

Preliminary Geotechnical Investigation Report - 50 Welham Rd, Barrie



March 29, 2023

Prepared for:
TLM Holdings Inc.

Cambium Reference: 13014-001

CAMBIUM INC.

866.217.7900
cambium-inc.com

Peterborough | Barrie | Oshawa | Kingston



Table of Contents

1.0	Introduction	1
2.0	Methodology	2
2.1	Borehole Investigation	2
2.2	Physical Laboratory Testing	3
3.0	Subsurface Conditions	4
3.1	Topsoil / Organic Soil	4
3.2	Gravelly Sand.....	4
3.3	Sand to Silty Sand.....	4
3.4	Sandy to Clayey Silt	5
3.5	Bedrock	6
3.6	Groundwater.....	6
4.0	Geotechnical Considerations	8
4.1	Site Preparation.....	8
4.2	Frost Penetration.....	8
4.3	Excavation and Shoring	9
4.4	Dewatering	9
4.5	Backfill and Compaction.....	10
4.5.1	Engineered Fill	11
4.6	Foundation Design	12
4.7	Slab on Grade Design Parameters.....	13
4.8	Lateral Earth Pressure	13
4.9	Perimeter Drainage	14
4.10	Seismic Site Classification.....	14
4.11	Buried Utilities	15
4.12	Pavement Design	15
4.13	Design Review and Inspections	17



5.0 Closing

18

List of Appended Figures

Figure 1 Borehole Location Plan

List of Appendices

Appendix A Borehole Logs

Appendix B Physical Laboratory Testing Results

Appendix C 2015 National Building Code Seismic Hazard Values

Appendix D Land Information & Development Plans



1.0 Introduction

Cambium Inc. (Cambium) was retained by TLM Holdings Inc. (Client) c/o Tonlu Holdings Limited to complete a preliminary geotechnical investigation in support of a proposed development at 50 Welham Road in Barrie, Ontario (Site). The proposed development area currently consists of an undeveloped wooded area with walking and all terrain vehicle (ATV) trails. It is understood that the proposed development will consist of an industrial subdivision with a street connecting the subdivision to Welham Road on the south side of the site.

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 new buildings and associated infrastructure. A Site Plan, including borehole locations, is included as Figure 1 of this report.

This report presents the methodology and findings of the geotechnical investigation to determine the subsurface soil and groundwater conditions and provide design recommendations. Based on the results of this investigation, the report provides geotechnical engineering recommendations pertaining to the proposed development including soil bearing capacity, foundation design, seismic site classification, excavations and dewatering, backfill and compaction, frost depth, sub-drainage, and pavement recommendations.

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



2.0 Methodology

2.1 Borehole Investigation

A borehole investigation was completed on May 31 and June 1, 2021, to assess subsurface conditions at the Site. A total of six boreholes, designated as BH101-21 through BH106-21 were advanced throughout the Site. All boreholes were terminated at depths ranging from 4.7 to 6.5 m below ground surface (mbgs).

The borehole elevations were surveyed using a Sokkia GNSS system. The borehole UTM coordinates and elevations are provided on the borehole logs in Appendix A. It is noted that at the time of the survey a detailed topographic survey was unavailable, and thus the borehole and monitoring well elevations were tied into a local benchmark denoted “the top bolt of the fire hydrant at northern end of Welham Road”, as such, the elevations provided within this report are not Geodetic. Prior to completing detailed design, Cambium would recommend tying our survey into a known Geodetic benchmark from the topographic survey and updating the elevations included within this report and the hydrogeological assessment report.

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 solid 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 surface 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.

Four boreholes BH101-21, BH102-21, BH103-21, and BH105-21 were outfitted as monitoring wells in order to determine the static groundwater elevation at the Site.



Borehole logs are provided in Appendix A. Site soil and groundwater conditions are described and geotechnical recommendations are discussed in the following sections of this report.

2.2 Physical Laboratory Testing

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



3.0 Subsurface Conditions

Based on the results of the borehole investigation, the subsurface conditions at the Site consist predominantly of a surficial layer of topsoil overlying brown sand to silt and sand with varying amounts of gravel and clay, which extended to the borehole termination depths. Layers of silt and silty clay were also encountered within the sand layer in most of the boreholes. The boreholes were terminated in native soils and bedrock was not encountered within the investigation depths.

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

3.1 Topsoil / Organic Soil

A layer of brown sandy silt to gravelly sand topsoil / organic soil was observed at the surface of boreholes BH101-21, BH102-21, BH104-21 and BH105-21. The organic soil varied in thickness from 305 mm to 760 mm. It was observed to be in a dense to very dense state of compaction based on SPT blow counts of 34 to over 50 for 125 mm of penetration with moisture content analysis yielding results between 2.1% and 6.7%. Boreholes BH103-21 and BH106-21 were advanced closer to the trails described in Section 1.0 of this report; providing possible reasoning for the absence of topsoil found at these locations. Each individual topsoil thickness can be found in the borehole logs in Appendix A.

3.2 Gravelly Sand

Borehole BH103-21 encountered a 760 mm thick layer of gravelly sand with trace silt beginning at the collar of the borehole. An SPT N blow count of 50 for 205 mm of penetration was recorded in the gravelly sand materials indicating a very dense relative density, with a slightly moist natural moisture content based on laboratory tests ranging from 2.1% to 2.6%.

