Geotechnical Investigation Report - 537086 Main Street, Horning's Mills, Ontario

March 11, 2024

Prepared for:
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1.0 Introduction

Cambium Inc. (Cambium) was retained by Angelo Carnevale (Client) to complete a geotechnical investigation in support of a proposed residential development located at 537086 Main Street in Horning's Mills, Township of Melancthon, Ontario (Site).

This report presents and summarizes the methodology and findings of the geotechnical investigation conducted by Cambium at the Site. Based on the results of the investigation, geotechnical engineering recommendations relevant to the proposed development are provided. In addition, the results of visual slope stability and karst assessments conducted by Cambium at the Site are presented in this report.

1.1 Reviewed Documents

The following project documents were received and reviewed during the drafting of this report:

[1] GSP Group Inc. – Kitchener, Ontario
Development Concept – 537080 Main Street, Horning's Mills; 1:2000; Project No. 22028; February 2, 2022.

[2] Van Harten Surveying Inc. – Orangeville, Ontario
Lot 13, Concession 2 – Preliminary Topo (32159-23) UTM 2010; received by email on May 4, 2023.

1.2 Standards and Guidelines

Applicable standards, guidelines and other normative documents utilized in preparing geotechnical engineering recommendations for this report are provided below.

[3] Canadian Foundation Engineering Manual – 4th Edition; Canadian Geotechnical Society; 2006.

[4] Technical Guide – River & Stream Systems: Erosion Hazard Limit; Ontario Ministry of Natural Resources; 2002.

2.0 Site and Project Description

2.1 Site Description

The Site covers an area of approximately 10.2 acres and is bordered by Dufferin County Road 124 to the west, Main Street to the east, and on all other sides by both vacant and residentially developed properties. The current parcel is vacant and used for agricultural purposes. The adjoining parcel on the eastern side of the property with the civic address 537080 Main Street is developed with a residential dwelling and a barn structure.

The ground elevation at the Site generally falls from west to east, from a maximum elevation of around 482 m above sea level (mASL) along the western property line bordering County Road 124 to elevations around 458 mASL along the eastern property line bordering Main Street. The ground elevation predominantly falls at shallow inclinations (approximately 20H:1V) throughout the property, at times steepening to inclinations of about 10H:1V.

Two defined slope areas exist within the Site, with one slope area along the eastern property line bordering Main Street (height difference of about 4 m to 5 m between the top and bottom of bank based on [2], and maximum inclination approximately 6H:1V) and the second slope area intersecting the southeastern corner of the property (height difference of up to about 4 m, and maximum inclination approximately 5H:1V). Both of the slope areas are regulated by the Nottawasaga Valley Conservation Authority (NVCA) under O.Reg. 172/06 in conjunction with Horning’s Mills Creek.

A Site Location Plan is provided as Figure 1 of this report for reference.

2.2 Project Description

Based on the concept plan provided to Cambium [1], the proposed development will consist of 19 separate residential lots, accessed from Main Street by two new roadways. In the southeastern corner of the Site, near Horning’s Mills Creek, parkland is currently proposed.

It is understood that the lots will be privately serviced.

3.0 Methodology

3.1 Borehole Investigation

Seven boreholes were advanced throughout the Site on May 11 and 12, 2023, at predetermined locations confirmed with the Client and staked by Cambium during a site visit conducted on May 9, 2023. The boreholes were designated as BH101-23 to BH107-23 and were terminated at depths ranging from 4.5 m below ground surface (mbgs) to 5.2 mbgs.

BH101-23, BH104-23 and BH106-23 were outfitted with monitoring wells to allow for subsequent groundwater level monitoring at the Site.

Borehole drilling and sampling were completed using a track-mounted drill rig operating under the supervision of a Cambium geotechnical analyst. The boreholes were advanced to the sampling depths by means of continuous flight hollow and 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 sampler 305 mm into the soil, using a 63.5 kg drop hammer falling 750 mm, as per ASTM D1586 procedures. The SPT N values are used in this report to assess the consistency of cohesive soils and relative density of non-cohesive materials. Soil samples were collected at approximately 0.75 m intervals in the upper 3.0 mbgs and at 1.5 m intervals below that depth.

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. Borehole logs are provided in Appendix A.

3.2 Site Survey

The borehole coordinates were obtained during the geotechnical investigation using a handheld GPS-enabled device. The approximate borehole elevations were determined by interpolating between 0.25 m contour lines provided on a topographic survey of the property conducted by others [2].

3.3 Physical Laboratory Testing

Physical laboratory testing, including five particle size distribution 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. The physical laboratory testing results are presented in Appendix B and are discussed in Section 4.0.

4.0 Subsurface Conditions

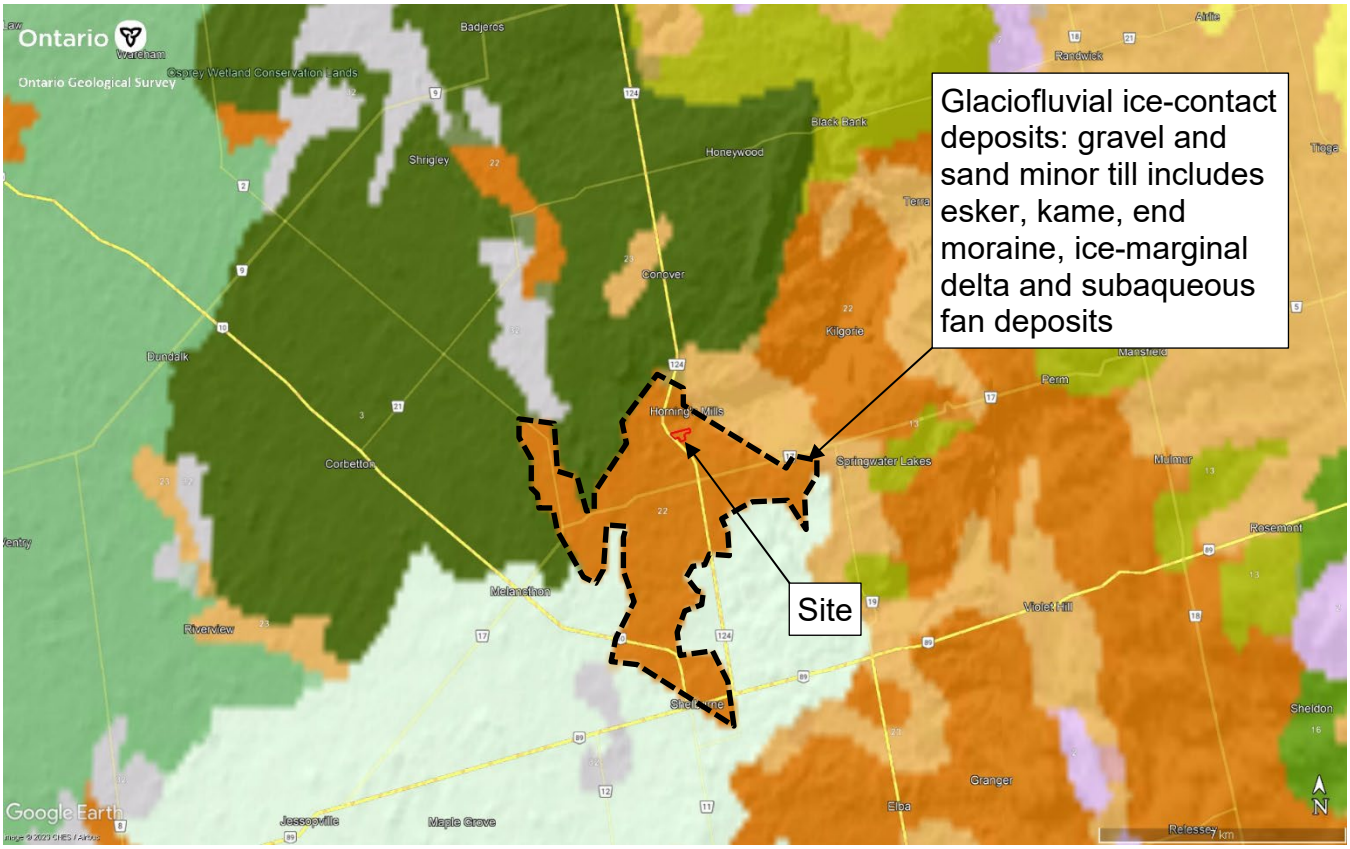
The stratigraphy encountered in the boreholes is indicated on the attached borehole logs in Appendix A. It is noted that the conditions indicated on the borehole logs are for specific locations only and can vary between and beyond the borehole locations. The soil boundaries indicated on the borehole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

In general, the encountered subsurface conditions consist of surficial topsoil and silty sand containing organics, primarily underlain by non-cohesive soil deposits.

4.1 Regional Geology

Ontario Geological Survey (OGS) quaternary geologic mapping indicates that the Site is projected to fall within a formation of glaciofluvial ice-contact deposits, including gravel and sand minor till including esker, kame, end moraine, ice-marginal delta and subaqueous fan deposits.

Embedded Figure 1 shows the site (outlined in red) and surrounding quaternary geologic formations.



Embedded Figure 1: Quaternary geologic mapping

4.2 Surficial Soils

A surficial layer of topsoil containing organics was encountered in all boreholes advanced at the Site. The recorded thickness of the topsoil layer varied between 125 mm and 150 mm.

Below the topsoil, a layer of brown silty sand, predominantly containing organics, was encountered in all boreholes. The silty sand containing organics extended to a depth of about 0.8 mbgs and contained trace amounts of gravel and clay.

SPT N values recorded for the surficial soils ranged between 5 and 18, indicating loose to compact relative density. Natural moisture contents determined by laboratory testing ranged between 8.4% and 25.4%.

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

4.3 Non-Cohesive Deposits

Below the surficial soils described above, non-cohesive soil deposits inferred to be native were generally encountered to the termination depths of the boreholes. The composition of the non-cohesive deposits ranged significantly from finer-grained non-cohesive soils (sand and silt, silty sand, sand with some silt) to coarser-grained non-cohesive soils (gravel and sand, gravelly sand, to gravelly silty sand). The soils were predominantly brown in colour.

SPT N values within the non-cohesive deposits generally ranged between 8 and 25 up to a depth of 1.5 mbgs, indicating loose to compact relative density. Below a depth of 1.5 mbgs, the recorded SPT N values generally ranged between 33 and 100, indicating dense to very dense relative density. At varying locations and depths within this formation, auger advancement was noted as being difficult and split spoon refusal was noted, at times leading to minimal sample recovery, which is often indicative of cobbles/boulders being present within the investigated soils. Organics were noted within the non-cohesive soils between 1.5 mbgs and 2.3 mbgs in BH102-23, however it is unclear whether the encountered organics are present within the deposit or represent caved material due to the drilling method (i.e., use of solid stem augers).

Natural moisture contents in the non-cohesive deposits ranged between 3.2% and 17.2% based on laboratory testing. Particle size distribution analysis was completed on four samples collected from the non-cohesive deposits. The testing results are provided in Appendix B and summarized in Table 1.

