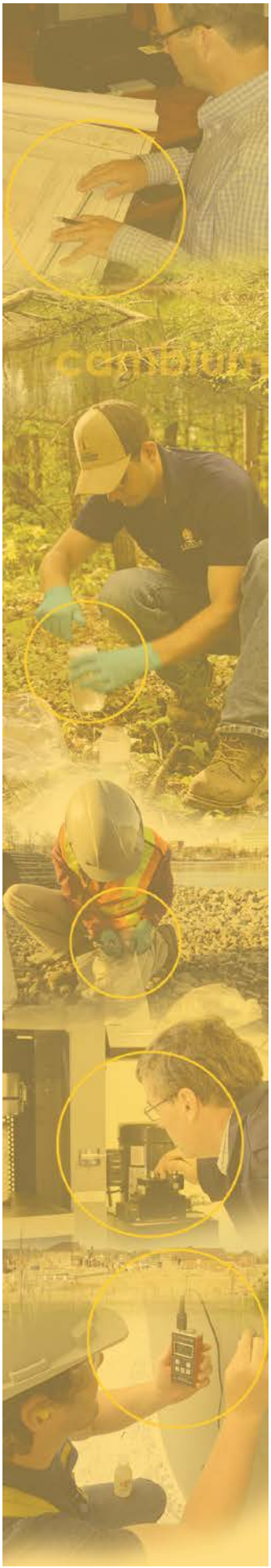

Geotechnical Investigation Report 101 Edward Street & 111 George Street, Creemore, Ontario

Cambium Reference No.: 8767-001

May 17, 2019

Prepared for: 2408969 Ontario Ltd.

Cambium Inc.

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1.0 INTRODUCTION

Cambium Inc. (Cambium) was retained by 2408969 Ontario Ltd. (Client) to complete a geotechnical investigation in support of the design and construction of a mixed density residential development and pumping station at 101 Edward Street and 111 George Street in Creemore, Ontario (Site).

The Edward Street property is an irregularly shaped lot, approximately 2.9 hectares in size, currently undeveloped with relatively flat topography, primarily vegetated with field grasses, shrubs and trees were noted primarily at the eastern side of the property. The George Street property is an irregularly shaped lot with relatively flat topography, approximately 1.9 hectares in size, currently partially developed with a residential dwelling and various outbuildings noted at the north end of the property, primarily vegetated with grass, shrubs and small trees were noted along the northern extent of the property.

At the time of investigation, the proposed development at Edward Street consists of nineteen single family residential dwellings with six five-unit townhouse blocks proposed at the east end of the property. The proposed George Street development consists of six single family residential dwellings at the north end of the site, with a stormwater management area towards the south end of the site and a proposed sanitary sewer pumping station at the southern extent of the property.

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 residential development. A Site Plan, including borehole locations, is included as Figure 1 of this report.

2.0 METHODOLOGY

2.1 BOREHOLE INVESTIGATION

A borehole investigation was completed on February 27th, 2019 and March 5th, 2019 to assess subsurface conditions at the Site. A total of six (6) boreholes were advanced between the two properties, four (4) boreholes designated as BH101-19 through BH104-19, were advanced throughout the Edward Street property, with the remaining two (2) boreholes, BH105-19 and BH106-19, advanced within the George Street site. Each of the boreholes were terminated at depths ranging from 5.0 m to 8.1 m below ground surface (mbgs).

Within the Edward Street property boreholes BH101-19 and BH104-19 were advanced within the proposed townhouse block, with boreholes BH102-19 and BH103-19 advanced within the proposed single family dwelling area. Borehole BH105-19 was advanced in the north end of the George Street property, with BH106-19 advanced within the footprint of the proposed sanitary pumping station at the south end of the site.

The borehole locations and elevations were surveyed using a Topcon RTK GPS system. The elevations were adjusted based on the elevation of the top nut of the fire hydrant on George Street, east of Concession Road 3, with an elevation of 254.32 mASL as provided by Martin W. Knisley, OLS. 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 (3) boreholes, BH101-19, BH102-19 and BH106-19 were outfitted as monitoring wells in order to determine the static groundwater elevation at the properties.

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 three (3) sieve analyses (LS-702) and three (3) 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

The subsurface conditions at the site consist predominantly of topsoil overlying sand and gravel soils with silty sand soils encountered in boreholes BH102-19, BH105-19, and BH106-19. These soils were encountered throughout the boreholes to the termination depths ranging from 5.0 mbgs to 8.1 mbgs. A layer of topsoil was encountered at the surface of each of the borehole locations.

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

3.1 TOPSOIL

A layer of black to brown topsoil between 100 mm and 600 mm in thickness was encountered at the surface of each of the borehole advanced during the investigation. The topsoil was frozen at the time of the investigation and loose in relative density, based on laboratory testing the topsoil had a natural moisture content ranging between 7% and 22%.

3.2 NATIVE SOILS

Beneath the topsoil discussed above, the native soils consisted of glaciofluvial outwash deposits generally consisting of gravel and sand or silty sand deposits, which extended to the termination depths ranging from 5.0 mbgs to 8.1 mbgs.

3.2.1 SAND AND GRAVEL SOILS

The texture of the native soils across each of the sites primarily consisted of gravel and sand deposits with trace amounts of silt and clay. The SPT “N” values varied between 20 and greater than 50 blows, indicating a compact to very dense relative density. Based on laboratory testing, the natural moisture content ranged between 4% and 18%. Each of the boreholes except BH102-19 and BH106-19 were terminated in sand and gravel soils.

Laboratory particle size distribution analyses were completed for three (3) samples of the sand and gravel soils, taken from the boreholes and depths provided in Table 1 in order to identify the varying textures encountered throughout the overburden material. The testing results are provided in Appendix B and are summarized in Table 1 based on the USCS.

Table 1 Particle Size Distribution – Sand and Gravel Soils

Borehole ID	Depth (mbgs)	Description	% Gravel	% Sand	% Silt	% Clay
BH101-19	1.5 – 2.0	Sand and Gravel some Silt trace Clay	40	42	18	
BH101-19	2.3 – 2.7	Gravel and Sand trace Silt trace Clay	52	38	8	2
BH103-19	2.3 – 2.7	Gravel and Sand trace Silt trace Clay	46	43	11	
BH105-19	1.5 – 2.0	Gravel and Sand trace Silt trace Clay	45	40	15	

3.2.2 SILTY SAND SOILS

Silty sand soils were encountered at depths between 2.0 mbgs and 3.6 mbgs in boreholes BH102-19, BH105-19 and BH106-19. The silty sand soils primarily consisted of silty sand with traces of gravel and clay. The SPT "N" values varied between 11 and 44, indicating a compact to dense relative density. Based on laboratory testing, the natural moisture content ranged between 10% and 14%. Boreholes BH102-19 and BH106-19 were terminated in silty sand soils at depths of 5.0 mbgs and 8.1 mbgs respectively.

Laboratory particle size distribution analyses were completed for two (2) samples of the sand and gravel soils, taken from the boreholes and depths provided in Table 1 in order to identify the varying textures encountered throughout the overburden material. The testing results are provided in Appendix B and are summarized in Table 1 based on the USCS.