3.3 Sand to Silty Sand

Sand to silty sand soils were found in all the boreholes advanced throughout the site. These soils contained varying amounts of silt, gravel and clay. The sand to silty sand soils were found



underlying the topsoil or gravelly sand soils described above in all boreholes except for BH106-21 where it was encountered at the surface of the borehole. Generally, the sand to silty sand soils extended to termination depths in all boreholes; in boreholes BH103-21 through BH106-21 a predominately silt layer was encountered at varying depths and thicknesses. SPT N values measured in the sand to silty sand soils ranged from 16 to 50 for 75 mm of penetration indicating a compact to very dense relative density, with natural moisture contents ranging from 1.3% to 23.0% based on laboratory testing.

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

Table 1 Particle Size Distribution – Sand to Silty Sand

Borehole ID	Depth (mbgs)	Description	Gravel %	Sand %	Silt %	Clay %	Moisture content %
BH101-21 SS6	4.6 – 5.0	Sand, trace Silt, trace Gravel	2	93	5		3.4
BH103-21 SS3	1.5 – 1.6	Silty Sand, trace Gravel	4	70	26		5.5
BH105-21 SS4	2.3 – 2.7	Silty Sand, trace gravel	1	73	26		8.3
BH106-21 SS2	0.6 – 1.2	Silty Sand some Clay trace Gravel	6	42	34	18	11.1

3.4 Sandy to Clayey Silt

A layer of predominately silt soil was encountered in boreholes BH103-21 through BH106-21; the silt material contained varying amounts of sand, clay and gravel. In borehole BH103-21, a clayey sandy silt was encountered from approximately 2.25 to 3.0 mbgs. A silt layer with trace to some clay, sand, and gravel was encountered from 0.9 to 1.75 mbgs in borehole BH104-21 and from 3.4 to 4.6 mbgs in borehole BH105-21. In borehole BH106-21, a silt and sand soil with trace gravel was encountered from 1.5 to 3.0 mbgs. The predominately silt materials were brown to grey in colour and were found to have a dense to very dense relative density based on the SPT N values ranging from 45 to over 50 for 180 mm of penetration. Natural moisture contents ranged from 7.8% to 16.6% based on the result of laboratory testing.



Laboratory particle size distribution analysis was completed on one sample of the clayey sandy silt soils in order to confirm the soil texture. The testing results are provided in Appendix B and are summarized in Table 2 based on the USCS.

Table 2 Particle Size Distribution – Silt and Sand to Clayey Sandy Silt

Borehole ID	Depth (mbgs)	Description	Gravel %	Sand %	Silt %	Clay %	Moisture content %
BH103-21 SS4	2.3 – 2.7	Clayey Sandy Silt, trace Gravel	4	31	33	32	16.6

3.5 Bedrock

Bedrock was not encountered within the investigation depths. All the boreholes were terminated in native soils at depths ranging from 4.7 to 6.5 mbgs. The elevation of each borehole and the respective termination depths are provided in .

Table 3 Borehole Termination Depth – Elevations

Borehole ID	Borehole Elevation (m ASL)	Borehole Termination Depth (mbgs)	Borehole Termination Elevation (masl)
BH101-21	265.30	6.2	259.10
BH102-21	258.51	6.2	252.31
BH103-21	267.20	6.3	260.90
BH104-21	267.68	4.7	262.98
BH105-21	266.86	6.5	260.36
BH106-21	268.80	6.5	262.30

Note: Elevations are not Geodetic

3.6 Groundwater

Wet soils were encountered at a depth of approximately 6.1 mbgs in BH101-21 and at a depth of 3.4 mbgs in BH105-21. Caving (sloughing) was not observed in any of the boreholes. During the site investigation three monitoring wells were installed in boreholes BH101-21, BH102-21, BH103-21 and BH105-21 to monitor the static groundwater level and any seepage/upsurge after installation.



The moisture content of the soils ranged from 1.3% to 23%. It should be noted that soil moisture and groundwater levels at the Site may fluctuate seasonally and in response to climatic events.

Groundwater levels were initially measured on June 15, 2021, in all the newly installed monitoring wells. A spring groundwater level monitoring was also completed from March 2022 to June 2022. The recorded groundwater levels are presented in Table 4 below.

Table 4 Well Details and Measured Groundwater Levels

Well		BH101-21	BH102-21	BH103-21	BH105-21
Top of Pipe Elevation (masl)		266.26	259.34	268.15	267.66
Ground Surface Elevation (masl)		265.30	258.51	267.19	266.86
Stick-up (m)		0.96	0.82	0.96	0.81
June 15, 2021	Water Level (mbgs)	DRY	DRY	DRY	DRY
	Groundwater Elev.(masl)	-	-	-	-
March 22, 2022	Water Level (mbgs)	DRY	DRY	DRY	DRY
	Groundwater Elev.(masl)	-	-	-	-
April 21, 2022	Water Level (mbgs)	6.01	6.12	4.97	6.03
	Groundwater Elev.(masl)	259.29	252.41	262.22	260.85
May 24, 2022	Water Level (mbgs)	6.00	6.08	DRY	5.28
	Groundwater Elev.(masl)	259.30	259.43	-	261.57
June 27, 2022	Water Level (mbgs)	DRY	DRY	DRY	DRY
	Groundwater Elev.(masl)				

Note: Elevations are not Geodetic

As presented above, the manual measured groundwater levels in the monitoring wells ranged in depth from 4.97 mbgs to dry. The high groundwater elevation and depth encountered during our monitoring program was 262.22 masl and 4.97 mbgs, respectively.

Based on our monitoring program, the wells were found dry for most part of the year, except for spring months of April and May 2022, indicating that the presence of deeper water table conditions across all seasons at the Site.



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

Any organic materials or fill material encountered should be excavated and removed beneath the proposed building footprint(s) and paving structures; additionally this material should be excavated and removed to a minimum distance of 3 m around proposed structures.

