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Geotechnical Investigation

Proposed Cardinal Creek Village
Residential/Commercial Development
Old Montreal Road
Ottawa, Ontario

Prepared For

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Report PG1796-4, Revision 1

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APPENDICES

1.0 INTRODUCTION

Paterson Group (Paterson) was commissioned by Tamarack Homes (Tamarack) to conduct a geotechnical investigation for the proposed residential development to be located along Old Montreal Road at Frank Kenny Road, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan presented in Appendix 3).

The objectives of the investigation were to:

- ☐ Determine the subsoil and groundwater conditions at this site by means of boreholes.
- ☐ Provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect its design.

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.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation. Therefore, the present report does not address environmental issues.

2.0 PROPOSED DEVELOPMENT

It is expected that the development will consist of residential dwellings with associated local roadways and serviced by municipal services. It is further anticipated that commercial buildings and schools will be located within the proposed development, as well as, local and arterial roadways through the development.

3.0 METHOD OF INVESTIGATION

3.1 Field Investigation

Field Program

The field program for the investigation was carried out between March 27 and April 9, 2012, June 26 and 27, 2012, November 2 to 9, 2012 and January 31, February 4, 5, 6, 13, 14, 15 and June 6, 2013. At that time, 86 additional boreholes were advanced to depths varying between 1.5 and 15.5 m below ground surface. The original field investigation was carried out between January 19 and 26, 2009. At that time, twenty-one (21) boreholes were advanced to depths varying between 0.7 and 9.8 m below ground surface. Additional boreholes and test pits were placed throughout the subject site as part of supplemental investigations completed after our main investigation. The test hole locations were distributed across the site in a manner to provide general coverage at the subject site. The locations of the test holes are shown on Drawing PG1796-6 - Test Hole Location Plan included in Appendix 3.

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

Sampling and In Situ Testing

Soil samples were recovered from auger flights, a 50 mm diameter split-spoon sampler or 75 mm diameter thin walled Shelby tubes recovered using a piston sampler. The soil samples were classified on site and placed in sealed plastic bags. The Shelby tubes were sealed at both ends. All samples were transported to our laboratory. The depths at which the auger, split-spoon and Shelby tube samples were recovered from the boreholes are shown as AU, SS and TW, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

The 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.

Undrained shear strength testing, using a field vane apparatus, was carried out in cohesive soils.

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 of this report.

Groundwater

Flexible standpipes or monitoring wells were installed in majority of the boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The borehole locations were selected by Paterson personnel to provide general coverage of the site. The locations of these boreholes in the field and the ground surface elevation at the borehole locations were determined by Stantec Geomatics. It is understood that the elevations are referenced to Geodetic datum.

The locations of the boreholes and the ground surface elevation at each borehole location are presented in Drawing PG1796-6 - Test Hole Location Plan included in Appendix 3.

The ground surface elevations at the location of BH39-12 to BH55-12 are inferred from contour mapping provided by Stantec. The approximate locations of BH 39-12 to BH55-12 are presented in Drawing PG1796-6 - Test Hole Location Plan included in Appendix 3.

3.3 Laboratory Testing

The soil samples recovered from the subject site were examined in our laboratory to review the results of the field logging.

A supplemental investigation was completed in June 2013, which consisted of a fully sampled borehole (BH 89-13) located within the north portion of the site. Four (4) samples were submitted for unidimensional consolidation, five (5) samples were submitted for Atterberg limits testing and moisture content testing was completed on all recovered soil samples from BH 89-13. During the previous investigation, two (2) Shelby tube samples were submitted for unidimensional consolidation and Atterberg limits testing.

The available results of the consolidation and Atterberg limits testing are presented on the Consolidation Test and Atterberg Limits' Results sheets, respectively, presented in Appendix 1 and are further discussed in Sections 4 and 5.

3.4 Analytical Testing

Eleven (11) soil samples were submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The samples were submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the soil. The results are provided in Appendix 1, and are discussed further in Subsection 6.8.

4.0 OBSERVATIONS

4.1 Surface Conditions

The subject site consists mostly of undeveloped land consisting of agricultural land, grass areas or densely wooded areas. Residential dwellings, associated laneways and landscaped areas are present along Old Montreal Road.

4.2 Subsurface Profile

Generally, the overburden profile consists of topsoil or fill overlying a stiff to very stiff silty clay deposit. Glacial till, consisting of silty clay with sand, gravel, cobbles and boulders was encountered below the silty clay. Bedrock was noted below the glacial till at several boreholes.

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.

Silty Clay

A total of six (6) silty clay samples collected during the current and previous investigations were subjected to unidimensional consolidation testing. The results are presented in Subsection 5.3 and indicate that the silty clay is overconsolidated with overconsolidation ratios of 2.7 and 2.0 in BH 4B and BH 5, respectively.

One (1) silty clay sample was submitted for Atterberg Limits testing from the previous investigation. Eight (8) silty clay samples were submitted for Atterberg Limits testing from present investigation. The tested material was classified as Inorganic Clays of High Plasticity (CH) and Inorganic Clays of Low Plasticity (CL). The results are summarized in Table 1 and presented on the Atterberg Limits Results sheets in Appendix 1.

Table 1 - Summary of Atterberg Limits Tests

Sample	Liquid Limit %	Plastic Limit %	Plasticity Index %	Classification
BH 4B TW 1	61	28	33	CH - Clays of High Plasticity
BH57-12 SS 7	66	27	39	CH - Clays of High Plasticity
BH58-12 SS 6	63	23	40	CH - Clays of High Plasticity
BH 67-13 SS 6	75	30	46	CH - Clays of High Plasticity
BH 89-13 TW 2	79	30	48	CH - Clays of High Plasticity
BH 89-13 TW 3	54	26	29	CH - Clays of High Plasticity
BH 89-13 TW 4	46	26	20	CL - Clays of Low Plasticity
BH 89-13 TW 5	50	23	27	CL - Clays of Low Plasticity
BH 89-13 TW 6	43	20	23	CL - Clays of Low Plasticity

Practical Refusal to Augering/Excavation

Practical refusal to augering and/or bedrock was observed at depths ranging from ground surface to 9.3 m below the ground surface at BH 2-12 to BH 8-12, BH 11-12 to 15-12, BH 17-12, BH 18-12, BH 20-12, BH 22-12 to BH 31-12, BH 39-12, BH 40-12, BH 41-12, BH 44-12, BH 48-12, BH 71-12, BH 73-12 to BH 77-A, BH 79-12 to BH 82A-12, BH 83-13, BH 86-13, BH 3, BH 6, BH 7, BH 11, BH 14, BH 16, BH 17 and BH 18.

TP 1 to TP 70 were completed in November 2013 to provide additional coverage of the bedrock depth at selected locations throughout the development. Bedrock surface elevations encountered at the test pit locations are presented in Drawing PG1796-6 - Test Hole Location Plan in Appendix 3.

Based on available geological mapping, the depth to bedrock in the area is expected to range from 15 to 50 m within the west portion of the site and ground surface to 10 m depth within the east portion of the site. Available geological mapping indicates that dolostone, limestone and shale is present in the subject area.

4.3 Groundwater

Groundwater levels (GWLs) were measured in the standpipes installed in the boreholes and the results are summarized in Table 2. It should be noted that surface water can become perched within the borehole backfill material. The groundwater level can also be estimated based on moisture levels and colour of the recovered soil samples. Based on these observations at the borehole locations, the groundwater table is expected between a 3 to 5 m below original ground surface. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could be different at the time of construction.

Table 2
Summary of Groundwater Levels

Test Hole Number	Ground Surface Elevation (m)	Groundwater Level		Recording Date
		Depth (m)	Elevation (m)	
BH 1-12	67.86	6.75	61.11	April 13, 2012
BH 2-12	64.29	0.40	63.89	April 13, 2012
BH 3-12	65.38	0.43	64.95	April 13, 2012
BH 4-12	65.15	1.07	64.08	April 13, 2012
BH 5-12	62.37	0.40	61.97	April 13, 2012
BH 6-12	61.27	2.31	58.96	April 13, 2012
BH 7-12	70.88	1.42	69.46	April 13, 2012
BH 8-12	90	0.62	89.38	April 13, 2012
BH 9-12	53.33	7.01	46.32	April 13, 2012
BH 10-12	55.6	1.25	54.35	April 13, 2012
BH 11-12	67.84	0.40	67.44	April 13, 2012
BH 12-12	71	0.47	70.53	April 13, 2012
BH 13-12	73.24	0.59	72.65	April 13, 2012
BH 14-12	70.34	1.24	69.10	April 13, 2012
BH 15-12	71.07	2.77	68.30	April 13, 2012
BH 16-12	56.07	Dry	n/a	April 13, 2012
BH 17-12	73.11	0.61	72.50	April 13, 2012
BH 18-12	76.69	2.50	74.19	April 13, 2012
BH 19-12	53.92	5.80	48.12	April 13, 2012
BH 20-12	76.36	0.72	75.64	April 13, 2012
BH 21-12	53.89	8.55	45.34	April 13, 2012
BH 22-12	78.53	Dry	n/a	April 13, 2012
BH 23-12	55.5	2.12	53.38	April 13, 2012
BH 24-12	87.44	Dry	n/a	April 13, 2012
BH 25-12	81.91	0.66	81.25	April 13, 2012
BH 26-12	89.45	0.97	88.48	April 13, 2012

Table 2 (continued)
Summary of Groundwater Levels

Test Hole Number	Ground Surface Elevation (m)	Groundwater Level		Recording Date
		Depth (m)	Elevation (m)	
BH 27-12	96.23	Dry	n/a	April 13, 2012
BH 28-12	89.1	0.40	88.70	April 13, 2012
BH 29-12	87.2	Damaged	n/a	April 13, 2012
BH 30-12	88.74	Damaged	n/a	April 13, 2012
BH 31-12	86.7	1.12	85.58	April 13, 2012
BH 1	67.45	0.61	66.84	February 3, 2009
BH 2	60.07	0.69	59.38	February 3, 2009
BH 3	63.94	Damaged	n/a	February 3, 2009
BH 4	53.72	0.87	52.85	February 3, 2009
BH 5	53.28	1.30	51.98	February 3, 2009
BH 6	77.71	Damaged	n/a	February 3, 2009
BH 7	72.32	0.50	71.82	February 3, 2009
BH 8	87.11	0.82	86.29	February 3, 2009
BH 9B	57.53	0.53	57.00	February 3, 2009
BH 10	86.36	1.52	84.84	February 3, 2009
BH 11	89.75	Damaged	n/a	February 3, 2009
BH 12	80.38	0.61	79.77	February 3, 2009
BH 14	88.88	0.61	88.27	February 3, 2009
BH 15	88.13	1.86	86.27	February 3, 2009
BH 16	67.96	0.50	67.46	February 3, 2009
BH 17	86.28	0.88	85.40	February 3, 2009
BH 18	54.83	Damaged	n/a	February 3, 2009
BH 19	71.73	Damaged	n/a	February 3, 2009

Notes : The ground surface elevation at the borehole locations were determined by Stantec Geomatics. It is understood that the elevations are referenced to geodetic datum.

Table 2 (continued)
Summary of Groundwater Levels

Test Hole Number	Ground Surface Elevation (m)	Groundwater Level		Recording Date
		Depth (m)	Elevation (m)	
* BH 39-12	100.0	7.35	92.65	December 6, 2012
* BH 40-12	97.5	10.39	87.11	December 6, 2012
* BH 41-12	75.5	6.53	68.97	December 6, 2012
BH 42-12	54.5	1.31	53.19	December 6, 2012
BH 43-12	54.3	2.02	52.28	December 6, 2012
BH 44-12	54.4	2.62	51.78	December 6, 2012
BH45-12	54.3	2.38	51.92	December 6, 2012
BH46-12	54.2	1.79	52.41	December 6, 2012
BH47-12	54.1	1.29	52.81	December 6, 2012
* BH48-12	68.6	10.34	58.26	December 6, 2012
BH49-12	53.8	1.89	51.91	December 6, 2012
BH52-12	51.5	11.39	40.11	December 6, 2012
BH53-12	54.4	0.20	54.20	December 6, 2012
BH54-12	54.8	1.58	53.22	December 6, 2012
BH55-12	54.6	5.28	49.32	December 6, 2012
BH 57-12	54.83	2.20	52.63	March 27, 2013
BH 58-12	56.13	2.15	53.98	March 27, 2013
BH 59-12	66.88	0.92	65.96	March 27, 2013
BH 66-12	60.6	Damaged	n/a	March 27, 2013
BH 67-12	67.29	Damaged	n/a	March 27, 2013
BH 70-12	72.78	Damaged	n/a	March 27, 2013
BH 72-12	77.23	Damaged	n/a	March 27, 2013
BH 73-12	80.21	0.56	79.65	March 27, 2013
BH 75-12	83.02	0.64	82.38	March 27, 2013
BH 76-12	87.83	2.88	84.95	March 27, 2013
BH 78-12	91.8	4.60	87.20	March 27, 2013

Table 2 (continued)
Summary of Groundwater Levels

Test Hole Number	Ground Surface Elevation (m)	Groundwater Level		Recording Date
		Depth (m)	Elevation (m)	
BH 81-12	95.77	Damaged	n/a	March 27, 2013
BH 83-13	62.4	1.56	60.84	March 27, 2013
BH 84-13	55.37	Damaged	n/a	March 27, 2013

Notes : The ground surface elevations at the location of BH39-12 to BH55-12 are inferred from contour mapping provided by Stantec.
* - Denotes borehole with monitoring well installed.

5.0 DISCUSSION

5.1 Geotechnical Assessment

The subject site is adequate for the proposed development. It should be noted that where silty clay is present below underside of footing of the proposed buildings, a permissible grade raise restriction is required. Also, in areas where shallow auger refusals were noted, buried services may require trenching through bedrock.

For the subject lands bordering along Cardinal Creek and associated tributaries of Cardinal Creek, a study to determine the geotechnical limit of hazard lands was completed. The results of our study are discussed in Subsection 6.9.

The above and other considerations are further discussed in the following sections.

Several geotechnical issues have been addressed in separate memorandum and letter reports for the proposed development. Relevant memorandum, letter reports and design drawings prepared by David Schaeffer Engineering Limited (DSEL) are presented in Appendix 2. Items covered from a geotechnical perspective include:

☐ Grading plan review
☐ Watermain crossing at Cardinal Creek
☐ SWMP review
☐ North Tributary realignment program
☐ Highway 174 service crossing
☐ Clay liner system for exposed bedrock along North Tributary crossing
☐ Service impacts on adjacent building foundations
☐ Side slopes for temporary diversion channel

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

If encountered, existing foundation walls and other construction debris should be entirely removed from within the building perimeters. Under paved areas, existing construction remnants such as foundation walls should be excavated to a minimum of 1 m below final grade.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Bedrock Removal

Based on the volume of the bedrock encountered in the area, it is expected that line-drilling in conjunction with hoe-ramming or controlled blasting will be required to remove the bedrock. In areas of weathered bedrock and where only a small quantity of bedrock is to be removed, bedrock removal may be possible by hoe-ramming.

5.3 Foundation Design

Table 3 presents the bearing resistance values for footings founded on the anticipated subgrade materials.

Table 3 - Bearing Resistance Values

Bearing Surface	Bearing Resistance Values	
	Serviceability Limit State (kPa)	Ultimate Limit State (kPa)
Undisturbed, Stiff Silty Clay	150	225
Undisturbed, Compact Glacial Till	150	225
Clean, Weathered Bedrock	500	750

A geotechnical resistance factor of 0.5 was applied to the reported bearing resistance values at ULS. The bearing resistance value at SLS will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively, for footings placed on a silty clay or glacial till bearing surface. A negligible total and differential settlement will be applicable for footings placed on the clean, weathered bedrock surface.

It should be noted that the maximum width for footings placed on an undisturbed, silty clay bearing surface will be 3 m for strip footings and 5 m for pad footings.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Settlement/Grade Raise

Consideration must be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. For dwellings, a minimum value of 50% of the live load is often recommended by Paterson.

Generally, the potential long term settlement is evaluated based on the compressibility characteristics of the silty clay. These characteristics are estimated in the laboratory by conducting unidimensional consolidation tests on undisturbed soil samples collected using Shelby tubes in conjunction with a piston sampler. Six (6) site specific consolidation tests were carried out for this project. The available results of the consolidation tests are presented in Table 4 and in Appendix 1.

Value p'_c is the preconsolidation pressure of the sample and p'_o is the effective overburden pressure. The difference between these values is the available preconsolidation. The increase in stress on the soil due to the cumulative effects of the fill surcharge, the footing pressures, the slab loadings and the lowering of the groundwater should not exceed the available preconsolidation if unacceptable settlements are to be avoided.

The values C_{cr} and C_c are the recompression and compression indices, respectively, and are a measure of the compressibility of the soil due to stress increases below and above the preconsolidation pressures. The higher values for the C_c, as compared to the C_{cr}, illustrate the increased settlement potential above, as compared to below, the preconsolidation pressure.

Table 4
Summary of Consolidation Test Results

Borehole No.	Sample	Depth (m)	p'_c (kPa)	p'_o (kPa)	C_{cr}	C_c	Q (*)
BH4B	TW 1	4.19	174	64	0.015	2.432	G
BH5	TW 1	5.69	147	74	0.021	1.863	G
BH 89-13	TW 2	4.97	174	67	0.02	1.449	G
BH 89-13	TW 3	8.08	221	86	0.02	1.595	G
BH 89-13	TW 4	12.65	234	115	0.02	2.217	G
BH 89-13	TW 5	18.74	281	152	0.019	1 .15	G

* - Q - Quality assessment of sample - G: Good F: Fair P: Poor

It should be noted that the values of p'_c, p'_o, C_{cr} and C_c are determined using standard engineering practices and are estimates only. In addition, natural variations within the soil deposit would also affect the results. Furthermore, the p'_o parameter is directly influenced by the groundwater level. While the groundwater levels were measured at the time of the fieldwork, the levels vary with time and this has an impact on the available preconsolidation. Lowering the groundwater level increases the p'_o and therefore reduces the available preconsolidation. Unacceptable settlements could be induced by a significant lowering of the groundwater level. The p'_o values for the consolidation tests carried out for the present investigation are based on the long term groundwater level observed at each borehole location. The groundwater level is based on the colour and undrained shear strength profile of the silty clay.

Based on the existing borehole information and testing results, a permissible grade raise restriction of 2 m is recommended for proposed buildings within the north portion of the subject site, where the existing ground surface ranges between geodetic elevations of 53 to 56 m. A permissible grade raise restriction of 3 m is applicable for buildings within the remainder of the subject site where silty clay is present below proposed underside of footing elevation. A post-development groundwater lowering of 0.5 m was assumed. The permissible grade raise areas for housing are outlined in Drawing PG1796-7 - Permissible Grade Raise Areas - Buildings in Appendix 3.

A grading plan review was completed by Paterson. A summary of the design information at the lot and block locations are presented in PG1796-MEMO.24 dated September 19, 2014 in Appendix 2.

It should be noted that a permissible grade raise restriction of 3 m is recommended for roadways within the north portion of the site, where the existing ground surface ranges between geodetic elevations of 53 to 56 m. Also, a 4 m permissible grade raise restriction is recommended for roadways within the remainder of the subject site. If proposed roadway grades exceed our permissible grade raise recommendations, a settlement surcharge program can be implemented to ensure long-term settlements are minimal.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a stiff silty clay or compact glacial till above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Where the grade raise restrictions can be accommodated, the design of the footings can be carried out based on the bearing resistance values provided in Table 3. Where the grade raise is close to, but below, the maximum permissible grade raise, consideration should be given to using more reinforcement in the design of the foundation (footings and walls) to reduce the risks of cracking in the concrete foundation. The use of control joints within the brick work between the garage and basement area should also be considered.

5.4 Design for Earthquakes

For foundations constructed within the north portion of the subject site, where the existing ground surface elevations range between 53 to 56 m geodetic elevation, a seismic Site Class D is applicable for design. The remainder of the subject site can be designed using a seismic Site Class C as defined in the Ontario Building Code 2012 (OBC 2012; Table 4.1.8.4.A). The soils encountered at borehole locations are not susceptible to liquefaction. It should be noted that the proposed residential buildings constructed over glacial till or bedrock can be designed according to Part 9 of the current Ontario building code.

5.5 Basement Slab

With the removal of all topsoil and fill containing organic matter within the footprints of the proposed buildings, the native soil surface or engineered fill will be considered to be an acceptable subgrade surface on which to commence backfilling for floor slab construction. Provision should be made for proof-rolling the soil subgrade using heavy vibratory compaction equipment prior to placing any fill. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II is recommended for backfilling below the floor slab. It is recommended that the upper 200 mm of sub-slab fill consist of 19 mm clear crushed stone.

5.6 Thrust Blocks and Maintenance Holes

The details of standard thrust blocks should be as per the most recent Material Specifications and Standard Detail Drawings. Blocking details require specified minimum soil bearing capacities. However, from a geotechnical perspective, the bearing capacity, especially in cohesionless soils, is dependent upon the direction of application of the load.

Thrust blocks resisting lateral loads should be sized on a pro-rata basis and the allowable lateral soil bearing capacity. Those resisting vertical loads (downward) should be sized based on the allowable vertical soil bearing capacity. The lateral and vertical bearing capacities of the bearing media expected along the subject site are presented in Table 5.

Table 5 - Summary of Allowable Bearing Pressures For Thrust Block Sizing

Bearing Surface	Allowable Bearing Pressure (kPa)	
	Lateral	Vertical
Engineered fill	100	150
Stiff Silty Clay	100	150
Glacial Till	100	150
Clean, Weathered Bedrock	150	150
Surface Sounded Bedrock	500	500

The allowable lateral bearing capacities presented above are based on a soil cover of at least 2 m. The allowable vertical bearing pressures are provided on the assumption that the thrust block concrete is placed against undisturbed soil or clean, surface-sounded bedrock bearing surfaces.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed in the dry prior to the placement of concrete. In bedrock, the footing beds should be free of any loose materials.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

The total ultimate friction force exerted on the backfilled pipe in response to longitudinal forces is a function of the depth of the trench and diameter of the pipe and can be calculated using the following equation:

$$f_{ult} = \pi \cdot D \cdot H \cdot \gamma \cdot \tan(\delta)$$

where:
f_{ult} - Ultimate friction force (kN)
D - Outer diameter of pipe (m)
H - Height of backfill from the centre of pipe (m)
γ - Unit weight of cover material:
assume 20 kN/m^3 for engineered fill above groundwater level
and 12 kN/m^3 below groundwater level
$\tan(\delta)$ - Friction factor:
0.35 for iron/steel pipe
0.40 for concrete pipe
0.35 for plastic pipe

Maintenance holes or chambers may be founded on bedrock, stiff silty clay, glacial till, or engineered fill and can be designed using the allowable bearing pressures presented in Table 5. Engineered fill under maintenance holes or chambers should consist of OPSS Granular A (crushed stone) or Granular B Type II material placed in maximum 300 mm thick layer and compacted to a minimum of 98% of its SPMDD.

5.6 Pavement Design

For design purposes, the pavement structure presented in the following tables could be used for the design of car parking areas and local roadways.

Table 6 - Recommended Pavement Structure - Driveways

Thickness (mm)	Material Description
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 7 - Recommended Pavement Structure - Local Residential Roadways

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil	

Table 8 - Recommended Pavement Structure - Roadways with Bus Traffic

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course** - HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

Due to the impervious nature of the subgrade materials consideration should be given to installing sub-drains during the pavement construction. These drains should be installed at each catch basin, be at least 3 m long and should extend in four orthogonal directions or longitudinally when placed along a curb. Along local streets, the drains should be placed along the edges of the pavement. The sub-drain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

Gravel Covered Areas

If gravel covered finished areas are required, such as along the hydro service corridor, a 300 mm layer of OPSS Granular A crushed stone compacted to 95% of the material's SPMDD using suitable compaction equipment is recommended to allow for vehicle traffic. It is expected that gravel covered areas may require annual maintenance, such as, regrading and padding in poor performing areas.

6.0 DESIGN AND CONSTRUCTION PRECAUTIONS

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for proposed structures. The system should consist of a 100 to 150 mm diameter, geotextile-wrapped, perforated, corrugated, plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Platon or Miradrain G100N) connected to a drainage system is provided.

6.2 Protection Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover (or equivalent) should be provided in this regard.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

6.3 Excavation Side Slopes

The excavation for the proposed development will be mostly through silty clay and/or glacial till. Above the groundwater level, for excavations to depths of approximately 3 m, the excavation side slopes should be stable in the short term at 1H:1V. The lowermost 1.2 m can be vertical provided the material consists of stiff in situ silty clay. Flatter slopes could be required for deeper excavations or for excavation below the groundwater level. Where such side slopes are not permissible or practical, temporary shoring should be used. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

The slope cross-sections recommended above are for temporary slopes. Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the soft to firm grey silty clay or bedrock, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extent at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

It should generally be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material’s SPMDD.

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long (in the trench direction) and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

Bedrock/Soil Transitions

In areas where the service subgrade transitions from soil to bedrock. It is recommended that the founding medium be inspected in the field to determine how steeply the bedrock surface, where encountered, drops off. A transition treatment should be provided where the bedrock slopes at more than 3H:1V. At these locations, the bedrock should be excavated, and extra bedding placed to provide a 3H:1V transition from the bedrock subgrade toward the soil subgrade. This treatment will reduce the propensity for bending stresses to occur in the watermain.

Backfill Requirements

Well fractured bedrock should be acceptable as backfill above the cover material provided that the rock fill is placed only from at least 300 mm above the obvert of the service pipe and that all stones are 300 mm or smaller in their longest dimension.

The trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

6.5 Groundwater Control

Due to the relatively impervious nature of the silty clay, it is expected that groundwater infiltration into the excavations should be controllable using open sumps and pumps for the relatively shallow excavations.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary MOE permit to take water (PTTW) will be required for this project if more than 50,000 L/day are to be pumped during the construction phase. At least 3 to 4 months should be allowed for completion of the application and issuance of the permit by the MOE.

The dewatering which is anticipated to be necessary to install services and construct stormwater management facilities, is expected to be of a short term temporary nature. As such, no long term impacts, from either a hydrogeological or geotechnical perspective are expected. The Permit To Take Water application process is recommended to be closely tied to the detailed design of the stormwater management design and a plan should be established to cover dewatering for the first phases of the development which would take place over a three to five year time frame.

6.6 Winter Construction

The subsoil conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur. Precautions should be taken if winter construction is considered for this project.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be carried out in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.7 Landscaping and Outdoor Structures Considerations

The lots which are subjected to landscaping and outdoor structure setback considerations due to an underlying silty clay deposit are present within the subject site. The subject lots are highlighted in Drawing PG1796-17 - Recommended Tree Setbacks for Buildings in Appendix 3. The following restrictions are recommended.

Tree Planting Restrictions

The proposed residential dwellings are located in a low sensitivity area with respect to tree plantings over a silty clay deposit. It is recommended that trees placed within 3 m of the foundation wall should consist of low water demand trees with shallow root systems that extend less than 1.5 m below ground surface. Trees placed greater than 3 m from the foundation wall may consist of typical street trees, which are typically moderate water demand species with roots extending to a maximum depth of 2 m below ground surface.

It is well documented in the literature, and is our experience, that fast-growing trees located near buildings founded on cohesive soils that shrink on drying can result in long-term differential settlements of the structures. Tree varieties that have the most pronounced effect on foundations are seen to consist of poplars, willows and some maples (i.e. Manitoba Maples) and, as such, they should not be considered in the landscaping design.

Swimming Pools

The in-situ soils are considered to be acceptable for swimming pools. Above ground swimming pools must be placed at least 3 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer`s requirements.

Aboveground Hot Tubs

Hot tub construction is considered routine, and can be constructed in accordance with the manufacturer’s specifications.

Installation of Decks or Additions

Additional grading around proposed deck or addition should not exceed permissible grade raises. Otherwise, standard construction practices are considered acceptable.

6.8 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. These results are indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The results of the chloride content, pH and resistivity indicate the presence of a non-aggressive environment for exposed ferrous metals at this site.

6.9 Limit of Hazard Lands

Review of Existing Reports

A review of available reports was completed by Paterson. The reviewed reports included:

- ❏ “Cardinal Creek - Geomorphic Assessment - City of Ottawa” dated April 2007 and prepared by Geomorphic Solutions.
- ❏ “Erosion Study and Slope Stability Evaluation, Cardinal Creek, Cumberland, Ontario” dated January 1990 and prepared by Golder Associates.
- ❏ “Cardinal Creek Village - Erosion Threshold Assessment” dated January 2013 and prepared by Parish Geomorphic.
- ❏ “Cardinal Creek Village - Erosion Threshold Assessment - Main” dated May 2013 and prepared by Parish Geomorphic.
- ❏ Memorandum Report “Cardinal Creek Village - Meander Belt Width Delineation” dated April 4, 2013 and prepared by Parish Geomorphic.

Based on these reports reviewed by Paterson, the subject section of Cardinal Creek bordering the west property limits was labeled as Reach C11 and Reach C12. The subject section of the Cardinal Creek labeled as C12 is located from the mouth of the creek to the former Rail Line and section of watercourse documented as C11 is located between the former Rail Line and Old Montreal Road. The tributaries to Cardinal Creek located on the south portion of the subject site traveling from the east to west were labeled as TRH1 (South Tributary), TRH2 (Mid Branch 2), TRH3 (South Tributary), TRH4 (Mid Branch 1) and TRH5 intersect the Cardinal Creek to the southwest of the subject site.

Section C12 was considered to be (S-Stable), In Regime and Section C11 is considered to be (M-Lateral Migration), Stressed based on the Downs Evolution Model completed in 2006, with a Rapid Geomorphic Assessment (RGA) score of 0.14 and 0.34, respectively. The Rapid Speed Assessment Technique (RSAT) provides a score of 23.5 for C11 and C12 which is considered a moderate (20-35) degree of stream health. Sections TRH1, TRH2, TRH3, TRH4 and TRH5 were not classified by the report conducted by Geomorphic Solutions (2007) due to access restrictions.

Section C11 and C12 of the Cardinal Creek is considered a Stream Order No.4 (Strahler, 1952), with gradient(%) of 0.47 and 0.54 (Geomorphic Solutions, April 2007), respectively. The tributaries to the Cardinal Creek located throughout the south portion of the subject site (TRH1, TRH2, TRH3, TRH4 and TRH5) were considered a Stream Order No. 1 and 2 (Strahler, 1952) with gradient(%) of 0.74 in TRH2 to 5.07 in TRH4 of 5.07 (Geomorphic Solutions, April, 2007).

Slope Condition Field Review

The slope stability analysis was completed using topographical mapping, as well as, a site visit to review slope condition by Paterson field personnel. The initial site visit for slope condition review was completed on April 9, 2009 of the existing conditions of Cardinal Creek and the north tributary located along the west property limits. The second site visit to review the slope condition was completed on April 18, 2012 throughout the south portion of the subject site documenting the conditions of the tributaries to the Cardinal Creek (south tributary, mid branch 1 and mid branch 2). Also, the slope condition and top of slope for the slope located north of the hydro corridor easement was also reviewed by representatives of City of Ottawa, RVCA, Tamarack, DSEL and Paterson on August 27, 2013.

Photograph 1 and Photograph 2 taken during the initial slope condition review on April 9, 2009 presented in Appendix 3 illustrates where Cardinal Creek has meandered in close proximity of the valley corridor wall causing erosion and exposing the clay surface from consequent slip failures. Photograph 3 and Photograph 4 taken from the north banks of the Cardinal Creek on April 9, 2009 illustrates the water cresting over the meandering watercourse and covering the valley corridor from the mouth of the Cardinal Creek to the former Rail Line. It is noted that the subject section of watercourse is considered stable to moderately stable.

The majority of the tributaries to Cardinal Creek were observed to be stable based on the slope condition review conducted on April 18, 2012 with some toe erosion noted throughout where the watercourse is located in close proximity to the valley corridor wall.

A total of 17 slope cross-sections were studied along the Cardinal Creek slope and north tributary slopes. The cross section locations are presented on Drawings PG1796-8A and 8B - Limit of Hazard Lands in Appendix 3. It should be noted that two (2) additional slope sections (Sections D and E) were completed along the slope located just south of the hydro easement within the northeast portion of the subject site. The cross-section locations are presented in Drawing PG1796-6 - Test Hole Location Plan in Appendix 3.

The existing slopes bordering the watercourses are mainly overgrown with mature trees with grass covered areas along the valley corridor walls. The existing valley corridor of Cardinal Creek and the subject tributaries contain a 1 to 18 m wide watercourse, which meanders throughout the valley floor. At the time of our site visit, the water depth was noted to be approximately 0.1 to 1.5 m.

Also, the slope (north tributary) located just south of the hydro easement within the northeast portion of the subject site was noted to be treed and stable.

Slope Stability Analysis

The analysis of the stability of the slope was carried out using SLIDE, a computer program which permits a two-dimensional slope stability analysis using several methods including the Bishop's method, which is a widely used and accepted analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to those favoring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsoil and groundwater conditions, a factor of safety greater than one is usually required to ascertain the risks of failure are acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the failure of the slope would endanger permanent structures.

The sections for existing conditions were analyzed taking into account groundwater level at ground surface. Subsoil conditions at the sections were determined 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. Bedrock outcrops were observed along the valley floor and exposed boulders were noted along the subject section of Cardinal Creek valley corridor walls from Old Montreal Road to approximately 250 m north of Old Montreal Road. The soil parameters utilized in our analysis are summarized in Table 9 and on the attached slope stability sections. The soil parameters were determined for the slope soils based on subsoil conditions at the boreholes along the top of slope.

Table 9 - Slope Stability Analysis Parameters

Static Conditions - Mohr-Coulomb Strength Type

Soil Type	Internal Angle of Friction (degrees)	Effective Cohesion (kPa)	Unit Weight (kN/m^3)
Silty Clay Crust	36	9	17
Grey Silty Clay	36	12	16
Glacial Till	33	1	20

Seismic Loading - Undrained Conditions[1]

Soil Type	Cohesion (Shear Strength) (kPa)	Unit Weight (kN/m^3)
Silty Clay Crust	100	17
Grey Silty Clay	80	16

Note:

[1] Due to the rapid nature of a seismic event, cohesive soils require analysis under undrained conditions for seismic review.

Static Conditions Analysis - Existing Conditions

The results for the existing static slope conditions at the slope stability sections are presented in Appendix 3. The slope stability factors of safety were found to be greater than 1.5 at all sections analyzed, except for Sections A and P which require a 5.6 and 14.8 m stable slope allowance from top of slope, respectively.

Seismic Loading Analysis

An analysis considering seismic loading was also completed. A horizontal seismic acceleration, K_h, of 0.21G was considered for the analyzed sections. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

The results of the analyses including seismic loading are presented in Appendix 3. The results indicate that the factors of safety for all the sections are greater than 1.1. Based on these results, the slopes are considered to be stable under seismic loading.

Limit of Hazard Lands

For existing conditions, the toe erosion allowance for the valley corridor slopes was based on the cohesive nature of the soils, the observed current erosional activities and the width and location of the current watercourse. Signs of erosion were noted in areas where the existing watercourse has meandered in close proximity to the toe of the corridor wall. Some minor to moderate sloughing failures were noted in the lower portion of the slopes, leaving some exposed root systems along the slope face. It is considered that a toe erosion allowance of 5 to 7 m is appropriate for the corridor walls confining the existing watercourse within the subject section of Cardinal Creek and subject tributaries. The toe erosion allowance should be applied from the top of stable slope, where the watercourse has meandered in close proximity to the toe of the corridor wall/existing slope. The toe erosion allowance should be taken from the bank full water’s edge in areas where the watercourse is greater than 15 m from the toe of the existing slope. The limit of hazard lands for the subject site are presented on Drawings PG1796-8A and 8B - Limit of Hazard Lands in Appendix 3.

The selection of appropriate toe erosion allowance took into consideration MNR recommendations for stiff cohesive soil slopes where active erosion was observed. The MNR recommendations vary between 5 to 8 m and based on our available soils information and site observations, a toe erosion allowance of 7 m was selected for the slopes along Cardinal Creek, where silty clay was observed at the slope toe. Based on our analysis, a toe erosion allowance of 7 m is still considered appropriate for the subject slopes along Cardinal Creek where silty clay is encountered at the slope toe.

A slope stability section (Section X) was completed for the side slopes of the north tributary watercourse. Based on our analysis and field observations, the slope was noted to be stable and heavily treed. Bedrock outcrops were noted along the base of the watercourse within the first 75 m of the watercourse running north from the culvert crossing, the remainder of the slope consists of a stiff silty clay. Conservatively, a toe erosion allowance of 5 m was used for our limit of hazard lands setback calculations. However, the toe erosion allowance was applied from the watercourse edge to the slope toe. It should be noted that an additional analysis was completed to verify that a stable slope is still available upon completion of 5 m of erosion occurring at the slope toe. Figure 14C present the results of our slope stability analysis including 5 m of erosion at the slope toe. Based on our analysis, a stable slope is still available upon completion of 5 m of erosion at the slope toe due to the overall gradient of the slope being greater than 3H:1V and very stable. In accordance with MNR guidelines, the toe erosion allowance can be taken from the toe of slope followed by a 3H:1V slope, which along with a 6 m access allowance provide a geotechnical limit of hazard lands setback. Therefore, the setback lines noted in Drawing PG1796-8a - Limit of Hazard Lands in Appendix 3 are considered appropriate for the north tributary slopes.

It is understood that a slope reinstatement program will be completed at Section Q where a slope failure has occurred. It is recommended that the lower portion of the slope face be re-shaped to improve overall slope stability of the slope. The re-shaping will result in an overall slope stability factor of safety of greater than 1.5.

Several options are under consideration for the remedial slope program at Section Q along the east slope of Cardinal Creek. It is understood that concrete vertical walls will not be approved by the RVCA, therefore, concrete vertical walls will not be considered as an option. The overall objective of the remedial slope program is to provide a stable slope along with an adequate toe erosion protection system. A stable slope can be reinstated by removing the previously failed materials and placing a series of geogrids along with an appropriate granular fill and reinforced topsoil finish to allow vegetation to re-establish and reduce surficial erosion. An adequate toe erosion protection system could consist of rip-rap extended above flood levels or a Scour-Stop^{TM} product or equivalent to allow vegetation to reestablish. These systems can be placed along the slope toe where the watercourse is in contact with the slope toe.

As previously stated, two (2) additional slope sections (Sections D and E) were completed along the slope located just south of the hydro easement within the northeast portion of the subject site. The cross section locations are presented on Drawing PG1796-6 - Test Hole Location Plan in Appendix 3. The slope was noted to be treed and was observed to be stable. Based on our observations and slope stability analysis, the subject slopes are stable and no stable slope allowance is required. It should be further noted that limit of hazard lands setback is not required for the slope located just south of the hydro easement within the northeast portion of the subject site.

7.0 RECOMMENDATIONS

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

- ☐ Review master grading plan from a geotechnical perspective.
- ☐ Observation of all bearing surfaces prior to the placement of concrete.
- ☐ Sampling and testing of the concrete and fill materials used.
- ☐ Observation of all subgrades prior to backfilling.
- ☐ Field density tests to determine the level of compaction achieved.
- ☐ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 STATEMENT OF LIMITATIONS

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

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

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Tamarack (Queen Street) Corp. or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

David J. Gilbert, P.Eng.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Carlos P. Da Silva, P.Eng.

Report Distribution:

- ☐ Tamarack (Queen Street) Corp. (3 copies)
- ☐ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

CONSOLIDATION TEST RESULTS

ATTERBERG LIMITS RESULTS

ANALYTICAL TEST RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

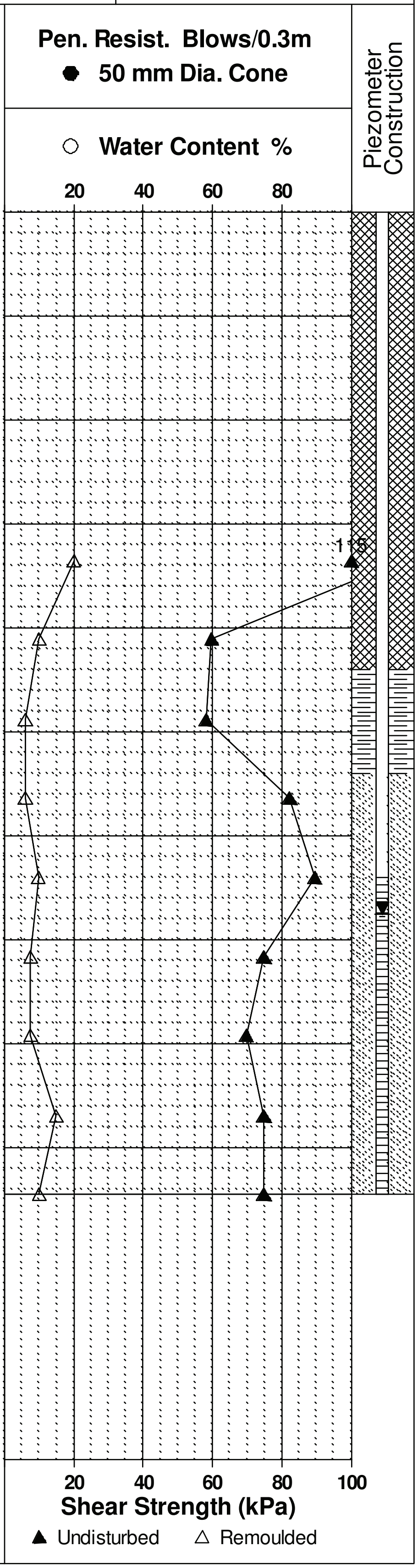
BORINGS BY CME 55 Power Auger

DATE March 27, 2012

FILE NO. **PG1796**

HOLE NO. **BH 1-12**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	67.86
Brown **SILTY CLAY,** trace sand	AU	1				
0.51						
	SS	2	83	19	1	66.86
	SS	3	100	15		
					2	65.86
	SS	4	100	8		
					3	64.86
Very stiff to stiff, brown **SILTY CLAY**						
- grey by 4.3m depth					4	63.86
					5	62.86
					6	61.86
					7	60.86
					8	59.86
					9	58.86
9.45						
End of Borehole						
(GWL @ 6.75m-April 13, 2012)						



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG1796**

REMARKS

HOLE NO. **BH 2-12**

BORINGS BY CME 55 Power Auger

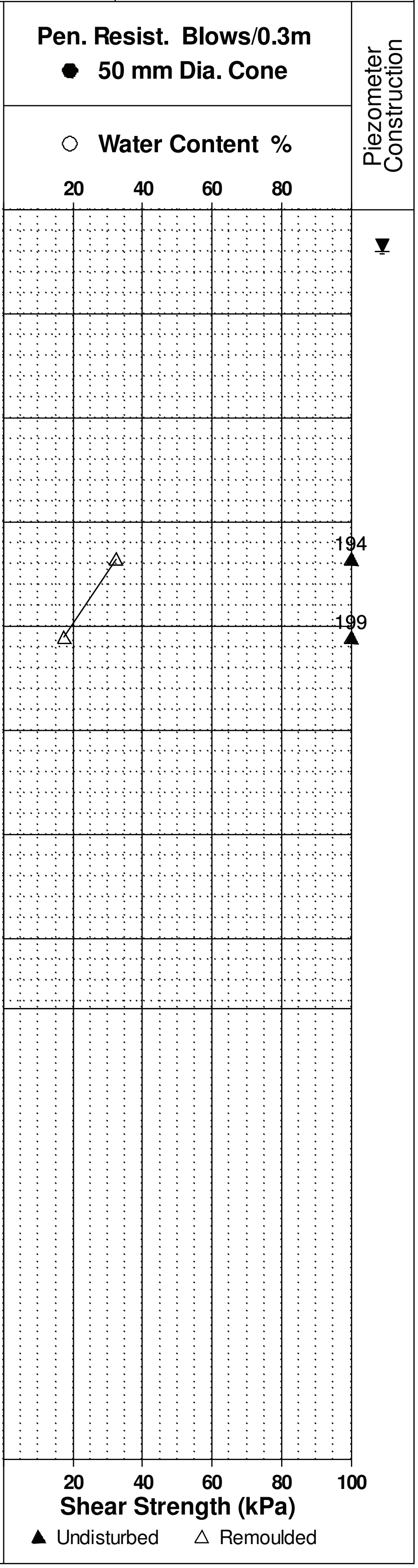
DATE March 28, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	64.29
TOPSOIL 0.28	AU	1				
Brown **SILTY CLAY,** trace sand 0.76	AU	2				
Very stiff, brown **SILTY CLAY**	SS	3	100	24	1	63.29
	SS	4	100	18	2	62.29
	SS	5	100	14	3	61.29
					4	60.29
4.95	SS	6	62	16	5	59.29
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders	SS	7	0	50+		
					6	58.29
	SS	8	29	16	7	57.29
7.67						

End of Borehole

Practical refusal to augering @ 7.67m depth

(GWL @ 0.40m-April 13, 2012)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE March 27, 2012

FILE NO. PG1796

HOLE NO. BH 3-12

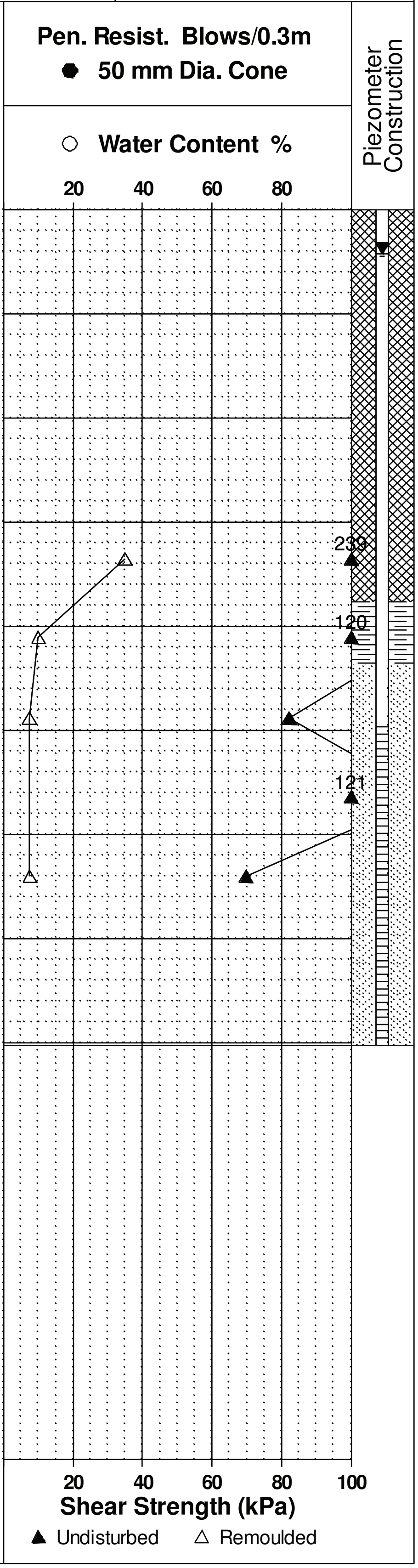
SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.33	AU	1		
Hard to very stiff, brown **SILTY CLAY** - stiff and grey by 4.3m depth	6.63	AU	2		
		SS	3	100	21
		SS	4	100	19
		SS	5	100	14
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders	8.02	SS	6	67	50+
		SS	7	100	50+

End of Borehole

Practical refusal to augering @ 8.02m depth

(GWL @ 0.43m-April 13, 2012)

DEPTH (m)	ELEV. (m)
0	65.38
1	64.38
2	63.38
3	62.38
4	61.38
5	60.38
6	59.38
7	58.38
8	57.38



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE March 27, 2012

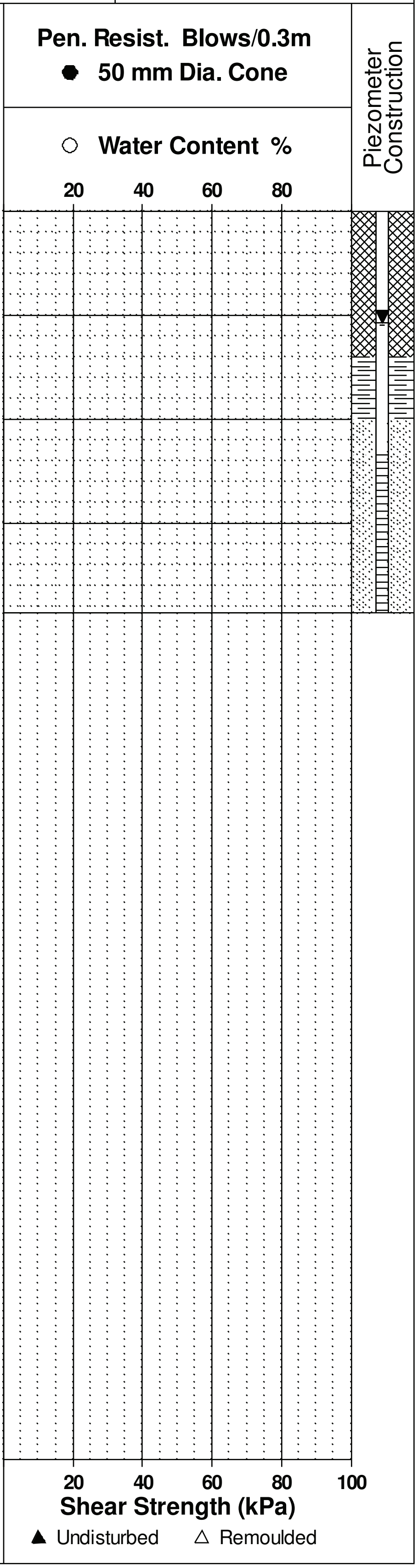
FILE NO. **PG1796**

HOLE NO. **BH 4-12**

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.38				
Brown **SILTY CLAY,** trace sand	0.60	AU	1		
Hard, brown **SILTY CLAY**	1.90	SS	2	100	25
		SS	3	83	22
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders, trace clay	2.97	SS	4	62	41
BEDROCK: Black shale	3.86	SS	5	25	50+
End of Borehole					

(GWL @ 1.07m-April 13, 2012)

DEPTH (m)	ELEV. (m)
0	65.15
1	64.15
2	63.15
3	62.15



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE March 27, 2012

FILE NO. PG1796

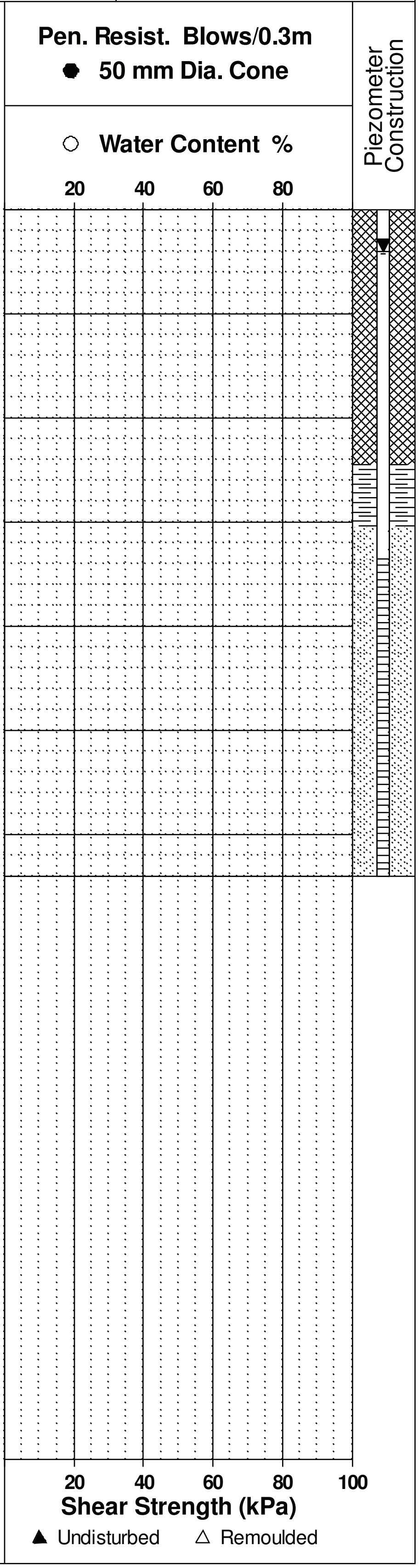
HOLE NO. BH 5-12

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	62.34
TOPSOIL	0.28	AU	1				
Hard to very stiff, brown **SILTY CLAY**		SS	2	58	25	1	61.34
		SS	3	100	19	2	60.34
		SS	4	100	24		
		SS	5	100	17	3	59.34
	3.73						
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders		SS	6	75	49	4	58.34
		SS	7	50	34	5	57.34
	5.64						
GLACIAL TILL: Grey silty sand with gravel, cobbles and boulders		SS	8	100	50+	6	56.34
	6.40						

End of Borehole

Practical refusal to augering @ 6.40m depth

(GWL @ 0.40m-April 13, 2012)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG1796**

REMARKS

HOLE NO. **BH 6-12**

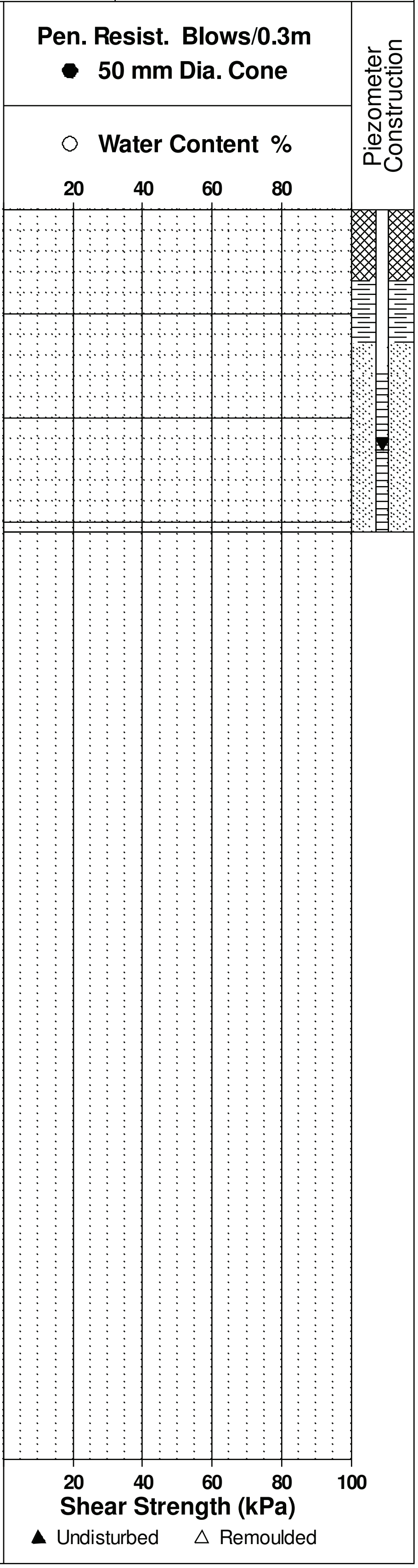
BORINGS BY CME 55 Power Auger

DATE March 28, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	61.27
TOPSOIL 0.30						
Brown **SILTY CLAY** 0.69						
GLACIAL TILL: Brown silty clay with sand, gravel and rock fragments	SS	1	67	20	1	60.27
1.68	SS	2	100	50+		
GLACIAL TILL: Grey silty sand with gravel and rock fragments					2	59.27
	SS	3	67	50+		
3.10					3	58.27
End of Borehole	SS	4	50	50+		

