Geotechnical Investigation - Proposed Residential Development, Ontario Street, Brighton, ON

July 11, 2022

Prepared for:
Tomba Enterprises Ltd.

Cambium Reference: 13654-001

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1.0 Introduction

Cambium Inc. (Cambium) was retained by Bicorp Design Group Ltd. on behalf of Tomba Enterprises Ltd. (The Client) to conduct a geotechnical investigation and provide geotechnical engineering design advice for the proposed residential subdivision to be located at the current municipal address of 214 Ontario Street in Brighton, Ontario. A Site Location Plan is provided as Figure 1.

This report encompasses the geotechnical findings of this initial investigation on this property. Due to access restrictions, the subsurface conditions in some sections of the property could not be determined. An update to the geotechnical report, including additional boreholes across the site will be required prior to detailed design.

Cambium is also providing a Hydrogeological Study for this site. The results of the study are providing under a separate report cover.

1.1 Site Description

The existing site is a rectangular shaped parcel of land that fronts on to southbound lane of Ontario Street for a length measuring about 109 m and extends westward for approximately 230 m. The eastern half of the site has been previously developed for slab on grade structures (greenhouses) and a gravel parking lot. A raised septic bed and trailer were also observed on the site. The remainder of the site is heavily vegetated with trees and shrubs. Some walking trails have been cleared around the site to provide limited access.

1.2 The Project

Based on preliminary development plans provided to us, dated July 2020, the proposed subdivision will be composed of eighty-seven (87) townhouse units. It is understood that some of the buildings may have up to 1 underground level.

At the time of writing this report, the finished floor elevations (FFE) were not provided. However, it is anticipated that the site grade will be at or above the elevation of Ontario Street, and based

on conventional design, that any basements will extend, at most, 1.8 meters below ground surface (mbgs).

2.0 Investigation Methodology

2.1 Field Work

The field investigation involved advancing six (6) boreholes across the site from August 30th to August 31st, 2021. Boreholes were advanced to depths ranging from 6.1 to 6.7 mbgs. The locations of the boreholes relative to the existing site conditions and proposed site conditions are provided on Figures 2A and 2B, respectively. Records of the individual boreholes are provided on the Borehole Logs in Appendix A.

Drilling and sampling was completed using a track mounted drill rig operating under the fulltime supervision of a Cambium technician. The boreholes were advanced to the sampling depths by means of continuous flight stem augers and 50 mm O.D. split spoon samplers. Standard Penetration Test (SPT) results (N-Values) were recorded for the sampled intervals as the number of blows required to drive a split spoon sampler 305 mm in to the soil using a 63.5 kg drop hammer falling 750 mm, as per ASTM D1586 procedures.

Borehole samples were inspected and logged in the field using visual and tactile methods. Soil samples were placed in labelled plastic containers for transport and sent to our geotechnical laboratory for review by a senior geotechnical engineer, physical laboratory testing, and temporary storage. Open boreholes were checked for groundwater and stability prior to backfilling and were backfilled in accordance with O.Reg. 903, as amended. Three (3) groundwater monitoring wells was installed in select boreholes (BH102-21, BH104-21, and BH106-21) to measure stabilized groundwater levels.

GPS coordinates of each borehole were obtained using a handheld GPS device. Boreholes were survey using real-time kinematic (RTK) surveying equipment systems referenced to a site benchmark provided by the Bicorp Design Group Ltd. The recorded elevations are based on the topographic data collected by Gifford, Harris Surveying Ltd.

2.2 Physical Laboratory Testing

Physical laboratory testing was completed on select soil samples to assess geotechnical parameters. Natural moisture contents were measured for all soil samples (ASTM D2216), and particle size distribution testing was completed on select samples (ASTM D6913 and D1140). The results are summarized in the respective stratigraphy sections in Section 3.0 and noted on the corresponding borehole logs. Detailed results of the particle size distribution testing are provided in Appendix B.

3.0 Subsurface Conditions

The subsurface soil and groundwater conditions encountered in the boreholes are presented on the attached Borehole Logs in Appendix A. The stratigraphic boundaries indicated on the logs are inferred from non-continuous samples and observations of drilling resistance and typically represent a transition from one soil type to another, sometime gradually. The boundaries should not be interpreted to represent exact planes of geologic change. The subsurface conditions have been confirmed in a series of widely spaced boreholes and will vary between and beyond the borehole locations.

3.1 Stratigraphy

The following stratigraphy is based on the borehole findings, as well as the geotechnical laboratory testing conducted on representative soil samples.

3.1.1 Topsoil

Topsoil was encountered from the surface of BH101-21, BH105-21, and BH106-21. The topsoil ranges in thickness from 50 to 300 mm. Probable buried topsoil deposits were encountered within the fill material (Section 3.1.2) in BH102-21 at a depth of 0.3 mbgs, and in BH104-21 at a depth of 0.5 mbgs.

3.1.2 Fill Material

Fill material was encountered underlying the surficial topsoil layer in BH101-21, and from the surface from BH102-21 through BH104-21. The fill material ranges in thickness from 0.3 to 1.0 m.

The fill material varies in composition depending where encountered but is predominantly composed of sand. The sand ranges from silty with trace to some gravel to sand and gravel. Organics were also noted within the fill material in BH103-21, and in BH102-21 and BH104-21 as noted in the previous section. It should be noted that the brown sand encountered from the surface of BH102-21 was likely placed as part of the gravel parking lot base material, and the

silty sand encountered in BH104-21 was likely placed as part of the base material for the slab on grade structures that previously existed on site.

SPT N-Values recorded within the fill material in BH103-21 and BH104-21 and range from 4 to 5 blows per 305 mm of penetration (bpf), indicative of a loose relative density.

3.1.3 Sand

A native deposit of sand was encountered underlying the fill material in BH101-21 through BH104-21 and underlying the topsoil in BH105-21 and BH106-21. The sand is brown to grey brown in colour and contains trace to some silt and trace gravel. The sand deposit was encountered at depths ranging from 0.3 to 1.0 mbgs and extends to depths ranging from 3.9 to 4.2 mbgs. The thickness of the sand deposit ranges from 3.2 to 3.8 m and averages 3.5 m.

SPT N-Values recorded within the sand deposit range from 2 to 19 bpf, indicative of a very loose to compact relative density.

Grain size analysis testing was completed on three (3) samples taken from the sand deposit and the results are summarized in Table 1. Detailed result diagrams are provided in Appendix B.

Table 1 Particle Size Distribution Results – Sand

Sample Location	Depth (mbgs)	Soil	% Gravel	% Sand	% Silt and Clay
BH103-21 SS3	1.5 – 2.0	Sand, some silt	0	90	10
BH103-21 SS4	2.3 – 2.7	Sand, trace silt, trace gravel	2	95	3
BH106-21 SS5	3.0 – 3.5	Sand, trace silt	0	99	1

3.1.4 Clay and Silt

A native deposit of clay and silt was encountered underlying the sand deposit at all borehole locations. The clay and silt deposit was encountered at depths ranging from 3.9 to 4.1 mbgs. Where fully penetrated, the clay and silt deposit extends to depths ranging from 5.6 to 6.1 mbgs. Thicknesses of the clay and silt deposit at these borehole locations range from 1.6 to 2.1 m. BH102-21 and BH103-21 terminated within the clay and silt deposit at a depth of 6.1 mbgs.

The clay and silt deposit is grey and colour and contains trace amounts of sand. Trace gravel and larger quantities of sand were encountered in the lower portions of the deposit as the deposit transitions to the underlying glacial till.

SPT N-Values recorded within the clay and silt range from 2 to 14 bpf, indicative of a soft to stiff consistency.

Grain size analysis testing was completed on one (1) sample taken from the clay and silt deposit and the results are summarized in Table 2. A detailed result diagram is provided in Appendix B.

Table 2 Particle Size Distribution Results – Clay and Silt

Sample Location	Depth (mbgs)	Soil	% Gravel	% Sand	% Silt	% Clay
BH101-21 SS7	4.6 to 5.0	Clay and Silt, trace sand, trace gravel	1	6	45	48

Atterberg Limits testing was completed on a sample of the clay and silt and the results are summarized on Table 3 below. A detailed result diagram is provided in Appendix B.

Table 3 Atterberg Limits – Clay and Silt

Sample Location	Depth (mbgs)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
BH104-21 SS7	4.6 to 5.0	37.3	18.0	19.3

The results of the Atterberg limits testing indicate that the clay and silt deposit is of low plasticity in nature.

3.1.5 Glacial Till

Deposits of native glacial till were encountered underlying the clay and silt deposit in BH101-21, and in BH104-21 through BH106-21 at depths ranging from 5.6 to 6.1 mbgs. Where encountered, all boreholes terminated within the glacial till deposit at depths ranging from 6.1 to 6.1 mbgs.

Glacial till is typically a heterogeneous mixture of all grain sizes due to the method of deposition. At this site, the glacial till is generally composed of grey gravelly silty sandy silt with some clay.

The SPT N-values measured in the glacial till range from 17 to over 49 bpf, indicative of a compact to dense relative density.

Grain size analysis testing was completed on two (2) samples of the glacial till and the results are summarized in Table 4. Detailed result diagrams are provided in Appendix B.

Table 4 Particle Size Distribution Results – Glacial Till

Borehole	Depth (m)	Soil	% Gravel	% Sand	% Silt	% Clay
BH101-21 SS8B	5.6 to 6.1	Silty Sand, gravelly, some clay	24	36	30	10
BH104-21 SS9	6.1 to 6.7	Silty Sand, gravelly, some clay	21	44	23	12

3.2 Groundwater

Unstabilized groundwater level observations were made following drilling at all borehole locations. Three (3) groundwater monitoring wells were installed in select boreholes to measure stabilized groundwater conditions. A summary of the groundwater conditions observed after drilling and when measured in the wells is provided in Table 5 below.

Table 5 Summary of Groundwater Measurements

Borehole Location	Groundwater Level Following Drilling (mbgs)	Groundwater Level, 14/09/2021 (m/mASL)
BH101-21	Dry	-
BH102-21	1.8	1.3 / 78.0
BH103-21	1.2	-
BH104-21	3.7	1.0 / 77.8
BH105-21	2.4	-
BH106-21	2.1	1.0 / 77.9

It is anticipated, based on the above measurements, that the groundwater level is at about ±78 mASL.

Seasonal fluctuations and precipitation events may cause significant changes to the depth of the groundwater table over time.

Additional information pertaining to groundwater at the site is discussed in the Hydrogeological Investigation report by Cambium under a sperate cover.

4.0 Geotechnical Design and Recommendations

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

This report assumes 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 are 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 anticipated that the proposed townhouse blocks will be constructed with, at most, one (1) basement level extending at most 2 mbgs.

