Landslide Hazard Assessment

Petrie's Landing III

8600 Jeanne D'Arc Boulevard
Ottawa, Ontario

Prepared for 6382983 Canada Inc.

Report PG6414 – 2 dated May 5, 2023

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Appendices

1.0 Introduction

1.1 Purpose of Study and Scope of Work

Paterson Group (Paterson) was commissioned by 6382983 Canada Inc. to conduct a landslide risk assessment for the proposed multi-storey buildings development to be located within the complex at 8600 Jeanne D'Arc Boulevard, Ottawa, Ontario (reference should be made to Figure 1 - Key Plan in Appendix 2 of this report). The study has been prepared in response to the requirement by the Rideau Valley Conservation Authority (RVCA) as part of the Site Plan Approval process for the City of Ottawa for the subject site.

The objectives of the risk assessment were to:

- ❑ Demonstrate that any landslide on the sloped areas, including a large "catastrophic landslide", has an annual probability less than 1:10,000.

- ❑ If the landslide hazard cannot be demonstrated to have an annual probability of less than 1:10,000, it must be demonstrated that the individual risk is $<1x10^{-5}$ per year and group risk falls within the "Acceptable" zone on a suitable group risk chart.

- ❑ If none of these criteria can be satisfied without mitigation measures, then the mitigation actions required must be demonstrated to reduce the risk below 10^{-5} per year and to "as low as reasonably practicable" (ALARP). If mitigation is required, further discussion with the RVCA will be required to determine what will be acceptable.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

1.2 Risk Assessment Methodology

The methodology of this study was undertaken using a combination of the criteria and requirements set out by the following risk assessment guidelines:

- ❑ Fraser Valley Regional District's Hazard Acceptability Thresholds for Development Applications dated October 2020

- ❑ The Association of Professional Engineers and Geoscientists of British Columbia's (APEGBC) Guidelines for Legislates Landslide Assessments for Proposed Residential Developments in BC, dated May 2010

- ❑ Geological Survey of Canada's Open File 7312 - Landslide Risk Evaluation Technical Guidelines and Best Practices, dated 2013

The scope of work used in this assessment included a review of published literature describing local landslides and their associated triggers, geotechnical hazards, inventoried regional landslides and the geological setting of the study area. Desktop review of published topographic mapping, LiDAR imaging, and other geological mapping was also used as part of this assessment.

Field reconnaissance was carried out over several geotechnical field programs that have taken place throughout the subject site, including field review and subsurface investigations. Review of publicly available well records located in close proximity to the subject site was also considered as part of our assessment.

1.3 Proposed Development

Based on available information, the proposed development will consist of several multi-storey residential and mixed-use buildings. Associated asphaltic parking areas, access lanes and landscaped areas are also anticipated as part of the development. It is expected that the proposed buildings will be fully municipally serviced.

1.4 Review of Previous Geotechnical Investigation

For this assessment, subsurface information was collected from a set of site-specific investigations carried out by Paterson throughout the subject site. The results of the previous investigations are presented in the following reports:

- ❒ Report Prepared for Brigil Homes – Preliminary Geotechnical Investigation – 32 Acre Property – North Service Road, Ottawa, Ontario – PG1565-1 dated December 10, 2007.

- ❒ Report prepared for 6382983 Canada Inc. – Geotechnical Investigation – 8600 Jeanne D'Arc Boulevard, Ottawa, Ontario – PG6414-1 dated December 23, 2022.

2.0 Background of Study Area

2.1 Field Investigation

Geotechnical Investigations

Paterson has undertaken two geotechnical investigations at the subject site. The initial portion of the geotechnical investigation was carried out on November 8, 2007. At that time a total of three (3) boreholes were advanced to a maximum depth of 9.6 m. below ground surface. An additional geotechnical investigation was carried out in October 2022 and consisted of eleven (11) boreholes advanced to a maximum depth of 9.6 m below the existing ground surface throughout the subject site.

The test hole locations were placed in a manner to provide general coverage of the subject site taking into consideration site access, features and underground utilities. The borehole locations were determined in surveyed in the field by Paterson personnel. The locations of the boreholes are illustrated on Drawing PG6414-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were completed using a track-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of personnel from Paterson's geotechnical division under the direction of a senior engineer. The testing procedure for boreholes consisted of augering to the required depths and at the selected locations and sampling the overburden.

Sampling and In Situ Testing

Borehole samples were recovered from a 50 mm diameter split-spoon (SS) or the auger flights (AU). All soil samples were visually inspected and initially classified on site. The split-spoon and auger samples were placed in sealed plastic bags and transported to our laboratory for further examination and classification. The depths at which the split-spoon and auger samples were recovered from the test holes are shown as SS and AU, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

A Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split spoon samples. The SPT results are recorded as "N" values on the Soil Profile and Test Data sheets. The "N" value is the number of blows required to drive the split spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

The thickness of the overburden was evaluated during the course of the current investigation by a dynamic cone penetration test (DCPT) at boreholes BH 1-22 to BH 9-22. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at its tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

Undrained shear strength testing was carried out at regular depth intervals in cohesive soils using a field vane apparatus.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1.

Groundwater

Groundwater monitoring wells were installed in boreholes BH1-22, BH8-22 and BH10-22, and flexible standpipe piezometers were installed in all other boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. All groundwater observations are noted on the Soil Profile and Test Data sheets presented in Appendix 1.

Geotechnical Laboratory Testing

Soil samples were collected from the subject site during the investigation and were visually examined in our laboratory to review the results of the field logging. Seven (7) soil samples were submitted for Atterberg Limit testing, one (1) sample was submitted for Sieve Analysis and one (1) sample was submitted for Shrinkage.

The results of the Atterberg Limit's testing are presented on Table 1 below, and on Atterberg's Limits Testing Results sheet, presented in Appendix 1.

Table 1 - Atterberg Limits Results

Sample	Depth (m)	LL (%)	PL (%)	PI (%)	w (%)	Classification
BH 3-22 SS3	1.83	73	23	50	46.4	CH
BH 5-22 SS3	1.83	80	24	56	36.3	CH
BH 6-22 SS3	1.83	84	23	61	62.6	CH
BH 7-22 SS3	1.83	86	24	62	53.4	CH
BH 9-22 SS2	1.07	88	26	62	47.2	CH
BH 10-22 SS2	1.07	76	25	51	40.0	CH
BH 11-22 SS2	1.07	76	25	51	39.1	CH

Notes: LL: Liquid Limit; PL: Plastic Limit; PI: Plasticity Index; w: water content;
CH: Inorganic Clay of High Plasticity.

The results of the shrinkage limit test indicate a shrinkage limit of 21.2% and a shrinkage ratio of 1.73.

Grain size distribution (sieve and hydrometer analysis) was also completed on selected soil samples. The results of the grain size analysis are summarized in Table 2 and presented on the Grain-Size Distribution and Hydrometer Testing Results sheets in Appendix 1.

Table 2 - Summary of Grain Size Distribution Analysis

Test Hole	Sample	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH 10-22	SS3	0.0	0.2	28.3	71.5

2.2 Existing Conditions

Surface Conditions

The subject site is currently undeveloped and generally vacant. In addition, Taylor Creek, a tributary to Ottawa River, meanders along the west portion of the subject site surrounded by an area with heavy vegetation, shrubs, and trees. Some signs of toe erosion were noted where the watercourse is in proximity to the valley corridor wall.

The site is bordered to the north by Jeanne D'Arc Boulevard, followed by the Petrie Islands group and Ottawa River, to the east by an educational institution, to the south by Highway 174, and to the west by a residential development.

The ground surface across the subject site is generally flat with a gradual slope towards the north. However, the margins of the creek located on the west portion of the subject site present a steeper slope. It should also be noted that the area following Jeanne D'Arc Boulevard and along Ottawa River is composed of a sloped terrain and valley corridors.

Due to the presence of the slopes bordering Taylor Creek, a slope stability assessment was carried out considering the slope conditions present in the subject site and described above. The results of the slope stability assessment are discussed further in Section 3.0 of this report.

Since the toe of slope located along the Ottawa River is protected from erosion by shoreline protection measures, it is our opinion that a slope stability assessment for the north boundary of the subject site is not required. In addition, as the north boundary of the subject site is at least 6 m from top of slope, an erosion access allowance would not interfere with the subject site.

Subsurface Conditions

Generally, the overburden profile consisted of a thin layer of topsoil underlain by a very deep clay deposit, followed by an inferred glacial till deposit.

The silty clay deposit generally consisted of a hard to very stiff weather silty clay crust followed by a firm to stiff grey silty clay deposit. The brown silty clay deposit was observed to extend to depths ranging between 2.3 m to 5.9 m below the existing grade.

Practical refusal to DCPT was only encountered at BH9-22 at an approximate depth of 41 m below existing grade. A glacial till deposit was inferred below the silty clay layer based on the number of blows required to advance the DCPT at all locations.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profiles encountered at each test hole location and Drawing PG5201-2 – Test Hole Location Plan in Appendix 2.

Bedrock

Based on available geological mapping, the bedrock in the subject site consists of interbedded limestone and dolomite of the Gull River formation. The overburden drift thickness is estimated to range between 25 to 50 m.

Groundwater

Groundwater level readings were recorded on November 7, 2022 and November 13, 2007 and are presented in Table 3 and on the Soil Profile and Test Data sheets in Appendix 1. It should be noted that surface water can become trapped within a backfilled borehole that can lead to higher than typical groundwater level observations. Additionally, groundwater levels are subject to seasonal fluctuations, therefore the groundwater levels could vary at the time of construction.

Long-term groundwater level can be estimated based on the observed color, moisture levels and consistency of the recovered soil samples. Based on these observations, the long-term groundwater is between 3.0 to 4.0 m in the areas of BH6-22 to BH9-22 and between 4.0 to 6.0 m in the areas of the remaining boreholes.

Table 3 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Depth (m)	Groundwater Elevation (m)	Recording Date
BH1	53.07	1.59	51.48	November 13, 2007
BH2	52.31	2.7	49.61	November 13, 2007
BH3	49.65	1.53	48.12	November 13, 2007
BH1-22*	51.16	5.72	45.44	November 7, 2022
BH2-22	52.14	7.11	45.03	November 7, 2022
BH3-22	52.67	2.05	50.62	November 7, 2022
BH4-22	51.32	2.22	49.10	November 7, 2022
BH5-22	51.18	2.66	48.52	November 7, 2022
BH6-22	53.46	5.18	48.28	November 7, 2022
BH7-22	53.33	7.42	45.91	November 7, 2022
BH8-22*	53.04	3.20	49.84	November 7, 2022
BH9-22	52.77	3.65	49.12	November 7, 2022
BH10-22*	52.22	5.22	47.00	November 7, 2022
BH11-22	51.5	1.75	49.75	November 7, 2022

Note:
- The ground surface elevations are referenced to a geodetic datum.
- * Borehole with groundwater monitoring well

3.0 Slope Stability Analysis

Slope Conditions

Paterson completed a field review of the slope along Taylor Creek, which was observed to meander along the west portion of the subject site. The slope face presents an approximate inclination of 3H:1V and appeared to be well vegetated, covered with grass and mature trees. The creek was generally observed to be located along the toe of the slope except for the northwest portion of the site where the creek was noted to present over 40 m of setback from the bottom of the slope.

The creek flows under a concrete culvert under Jeanne D'Arc Boulevard. Blast stone and rip-rap stone material were observed to have been placed to protect against erosion next to the culvert and road embankment.

Some signs of erosion and scouring were observed along the path of the creek towards the south. Paterson also surveyed the top and toe of the slope on this date using a mobile GPS unit.

Slope Stability Analysis

The slope stability analysis was modeled in SLIDE, a computer program which permits a two-dimensional slope stability analysis calculating several methods including the Bishop's method, which is a widely accepted slope analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to forces favoring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsurface soil and groundwater conditions, a factor of safety greater than 1.0 is generally required for the failure risk to be considered acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the slope failure would comprise permanent structures. An analysis considering seismic loading was also completed. A horizontal acceleration of 0.16 g was considered for the sections for the seismic loading condition. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

Five (5) slope cross-sections were analyzed based on the existing conditions observed during our site visit, and review of the available topographic mapping. The slope stability analysis was completed at each slope cross-section under worst-case-scenario by assigning cohesive soils under fully saturated conditions. Subsoil conditions at the cross-sections were inferred based on the findings at borehole locations along the top of slope, field observations during site visits and general knowledge of the area's geology.

The cross-section locations are presented on Drawing PG6414-1 – Test Hole Location Plan in Appendix 2. It should be noted that details of the slope height and slope angle at the cross-section locations are presented in Figures 4A through 8B in Appendix 2 from the topographic data identified on Drawing PG6414-1 - Test Hole Location Plan in Appendix 2.

The effective strength soil parameters used for static analysis were chosen based on the subsoil information recovered during the geotechnical investigation. The effective strength soil parameters used for static analysis are presented in Table 4.

Table 4 – Effective Stress Soil Parameters (Static Analysis)

Soil Layer	Unit Weight (kN/m^3)	Friction Angle (degrees)	Cohesion (kPa)
Topsoil	16	30	5
Brown Silty Clay	17	33	5
Grey Silty Clay	17	33	10
Glacial Till	20	38	5

The total strength parameters for seismic analysis were chosen based on the subsurface conditions observed in the test holes, and our general knowledge of the geology in the area. The strength parameters used for seismic analysis at the slope cross-sections are presented in Table 5.

Table 5 – Total Stress Soil Parameters (Seismic Analysis)

Soil Layer	Unit Weight (kN/m^3)	Friction Angle (degrees)	Cohesion (kPa)
Topsoil	16	30	5
Brown Silty Clay	17	-	100
Grey Silty Clay 1 (to a depth of 9.6 m)	17	-	50
Grey Silty Clay 2	17	-	60
Glacial Till	20	37	0

Stable Slope Allowance

The static analysis results for slope sections A, B, C, D and E are presented in Figures 4A, 5A, 6A, 7A, and 8A, respectively, provided in Appendix 2.

The factor of safety for the slope was greater than 1.5 for slope section B. A factor of safety less than 1.5 was noted for Section A, C, D and E, therefore a slope stability setback would be required, if the existing slope was not re-graded as part of the proposed development. A stable slope setback of 4 m, 15 m and 4 m for Section A, C and Section D, respectively would be required if the existing slope is not modified.

Slope section E was noted to have a factor of safety lower than 1.5 under static loading at the toe of the slope. The low factor of safety indicates a potential of minor surficial slope failure at the toe of the slope mainly caused by erosion. The potential slope failure is limited to the upper layer of soil and concentrated at the toe of the slope. Such failure will not affect the stability of the upper section of the slope.

The results of the analyses with seismic loading are shown in Figures 4B, 5B, 6B, 7B and 8B presented in Appendix 2. The factor of safety for the slopes was greater than 1.1 for all slope sections. Based on these results, the slopes are considered to be stable under seismic loading. No further stable slope setback is required.

Toe Erosion and Erosion Access Allowance

The slopes were generally observed to be vegetated with trees and brush. Furthermore, flow from the creek in the watercourse at the base of the slopes was observed to be minimal at the time of inspection though, signs of active erosion were observed at the toe of the slopes.

The toe of erosion allowance is based on the nature of the soils, the observed current erosion activities, and the width and location of the current watercourse. Based on the soil profile encountered at the test hole locations, and our site observations completed during the slope stability assessment, a toe erosion allowance of 7 m is recommended for slope section A, B, C, and D.

It should be noted that toe erosion at slope section A was measured from the toe of the slope as allowed by the guidelines when the watercourse is located at 30 m or greater from the base of the slope. It is expected that failure of the slope due to toe erosion would occur along the flat plane adjacent to the watercourse. As such, the toe erosion for slope section A does not affect the required setback at section A.

As noted above, the slope section E was noted to have a factor of safety lower than 1.5 under static loading at the toe of the slope. Such failure will not affect the stability of the upper section of the slope. However, given the lower factor of safety, an increased toe allowance of 8 m was utilized for slope section E.

Further, based on the generally accepted guidelines, a 6 m erosion access allowance was recommended from the top of stable slope for the slopes to allow for future maintenance of the slope.

To lower the erosion allowance setback, an erosion protection program consisting of covering the banks of the creek with rip rap and blast stone material can be completed. Note that the current setbacks are provided for the current conditions at the base of the slope. Paterson should prepare the erosion protection program and review its implementation to re-evaluate the erosion allowance setbacks.

Limit of Hazard Lands

The results of the slope stability assessment indicate that Limit of Hazard Lands setbacks of 10, 27, 28, 17 and 14 m, as measured form the top of the slope, should be provided for any proposed structures at the subject site in the areas of Section A, B, C, D and E respectively, in order to provide a suitable factor of safety of 1.5 under static conditions and 1.1 under seismic conditions.

Furthermore, grade raise is not recommended in the limit of hazard lands. If any grading is recommended in the area, Paterson should review for any negative impact on the slope.

It is recommended that the existing vegetation and mature trees not be removed from the slope faces as the presence of the vegetation reduces surficial erosion activities. If the existing vegetation needs to be removed along the slope faces, it is recommended that a 100 to 150 mm of topsoil mixed with a hardy seed, or an erosional control blanket be placed across the exposed slope face.

Seismic Design Considerations

Based on the results of the geotechnical investigation, a seismic **Site Class E** is considered applicable for foundation design within the area of the subject site as per Table 4.1.8.4.A of the OBC 2012.

Due to the compactness of the silty clay deposit and the long-term groundwater level, soils underlying the subject site are not susceptible to liquefaction. Refer to the latest revision of the OBC 2012 for a full discussion of the earthquake design requirements.

4.0 Landslide Hazard and Risk Assessment

4.1 General Methodology of Assessment

The methodology for the landside hazard assessment undertaken for this report may be considered as the following:

- ❏ Identify factors that are documented to contribute to the susceptibility for a landslide to occur throughout sloped terrain.
- ❏ Relate the aforementioned factors to the susceptibility for a landslide to occur throughout the subject site.
- ❏ Estimate the probability of a landslide to occur throughout the subject site based on historical regional landslide inventories. A baseline regional probability will be adjusted to a site-specific probability considering the site-specific factors that may promote landslide susceptibility using a Frequency Estimation Method.

If the hazard under consideration cannot be demonstrated to have an annual probability of less than 1:10,000, a group risk assessment estimating the annual probability of loss of lives would be carried out in accordance with the following equation:

$$\text{Risk} = P(H) \times P(S{:}H) \times P(T{:}S) \times V \times E$$

Where R = the risk or annual probability of loss of life of an individual, P(H) = the annual probability that a landslide occurs, P(S:H) = the probability of impacting the elements taking into consideration the scale and location of the landslide events, P(T:S) = the temporal spatial probability of the elements being present at the time of a landslide (i.e.- the probability that a person is present at the location at risk), V = the vulnerability, or likelihood of death or permanent injury of the individual given they are impacted and E = the number of elements that would be impacted. E will also be considered the number of occupants for the grouped areas.

4.2 Factors Affecting Landslide Susceptibility

The following sections discuss factors understood to affect the potential for a landslide to occur. The factors are described briefly and subsequently discussed on their impact to the susceptibility of a landslide throughout the subject site. The study area for the purpose of this discussion is considered as the area bound by the area considered by the Geological Survey of Canada under Open File 5311. The property discussed throughout this report is considered the subject site.

4.2.1 Clay Overburden

Based on the findings of the geotechnical investigation, the slope profiles throughout the subject site consist primarily of a silty clay deposit underlain by an inferred relatively thin layer of glacial till and further by bedrock. Based on geological mapping undertaken by the Geological Survey of Canada under Open File 5311, the local deposit is considered as offshore marine sediments consisting of erosional terraces.

The clay deposit encountered throughout the subject site was observed to consist of a hard to very stiff, weathered, brown silty clay crust extending to depths between 2.3 and 5.9 m below the ground surface. The brown silty clay was underlain by a deep firm to stiff grey silty clay deposit underlain by an inferred glacial till. Sand was not encountered above the clay deposit to form a "sand cap" layer at any borehole as has been documented throughout the Ottawa valley.

Review of landslides inventoried under Geological Survey of Canada (GSC) Open Files 5311, 7432 and 8600 document approximately 132 large landslide footprints throughout the Ottawa region. There is some overlap between these three inventories given the background for each document. Open File (OF) 5311 identifies these footprints as "*Landslide Area – Reworked Marine Sediments*". OF8600 identifies these landslide footprints with greater precision, as it is understood to have been carried using digital elevation models (DEM) and LiDAR imaging for the boundary occupied by the City of Ottawa. OF7432 is a compilation of radiocarbon dates for approximately 45 landslides throughout the Ottawa Valley.

Review of the surficial geology for land adjacent to the landslides inventoried by the above-noted sources indicated approximately 83% (i.e., 109 out of 114 landslides captured by the study area published in OF5311) of these landslides may have originated from marine deposits consisting of clay. The remaining five landslides were considered to have consisted of alluvial sediments and/or organic deposits.

It has been documented that approximately 10 very large (i.e., surface area greater than 1 km2) landslides in the Ottawa Valley have occurred throughout subsurface profiles containing a surficial sand cap layer (Fransham and Gadd, 1977). This study provided a surficial geology map for the Ottawa Valley identifying areas of sand and gravel overlying clay and areas consisting solely of silt and clay.

The study concluded there is a higher incidence for very large landslides to occur throughout clay deposits with an overlying sand cap. Nearly a hundred additional landslides have been identified by GSC throughout the area of the mapping prepared by Fransham and Gadd. The majority of the more recently documented smaller-sized landslides have occurred throughout the "clay" unit.

The presence of a weathered clay crust had been considered favorable in resisting the potential for a landslide to occur. However, review of 37 landslides throughout the Ottawa Valley and downstream of the Ottawa River and throughout Champlain Sea marine clay deposits indicate that clay crust and sand-capped clay deposits behave similarly during large retrogressive landslides (Perret, 2019). Based on this, it is inconclusive if the presence of a clay crust may or may not improve the resistance for clay soils to be susceptible to a landslide.

Further, studies have related the retrogression of landslides to the undrained shear strength using Taylor's stability number (Ns) as indicated below:

$$N_s = yH/S_u$$

Where y = unit weight of clay (kN/m^3), H = bank height (m) and S_u = peak undrained shear strength (kPa). Analysis of forty landslides determined that N_s should be greater than or equal to 6 for the potential of retrogression to occur (Mitchell & Markell, 1974). Shear strength at the subject site ranges between 25 to 249 kPa for areas where the bank height is observed to be at most 10 m. Based on this, the worse-case scenario N_s values are less than 6, which would not suggest the potential for retrogression.

Mitchell and Markell have also explored the sensitivity of clays as a factor in retrogression. They concluded sensitivity for retrogressive clays ranges between 10 to 1,000. The sensitivity of the clay deposit throughout the subject site has been observed to be less than 10. The sensitivity of the clay deposit throughout the subject site is considered to be on the lower end for Champlain Sea clay deposits.

Therefore, the potential for a very large retrogressive landslide is not considered to be very likely throughout the subject site given the presence of the subsurface profile encountered during the geotechnical investigation.

4.2.2 Bedrock Depth and Surface Relief

Overburden thickness and surface relief are understood to be significant factors contributing to the potential for a landslide. Landslide susceptibility mapping carried out throughout National Topographic System (NTS) area 31H generally correlated higher values of drift thickness and surface relief to a higher rate of landslide incidence in Champlain Sea clays (Quinn, 2014). The study considered a weight of evidence approach which assigns a positive or negative weight for the ranges in these parameters with respect to the frequency of landslide occurrence.

A similar review was carried out to understand the relationship between overburden thickness and topographic relief for landslides that have occurred throughout the study area (area comprised by OF5311). The results of our interpretation of the available information are summarized in Table 6 and Table 7 below.

Table 6 – Summary of Drift Thickness Throughout Historic Landslide Footprints		
Drift Thickness	**Number of Incidences**	**%**
0 to 1	0	0.0
1 to 2	0	0.0
2 to 3	0	0.0
3 to 5	0	0.0
5 to 10	8	7.0
10 to 15	7	6.1
15 to 25	34	29.8
25 to 50	49	43.0
50 to 100	16	14.0
Total Landslides Within Study Area	114	94.2
Total Landslides Documented by Open Files	121	
Drift thickness interpreted using Google Earth and is considered subjective, however, appropriate based on the available information for each of the landslides identified by OF5311, OF7432 and OF8600 and the purpose of this assessment.		

Table 7 – Summary of Topographic Relief Throughout Historic Landslide Footprints		
Topographic Relief	**Number of Incidences**	**%**
<1	0	0.0
1-2	0	0.0
2-3	1	0.9
3-4	2	1.8
4-5	0	0.0
5-6	2	1.8
6-7	0	0.0
7-8	2	1.8
8-9	3	2.7
9-10	3	2.7
10-12	8	7.1
12-14	11	9.7
14-16	16	14.2
16-18	8	7.1
18-20	5	4.4
20-25	21	18.6
25-30	12	10.6
30-40	13	11.5
>40	6	5.3
Total Landslides Within Study Area Capable of Being Measured	113	93.4
Total Landslides Documented by Open Files	121	

Topographic relief was interpreted using DEM provided by Google Earth. Relief was considered as the difference between the lowest and highest elevations, distances extending beyond a landslide footprint. Greater distances were considered where a landslide formed into a slope profile. Significantly large landslides could not be evaluated reasonably due to the highly variable topography beyond their footprint. The measure is considered subjective, however, appropriate based on the available topographic information for each of the landslides identified by OF5311, OF7432 and OF8600 and the purpose of this assessment.

In summary, incidences of landslides occur more frequently in areas with intermediate overburden thickness ranging between 15 to 40 m, and greater than 10 m of topographic relief throughout the study area. Based on the current test hole coverage and slope stability sections, it is anticipated that more than 45 m of overburden may be present throughout the subject site. Further, up to 11 m of relief may be observed at the western portion of the subject site along slope stability cross section D and less than 10 m of relief may be observed throughout the remainder of the subject site including the north boundary leading to Petrie Island group. The potential for a landslide as based on the above-noted factors is discussed in further detail in *Section 4.3 – Hazard Assessment* of this report.

4.2.3 Groundwater

Groundwater is understood to be a factor contributing to landslide susceptibility. Landslides throughout Ottawa Valley have been understood to generally occur most frequently during the spring thaw, which results in seasonal increases in the depth of the groundwater table and porewater pressure. It has been documented that larger slopes typically fail by a combination of a downward gradient throughout the table lands and an upward gradient (artesian) throughout the bottom of the slope profile and along the channel (Hugenholtz and Lacelle, 2004).

Groundwater regimes with primarily downward gradients from the table lands to the watercourse typically have stronger stability attributes in resisting the potential for a slope failure. Groundwater regimes may be influenced by other factors, such as rising bedrock surfaces (Quinn et al., 2010). The combination of a temporary (seasonal) artesian groundwater table gradient throughout the lower portion of the slope and rising bedrock surface may significantly impact the stability of a slope.

Our slope stability assessment in Section 3.1 of this report considered fully saturated slope conditions along the banks of Taylor Creek. Fully saturated slope conditions are anticipated to govern over the downward gradient conditions as a loading case from a slope stability perspective.

The slope stability factors of safety were found to be greater than 1.5 for slope Section B. The slope stability factors of safety were found to be lower than 1.5 for slope Sections A, C, D and E. An appropriate stable slope allowance has been incorporated as part of the Limit of Hazard Lands line depicted on Drawing PG6414-1 – Test Hole Location plan in Appendix 2 of this report.

