Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL INVESTIGATION
SLOPE STABILITY AND EROSION HAZARD LIMIT
PROPOSED 22 UNIT TOWNHOUSE DEVELOPMENT
435 BIG BAY POINT ROAD
BARRIE, ONTARIO
FOR
ADA HOMES LTD.

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PML Ref.: 17BF012
Report: 1
June 2017

Peto MacCallum Ltd.
CONSULTING ENGINEERS

June 13, 2017

PML Ref.: 17BF012
Report: 1

Mr. Andrew Adamek
ADA Homes Ltd.
1 Channen Court
Barrie, Ontario
L4M 6T4

Dear Mr. Adamek

Geotechnical Investigation
Slope Stability and Erosion Hazard Limit
Proposed 22 Unit Townhouse Development
435 Big Bay Point Road
Barrie, Ontario

Peto MacCallum Ltd. (PML) is pleased to present the results of the geotechnical investigation recently completed at the above noted project site. Authorization for this work was provided by Mr. A. Adamak, in the signed Engineering Services Agreement, PML Ref.: 17BF012, dated March 30, 2017.

A 22 unit townhouse development is planned on the parcel of land at 435 Big Bay Point Road in Barrie. Full depth basements, site servicing and paved access are proposed. The east part of the property comprises Lover's Creek ravine which is about 10 m deep. The proposed site layout is shown on Drawing 1, appended.

The purpose of this investigation was to determine the subsurface conditions at the site, and based on this information provide comments and geotechnical engineering recommendations for the building foundations. An assessment of the slope stability of the Lover's Creek ravine and Erosion Hazard Limit was carried out.

Geo-environmental services (observations, recording, testing or assessment of the environmental conditions of the soil and ground water) were not within the terms of reference for this assignment, and no work has been carried out in this regard. If excess soils requiring off-site disposal are generated, a program of sampling and testing will be needed to determine the chemical properties of the soil to evaluate receiving site options, in accordance with the MOECC document; Management of Excess Soil – A Guide for Best Management Practices, January 2014.

The comments and recommendations provided in this report are based on the site conditions at the time of the investigation, and are applicable only to the proposed works as addressed in the report. Any changes in the proposed plans will require review by PML to assess the validity of the report, and may require modified recommendations, additional investigation and/or analysis.

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INVESTIGATION PROCEDURES

The field work for this investigation was carried out on April 20 and 21, 2017 and consisted of Boreholes 1 and 2 advanced to 15.7 and 15.4 m, respectively, near the edge of the ravine slope, and Boreholes 3 and 4, advanced to 6.5 m depth set away from the slope. The borehole locations are shown on Drawing 1, appended.

Co-ordination of clearances of underground utilities was provided by PML with the aid of a sub-contracted private utility locating company.

The boreholes were advanced using continuous flight solid stem augers, powered by a rubber tire mounted CME-75 drill rig, equipped with an automatic hammer, supplied and operated by a specialist drilling contractor working under the full time supervision of a member of PML's engineering staff.

Representative samples of the overburden in the boreholes were recovered at frequent depth intervals for identification purposes using a conventional split spoon sampler. Standard penetration tests were carried out simultaneously with the sampling operations to assess the strength characteristics of the substrata. The ground water conditions in the boreholes were assessed during drilling by visual examination of the soil samples, the sampler and drill rods as the samples were retrieved, and measurement of the water level in the open boreholes, if any. Piezometers comprising 19 mm PVC pipe were installed in two of the boreholes to permit monitoring of the ground water table.

Boreholes without piezometers were backfilled in accordance with O.Reg. 903. As per O.Reg. 903 the piezometers become the property of the Owner and will have to be decommissioned when no longer required. PML would be pleased to assist in this regard.

The location of the boreholes were established in the field by PML, utilizing a plan provided by the Client, and cognizant of underground utilities. Surface elevations of the boreholes were referenced to the following Temporary Bench Mark (TBM), as shown on Drawing 1, attached, and described as follows:

TBM: Top of SIB at Northwest Corner of Property

Elevation 250.50 (metric, geodetic)

All recovered soil samples were returned to our laboratory for moisture content determinations and detailed examination to confirm field classification. Two soil samples were submitted for grain size analysis and accompanying Atterberg limits testing. The results are presented on Figures 1 and 2, appended.

SITE DESCRIPTION AND SUMMARIZED SUBSURFACE CONDITIONS

The lot at 435 Big Bay Point Road is currently occupied by a single detached residence at the northwest corner on the site, with a side yard clearing at the northeast corner of the site. The south portion of the site is lightly wooded, bordered be residences to the south and west, with the east part of the site comprising the approximate 10 m deep Lover's Creek ravine. Based on the topographic plan provided, the tableland is relatively flat with relief of about 2 m from west to east.

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions, including soil classifications, inferred stratigraphy, Standard Penetration test N values, standpipe installation details, ground water observations and the results of laboratory moisture content determinations.