Practical refusal to augering @ 3.10m depth

(GWL @ 2.31m-April 13, 2012)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE April 5, 2012

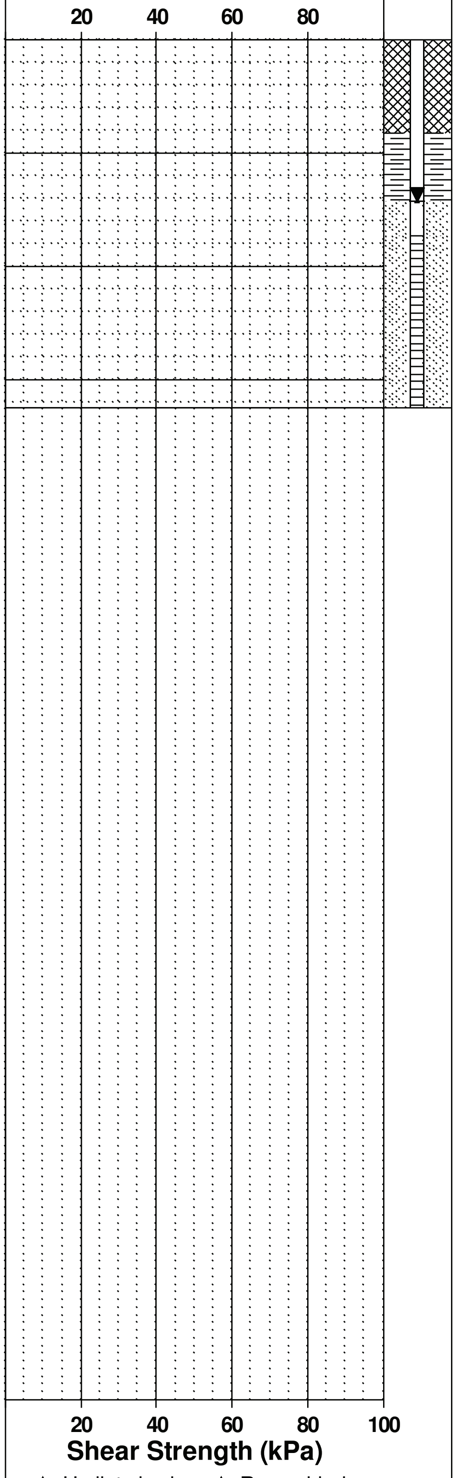
FILE NO. PG1796

HOLE NO. BH 7-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	70.88
TOPSOIL 0.08		AU	1				
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders		SS	2	50	14	1	69.88
		SS	3	75	66	2	68.88
3.25		SS	4	100	50+	3	67.88
End of Borehole Practical refusal to augering @ 3.25m depth (GWL @ 1.42m-April 13, 2012)							

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

○ **Water Content %**



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

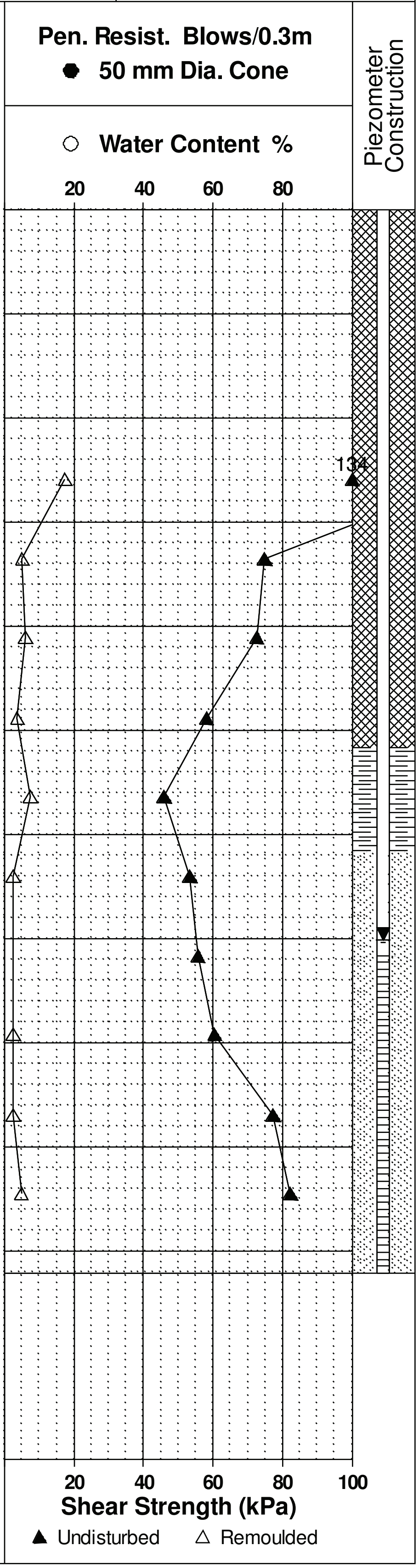
BORINGS BY CME 55 Power Auger

DATE April 5, 2012

FILE NO. PG1796

HOLE NO. BH 9-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.33
TOPSOIL 0.23							
		SS	1	100	14	1	52.33
		SS	2	100	16		
						2	51.33
Very stiff to stiff, brown **SILTY CLAY**						3	50.33
- grey by 3.6m depth						4	49.33
						5	48.33
						6	47.33
						7	46.33
						8	45.33
						9	44.33
						10	43.33
10.21							
End of Borehole							
(GWL @ 7.01m-April 13, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG1796**

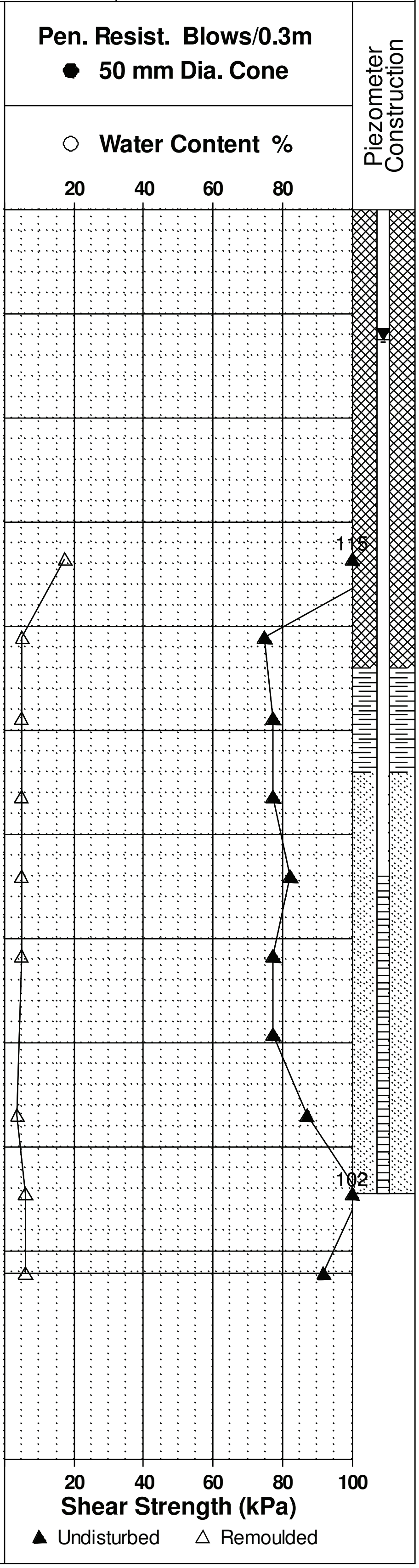
REMARKS

HOLE NO. **BH10-12**

BORINGS BY CME 55 Power Auger

DATE April 5, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	55.60
FILL: Brown silty sand with gravel, roots, trees, plants	AU	1				
	AU	2				
1.14	SS	3	62	8	1	54.60
Very stiff to stiff, brown **SILTY CLAY** - grey by 4.3m depth	SS	4	100	18		
					2	53.60
	SS	5	100	12		
					3	52.60
					4	51.60
					5	50.60
					6	49.60
					7	48.60
					8	47.60
					9	46.60
					10	45.60
10.21 End of Borehole (GWL @ 1.25m-April 13, 2012)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

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FILE NO. **PG1796**

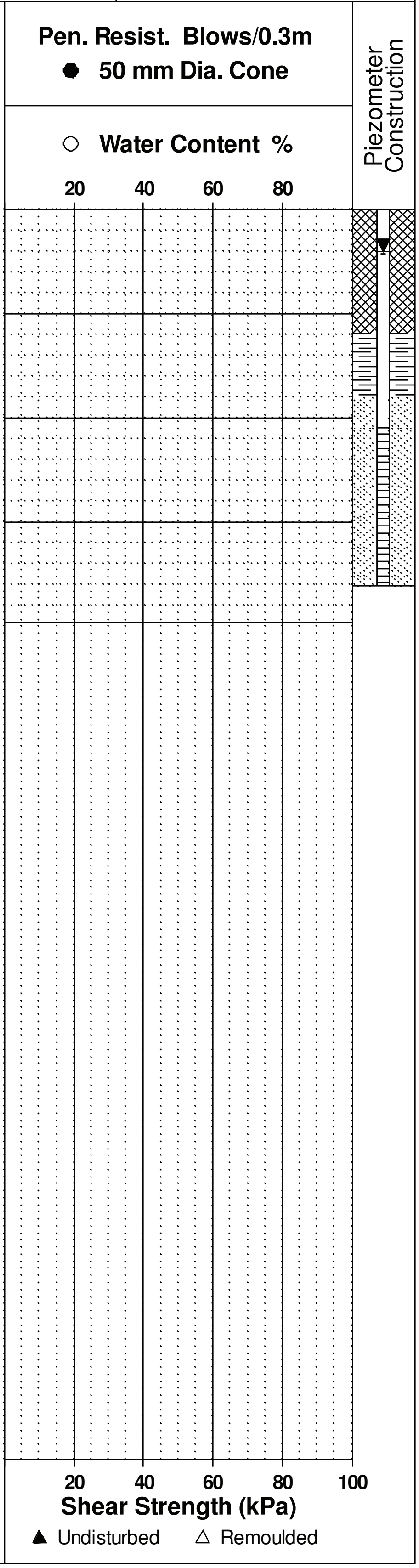
REMARKS

HOLE NO. **BH11-12**

BORINGS BY CME 55 Power Auger

DATE March 28, 2012

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	67.84
FILL: Brown silty sand 0.13	AU	1				
TOPSOIL 0.36						
Very stiff, brown **SILTY CLAY**	SS	2	100	18	1	66.84
	SS	3	100	25		
2.21					2	65.84
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders	SS	4	100	50+		
					3	64.84
	SS	5	55	48		
3.96						
End of Borehole Practical refusal to augering @ 3.96m depth (GWL @ 0.40m-April 13, 2012)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE March 28, 2012

FILE NO. PG1796

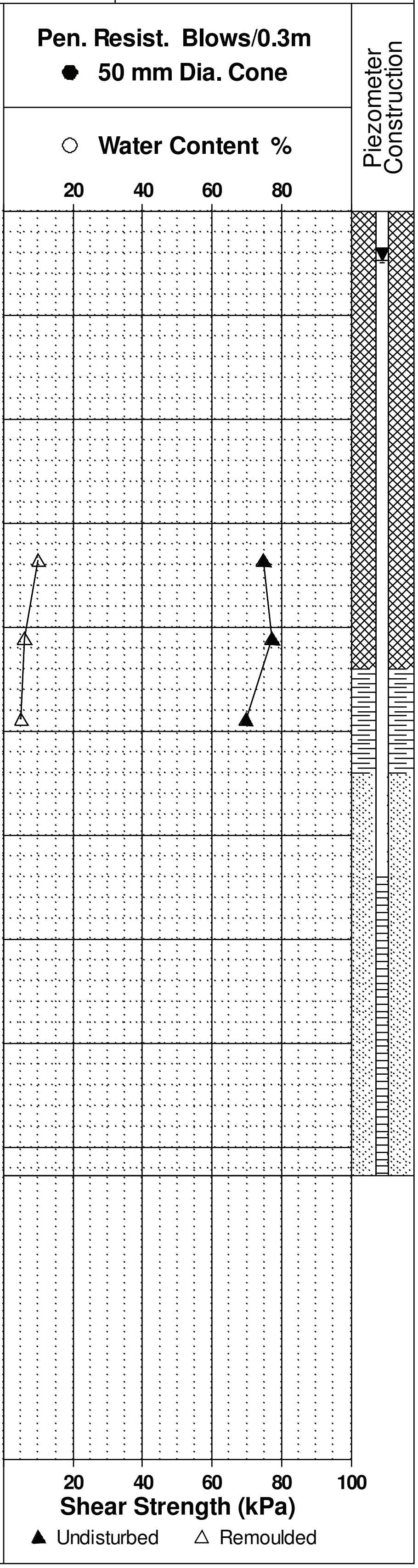
HOLE NO. BH12-12

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	71.00
TOPSOIL	0.30						
Very stiff to stiff, brown **SILTY CLAY** - grey by 3.0m depth		SS	1	100	22	1	70.00
		SS	2	100	16	2	69.00
		SS	3	58	6	3	68.00
	5.11					4	67.00
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders		SS	4	100	13	5	66.00
		SS	5	100	5	6	65.00
		SS	6	100	15	7	64.00
		SS	7	100	15	8	63.00
	9.27	SS	8	50	50+	9	62.00

End of Borehole

Practical refusal to augering @ 9.27m depth

(GWL @ 0.47m-April 13, 2012)



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
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REMARKS

BORINGS BY CME 55 Power Auger

DATE March 29, 2012

FILE NO. PG1796

HOLE NO. BH13-12

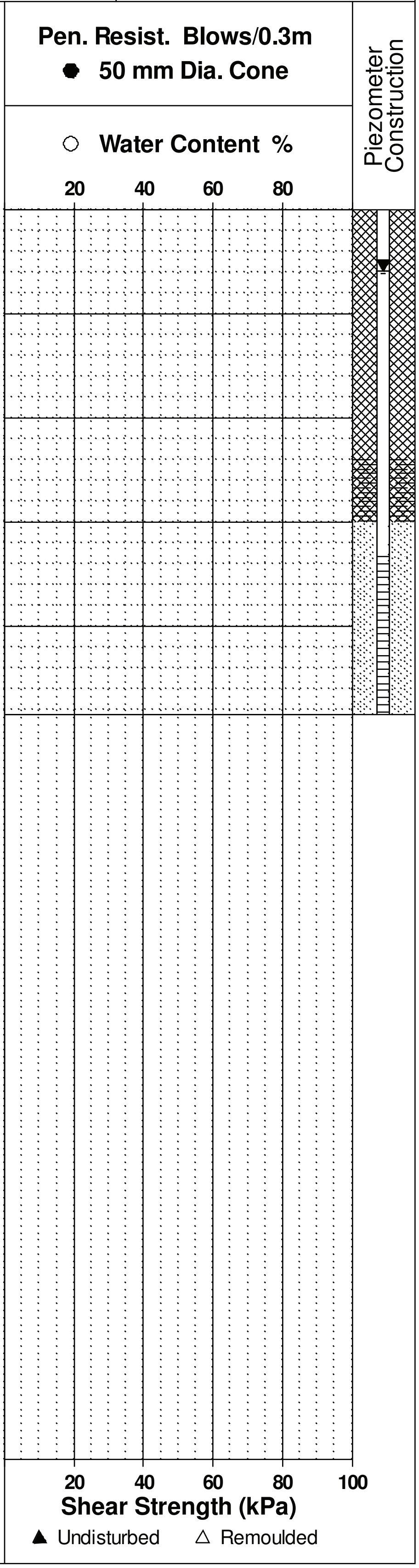
SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.25	AU	1		
GLACIAL TILL: Brown silty sand with clay, gravel, cobbles and boulders	SS	2	62	12
	SS	3	73	50+
	SS	4	83	50+
	SS	5	80	50+
4.85	SS	6	75	50+

DEPTH (m)	ELEV. (m)
0	73.24
1	72.24
2	71.24
3	70.24
4	69.24

End of Borehole

Practical refusal to augering @ 4.85m depth

(GWL @ 0.59m-April 13, 2012)



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE March 28, 2012

FILE NO. PG1796

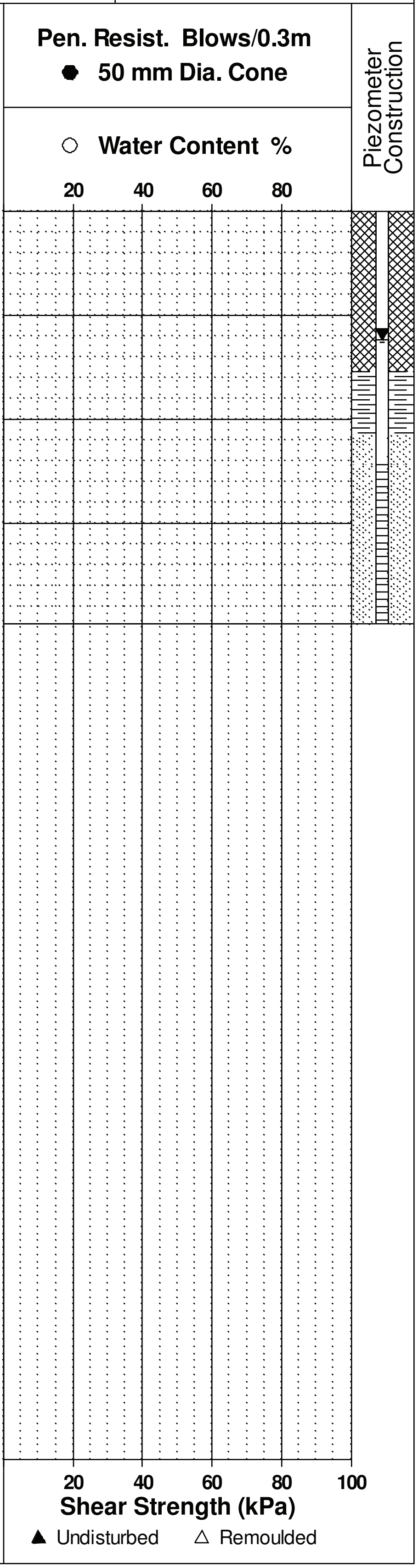
HOLE NO. BH14-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	70.34
TOPSOIL 0.41	■						
Very stiff, brown **SILTY CLAY**	▨	SS	1	100	15	1	69.34
	▨	SS	2	100	27	2	68.34
2.54	▨	SS	3	89	50+		
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders						3	67.34
		SS	4	62	3		
3.73							
BEDROCK: Black shale 3.96		SS	5	33	50+		

End of Borehole

Practical refusal to augering @ 3.96m depth

(GWL @ 1.24m-April 13, 2012)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE March 28, 2012

FILE NO. PG1796

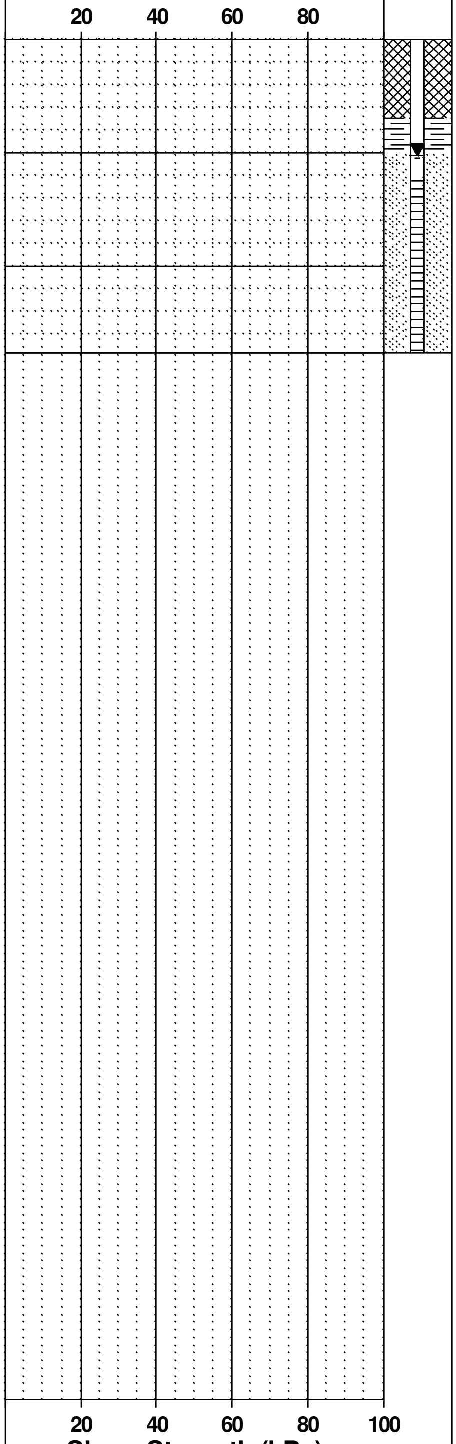
HOLE NO. BH15-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	71.07
TOPSOIL 0.28							
Very stiff, brown **SILTY CLAY**		AU	1				
1.45		SS	2	100	27	1	70.07
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders 2.21		SS	3	83	27	2	69.07
BEDROCK: Black shale		SS	4	100	50+		
2.77		SS	5	0	50+		
End of Borehole Practical refusal to augering @ 2.77m depth (GWL @ 1.03m-April 13, 2012)							

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

○ **Water Content %**

Piezometer Construction



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

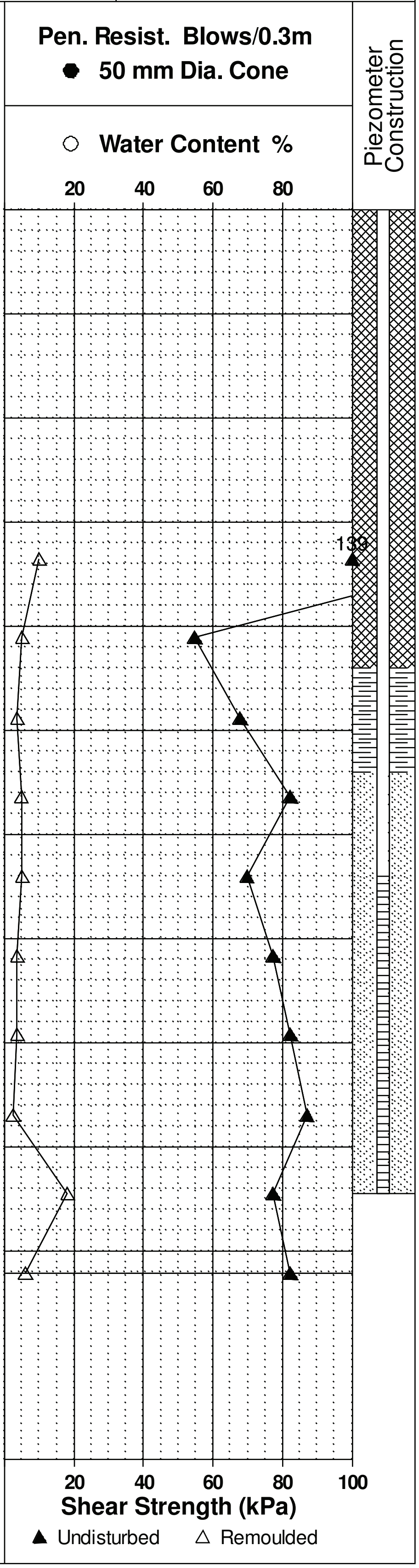
BORINGS BY CME 55 Power Auger

DATE March 30, 2012

FILE NO. PG1796

HOLE NO. BH16-12

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
TOPSOIL 0.30					0	56.07
	AU	1				
	SS	2	100	24	1	55.07
	SS	3	100	10	2	54.07
	SS	4	100	6		
					3	53.07
Very stiff to stiff, brown **SILTY CLAY** - grey by 4.3m depth					4	52.07
					5	51.07
					6	50.07
					7	49.07
					8	48.07
					9	47.07
					10	46.07
10.21						
Dynamic Cone Penetration Test commenced at 10.21m depth. Cone pushed to 24.4m depth. Practical cone refusal at 24.41m depth. (BH dry - April 13, 2012)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE March 28, 2012

FILE NO. PG1796

HOLE NO. BH17-12

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
TOPSOIL (to 0.28)	AU	1			0	73.11
Very stiff, brown **SILTY CLAY** (to 1.45)	SS	2	100	31	1	72.11
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders (to 3.86)	SS	3	100	17	2	71.11
	SS	4	44	50+		
	SS	5	83	50+	3	70.11
BEDROCK: Black shale (to 4.82)					4	69.11
	SS	6	100	50+		
	SS	7	100	50+		

End of Borehole

Practical refusal to augering @ 4.82m depth

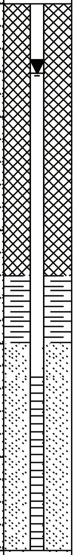
(GWL @ 0.61m-April 13, 2012)

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

○ **Water Content %**

20 40 60 80

Piezometer Construction



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

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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
Ottawa, Ontario

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REMARKS

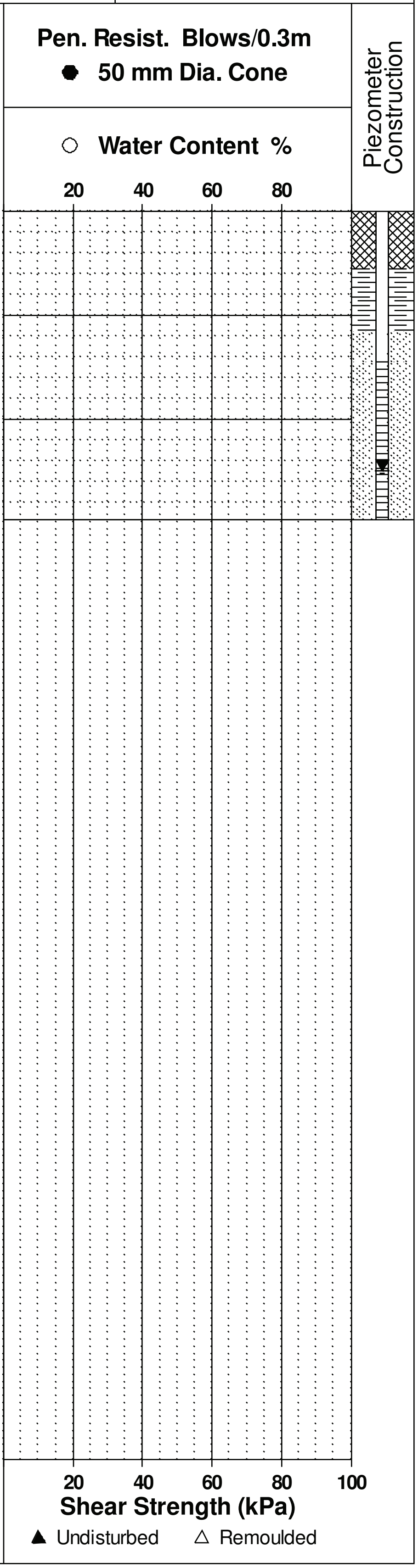
BORINGS BY CME 55 Power Auger

DATE March 30, 2012

FILE NO. PG1796

HOLE NO. BH18-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.69
TOPSOIL 0.30							
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders		AU	1				
		SS	2	62	12	1	75.69
		SS	3	71	33	2	74.69
2.97		SS	4	100	50+		
End of Borehole Practical refusal to augering @ 2.97m depth (GWL @ 2.50m-April 13, 2012)							



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
Ottawa, Ontario

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REMARKS

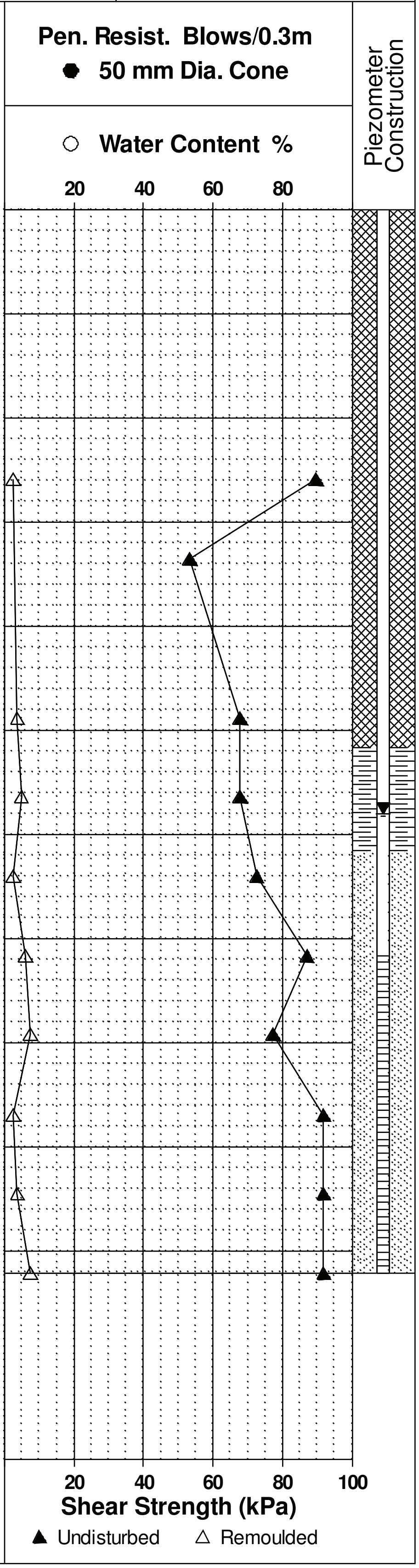
BORINGS BY CME 55 Power Auger

DATE March 30, 2012

FILE NO. PG1796

HOLE NO. BH19-12

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	53.92
TOPSOIL 0.20	AU	1				
	SS	2	100	24	1	52.92
Very stiff to stiff, brown **SILTY CLAY** - grey by 2.8m depth	SS	3	100	7	2	51.92
					3	50.92
	TW	4	83		4	49.92
					5	48.92
					6	47.92
					7	46.92
					8	45.92
					9	44.92
10.21					10	43.92
End of Borehole (GWL @ 5.80m-April 13, 2012)						



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
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REMARKS

BORINGS BY CME 55 Power Auger

DATE March 28, 2012

FILE NO. PG1796

HOLE NO. BH20-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.36
TOPSOIL 0.28		AU	1				
Very stiff, brown **SILTY CLAY,** trace sand 0.69		AU	2				
GLACIAL TILL: Very dense, brown silty sand with gravel, cobbles and boulders		SS	3	62	44	1	75.36
		SS	4	53	78	2	74.36
		SS	5	67	50+	3	73.36
						4	72.36
		SS	6	50	50+		
5.16						5	71.36

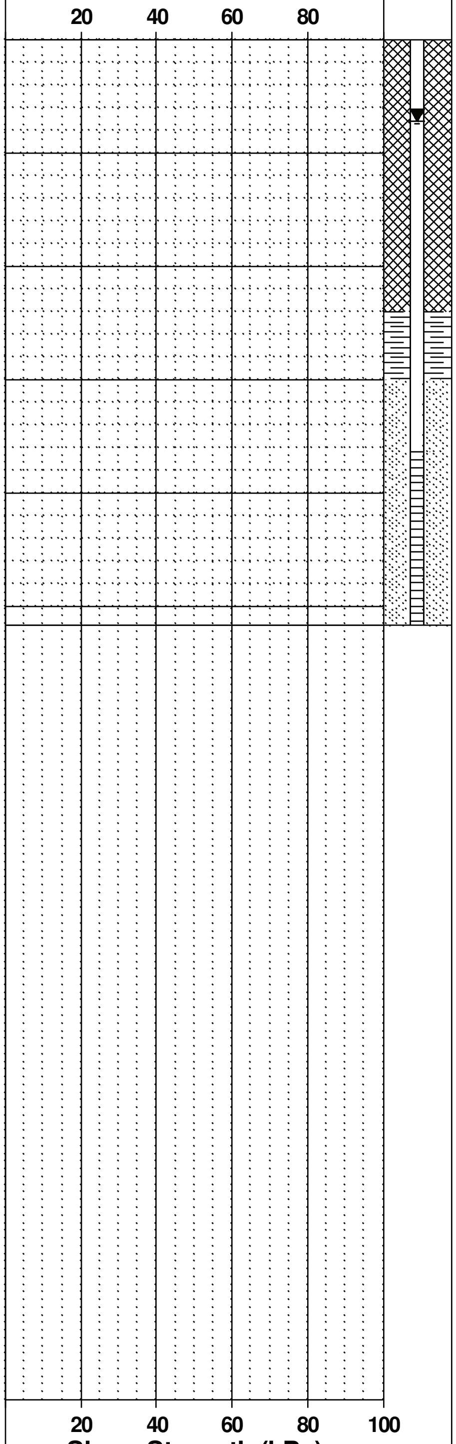
End of Borehole

Practical refusal to augering @ 5.16m depth

(GWL @ 0.72m-April 13, 2012)

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

○ **Water Content %**



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE April 2, 2012

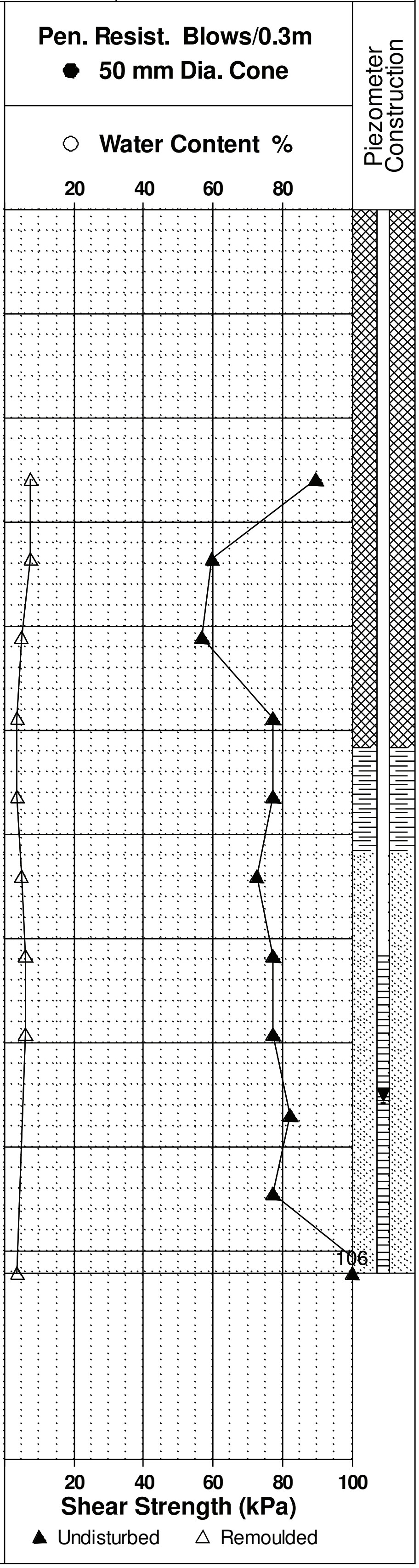
FILE NO. PG1796

HOLE NO. BH21-12

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	53.89
TOPSOIL 0.25	AU	1				
	SS	2	100	16	1	52.89
	SS	3	100	8	2	51.89
Very stiff to stiff, brown **SILTY CLAY**					3	50.89
- grey by 3.6m depth					4	49.89
					5	48.89
					6	47.89
					7	46.89
					8	45.89
					9	44.89
10.21					10	43.89

Dynamic Cone Penetration Test commenced at 10.21m depth. Cone pushed to 26.4m depth. Practical cone refusal at 26.39m depth.

(GWL @ 8.55m-April 13, 2012)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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REMARKS

BORINGS BY CME 55 Power Auger

DATE April 2, 2012

FILE NO. PG1796

HOLE NO. BH22-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	78.53
TOPSOIL 0.30		AU	1				
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders		SS	2	60	50+	1	77.53
1.52		SS	3	100	50+		
BEDROCK: Black shale 2.23						2	76.53
End of Borehole Practical refusal to augering @ 2.23m depth (BH dry upon completion)							

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

○ Water Content %

20 40 60 80

Piezometer Construction

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE April 4, 2012

FILE NO. PG1796

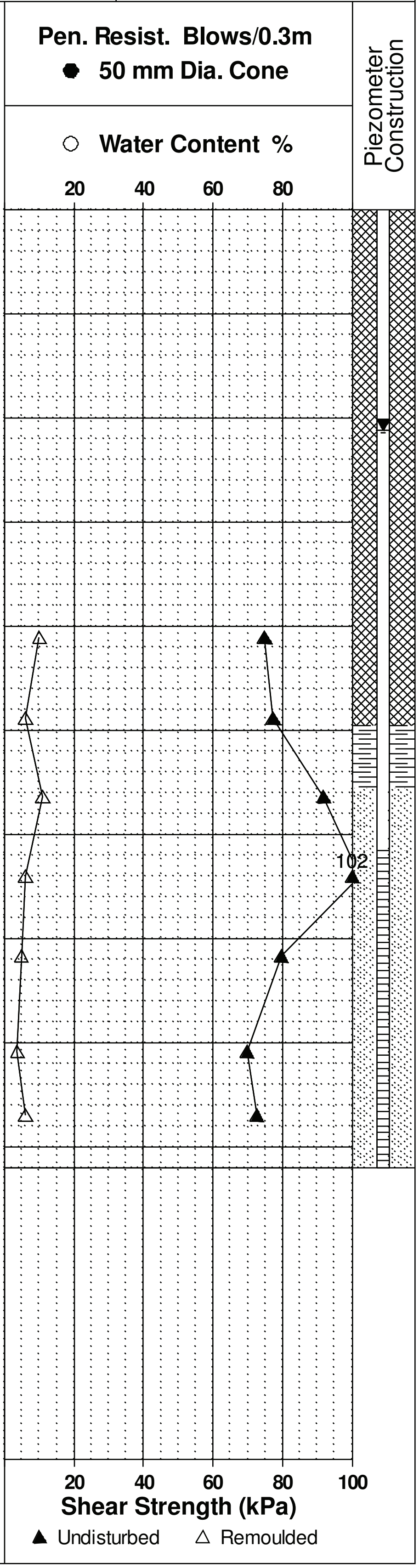
HOLE NO. BH23-12

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	55.50
TOPSOIL 0.20						
	SS	1	83	15	1	54.50
	SS	2	100	20	2	53.50
	SS	3	100	20	3	52.50
	SS	4	100	8		
Very stiff to stiff, brown **SILTY CLAY**					4	51.50
- grey by 4.3m depth					5	50.50
					6	49.50
					7	48.50
8.92					8	47.50
GLACIAL TILL: Grey silty sand with gravel, cobbles and boulders 9.20	SS	5		50+	9	46.50

End of Borehole

Practical refusal to augering @ 9.20m depth

(GWL @ 2.12m-April 13, 2012)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE April 2, 2012

FILE NO. PG1796

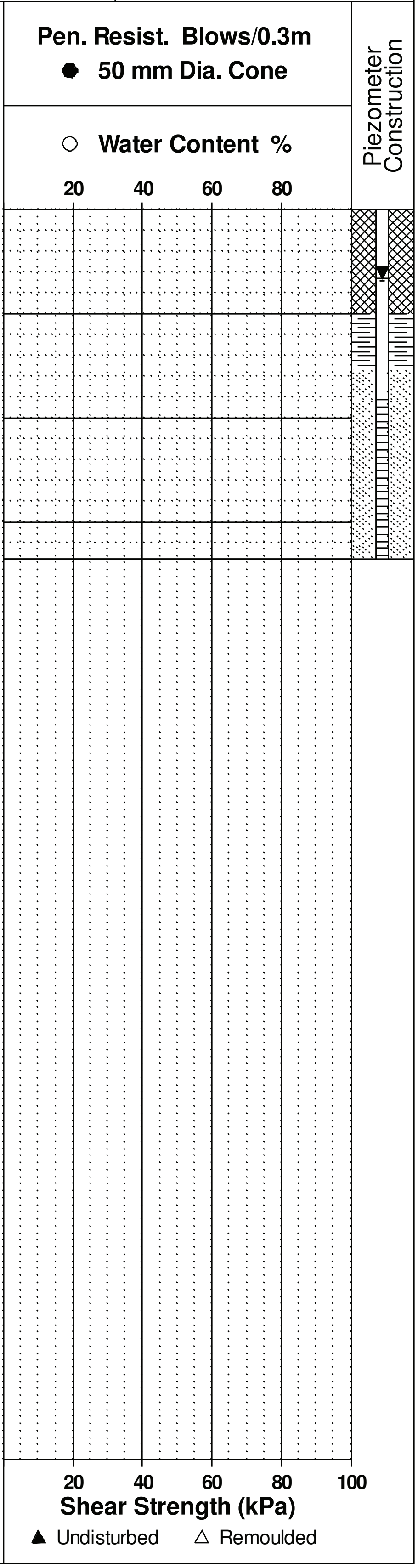
HOLE NO. BH25-12

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	81.91
TOPSOIL 0.20						
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders	AU	1				
	SS	2	50	25	1	80.91
	SS	3	20	50+		
					2	79.91
	SS	4	67	50+		
					3	78.91
3.35	SS	5	71	50+		

End of Borehole

Practical refusal to augering @ 3.35m depth

(GWL @ 0.66m-April 13, 2012)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE November 6, 2012

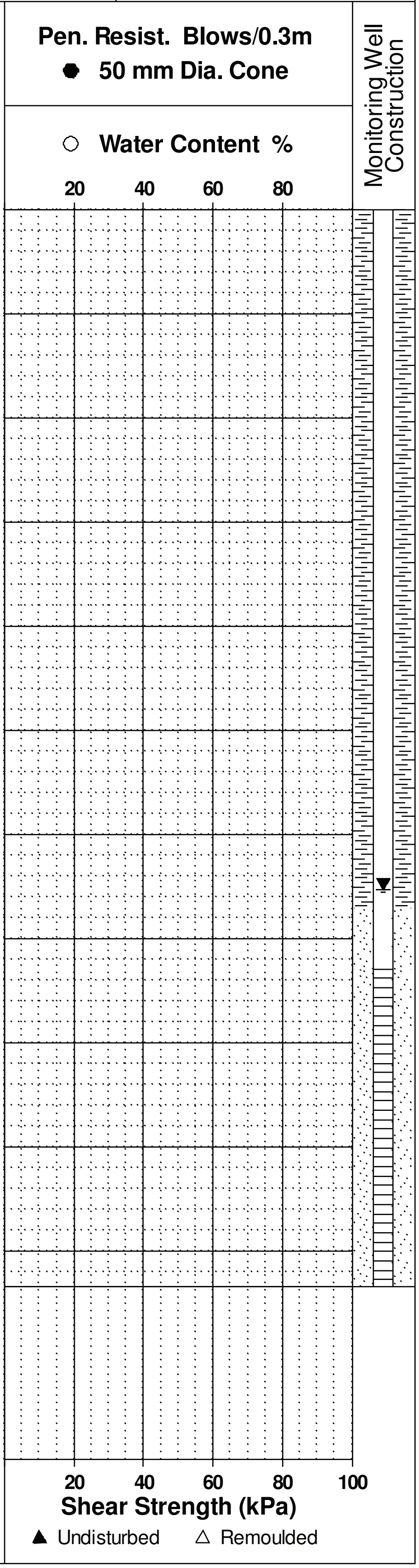
FILE NO. PG1796

HOLE NO. BH41-12

SOIL DESCRIPTION	
GROUND SURFACE	
TOPSOIL	0.23
Very stiff, brown **SILTY CLAY**	1.09
BEDROCK: Weathered black shale interbedded with grey dolostone and limestone	2.79
BEDROCK: Grey dolostone interbedded with limestone - 70mm thick fractured seam at 6.8m depth - fractured from 8.48 to 8.63m	10.34
End of Borehole (GWL @ 6.53m-Dec. 6, 2012)	

SAMPLE			
TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	86	50+
RC	1	100	38
RC	2	100	87
RC	3	100	100
RC	4	100	90
RC	5	100	90
RC	6	100	93

DEPTH (m)	ELEV. (m)
0	71.79
1	70.79
2	69.79
3	68.79
4	67.79
5	66.79
6	65.79
7	64.79
8	63.79
9	62.79
10	61.79



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

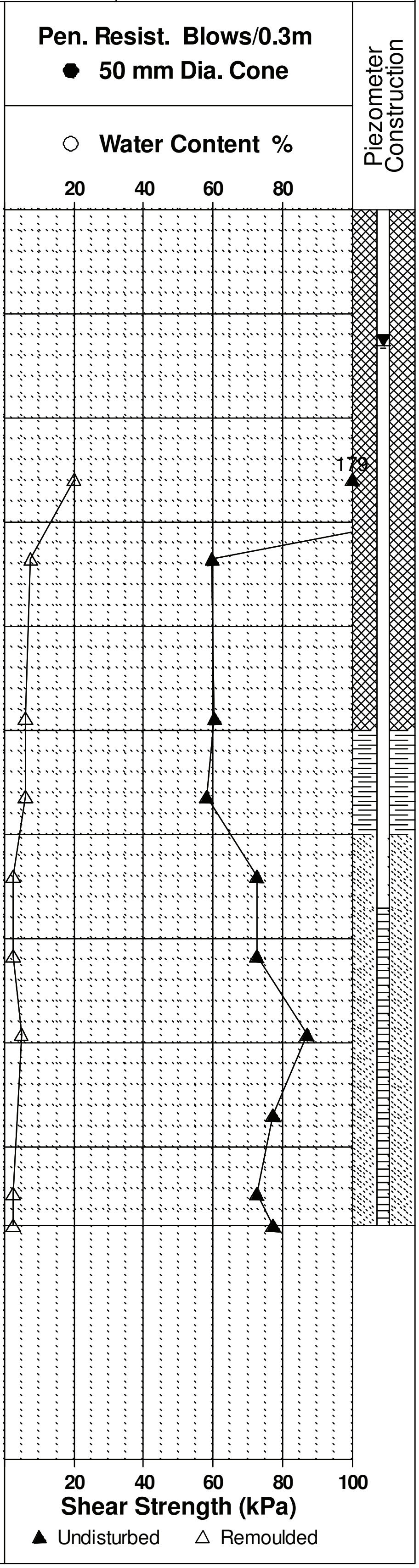
FILE NO. PG1796

REMARKS

HOLE NO. BH42-12

BORINGS BY CME 55 Power Auger **DATE** November 5, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.37
TOPSOIL 0.33	■	AU	1				
Very stiff to stiff, brown **SILTY CLAY** - grey by 4.3m depth	▨	AU	2				
	▨	SS	3	100	11	1	53.37
	▨	SS	4	100	10		
	▨					2	52.37
	▨					3	51.37
	▨					4	50.37
	▨					5	49.37
	▨					6	48.37
	▨					7	47.37
	▨					8	46.37
	▨					9	45.37
9.75							
End of Borehole (GWL @ 1.31m-Dec. 6, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

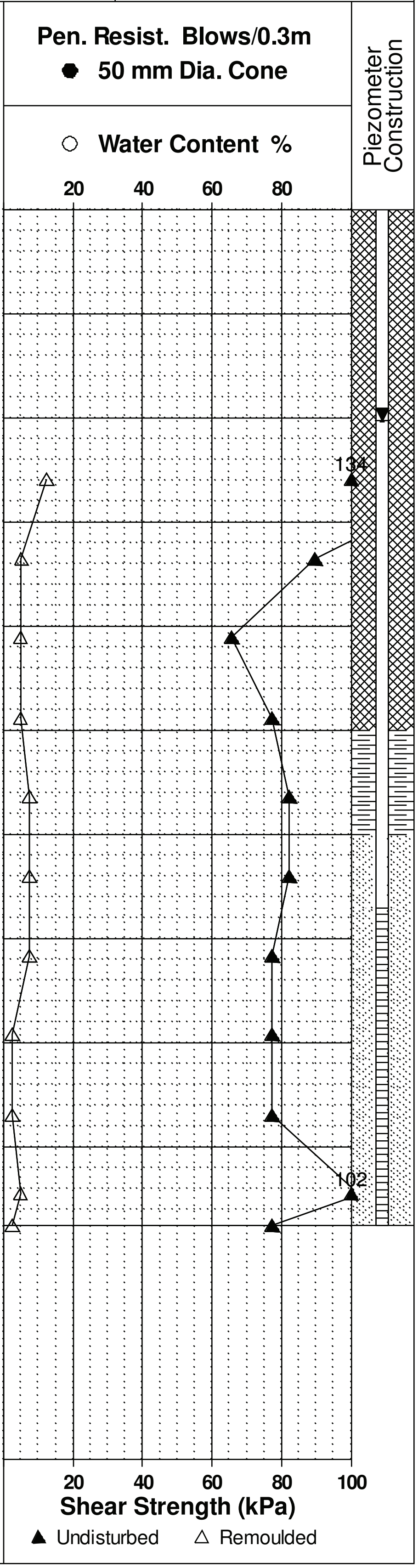
REMARKS

HOLE NO. **BH43-12**

BORINGS BY CME 55 Power Auger

DATE November 5, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.31
TOPSOIL 0.23		AU	1				
		AU	2				
		SS	3	100	11	1	53.31
		SS	4	100	6	2	52.31
Very stiff to stiff, brown **SILTY CLAY**						3	51.31
- grey-brown by 3.6m depth						4	50.31
						5	49.31
- grey by 6.0m depth						6	48.31
						7	47.31
						8	46.31
						9	45.31
9.75							
End of Borehole (GWL @ 2.02m-Dec. 6, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE November 5, 2012

FILE NO. PG1796

HOLE NO. BH44-12

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.41
Very stiff to stiff, brown **SILTY CLAY** - grey by 2.8m depth	7.64
Inferred **BEDROCK**	7.87

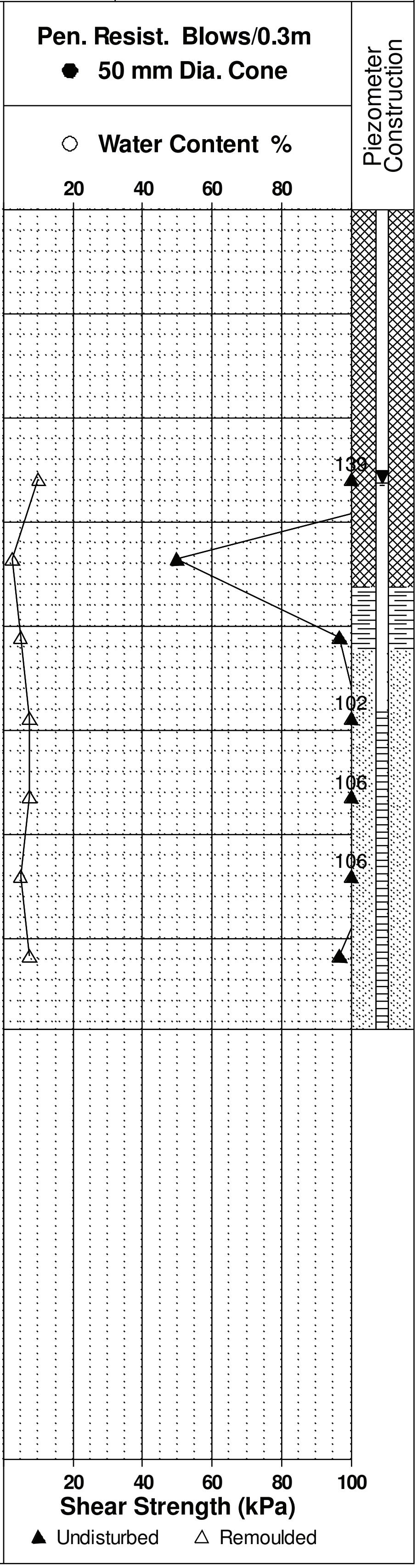
End of Borehole

Practical refusal to augering at 7.87m depth

(GWL @ 2.62m-Dec. 6, 2012)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	100	10
SS	3	100	6

DEPTH (m)	ELEV. (m)
0	54.29
1	53.29
2	52.29
3	51.29
4	50.29
5	49.29
6	48.29
7	47.29



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

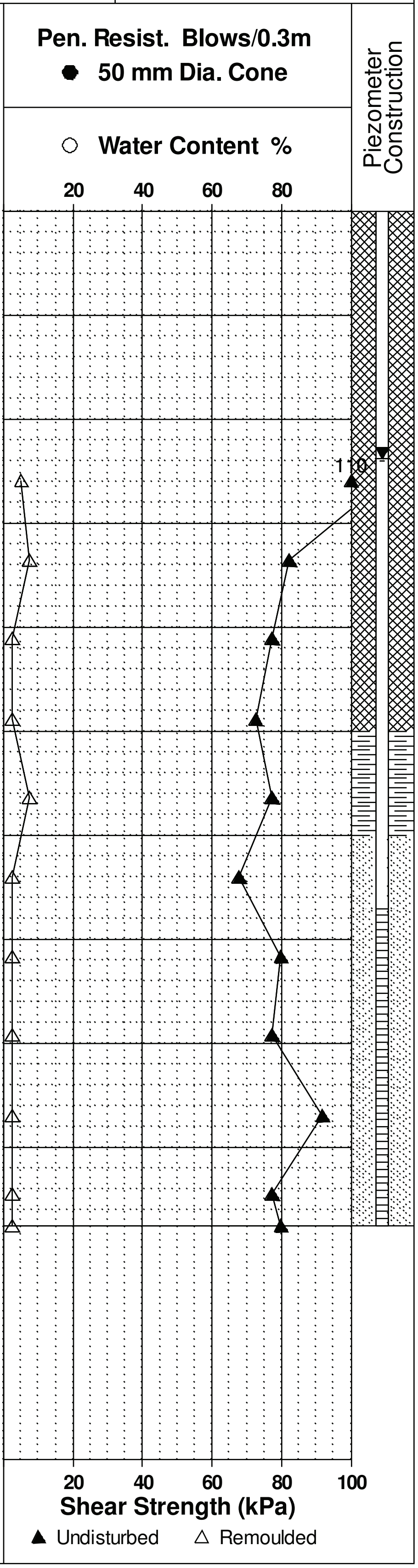
BORINGS BY CME 55 Power Auger

DATE November 6, 2012

FILE NO. PG1796

HOLE NO. BH45-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL 0.25						0	54.21
		SS	1	100	11	1	53.21
		SS	2	100	6	2	52.21
						3	51.21
Very stiff to stiff, brown **SILTY CLAY**						4	50.21
						5	49.21
- grey-brown by 5.9m depth						6	48.21
						7	47.21
						8	46.21
						9	45.21
9.75							
End of Borehole (GWL @ 2.38m-Dec. 6, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