Further, the groundwater regime throughout the subject site is expected to follow general surficial topography such that drainage would be expected to occur from south to north and towards the Ottawa River. Taylor creek is expected to divert excessive surface and meltwater from entering and ponding throughout the subject site.

Further, the Ottawa River experiences seasonal variations of flow with higher periods of flow being a result of springtime snowmelt, and periods of low flow during dry summer periods or winter. Periods of heavy springtime flow may also be coupled by temporary rises in the river surface that may extend beyond the confinement of the shoreline. Based on currently published 100-year floodplain mapping prepared by the RVCA, the current 100-year flood plain does not extend to the subject site. Therefore, it is not expected that the seasonal fluctuations in the groundwater table along the Ottawa River would impact susceptibility to a landslide.

4.2.4 Toe Erosion

Landslides throughout the Ottawa Valley have been documented to occur most frequently adjacent to a watercourse. The formation of valley corridors by the presence of watercourses permits erosion along the toe of the slope and subsequent down-cutting by the erosional force of the watercourse. Sufficient downcutting, oversteepening and erosion of the slope may result in instability of the slope and the potential for a landslide.

There is a relationship between stream flow (via flow accumulation) and landslide incidence such that larger landslides tend to be associated with larger watercourses (Quinn et al., 2010). The relationship was extrapolated further such that the interpreted flow accumulation may be used as an estimate for mean annual flow and that stream order had been considered a reasonable surrogate for stream flow. Stream order is considered as the degree of a tributary and branch streams with respect to an artery stream. Larger stream order values indicate a stream is close to the principal stream, whereas smaller values indicate the streams are considered to be distant tributaries from an artery stream.

Higher values of stream flow are correlated to higher degrees of stream order which are further correlated to older and fully developed watercourses. Smaller values of stream order are correlated to younger and less developed watercourses.

Generally, landslide density throughout the study area undertaken throughout NTS 31H was high for streams with order 5 to 8, low for order 4 and very low for streams up to order 3 and greater than or equal to order 9 (Quinn, 2009).

The findings are similar for flow accumulation such that streams with less flow or of smaller degrees of stream orders have a negative weight and are not correlated with landslide incidence (Quinn, 2014). There is some evidence presented by a study area in Norway that younger streams have not fully developed their watercourse morphology and may be more erodible than larger, mature streams. However, the methodology undertaken to assess this for the study area of NTS 31H could not confirm this relationship for local and regional conditions at that time (Quinn, 2014).

Stream sinuosity was also explored as a variable impacting slope stability. Stream sinuosity is defined as the ratio of the total length along a stream segment to the shortest length between its endpoints (Quinn, 2014). Based on the review for the area of NTS 31H, it has been observed that landslides tend to be infrequent along streams with low sinuosity. Weights can be assigned to quantify the likelihood of landslides occurring for the calculated sinuosity. In this sense, higher weights were attributed to watercourses with high indices of sinuosity, indicating channels with wider and more tightly spaced meander belts experience higher rates of erosion. A negative weight was attributed to streams having a sinuosity less than 1.338, and a weight of 0.571 was attributed to streams having a sinuosity up to 1.659 (Quinn, 2014). Preferential occurrence of landslides in slopes situated on the outside of meander belts rather than in streams with low levels of sinuosity was similarly observed by Hugenholtz (2004).

A geomorphic study was undertaken by Aecom Canada Ltd. in 2015 for the Taylor Creek watershed. The study classified the creek as quite sinuous and with a stream order equal to 2. The stream order of the watercourse located throughout the subject site would not correlate with an increase to landslide susceptibility. However, it was estimated that, within the subject site, Taylor Creek presents a sinuosity index higher than 1.659. Therefore, the stream sinuosity might indicate a higher probability of landslide occurrence within the subject site. It should be noted that over the totality of its course, the sinuosity index of Taylor Creek is expected to be lower.

It should be acknowledged that some signs of toe erosion have been documented throughout the valley corridor during recent site visits. In our experience, the erosion observed to date is considered normal and tolerable for the surface and subsoil features forming these valley corridors. However, the factor of toe erosion in consideration of the global stability of the subject slopes should not be neglected. The toe erosion and erosion access allowances recommended as part of the Limit of Hazard Lands provided in Section 3.0 of this report should be considered an appropriate and sufficient measure to account for the presence of the watercourse at the bottom of the slope.

Based on the above, an increase in magnitude for the calculated landslide frequency was included in the analysis. This is discussed in further detail in Section 4.3 – Hazard Assessment of this report. It should be noted that, if toe erosion improvement measurements are implemented at the subject site, as discussed in our Geotechnical Report PG6414-1 dated December 23, 2022, the aforementioned magnitude increase should be disregarded.

Regarding the Ottawa River, saturation of the toe of the slope is expected during temporary periods of flooding. However, given the presence of shoreline protection measures undertaken along the Ottawa River and in proximity to the subject site, it is expected there is negligible risk that significant toe erosion will occur that would impact the subject site. Therefore, the presence of the Ottawa River is not believed to significantly impact slope stability or landslide susceptibility throughout the subject site.

4.2.5 Proximity to Landslides

The proximity of land to previous landslides has been documented as a significant factor in assessing the susceptibility of potential for future landslides. It had been assessed that there is between 49.2 and 96.7% likelihood of a landslide in areas located less than 50 to 2,000 m from a previous landslide event (Quinn et al., 2011). It is further documented that areas that have previously been affected by landslide events are more vulnerable to experiencing new landslides. This was observed by Hugenholtz (2004) in their review of Green's Creek and the concentration of landslides to re-occur in concentrated areas along the creek alignment.

Landslide inventory mapping published by GSC indicates the presence of potentially up to 5 landslides within a proximity of 2 km to the subject site. However, none of these landslides intersect the subject site.

Landslides Oln16, Oln17 and Oln18 are located approximately 1.6 km to the southeast of the subject site. The totality of the group has been reported by GSC to have retrogressed into their respective sides of the incised valley of a tributary of Cardinal Creek (GSC OF8600, 2019).

Landslide Oln15, located approximately 1 km to the southeast of the subject site, is considered a "probable landslide" which may have retrogressed into the scarp slope above a terrace surface of the proto-Ottawa River (GSC OF8600, 2019).

Finally, landslide Oln14, located approximately 1.2 km to the west of the subject site, has been reported to have retrogressed into the scarp slope along the margin of a terrace of the proto-Ottawa River (GSC OF8600, 2019).

The areas of the aforementioned landslides experienced a topographic relief ranging approximately between 8 and 29 m and a relatively steep slope along their flank, with angles ranging approximately between 17 and 24 degrees.

Oln16 retrogressed into the western side of the incised valley of Cardinal Creek and has been heavily altered by urban development (OF8600). The area of Oln16 experiences approximately 14 to 16 m of topographic relief and is incised by a creek identified as having a stream order of 4 and sinuosity of 1.39 (Geomorphic Solutions, 2007). Drift thickness throughout the area of Oln15 and Oln16 ranges between 25 to 50 m. Oln17 and Oln18 have been documented by GSC OF5311 as having drift thickness ranging between 15 to 25 m. However, drift thickness is anticipated to range between 14 to 16 m for Oln18 as based on site-specific test hole coverage. Oln14 has been documented as having a drift thickness of approximately 18 m.

Comparatively, Oln14 and Oln15 do not share parameters of susceptibility with Oln16, Oln17 and Oln18. The areas of Oln 16, Oln17 and Oln18 are not considered indicative of a higher probability for a landslide to occur throughout the subject site given the higher relief and moderate drift thickness throughout their footprints compared to the same characteristics for the subject site. Then, these areas are generally considered to be more susceptible to a landslide than the areas surrounding Taylor Creek throughout the subject site.

Further, given Oln14 and Oln 15 retrogressed into the scarp slope along the margin of the proto-Ottawa River, it is speculated that this landslide may have been triggered by extensive toe erosion by the proto-Ottawa River. This trigger factor was discussed in Section 4.2 of this report and was not considered to currently affect landslide susceptibility given the improved shoreline protection against toe erosion with respect to the currently established Ottawa River watercourse alignment. Therefore, it is not considered that the presence of Oln14 and Oln15 indicate a higher likelihood of a landslide to occur throughout the subject site.

Although the subject site does not share many of the attributes that may have contributed to the formation of the nearby landslides, its proximity to historical landslides is significant. Based on this review, it is considered appropriate and conservative to increase the baseline probability for a landslide to occur throughout the subject by one order of magnitude to account for this frequency of local incidences.

4.2.6 Earthquakes

Earthquakes are understood to be a major contributing factor in triggering some of the largest landslides inventoried throughout Champlain Sea clay deposits. Many large landslides have been estimated to have occurred approximately 4,550 years before present (BP) and another significant cluster approximately 7,060 years BP (GSC OF7432, 2021; Aylsworth and Lawrence, 2003). The lower bound of these paleo-earthquakes have been estimated to have consisted of M5.9 to M6.0 earthquakes. Several landslides were triggered by the 1663 M7 Charlevoix and 2010 Val-des-Bois M6.2 earthquakes.

The behavior of clay slopes during earthquakes is uncertain and is a topic of current research. Current research suggests that large earthquakes can propagate failures along pre-existing or partially developed planes of weakness along the slope footprint. The critical length of the propagation is understood to be influenced by the sensitivity and fracture toughness, or brittleness, of the clay deposit (Quinn et al. 2012).

The slopes and clay deposit throughout the subject site have been subject to large historic earthquakes that may have triggered significantly large historic landslides throughout the Ottawa Valley. Earthquake-induced landslides generally occur where the potential for slope failures already exists and has generally been assessed as part of our slope stability analysis.

Pseudo-static (seismic) loading of the slope profiles considered a PGA of 0.16g and resulted in factors of safety exceeding 1.1 as discussed in Section 3.0 of this report. This PGA is considered equivalent to a 1:1,670-year earthquake event. This value is considered suitable for assessing the stability of the subject slopes when subject to loading that may be associated with earthquakes experienced locally.

Further, larger landslides are understood to be associated with clay deposits with remolded shear strength measurements equal to or less than 1 kPa (Quinn et al., 2011). It would be expected that clay deposits with such low values of remolded strength to be conductive to propagating planes of weakness and unable to resist high earthquake loads. Review of our test hole coverage indicated that remolded shear strength values typically range between 3 and 80 kPa and exceed the 1 kPa threshold associated with landslides. Based on this, it is not expected a significant shear band would propagate throughout the slopes located throughout the subject site that would increase landslide susceptibility due to earthquake loading.

This conclusion may be extrapolated further to the potential for sources of subsurface vibrations such as those associated with building construction, compaction equipment and general earthworks equipment. These sources of vibrations are not anticipated to exceed or be close to the magnitude of vibrations associated with the assessed earthquake load of 0.16g.

Given the above, earthquake loading is not anticipated to impact landslide susceptibility. This would also be considered unlikely given the relatively shallow relief throughout the majority of the tributary. However, a return period of 1,670 years may be considered the upper bound of the baseline probability for landslides to occur throughout the subject site.

4.3 Hazard Assessment

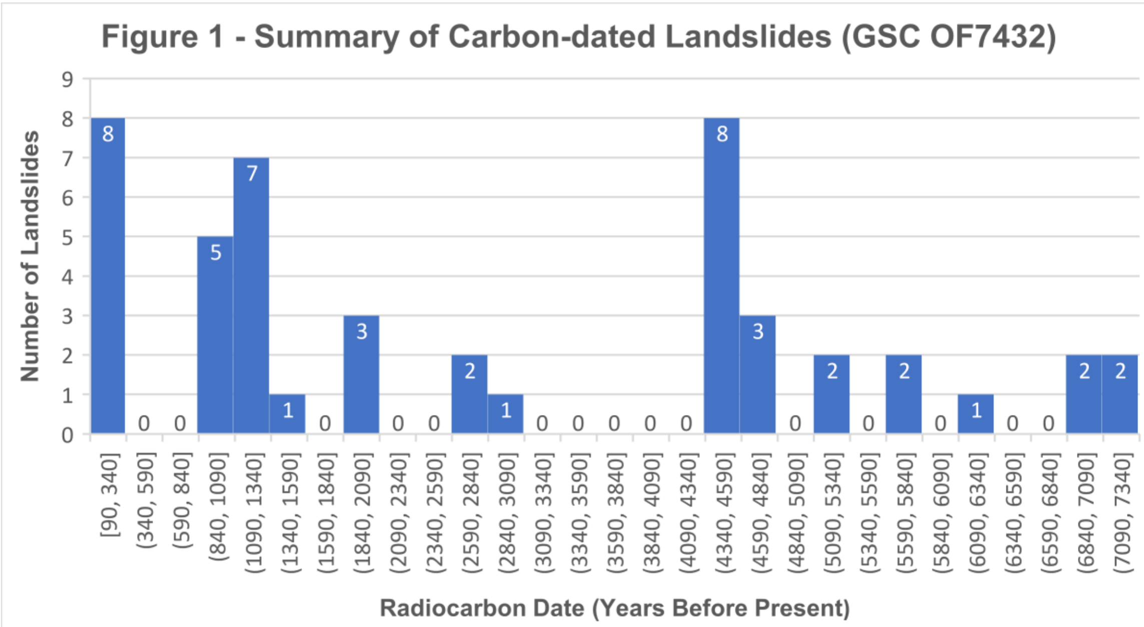
Frequency Estimation Method

Approximately 132 individual landslides have been identified between GSC files OF8600, OF7432 and OF5311. The study area between these files considers an approximate surface area of approximately 11,800 km^2. This surface area may be decreased to approximately 6,845 km^2 when neglecting the area comprised of bedrock. The study area was reduced accordingly to consider the absence of Champlain Sea marine deposits throughout areas of bedrock outcrops and where overburden is not present. An average landslide density of 1.9×10^{-2} per km^2 may be extrapolated from this information.

Based on the information provided in OF5311, landslides have not been recorded to have originated from areas comprised of till or glaciofluvial deposits. The study area may be therefore reduced further to approximately 5,354 km^2 and consisting of nearshore and offshore marine deposits, alluvial sediments, organic deposits, and sand dunes. The surficial deposits are considered susceptible to a landslide given their vulnerability to failure by the factors discussed in the preceding sections of this report. Based on this, the baseline landslide frequency, and probability, may be considered as 2.5×10^{-2} per km^2 throughout the study area.

The estimated density may vary notably across the study area given that many landslides generally occurred in localized clusters. The distinct clusters of landslides are likely indicative of conditions that are more conducive to landslide hazards in localized zones rather than the entire study area. However, this is considered appropriate as an average density for the purpose of this assessment.

The temporal frequency of landslide occurrence may vary substantially across the study area. OF7432 sought to carbon date 45 separate landslide features throughout the study area. The landslides interpreted by that study documented landslides having occurred potentially between approximately 90 to 7,140 years before present. The results from the study and approximations provided by OF8600, neglecting the potential deviation and range of uncertainty, are summarized in Figure 1 below.



Temporal factors such as periods of increased earthquakes and climatic factors affecting these frequencies have been explored by others. Based on the above, more than half of the carbon dated landslides have occurred within the past 3,090 years, and over a quarter within the past 1,090 years.

Quinn et al. (2011) proposed a conservative lower bound of 500 years as a return period for the study area of NTS 31H. This value could be considered appropriate throughout the subject site based on the information presented above. However, the study area of NTS 31H considers a much higher density of landslides (i.e., 1,248 landslides over 75-80,000km^2) than the study area considered for the subject site.

Based on this, a return period equivalent to the average frequency of landslides (i.e., 132 landslides over 7,140 years) provides a smaller lower bound return period of approximately one large landslide every 54.1 years. An upper bound return period of 1,670 years was indicated in Subsection 4.2 of this report. Then, a 54.1-year return period is within the previously defined range. With a return period of 54.1 years, a baseline landslide probability of 4.6x10^{-4} landslides per km^2 per annum is calculated over the study area defined by the GSC files.

The current baseline probability ($4.6x10^{-4}$ per km^2 per annum) assumes uniform susceptibility across the study area. The baseline estimate may be adjusted based on our judgement of a combination of regional landslide inventories, local site attributes and our experience assessing the performance of slopes comprised of Champlain Sea marine deposits throughout the study area. Based on our review, it had been assessed that the proximity of historic landslides to the subject site was of sufficient significance to increase the estimate by one order of magnitude. Therefore, the baseline probability may be considered as $4.6x10^{-3}$ per km^2 per annum.

Toe erosion was also considered a notable factor affecting landslide susceptibility, as discussed in Subsection 4.2 of this report. The cumulative percentage for this variable was considered as having its own rate of landslide incidence throughout the study area. Therefore, the landslide probability was increased by one order of magnitude to account for the toe erosion observed at the subject site. However, it should be noted that if toe erosion improvement is implemented, the aforementioned probability increase should be disregarded.

The probabilities for landslides to occur throughout the subject site considering drift thickness (Table 8) and surface relief (Table 9) are estimated accordingly in Table 10.

Table 8 – Summary of Drift Thickness Throughout Historic Landslide Footprints

Drift Thickness (m)	Number of Incidences	%	Probability (54.1-year return period, cumulative)
0 to 1	0	0.0	0.0
1 to 2	0	0.0	0.0
2 to 3	0	0.0	0.0
3 to 5	0	0.0	0.0
5 to 10	8	7.0	0.0013
10 to 15	7	6.1	0.0024
15 to 25	34	29.8	0.0079
25 to 50	49	43.0	0.0159
50 to 100	16	14.0	0.0185

Table 9 – Summary of Surface Relief Throughout Historic Landslide Footprints

Surface Relief (m)	Number of Incidences	%	Probability (54.1-year return period, cumulative)
0 to 4	0	0.0	0.0005
4 to 6	0	0.0	0.0008
6 to 8	1	0.9	0.0011
8 to 10	2	1.8	0.0021
10 to 12	0	0.0	0.0034
12 to 14	2	1.8	0.0052
14 to 16	0	0.0	0.0079
16 to 18	2	1.8	0.0092
18 to 20	3	2.7	0.0100
20 to 25	3	2.7	0.0135
25 to 30	8	7.1	0.0154
30 to 40	11	9.7	0.0175
>40	16	14.2	0.0185

Table 10 – Estimate of Landslide Probability

Surface Relief (m)	Drift Thickness (m)			
	0 to 10	0 to 15	0 to 25	0 to 50
0 to 4	2.9E-08	5.4E-08	1.8E-07	3.6E-07
0 to 6	4.8E-08	9.1E-08	3.0E-07	5.9E-07
0 to 8	6.8E-08	1.3E-07	4.1E-07	8.3E-07
0 to 10	1.3E-07	2.4E-07	**7.7E-07**	**1.5E-06**
0 to 12	2.0E-07	3.8E-07	**1.2E-06**	**2.5E-06**
0 to 14	3.1E-07	5.8E-07	1.9E-06	3.8E-06
0 to 16	4.6E-07	8.7E-07	2.8E-06	5.7E-06
0 to 18	5.4E-07	1.0E-06	3.3E-06	6.6E-06
0 to 20	5.9E-07	1.1E-06	3.6E-06	7.2E-06
0 to 25	7.9E-07	1.5E-06	4.9E-06	9.7E-06

Note: Bolded text is considered reflective of site-specific conditions.
The above-noted values are considered in units of landslide per annum.

Based on our assessment, the probability for a landslide to occur throughout the subject site has been estimated to range between **1:401,185 and 1:1,298,139 per annum** for a 1:54.1-year return period (product of baseline probability, probability of landslide occurrence based on cumulative drift thickness between 0 and 50 m and probability based on cumulative surface relief between 0 and 12 m).

Based on the above, the annual probability of a large landslide occurring at or directly impacting the subject site is estimated to be less than 1:10,000 per annum.

5.0 Conclusion

In summary, a multi-storey residential and mixed used buildings development is currently being proposed to occupy the subject site. Several pre-historic landslide events are understood to have taken place in close proximity to the subject site. Based on our review, these landslides have occurred throughout sections of watercourse and their tributaries that were more susceptible to these hazards than those present at the subject site.

Field investigations and reconnaissance carried out by Paterson throughout the subject site did not indicate any signs of movement, activity, or cause of concern with respect to landslide susceptibility. The area was also reviewed by means of available published literature of the surrounding inventory, research and studies carried out by others specializing in the field of earthquakes, landslides, and geology. Using a combination of the above and our experience with sites of very similar geology throughout the Ottawa region, the annual probability of a large catastrophic landslide occurring at or directly impacting the subject site is estimated to be less than 1:10,000. Based on our interpretation of the information available to carry out this assessment, the subject site is considered safe and suitable for consideration of the purpose of the proposed development.

6.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project and the applicable guidelines.

A geotechnical investigation of this nature is a limited sampling of a site. The recommendations are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around the test locations. The extent of the limited area depends on the soil, bedrock, and groundwater conditions, as well the history of the site reflecting natural, construction, and other activities. Should any conditions at the site be encountered which differ from those at the test locations, we request notification immediately in order to permit reassessment of our recommendations.

The assessments provided in this report are intended for the use of design professionals associated with this project. 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 than 6382983 Canada Inc. or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
May 9, 2023
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Drew Petahtegoose, B. Eng.

David J. Gilbert, P.Eng

Report Distribution:

- ❑ 6382983 Canada Inc.
- ❑ Paterson Group Inc

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ATTERBERG LIMITS TESTING RESULTS

GRAIN SIZE DISTRIBUTION AND HYDROMETER TESTING RESULTS

SHRINKAGE TESTING RESULTS

EARTHQUAKES CANADA SEISMIC HAZARD (NBCC 2015)

TABLE 1 – SUMMARY OF REVIEWED LANDSLIDE INVENTORY DATA

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

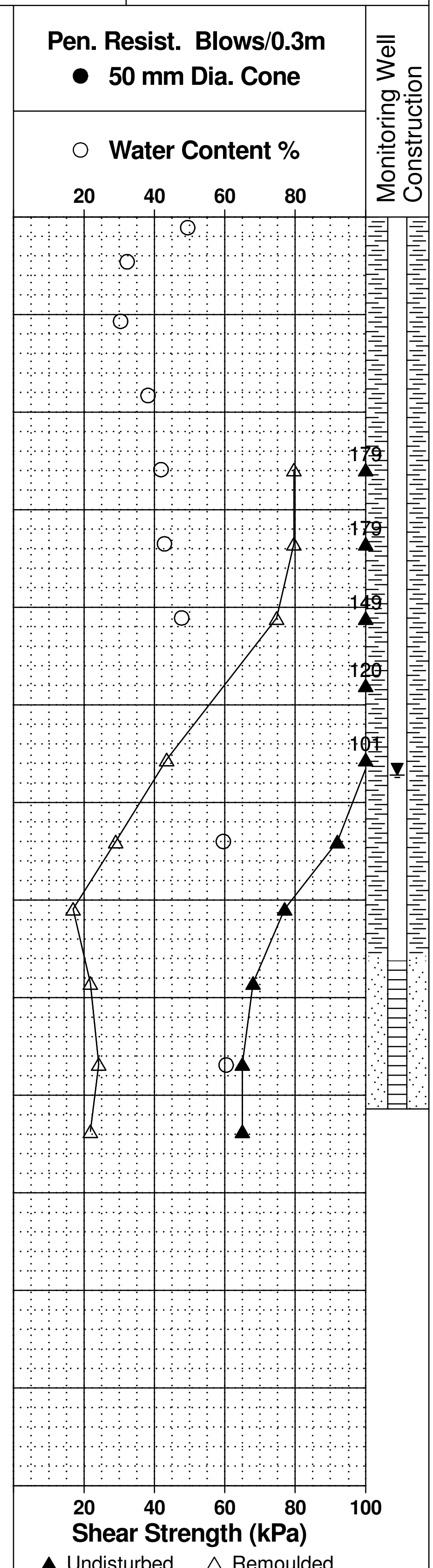
BORINGS BY CME-55 Low Clearance Drill

DATE October 20, 2022

FILE NO. **PG6414**

HOLE NO. **BH 1-22**

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	51.16
TOPSOIL	0.23	AU	1				
Hard to very stiff, brown **SILTY CLAY**	5.94	AU	2				
		SS	3	75	17	1	50.16
		SS	4	100	13	2	49.16
		SS	5	100	P	3	48.16
		SS	6	100	P	4	47.16
		SS	7	100	P	5	46.16
Stiff, grey **SILTY CLAY**	9.60	SS	8	100	P	6	45.16
		SS	9	100	P	7	44.16
						8	43.16
						9	42.16
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 32.6m depth.						10	41.16
						11	40.16
						12	39.16
						13	38.16



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Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE October 20, 2022

FILE NO. PG6414

HOLE NO. BH 1-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Monitoring Well Construction
GROUND SURFACE									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 32.6m depth.						13	38.16		
						14	37.16		
						15	36.16		
						16	35.16		
						17	34.16		
						18	33.16		
						19	32.16		
						20	31.16		
						21	30.16		
						22	29.16		
						23	28.16		
						24	27.16		
						25	26.16		
						26	25.16		

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

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

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Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

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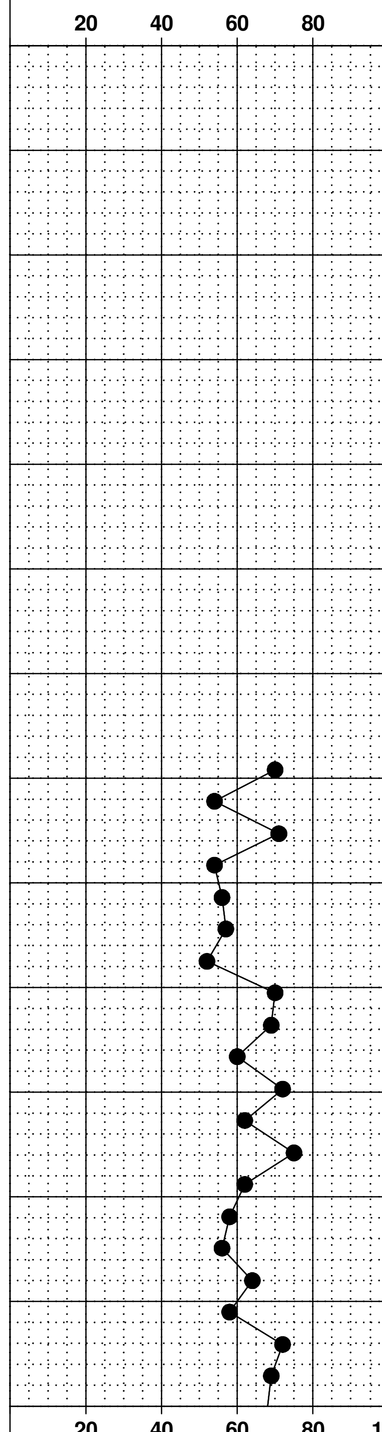
DATE October 20, 2022

FILE NO. PG6414

HOLE NO. BH 1-22

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 %	Monitoring Well Construction
GROUND SURFACE									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 32.6m depth.						26	25.16		
						27	24.16		
						28	23.16		
						29	22.16		
						30	21.16		
						31	20.16		
						32	19.16		
						33	18.16		
						34	17.16		
						35	16.16		
						36	15.16		
						37	14.16		
						38	13.16		
						39	12.16		



