Geotechnical Engineering

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Slope Stability Assessment

Proposed Residential Development
Vacant Property
Building Supply Road
Burnstown, Ontario

Prepared For

KDSA Development Corporation

March 3, 2017

Report: PG3155-LET.05

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KDSA Development Corporation

Subject: **Slope Stability Assessment**
Proposed Residential Development
Vacant Property - Building Supply Road - Burnstown

Further to your request and authorization, Paterson Group (Paterson) conducted a slope stability assessment for the proposed residential development to be located within the vacant property at the end of Building Supply Road, in Lot 17, Concession 2 - Township of McNab/Braeside, in the County of Renfrew.

The following revised geotechnical investigation and slope stability report includes the comments and clarification requirements discussed with the Township of McNab/ Braeside on December 1st, 2016.

1.0 Introduction

A slope stability analysis was completed along the north limits of the subject site to determine the geotechnical stable slope allowance. The following report presents our findings and recommendations.

Detailed design of the proposed residential development have not been finalized at this time. However, based on the drawings submitted as part of the draft plan submission dated July 6, 2016 prepared by Jp2g Consultants Inc., the site will be subdivided for residential lots with a primary access road along the south side of the site with associated access lanes, driveways and landscaped areas.

2.0 Field Investigation

The field portion of the current slope stability assessment was completed on May 19 and 20, 2016 and consisted of extending a total of 12 test pits within the east portion of the subject site to a maximum depth of 5.5 m below existing ground surface. The field portion of the previous slope stability assessment was carried out on May 6, 14 and 15, 2014 and consisted of 2 boreholes drilled using a track mounted drill rig extending to a maximum depth of 15.1 m within the west portion of the subject site. Relevant test holes completed as part of our previous Hydrogeological Study have been attached to the current report for reference purposes only. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division.

The location and ground surface elevation at each test hole location were surveyed by Adam Kasprzak Surveying Limited. It is our understanding that the elevations are referenced to a geodetic datum. The location and ground surface elevation at each test hole location are presented on Drawing PG3155-2 - Revision 3 - Test Hole Location Plan attached to this report.

3.0 Field Observations

The subject site occupies approximately 1.3 km of the south shore of the Madawaska River located at the end of Building Supply Road. The site is currently a vacant treed property which slopes down towards the north of the subject site. Based on the topographic mapping prepared by Adam Kasprzak Surveying Limited, the ground surface varies up to 48 m in elevation across the subject site. Bedrock outcrop was observed at several locations across the top of the slope during our cursory review during our field investigations and on December 23, 2013 and on May 6, 2014. Three shallow drainage erosional channels were observed along the 1.3 km stretch of slope bordering the Madawaska River exposing gravel, cobbles and boulders at the base of the shallow channels.

The subsurface profile encountered at the test hole locations completed during the current field investigation within the east portion of the subject site consists of a thin layer of topsoil overlying a silty sand with gravel and/or glacial till overlying bedrock with the exception of TP21-16 and TP25-16. TP21-16 and TP25-16 was terminated in a compact to dense glacial till at a depth of 5.5 and 5.1 m, respectively. It should be noted that up to 2 m of fill was observed at TP23-16 and TP24-16 which mainly consisted of cobbles, boulders and bedrock fragments with some sand and topsoil. It is suspected that the fill material encountered at the two test holes located at the toe of the slope were the result of loose boulders and bedrock fragments that had fallen from the slope face from the repeated freeze-thaw cycles.

The subsurface profile encountered at the borehole locations within the west portion of the subject site consists of a thin topsoil and organic layer overlying a loose to dense sandy silt to silty sand with trace clay and gravel which inturn, is overlying a dense glacial till consisting of a sandy silt with gravel, cobbles, boulders trace clay. Bedrock was encountered below the glacial till at a depth of 1.3 and 12.3 m at BH 2 and BH 1, respectively.

Reference should be made to the Soil Profile and Test Data sheets attached to the present report for specific details of the soil profile encountered at the borehole locations.

4.0 Geotechnical Stable Slope Allowances

Slope Conditions

A geotechnical stable slope setback line has been provided along the 1.3 km shoreline of the subject site that borders the south side of the Madawaska River. Three slope cross-sections (Section A, B and C) were studied as the worst case scenarios during our primary investigation using topographic mapping prepared by Douglas W. Patterson Limited and based on the two (2) test holes completed within the west portion of the site. Three (3) additional slope cross-sections (Section D, E and F) were studied at the worst case scenarios. Section C was revised using the topographic mapping prepared by Adam Kasprzak Surveying Limited and recent subsoil information recovered during the current field investigation on May 19 and 20, 2016.

The inferred subsoil profiles within the central and east portion of the subject site were conservatively based on general knowledge of the subject area. The cross section locations are presented on Drawing PG3155-2 - Revision 3 - Test Hole Location Plan in Appendix 2.

Based on the topographic mapping prepared by Adam Kasprzak Surveying Limited, elevations across the subject site varied up to 48 m in height. A near vertical bedrock face which extends approximately 25 m above the Madawaska River was observed approximately 280 to 360 m east of the west limits of the subject site.

Bedrock outcrop was observed along the west and central portion of the subject slope with the exception of the area within the vicinity of Section A where an approximate 200 m wide slip failure was observed at the base of the subject slope. The remainder of the slope face and the subject site is occupied by adolescent to mature coniferous and deciduous trees. Some erosional features from the three shallow drainage swales along the slope face and minor signs of active erosion were noted along the toe of the slope along the waters edge.

The east portion of the subject site at the location of Section C is occupied by an approximate 22 m high slope which is set back approximately 40 to 50 m from the controlled water mark along the north side of the site. Based on the topographic mapping prepared by Adam Kasprzak Surveying Limited, the existing slope at Slope Cross-Section C varies between 1.5H:1V to 2H:1V before levelling off to slopes of less than 3H:1V.

Slope Stability Analysis

The analysis of the stability of the slope was carried out using SLIDE, a computer program which permits a two-dimensional slope stability analysis using several methods including the Bishop's method, which is a widely used and accepted analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to those favoring failure. Theoretically, a factor of safety of 1 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsoil and groundwater conditions, a factor of safety greater than 1 is usually required to ascertain the risks of failure are acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the failure of the slope would affect settlement sensitive structures such as residential dwellings, garages, storage structures, pools and decks.

The cross-sections were analyzed taking into account groundwater at a conservative depth of 3 m below existing ground surface for the subject slope based on the groundwater conditions observed within the open test holes completed during the supplemental geotechnical investigation and test wells installed during the hydrogeological study. Subsoil conditions at the cross-sections were inferred based on the findings at the 2 boreholes within the west portion of the subject slope and 12 test pits completed within the east portion of the site and general knowledge of the area's geology. The slope cross-sections were based on the topographic information prepared by Adam Kasprzak Surveying Limited.

Static Analysis

The results for the slope conditions at Sections A, B, C, D, E and F are shown in Figures 2a, 3a, 4a, 5a, 6a and 7a attached to the present report. The factor of safety under static conditions was found to be less than 1.5 for all sections analysed with the exceptions of Section D, E and F which are slightly greater than the 1.5 factor of safety.

The factor of safety under static conditions was found to be less than 1.0 for Section A and therefore are considered unstable from a geotechnical perspective. Due to the current slip failures noted along the slope face within the area of Section A, subsequent slip failures are anticipated within the geotechnical set back limits which are illustrated in Figure 2a.

The geotechnical stable slope allowance required for the subject slopes with a minimum factor of safety of 1.5 is identified for each profile in the attached figures.

Seismic Loading Analysis

An analysis considering seismic loading was also completed. A horizontal seismic acceleration, K_h, of 0.38 g was considered for the analyzed sections. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

The results of the analyses including seismic loading are shown in Figures 2b, 3b, 4b, 5b, 6b and 7b for the slope sections. Based on these results, the slope cross-sections analysed are less than the recommended factor of safety of 1.1 with the exception of Section D, E and F which are slightly greater that the 1.1 factor of safety.

Geotechnical Stable Slope Allowance

The geotechnical stable slope allowance line defines the geotechnical setback where development is restricted. The geotechnical stable slope allowance includes the stable slope allowance based on our slope stability analysis, as well as a 6 m erosion access allowance and a 4 m toe erosion allowance. The toe erosion allowance for the valley corridor at the toe of the slope was based on the cohesive nature and density of the soils, the observed current erosional activities and the width and location of the current watercourse. Minor signs of erosion were noted along the Madawaska River especially where the watercourse meets the toe of the corridor wall. It is considered that a toe erosion allowance of 4 m is appropriate for the valley corridor walls.

The geotechnical stable slope allowance based on the results of the analysis vary between 42 and 68 m from the controlled water mark of 145.0 m at Slope Cross Section B and Slope Cross Section A, respectively. There is also an Ontario Hydro flood limit of 146.3 m which is included in the sections.

A review of Section C was competed based on the subsoil information recovered during our field investigation on May 19 and 20, 2016 and topographic mapping prepared by Adam Kasprzak Surveying Limited. An approximate 55 m wide section of the slope was determined to be less than the minimum recommended factor of safety of 1.5 for stable slope allowance of the approximately 22 m high slope located 40 to 50 m from the controlled water mark. The 55 m wide section of slope is located inland approximately 45 m from the controlled water mark and extends up to 100 m to the top of the 1.5H:1V to 2H:1V slope.

The geotechnical stable slope allowance was based on conservative bedrock elevations due to the limited subsoil information within the subject slope. Based on our analysis results, a blended geotechnical stable slope allowance considering the erosion access and toe erosion allowance for the proposed development is indicated on Drawing PG3155-2 - Revision 3 - Test Hole Location Plan attached to this report.

Maintaining Vegetation along the Slope Face

It has been well documented in literature that vegetation including grass and small shrubs minimize surficial erosion along the slope face by producing a thin root mass overlying the slope face. It has been further documented that large deep rooted trees along a slope face can assist in the overall stability of the slope.

With that said, it is recommended that the existing root system be maintained by encouraging the overall health of the existing trees and to promote new growth for the future stability of the existing slope. The removal of dead trees is considered acceptable from a geotechnical perspective provided that the existing root system remains in place. It is strongly encouraged that the dead trees be replaced with a fast growing, deep rooted trees to replace the decaying root system from the former tree to maintain the stability of the slope.

It is also understood that responsible trimming and removal of isolated trees may encourage the health of neighbouring trees and subsequently improving the underlying root system. However, trimming and removal of trees should be reviewed by an arborist to ensure that the overall health of the existing trees and associated root systems is maintained.

Trimming and the removal of live trees is considered acceptable from a geotechnical perspective in areas where the root system does not aid in the overall stability of the slope, specifically in areas where shallow bedrock not exceeding 2 m in depth exists. Subsoil information recovered during the supplemental geotechnical investigations completed at each lot can evaluate the depth of bedrock at the test hole locations.

Water Access

Access to the water's edge via access trails, pedestrian pathway, staircase and other structures along the slope can be accommodated at each lot pending a site specific geotechnical review. In areas where the factor of safety of sections of the slope is found to less than 1.0, a slope stabilization program by the geotechnical consultant will be required to assess and mitigate issues associated with the proposed water access feature or structure.

The slope stabilization programs is generally site specific and are dependant on site features and water access structure being considered. These slope stabilization programs may consist of slightly re-shaping and reinforcing the slope which could consist of rip-rap, Scour Stop, GeoWeb, Terramesh, Geogrid and/or Geotextile membranes.

5.0 Recommendations

The following recommendations are provided:

- ❏ The geotechnical stable slope allowance including the erosion access and toe erosion allowance are presented on Drawing PG3155-2 - Revision 3 - Test Hole Location Plan illustrates the construction limit for residential dwellings, garages, storage structures, pools and decks.
- ❏ The existing root system within the slope section should be maintained by encouraging the overall health of the existing trees and promote new growth for future stability of the existing slope. The removal of dead treas is considered acceptable from a geotechnical perspective provided that the existing root remains in place. It is strongly encouraged that dead trees be replaced with fast growing, deep rooted trees to replace the decaying root system from the former tree to maintain the stability of the slope. Responsible trimming and removal of isolated trees may be used to encourage the health of the neighbouring trees and subsequently improve the underlying root system. However, trimming and removal of trees should be reviewed by an arborist to ensure that the overall health of the existing trees and associated roots systems is maintained. Trimming and the removal of live trees is considered acceptable from a geotechnical perspective in areas where the root system does not aid in the overall stability of the slope, specifically in areas where shallow bedrock not exceeding 2 m in depth exists. Subsoil information recovered during the supplemental geotechnical investigations completed at each lot can evaluate the depth of bedrock at the test hole locations.

- ❏ Any future development along existing slope(s) should be graded to manage surface erosion along the slope face. A vegetative cover such as a thin layer of topsoil and seeded with a hardy grass seed can also be considered to lessen surficial erosion. Along with the surface grading, water from eave troughs and filter backwash from pools (if applicable) should be directed to shallow swales, storm sewers, flow speaders or drainage trenches to mitigate surficial erosion along the slope face within the geotechnical slope stability allowance. Where swales and ditches are sloped in excess of 5H:1V, it is recommended that the base of the ditch be lined with a geotextile separation layer such as a Terrafix 270R or equivalent and capped with a minimum 300 mm thick layer of clear 100 to 200 mm rip-rap to dissipate flow energy and to lessen surficial erosion.

- During the design phase of the single family residential dwellings, a review of the proposed final grading plan is required to assess the influence of the expected loading on the slope stability. Considerations such as incorporating a basement level and/or a walk-out basement along with below grade drainage will lessen the loading on the slope and improve long term stability.