Any topsoil and materials with significant quantities of organics and deleterious materials (i.e., construction debris, asphalt etc.) are not appropriate for use as fill below parking and driving areas.

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

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

4.2 Frost Penetration

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



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

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

4.3 Excavation and Shoring

All excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA). The generally dense to very dense soils may be classified as Type 2 soils above the groundwater table in accordance with OHSA. Type 2 soils may be excavated vertically to a depth of 1.2 m at the bottom of the excavation, prior to being graded with unsupported side slopes no steeper than 1H:1V to surface. If the groundwater table is encountered during construction, the soils that lie below the groundwater table may be classified as Type 3 soils. The generally compact soils may be classified as Type 3 soils above the groundwater table in accordance with OHSA. Type 3 soils may be excavated with unsupported side slopes no steeper than 1H:1V.

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). If shoring is required, soldier piles and lagging is likely the most cost-effective method.

4.4 Dewatering

Wet soils were encountered in BH101-21 and BH105-21 during the drilling investigation as noted in Section 0. Groundwater levels were initially measured in the monitoring wells on June 15, 2021 and a spring groundwater level monitoring program was also completed on a monthly basis from March 2022 to June 2022. Per Table 4, the measured groundwater levels in the monitoring wells during the monitoring events ranged in depth from 4.97 mbgs to dry



(monitoring wells installed to 6.6 mbgs). It is noted that the elevation of the groundwater table will vary due to seasonal conditions and in response to heavy precipitation events.

Based on the groundwater conditions measured after completing the borehole drilling and the anticipated foundation excavations, groundwater seepage is not anticipated. If groundwater seepage is encountered, it should be manageable using filtered sumps and pumps within the excavations. A Permit to Take Water (PTTW) or registration on the Environmental Activity and Sector Registry (EASR) through the Ministry of the Environment Conservation and Parks (MOECP) will likely not be required unless deep excavations are required (possibly for Stormwater Management Ponds), as pumping rates is not likely to exceed 50,000 L/day. If possible, it is recommended that construction excavations should be avoided during the wet/spring seasons to reduce the need for pro-active dewatering.

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

4.5 Backfill and Compaction

Excavated topsoil or organic soil from the Site is not appropriate for use as fill below grading areas. Excavated sand to silt and sand soils not containing organics or significant deposits of silt and clay may be appropriate for use as fill below grading areas, provided that the actual or adjusted moisture content at the time of construction is within a range that permits compaction to required densities. Some moisture content adjustments may be required depending upon seasonal conditions. 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 full time 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. Foundation wall and any buried utility backfill material should consist of free-draining imported granular material meeting the specifications for Granular B Type I material complying with OPSS 1010.MUNI, compacted to 98% of SPMDD within the building footprint(s) and 95% of SPMDD immediately adjacent to the foundation walls, taking care to keep heavy compaction equipment from damaging the walls.

The backfill material, if any, in the upper 300 mm below the pavement subgrade elevation should be compacted to 98% of SPMDD in all areas.

4.5.1 Engineered Fill

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

- I. Remove any and all existing vegetation, surficial topsoil / organics, organic fills or fills and any loose soils to a competent subgrade for a suitable envelope.
- II. The area of the engineered fill should extend horizontally 1 m beyond the outside edge of the foundations then extend downward at a 1:1 slope to the competent approved native soil.
- III. The subgrade or base of the engineered fill area must be approved by Cambium prior to placement of any new fill, to ensure that suitability of subgrade condition.
- IV. Place approved OPSS 1010.MUNI SSM or Granular 'B' Type I material at a moisture content at or near optimum moisture in suitable maximum 200 mm thick lifts, compacted to 100% of SPMDD. 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. Any frost penetration into the fill material must be removed prior to placement of subsequent lifts of fill and reviewed by Cambium.
- V. Full time testing and inspection of the engineered fill will be required for it to be used as a founding material, as outlined in Section 4.2.2.2 of the Ontario Building Code.



4.6 Foundation Design

Design and construction recommendations for potential foundation systems are outlined below. It is assumed that the proposed development will consist predominantly of single storey structures of slab on grade design (i.e., no basement). Foundations for such structures at this site may consist of shallow spread footings founded directly on native, undisturbed soils. It is understood that the Site may be regraded, and our foundation recommendations may change depending upon the final grades. Cambium should be contacted to review the final grading plan and provide any necessary changes to the foundation recommendations outlined below.

Foundations constructed on undisturbed, compact to very dense native sand to silty sand may be designed for an allowable bearing capacity of 180 kPa at serviceability limit state (SLS) and 235 kPa at ultimate limit state (ULS).

Alternatively, in areas where the proposed founding levels are above the level of competent native soil, or where subexcavation is required, footings can be made to bear directly on a pad of engineered fill, such as that conforming to OPSS 1010.MUNI Granular B Type II. Footings placed on approved engineered fill and appropriately protected from frost may be designed for an allowable bearing capacity of 150 kPa at SLS and 200 kPa at ULS. Engineered fill should be placed and compacted per the requirements outlined in Section 4.5.

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 suitably reinforced.

Settlement potential at the SLS loading is less than 25 mm and differential settlement should be less than 10 mm.

The quality of the subgrade should be inspected by Cambium during construction, prior to constructing the footings, to confirm bearing capacity estimates. It is noted that dense to very dense soils were observed at varying depths and higher design bearing capacity values may be possible depending on footing elevations and location.