Table 2 Particle Size Distribution – Silty Sand Soils

Borehole ID	Depth (mbgs)	Description	% Gravel	% Sand	% Silt	% Clay
BH102-19	4.6 – 5.0	Silty Sand trace Gravel trace Clay	2	61	29	8
BH106-19	4.6 – 5.0	Sand with Silt trace Gravel trace Clay	7	62	26	5

3.3 BEDROCK

Bedrock was not encountered within the investigation depths. Each of the boreholes were terminated at depths ranging from 5.0 mbgs to 8.1 mbgs in compact to dense native soils. The elevation of each borehole and their respective termination depths are identified in Table 3 below.

Table 3 Borehole Termination Depth – Elevations

Borehole ID	Borehole Elevation (mASL)	Borehole Termination Depth (mbgs)	Borehole Termination Elevation (mASL)
BH101-19	252.83	6.6	246.23
BH102-19	254.61	5.0	249.61
BH103-19	253.66	5.0	248.66
BH104-19	252.53	5.0	247.53
BH105-19	252.53	5.0	247.53
BH106-19	252.67	8.1	244.57

3.4 GROUNDWATER

Groundwater (free water) was noted in each of the boreholes advanced throughout the site. The observed groundwater elevation and caving (sloughing) depths are summarised in Table 4. During the site investigation four (4) monitoring wells, denoted as MW1 through MW4, and two (2) piezometers, denoted as P1 and P2, installed by others, were observed within the Edward Street property, the groundwater levels were recorded at these monitoring points during the subsequent groundwater monitoring trips on March 8th, 2019 and April 1st, 2019.

The moisture content of the soils generally ranged from 4% to 22%. It should be noted that soil moisture and groundwater levels at the Site may fluctuate seasonally and in response to climatic events.

Table 4 Ground Water and Caving Observations

Measurement Date	Borehole ID	Ground Surface Elevation (mASL)	Top of Standpipe Elevation (mASL)	Groundwater Depth (mbgs)	Ground Water Elevation (mASL)	Caving Depth (mbgs)
February 27th, 2019	BH101-19	252.83	253.42	*	*	*
	BH102-19	254.61	255.23	*	*	*
	BH103-19	253.66	-	1.20	252.43	2.40
	MW1	254.50	255.46	2.06	252.44	-
	MW2	254.04	254.83	1.79	252.25	-
	MW3	253.80	254.82	1.67	252.12	-
	MW4	253.50	254.39	1.48	252.03	-
March 5th, 2019	BH104-19	252.53	-	1.50	251.03	3.00
	BH105-19	252.53	253.27	*	*	*
	BH106-19	252.67	253.48	*	*	*
March 8th, 2019	BH101-19	252.83	253.42	1.67	251.16	-
	BH102-19	254.61	255.23	1.93	252.68	-
	BH105-19	252.53	253.27	1.71	250.82	-
	BH106-19	252.67	253.48	2.11	250.56	-
	MW1	254.50	255.46	2.11	252.38	-
	MW2	254.04	254.83	1.86	252.18	-
	MW3	253.80	254.82	1.84	251.95	-
	MW4	253.50	254.39	1.54	251.96	-
	P1	252.74	253.64	Blockage at Grade	-	-
	P2	253.40	254.46	2.29	251.11	
April 1st, 2019	BH101-19	252.83	253.42	1.22	251.61	-
	BH102-19	254.61	255.23	0.66	253.94	-
	BH105-19	252.53	253.27	0.92	251.61	-
	BH106-19	252.67	253.48	1.37	251.30	-
	MW1	254.50	255.46	1.27	253.23	-
	MW2	254.04	254.83	1.01	253.03	-
	MW3	253.80	254.82	0.91	252.89	-
	MW4	253.50	254.39	0.66	252.84	-
	P1	252.74	253.64	Blockage at Grade	-	-
	P2	253.40	254.46	1.42	251.98	-

**Unable to measure at time of installation due to use of hollow stem augers and groundwater disturbance from drilling process*

4.0 GEOTECHNICAL CONSIDERATIONS

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

4.1 SITE PREPARATION

The existing topsoil and any organic materials encountered should be excavated and removed from beneath the proposed building footprints; additionally this material should be excavated and removed to a minimum distance of 3 m around the building footprints. Any topsoil and materials with significant quantities of organics and deleterious materials (i.e., construction debris, asphalt etc.) are not appropriate for use as fill below buildings or grading and parking areas.

The exposed subgrade should be proof-rolled and inspected by a qualified geotechnical engineer prior to placement of 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 silty sand and gravel soils can become 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 1.4 mbgs.

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

It is assumed that the pavement structure thickness will be less than 1.4 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 BACKFILL

All excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA). The generally compact to very dense native sand and gravel and silty sand soils may be classified as Type 2 soils above the groundwater table in accordance with OHSA. Type 2 soils may be excavated with unsupported trench walls no deeper than 1.2 m, above which side slopes no steeper than 1H:1V are required. 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 or appropriately shored.

4.4 DEWATERING

Groundwater was encountered in each of the boreholes and monitoring wells across the site at elevations ranging of 250.56 mASL to 253.94 mASL. Seepage may occur across the Site if high groundwater conditions are present during construction due to seasonal fluctuations. If groundwater seepage is encountered it should be manageable with filtered sumps and pumps and depending on size of excavation. Depending upon excavation depths and seasonal conditions at the time of construction, any dewatering efforts may need to be registered in the Environmental Activity and Sector Registry (EASR) with the Ministry of the Environment, Conservation, and Parks. It is noted that the elevation of the groundwater table will vary due to seasonal conditions and in response to heavy precipitation events. In order to minimize predictable water issues and costs, it is recommended that excavation and in-ground construction be performed in drier seasons. It is noted that for the sewage pumping station, depending upon seasonal conditions, advance dewatering using a well-point system and registry in the EASR may be required.

4.5 BACKFILL AND COMPACTION

Excavated topsoil from the Site is not appropriate for use as fill below grading and parking areas. Excavated sand and gravel soils not containing organics, may be appropriate for use as fill below grading and parking areas, provided that the actual or adjusted moisture content at the time of construction is within a range that permits compaction to required densities. Some moisture content adjustments may be required depending upon seasonal conditions. Geotechnical inspections and testing of engineered fill are required to confirm acceptable quality.

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 or an approved equivalent. Foundation wall and any buried utility backfill material should consist of free-draining imported granular material.

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

4.6 FOUNDATION DESIGN

We understand that the proposed development at 101 Edward Street and 111 George Street consists of single family detached homes, multiunit townhouse blocks at the eastern side of the Edward street property and a sanitary pumping station at the south end of the George street property.