Table 1 Particle Size Distribution – Non-Cohesive Deposits

Sample ID	Depth (mbgs)	Description	% Gravel	% Sand	% Silt	% Clay	% Moisture Content
BH102-23-SS4	2.3 – 2.9	Silty Gravel and Sand trace Clay	36	36	21	7	4.4
BH103-23-SS3	1.5 – 2.1	Sand and Silt trace Gravel trace Clay	9	44	40	7	12.5
BH105-23-SS2	0.8 – 1.4	Sand and Gravel some Silt trace Clay	35	44	18	3	6.2
BH107-23-SS2	0.8 – 1.4	Silty Sand trace Gravel trace Clay	7	68	20	5	6.6

4.4 Cohesive Deposits

A layer of predominantly cohesive soil was encountered in BH101-23 between depths of 1.5 mbgs and 2.3 mbgs.

The soil was classified as a brown silt with some clay and some sand, and a trace amount of gravel. The recorded SPT N value of 36 indicated hard consistency. Table 2 summarizes the results of the particle size distribution analysis and natural moisture content testing completed on the retrieved sample.

Table 2 Particle Size Distribution – Cohesive Deposits

Sample ID	Depth (mbgs)	Description	% Gravel	% Sand	% Silt	% Clay	% Moisture Content
BH101-23-SS3	1.5 – 2.1	Silt some Clay some Sand trace Gravel	1	11	74	14	22.3

4.5 Bedrock

Bedrock was not confirmed in any of the boreholes advanced by Cambium at the Site. The boreholes were terminated at depths ranging between 4.5 mbgs and 5.2 mbgs, corresponding to absolute elevations between 459.5 mASL and 475.8 mASL.

In BH103-23, BH105-23, BH106-23 and BH107-23, split spoon refusal (i.e., split spoon bouncing on a probable hard surface) was encountered within the final sampling interval prior to reaching the proposed termination depth, and the boreholes were terminated between depths of 4.5 mbgs and 5.1 mbgs. To determine whether the early termination depths are indicative of a bedrock surface at the Site, further confirmation would be required using methods outside of the current scope of work (i.e., coring or other methods such as geophysical surveys or test pit works). A drift thickness map showing approximate projected drift thicknesses in the project area is provided in Section 5.0 below.

4.6 Groundwater

The soils were predominantly described as being dry to moist throughout the borehole investigation. Wet soils were encountered at a depth of approximately 4.6 mbgs in BH104-23,

which was advanced near the lowest ground elevations at the Site. BH102-23 and BH103-23 were observed to be open and dry upon completion of drilling. In BH105-23 and BH107-23, caving occurred to depths of 3.6 mbgs and 3.9 mbgs respectively (about 0.9 m to 1.2 m above the borehole termination depth), and no water was observed in the boreholes upon completion.

Monitoring wells were installed in BH101-23, BH104-23 and BH106-23 to allow for subsequent groundwater level monitoring at the Site. The water levels measured in the installed wells following the investigation are summarized in Table 3.

Table 3 Groundwater Observations During Monitoring Events

Date	Borehole	Ground Elevation (mASL)	Water Level in Monitoring Well (mbgs)	Water Level Elevation (mASL)	Bottom of Well Elevation (mASL)
June 6, 2023	BH101-23	480.25	Dry	-	475.7
	BH104-23	464.45	4.3	460.15	459.9
	BH106-23	474.35	Dry	-	469.9
August 8, 2023	BH101-23	480.25	Dry	-	475.7
	BH104-23	464.45	4.5	459.95	459.9
	BH106-23	474.35	Dry	-	469.9

During the monitoring event conducted on June 6, 2023, water was solely encountered in BH104-23, at a depth of 4.3 mbgs (absolute elevation of approximately 460.15 mASL).

It is noted that the encountered and measured groundwater levels reflect the groundwater conditions in the boreholes at the time of the borehole investigation and subsequent monitoring events between May and August 2023. Groundwater levels at the Site may be anticipated to vary between and beyond the borehole locations and to fluctuate with seasonal variations in precipitation and snowmelt.

4.7 Percolation Rates

Percolation rates were estimated for each of the soil samples submitted for particle size distribution testing, with the results summarized in Table 4.

Table 4 Estimated Percolation Rates

Sample ID	Depth	Description	Estimated Percolation Rate [min/cm]
BH101-23-SS3	1.5 – 2.1	Silt some Clay some Sand trace Gravel	30
BH102-23-SS4	2.3 – 2.9	Silty Gravel and Sand trace Clay	12
BH103-23-SS3	1.5 – 2.1	Sand and Silt trace Gravel trace Clay	20
BH105-23-SS2	0.8 – 1.4	Sand and Gravel some Silt trace Clay	10
BH107-23-SS2	0.8 – 1.4	Silty Sand trace Gravel trace Clay	18

5.0 Slope Stability and Karst Assessments

On May 9, 2023, a Site visit was conducted by Cambium personnel to conduct visual slope stability assessments of relevant slope areas within the property boundaries (slope area to the east along Main Street, and in the southeastern corner of the property near Horning's Mills Creek). In addition, a visual karst assessment was completed to fulfil project-specific permitting requirements communicated to Cambium by the Client. The results of these assessments are documented in this Section of the report.

5.1 Slope Stability Assessment

A visual slope stability assessment was conducted separately for two distinct slope areas at the Site (one slope area parallel to Main Street along the eastern property line, and an additional slope area intersecting the southeastern corner of the property near Horning's Mills Creek).

During the slope stability assessment, the top of bank of both slope areas was inferred and staked by Cambium, with coordinates for the inferred top of bank obtained at each stake location using a handheld GPS-enabled device. The inferred top of bank is provided for both slope areas on the Borehole Location Plan appended as Figure 2 of this report.

The visual slope stability assessment was conducted for both slope areas according to the criteria defined in the Ontario MNRF Technical Guide [4]. The Slope Stability Rating Chart per Table 4.2 of the Technical Guide was completed for both slope areas, with the results summarized in Table 5, including commentary and explanations for the selected rating values. The completed rating charts can be found in Appendix C of this report, and photographs taken during the inspection are included in Appendix D.

Table 5 Slope Stability Rating Chart – Results

Criterion	Slope area adjacent to Main Street (eastern property line) *Photographs 1 to 8 in Appendix D*	Slope area near Horning's Mills Creek (southeastern corner of property) *Photographs 9 to 16 in Appendix D*
Slope Inclination	Maximum inclination approx. 6H:1V based on [2], giving a rating of **0**.	Maximum inclination of approx. 5H:1V based on [2], giving a rating of **0**.
Soil Stratigraphy	Predominantly non-cohesive sands and gravels based on the geotechnical investigation. Based on quaternary geologic mapping, the encountered materials could potentially represent glacial till formations, therefore a recommended rating of **6** to **9** applies.	
Seepage from Slope Face	None observed, giving a rating of **0**.	
Slope Height	Maximum 5 m based on [2], giving a rating of **2**.	Maximum 4 m based on [2], giving a rating of **2**.
Vegetation Cover on Slope Face	Forested with mature trees, giving a rating of **0**.	Vegetation ranges from grass to low-lying shrubs, to mature trees, giving a rating of **0** to **4**.
Table Land Drainage	The table land is gently sloped towards the slope area, which may result in minor drainage occurring over the slope, giving a rating of **2**.	
Proximity of Watercourse to Slope Toe	No regulated watercourse exists adjacent to the slope toe. A ditch exists between the western road edge of Main Street and the slope toe area and was directing water on the inspection date. While not expected to cause significant and continual erosion of the slope toe, a conservative rating of **6** is applied.	Horning's Mills Creek is located within 15 m of the slope toe area based on available NVCA mapping. Based on the NVCA mapping, the creek source is located approximately 150 m south of the southern property line, and the creek was not directing water on the inspection date. A conservative rating of **6** is applied.
Previous Landslide Activity	No evidence of previous landslide activity was noted, giving a rating of **0**.	

Based on the slope stability rating chart results, a rating between **16 and 19** would apply for the eastern slope area adjacent to Main Street, and a rating between **16 and 23** would apply for the southeastern slope area near Horning's Mills Creek.

The rating values indicate that both slopes can be classified as having a ***low potential for slope instability*** (rating value less than 24). For low potential slopes, the minimum investigation requirements per the Technical Guide consist of a visual site inspection and letter report. The fieldwork completed by Cambium and the current report are considered to fulfil the investigation requirements for low potential slopes.

From a geotechnical perspective and given the low potential for slope instability, the permitting authority can consider permitting the development at a distance of at least 6 m (erosion access allowance) from the top of bank, however, it is noted a site-specific setback/erosion access allowance will be stipulated by the NVCA or the local municipality.

5.2 Karst Assessment

As part of Cambium's scope of work, a karst assessment including a desktop review and field inspection was completed for the Site. The field inspection for evidence of karst conditions was completed concurrently with the visual slope assessment described above.

The following available information was reviewed by Cambium prior to conducting the visual inspection:

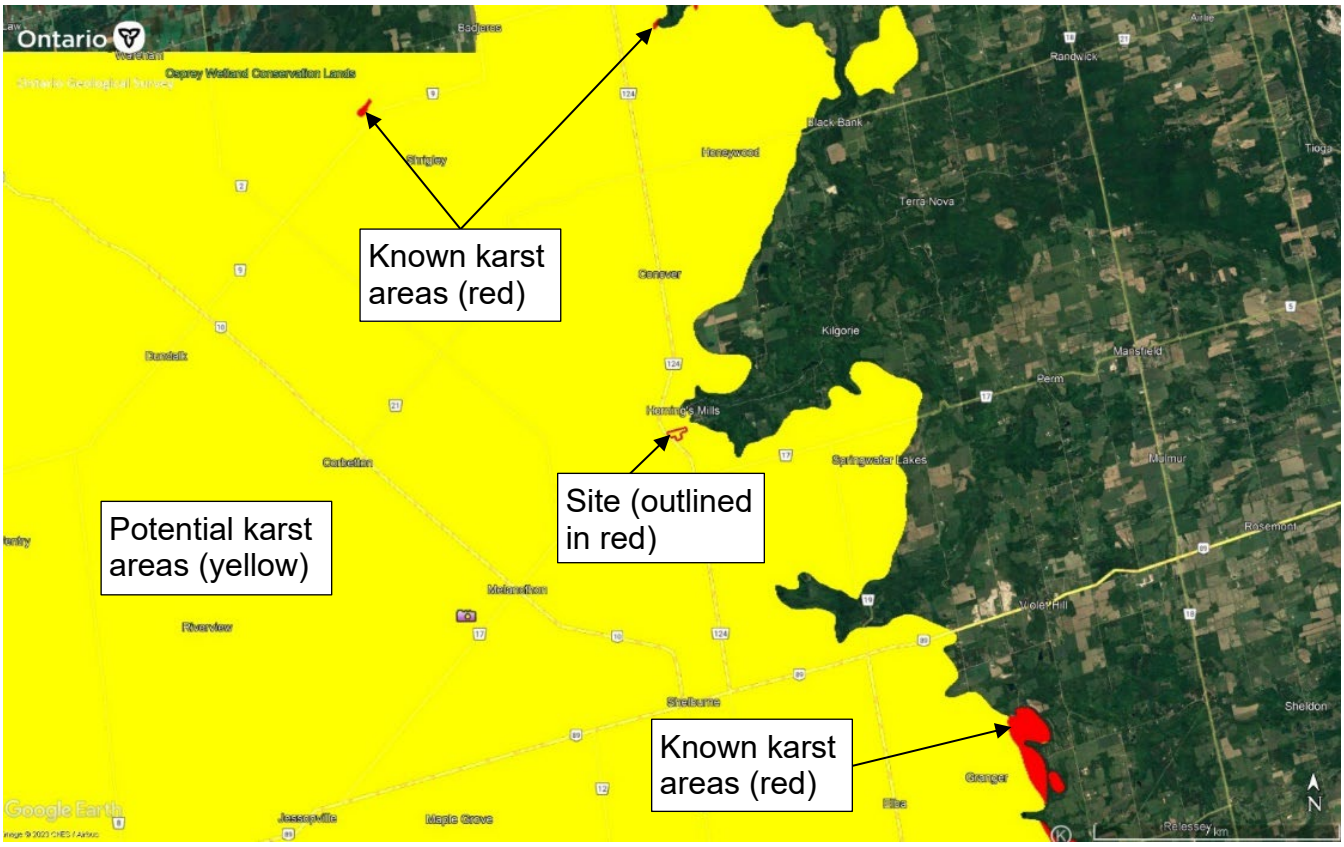
- Karst mapping:
  Brunton, F.R. and Dodge, J.E.P.; Karst of Southern Ontario and Manitoulin Island; Ontario Geological Survey, Groundwater Resources Study 5; 2008.
- Drift thickness mapping:
  Gwyn, Q.H.J. and Frazer, J.Z.; Drift Thickness of the Dundalk Area, Southern Ontario; Ontario Div. Mines, Prelim. Map P.1023, Drift Thickness Ser., Scale 1:50,000. Geological compilation; 1975.