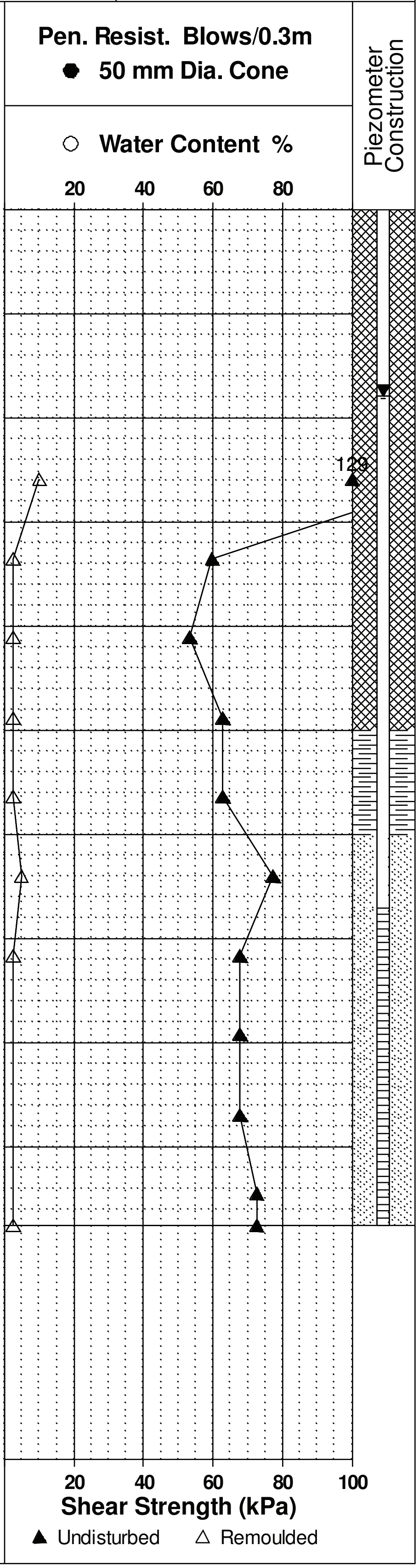
REMARKS

HOLE NO. **BH46-12**

BORINGS BY CME 55 Power Auger

DATE November 6, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	54.15
TOPSOIL 0.33						
	SS	1	100	9	1	53.15
	SS	2	100	9		
					2	52.15
					3	51.15
Very stiff to stiff, brown **SILTY CLAY**						
					4	50.15
- grey by 4.3m depth						
					5	49.15
					6	48.15
					7	47.15
					8	46.15
					9	45.15
9.75						
End of Borehole (GWL @ 1.79m-Dec. 6, 2012)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

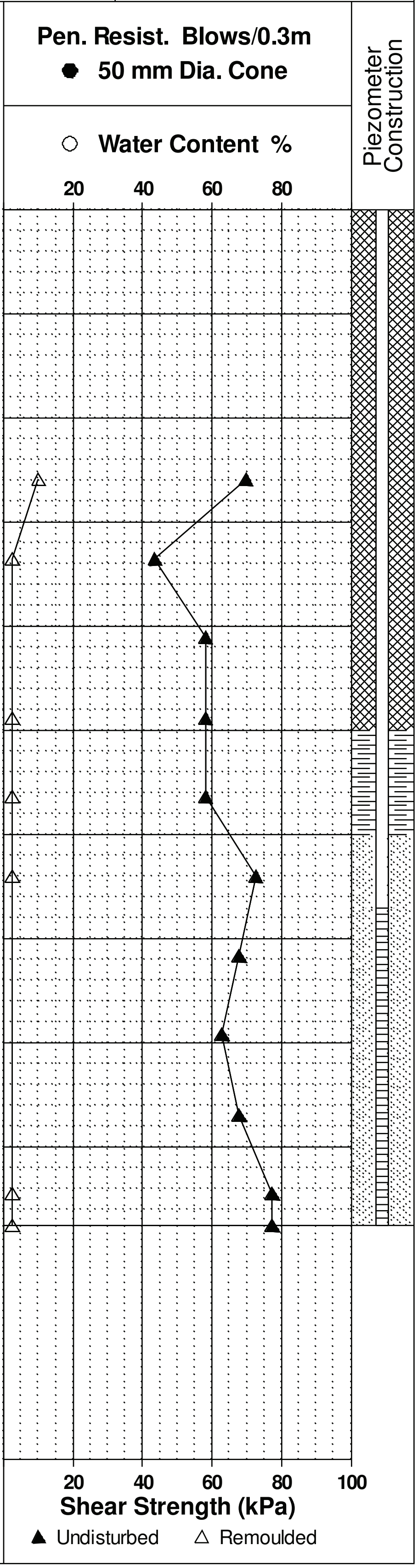
BORINGS BY CME 55 Power Auger

DATE November 6, 2012

FILE NO. PG1796

HOLE NO. BH47-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.07
TOPSOIL 0.25		AU	1				
		SS	2	100	8	1	53.07
		SS	3	100	5		
						2	52.07
						3	51.07
Very stiff to stiff, brown **SILTY CLAY**						4	50.07
- grey by 5.1m depth						5	49.07
						6	48.07
						7	47.07
						8	46.07
						9	45.07
9.75							
End of Borehole							
(GWL @ 1.29m-Dec. 6, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE November 7, 2012

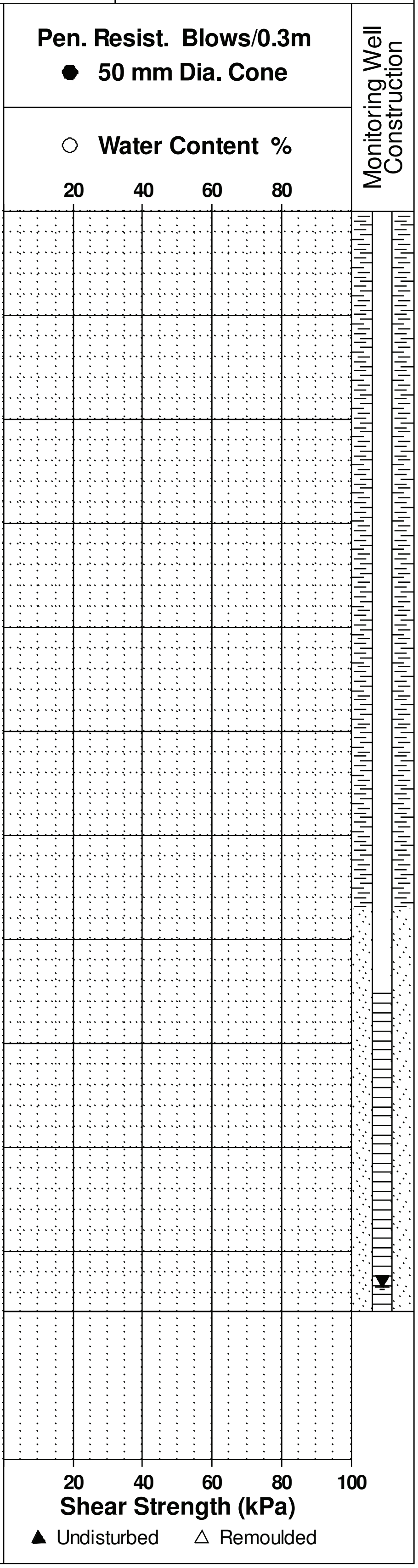
FILE NO. PG1796

HOLE NO. BH48-12

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
FILL: Brown silty sand with gravel and clay	0.60
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders	1.52
BEDROCK: Weathered grey shaley limestone interbedded with dolostone to 2.9m depth, occasional mud seams	2.90
BEDROCK: Grey dolostone interbedded with limestone - sound by 5.4m depth	10.57
End of Borehole (GWL @ 10.34m-Dec. 6, 2012)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	50	51
SS	2	83	22
RC	1	100	31
RC	2	100	82
RC	3	100	100
RC	4	100	100
RC	5	100	100
RC	6	94	85

DEPTH (m)	ELEV. (m)
0	67.92
1	66.92
2	65.92
3	64.92
4	63.92
5	62.92
6	61.92
7	60.92
8	59.92
9	58.92
10	57.92



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

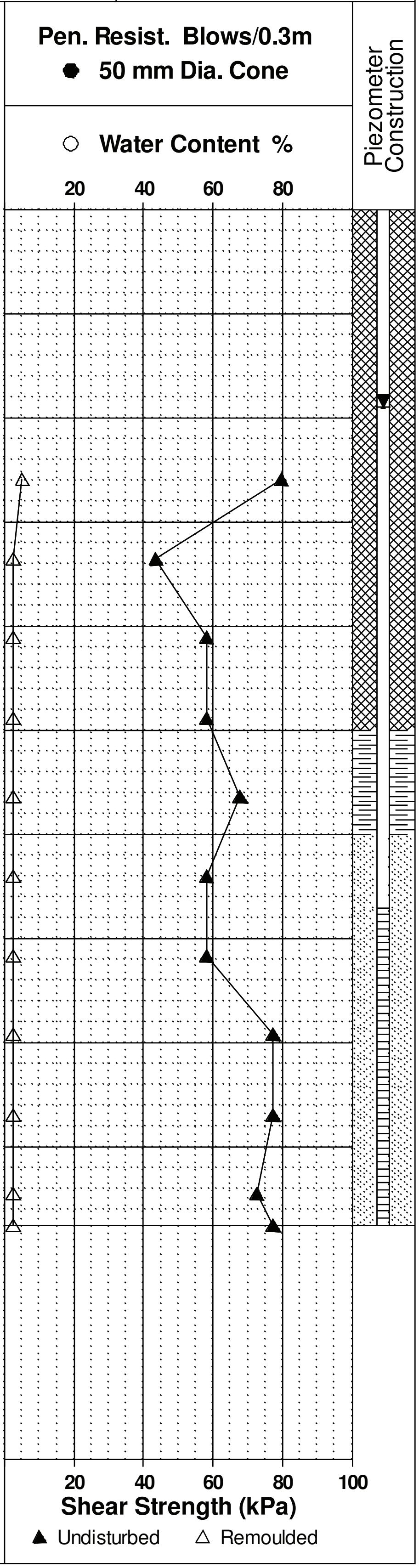
BORINGS BY CME 55 Power Auger

DATE November 8, 2012

FILE NO. **PG1796**

HOLE NO. **BH49-12**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.39
TOPSOIL 0.25							
		SS	1	100	10	1	53.39
		SS	2	100	6		
						2	52.39
Very stiff to stiff, brown **SILTY CLAY**						3	51.39
- grey-brown by 3.5m depth							
- grey by 4.3m depth						4	50.39
						5	49.39
						6	48.39
						7	47.39
						8	46.39
						9	45.39
9.75							
End of Borehole							
(GWL @ 1.89m-Dec. 6, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

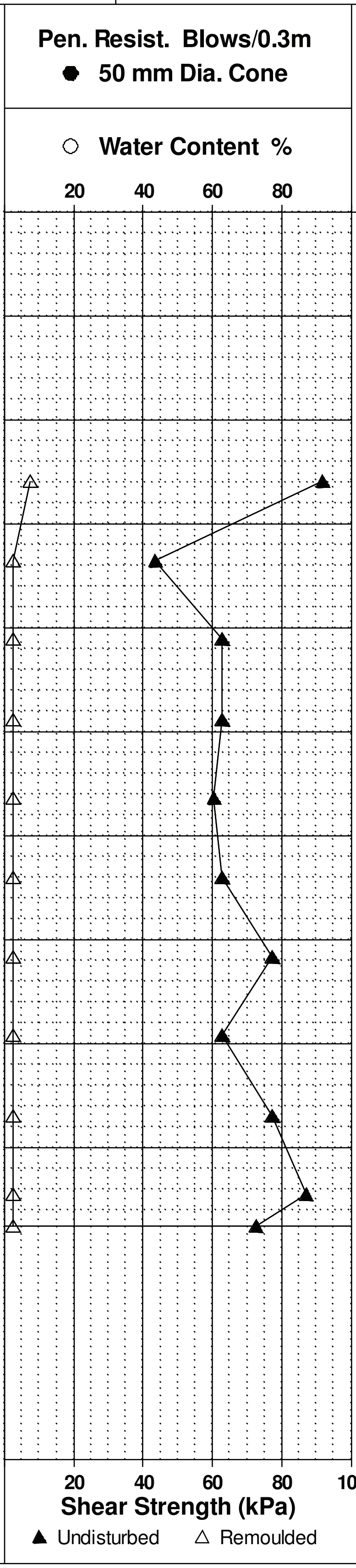
BORINGS BY CME 55 Power Auger

DATE November 8, 2012

FILE NO. PG1796

HOLE NO. BH50-12

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	54.17
TOPSOIL 0.30						
	SS	1	100	11	1	53.17
	SS	2	100	5		
					2	52.17
					3	51.17
Very stiff to stiff, brown **SILTY CLAY**					4	50.17
					5	49.17
- grey by 5.9m depth					6	48.17
					7	47.17
					8	46.17
					9	45.17
9.75						
End of Borehole						



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

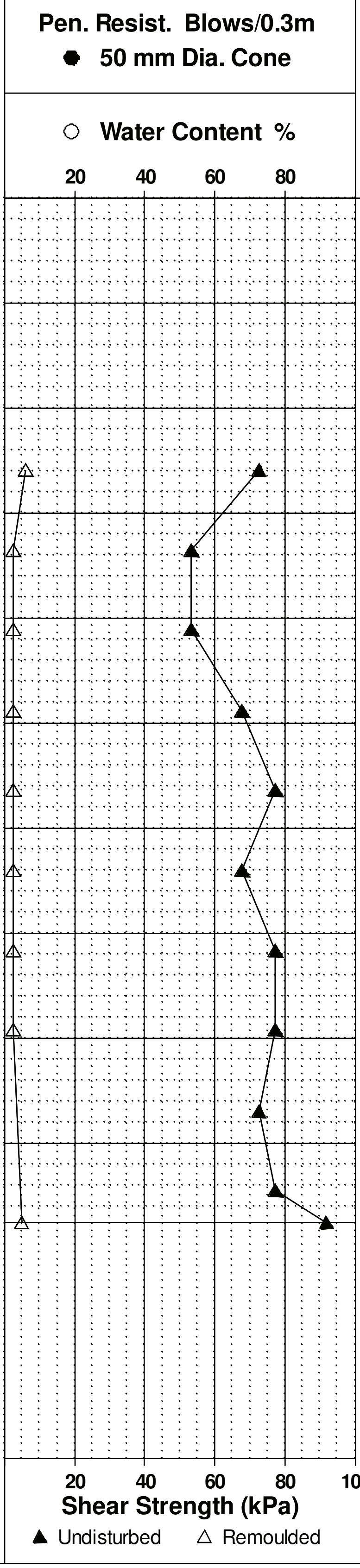
BORINGS BY CME 55 Power Auger

DATE November 8, 2012

FILE NO. PG1796

HOLE NO. BH51-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	54.00	
TOPSOIL 0.30		AU	1					
Brown **SILTY CLAY,** trace gravel and roots 0.69		AU	2					
		SS	3	100	10	1	53.00	
		SS	4	100	5	2	52.00	
Very stiff to stiff, brown **SILTY CLAY**						3	51.00	
- grey-brown by 3.5m depth						4	50.00	
						5	49.00	
- grey by 5.9m depth						6	48.00	
						7	47.00	
						8	46.00	
						9	45.00	
9.75								
End of Borehole								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

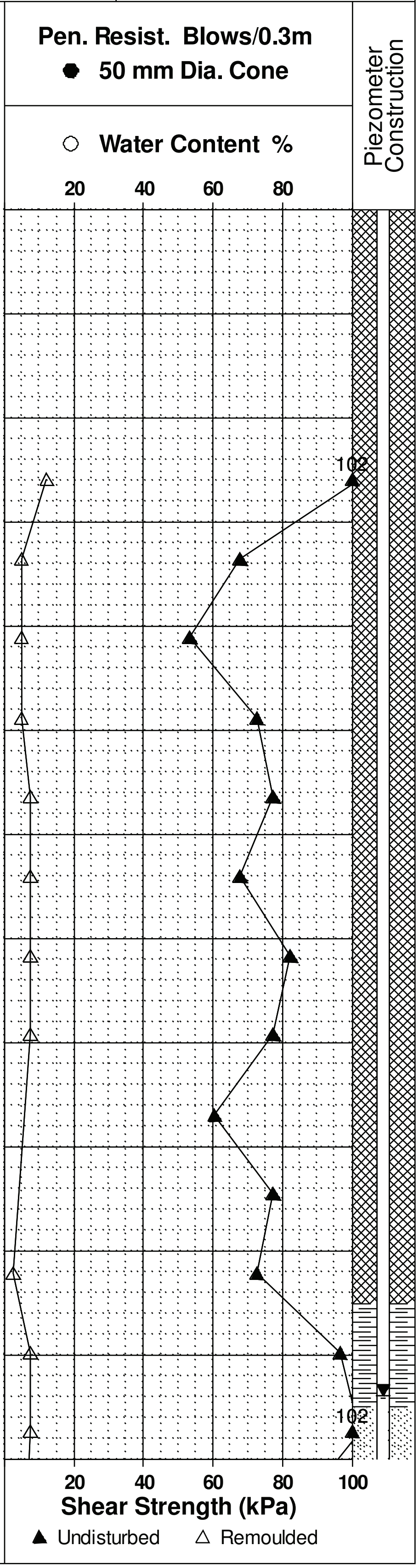
REMARKS

HOLE NO. **BH52-12**

BORINGS BY CME 55 Power Auger

DATE November 9, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	51.86
TOPSOIL 0.28	AU	1				
	AU	2				
	SS	3	100	8	1	50.86
	SS	4	100	6		
					2	49.86
					3	48.86
					4	47.86
					5	46.86
Very stiff to stiff, brown **SILTY CLAY**						
- grey by 6.6m depth					6	45.86
					7	44.86
					8	43.86
					9	42.86
					10	41.86
					11	40.86
					12	39.86



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

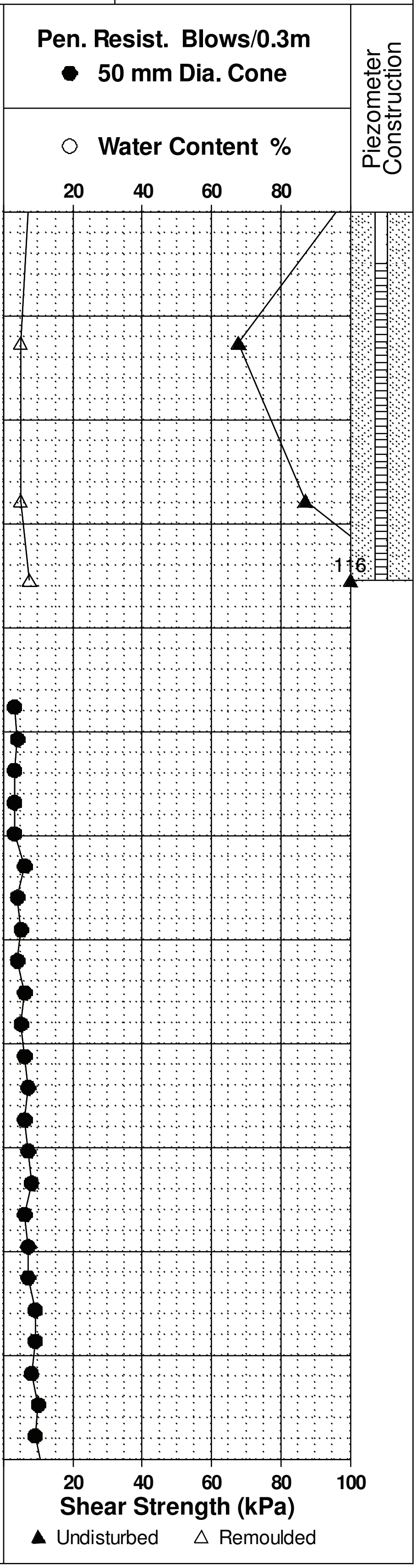
BORINGS BY CME 55 Power Auger

DATE November 9, 2012

FILE NO. PG1796

HOLE NO. BH52-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
						12	39.86
		TW	5	100			
						13	38.86
Stiff, grey **SILTY CLAY**							
		TW	6	100		14	37.86
						15	36.86
15.54							
Dynamic Cone Penetration Test commenced at 15.54m depth. Cone pushed to 16.5m depth.							
						16	35.86
						17	34.86
						18	33.86
						19	32.86
						20	31.86
						21	30.86
						22	29.86
						23	28.86
						24	27.86



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

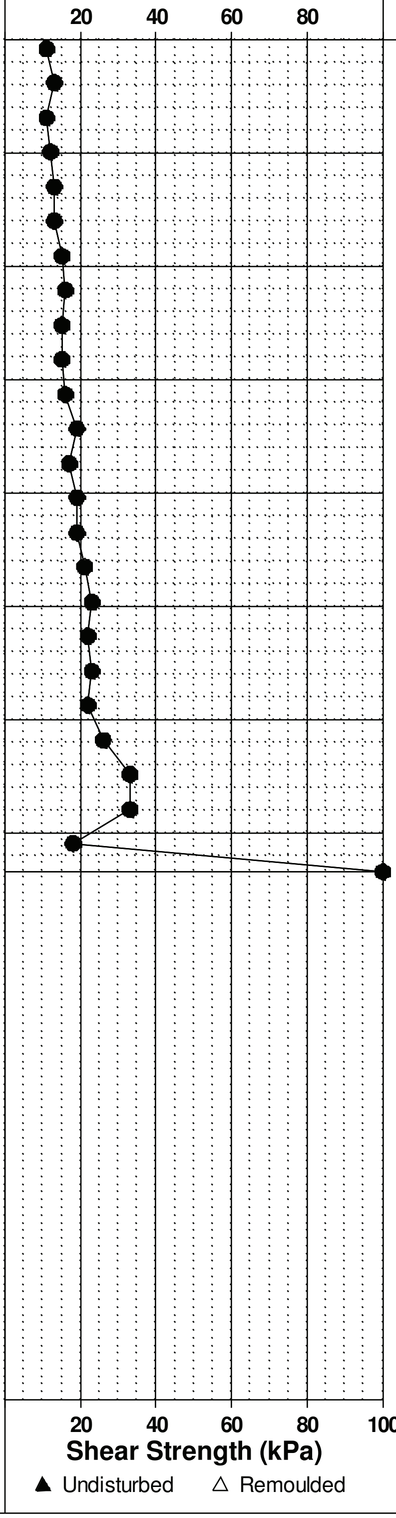
DATUM	Ground surface elevations provided by Stantec Geomatics Limited.	**FILE NO.**	**PG1796**
REMARKS		**HOLE NO.**	**BH52-12**
BORINGS BY	CME 55 Power Auger	**DATE**	November 9, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						24	27.86
						25	26.86
						26	25.86
						27	24.86
						28	23.86
						29	22.86
						30	21.86
						31	20.86
31.34							
End of Borehole Practical cone refusal at 31.34m depth. (GWL @ 11.39m-Dec. 6, 2012)							

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

○ Water Content %

Piezometer Construction



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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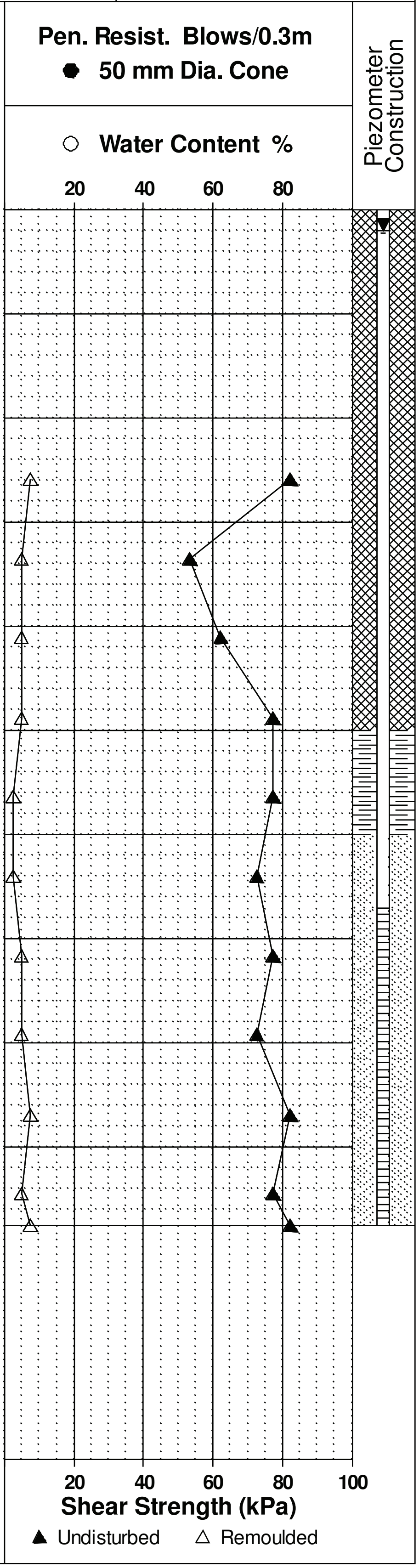
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.	**FILE NO.**	**PG1796**
REMARKS		**HOLE NO.**	**BH53-12**
BORINGS BY	CME 55 Power Auger	**DATE**	November 12, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	54.10
TOPSOIL 0.20	AU	1				
	AU	2				
	SS	3	100	10	1	53.10
	SS	4	100	6	2	52.10
					3	51.10
Very stiff to stiff, brown **SILTY CLAY**						
- grey-brown by 4.3m depth					4	50.10
					5	49.10
					6	48.10
					7	47.10
					8	46.10
					9	45.10
9.75						
End of Borehole						
(GWL @ 0.20m-Dec. 6, 2012)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

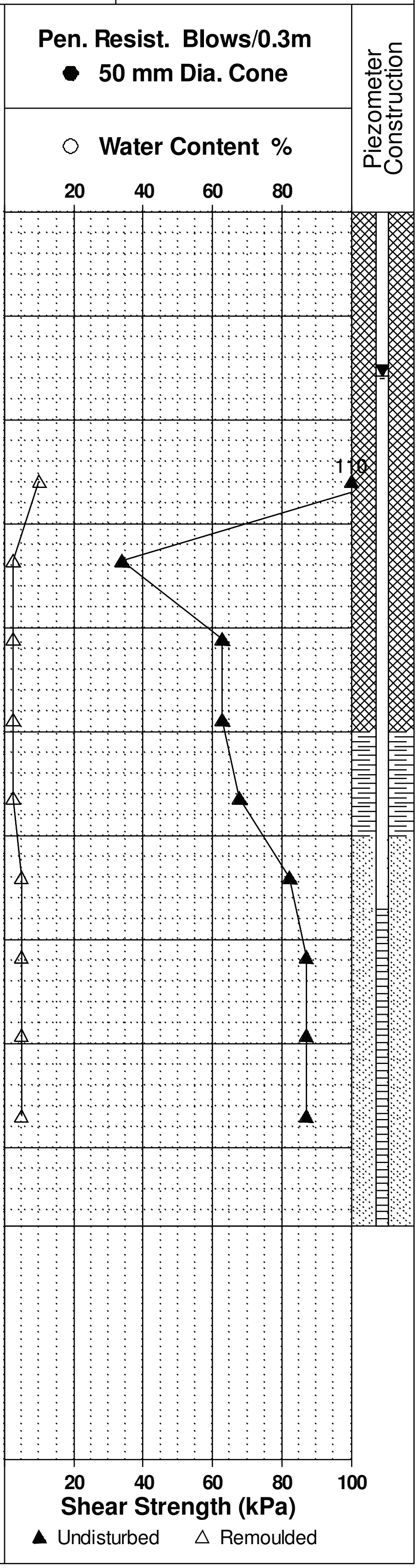
BORINGS BY CME 55 Power Auger

DATE November 13, 2012

FILE NO. PG1796

HOLE NO. BH54-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.79
TOPSOIL 0.30		AU	1				
		AU	2				
		SS	3	100	8	1	53.79
		SS	4	100	7	2	52.79
						3	51.79
Very stiff to stiff, brown **SILTY CLAY**						4	50.79
						5	49.79
						6	48.79
						7	47.79
- grey by 7.4m depth						8	46.79
						9	45.79
9.75 End of Borehole							
(GWL @ 1.58m-Dec. 6, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

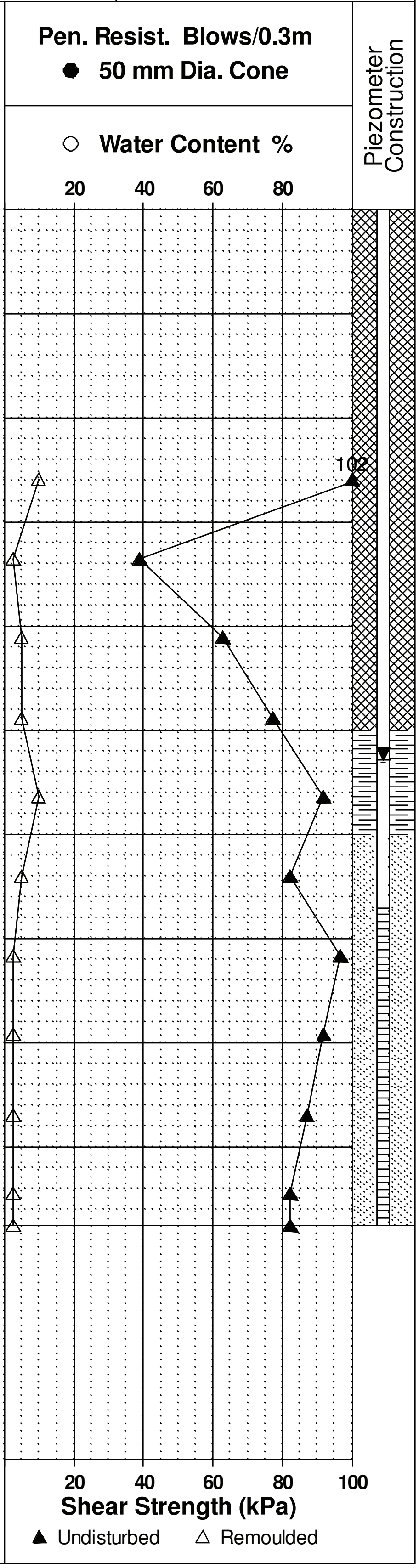
REMARKS

HOLE NO. BH55-12

BORINGS BY CME 55 Power Auger

DATE November 9, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.62
TOPSOIL 0.28		AU	1				
		AU	2				
		SS	3	100	6	1	53.62
		SS	4	100	7	2	52.62
						3	51.62
Very stiff to stiff, brown **SILTY CLAY**						4	50.62
- grey-brown by 5.1m depth						5	49.62
						6	48.62
						7	47.62
						8	46.62
						9	45.62
9.75							
End of Borehole							
(GWL @ 5.28m-Dec. 6, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

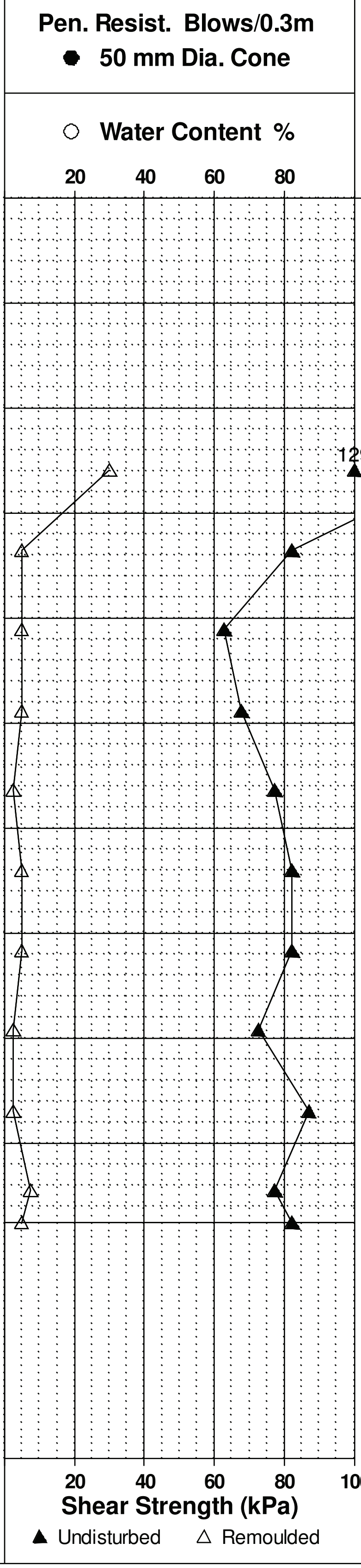
BORINGS BY CME 55 Power Auger

DATE November 13, 2012

FILE NO. **PG1796**

HOLE NO. **BH56-12**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.02
TOPSOIL 0.30							
		SS	1	100	10	1	53.02
		SS	2		7		
						2	52.02
						3	51.02
Very stiff to stiff, brown **SILTY CLAY**						4	50.02
						5	49.02
						6	48.02
						7	47.02
- grey by 7.4m depth							
						8	46.02
						9	45.02
9.75 End of Borehole							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

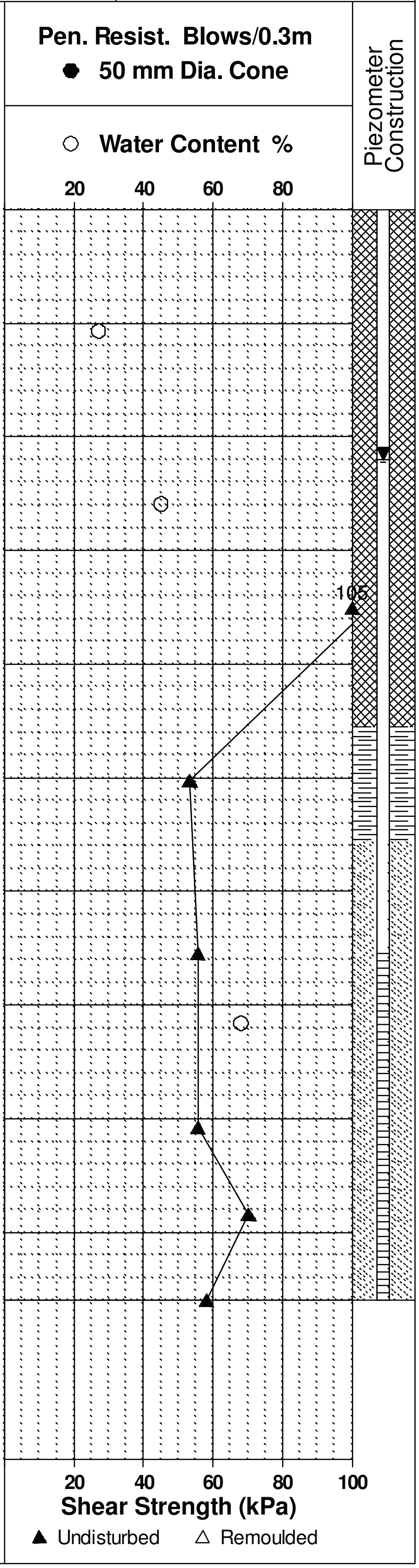
DATE February 4, 2013

FILE NO. PG1796

HOLE NO. BH57-12

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.15				
FILL: Crushed stone with sand	0.41	AU	1		
FILL: Brown silty sand with gravel	0.69	AU	2		
Very stiff to stiff, brown **SILTY CLAY** - grey by 5.2m depth	9.60	SS	3	100	18
		SS	4	83	17
		SS	5	100	8
		SS	6	100	2
		SS	7	100	W
		SS	8	100	W
End of Borehole (GWL @ 2.20m-Mar. 27, 2013)					

DEPTH (m)	ELEV. (m)
0	54.83
1	53.83
2	52.83
3	51.83
4	50.83
5	49.83
6	48.83
7	47.83
8	46.83
9	45.83



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Proposed Residential Development - Queen Street
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REMARKS

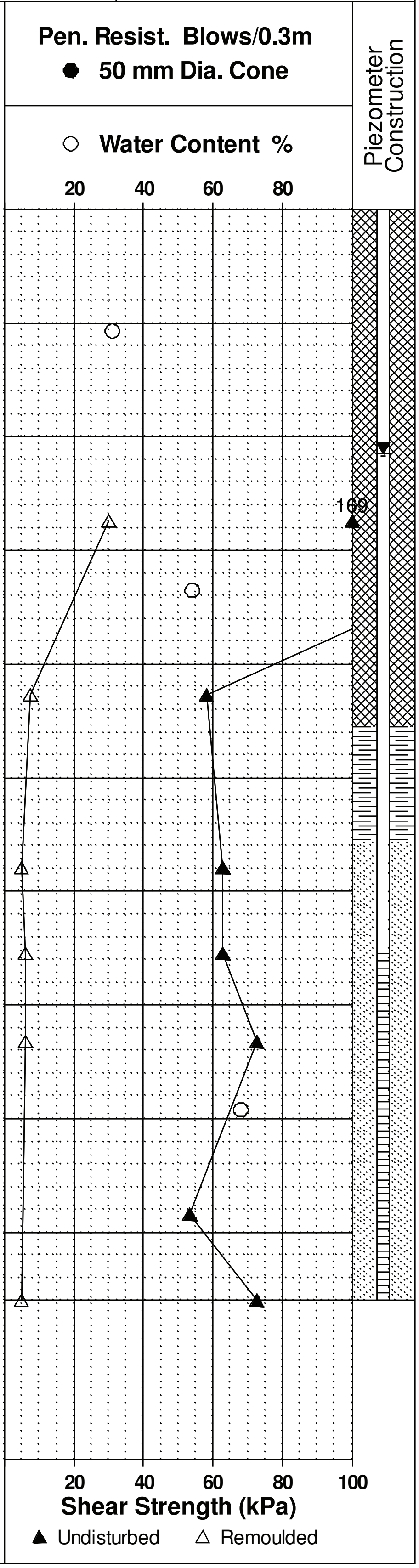
BORINGS BY CME 55 Power Auger

DATE February 4, 2013

FILE NO. PG1796

HOLE NO. BH58-12

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	56.13
Asphaltic concrete	0.18						
FILL: Crushed stone with sand	0.41	AU	1				
FILL: Brown silty sand with gravel	0.69	AU	2				
						1	55.13
		SS	3	58	21		
		SS	4	100	7		
						2	54.13
Very stiff to stiff, brown **SILTY CLAY**						3	53.13
		SS	5	100	4		
- grey-brown by 3.7m depth							
						4	52.13
		SS	6	100	2		
						5	51.13
						6	50.13
						7	49.13
		SS	7	100	W		
						8	48.13
- grey by 8.3m depth							
						9	47.13
	9.60						
End of Borehole							
(GWL @ 2.15m-Mar. 27, 2013)							



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REMARKS

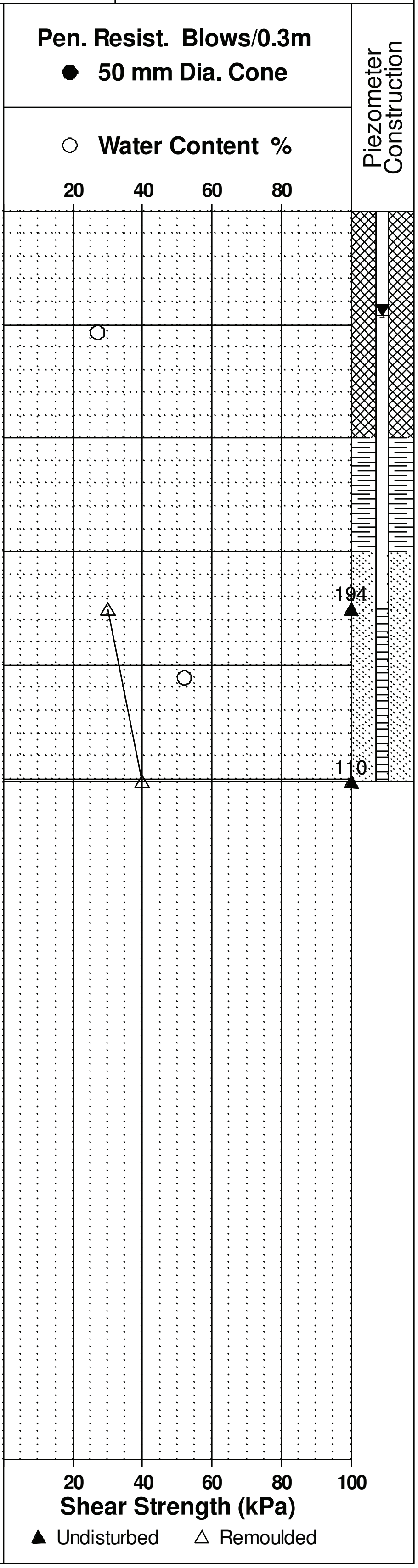
BORINGS BY CME 55 Power Auger

DATE February 6, 2013

FILE NO. PG1796

HOLE NO. BH59-12

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	66.88
Asphaltic concrete 0.20						
FILL: Crushed stone with sand 0.38	AU	1				
FILL: Brown silty sand with gravel 0.69	AU	2				
	SS	3	50	13	1	65.88
	SS	4	100	16		
					2	64.88
Very stiff, brown **SILTY CLAY**	SS	4	100	8		
					3	63.88
	SS	6	100	4	4	62.88
5.03					5	61.88
End of Borehole						
(GWL @ 0.92m-Mar. 27, 2013)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

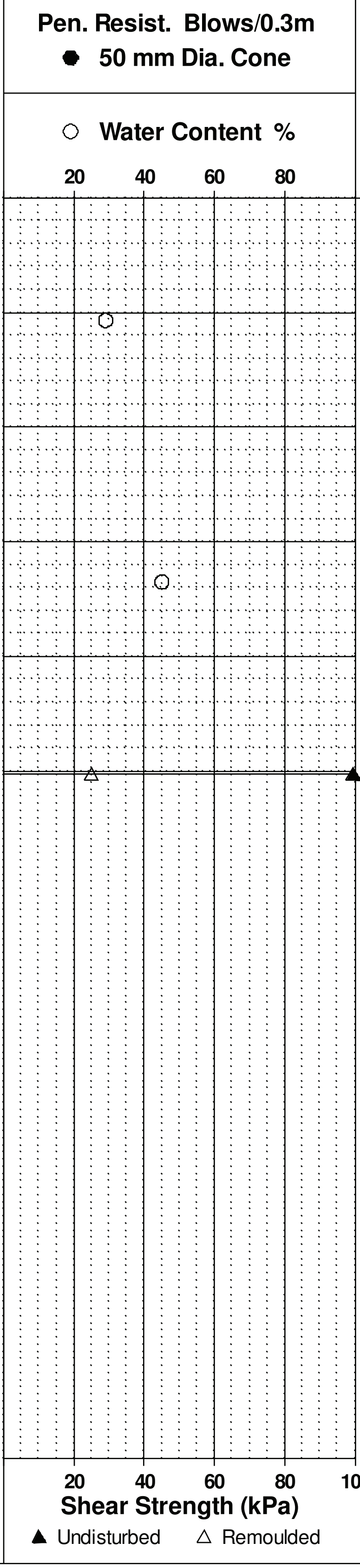
BORINGS BY CME 55 Power Auger

DATE February 6, 2013

FILE NO. PG1796

HOLE NO. BH60-12

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	67.40
Asphaltic concrete 0.20						
FILL: Crushed stone with sand 0.38						
FILL: Brown silty sand with gravel 0.69						
	SS	1	83	55	1	66.40
	SS	2	100	16	2	65.40
Very stiff to stiff, brown **SILTY CLAY**	SS	3	100	14	3	64.40
	SS	4	100	8		
	SS	5	100	4	4	63.40
5.03					5	62.40
End of Borehole (BH dry upon completion)						



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Geotechnical Investigation
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Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE February 6, 2013

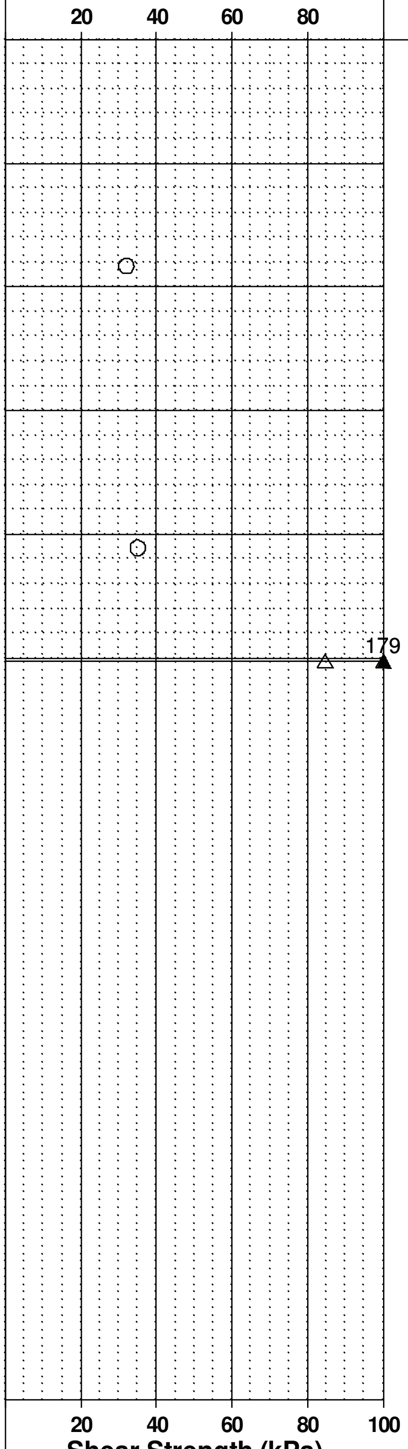
FILE NO. PG1796

HOLE NO. BH61-12

SOIL DESCRIPTION		SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	67.67
Asphaltic concrete	0.20						
FILL: Crushed stone with sand	0.38	AU	1				
FILL: Brown silty sand with gravel	0.69	AU	2				
Very stiff, brown **SILTY CLAY**		SS	3	83	8	1	66.67
		SS	4	100	16	2	65.67
		SS	5	100	13	3	64.67
		SS	6	100	7		
		SS	7	100	8	4	63.67
	5.03					5	62.67
End of Borehole (BH dry upon completion)							

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

○ Water Content %



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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REMARKS

BORINGS BY CME 55 Power Auger

DATE February 6, 2013

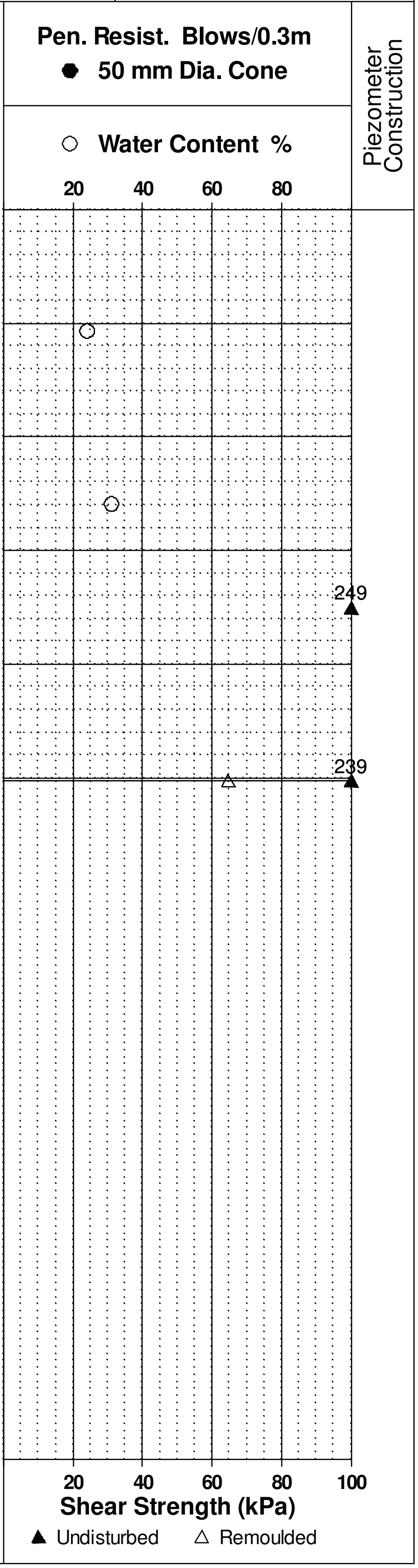
FILE NO. PG1796

HOLE NO. BH62-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.18				
FILL: Brown silty sand with gravel	0.66	AU	1		
		AU	2		
Hard, brown **SILTY CLAY**		SS	3	100	12
		SS	4	100	18
		SS	5	100	12
		SS	6	100	9
	5.03				
End of Borehole					
(BH dry upon completion)					

DEPTH (m)	ELEV. (m)
0	67.55
1	66.55
2	65.55
3	64.55
4	63.55
5	62.55

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



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REMARKS

BORINGS BY CME 55 Power Auger

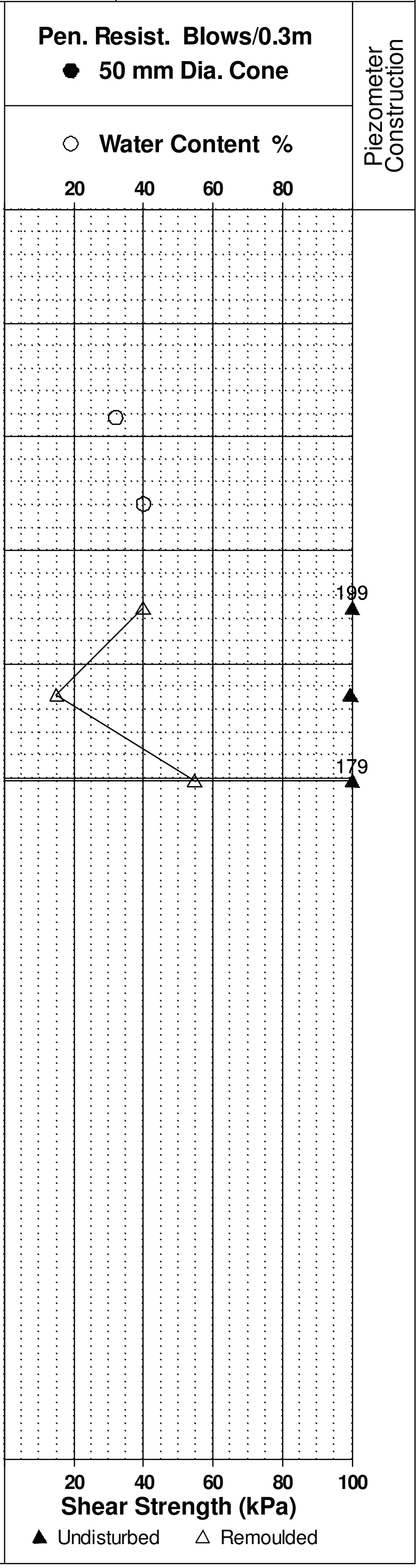
DATE February 6, 2013

FILE NO. PG1796

HOLE NO. BH63-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
FILL: Brown silty sand with gravel		AU	1		
0.51					
Very stiff, brown **SILTY CLAY**		SS	2	8	16
		SS	3	100	15
		SS	4	100	7
5.03					
End of Borehole					
(BH dry upon completion)					

DEPTH (m)	ELEV. (m)
0	65.40
1	64.40
2	63.40
3	62.40
4	61.40
5	60.40



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REMARKS

BORINGS BY CME 55 Power Auger

DATE February 5, 2013

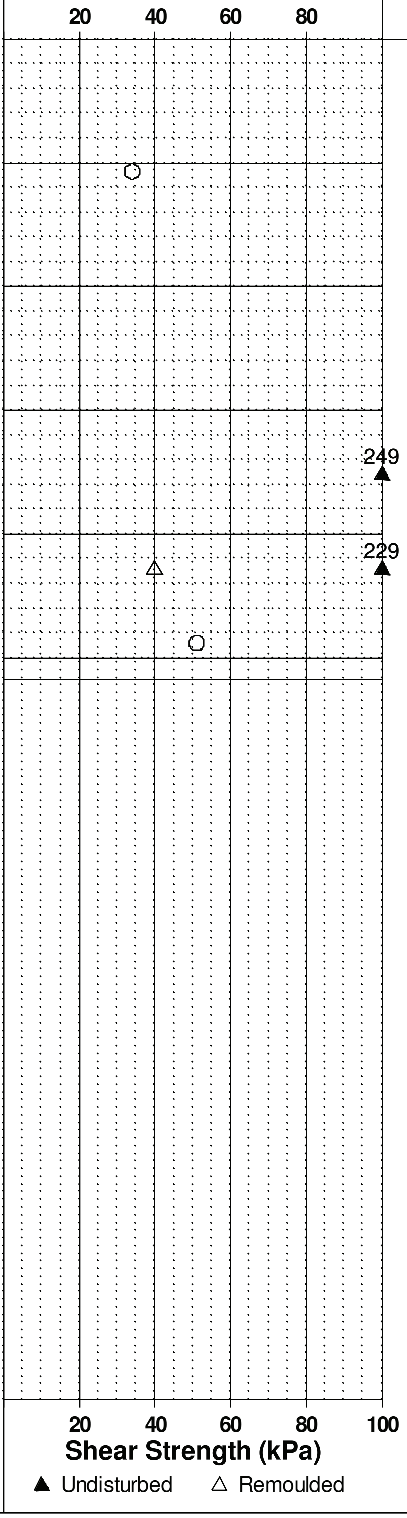
FILE NO. PG1796

HOLE NO. BH64-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	63.98
FILL: Crushed stone with sand — 0.30	▨	AU	1				
FILL: Brown silty sand with gravel	▨	AU	2				
	▨	SS	3	12	15	1	62.98
— 1.45							
Hard, brown **SILTY CLAY**	▨	SS	4	100	14	2	61.98
	▨	SS	5	100	5		
						3	60.98
						4	59.98
	▨	SS	6	100	2	5	58.98
— 5.18							
End of Borehole							
(BH dry upon completion)							