Assuming that the site is prepared as outlined above, the native sub-soils are competent to support the proposed structures on conventional strip and spread footings. Assuming any new exterior footings will be placed a minimum of 1.4 m below final adjacent grade for frost protection, these footings can be founded on compact to very dense sand and gravel or silty sand soils at depth. Any required grade raises to the footing elevations can be accomplished with engineered fill placed in accordance with the recommendations in Section 4.5. New footings for residential structures situated at a minimum depth of 1.4 m below the final adjacent grade, founded in undisturbed compact to very dense native sand and gravel or silty sand soils may be designed for an allowable bearing capacity of 175 kPa at serviceability limit state (SLS) and 205 kPa at ultimate limit state (ULS) in the residential areas.

In addition to the recommendations above, the structures may be founded on approved engineered fill soils overlying native sand and gravel soils subject to the approval by Cambium. Structures founded on approved engineered fill soils may be designed for an allowable bearing capacity of 150 kPa at SLS and 180 kPa at ULS in all areas.

It is understood the sanitary pumping station located at the south end of the George Street property by be founded at a depth of up to 5.0 mbgs. If the pumping station is founded at or above 5.0 mbgs on compact to dense native sand and gravel or silty sand soils, may be designed for an allowable bearing capacity 175 kPa at SLS and 205 kPa at ULS.

The quality of the subgrade should be inspected by Cambium during construction, prior to constructing the footings, to confirm bearing capacity estimates and suitability of any engineered fill. Settlement potential at the above-noted SLS loadings is less than 25 mm and differential settlement should be less than 10 mm.

4.7 LATERAL EARTH PRESSURE

Lateral earth pressure coefficients (K) are shown in Table 5. It is assumed that potential lateral loads will result from cohesionless, frictional materials, such as granular backfill.

Table 5 Lateral Earth Pressure Coefficients

K	Unfactored
Ko (at rest)	0.42
Ka (active)	0.27
Kp (passive)	3.70

The coefficients provided in Table 5 assume that the surface of the granular backfill is horizontal against any proposed retaining wall, and the wall is vertical and smooth. Cambium should be contacted to provide updated lateral earth pressure coefficients should the assumptions differ to those noted and if the soil slopes at an angle against the retaining wall.

A unit weight of 22 kN/m^3 should be assumed for compacted granular backfill loadings.

4.8 FLOOR SLABS

To create a stable working surface, to distribute loadings, and for drainage purposes, an allowance should be made to provide at least 200 mm of OPSS 1010 Granular A compacted to 98% of SPMDD beneath all floor slabs. In wet areas the Granular A may be substituted with 19 mm clear stone underlain by a geotextile (Terrafix 270R or similar approved).

It is noted that the floor slabs should be constructed a minimum 500 mm above the high water level.

4.9 SUBDRAINAGE

Given that groundwater was observed across the site at elevations ranging of 250.56 mASL to 253.94 mASL, geotextile wrapped subdrains set in a trench of clear stone and connected to a sump or other frost-free positive outlet are recommended below the floor slab and around the perimeter of building foundations. It is noted that the slab and foundation walls of the structures should be water proofed.

4.10 BURIED UTILITIES

Trench excavations above the groundwater table should generally consider Type 2 soil conditions, which require unsupported trench walls no greater than 1.2 m in depth, above which side slopes no steeper than 1H:1V are required. Any excavations below the water table should generally consider Type 4 soil conditions which require side slopes of 3H:1V or flatter. Bedding and cover material for any services should consist of OPSS 1010-3 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 percent of SPMDD. The cover material shall be a minimum of 300 mm over the top of the pipe and compacted to 98 percent of SPMDD, taking care not to damage the utility pipes during compaction.

4.11 INFILTRATION TESTING

In order to help determine the infiltration rate of site soils a particle size distribution test (sieve and hydrometer analyses) was completed on one (1) sample of near surface sand and gravel soil. In order to determine the rate at which water will be absorbed into the soil ("T" time), the soil was classified according to the USCS and the T Time was interpolated based on the USCS gradation charts for a particle size distribution test (hydrometer analyses). Hydraulic conductivity values were calculated using Hazen's equation. Based on these test results, a percolation time of 6 min/cm is appropriate for the native sand and gravel soils.

Percolation rate for the sample tested is provided in Table 6 and results are attached in Appendix B.

Table 6 Infiltration Test Results

Borehole	Depth (mbgs)	Soil	Percolation Time (min/cm)	Hydraulic Conductivity, K_{fs} (cm/s)
BH101-19	2.3 – 2.7	Gravel and Sand trace Silt trace Clay	6	5.6×10^{-3}

4.12 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". Based on the explored soil properties and in accordance with Table 4.1.8.4.A of the OBC (2006), it is recommended that Site Class "D" (stiff 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 0.059g and 0.100g respectively using the 2015 National Building Code Seismic Hazard Calculation. A detailed report of the calculation and its results can be found in Appendix C.

4.13 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 percent 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 percent SPMDD.

The recommended pavement structure should satisfy applicable standards for parking and driving areas and should, as a minimum, consist of the pavement layers identified in Table 7. The light duty pavement structure is intended for parking areas while the heavy duty pavement structure is appropriate for areas where heavy traffic or heavy loads are anticipated.

Table 7 Recommended Minimum Pavement Structure

Pavement Layer	Light Duty	Heavy Duty
Surface Course Asphalt	40 mm HL3 or HL4	40 mm HL3 or HL4
Binder Course Asphalt	50 mm HL8	90 mm HL8 (2 lifts)
Granular Base	150 mm OPSS 1010 Granular A	150 mm OPSS 1010 Granular A
Granular Subbase	300 mm OPSS 1010 Granular B	400 mm OPSS 1010 Granular B

Material and thickness substitutions must be approved by the Design Engineer.

The thickness of the subbase layer could be increased at the discretion of the Engineer, to accommodate site conditions at the time of construction, including soft or weak subgrade soil replacement.

Compaction of the subgrade should be verified by the Engineer prior to placing the granular fill. Granular layers should be placed in 150 mm 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 percent to shed runoff. Abutting pavements should be sawcut to provide clean vertical joints with new pavement areas.

4.14 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 ext. 405.

Respectfully submitted,

CAMBIUM INC.

Rob Gethin, P.Eng.
Senior Project Manager

RLG/jb

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Appended Figures

GEOTECHNICAL INVESTIGATION

2408969 ONTARIO LTD.

101 Edward Street and 111 George Street, Creemore, Ontario

LEGEND

- Benchmark
- Monitoring Well Location (Cambium Inc.)
- Borehole Location (Cambium Inc.)
- Monitoring Well Location (installed by others)
- Subject Property (approximate)

Notes:
- Subject Property is approximate and was obtained from the County of Simcoe online GIS.
- Benchmark is the top nut of a fire hydrant with an elevation of 254.32m.
- 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.