4.7 Slab on Grade Design Parameters

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

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

- Compacted earth fill: 16,000 kPa/m
- Engineered Fill: 22,000 kPa/m
- Native, undisturbed soils: 30,000 kPa/m

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

It is necessary that the slab be provided with a capillary moisture barrier and drainage layer. This is made by placing the slab on a minimum 200 mm layer of 19 mm diameter crushed clear stone and nominally compacted by vibration to a dense state. The upper 50 mm of clear stone may be replaced with 50 mm of OPSS Granular A to create a working surface. A geotextile separator (Terrafix 270R or equivalent) would be required between the clear stone and Granular A.

4.8 Lateral Earth Pressure

Lateral earth pressure coefficients (K) are shown in Table 5. It is assumed that potential lateral loads will result from cohesion less, frictional materials, such as granular backfill and the encountered near surface native sand.



Table 5 Lateral Earth Pressure Coefficients

Stratum/Parameter	γ	ϕ	K_a	K_o	K_p
Native Undisturbed Sand	20	34	0.28	0.44	3.54
Granular Backfill	22	35	0.27	0.43	3.70

- Where:
- γ = bulk unit weight of soil (kN/m³)
 - 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 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.

4.9 Perimeter Drainage

Perimeter foundation drainage is not considered necessary for slab-on-grade structures provided that the finished floor slab elevation is set above the exterior surface grades

4.10 Seismic Site Classification

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



soil properties and in accordance with Table 4.1.8.4.A, it is recommended that Site Class “C” (very dense soil) be applied for structural design at the Site.

Peak ground acceleration and spectral acceleration (period of 0.2 seconds) for the site are calculated to be 0.064g and 0.109g respectively using the 2015 National Building Code Seismic Hazard Calculation, shown in Appendix C.

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

4.11 Buried Utilities

Where required, trench excavations should generally consider Type 2 or Type 3 soil conditions per the recommendations in Section 4.3. To prevent potential damage caused by frost, any services/utilities should be located 1.5 m below final grade or be appropriately insulated.

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% of SPMDD. The cover material shall be a minimum of 300 mm over the top of the pipe and compacted to 98% of SPMDD, taking care not to damage the utility pipes during compaction.

4.12 Pavement Design

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



The recommended minimum pavement structure design has been developed for two traffic loading scenarios, light duty and heavy duty. The light duty design is appropriate for areas where no truck traffic is anticipated. The heavy-duty design should meet the City of Barrie Transportation Design Manual (2020) requirements and as a minimum, consist of the pavement layers identified in Table 6. The heavy-duty pavement structure recommended below assumes that the annual average daily traffic (AADT) is less than 2,500, and is appropriate for areas where heavy traffic or heavy loads are anticipated. If the predicted AADT is higher than that assumed, Cambium should be contacted to reassess this recommendation. It is noted that the minimum pavement structure may be reassessed following further geotechnical investigations.

Table 6 Recommended Minimum Pavement Structure

Pavement Layer	Light Duty	Heavy Duty
Surface Course Asphalt	40 mm HL3 or SP12.5	40 mm HL3 or SP12.5
Binder Course Asphalt	50 mm HL4, HL8 or SP19	70 mm HL4, HL8 or SP19
Granular Base	150 mm OPSS 1010 Granular A	150 mm OPSS 1010 Granular A
Granular Subbase	300 mm OPSS 1010 Granular B	450 mm OPSS 1010 Granular B

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

Compaction of the subgrade should be verified by the Engineer prior to placing the granular fill. Granular layers should be placed in 150 mm thick maximum loose lifts and compacted to at least 100% of SPMDD. The granular materials specified should conform to OPSS standards, as confirmed by appropriate materials testing.

The asphaltic concrete should be compacted between 92 to 96.5% Maximum Relative Density (MRD).

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

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



4.13 Design Review and Inspections

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

We should be contacted to review and approve design drawings, prior to tendering or commencing construction, to ensure that all pertinent geotechnical-related factors have been addressed. It is important that onsite geotechnical supervision be provided at this site for excavation and backfill procedures, deleterious soil removal, subgrade inspections and compaction testing.



5.0 Closing

We trust that the information contained in this report meets your current requirements. If you have questions or comments regarding this document, please do not hesitate to contact the undersigned at (705) 719-0700 ext. 405.

Respectfully submitted,

CAMBIUM INC.

Rob Gethin, P.Eng.
Group Manager - Geotechnical



SEB/RLG/mg/bw



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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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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The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.





Appended Figures



GEOTECHNICAL INVESTIGATION

TLM HOLDINGS INC.
50 Welham Rd
Barrie, Ontario

LEGEND

-  Borehole
-  Monitoring Well

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.



194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

BOREHOLE LOCATION PLAN

Project No.:	13014-001	Date:	June 2021
Scale:	1:5,000	Rev.:	
Created by:	TLC	Projection:	NAD 1983 UTM Zone 17N
Checked by:	MG	Figure:	1

O:\GIS\XDS\13000-13099\13014\001_Rinomat Group - Geo & HydroG - 50 Welham Rd, Barrie\2021\06-15 FIG 1 - Borehole Location Plan.mxd



Appendix A

Borehole Logs



Peterborough
 Barrie
 Oshawa
 Kingston
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Log of Borehole:

BH102-21

Page 1 of 1

Client: TLM Holdings Inc. **Project Name:** 50 Welham Rd, Barrie **Project No.:** 13014-001
Contractor: Walker Drilling **Method:** Solid Stem Augers **Date Completed:** May 31, 2021
Location: 50 Welham Road, Barrie, Ontario **UTM:** 17T: 605636 m East, 4912810 m North **Elevation:** 258.51 mASL