4.1 Excavations

Excavations for the proposed development will extend through the topsoil, fill material, and the upper deposits of the native sand. Based on the current development plans, excavations are not anticipated to extend in to the underlying clay and silt or glacial till deposits. It should be noted that the proposed finished floor elevations (FFE) have not been provided at the time of completing this report.

Temporary excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA), Ontario Regulation 213/91 (as amended). For practical purposes, the overburden soils at the site above the water table can be considered to be Type 3 soils, as such excavation side slopes should be no steeper than 1H:1V. The overburden soils at this site below the water table, particularly within the sand deposit should be considered as Type 4 soils, as such excavation side slopes should be no steeper than 3H:1V or appropriately shored.

Minimum support system requirements (shoring) are stipulated in Sections 235 through 238 of the Occupational Health and Safety Act (OHSA), Construction Projects, Part III.

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).

4.2 Groundwater Control

Groundwater control and considerations pertaining to groundwater and drainage are discussed in greater detail in the Cambium Hydrogeological Investigation Report under a separate cover.

For design purposes, the stabilized groundwater levels can be taken as ±78.0 mASL. As such, excavations for the proposed townhouses, if existing grades are maintained, or raised by less than 1 m, are anticipated to extend below the measured groundwater level.

The Ministry of the Environment, Conservation and Parks stipulate the requirements for Permit to Take Water (PTTW) approvals for construction related activities. Under the requirements, specific construction related water taking activities are eligible for Environmental Activity and Sector Registry (EASR). The trigger volume for EASR is water taking more than 50,000 litres/day. Volumes beyond 400,000 litres/day will require the application of a PTTW. This includes water that is collected from open excavations as well as precipitation and/or surface runoff that enters the excavation.

4.3 Foundation Design

The proposed development will consist of low-rise residential buildings. Foundations for such structures at this site may consist of shallow spread footings founded directly on native, undisturbed sand or on a pad of compacted engineered fill placed directly on native, undisturbed sand.

Foundations made to bear directly on the native, undisturbed sand, or on top of adequately compacted engineered fill should be sized using a net reaction at **SLS** of **100 kPa** and factored geotechnical resistance at **ULS** of **200 kPa**. Pad foundations should be limited to, at most, 2.2 m in length, and continuous strip foundations should be limited to, at most, 1.2 m in width.

Settlement potential at these loadings conditions should be less than 25 mm and differential settlement should be less than 20 mm.

Engineered fill placed directly under foundations should be placed directly on undisturbed glacial till or directly on sound bedrock and should conform to Ontario Provincial Standards Specification (OPSS) 1010.MUNI Granular B Type II. The imported engineered fill should be placed in maximum 200 mm thick lifts to at least 98 % of the standard proctor maximum dry density (SPMDD) value. To allow for adequate spread of the loading below and beyond the footings, the engineered fill should extend a horizontal distance of at least 300 mm beyond the edge of the footings and then down and away from the edges at an angle of 1H:1V, or flatter. Excavations should be sized to accommodate fill placement.

To reduce cracking in the footings, foundation walls, and concrete slab on grades where footings change between different subgrade materials, suitable transition zones should be created and the footings adequately reinforced.

Footings stepped from one level to another must be at a slope no exceeding 10H:7V from the outside edges of each foundation.

4.4 Frost Protection of Foundations

All exterior footings of the proposed building should be provided with at least 1.4 m of earth cover for frost protection purposes. If the required depth of earth cover is not practicable, a combination of earth cover and polystyrene insulation could be considered. An insulation detail could be provided upon request.

4.5 Grade Raise Restriction

As previously indicated, the FFE for the proposed development has not yet been provided to Cambium at the time of writing this report. Additionally, the site is currently set at about 1 m below the elevation of the adjacent roadway. Design may require the grade of the site to be raised.

The site is underlain by a deposit of stiff to soft clay and silt which is sensitive to secondary settlement. The cohesive soils have a limited capacity to support loads imposed by grade raise fill material in combination with the loads from house foundations.

The settlement response of the clay and silt deposit to the increase in loading is influenced by variables such as the existing effective overburden pressure, the past preconsolidation pressure of the clay and silt at the site, the compressibility characteristics of the deposit, and the presence or absence of drainage paths within the deposit. The settlement response of clay and silt deposit can be significant when the stress increase is at or near the difference between the preconsolidation pressure and the existing overburden stress. To limit the post development consolidation to acceptable amounts (25 mm), a grade raise limitation must be adhered to.

For this site, it is required that a grade raise of earth fill or granular material be limited to at the most 1.5 m above the existing grade.

4.6 Foundation Wall Backfill

To avoid frost adhesion and possible heaving, all foundation walls are to be backfilled with non-frost susceptible granular material such as imported material meeting OPSS Granular B Type I or II for a minimum lateral distance of 0.6 m out from the wall. The existing grey brown sand may be reused as backfill material. If the existing sand is reused as foundation wall backfill, the material must be free of organic material and verified by geotechnical personnel.

Where backfill will support areas of hard surfacing (pavements, walkways, etc.) the backfill should be placed in maximum 200 mm thick lifts and compacted to at least 95% of the SPMDD value. Light, walk behind compaction equipment should be used in proximity to foundation walls.

4.7 Earth Pressure Design Parameters

The appropriate values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows in Table 7:

Table 6 Earth Pressure Design Values

Stratum/Parameter	γ	φ	Ka	Ko	Kp
Earth Fill (reused native sand)	18	30	0.33	0.50	3.00
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:

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

4.8 Sliding Resistance

The factored geotechnical resistance to sliding of foundation elements is developed by friction between the base of the concrete 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 $\boldsymbol{R_f = 0.8\,N\,tan\varphi}$ for foundations on soil.

4.9 Floor Slab Design Parameters

The finished floor elevations for the proposed townhouse units have not been provided to us at the time of preparation of this report. It is anticipated that the basement floors will be set at about 1.8 mbgs.

All organic material, deleterious material, and disturbed material must be removed prior to constructing floor slabs. These materials do not constitute an adequate subgrade for support of a slab on grade. Compacted engineered fill such as material meeting OPSS.MUNI 1010 Granular A, or B Type I or II placed directly on undisturbed native sand is suitable for the support of a conventional slab on grade following approval by Cambium. The existing fill material at the site and topsoil at this site should not be reused as fill under the slab.

The modulus of subgrade reaction appropriate for slab design on the soils at the site can be taken as 22,000 kPa/m.

It is recommended that the slabs are provided with a capillary moisture barrier. This is made by placing the slab on a minimum 200 mm layer of clear stone and nominally compacted by vibration to a dense state. The upper 50 mm of clear stone can be replaced with OPSS.MUNI 1010 Granular A to create a working surface, if required.

Underslab drainage is not required beyond the capillary moisture barrier for floor slabs set at 300 mm or higher than the exterior grade.

4.10 Basement and Subfloor Drainage

The groundwater level measured at this site can be taken at about ±78 mASL.

To assist in maintaining basements dry from seepage, it is recommended that exterior grades around the buildings be sloped away for a distance of at least 1.2 m. As well, perimeter foundation drains should be provided, consisting of perforated pipe with filter fabric (minimum 100 mm diameter) surrounded by granular filter (minimum 150 mm thick), and freely out letting to a sump or other frost-free outlet. The granular filter should consist of 19 mm Clear Stone (OPSS.MUNI 1004) surrounded by filter fabric (Terrafix 270 R or approved equivalent).

The basement walls, in the case of open excavations, must be provided with damp-proofing provisions in conformance to the Section 9.13.2 (1 through 8) of the Ontario Building Code (2017). Backfill requirements for the foundation walls are provided in Section 4.6.

A subfloor drainage system is recommended due to the elevated groundwater level at the site. The subfloor drainage system should consist of 100 mm diameter perforated pipes located at a maximum spacing of 6.0 m center to center. The underfloor drainage system should outlet to a suitable discharge point under gravity flow away from the structures or to a sump pit.

Perimeter foundation drainage, underfloor drainage systems and the installation and outlets must conform to applicable plumbing code requirements.

4.11 Site Servicing

4.11.1 Excavation and Dewatering

Excavations for proposed site services should adhere to the recommendations provided in Sections 4.1. Specific Site dewatering recommendations will be provided in the site-specific Hydrogeological Report, under a separate cover.

4.11.2 Bedding

The underlying native undisturbed sand will provide adequate support for buried services on conventional well graded granular base material.

Granular bedding material should consist of a conventional Class 'B' bedding, such as OPSS.MUNI 1010 Granular A. The use of 19 mm clear stone (OPSS.MUNI 1004) as bedding is also acceptable. The bedding materials should be compacted to a minimum 95% of SPMDD. Clear stone bedding material should be nominally compacted to a dense state.

4.11.3 Trench Backfill

In general, excavated soils encountered on site may be re-used as backfill, provided the moisture content of these materials is within 2% of optimum to ensure adequate compaction, the trenches are wide enough to accommodate large compaction equipment, and the soil is free of any organic material. Soils with elevated moisture could be put aside to dry, tilled to reduce the moisture content so that they can be effectively compacted, or could be mixed with dryer material. Alternatively, materials of higher moisture content could be wasted and replaced with imported material which can be readily compacted.

The backfill should consist of clean earth fill and should be placed in lifts of 200 mm thickness or less and compacted to a minimum 95% of SPMMD (in settlement sensitive areas) and 90% of SPMDD (in non-settlement sensitive areas) at a water content within 2% of optimum. Existing earth fill and native soils will be difficult to place and compact successfully in narrow trench excavations, where large compaction equipment could not operate. For narrow trench excavations, it is recommended that free draining granular material, such as OPSS.MUNI 1010 Granular B Type I or II be used in order to allow for adequate compaction using walk behind vibratory equipment.

The placement and inspection of any earth fill as backfill must be conducted under the full-time observation of Cambium.

4.12 Pavement Design Consideration

4.12.1 Subgrade Preparation

The performance of the pavement is dependent upon proper subgrade preparation. All topsoil and organic materials should be removed from the subgrade. The subgrade should be proof

rolled and inspected by Cambium personnel. Any areas where rutting or appreciable deflection is noted should be sub-excavated and replaced with suitable earth fill. The earth fill may be taken from other parts of the site for reuse. The fill should be compacted to at least 98% of SPMDD. Subgrades composed of exposed bedrock do not require proofrolling.

The most severe loading conditions on pavement subgrades may occur during construction, and subgrades may become disturbed due to construction operations. Therefore, the recommended pavement structure provided may not be adequate due to the presence of localized disturbed areas and it may be necessary to increase the thickness of the Granular B Type II subbase and/or incorporate a woven geotextile separator between the subgrade surface and the granular base. The requirement for an increase in the pavement structure and/or incorporating geotextile will be evaluated by Cambium personnel during proof roll inspections.