Due to the soil sampling procedures and limited sample size, the depth demarcations on the borehole logs must be viewed as "transitional" zones between layers, and cannot be construed as exact geologic boundaries between layers. PML should be retained to assist in determining geologic boundaries in the field during construction, if required.

The stratigraphy encountered in the boreholes consisted of topsoil, locally over sand, underlain by a major silty sand till deposit.

Topsoil

A 180 to 220 mm layer of sand topsoil was encountered at the surface of all boreholes.

Sand

Below the topsoil in Boreholes 2 and 3, a sand unit was encountered down to 1.4 m depth (elevation 247.2 to 249.1). The layer contained trace silt and gravel and was very loose to compact. The sand was moist or very moist, with moisture contents of 5 to 18%.

Within the till deposit in Borehole 2, a lower sand deposit was encountered between 10 and 13 m depth (elevation 235.6 to 238.6). The layer was very dense and was moist to wet with a water content of 9%.

Silty Sand Till

A major till deposit was encountered below the topsoil of sand in all boreholes, extending to the 6.5 to 15.7 m depth of exploration. The till unit comprised silty sand, with cobbles and boulders noted. Samples of the till (less aggregates greater than 20 mm size) from Boreholes 1 and 2 were submitted for grain size analyses and the results are presented on Figures 1 and 2. Associated Atterberg limits testing showed both samples were non-plastic. The till was compact to very dense, locally very loose in the upper 1.0 m. The unit was typically moist with water contents typically less than 12%. Wet sand seams were noted locally.

Ground Water

The first water strike and the ground water levels measured upon completion of augering, are provided in the table below, on a borehole by borehole basis. The water levels were also measured in the piezometers about two weeks after installation and are also tabulated below:

BOREHOLE	FIRST WATER STRIKE IN BOREHOLE AT TIME OF DRILLING (APRIL 20 & 21, 2017) DEPTH (m)	WATER / WET CAVE LEVEL UPON COMPLETION OF AUGERING (APRIL 20 & 21, 2017) DEPTH (m) / ELEVATION	MEASURED WATER LEVEL IN PIEZOMETERS (MAY 5, 2017) DEPTH (m) / ELEVATION
1	7.6	Wet Cave at 7.0 / 242.4	4.9 / 244.5
2	9.1	Water at 6.7 / 241.9	2.0 / 246.6
3	3.2	Water at 5.5 / 245.0	--
4	3.1	Water at 3.4 / 246.9	--

Ground water levels are subject to seasonal fluctuations, and in response to variations in precipitation.

GEOTECHNICAL ENGINEERING CONSIDERATIONS

General

A 22 unit townhouse development is planned on the parcel of land at 435 Big Bay Point Road in Barrie. Full depth basements, site servicing and paved access are proposed. The east side of the property comprises the approximate 10 m deep Lover's Creek ravine. The proposed site layout is shown on Drawing 1, appended.

The stratigraphy encountered in the boreholes consisted of topsoil, locally over sand, underlain by a major silty sand till deposit. The stabilized ground water table in the Borehole 1 and 2 piezometers was measured to be 2.0 and 4.9 m below grade, elevation 244.5 and 246.6, respectively.

Foundations

The proposed townhouses can be supported on strip and spread footings. Design elevations have yet to be established. However, with only minor grading anticipated, it is anticipated that basement footings will be founded in the native silty sand till deposit.

A geotechnical bearing resistance at Serviceability Limit State (SLS) of 150 kPa and a factored bearing resistance at Ultimate Limit State (ULS) of 225 kPa can be adopted for design of footings supported on the native till.

Footings subject to frost action should be provided with a minimum 1.2 m of earth cover or equivalent.

Settlement based on the geotechnical bearing resistance at SLS should be less than 25 mm with a differential settlement of 75% of the value. The factored bearing resistance at ULS assumes a minimum footing width of 600 mm with minimum footing embedment of 600 mm.

Prior to placement of structural concrete, all founding surfaces must be inspected by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions.

Seismic Design

Site Classification D is applicable for Seismic Site Response as set out in Table 4.1.8.4.A of the Ontario Building Code (2012). Based on the soil profile revealed in the boreholes there is a low potential for liquefaction.

Basement Walls and Floor Slab

Basement walls must be designed to resist the unbalanced lateral pressure due to the weight of the retained soil. The lateral earth pressure, p, may be computed using the following equation and assuming a triangular pressure distribution:

$$p = K(\gamma h + q)$$

Where

K = lateral earth pressure coefficient
= 0.5, assuming level backfill

γ = unit weight of retained soil
= 20.0 kN/m^3

h = depth at which pressure is computed

q = surcharge adjacent to the wall (kPa)

It is recommended that the exterior of basement walls be damp proofed and the backfill behind the wall comprise free draining material such as OPSS Granular B, in conjunction with perimeter weeping tile system to prevent the buildup of hydrostatic pressure behind the wall. The weeping tile should be surrounded by a minimum 150 mm thick layer of clear crushed stone (20 mm nominal size) or pea gravel, fully wrapped with synthetic filter fabric to prevent migration of fines which may otherwise clog the system. The weeping tile should be positively sloped to a frost free sump or outlet.