CAMBIUM

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MONITORING WELL/ BOREHOLE LOCATION PLAN

Project No.: 8767-001		Date: April 2019 Rev.:	
Scale: 1:2,500		Projection: NAD 1983 UTM Zone 17N	
Created by: TLC	Checked by: RG	Figure:	1

O:\GIS\project_MXDs\8700 to 8799\8767-001 C.C. Tatham & Associates Ltd. (Barrie) - Creemore Development\GEO\2019-04-01 FIG 1 - MW BH Location Plan.mxd

Appendix A
Borehole Logs

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

Log of Borehole: BH101-19

Client: 2408969 Ontario Ltd.
Project Name: 101 Edward St and 111 George St
Project No.: 8767-001
Contractor: Canadian Soil Drilling
Method: Solid/Hollow Stem Augers
Date Completed: February 27, 2019
Location: 101 Edward Street, Creemore
UTM: 17 T, 4908518, 572313
Elevation: 252.83 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
252 / 0		Topsoil: Dark brown sandy top soil, moist, loose	1	GS	-	-			Cap	Top of Standpipe Elevation = 253.417 mASL
		Sand and Gravel: Brown sand and gravel, trace silt, moist, very dense							Bentonite Plug	Groundwater measured at 1.219 mbgs (251.608 mASL) on April 1st, 2019
252 / 1			2	SS	70	50/255			PVC Standpipe	
251 / 2		Dense, saturated	3	SS	80	40			Sand Pack	GSA SS3: 40% Gravel, 42% Sand, 18% Silt and Clay
		Very dense	4	SS	80	50/255			PVC Screen	GSA SS4: 52% Gravel, 38% Sand, 8% Silt, 2% Clay
250 / 3			5	SS	90	50/255			Cap	
249 / 4										Changed solid stem to hollow stem augers at 3.6 mbgs
248 / 5		Dense	6	SS	40	30				
247 / 6		Less gravel	7	SS	100	38				
246 / 7		Borehole terminated at 6.6 mbgs								
245 / 8										
244 / 9										

Logged By: Jacob Bell
Input By: Chris Malliaros

Peterborough
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Oshawa
Kingston
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Log of Borehole: BH102-19

Client:	2408969 Ontario Ltd.	**Project Name:**	101 Edward St and 111 George St	**Project No.:**	8767-001
Contractor:	Canadian Soil Drilling	**Method:**	Solid/Hollow Stem Augers	**Date Completed:**	February 27, 2019
Location:	101 Edward Street, Creemore	**UTM:**	17 T, 4908438, 572043	**Elevation:**	254.61 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
0 / 254		Topsoil: Dark brown sandy topsoil, moist, loose	1	GS	-	-			Cap	Top of Standpipe Elevation = 255.228 mASL
									Bentonite Plug	
1 / 253		Sand and Gravel: Brown sand and gravel, trace silt, occasional cobbles, moist, dense	2	SS	70	38			PVC Standpipe	Groundwater measured at 0.663 mbgs (253.944 mASL) on April 1st, 2019
2 / 252		Very dense	3	SS	55	50/230			Sand Pack	
		Less gravel, saturated, dense	4	SS	60	39			PVC Screen	
3 / 251		Less cobbles, compact	5	SS	10	20			Cap	
4 / 250		Silty Sand: Brown silty sand, trace gravel, saturated, compact	6	SS	40	16				Changed solid stem to hollow stem augers at 3.6 mbgs GSA SS6: 2% Gravel 61% Sand 29% Silt 8% Clay
5 / 249		Borehole terminated at 5.0 mbgs								
6 / 248										
7 / 247										
8 / 246										
9										

Logged By: Jacob Bell **Input By:** Chris Malliaros

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Log of Borehole: BH103-19

Client: 2408969 Ontario Ltd. **Project Name:** 101 Edward St and 111 George St **Project No.:** 8767-001

Contractor: Canadian Soil Drilling **Method:** Solid Stem Augers **Date Completed:** February 27, 2019

Location: 101 Edward Street, Creemore **UTM:** 17T, 4908468, 572201 **Elevation:** 253.66 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
253 / 0		Topsoil: Dark brown sandy topsoil, moist, loose	1	GS	-	-				
		Sand and Gravel: Dark brown sand and gravel, trace silt, trace organics, moist, dense								
252 / 1		No organics at 0.9 mbgs, saturated	2	SS	40	39				
			3	SS	80	45				
251 / 2										
			4	SS	60	41				GSA SS4: 46% Gravel 43% Sand 11% Silt and Clay
250 / 3										
			5	SS	100	45				
249 / 4										
			6	SS	100	41				
248 / 5		Borehole terminated at 5.0 mbgs								
247 / 6										
246 / 7										
245 / 8										Borehole caving at 2.4 mbgs and water level in open borehole upon completion at 1.2 mbgs
		9								

Logged By: Jacob Bell **Input By:** Chris Malliaros

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Log of Borehole: BH104-19

Client: 2408969 Ontario Ltd. **Project Name:** 101 Edward St and 111 George St **Project No.:** 8767-001

Contractor: Canadian Soil Drilling **Method:** Solid Stem Augers **Date Completed:** March 5, 2019

Location: 111 George Street, Creemore **UTM:** 17 T, 4908438, 572301 **Elevation:** 252.53 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
252 / 0		Topsoil: Brown sandy topsoil, moist, loose	1	GS	-	-				
		Sand and Gravel: Brown sand and gravel, trace silt, moist, dense								
252 / 1			2	SS	70	42				
		Some orange segments								
251 / 2		Compact, wet	3	SS	90	25				
250 / 3		Saturated, dense	4	SS	80	38				
			5	SS	100	35				
249 / 4										
248 / 5			6	SS	90	30				
		Borehole terminated at 5.0 mbgs								
247 / 6										
246 / 7										
245 / 8										Borehole caving at 3.0 mbgs and water level in open borehole upon completion at 1.5 mbgs
244 / 9										

Logged By: Chris Malliaros **Input By:** Chris Malliaros

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Log of Borehole: BH105-19

Client: 2408969 Ontario Ltd.
Project Name: 101 Edward St and 111 George St
Project No.: 8767-001
Contractor: Canadian Soil Drilling
Method: Solid Stem Augers
Date Completed: March 5, 2019
Location: 111 George Street, Creemore
UTM: 17 T, 4908388, 572339
Elevation: 252.53 mASL

Elevation (m) / Depth	Description	Number	Type	% Recovery	SPT (N)	Well Installation	Remarks
252 / 0	Topsoil: Brown sandy topsoil, some gravel, moist, loose	1	GS	-	-	Cap	Top of Standpipe Elevation = 253.27 mASL
252 / 1	Sand and Gravel: Brown sand and gravel, trace silt, moist, dense	2	SS	70	45	Bentonite Plug	Groundwater measured at 0.921 mbgs (251.605 mASL) on April 1st, 2019
251 / 2	Brown to grey	3	SS	70	39	PVC Standpipe	GSA SS3: 45% Gravel 40% Sand 15% Silt and Clay
250 / 3	Silty Sand: Brown silty sand, trace clay, trace gravel, some cobbles, wet, dense	4	SS	60	35	Sand Pack	
249 / 4	Saturated	5	SS	90	44	PVC Screen	Changed solid stem to hollow stem augers at 3.6 mbgs
248 / 5	Sand and Gravel: Brown sand and gravel, trace silt, less cobbles, saturated, dense	6	SS	100	35	Cap	
247 / 6	Borehole terminated at 5.0 mbgs						
246 / 7							
245 / 8							
244 / 9							