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

○ Water Content %



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

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REMARKS

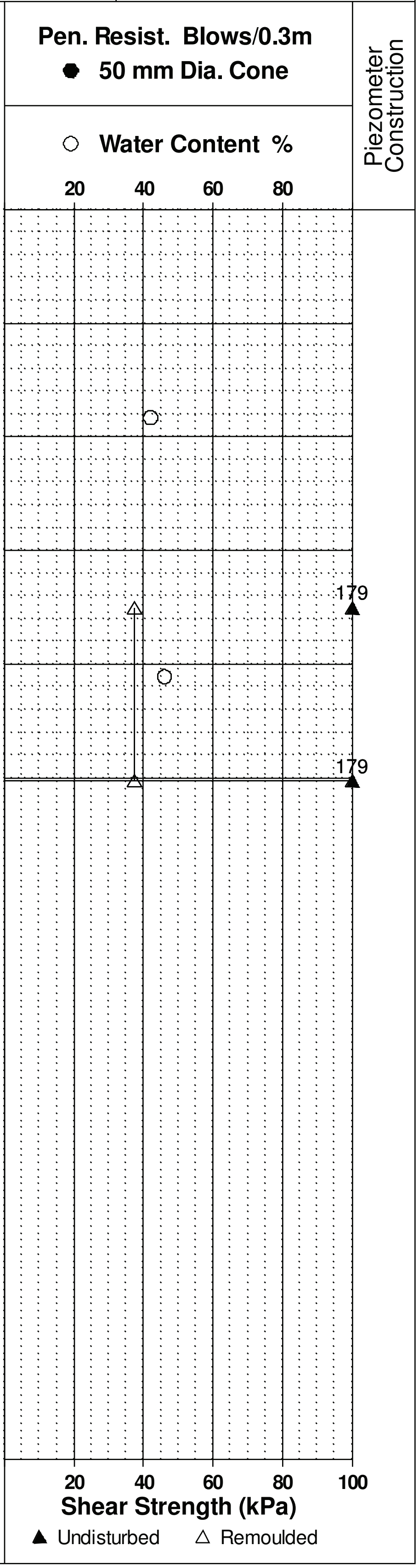
BORINGS BY CME 55 Power Auger

DATE February 6, 2013

FILE NO. PG1796

HOLE NO. BH65-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	60.63
Asphaltic concrete 0.18							
FILL: Brown silty sand with gravel		AU	1				
0.71		AU	2				
		SS	3	42	14	1	59.63
		SS	4	100	7	2	58.63
Very stiff, brown **SILTY CLAY**		SS	5	100	4	3	57.63
		SS	6	100	6	4	56.63
5.03						5	55.63
End of Borehole (BH dry upon completion)							



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REMARKS

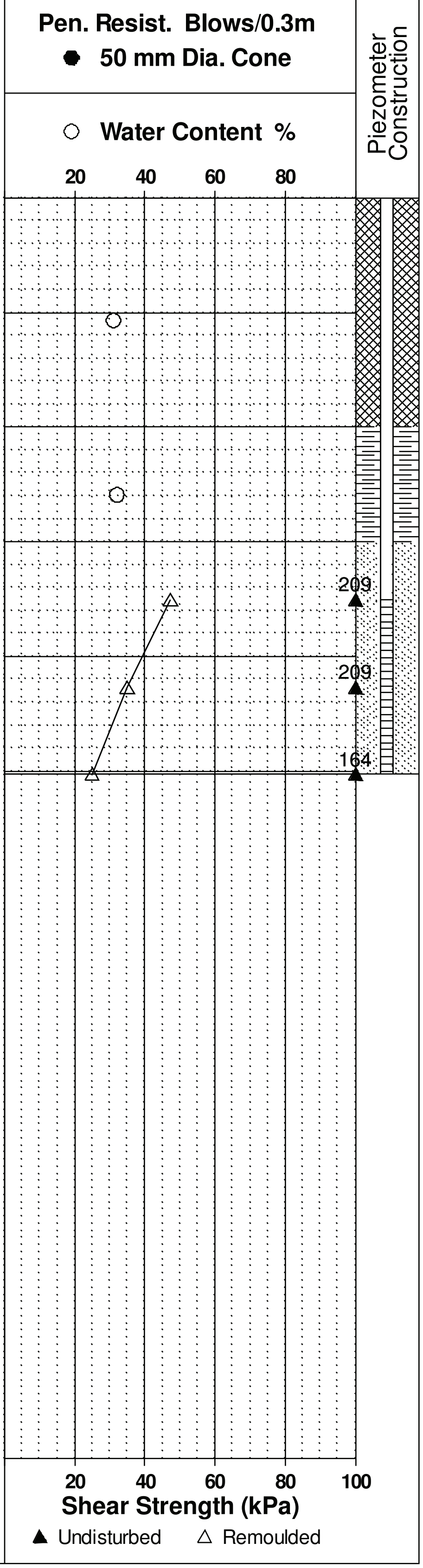
BORINGS BY CME 55 Power Auger

DATE February 5, 2013

FILE NO. PG1796

HOLE NO. BH66-12

SOIL DESCRIPTION		SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	60.60
Asphaltic concrete	0.18						
FILL: Crushed stone with sand	0.36	AU	1				
FILL: Brown silty sand with gravel	0.86	AU	2				
Hard to very stiff, brown **SILTY CLAY**		SS	3	58	21	1	59.60
		SS	4	71	9	2	58.60
		SS	5	100	12	3	57.60
						4	56.60
	5.03					5	55.60
End of Borehole							
(BH dry upon completion)							



SOIL PROFILE AND TEST DATA

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FILE NO. **PG1796**

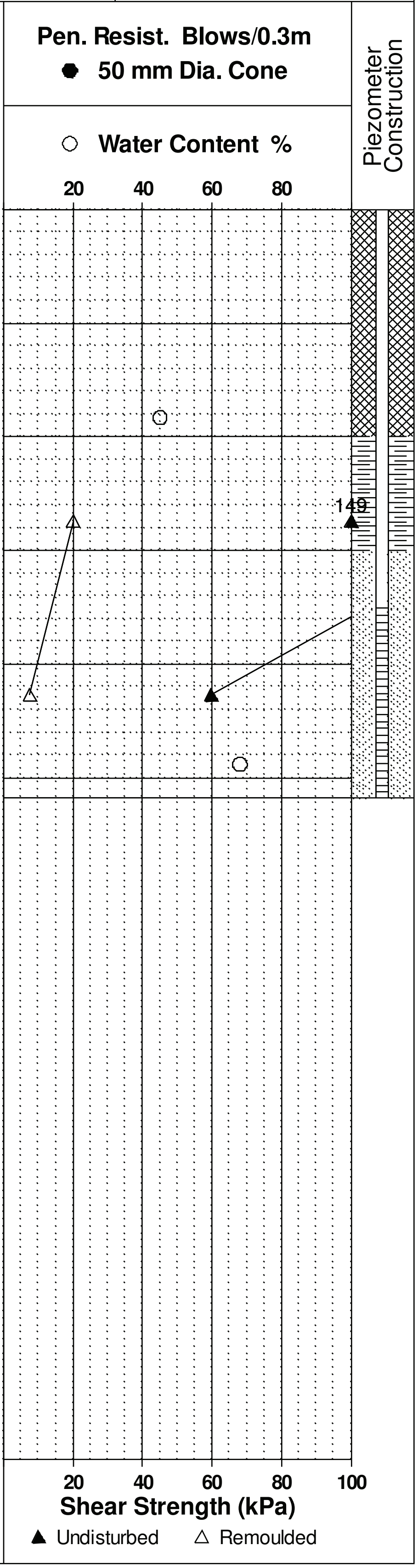
REMARKS

HOLE NO. **BH67-12**

BORINGS BY CME 55 Power Auger

DATE February 5, 2013

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	67.29
Asphaltic concrete 0.20						
FILL: Crushed stone with sand 0.36	AU	1				
FILL: Brown silty sand with gravel 0.60	AU	2				
	SS	3	83	11	1	66.29
	SS	4	100	5	2	65.29
Very stiff to stiff, brown **SILTY CLAY**					3	64.29
	SS	5	100	3	4	63.29
- grey-brown by 4.4m depth						
5.18	SS	6	100	2	5	62.29
End of Borehole						



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REMARKS

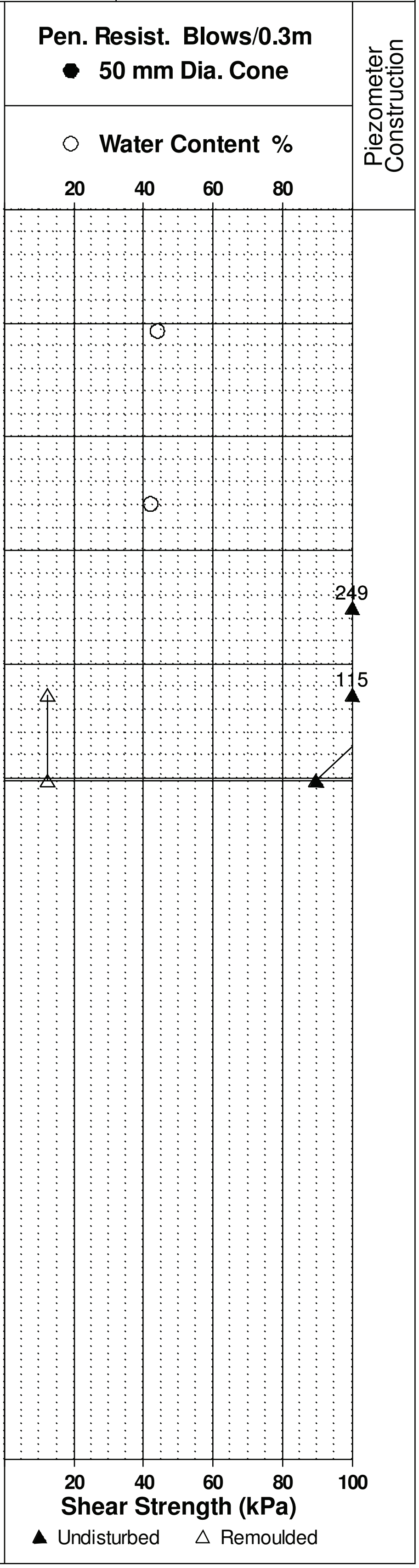
BORINGS BY CME 55 Power Auger

DATE February 5, 2013

FILE NO. PG1796

HOLE NO. BH68-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	70.35
Asphaltic concrete 0.20							
FILL: Crushed stone with sand 0.46		AU	1				
FILL: Brown silty sand with gravel 0.68		AU	2				
FILL: Brown silty clay with gravel 0.91							
		SS	3	25	12	1	69.35
		SS	4	100	11	2	68.35
Hard to very stiff, brown **SILTY CLAY**		SS	5	100	12		
						3	67.35
						4	66.35
- stiff by 4.4m depth							
5.03						5	65.35
End of Borehole (BH dry upon completion)							



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REMARKS

BORINGS BY CME 55 Power Auger

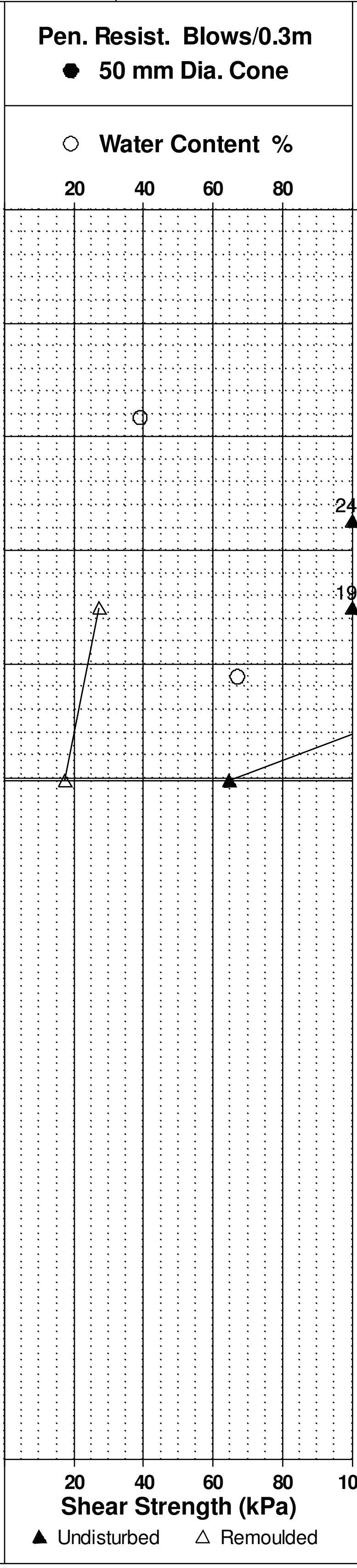
DATE February 5, 2013

FILE NO. PG1796

HOLE NO. BH69-12

SOIL DESCRIPTION	Depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.20				
FILL; Crushed stone with sand	0.33	AU	1		
FILL: Brown silty sand with gravel	0.69	AU	2		
Hard to very stiff, brown **SILTY CLAY** - stiff by 3.8m depth		SS	3	75	18
		SS	4	100	13
	5.03	SS	5	100	3
End of Borehole (BH dry upon completion)					

DEPTH (m)	ELEV. (m)
0	71.21
1	70.21
2	69.21
3	68.21
4	67.21
5	66.21



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REMARKS

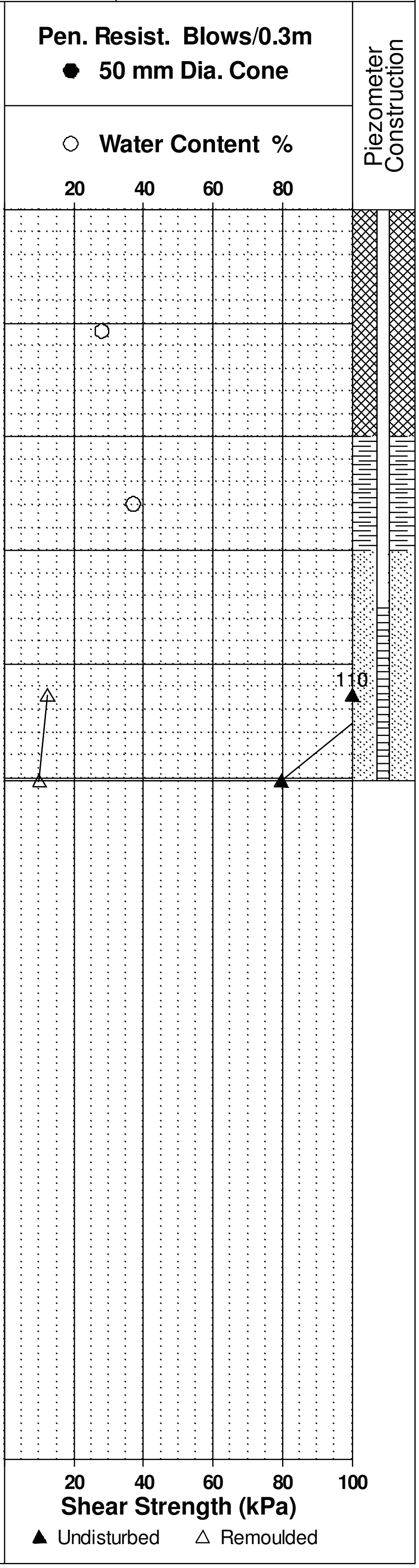
BORINGS BY CME 55 Power Auger

DATE February 5, 2013

FILE NO. PG1796

HOLE NO. BH70-12

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	72.78
Asphaltic concrete 0.18						
FILL: Crushed stone with sand 0.38	AU	1				
FILL: Brown silty sand with gravel 0.79	AU	2				
	SS	3	58	11	1	71.78
	SS	4	100	20	2	70.78
Very stiff to stiff, brown **SILTY CLAY**	SS	5	100	12		
	SS	6	100	9	3	69.78
					4	68.78
5.03					5	67.78
End of Borehole (BH dry upon completion)						



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SOIL PROFILE AND TEST DATA

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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

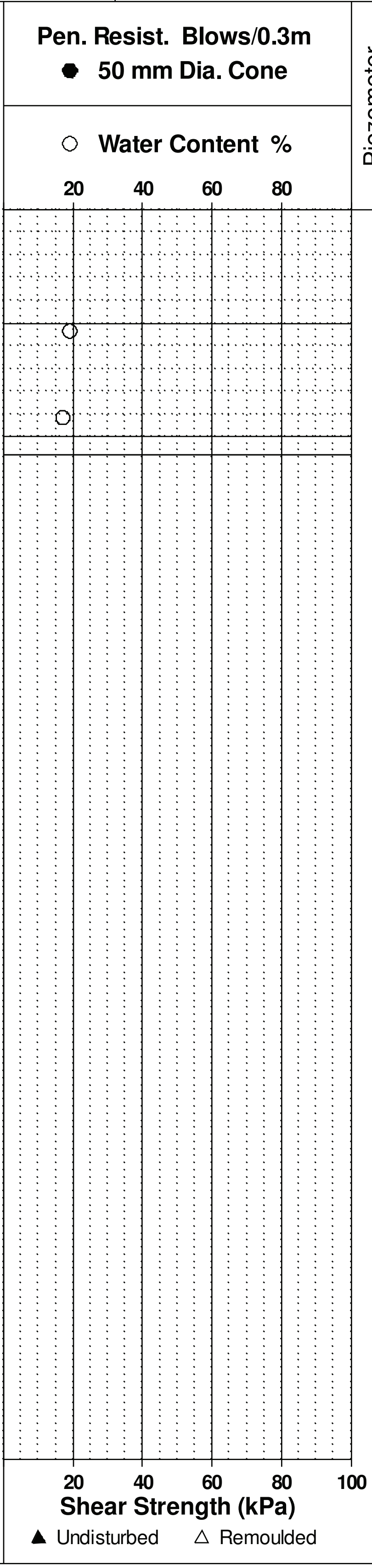
BORINGS BY CME 55 Power Auger

DATE February 4, 2013

FILE NO. PG1796

HOLE NO. BH71-12

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	75.79
Asphaltic concrete — 0.20						
FILL: Crushed stone with sand — 0.38	AU	1				
	AU	2				
FILL: Brown silty sand with gravel — 1.45	SS	3		15	1	74.79
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles, boulders — 2.16	SS	4		40	2	73.79
End of Borehole Practical refusal to augering at 2.16m depth (BH dry upon completion)						



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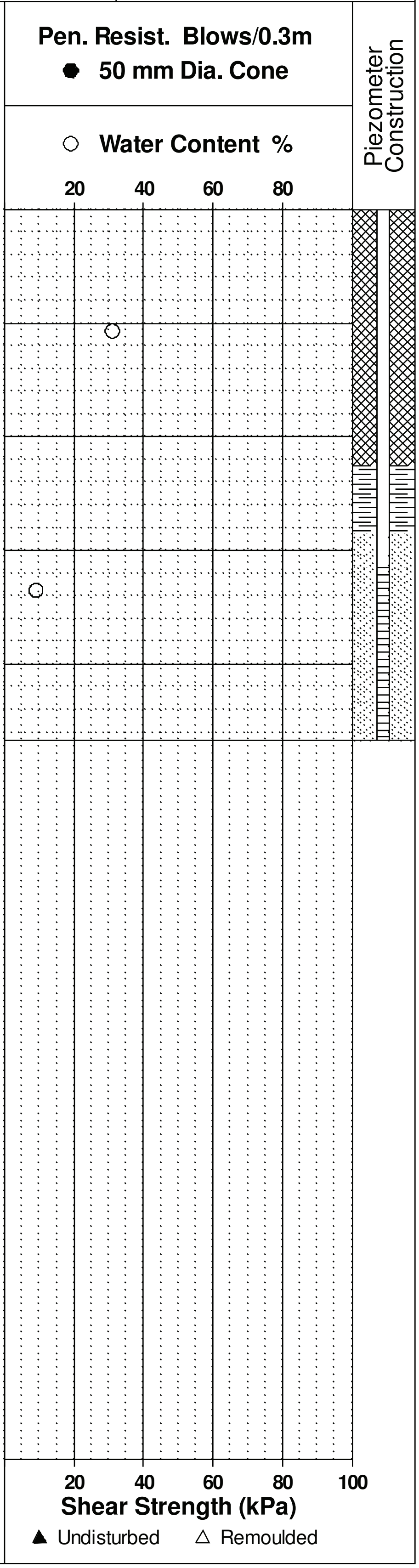
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.
REMARKS	
BORINGS BY	CME 55 Power Auger
DATE	February 4, 2013
FILE NO.	**PG1796**
HOLE NO.	**BH72-12**

SOIL DESCRIPTION		SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.20				
FILL: Crushed stone with sand	0.38	AU	1		
FILL: Brown silty sand with gravel	0.69	AU	2		
Stiff, brown **SILTY CLAY**	1.45	SS	3	50	23
GLACIAL TILL: Brown silty clay with sand, gravel, trace cobbles	2.20	SS	4	67	13
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders		SS	5	43	50+
		SS	6	83	27
	4.67	SS	7		50+
End of Borehole					
(BH dry upon completion)					

DEPTH (m)	ELEV. (m)
0	77.23
1	76.23
2	75.23
3	74.23
4	73.23



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 31, 2013

FILE NO. PG1796

HOLE NO. BH73-12

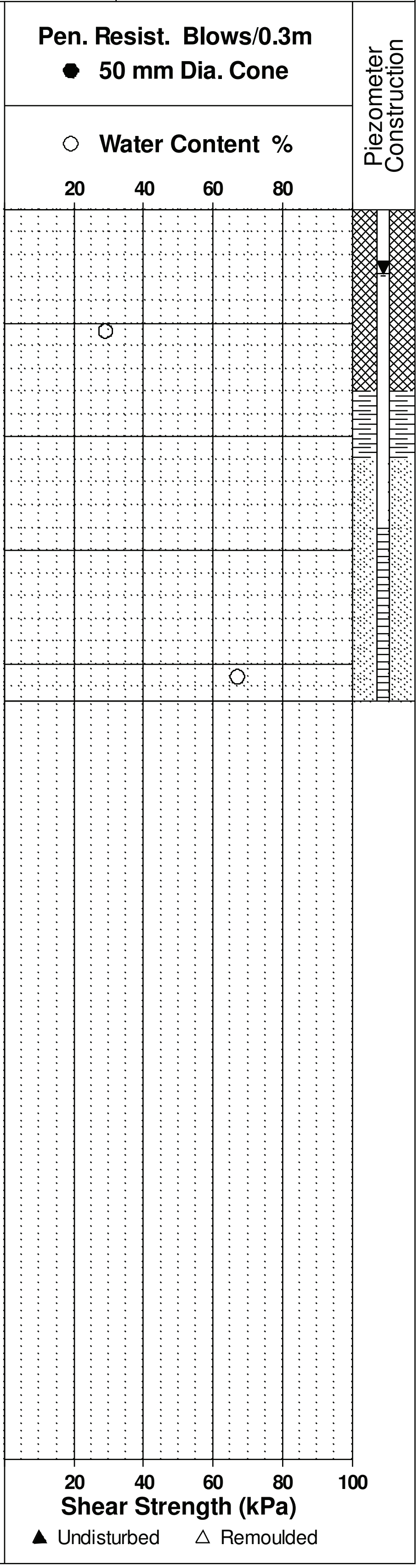
SOIL DESCRIPTION	Depth to base (m)	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
FILL: Crushed stone with sand	0.33	AU	1		
FILL: Brown silty sand with clay and gravel	0.69	AU	2		
Very stiff to stiff, brown **SILTY CLAY**	2.90	SS SS SS	3 4 5	33 83 100	9 13 18
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders	3.73	SS	6	67	10
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders, trace clay	4.32	SS	7		21

End of Borehole

Practical refusal to augering at 4.32m depth

(GWL @ 0.56m-Mar. 27, 2013)

DEPTH (m)	ELEV. (m)
0	80.21
1	79.21
2	78.21
3	77.21
4	76.21



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SOIL PROFILE AND TEST DATA

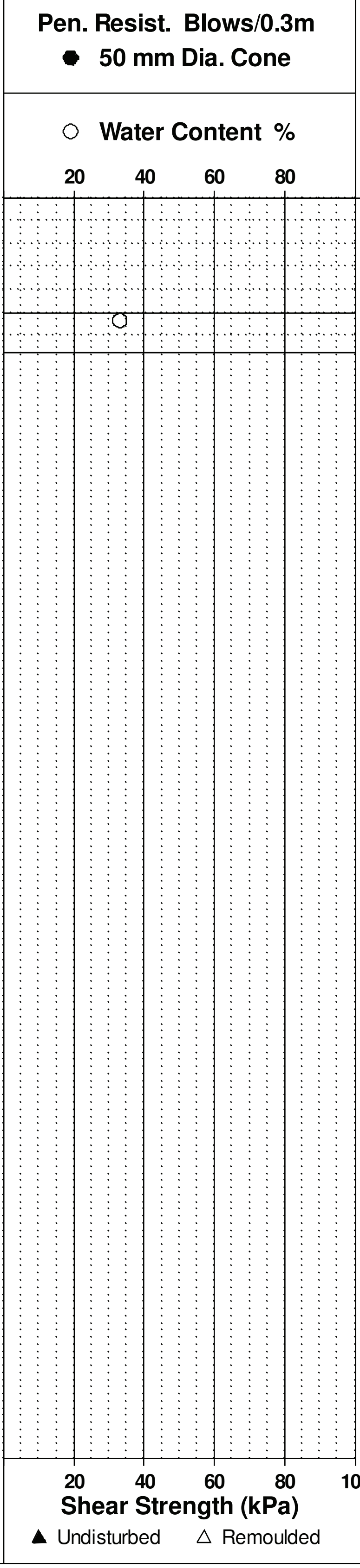
Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.
REMARKS	
BORINGS BY	CME 55 Power Auger
DATE	January 31, 2013
FILE NO.	**PG1796**
HOLE NO.	**BH74-12**

SOIL DESCRIPTION	Depth to base (m)	STRATA PLOT
GROUND SURFACE		
FILL: Crushed stone with sand	0.30	▨
FILL: Brown silty sand with gravel	0.69	▨
Very stiff, brown **SILTY CLAY**	0.99	▨
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders	1.35	^^^
End of Borehole Practical refusal to augering at 1.35m depth (BH dry upon completion)		

SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
SS	1	80	15

DEPTH (m)	ELEV. (m)
0	81.02
1	80.02



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE February 1, 2013

FILE NO. PG1796

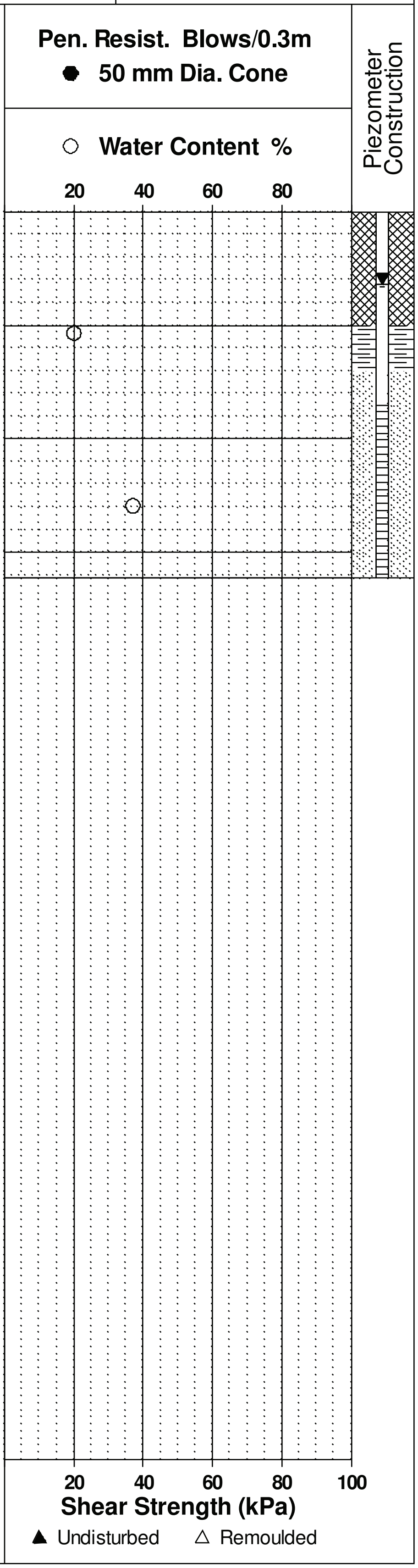
HOLE NO. BH75-12

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	83.02
Asphaltic concrete 0.20						
FILL: Crushed stone with sand 0.51	AU	1				
FILL: Brown silty sand with gravel 0.81	AU	2				
Compact, brown **SILTY SAND** with gravel 1.45	SS	3	50	10	1	82.02
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders 3.22	SS	4	100	50+		
	SS	5	0	50+	2	81.02
					3	80.02

End of Borehole

Practical refusal to augering at 3.22m depth

(GWL @ 0.64m-Mar. 27, 2013)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE February 1, 2013

FILE NO. PG1796

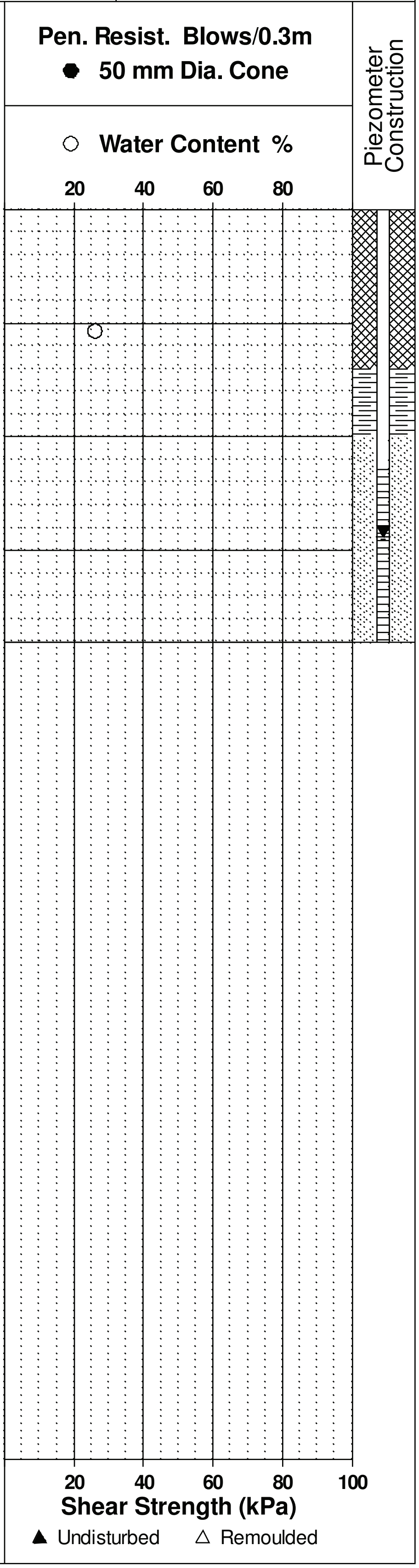
HOLE NO. BH76-12

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	87.83
Asphaltic concrete 0.20						
FILL: Crushed stone with sand 0.46	AU	1				
FILL: Brown silty sand with gravel 0.69	AU	2				
Loose, brown **SILTY SAND** with gravel, trace cobbles	SS	3	83	6	1	86.83
1.45	SS	4	100	50+		
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders, trace clay					2	85.83
	SS	5	50	1		
- brown silty clay matrix from 1.8 to 3.0m depth					3	84.83
	SS	6	77	50+		
3.81						

End of Borehole

Practical refusal to augering at 3.81m depth

(GWL @ 2.88m-Mar. 27, 2013)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE February 1, 2013

FILE NO. PG1796

HOLE NO. BH77-12

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									
FILL: Crushed stone with sand 0.28	▨	AU	1			0	88.17		
FILL: Brown silty sand with gravel 0.69	▨	AU	2						
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders	^^^	SS	3	33	15	1	87.17		
	^^^	SS	4	0	14	2	86.17		
2.26									
End of Borehole Practical refusal to augering at 2.26m depth									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

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FILE NO. PG1796

REMARKS

HOLE NO. BH77A-12

BORINGS BY CME 55 Power Auger

DATE February 1, 2013

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						0	88.17		
OVERBURDEN						1	87.17		
						2	86.17		
2.21									
End of Borehole Practical refusal to augering at 2.21m depth									

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

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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
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REMARKS

BORINGS BY CME 55 Power Auger

DATE February 1, 2013

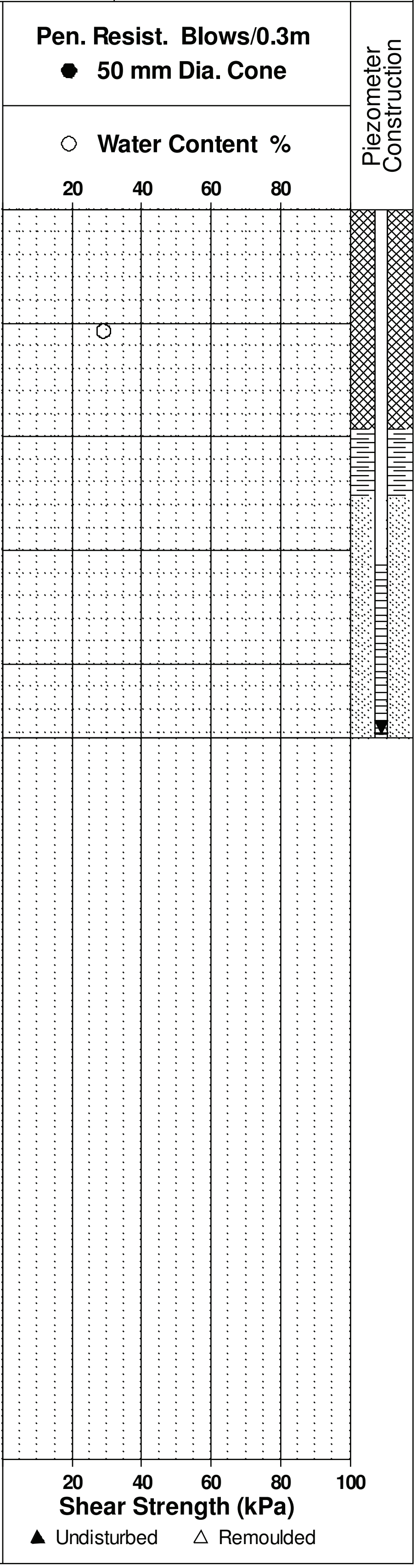
FILE NO. PG1796

HOLE NO. BH78-12

SOIL DESCRIPTION	STRATA DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	91.80
FILL: Crushed stone	0.30	AU	1				
FILL: Brown silty sand with gravel	0.69	AU	2				
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders	1.75	SS	3	25	3	1	90.80
						2	89.80
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders		SS	4		50+		
		SS	5	100	50+	3	88.80
						4	87.80
	4.65	SS	6	0	50+		

End of Borehole

(GWL @ 2.88m-Mar. 27, 2013)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE February 1, 2013

FILE NO. PG1796

HOLE NO. BH79-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	94.45
FILL: Crushed stone 0.28							
FILL: Brown silty sand with gravel 0.69		AU	1				
GLACIAL TILL: Brown silty sand with gravel, trace clay and organics		SS	2	50	8	1	93.45
1.68		SS	3	100	50+		
End of Borehole Practical refusal to augering at 1.68m depth (BH dry upon completion)							

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

○ **Water Content %**

20 40 60 80

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

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

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REMARKS

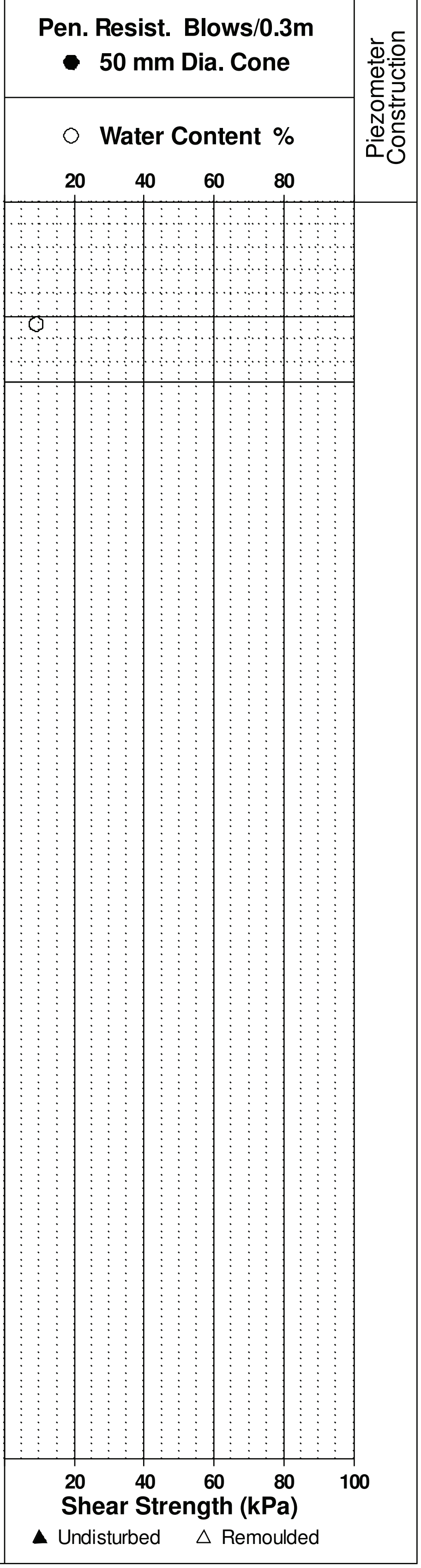
BORINGS BY CME 55 Power Auger

DATE January 31, 2013

FILE NO. PG1796

HOLE NO. BH80-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	96.02
FILL: Crushed stone 0.30		AU	1				
FILL: Brown silty sand with gravel, cobbles, clay 1.07		AU	2				
		SS	3	38	20	1	95.02
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders 1.58		SS	4	100	50+		
End of Borehole Practical refusal to augering at 1.58m depth (BH dry upon completion)							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

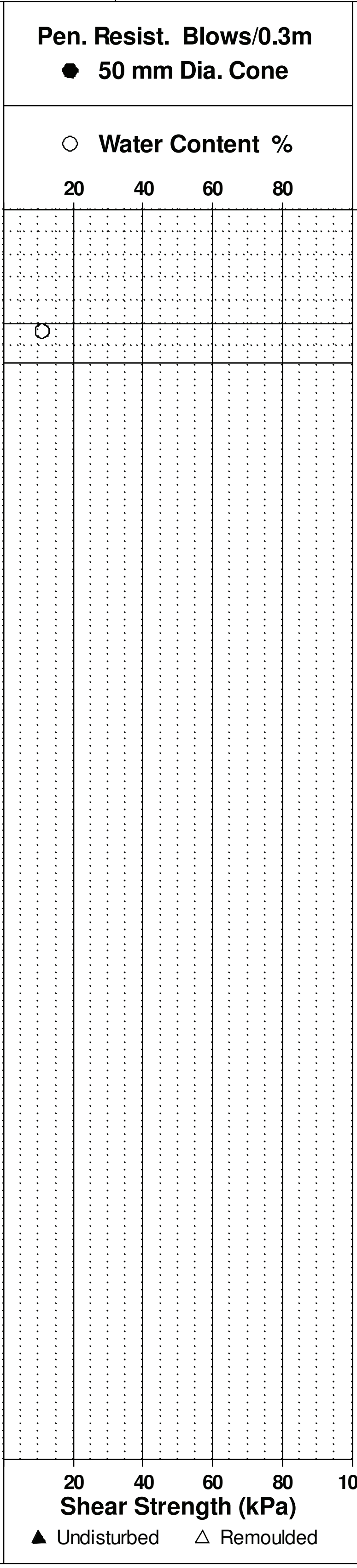
BORINGS BY CME 55 Power Auger

DATE February 1, 2013

FILE NO. PG1796

HOLE NO. BH81-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	95.77	
FILL: Crushed stone with sand 0.30	▨	AU	1					
FILL: Brown silty sand with gravel 0.69	▨	AU	2					
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders, trace clay 1.35	^	SS	3	57	15	1	94.77	
End of Borehole Practical refusal to augering at 1.35m depth (Piezometer damaged - March 27, 2013)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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FILE NO. PG1796

REMARKS

HOLE NO. BH81A-12

BORINGS BY CME 55 Power Auger

DATE February 1, 2013

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						0	95.77		
OVERBURDEN						1	94.77		
1.35									
End of Borehole Practical refusal to augering at 1.35m depth									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

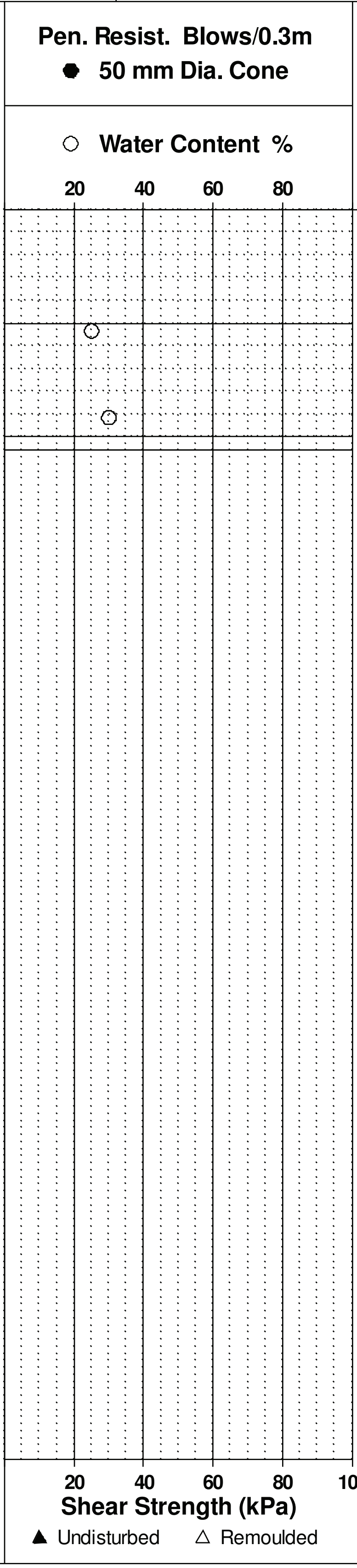
BORINGS BY CME 55 Power Auger

DATE January 31, 2013

FILE NO. PG1796

HOLE NO. BH82-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	95.86	
FILL: Crushed stone with gravel — 0.30		AU	1					
FILL: Brown silty sand with gravel — 1.45		SS	2	58	31	1	94.86	
GLACIAL TILL: Brown silty sand with gravel, trace clay — 2.11		SS	3	78	31	2	93.86	
End of Borehole Practical refusal to augering at 2.11m depth (BH dry upon completion)								



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 31, 2013

FILE NO. PG1796

HOLE NO. BH82A-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	95.86		
OVERBURDEN						1	94.86		
1.52									
End of Borehole Practical refusal to augering at 1.52m depth									

Water Content %: 20 40 60 80

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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FILE NO. **PG1796**

REMARKS

HOLE NO. **BH83-13**

BORINGS BY CME 55 Power Auger

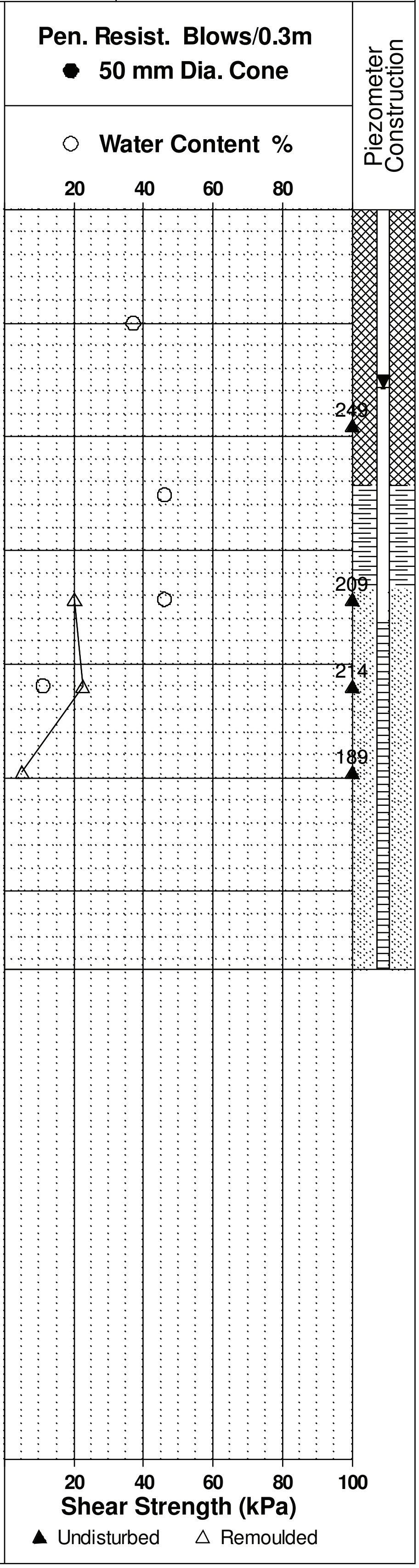
DATE February 13, 2013

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	62.40
TOPSOIL 0.18	AU	1				
Hard to very stiff, brown **SILTY CLAY**	SS	2	62	10	1	61.40
					2	60.40
	SS	3	100	13		
					3	59.40
					4	58.40
5.20					5	57.40
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders	SS	4		30		
	SS	5	0	50+	6	56.40
6.68						

End of Borehole

Practical refusal to augering at 6.68m depth

(GWL @ 1.56m-Mar. 27, 2013)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

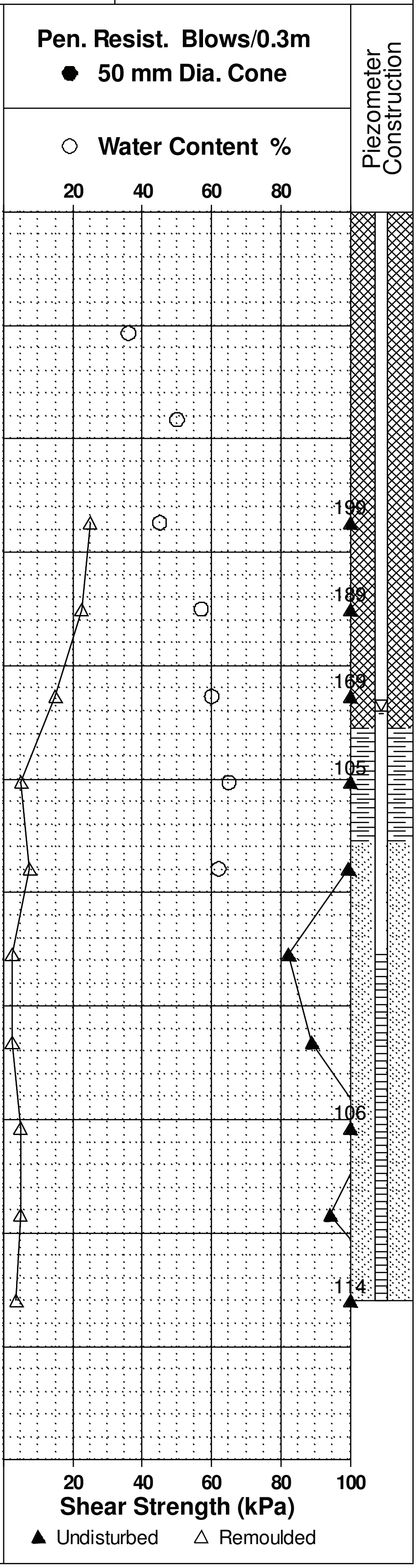
REMARKS

HOLE NO. BH84-13

BORINGS BY CME 55 Power Auger

DATE February 14, 2013

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	55.37
	AU	1				
	SS	2	50	9	1	54.37
	SS	3	100	10		
					2	53.37
					3	52.37
Very stiff to stiff, brown **SILTY CLAY**					4	51.37
					5	50.37
- stiff to very stiff and grey by 5.9m depth					6	49.37
					7	48.37
					8	47.37
					9	46.37
9.60						
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 13.4m depth.					10	45.37
					11	44.37



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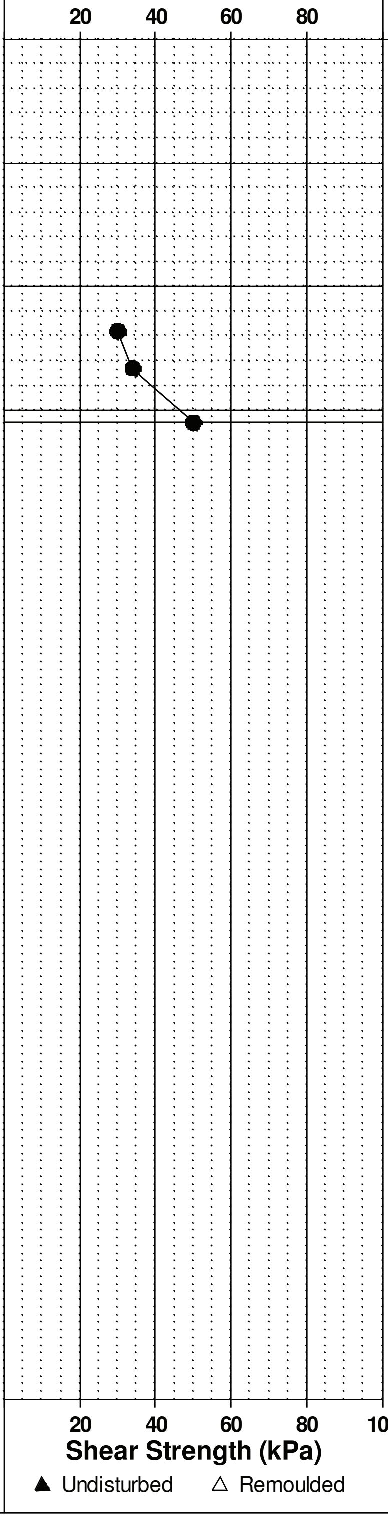
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.	**FILE NO.** PG1796
REMARKS	**HOLE NO.** BH84-13
BORINGS BY CME 55 Power Auger **DATE** February 14, 2013	

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE									
						11	44.37		
						12	43.37		
						13	42.37		
						14	41.37		
14.10 End of Borehole Practical DCPT refusal at 14.10m depth (GWL @ 4.4m depth based on field observations)									



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
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REMARKS

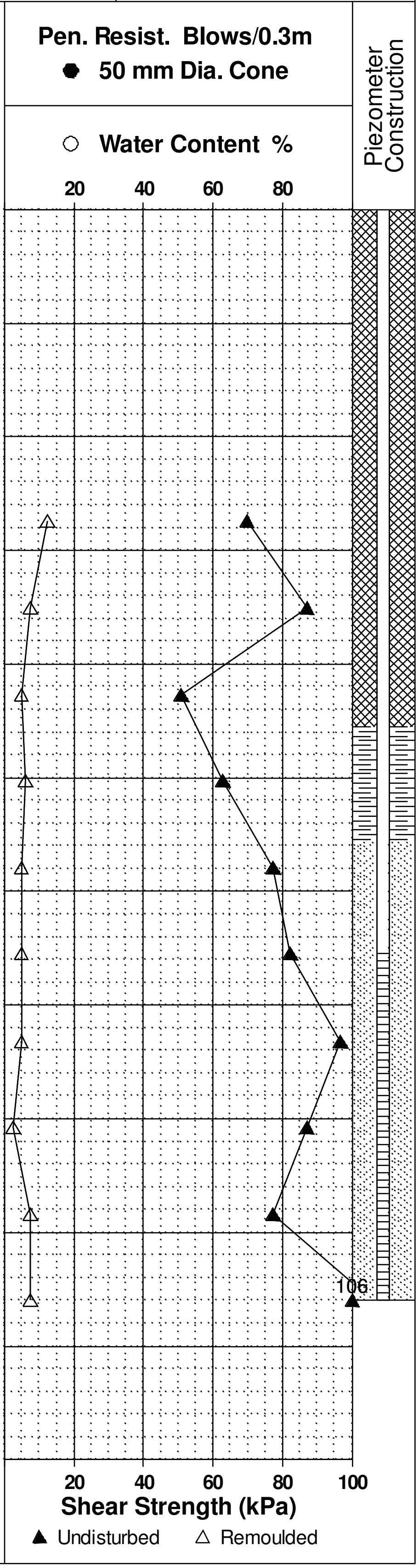
BORINGS BY CME 55 Power Auger

DATE February 15, 2013

FILE NO. PG1796

HOLE NO. BH85-13

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	54.34
TOPSOIL 0.28						
	SS	1	100	9	1	53.34
	SS	2	100	5		
					2	52.34
					3	51.34
Stiff, brown **SILTY CLAY** - grey by 4.6m depth					4	50.34
					5	49.34
					6	48.34
					7	47.34
					8	46.34
					9	45.34
9.60						
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 13.4m depth.					10	44.34
					11	43.34



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SOIL PROFILE AND TEST DATA

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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

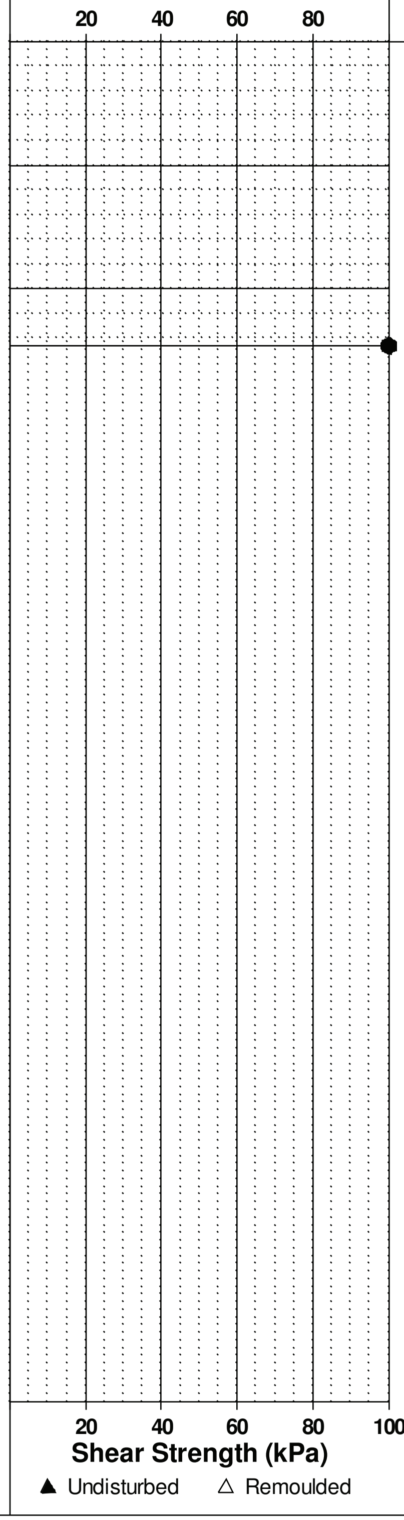
BORINGS BY CME 55 Power Auger

DATE February 15, 2013

FILE NO. PG1796

HOLE NO. BH85-13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
						11	43.34		
						12	42.34		
						13	41.34		
13.46									
End of Borehole Practical DCPT refusal at 13.46m depth									



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
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REMARKS