4.12.2 Flexible Pavement Structure

The pavement structure recommended in Table 8 below assumes that traffic flow will be limited to residential use and that the subgrades will be prepared as described above.

Table 7 Recommended Minimum Pavement Structure

Pavement Layer	Residential Roadways
Surface Course Asphalt	60 mm HL3 or SP 12.5
Granular Base	150 mm OPSS 1010 Granular A
Granular Subbase	300 mm OPSS 1010 Granular B

Material and thickness substitutions must be approved by the Design Engineer. The thickness of the subbase layer could also 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 no more than 300 mm thick 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.

4.12.3 Pavement Transitions

Existing asphaltic concrete should be neatly saw cut at pavement transition areas. The joints should tack coat in accordance with OPSS.MUNI 310 requirements.

4.12.4 Pavement Drainage

The design of a storm water management system is beyond the scope of this investigation; however, it is recommended that the subgrade, subbase, base, and asphalt surfaces should be shaped and crown to promote drainage of the pavement structure.

5.0 Report Limitations

5.1 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. 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.

5.2 Changes in Site and Project Scope

This geotechnical engineering report is intended for planning and design purposes only.

Subsurface conditions can be altered by the passage of sufficient time, natural occurrences, and human intervention. In particular, consideration should be given to contractual responsibilities as they relate to control of groundwater seepage, disturbance of soils, and frost protection.

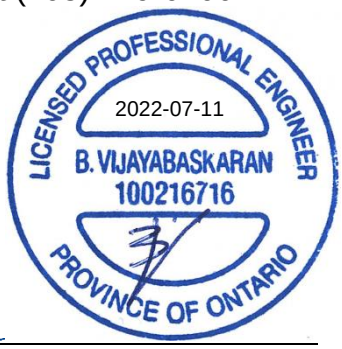
The design parameters provided and the engineering advice offered in this report are intended for use by the owner and its retained design consultants. If there are changes to the project scope and development features, these interpretations made of the subsurface information, for geotechnical design parameters, advice, and comments relating to constructability issues and quality control may not be complete for the project. Cambium should be retained to conduct further review to interpret the implications of such changes with respect to this report.

It is understood that the conducted investigation was for preliminary design purposes and that areas of the site could not be accessed. Additional boreholes should be advanced through the inaccessible areas of the site at a later date and the recommendations provided in this report should be verified at that time and updated accordingly.

6.0 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 reviewer at (705) 719-0700.

Respectfully submitted,



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7.0 Standard 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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The findings and results presented in reports prepared by Cambium are based on the materials and information provided by the client to Cambium and on the facts, conditions and circumstances encountered by Cambium during the performance of the work requested by the client. In formulating its findings and results into a report, Cambium assumes that the information and materials provided by the client or obtained by Cambium from the client or otherwise are factual, accurate and represent a true depiction of the circumstances that exist. Cambium relies on its client to inform Cambium if there are changes to any such information and materials. Cambium does not review, analyze or attempt to verify the accuracy or completeness of the information or materials provided, or circumstances encountered, other than in accordance with applicable accepted industry practice. Cambium will not be responsible for matters arising from incomplete, incorrect or misleading information or from facts or circumstances that are not fully disclosed to or that are concealed from Cambium during the provision of services, work or reports.

Facts, conditions, information and circumstances may vary with time and locations and Cambium's work is based on a review of such matters as they existed at the particular time and location indicated in its reports. No assurance is made by Cambium that the facts, conditions, information, circumstances or any underlying assumptions made by Cambium in connection with the work performed will not change after the work is completed and a report is submitted. If any such changes occur or additional information is obtained, Cambium should be advised and requested to consider if the changes or additional information affect its findings or results.

When preparing reports, Cambium considers applicable legislation, regulations, governmental guidelines and policies to the extent they are within its knowledge, but Cambium is not qualified to advise with respect to legal matters. The presentation of information regarding applicable legislation, regulations, governmental guidelines and policies is for information only and is not intended to and should not be interpreted as constituting a legal opinion concerning the work completed or conditions outlined in a report. All legal matters should be reviewed and considered by an appropriately qualified legal practitioner.

Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

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Cambium's services, work and reports may be relied on by the client and its corporate directors and officers, employees, and professional advisors. Cambium is not responsible for the use of its work or reports by any other party, or for the reliance on, or for any decision which is made by any party using the services or work performed by or a report prepared by Cambium without Cambium's express written consent. Any party that relies on services or work performed by Cambium or a report prepared by Cambium without Cambium's express written consent, does so at its own risk. No report of Cambium may be disclosed or referred to in any public document without Cambium's express prior written consent. Cambium specifically disclaims any liability or responsibility to any such party for any loss, damage, expense, fine, penalty or other such thing which may arise or result from the use of any information, recommendation or other matter arising from the services, work or reports provided by Cambium.

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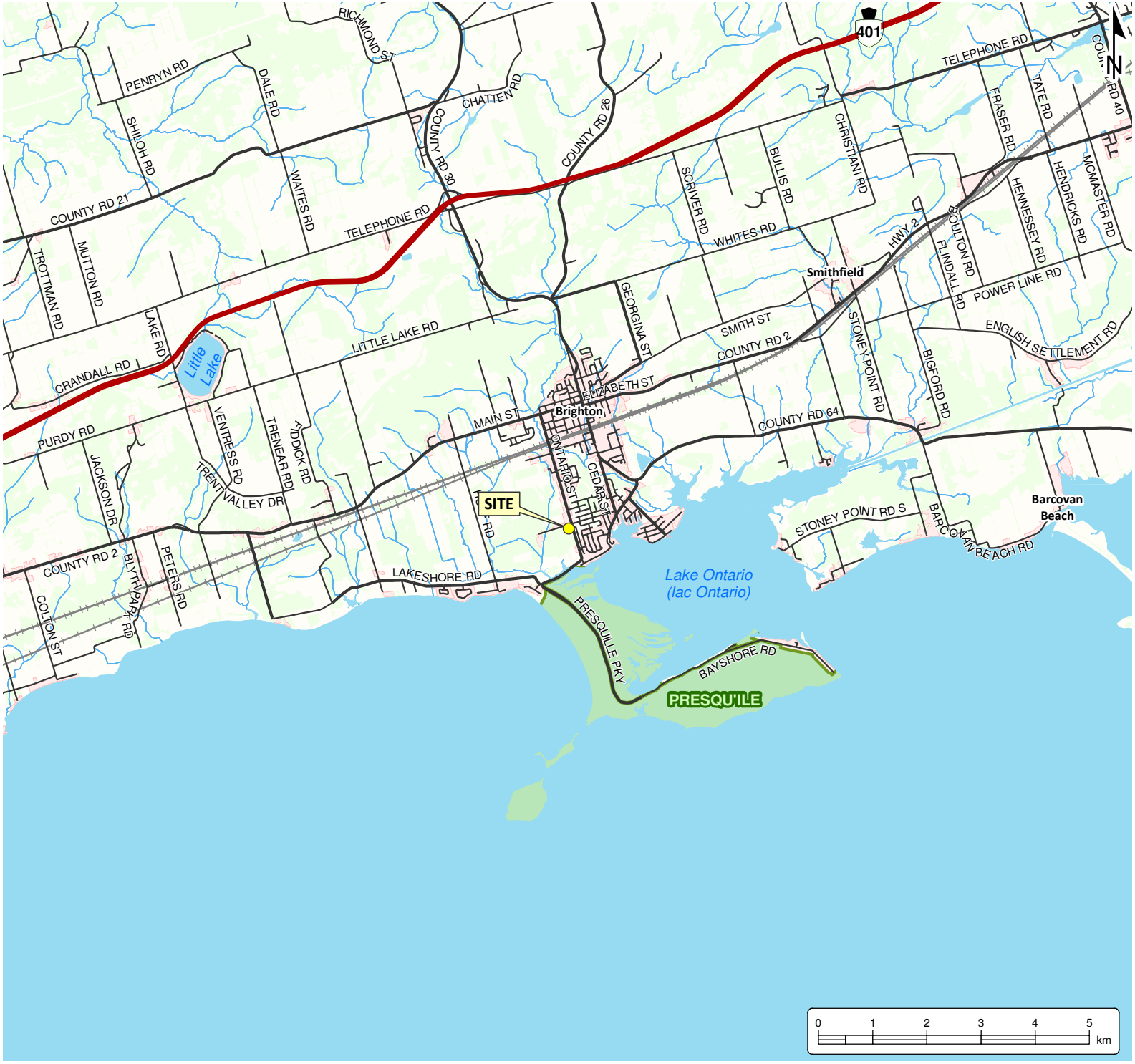
Appended Figures

GEOTECHNICAL INVESTIGATION

TOMBA ENTERPRISES LTD.
214 Ontario Street
Brighton, Ontario



LEGEND

- Highway
- Major Road
- Minor Road
- Railroad
- Watercourse
- Water Area
- Provincial Park
- Wooded Area
- Built Up Area

Notes:
- 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 general reference use only.

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SITE LOCATION MAP

Project No.: 13654-001		Date: September 2021 Rev.:	
Scale: 1:100,000		Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: BV	Figure:	1

O:\GIS\MXDs\13600-13699\13654-001 Tomba Enterprises Ltd. -GEO - 214 Ontario Street, Brighton\2021-09-30 FIG 1 - Site Location Plan.mxd

GEOTECHNICAL INVESTIGATION

TOMBA ENTERPRISES LTD.
214 Ontario Street
Brighton, Ontario

LEGEND

- Borehole
- Site (approximate)

Notes:
- Site is approximate and was obtained from the Ministry of Natural Resources and Forestry - Make a Topographic Map.
- 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 general reference use only.