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DATE October 20, 2022

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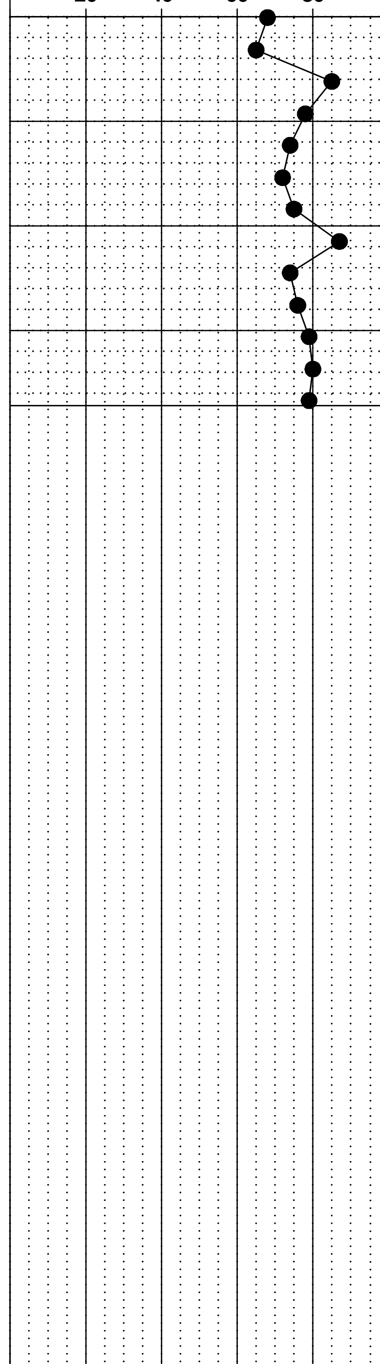
SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Monitoring Well Construction
GROUND SURFACE								20 40 60 80	
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 32.6m depth.						39	12.16		
						40	11.16		
						41	10.16		
						42	9.16		
42.72									
No DCPT refusal encountered by 42.72m depth, borehole terminated. (GWL @ 5.72m - Nov. 7, 2022)									



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

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SOIL PROFILE AND TEST DATA

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DATUM Geodetic

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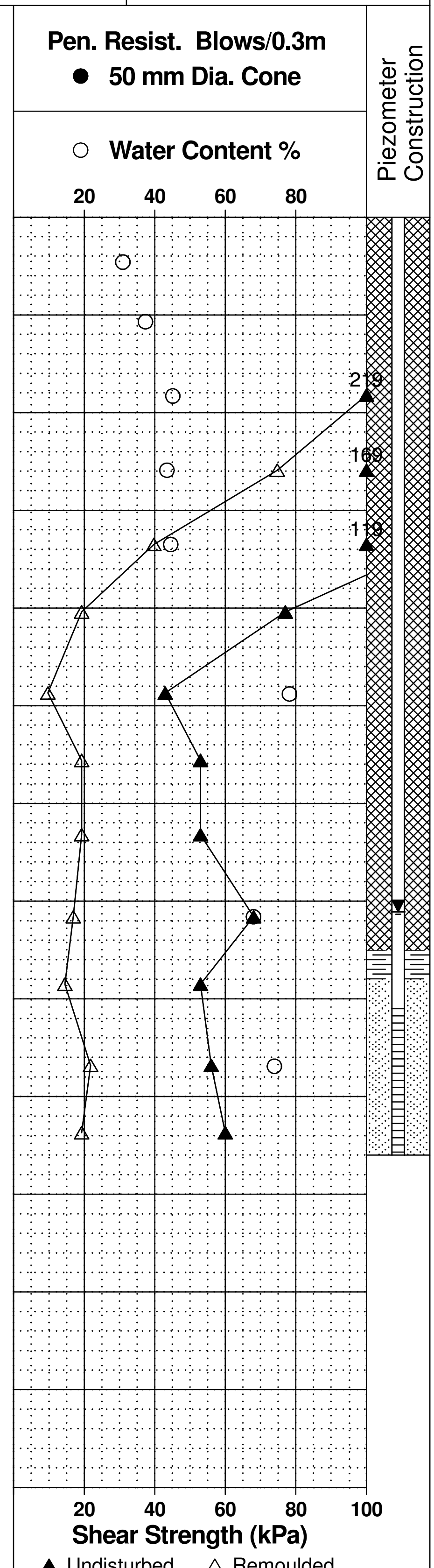
FILE NO. PG6414

HOLE NO. BH 2-22

SOIL DESCRIPTION	Depth of layer base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	52.14
TOPSOIL	0.20						
Hard to stiff, brown **SILTY CLAY**	4.42	AU	1				
		SS	2	67	14	1	51.14
		SS	3	75	P	2	50.14
		SS	4	83	P		
		SS	5	100	P	3	49.14
						4	48.14
Stiff, grey **SILTY CLAY**	9.60	SS	6	100	P	5	47.14
						6	46.14
		SS	7	100	P	7	45.14
						8	44.14
		SS	8	100	P	9	43.14
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 20.1m depth.						10	42.14
						11	41.14
						12	40.14
						13	39.14



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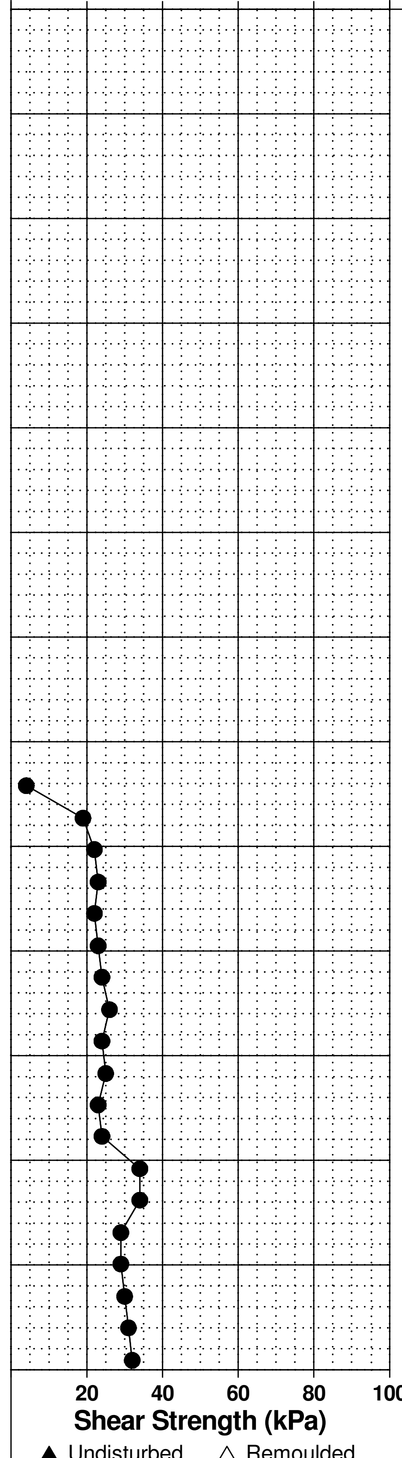
HOLE NO. BH 2-22

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								20 40 60 80	
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 20.1m depth.						13	39.14		
						14	38.14		
						15	37.14		
						16	36.14		
						17	35.14		
						18	34.14		
						19	33.14		
						20	32.14		
						21	31.14		
						22	30.14		
						23	29.14		
						24	28.14		
						25	27.14		
						26	26.14		



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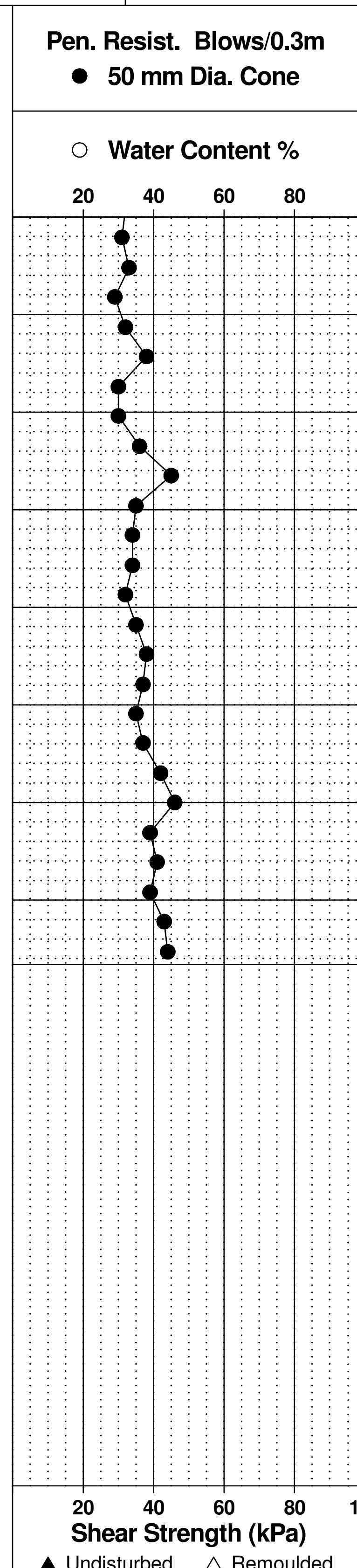
HOLE NO. BH 2-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 20.1m depth.						26	26.14
						27	25.14
						28	24.14
						29	23.14
						30	22.14
						31	21.14
						32	20.14
						33	19.14
33.66							
No DCPT refusal encountered by 33.66m depth, borehole terminated. (GWL @ 7.11m - Nov. 7, 2022)							



Piezometer Construction

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FILE NO. PG6414

HOLE NO. BH 3-22

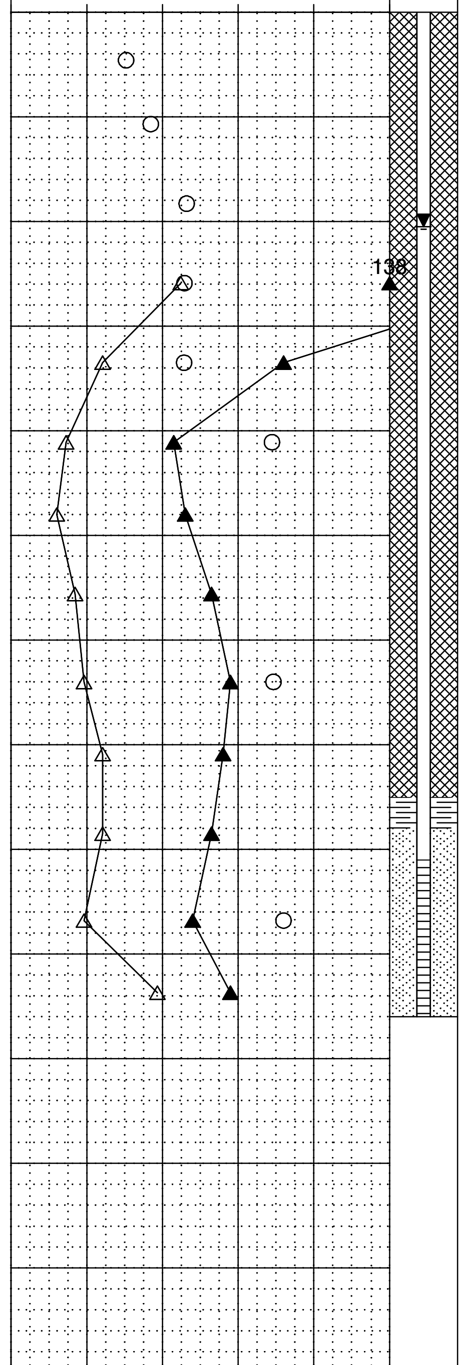
SOIL DESCRIPTION	Bottom depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.25				
Hard to stiff, brown **SILTY CLAY**	3.73	AU	1		
		SS	2	67	15
		SS	3	67	9
		SS	4	100	P
		SS	5	100	P
Firm to stiff, grey **SILTY CLAY**	9.60	SS	6	100	P
		SS	7	100	P
		SS	8	100	P
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 31.7m depth.					

DEPTH (m)	ELEV. (m)
0	52.67
1	51.67
2	50.67
3	49.67
4	48.67
5	47.67
6	46.67
7	45.67
8	44.67
9	43.67
10	42.67
11	41.67
12	40.67
13	39.67

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

Piezometer Construction

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BORINGS BY CME-55 Low Clearance Drill

DATE October 21, 2022

FILE NO. PG6414

HOLE NO. BH 3-22

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 % (20 40 60 80)	Piezometer Construction
GROUND SURFACE									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 31.7m depth.						13	39.67		
						14	38.67		
						15	37.67		
						16	36.67		
						17	35.67		
						18	34.67		
						19	33.67		
						20	32.67		
						21	31.67		
						22	30.67		
						23	29.67		
						24	28.67		
						25	27.67		
						26	26.67		

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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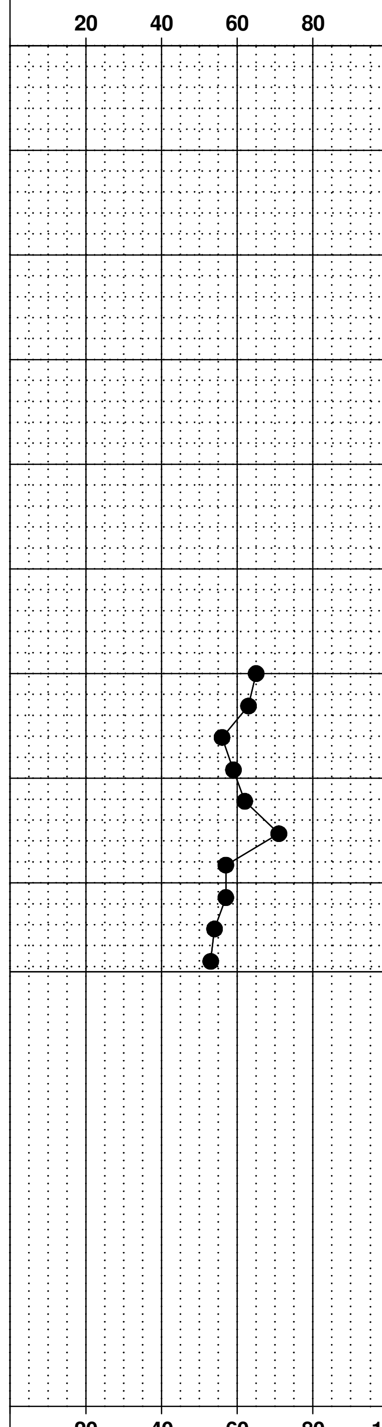
FILE NO. PG6414

HOLE NO. BH 3-22

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									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 31.7m depth.						26	26.67		
						27	25.67		
						28	24.67		
						29	23.67		
						30	22.67		
						31	21.67		
						32	20.67		
						33	19.67		
						34	18.67		
34.85									
No DCPT refusal encountered by 34.85m depth, borehole terminated. (GWL @ 2.05m - Nov. 7, 2022)									



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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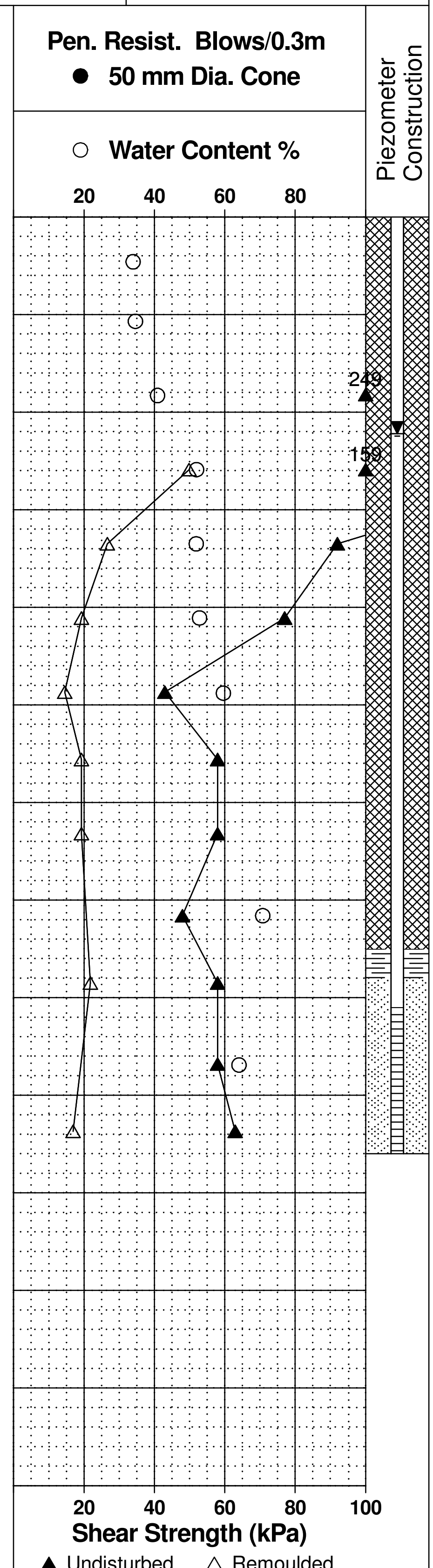
BORINGS BY CME-55 Low Clearance Drill **DATE** October 21, 2022

FILE NO. PG6414

HOLE NO. BH 4-22

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.18				
Hard to stiff, brown **SILTY CLAY**	4.50	AU	1		
		SS	2	83	18
		SS	3	83	P
		SS	4	67	P
		SS	5	67	P
		SS	6	75	P
Firm to stiff, grey **SILTY CLAY**	9.60	SS	7	50	P
		SS	8	92	P
		SS	9	67	P
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 28.9m depth.					

DEPTH (m)	ELEV. (m)
0	51.32
1	50.32
2	49.32
3	48.32
4	47.32
5	46.32
6	45.32
7	44.32
8	43.32
9	42.32
10	41.32
11	40.32
12	39.32
13	38.32



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DATE October 21, 2022

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HOLE NO. BH 4-22

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 % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 28.9m depth.						13	38.32		
						14	37.32		
						15	36.32		
						16	35.32		
						17	34.32		
						18	33.32		
						19	32.32		
						20	31.32		
						21	30.32		
						22	29.32		
						23	28.32		
						24	27.32		
						25	26.32		
						26	25.32		

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

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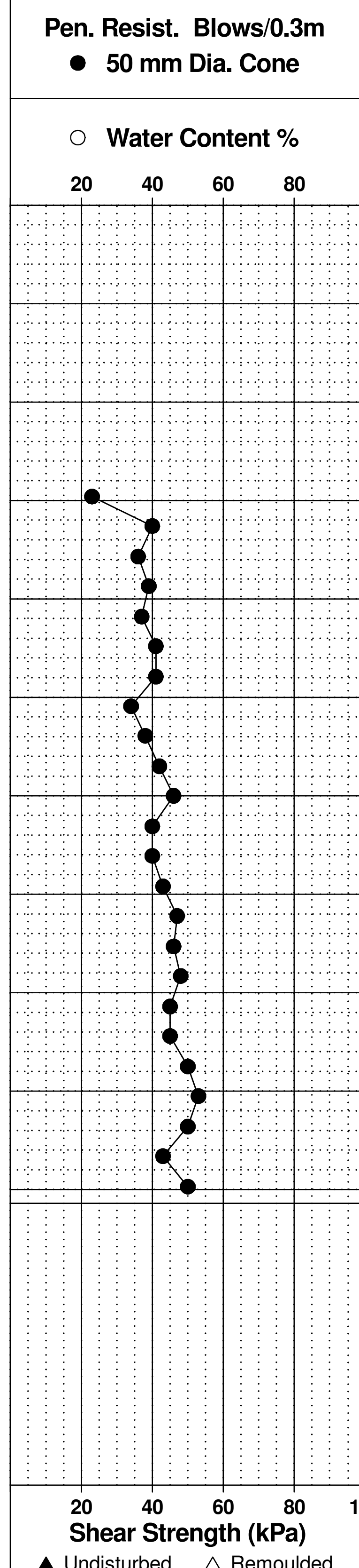
HOLE NO. BH 4-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE								
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 28.9m depth.						26	25.32	
						27	24.32	
						28	23.32	
						29	22.32	
						30	21.32	
						31	20.32	
						32	19.32	
						33	18.32	
						34	17.32	
						35	16.32	
36.14						36	15.32	
No DCPT refusal encountered by 36.14m depth, borehole terminated. (GWL @ 2.22m - Nov. 7, 2022)								



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SOIL PROFILE AND TEST DATA

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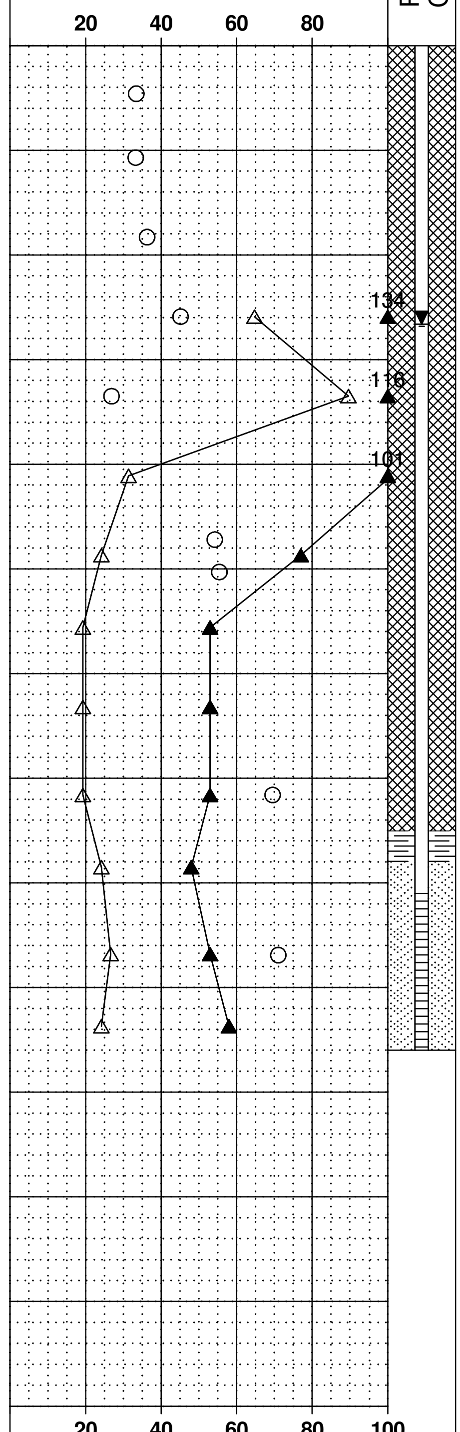
FILE NO. PG6414

HOLE NO. BH 5-22

SOIL DESCRIPTION	STRATA PLOT	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	51.18
TOPSOIL 0.20		AU	1				
Hard to stiff, brown **SILTY CLAY**		SS	2	75	18	1	50.18
		SS	3	83	16	2	49.18
		SS	4	83	P		
		SS	5	75	P	3	48.18
		SS	6	0	P	4	47.18
4.88		SS	7	100	P	5	46.18
Stiff, grey **SILTY CLAY**						6	45.18
		SS	8		P	7	44.18
						8	43.18
		SS	9		P	9	42.18
9.60							
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 33.3m depth.						10	41.18
						11	40.18
						12	39.18
						13	38.18

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



Piezometer Construction

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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HOLE NO. BH 5-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 33.3m depth.						13	38.18		
						14	37.18		
						15	36.18		
						16	35.18		
						17	34.18		
						18	33.18		
						19	32.18		
						20	31.18		
						21	30.18		
						22	29.18		
						23	28.18		
						24	27.18		
						25	26.18		
						26	25.18		

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

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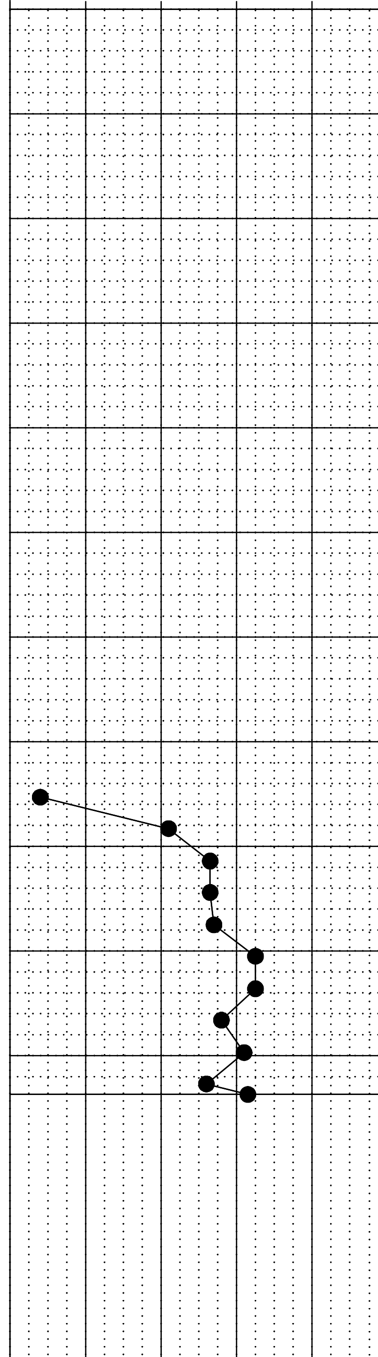
HOLE NO. BH 5-22

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								20 40 60 80	
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 33.3m depth.						26	25.18		
						27	24.18		
						28	23.18		
						29	22.18		
						30	21.18		
						31	20.18		
						32	19.18		
						33	18.18		
						34	17.18		
						35	16.18		
36.37						36	15.18		
No DCPT refusal encountered by 36.37m depth, borehole terminated. (GWL @ 2.66m - Nov. 7, 2022)									



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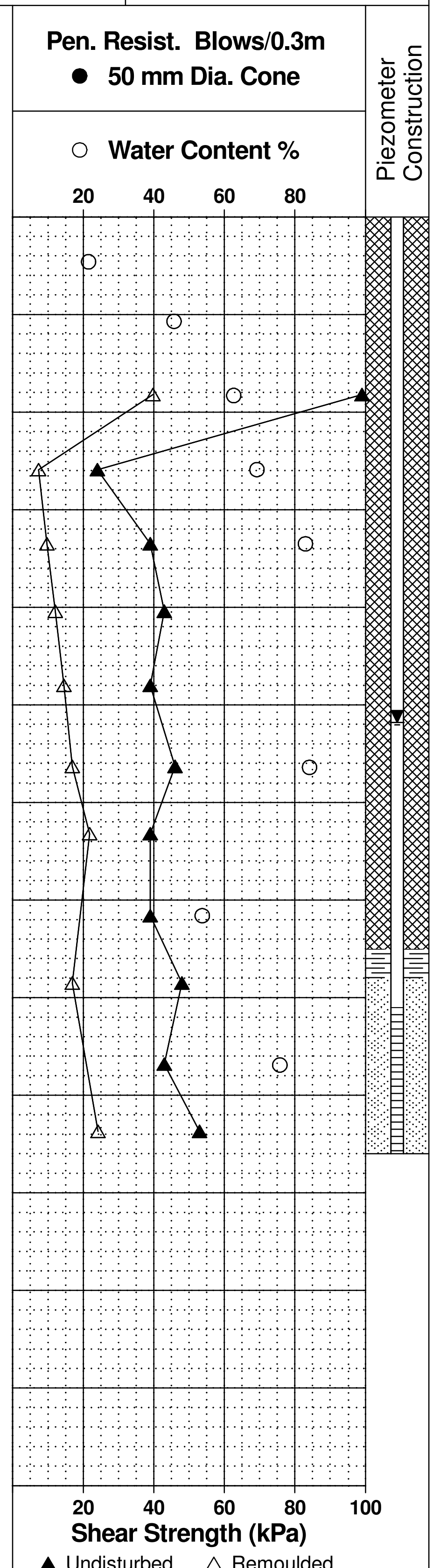
HOLE NO. BH 6-22

