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June 3, 2021

Northern Designs
93 Milroy Drive
Peterborough, ON K9H 7T2

Attn: Dennis Jenkins

Re: Slope Stability Assessment – 912 Birchview Rd, Lakefield
Cambium Reference No: 12708-002

Dear Mr. Jenkins,

As requested, Cambium Inc. (Cambium) representatives were on-site at 912 Birchview Road, Lakefield, Ontario (Site) on April 12, 2020 to conduct a slope stability assessment. It is understood that the work was required to determine the erosion hazard limit for the slope on the property through a slope stability study based on the Ontario Ministry of Natural Resources and Forestry (MNR) "Geotechnical Principles For Stable Slopes" (June 1998). It is understood that the Client proposes to construct an addition to the existing residential home, an adequate distance back of the top of constructed slope, in order to remain outside the erosion hazard limit. A small boathouse is also to be constructed near the shore. The boathouse will fall within the erosion hazard limit, therefore should be designed as non-habitable. The proposed location of the home addition and boat house is shown in Figure 1.

FIELD INSPECTION

To complete the inspection a visual assessment of the slope was conducted on April 12, 2021 by a qualified member of Cambium's geotechnical team. Typically, a soil investigation would be completed, however limestone bedrock was outcropping within the slope and as such, no soil investigation was required. A survey of the slope was completed by Elliot and Parr on February 1, 2021 which was used in this report to establish slope height and inclination, and to generate the cross section provided in Figure 2. The slope data was confirmed by a laser level survey by Cambium on April 12, 2021. The field investigation results are summarized below with proposed development and applicable setbacks provided in Figure 1.

SLOPE INSPECTION RECORD

The characteristics of the slope were assessed following Table 4.1: Slope Inspection Record, of the Technical Guide, which is provided in Appendix A. There is currently a 1 storey wood frame dwelling on the slope. The toe of the slope has had previous excavation, for landscaping purposes, including a cut into the weathered limestone across the toe of the slope. The area identified as a slope is characterized by an inclination of 3 horizontal to 1 vertical (3H:1V) from approximately 249.0 masl to 243.5 masl, transitioning to a slope steeper than 2H:1V from an approximate

12708-002



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elevation of 243.5 masl to 238.0 masl. The final section of slope is characterised by an inclination steeper than 1H:1V from an approximate elevation of 238.0 masl to 235.0 masl. The overall height of the slope is 14.1 m, although the client intends to construct the addition on bedrock between existing approximate elevations of 244.0 masl to 248.0 masl, 9.4 m above the base of the slope. These features are evident in the cross section presented in Figure 2.

Based on MOECP Well Records, physiographic mapping and visual assessments of the Site, the soil stratigraphy consists of a thin strata of topsoil and other organic matter overlying bedrock; the site inspection confirmed this, as limestone bedrock is fully exposed at the top of the slope, in the slope face and toe where previous landscaping excavations had cut into the toe. The Site is well vegetated with mature trees, shrubs and grass. The land at the top of the slope is table flat land with no apparent drainage over the slope. The bottom of the slope is characterized by large landscaping boulders as well as stone patio. No erosion features such as scouring, undercutting or bare areas were observed at the top or mid slope. Small areas of minor eroding topsoil, weathered stone and gravel were observed where previous excavation had cut into the toe. No slope slide features such as tension cracks, scarps, slumps or bulges were observed.

SLOPE STABILITY RATING CHART

The slope at the Site is defined as the inclination that extends from Clear Lake southeast to approximately 40 m inland, towards the Birchview Road. The stability of the slope was assessed on-site following Table 4.2: Slope Stability Rating Chart, of the Technical Guide. As per the appended Slope Stability Rating Chart provided in Appendix A, the total ratings value sums to 30 for the slope. This deems that the slope has a slight potential for instability. Specific items of interest that contribute to this rating are outlined below:

1. Slope Inclination – The surface of the slope was determined to have an inclination of steeper than 2H:1V below the proposed building, giving a rating of 16.
2. Soil Stratigraphy –The slope consists almost entirely of limestone bedrock with a thin stratum of topsoil and organic matter, giving a rating of 0.
3. Seepage from Slope Face – At the time of the investigation, there was no seepage from the slope face, giving a rating of 0.
4. Slope Height – The slope height for the site was greater than 10 m, resulting in a rating of 6.
5. Vegetation Cover on Slope Face – The slope is well vegetated with mature trees, shrubs and grasses, giving a rating of 0.
6. Table Land Drainage – The table land was relatively flat, with no apparent drainage over the slope, giving a rating of 0.



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7. Proximity of Watercourse to Slope Toe – Clear Lake is located at the base of the slope, and therefore carries a rating of 6.
8. Previous Landslide Activity – No previous landslide activity was observed at the time of the investigation, giving a rating of 0.

Many of these properties are easily visible in the site photographs found in Appendix B.

SLOPE SURVEY

Based on a slope rating of 30 and a characterization of slight potential for slope instability, surveying of the slope was deemed necessary. A laser level survey was completed during the site investigation and was used to provide elevations for the cross section is illustrated on Figure 1 and presented in Figure 2.