- Based on the anticipated development, no restriction is expected for reasonable grade raises at the subject site. The permissible grade raise can be reviewed by the geotechnical consultant on a lot by lot basis along with the final grading plans to determine any impacts on the overall stability of the existing slope.

- From a geotechnical perspective, during the design phase of the proposed residential development including side slopes along the primary access road and and access lanes, grading should be shaped to a maximum slope of 3H:1V which is considered stable over the long term.

- A supplemental geotechnical investigation is required by a lot by lot basis to confirm the subsoil conditions inferred during our slope stability analysis. The subsoil, bedrock and groundwater conditions inferred during our slope stability investigation can be confirmed by excavating test pits and/or drilling boreholes at strategic locations across the subject section of the slope.

6.0 General Conditions

Detailed information regarding the proposed development within the individual lots are not known at the time of issuance of the current report. As a result, general site conditions for the individual lots are dependant on the proximity of the proposed settlement sensitive structure to the geotechnical stable slope allowance and have been presented in zones as illustrated on Drawing PG3155-2 - Revision 3 - Test Hole Location Plan.

Zone 1 (Brown Area)

The area identified as Zone 1 is located within the geotechnical stable slope allowance where the placement of structures are not permitted. Access to the water's edge via access trails, pedestrian pathway, staircase and other structures related to access along the slope can be accommodated for each lot pending a site specific geotechnical review. Furthermore, any approved drainage works at specific locations will require a geotechnical review.

The Geotechnical Stable Slope Allowance will be placed in a restrictive Environmental Protection Zone with a holding provision (EP-h), whereby lifting the "h" to permit development in the zone will require a lot specific geotechnical assessment for the proposed slope access works.

Zone 2 (Yellow Area)

The area identified as Zone 2 is located directly to the south of the geotechnical stable slope allowance where the following conditions must be met for the installation of structures such as dwellings, garages, outbuildings, pools and staircases located within the subject zone:

- ❏ The concentrated water run-off from roof drains, patios and driveways should not be directed to the crest of the slope of the Geotechnical Stable Slope Allowance, although limited sheet flow is permitted.

- ❏ The installation of residential structures, swimming pools (both in-ground and above ground), tennis courts and other auxiliary structures requires additional geotechnical assessment to address grading and drainage concerns towards the Geotechnical Stable Slope Allowance.

- ❏ The extent of fill placement above permissible grading requirements within Zone 2, requires a geotechnical review and assessment.

- ❏ The Geotechnical Stable Slope Allowance will be placed in a restrictive Environmental Protection Zone with a holding provision (EP-h), whereby lifting the “h” to permit development in the zone will require a lot specific geotechnical assessment for the proposed works.

- ❏ The recommendations and slope stabilization requirements presented in this report, will be provided to prospective lot owners as a guide for the development of the lot.

Zone 3 (Green Area)

The area identified as Zone 3 is located in an area where the geotechnical conditions are in compliance with the Geotechnical Stable Slope Allowance and with no geotechnical conditions. Any structures considered for this area are acceptable provided a reasonable design is implemented in general accordance with geotechnical recommendations provided in the previous sections of this report.

7.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. Our recommendations should be reviewed when the project drawings and specifications are complete.

A geotechnical investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations or inferred during our slope stability analysis, we request that we be notified immediately in order to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein, or by person(s) other KDSA Development Corporation or their agents, without review by this firm for the applicability of our recommendations to the altered use of the report.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

Richard Groniger, C. Tech.

Carlos P. Da Silva, P.Eng.

Attachments

- ❑ Soil Profile and Test Data sheets
- ❑ Photographs
- ❑ Figure 1 - Key Plan
- ❑ Figure 2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b, 6a, 6b, 7a and 7b - Slope Cross Sections
- ❑ Drawing PG3155-3 - Revision 3 - Test Hole Location Plan

Report Distribution

- ❑ KDSA Developments Corporation (3 copies)
- ❑ Paterson Group (1 copy)

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP 1-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	191.19		
FILL: Loose, brown silty sand, some cobbles and boulders		G	1						
1.20						1	190.19		
TOPSOIL		G	2						
1.50						2	189.19		
GLACIAL TILL: Compact to dense, brown silty sand, some gravel and cobbles		G	3			3	188.19		
						4	187.19		
4.20									
End of Test Pit TP terminated in glacial till at 4.20m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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Burnstown, Ontario

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FILE NO. PG3155

REMARKS

HOLE NO. TP 2-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	188.90		
Compact, brown **SILTY SAND,** some gravel and cobbles		G	1						
0.90						1	187.90		
GLACIAL TILL: Dense to very dense, brown silty sand, some gravel and cobbles, trace boulders						2	186.90		
		G	2			3	185.90		
4.00						4	184.90		
End of Test Pit TP terminated in glacial till at 4.00m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
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FILE NO. PG3155

REMARKS

HOLE NO. TP 3-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.10		G	1			0	181.23		
Loose to compact, brown **SILTY SAND,** trace to some gravel, some boulders		G	2			1	180.23		
2.00						2	179.23		
End of Test Pit TP terminated on bedrock surface at 2.00m depth (GWL @ 2.0m depth)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
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Burnstown, Ontario

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FILE NO. PG3155

REMARKS

HOLE NO. TP 4-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	179.62	20 40 60 80	
TOPSOIL		G	1						
0.40									
		G	2			1	178.62		▽
Loose to compact, brown **SILTY SAND,** trace some gravel and cobbles, trace boulders		G	3			2	177.62		
3.00						3	176.62		
End of Test Pit									
TP terminated in silty sand at 3.00m depth									
(GWL @ 1.2m depth)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
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Burnstown, Ontario

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FILE NO. PG3155

REMARKS

HOLE NO. TP 5-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.40		G	1			0	175.96		
Loose, dark brown **SILTY SAND,** some cobbles and boulders 0.90		G	2			1	174.96		
GLACIAL TILL: Dense, brown silty sand, some gravel and cobbles		G	3			2	173.96		▽
3.20						3	172.96		
End of Test Pit TP terminated in glacial till at 3.20m depth (GWL @ 2.5m depth)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %; scale 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
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Burnstown, Ontario

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FILE NO. PG3155

REMARKS

HOLE NO. TP 6-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
PEAT		G	1			0	173.66		
0.30									
Compact, brown **SILT,** some sand		G	2			1	172.66		
						2	171.66		
2.40									
Compact, brown **SILTY SAND,** some gravel, cobbles and boulders		G	3						
2.80									
End of Test Pit									
TP terminated in silty sand at 2.80m depth									
(GWL @ 0.3m depth)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
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FILE NO. PG3155

REMARKS

HOLE NO. TP 7-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.20		G	1			0	173.51		
Loose to compact, brown **SILTY SAND,** trace gravel and cobbles		G	2			1	172.51		▽
						2	171.51		
GLACIAL TILL: Dense, brown silty sand, some gravel, cobbles and boulders 2.50		G	3			3	170.51		
End of Test Pit 3.20									
TP terminated in glacial till at 3.20m depth									
(GWL @ 1.5m depth)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %
20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP 8-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	172.80		
Loose to compact, brown **SILTY SAND,** some gravel and cobbles		G	1						
0.70						1	171.80		
GLACIAL TILL: Compact to very dense, brown silty sand, some gravel, cobbles and boulders		G	2			2	170.80		▽
						3	169.80		
3.90									
End of Test Pit TP terminated in glacial till at 3.90m depth (GWL @ 2.0m depth)									

Pen. Resist. Blows/0.3m: ○ Water Content % — 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP 9-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	165.93		
Compact, dark brown **SILTY SAND,** some gravel and cobbles		G	1						
0.70						1	164.93		▽
GLACIAL TILL: Dense to very dense, brown silty sand with gravel, trace cobbles and boulders						2	163.93		
- grey by 3.0m depth		G	2			3	162.93		
3.30									
End of Test Pit TP terminated in glacial till at 3.30m depth (GWL @ 0.9m depth)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %; 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100; ▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP10-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	165.69		
TOPSOIL 0.40		G	1						▽
Loose to compact, dark brown **SILTY SAND,** trace gravel 0.90		G	2			1	164.69		
Very dense, brown **SILTY SAND** with gravel, some cobbles and boulders		G	3			2	163.69		
2.40 End of Test Pit									
TP terminated on possible bedrock surface at 2.40m depth									
(Groundwater infiltration at 0.5m depth)									

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP11-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	169.77		
TOPSOIL 0.30		G	1						
Loose, dark brown **SILTY SAND,** some gravel and cobbles 1.00		G	2			1	168.77		
GLACIAL TILL: Very dense, brown silty sand with gravel, cobbles and boulders						2	167.77		▽
		G	3						
3.10 End of Test Pit						3	166.77		
TP terminated in glacial till at 3.10m depth									
(GWL @ 2.4m depth)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP12-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.20		G	1			0	184.96		
		G	2			1	183.96		
Loose to compact, brown **SILTY SAND,** some gravel, cobbles and boulders						2	182.96		
		G	3			3	181.96		
4.10						4	180.96		
End of Test Pit TP terminated in silty sand at 4.10m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP13-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.30		G	1			0	182.17		
Loose to compact, dark brown **SILTY SAND,** some cobbles and boulders 0.80		G	2			1	181.17		
GLACIAL TILL: Compact to very dense, brown silty sand, some gravel, cobbles and boulders						2	180.17		▽
						3	179.17		
3.60		G	3						
End of Test Pit TP terminated on possible bedrock surface at 3.60m depth (GWL @ 2.0m depth)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation - Proposed Roadway
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

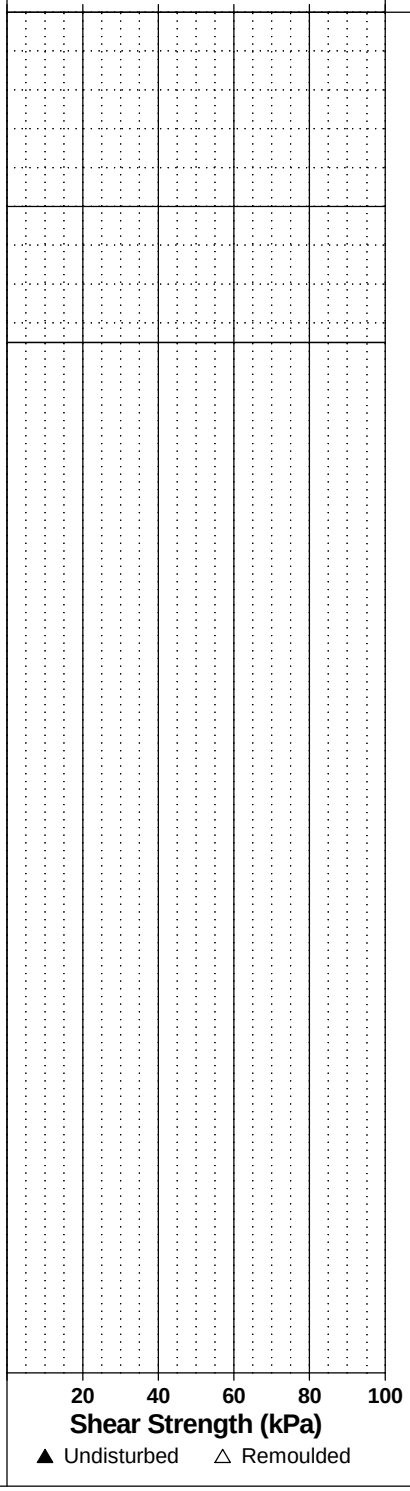
FILE NO. PG3155

REMARKS

HOLE NO. TP14-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL						0	178.77		
0.25									
Loose to dense, dark brown **SILTY SAND,** some boulders		G	1						
0.70									
Dense to very dense, brown **SILTY SAND** with gravel, cobbles and boulders		G	2			1	177.77		
1.70									
End of Test Pit									
TP terminated on bedrock surface at 1.70m depth									
(TP dry upon completion)									



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP15-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.30						0	167.10		
Very dense, brown **SILTY SAND** with cobbles and boulders		G	1			1	166.10		
						2	165.10		
2.80 End of Test Pit TP terminated on bedrock surface at 2.80m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %; scale 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

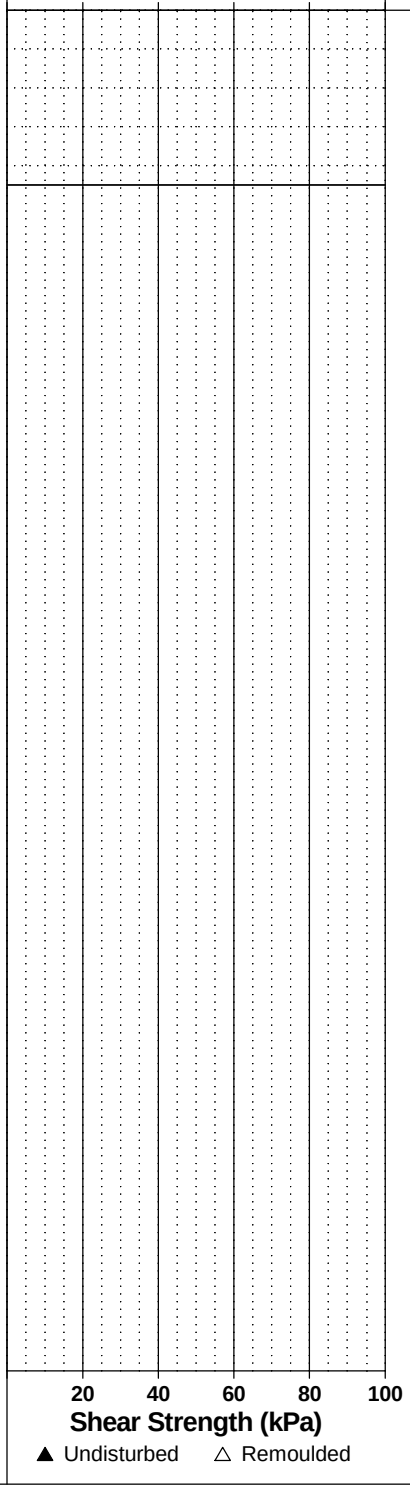
FILE NO. PG3155

REMARKS

HOLE NO. TP16-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	168.98		
Very dense, dark brown **SILTY SAND** with cobbles and boulders		G	1						
0.90									
End of Test Pit TP terminated on bedrock surface at 0.90m depth (TP dry upon completion)									