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.46
TOPSOIL	0.20	AU	1				
Very stiff to stiff, brown **SILTY CLAY**		SS	2	100	7	1	52.46
	2.29	SS	3	67	P	2	51.46
Soft to firm, grey **SILTY CLAY**		SS	4	83	P		
		SS	5	100	P	3	50.46
						4	49.46
						5	48.46
		SS	6	100	P	6	47.46
		SS	7	100	P	7	46.46
						8	45.46
- stiff by 9.1m depth		SS	8	100	P	9	44.46
	9.60						
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 32.3m depth.						10	43.46
						11	42.46
						12	41.46
						13	40.46



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FILE NO. PG6414

HOLE NO. BH 6-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 32.3m depth.						13	40.46		
						14	39.46		
						15	38.46		
						16	37.46		
						17	36.46		
						18	35.46		
						19	34.46		
						20	33.46		
						21	32.46		
						22	31.46		
						23	30.46		
						24	29.46		
						25	28.46		
						26	27.46		

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

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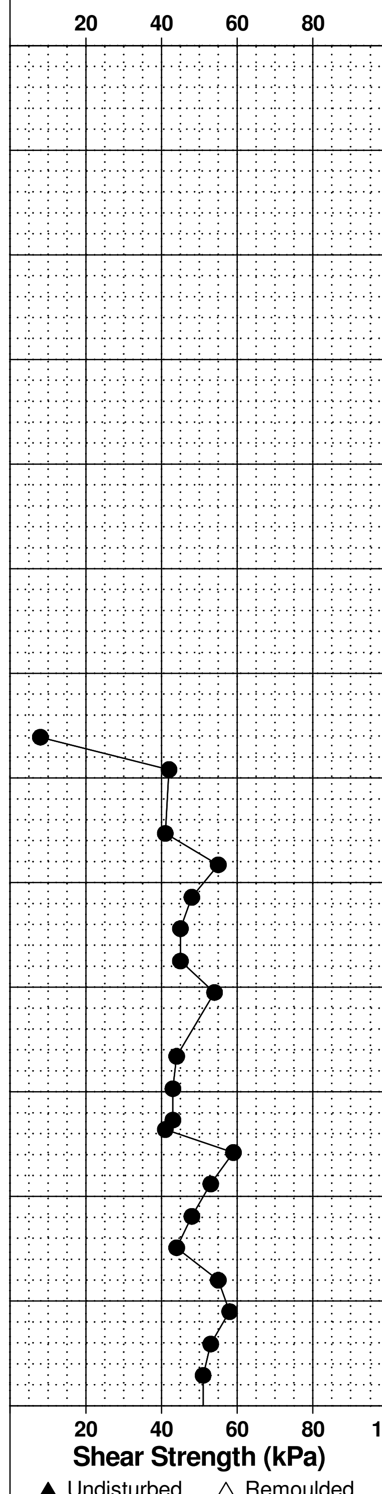
HOLE NO. BH 6-22

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									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 32.3m depth.						26	27.46		
						27	26.46		
						28	25.46		
						29	24.46		
						30	23.46		
						31	22.46		
						32	21.46		
						33	20.46		
						34	19.46		
						35	18.46		
						36	17.46		
						37	16.46		
						38	15.46		
						39	14.46		



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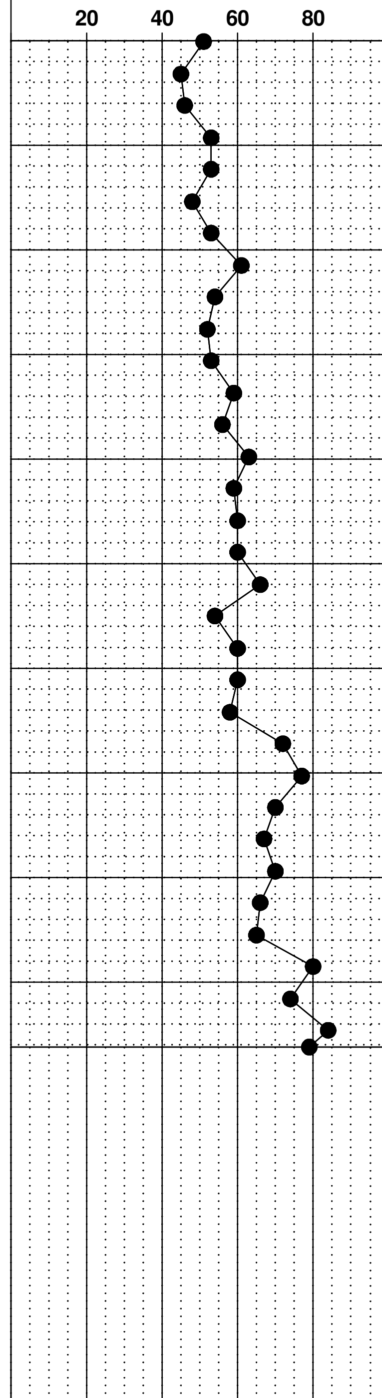
HOLE NO. BH 6-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 32.3m depth.						39	14.46
						40	13.46
						41	12.46
						42	11.46
						43	10.46
						44	9.46
						45	8.46
						46	7.46
						47	6.46
						48	5.46
48.62							
No DCPT refusal encountered by 48.62m depth, borehole terminated. (GWL @ 5.18m - Nov. 7, 2022)							

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



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

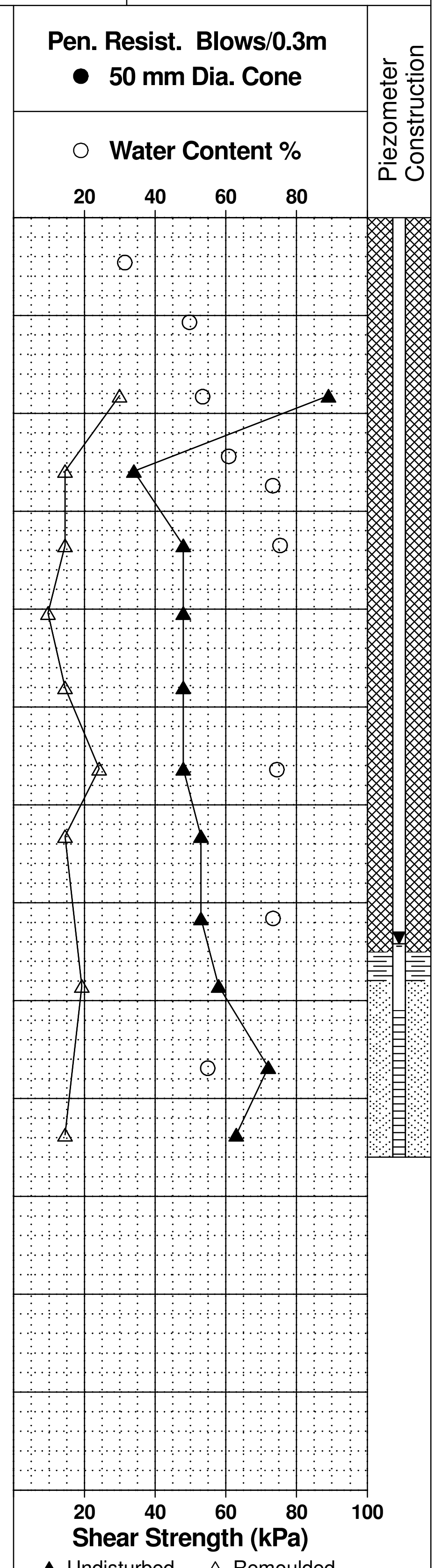
DATE October 25, 2022

FILE NO. PG6414

HOLE NO. BH 7-22

SOIL DESCRIPTION	Strata boundary depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.15	AU	1		
Hard to stiff, brown **SILTY CLAY**		SS	2	67	6
		SS	3	75	P
	2.67	SS	4	83	P
Firm to stiff, grey **SILTY CLAY**		SS	5	83	P
		SS	6	100	P
		SS	7	100	P
	9.60	SS	8	100	P
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 33.2m depth.					

DEPTH (m)	ELEV. (m)
0	53.33
1	52.33
2	51.33
3	50.33
4	49.33
5	48.33
6	47.33
7	46.33
8	45.33
9	44.33
10	43.33
11	42.33
12	41.33
13	40.33



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SOIL PROFILE AND TEST DATA

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Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE October 25, 2022

FILE NO. PG6414

HOLE NO. BH 7-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 33.2m depth.						13	40.33		
						14	39.33		
						15	38.33		
						16	37.33		
						17	36.33		
						18	35.33		
						19	34.33		
						20	33.33		
						21	32.33		
						22	31.33		
						23	30.33		
						24	29.33		
						25	28.33		
						26	27.33		

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE October 25, 2022

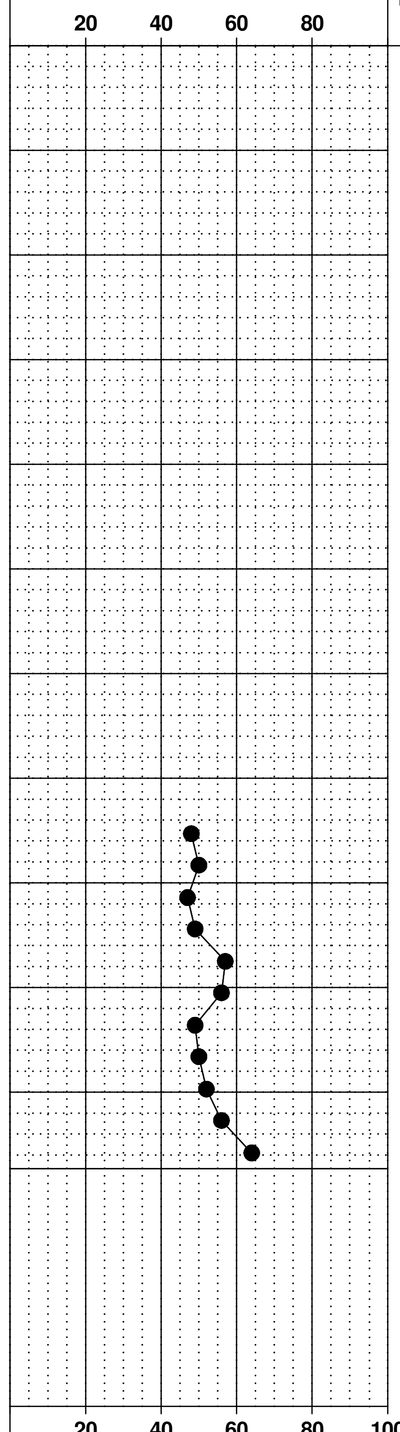
FILE NO. PG6414

HOLE NO. BH 7-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 33.2m depth.						26	27.33
						27	26.33
						28	25.33
						29	24.33
						30	23.33
						31	22.33
						32	21.33
						33	20.33
						34	19.33
						35	18.33
						36	17.33
36.73							
No DCPT refusal encountered by 36.73m depth, borehole terminated. (GWL @ 7.42m - Nov. 7, 2022)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



Piezometer Construction

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SOIL PROFILE AND TEST DATA

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DATUM Geodetic

REMARKS

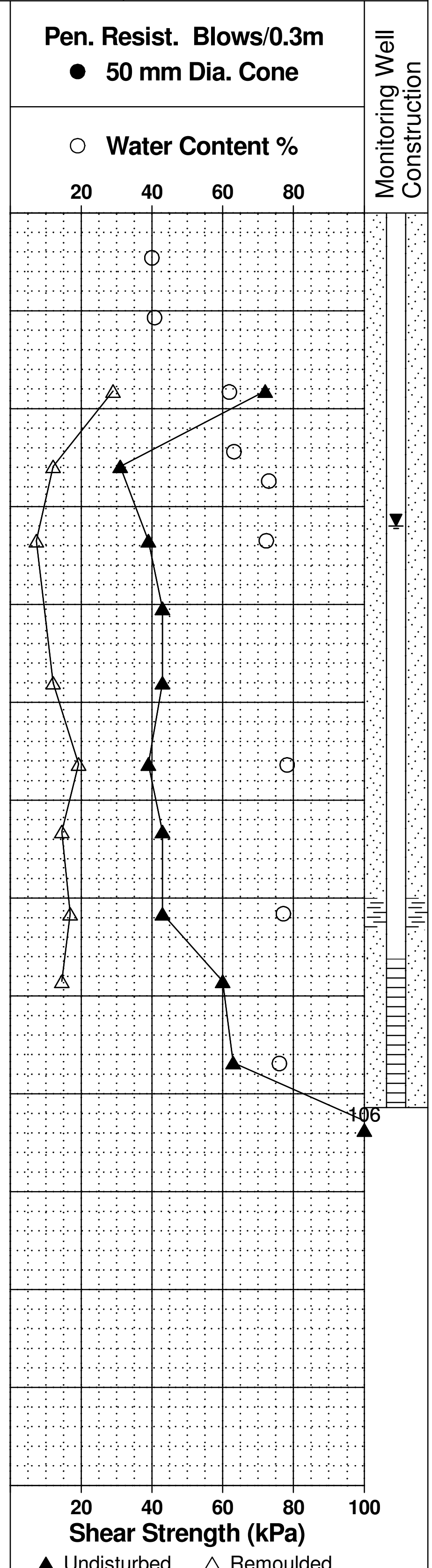
BORINGS BY CME-55 Low Clearance Drill

DATE October 25, 2022

FILE NO. **PG6414**

HOLE NO. **BH 8-22**

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.04
TOPSOIL	0.13						
Hard to stiff, brown **SILTY CLAY**		AU	1				
		SS	2		8	1	52.04
		SS	3	83	P	2	51.04
	2.51						
Firm to stiff, grey **SILTY CLAY**		SS	4	83	P		
		SS	5	100	P	3	50.04
						4	49.04
						5	48.04
		SS	6	100	P	6	47.04
		SS	7	67	P	7	46.04
						8	45.04
		SS	8		P	9	44.04
	9.60						
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 29.6m depth.						10	43.04
						11	42.04
						12	41.04
						13	40.04



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SOIL PROFILE AND TEST DATA

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DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill **DATE** October 25, 2022

FILE NO. PG6414

HOLE NO. BH 8-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Monitoring Well Construction
GROUND SURFACE									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 29.6m depth.						13	40.04		
						14	39.04		
						15	38.04		
						16	37.04		
						17	36.04		
						18	35.04		
						19	34.04		
						20	33.04		
						21	32.04		
						22	31.04		
						23	30.04		
						24	29.04		
						25	28.04		
						26	27.04		

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
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DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE October 25, 2022

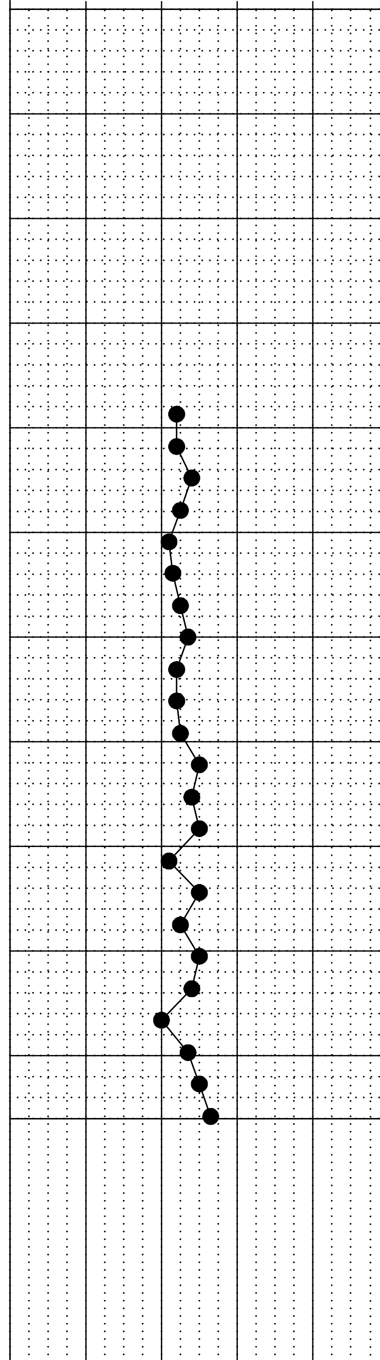
FILE NO. PG6414

HOLE NO. BH 8-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 29.6m depth.						26	27.04
						27	26.04
						28	25.04
						29	24.04
						30	23.04
						31	22.04
						32	21.04
						33	20.04
						34	19.04
						35	18.04
						36	17.04
36.60							
No DCPT refusal encountered by 36.60m depth, borehole terminated. (GWL @ 3.20m - Nov. 7, 2022)							

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

Monitoring Well Construction



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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

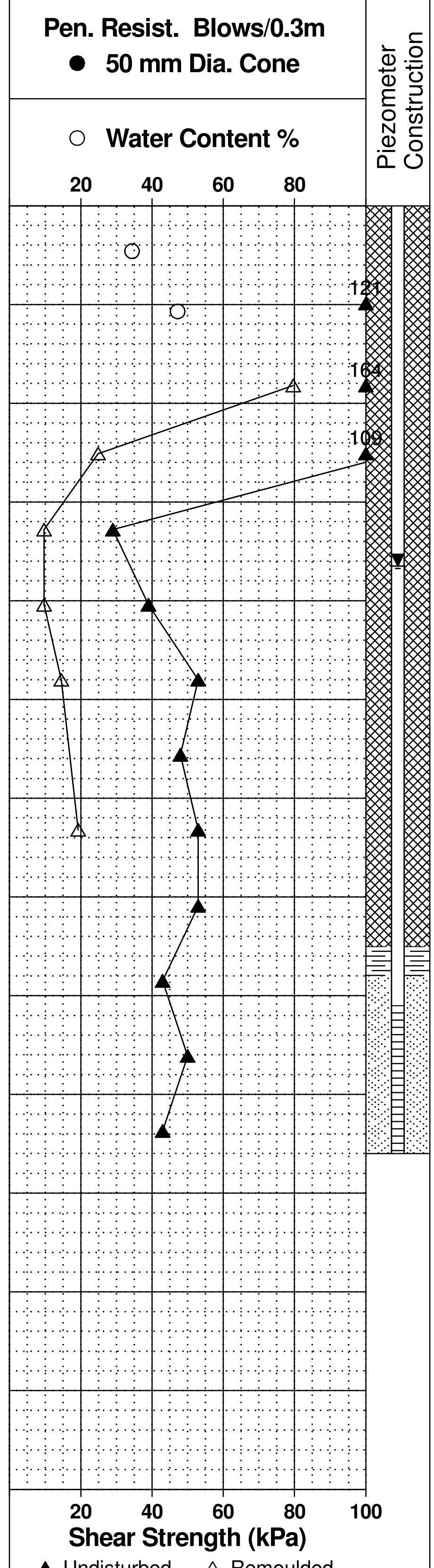
DATE October 26, 2022

FILE NO. PG6414

HOLE NO. BH 9-22

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.13				
Hard to very stiff, brown **SILTY CLAY**	2.97	AU	1		
		SS	2	67	P
Firm to stiff, grey **SILTY CLAY**	9.60				
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 29.3m depth.					

DEPTH (m)	ELEV. (m)
0	52.77
1	51.77
2	50.77
3	49.77
4	48.77
5	47.77
6	46.77
7	45.77
8	44.77
9	43.77
10	42.77
11	41.77
12	40.77
13	39.77



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE October 26, 2022

FILE NO. PG6414

HOLE NO. BH 9-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE								20 40 60 80	
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 29.3m depth.						13	39.77		
						14	38.77		
						15	37.77		
						16	36.77		
						17	35.77		
						18	34.77		
						19	33.77		
						20	32.77		
						21	31.77		
						22	30.77		
						23	29.77		
						24	28.77		
						25	27.77		
						26	26.77		

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

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SOIL PROFILE AND TEST DATA

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Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

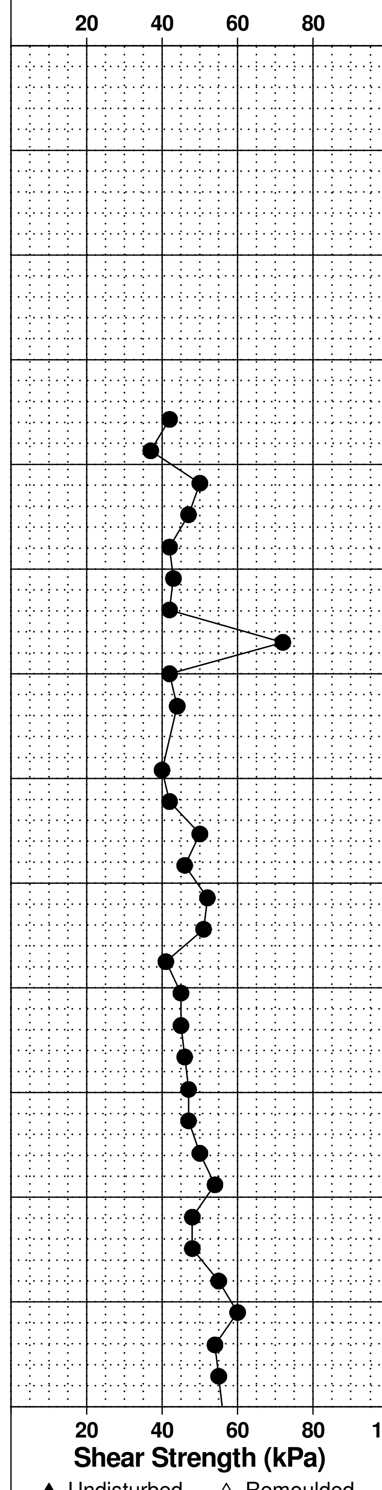
BORINGS BY CME-55 Low Clearance Drill

DATE October 26, 2022

FILE NO. PG6414

HOLE NO. BH 9-22

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									
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 29.3m depth.						26	26.77		
						27	25.77		
						28	24.77		
						29	23.77		
						30	22.77		
						31	21.77		
						32	20.77		
						33	19.77		
						34	18.77		
						35	17.77		
						36	16.77		
						37	15.77		
						38	14.77		
						39	13.77		



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

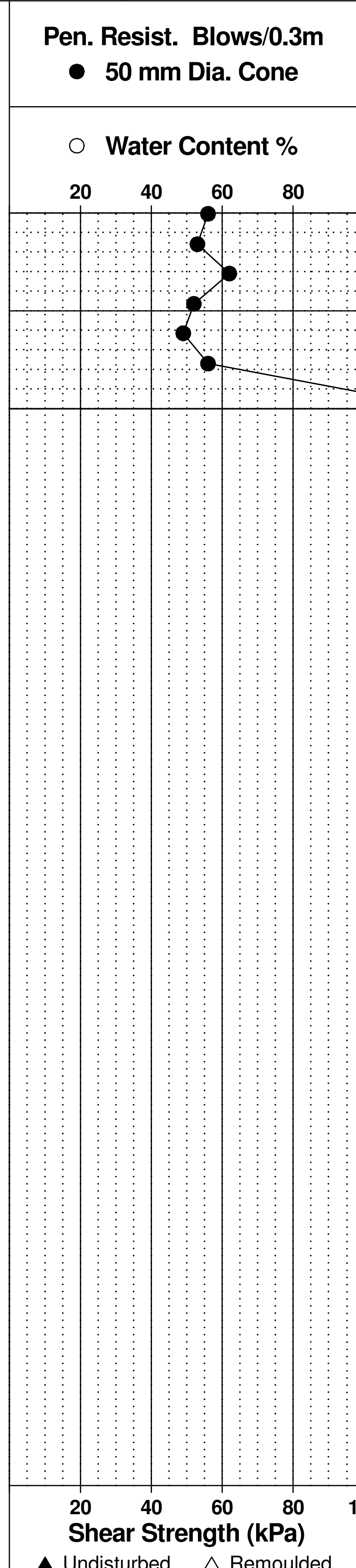
BORINGS BY CME-55 Low Clearance Drill

DATE October 26, 2022

FILE NO. PG6414

HOLE NO. BH 9-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 29.3m depth.						39	13.77
						40	12.77
41.00						41	11.77
End of Borehole Practical DCPT refusal at 41.00m depth. (GWL @ 3.65m - Nov. 7, 2022)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

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Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

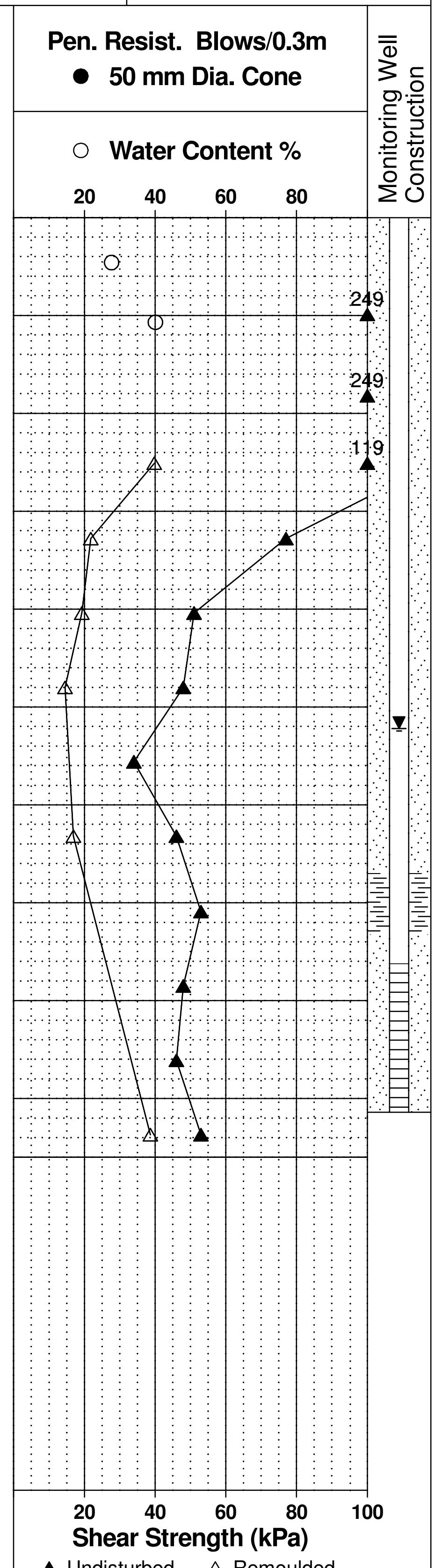
DATE October 26, 2022

FILE NO. PG6414

HOLE NO. BH10-22

SOIL DESCRIPTION	Depth to base (m)	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE						
TOPSOIL	0.18		AU	1		
Hard to stiff, brown **SILTY CLAY**	3.66		SS	2	67	P
Stiff to firm, grey **SILTY CLAY**	9.60					
End of Borehole						
(GWL @ 5.22m - Nov. 7, 2022)						

DEPTH (m)	ELEV. (m)
0	52.22
1	51.22
2	50.22
3	49.22
4	48.22
5	47.22
6	46.22
7	45.22
8	44.22
9	43.22



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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

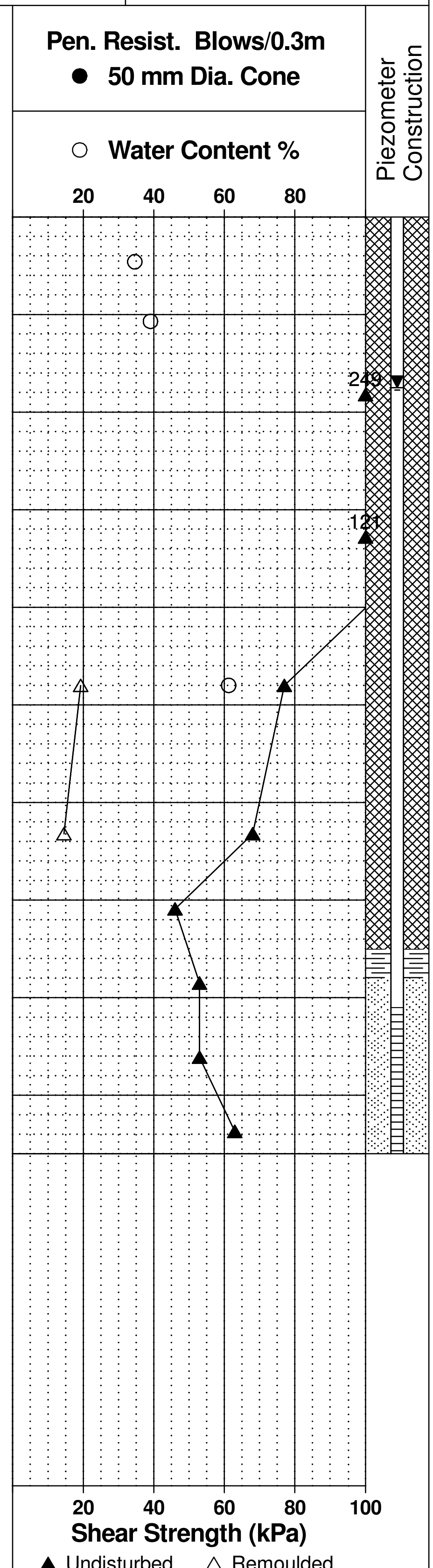
DATE October 26, 2022

FILE NO. PG6414

HOLE NO. BH11-22

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.18				
Hard to stiff, brown **SILTY CLAY**	5.18	AU	1		
		SS	2	75	P
		G	3		
Firm to stiff, grey **SILTY CLAY**	9.60				
End of Borehole					
(GWL @ 1.75m - Nov. 7, 2022)					

DEPTH (m)	ELEV. (m)
0	51.50
1	50.50
2	49.50
3	48.50
4	47.50
5	46.50
6	45.50
7	44.50
8	43.50
9	42.50



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Prop. Residential Subdivision, North Service Road
Ottawa, Ontario

DATUM Ground surface elevations provided by McIntosh Perry Surveying Inc.