SLOPE ASSESSMENT

A slope with slight potential for instability would typically have an investigation that includes a preliminary engineering analysis to determine the Factor of Safety (FOS) for the Site. Due to the presence of in-situ competent bedrock exposed throughout the site, it is Cambium's opinion that the engineering analysis would produce a FOS that greatly exceeds the requirements of this site, and as such has been excluded from this report. Cambium recommends footing/bedrock inspections prior to placement of footings/concrete slab-on-grade to confirm the footings are placed on bedrock that is unweathered and free of voids and fractures.

TOE EROSION ALLOWANCE

Toe erosion for this Site was assessed through a visual inspection. Upon inspection of the toe of the slope and shoreline, there was no observation of substantial active or historical erosion at the base of the slope due to the watercourse. The toe of the slope consisted of landscaped armour stone patio and was well vegetated immediately above the exposed rock with mature trees and shrubs. Minor erosion of topsoil and shallow weathered stone where the toe had been previously excavated. These localized areas of shallow erosion were underlain by solid limestone bedrock.

Based on the above information and Table 3: Determination of Toe Erosion Allowance from (MNRF) "Geotechnical Principles for Stable Slopes" (June 1998), the suggested toe erosion allowance for this Site is deemed to be between 0 m and 1 m.

It is Cambium's recommendation that the toe erosion allowance be 0 m. This value is deemed justified due to the exposed limestone bedrock at the base of the slope and ability of the armour stone landscaping along the shore to withstand erosion caused by waves and ice.



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STABLE SLOPE ALLOWANCE

As stated above, due to the presence of near-surface bedrock and the moderate inclination of the slope, there is no significant potential for immediate or sudden failure and any slope that is 1H:1V or less may be considered stable. As such, the point in the slope where the Client intends to excavate and level out the lot for construction is considered stable. The top of stable slope is then considered to be at the top of existing slope, is represented in Figure 2.

EROSION ACCESS ALLOWANCE

The erosion access allowance is the last component used to determine the landward limit of the erosion hazards. This allowance is used to provide emergency access to erosion prone areas, construction access, and protection against unforeseen conditions, which could have an adverse effect on the natural condition of the slope. The Technical Guide suggests an erosion access allowance of 6 m, which Cambium agrees with in this scenario.

EROSION HAZARD LIMIT

The erosion hazard limit is considered to be landward sum of the horizontal components of each of:

- Toe Erosion Allowance (TEA)
- Stable Slope Allowance (SSA)
- Erosion Access Allowance (ESA)

The erosion hazard limit is often used in conservation policy to establish setbacks from slopes, at which development may occur without being negatively affected by the slope.

The erosion hazard limit incorporates all three allowances in this scenario by applying a setback, equivalent to the sum of the toe erosion allowance and erosion access allowance, from the excavation point on the slope which is considered to be stable in its current state. This is illustrated in Figure 1 and Figure 2 as a 6 m setback from the point top of existing stable slope.

GEOTECHNICAL DISCUSSION

The presence of near-surface bedrock at site, including exposed outcrops within the upper slope, conservatively provides stable slopes at inclinations of 1H:1V or less. The proposed construction of the home falls landward of the erosion hazard limit and is to be founded on bedrock outside of the erosion hazard limits and will have no negative impact on the stability of the slope. No habitable structure should be constructed within the erosion hazard limit without further study and engineered protection. The boathouse, staircases and walkways should be founded on competent bedrock and removal of vegetation should be avoid where feasible. No walkways or staircases should be founded on a slopes steeper than 1H:1V. The proposed boat house should be founded on



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competent bedrock. The construction of the boat house should not result in any excavation into the toe of the slope or undermining of the slope.

EROSION CONTROL

During construction, care should be taken to retain as much of the vegetation on the slope as possible and erosion control measures should be put in place to maintain the stable slope, including revegetation of the slope if any bushes are removed and ensuring that there is no concentration of runoff from downspouts down the slope.

CLOSING

Please note that this report letter is governed by the attached qualifications and limitations. We trust that this letter meets your current needs for this project. If you have questions or comments regarding this document, please do not hesitate to contact the undersigned.

Best regards,

Cambium Inc.

Luke Jenkins, EIT.
Project Coordinator

Stuart Baird, P.Eng., M.Eng.
Director – Geotechnical and
Construction Monitoring

SEB/lrj

Figure 1: Site Plan

Figure 2: Cross Section A-A'

Appendix A: Slope Stability Rating Chart

Appendix B: Site Photographs

P:\12700 to 12799\12708-002 Northern Designs - Slope Stability - 912 Birchview Rd, Lakefield\Deliverables\2021-04-19 LTR RPT - Slope Stability 912 Birchview Rd. Clear Lake.docx



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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



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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.