Alternatively, in lieu of imported OPSS Granular B, a proprietary drainage board product could be provided in conjunction with reuse of site excavated soil as wall backfill.

Backfill should be placed in maximum 200 mm thick lifts and compacted to 95% Standard Proctor maximum dry density. Over compaction close to the wall should be avoided as this could generate excessive pressure on the wall. Suitable bracing and/or precautions should be taken to ensure the wall is not damaged during backfill/compaction activities.

Basement floor slab construction is considered feasible on the native till material.

A minimum 200 mm thick base layer of crushed stone (nominal 20 mm size) is recommended directly beneath the floor slab. Where a vapour sensitive floor finish is to be used then the use of polyethylene sheeting or similar means should be incorporated as a vapour barrier.

Exterior grades should be established to promote surface drainage away from the building.

Site Servicing

It is understood that only minor grading is required to achieve proposed site grades. Invert elevations were not provided by the Client, however are generally anticipated to be 2.0 and 3.5 m below proposed grade.

Trench Excavation and Ground Water Control

Trench excavation and ground water control are described later in the report under Excavation and Ground Water Control.

Pipe Bedding

Native soils are suitable for supporting utilities. Locally, existing fill may exist at proposed invert levels for shallow services. Where existing fill or other deleterious material is encountered at the design invert level, such material should be sub-excavated and replaced with an increased thickness of bedding.

Standard Granular A bedding, in accordance with OPSS, compacted to 95% Standard Proctor maximum dry density should be satisfactory. For flexible pipes, bedding and cover material should comprise OPSS Granular A. For rigid pipes, the bedding material should comprise OPSS Granular A and cover material may comprise select native soil free of oversized material.

Trench Backfill

Backfill in trenches should be placed in maximum 200 mm thick loose lifts compacted to at least 95% Standard Proctor maximum dry density to minimize post construction settlement in the backfill. Backfill for at least the upper 1 m of trench should be close to the optimum moisture content to prevent subgrade instability issues.

Backfill for service trenches should comprise inorganic soil, free of boulders, frozen or otherwise deleterious material, at a moisture content suitable for compaction. The excavated inorganic site soil is generally considered suitable for reuse, subject to exclusions of deleterious content, and subject to geotechnical field review and approval during construction.

Earthworks operations should be inspected by PML to verify subgrade preparation, backfill materials, placement and compaction efforts and ensure the specified degree of compaction is achieved throughout.

Excavation and Ground Water Control

Excavation for proposed services is expected to extend to about 2.0 to 4.0 m depth below existing grade. Excavations for basements are anticipated to extend to about 3.0 m below existing grade.

Excavation utilizing open cut methods is considered feasible and based on the boreholes will encounter fill and the major till deposit. Harder digging and the presence of cobbles and boulders should be expected in the till soil.

The site soils should be considered as Type 3 soil requiring excavation sidewalls to be constructed at no steeper than one horizontal to one vertical (1H:1V) from the base of the excavation in accordance with the Occupational Health and Safety Act.

The stabilized ground water level noted in the piezometers in Boreholes 1 and 2 was at 2.0 to 4.9 m depth (elevation 244.5 to 246.6), although the ground water level encountered during drilling was significantly lower. It is believed that excavation will typically be above the ground water level and it is anticipated that conventional sump pumping techniques should be adequate to handle ground water seepage quantities, where encountered.

Water taking in Ontario is governed by the Ontario Water Resources Act (OWRA) and the Water Taking and Transfer Regulation O.Reg. 387/040, Section 34 of the OWRA requires any one taking more than 50,000 L/d to obtain a PTTW from the Ministry of Environment and Climate Change (MOECC). This requirement applies to all withdrawals, whether for consumption, temporary construction dewatering or permanent drainage improvements. In April of 2016 the MOECC made some changes to the PTTW requirements. Projects assessed to be taking more than 50,000 L/d but less than 400,000 L/d of ground water can obtain a permit/permission online via the Environmental Activity and Sector Registry (EASR) system. Where water taking is assessed to be more than 400,000 L/d then a Category 3 PTTW will be required.

Neither a PTTW nor registry on the EASR is anticipated for the excavation as described above.

It is recommended that a test dig be undertaken to allow prospective contractors an opportunity to observe and evaluate the conditions likely to be encountered and assess preferred means of excavation and ground water control measures based on their own experience.

Pavement Design and Construction

The site soils comprise variable low frost susceptible sand to highly frost susceptible silty sand till. The following typical pavement thicknesses are provided:

MATERIAL	LIGHT DUTY (PARKING)	HEAVY DUTY (SITE ACCESS / FIRE ROUTE)
Asphalt (mm)	70	110
Granular A Base Course (mm)	150	150
Granular B Subbase Course (mm)	300	300
Total Thickness (mm)	520	560

Following rough grading, subgrade preparation should include proofrolling and compacting the exposed subgrade with a heavy compactor. Any unstable zones identified during this process should be sub-excavated and replaced with compacted select material.