BORINGS BY CME 55 Power Auger

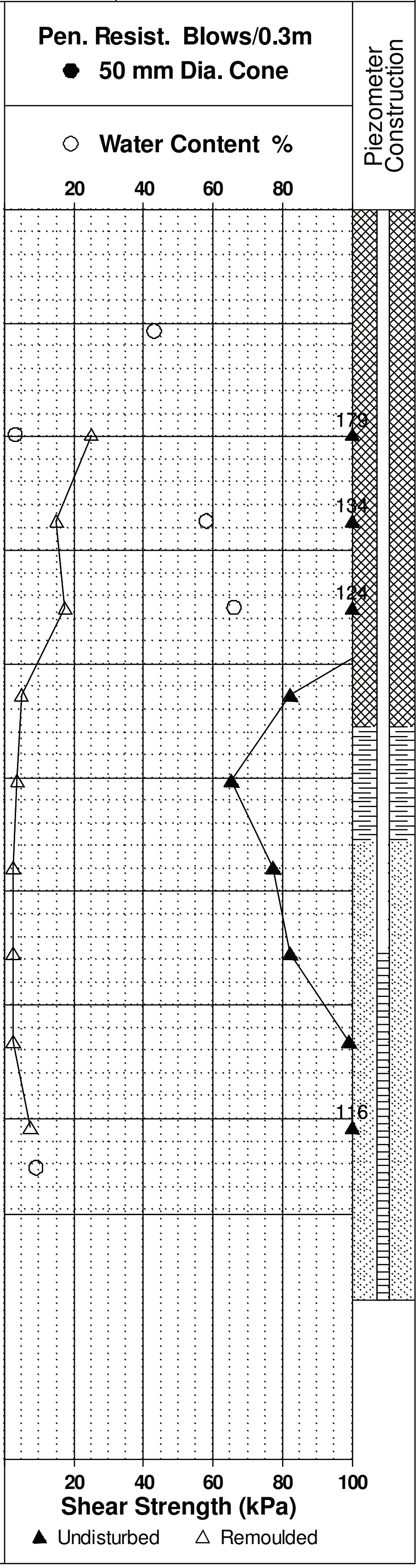
DATE February 14, 2013

FILE NO. PG1796

HOLE NO. BH86-13

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.33	SS	1	50	10
	SS	2	100	7
Very stiff to stiff, brown **SILTY CLAY** 8.23				
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders 8.84	SS	3	50	50+
End of Borehole Practical refusal to augering at 8.84m depth				

DEPTH (m)	ELEV. (m)
0	54.08
1	53.08
2	52.08
3	51.08
4	50.08
5	49.08
6	48.08
7	47.08
8	46.08



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Watermain Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM	Approximate geodetic
REMARKS	
BORINGS BY	CME 55 Power Auger
DATE	June 6, 2013
FILE NO.	**PG1796**
HOLE NO.	**BH89-13**

SOIL DESCRIPTION

GROUND SURFACE

TOPSOIL 0.30

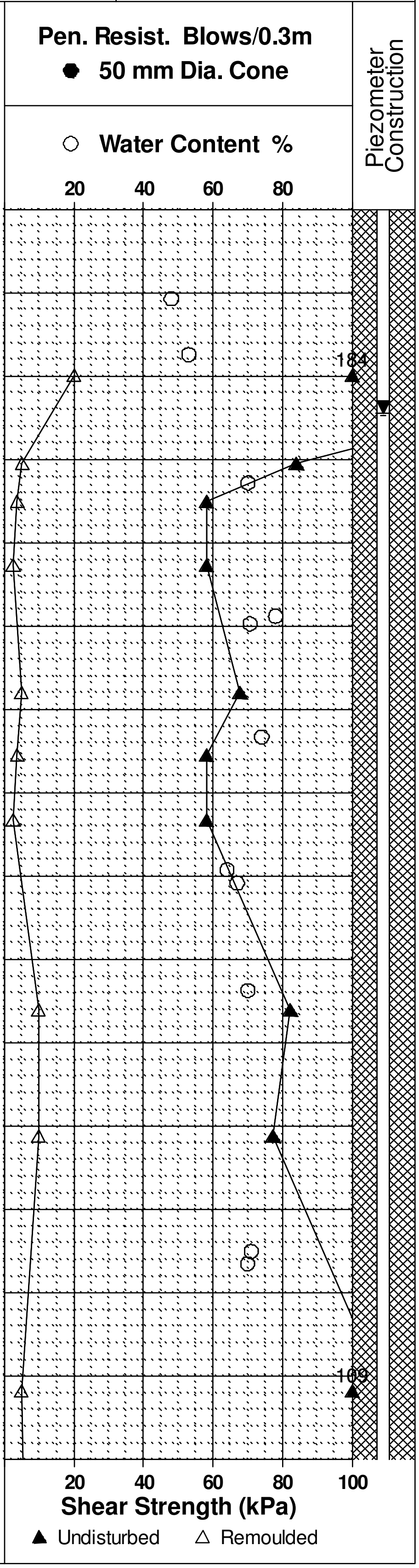
Very stiff to stiff, brown **SILTY CLAY**

- grey by 4.4m depth

SAMPLE

TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	100	5
TW	2	100	
TW	3	83	
TW	4	100	

DEPTH (m)	ELEV. (m)
0	53.64
1	52.64
2	51.64
3	50.64
4	49.64
5	48.64
6	47.64
7	46.64
8	45.64
9	44.64
10	43.64
11	42.64
12	41.64
13	40.64
14	39.64
15	38.64



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Watermain Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

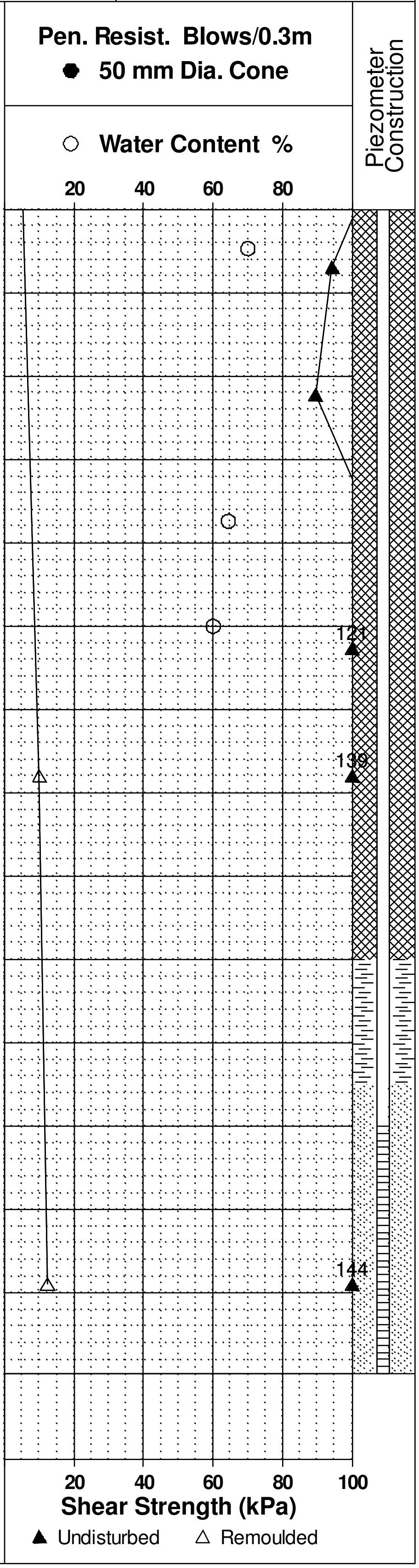
BORINGS BY CME 55 Power Auger

DATE June 6, 2013

FILE NO. **PG1796**

HOLE NO. **BH89-13**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Very stiff, grey **SILTY CLAY**						15	38.64
						16	37.64
						17	36.64
						18	35.64
		TW	5	100			
						19	34.64
						20	33.64
						21	32.64
						22	31.64
						23	30.64
						24	29.64
		TW	6	100			
						25	28.64
						26	27.64
						27	26.64
28.12						28	25.64
GLACIAL TILL: Very dense, grey silty sand with clay, gravel and cobbles		SS	7		68		
28.96							
End of Borehole (GWL @ 2.44m -June 27/13)							



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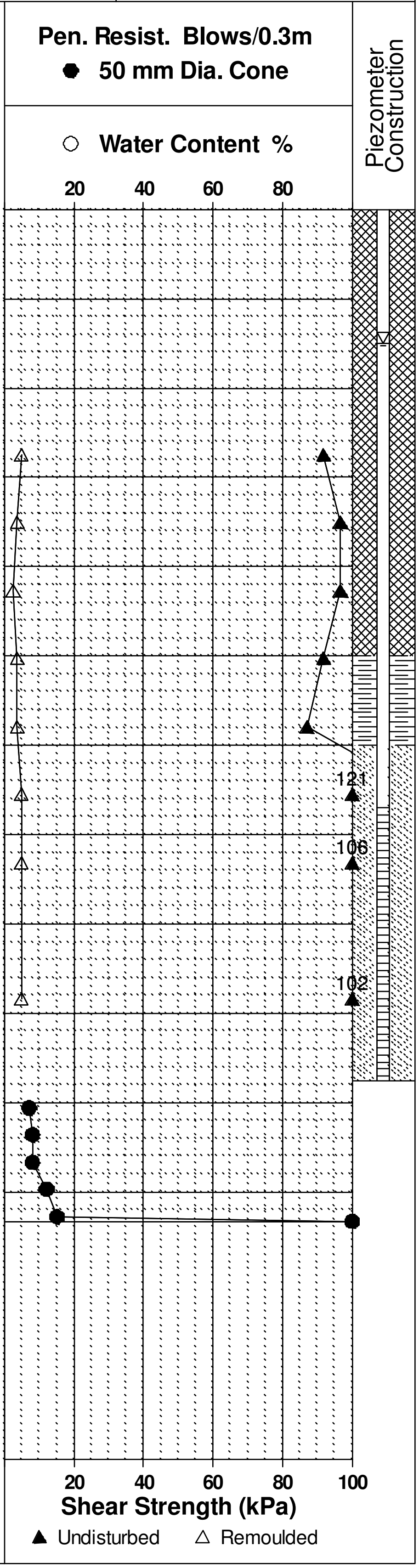
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Watermain Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic
FILE NO. PG1796
REMARKS
HOLE NO. BH90-13
BORINGS BY CME 55 Power Auger
DATE November 22, 2013

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.30	AU	1		
	SS	2	67	6
	SS	3	100	2
Stiff to very stiff, brown **SILTY CLAY** 8.99				
GLACIAL TILL: Grey-brown silty clay with sand, gravel, cobbles and boulders 9.75	SS	4	83	4
Dynamic Cone Penetration Test commenced at 9.75m depth.				
Inferred **GLACIAL TILL** 11.33				
End of Borehole Practical DCPT refusal at 11.33m depth. (GWL @ 1.5m depth based on field observations)				

DEPTH (m)	ELEV. (m)
0	44.28
1	43.28
2	42.28
3	41.28
4	40.28
5	39.28
6	38.28
7	37.28
8	36.28
9	35.28
10	34.28
11	33.28



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Highway Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic

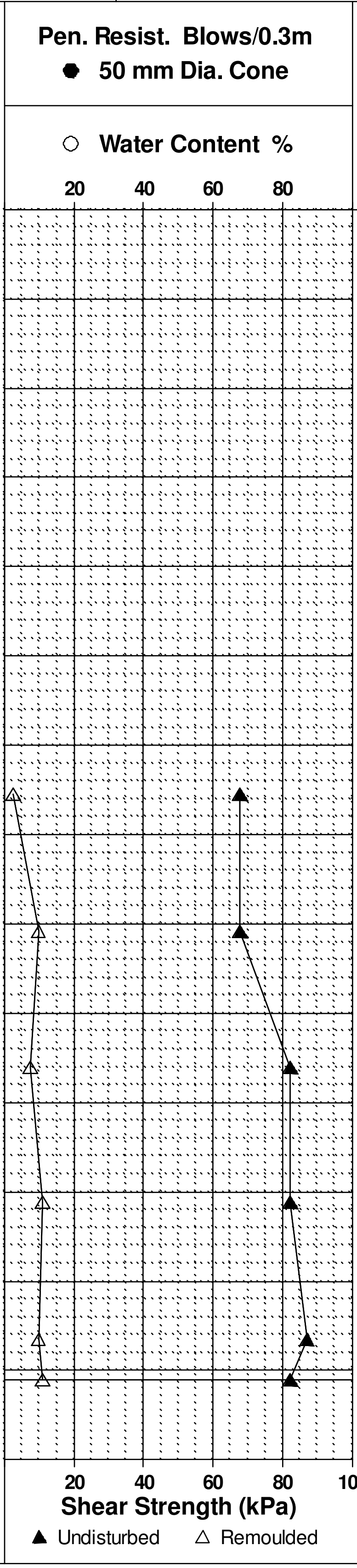
FILE NO. **PG1796**

REMARKS

HOLE NO. **BH91-13**

BORINGS BY CME 55 Power Auger **DATE** November 22, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	53.10	
						1	52.10	
						2	51.10	
Inferred **SILTY CLAY**						3	50.10	
						4	49.10	
						5	48.10	
6.10						6	47.10	
						7	46.10	
						8	45.10	
Stiff, grey **SILTY CLAY**						9	44.10	
						10	43.10	
						11	42.10	
						12	41.10	
13.11						13	40.10	
End of Borehole (BH dry upon completion)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Highway Crossing - Cardinal Creek Village
Ottawa, Ontario

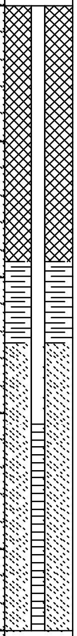
DATUM Approximate geodetic
REMARKS
BORINGS BY Geo Probe
DATE January 23, 2014
FILE NO. PG1796
HOLE NO. BH92-14

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	46.79
Asphaltic concrete 0.10	AU	1				
	AU	2				
FILL: Brown silty sand with gravel - trace blast rock by 3.0m depth	SS	3	89	21		
	SS	4	62	34	1	45.79
	SS	5	67	19	2	44.79
	SS	6	54	16	3	43.79
	SS	7	67	35		
	SS	8	4	26	4	42.79
4.60	SS	9	0	50+		
End of Borehole Practical refusal to augering at 4.60m depth.						

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

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

Piezometer Construction



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Highway Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

BORINGS BY Geo Probe

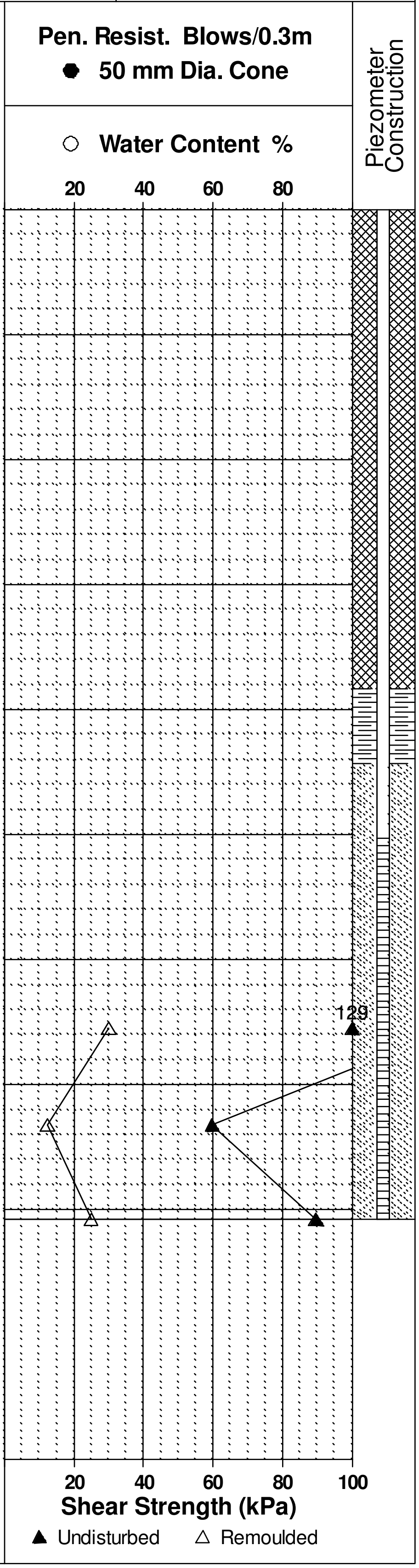
DATE January 23, 2014

FILE NO. PG1796

HOLE NO. BH92A-14

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.10				
FILL: Brown silty sand with gravel - trace blast rock by 3.0m depth	4.57				
Very stiff to stiff, brown **SILTY CLAY**	8.08	SS	1	67	7
		SS	2		2
End of Borehole					

DEPTH (m)	ELEV. (m)
0	46.79
1	45.79
2	44.79
3	43.79
4	42.79
5	41.79
6	40.79
7	39.79
8	38.79



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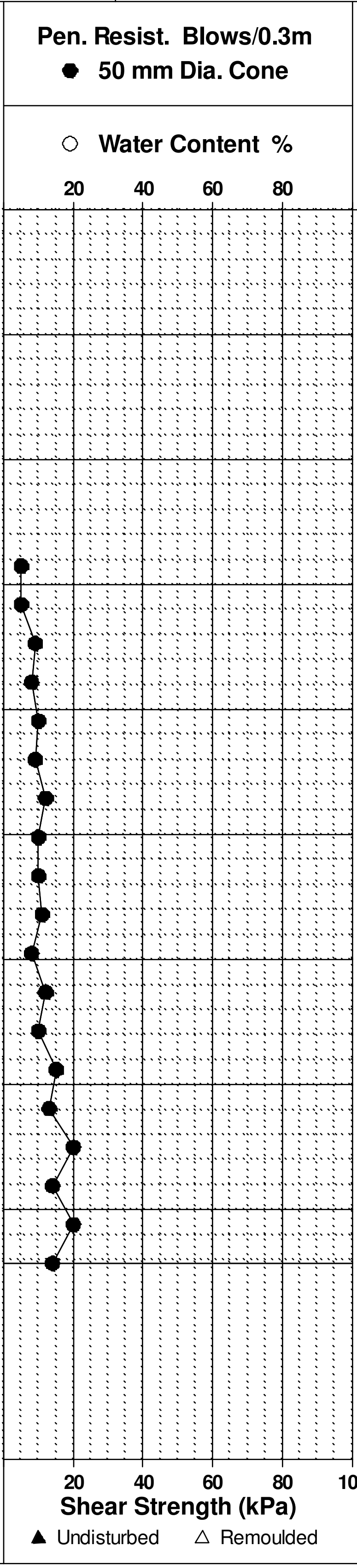
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Watermain Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic
REMARKS
BORINGS BY Portable Drill
DATE January 24, 2014
FILE NO. PG1796
HOLE NO. BH93-14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	44.27	⊻
TOPSOIL 0.20		AU	1					
Very stiff to stiff, brown **SILTY CLAY**		SS	2	0	8			
		SS	3	83	2	1	43.27	
2.03		SS	4	62	3	2	42.27	
Dynamic Cone Penetration Test commenced at 2.03m depth.								
						3	41.27	
Inferred **SILTY CLAY**						4	40.27	
						5	39.27	
6.60						6	38.27	
Inferred **GLACIAL TILL**						7	37.27	
8.43						8	36.27	
End of Borehole BH terminated in inferred glacial till at 8.43m depth (GWL @ 0.15m depth based on field observations)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 20, 2009

FILE NO. PG1796

HOLE NO. BH 1

SOIL DESCRIPTION

GROUND SURFACE

FILL: Grey-brown silty clay with topsoil

1.45

Very stiff to stiff, brown **SILTY CLAY**

- grey-brown by 3.6m depth

- stiff to very stiff and grey by 5.2m depth

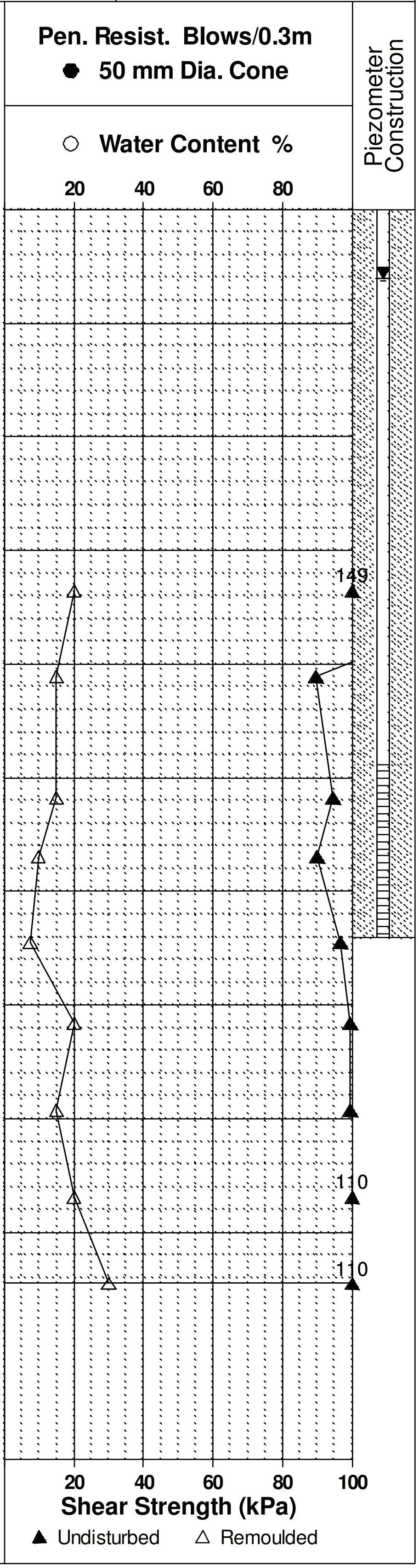
9.45

End of Borehole

(GWL @ 0.61m-Feb. 3/09)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	83	10
SS	3	100	11
SS	4	100	4

DEPTH (m)	ELEV. (m)
0	67.45
1	66.45
2	65.45
3	64.45
4	63.45
5	62.45
6	61.45
7	60.45
8	59.45
9	58.45



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

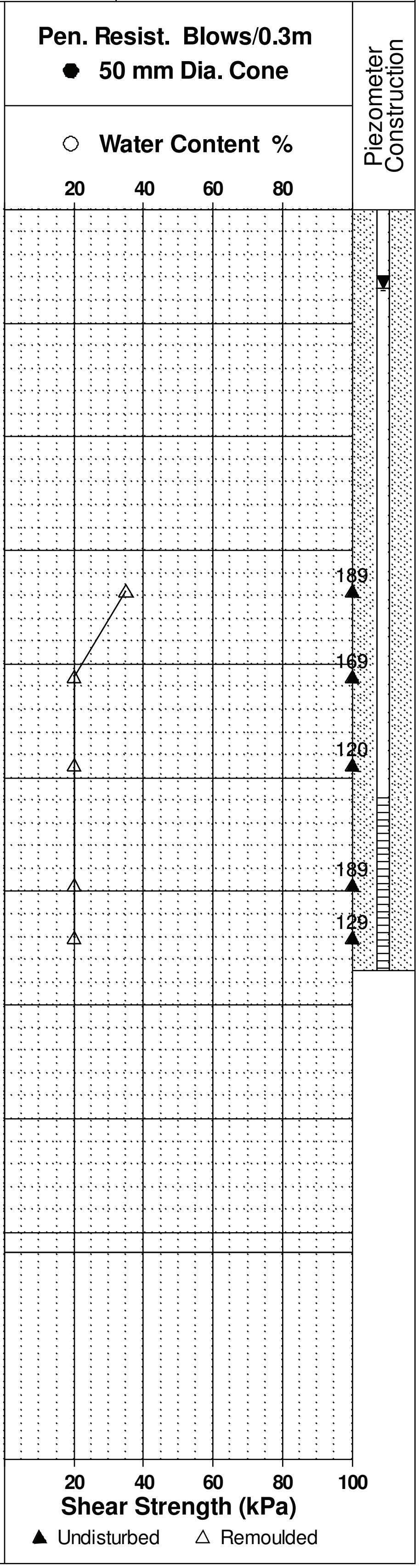
REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger

DATE January 20, 2009

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	60.07
TOPSOIL 0.04		AU	1				
Very stiff, brown **SILTY CLAY**		SS	2	75	10	1	59.07
- grey-brown by 2.2m depth		SS	3	100	13	2	58.07
		SS	4	100	6	3	57.07
						4	56.07
						5	55.07
6.71						6	54.07
GLACIAL TILL: Grey-brown silty clay with sand, gravel, cobbles and boulders		SS	5	38	33	7	53.07
		SS	6	67	41	8	52.07
		SS	7	0	50+		
9.17		SS	8	0	50+	9	51.07
End of Borehole (GWL @ 0.69m-Feb. 3/09)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 20, 2009

FILE NO. PG1796

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	63.94		
TOPSOIL 0.20		AU	1						
Very stiff, brown **SILTY CLAY**		SS	2	58	12	1	62.94		
1.60									
BEDROCK: Weathered black shale		SS	3	50	50+				
						2	61.94		
2.29		AU	4						
End of Borehole Practical refusal to augering @ 2.29m depth (BH dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

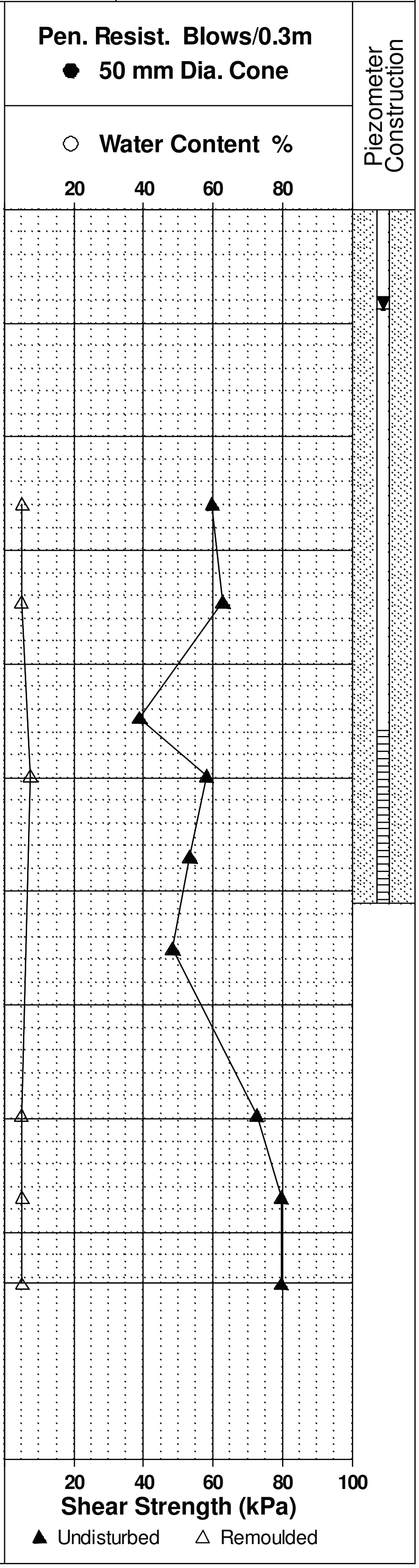
REMARKS

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger

DATE January 21, 2009

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.72
TOPSOIL 0.20		AU	1				
		SS	2	75	9	1	52.72
		SS	3	92	4	2	51.72
Stiff, brown **SILTY CLAY** - grey-brown by 3.0m depth - grey by 3.7m depth						3	50.72
		SS	4		P		
						4	49.72
						5	48.72
						6	47.72
		TW	1			7	46.72
						8	45.72
						9	44.72
9.45							
End of Borehole (GWL @ 0.87m-Feb. 3/09)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

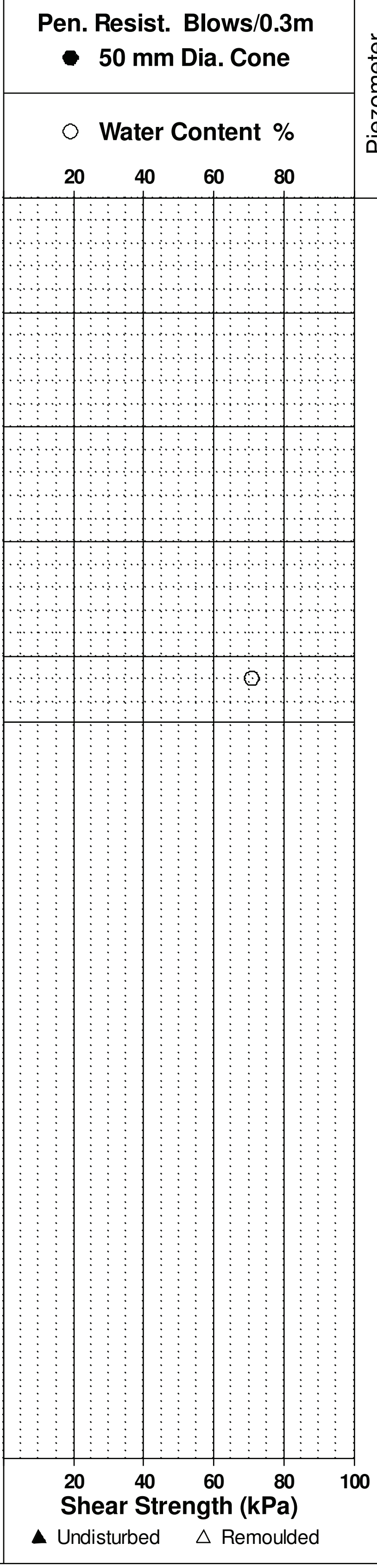
BORINGS BY CME 55 Power Auger

DATE January 21, 2009

FILE NO. PG1796

HOLE NO. BH 4B

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.72
OVERBURDEN						1	52.72
						2	51.72
						3	50.72
3.81							
Grey **SILTY CLAY**	▨	TW	1			4	49.72
4.42							
End of Borehole (BH 4B located 1.5m south of BH 4 location)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

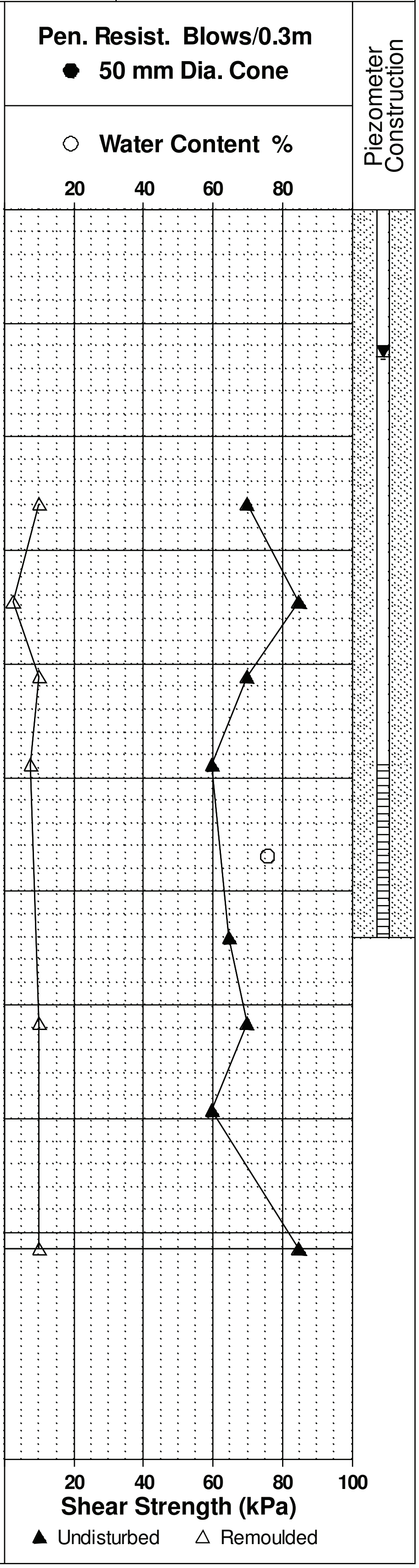
BORINGS BY CME 55 Power Auger

DATE January 21, 2009

FILE NO. PG1796

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.28
TOPSOIL 0.25		AU	1				
Stiff, brown **SILTY CLAY**		SS	2	62	8	1	52.28
- red-brown by 1.4m depth		SS	3	100	6		
						2	51.28
- grey-brown by 2.8m depth						3	50.28
- grey by 3.7m depth						4	49.28
						5	48.28
		TW	1	62			
						6	47.28
						7	46.28
						8	45.28
		TW	2	67			
						9	44.28
9.14							
End of Borehole							
(GWL @ 1.30m-Feb. 3/09)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

REMARKS

HOLE NO. BH 6

BORINGS BY CME 55 Power Auger

DATE January 20, 2009

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	77.71		
TOPSOIL 0.30									
GLACIAL TILL: Grey silty sand with clay, gravel, cobbles and boulders 1.01									
		SS	1	92	10	1	76.71		
BEDROCK: Weathered, black shale 1.75		SS	2	67	50+				
		AU	3						
End of Borehole Practical refusal to augering @ 1.75m depth (BH dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 20, 2009

FILE NO. PG1796

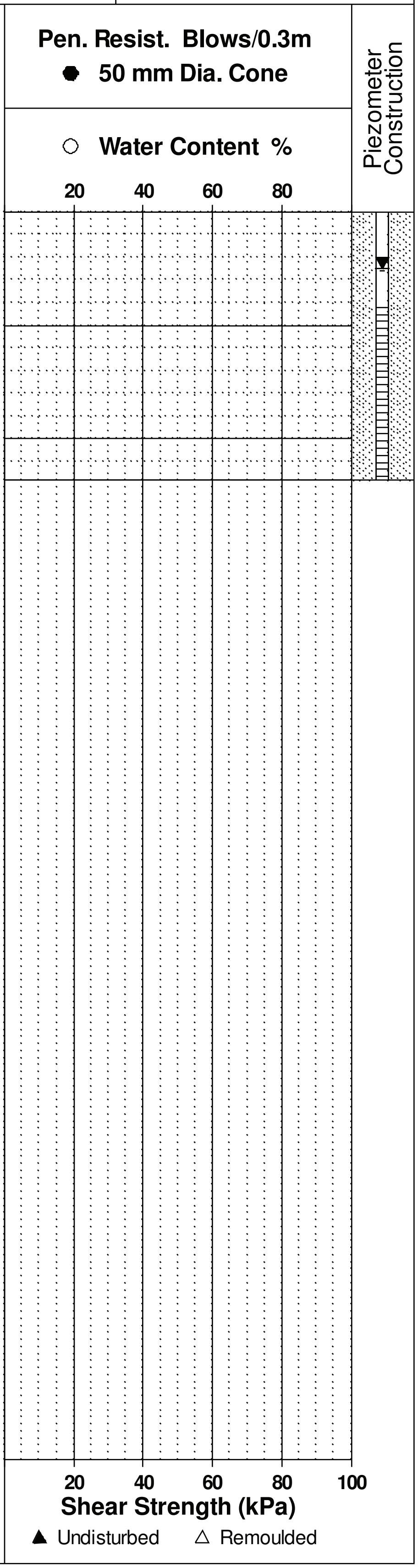
HOLE NO. BH 7

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	72.32
TOPSOIL 0.30	AU	1				
25mm Topsoil Very stiff, grey-brown **SILTY CLAY**	SS	2	100	11	1	71.32
1.93	SS	3	83	9	2	70.32
GLACIAL TILL: Very dense, brown sandy silt with gravel, cobbles and boulders 2.36	SS	4	0	50+		

End of Borehole

Practical refusal to augering @ 2.36m depth

(GWL @ 0.50m-Feb. 3/09)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

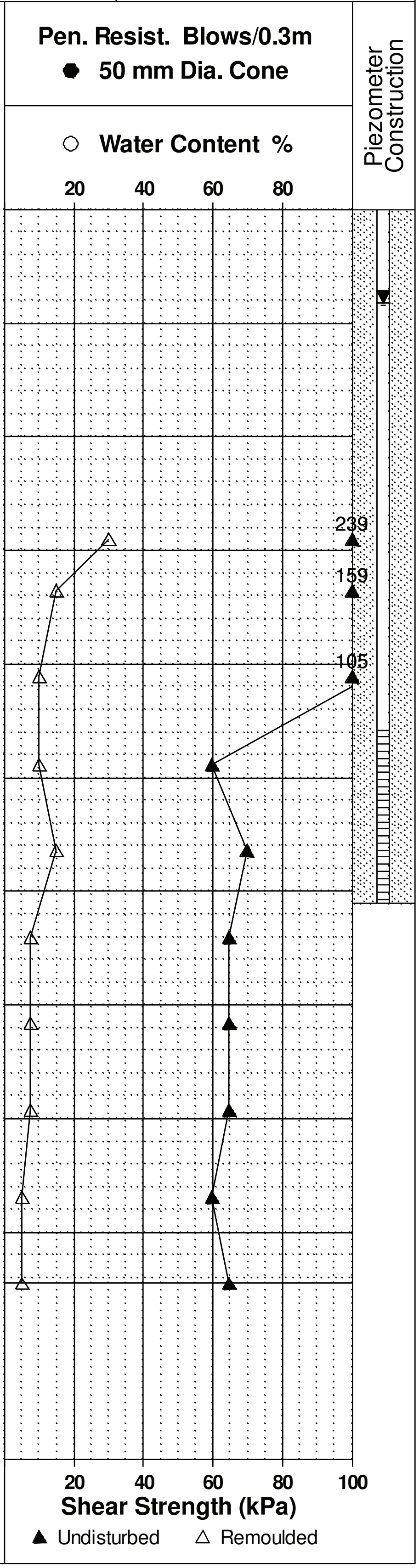
DATE January 23, 2009

FILE NO. PG1796

HOLE NO. BH 8

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TIOPSOIL	0.30	AU	1		
Hard to very stiff, brown **SILTY CLAY**		SS	2	42	9
- stiff and grey-brown by 4.3m depth		SS	3	67	5
- grey by 7.9m depth	9.45				
End of Borehole					
(GWL @ 0.82m-Feb. 3/09)					

DEPTH (m)	ELEV. (m)
0	87.11
1	86.11
2	85.11
3	84.11
4	83.11
5	82.11
6	81.11
7	80.11
8	79.11
9	78.11



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 22, 2009

FILE NO. PG1796

HOLE NO. BH 9

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						0	57.53		
TOPSOIL 0.20									
FILL: Brown silty clay with sand and gravel		AU	1						
		SS	2	50	20	1	56.53		
1.45									
End of Borehole Practical refusal to augering @ 1.45m depth									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

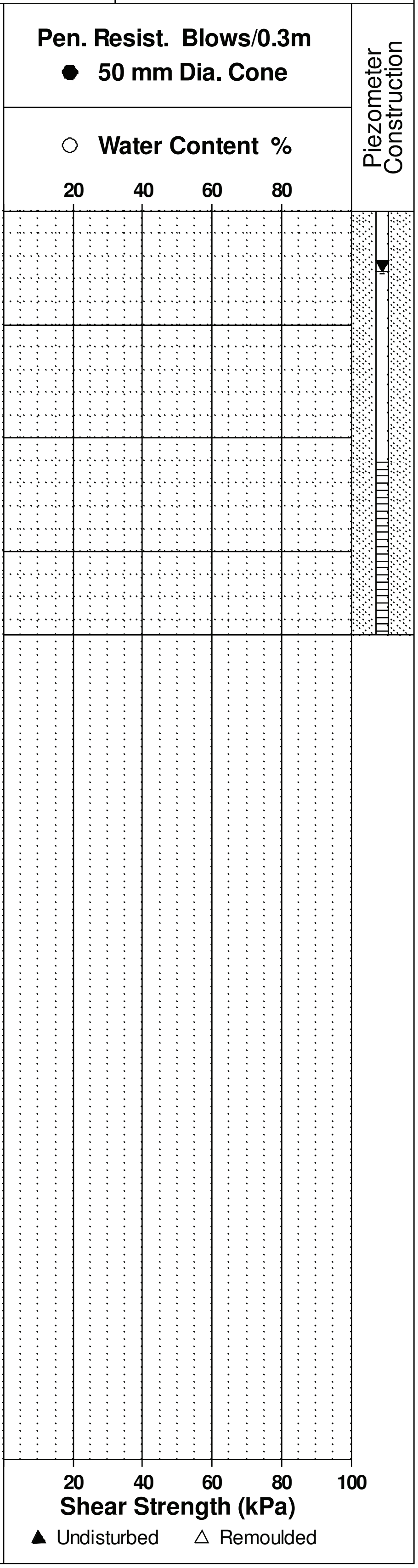
REMARKS

HOLE NO. BH 9B

BORINGS BY CME 55 Power Auger

DATE January 22, 2009

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	57.00
TOPSOIL 0.20							
Very stiff, brown **SILTY CLAY**						1	56.00
		SS	1	71	17		
2.29						2	55.00
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles and boulders		SS	2	54	35		
		SS	3	75	50+	3	54.00
3.73							
End of Borehole Practical refusal to augering @ 3.73m depth (GWL @ 0.53m-Feb. 3/09)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

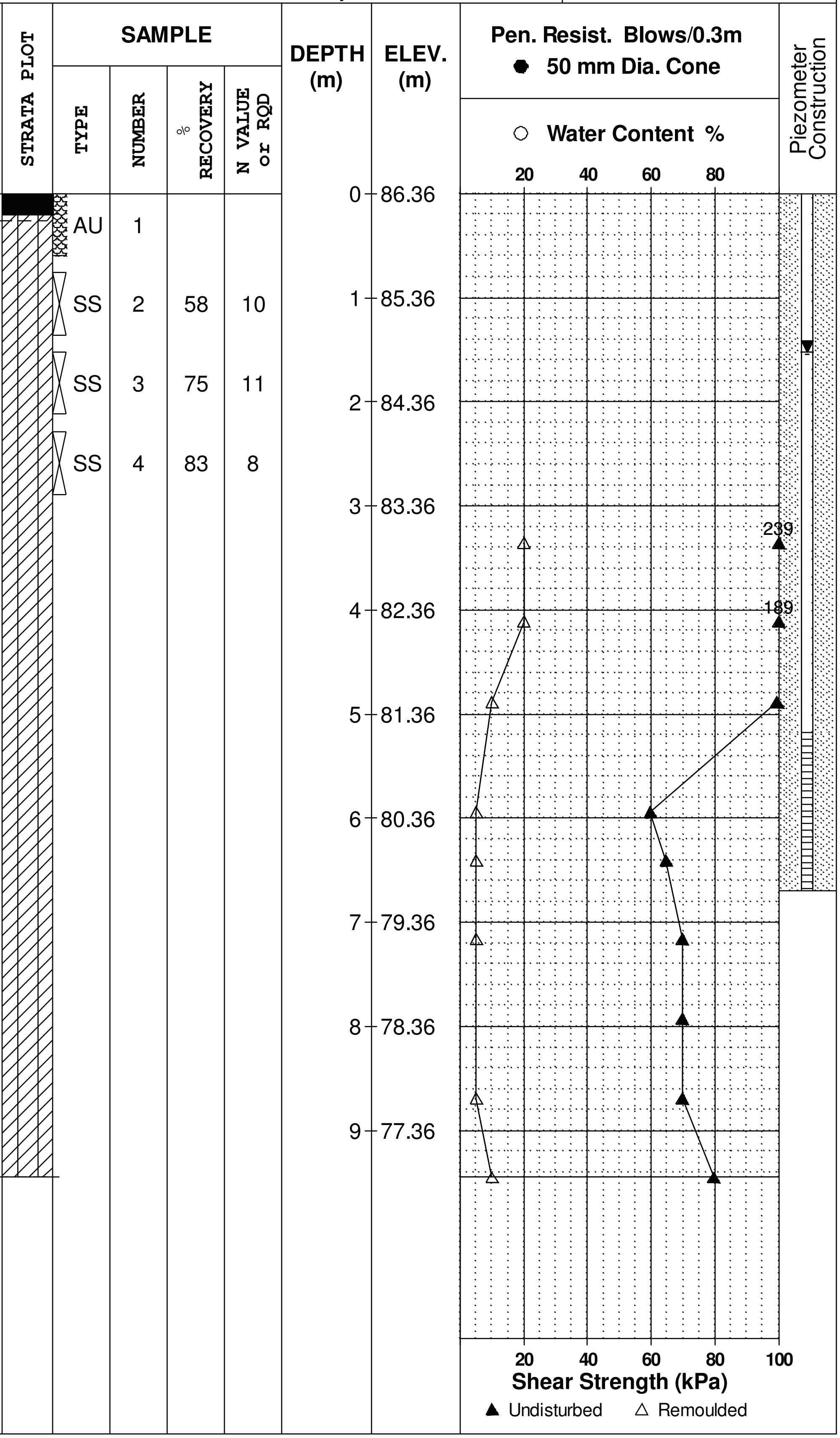
BORINGS BY CME 55 Power Auger

DATE January 22, 2009

FILE NO. PG1796

HOLE NO. BH10

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	86.36
TOPSOIL 0.20	AU	1				
	SS	2	58	10	1	85.36
	SS	3	75	11	2	84.36
	SS	4	83	8		
Hard to very stiff, brown **SILTY CLAY**					3	83.36
- stiff and grey by 4.3m depth					4	82.36
					5	81.36
					6	80.36
					7	79.36
					8	78.36
					9	77.36
9.45						
End of Borehole						
(GWL @ 1.52m-Feb. 3/09)						



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

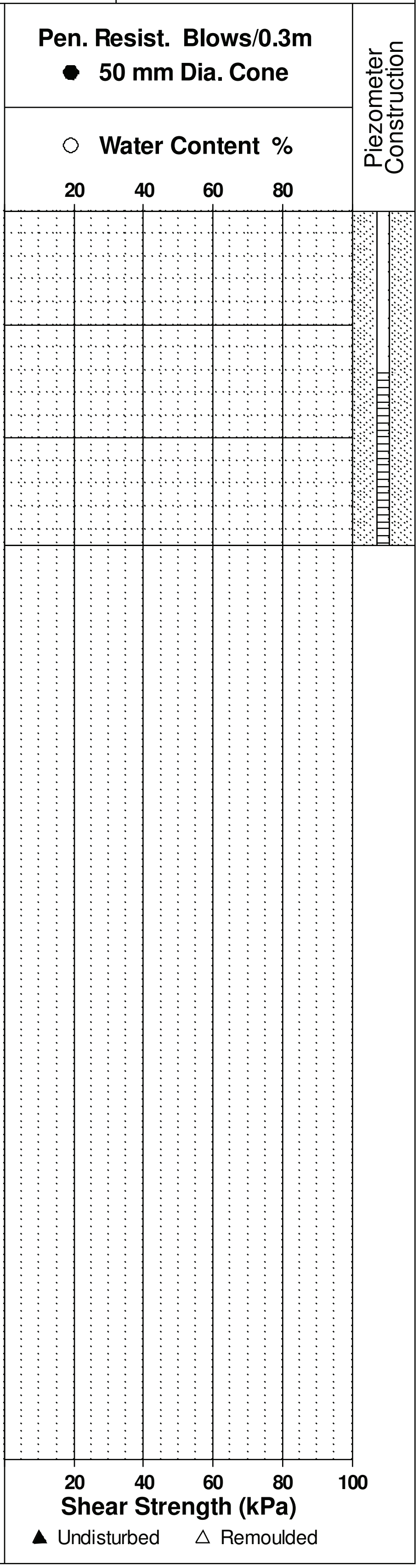
BORINGS BY CME 55 Power Auger

DATE January 23, 2009

FILE NO. PG1796

HOLE NO. BH11

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	89.75
TOPSOIL 0.30	AU	1				
Very stiff, brown **SILTY CLAY** with organic matter 0.69						
GLACIAL TILL: Compact to dense, brown silty sand with clay, gravel, cobbles and boulders	SS	2	75	8	1	88.75
	SS	3	50	20	2	87.75
2.95	SS	4	80	50+		
End of Borehole Practical refusal to augering @ 2.95m depth						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

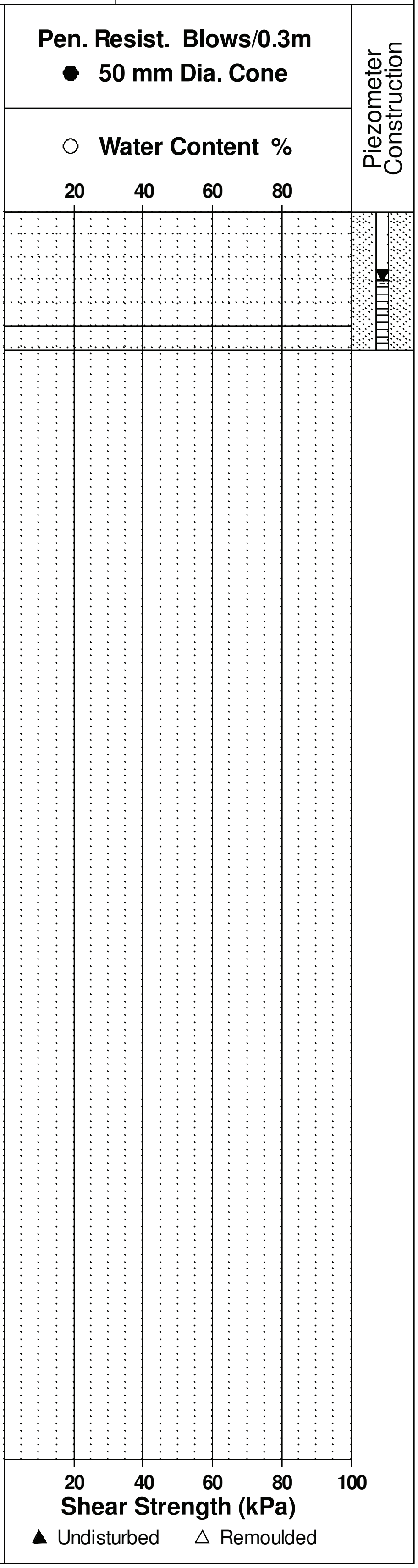
BORINGS BY CME 55 Power Auger

DATE January 22, 2009

FILE NO. PG1796

HOLE NO. BH12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	80.38
TOPSOIL 0.20		AU	1				
GLACIAL TILL: Very dense, brown silty sand with clay, gravel, cobbles and boulders 1.22		SS	2		50+	1	79.38
End of Borehole Practical refusal to augering @ 1.22m depth (GWL @ 0.61m-Feb. 3/09)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 26, 2009

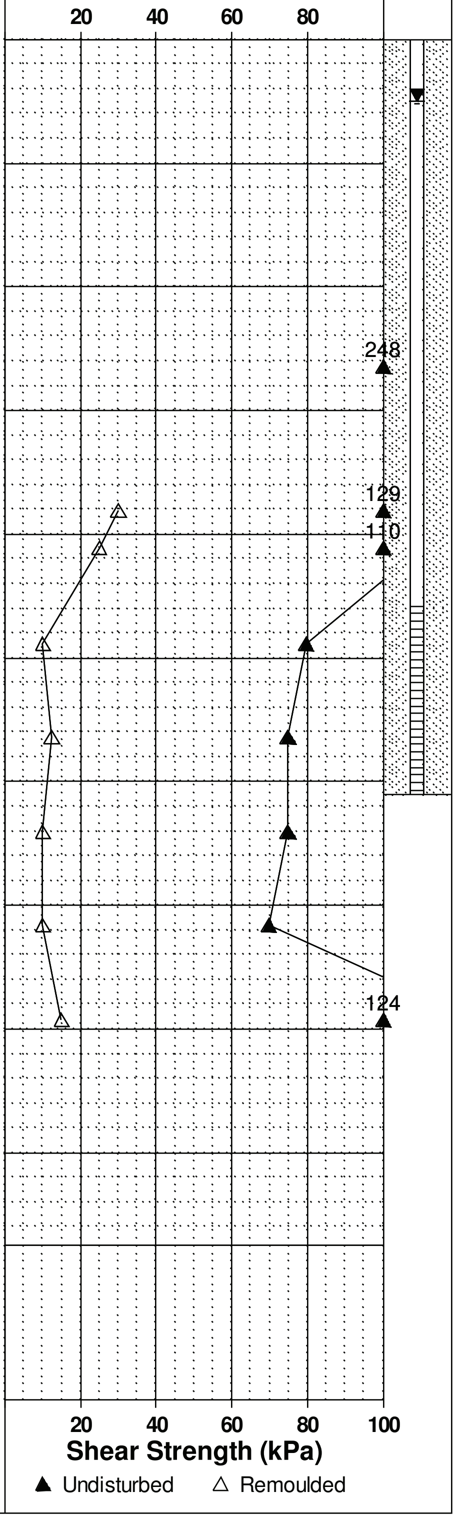
FILE NO. PG1796

HOLE NO. BH16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	67.96
TOPSOIL 0.30		AU	1				
Hard to very stiff, brown **SILTY CLAY**		SS	2	79	10	1	66.96
		SS	3	100	10	2	65.96
		SS	4	100	8		
		SS	5	100	5	3	64.96
- grey by 4.0m depth						4	63.96
						5	62.96
						6	61.96
						7	60.96
8.08						8	59.96
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders		SS	6	42	4	9	58.96
9.75							
End of Borehole (GWL @ 0.50m-Feb. 3/09)							

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

○ Water Content %



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG1796**

REMARKS

HOLE NO. **BH17**

BORINGS BY CME 55 Power Auger

DATE January 23, 2009

SOIL DESCRIPTION

GROUND SURFACE

TOPSOIL 0.20

Very stiff, brown **SILTY CLAY**

- stiff and grey-brown by 5.9m depth

- grey by 6.6m depth

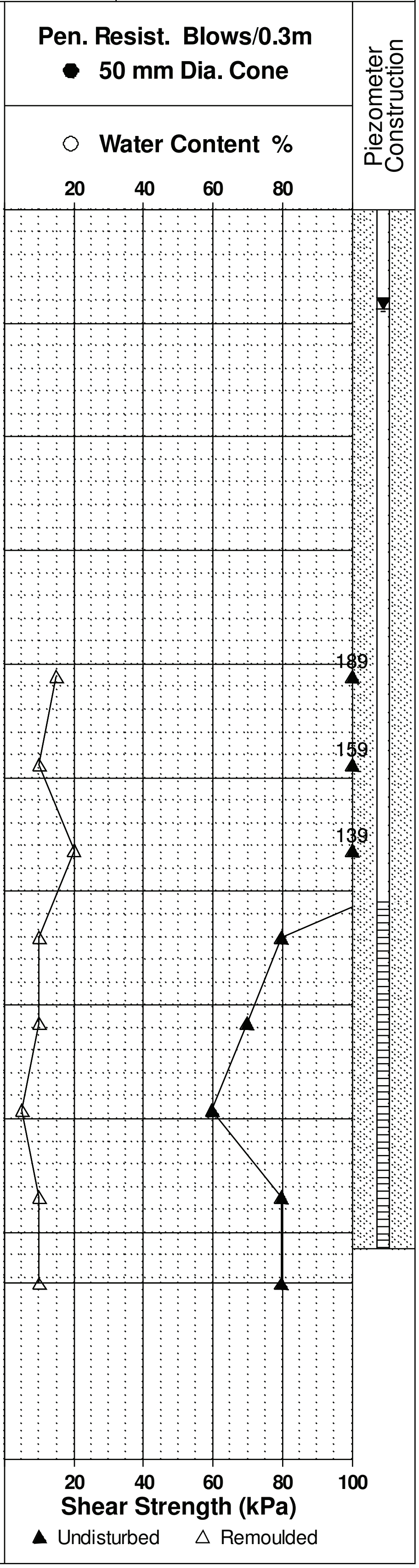
9.45

End of Borehole

(GWL @ 0.88m-Feb. 3/09)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	54	14
SS	3	50	12
SS	4	71	9
SS	5	75	5