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

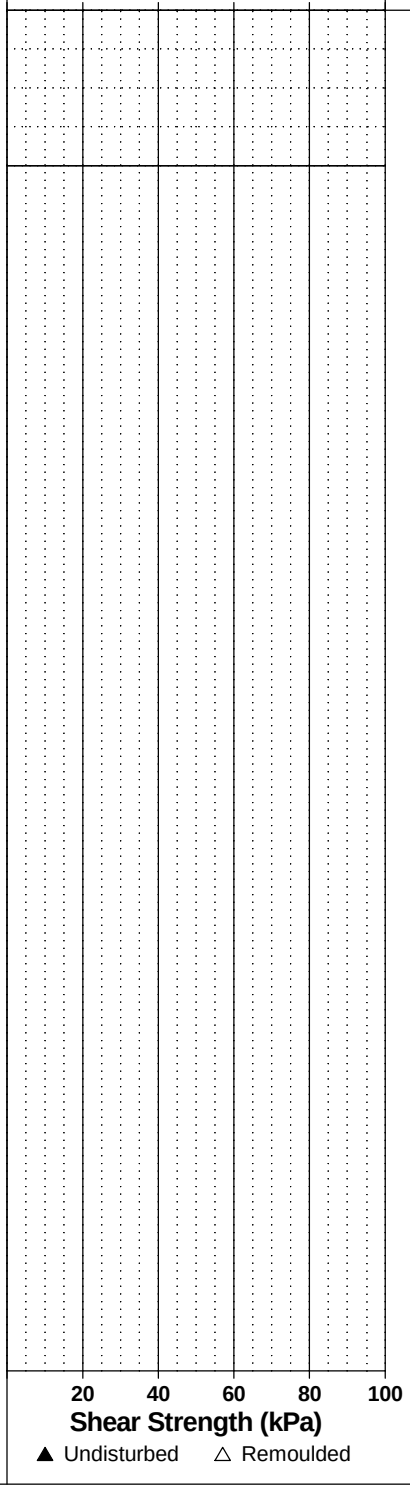
FILE NO. PG3155

REMARKS

HOLE NO. TP17-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	172.58		
Very dense, dark brown **SILTY SAND** with boulders		G	1						
0.80									
End of Test Pit TP terminated on bedrock surface at 0.80m depth (TP dry upon completion)									



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP18-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	173.19	20 40 60 80	
Very dense, dark brown **SILTY SAND** with cobbles and boulders		G	1						
1.10						1	172.19		
End of Test Pit TP terminated on bedrock surface at 1.10m depth (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP19-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	170.37	20 40 60 80	
Very dense, dark brown **SILTY SAND** with cobbles and boulders		G	1			1	169.37		
1.90									
End of Test Pit TP terminated on bedrock surface at 1.90m depth (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP20-16

BORINGS BY Excavator **DATE** May 19, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.15						0	165.59		
Dense to very dense, brown **SILTY SAND** with gravel, cobbles and boulders		G	1			1	164.59		
		G	2			2	163.59		
2.30 End of Test Pit TP terminated on bedrock surface at 2.30m depth (TP dry upon completion)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP21-16

BORINGS BY Excavator **DATE** May 20, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOI 0.20		G	1			0	156.02		
Loose, dark brown **SILTY SAND,** some cobbles and boulders 0.60		G	2			1	155.02		
GLACIAL TILL: Compact to dense, brown silty sand, some cobbles and boulders						2	154.02		
						3	153.02		
						4	152.02		
		G	3			5	151.02		
5.50 End of Test Pit									
TP terminated in glacial till at 5.50m depth									
(Groundwater infiltration at 3.5m depth)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP22-16

BORINGS BY Excavator **DATE** May 20, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	160.58	20 40 60 80	
TOPSOIL 0.10									
Loose, dark brown **SILTY SAND,** some cobbles 0.70						1	159.58		
GLACIAL TILL: Compact, brown silty sand, some cobbles and boulders						2	158.58		
3.10						3	157.58		
End of Test Pit									
TP terminated on bedrock surface at 3.10m depth									
(Groundwater infiltration at bottom of test pit)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

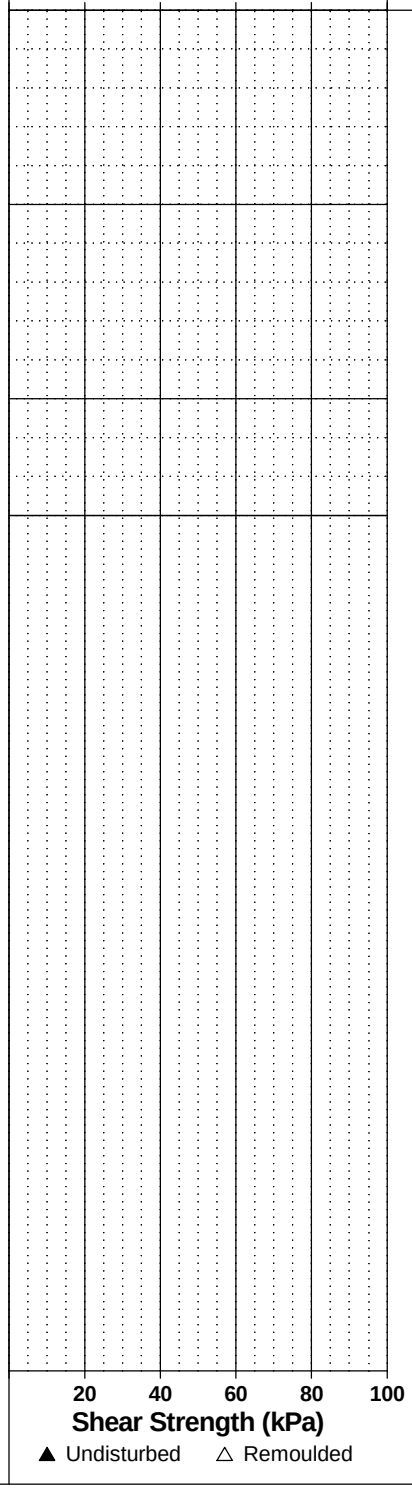
FILE NO. PG3155

REMARKS

HOLE NO. TP23-16

BORINGS BY Excavator **DATE** May 20, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	148.46		
FILL: Boulders and cobbles with sand and topsoil		G	1			1	147.46		
1.20									
GLACIAL TILL: Compact, brown silty sand with gravel and cobbles						2	146.46		
2.60		G	2						
End of Test Pit TP terminated on bedrock at 2.60m depth (Groundwater infiltration at bottom of test pit)									



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP24-16

BORINGS BY Excavator **DATE** May 20, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	147.10		
FILL: Boulders with topsoil and sand		G	1			1	146.10		
						2	145.10		
GLACIAL TILL: Compact to very dense, brown silty sand with gravel, cobbles and boulders						3	144.10		▽
		G	2			4	143.10		
4.90 End of Test Pit TP terminated on inferred bedrock surface at 4.90m depth (Groundwater infiltration at 3.0m depth)									

Pen. Resist. Blows/0.3m: ○ Water Content % — 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP25-16

BORINGS BY Excavator **DATE** May 20, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
TOPSOIL 0.15						0	158.13		
Loose to dense, dark brown **SILTY SAND** with cobbles and boulders		G	1			1	157.13		
1.50						2	156.13		
GLACIAL TILL: Compact to very dense, brown silty sand with gravel, cobbles and boulders		G	2			3	155.13		▽
5.10						4	154.13		
End of Test Pit						5	153.13		
TP terminated in glacial till at 5.10m depth									
(Groudnwater infiltration at 3.0m depth)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %
Water Content %: 20, 40, 60, 80
Shear Strength (kPa): 20, 40, 60, 80, 100
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Slope Stability Investigation
Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. TP26-16

BORINGS BY Excavator **DATE** May 20, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	160.94		
Loose, dark brown **SILTY SAND,** some boulders									
		G	1			1	159.94		
1.20									
End of Test Pit TP terminated on bedrock surface at 1.20m depth (TP dry upon completion)									

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. BH 1

BORINGS BY CME 45 Power Auger **DATE** May 14, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	177.98
TOPSOIL 0.10		AU	1				
Loose to dense, brown **SANDY SILT,** trace clay and gravel		SS	2	75	4	1	176.98
		SS	3	83	47	2	175.98
2.59							
		SS	4	58	36	3	174.98
						4	173.98
						5	172.98
						6	171.98
GLACIAL TILL: Dense, brown sandy silt with gravel, cobbles and boulders, trace clay						7	170.98
						8	169.98
						9	168.98
						10	167.98
		RC	1	30		11	166.98
12.32						12	165.98
		RC	2	100	42	13	164.98
IGNEOUS BEDROCK							
		RC	3	100	42	14	163.98
15.09						15	162.98
End of Borehole							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Building Supply Road
Burnstown, Ontario

DATUM Ground surface elevations at borehole locations provided by Adam Kasprzak Surveying Limited.

FILE NO. PG3155

REMARKS

HOLE NO. BH 2

BORINGS BY CME 45 Power Auger **DATE** May 15, 2014

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	169.00
TOPSOIL 0.20							
Very dense, brown **SILTY SAND**		SS	1		50+	1	168.00
1.30							
		RC	1	98	62	2	167.00
IGNEOUS BEDROCK							
		RC	2	100	78	3	166.00
4.34						4	165.00
End of Borehole							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Braeburn Estates - Building Supply Road
Burnstown, Ontario
Burnstown, Ontario

DATUM Ground surface elevation interpolated from topographic plan prepared by Adam Kasprzak Surveying Ltd.

FILE NO. PH2610

REMARKS

HOLE NO. TP 1

BORINGS BY Backhoe **DATE** March 10, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	187.30	20 40 60 80	
TOPSOIL									
0.20									
Compact, reddish brown **SAND-GRAVEL,** some cobbles, silt and clay		G	1						
1.00						1	186.30		
Compact, grey **SANDY SILT,** some gravel		G	2						
1.70									
End of Test Pit									
(TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Braeburn Estates - Building Supply Road
Burnstown, Ontario
Burnstown, Ontario

DATUM Ground surface elevation interpolated from topographic plan prepared by Adam Kasprzak Surveying Ltd.

FILE NO. PH2610

REMARKS

HOLE NO. TP 2

BORINGS BY Backhoe **DATE** March 10, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	181.50	20 40 60 80	
TOPSOIL									
0.15									
Dense, light brown **SILTY SAND,** some gravel and cobbles		G	3			1	180.50		
1.30									
Dense, grey-brown **SILTY SAND,** some fine sand seams		G	4						
1.70									
End of Test Pit									
(TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Braeburn Estates - Building Supply Road
Burnstown, Ontario
Burnstown, Ontario

DATUM Ground surface elevation interpolated from topographic plan prepared by Adam Kasprzak Surveying Ltd.

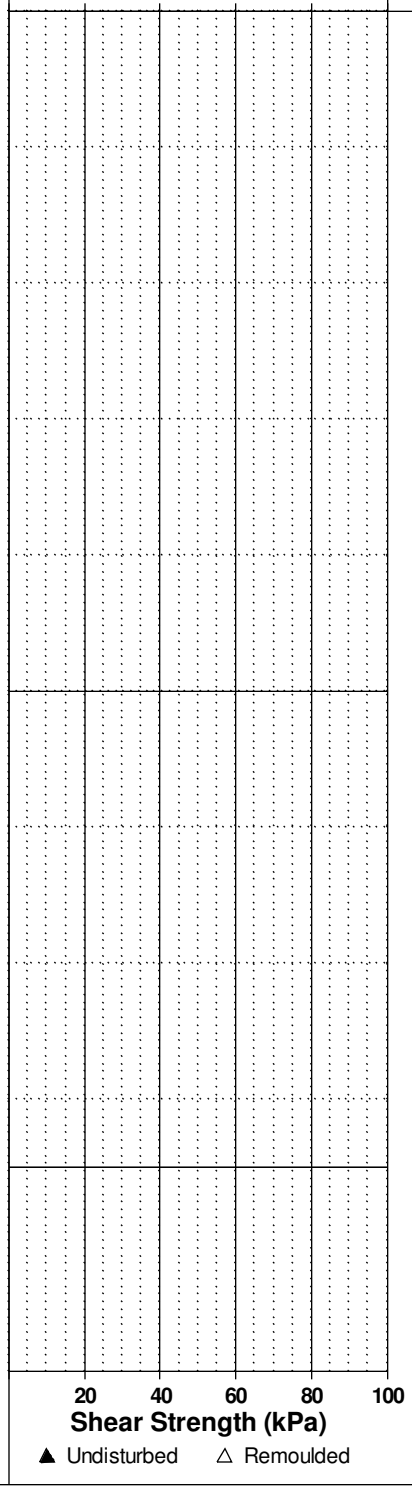
FILE NO. PH2610

REMARKS

HOLE NO. TP 3

BORINGS BY Backhoe **DATE** March 10, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	179.00		
TOPSOIL 0.15									
Loose, reddish brown **SAND,** trace silt 0.80		G	5						
						1	178.00		
Light brown **FINE SAND** 1.70		G	6						
End of Test Pit (TP dry upon completion)									



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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Braeburn Estates - Building Supply Road
Burnstown, Ontario
Burnstown, Ontario

DATUM Ground surface elevation interpolated from topographic plan prepared by Adam Kasprzak Surveying Ltd.

