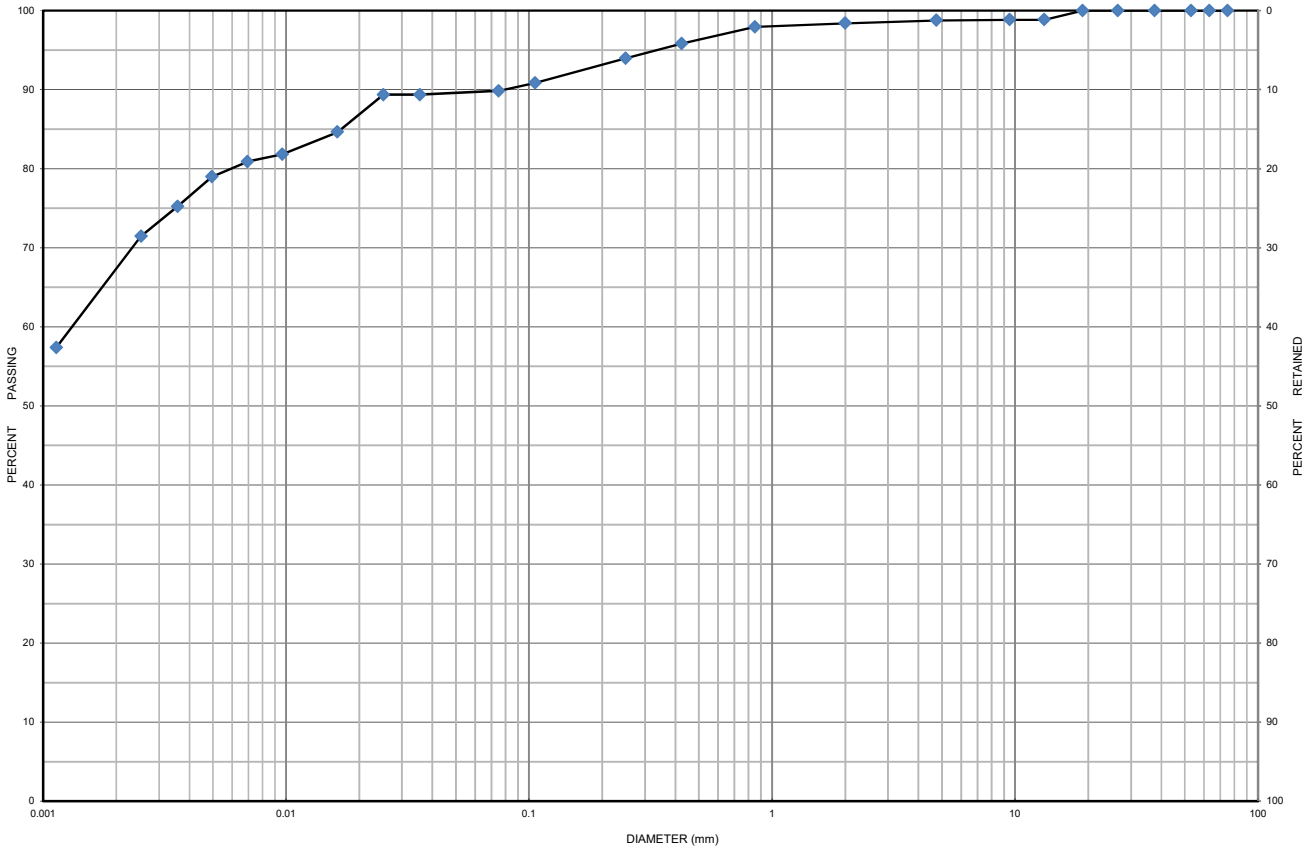
Project Number: *12689-001* **Client:** *Tonlu Holdings Limited*

Project Name: *80 Big Bay Point Road & 315 Bayview Drive, Barrie*

Sample Date: *March 15, 2021* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 201-21 SS 7* **Depth:** *6.1 m to 6.6 m* **Lab Sample No:** *S-21-0404*

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 201-21	SS 7	6.1 m to 6.6 m	1	9	23	67	41.0

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Clay trace Sand trace Gravel	CL	0.0014	0.0000	0.0000	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *June 24, 2021*