DEPTH (m)	ELEV. (m)
0	86.28
1	85.28
2	84.28
3	83.28
4	82.28
5	81.28
6	80.28
7	79.28
8	78.28
9	77.28



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG1796**

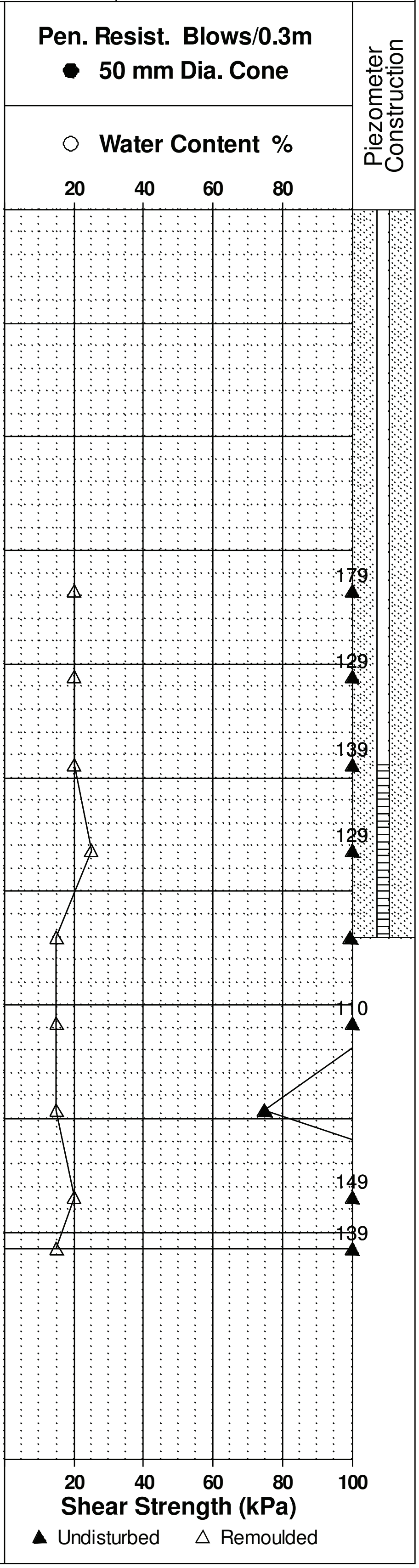
REMARKS

HOLE NO. **BH18**

BORINGS BY CME 55 Power Auger

DATE January 19, 2009

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	54.83
TOPSOIL 0.25						
25mm Topsoil	AU	1				
	SS	2	50	8	1	53.83
	SS	3	83	8	2	52.83
	SS	4	58	7		
					3	51.83
Very stiff to stiff, brown **SILTY CLAY**						
- grey-brown by 4.9m depth					4	50.83
					5	49.83
					6	48.83
- grey by 6.6m depth						
					7	47.83
					8	46.83
9.14					9	45.83
End of Borehole						
(Piezometer blocked - Feb. 3/09)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

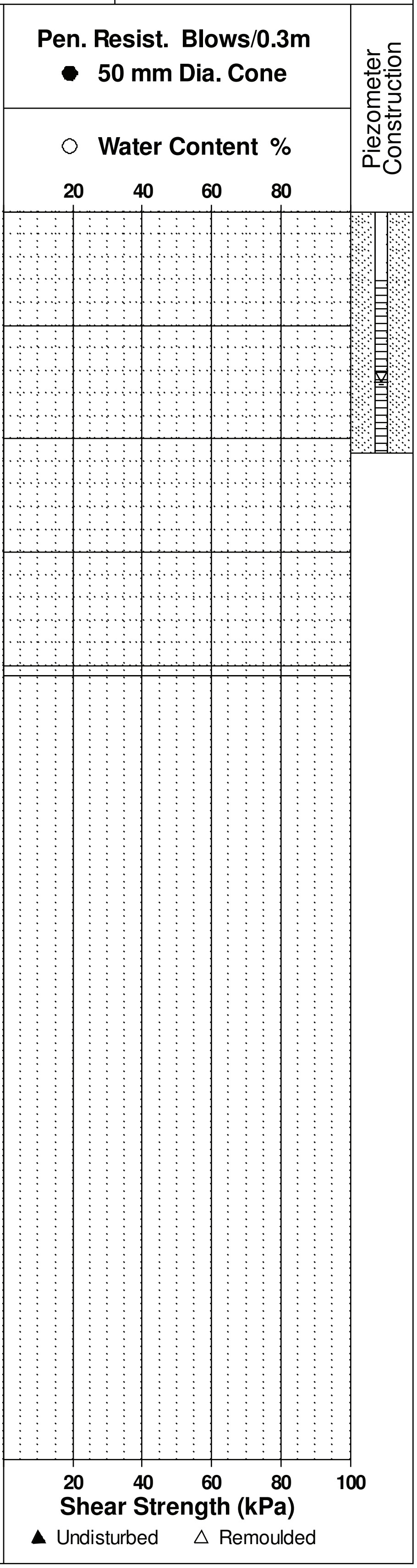
DATUM	Ground surface elevations provided by Stantec Geomatics Ltd.
REMARKS	
BORINGS BY	CME 55 Power Auger
DATE	January 22, 2009
FILE NO.	**PG1796**
HOLE NO.	**BH19**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	71.73
TOPSOIL (to 0.30)		AU	1				
GLACIAL TILL: Brown silty sand with clay, gravel, cobbles (to 1.91)		SS	2	33	16	1	70.73
		SS	3	76	50+		
BEDROCK: Weathered, black shale (to 4.09)		SS	4	50	50+	2	69.73
		SS	5	0	50+	3	68.73
		AU	6				
End of Borehole						4	67.73

Practical refusal to augering @ 4.09m depth

(BH dry - Feb. 3/09)

(GWL @ 1.5m depth upon completion)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. TP 1-12

BORINGS BY Backhoe

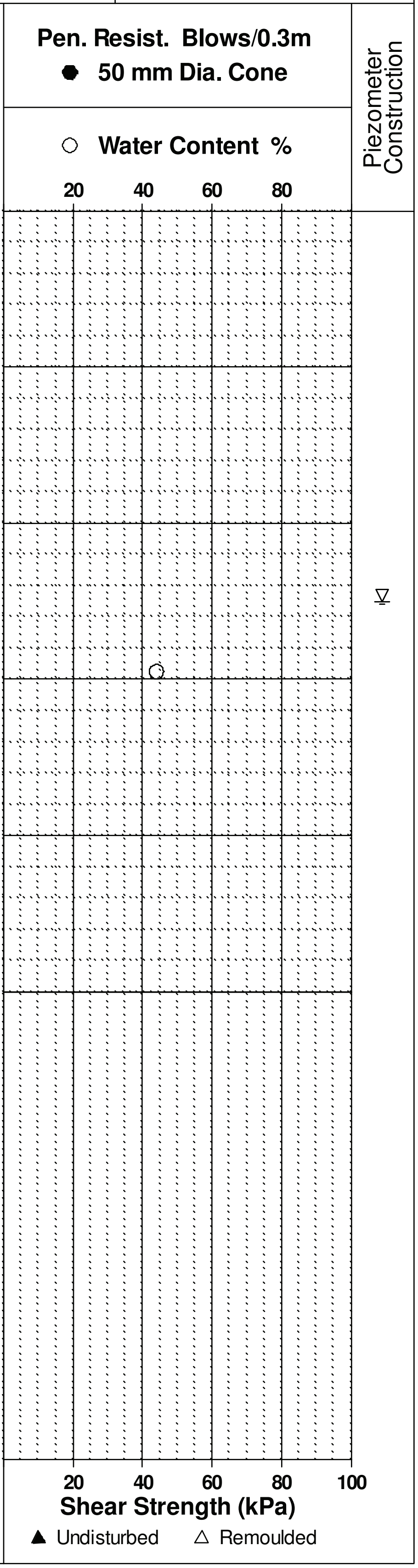
DATE December 18, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	87.12
TOPSOIL 0.30						
					1	86.12
					2	85.12
Hard to very stiff, brown **SILTY CLAY,** trace sand seams						
	G	1			3	84.12
					4	83.12
5.00					5	82.12

End of Test Pit

TP terminated in very stiff silty clay at 5.00m depth

(Groundwater infiltration at 2.5m depth)



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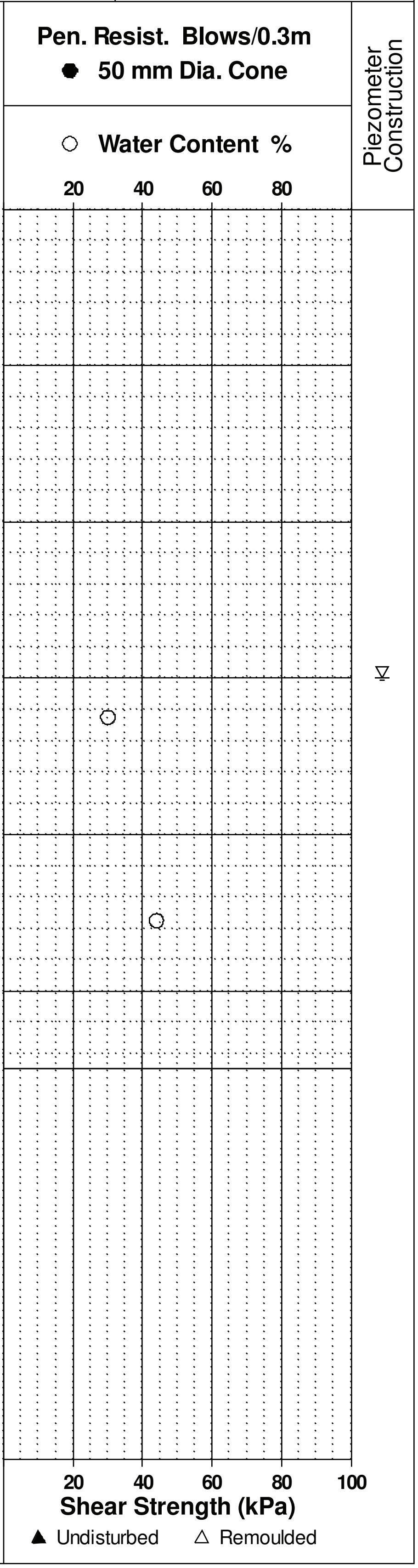
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.
REMARKS	
BORINGS BY	Backhoe
DATE	December 18, 2012
FILE NO.	PG1796
HOLE NO.	TP 2-12

SOIL DESCRIPTION	STRATA PLOT (depth, m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.10				
Very stiff, brown **SILTY CLAY,** some sand	1.25				
Hard to very stiff, brown **SILTY CLAY,** trace sand seams		G	1		
	5.50	G	2		
End of Test Pit TP terminated in very stiff silty clay at 5.50m depth (Groundwater infiltration at 3.0m depth)					

DEPTH (m)	ELEV. (m)
0	86.43
1	85.43
2	84.43
3	83.43
4	82.43
5	81.43



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.
FILE NO. **PG1796**
REMARKS
HOLE NO. **TP 3-12**
BORINGS BY Backhoe
DATE December 18, 2012

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						0	87.65		
TOPSOIL 0.20									
						1	86.65		
						2	85.65		
Hard to stiff, brown **SILTY CLAY**									
						3	84.65		
		G	1						
						4	83.65		
									⊻
5.00						5	82.65		
End of Test Pit TP terminated in stiff silty clay at 5.00m depth (Groundwater infiltration at 4.5m depth)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

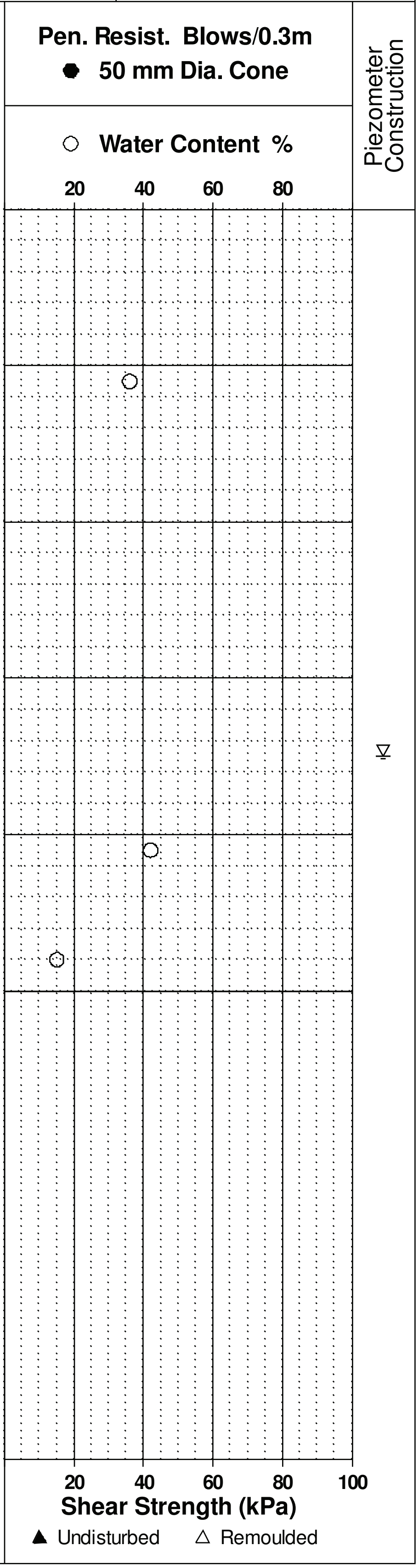
BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP 4-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.33
TOPSOIL 0.25							
		G	1			1	87.33
Hard to very stiff, brown **SILTY CLAY,** trace sand seams						2	86.33
						3	85.33
4.30		G	2			4	84.33
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles, trace boulders 5.00		G	3			5	83.33
End of Test Pit TP terminated in dense glacial till at 5.00m depth (Groundwater infiltration at 3.5m depth)							



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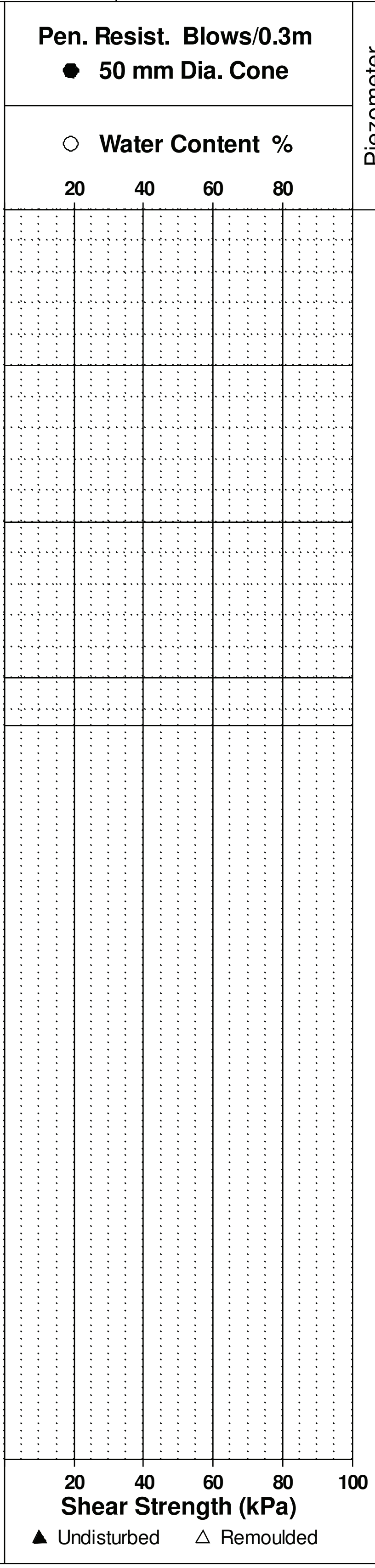
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.
REMARKS	
BORINGS BY	Backhoe
DATE	December 18, 2012
FILE NO.	**PG1796**
HOLE NO.	**TP 5-12**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	89.64	
TOPSOIL 0.05								
Brown **SILTY SAND,** some clay 0.25								
						1	88.64	
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders								
						2	87.64	
						3	86.64	
3.30								
End of Test Pit TP termination on inferred bedrock surface at 3.30m depth (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.
REMARKS	
BORINGS BY	Backhoe
DATE	December 18, 2012
FILE NO.	**PG1796**
HOLE NO.	**TP 6-12**

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						0	90.33		
TOPSOIL 0.20									
Stiff, brown **SILTY CLAY** 0.30									
						1	89.33		
GLACIAL TILL: Compact, brown silty clay with sand, gravel, cobbles, trace boulders									
						2	88.33		▽
3.00						3	87.33		
End of Test Pit TP terminated in compact glacial till at 3.00m depth (Groundwater infiltration high at 2.2m depth)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

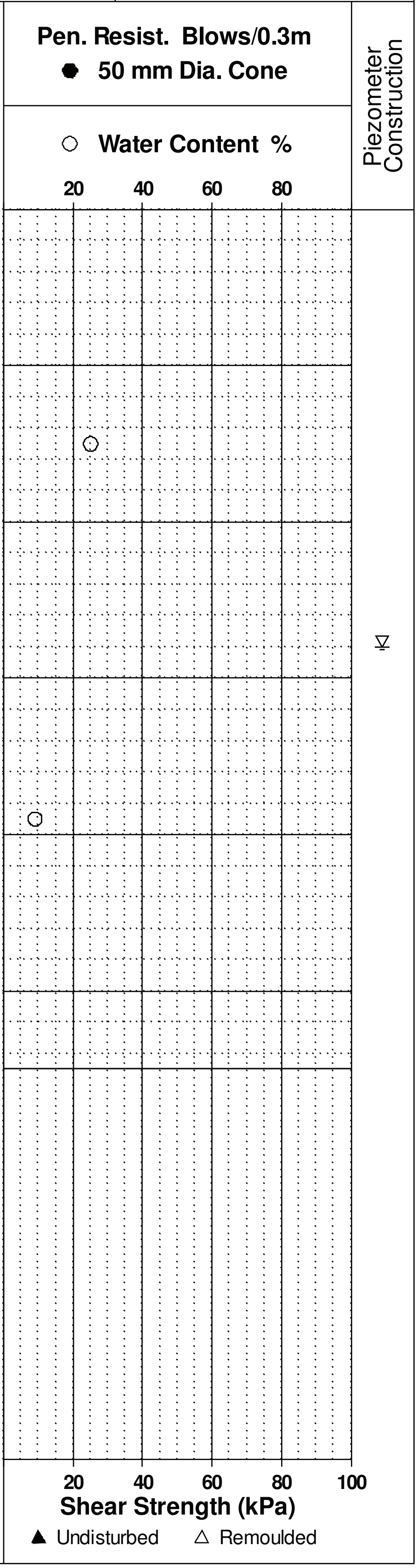
HOLE NO. TP 7-12

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.82
TOPSOIL	0.20						
Hard to very stiff, brown **SILTY CLAY**						1	88.82
		G	1				
						2	87.82
	2.80						
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, trace boulders	3.10					3	86.82
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles, trace cobbles and boulders		G	2				
						4	85.82
						5	84.82
	5.50						

End of Test Pit

TP terminated in dense glacial till at 5.50m depth

(Groundwater infiltration at 2.8m depth)



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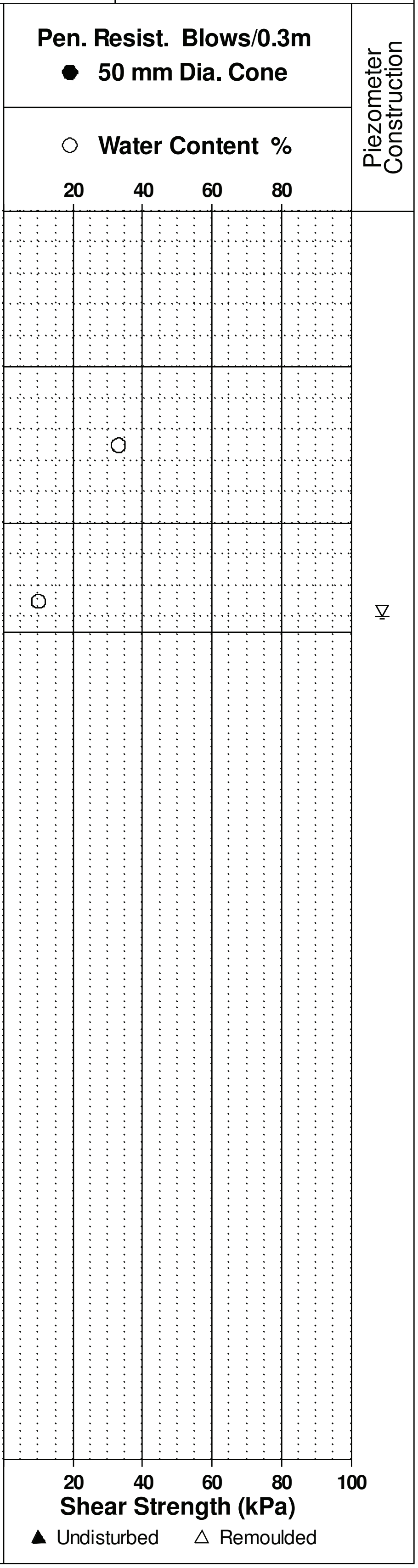
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.
REMARKS	
BORINGS BY	Backhoe
DATE	December 18, 2012
FILE NO.	PG1796
HOLE NO.	TP 8-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE							
TOPSOIL 0.30						0	90.51
Hard to very stiff, brown **SILTY CLAY** 1.70		G	1			1	89.51
GLACIAL TILL: Brown silty clay with sand, trace gravel, cobbles, boulders 2.70		G	2			2	88.51
End of Test Pit TP terminated on inferred bedrock surface at 2.70m depth (Groundwater infiltration at 2.6m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

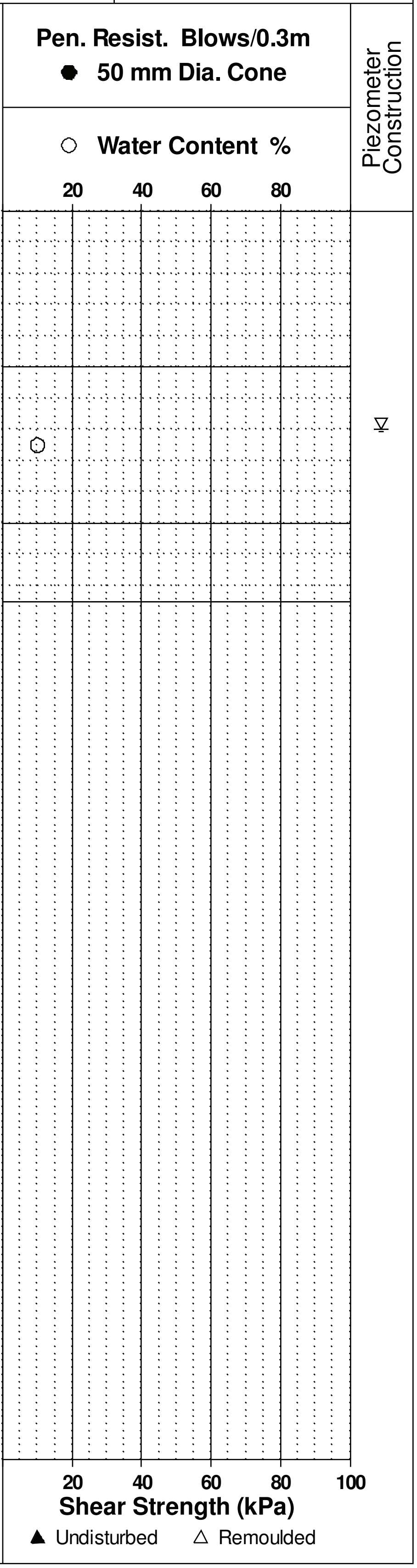
BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP 9-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.98
TOPSOIL 0.20	■						
Hard to very stiff, brown **SILTY CLAY** 1.35	▨					1	88.98
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles, trace boulders 2.50	^	G	1			2	87.98
End of Test Pit TP terminated on inferred bedrock surface at 2.5m depth (Groundwater infiltration at 1.4m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

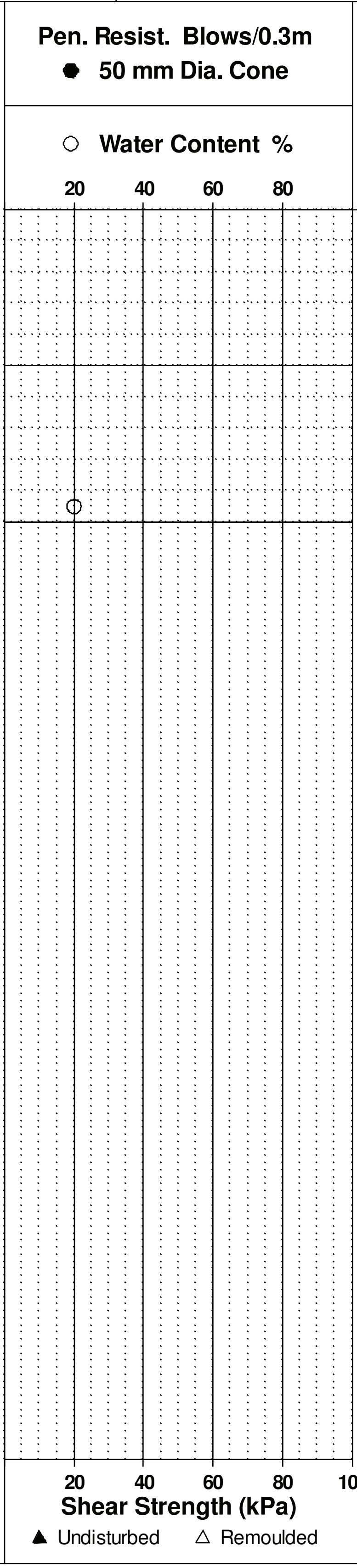
REMARKS

HOLE NO. TP10-12

BORINGS BY Backhoe

DATE December 18, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	92.09	
TOPSOIL 0.20								
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, trace boulders 2.00		G	1			1	91.09	
End of Test Pit TP terminated on inferred bedrock surface at 2.00m depth (TP dry upon completion)						2	90.09	



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

REMARKS

HOLE NO. **TP11-12**

BORINGS BY Backhoe

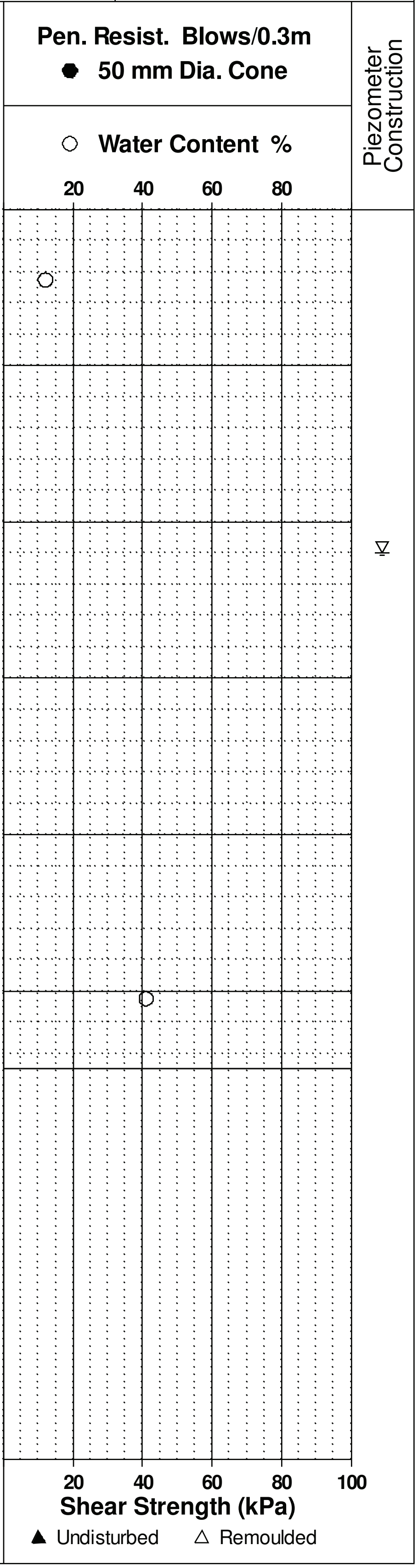
DATE December 18, 2012

SOIL DESCRIPTION	STRATA PLOT (depth, m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.15				
Stiff, brown **SILTY CLAY** with sand	0.90	G	1		
Hard to stiff, brown **SILTY CLAY**	3.00				
Stiff, grey **SILTY CLAY**	5.50	G	2		
End of Test Pit					

DEPTH (m)	ELEV. (m)
0	87.13
1	86.13
2	85.13
3	84.13
4	83.13
5	82.13

TP terminated in stiff silty clay at 5.50m depth

(Groundwater infiltration at 2.2m depth)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP12-12

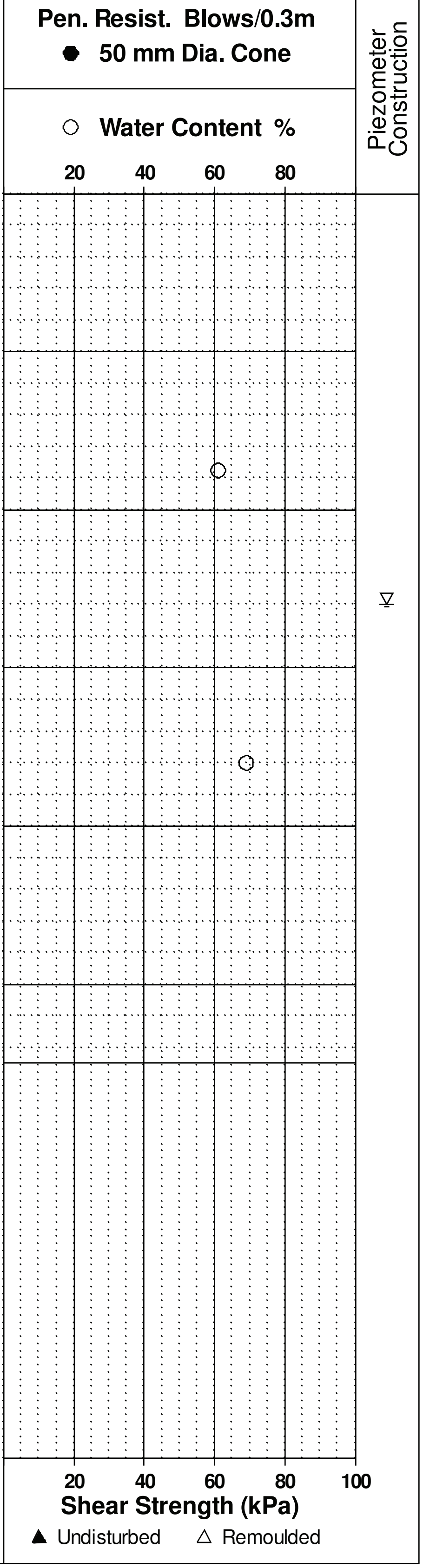
SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.10				
Stiff, brown **SILTY CLAY,** trace sand	0.50				
Hard to stiff, brown **SILTY CLAY**	2.60	G	2		
Stiff, grey **SILTY CLAY**	5.50	G	3		

End of Test Pit

TP terminated in stiff silty clay at 5.50m depth

(Groundwater infiltration at 2.6m depth)

DEPTH (m)	ELEV. (m)
0	87.50
1	86.50
2	85.50
3	84.50
4	83.50
5	82.50



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

HOLE NO. TP13-12

BORINGS BY Backhoe

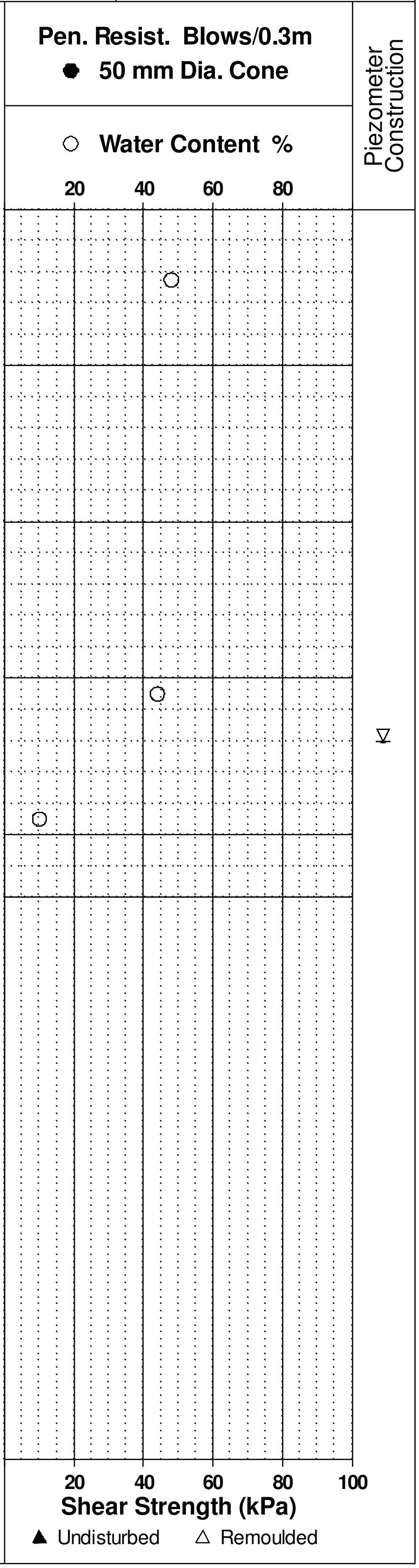
DATE December 18, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	88.52
TOPSOIL 0.30						
Stiff, brown **SILTY CLAY,** trace sand 0.60	G	1				
					1	87.52
Hard to very stiff, brown **SILTY CLAY**	G	2			2	86.52
3.40					3	85.52
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles, trace boulders 4.40	G	3			4	84.52

End of Test Pit

TP terminated in dense glacial till at 4.40m depth

(Groundwater infiltration at 3.4m depth)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

REMARKS

HOLE NO. **TP14-12**

BORINGS BY Backhoe **DATE** December 18, 2012

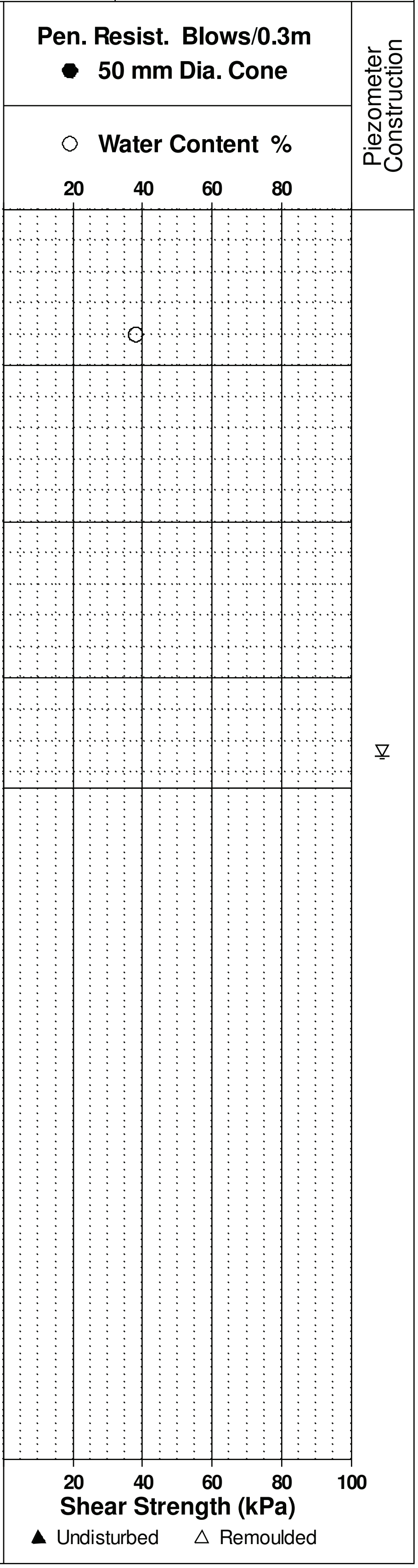
SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.15				
Hard to very stiff, brown **SILTY CLAY,** trace sand	1.15	G	1		
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles, boulders, trace clay	3.70				

End of Test Pit

TP terminated on inferred bedrock surface at 3.70m depth

(Groundwater infiltration at 3.5m depth)

DEPTH (m)	ELEV. (m)
0	92.23
1	91.23
2	90.23
3	89.23



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.	**FILE NO.**	**PG1796**
REMARKS		**HOLE NO.**	**TP15-12**
BORINGS BY	Backhoe **DATE** December 18, 2012		

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						0	95.08		
TOPSOIL 0.30									
						1	94.08		
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles, trace boulders									
						2	93.08		
2.80									▽
End of Test Pit TP terminated on inferred bedrock surface at 2.80m depth (Groundwater infiltration at 2.7m depth)									

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

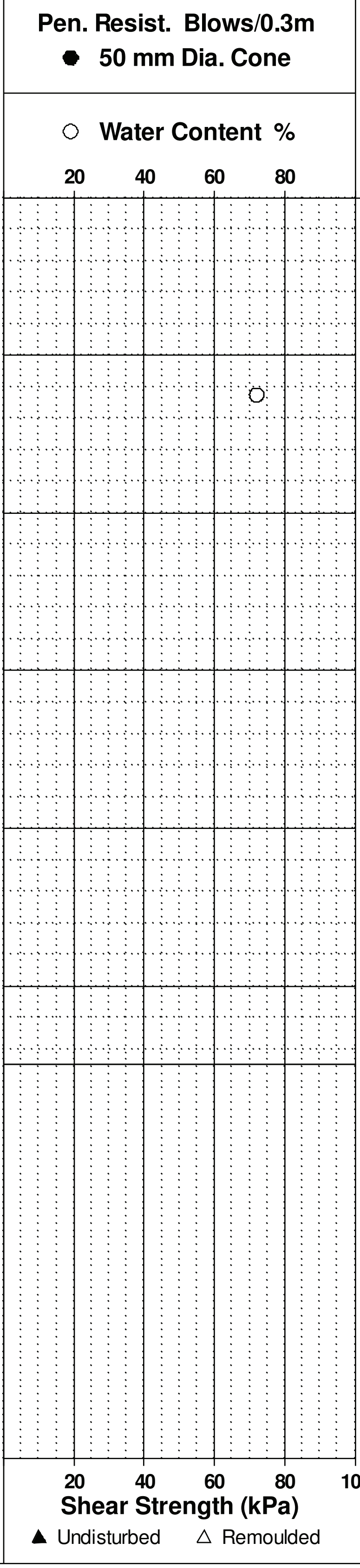
BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP16-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	88.51	
TOPSOIL 0.20								
Stiff to very stiff, brown **SILTY CLAY,** trace sand 1.00						1	87.51	
Hard to stiff, brown **SILTY CLAY** 3.60		G G	1 2			2 3	86.51 85.51	∇
Stiff, grey **SILTY CLAY** 5.50						4 5	84.51 83.51	
End of Test Pit TP terminated in stiff silty clay at 5.50m depth (Groundwater infiltration at 2.3m depth)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.	**FILE NO.** PG1796
REMARKS	**HOLE NO.** TP17-12
BORINGS BY Backhoe **DATE** December 18, 2012	

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.74		
TOPSOIL 0.15									
Brown **SILTY SAND** with clay 0.75									
Very stiff, brown **SILTY CLAY,** trace sand 1.05						1	86.74		
Very stiff to stiff, brown **SILTY CLAY** 2.30						2	85.74		
End of Test Pit TP terminated on inferred bedrock surface at 2.30m depth (TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

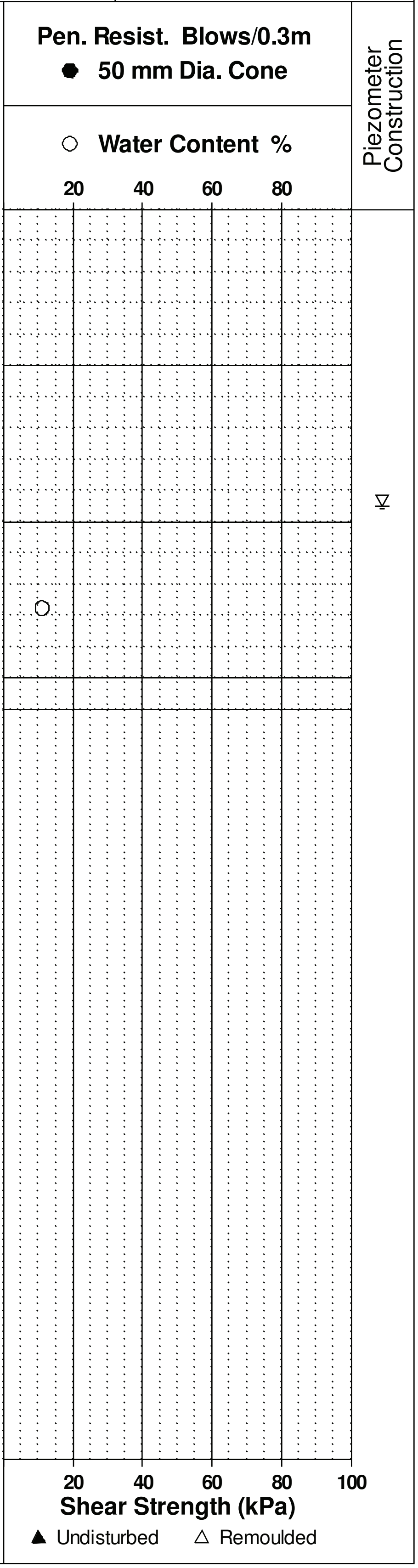
REMARKS

HOLE NO. **TP18-12**

BORINGS BY Backhoe

DATE December 18, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.64
TOPSOIL 0.15							
Stiff, brown **SILTY CLAY** with sand 1.20						1	86.64
Hard to very stiff, brown **SILTY CLAY** 1.90						2	85.64
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, trace boulders 3.20		G	1			3	84.64
End of Test Pit TP terminated on inferred bedrock surface at 3.20m depth (Groundwater infiltration at 1.9m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

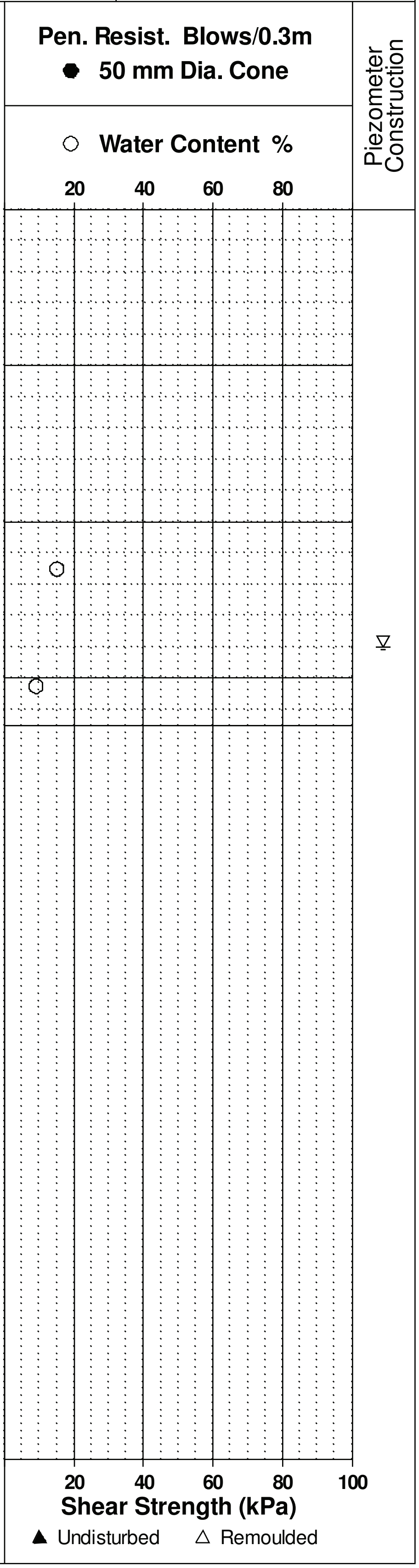
BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP19-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.02
TOPSOIL 0.25							
Compact, brown **SILTY SAND,** some clay 0.95						1	89.02
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles, trace boulders		G	1			2	88.02
- grey by 2.8m depth 3.30		G	2			3	87.02
End of Test Pit TP terminated in dense glacial till at 3.30m depth (Groundwater infiltration at 2.8m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

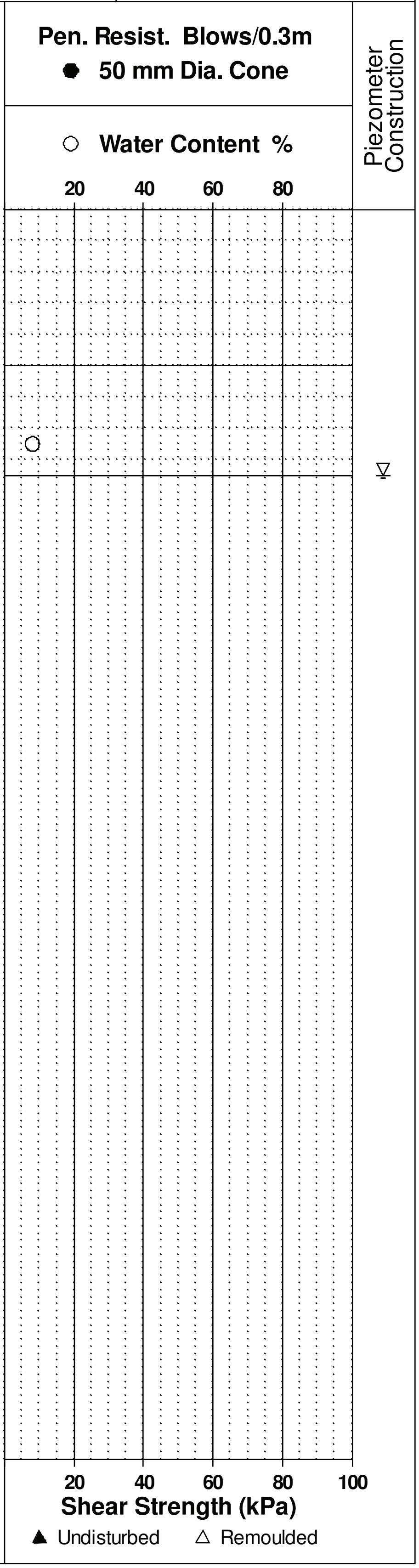
BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP20-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.24
TOPSOIL 0.40	■						
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles, trace clay and boulders 1.70	^^^	G	1			1	88.24
End of Test Pit TP terminated on inferred bedrock surface at 1.70m depth (Groundwater infiltration at 1.7m depth)							

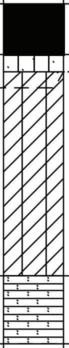


SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.
FILE NO.	**PG1796**
REMARKS	
HOLE NO.	**TP21-12**
BORINGS BY	Backhoe
DATE	December 18, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.41		
TOPSOIL 0.30									
Compact, brown **SILTY SAND** 0.40									
Very stiff, brown **SILTY CLAY,** trace sand 1.60						1	88.41		
Fractured **BEDROCK** 2.00						2	87.41		
End of Test Pit (TP dry upon completion)									



Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

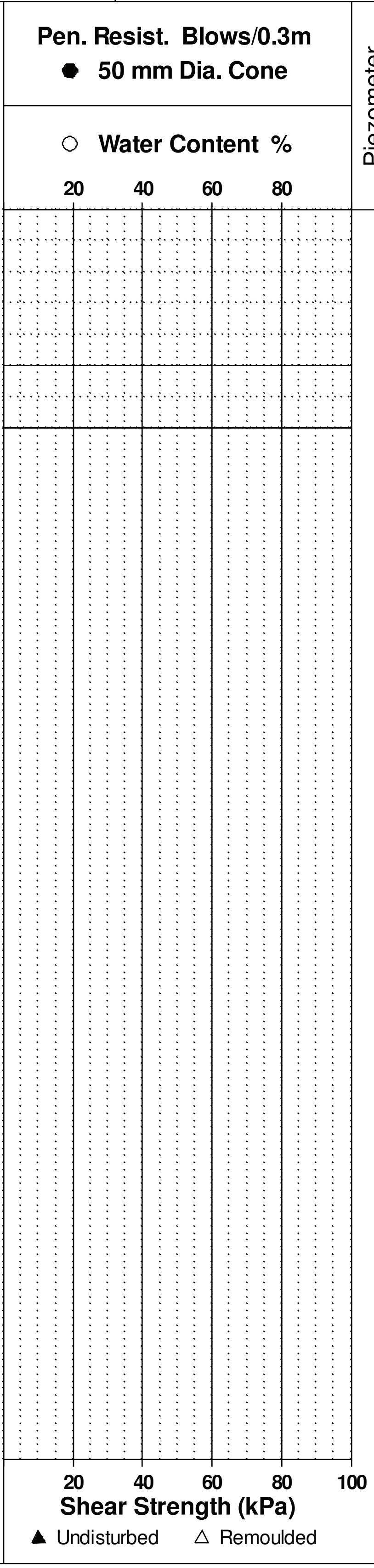
BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP22-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	89.36	
TOPSOIL 0.30	■							
Very stiff, brown **SILTY CLAY,** trace sand 1.40	▨					1	88.36	
End of Test Pit TP terminated on inferred bedrock surface at 1.40m depth (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
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FILE NO. **PG1796**

REMARKS

HOLE NO. **TP23-12**

BORINGS BY Backhoe

DATE December 18, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	93.53
TOPSOIL 0.35	■						
Very stiff, brown **SILTY CLAY,** trace sand 0.75	▨						
End of Test Pit TP terminated on inferred bedrock surface at 0.75m depth (TP dry upon completion)							

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

○ **Water Content %**
20 40 60 80

Piezometer Construction

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

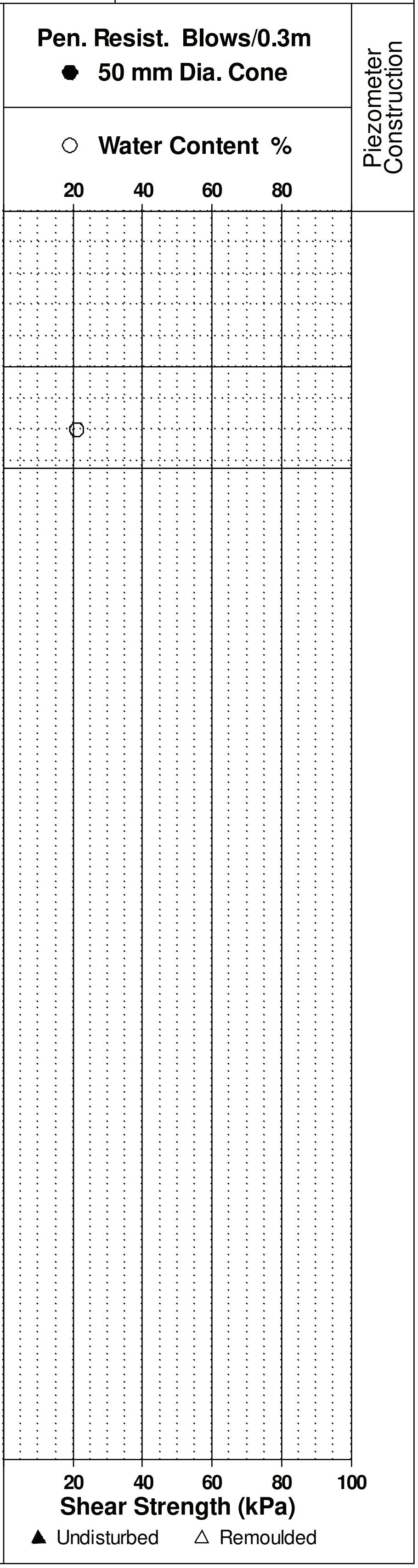
REMARKS

HOLE NO. TP24-12

BORINGS BY Backhoe

DATE December 18, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	93.69
TOPSOIL 0.30							
GLACIAL TILL: Very stiff, brown silty clay with sand, gravel, trace cobbles and boulders 1.65						1	92.69
		G	1				
End of Test Pit TP terminated on inferred bedrock surface at 1.65m depth (TP dry upon completion)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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FILE NO. **PG1796**

REMARKS

HOLE NO. **TP25-12**

BORINGS BY Backhoe

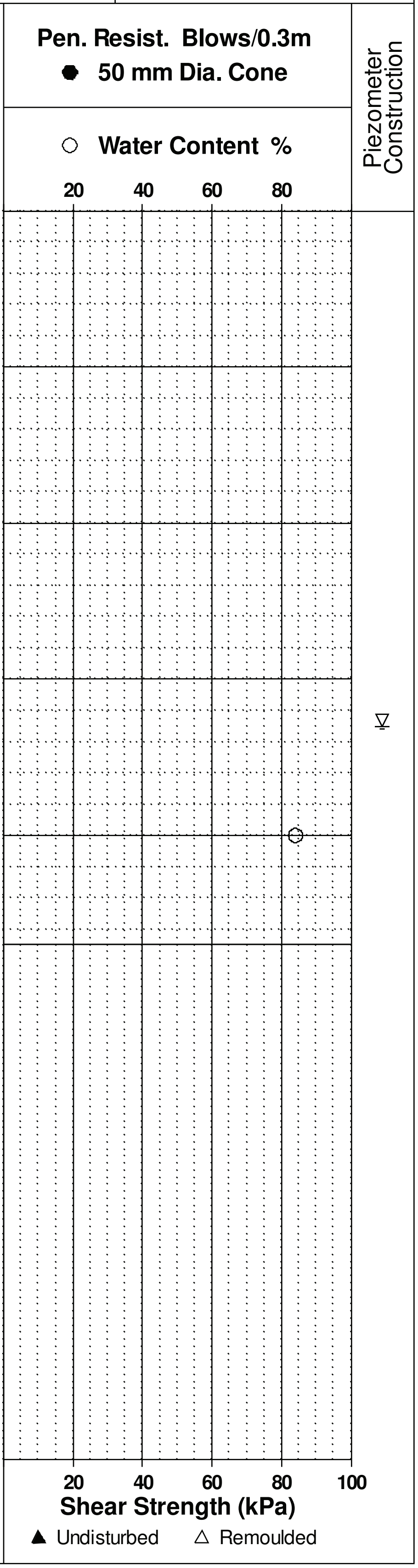
DATE December 17, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	88.41
TOPSOIL — 0.25						
Brown **SILTY SAND,** trace clay — 0.35						
Very stiff, brown **SILTY CLAY,** trace sand — 1.00					1	87.41
Hard to stiff, brown **SILTY CLAY** — 3.30					2	86.41
					3	85.41
Stiff, grey **SILTY CLAY** — 4.70	G	1			4	84.41