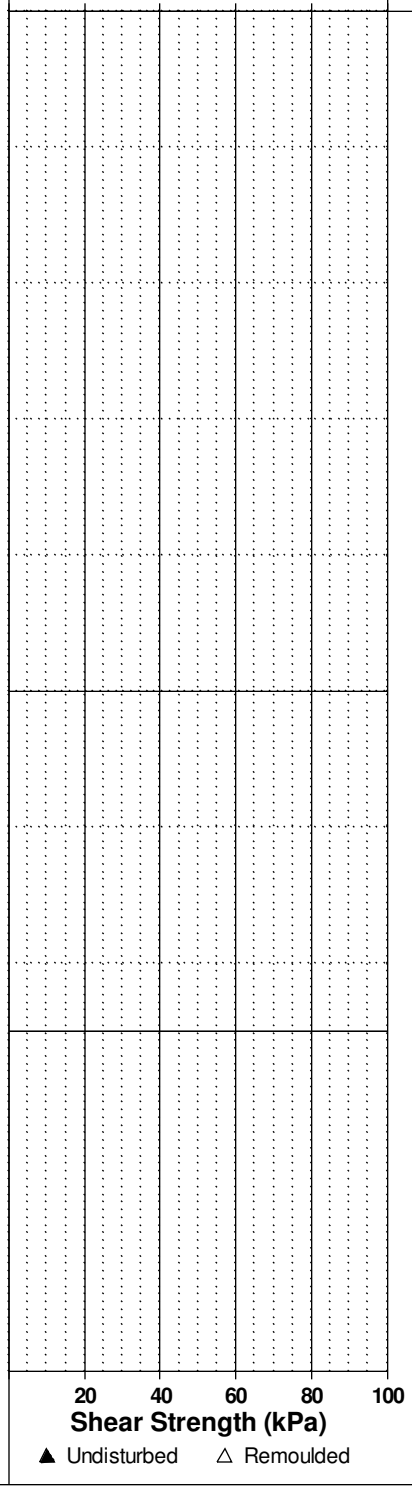
FILE NO. PH2610

REMARKS

HOLE NO. TP 4

BORINGS BY Backhoe **DATE** March 10, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	179.00		
TOPSOIL									
0.20									
Reddish brown **SILTY FINE SAND,** some cobbles and boulders						1	178.00		
1.00									
Grey-brown **SANDY SILT**									
1.50									
End of Test Pit									
(TP dry upon completion)									



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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Braeburn Estates - Building Supply Road
Burnstown, Ontario
Burnstown, Ontario

DATUM Ground surface elevation interpolated from topographic plan prepared by Adam Kasprzak Surveying Ltd.

FILE NO. PH2610

REMARKS

HOLE NO. TP 5

BORINGS BY Backhoe **DATE** March 10, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	174.00		
TOPSOIL									
0.20									
Compact, reddish brown **SILTY SAND,** some gravel, cobbles and boulders		G	7			1	173.00		
1.30									
Compact, grey-brown **SILTY SAND,** some gravel		G	8						
1.80									
End of Test Pit (TP dry upon completion)									

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Braeburn Estates - Building Supply Road
Burnstown, Ontario
Burnstown, Ontario

DATUM Ground surface elevation interpolated from topographic plan prepared by Adam Kasprzak Surveying Ltd.

FILE NO. PH2610

REMARKS

HOLE NO. TP 6

BORINGS BY Backhoe **DATE** March 10, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	166.50
TOPSOIL							
0.15							
Compact to dense, light brown **SANDY SILT,** some clay		G	9				
0.70							
Loose, grey-brown coarse **SAND**		G	10				
1.00						1	165.50
Grey-brown **CLAYEY SILT,** some sand and gravel		G	11				
1.70							
End of Test Pit							
(Groundwater infiltration at 0.7m depth)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Braeburn Estates - Building Supply Road
Burnstown, Ontario
Burnstown, Ontario

DATUM Ground surface elevation interpolated from topographic plan prepared by Adam Kasprzak Surveying Ltd.

FILE NO. PH2610

REMARKS

HOLE NO. TP 7

BORINGS BY Backhoe **DATE** March 10, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	165.00		
TOPSOIL									
0.20									
Compact, reddish brown **SILTY SAND** with cobbles and boulders						1	164.00		
1.00									
Compact, grey-brown **SANDY SILT,** some gravel									▽
1.30									
Loose, grey-brown coarse **SAND** with gravel		G	12						
1.50									
End of Test Pit									
(Groundwater infiltration at 1.3m depth)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Braeburn Estates - Building Supply Road
Burnstown, Ontario
Burnstown, Ontario

DATUM Ground surface elevation interpolated from topographic plan prepared by Adam Kasprzak Surveying Ltd.

FILE NO. PH2610

REMARKS

HOLE NO. TP 8

BORINGS BY Backhoe **DATE** March 10, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	149.00	20 40 60 80	
TOPSOIL 0.10									
Compact, red-brown **SILTY SAND** with cobbles and boulders		G	13			1	148.00		
1.30									
End of Test Pit Refusal on inferred boulders at 1.30m depth (TP dry upon completion)								20 40 60 80 100 **Shear Strength (kPa)** ▲ Undisturbed △ Remoulded	

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

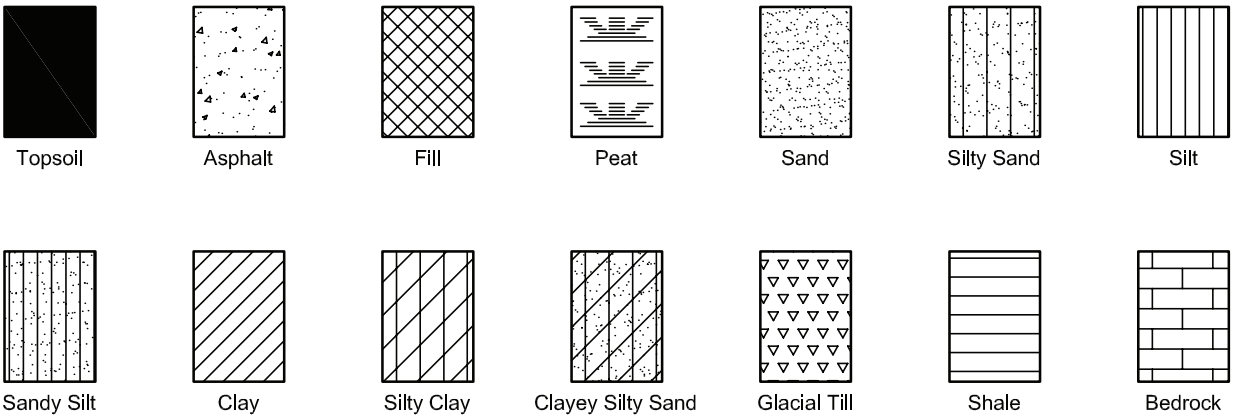
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

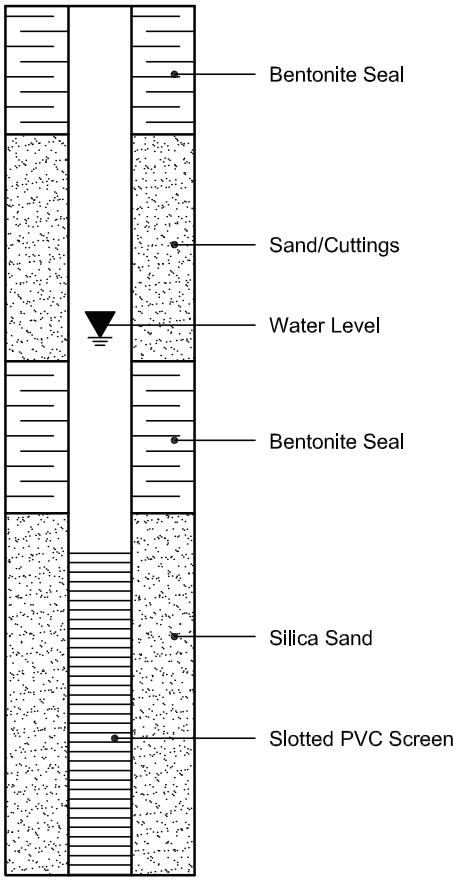
SYMBOLS AND TERMS (continued)

STRATA PLOT

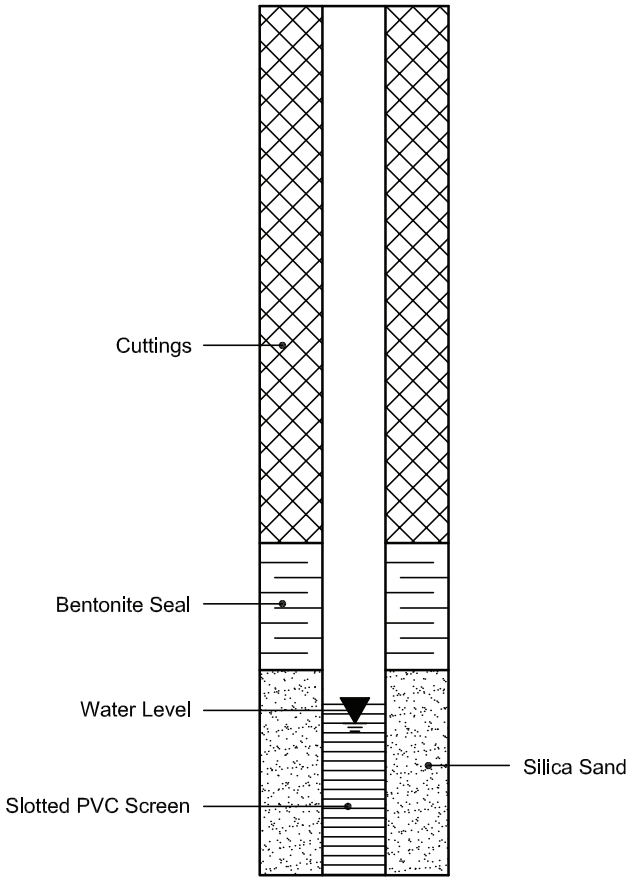


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Photographs

Photograph 1 – North limits of the subject site bordered by the Madawaska River.

Photograph 2 – Illustrates the slip failures observed along the slope face near Slope Cross Section A.

Photographs

Photograph 3 – Exposed bedrock observed at several locations along the west and central portions of the subject slope

Photograph 4 – One (1) of three (3) shallow drainage streams located along the subject slope.