Based on the desktop review of available karst mapping, the Site is located at the eastern edge of a ***potential karst area*** (yellow area shown on Embedded Figure 2 below), which indicates areas of carbonate rock units identified as most susceptible to karst processes. The nearest ***known karst areas*** (red areas shown on Embedded Figure 2 below) are located between approximately 12 km and 14 km to the northwest, north and southeast of the Site. Known karst areas indicate areas where karst features have been confirmed by visual observation, measured field data or data from published reports.

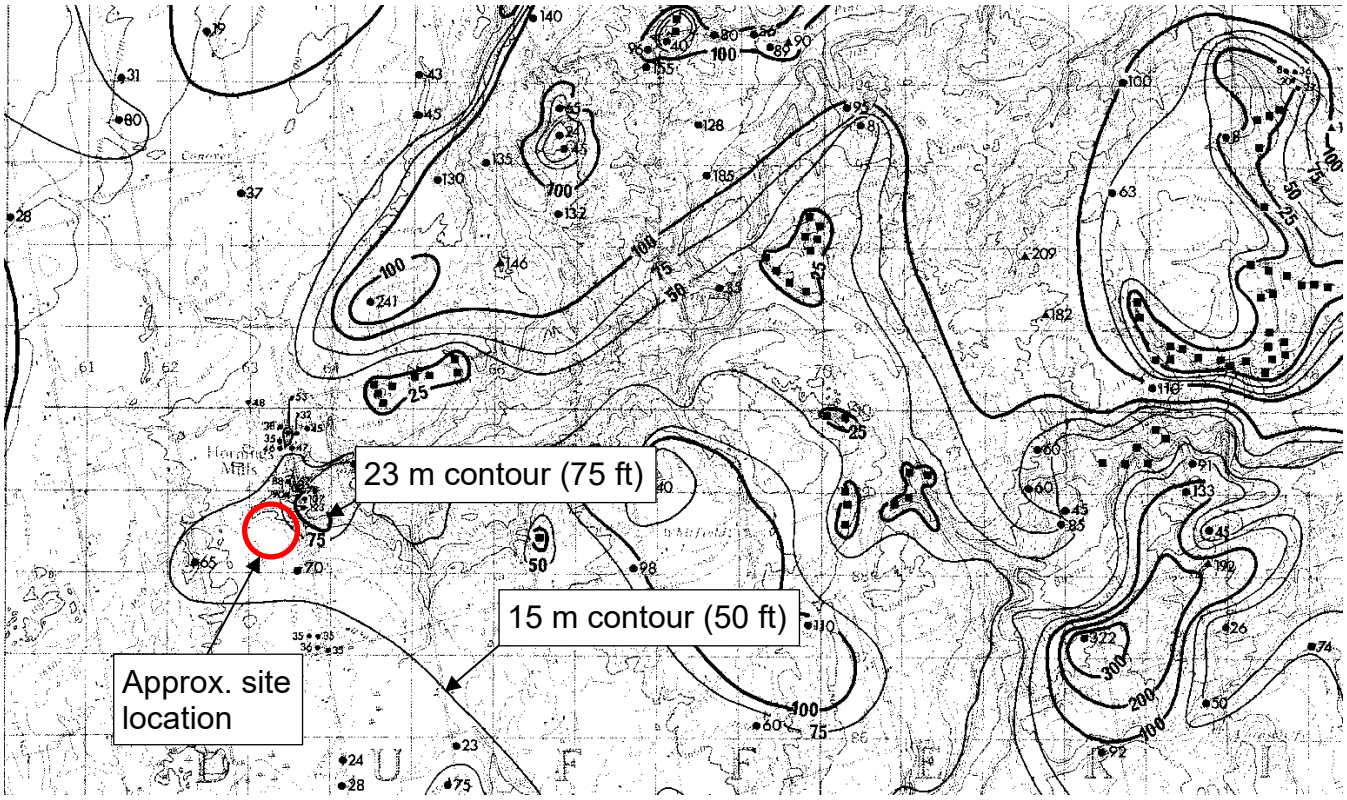
Further to the karst mapping, available drift thickness mapping for the project area indicates that the drift thickness (i.e., depth of bedrock from the ground surface) is projected to be

between approximately 15 m and 23 m in the project area. The bedrock drift thickness mapping is shown on Embedded Figure 3.

Given that the Site is located at the edge of a potential karst area, with no inferred or known karst areas in the immediate vicinity of the Site, the desktop review indicated a low probability of karst conditions being present at the Site. Further, the projected drift thickness (> 15 m) indicates that karst conditions, if present at the Site, will likely be difficult/impossible to observe from the surface during the visual assessment.



Embedded Figure 2*: *Karst mapping



Embedded Figure 3: Drift thickness mapping

During the visual inspection, no bedrock outcropping was confirmed and therefore, no karstification or features such as voids in bedrock were observed from the surface.

Water was observed in the ditch area along Main Street but was not disappearing into the ground surface at any location along the ditch alignment. A pond containing standing water was observed on the neighbouring property on the east side of Main Street (see Photograph 8 in Appendix D). No sinkholes, conical depressions, pinnacled surfaces, etc., were observed during the inspection.

In summary, ***no conditions indicating the presence of karst were observed during the visual inspection***. As noted above, given the projected depth of bedrock (> 15 m), visual observations of the bedrock surface were unlikely to be made from the surface during the inspection, and any physical exposure of bedrock using methods such as a test pit investigation would likely be impractical. Early refusal was encountered in some boreholes

around a depth of approximately 5 mbgs, which could indicate a higher bedrock surface at the Site than anticipated based on drift thickness mapping. It should be noted that the early refusal depths encountered in some boreholes could also be indicative of larger cobbles and boulders present within the investigated soils, and therefore should not be taken as definitively confirming a bedrock surface at the Site.

Should further confirmation of the existence of karst conditions be required at certain locations throughout the Site, it may be cost effective to consider geophysical investigation methods (georadar) to effectively map bedrock and any cavities (should they exist).

It is understood that test well installations for water supply will be conducted at the Site. It is recommended to document bedrock observations during the well installations (i.e., drift thickness at well location, and type and composition of bedrock), and to report any relevant observations encountered during well installation and subsequent testing to Cambium.

6.0 Geotechnical Considerations

This section of the report provides engineering information on, and recommendations for, the geotechnical design aspects of the project based on our interpretation of the borehole information, the laboratory test data, and our understanding of the project requirements. The information in this portion of the report is provided for planning and design purposes for the guidance of the design engineers and architects. Where comments are made on construction, they are provided only to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the Site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own independent interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like. Cambium will not assume any responsibility for construction-related decisions made by contractors on the basis of this report.

6.1 Site Preparation

Existing topsoil and organic material, any loose reworked/disturbed native materials and any deleterious material (i.e., construction debris, fibrous material, asphalt, brick fragments, etc.) encountered should be excavated and removed beneath proposed development areas prior to construction. Additionally, this material should be excavated and removed to a minimum distance of 3 m around the building footprint. Any topsoil and materials with significant quantities of organics and deleterious materials are not appropriate for use as fill.

The exposed subgrade should be proof-rolled and inspected by a qualified geotechnical engineer prior to placement of any granular fill or foundations. Any loose/soft soils identified at the time of the 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 become unstable if wet or saturated. Such conditions are common in the spring and late fall. Under these conditions, temporary use of granular fill, and possible separating/reinforcing geotextiles, may be required to prevent severe rutting on construction access routes.

6.2 Frost Penetration

Based on climate data and design charts, the maximum frost penetration depth below the surface at the Site is estimated at 1.6 mbgs. Exterior footings for the proposed structure should be situated at or below this depth for frost penetration or should be appropriately protected. Any services should be located below this depth or be sufficiently insulated.

6.3 Excavations

Excavations will be required at the Site to construct footings for the proposed structures, which are currently assumed to be single detached dwellings. It is currently not known whether the structures will be constructed with basements, however, for the purposes of these recommendations it is assumed that excavation depths below the current ground surface will range between 1.6 mbgs and 3 mbgs.

Where sufficient space is available between the proposed building lines and property boundaries, unsupported excavations can be carried out and must be completed in accordance with Occupation Health and Safety (OHSA) requirements, as detailed below.

For practical purposes, the overburden soils at the Site above the groundwater table and within continually dewatered depths can be considered Type 3 soils, as such, excavation side slopes should be no steeper than 1H:1V. Soils below the groundwater table are to be considered Type 4 soils in accordance with OHSA, and excavation side slopes are to be limited to 3H:1V.

It is noted that a workspace allowance of approximately 0.5 m should be maintained between building lines and the toe of the adjacent temporary excavation slopes (applies for slopes with a maximum inclination of 1H:1V).

Excavation slopes should be protected during construction from precipitation, runoff, or snow/ice melt 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).

The crest area of unsupported excavation slopes is to be held free of any loading (i.e., by heavy machinery, stockpiled construction materials, etc.).

6.4 Groundwater Control and Dewatering

During the water level monitoring events conducted in June and August 2023, two of the installed monitoring wells were dry and the water level in BH104-23, located in the eastern portion of the property, was at or lower than approximately 4.3 mbgs.

Though the extent of the dewatering methods will be dependent on actual excavation depths, it is not anticipated that excavations required to construct proposed dwellings will encounter significant groundwater seepage. It is generally recommended to conduct further water level monitoring events during high groundwater seasons (i.e., during the spring following snowmelt and significant precipitation events) to confirm seasonal high groundwater levels. The recommendations provided in this section should be revisited and revised as necessary if significantly higher groundwater levels are measured in the monitoring wells.

Based on currently available information, infiltrating surface water or groundwater should be manageable using filtered sumps and pumps. It is generally recommended to conduct excavation and foundation construction works during drier seasons to minimize or mitigate potential groundwater-related issues.

Should dewatering methods be deemed necessary for any excavations at the Site, any dewatering methods employed at the Site must ensure that the water table is maintained at least 1 m below the excavation base for the duration of construction. The Contractor is responsible for selecting and designing an appropriate dewatering method to meet project requirements.

6.5 Foundation Design

6.5.1 Conventional Shallow Footings

From a geotechnical perspective, conventional shallow footings placed on competent native soils may be used to transfer loads from the proposed structures to the soils below. In general, the dense to very dense non-cohesive soils and hard cohesive soils encountered below a depth of 1.5 mbgs throughout the Site are considered competent to directly support loads from shallow footings.