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

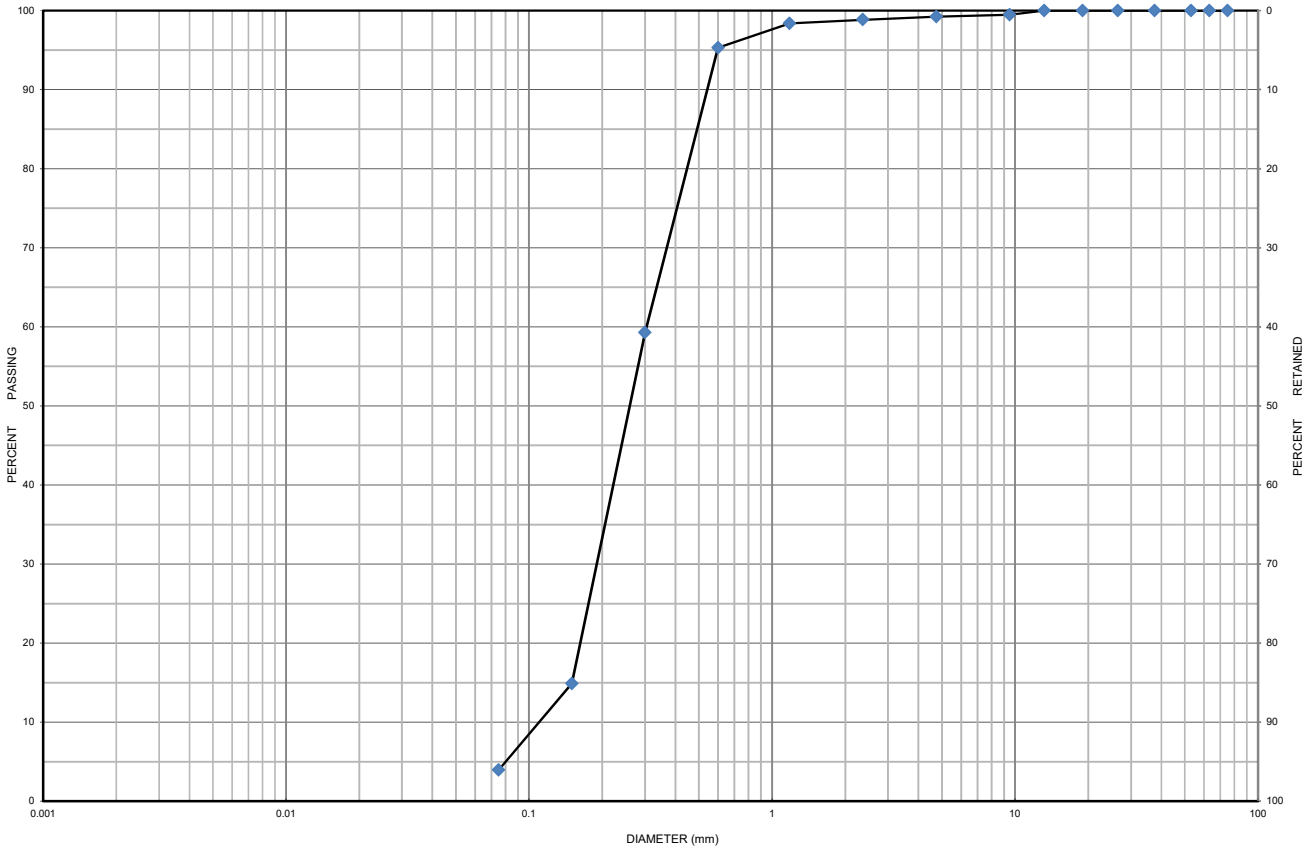
Project Number: *12689-001* **Client:** *Tonlu Holdings Limited*

Project Name: *80 Big Bay Point Road & 315 Bayview Drive, Barrie*

Sample Date: *March 15, 2021* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 202-21 SS 3* **Depth:** *1.5 m to 2 m* **Lab Sample No:** *S-21-0405*

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 202-21	SS 3	1.5 m to 2 m	1	95	4		4.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand trace Silt trace Gravel	SP	0.310	0.195	0.120	2.58	1.02