SUBSURFACE PROFILE				SAMPLE											
Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture			SPT (N)			Well Installation	Remarks
								25	50	75	10	20	30		
0			SANDY SILT: Brown, dry, dense, trace gravel, with organics [TOPSOIL]	1A	SS	90	43								Cap Top of Standpipe (TOS) elevation: 259.34 mASL. Well dry when measured on June 15, 2021 Bentonite Plug PVC Standpipe GSA SS3: 4% Gravel 70% Sand 26% Silt Sand Pack PVC Screen Cap
258			SILTY SAND: Brown, dry, dense, trace gravel	1B											
			-very dense, more silt	2	SS	10									
	1						50=125 mm								
			-moist	3	SS	20									
257							50=125 mm								
	2			4	SS	60									
256							50=75 mm								
	3			5	SS	20									
255							50=150 mm								
	4														
254				6	SS	60									
	5						50=75 mm								
253															
	6														
			-grey	7	SS	50									
252			Borehole terminated in silty sand at 6.2 mbgs due to exploration depth achieved.				50=150 mm								
	7														

Logged By: BW

Input By: BW



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Log of Borehole:

BH103-21

Page 1 of 1

Client: TLM Holdings Inc. **Project Name:** 50 Welham Rd, Barrie **Project No.:** 13014-001
Contractor: Walker Drilling **Method:** Solid Stem Augers **Date Completed:** May 31, 2021
Location: 50 Welham Road, Barrie, Ontario **UTM:** 17T: 605300 m East, 4912702 m North **Elevation:** 267.20 mASL

SUBSURFACE PROFILE				SAMPLE											
Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture			SPT (N)			Well Installation	Remarks
								25	50	75	10	20	30		
267	0		GRAVELLY SAND: Brown, dry, very dense, trace silt	1	SS	60	50=205 mm							Cap	Top of Standpipe (TOS) elevation: 268.15 mASL. Well dry when measured on June 15, 2021
				2A											
				2B	SS	80	50								
266	1		SAND: Brown, dry, very dense, trace gravel, trace silt	3	SS	70	50=230 mm							Bentonite Plug	
				4	SS	80	45							PVC Standpipe	
265	2		SANDY SILT: Grey, moist, dense, clayey, trace gravel	5	SS	100	50=205 mm								GSA SS4: 4% Gravel 31% Sand 33% Silt 32% Clay
264	3		SILTY SAND: Grey, moist, very dense, trace clay, trace gravel	6	SS	60	28								
263	4		SAND: Grey, moist, compact, some gravel, trace cobbles	7	SS	70	50=100 mm							Sand Pack	
262	5													PVC Screen	
261	6		-very dense											Cap	
			Borehole terminated in sand at 6.3 mbgs due to exploration depth achieved.												
	7														

Logged By: BW

Input By: BW



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Log of Borehole:

BH104-21

Page 1 of 1

Client: TLM Holdings Inc.

Project Name: 50 Welham Rd, Barrie

Project No.: 13014-001

Contractor: Walker Drilling

Method: Solid Stem Augers

Date Completed: June 1, 2021

Location: 50 Welham Road, Barrie, Ontario

UTM: 17T: 605433 m East, 4912701 m North

Elevation: 267.68 mASL

SUBSURFACE PROFILE				SAMPLE											
Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture			SPT (N)			Well Installation	Remarks
								25	50	75	10	20	30		
0			GRAVELLY SAND: Brown dry, very dense, trace silt, trace cobbles, with organics [TOPSOIL]	1	SS	50	50=205 mm								Borehole open and dry upon completion.
267			SAND: Brown, dry, very dense, trace gravel	2A	SS	50	50=230 mm								
	1		SILT: Brown dry, very dense, trace clay, trace sand, trace gravel	2B											
266			SILTY SAND: Grey, dry, very dense, trace gravel	3	SS	80	50=125 mm								
	2			4	SS	70	50=150 mm								
265			-trace cobbles	5	SS	50	50=125 mm								
264															
263			-moist	6	SS	50	50=100 mm								
	5		Borehole terminated in silty sand at 4.7 mbgs due to auger refusal.												
262															
	6														
261															
	7														

Logged By: BW

Input By: BW



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Log of Borehole:

BH105-21

Page 1 of 1

Client: TLM Holdings Inc.
Contractor: Walker Drilling
Location: 50 Welham Road, Barrie, Ontario

Project Name: 50 Welham Rd, Barrie
Method: Solid Stem Augers
UTM: 17T: 605366 m East, 4912445 m North

Project No.: 13014-001
Date Completed: June 1, 2021
Elevation: 266.86 mASL

SUBSURFACE PROFILE				SAMPLE													
Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture			SPT (N)	Well Installation	Remarks				
								25	50	75	10	20	30	40			
0			SANDY SILT: Brown, dry, very dense, trace gravel, with organics [TOPSOIL]	1	SS	60	50=205 mm									Cap	Top of Standpipe (TOS) elevation: 267.66 mASL. Well dry when measured on June 15, 2021
266	1		SILTY SAND: Brown, dry, very dense, trace gravel	2	SS	70	50=230 mm										
				3	SS	60	50=150 mm										
265	2		-dense, moist	4A	SS	80	47										
			-grey, wet, dense, increase in silt content, decrease in gravel content	4B													
264	3		-very dense	5	SS	80	50=255 mm										GSA SS4B: 2% Gravel 73% Sand 26% Silt
263	4																
262	5		SAND: Grey, saturated, dense, some silt	6	SS	70	40										
261	6		-very dense, trace cobbles	7	SS	70	50=255 mm										
260	7		Borehole terminated in sand at 6.5 mbgs due to exploration depth achieved.														