% Moisture: 25 50 75
SPT (N): 10 20 30 40

Logged By: Chris Malliaros
Input By: Chris Malliaros

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Log of Borehole: BH106-19

Client: 2408969 Ontario Ltd.
Project Name: 101 Edward St and 111 George St
Project No.: 8767-001
Contractor: Canadian Soil Drilling
Method: Solid/Hollow Stem Augers
Date Completed: March 5, 2019
Location: 111 George Street, Creemore
UTM: 17 T, 4908284, 572374
Elevation: 252.67 mASL

Elevation (m) Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	SPT (N) (10 20 30 40)	Well Installation	Remarks
252 / 0		Topsoil: Dark brown sandy topsoil, trace gravel, trace silt, moist, loose	1	GS	-	-			Cap	Top of Standpipe Elevation = 253.477 mASL
		Sand and Gravel: Brown sand and gravel, trace silt, moist, very dense	2	SS	50	50/ 255			Bentonite Plug	Groundwater measured at 1.365 mbgs (251.304 mASL) on April 1st, 2019
251 / 1									PVC Standpipe	
			3	SS	85	41				
251 / 2		Saturated, dense, grey							Sand Pack	
			4	SS	100	38				
250 / 3		Brown							PVC Screen	
			5	SS	90	32			Cap	
249 / 4		Silty Sand: Brown silty sand, trace clay, trave gravel occasional cobbles, saturated, dense								Changed solid stem to hollow stem augers at 3.6 mbgs
248 / 5		Grey	6	SS	70	33				GSA SS6: 7% Gravel 62% Sand 25% Silt 5% Clay
247 / 6		Less cobbles, compact	7	SS	90	28				
246 / 7										
245 / 8			8	SS	100	11				
244 / 9		Borehole terminated at 8.1 mbgs								

Logged By: Chris Malliaros
Input By: Chris Malliaros

Appendix B

Physical Laboratory Testing Results

Grain Size Distribution Chart

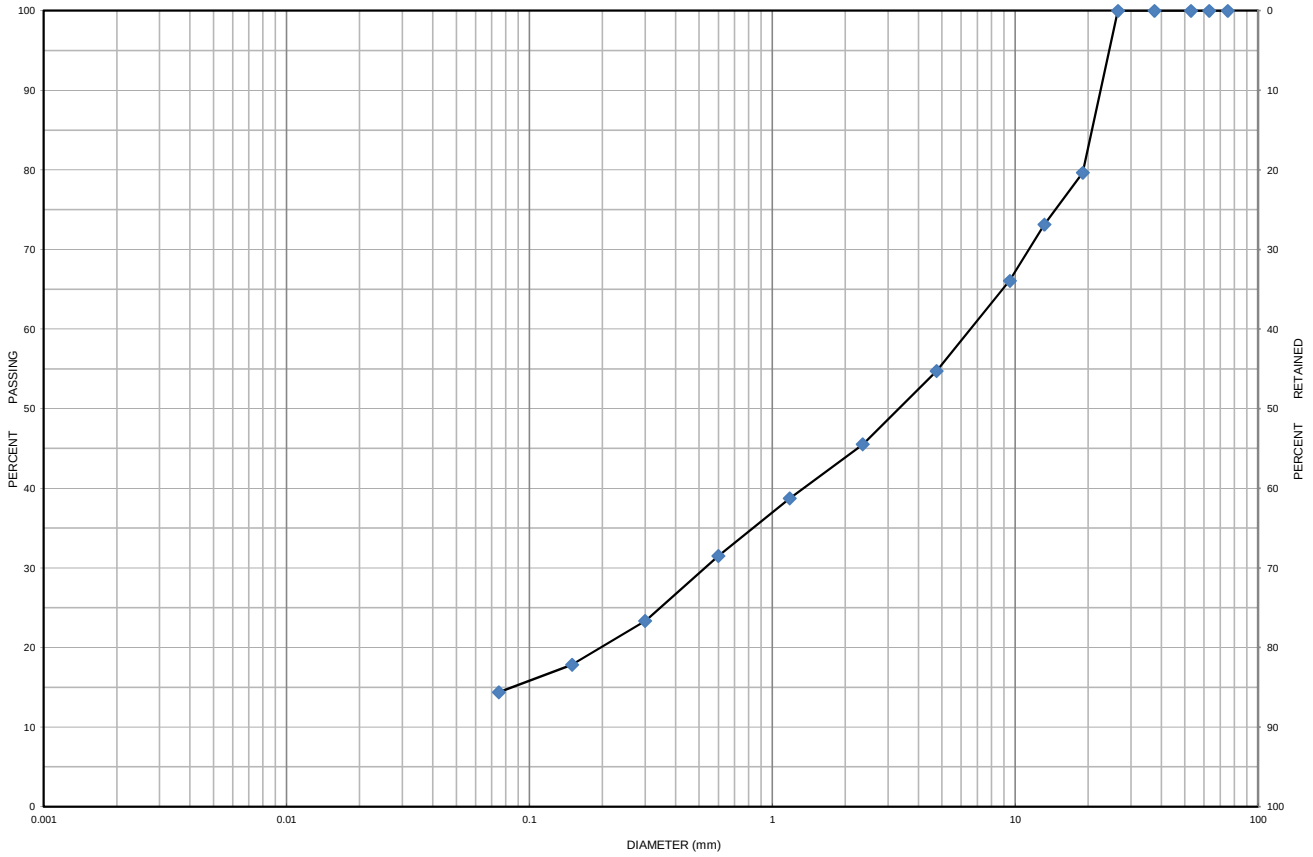
Project Number: *8767-001* **Client:** *C.C. Tatham & Associates Ltd. (Barrie)*

Project Name: *Creemore Development*

Sample Date: *February 27, 2019* **Sampled By:** *Jacob Bell - Cambium Inc.*

Location: *BH 105-19 SS 3* **Depth:** *1.5 m to 2 m* **Lab Sample No:** *S-19-0141*

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			

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 105-19	SS 3	1.5 m to 2 m	45	40	15		5.9

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravel and Sand some Silt	GP-SP	6.500	0.530	-	-	-