Additional information available upon request

Issued By: _____ *Date Issued:* *June 24, 2021*

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

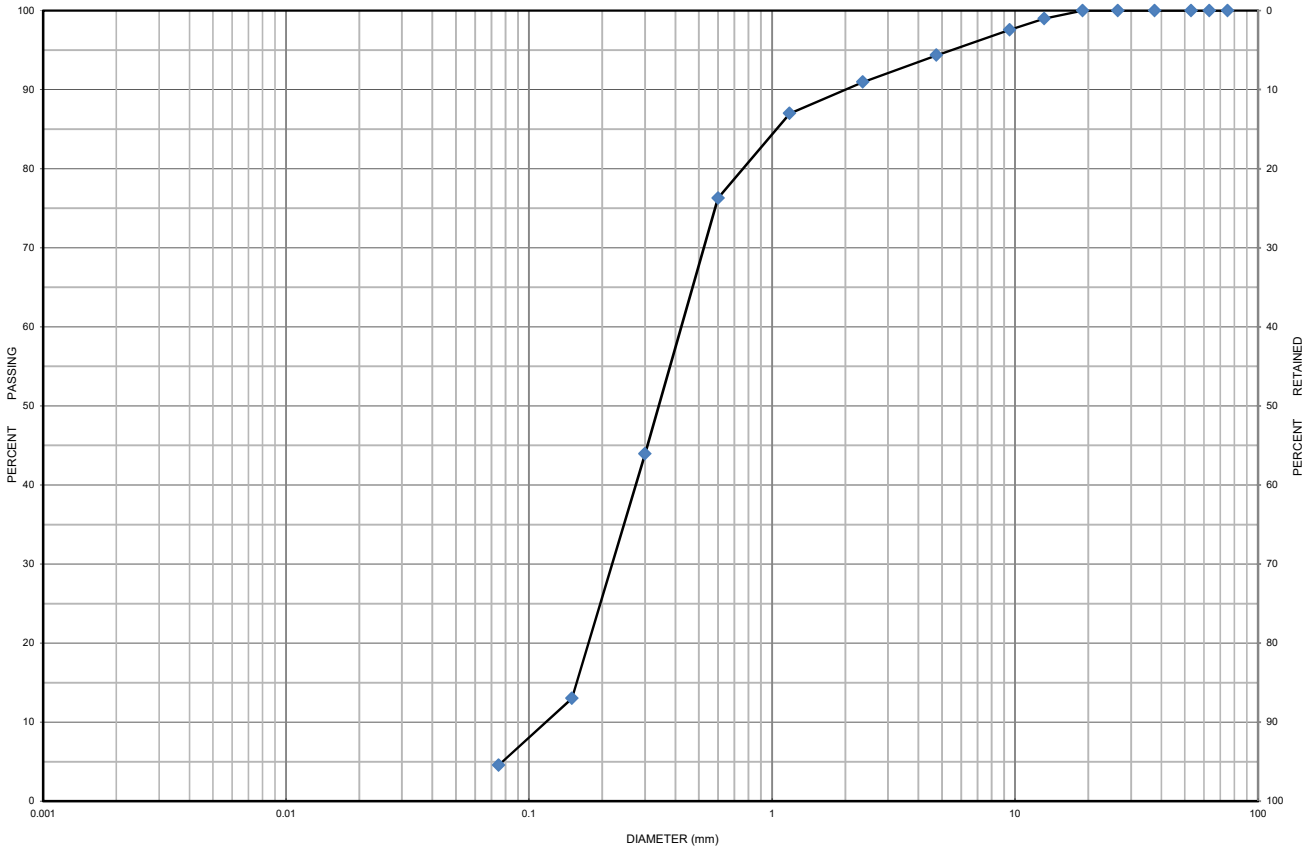
Project Number: *12689-001* **Client:** *Tonlu Holdings Limited*

Project Name: *80 Big Bay Point Road & 315 Bayview Drive, Barrie*

Sample Date: *March 15, 2021* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 203-21 SS 3* **Depth:** *1.5 m to 2 m* **Lab Sample No:** *S-21-0403*

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 203-21	SS 3	1.5 m to 2 m	6	90	4		4.9

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand trace Gravel trace Silt	SP	0.425	0.225	0.125	3.40	0.95