Imported material for the granular base and subbase should conform to OPSS gradation specifications for Granular A and Granular B, and should be compacted to 100% Standard Proctor maximum dry density. Asphalt should be compacted in accordance with OPSS 310.

The pavement design considers that construction will be carried out during the drier time of the year and that the subgrade is stable, as determined by proofrolling operations. Where wet and/or unstable subgrade is identified, remediation may include increasing the depth of subbase, the use of Granular B Type II and/or use of geogrid reinforcement, subject to geotechnical review during construction.

For the pavement to function properly, it is essential that provisions be made for water to drain and not collect in the base material. The incorporation of subdrains is recommended in conjunction with crowning of the final surface to promote drainage away from the structure. Subdrains should be installed at least 300 mm below the subgrade level. For details regarding pipe, filter cloth or pipe sock, bedding and cover material, refer to OPSD 216 Series. Subdrains should lead to a frost free outlet and/or be connected to storm sewer system. Maintenance holes/catch basins should be backfilled using free draining material with frost tapers and stub drains extending out from the structures. The above measures will help drain the pavement structure as well as minimize frost movement between maintenance hole/catch basins and pavement.

Geotechnical Review and Construction Inspection and Testing

It is recommended that the final design drawings be submitted to PML to review the compatibility with site conditions and recommendations of this report.

Earthworks operations should be carried out under the supervision of PML to approve subgrade preparation, backfill materials, placement and compaction procedures, and verify that the specified compaction standards are achieved throughout fill materials.

Prior to placement of structural concrete, all founding surfaces must be inspected by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions.

The comments and recommendations provided in the report are based on the information revealed in the boreholes. Conditions away from and between boreholes may vary, considering previous activity at the site. Geotechnical review during construction should be on going to confirm the subsurface conditions are substantially similar to those encountered in the boreholes, which may otherwise require modification to the original recommendations.

Slope Stability Assessment

The east part of the site comprises the approximate 10 m deep Lover's Creek ravine. PML attended the site on April 26, 2017, to review the existing condition of the slope. The existing slope was rated using the Slope Stability Rating Chart, from the MNR Technical Guide, appended as Enclosure 1. Observations are tabulated on the Chart and described below.

1. The slope was 2H:1V or flatter, however a local area at the north end adjacent to Big Bay Point Road was steeper at about 1H:1V slope (Photograph 1).
2. Based on the boreholes the slope comprises predominantly glacial till.
3. No seepage was observed on the slope.
4. The slope is up to 10 m high.
5. The slope is occupied by mature trees with sparse surface vegetation (Photographs 2 and 3).
6. It appears that there may be minor drainage from the tableland over the slope, but there was no active erosion.
7. Lover's Creek was more than 15 m from the toe of the slope.
8. There is no visual evidence of slope instability.

Based on the observations and Slope Stability Rating, there is a low potential for slope instability.

We conducted a Slope Stability Analysis utilizing the software SLOPE from RocScience. The soil/slope model and results are shown on Enclosure 2. The computed minimum Factor of Safety was 1.8 which is satisfactory against an overall slope failure.

As noted earlier, there is a local area adjacent to Big Bay Point Road where the ravine slope is steeper at about 1H:1V. It appeared that this may have been a result of regrading/fill placement. This local slope area should be flattened to match the remainder of the slope and vegetated.

Erosion Hazard Limit

In order to determine the development set back from the top of slope, it is necessary to define the Erosion Hazard Limit at the site which includes assessment of the stability of the slope. In this regard, reference is made to the Technical Guide – River and Stream Systems: Erosion Hazard Limit, Ontario Ministry of Natural Resources, 2002, (Technical Guide). The Erosion Hazard Limit is determined by:

- Toe Erosion Allowance
- Stable Slope Allowance
- Flooding Hazard Limit or Meander Belt Allowance
- Erosion Access Allowance

The Toe Erosion Allowance is a set back to accommodate potential erosion due to current action from a creek within 15 m of the toe of valley slope that may weaken and/or undermine the toe. Where the creek is greater than 15 m from the toe of the valley slope the Toe Erosion Allowance component is removed from the assessment. In this regard, Lover's Creek is more than 15 m from the toe of the valley slope, and therefore there is no requirement for Toe Erosion Allowance.

The Stable Slope Allowance is a setback to ensure safety if slumping or failure of the existing slope should occur. In accordance with Table 4.3 of the Technical Guide, a design minimum factor of safety of 1.3 to 1.5 is recommended for active land use (habitable structures). As discussed earlier, a Slope Stability Analyses was carried out which determined a minimum Factor of Safety of 1.8 for the subject slope which is within the guideline. Thus, the existing slope is safe and a Stable Slope Allowance is not required.

The Lover's Creek system at the location of the site is a Confined System (a valley surrounds the creek). Therefore, there is no requirement for a Flood Hazard Limit.

The Erosion Access Allowance is intended to facilitate access to maintain the slope, if required. This requirement should be confirmed by regulatory authorities.

In summary, no set back is required, except an allowance to facilitate access to maintain the ravine slope, if required. This requirement should be confirmed by regulatory authorities.