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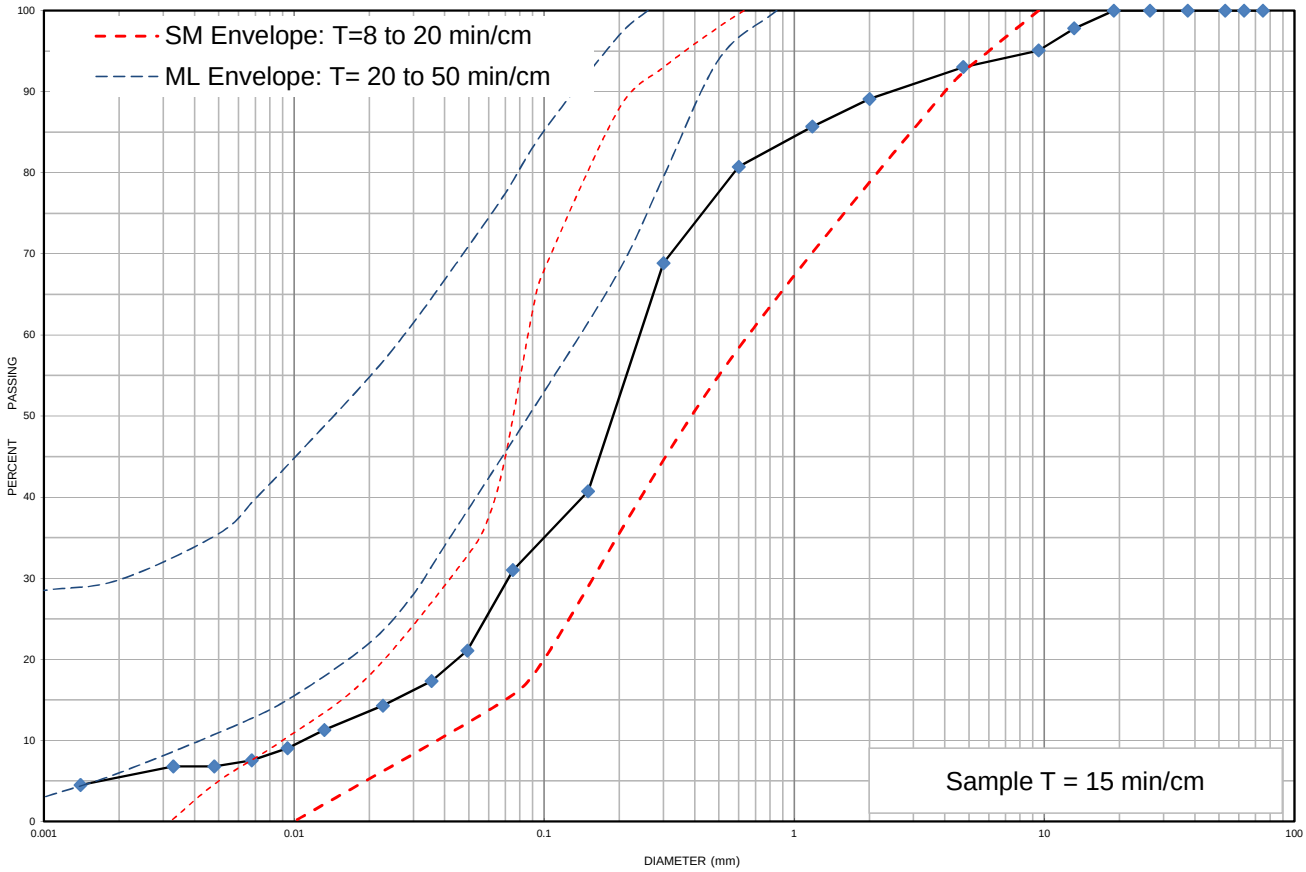
Grain Size Distribution Chart

Project Number:	*8767-001*	**Client:**	*C.C. Tatham & Associates Ltd. (Barrie)*		
Project Name:	*Creemore Development*				
Sample Date:	*February 27, 2019*	**Sampled By:**	*Jacob Bell - Cambium Inc.*		
Location:	*BH 106-19 SS 6*	**Depth:**	*4.6 m to 5 m*	**Lab Sample No:**	*S-19-0142*

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			

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 106-19	SS 6	4.6 m to 5 m	7	62	31		11.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand trace Gravel trace Clay	SM	0.240	0.072	0.012	20.00	1.80

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Grain Size Distribution Chart

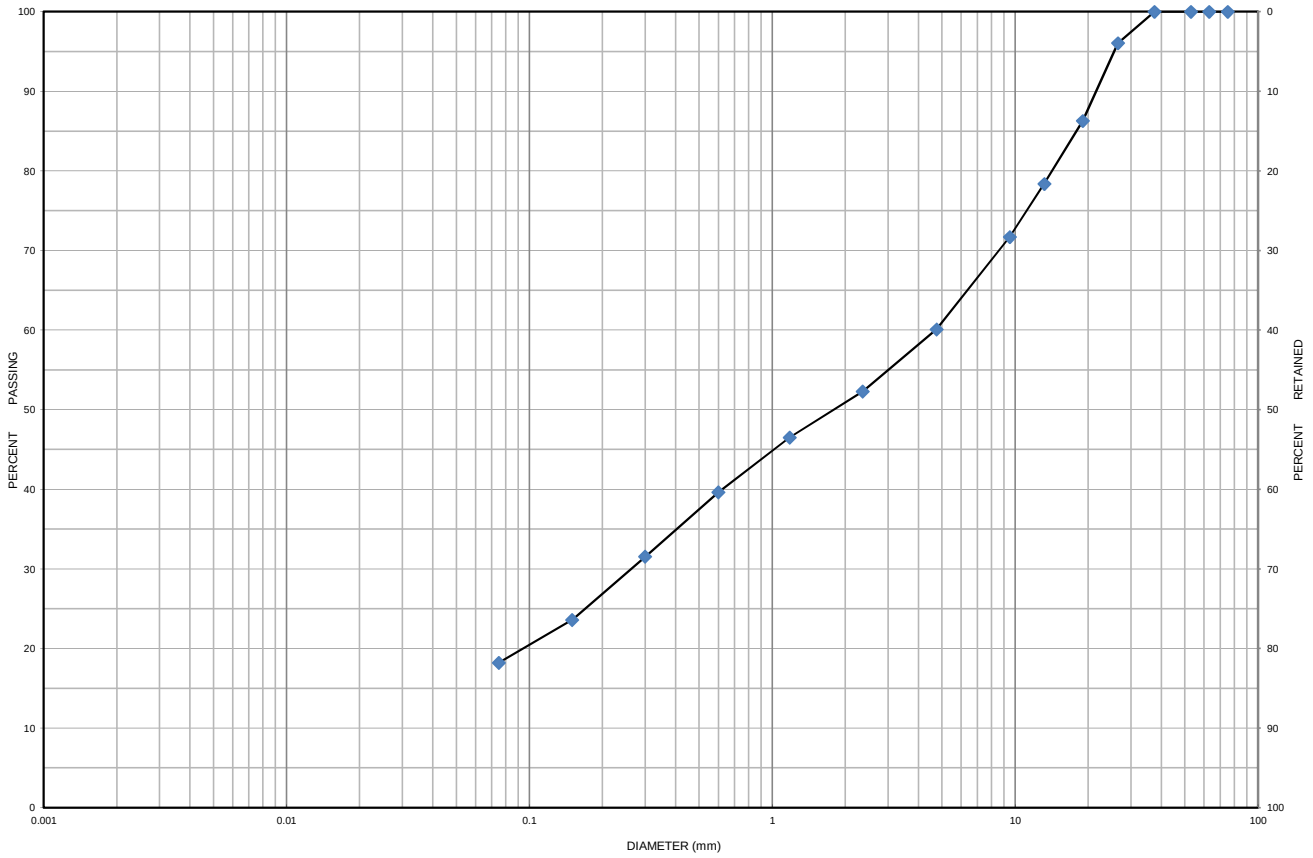
Project Number: *8767-001* **Client:** *C.C. Tatham & Associates Ltd. (Barrie)*