FIGURE 1

KEY PLAN

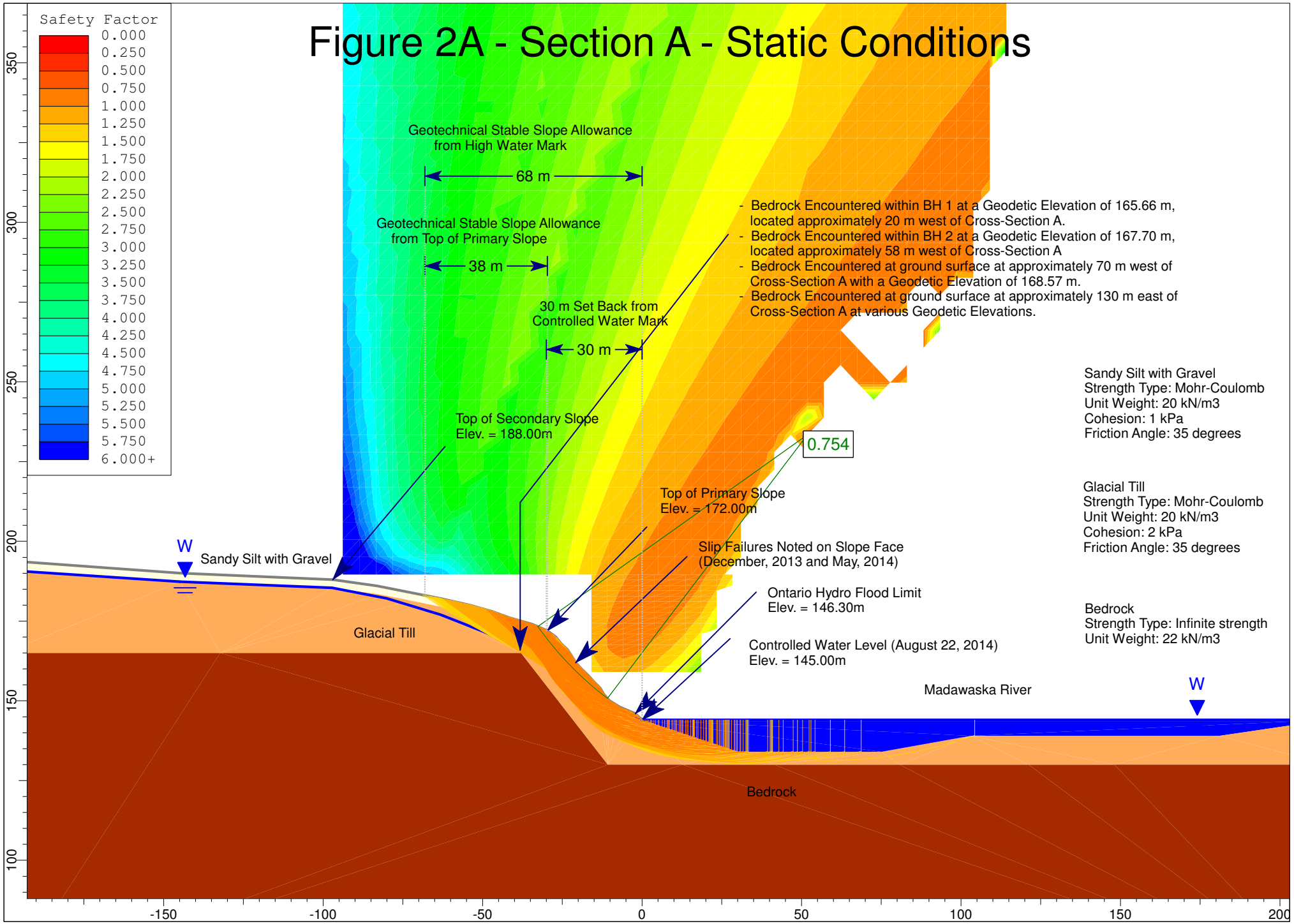


Figure 2A - Section A - Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Geotechnical Stable Slope Allowance from High Water Mark
68 m
Geotechnical Stable Slope Allowance from Top of Primary Slope
38 m
30 m Set Back from Controlled Water Mark
30 m
- Bedrock Encountered within BH 1 at a Geodetic Elevation of 165.66 m, located approximately 20 m west of Cross-Section A.
- Bedrock Encountered within BH 2 at a Geodetic Elevation of 167.70 m, located approximately 58 m west of Cross-Section A
- Bedrock Encountered at ground surface at approximately 70 m west of Cross-Section A with a Geodetic Elevation of 168.57 m.
- Bedrock Encountered at ground surface at approximately 130 m east of Cross-Section A at various Geodetic Elevations.
Sandy Silt with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
0.754
Top of Secondary Slope Elev. = 188.00m
Top of Primary Slope Elev. = 172.00m
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
W
Sandy Silt with Gravel
Slip Failures Noted on Slope Face (December, 2013 and May, 2014)
Ontario Hydro Flood Limit Elev. = 146.30m
Glacial Till
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Controlled Water Level (August 22, 2014) Elev. = 145.00m
Madawaska River
W
Bedrock
350
300
250
200
150
100
-150
-100
-50
0
50
100
150
200

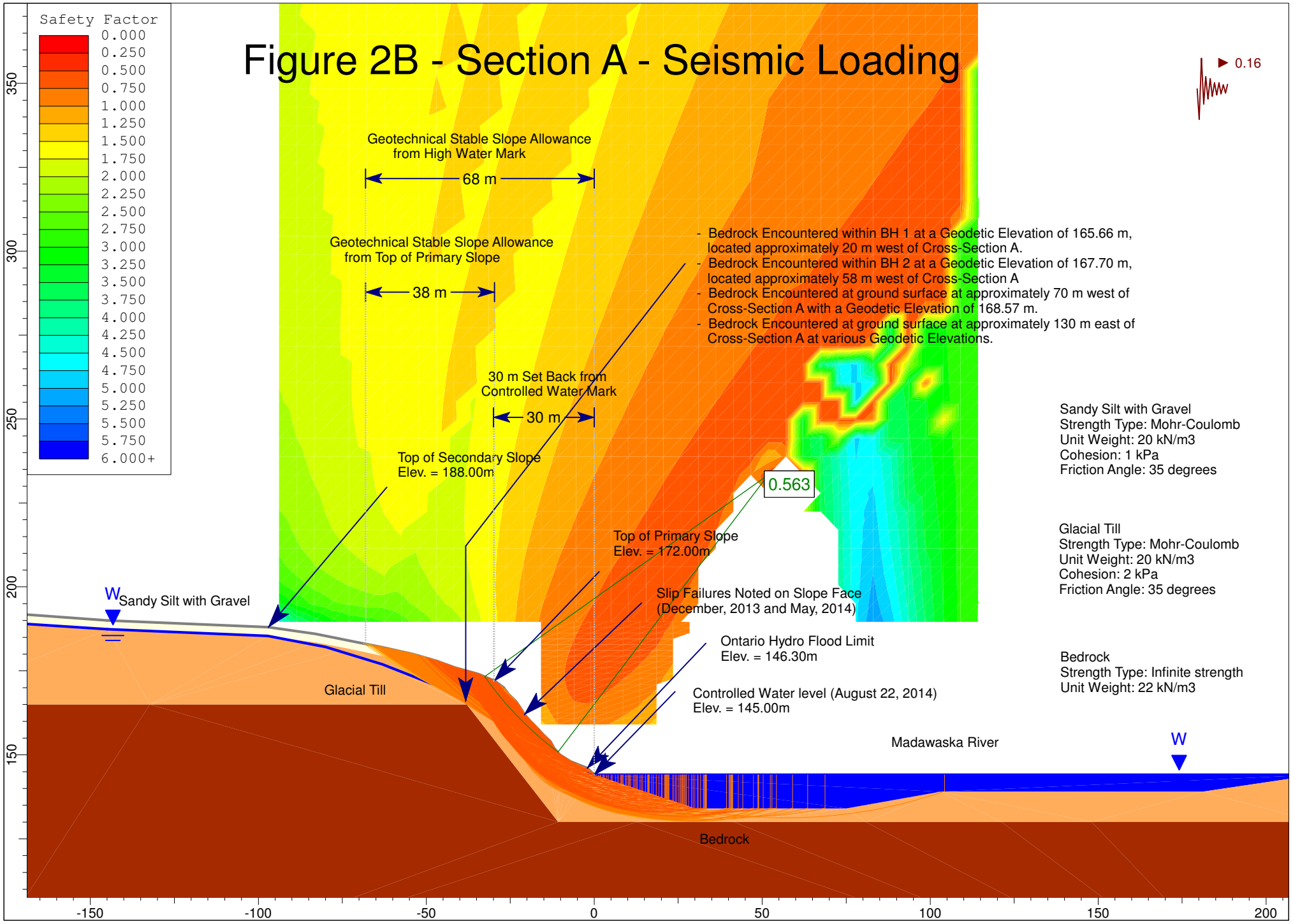


Figure 2B - Section A - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
Geotechnical Stable Slope Allowance from High Water Mark
68 m
Geotechnical Stable Slope Allowance from Top of Primary Slope
38 m
30 m Set Back from Controlled Water Mark
30 m
Top of Secondary Slope Elev. = 188.00m
Top of Primary Slope Elev. = 172.00m
0.563
- Bedrock Encountered within BH 1 at a Geodetic Elevation of 165.66 m, located approximately 20 m west of Cross-Section A.
- Bedrock Encountered within BH 2 at a Geodetic Elevation of 167.70 m, located approximately 58 m west of Cross-Section A
- Bedrock Encountered at ground surface at approximately 70 m west of Cross-Section A with a Geodetic Elevation of 168.57 m.
- Bedrock Encountered at ground surface at approximately 130 m east of Cross-Section A at various Geodetic Elevations.
Sandy Silt with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
W
Sandy Silt with Gravel
Slip Failures Noted on Slope Face (December, 2013 and May, 2014)
Ontario Hydro Flood Limit Elev. = 146.30m
Controlled Water level (August 22, 2014) Elev. = 145.00m
Glacial Till
Madawaska River
W
Bedrock
350
300
250
200
150
-150
-100
-50
0
50
100
150
200

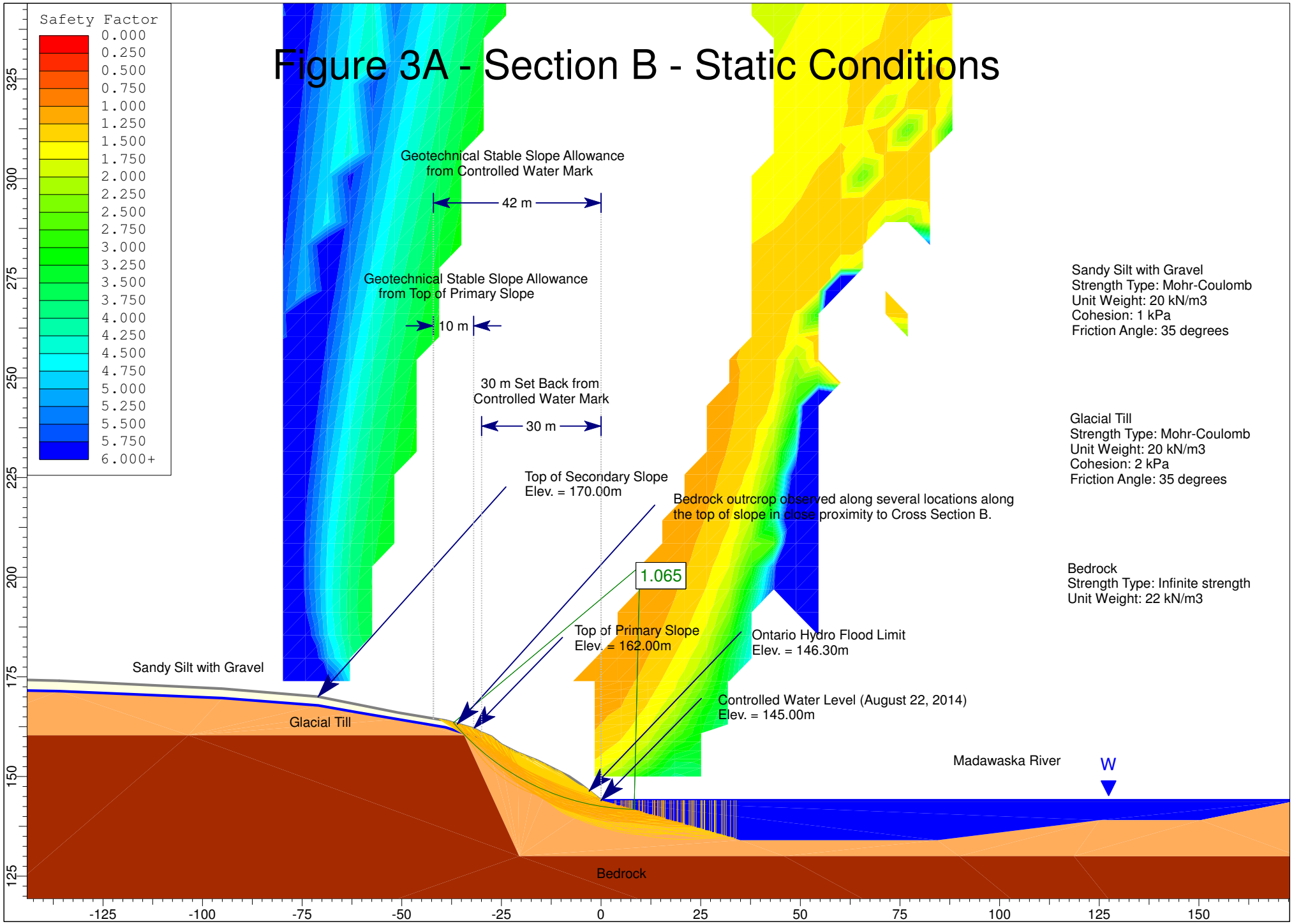


Figure 3A - Section B - Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Geotechnical Stable Slope Allowance from Controlled Water Mark
42 m
Geotechnical Stable Slope Allowance from Top of Primary Slope
10 m
30 m Set Back from Controlled Water Mark
30 m
Top of Secondary Slope Elev. = 170.00m
Bedrock outcrop observed along several locations along the top of slope in close proximity to Cross Section B.
1.065
Top of Primary Slope Elev. = 162.00m
Ontario Hydro Flood Limit Elev. = 146.30m
Controlled Water Level (August 22, 2014) Elev. = 145.00m
Sandy Silt with Gravel
Glacial Till
Bedrock
Madawaska River
W
Sandy Silt with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
325
300
275
250
225
200
175
150
125
-125
-100
-75
-50
-25
0
25
50
75
100
125
150