REMARKS

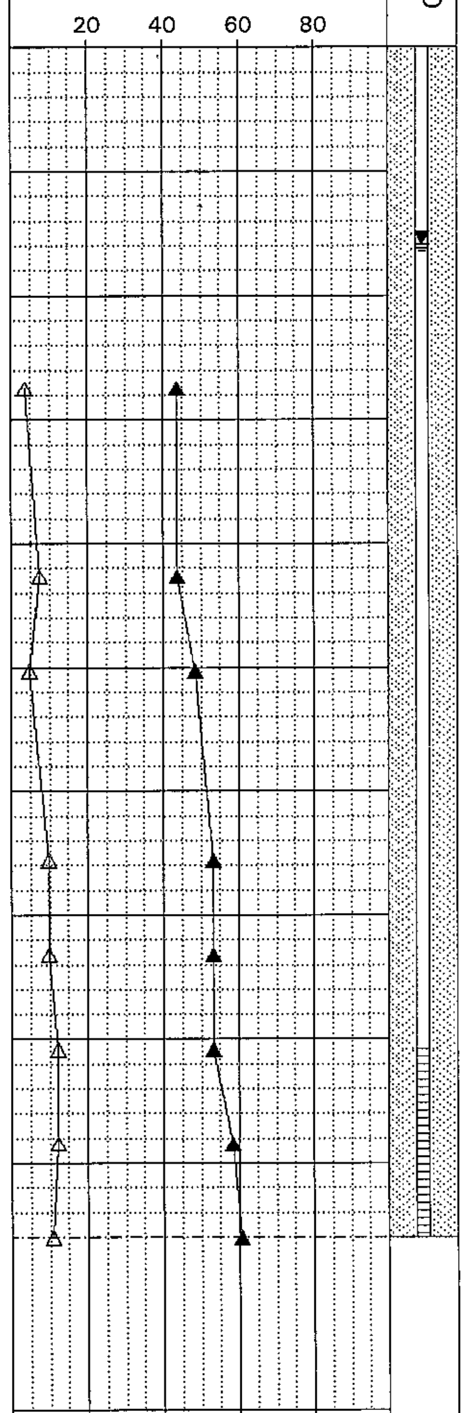
BORINGS BY CME 55 Power Auger **DATE** 8 NOV 07

FILE NO. PG1565

HOLE NO. BH 1

SOIL DESCRIPTION		SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.07
TOPSOIL	0.13						
Brown **SILTY CLAY** with organic matter	0.46	AU	1				
		SS	2	75	11	1	52.07
Stiff to firm, brown **SILTY CLAY**, some sand seams		SS	3	100	5	2	51.07
- grey by 2.3m depth						3	50.07
		TW	4	67		4	49.07
						5	48.07
- stiff by 5.6m depth		TW	5	96		6	47.07
						7	46.07
						8	45.07
						9	44.07
	9.60						
End of Borehole							
(GWL @ 1.59m-Nov. 13/07)							

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



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Prop. Residential Subdivision, North Service Road
Ottawa, Ontario

DATUM Ground surface elevations provided by McIntosh Perry Surveying Inc.

FILE NO. **PG1565**

REMARKS

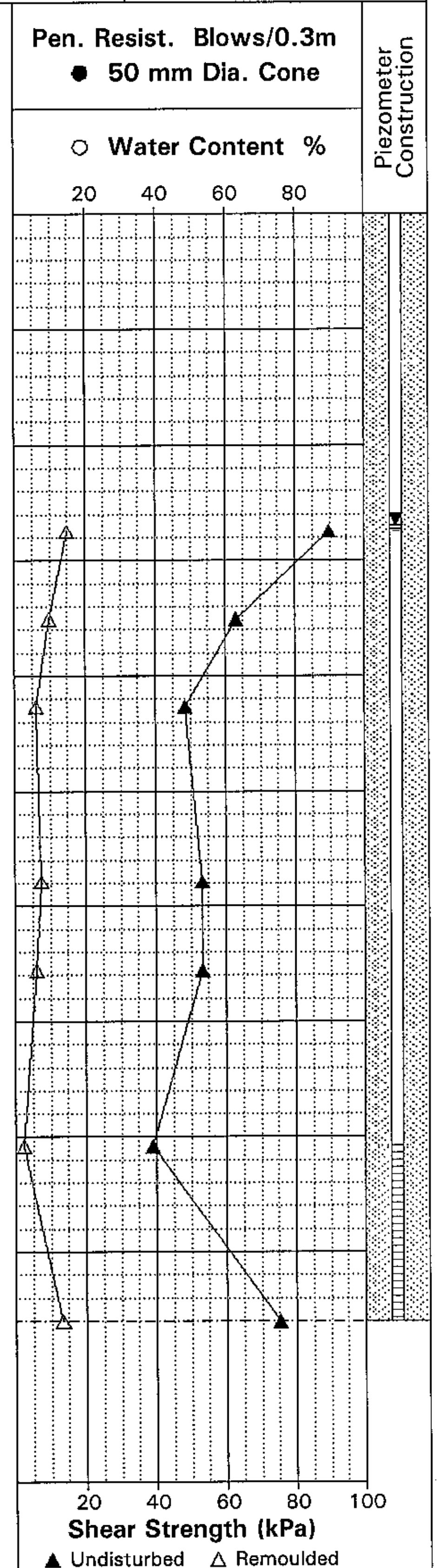
HOLE NO. **BH 2**

BORINGS BY CME 55 Power Auger

DATE 8 NOV 07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	52.31
TOPSOIL 0.10		AU	1				
Brown SILTY CLAY with organic matter 0.46						1	51.31
		SS	2	75	14		
		SS	3	100	9	2	50.31
Very stiff to stiff, brown SILTY CLAY						3	49.31
- grey by 3.0m depth						4	48.31
		TW	4	88		5	47.31
						6	46.31
		TW	5	98		7	45.31
						8	44.31
		TW	6	100		9	43.31
9.60 End of Borehole							

(GWL @ 2.70m-Nov. 13/07)



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Prop. Residential Subdivision, North Service Road
Ottawa, Ontario

DATUM Ground surface elevations provided by McIntosh Perry Surveying Inc.

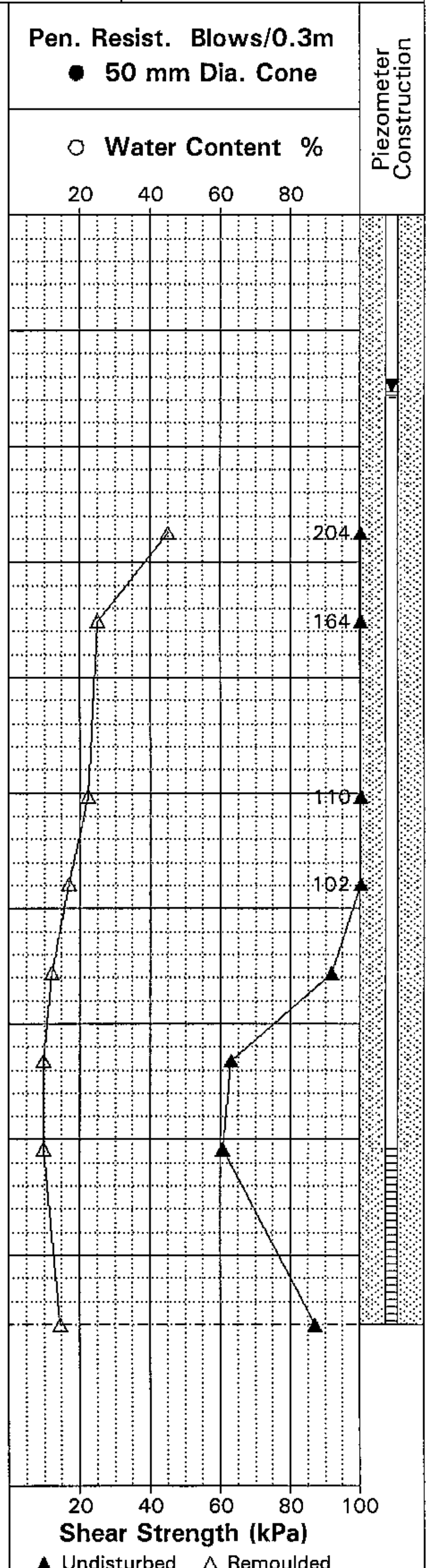
FILE NO. **PG1565**

REMARKS

HOLE NO. **BH 3**

BORINGS BY CME 55 Power Auger DATE 8 NOV 07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	49.65
TOPSOIL 0.10		AU	1				
		SS	2	100	17	1	48.65
		SS	3	100	16	2	47.65
						3	46.65
Hard to very stiff, brown **SILTY CLAY**		SS	4	58	11	4	45.65
- very stiff to stiff and grey by 5.0m depth						5	44.65
						6	43.65
						7	42.65
						8	41.65
		TW	5	92		9	40.65
9.60							
End of Borehole							
(GWL @ 1.53m-Nov. 13/07)							



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

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 = $(D30)^2 / (D10 \times D60)$
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

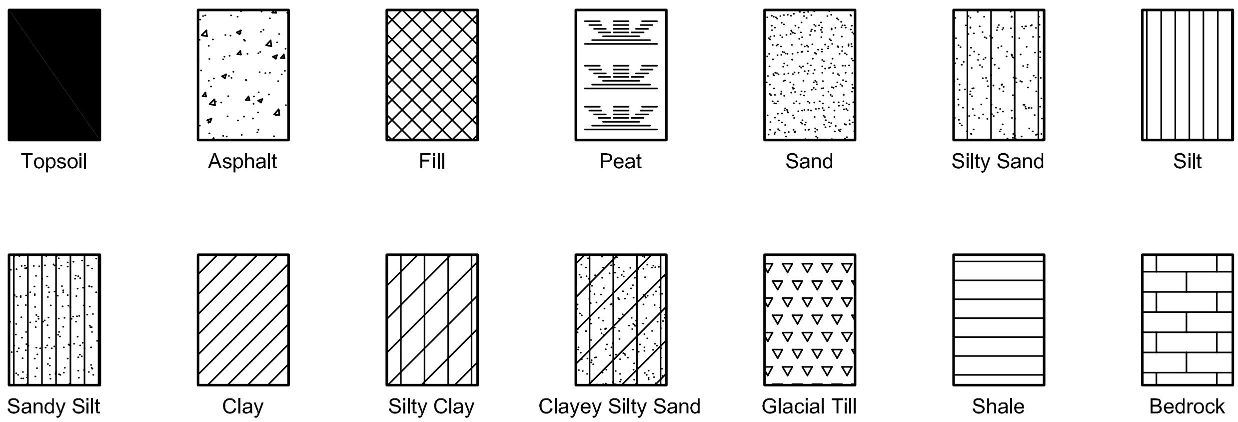
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

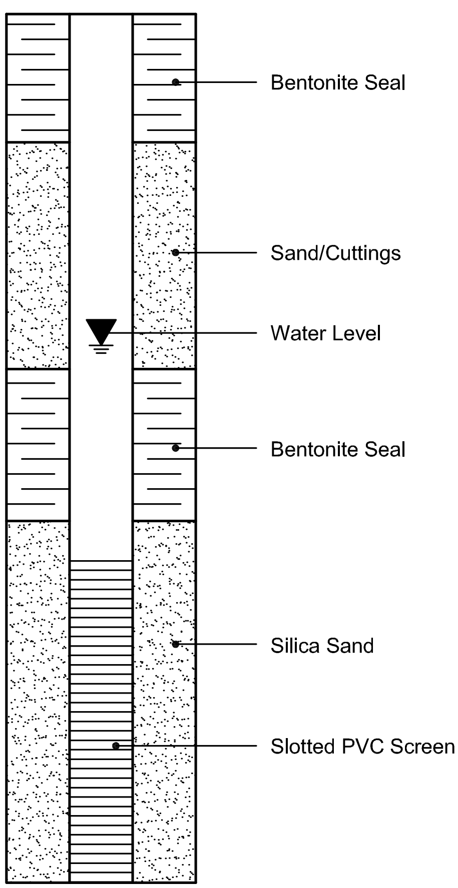
SYMBOLS AND TERMS (continued)

STRATA PLOT

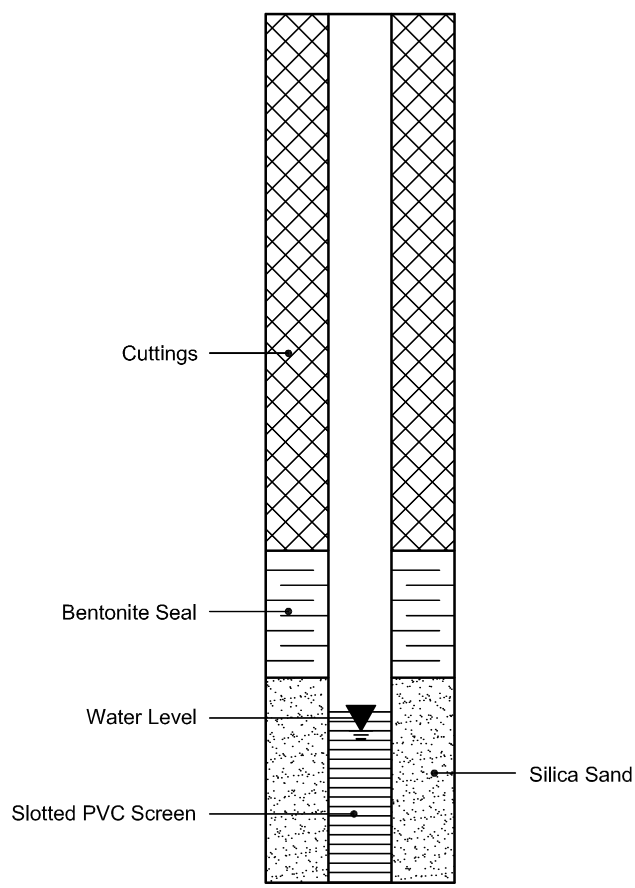


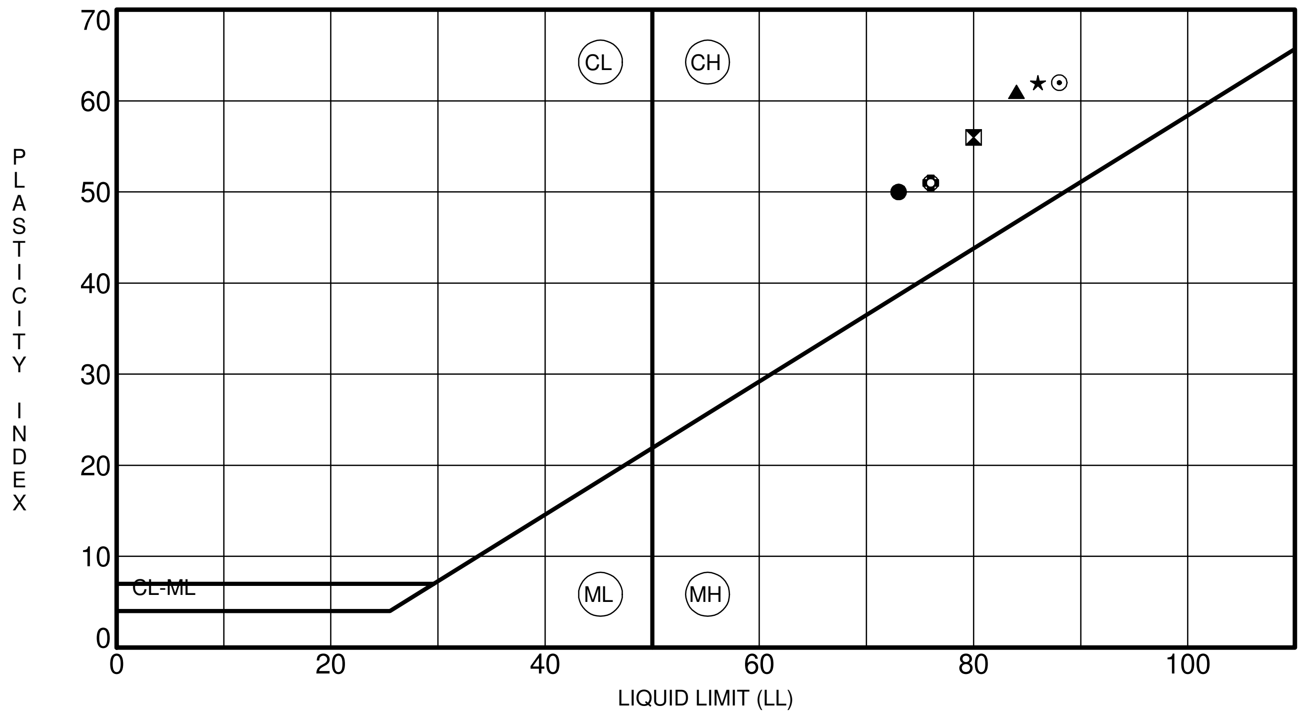
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



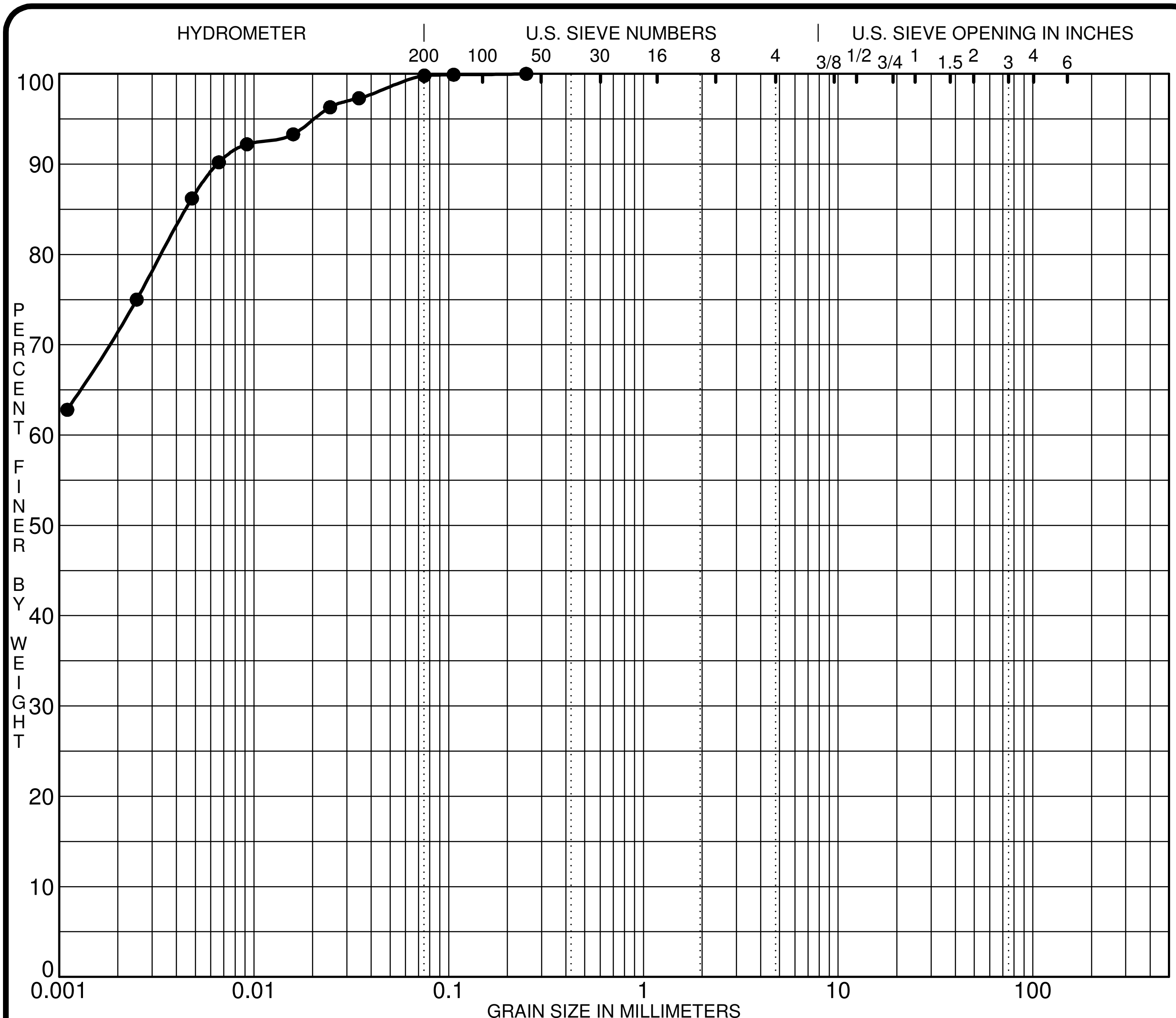


	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH 3-22**	**SS3**	**73**	**23**	**50**		**CH - Inorganic clay of high plasticity**
⊠	**BH 5-22**	**SS3**	**80**	**24**	**56**		**CH - Inorganic clay of high plasticity**
▲	**BH 6-22**	**SS3**	**84**	**23**	**61**		**CH - Inorganic clay of high plasticity**
★	**BH 7-22**	**SS3**	**86**	**24**	**62**		**CH - Inorganic clay of high plasticity**
⊙	**BH 9-22**	**SS2**	**88**	**26**	**62**		**CH - Inorganic clay of high plasticity**
✪	**BH10-22**	**SS3**	**76**	**25**	**51**		**CH - Inorganic clay of high plasticity**
○	**BH11-22**	**SS2**	**76**	**25**	**51**		**CH - Inorganic clay of high plasticity**

CLIENT **Brigil Homes**
FILE NO. **PG6414**
PROJECT **Geotechnical Investigation - Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.**
DATE **26 Oct 22**

patersongroup **Consulting Engineers**
9 Auriga Drive, Ottawa, Ontario K2E 7T9

ATTERBERG LIMITS' RESULTS



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH10-22**	**SS3**	**CH - Inorganic clay of high plasticity**						
⊠									
▲									
★									

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH10-22**	**SS3**	**0.25**				**0.0**	**0.2**	**99.8**	
⊠										
▲										
★										

CLIENT **Brigil Homes** FILE NO. **PG6414**

PROJECT **Geotechnical Investigation - Prop. Multi-Storey Buildings - 8600 Jeanne D'Arc Blvd.** DATE **26 Oct 22**

patersongroup **Consulting Engineers**

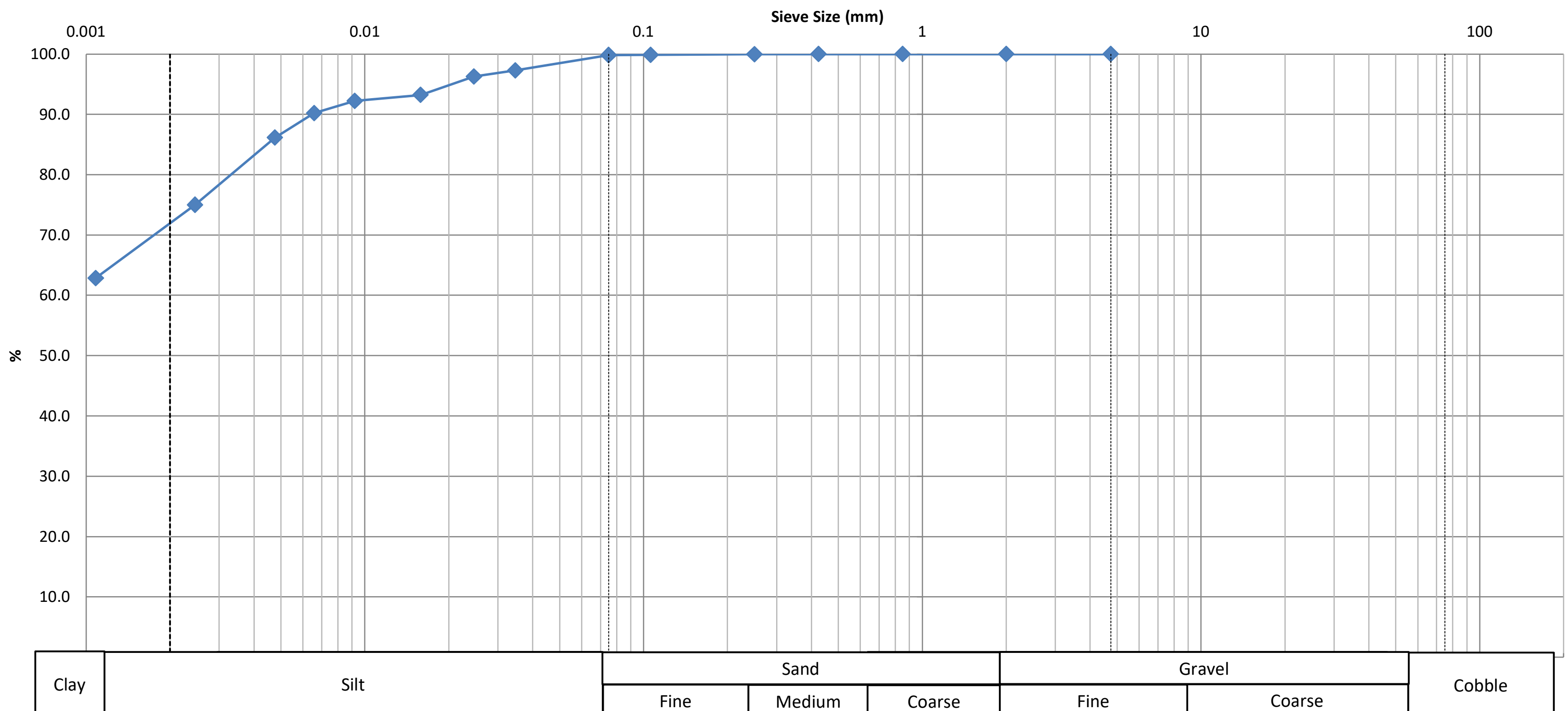
9 Auriga Drive, Ottawa, Ontario K2E 7T9

GRAIN SIZE DISTRIBUTION

PATERSON GROUP

SIEVE ANALYSIS
ASTM C136

CLIENT:	Brigil Petrie 3	DEPTH:	5'0" to 7'0"	FILE NO:	PG6414
CONTRACT NO.:		BH OR TP No.:	BH10-22 SS3	LAB NO:	40446
PROJECT:	8600 Jeanne D'Arc			DATE RECEIVED:	28-Oct-22
				DATE TESTED:	2-Nov-22
DATE SAMPLED:	24-Oct-22			DATE REPORTED:	7-Nov-22
SAMPLED BY:	JM			TESTED BY:	DK/CS



Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					40.7					
	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)		
					0.0	0.2	28.3	71.5		

Comments:

REVIEWED BY:	Curtis Beadow	Joe Forsyth, P. Eng.