CLOSURE

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to call our office.

Sincerely

Peto MacCallum Ltd.

Turney Lee-Bun, P.Eng.
Vice-President

TLB:jlb

Enclosure(s):
Figures 1 and 2 – Particle Size Distribution Charts
List of Abbreviations
Log of Borehole Nos. 1 to 4
Drawing No. 1 - Borehole Location Plan
Photograph No.'s 1 to 4
Enclosure 1 – Slope Stability Rating Chart
Enclosure 2 – Slope Stability Analysis

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PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17BF012
Figure No.: 1

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL	COBBLES	UNIFIED
			SAND					
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL	COBBLES	M.I.T.
	SILT			SAND					
CLAY	SILT		V. FINE	FINE	MED	COARSE	GRAVEL		U.S. BUREAU
			SAND						

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PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17BF012
Figure No.: 2

SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL	COBBLES	UNIFIED
			SAND					
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL	COBBLES	M.I.T.
	SILT			SAND					
CLAY	SILT		V. FINE	FINE	MED	COARSE	GRAVEL		U.S. BUREAU
			SAND						

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: - The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	ST	Slotted Tube Sample
WS	Washed Sample	TW	Thinwall Open
SB	Scraper Bucket Sample	TP	Thinwall Piston
AS	Auger Sample	OS	Oesterberg Sample
CS	Chunk Sample	FS	Foil Sample
GS	Grab Sample	RC	Rock Core

PH	Sample Advanced Hydraulically
PM	Sample Advanced Manually

SOIL TESTS

Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

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LOG OF BOREHOLE NO. 1

17T 607301E 4912191N

PROJECT Proposed 22 Unit Townhouse Development
PML REF. 17BF012
LOCATION 435 Big Bay Point Road, Barrie, Ontario
BORING DATE April 21, 2017
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 249.40				
0.0	249.22	TOPSOIL: Dark brown, sand, trace silt, trace gravel, very moist		1	SS	2
1.0		SILTY SAND TILL: Very loose to dense, brown, silty sand, trace gravel, cobbles and boulders, moist		2	SS	31
2.0	247.3	Becoming dense to very dense		3	SS	9
3.0				4	SS	31
4.0				5	SS	69
5.0				6	SS	52
6.0				7	SS	48
7.0				8	SS	42
8.0				9	SS	73
9.0				10	SS	80/290 mm
10.0				11	SS	66/290 mm
11.0				12	SS	59
12.0						
13.0						
14.0						
15.0		CONTINUED				

ELEVATION SCALE: 249, 248, 247, 246, 245, 244, 243, 242, 241, 240, 239, 238, 237, 236, 235

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Stick-up pipe
Concrete
Bentonite seal
19 mm slotted pipe
Filter sand
First water strike at 7.6 m

NOTES

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LOG OF BOREHOLE NO. 1

17T 607301E 4912191N

PROJECT Proposed 22 Unit Townhouse Development — **PML REF.** 17BF012

LOCATION 435 Big Bay Point Road, Barrie, Ontario — **BORING DATE** April 21, 2017 — **ENGINEER** GW

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
15.0	CONTINUED FROM PREVIOUS PAGE									
	SILTY SAND TILL: Very dense, grey, silty sand, trace gravel, cobbles and boulders, moist, local wet seams		13	SS	47	234	● at 80	○ at 10		
15.7										
233.7	BOREHOLE TERMINATED AT 15.7 m									Upon completion of augering Wet cave at 7.0 m Water Level Readings: Date — Depth — Elev. 2017-05-05 — 4.9 — 244.5
16.0										
17.0										
18.0										
19.0										
20.0										
21.0										
22.0										
23.0										
24.0										
25.0										
26.0										
27.0										
28.0										
29.0										
30.0										

NOTES

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LOG OF BOREHOLE NO. 2

17T 607305E 4912192N

PROJECT Proposed 22 Unit Townhouse Development — **PML REF.** 17BF012

LOCATION 435 Big Bay Point Road, Barrie, Ontario — **BORING DATE** April 21, 2017 — **ENGINEER** GW

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 248.60				
0.0	248.42	TOPSOIL: Dark brown, sand, trace silt, trace gravel, very moist		1	SS	3
1.0		SAND: Very loose to compact, brown, sand, trace silt, trace gravel, moist		2	SS	20
1.4	247.2	SILTY SAND TILL: Dense to compact, brown, silty sand, trace gravel, cobbles and boulders, moist		3	SS	32
2.0				4	SS	28
2.9	245.7	Becoming very dense		5	SS	66
3.0						
4.0				6	SS	90/270 mm
5.0						
6.0				7	SS	50/140 mm
7.0						
8.0				8	SS	50/140 mm
9.0				9	SS	72/270 mm
10.0	238.6	SAND: Very dense, brown, sand, trace silt, trace gravel, moist to wet		10	SS	86/270 mm
11.0						
12.0				11	SS	50/140 mm
13.0	235.6	SILTY SAND TILL: Very dense, grey, silty sand, trace gravel, cobbles and boulders, moist		12	SS	50/100 mm
14.0						
15.0		CONTINUED				