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BOREHOLE LOCATION PLAN EXISTING CONDITIONS

Project No.: 13654-001		Date: September 2021 Rev.:	
Scale: 1:1,500		Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: BV	Figure:	**2A**

O:\GIS\MXDs\13600-13899\13654-001 Tomba Enterprises Ltd. GEO - 214 Ontario Street, Brighton\2021-09-30 FIG 2A - Borehole Location Plan.mxd

GEOTECHNICAL INVESTIGATION
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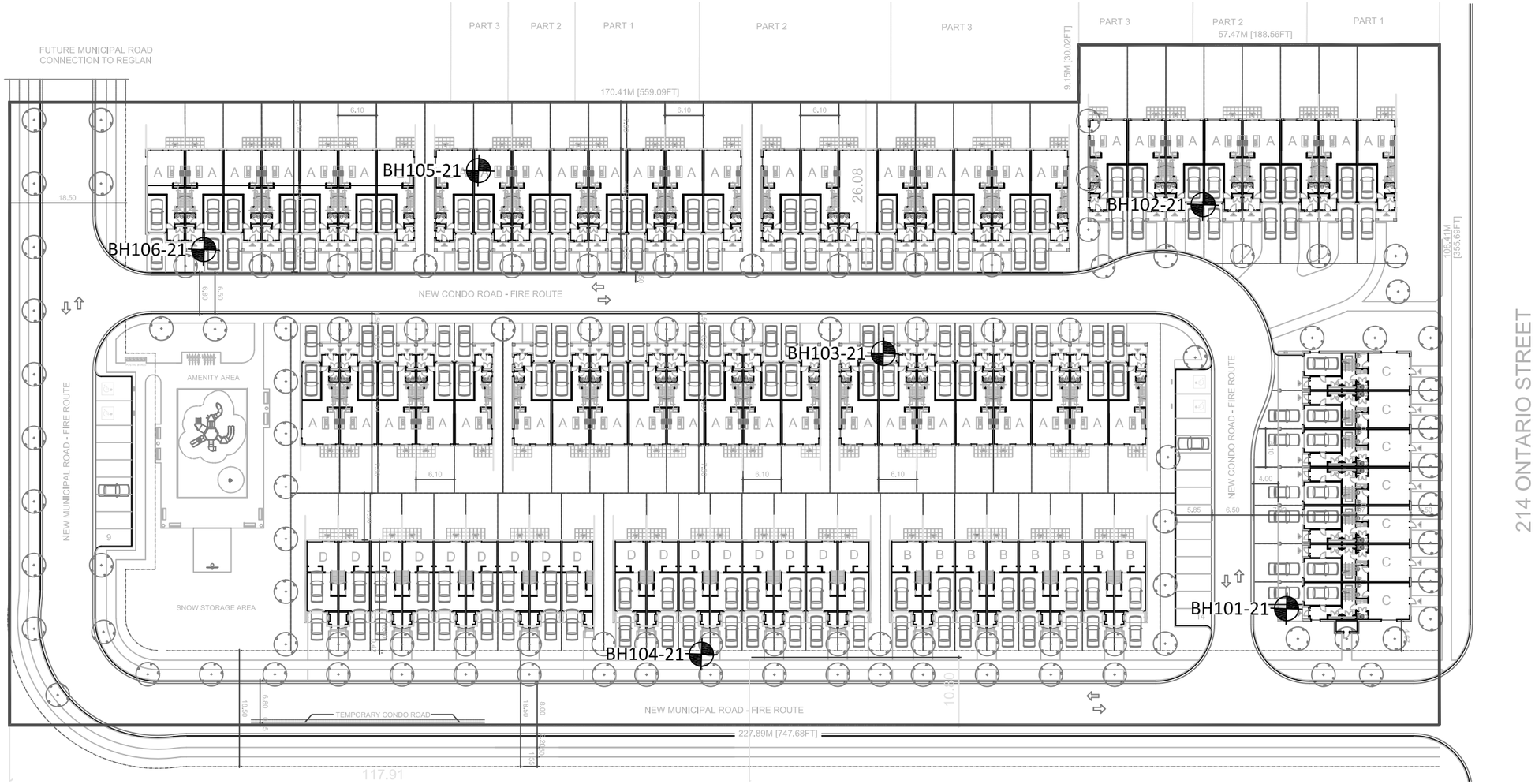
Brighton, Ontario

LEGEND



Notes:
1. Base Site Plan was obtained from Bicorp Design Group Ltd., Site Plan - Design H5, A1-H5, Dated July 2020.
2. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.

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BOREHOLE LOCATION PLAN
PROPOSED CONDITIONS

Project No.: 13654-001		Date: September 2021	Rev.:
Horizontal Scale: 1:750		Vertical Scale: N/A	
Drawn By: TLC	Checked By: BV	Figure: 2B	

Appendix A

Borehole Logs

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Oshawa
Kingston
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Log of Borehole: BH101-21

Client:	Tomba Enterprises Ltd.	**Project Name:**	214 Ontario Street, Brighton, Ontario	**Project No.:**	13654-001
Contractor:	Canadian Environmental Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	August 30, 2021
Location:	214 Ontario Street, Brighton, Ontario	**UTM:**	18T, 4877790.50 m N, 280531.69 m E	**Elevation:**	78.79 mASL

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (20 40 60 80)	Well Installation	Remarks
0 / 78		TOPSOIL: 50 mm	1A / 1B / 1C	SS	71	13				
		FILL: Grey brown sand and gravel, trace silt, moist								
1 / 77		SAND: Grey brown, trace silt, trace gravel, very loose to loose, moist -wet below	2	SS	72	8				
			3	SS	89	2				
2 / 76			4	SS	72	2				
3 / 75			5	SS	79	6				
4 / 74		CLAY and SILT: Grey, trace sand, trace gravel, stiff, moist	6A / 6B	SS	100	10				
5 / 73			7	SS	67	11				
6 / 72		TILL: Grey silty sand, gravelly, some clay, compact, wet	8A / 8B	SS	67	23				
7		Borehole terminated at 6.1 mbgs.								

SS7 GSA
Gravel 1%
Sand 6%
Silt 45%
Clay 48%

SS8B GSA
Gravel 24%
Sand 36%
Silt 30%
Clay 10%

BH caved to 0.9 mbgs upon completion.

Logged By: FI **Input By:** FI

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Log of Borehole: BH102-21

Client:	Tomba Enterprises Ltd.	**Project Name:**	214 Ontario Street, Brighton, Ontario	**Project No.:**	13654-001
Contractor:	Canadian Environmental Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	August 30, 2021
Location:	214 Ontario Street, Brighton, Ontario	**UTM:**	18 T, 4877847.84 m N, 280499.09 m E	**Elevation:**	79.26 mASL

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (20 40 60 80)	Well Installation	Remarks
0 / 79		FILL: Brown sand, some gravel, trace silt, moist [Base Material]	1A, 1B						Monument, Cap	
		FILL: Black silty sand, with organics, moist [Probable buried topsoil]	1C	SS	83	7				
1 / 78		SAND: Brown, some silt, loose to compact, moist	2	SS	94	18				
		-grey brown, trace silt, trace gravel, wet below							Bentonite Plug, PVC Standpipe	
2 / 77			3	SS	67	12				
			4	SS	100	9				
3 / 76			5	SS	89	11				
4 / 75		CLAY and SILT: Grey, trace sand, firm, moist	6A, 6B	SS	100	34			Sand Pack, PVC Screen	
			7	SS	72	3				
5 / 74		-trace gravel								
6 / 73			8	SS	83	5			Cap	
		Borehole terminated at 6.1 mbgs.								Water level at 1.8 mbgs and BH remained open upon completion.
7 / 72										

Logged By: FI **Input By:** FI

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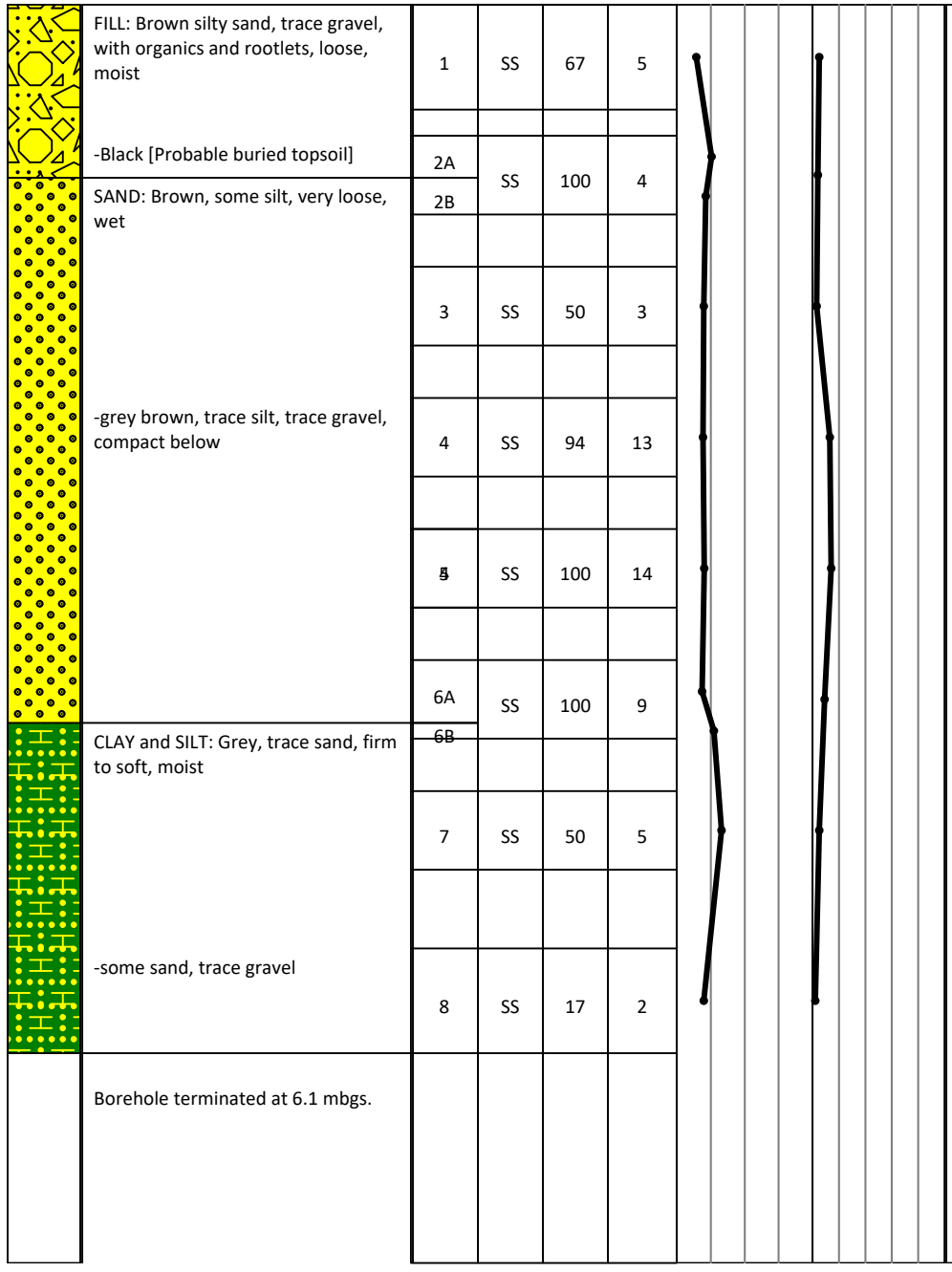
Log of Borehole: BH103-21