End of Test Pit

TP terminated in stiff silty clay at 4.70m depth

(Groundwater infiltration at 3.3m depth)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP26-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	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						0	88.44		
TOPSOIL 0.15									
Hard to very stiff, brown **SILTY CLAY,** trace sand 0.60									
Very stiff, brown **SILTY CLAY** 1.80						1	87.44		
GLACIAL TILL: Dense, brown silty clay with sand, gravel, cobbles, trace boulders - grey by 2.8m depth 3.30						2	86.44		
						3	85.44		▽
End of Test Pit TP terminated in dense glacial till at 3.30m depth (Groundwater infiltration high at 3.14m depth)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 18, 2012

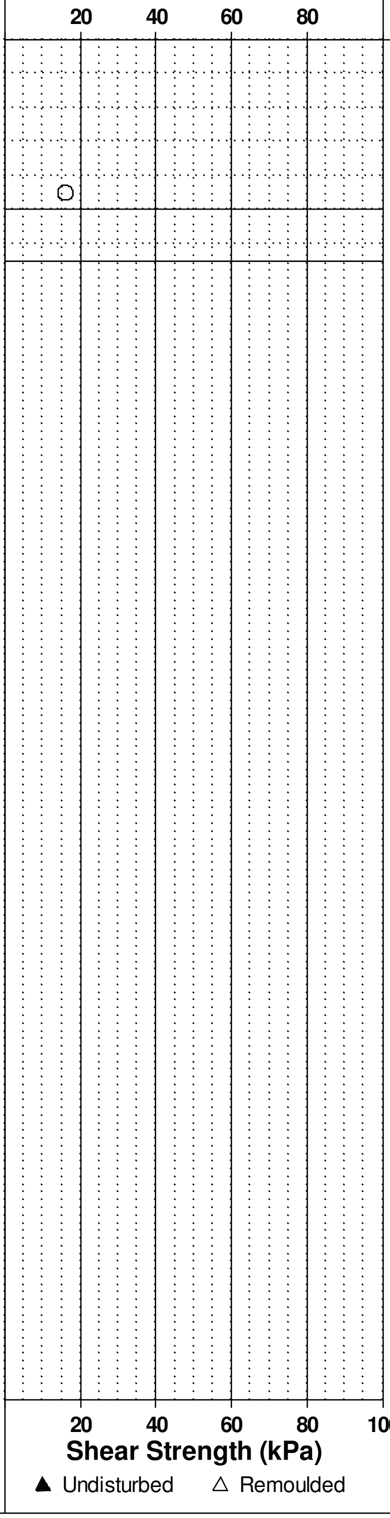
FILE NO. PG1796

HOLE NO. TP27-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.90
TOPSOIL 0.15							
GLACIAL TILL: Compact to dense, brown silty sand with clay, gravel, cobbles, trace boulders 1.30		G	1			1	89.90
End of Test Pit TP terminated on inferred bedrock surface at 1.30m depth (TP dry upon completion)							

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

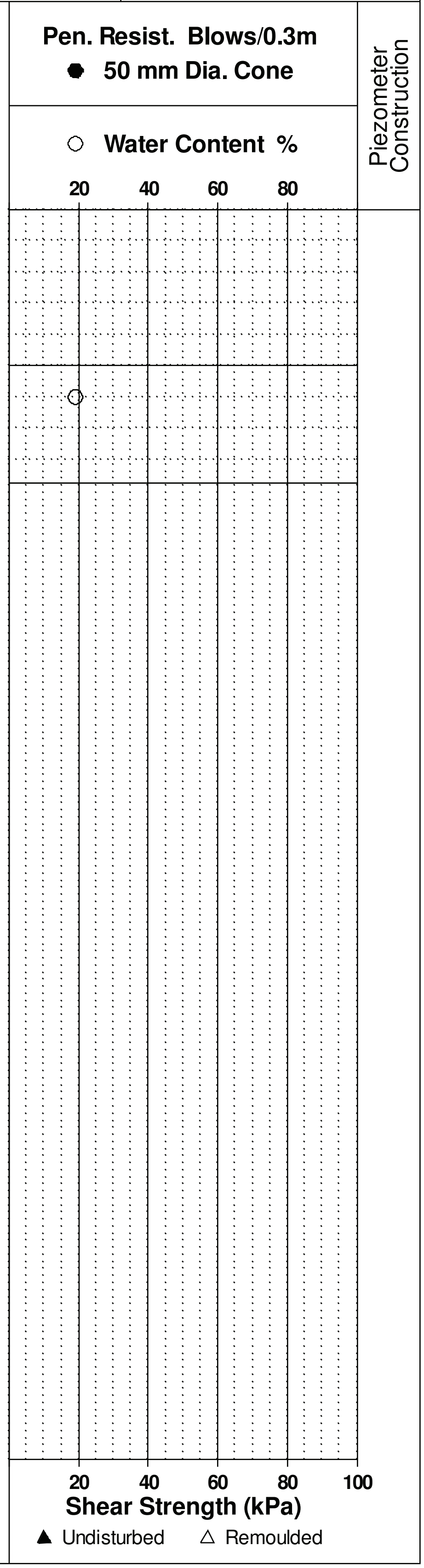
BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP28-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.94
TOPSOIL/ORGANICS 0.60	■						
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, trace boulders 1.75	^^^	G	1			1	86.94
End of Test Pit TP terminated on inferred bedrock surface at 1.75m depth (TP dry upon completion)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

REMARKS

HOLE NO. **TP29-12**

BORINGS BY Backhoe

DATE December 18, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	87.08		
TOPSOIL 0.15	■								
Very stiff, brown **SILTY CLAY,** trace sand 1.00	▨					1	86.08		
						2	85.08		
Hard to stiff, brown **SILTY CLAY**	▨					3	84.08		
4.35						4	83.08		
End of Test Pit TP terminated on inferred bedrock surface at 4.35m depth (TP dry upon completion)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP30-12

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
TOPSOIL	0.15
Loose, brown **SILTY SAND**	0.25
Stiff, brown **SILTY CLAY,** trace sand	0.85
Hard to stiff, brown **SILTY CLAY**	4.60
Stiff, grey **SILTY CLAY**	5.80

End of Test Pit

TP terminated in stiff silty clay at 5.80m depth

(Groundwater infiltration at 4.6m depth)

STRATA PLOT

SAMPLE: TYPE | NUMBER | % RECOVERY | N VALUE or RQD

DEPTH (m)	ELEV. (m)
0	86.57
1	85.57
2	84.57
3	83.57
4	82.57
5	81.57
6	80.57

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

∇ (at 4.60 m)

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE December 17, 2012

FILE NO. PG1796

HOLE NO. TP31-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	82.57		
TOPSOIL 0.20									
Loose, brown **SILTY SAND,** trace clay 0.50									
Hard to very stiff, brown **SILTY CLAY**						1	81.57		
						2	80.57		
3.50						3	79.57		∇
Stiff, grey **SILTY CLAY** 4.17						4	78.57		
End of Test Pit TP terminated on inferred bedrock surface at 4.17m depth (Groundwater infiltration at 3.5m depth)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

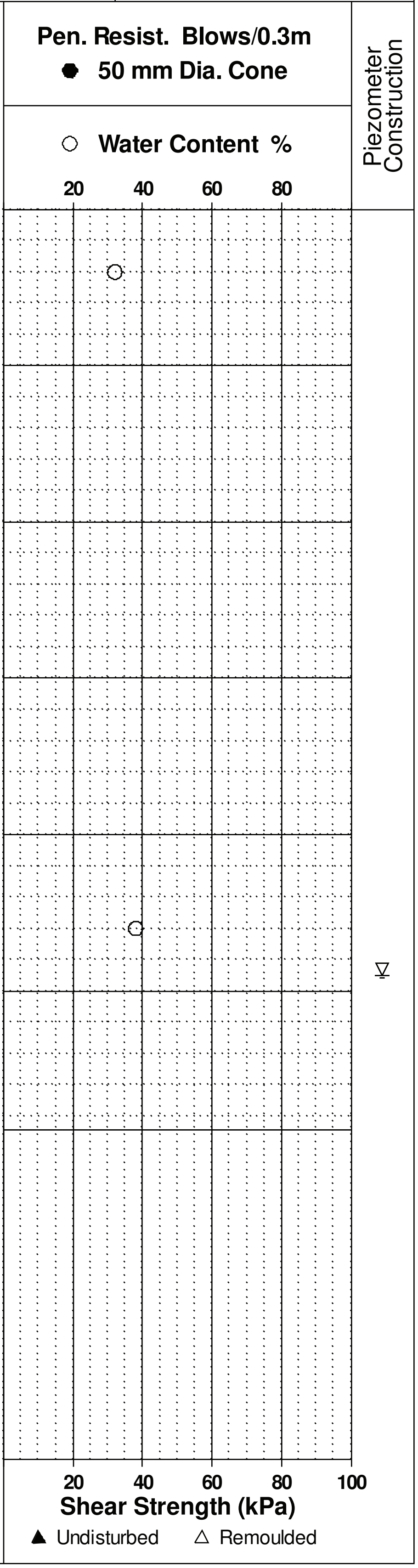
BORINGS BY Backhoe

DATE December 17, 2012

FILE NO. PG1796

HOLE NO. TP32-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	82.26
TOPSOIL 0.20	■						
Loose, brown **SILTY SAND,** trace clay 0.60		G	1				
						1	81.26
						2	80.26
Hard to very stiff, brown **SILTY CLAY** 4.90	▨	G	2				
						3	79.26
						4	78.26
Stiff, grey **SILTY CLAY** 5.89	▨					5	77.26
End of Test Pit TP terminated on inferred bedrock surface at 5.89m depth (Groundwater infiltration high at 4.9m depth)							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

REMARKS

HOLE NO. **TP33-12**

BORINGS BY Backhoe

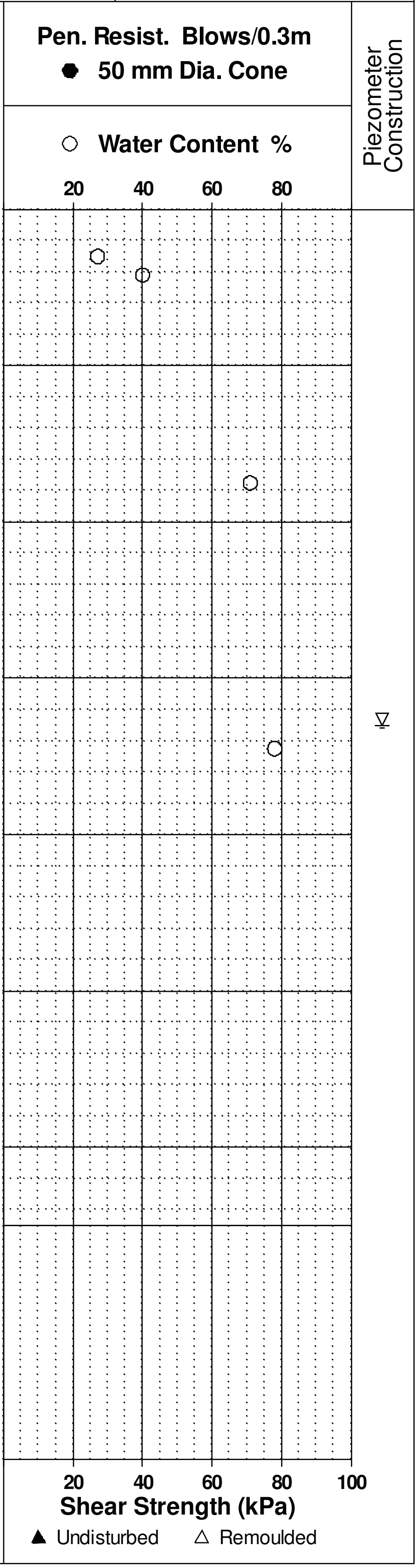
DATE December 17, 2012

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.25				
Loose, brown **SILTY SAND**	0.35	G	1		
Stiff, brown **SILTY CLAY,** trace sand	0.50	G	2		
Hard to very stiff, brown **SILTY CLAY**	3.30	G	3		
Stiff, grey **SILTY CLAY**	6.50	G	4		
End of Test Pit					

TP terminated in stiff silty clay at 6.50m depth

(Groundwater infiltration at 3.3m depth)

DEPTH (m)	ELEV. (m)
0	86.70
1	85.70
2	84.70
3	83.70
4	82.70
5	81.70
6	80.70



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 17, 2012

FILE NO. PG1796

HOLE NO. TP34-12

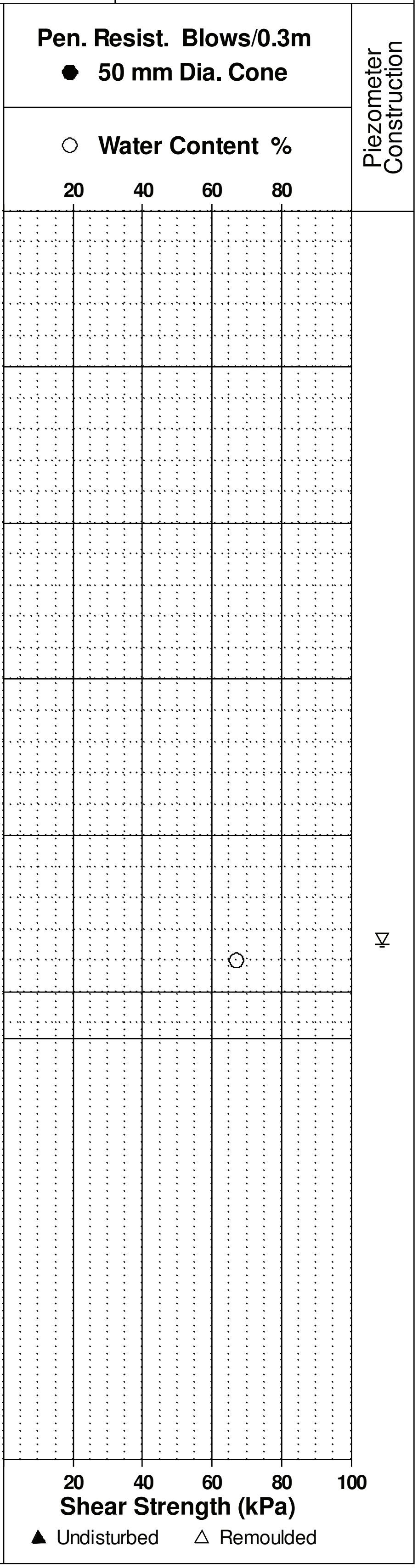
SOIL DESCRIPTION	Depth (m)	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE						
TOPSOIL	0.25					
Loose, brown **SILTY SAND**	0.50					
Stiff, brown **SILTY CLAY,** trace sand	0.90					
Hard to stiff, brown **SILTY CLAY**	4.70					
Stiff, grey **SILTY CLAY**	5.30		G	1		

End of Test Pit

TP terminated in stiff silty clay at 5.30m depth

(Groundwater infiltration at 4.7m depth)

DEPTH (m)	ELEV. (m)
0	86.21
1	85.21
2	84.21
3	83.21
4	82.21
5	81.21



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 20, 2012

FILE NO. PG1796

HOLE NO. TP35-12

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
TOPSOIL	0.20
Stiff, brown **SILTY CLAY** with sand	0.50
Hard to very stiff, brown **SILTY CLAY**	2.40
Stiff, grey **SILTY CLAY**	5.00

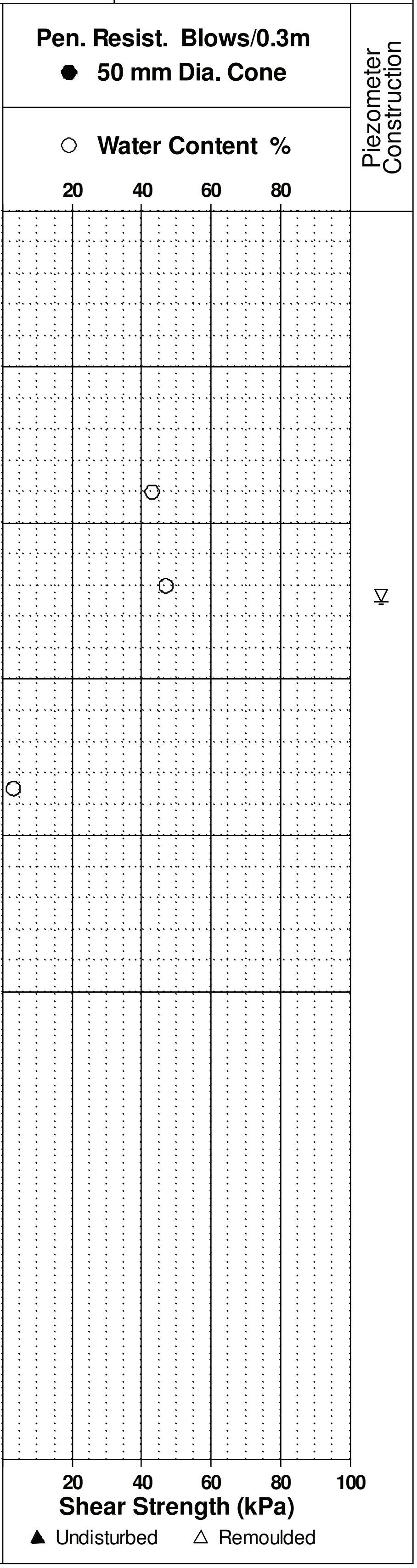
End of Test Pit

TP terminated in stiff silty clay at 5.00m depth

(Groundwater infiltration at 2.5m depth)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
G	1		
G	2		
G	3		

DEPTH (m)	ELEV. (m)
0	68.28
1	67.28
2	66.28
3	65.28
4	64.28
5	63.28



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

REMARKS

HOLE NO. **TP36-12**

BORINGS BY Backhoe

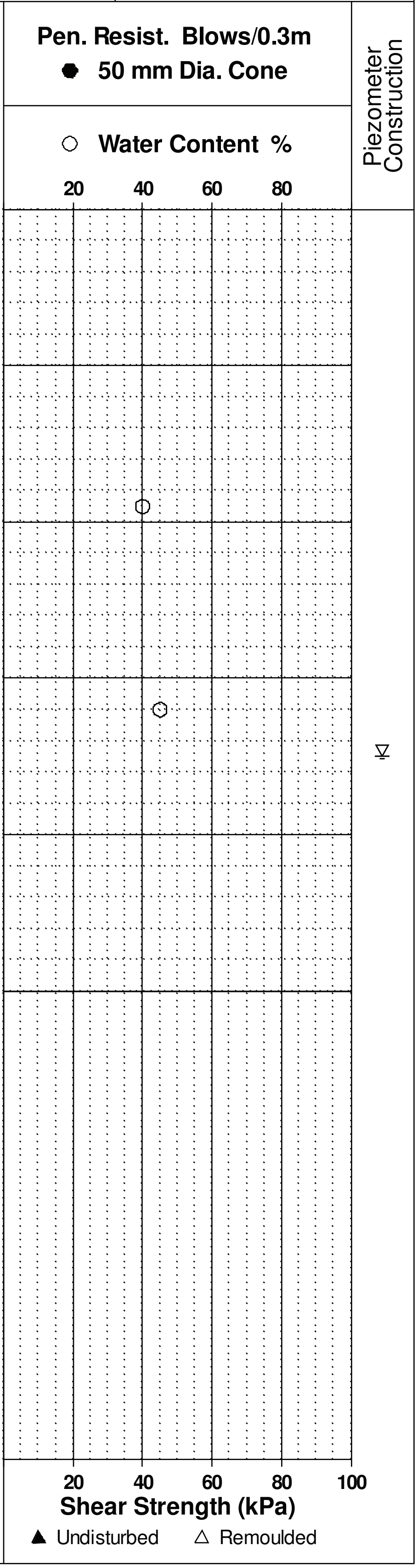
DATE December 20, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	62.51
TOPSOIL — 0.35						
					1	61.51
Hard to very stiff, brown **SILTY CLAY,** trace sand	G	1				
					2	60.51
					3	59.51
	G	2				
— 3.60						
					4	58.51
Stiff, grey **SILTY CLAY**	G	3				
— 5.00					5	57.51

End of Test Pit

TP terminated in stiff silty clay at 5.00m depth

(Groundwater infiltration at 3.5m depth)



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
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REMARKS

BORINGS BY Backhoe

DATE December 20, 2012

FILE NO. PG1796

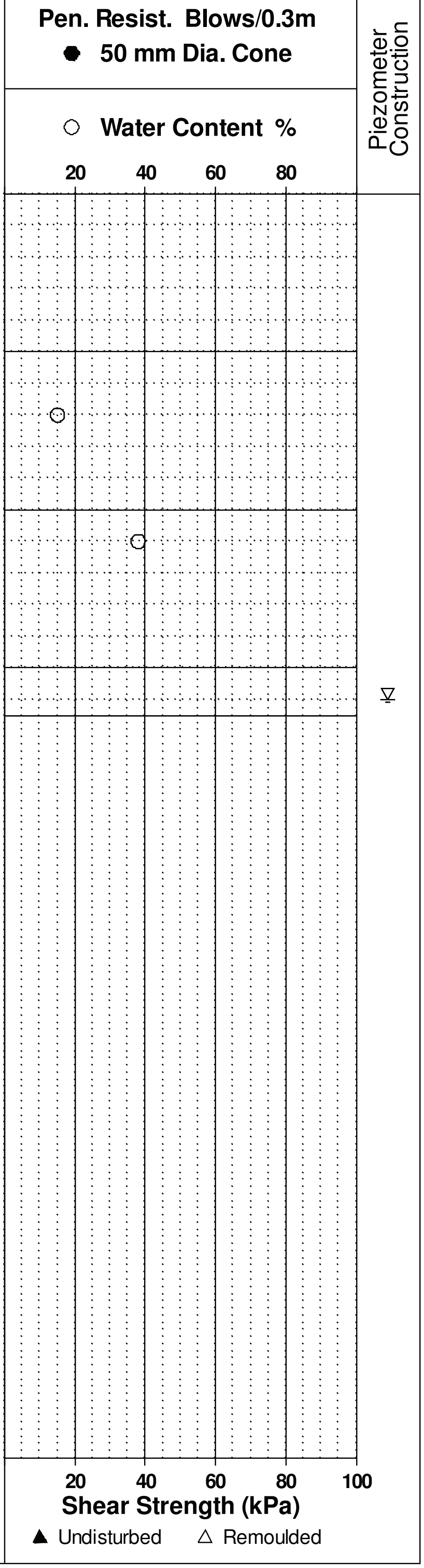
HOLE NO. TP37-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	56.90
TOPSOIL 0.30							
Hard to very stiff, brown **SILTY CLAY,** trace sand						1	55.90
		G	1				
1.70							
GLACIAL TILL: Brown silty sand with clay, gravel, cobbles, boulders						2	54.90
		G	2				
						3	53.90
3.30							

End of Test Pit

TP terminated on inferred bedrock surface at 3.30m depth

(Groundwater infiltration moderate to high at 3.2m depth)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

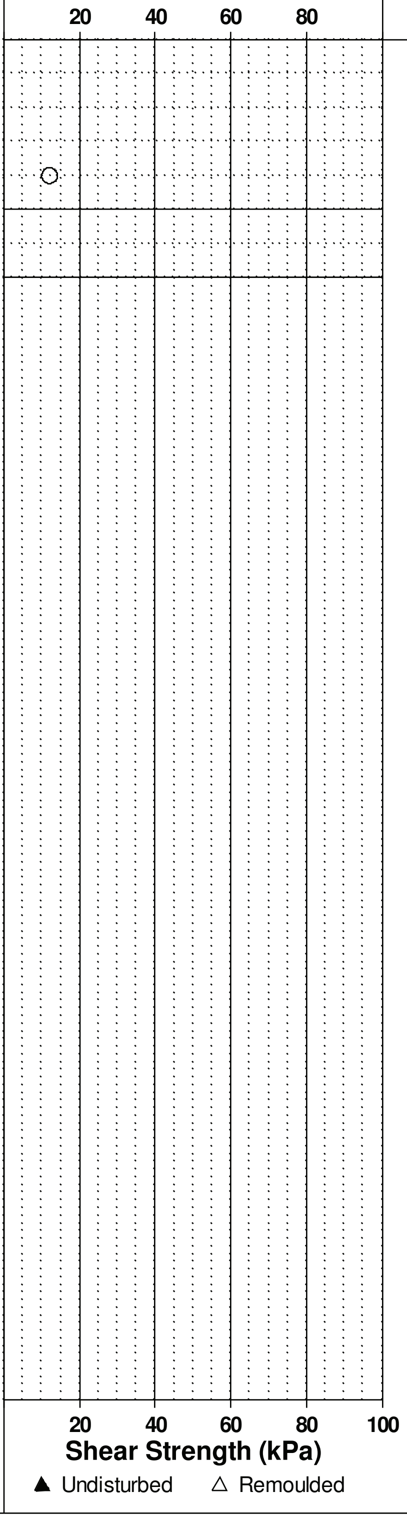
REMARKS

HOLE NO. TP38-12

BORINGS BY Backhoe

DATE December 20, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	57.35		
TOPSOIL 0.30									
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles, boulders 1.40		G	1			1	56.35		
End of Test Pit TP terminated on inferred bedrock surface at 1.40m depth (Groundwater infiltration at 1.4m depth)									



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
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FILE NO. **PG1796**

REMARKS

HOLE NO. **TP39-12**

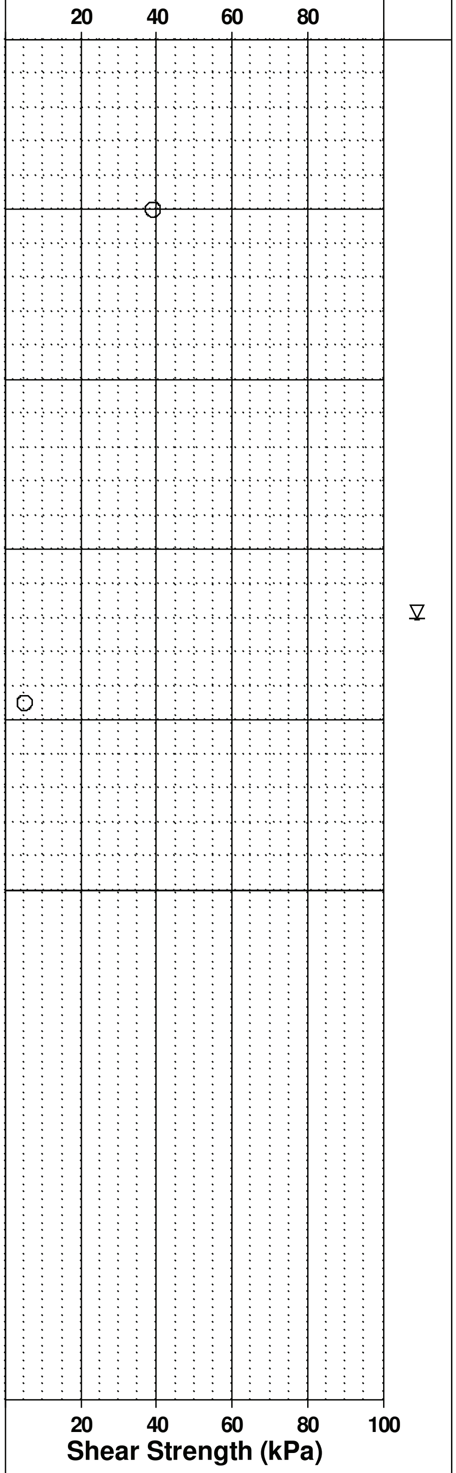
BORINGS BY Backhoe

DATE December 20, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	68.96
TOPSOIL — 0.25							
Stiff, brown **SILTY CLAY,** trace sand — 0.70							
Hard to very stiff, brown **SILTY CLAY** — 3.40		G	1			1	67.96
						2	66.96
						3	65.96
GLACIAL TILL: Compact to dense, grey sand with gravel, cobbles, trace clay — 5.00		G	2			4	64.96
End of Test Pit						5	63.96

TP terminated on inferred bedrock surface at 5.00m depth

(Groundwater infiltration at 3.4m depth)



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

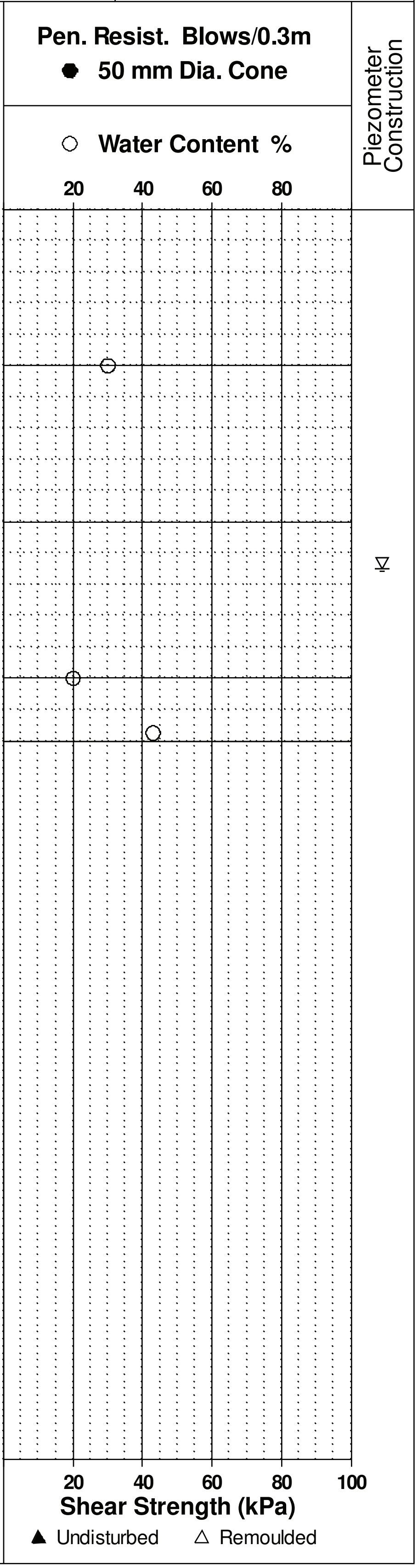
BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. PG1796

HOLE NO. TP40-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	70.69
TOPSOIL 0.35							
Hard to very stiff, brown **SILTY CLAY**		G	1			1	69.69
2.60						2	68.69
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles, trace boulders		G	2			3	67.69
3.40		G	3				
End of Test Pit TP terminated on inferred bedrock surface at 3.40m depth (Groundwater infiltration at 2.3m depth)							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 19, 2012

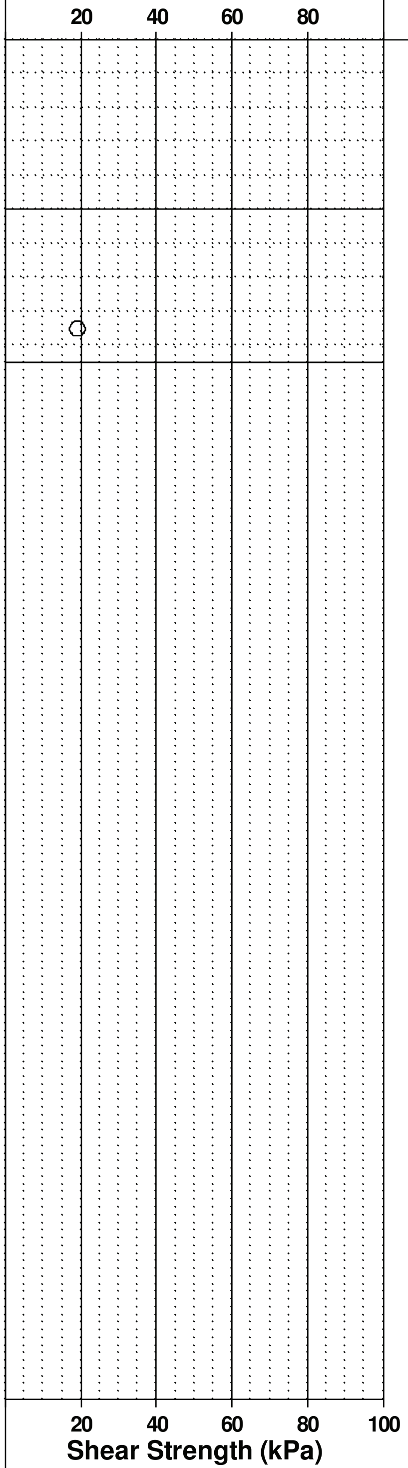
FILE NO. PG1796

HOLE NO. TP41-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	69.64
TOPSOIL 0.40	■						
GLACIAL TILL: Very stiff, brown silty clay with sand, gravel, trace cobbles and boulders 1.90	^^^					1	68.64
		G	1				
End of Test Pit TP terminated on inferred bedrock surface at 1.90m depth (TP dry upon completion)							

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
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REMARKS

BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. PG1796

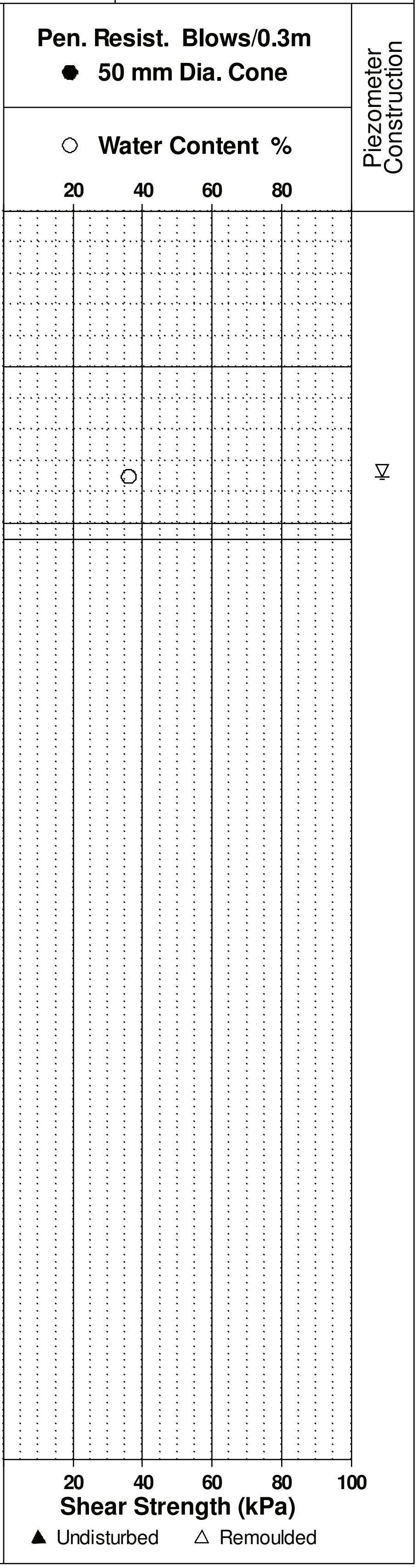
HOLE NO. TP42-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	71.87
TOPSOIL 0.35							
Hard to very stiff, brown **SILTY CLAY** 2.00		G	1			1	70.87
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles, trace clay and boulders 2.10						2	69.87

End of Test Pit

TP terminated on inferred bedrock surface at 2.10m depth

(Groundwater infiltration at 1.7m depth)



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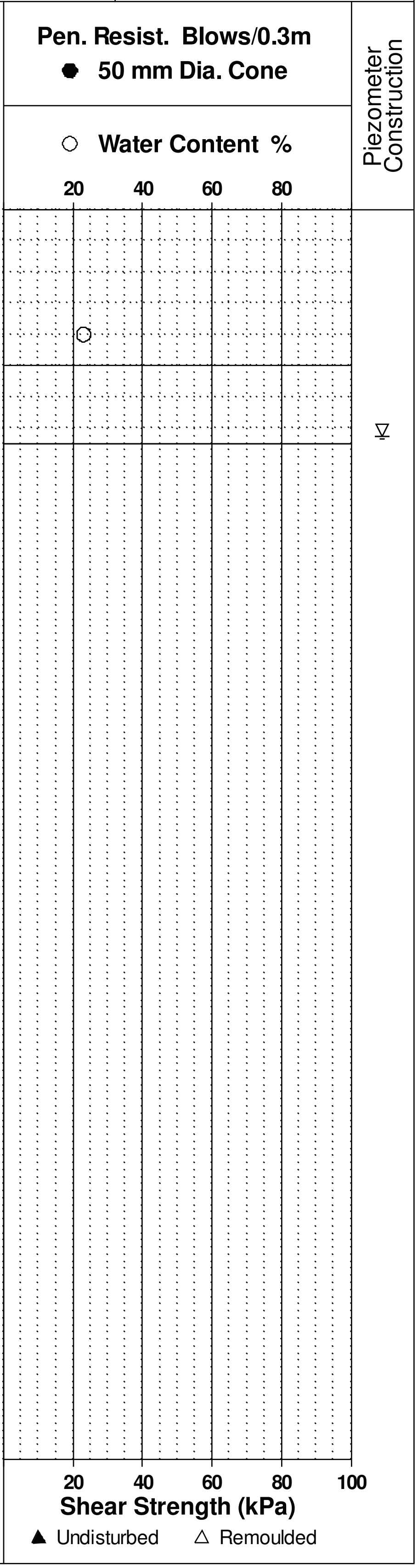
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.
REMARKS	
BORINGS BY	Backhoe
DATE	December 18, 2012
FILE NO.	PG1796
HOLE NO.	TP43-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	74.00
TOPSOIL 0.30							
GLACIAL TILL: Hard to very stiff, brown silty clay with sand and gravel - with cobbles and boulders by 1.25m depth 1.50		G	1			1	73.00
End of Test Pit TP terminated on inferred bedrock surface at 1.50m depth (Groundwater infiltration at 1.4m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

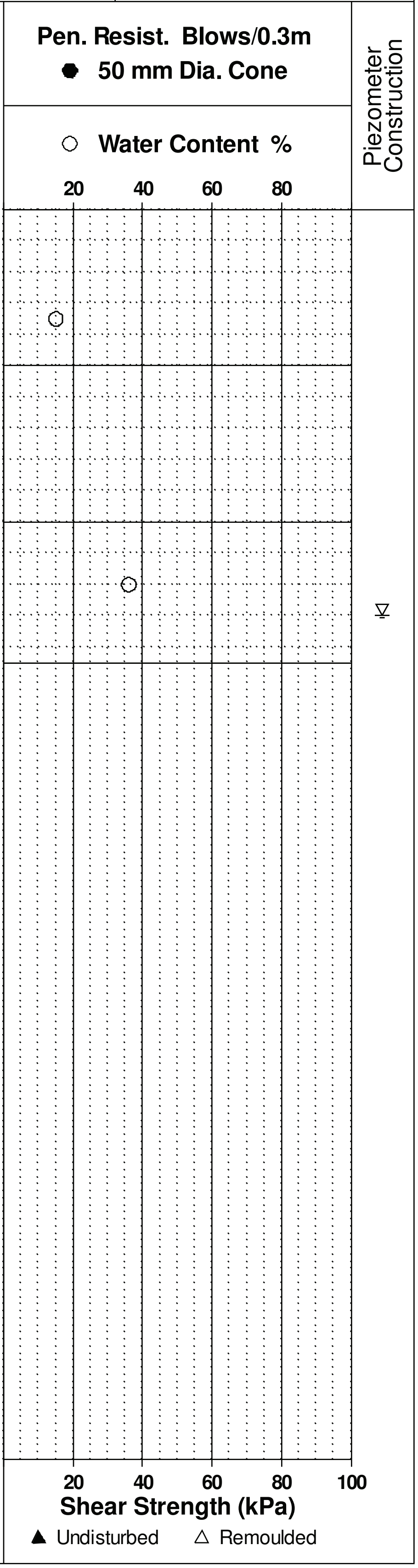
BORINGS BY Backhoe

DATE December 18, 2012

FILE NO. PG1796

HOLE NO. TP44-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	80.73
TOPSOIL 0.10							
Stiff, brown **SILTY CLAY** with sand 1.00		G	1			1	79.73
Hard to very stiff, brown **SILTY CLAY** 2.90		G	2			2	78.73
End of Test Pit TP terminated on inferred bedrock surface at 2.90m depth (Groundwater infiltration at 2.6m depth)							



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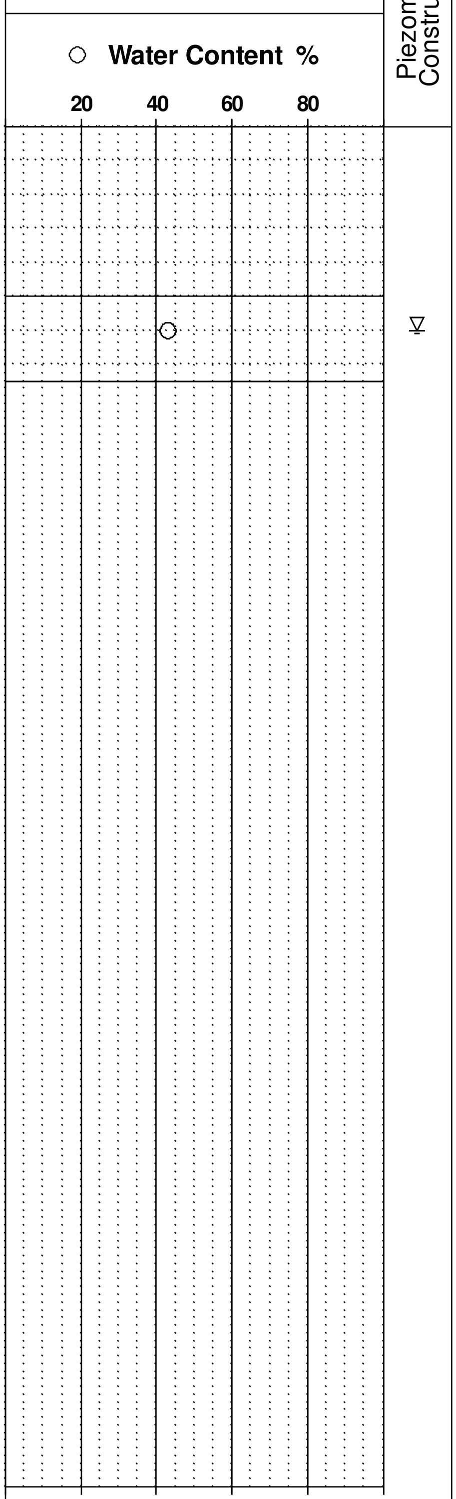
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.
REMARKS
BORINGS BY Backhoe
DATE December 19, 2012
FILE NO. PG1796
HOLE NO. TP45-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	75.00
TOPSOIL (to 0.35)							
GLACIAL TILL: Hard to very stiff, brown silty clay with sand, gravel, cobbles, boulders (0.35 to 1.50)		G	1			1	74.00
End of Test Pit TP terminated on inferred bedrock surface at 1.50m depth (Groundwater infiltration at 1.2m depth)							



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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

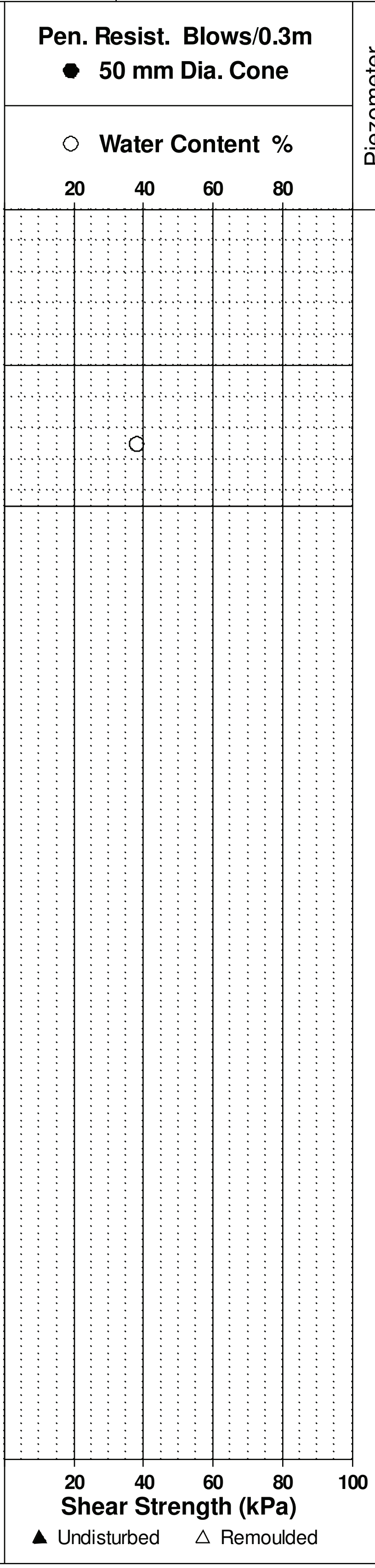
BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. **PG1796**

HOLE NO. **TP46-12**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	73.43	
TOPSOIL 0.25	■							
Hard to very stiff, brown **SILTY CLAY**	▨					1	72.43	
		G	1					∇
- some sand by 1.8m depth 1.90	▨							
End of Test Pit TP terminated on inferred bedrock surface at 1.90m depth (Groundwater infiltration at 1.75m depth)								



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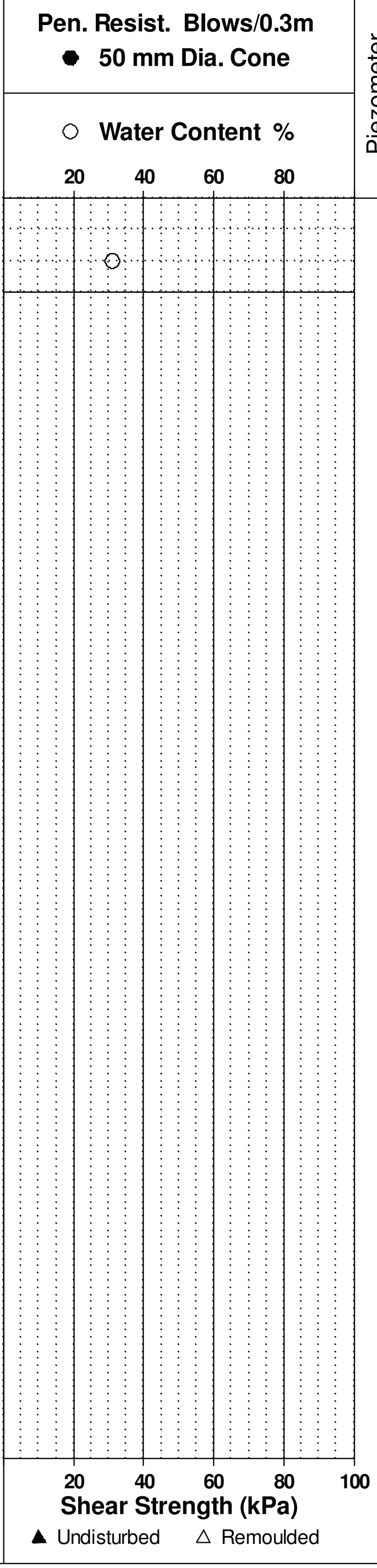
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM	Ground surface elevations provided by Stantec Geomatics Limited.	**FILE NO.**	**PG1796**
REMARKS		**HOLE NO.**	**TP47-12**
BORINGS BY	Backhoe **DATE** December 19, 2012		

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	72.98	
TOPSOIL 0.25	■							
Firm, brown **SILTY CLAY,** some organics, trace sand and gravel 0.60	▨	G	1					
End of Test Pit TP terminated on inferred bedrock surface at 0.60m depth (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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REMARKS

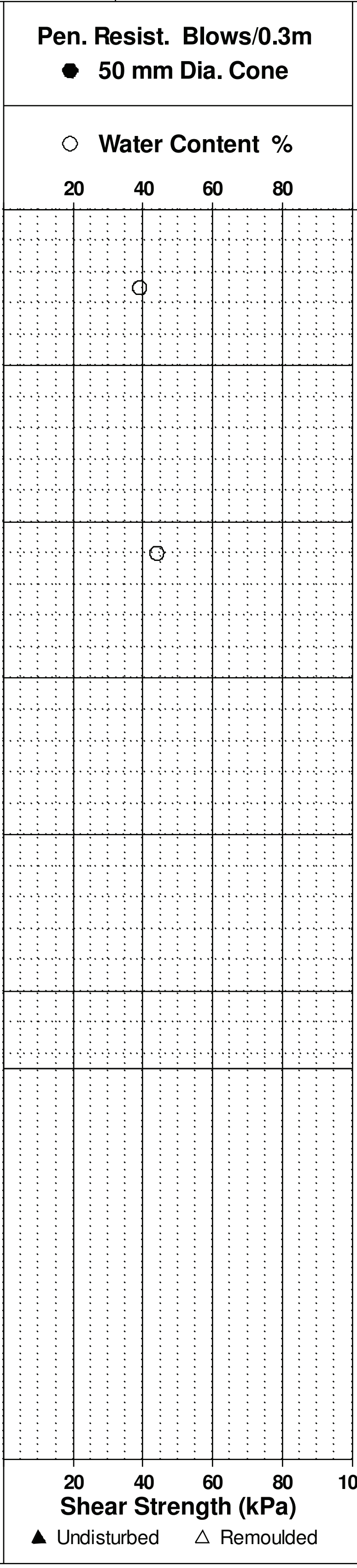
BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. PG1796

HOLE NO. TP48-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	57.24	
FILL: Brown silty clay, some sand	⊠	G	1					
0.70								
TOPSOIL	■							
0.90								
	▨					1	56.24	
	▨	G	2			2	55.24	
Hard to very stiff, brown **SILTY CLAY**	▨					3	54.24	
	▨					4	53.24	
	▨					5	52.24	
5.50								
End of Test Pit TP terminated in very stiff silty clay at 5.50m depth (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

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REMARKS

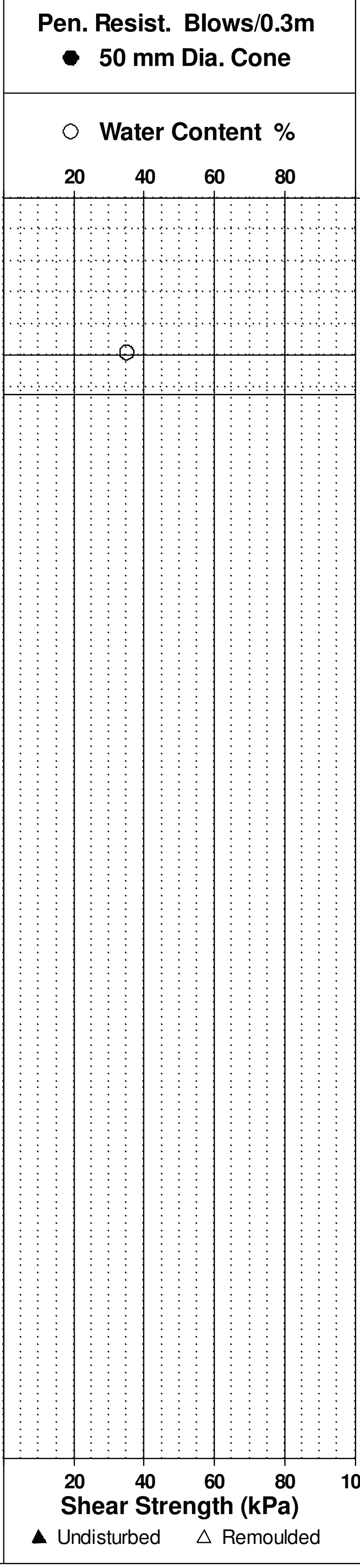
BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. PG1796

HOLE NO. TP49-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	70.86	
TOPSOIL 0.30								
GLACIAL TILL: Hard to very stiff, brown silty clay with some sand, trace boulders 1.25		G	1			1	69.86	
End of Test Pit TP terminated on inferred bedrock surface at 1.25m depth (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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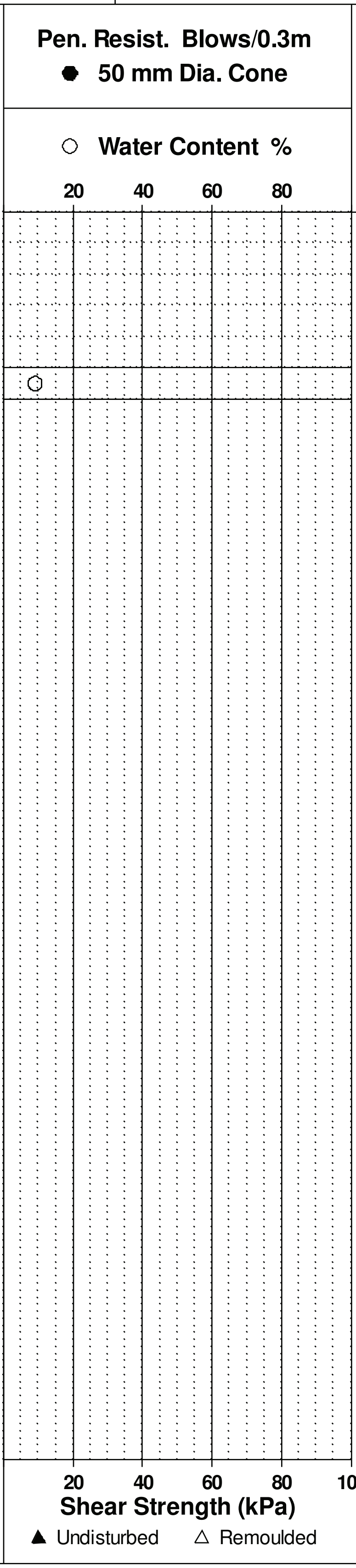
DATUM	Ground surface elevations provided by Stantec Geomatics Limited.
REMARKS	
BORINGS BY	Backhoe
DATE	December 19, 2012
FILE NO.	**PG1796**
HOLE NO.	**TP50-12**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	78.83
TOPSOIL 0.35	■						
GLACIAL TILL: Hard to very stiff, brown silty clay with sand, occasional gravel, cobbles, boulders 1.20	^^^	G	1			1	77.83
End of Test Pit TP terminated on inferred bedrock surface at 1.20m depth (TP dry upon completion)							



Piezometer Construction

SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Queen Street
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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 19, 2012