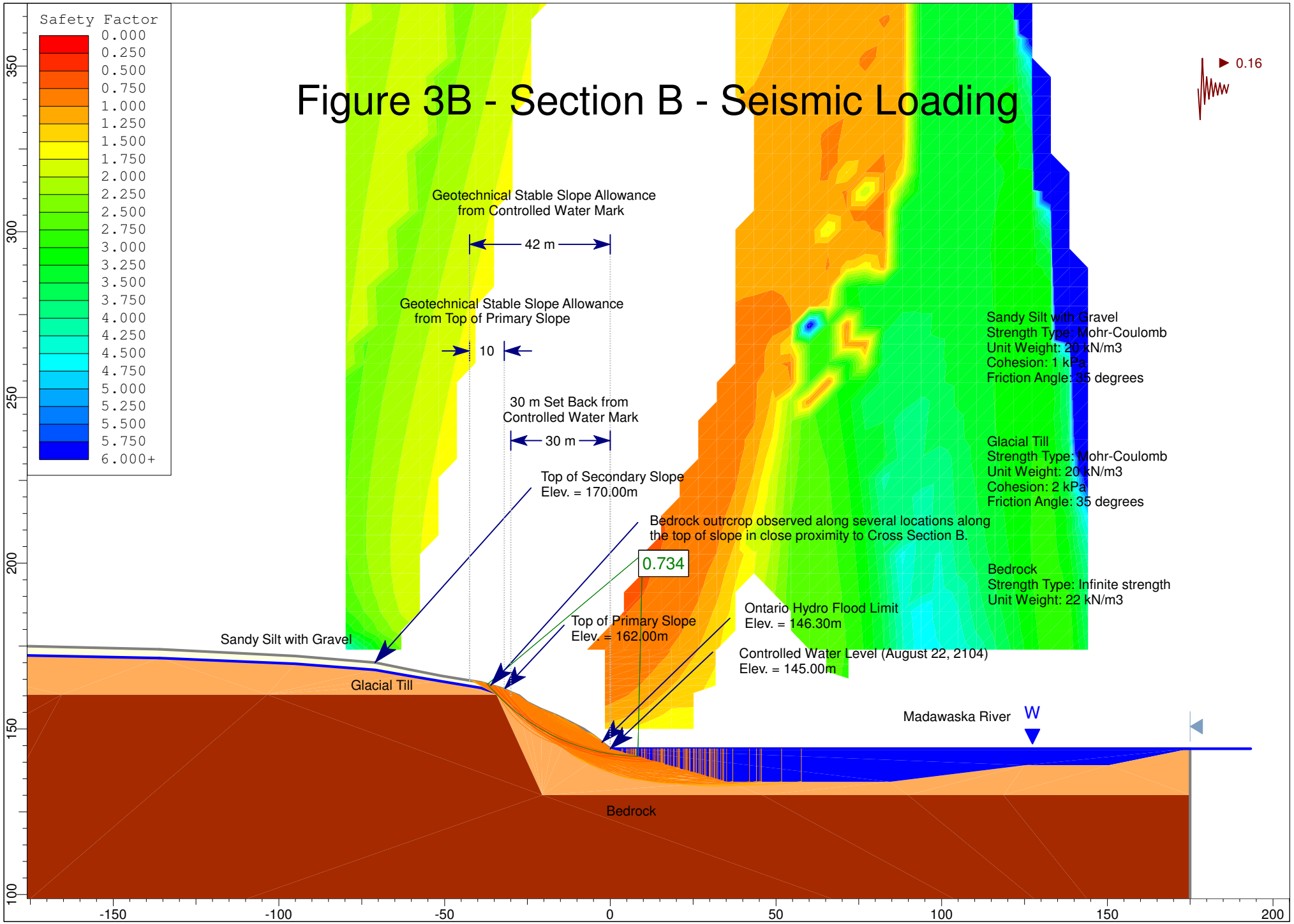


Figure 3B - Section B - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
Geotechnical Stable Slope Allowance
from Controlled Water Mark
42 m
Geotechnical Stable Slope Allowance
from Top of Primary Slope
10
30 m Set Back from
Controlled Water Mark
30 m
Top of Secondary Slope
Elev. = 170.00m
Bedrock outcrop observed along several locations along
the top of slope in close proximity to Cross Section B.
0.734
Top of Primary Slope
Elev. = 162.00m
Ontario Hydro Flood Limit
Elev. = 146.30m
Controlled Water Level (August 22, 2104)
Elev. = 145.00m
Sandy Silt with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Sandy Silt with Gravel
Glacial Till
Madawaska River
W
Bedrock
350
300
250
200
150
100
-150
-100
-50
0
50
100
150
200

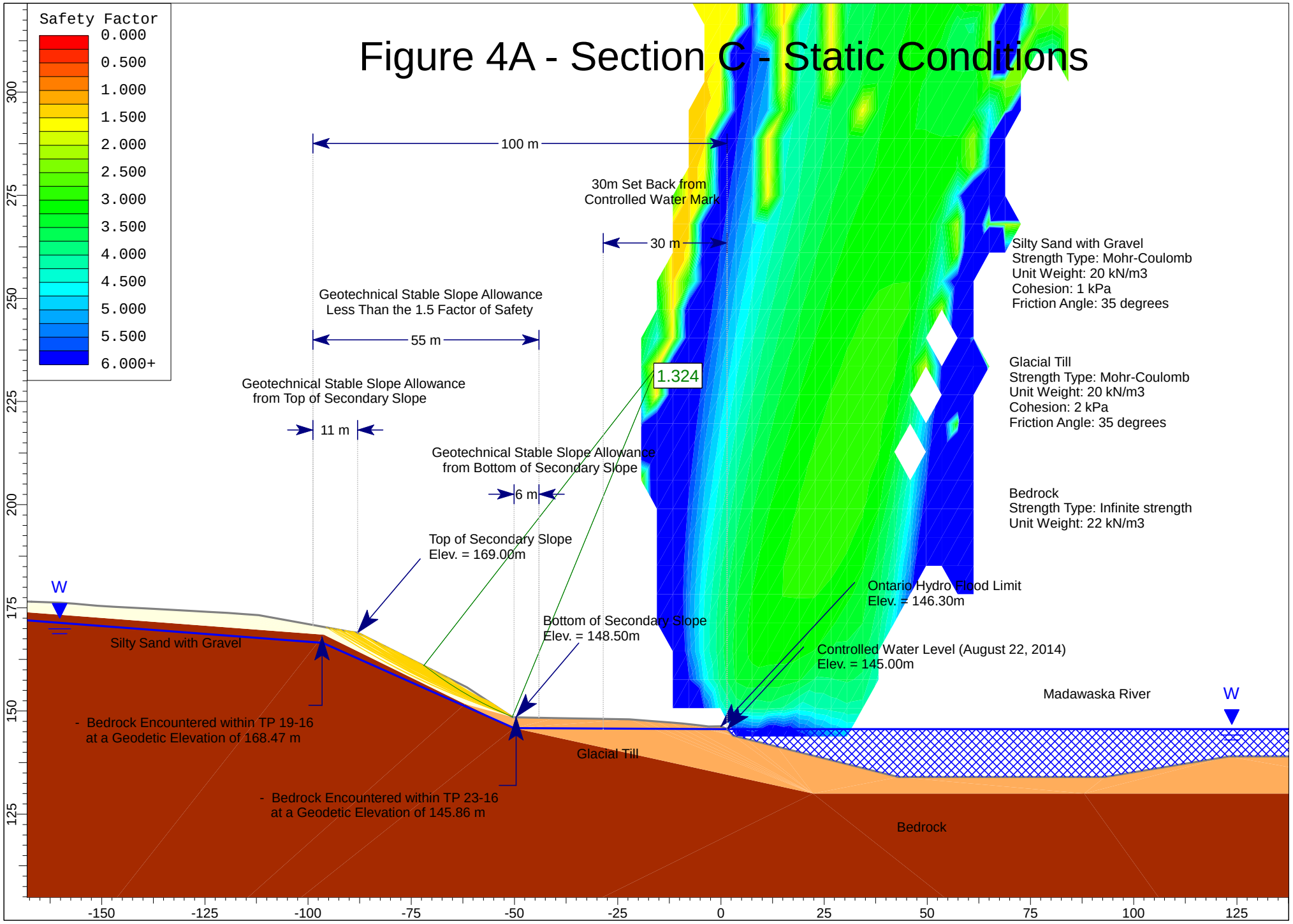


Figure 4A - Section C - Static Conditions
Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
100 m
30m Set Back from
Controlled Water Mark
30 m
Geotechnical Stable Slope Allowance
Less Than the 1.5 Factor of Safety
55 m
Geotechnical Stable Slope Allowance
from Top of Secondary Slope
11 m
Geotechnical Stable Slope Allowance
from Bottom of Secondary Slope
6 m
1.324
Top of Secondary Slope
Elev. = 169.00m
Bottom of Secondary Slope
Elev. = 148.50m
Silty Sand with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Ontario Hydro Flood Limit
Elev. = 146.30m
Controlled Water Level (August 22, 2014)
Elev. = 145.00m
Madawaska River
W
W
Silty Sand with Gravel
- Bedrock Encountered within TP 19-16
at a Geodetic Elevation of 168.47 m
Glacial Till
- Bedrock Encountered within TP 23-16
at a Geodetic Elevation of 145.86 m
Bedrock
300
275
250
225
200
175
150
125
-150
-125
-100
-75
-50
-25
0
25
50
75
100
125

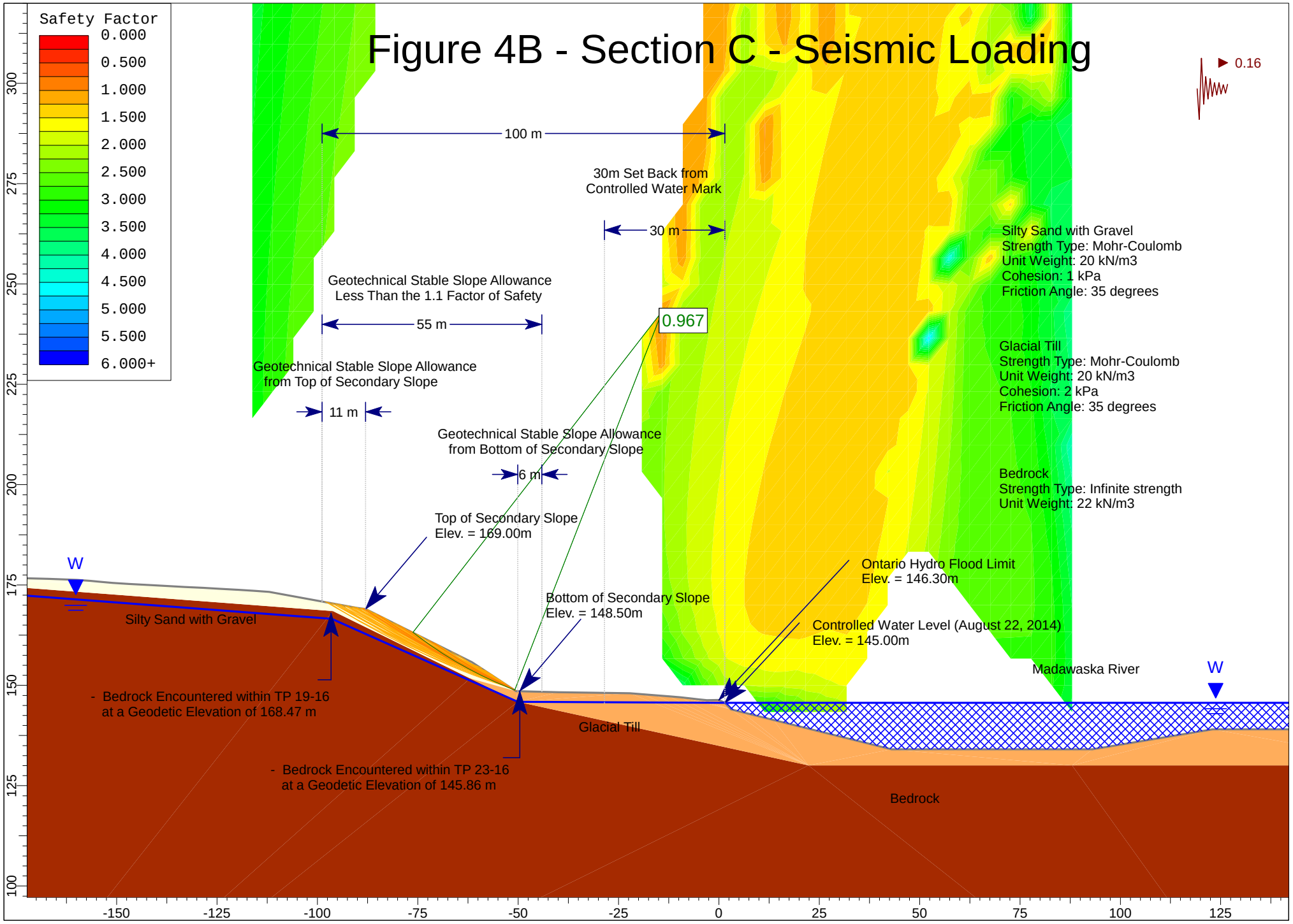


Figure 4B - Section C - Seismic Loading
Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
0.16
100 m
30m Set Back from
Controlled Water Mark
30 m
Geotechnical Stable Slope Allowance
Less Than the 1.1 Factor of Safety
55 m
0.967
Geotechnical Stable Slope Allowance
from Top of Secondary Slope
11 m
Geotechnical Stable Slope Allowance
from Bottom of Secondary Slope
6 m
Top of Secondary Slope
Elev. = 169.00m
Bottom of Secondary Slope
Elev. = 148.50m
Silty Sand with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
Ontario Hydro Flood Limit
Elev. = 146.30m
Controlled Water Level (August 22, 2014)
Elev. = 145.00m
Madawaska River
W
W
Silty Sand with Gravel
- Bedrock Encountered within TP 19-16
at a Geodetic Elevation of 168.47 m
Glacial Till
- Bedrock Encountered within TP 23-16
at a Geodetic Elevation of 145.86 m
Bedrock
300
275
250
225
200
175
150
125
100
-150
-125
-100
-75
-50
-25
0
25
50
75
100
125