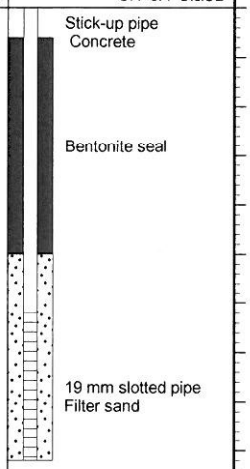
ELEVATION SCALE: 248, 247, 246, 245, 244, 243, 242, 241, 240, 239, 238, 237, 236, 235, 234

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL



NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 2

17T 607305E 4912192N

PROJECT Proposed 22 Unit Townhouse Development
PML REF. 17BF012
LOCATION 435 Big Bay Point Road, Barrie, Ontario
BORING DATE April 21, 2017
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER ○ Q / DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
15.0	CONTINUED FROM PREVIOUS PAGE						50 100 150 200 / 20 40 60 80	10 20 30 40		
15.4	SILTY SAND TILL: Very dense, grey, silty sand, trace gravel, cobbles and boulders, moist		13	SS	50/120 mm		>>●	○		
233.2	BOREHOLE TERMINATED AT 15.4 m									Upon completion of augering Water at 6.7 m Cave at 10.7 m Water Level Readings: Date Depth Elev. 2017-05-05 2.0 246.6

16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0

NOTES

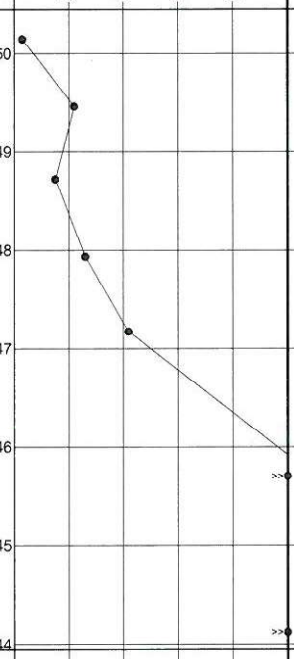
Peto MacCallum Ltd.
CONSULTING ENGINEERS

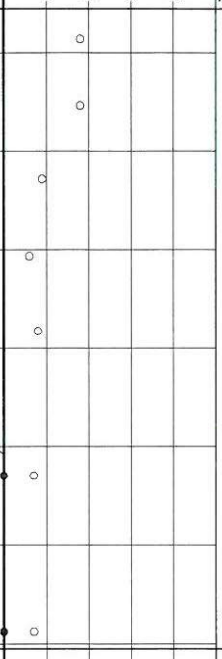
LOG OF BOREHOLE NO. 3

17T 607295E 4912217N

PROJECT Proposed 22 Unit Townhouse Development
PML REF. 17BF012
LOCATION 435 Big Bay Point Road, Barrie, Ontario
BORING DATE April 20, 2017
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 250.45				
0.0	250.25	TOPSOIL: Dark brown, sand, trace silt, trace gravel, very moist		1	SS	3
0.20		SAND: Very loose to compact, brown, sand, trace silt, trace gravel, very moist		2	SS	22
1.4	249.1	SILTY SAND TILL: Compact to dense, brown, silty sand, trace gravel, cobbles and boulders, moist to very moist		3	SS	15
2.0				4	SS	26
3.0				5	SS	42
4.0	246.5	Becoming very dense		6	SS	77/290 mm
5.0						
6.0						
6.5	244.0	BOREHOLE TERMINATED AT 6.5 m		7	SS	72/270 mm
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						





UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS	GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	First water strike at 3.2 m	
	Upon completion of augering Water at 5.5 m No cave	

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 4

17T 607283E 4912174N

PROJECT Proposed 22 Unit Townhouse Development
PML REF. 17BF012
LOCATION 435 Big Bay Point Road, Barrie, Ontario
BORING DATE April 20, 2017
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 250.25					
0.22 / 250.03	TOPSOIL: Dark brown, sand, trace silt, trace gravel, very moist		1	SS	3	250
	SILTY SAND TILL: Very loose to compact, brown, silty sand, trace gravel, cobbles and boulders, very moist		2	SS	10	249
			3	SS	16	
2.1 / 248.2	Becoming dense to very dense		4	SS	43	248
	Sand seam, wet		5	SS	61	247
			6	SS	50/290 mm	246
6.5 / 243.8	BOREHOLE TERMINATED AT 6.5 m		7	SS	83/270 mm	245, 244