Logged By: BW

Input By: BW



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 Oshawa
 Kingston
 T: 866-217-7900
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Log of Borehole:

BH106-21

Page 1 of 1

Client: TLM Holdings Inc.
Contractor: Walker Drilling
Location: 50 Welham Road, Barrie, Ontario

Project Name: 50 Welham Rd, Barrie
Method: Solid Stem Augers
UTM: 17T: 605366 m East, 4912445 m North

Project No.: 13014-001
Date Completed: June 1, 2021
Elevation: 268.80 mASL

SUBSURFACE PROFILE				SAMPLE											
Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	% Moisture			SPT (N)			Well Installation	Remarks
								25	50	75	10	20	30		
0			SAND: Brown, dry, compact, trace silt	1A	SS	80	16							Borehole open and dry upon completion. GSA SS4: 6% Gravel 42% Sand 34% Silt 18% Clay	
			SILTY SAND: Brown, dry, dense, some clay, trace gravel	1B											
268	1		-moist, less clay	2	SS	90	33								
267	2		SILT AND SAND: Grey, moist, very dense, trace gravel	3	SS	80	50=230 mm								
266	3			4	SS	80	50=180 mm								
265	4		SAND: Grey, moist, very dense, trace silt, trace gravel	5	SS	80	50=255 mm								
264	5			6	SS	70	50=230 mm								
263	6			7	SS	80	50=280 mm								
262	7		Borehole terminated in sand at 6.5 mbgs due to exploration depth achieved.												

Logged By: BW

Input By: BW



DRAFT

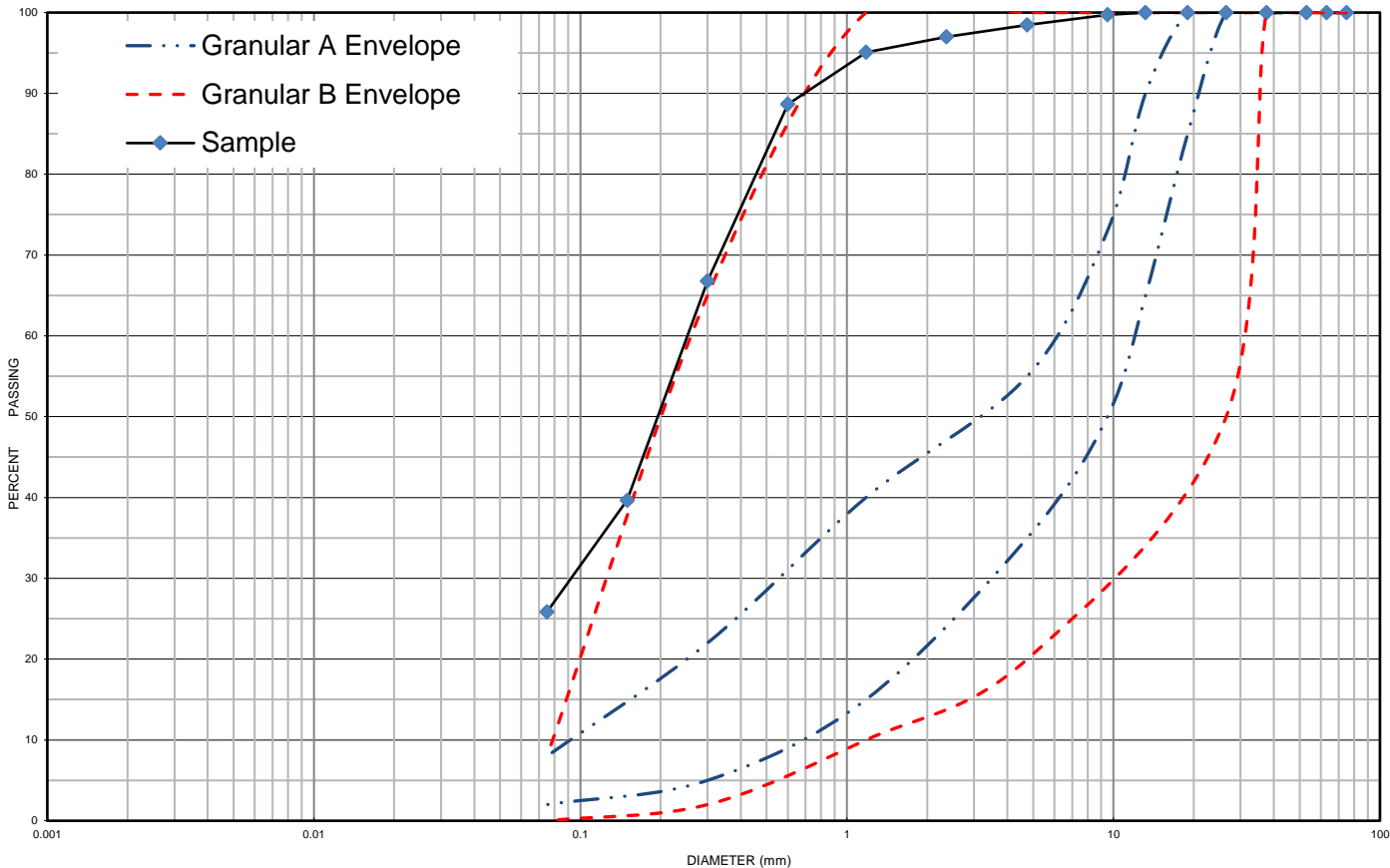
Appendix B
Physical Laboratory Testing Results



Grain Size Distribution Chart

Project Number: 13014-001 **Client:** Rinomato Group
Project Name: 50 Welham Rd, Barrie
Sample Date: June 1, 2021 **Sampled By:** Ben White - Cambium Inc.
Location: BH 105-21 SS 4B **Depth:** 1.5 m to 2.7 m **Lab Sample No:** S-21-0626