Client: Tomba Enterprises Ltd. **Project Name:** 214 Ontario Street, Brighton, Ontario **Project No.:** 13654-001

Contractor: Canadian Environmental Drilling **Method:** Hollow Stem Augers **Date Completed:** August 30, 2021

Location: 214 Ontario Street, Brighton, Ontario **UTM:** 18T, 4877810.38 m N, 280455.32 m E **Elevation:** 79.14 mASL

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N)	Well Installation	Remarks
79	0	FILL: Brown silty sand, trace gravel, with organics and rootlets, loose, moist	1	SS	67	5		
		-Black [Probable buried topsoil]	2A	SS	100	4		
78	1	SAND: Brown, some silt, very loose, wet	2B					
			3	SS	50	3		SS3 GSA Gravel 0% Sand 90% Silt and Clay 10%
77	2	-grey brown, trace silt, trace gravel, compact below	4	SS	94	13		SS4 GSA Gravel 2% Sand 95% Silt and Clay 3%
			5	SS	100	14		
76	3							
75	4		6A	SS	100	9		
		CLAY and SILT: Grey, trace sand, firm to soft, moist	6B					
			7	SS	50	5		
74	5	-some sand, trace gravel						
			8	SS	17	2		
73	6	Borehole terminated at 6.1 mbgs.						Water level at 1.2 mbgs and cave to 1.5 mbgs upon completion.
72	7							



Logged By: FI **Input By:** FI

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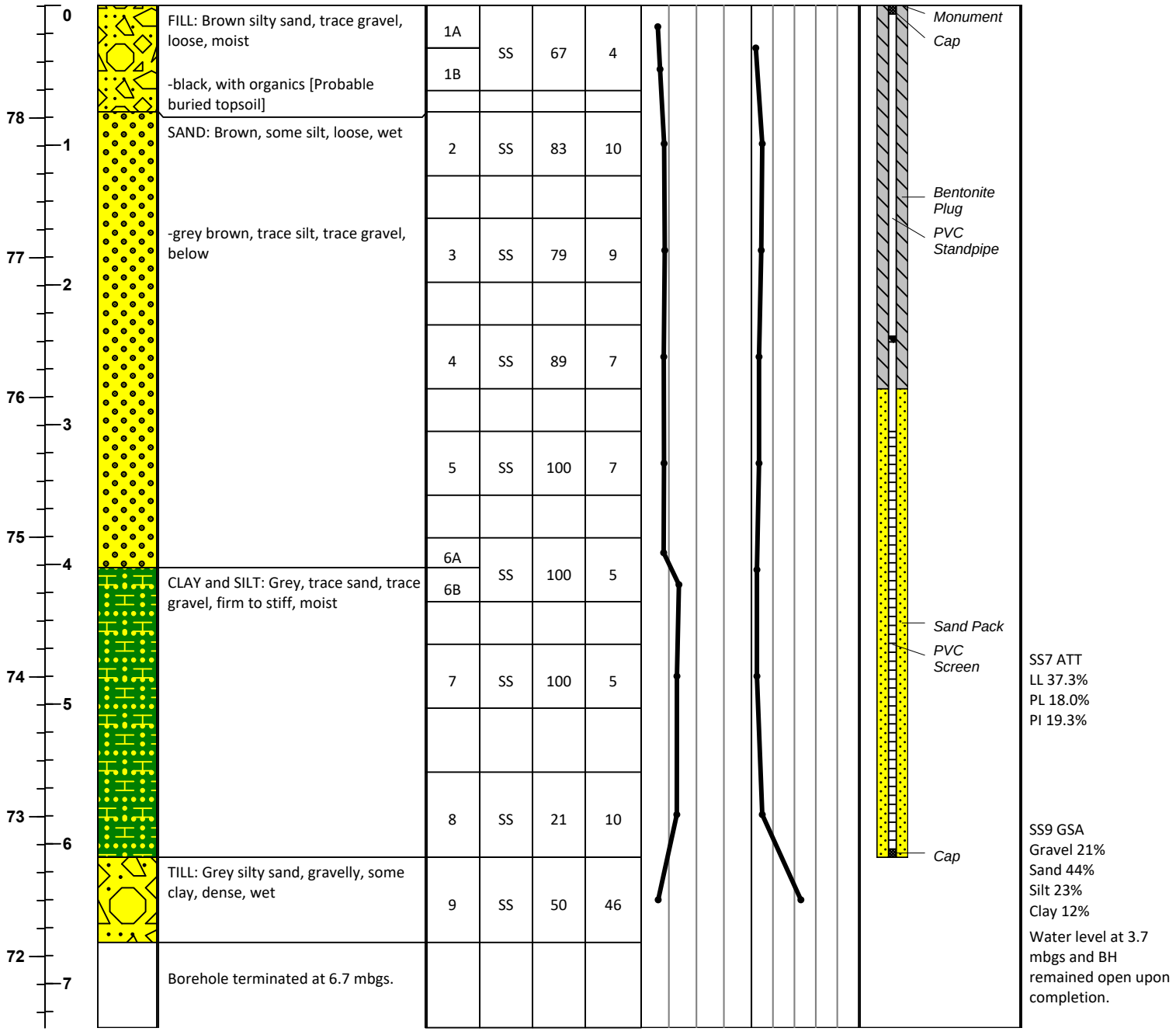
Log of Borehole: BH104-21

Client: Tomba Enterprises Ltd. **Project Name:** 214 Ontario Street, Brighton, Ontario **Project No.:** 13654-001

Contractor: Canadian Environmental Drilling **Method:** Hollow Stem Augers **Date Completed:** August 31, 2021

Location: 214 Ontario Street, Brighton, Ontario **UTM:** 18T, 4877757.28 m N, 280447.14 m E **Elevation:** 78.81 mASL



Logged By: FI **Input By:** FI

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Kingston
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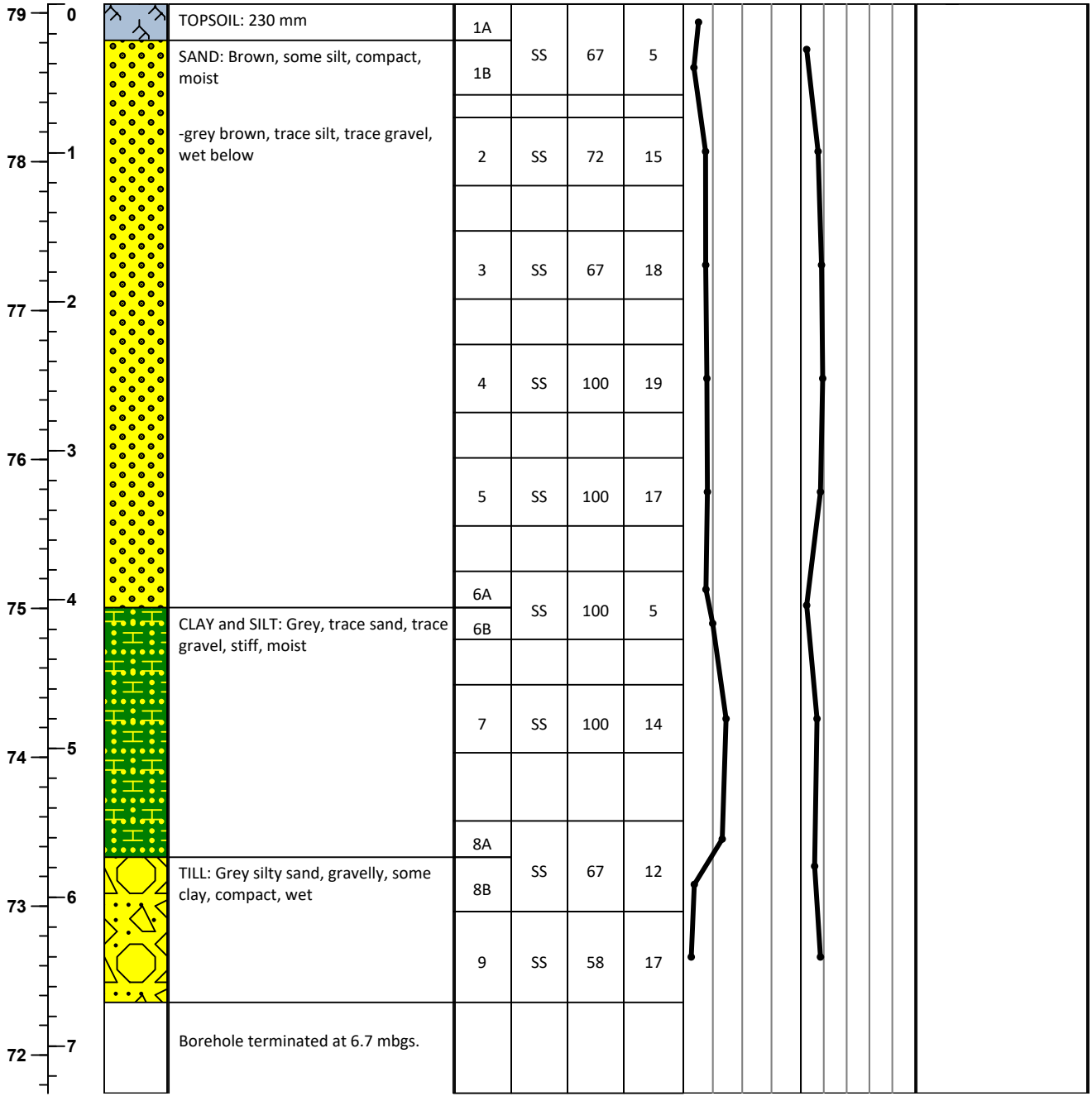
Log of Borehole: BH105-21

Client:	Tomba Enterprises Ltd.	**Project Name:**	214 Ontario Street, Brighton, Ontario	**Project No.:**	13654-001
Contractor:	Canadian Environmental Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	August 31, 2021
Location:	214 Ontario Street, Brighton, Ontario	**UTM:**	18T, 4877819.09 m N, 280387.41 m E	**Elevation:**	79.06 mASL



Water level at 2.4 mbgs and BH remained open upon completion.