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

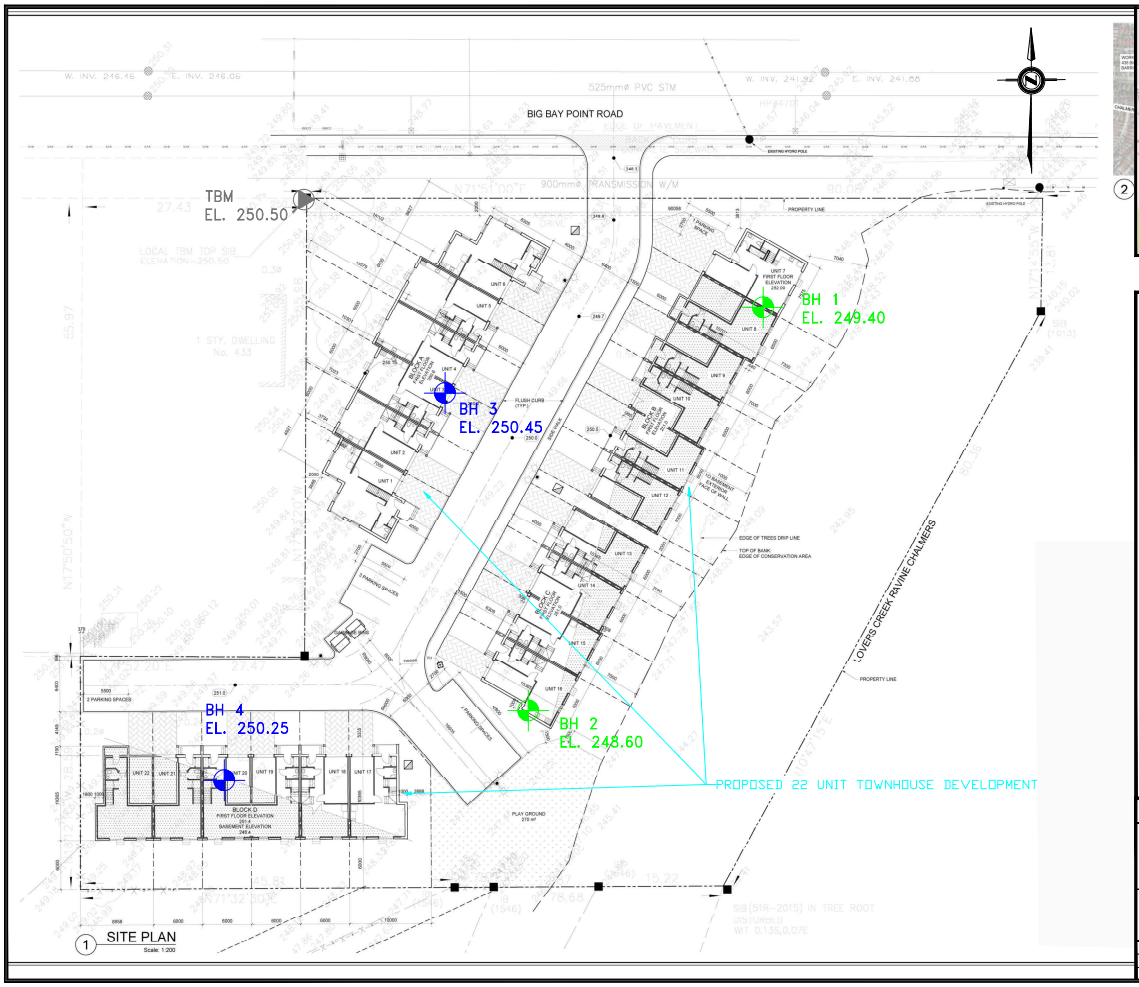
UNIT WEIGHT kN/m³

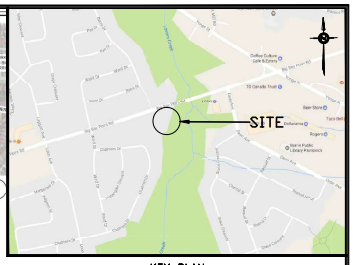
GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

First water strike at 3.1 m

Upon completion of augering
Water at 3.4 m
Cave at 4.1 m

NOTES





KEY PLAN
BARRIE, ONTARIO

LEGEND:

BH 1 EL. 249.40	BOREHOLE 1 (WITH STANDPIPE) SURFACE ELEVATION
BH 3 EL. 250.45	BOREHOLE 3 SURFACE ELEVATION
TBM EL. 250.50	TEMPORARY BENCH MARK TOP OF S.I.B. AT NORTHWEST CORNER OF PROPERTY ELEVATION 250.50 (METRIC, GEODETIC)

REFERENCE:
BASE PLAN PROVIDED BY CLIENT.

0m 8 16 24 32 40
SCALE

BOREHOLE LOCATION PLAN

PROPOSED 22 UNIT TOWNHOUSE DEVELOPMENT
435 BIG BAY POINT ROAD
BARRIE, ONTARIO

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	RB	DATE	SCALE	PML REF.	DRAWING NO.
CHECKED	GW	JUNE 2017	AS SHOWN	17BF012	1
APPROVED	GW				

Photograph 1: Steepest portion of slope (about 1H to 1V) adjacent Big Bay Point Road.

Photograph 2: Looking south, well vegetated with mature trees, however no surface vegetation.

Photograph 3: Looking north, at south end of site, slightly more surface vegetation.