Should incompetent (loose, soft and/or deleterious) soils be encountered at the proposed footing depths following excavation, these soils are to be sub-excavated down to competent soils under the guidance of a qualified geotechnical engineer and replaced with competent engineered fill as detailed in Section 6.6. The recommendations and bearing capacities provided in this report assume that any incompetent materials encountered at underside of footing depths will be sub-excavated and replaced in this manner.

Further, any large cobbles or boulders encountered at footing subgrade elevations are to be removed and replaced with engineered fill or other material approved by a geotechnical engineer.

Provided that footings are constructed according to the recommendations provided above, bearing directly on competent native soils with any localized incompetent soils removed and replaced with competent engineered fill material, the following bearing capacities can be provided:

- Serviceability Limit State (SLS): 150 kPa
- Ultimate Limit State (ULS): 225 kPa

The bearing capacities given above apply for strip foundations with a width of 0.5 to 1 m, and for spread footings with dimensions between 1 m x 1 m and 2 m x 2 m, with all footings having at least 1.6 m of adjacent earth cover satisfying frost penetration depth requirements. It is noted that the provided SLS bearing capacity represents the allowable bearing capacity value as calculated according to the methodology in [3], and is to be compared with unfactored load

values. The provided ULS bearing capacity represents the factored bearing resistance calculated according to the methodology in [3] and is to be compared with load values increased by load factors according to applicable standards/building codes. If any proposed structures are subject to stringent settlement requirements (i.e., such that estimated settlement in the order of 20 mm to 25 mm is not tolerable), it is recommended that a geotechnical engineer be retained to conduct a detailed settlement analysis, to ensure that project-specific requirements are met.

Cambium should be contacted to review final site grading plans and foundation dimensions and elevations, in order to confirm the bearing capacities provided in this report. A qualified geotechnical engineer should be retained to confirm bearing capacities onsite, following excavation to the proposed footing subgrade elevations, or to develop further recommendations such as the required depth of engineered fill pads.

6.5.2 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.MUNI 1010 Granular A compacted to 98% of Standard Proctor Maximum Dry Density (SPMDD) beneath all floor slabs. It is recommended that all floor slabs are situated at least 500 mm above the seasonal high groundwater elevation.

Within any interior areas that may be exposed to freezing conditions for extended periods of time, the floor slab may be susceptible to frost heaving, depending on the composition of the subgrade. The subgrade underlying these areas should be adequately insulated to prevent frost penetration.

Any basement floor slabs (if applicable) should be underlain by a 300 mm thick layer of 19 mm diameter crushed clear stone wrapped in a geotextile (Terrafix 270R or equivalent) and hydraulically connected to perimeter subdrains. The clear stone material should be nominally compacted to a dense state.

6.6 Backfill and Compaction

Engineered fill, if required for foundations, should consist of free-draining granular material meeting the specifications of OPSS 1010 Granular B or an approved equivalent and should be placed in maximum 200 mm thick lifts compacted to 100% of SPMDD, as confirmed by nuclear densometer testing.

Imported material for engineered fill should consist of clean, no-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. Excavated sand and gravel materials at the Site may be suitable for re-use as backfill for foundation walls and for grading purposes. Geotechnical testing of the material will be required to confirm suitability and compaction parameters (i.e., Proctor testing to confirm optimum moisture content). The fines (silt and clay) content of materials utilized as backfill for foundation walls/grading should not exceed 35%, which will need to be confirmed by sampling from stockpiled material and conducting confirmatory grain size analyses. The fines content of the samples collected during the borehole investigation and subsequently selected for particle size distribution testing generally ranged between 21% and 28%, however higher fines contents between 47% and 88% were also determined for samples collected from the Site.

Typically, backfill should be placed in maximum 300 mm thick lifts and should be compacted to a minimum of 98% of SPMDD. Backfill adjacent to the structural elements (i.e., foundation walls) should be compacted to 95% of SPMDD taking care not to damage the adjacent structures. The backfill material in the upper 300 mm below the pavement subgrade elevation should be compacted to 100% of SPMDD in all areas.

All existing vegetation, topsoil, organic and non-organic fills, and any loose soils shall be removed down to a competent base. Backfill areas must be approved by a qualified geotechnical engineer prior to placement of any new fill, to ensure the suitability of subgrade conditions.

6.6.1 Engineered Fill

Where the existing 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/disturbed 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 an imaginary 1H:1V slope to the competent approved native soil. The exposed edges of the engineered fill should be sloped at a maximum of 3H:1V to avoid weakening of the engineered fill edges due to slope movement. If fill is required adjacent to sloped banks (i.e., slope steeper than 3H:1V), the fill shall be placed in stepped planes to avoid a plane weakness.

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. The engineered fill should be placed at least 600 mm above the elevation of the proposed underside of footing.

VI. Due to the potential negative effects of differential settlement between the engineered fill and the native soils, in any block where footings are to be placed partly on engineered fill and partly on native soils, reinforcing steel bars should be included and placed within the footings and the top of the foundation walls. All tie reinforcing steel bars should be included and placed within the top of the foundation walls. All tie

reinforcing steel bars should have at least 600 mm of overlap. The actual steel reinforcement design should be confirmed / designed by the project structural engineer.

VII. 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.

6.7 Subdrainage

The exterior grade around any buildings should be sloped from the walls to direct surface runoff away from the building. In order to deal with seasonal perched water and/or the water table, perimeter subdrains consisting of geotextile-wrapped perforated pipe subdrains set in a trench of clear stone and connected to a sump or other frost-free positive outlet are recommended.

Subsurface walls should be adequately damp proofed above the water table and waterproofed below the water table.

6.8 Buried Utilities

Bedding and cover material for any buried utilities should consist of OPSS 1010 Granular A or B Type II, placed in accordance with pertinent Ontario Provincial Standard Drawings (OPSD 802.013). The bedding and cover material shall be placed in maximum 200 mm thick lifts and should be compacted to at least 98% of SPMDD.

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

6.9 Lateral Earth Pressure

Lateral earth pressure coefficients (K) are shown in Table 6 and may be used for the preliminary design of temporary and permanent structures at the Site. 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 6 Lateral Earth Pressure Coefficients

Stratum/Parameter	γ / γ ‘ [kN/m^3]	Φ [°]	c [kN/m^2]	K_o [-]	K_a [-]	K_p [-]
Non-Cohesive Soils (Sand and Gravel) *compact to dense*	19.5 / 10.5	30	0	0.50	0.33	3.00
Engineered Fill (per recommendations provided above)	20.5 / 11.5	32	0	0.47	0.31	3.25

Where: γ = bulk unit weight of soil (kN/m^3)
γ' = submerged (effective) unit weight of soil (kN/m^3)
φ = internal angle of friction (degrees)
c = soil cohesion (kN/m^2)
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 6 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.

6.10 Pavement Design

The performance of pavement is dependent on proper subgrade preparation. All topsoil and organic materials should be removed and backfilled with approved engineered fill or native material (if tested and approved for use by a qualified geotechnical/pavement engineer), compacted to 98% of SPMDD. The subgrade should be proof rolled and inspected by a geotechnical engineer. Any areas were boulders, rutting, or appreciable deflection is noted should be sub-excavated and replaced with suitable fill. The fill should be compacted to at least 100% of SPMDD.

The recommended pavement structure should meet relevant standards, if prescribed by the local municipality. A preliminary minimum pavement structure is provided in Table 7.

Table 7 Minimum Pavement Structure

Pavement Layer	Compaction Requirements	Minimum Thickness and Material Requirements
Surface Course Asphalt	92% - 96.5% MRD (OPSS 310)	40 mm HL3
Binder Course Asphalt	92% - 96.5% MRD (OPSS 310)	50 mm HL8
Granular Base	100% SPMDD (ASTM-D698)	150 mm OPSS 1010 Granular A
Granular Subbase	100% SPMDD (ASTM-D698)	300 mm OPSS 1010 Granular B Type I

Final material and thickness requirements, and any material/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 any soft or weak subgrade soil replacement.

Compaction of the subgrade should be verified by the Engineer prior to placing the granular fill. Granular layers should be placed in 200 mm maximum loose lifts and compacted to at least 100% of SPMDD. The granular materials specified should conform to OPSS standards, as confirmed by appropriate materials testing. Asphalt materials should be rolled and compacted as per OPSS 310.

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.

7.0 Report Limitations

7.1 Design Review and Inspections

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

7.2 Changes in Site and Project Scope

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

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

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

8.0 Closing

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

Respectfully submitted,

Cambium Inc.

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DS

LICENSED PROFESSIONAL ENGINEER
S.E.BAIRD
90405788
PROVINCE OF ONTARIO

2024-03-12

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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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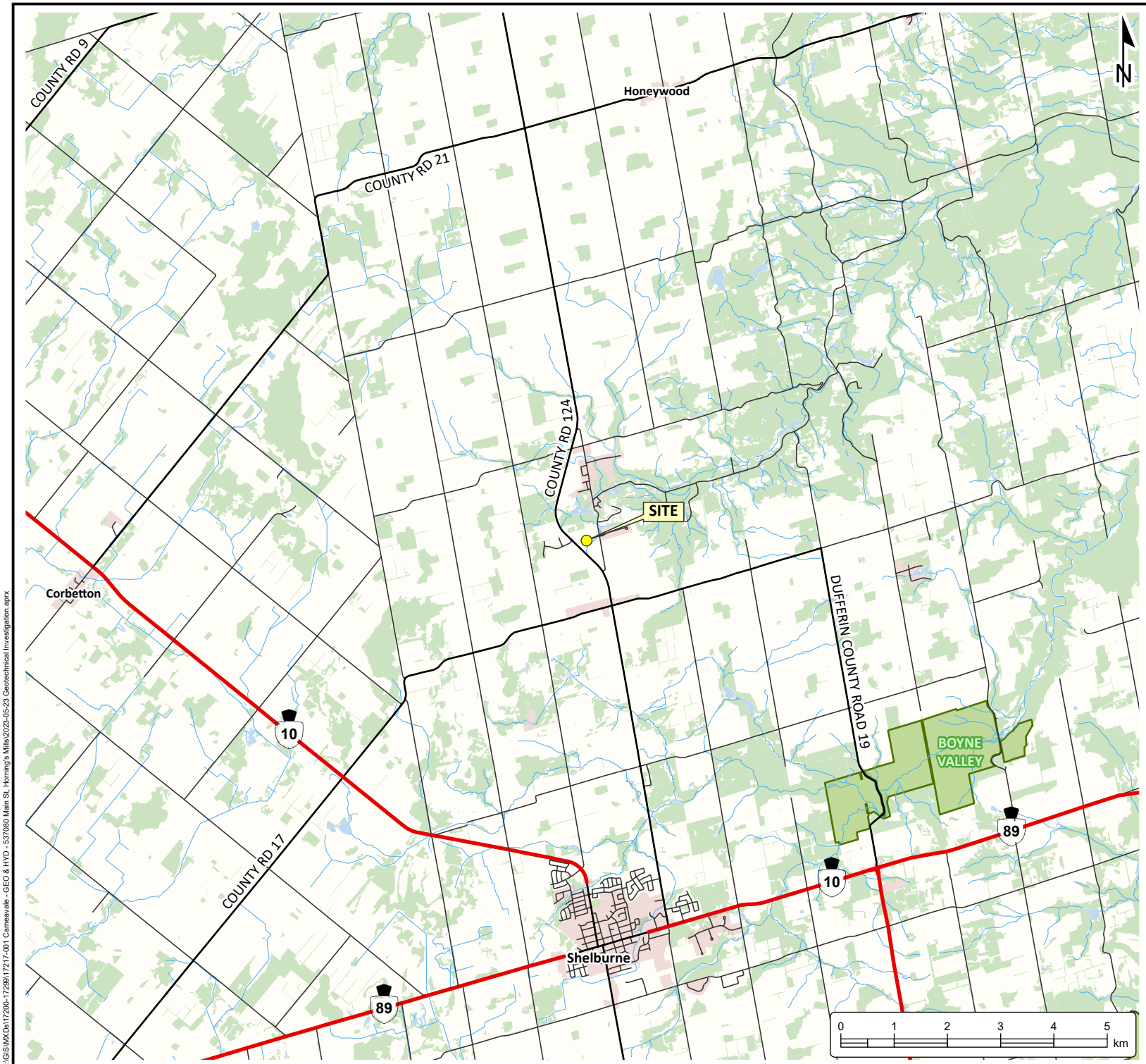
Personal Liability