Logged By: FI **Input By:** FI

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Kingston
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Log of Borehole: BH106-21

Client:	Tomba Enterprises Ltd.	**Project Name:**	214 Ontario Street, Brighton, Ontario	**Project No.:**	13654-001
Contractor:	Canadian Environmental Drilling	**Method:**	Hollow Stem Augers	**Date Completed:**	August 31, 2021
Location:	214 Ontario Street, Brighton, Ontario	**UTM:**	18T, 4877793.66 m N, 280349.65 m E	**Elevation:**	78.86 mASL

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N)	Well Installation	Remarks
78	0	TOPSOIL: 300 mm	1A	SS	67	9	Monument, Cap	
		SAND: Brown, trace silt, compact, moist	1B					
	1	-grey brown, wet below	2	SS	56	11	Bentonite Plug, PVC Standpipe	
77	2		3	SS	100	14		
		-loose below	4	SS	89	9	Sand Pack, PVC Screen	
76	3		5	SS	100	8		SS5 GSA Gravel 0% Sand 99% Silt and Clay 1%
75	4		6A	SS	100	9		
		CLAY and SILT: Grey, trace sand, trace gravel, stiff, moist	6B					
74	5		7	SS	100	9		
			8A					
73	6	TILL: Grey silty sand, gravelly, some clay, dense, moist	8B	SS	63	7		
			9	SS	42	49		
72	7	Borehole terminated at 6.7 mbgs.					Cap	Water level at 2.1 mbgs and BH remained open upon completion.

% Moisture: 25 50 75
SPT (N): 20 40 60 80

Logged By: FI **Input By:** FI

Appendix B

Physical Laboratory Testing

Grain Size Distribution Chart

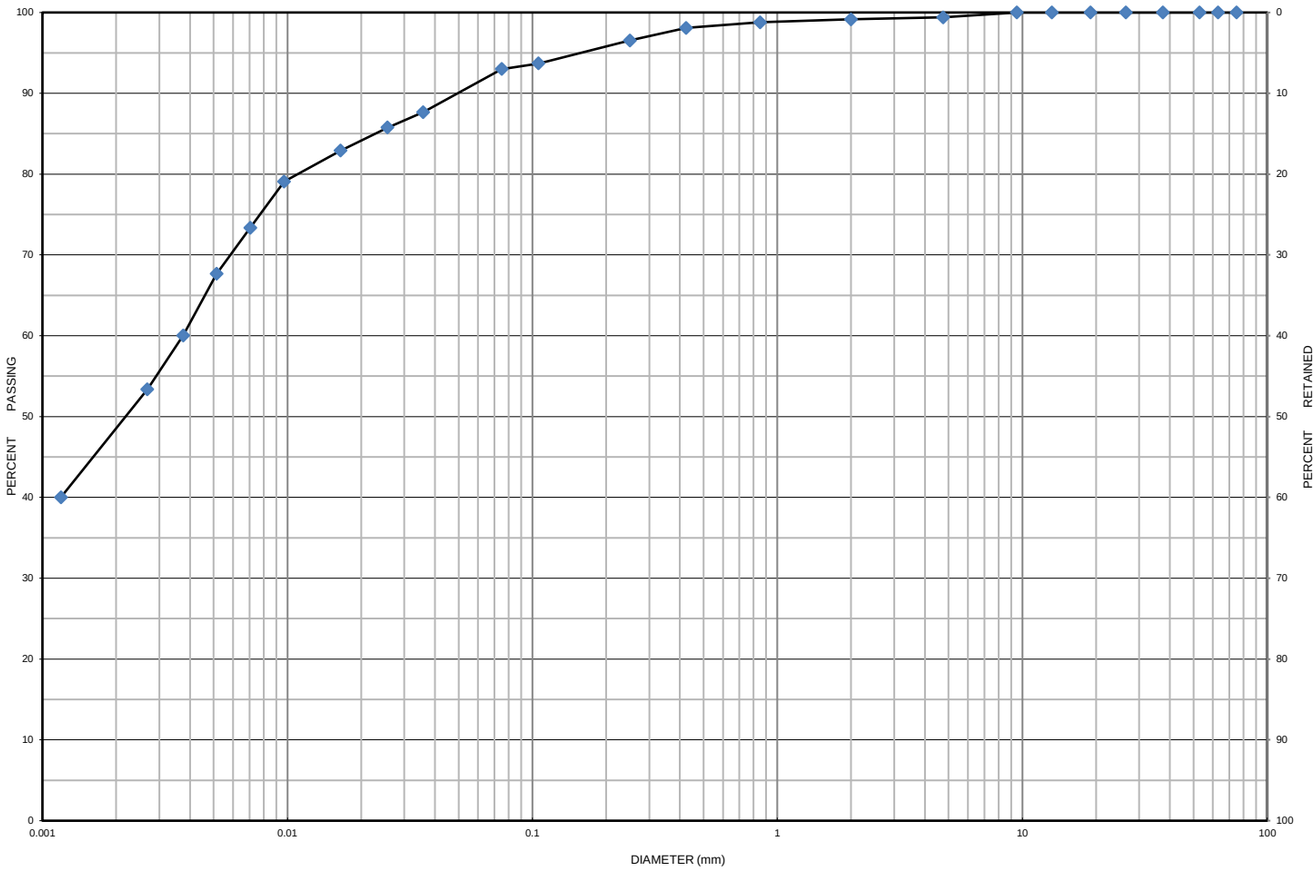
Project Number: *13654-001* **Client:** *Tomba Enterprises Ltd.*

Project Name: *214 Ontario Street, Brighton*

Sample Date: *August 30 & 31, 2021* **Sampled By:** *Farhan Imtiaz - Cambium Inc.*

Location: *BH 101-21 SS 7* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *S-21-1050*

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 101-21	SS 7	4.6 m to 5 m	1	6	45	48	32.4

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Clay and Silt trace Sand trace Gravel	CL	0.0038	-	-	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *September 14, 2021*

(Senior Project Manager)

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Grain Size Distribution Chart

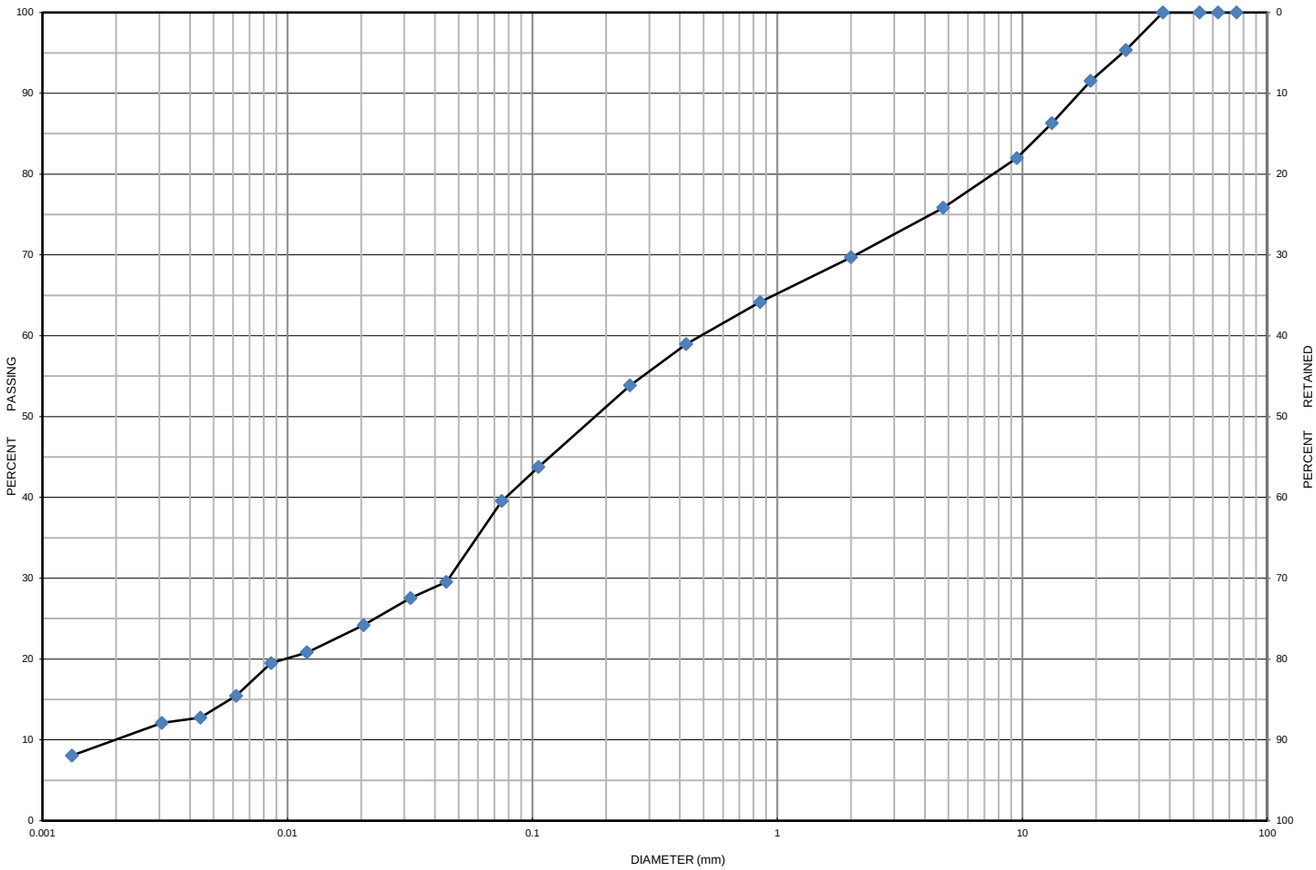
Project Number: *13654-001* **Client:** *Tomba Enterprises Ltd.*

Project Name: *214 Ontario Street, Brighton*

Sample Date: *August 30 & 31, 2021* **Sampled By:** *Farhan Imtiaz - Cambium Inc.*

Location: *BH 101-21 SS 8B* **Depth:** *5.6 m to 6.1 m* **Lab Sample No:** *S-21-1051*

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 101-21	SS 8B	5.6 m to 6.1 m	24	36	30	10	6.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Gravelly Sand some Clay	SM	0.495	0.046	0.002	247.50	2.14

Additional information available upon request

Issued By: _____ *Date Issued:* *September 14, 2021*

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Grain Size Distribution Chart