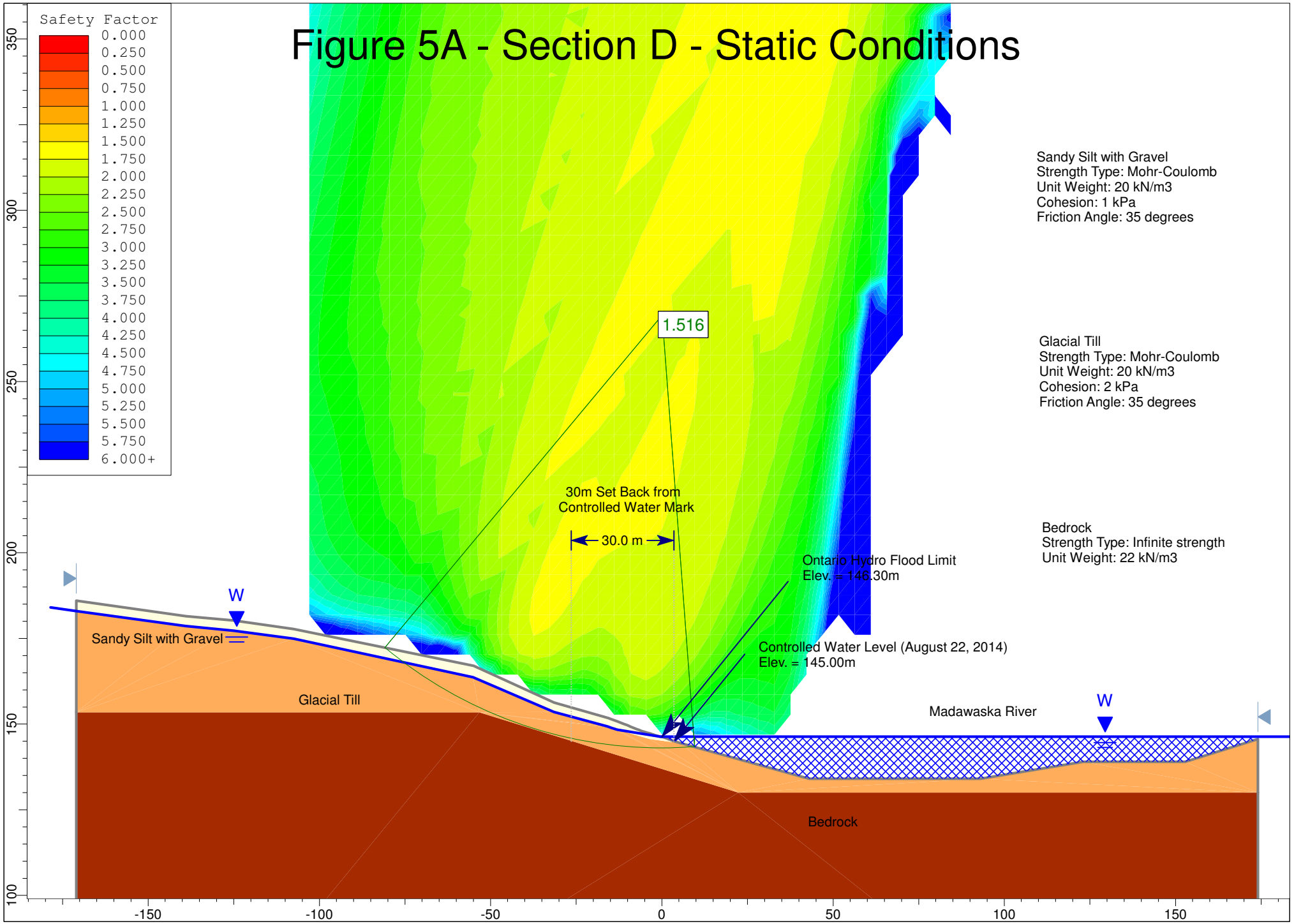


Figure 5A - Section D - Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.516
Sandy Silt with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
30m Set Back from
Controlled Water Mark
30.0 m
Ontario Hydro Flood Limit
Elev. = 146.30m
Controlled Water Level (August 22, 2014)
Elev. = 145.00m
W
W
Sandy Silt with Gravel
Glacial Till
Madawaska River
Bedrock
350
300
250
200
150
100
-150
-100
-50
0
50
100
150

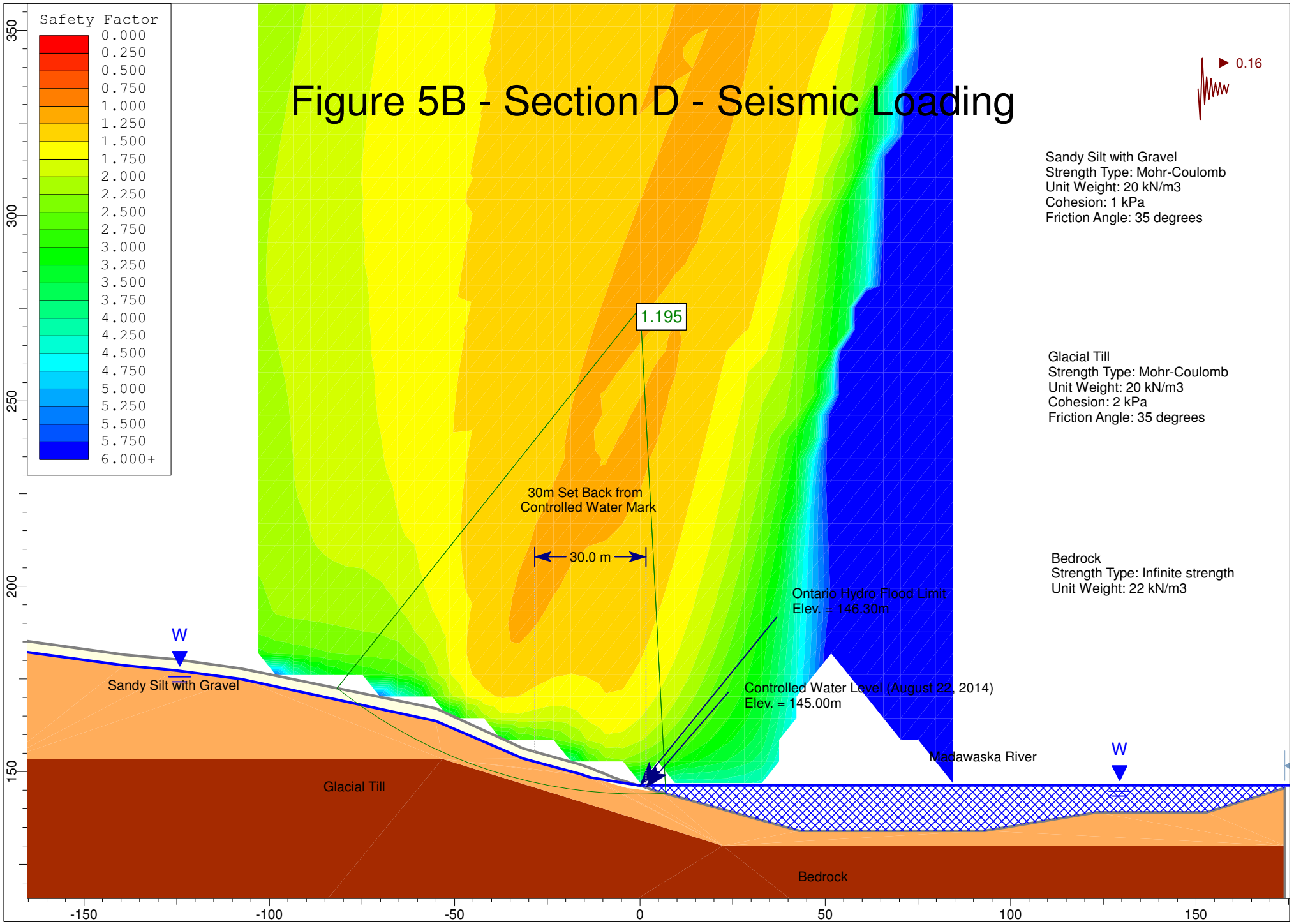


Figure 5B - Section D - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
Sandy Silt with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
1.195
30m Set Back from
Controlled Water Mark
30.0 m
Ontario Hydro Flood Limit
Elev. = 146.30m
Controlled Water Level (August 22, 2014)
Elev. = 145.00m
W
W
Sandy Silt with Gravel
Glacial Till
Madawaska River
Bedrock
350
300
250
200
150
-150
-100
-50
0
50
100
150

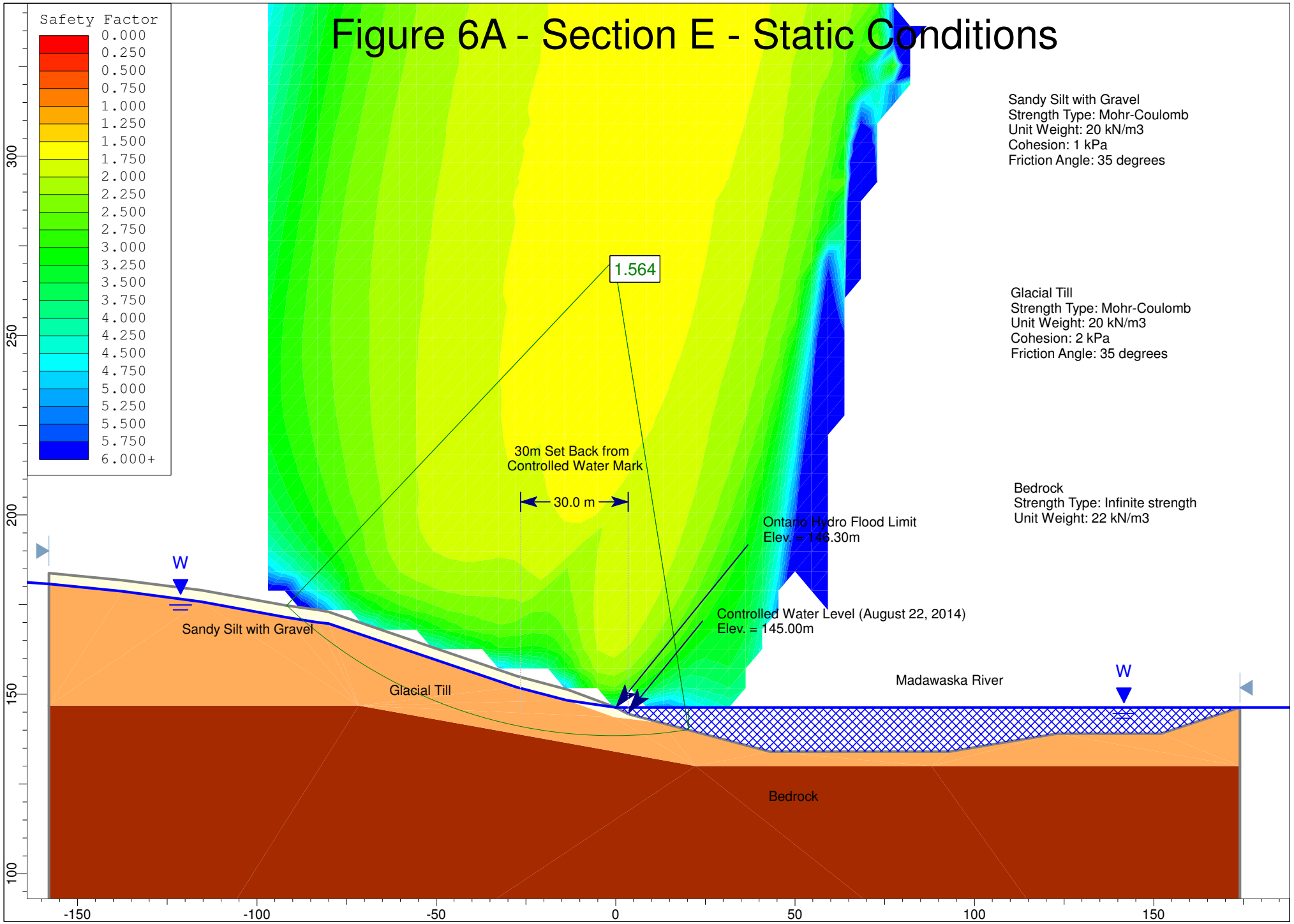


Figure 6A - Section E - Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.564
Sandy Silt with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
30m Set Back from
Controlled Water Mark
30.0 m
Ontario Hydro Flood Limit
Elev. = 146.30m
Controlled Water Level (August 22, 2014)
Elev. = 145.00m
W
W
Sandy Silt with Gravel
Glacial Till
Madawaska River
Bedrock
300
250
200
150
100
-150
-100
-50
0
50
100
150