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

ANGELO CARNEVALE
537080 Main Street,
Hornings Mills, Ontario

LEGEND

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

Notes:
- Base mapping features are © King's Printer of Ontario, 2022 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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SITE LOCATION PLAN

Project No.:	17217-001	Date:	May 2023
		Rev.:	
Scale:	1:100,000	Projection:	NAD 1983 UTM Zone 17N
Created by:	MAT	Checked by:	RG
Figure:	1		

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GEOTECHNICAL INVESTIGATION

ANGELO CARNEVALE
537080 Main Street,
Hornings Mills, Ontario

LEGEND

- Borehole
- Monitoring Well
- Inferred Top of Bank (Cambium, May 2023)
- Site (approximate)

Notes:
- Base mapping features are © King's Printer of Ontario, 2022 (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.
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BOREHOLE LOCATION PLAN

Project No.: 17217-001		Date: June 2023 Rev.:	
Scale: 1:3,000		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: RG	Figure:	2

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Appendix A

Borehole Logs

CAMBIUM

Client: Angelo Carnevale
Contractor: Walker Drilling
Project No.: 17217-001
Location: 537090 Main Street

Project Name: 537090 Main Street, Horning's Mills, ON
Method: Track Mounted Hollow Stem Auger
Elevation: 480.25 mASL
UTM: 17 T **N:** 4888586 **E:** 563201

Log of Borehole: BH101-23
Page: 1 of 1
Date Completed: May 11, 2023

SUBSURFACE PROFILE				SAMPLE							
Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI / % Moisture (25 50 75)	Shear Strength Cu, kPa (nat V. rem V.) / SPT (N) (20 40 60 80)	Well Installation	Log Notes
480.2	0		**TOPSOIL:** (~125mm thick) 480.12	1A	SS			18.6%		Cap	Monitoring well dry when measured on June 6, 2023.
			0.13 **(SM) SILTY SAND:** trace clay, trace gravel, trace organic matter; brown; non-cohesive, moist, loose 479.49	1B	SS	30	5	18.0%	5	Bentonite Plug	
479.8	0.5										
479.2	1		0.76 **(SW) SAND:** some silt, trace gravel; brown; non-cohesive, moist, compact 478.73	2	SS	60	13	9.7%	13	Riser	
478.8	1.5		1.52 **(ML) SILT:** some clay, some sand, trace gravel; brown; cohesive, moist, hard 477.96	3	SS	60	36	22.3%	36		
478.2	2										
477.8	2.5		2.29 **(GW) GRAVEL:** AND SAND: trace silt; brown; non-cohesive, moist, very dense 475.68	4	SS	70	64	3.4%	64	Sand Pack	
477.2	3			5	SS	40	72	3.8%	72	PVC Screen	
476.8	3.5										
476.2	4										
475.8	4.5		4.57 **(SM) SILTY SAND:** some gravel; brown; non-cohesive, dry, compact 475.07	6	SS	70	20	3.5%	20	Cap	
475.2	5		5.18 Borehole terminated @ 5.2 mbgs due to target depth achieved.								
474.8	5.5										
474.2	6										
473.8	6.5										
473.2	7										
472.8											

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
3	1	11	74	14

1m = 24 units

Logged By: WA **Input By:** WA

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client: Angelo Carnevale
Contractor: Walker Drilling
Project No.: 17217-001
Location: 537090 Main Street

Project Name: 537090 Main Street, Horning's Mills, ON
Method: Track Mounted Solid Stem Auger
Elevation: 478.2 mASL
UTM: 17 T **N:** 4888617 **E:** 563305

Log of Borehole: BH102-23
Page: 1 of 1
Date Completed: May 11, 2023

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.) — 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
478.2	0	**TOPSOIL:** (~150mm thick)	478.05	1A	SS			24.0%			
		(SM) SILTY SAND: trace clay, trace gravel; brown; non-cohesive, moist, compact	0.15	1B	SS	60	12	10.6%	12		
477.7	0.5		477.44								
		(SW) SAND: some silt, some gravel; brown; non-cohesive, moist, very dense	0.76	2	SS	70	56	5.4%	56		
477.2	1		476.68								
476.7	1.5	**(GW) GRAVEL:** Silty GRAVEL and SAND, trace clay; trace organic matter; brown; non-cohesive, moist, very dense	1.52	3	SS	70	57	5.8%	57		
476.2	2										
475.7	2.5	- less to no organic matter		4	SS	70	71	4.4%	71		
475.2	3										
				5	SS	70	100	5.2%	100		
474.7	3.5										
474.2	4										
473.7	4.5		473.63								
		(SM) SILTY SAND: some gravel; brown; non-cohesive, moist to dry, very dense	4.57	6	SS	70	71	4.0%	71		
473.2	5		473.17								Borehole was open and dry upon completion of drilling
		Borehole terminated @ 5 mbgs due to target depth achieved.	5.03								
472.7	5.5										
472.2	6										
471.7	6.5										
471.2	7										
470.7											

1m = 24 units

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
4	36	36	21	7

Logged By: WA **Input By:** WA

CAMBIUM

Client: Angelo Carnevale
Contractor: Walker Drilling
Project No.: 17217-001
Location: 537090 Main Street

Project Name: 537090 Main Street, Horning's Mills, ON
Method: Track Mounted Solid Stem Auger
Elevation: 470.05 mASL
UTM: 17 T **N:** 4888687 **E:** 563505

Log of Borehole: BH103-23
Page: 1 of 1
Date Completed: May 11, 2023

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI	% Moisture	Shear Strength Cu, kPa (nat V. / rem V.)	SPT (N)	Well Installation	Log Notes
								25 50 75	25 50 75	20 40 60 80	20 40 60 80		
470	0	**TOPSOIL:** (~125mm thick)	469.92	1A	SS				21.0%				
		(SM) SILTY SAND: trace clay, trace gravel, trace organic matter; brown; non-cohesive, moist, compact	0.13	1B	SS	60	11		15.3%		11		
469.6	0.5		469.29										
		(SW) SAND: and SILT, trace gravel, trace clay; brown; non-cohesive, moist to wet, loose	0.76	2	SS	70	8		17.2%		8		
469	1												
468.6	1.5	- dense		3	SS	60	43		12.5%		43		
468	2		467.76										
		(SW) SAND: some silt, some gravel; brown; non-cohesive, moist to dry, very dense	2.29	4	SS	60	58		7.6%		58		
467.6	2.5												
467	3		467										
		(SW) gravelly SAND: some silt; brown; non-cohesive, moist to dry, very dense	3.05	5	SS	70	50		4.3%		50		
466.6	3.5												
466	4												
465.6	4.5		465.48										
		(SM) SILTY SAND: some gravel; brown; non-cohesive, moist to dry, very dense	4.57	6	SS	50	100		5.5%		100		Borehole was open and dry upon completion of drilling
465	5		465.33										Spoon bouncing at depth of 4.7mbgs
		Borehole terminated @ 4.7 mbgs due to SPT refusal encountered.	4.72										
464.6	5.5												
464	6												
463.6	6.5												
463	7												
462.6													

1m = 24 units

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
3	9	44	40	7

Logged By: WA **Input By:** WA

CAMBIUM

Client: Angelo Carnevale
Contractor: Walker Drilling
Project No.: 17217-001
Location: 537090 Main Street

Project Name: 537090 Main Street, Horning's Mills, ON
Method: Track Mounted Solid Stem Auger
Elevation: 464.45 mASL
UTM: 17 T **N:** 4888732 **E:** 563621

Log of Borehole: BH104-23
Page: 1 of 1
Date Completed: May 11, 2023

SUBSURFACE PROFILE				SAMPLE							
Elevation (m) / Depth	Lithology	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI; % Moisture 25 50 75	Shear Strength Cu, kPa (nat V. ✦, rem V. ⊕); SPT (N) 20 40 60 80	Well Installation	Log Notes
464.4 / 0		**TOPSOIL:** (~125mm thick)	464.32 / 0.13	1A	SS			23.3%		Cap	Water level measured within monitoring well at a depth of 4.3 mbgs (460.15 mASL) on June 6, 2023.
464 / 0.5		**(SM) SILTY SAND:** trace clay, trace organic matter; brown; non-cohesive, moist, compact	463.69 / 0.76	1B	SS	50	18	8.4%	18	Bentonite Plug	
463.4 / 1		**(SW) SAND:** some silt, trace gravel; brown; non-cohesive, moist, compact		2	SS	60	11	4.7%	11	Riser	
463 / 1.5		- some gravel; very dense		3	SS	70	61	8.9%	61		
462.4 / 2											
462 / 2.5				4	SS	50	50	7.1%	50	Sand Pack	
461.4 / 3											
461 / 3.5		- trace gravel		5	SS	60	53	8.0%	53	PVC Screen	
460.4 / 4											
460 / 4.5			459.88							Cap	
459.4 / 5		**(SM) gravelly SILTY SAND:** trace clay; brown; non-cohesive, wet, very dense	4.57 / 459.5	6	SS	70	100	10.3%	100		
459 / 5.5		Borehole terminated @ 5 mbgs due to target depth achieved.	4.95								
458.4 / 6											
458 / 6.5											
457.4 / 7											
457											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: WA **Input By:** WA

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client: Angelo Carnevale
Contractor: Walker Drilling
Project No.: 17217-001
Location: 537090 Main Street

Project Name: 537090 Main Street, Horning's Mills, ON
Method: Track Mounted Solid Stem Auger
Elevation: 472.6 mASL
UTM: 17 T **N:** 4888533 **E:** 563517

Log of Borehole: BH105-23
Page: 1 of 1
Date Completed: May 12, 2023

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.) — 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
472.6	0	**TOPSOIL:** (~150mm thick)	472.45	1A	SS			22.2%			
		(SM) SILTY SAND: trace clay, trace organic matter; brown; non-cohesive, moist, loose	0.15	1B	SS	60	8	21.1%	8		
472.1	0.5		471.84								
		(SW) SAND: and GRAVEL: some silt, trace clay; brown; non-cohesive, moist, compact	0.76	2	SS	70	25	6.2%	25		
471.6	1										
471.1	1.5	- very dense		3	SS	60	100	5.6%	100		
470.6	2										
470.1	2.5	- moist to dry		4	SS	40	61	7.2%	61		Auger shaking at depth of 2.3mbgs to depth of 3.0mbgs
469.6	3		469.55								
		(SM) gravelly SILTY SAND: brown; non-cohesive, moist to dry, very dense	3.05	5	SS	50	55	5.7%	55		Spoon bouncing
469.1	3.5										
468.6	4										
468.1	4.5		468.1	6	SS	20	50	4.7%	50		Spoon bouncing
		Borehole terminated @ 4.5 mbgs due to SPT refusal encountered.	4.5								Borehole caved to depth of 3.6mbgs and was dry upon completion of drilling
467.6	5										
467.1	5.5										
466.6	6										
466.1	6.5										
465.6	7										
465.1											