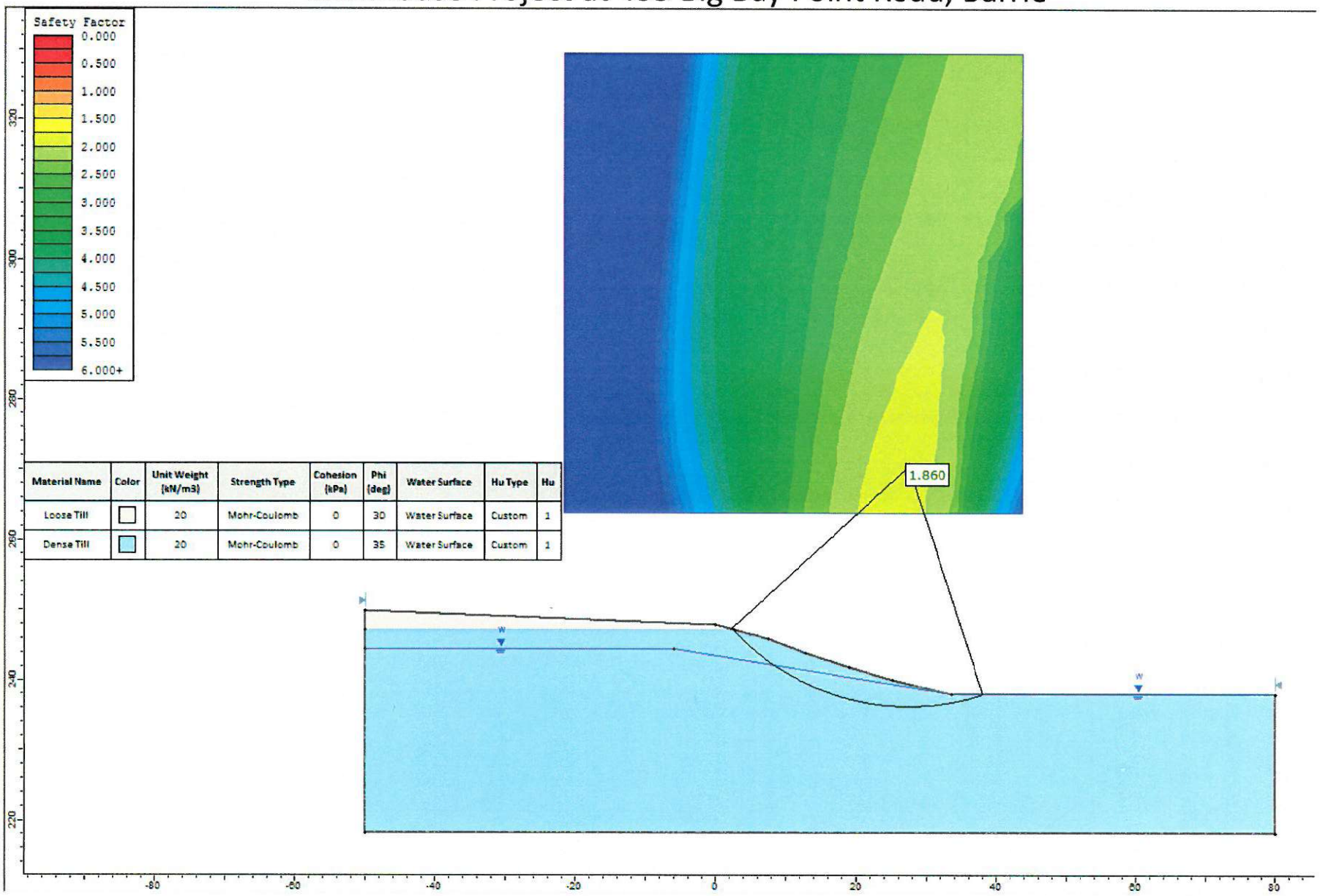
Photograph 4: At toe of slope, looking east, Lover's Creek in distance, over 15 m away.

SLOPE STABILITY RATING CHART [1]			
Site Location: 435 Big Bay Point Road, Barrie, Ontario		**PML Ref:** 17BF012	
Property Owner: ADA Homes Ltd.		**Inspection Date:** April 26, 2017	
Inspected By: Geoffrey White, P.Eng. / Richard Blair, P.Eng.		**Weather**: Cloudy, 13 C	
1.	**OVERALL 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 meters from slope toe		6
8.	**PREVIOUS LANDSLIDE ACTIVITY**		
	a) No		**0**
	b) Yes		6

SLOPE INSTABILITY RATING	RATING VALUES TOTAL	INVESTIGATION REQUIREMENTS	TOTAL **21**
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.	

PML Ref. 17BF012
Enclosure: 2

Slope Stability Analysis using SLIDE program from RocScience
Lover's Creek Ravine
Townhouse Project at 435 Big Bay Point Road, Barrie



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Loose Till		20	Mohr-Coulomb	0	30	Water Surface	Custom	1
Dense Till		20	Mohr-Coulomb	0	35	Water Surface	Custom	1