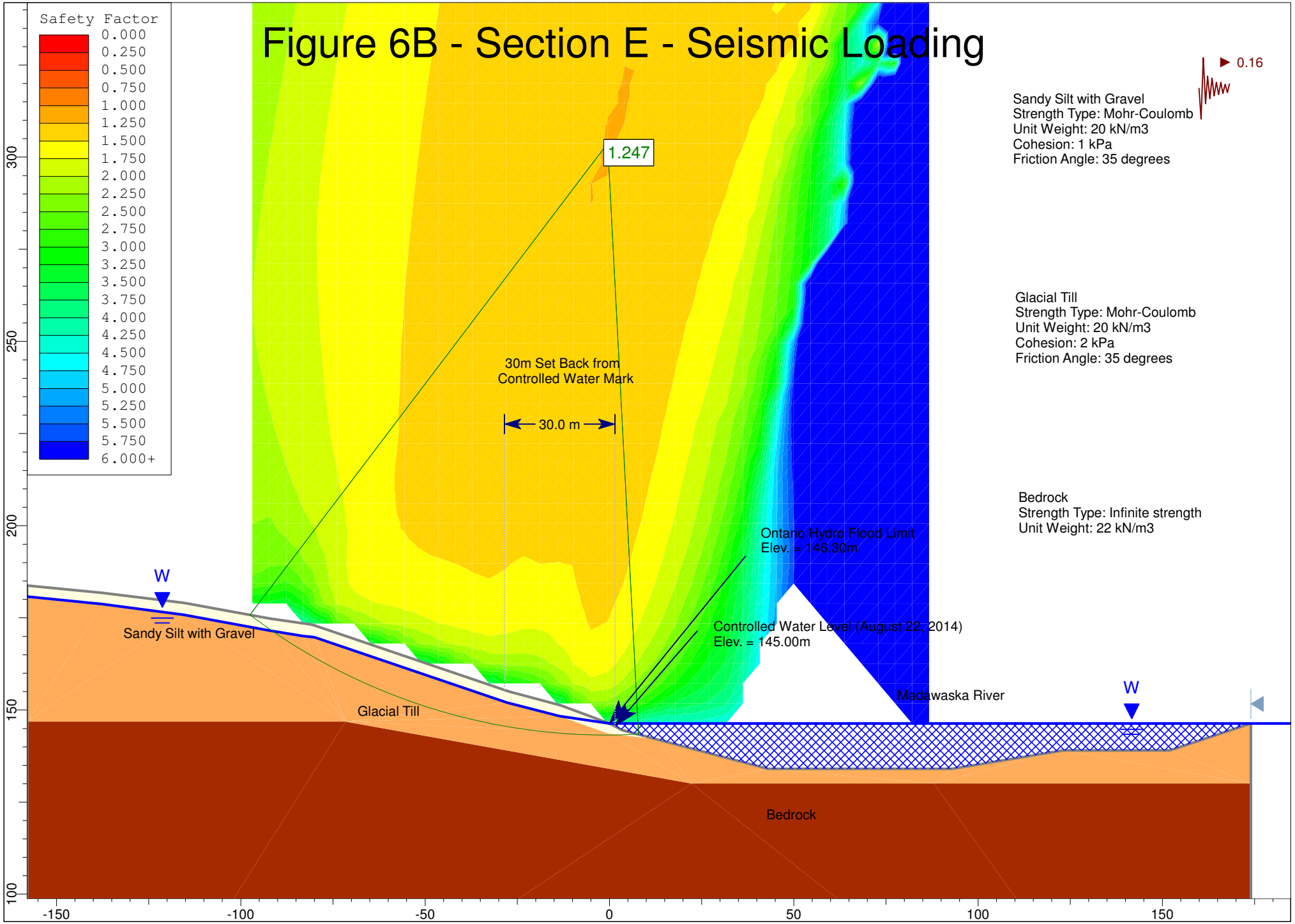


Figure 6B - Section E - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.247
0.16
Sandy Silt with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
30m Set Back from
Controlled Water Mark
30.0 m
Ontario Hydro Flood Limit
Elev. = 146.30m
Controlled Water Level (August 22, 2014)
Elev. = 145.00m
W
W
Sandy Silt with Gravel
Glacial Till
Madawaska River
Bedrock
300
250
200
150
100
-150
-100
-50
0
50
100
150

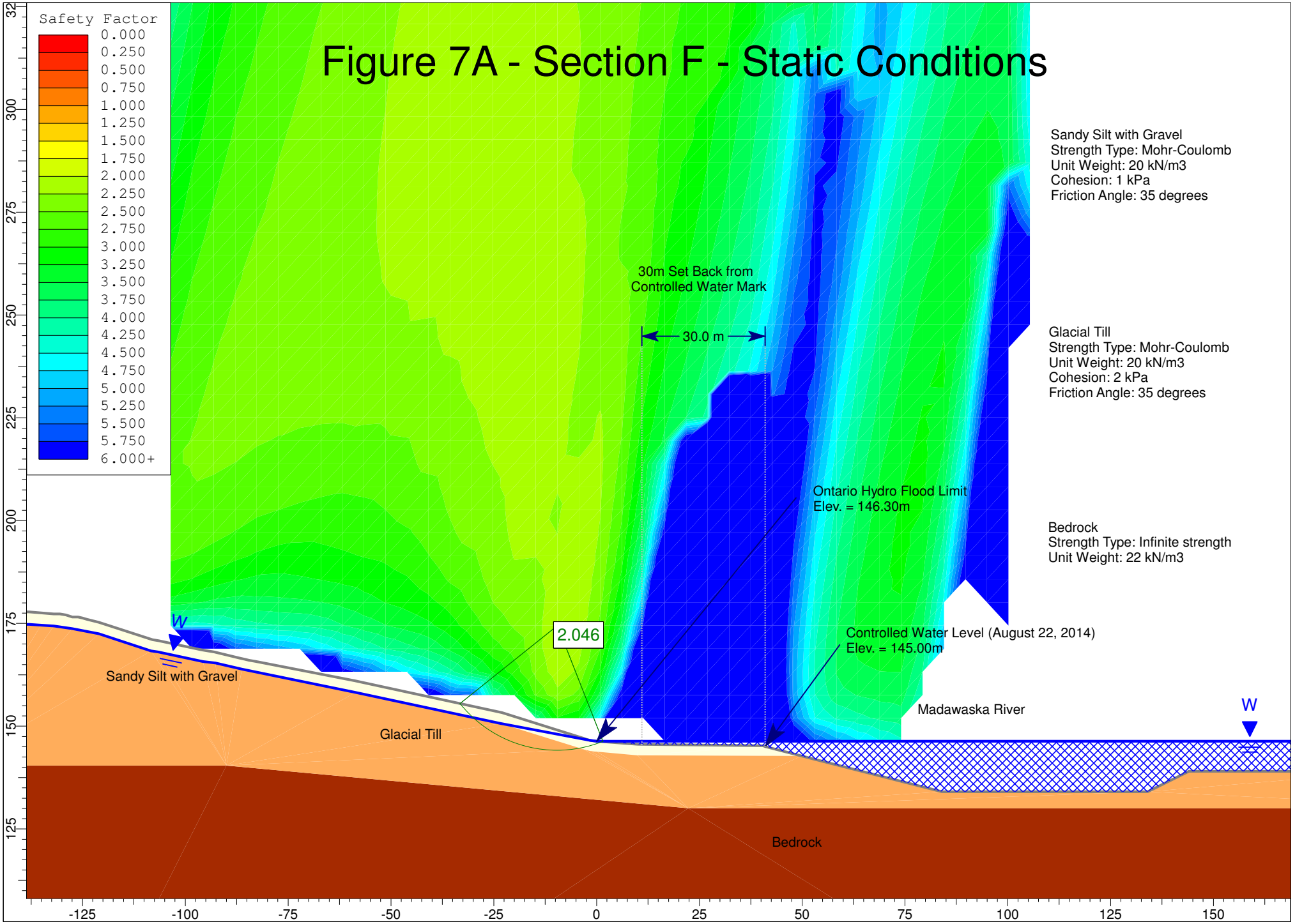


Figure 7A - Section F - Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Sandy Silt with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
30m Set Back from
Controlled Water Mark
30.0 m
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Ontario Hydro Flood Limit
Elev. = 146.30m
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
2.046
Controlled Water Level (August 22, 2014)
Elev. = 145.00m
W
Sandy Silt with Gravel
Glacial Till
Madawaska River
W
Bedrock
325
300
275
250
225
200
175
150
125
-125
-100
-75
-50
-25
0
25
50
75
100
125
150

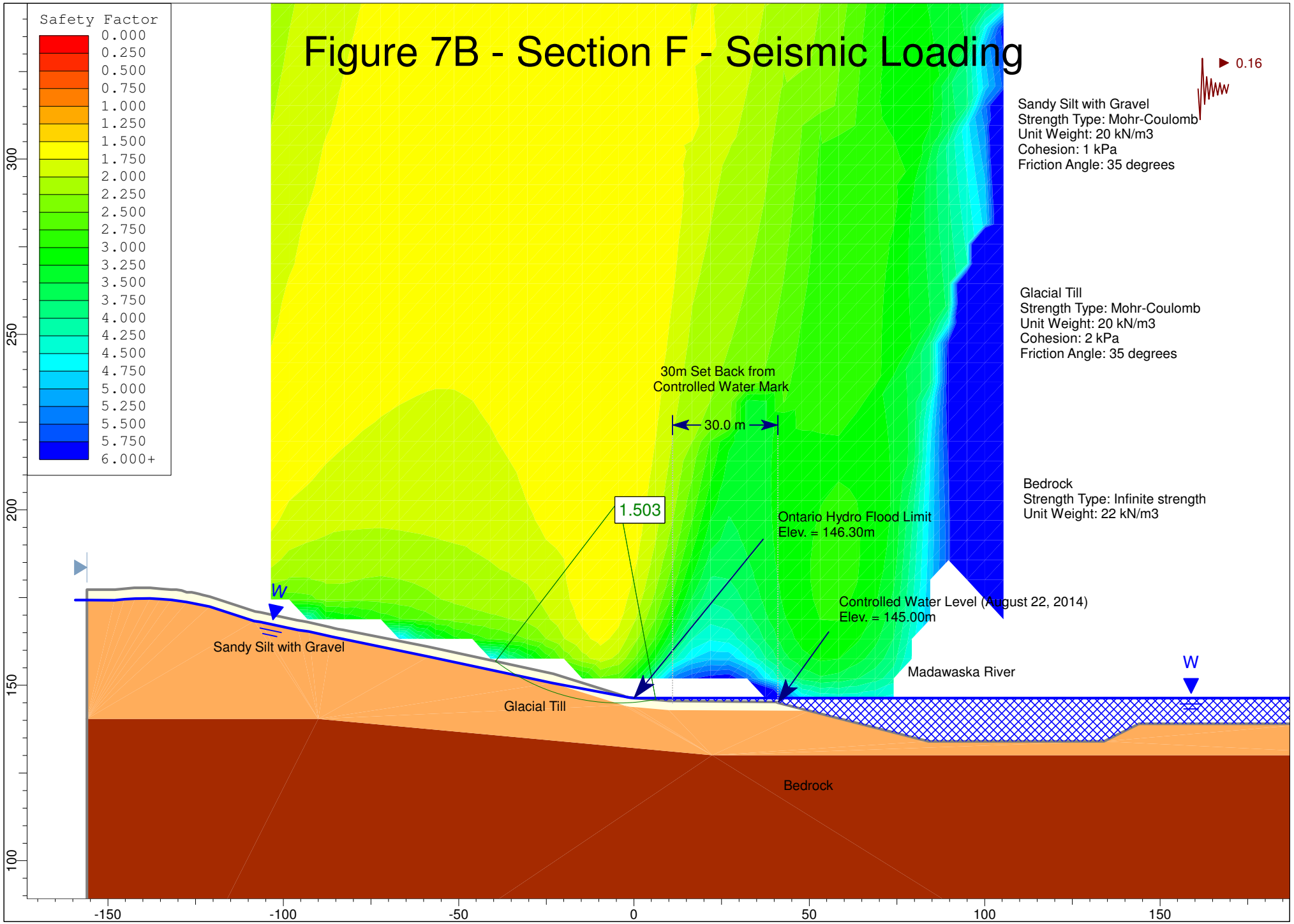


Figure 7B - Section F - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
Sandy Silt with Gravel
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Cohesion: 2 kPa
Friction Angle: 35 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 22 kN/m3
30m Set Back from
Controlled Water Mark
30.0 m
1.503
Ontario Hydro Flood Limit
Elev. = 146.30m
Controlled Water Level (August 22, 2014)
Elev. = 145.00m
W
W
Sandy Silt with Gravel
Glacial Till
Madawaska River
Bedrock
300
250
200
150
100
-150
-100
-50
0
50
100
150

LEGEND:

- TEST PIT LOCATION, CURRENT INVESTIGATION
- BOREHOLE LOCATION, PREVIOUS INVESTIGATION - PG3155, 2014
- TEST PIT LOCATION, PATERSON GROUP REPORT - PH2610, 2015
- TEST WELL LOCATION, PATERSON GROUP REPORT - PH2610, 2015
- 177.98 GROUND SURFACE ELEVATION (m)
- [165.66] BEDROCK SURFACE ELEVATION (m)
- (163.29) PRACTICAL REFUSAL TO EXCAVATION ON INFERRED BEDROCK SURFACE (m)
- A—A CROSS-SECTION LOCATION

ZONE 1 - NO BUILD ZONE WITH THE EXCEPTION OF APPROVED WATER ACCESS

ZONE 2 - BUILDABLE ZONE WITH GEOTECHNICAL CONDITIONS

ZONE 3 - BUILDABLE ZONE WITH NO GEOTECHNICAL CONDITIONS

TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS PROVIDED BY ADAM KASPRZAK SURVEYING LIMITED.

BASE PLAN PROVIDED BY JP2G CONSULTANTS INC.

SCALE: 1:1500

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
3	BASED PLAN UPDATED	MARCH 1, 2017	RG
2	PLACEMENT OF SLOPE STABILITY ZONES	FEB 19, 2017	RG
1	CONCEPTUAL SITE PLAN UPDATED	JULY 18, 2016	RG

KDSA DEVELOPMENT CORP.

PAVEMENT STRUCTURE RECOMMENDATIONS - SHADY MAPLE ROAD
PROPOSED RESIDENTIAL DEVELOPMENT - BUILDING SUPPLY ROAD
BURNSTOWN, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Stamp:

Scale:	1:1500
Drawn by:	RCG
Checked by:	RG
Approved by:	DJG
Date:	06/2016
Report No.:	PG3155-LET.05
Drawing No.:	PG3155-2
Revision No.:	3