1m = 24 units

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
2	35	44	18	3

Logged By: WA **Input By:** WA

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client: Angelo Carnevale
Contractor: Walker Drilling
Project No.: 17217-001
Location: 537090 Main Street

Project Name: 537090 Main Street, Horning's Mills, ON
Method: Track Mounted Solid Stem Auger
Elevation: 474.35 mASL
UTM: 17 T **N:** 4888425 **E:** 563458

Log of Borehole: BH106-23
Page: 1 of 1
Date Completed: May 12, 2023

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V. rem V.) 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
474.4	0	**TOPSOIL:** (~125mm thick)	474.22	1A	SS			25.4%		Cap	Monitoring well dry when measured on June 6, 2023.
		(SM) SILTY SAND: trace clay, trace gravel; trace organic matter; brown; non-cohesive, moist, compact	0.13 / 473.59	1B	SS	50	11	18.4%	11	Bentonite Plug	
473.8	0.5										
473.4	1	**(SM) SILTY SAND:** trace gravel; brown; non-cohesive, moist, compact	0.76	2	SS	80	19	15.6%	19	Riser	
472.8	1.5										
		- some gravel; dense		3	SS	60	33	8.8%	33		
472.4	2										
			471.91	4A	SS			4.2%			
471.8	2.5	**(SW) SAND:** trace gravel; light grey to white; transparent, moist to dry, very dense	2.44	4B	SS	70	100	2.8%	100	Sand Pack	
471.4	3		471.3								
		(SM) SILTY SAND: trace gravel; brown; non-cohesive, moist to dry, dense	3.05	5	SS	70	50	6.1%	50	PVC Screen	Spoon bouncing at depth of 3.2mbgs
470.8	3.5										
470.4	4										Auger shaking at depth of 3.2mbgs to depth of 4.4mbgs
			469.93								
469.8	4.5	**(GW) GRAVEL:** AND SAND: trace silt; brown; non-cohesive, moist to dry, dense	4.42 / 469.83	6	SS	40	50		50	Cap	Spoon bouncing at depth of 4.5mbgs.
469.4	5	Borehole terminated @ 4.5 mbgs due to SPT refusal encountered.	4.52								
468.8	5.5										
468.4	6										
467.8	6.5										
467.4	7										
466.8											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: WA **Input By:** WA

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client: Angelo Carnevale
Contractor: Walker Drilling
Project No.: 17217-001
Location: 537090 Main Street

Project Name: 537090 Main Street, Horning's Mills, ON
Method: Track Mounted Solid Stem Auger
Elevation: 480.9 mASL
UTM: 17 T **N:** 4888538 **E:** 563305

Log of Borehole: BH107-23
Page: 1 of 1
Date Completed: May 12, 2023

Elevation (m)	Depth	Description	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) / % Moisture	Shear Strength Cu, kPa / SPT (N)	Well Installation	Log Notes
480.9	0	**TOPSOIL:** (~125mm thick) 480.77	1A	SS			25.4%			
		0.13 **(SM) SILTY SAND:** trace organic matter; brown; non-cohesive, moist, compact	1B	SS	50	13	19.3%	13		
480.4	0.5	480.14								
		0.76 **(SM) SILTY SAND:** trace gravel, trace clay; brown; non-cohesive, moist, compact	2	SS	80	25	6.6%	25		
479.9	1									
		- very dense	3	SS	50	100	6.5%	100		
479.4	1.5									
478.9	2	478.61								
		2.29 **(SW) SAND:** some gravel, some silt, brown; non-cohesive, moist to dry, very dense	4	SS	70	89	3.6%	89		Spoon bouncing at depth of 2.6mbgs
478.4	2.5									
477.9	3		5	SS	60	50	4.7%	50		Spoon bouncing at depth of 3.2mbgs
477.4	3.5									
476.9	4									
476.4	4.5		6	SS	70	65	3.2%	65		
475.9	5	475.85								Spoon bouncing ad depth of 5.0mbgs
		5.05 Borehole terminated @ 5.1 mbgs due to SPT refusal encountered.								Borehole caved to depth of 3.9mbgs and was dry upon completion of drilling
475.4	5.5									
474.9	6									
474.4	6.5									
473.9	7									
473.4										

Atterberg Limits (%) LL PL PI — 25 50 75
% Moisture 25 50 75
Shear Strength Cu, kPa nat V. rem V. — 20 40 60 80
SPT (N) 20 40 60 80

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
2	7	68	20	5

1m = 24 units

Logged By: WA **Input By:** WA

Appendix B

Physical Laboratory Testing Results

Grain Size Distribution Chart

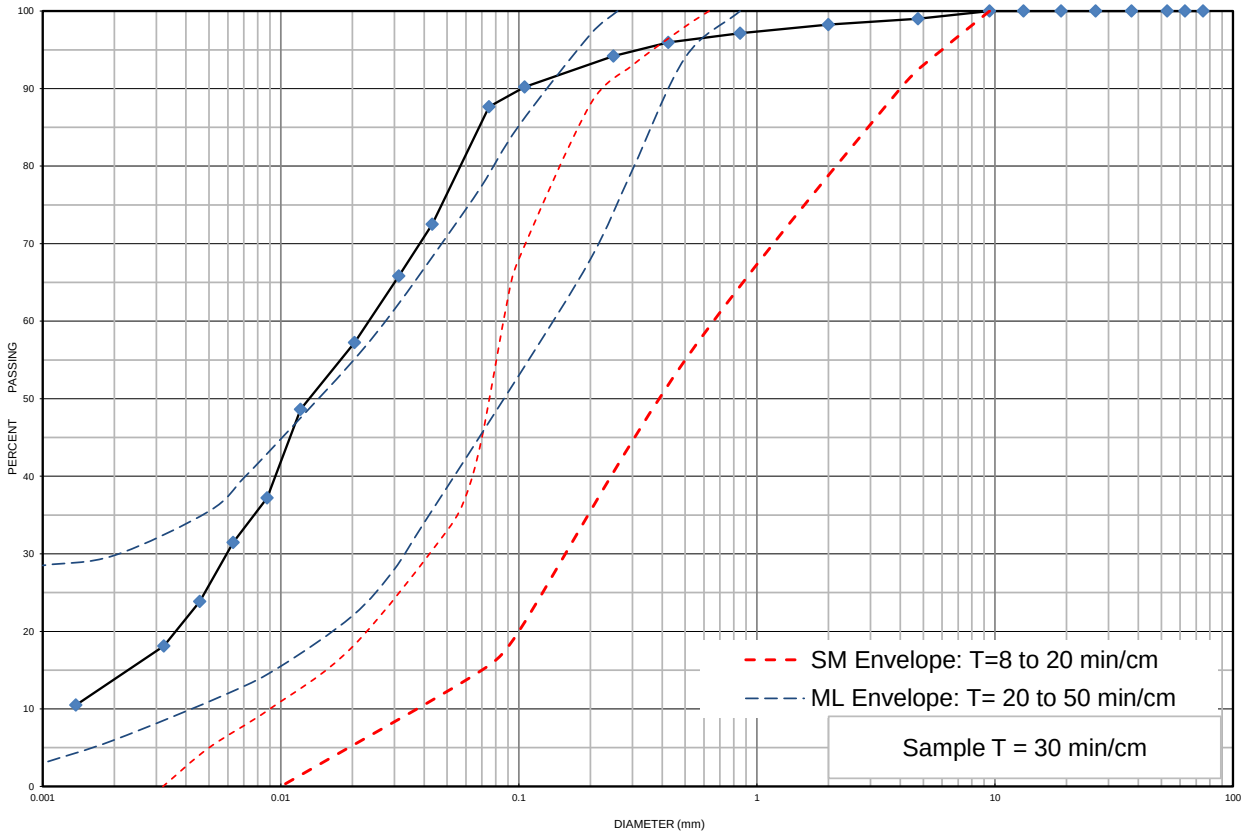
Project Number: *17217-001* **Client:** *Angelo Carnevale*

Project Name: *537090 Main Street Horning's Mills*

Sample Date: *May 11-12, 2023* **Sampled By:** *Waleed El-Taweel - Cambium Inc.*

Location: *BH 101-23 SS 3* **Depth:** *1.5 m to 2.1 m* **Lab Sample No:** *S-23-0825*

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



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

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-23	SS 3	1.5 m to 2.1 m	1	11	74	14	22.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silt some Clay some Sand trace Gravel	ML	0.0240	0.0059	-	-	-

Additional information availabe upon request

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(Senior Project Manager)

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Grain Size Distribution Chart

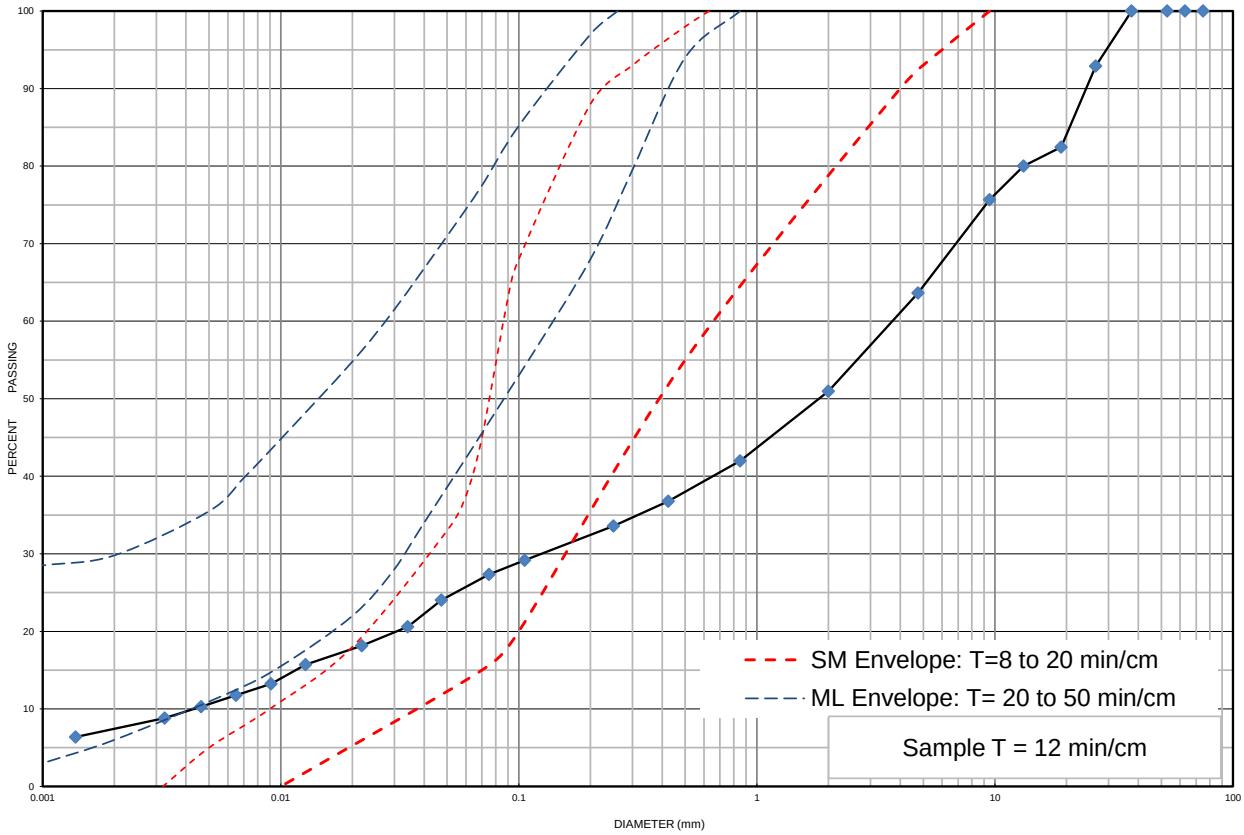
Project Number: *17217-001* **Client:** *Angelo Carnevale*