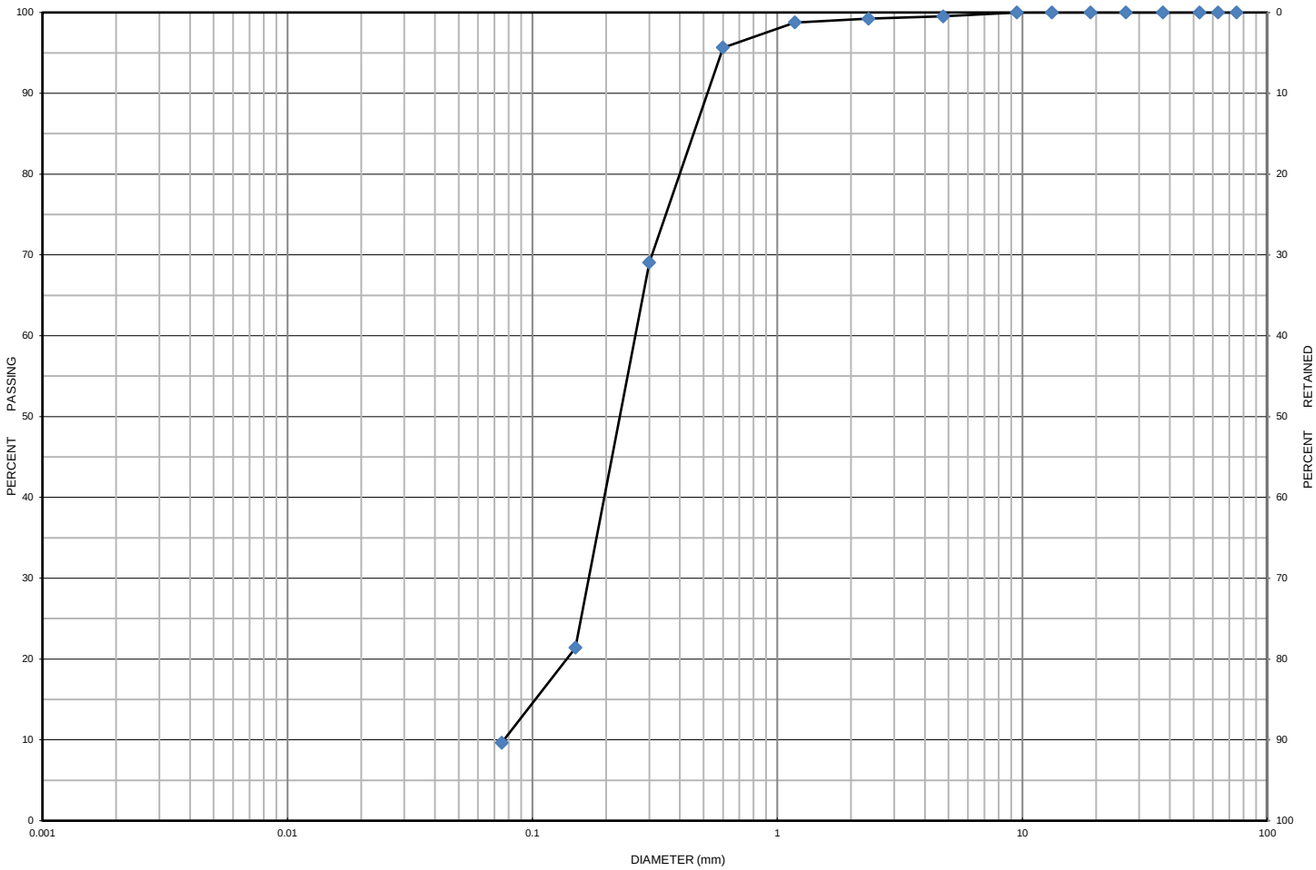
Project Number: *13654-001* **Client:** *Tomba Enterprises Ltd.*

Project Name: *214 Ontario Street, Brighton*

Sample Date: *August 30 & 31, 2021* **Sampled By:** *Farhan Imtiaz - Cambium Inc.*

Location: *BH 103-21 SS 3* **Depth:** *1.5 m to 2 m* **Lab Sample No:** *S-21-1052*

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 103-21	SS 3	1.5 m to 2 m	0	90	10		19.8

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand some Silt	SP	0.260	0.175	0.077	3.38	1.53

Additional information available upon request

Issued By: _____ *Date Issued:* *September 14, 2021*

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Grain Size Distribution Chart

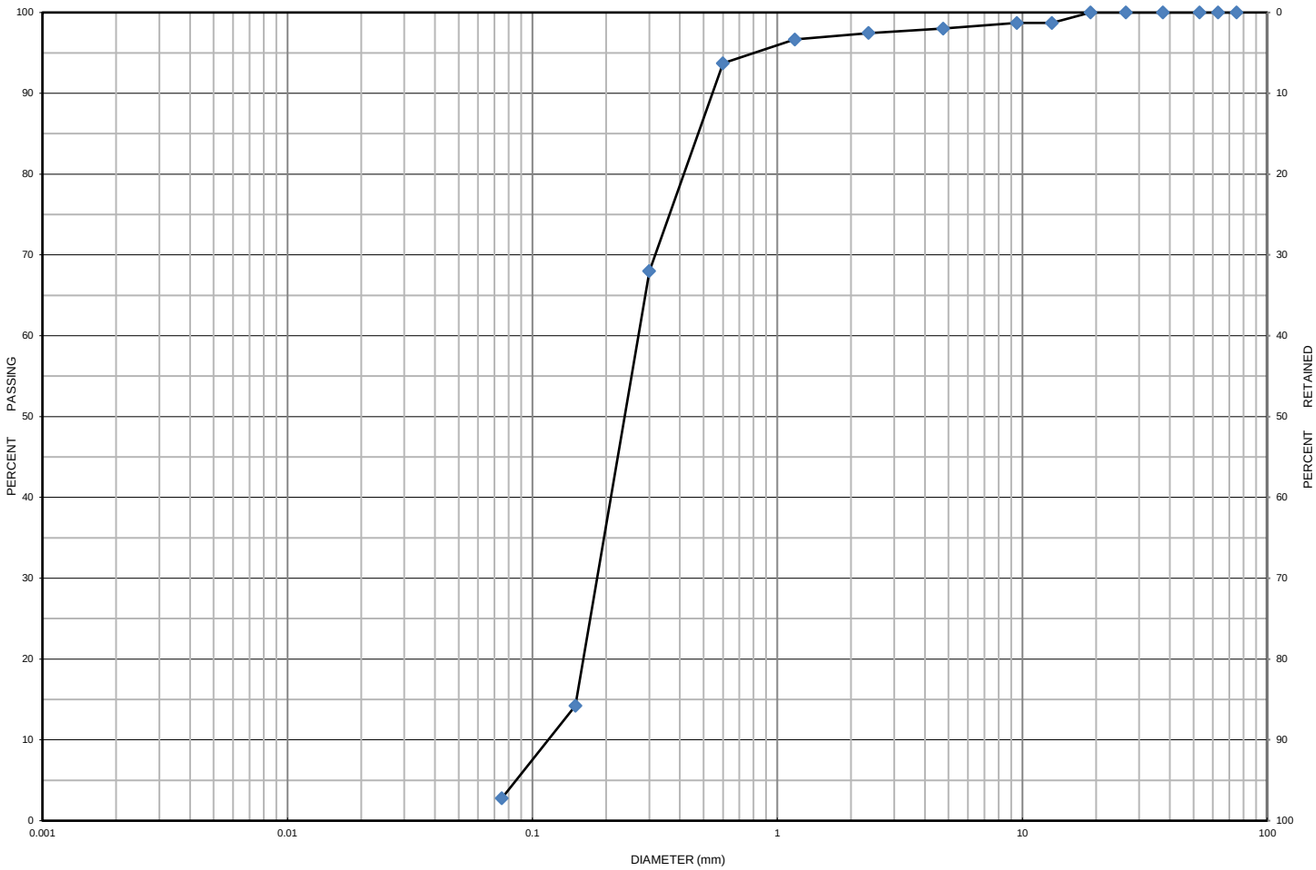
Project Number: *13654-001* **Client:** *Tomba Enterprises Ltd.*

Project Name: *214 Ontario Street, Brighton*

Sample Date: *August 30 & 31, 2021* **Sampled By:** *Farhan Imtiaz - Cambium Inc.*

Location: *BH 103-21 SS 4* **Depth:** *2.3 m to 2.7 m* **Lab Sample No:** *S-21-1053*

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 103-21	SS 4	2.3 m to 2.7 m	2	95	3		19.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand trace Silt trace Gravel	SP	0.265	0.185	0.125	2.12	1.03

Additional information available upon request

Issued By: _____ *Date Issued:* *September 14, 2021*

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Grain Size Distribution Chart

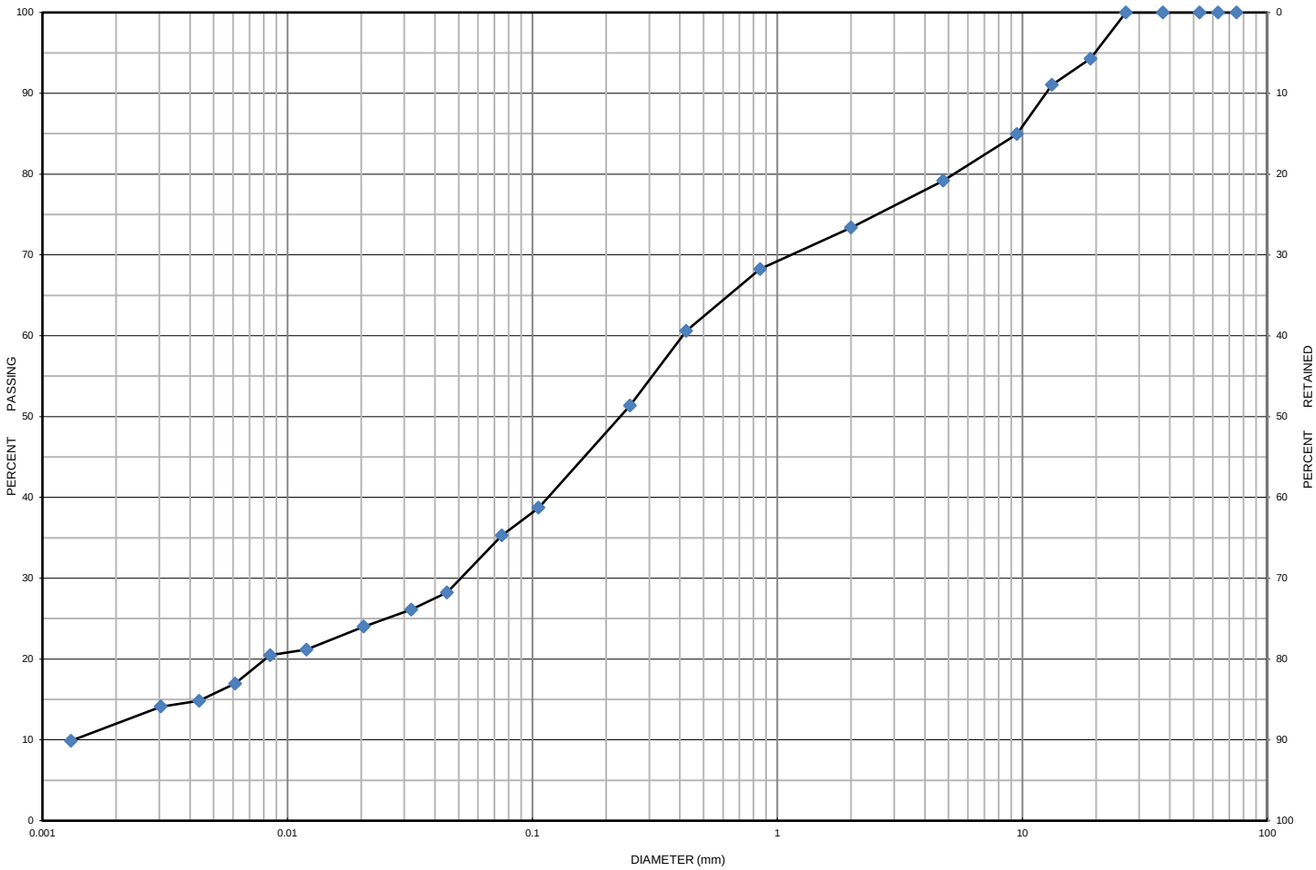
Project Number: *13654-001* **Client:** *Tomba Enterprises Ltd.*