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Appended Figures

O:\GIS\MXD\12700-12799\12708-002 Northern Designs - Slope Stability - 912 Birchview Rd, Lakefield\2021-05-11 FIG 1 - Site Plan.mxd



**912 BIRCHVIEW ROAD
SLOPE STABILITY**
NORTHERN DESIGNS
912 Birchview Road,
Lakefield, Ontario

LEGEND

- Top of Stable Slope
- Erosion Hazard Limit
- ○ Cross Section
- ▭ Proposed Boathouse
- ▨ Proposed Addition
- ▨ Deck
- ▭ Site (approximate)

Notes:
 - Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
 - Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
 - Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.



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SITE PLAN

Project No.:	12708-002	Date:	May 2021
Scale:	1:500	Rev.:	
Created by:	MAT	Checked by:	LJ
		Figure:	1



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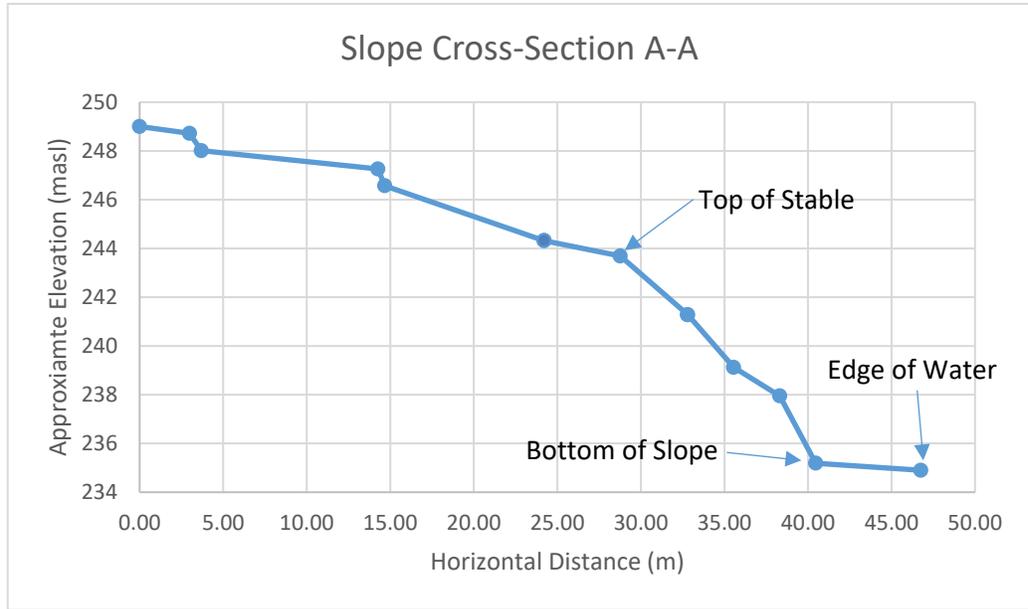


Figure 2: Cross Section A-A

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Appendix A

Slope Inspection Record and Rating Chart

TABLE 4.2 - SLOPE STABILITY RATING CHART

Site Location: *912 Birchview*
 Property Owner:
 Inspected By: *L. Jenkins*

File No.
 Inspection Date: *April 12, 2021*
 Weather: *rain, overcast*

1. SLOPE INCLINATION		
degrees	horiz. : vert.	
a) 18 or less	3 : 1 or flatter	0
b) 18 - 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 vegetation, 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 metres or more from slope toe		0
b) Less than 15 metres from slope toe		6
8. PREVIOUS LANDSLIDE ACTIVITY		
a) No		0
b) Yes		6
SLOPE INSTABILITY RATING VALUES INVESTIGATION RATING SUMMARY		TOTAL 30

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Appendix B

Site Photographs



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Photograph 1

Location:	Top of Main Slope Face
Viewing:	South West
Description:	Existing top of stable slope, table land conditions, existing residents.



Photograph 2

Location:	Top of Main Slope Face
Viewing:	North
Description:	View of existing top of stable slope below proposed addition, staircase to waterfront and proposed boathouse visible.



Photograph 3

Location:	Top of Main and Table Land
Viewing:	North East
Description:	Table land above top of stable slope, retaining wall for septic in location of proposed structure, neighboring house in proximity to slope.



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Photograph 4

Location: Middle of Slope

Viewing: South

Description: Exposed limestone bedrock visible up the main slope face, mature trees, existing building above top of stable slope.



Photograph 5

Location: Bottom of Main Slope

Viewing: East

Description: Main slope, exposed bedrock to toe of slope visible.



Photograph 6

Location: Bottom of Main Slope

Viewing: North East

Description: View of limestone patio at toe of slope, exposed bedrock above toe of slope, stair case down to shore. Shed in location of proposed boat house.



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Photograph 7

Location:	Bottom of Slope
Viewing:	North East
Description:	Exposed limestone bedrock vertical face, minor erosion of topsoil and weather stone, cedar with exposed root system due to erosion of surficial soils.



Photograph 8

Location:	Bottom of Main Slope
Viewing:	South
Description:	Main slope, exposed bedrock to toe of slope visible, evidence of minor topsoil and weathered stone erosion, armour stone present along back of patio.