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 105-21	SS 4B	1.5 m to 2.7 m	2	73	26		8.3
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Silty Sand trace Gravel		SM	0.255	0.091	0.000	-	-

Additional information available upon request

Issued By: *John Baird* Date Issued: June 16, 2021
 (Senior Project Manager)



Moisture Content



Project Number: 13014-001
Project Name: 50 Welham Rd., Barrie
Client: Rinomato Group
Date Taken: 2021-05-31

Lab Number: S-21-0622
Date Tested: 2021-06-09
Tested By: A. McLean

Borehole Number	Sample Number	Sample Depth (m)	Water Weight (g)	Water Content (%)	Additional Observations
101	6	4.572-5.029	18.0	3.4	NR
102	3	1.524-1.646	16.5	5.5	NR
103	4	2.286-2.743	106.4	16.6	NR
105	4B	2.591-2.743	62.0	8.3	NR
106	2	0.610-1.219	94.1	11.1	
101	1A	0.000-0.305	11.4	3.8	1,NR
101	1B	0.305-0.610	0.6	1.3	9,NR
101	2	0.610-1.219	5.2	2.7	
101	3	1.524-1.981	5.6	3.2	
101	4	2.286-2.743	9.6	4.4	
101	5	3.048-3.505	7.4	3.6	
101	7	6.096-6.218	7.1	3.3	
102	1A	0.000-0.533	12.5	5.2	1,2
102	1B	0.533-0.610	11.7	4.6	NR
102	2	0.610-0.732	4.1	4.6	NR
102	4	2.286-2.515	14.6	6.0	
102	5	3.048-3.200	16.7	5.7	NR
102	6	4.572-4.648	18.0	6.5	
102	7	6.096-6.248	20.1	5.8	
103	1	0.000-0.305	5.5	2.1	
103	2	0.762-1.067	5.7	2.6	
103	3	1.524-1.905	17.3	7.6	
103	5	3.048-3.444	30.1	9.3	
103	7	7.620-8.016	13.0	6.9	
104	1	0.000-0.366	5.7	2.1	1
104	2A	0.762-0.914	6.8	2.7	NR
104	2B	0.914-1.143	33.7	11.7	NR

- | | |
|------------------------------------|--|
| 1 – Contains organics | 6 – Very moist – near optimum moisture content |
| 2 – Contains rubble | 7 – Moist – below optimum moisture |
| 3 – Hydrocarbon Odour | 8 – Dry – dry texture – powdery |
| 4 – Unknown Chemical Odour | 9 – Very small – caution may not be representative |
| 5 – Saturated – free water visible | 10 – Hold sample for gradation analysis |



Moisture Content



Project Number: 13014-001
Project Name: 50 Welham Rd., Barrie
Client: Rinomato Group
Date Taken: 2021-05-31

Lab Number: S-21-0622
Date Tested: 2021-06-09
Tested By: A. McLean

Borehole Number	Sample Number	Sample Depth (m)	Water Weight (g)	Water Content (%)	Additional Observations
104	3	1.524-1.768	21.9	7.3	
104	4	2.286-2.591	17.1	6.7	
104	5	3.048-3.170	12.1	5.4	
104	6	4.572-4.663	16.0	6.8	
106	1A	0.000-0.305	6.0	2.9	1
106	1B	0.305-0.610	59.9	23.0	
106	3	1.524-1.905	26.7	8.3	
106	4	2.286-2.621	33.3	7.8	
106	5	3.048-3.444	32.1	11.5	
106	6	4.572-5.029	30.9	8.3	
106	7	6.096-6.523	12.2	6.1	
105	1	0.000-0.518	15.7	6.7	
105	2	0.762-1.143	20.4	6.2	
105	3	1.524-1.676	11.0	5.8	
105	4A	2.286-2.591	34.1	17.9	
105	5	3.048-3.444	35.1	10.9	
105	6	4.572-5.029	40.2	19.4	
105	7	6.096-6.492	16.9	9.4	

- | | |
|------------------------------------|--|
| 1 – Contains organics | 6 – Very moist – near optimum moisture content |
| 2 – Contains rubble | 7 – Moist – below optimum moisture |
| 3 – Hydrocarbon Odour | 8 – Dry – dry texture – powdery |
| 4 – Unknown Chemical Odour | 9 – Very small – caution may not be representative |
| 5 – Saturated – free water visible | 10 – Hold sample for gradation analysis |



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: 44.359N 79.677W

User File Reference: 50 Wellham Road

2021-07-14 12:44 UT

Requested by: Cambium, Inc.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.081	0.050	0.032	0.011
Sa (0.1)	0.112	0.072	0.048	0.017
Sa (0.2)	0.109	0.072	0.049	0.019
Sa (0.3)	0.093	0.063	0.043	0.017
Sa (0.5)	0.077	0.052	0.036	0.013
Sa (1.0)	0.047	0.031	0.021	0.006
Sa (2.0)	0.025	0.016	0.010	0.003
Sa (5.0)	0.006	0.004	0.002	0.001
Sa (10.0)	0.003	0.002	0.001	0.000
PGA (g)	0.064	0.041	0.027	0.009
PGV (m/s)	0.064	0.040	0.026	0.008