Additional information available upon request

Issued By: _____ *Date Issued:* *June 24, 2021*

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

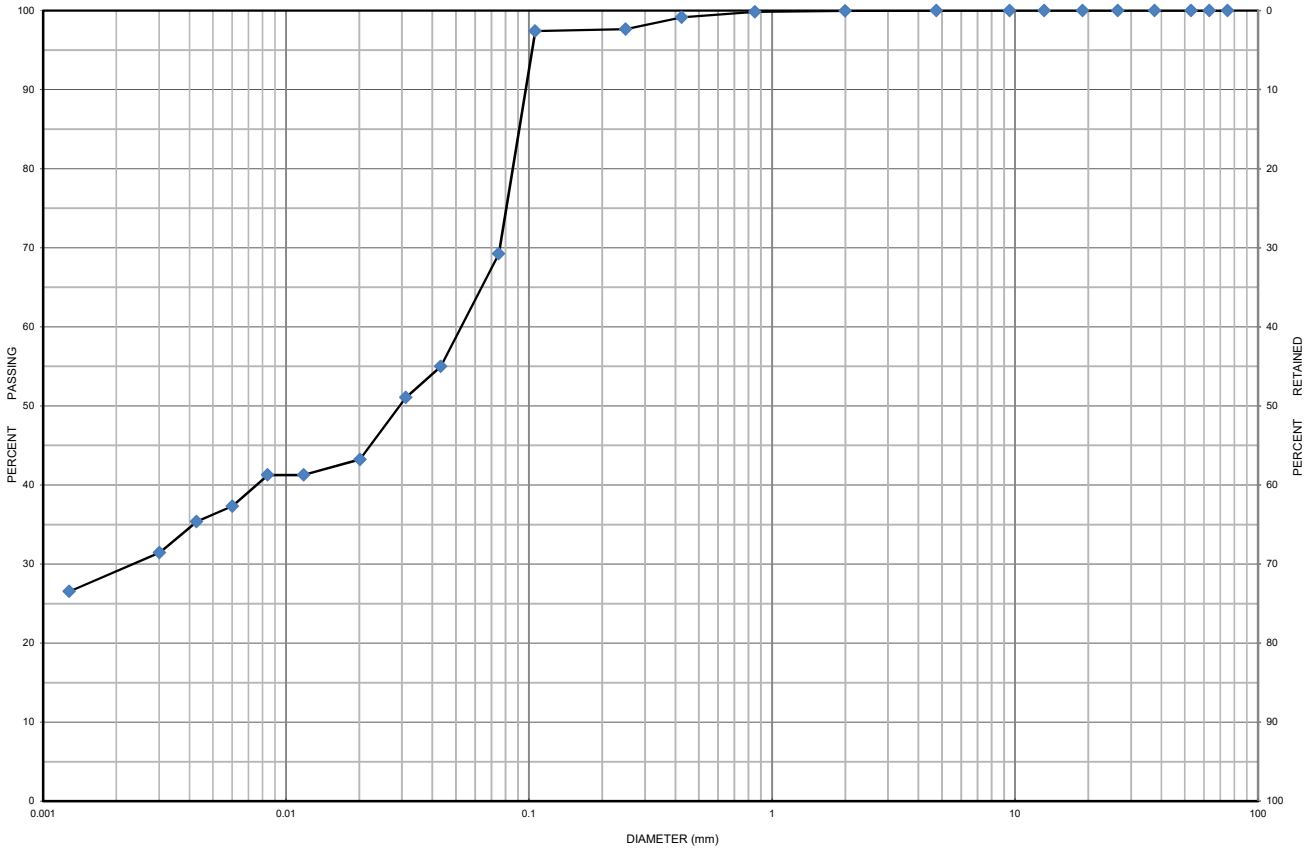
Project Number: *12689-001* **Client:** *Tonlu Holdings Limited*

Project Name: *80 Big Bay Point Road & 315 Bayview Drive, Barrie*

Sample Date: *March 15, 2021* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 204-21 SS 6* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *S-21-0401*

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 204-21	SS 6	4.6 m to 5 m	0	31	40	29	23.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Clayey Silt	ML	0.5200	0.0024	0.0000	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *June 24, 2021*