Project Name: *214 Ontario Street, Brighton*

Sample Date: *August 30 & 31, 2021* **Sampled By:** *Farhan Imtiaz - Cambium Inc.*

Location: *BH 104-21 SS 9* **Depth:** *6.1 m to 6.7 m* **Lab Sample No:** *S-21-1055*

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 104-21	SS 9	6.1 m to 6.7 m	21	44	23	12	15.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Gravelly Sand some Clay	SM	0.4100	0.0510	0.0014	292.86	4.53

Additional information available upon request

Issued By: _____ *Date Issued:* *September 14, 2021*

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Grain Size Distribution Chart

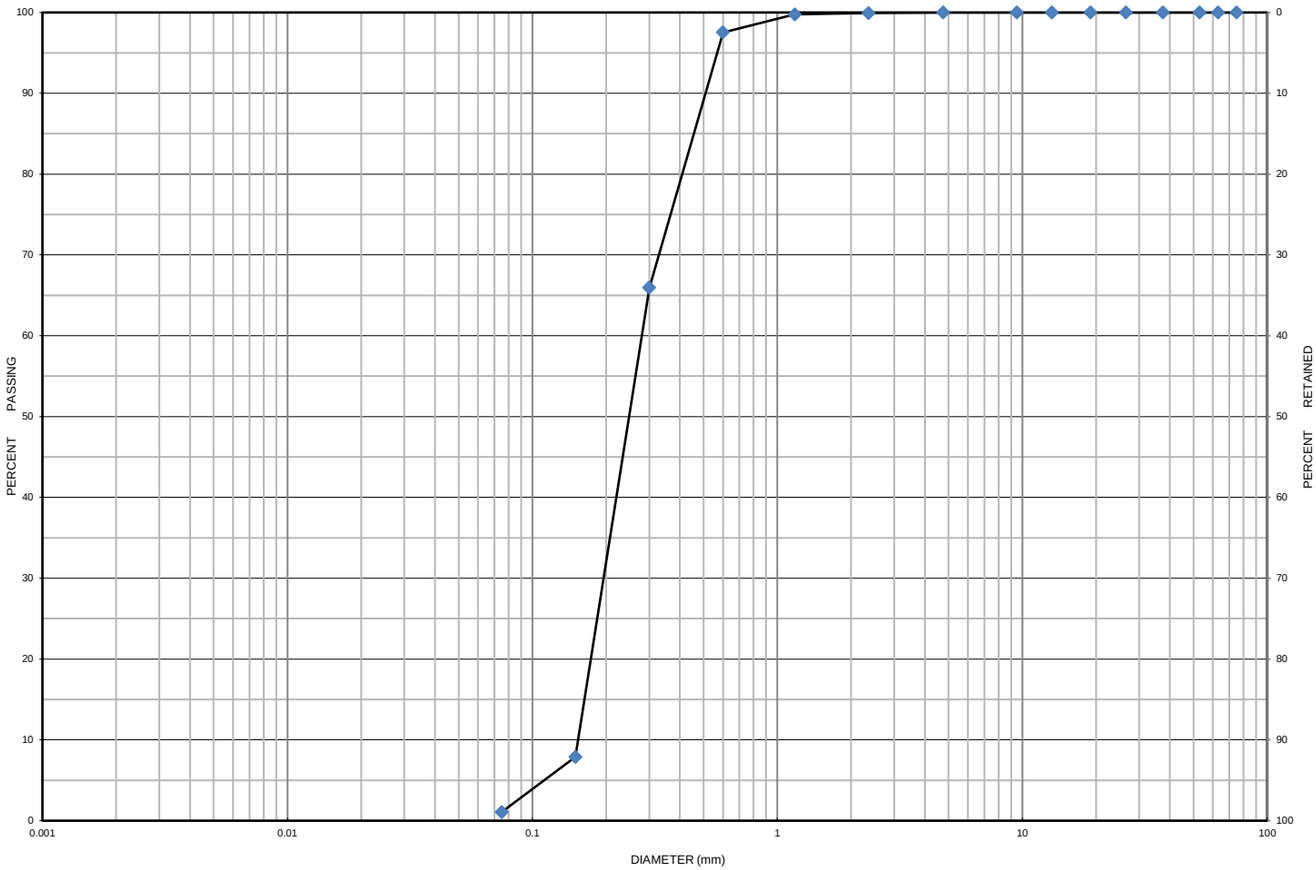
Project Number: *13654-001* **Client:** *Tomba Enterprises Ltd.*

Project Name: *214 Ontario Street, Brighton*

Sample Date: *August 30 & 31, 2021* **Sampled By:** *Farhan Imtiaz - Cambium Inc.*

Location: *BH 106-21 SS 5* **Depth:** *3 m to 3.5 m* **Lab Sample No:** *S-21-1056*

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 106-21	SS 5	3 m to 3.5 m	0	99	1		20.0

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand trace Silt	SP	0.275	0.195	0.155	1.77	0.89

Additional information available upon request

Issued By: _____ *Date Issued:* *September 14, 2021*

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Plasticity Chart

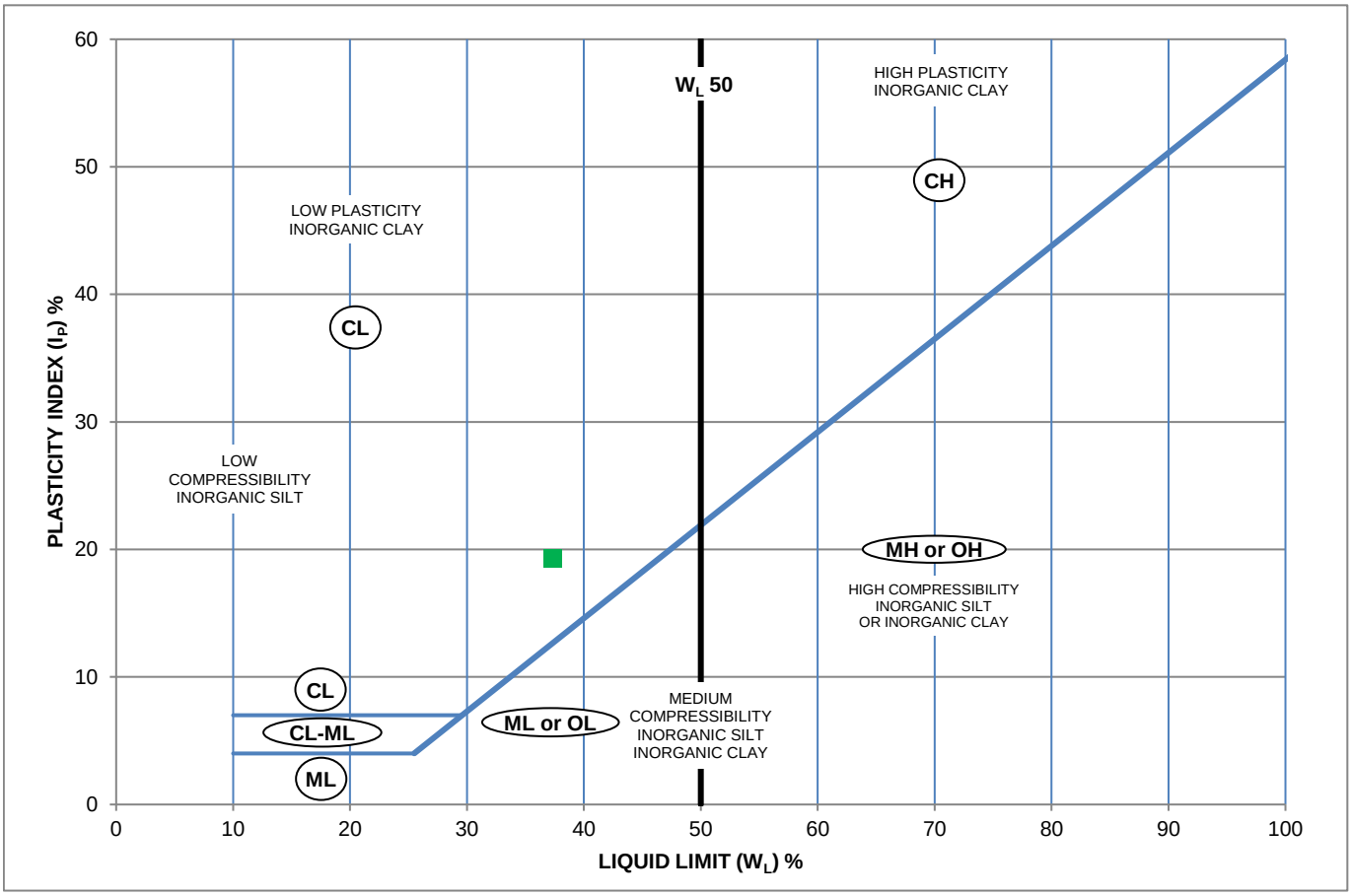
Project Number: *13654-001* **Client:** *Tomba Enterprises Ltd.*

Project Name: *214 Ontario Street, Brighton*

Sampled By: *Farhan Imtiaz - Cambium Inc.* **Sample Date:** *August 30 & 31, 2021*

Hole No.: *BH 104-21 SS 7* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *AG-21-1054*

Low Plasticity	High Plasticity



Symbol	Borehole	Sample	Depth	Description
■	BH 104-21	SS 7	4.6 m to 5 m	Clay and Silt trace Sand

Liquid Limit (%)	Plastic Limit	Plasticity Index (%)
37.3	***18.0***	***19.3***

Issued By: _____ *Date Issued:* *September 14, 2021*

(Senior Project Manager)

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