Notes: Spectral ($S_a(T)$, 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

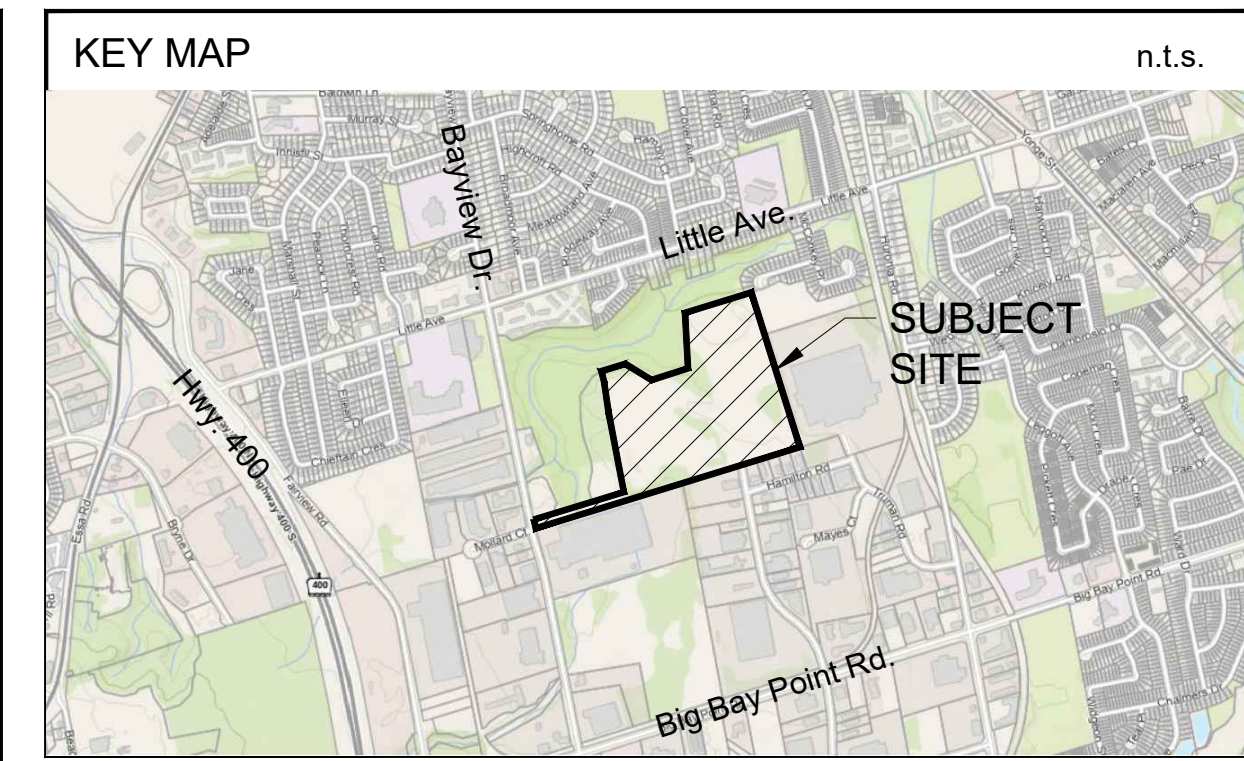
Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

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

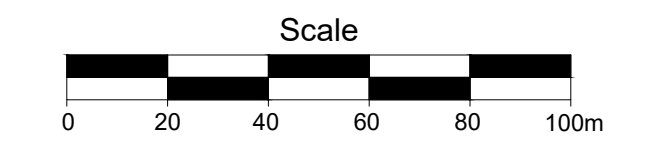


Appendix D
Land Information & Development Plans



DRAFT PLAN OF SUBDIVISION

PART OF NORTH HALVES OF LOTS 9 & 10, CONCESSION 13,
(GEOGRAPHIC TOWNSHIP OF INNISFIL),
CITY OF BARRIE,
COUNTY OF SIMCOE



LEGEND

SUBJECT LANDS

OWNER'S CERTIFICATE
I HEREBY AUTHORIZE INNOVATIVE PLANNING SOLUTIONS TO PREPARE THIS DRAFT PLAN OF SUBDIVISION AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION FOR APPROVAL.

DATE _____ OWNER'S NAME: _____

SURVEYOR'S CERTIFICATE
I CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE _____ SURVEYOR'S NAME: _____

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT

- | | |
|------------------|-----------------------------|
| a) SHOWN ON PLAN | g) SHOWN ON PLAN |
| b) SHOWN ON PLAN | h) MUNICIPAL WATER |
| c) SEE KEY PLAN | i) SAND, SILT GLACIAL TILL |
| d) RESIDENTIAL | j) SHOWN ON PLAN |
| e) SHOWN ON PLAN | k) MUNICIPAL WATER & SEWAGE |
| f) SHOWN ON PLAN | l) NONE |

LAND USE STATISTICS			
LAND USE	LOT / BLK. No.	UNITS	AREA (ha)
Industrial Lots	1 - 20	20	15.948
S.W.M. Pond	21		3.033
S.W.M Pond & Sanitary Easement	22		0.080
Environmental Protection	23		4.391
Streets			2.608
TOTAL	23	20	26.060

SCHEDULE OF REVISIONS			
No.	Date	Description	By
1	November 4, 2022	Update survey;	A.S.
2	November 22, 2022	Update survey;	A.S.
3	February 7, 2023	Revise D.P.	A.S.

IPS INNOVATIVE PLANNING SOLUTIONS
PLANNERS • PROJECT MANAGERS • LAND DEVELOPERS
647 WELHAM ROAD, UNIT 9, BARRIE, ON, L4N 0B7
tel: 705 • 812 • 3281 fax: 705 • 812 • 3438 e: info@ipscollinsinc.com www.ipscollinsinc.com

Date:	Sept. 9, 2022	Drawn By:	A.S.
File:	11 - 352	Checked:	K.G.