Project Name: *537090 Main Street Horning's Mills*

Sample Date: *May 11-12, 2023* **Sampled By:** *Waleed El-Taweel - Cambium Inc.*

Location: *BH 102-23 SS 4* **Depth:** *2.3 m to 2.9 m* **Lab Sample No:** *S-23-0826*

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 102-23	SS 4	2.3 m to 2.9 m	36	36	21	7	4.4

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Gravel and Sand trace Clay	SM	3.7000	0.1300	0.0042	880.95	1.09

Additional information availabe upon request

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Grain Size Distribution Chart

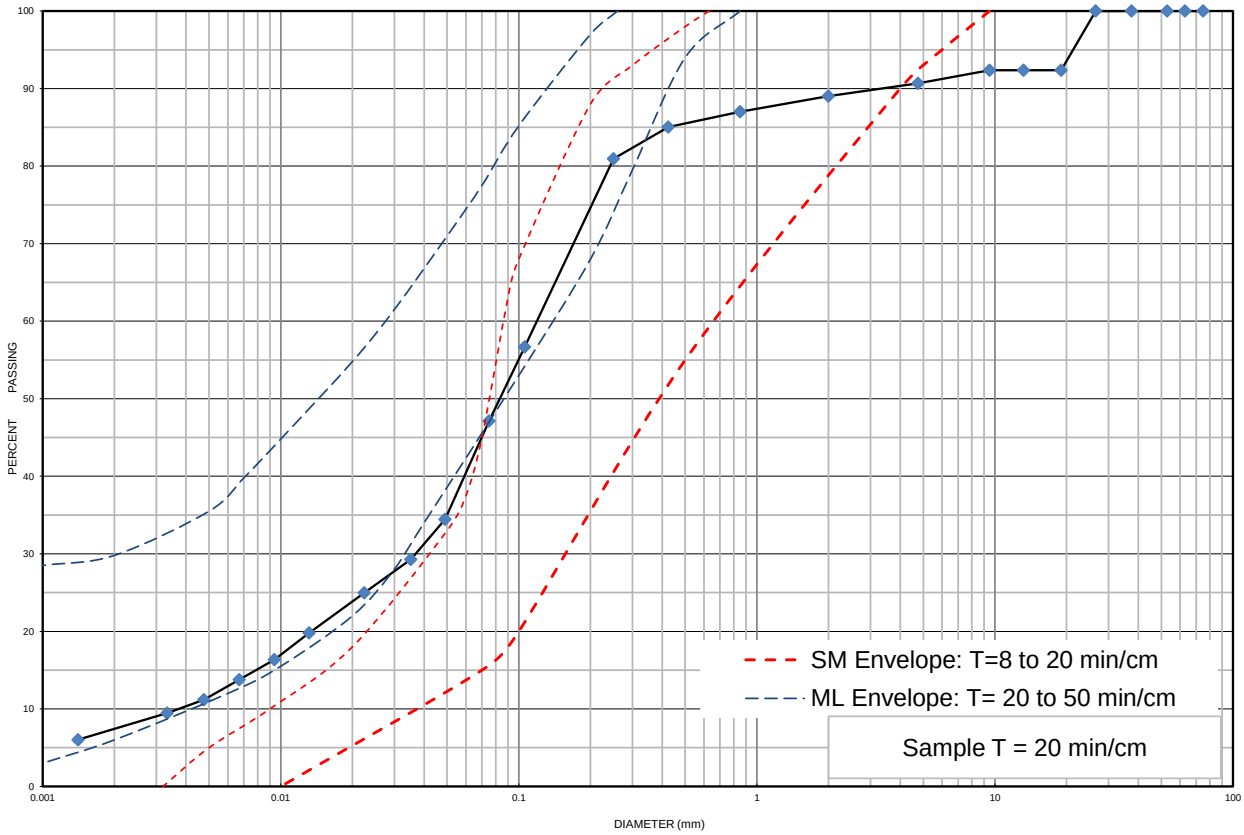
Project Number: *17217-001* **Client:** *Angelo Carnevale*

Project Name: *537090 Main Street Horning's Mills*

Sample Date: *May 11-12, 2023* **Sampled By:** *Waleed El-Taweel - Cambium Inc.*

Location: *BH 103-23 SS 3* **Depth:** *1.5 m to 2.1 m* **Lab Sample No:** *S-23-0827*

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



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

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 103-23	SS 3	1.5 m to 2.1 m	9	44	40	7	12.5

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand and Silt trace Gravel trace Clay	SM	0.1300	0.0370	0.0038	34.21	2.77

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Grain Size Distribution Chart

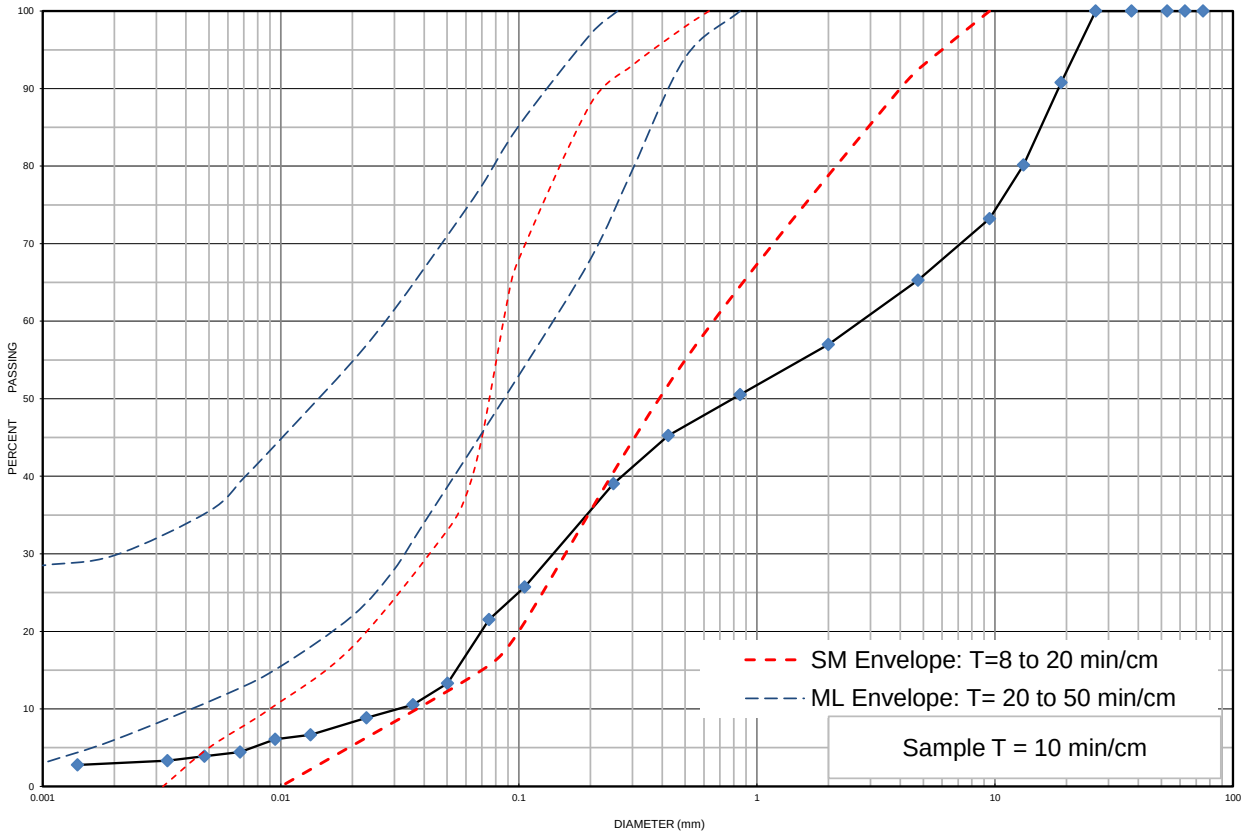
Project Number: *17217-001* **Client:** *Angelo Carnevale*

Project Name: *537090 Main Street Horning's Mills*

Sample Date: *May 11-12, 2023* **Sampled By:** *Waleed El-Taweel - Cambium Inc.*

Location: *BH 105-23 SS 2* **Depth:** *0.8 m to 1.4 m* **Lab Sample No:** *S-23-0828*

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 105-23	SS 2	0.8 m to 1.4 m	35	44	18	3	6.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand and Gravel some Silt trace Clay	SM	2.700	0.145	0.030	90.00	0.26

Additional information availabe upon request

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Grain Size Distribution Chart

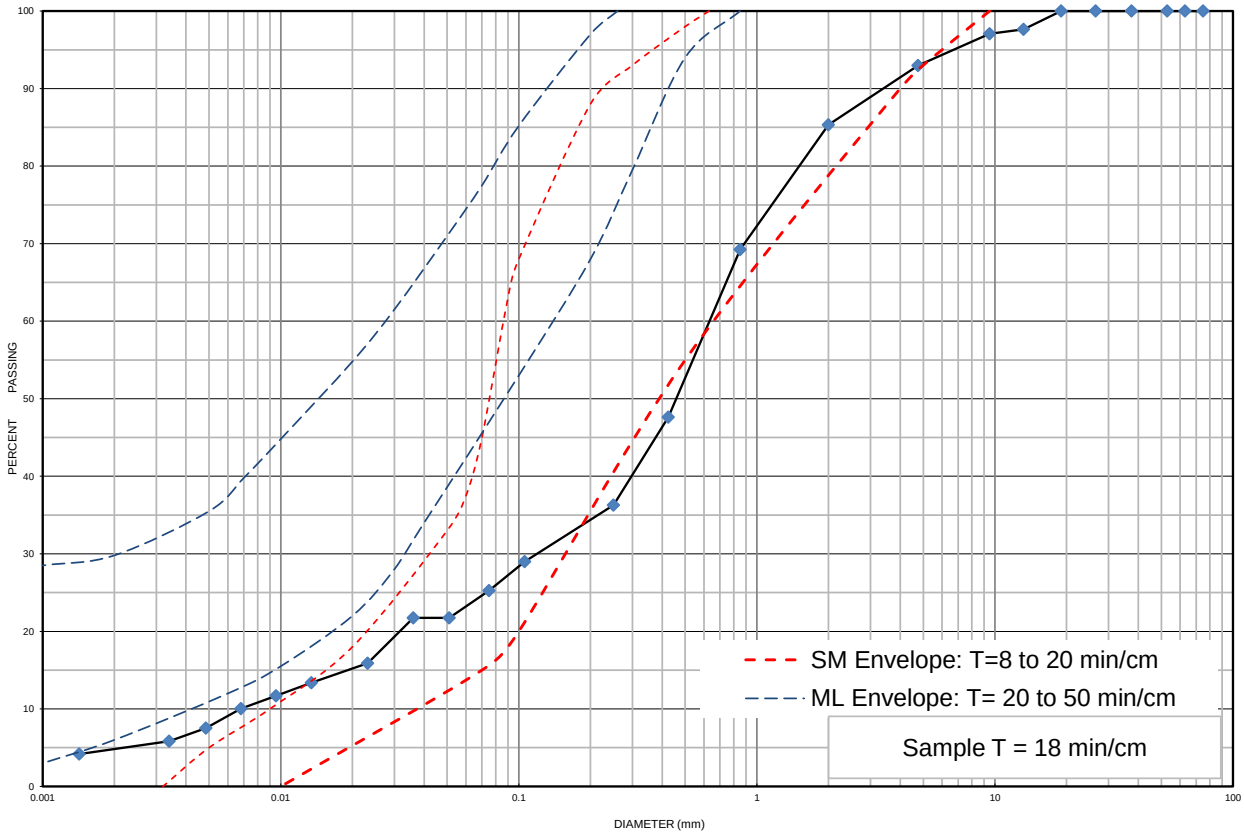
Project Number: *17217-001* **Client:** *Angelo Carnevale*