PATERSON GROUP

HYDROMETER
LS-702 ASTM-422

CLIENT:	Brigil Petrie 3	DEPTH:	5'0" to 7'0"	FILE NO.:	PG6414
PROJECT:	8600 Jeanne D'Arc	BH OR TP No.:	BH10-22 SS3	DATE SAMPLEI	24-Oct-22
LAB No. :	40446	TESTED BY:	DK/CS	DATE RECEIVE	28-Oct-22
SAMPLED BY:	JM	DATE REPT'D:	7-Nov-22	DATE TESTED:	2-Nov-22

SAMPLE INFORMATION

SAMPLE MASS	SPECIFIC GRAVITY
78.2	2.700

		HYGROSCOPIC MOISTURE		
INITIAL WEIGHT	50.00			
WEIGHT CORRECTED	35.52	TARE WEIGHT	50.00	ACTUAL WEIGHT
WT. AFTER WASH BACK SIEVE	0.12	AIR DRY	89.70	39.70
SOLUTION CONCENTRATION	40 g/L	OVEN DRY	78.20	28.20
		CORRECTED	0.710	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
26.5			
19			
13.2			
9.5			
4.75	**0.0**	0.0	**100.0**
2.0	**0.0**	0.0	**100.0**
Pan	**78.2**		
0.850	**0.00**	0.0	**100.0**
0.425	**0.00**	0.0	**100.0**
0.250	**0.02**	0.0	**100.0**
0.106	**0.06**	0.1	**99.9**
0.075	**0.08**	0.2	**99.8**
Pan	**0.12**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	8:19	54.0	6.0	23.0	0.0346	97.3	**97.3**
2	8:20	53.5	6.0	23.0	0.0246	96.3	**96.3**
5	8:23	52.0	6.0	23.0	0.0159	93.3	**93.3**
15	8:33	51.5	6.0	23.0	0.0092	92.2	**92.2**
30	8:48	50.5	6.0	23.0	0.0066	90.2	**90.2**
60	9:18	48.5	6.0	23.0	0.0048	86.2	**86.2**
250	12:28	43.0	6.0	23.0	0.0025	75.0	**75.0**
1440	8:18	37.0	6.0	23.0	0.0011	62.8	**62.8**

Moisture = 40.66%

REVIEWED BY:	C. Beadow	Joe Forsyth, P. Eng.

PATERSON GROUP

Linear Shrinkage
ASTM D4943-02

CLIENT:	Brigil Petrie 3	DEPTH	5'-0" to 7'-0"	FILE NO.:	PG6414
PROJECT:	8600 Jeanne D'Arc	BH OR TP No:	BH3-22	DATE SAMPLED	24-Oct
LAB No:	40447	TESTED BY:	CP/CS	DATE RECEIVED	28-Oct
SAMPLED BY:	J.M	DATE REPORTED:	7-Nov-22	DATE TESTED	2-Nov

LABORATORY INFORMATION & TEST RESULTS

Moisture	No. of Blows(6)	Calibration (Two Trials)	Tin NO.(X24)	
Tare	5	Tin	4.83	4.83
Soil Pat Wet + Tare	63.2	Tin + Grease	5	4.99
Soil Pat Wet	58.2	Glass	48.97	48.97
Soil Pat Dry + Tare	37.71	Tin + Glass + Water	91.36	91.38
Soil Pat Dry	32.71	Volume	37.39	37.42
Moisture	**77.93**	**Average Volume**	**37.41**	

Soil Pat + String	32.83
Soil Pat + Wax + String in Air	37.28
Soil Pat + Wax + String in Water	13.4
Volume Of Pat (Vdx)	23.88

RESULTS:

Shrinkage Limit	**21.29**
Shrinkage Ratio	**1.733**
Volumetric Shrinkage	**98.120**
Linear Shrinkage	**20.378**

REVIEWED BY:	Curtis Beadow	Joe Forsyth, P. Eng.

2015 National Building Code Seismic Hazard Calculation

INFORMATION: **Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836**
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 45.495N 75.489W **User File Reference:** 8600 Jeanne D'Arc Boulevard 2022-11-30 17:22 UT

Requested by: Petrie's Landing III

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.504	0.279	0.166	0.048
Sa (0.1)	0.584	0.334	0.206	0.066
Sa (0.2)	0.483	0.280	0.176	0.059
Sa (0.3)	0.364	0.212	0.134	0.046
Sa (0.5)	0.255	0.149	0.094	0.033
Sa (1.0)	0.125	0.073	0.047	0.016
Sa (2.0)	0.059	0.034	0.021	0.006
Sa (5.0)	0.015	0.008	0.005	0.001
Sa (10.0)	0.006	0.003	0.002	0.001
PGA (g)	0.310	0.180	0.112	0.035
PGV (m/s)	0.212	0.119	0.073	0.022

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

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

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

Table 1 - Petrie's Landing III - Summary of Reviewed Landslide Inventory Data

Location	Source	Site Code	Geographical Coordinate		Feature	Morphology	Scar Area	Age	Relief	Distance from PG5201	Surface Geology	Drift Thicknes	Bedrock
			Latitude	Longitude			(km2)		(m)	(m)		(m)	
Mississippi River	OF8600	Mss1	45.41279	-76.24891	Landslide	Source area with truncated debris field	0.08	Unknown	15.00	65.80	Marine Deposits	15 to 25	Granite
Mississippi River	OF8600	Mss2	45.41224	-76.25685	Landslide	Source area with debris field	0.03	Unknown	11.00	66.46	Marine Deposits	15 to 25	Granite
Mississippi River	OF8600	Mss3	45.40384	-76.24579	Landslide	Source area with debris field	0.11	Unknown	23.00	65.72	Marine Deposits	15 to 25	Marble
Mississippi River	OF8600	Mss4	45.40073	-76.25147	Landslide	Truncated source area	0.01	Unknown	14.00	66.25	Marine Deposits	15 to 25	Marble
Mississippi River	OF8600	Mss5	45.39957	-76.24593	Landslide	Source area with truncated debris field	0.02	Unknown	20.00	65.82	Erosional Terraces	15 to 25	Marble
Mississippi River	OF8600	Mss6	45.39906	-76.25294	Landslide	Source area with truncated debris field	0.04	Unknown	15.00	66.40	Marine Deposits	15 to 25	Marble
Mississippi River	OF8600	Mss7	45.39121	-76.25506	Landslide	Truncated source area	0.01	Unknown	15.00	66.74	Erosional Terraces	10 to 15	Interbedded Limestone and Shale
Mississippi River	OF8600	Mss8	45.38970	-76.25421	Landslide	Source area with truncated debris field	0.03	Unknown	12.00	66.71	Erosional Terraces	5 to 10	Interbedded Limestone and Shale
Mississippi River	OF8600	Mss9	45.38953	-76.25872	Landslide	Source area with truncated debris field	0.02	Unknown	15.00	67.07	Organic Deposits	5 to 10	Interbedded Limestone and Shale
Mississippi River	OF8600	Mss10	45.38715	-76.25825	Landslide	Source area with truncated debris field	0.01	Unknown	15.00	67.09	Erosional Terraces	5 to 10	Interbedded Limestone and Shale
Mississippi River	OF8600	Mss11	45.37849	-76.26739	Landslide	Truncated source area	0.03	Unknown	13.00	68.04	Erosional Terraces	50 to 100	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss12	45.37130	-76.26864	Landslide	Truncated source area	0.02	Unknown	11.00	68.32	Erosional Terraces	25 to 50	Interbedded Limestone and Dolomite
Mississippi Valley	OF8600	Mss13	45.36543	-76.27229	Landslide	Truncated source area	0.02	Unknown	12.00	68.77	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss14	45.36519	-76.27788	Landslide	Source area with truncated debris field	0.02	Unknown	12.00	69.22	Erosional Terraces	25 to 50	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss15	45.36304	-76.27430	Landslide	Source area with truncated debris field	0.03	Unknown	15.00	68.99	Erosional Terraces	25 to 50	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss16	45.36359	-76.26926	Landslide	Truncated source area	0.01	Unknown	17.00	68.57	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss17	45.36075	-76.26736	Landslide	Source area with debris field	0.06	Unknown	20.00	68.50	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss18	45.36124	-76.27193	Landslide	Truncated source area	0.01	Unknown	12.00	68.85	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss19	45.36122	-76.27561	Landslide	Source area with debris field	0.04	Unknown	10.00	69.15	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite

Table 1 - Petrie's Landing III - Summary of Reviewed Landslide Inventory Data

Location	Source	Site Code	Geographical Coordinate		Feature	Morphology	Scar Area	Age	Relief	Distance from PG5201	Surface Geology	Drift Thicknes	Bedrock
			Latitude	Longitude			(km2)		(m)	(m)		(m)	
Mississippi River	OF8600	Mss20	45.36267	-76.28135	Landslide	Source area with debris field	0.02	Unknown	10.00	69.57	Marine Deposits	15 to 25	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss21	45.35604	-76.26640	Landslide	Source area with debris field	0.11	Unknown	15.00	68.55	Erosional Terraces	25 to 50	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss22	45.35416	-76.27441	Landslide	Truncated source area	0.01	Unknown	17.00	69.25	Erosional Terraces	25 to 50	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss23	45.35244	-76.27982	Landslide	Truncated source area	0.01	Unknown	25.00	69.73	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss24	45.35168	-76.28166	Landslide	Truncated source area	0.01	Unknown	25.00	69.90	Erosional Terraces	25 to 50	Interbedded Limestone and Dolomite
Mississippi River	OF8600	Mss25	45.35103	-76.28318	Landslide	Truncated source area	0.02	Unknown	20.00	70.04	Erosional Terraces	25 to 50	Interbedded Limestone and Dolomite
Cody Creek	OF8600	Cdy1	45.35143	-76.26277	Landslide	Source area with truncated debris field	0.01	Unknown	16.00	68.40	Erosional Terraces	25 to 50	Interbedded Limestone and Dolomite
Cody Creek	OF8600	Cdy2	45.35023	-76.26130	Landslide, possibly	Source area with debris field	0.01	Unknown	***	68.32	***	***	***
Cody Creek	OF8600	Cdy3	45.34522	-76.26452	Landslide	Truncated source area	0.01	Unknown	21.00	68.73	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
Cody Creek	OF8600	Cdy4	45.34223	-76.26721	Landslide	Truncated source area	0.02	Unknown	17.00	69.04	Marine Deposits	15 to 25	Interbedded Limestone and Dolomite
Cody Creek	OF8600	Cdy5	45.33939	-76.25827	Landslide	Source area with truncated debris field	0.07	Unknown	17.00	68.42	Erosional Terraces	15 to 25	Interbedded Limestone and Dolomite
Cody Creek	OF8600	Cdy6	45.33979	-76.24991	Landslide	Source area with truncated debris field	0.06	Unknown	13.00	67.74	Marine Deposits	15 to 25	Interbedded Limestone and Dolomite
Cody Creek	OF8600	Cdy7	45.34175	-76.24524	Landslide, possibly	Source area with truncated debris field	0.10	Unknown	***	67.30	***	***	***
Cody Creek	OF8600	Cdy8	45.33762	-76.24262	Landslide	Source area with truncated debris field	0.03	Unknown	23.00	67.23	Marine Deposits	10 to 15	Interbedded Limestone and Dolomite
Cody Creek	OF8600	Cdy9	45.33822	-76.23647	Landslide	Source area with truncated debris field	0.01	Unknown	17.00	66.73	Marine Deposits	5 to 10	Interbedded Limestone and Dolomite
Cody Creek	OF8600	Cdy10	45.33477	-76.23220	Landslide	Source area with truncated debris field	0.06	Unknown	12.00	66.50	Marine Deposits	15 to 25	Interbedded Limestone and Dolomite
Cody Creek	OF8600	Cdy11	45.33386	-76.23415	Landslide, probably	Source area with truncated debris field	0.04	Unknown	**	66.69	**	**	**
Cody Creek	OF8600	Cdy12	45.32989	-76.22645	Landslide, probably	Source area with truncated debris field	0.04	Unknown	**	66.22	**	**	**
Cody Creek	OF8600	Cdy13	45.32654	-76.22004	Landslide, probably	Source area with truncated debris field	0.03	Unknown	**	65.83	**	**	**

Table 1 - Petrie's Landing III - Summary of Reviewed Landslide Inventory Data

Location	Source	Site Code	Geographical Coordinate		Feature	Morphology	Scar Area	Age	Relief	Distance from PG5201	Surface Geology	Drift Thicknes	Bedrock
			Latitude	Longitude			(km2)		(m)	(m)		(m)	
Cody Creek	OF8600	Cdy14	45.32031	-76.21358	Landslide	Source area with truncated debris field; isolated areas of debris field	0.05	Unknown	24.00	65.56	Marine Deposits	10 to 15	Interbedded Limestone and Dolomite
Cody Creek	OF8600	Cdy15	45.34728	-76.23587	Landslide, probably	Debris field within a narrow stream valley	0.01	Unknown		66.38			
Madawaska Lake reservoir	OF8600	Mdw1	45.40855	-76.35190	Landslide, former site of	Inundated beneath lake waters	**	Unknown	7.00	74.28	Marine Deposits	10 to 15	Marble
Fitzroy	OF8600	Ftz1	45.50319	-76.22097	Landslide	Truncated source area	0.03	Unknown	10.00	62.72	Alluvial Sediments	5 to 10	Interbedded Limestone and Dolomite
Fitzroy	OF8600	Ftz2	45.50437	-76.21394	Landslide	Truncated source area	0.02	Unknown	16.00	62.14	Alluvial Sediments	5 to 10	Interbedded Limestone and Dolomite
Fitzroy	OF8600	Ftz3	45.49835	-76.15980	Landslide	Source area with truncated debris field	0.16	Unknown	27.00	57.68	Erosional Terraces	10 to 15	Interbedded Limestone and Dolomite
Fitzroy	OF8600	Ftz4	45.50664	-76.13974	Landslide	Truncated source area	0.23	Unknown	11.00	56.03	Erosional Terraces	5 to 10	Interbedded Limestone and Dolomite
Buckhams Bay	OF8600	BkB1	45.48572	-76.10521	Landslide	Source area with truncated debris field	0.49	Unknown	34.00	53.20	Erosional Terraces	15 to 25	Interbedded Limestone and Dolomite
Buckhams Bay	OF8600	BkB2	45.48122	-76.10138	Landslide	Source area with truncated debris field	0.13	Unknown	30.00	52.90	Erosional Terraces	15 to 25	Interbedded Limestone and Dolomite
Buckhams Bay	OF8600	BkB3	45.47977	-76.09564	Landslide	Source area with truncated debris field	0.10	Unknown	30.00	52.44	Erosional Terraces	15 to 25	Interbedded Limestone and Dolomite
Carp Creek	OF8600	Crp1	45.34812	-76.04299	Landslide	Source area with debris field	0.10	Unknown	20.00	51.18	Marine Deposits	25 to 50	Interbedded Limestone and Shale
Rideau River	OF8600	Rid1	45.38818	-75.70428	Landslide	Truncated source area	0.05	Unknown	15.00	23.86	Erosional Terraces	5 to 10	Limestone
Rideau River	OF8600	Rid2	45.32436	-75.69166	Landslide	Source area with debris field	0.06	Unknown	30.00	27.86	Alluvial Sediments	15 to 25	Interbedded Dolomite and Sandstone
Rideau River	OF8600	Rid3	45.28377	-75.69606	Landslide, possibly	Truncated source area?	0.01	Unknown		31.72			
Rockcliffe	OF8600	Rkf1	45.45147	-75.67312	Landslide, probably	Truncated source area	0.02	Unknown		18.39			
Gloucester	OF8600	Glt1	45.44963	-75.59729	Landslide	Source area with debris field	0.12	About 1000 cal yr BP	30.00	12.63	Erosional Terraces	25 to 50	Interbedded Limestone and Dolomite
Orleans	OF8600	Oln1	45.45962	-75.55209	Landslide, possibly	Truncated source area?	0.02	Unknown		8.78			
Orleans	OF8600	Oln2	45.45719	-75.54766	Landslide	Debris field within a narrow stream valley	0.11	Unknown	17.00	8.62	Marine Deposits	25 to 50	Shale
Orleans	OF8600	Oln3	45.46016	-75.54108	Landslide	Debris field within a narrow stream valley	0.05	Unknown	5.00	7.97	Marine Deposits	50 to 100	Shale

Table 1 - Petrie's Landing III - Summary of Reviewed Landslide Inventory Data

Location	Source	Site Code	Geographical Coordinate		Feature	Morphology	Scar Area	Age	Relief	Distance from PG5201	Surface Geology	Drift Thicknes	Bedrock
			Latitude	Longitude			(km2)		(m)	(m)		(m)	
Orleans	OF8600	Oln4	45.45726	-75.54049	Landslide	Debris field within a narrow stream valley	0.02	Unknown	5.00	8.12	Nearshore Marine	50 to 100	Shale
Orleans	OF8600	Oln5	45.45487	-75.53897	Landslide	Debris field within a narrow stream valley	0.02	Unknown	9.00	8.18	Marine Deposits	50 to 100	Interbedded Limestone and Dolomite
Orleans	OF8600	Oln6	45.45863	-75.53838	Landslide	Debris field within a narrow stream valley	0.01	Unknown	3.00	7.89	Nearshore Marine	50 to 100	Shale
Orleans	OF8600	Oln7	45.45977	-75.53858	Landslide	Debris field within a narrow stream valley	0.00	Unknown	2.00	7.82	Nearshore Marine	50 to 100	Shale
Orleans	OF8600	Oln8	45.46051	-75.53690	Landslide	Debris field within a narrow stream valley	0.01	Unknown	7.00	7.66	Nearshore Marine	50 to 100	Shale
Orleans	OF8600	Oln9	45.46092	-75.53424	Landslide	Debris field within a narrow stream valley	0.02	Unknown	3.00	7.45	Nearshore Marine	50 to 100	Shale
Orleans	OF8600	Oln10	45.46378	-75.53684	Landslide	Truncated source area	0.07	Unknown	20.00	7.45	Nearshore Marine	50 to 100	Shale
Orleans	OF8600	Oln11	45.46497	-75.53146	Landslide	Truncated source area	0.06	Unknown	18.00	7.00	Nearshore Marine	50 to 100	Shale
Orleans	OF8600	Oln12	45.46706	-75.52809	Landslide	Truncated source area	0.05	Unknown	18.00	6.64	Nearshore Marine	25 to 50	Shale
Orleans	OF8600	Oln13	45.47042	-75.52019	Landslide, probably	Truncated source area	0.07	Unknown		5.87			
Orleans	OF8600	Oln14	45.48981	-75.50782	Landslide	Source area with debris field	0.08	Late Holocene?	18.00	4.07	Alluvial Sediments	15 to 25	Interbedded Limestone and Dolomite
Orleans	OF8600	Oln15	45.48871	-75.47487	Landslide, probably	Truncated source area	0.08	Unknown		1.57			
Orleans	OF8600	Oln16	45.48586	-75.47170	Landslide	Debris field within a narrow stream valley	0.07	Unknown	29.00	1.61	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
Orleans	OF8600	Oln17	45.48877	-75.46692	Landslide	Debris field within a narrow stream valley	0.04	Unknown	8.00	1.10	Marine Deposits	15 to 25	Interbedded Limestone and Dolomite
Orleans	OF8600	Oln18	45.49016	-75.46497	Landslide	Debris field within a narrow stream valley	0.03	Unknown	10.00	0.88	Marine Deposits	15 to 25	Interbedded Limestone and Dolomite
Cumberland	OF8600	Cmb1	45.51313	-75.43362	Landslide	Truncated source area	0.14	Unknown	35.00	2.88	Erosional Terraces	15 to 25	Shale
Cumberland	OF8600	Cmb2	45.51302	-75.40335	Landslide	Source area with debris field	0.04	Unknown	24.00	5.00	Marine Deposits	15 to 25	Interbedded Limestone and Dolomite
Cumberland	OF8600	Cmb3	45.51737	-75.38140	Landslide	Source area with debris field	0.53	relatively young, less than 2000(?)	30.00	6.87	Erosional Terraces	50 to 100	Dolomite
Cumberland	OF8600	Cmb4	45.51651	-75.33631	Landslide	Source area with debris field	0.02	Unknown	49.00	10.40	Nearshore Marine	25 to 50	Interbedded Limestone and Dolomite

PATERSON GROUP

Table 1 - Petrie's Landing III - Summary of Reviewed Landslide Inventory Data													
Location	Source	Site Code	Geographical Coordinate		Feature	Morphology	Scar Area	Age	Relief	Distance from PG5201	Surface Geology	Drift Thicknes	Bedrock
			Latitude	Longitude			(km2)		(m)	(m)		(m)	
Mer Bleue paleochannel	OF8600	MBu1	45.43409	-75.53765	Landslide	Truncated source area	0.02	Unknown	13.00	9.77	Erosional Terraces	25 to 50	Interbedded Limestone and Shale
Mer Bleue paleochannel	OF8600	MBu2	45.43092	-75.51828	Landslide	Source area with debris field	0.12	Unknown	15.00	9.11	Nearshore Marine	25 to 50	Shale
Mer Bleue paleochannel	OF8600	MBu3	45.42843	-75.51485	Landslide	Source area with debris field	0.01	Unknown	12.00	9.22	Nearshore Marine	25 to 50	Shale
Mer Bleue paleochannel	OF8600	MBu4	45.42782	-75.51290	Landslide	Truncated source area	0.01	Unknown	**	9.20	Nearshore Marine	25 to 50	Shale
Mer Bleue paleochannel	OF8600	MBu5	45.42639	-75.50741	Landslide, former site of	Completely altered	N.A.	Unknown	**	9.14	Nearshore Marine	25 to 50	Shale
Mer Bleue paleochannel	OF8600	MBu6	45.42500	-75.50289	Landslide, former site of	Completely altered	N.A.	Unknown	**	9.14	Nearshore Marine	25 to 50	Shale
Mer Bleue paleochannel	OF8600	MBu7	45.42364	-75.49702	Landslide, former site of	Completely altered	N.A.	Unknown	**	9.11	Nearshore Marine	25 to 50	Shale
Mer Bleue paleochannel	OF8600	MBu8	45.42335	-75.49197	Landslide, former site of	Completely altered	N.A.	Unknown	**	9.01	Nearshore Marine	25 to 50	Shale
Mer Bleue paleochannel	OF8600	MBu9	45.42158	-75.48102	Landslide	Truncated source area	0.03	Unknown	15.00	8.98	Erosional Terraces	25 to 50	Shale
Mer Bleue paleochannel	OF8600	MBu10	45.42089	-75.47444	Landslide	Truncated source area	0.03	Unknown	15.00	8.97	Nearshore Marine	25 to 50	Shale
Mer Bleue paleochannel	OF8600	MBu11	45.41891	-75.46077	Landslide	Truncated source area	0.03	Unknown	14.00	9.12	Nearshore Marine	15 to 25	Shale
Mer Bleue paleochannel	OF8600	MBu12	45.41829	-75.45649	Landslide	Truncated source area	0.01	Unknown	15.00	9.20	Nearshore Marine	15 to 25	Shale
Mer Bleue paleochannel	OF8600	MBu13	45.41206	-75.27053	Landslide	Source area with debris field	1.42	about 5200 cal yrBP	19.00	18.46	Nearshore Marine	25 to 50	Interbedded Limestone and Shale
Beta-90881	OF7432	1	45.46110	-75.26110	Landslide	*	*	3050±70	20.00	16.85	Nearshore Marine	15 to 25	Interbedded Limestone and Shale
Beta-122473	OF7432	1	45.44170	-75.22220	Landslide	*	*	4590±40	8.00	20.57	Nearshore Marine	25 to 50	Interbedded Limestone and Shale
Beta-122475	OF7432	1	45.44240	-75.19240	Landslide	*	*	2760±50	20.00	22.90	Erosional Terraces	25 to 50	Interbedded Limestone and Shale
Beta-127281	OF7432	1	45.54160	-75.24160	Landslide	*	*	5130±60	53.00	18.69	Nearshore Marine	10 to 15	Limestone
Beta-127284	OF7432	1	45.52080	-75.26670	Landslide	*	*	4440±80	21.00	16.12	Erosional Terraces	25 to 50	Interbedded Limestone and Shale
Beta-127244	OF7432	1	45.50000	-75.20280	Landslide	*	*	4570±70	30.00	21.13	Erosional Terraces	25 to 50	Interbedded Limestone and Shale

Table 1 - Petrie's Landing III - Summary of Reviewed Landslide Inventory Data

Location	Source	Site Code	Geographical Coordinate		Feature	Morphology	Scar Area	Age	Relief	Distance from PG5201	Surface Geology	Drift Thicknes	Bedrock
			Latitude	Longitude			(km2)		(m)	(m)		(m)	
Beta-122472	OF7432	1	45.48330	-75.19170	Landslide	*	*	4520±50	30.00	22.10	Nearshore Marine	15 to 25	Interbedded Limestone and Shale
Beta-127282	OF7432	1	45.47500	-75.12920	Landslide	*	*	4540±90	24.00	27.31	Nearshore Marine	15 to 25	Interbedded Limestone and Shale
Beta-127283	OF7432	1	45.52500	-75.01110	Landslide	*	*	4530±60	12.00	37.06	Erosional Terraces	10 to 15	Interbedded Limestone and Shale
Beta-122478	OF7432	1	45.51390	-75.00280	Landslide	*	*	4700±50	15.00	37.65	Erosional Terraces	15 to 25	Interbedded Limestone and Shale
Beta-122471	OF7432	1	45.51850	-74.95570	Landslide	*	*	1870±40	26.00	41.55	**	**	**
Beta-127242	OF7432	1	45.51380	-74.93750	Landslide	*	*	4820±70	26.00	43.02	**	**	**
Beta-122474	OF7432	1	45.53610	-75.15830	Landslide	*	*	4470±50	**	25.22	Nearshore Marine	25 to 50	Limestone
GSC-1922	OF7432	2	45.54370	-75.40110	Landslide	*	*	4620±80	81.00	7.33	Marine Deposits	15 to 25	Felsic Intrusive Rocks
GSC-2068	OF7432	4	45.52080	-75.49170	Landslide	*	*	6240±70	59.00	3.90	Marine Deposits	25 to 50	Dolomite
UCIAMS-71217	OF7432	6	45.57980	-75.04260	Landslide	*	*	7105±20	35.00	35.66	Erosional Terraces	50 to 100	Shale
UCIAMS-71211	OF7432	7	45.57020	-75.11560	Landslide	*	*	7140±20	31.00	29.58	Marine Deposits	50 to 100	Interbedded Limestone and Dolomite
GSC-1741	OF7432	10	45.46500	-75.75130	Landslide	*	*	120±150	**	24.33	Marine Deposits	25 to 50	Dolomite
UCIAMS-88796	OF7432	11	45.48290	-75.93490	Landslide	*	*	1125±15	29.00	39.20	Marine Deposits	25 to 50	Felsic Intrusive Rocks