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

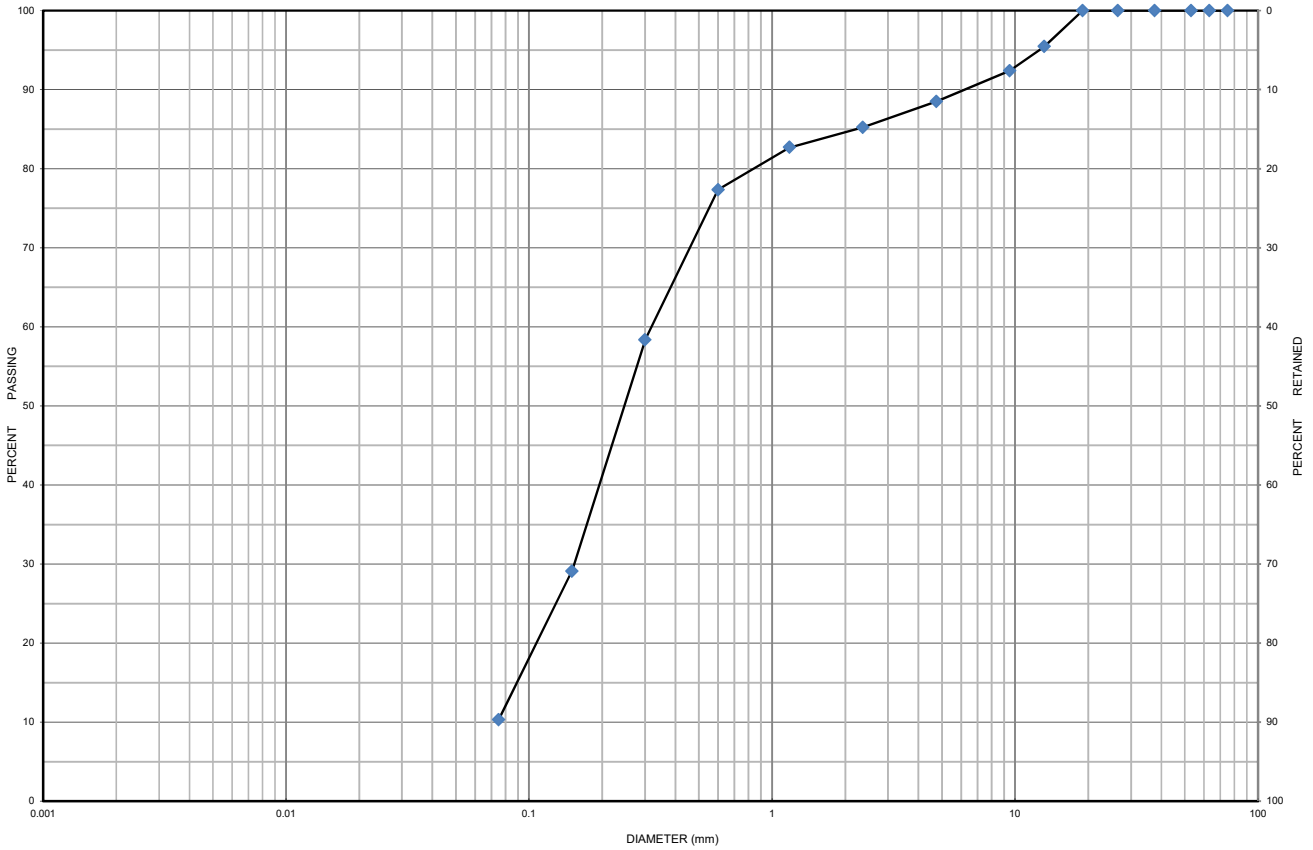
Project Number: *12689-001* **Client:** *Tonlu Holdings Limited*

Project Name: *80 Big Bay Point Road & 315 Bayview Drive, Barrie*

Sample Date: *March 15, 2021* **Sampled By:** *Chris Malliaros - Cambium Inc.*

Location: *BH 205-21 SS 2* **Depth:** *0.8 m to 1.2 m* **Lab Sample No:** *S-21-0402*

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 205-21	SS 2	0.8 m to 1.2 m	11	78	11		17.8

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand some Gravel some Silt	SP	0.320	0.155	0.000	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *June 24, 2021*

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
194 Sophia St. | Peterborough | ON | K9H 1E5

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: 44.351N 79.675W **User File Reference:** 80 Big Bay Point Road, Barrie, ON 2021-04-30 16:58 UT

Requested by: Farhana Jabin, 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)	0.112	0.072	0.048	0.017
Sa (0.2)	0.109	0.072	0.049	0.018
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)	0.024	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