Project Name: *537090 Main Street Horning's Mills*

Sample Date: *May 11-12, 2023* **Sampled By:** *Waleed El-Taweel - Cambium Inc.*

Location: *BH 107-23 SS 2* **Depth:** *0.8 m to 1.4 m* **Lab Sample No:** *S-23-0829*

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 107-23	SS 2	0.8 m to 1.4 m	7	68	20	5	6.6

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand trace Gravel trace Clay	SM	0.6400	0.1250	0.0068	94.12	3.59

Additional information availabe upon request

Issued By: _____ *Date Issued:* *May 24, 2023*

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Moisture Content

Project Number: 17217-001
Project Name: 537090 Main St, Horning's Mills
Client: Angelo Carnevale
Date Taken: 2023-05-11

Lab Number: S-23-0824
Date Tested: 2023-05-16
Tested By: D. Rock

Borehole Number	Sample Number	Sample Depth (m)	Water Weight (g)	Water Content (%)	Additional Observations
101	1A	0.00-0.13	15.2	18.6	NR,1
101	1B	0.13-0.61	14.4	18.0	NR,1
101	2	0.76-1.37	25.9	9.7	NR
101	3	1.52-2.13	81.1	22.3	NR
101	4	2.29-2.90	11.2	3.4	NR
101	5	3.05-3.20	6.3	3.8	NR
101	6	4.57-5.18	11.5	3.5	NR
102	1A	0.00-0.20	26.5	24.0	NR,1
102	1B	0.15-0.61	27.5	10.6	NR,1
102	2	0.76-1.37	15.2	5.4	
102	3	1.52-2.13	21.2	5.8	NR
102	4	2.29-2.90	20.5	4.4	NR
102	5	3.05-3.51	11.5	5.2	NR
102	6	4.57-5.03	8.6	4.0	
103	1A	0.00-0.13	30.2	21.0	NR,1
103	1B	0.13-0.61	28.5	15.3	NR
103	2	0.76-1.37	38.4	17.2	
103	3	1.52-2.13	53.2	12.5	NR
103	4	2.29-2.59	23.9	7.6	NR
103	5	3.05-3.35	11.5	4.3	NR
103	6	4.57-4.72	9.5	5.5	NR
104	1A	0.00-0.13	31.8	23.3	NR,1
104	1B	0.13-0.61	8.5	8.4	NR
104	2	0.76-1.37	13.4	4.7	NR
104	3	1.52-1.98	24.9	8.9	
104	4	2.29-2.59	18.9	7.1	NR
104	5	3.05-3.66	23.7	8.0	NR

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

Moisture Content

Project Number: 17217-001
Project Name: 537090 Main St, Horning's Mills
Client: Angelo Carnevale
Date Taken: 2023-05-11

Lab Number: S-23-0824
Date Tested: 2023-05-16
Tested By: D. Rock

Borehole Number	Sample Number	Sample Depth (m)	Water Weight (g)	Water Content (%)	Additional Observations
104	6	4.57-5.03	35.8	10.3	
105	1A	0.00-0.15	14.2	22.2	NR,1
105	1B	0.15-0.61	36.7	21.1	NR,1
105	2	0.76-1.37	34.2	6.2	NR
105	3	1.52-1.98	19.4	5.6	NR
105	4	2.29-2.59	12.2	7.2	NR
105	5	3.05-3.35	18.7	5.7	NR
105	6	4.57-4.65	6.4	4.7	NR
106	1A	0.00-0.13	23.7	25.4	NR,1
106	1B	0.13-0.61	17.1	18.4	NR,1
106	2	0.76-1.37	42.5	15.6	
106	3	1.52-2.13	30.7	8.8	NR
106	4A	2.29-2.59	7.5	4.2	NR
106	4B	2.44-2.74	5.9	2.8	NR
106	5	3.05-3.35	15.7	6.1	
107	1A	0.00-0.13	30.4	25.4	NR,1
107	1B	0.13-0.61	44.0	19.3	NR
107	2	0.76-1.37	53.2	6.6	NR
107	3	1.52-1.98	14.0	6.5	
107	4	2.29-2.74	14.0	3.6	NR
107	5	3.05-3.25	16.0	4.7	NR
107	6	4.57-5.03	9.4	3.2	

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

Appendix C

Slope Stability Rating Charts

SLOPE STABILITY RATING CHART

Site Location:	537080 Main St. - ***Eastern Slope Area (Main St.)***	File No.	17217-001
Property Owner:	Angelo Carnevale	Inspection Date:	2023-05-09
Inspected By:	JS/RG	Weather:	partly cloudy

Inspection Task		Rating Value
1. SLOPE INCLINATION		
Degrees	**Horizontal:Vertical**	
a) 18 or less	3:1 or flatter	**0**
b) 18 to 26	2:1 to more than 3:1	6
c) more than 26	Steeper than 2:1	16
2. SOIL STRATIGRAPHY		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		**6**
c) Glacial Till		**9**
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. SEEPAGE FROM SLOPE FACE		
a) None or near bottom only		**0**
b) Near mid-slope only		6
c) Near crest only or from several levels		12
4. SLOPE HEIGHT		
a) 2 m or less		0
b) 2.1 to 5 m		**2**
c) 5.1 to 10 m		4
d) more than 10 m		8
5. VEGETATION COVER ON SLOPE FACE		
a) Well vegetated, heavy shrubs or forested with mature trees		**0**
b) Light Vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetaion, bare		8
6. TABLE LAND DRAINAGE		
a) Table land flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		**2**
c) Drainage over slope, active erosion, gullies		4
7. PROXIMITY OF WATERCOURSE TO SLOPE TOE		
a) 15 m or more from slope toe		0
b) Less than 15 m from slope toe		**6**
8. PREVIOUS LANDSLIDE ACTIVITY		
a) No		**0**
b) Yes		6
	RATING VALUES TOTAL	**16…19**

SLOPE INSTABILITY RATING		INVESTIGATION REQUIREMENTS
1. Low Potential	<24	Site inspection only, confirmation, report letter
2. Slight Potential	25 - 35	Site inspection and surveying, preliminary study, detailed report
3. Moderate Potential	>35	Boreholes, piezometers, lab tests, surveying detailed report

Notes:

a) Choose only one rating value from each category; compare total rating value with above requirements

b) If there is a waterbody (stream, creek, river, pond, bay, lake) at the slope toe, the potential for toe erosion and undercutting should be evaluated in detail and protection provided if required.

c) For leda clay and rock slopes, additional evaluation must be carried out

Source: Table 8.1 Geotechnical Principles for Stable Slopes (June 1998), Ontario Ministry of Natural Resources

SLOPE STABILITY RATING CHART

Site Location:	537080 Main St. - *SE Slope Area (Creek)*	File No.	17217-001
Property Owner:	Angelo Carnevale	Inspection Date:	2023-05-09
Inspected By:	JS/RG	Weather:	partly cloudy

Inspection Task		Rating Value
1. SLOPE INCLINATION		
Degrees	**Horizontal:Vertical**	
a) 18 or less	3:1 or flatter	**0**
b) 18 to 26	2:1 to more than 3:1	6
c) more than 26	Steeper than 2:1	16
2. SOIL STRATIGRAPHY		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		**6**
c) Glacial Till		**9**
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. SEEPAGE FROM SLOPE FACE		
a) None or near bottom only		**0**
b) Near mid-slope only		6
c) Near crest only or from several levels		12
4. SLOPE HEIGHT		
a) 2 m or less		0
b) 2.1 to 5 m		**2**
c) 5.1 to 10 m		4
d) more than 10 m		8
5. VEGETATION COVER ON SLOPE FACE		
a) Well vegetated, heavy shrubs or forested with mature trees		**0**
b) Light Vegetation; Mostly grass, weeds, occasional trees, shrubs		**4**
c) No vegetaion, bare		8
6. TABLE LAND DRAINAGE		
a) Table land flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		**2**
c) Drainage over slope, active erosion, gullies		4
7. PROXIMITY OF WATERCOURSE TO SLOPE TOE		
a) 15 m or more from slope toe		0
b) Less than 15 m from slope toe		**6**
8. PREVIOUS LANDSLIDE ACTIVITY		
a) No		**0**
b) Yes		6
	RATING VALUES TOTAL	**16…23**

SLOPE INSTABILITY RATING		INVESTIGATION REQUIREMENTS
1. Low Potential	<24	Site inspection only, confirmation, report letter
2. Slight Potential	25 - 35	Site inspection and surveying, preliminary study, detailed report
3. Moderate Potential	>35	Boreholes, piezometers, lab tests, surveying detailed report

Notes:

a) Choose only one rating value from each category; compare total rating value with above requirements

b) If there is a waterbody (stream, creek, river, pond, bay, lake) at the slope toe, the potential for toe erosion and undercutting should be evaluated in detail and protection provided if required.

c) For leda clay and rock slopes, additional evaluation must be carried out

Source: Table 8.1 Geotechnical Principles for Stable Slopes (June 1998), Ontario Ministry of Natural Resources

Appendix D

Site Photographs

Eastern Slope Area bordering Main Street

Photograph 1: Views of table land, with stakes indicating inferred top of bank

Photograph 2: View of stake inferring top of bank, with existing dwelling visible

Photograph 3: View downslope, with mature trees on slope and Main Street visible

Photograph 4: Alternate view of slope, looking north

Photograph 5: View of bench area in slope, looking north

Photograph 6: View of ditch area and Main Street, looking north

Photograph 7: View of ditch area and Main Street, looking south

Photograph 8: View looking east across Main Street, with pond on neighbouring property

Southeastern Slope Area near Horning's Mills Creek

Photograph 9: View of table land

Photograph 10: View looking down (L) and up (R) slope area with grass vegetation

Photograph 11: View of slope with vegetation, and top of bank visible

Photograph 12: Alternative view of slope with grass vegetation, from top of bank

Photograph 13: View of slope with mature trees

Photograph 14: View of toe area of slope with vegetation

Photograph 15: Alternate view of toe area of slope

Photograph 16: View towards Main Street from toe area of slope