Table 1 - Petrie's Landing III - Summary of Reviewed Landslide Inventory Data

Location	Source	Site Code	Geographical Coordinate		Feature	Morphology	Scar Area	Age	Relief	Distance from PG5201	Surface Geology	Drift Thicknes	Bedrock
			Latitude	Longitude			(km2)		(m)	(m)		(m)	
UCIAMS-88704	OF7432	11	45.48530	-75.93630	Landslide	*	*	2805±20	29.00	39.30	Marine Deposits	25 to 50	Felsic Intrusive Rocks
GSC-6233	OF7432	11	45.48310	-75.93320	Landslide	*	*	7050±80	25.00	39.05	Marine Deposits	25 to 50	Felsic Intrusive Rocks
UCIAMS-88816	OF7432	11	45.48020	-75.93090	Landslide	*	*	200±15	24.00	38.88	Marine Deposits	15 to 25	Felsic Intrusive Rocks
GSC-6449	OF7432	11	45.47180	-75.91290	Landslide	*	*	1080±70	15.00	37.47	Marine Deposits	15 to 25	Interbedded Limestone and Dolomite
UCIAMS-88703	OF7432	11	45.47990	-75.91740	Landslide	*	*	180±20	26.00	37.77	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
GSC-6318	OF7432	11	45.47860	-75.91180	Landslide	*	*	1030±70	24.00	37.32	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
UCIAMS-88806	OF7432	11	45.47730	-75.90280	Landslide	*	*	1895±25	12.00	36.59	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
GSC-6482	OF7432	11	45.48120	-75.90670	Landslide	*	*	1210±50	8.00	36.88	Marine Deposits	25 to 50	Interbedded Limestone and Dolomite
GSC-6433	OF7432	11	45.48540	-75.89640	Landslide	*	*	1440±50	18.00	36.02	Marine Deposits	15 to 25	Felsic Intrusive Rocks
UCIAMS-88818	OF7432	11	45.48520	-75.90600	Landslide	*	*	2755±20	22.00	36.81	Marine Deposits	25 to 50	Felsic Intrusive Rocks
GSC-6355	OF7432	11	45.48250	-75.91180	Landslide	*	*	1170±50	27.00	37.30	Marine Deposits	25 to 50	Felsic Intrusive Rocks
Beta-139135	OF7432	11	45.49650	-75.92780	Landslide	*	*	310±40	10.00	38.57	Marine Deposits	50 to 100	Felsic Intrusive Rocks
UCIAMS-122468	OF7432	12	45.53530	-76.03060	Landslide	*	*	1095±20	21.00	47.24	Marine Deposits	15 to 25	Felsic Intrusive Rocks
UCIAMS-106656	OF7432	13	45.54090	-76.04890	Landslide	*	*	1150±15	22.00	48.81	Marine Deposits	25 to 50	Felsic Intrusive Rocks
UCIAMS-171460	OF7432	14	45.55390	-76.13020	Landslide	*	*	1305±20	9.00	55.62	Nearshore Marine	50 to 100	Felsic Intrusive Rocks
UCIAMS-171459	OF7432	15	45.55130	-76.14060	Landslide	*	*	185±20	9.00	56.44	Nearshore Marine	50 to 100	Felsic Intrusive Rocks
UCIAMS-106587	OF7432	16	45.55190	-76.28630	Landslide	*	*	1180±20	24.00	68.37	Erosional Terraces	15 to 25	Felsic Intrusive Rocks
UCIAMS-106575	OF7432	17	45.61920	-76.37190	Landslide	*	*	955±15	32.00	76.43	**	**	**

Table 1 - Petrie's Landing III - Summary of Reviewed Landslide Inventory Data

Location	Source	Site Code	Geographical Coordinate		Feature	Morphology	Scar Area	Age	Relief	Distance from PG5201	Surface Geology	Drift Thicknes	Bedrock
			Latitude	Longitude			(km2)		(m)	(m)		(m)	
UCIAMS-106650	OF7432	18	45.50140	-76.28260	Landslide	*	*	1145±20	52.00	67.79	Nearshore Marine	15 to 25	Felsic Intrusive Rocks
UCIAMS-106581	OF7432	19	45.51700	-76.27470	Landslide	*	*	5830±20	34.00	67.17	Nearshore Marine	15 to 25	Felsic Intrusive Rocks
UCIAMS-122453	OF7432	20	45.54620	-76.52600	Landslide	*	*	5745±20	**	87.99	**	**	**
UCIAMS-137113	OF7432	21	45.72570	-75.89150	Landslide	*	*	4525±20	52.00	44.56	**	**	**
UCIAMS-137101	OF7432	22	45.69440	-75.89960	Landslide	*	*	90±20	23.00	43.01	**	**	**
UCIAMS-122455	OF7432	23	45.80960	-75.95980	Landslide	*	*	940±15	25.00	55.15	**	**	**

'*' - Indicates information not provided by source (Geological Survey of Canada Open File 7432)

'' Indicates information could not be interpreted from available mapping.**

APPENDIX 2

FIGURE 1 – KEY PLAN

FIGURE 4A to 8B – SLOPE STABILITY ANALYSIS SECTIONS

DRAWING PG6414-1 - TEST HOLE LOCATION PLAN

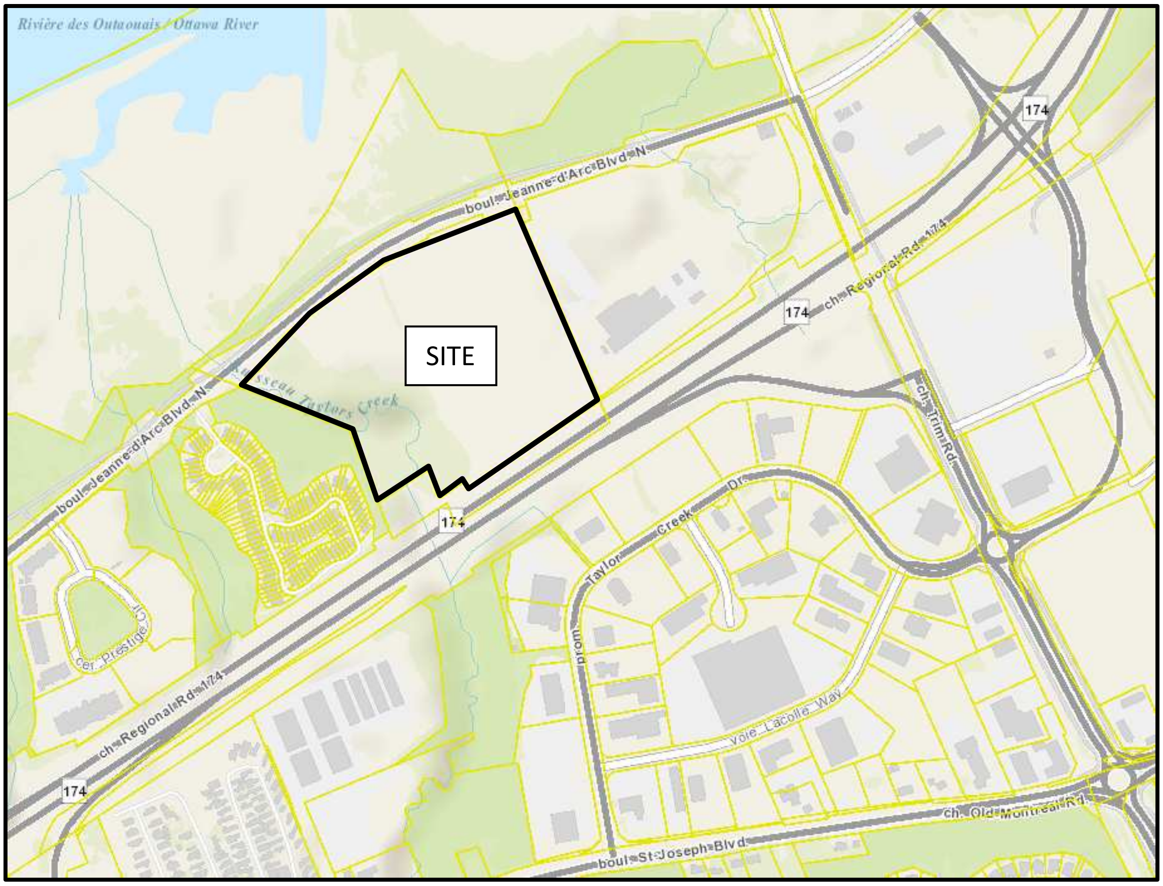


FIGURE 1

KEY PLAN

PATERSON GROUP

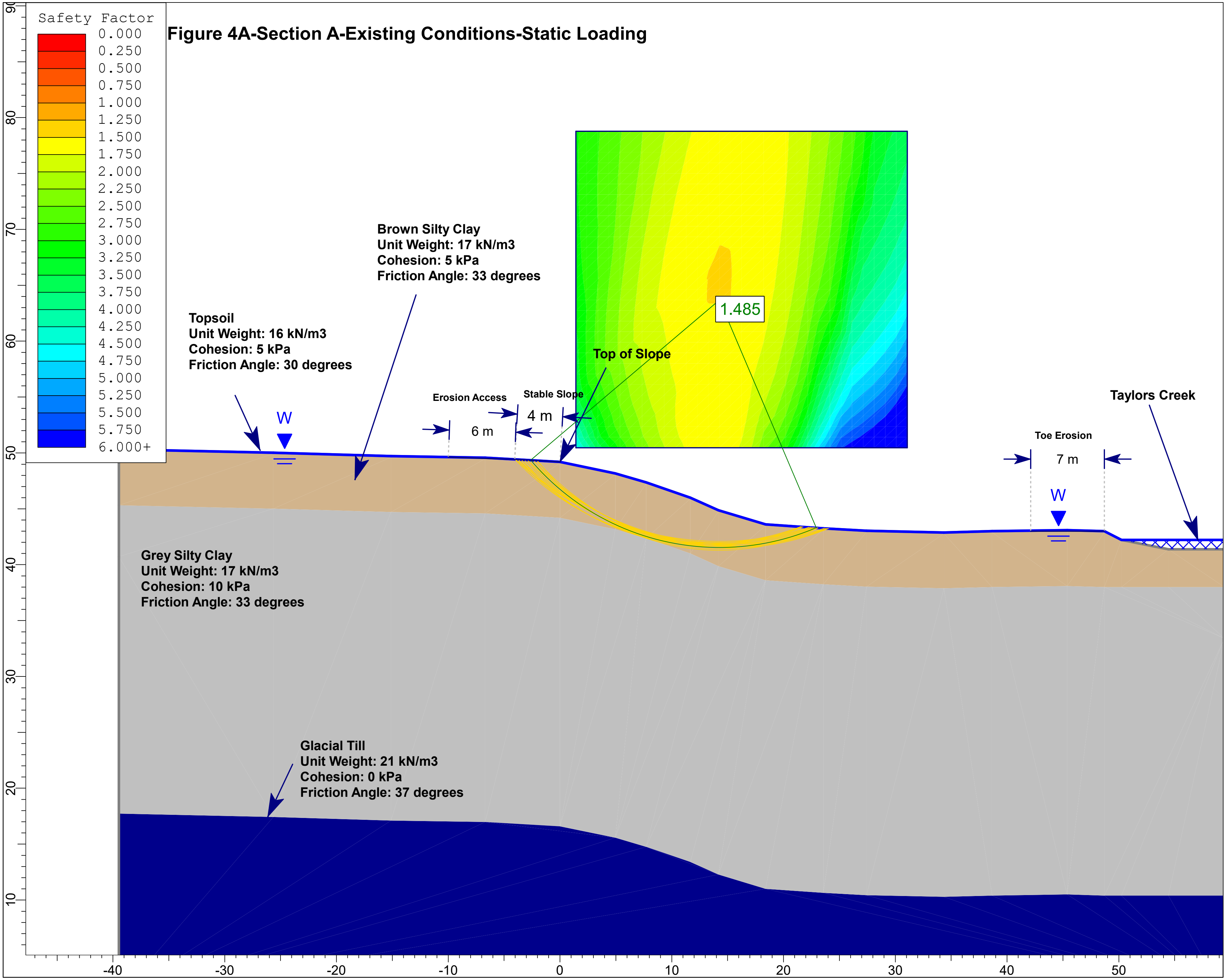


Figure 4A-Section A-Existing Conditions-Static Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.485
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
Topsoil
Unit Weight: 16 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Top of Slope
Erosion Access
Stable Slope
4 m
6 m
W
Taylors Creek
Toe Erosion
7 m
W
Grey Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 10 kPa
Friction Angle: 33 degrees
Glacial Till
Unit Weight: 21 kN/m3
Cohesion: 0 kPa
Friction Angle: 37 degrees
90
80
70
60
50
40
30
20
10
-40
-30
-20
-10
0
10
20
30
40
50

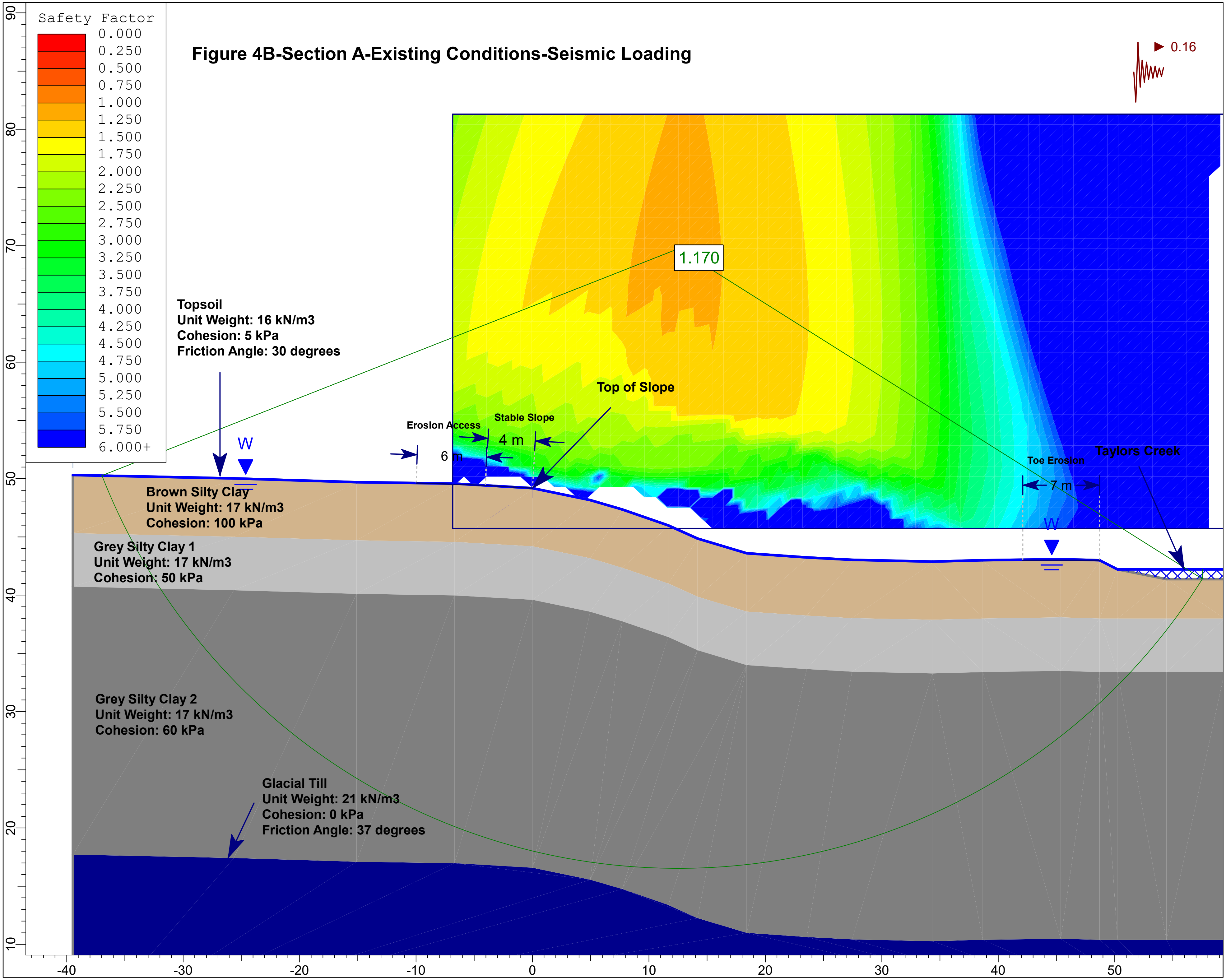


Figure 4B-Section A-Existing Conditions-Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
1.170
Topsoil
Unit Weight: 16 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Top of Slope
Erosion Access
Stable Slope
4 m
6 m
Toe Erosion
7 m
Taylors Creek
W
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 100 kPa
Grey Silty Clay 1
Unit Weight: 17 kN/m3
Cohesion: 50 kPa
Grey Silty Clay 2
Unit Weight: 17 kN/m3
Cohesion: 60 kPa
Glacial Till
Unit Weight: 21 kN/m3
Cohesion: 0 kPa
Friction Angle: 37 degrees

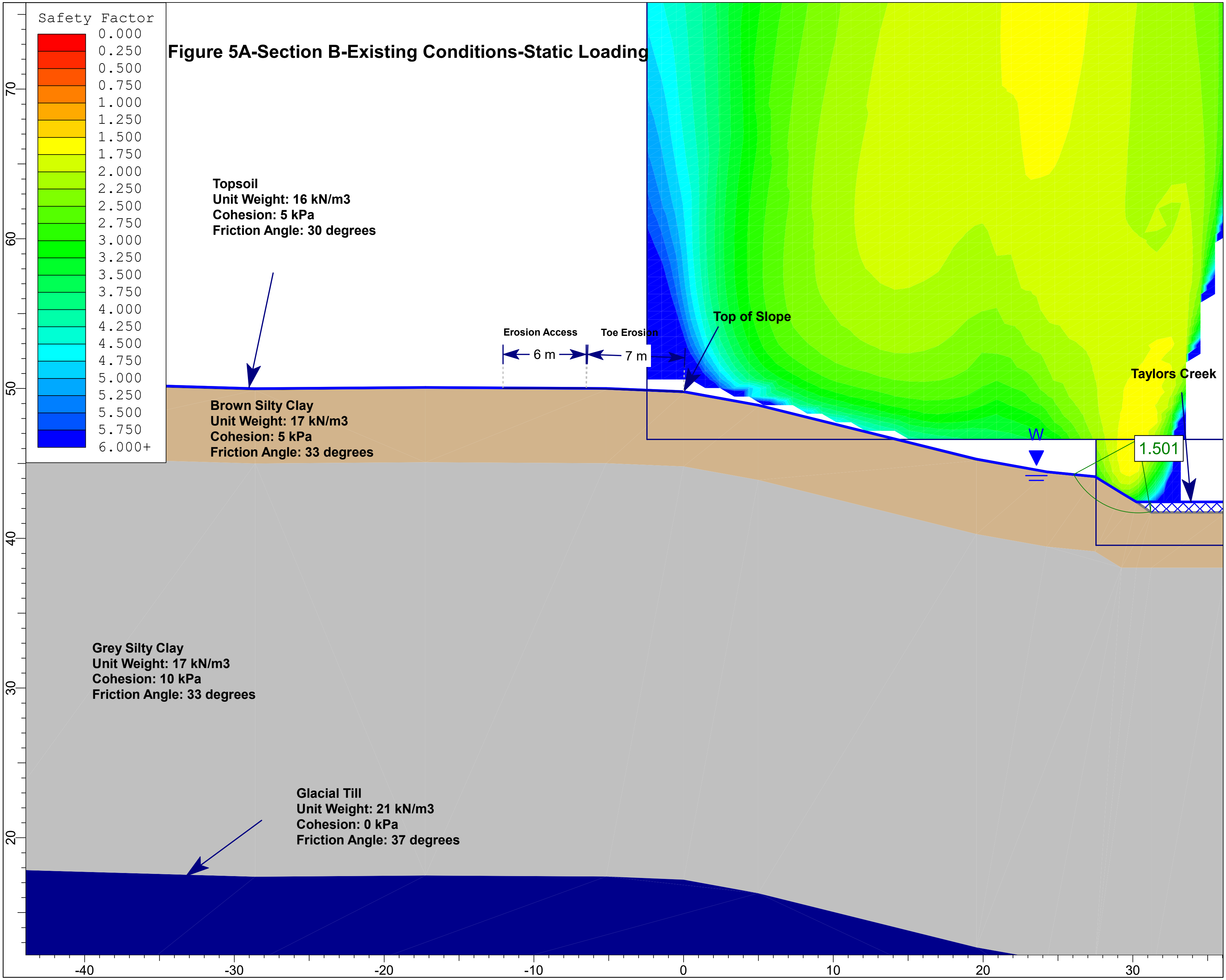
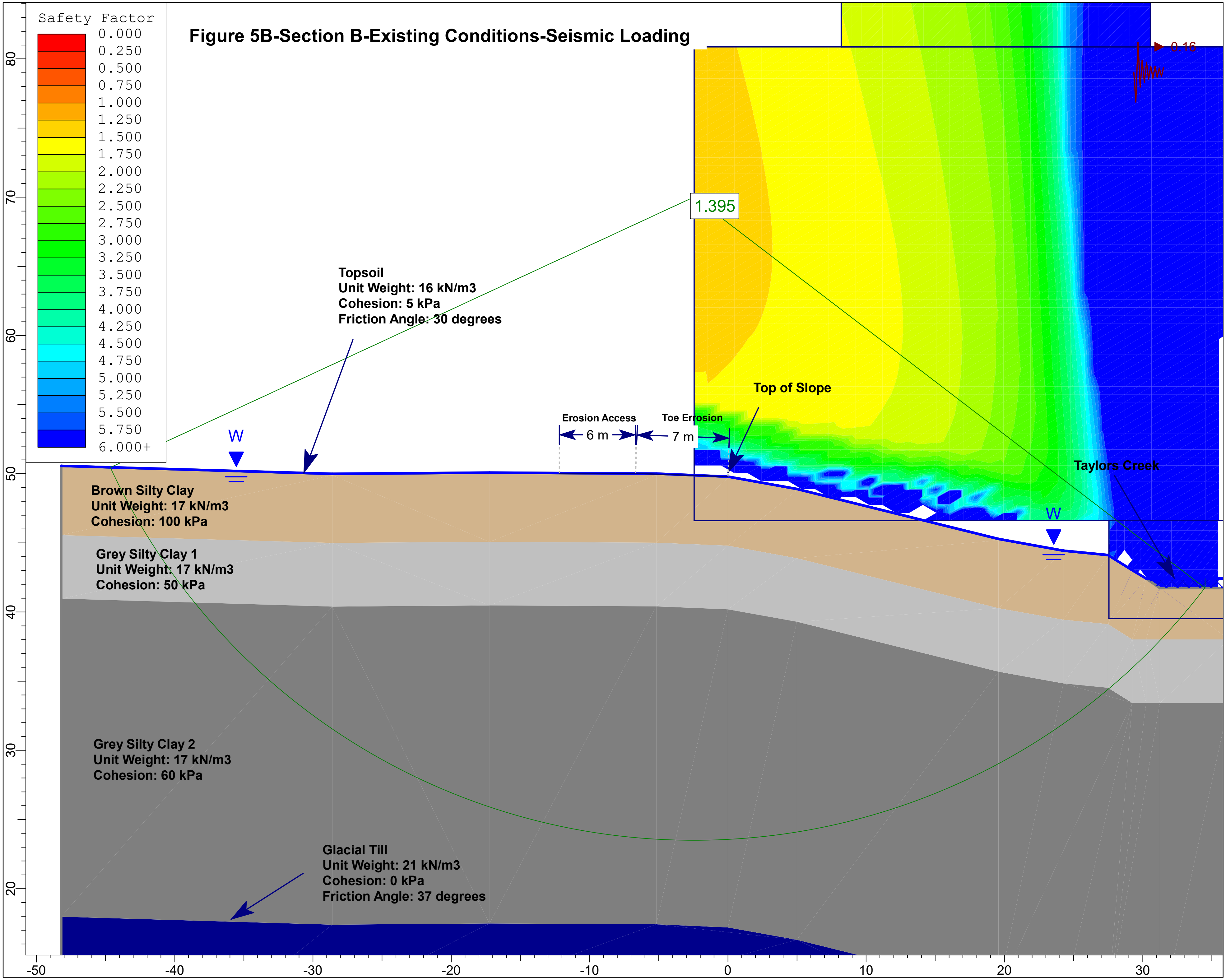

Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Figure 5A-Section B-Existing Conditions-Static Loading
Topsoil
Unit Weight: 16 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Erosion Access
6 m
Toe Erosion
7 m
Top of Slope
Taylors Creek
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
W
1.501
Grey Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 10 kPa
Friction Angle: 33 degrees
Glacial Till
Unit Weight: 21 kN/m3
Cohesion: 0 kPa
Friction Angle: 37 degrees
70
60
50
40
30
20
-40
-30
-20
-10
0
10
20
30