Project Name: *Creemore Development*

Sample Date: *February 27, 2019* **Sampled By:** *Jacob Bell - Cambium Inc.*

Location: *BH 101-19 SS 3* **Depth:** *1.5 m to 2 m* **Lab Sample No:** *S-19-0143*

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			

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-19	SS 3	1.5 m to 2 m	40	42	18		8.6

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand and Gravel some Silt	SP-GP	4.750	0.270	-	-	-

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Grain Size Distribution Chart

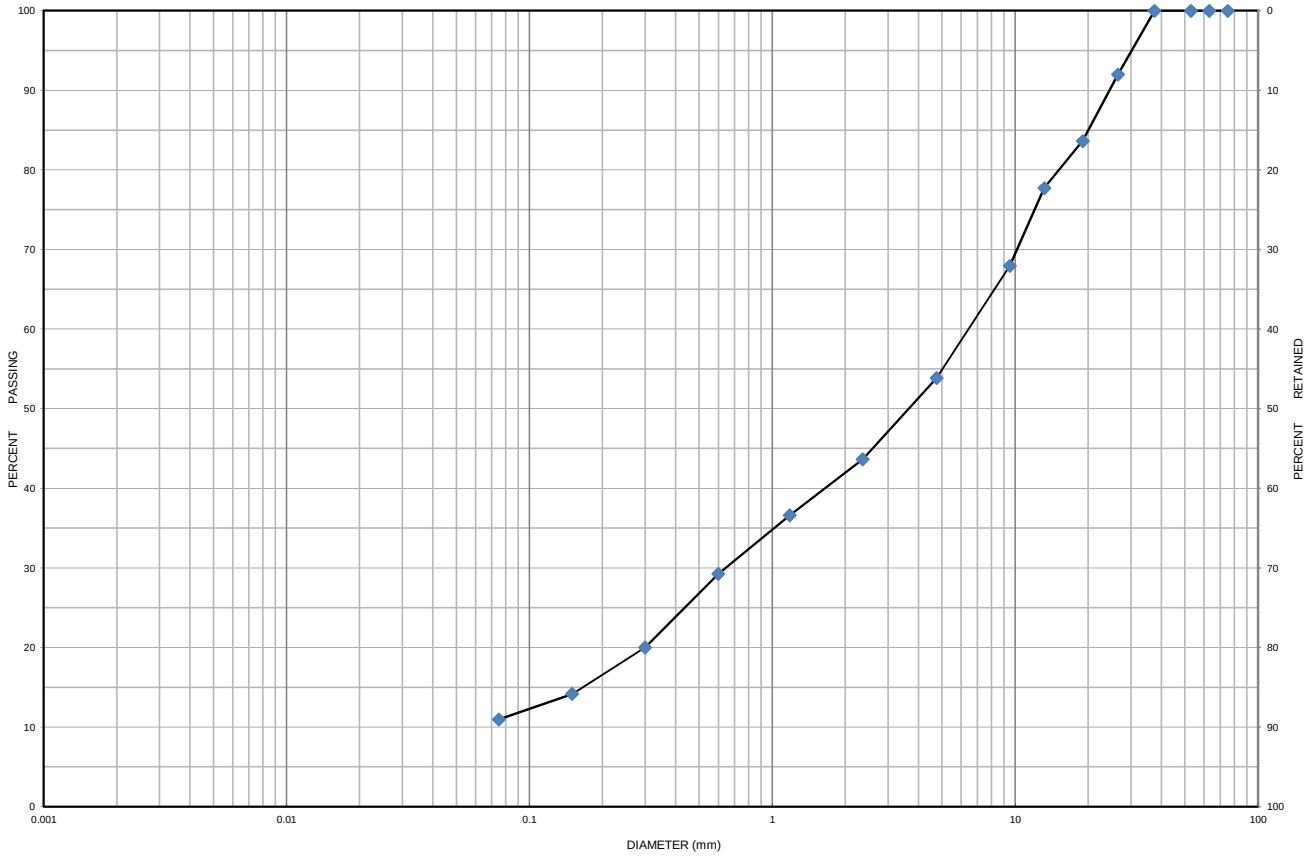
Project Number: *8767-001* **Client:** *C.C. Tatham & Associates Ltd. (Barrie)*

Project Name: *Creemore Development*

Sample Date: *February 27, 2019* **Sampled By:** *Jacob Bell - Cambium Inc.*

Location: *BH 103-19 SS 4* **Depth:** *2.3 m to 2.7 m* **Lab Sample No:** *S-19-0144*

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			

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 103-19	SS 4	2.3 m to 2.7 m	46	43	11		8.0

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravel and Sand some Silt	GW-SW	6.400	0.640	-	-	-

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Grain Size Distribution Chart

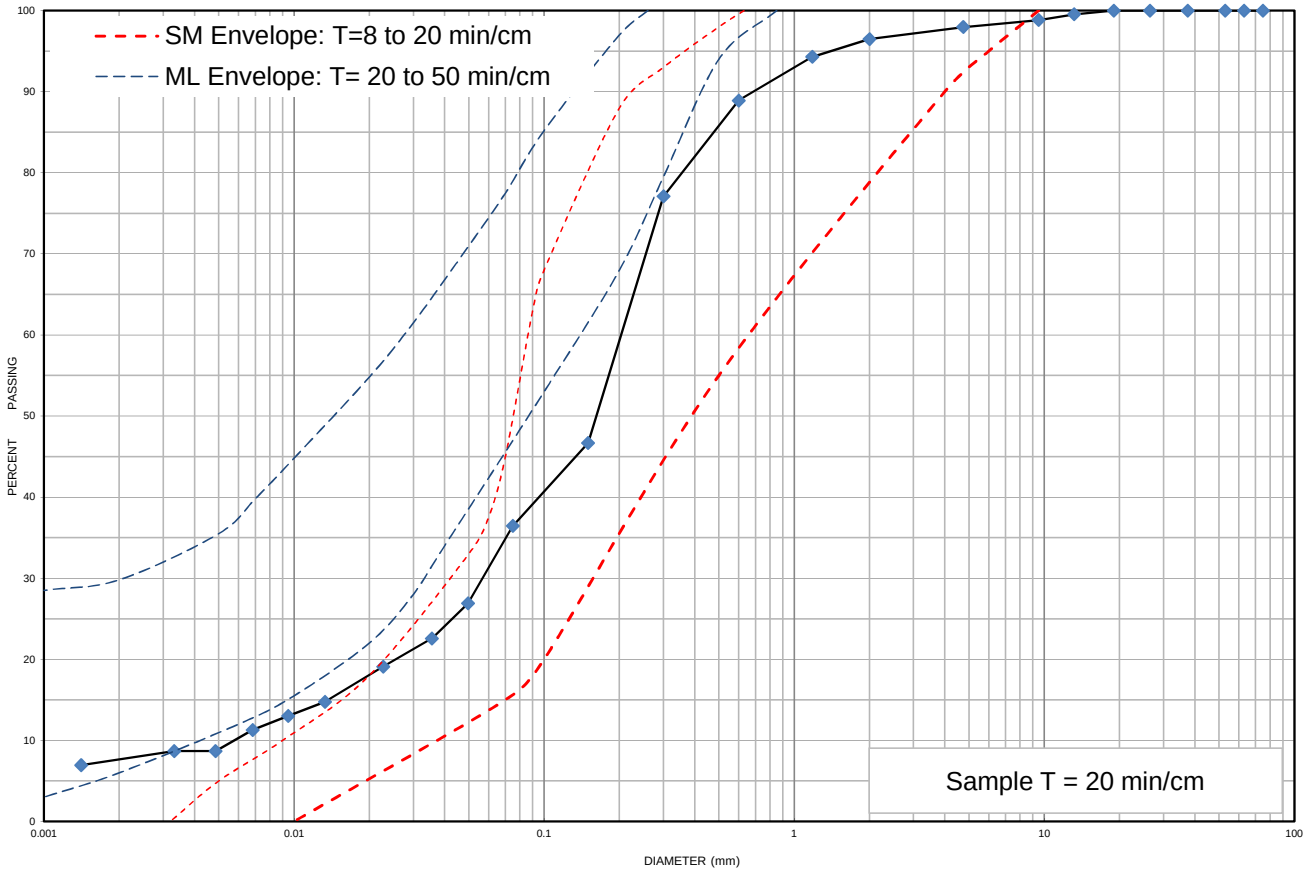
Project Number: *8767-001* **Client:** *C.C. Tatham & Associates Ltd. (Barrie)*