Figure 5B-Section B-Existing Conditions-Seismic Loading



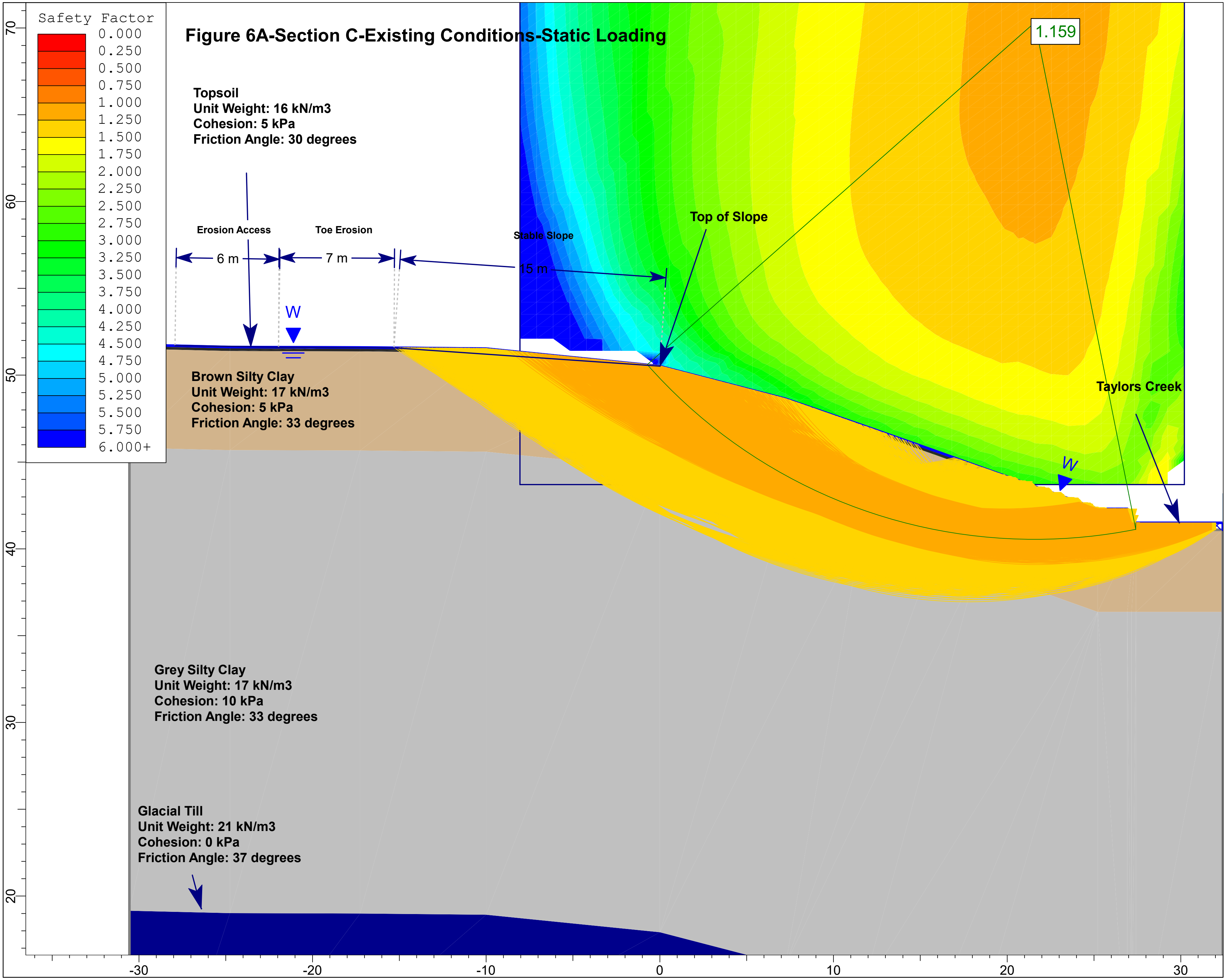
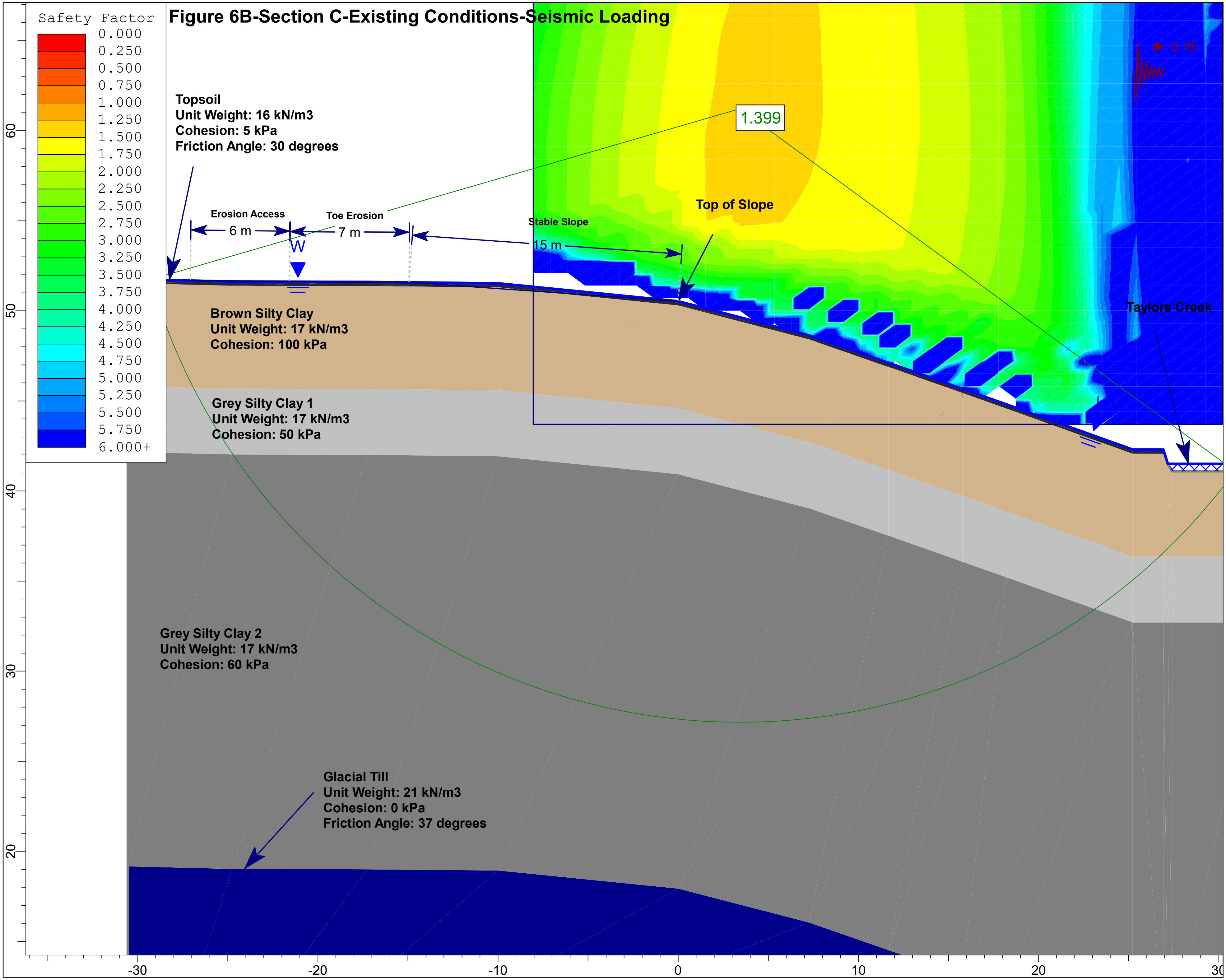


Figure 6A-Section C-Existing Conditions-Static Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.159
Topsoil
Unit Weight: 16 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Erosion Access
Toe Erosion
Stable Slope
6 m
7 m
15 m
Top of Slope
W
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
Taylors Creek
Grey Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 10 kPa
Friction Angle: 33 degrees
Glacial Till
Unit Weight: 21 kN/m3
Cohesion: 0 kPa
Friction Angle: 37 degrees
70
60
50
40
30
20
-30
-20
-10
0
10
20
30

Figure 6B-Section C-Existing Conditions-Seismic Loading



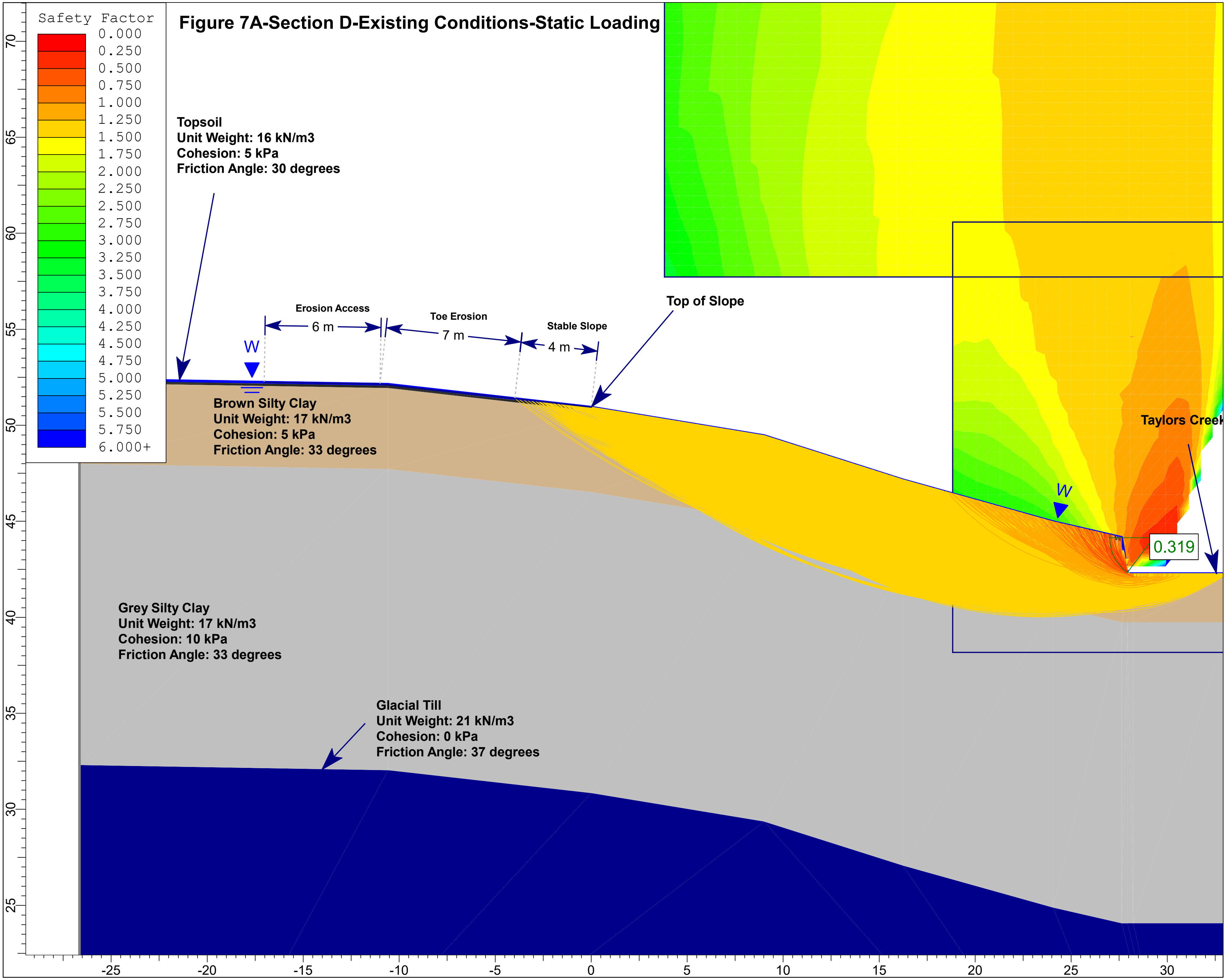


Figure 7A-Section D-Existing Conditions-Static Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Topsoil
Unit Weight: 16 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Erosion Access
6 m
Toe Erosion
7 m
Stable Slope
4 m
Top of Slope
W
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
Taylors Creek
W
0.319
Grey Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 10 kPa
Friction Angle: 33 degrees
Glacial Till
Unit Weight: 21 kN/m3
Cohesion: 0 kPa
Friction Angle: 37 degrees
70
65
60
55
50
45
40
35
30
25
-25
-20
-15
-10
-5
0
5
10
15
20
25
30

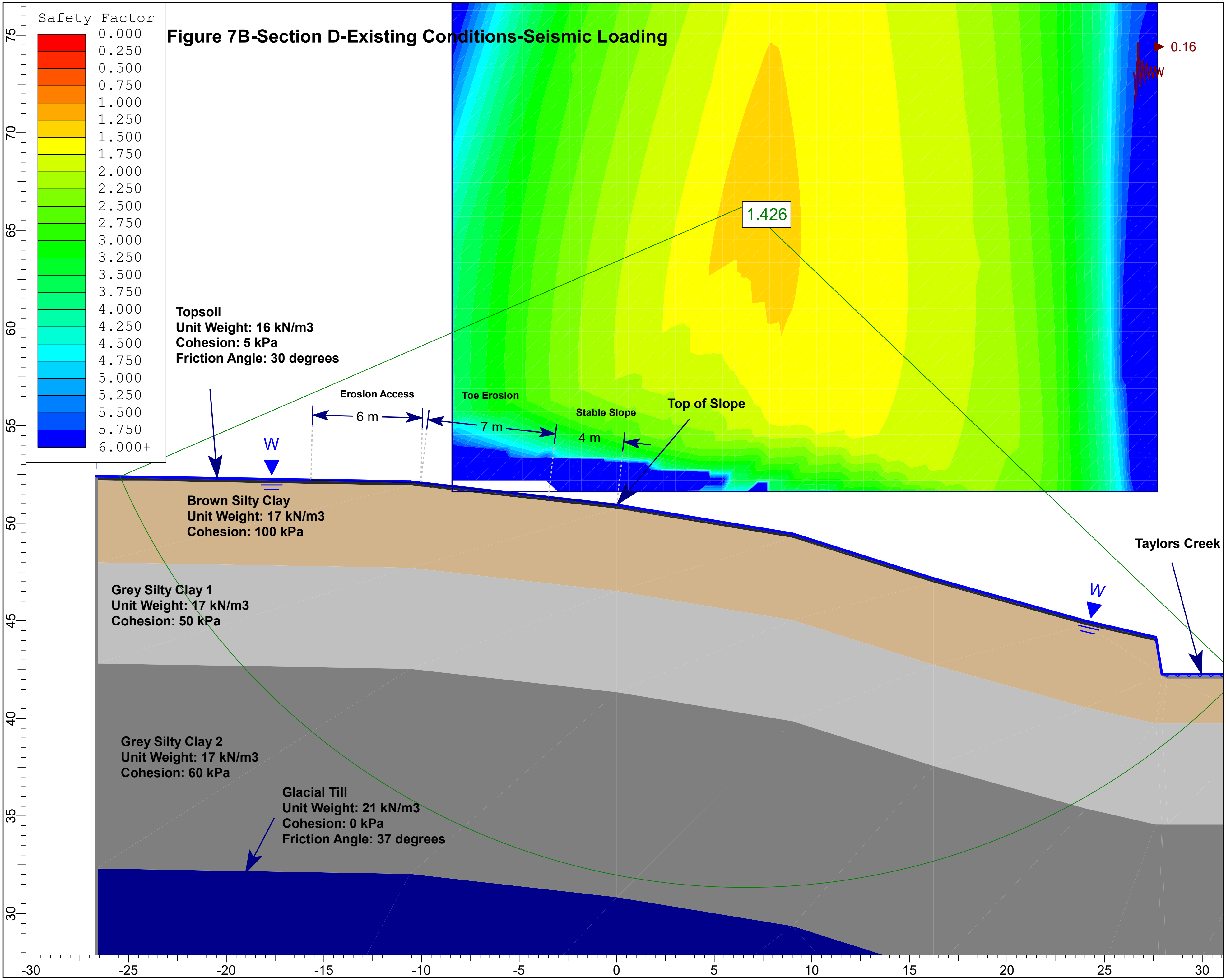


Figure 7B-Section D-Existing Conditions-Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.426
0.16
Topsoil
Unit Weight: 16 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Erosion Access
6 m
Toe Erosion
7 m
Stable Slope
4 m
Top of Slope
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 100 kPa
Grey Silty Clay 1
Unit Weight: 17 kN/m3
Cohesion: 50 kPa
Grey Silty Clay 2
Unit Weight: 17 kN/m3
Cohesion: 60 kPa
Glacial Till
Unit Weight: 21 kN/m3
Cohesion: 0 kPa
Friction Angle: 37 degrees
Taylors Creek

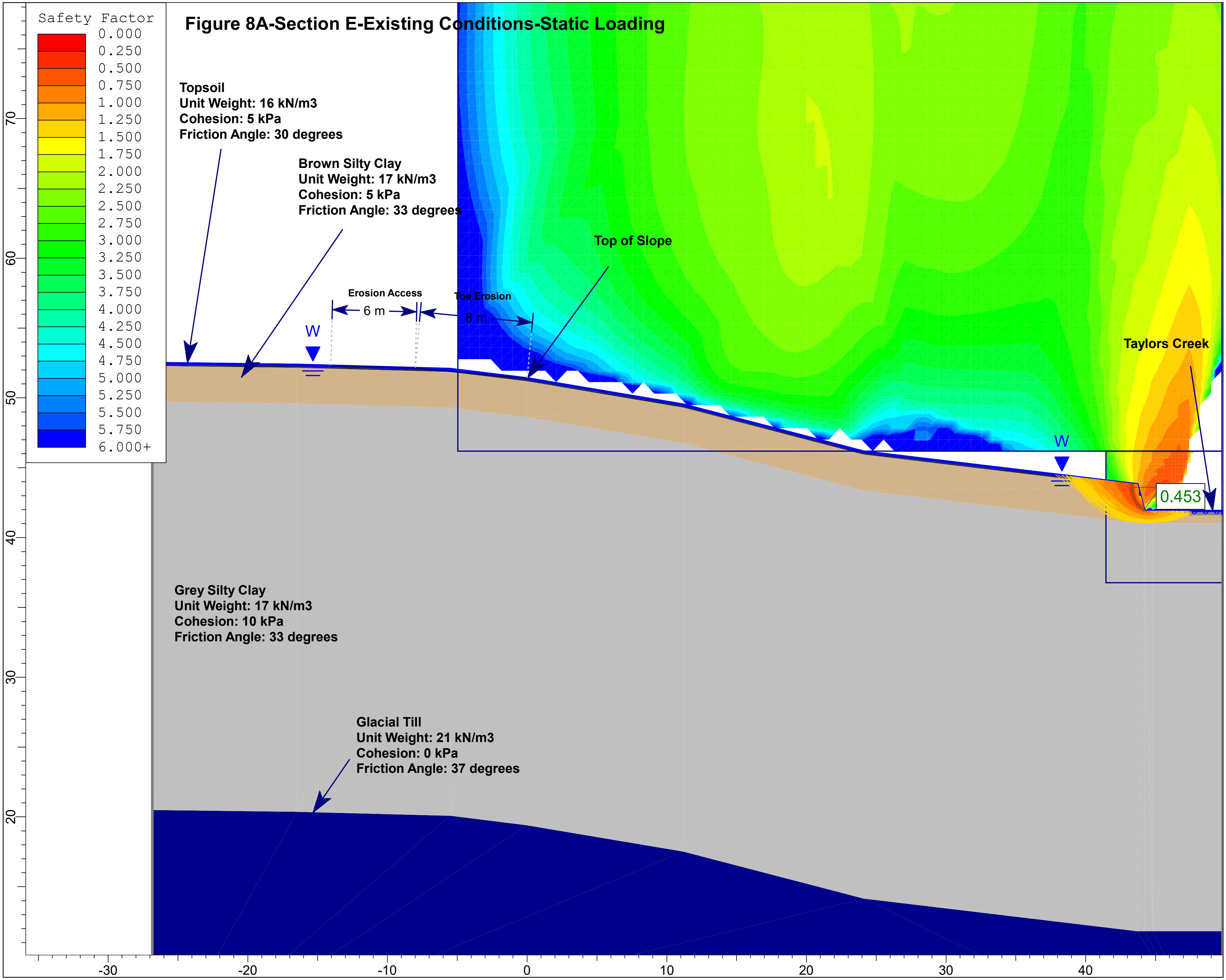


Figure 8A-Section E-Existing Conditions-Static Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Topsoil
Unit Weight: 16 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
Erosion Access
6 m
Toe Erosion
8 m
Top of Slope
W
W
Taylors Creek
0.453
Grey Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 10 kPa
Friction Angle: 33 degrees
Glacial Till
Unit Weight: 21 kN/m3
Cohesion: 0 kPa
Friction Angle: 37 degrees
70
60
50
40
30
20
-30
-20
-10
0
10
20
30
40

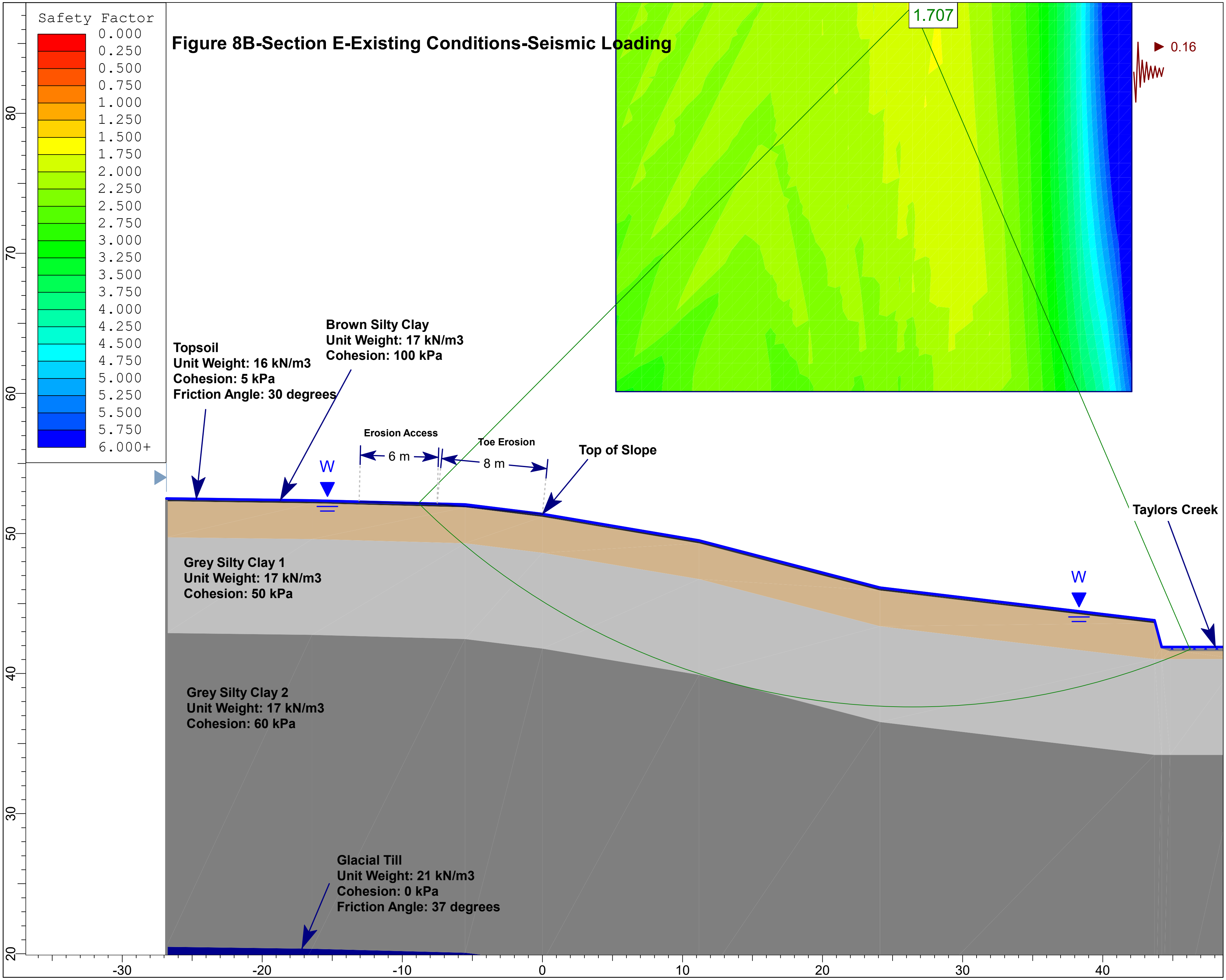
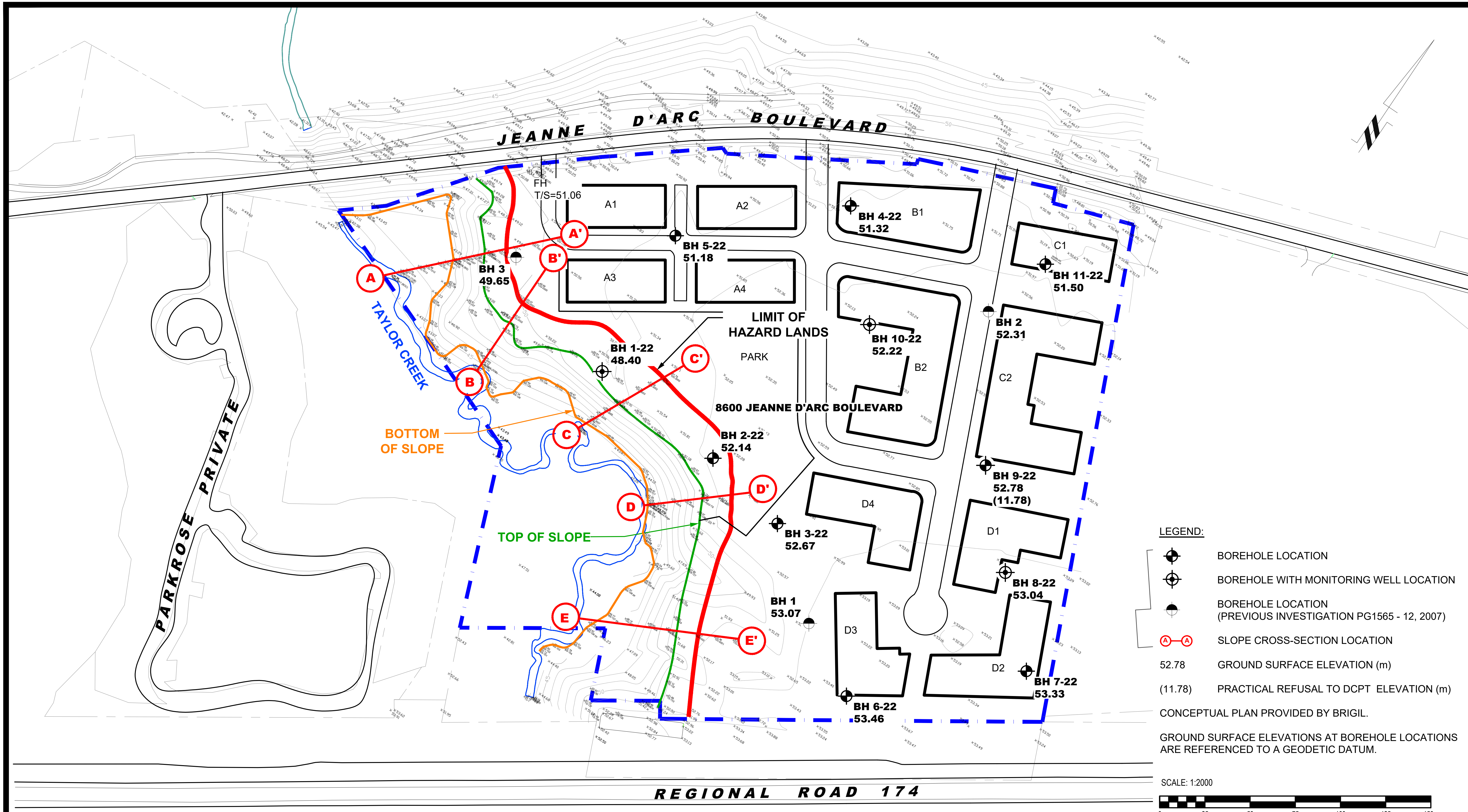


Figure 8B-Section E-Existing Conditions-Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.707
0.16
Topsoil
Unit Weight: 16 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 100 kPa
Erosion Access
6 m
Toe Erosion
8 m
Top of Slope
W
W
Taylors Creek
Grey Silty Clay 1
Unit Weight: 17 kN/m3
Cohesion: 50 kPa
Grey Silty Clay 2
Unit Weight: 17 kN/m3
Cohesion: 60 kPa
Glacial Till
Unit Weight: 21 kN/m3
Cohesion: 0 kPa
Friction Angle: 37 degrees
80
70
60
50
40
30
20
-30
-20
-10
0
10
20
30
40



PATERSON GROUP

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NO.	REVISIONS	DATE	INITIAL

BRIGIL

GEOTECHNICAL INVESTIGATION
PROPOSED MULTI-STOREY BUILDING
8600 JEANNE D'ARC BOULEVARD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:2000	Date: 10/2022
Drawn by: GK	Report No.: PG6414-1
Checked by: JV	Dwg. No.: PG6414-1
Approved by: DJG	Revision No.:

p:\autocad drawings\geotechnical\pg64xx\pg6414\pg6414-1 test hole location plan.dwg

11x17