Project Name: *Creemore Development*

Sample Date: *February 27, 2019* **Sampled By:** *Jacob Bell - Cambium Inc.*

Location: *BH 102-19 SS 6* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *S-19-0145*

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			

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 102-19	SS 6	4.6 m to 5 m	2	61	37		14.4

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand trace Clay trace Gravel	SM	0.210	0.057	0.0058	36.21	2.67

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Grain Size Distribution Chart

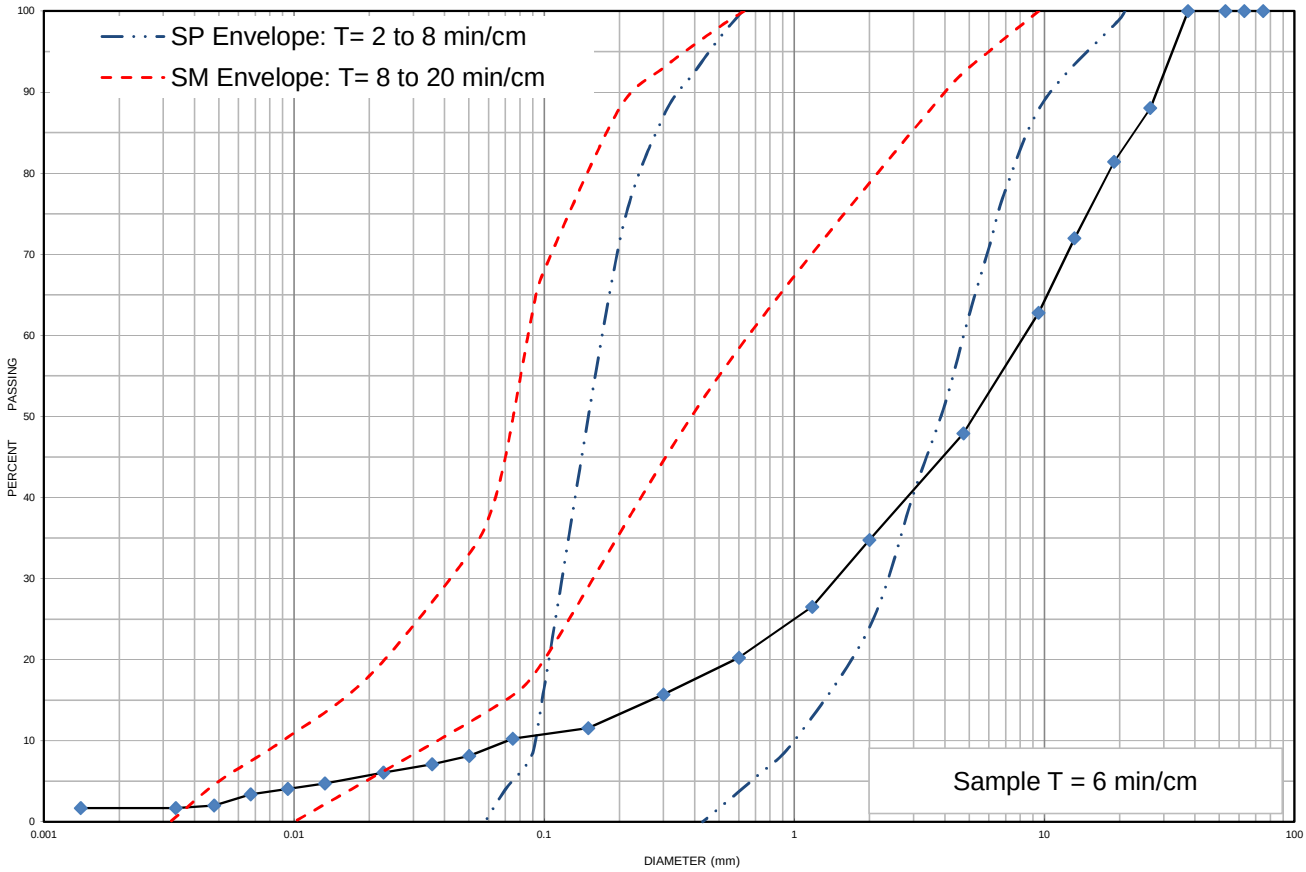
Project Number: *8767-001* **Client:** *C.C. Tatham & Associates Ltd. (Barrie)*

Project Name: *Creemore Development*

Sample Date: *February 27, 2019* **Sampled By:** *Jacob Bell - Cambium Inc.*

Location: *BH 101-19 SS 4* **Depth:** *2.3 m to 2.7 m* **Lab Sample No:** *S-19-0178*

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			

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-19	SS 4	2.3 m to 2.7 m	52	38	10		7.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravel and Sand trace Sand trace Clay	GP-SP	8.300	1.500	0.072	115.28	3.77

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Appendix C

2015 National Building Code Seismic Hazard Values

2015 National Building Code Seismic Hazard Calculation

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

Site: 44.325692N 80.09504W **User File Reference:** 101 Edward Street and 111 George Street 2019-04-03 15:22 UT

Requested by: Jacob Bell

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)	0.073	0.045	0.029	0.010
Sa (0.1)	0.102	0.065	0.044	0.015
Sa (0.2)	0.100	0.066	0.045	0.017
Sa (0.3)	0.087	0.058	0.040	0.015
Sa (0.5)	0.072	0.049	0.034	0.012
Sa (1.0)	0.045	0.030	0.020	0.006
Sa (2.0)	0.023	0.015	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)	0.059	0.037	0.025	0.008
PGV (m/s)	0.060	0.038	0.024	0.007

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