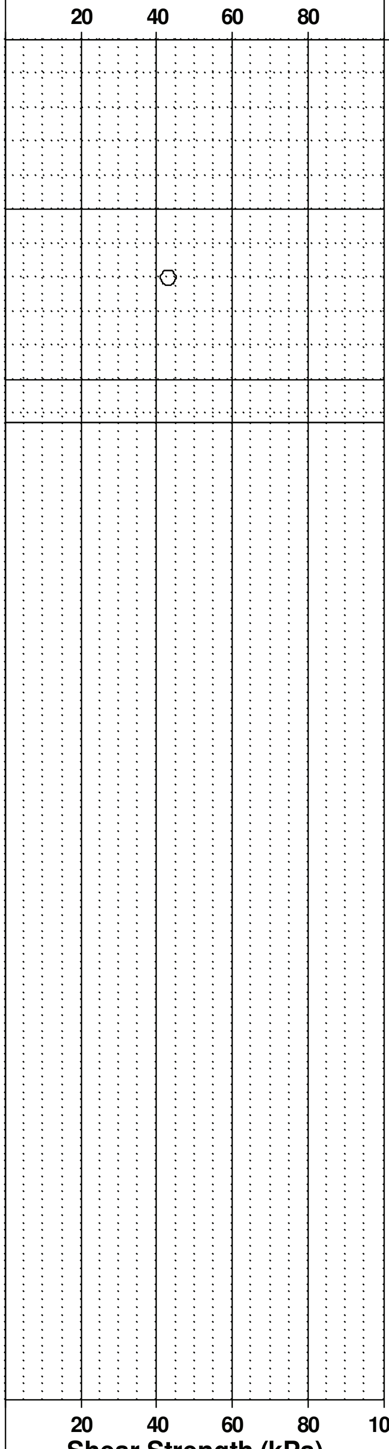
FILE NO. PG1796

HOLE NO. TP51-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	78.73
TOPSOIL 0.35							
Stiff, brown **SILTY CLAY** - very stiff to hard by 1.0m depth						1	77.73
		G	1				
2.25						2	76.73
End of Test Pit TP terminated on inferred bedrock surface at 2.25m depth (TP dry upon completion)							

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

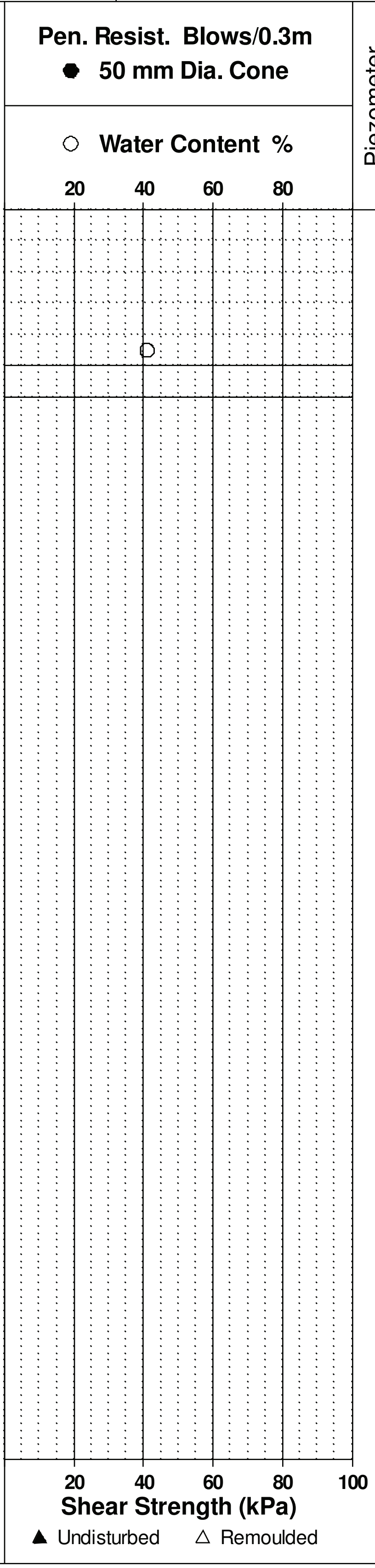
BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. PG1796

HOLE NO. TP52-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	80.59	
TOPSOIL 0.30	■							
Hard to very stiff, brown **SILTY CLAY** 1.20	▨	G	1			1	79.59	▽
End of Test Pit TP terminated on inferred bedrock surface at 1.20m depth (Groundwater infiltration at 1.1m depth)								



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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

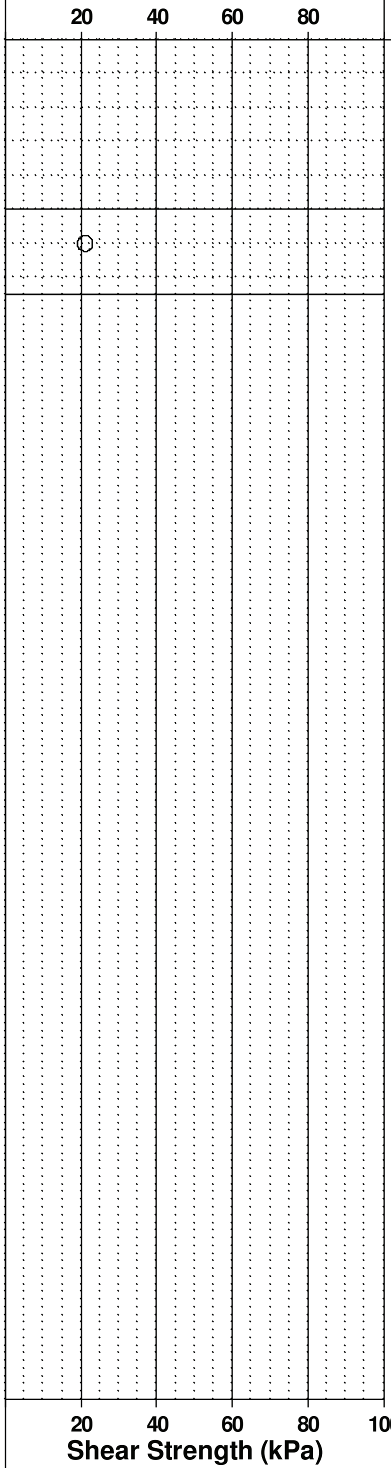
REMARKS

HOLE NO. TP53-12

BORINGS BY Backhoe

DATE December 19, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	81.45	
TOPSOIL 0.55								
GLACIAL TILL: Hard to very stiff, brown silty clay with sand, trace gravel and organics 1.50		G	1			1	80.45	
End of Test Pit TP terminated on inferred bedrock surface at 1.50m depth (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

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REMARKS

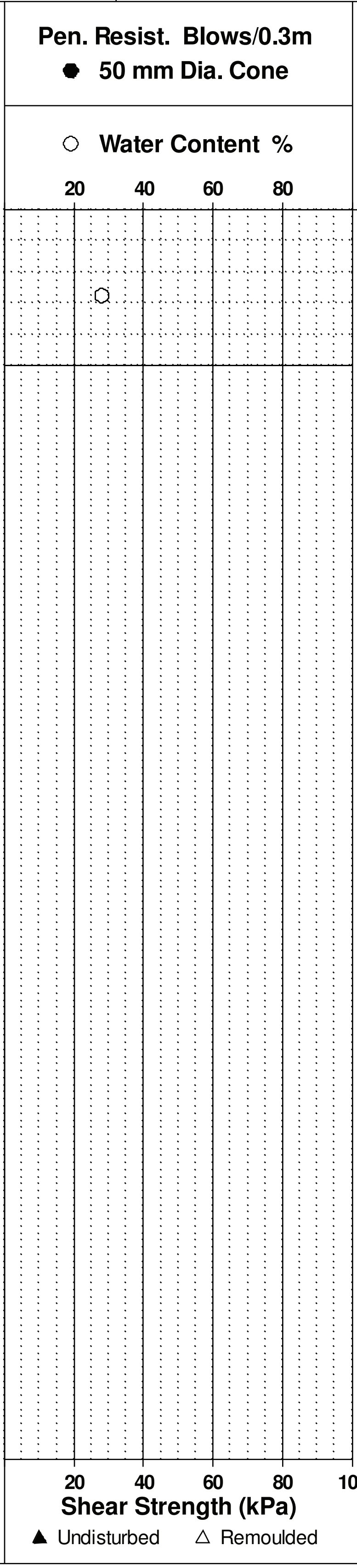
BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. PG1796

HOLE NO. TP54-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	85.32	
TOPSOIL 0.15								
GLACIAL TILL: Hard, brown silty clay with sand, trace gravel, cobbles, boulders 1.00		G	1					
End of Test Pit TP terminated on inferred bedrock surface at 1.00m depth (TP dry upon completion)						1	84.32	



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

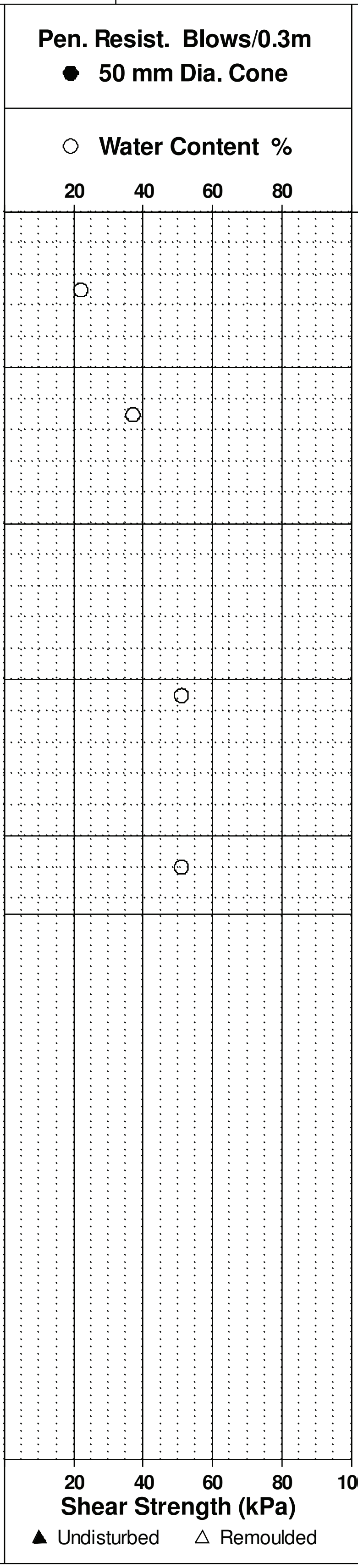
BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. PG1796

HOLE NO. TP55-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	55.00
FILL: Topsoil with organics 0.10							
FILL: Brown silty sand, trace clay and gravel 0.70		G	1				
TOPSOIL 0.85							
		G	2			1	54.00
Hard to very stiff, brown **SILTY CLAY**						2	53.00
		G	3			3	52.00
4.50		G	4			4	51.00
End of Test Pit TP terminated in very stiff silty clay at 4.50m depth (TP dry upon completion)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. PG1796

HOLE NO. TP56-12

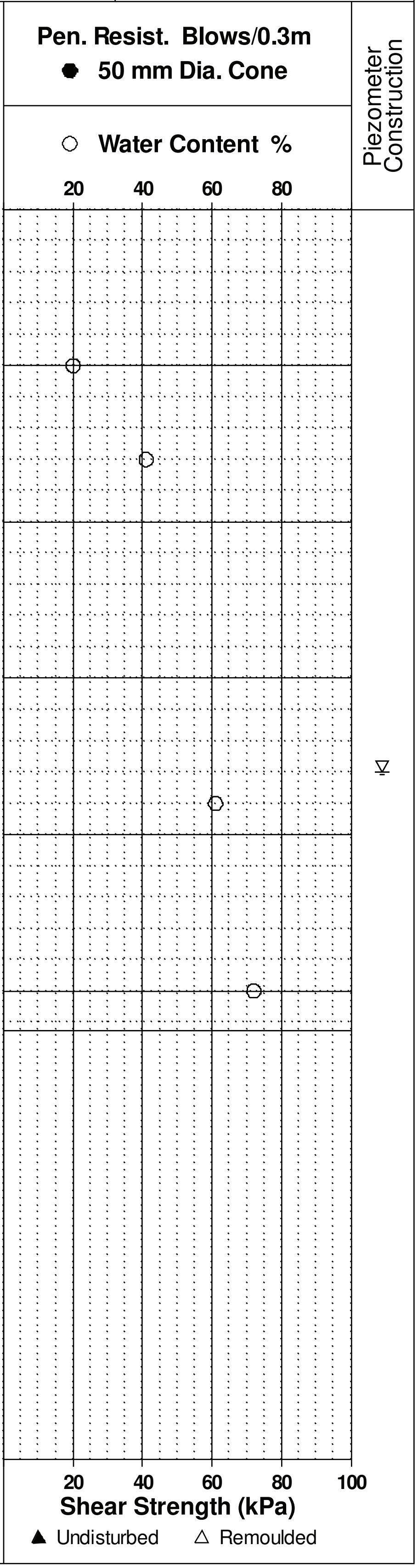
SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.60					
Compact, brown **SILTY SAND** 1.90		G G	1 2		
Hard to very stiff, brown **SILTY CLAY,** trace sand 3.60					
Very stiff to firm, grey **SILTY CLAY** 5.25		G G	3 4		

End of Test Pit

TP terminated in firm silty clay at 5.25m depth

(Groundwater infiltration at 3.6m depth)

DEPTH (m)	ELEV. (m)
0	53.33
1	52.33
2	51.33
3	50.33
4	49.33
5	48.33



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. PG1796

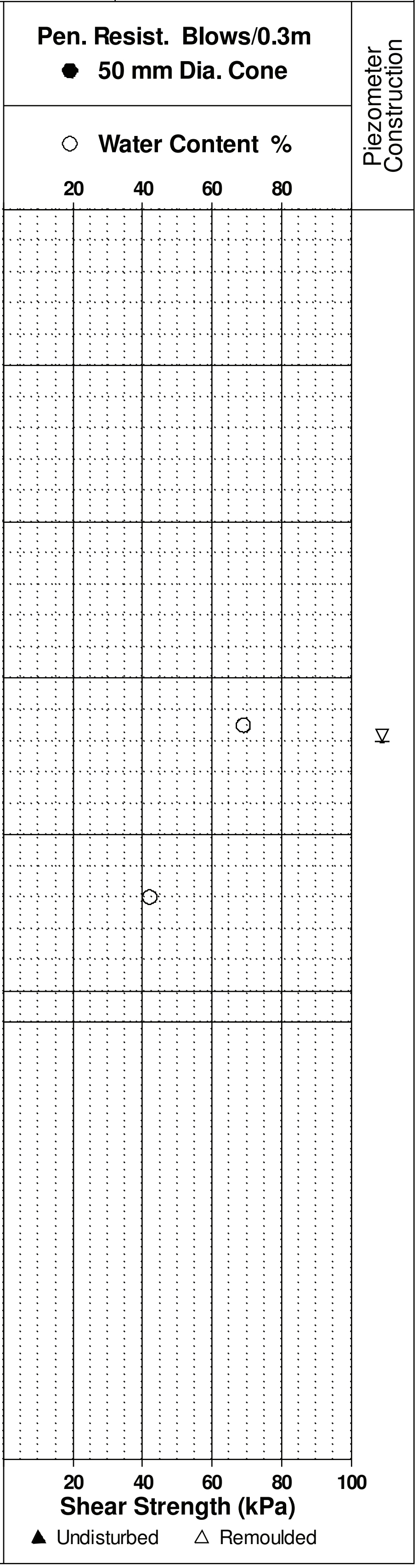
HOLE NO. TP57-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.37
TOPSOIL 0.15							
Very stiff to stiff, brown **SILTY CLAY**						1	52.37
						2	51.37
						3	50.37
3.40		G	1				
Stiff, grey **SILTY CLAY**						4	49.37
		G	2				
						5	48.37
5.20							

End of Test Pit

TP terminated in stiff silty clay at 5.20m depth

(Groundwater infiltration at 3.4m depth)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Backhoe

DATE December 19, 2012

FILE NO. **PG1796**

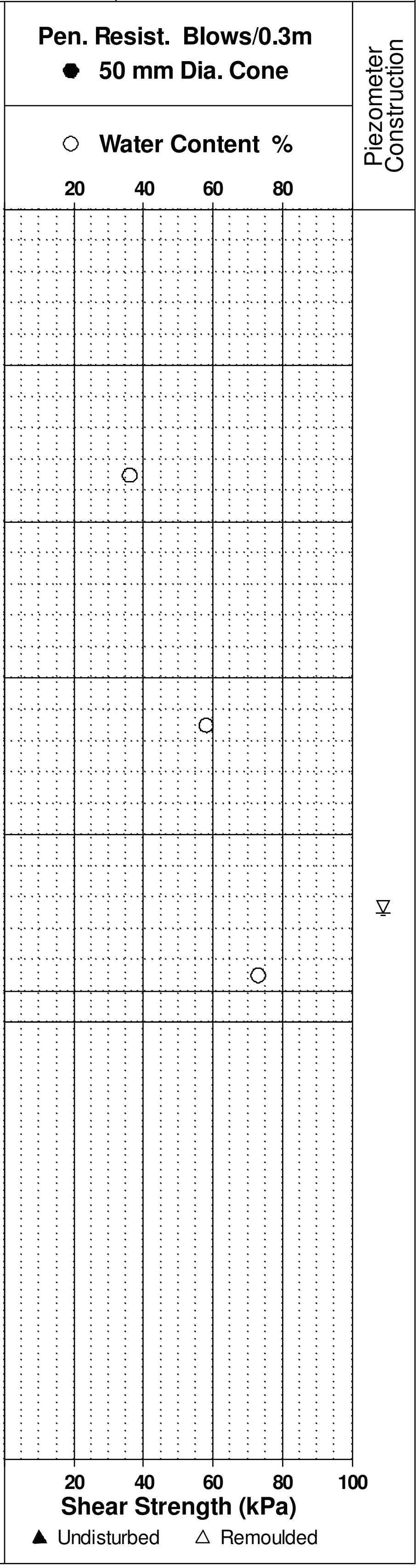
HOLE NO. **TP58-12**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.25
TOPSOIL 0.20	■						
Hard to very stiff, brown **SILTY CLAY,** trace sand 4.70	▨					1	52.25
		G	1				
						2	51.25
						3	50.25
		G	2				
						4	49.25
Hard to very stiff, grey **SILTY CLAY** 5.20	▨	G	3			5	48.25

End of Test Pit

TP terminated in very stiff silty clay at 5.20m depth

(Groundwater infiltration at 4.5m depth)



SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

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

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu - Uniformity coefficient = D60 / D10

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

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

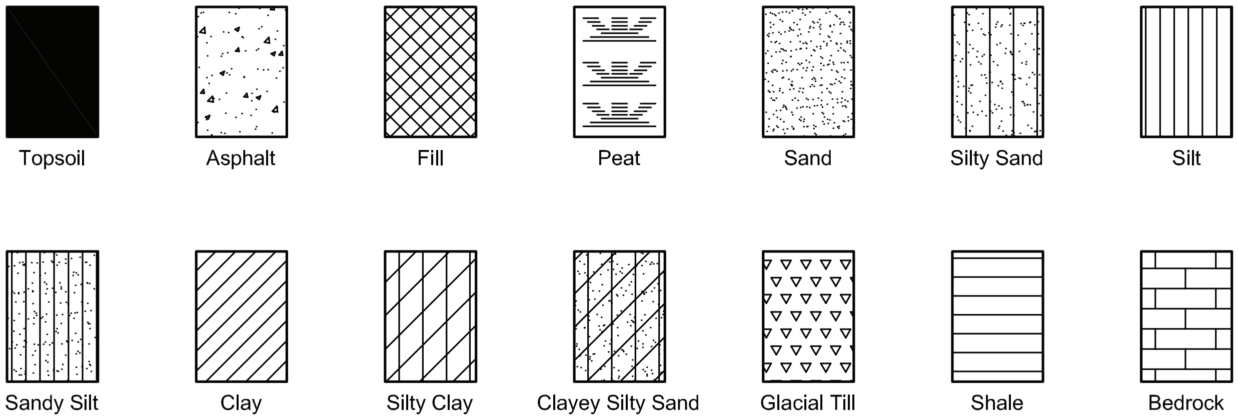
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

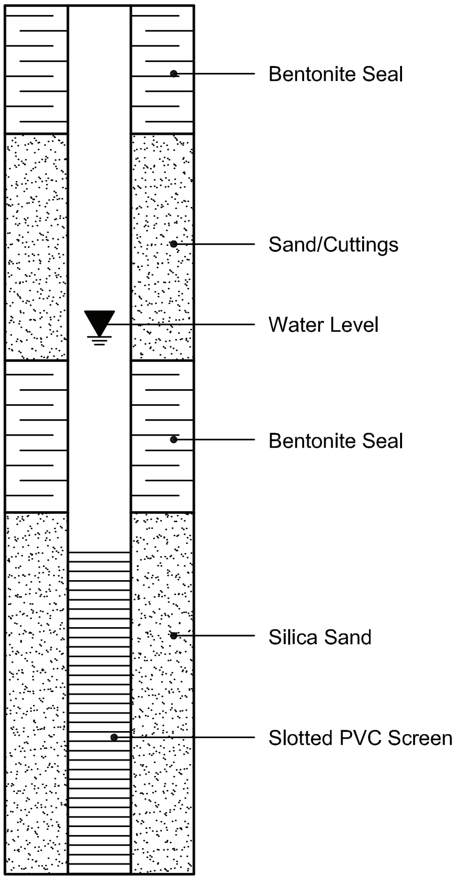
SYMBOLS AND TERMS (continued)

STRATA PLOT

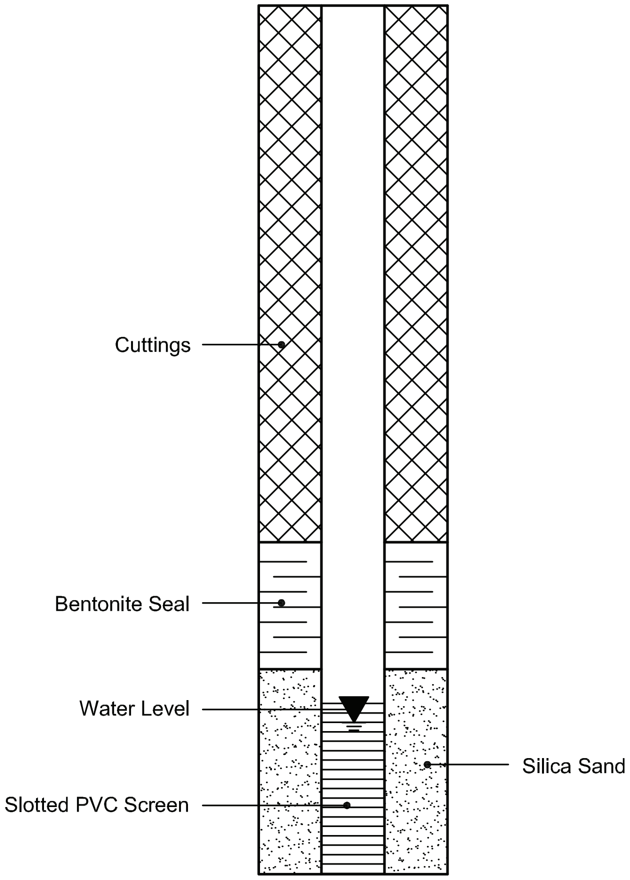


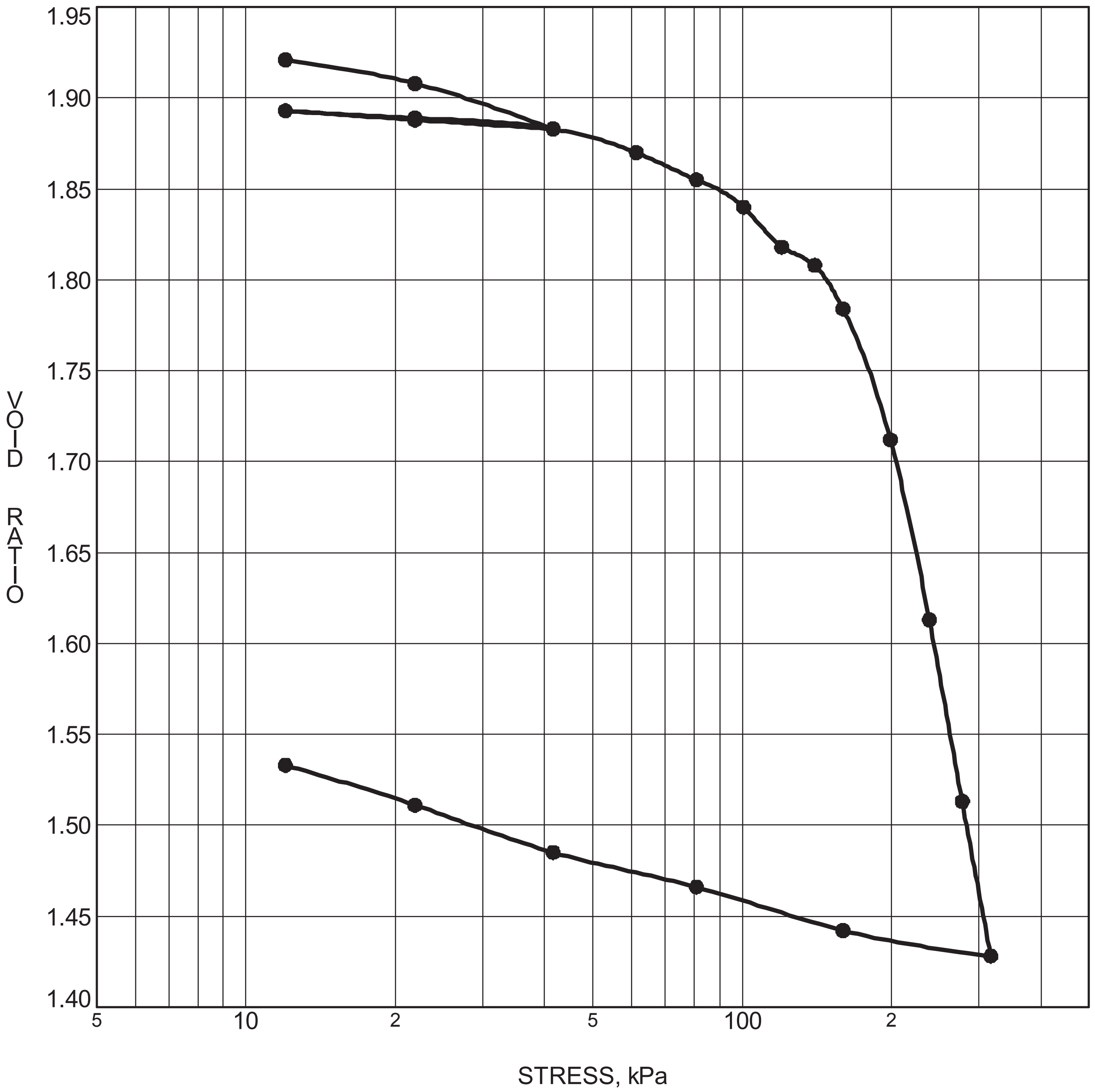
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





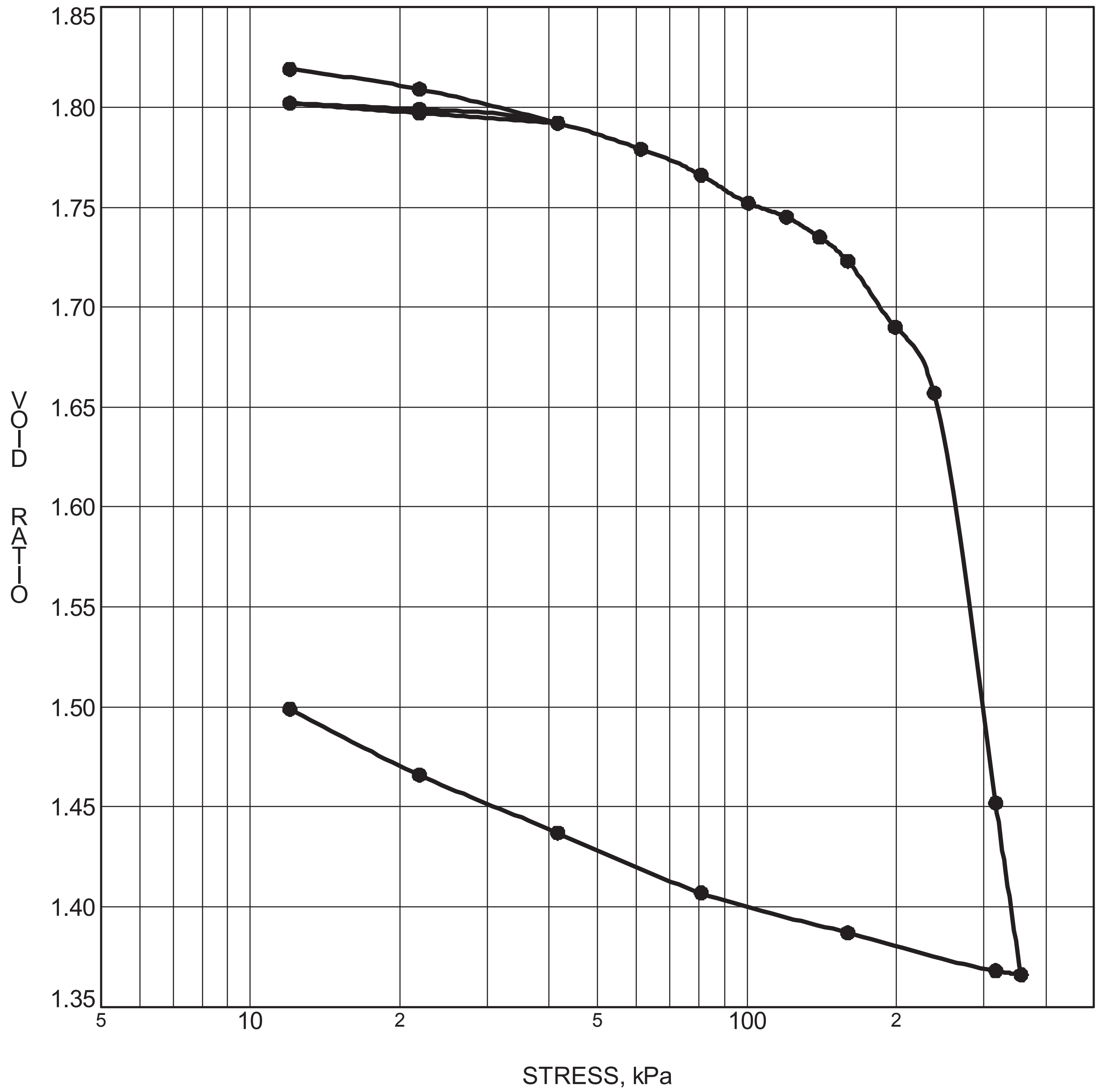
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH89-13**	p'_o	**67** kPa	Ccr	**0.020**
Sample No.	**TW 2**	p'_c	**174** kPa	Cc	**1.449**
Sample Depth	**4.97** m	OC Ratio	**2.6**	Wo	**70.7** %
Sample Elev.	**48.67** m	Void Ratio	**1.944**	Unit Wt.	**15.6** kN/m ^{3}

CLIENT	**Tamarack (Queen Street) Corporation**	FILE NO.	**PG1796**
PROJECT	**Geotechnical Investigation - Proposed Residential Development - Queen Street**	DATE	**24/06/2013**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH89-13**	p'_o	**86** kPa	Ccr	**0.020**
Sample No.	**TW 3**	p'_c	**221** kPa	Cc	**1.595**
Sample Depth	**8.08** m	OC Ratio	**2.6**	Wo	**67.0** %
Sample Elev.	**45.56** m	Void Ratio	**1.841**	Unit Wt.	**15.8** kN/m^3

CLIENT **Tamarack (Queen Street) Corporation**

PROJECT **Geotechnical Investigation - Proposed Residential Development - Queen Street**

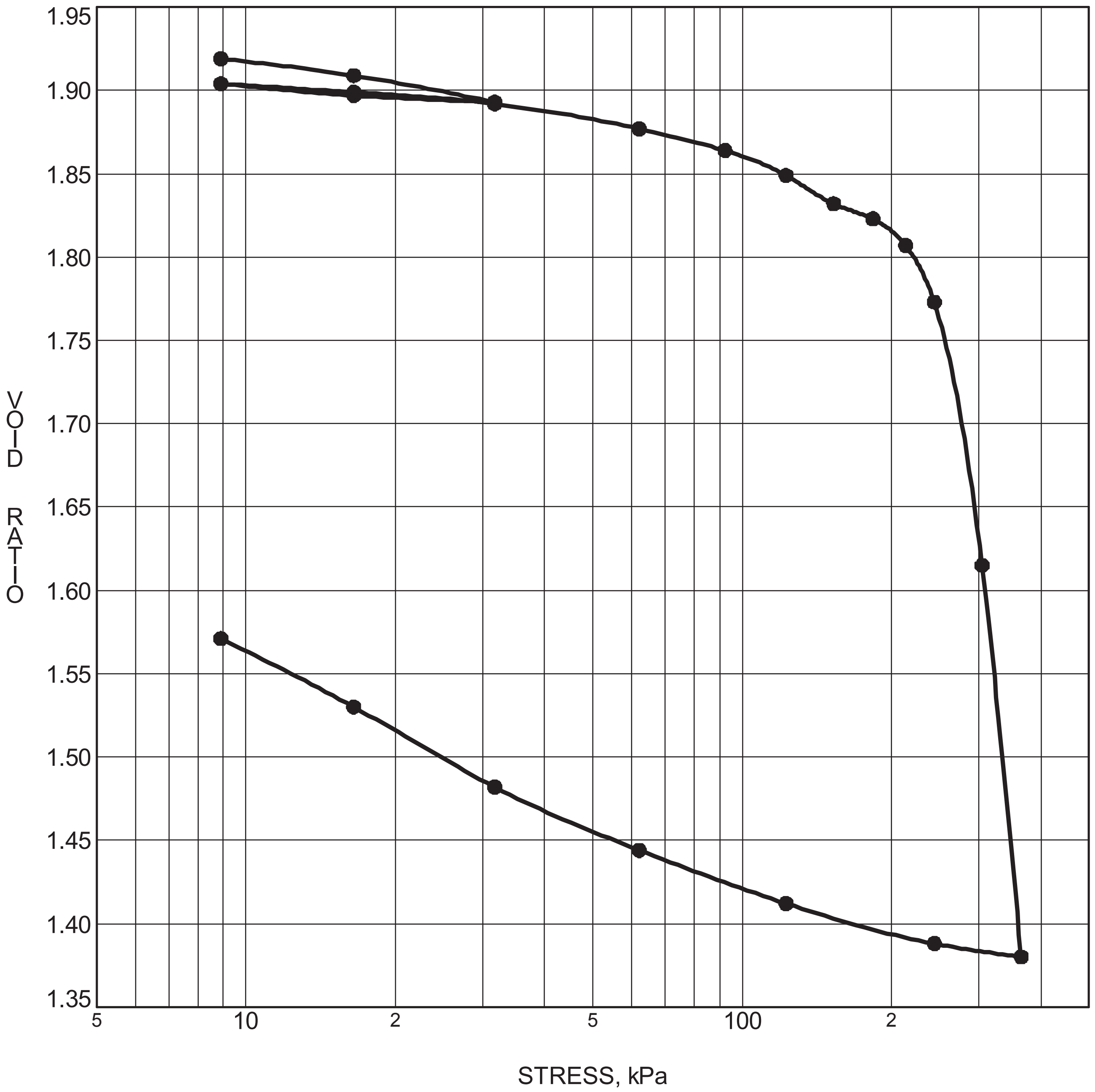
FILE NO. **PG1796**

DATE **24/06/2013**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY

Borehole No.	**BH89-13**	p'_o	**115** kPa	Ccr	**0.020**
Sample No.	**TW4**	p'_c	**234** kPa	Cc	**2.217**
Sample Depth	**12.65** m	OC Ratio	**2.0**	Wo	**70.0** %
Sample Elev.	**40.99** m	Void Ratio	**1.924**	Unit Wt.	**15.7** kN/m^3

CLIENT **Tamarack (Queen Street) Corporation**

FILE NO. **PG1796**

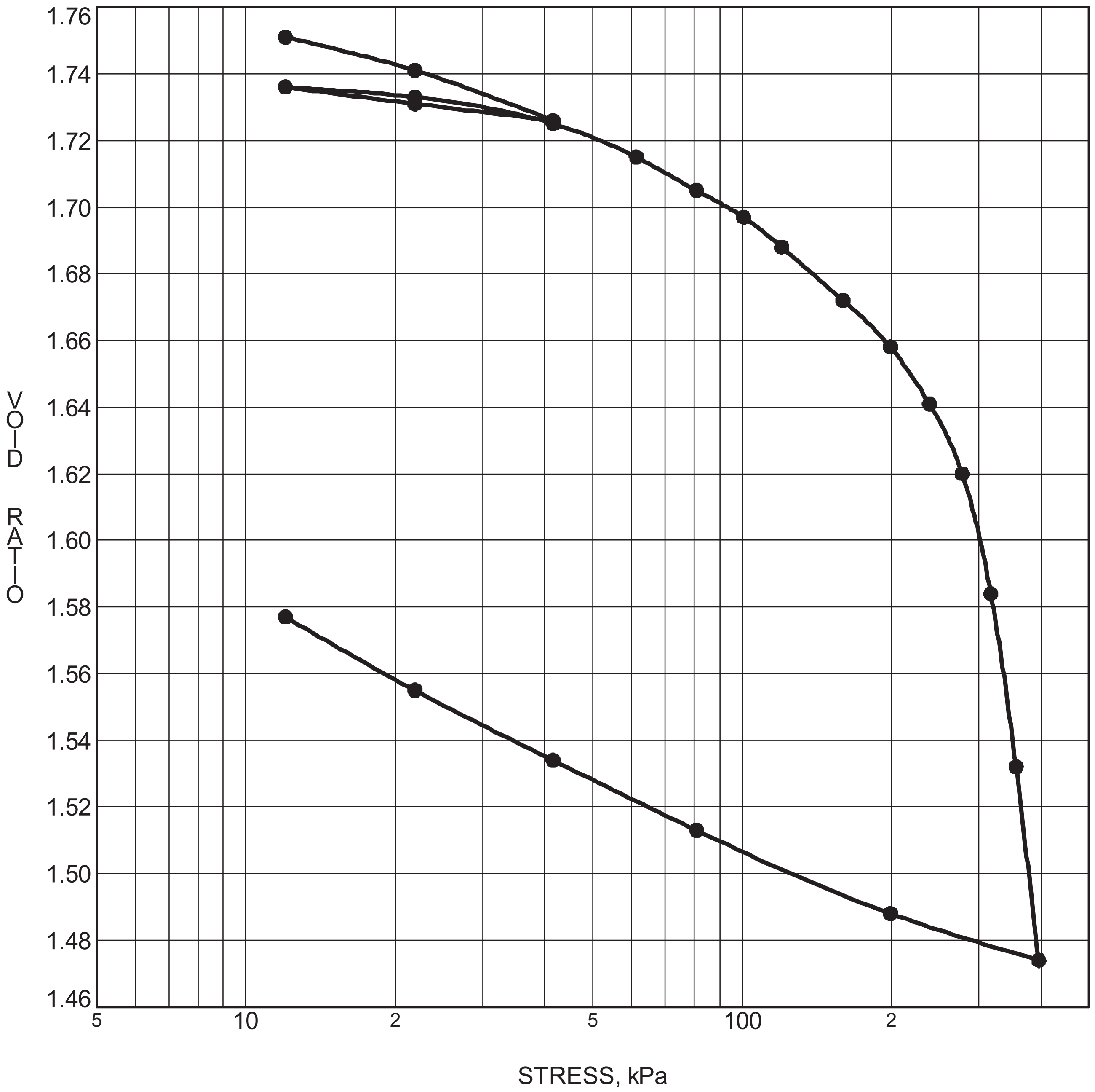
PROJECT **Geotechnical Investigation - Proposed Residential Development - Queen Street**

DATE **24/06/2013**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



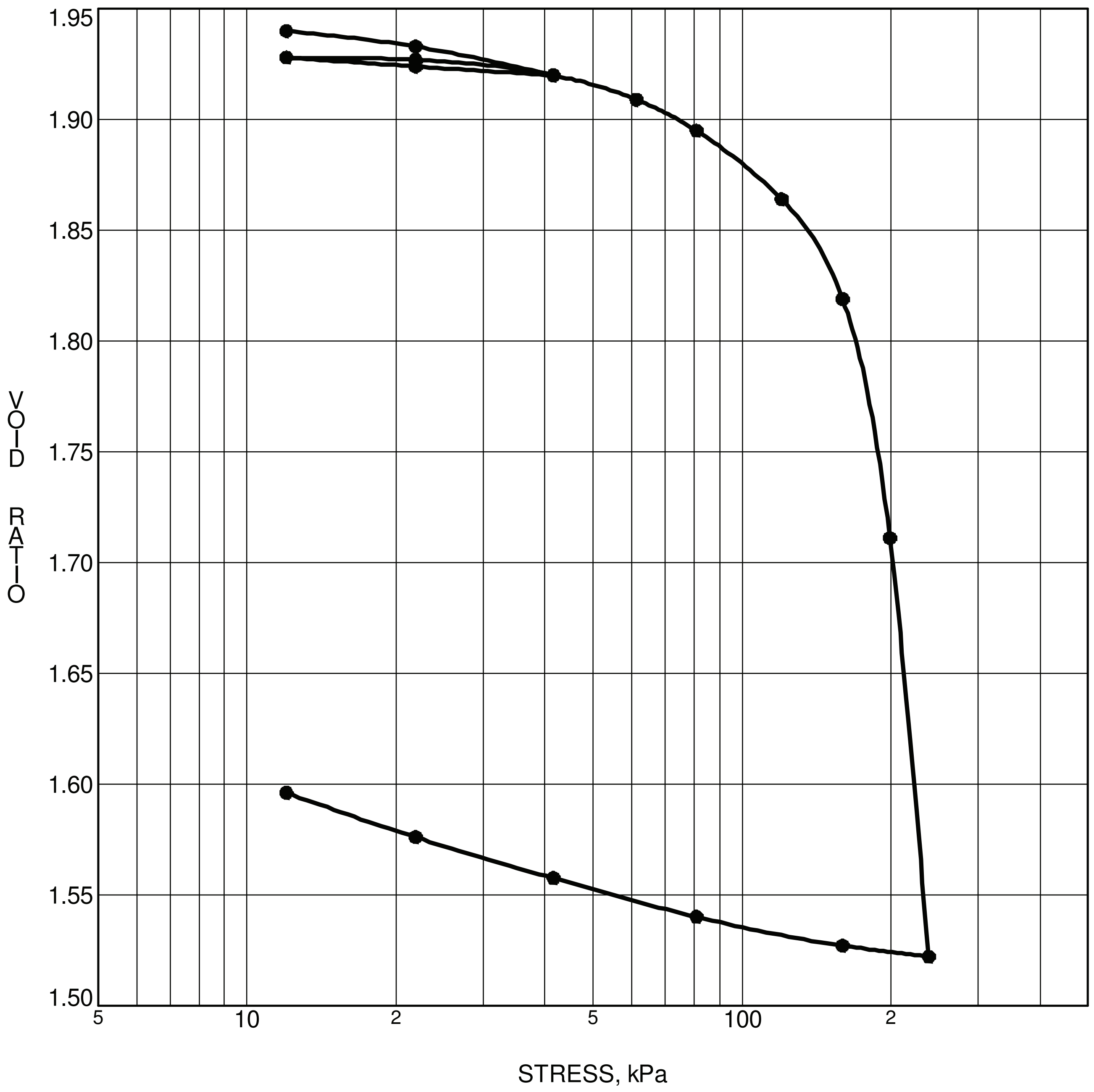
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH89-13**	p'_o	**152** kPa	Ccr	**0.019**
Sample No.	**TW 5**	p'_c	**281** kPa	Cc	**1.150**
Sample Depth	**18.74** m	OC Ratio	**1.8**	Wo	**64.4** %
Sample Elev.	**34.90** m	Void Ratio	**1.77**	Unit Wt.	**16.0** kN/m^3

CLIENT	**Tamarack (Queen Street) Corporation**	FILE NO.	**PG1796**
PROJECT	**Geotechnical Investigation - Proposed Residential Development - Queen Street**	DATE	**24/06/2013**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 4B**	p'_o	**64** kPa	Ccr	**0.015**
Sample No.	**TW 1**	p'_c	**174** kPa	Cc	**2.432**
Sample Depth	**4.19** m	OC Ratio	**2.7**	Wo	**70.8** %
Sample Elev.	**49.53** m	Void Ratio	**1.948**	Unit Wt.	**15.9** kN/m^3

CLIENT **Taggart Group of Companies**

FILE NO. **PG1796**

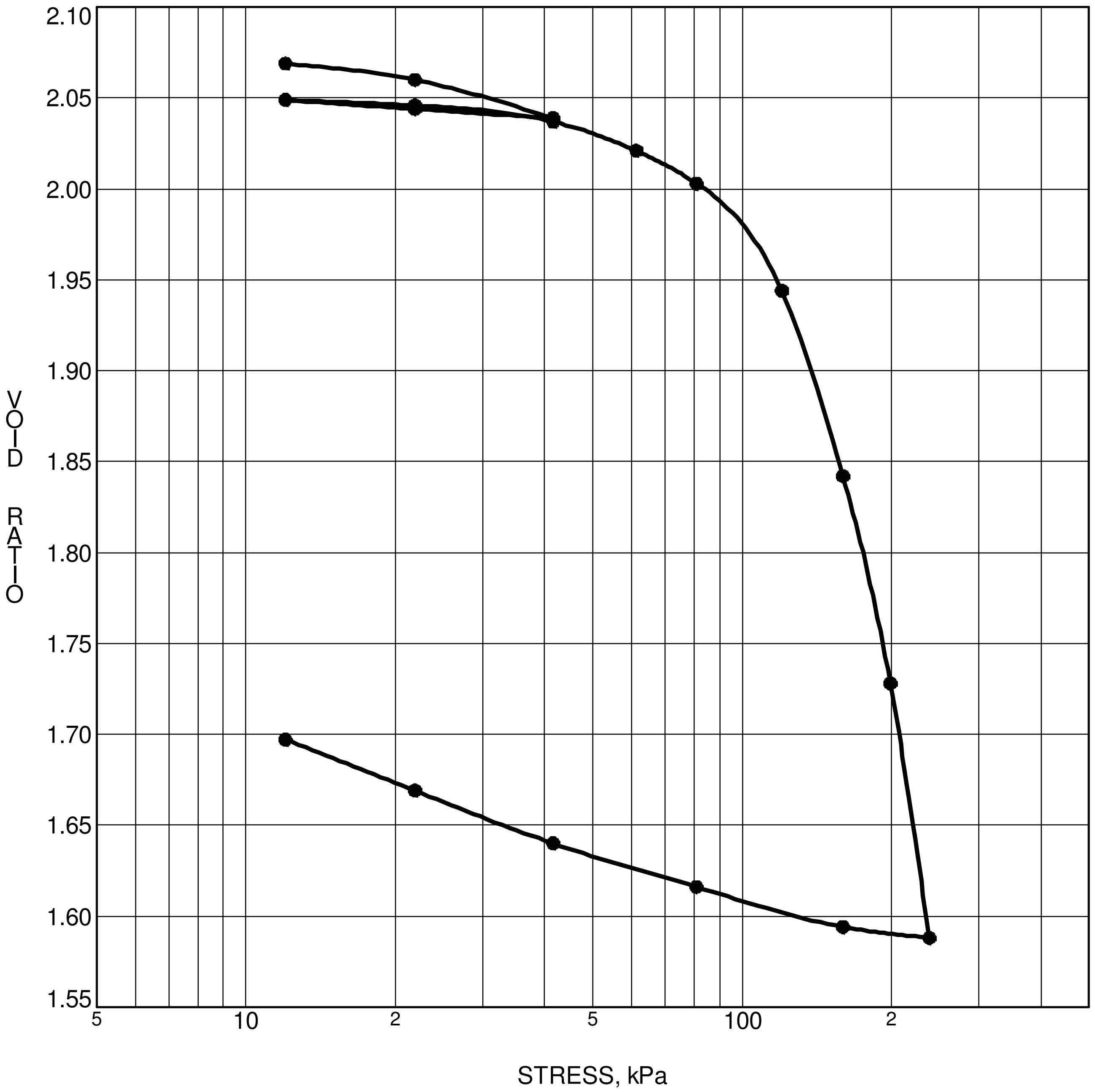
PROJECT **Geotechnical Investigation - Prop. Residential Development-Queen Street**

DATE **02/02/09**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY

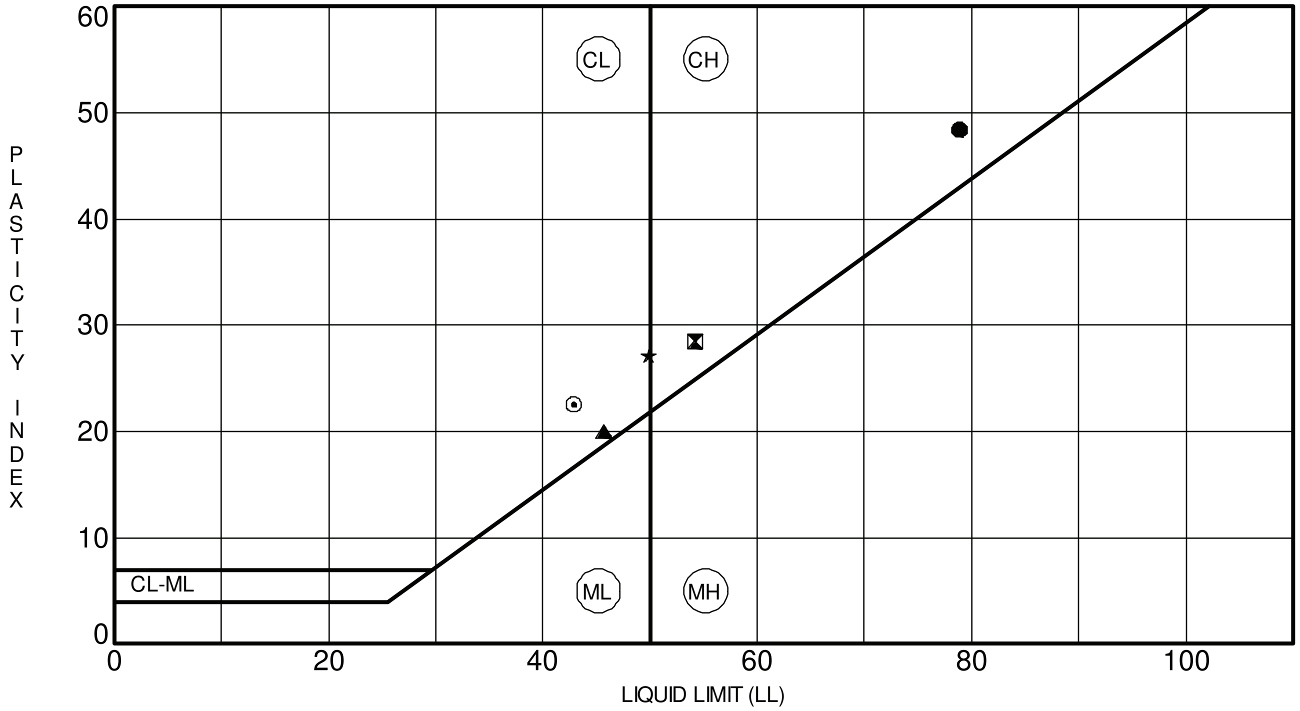
Borehole No.	**BH 5**	p'_o	**74** kPa	Ccr	**0.021**
Sample No.	**TW 1**	p'_c	**147** kPa	Cc	**1.863**
Sample Depth	**5.69** m	OC Ratio	**2.0**	Wo	**75.7** %
Sample Elev.	**47.59** m	Void Ratio	**2.081**	Unit Wt.	**15.7** kN/m^3

CLIENT	**Taggart Group of Companies**	FILE NO.	**PG1796**
PROJECT	**Geotechnical Investigation - Prop. Residential Development-Queen Street**	DATE	**29/01/09**

patersongroup **Consulting Engineers**

28 Concouse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



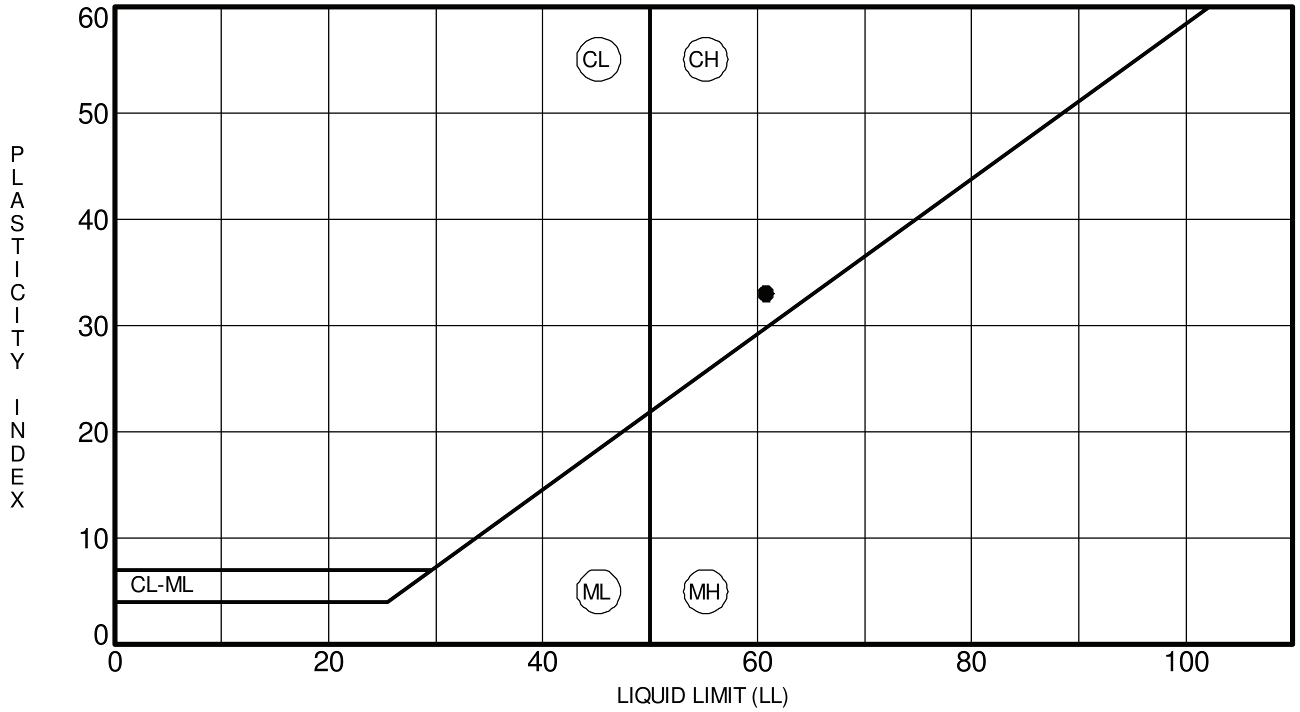
	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH89-13**	**TW 2**	**79**	**30**	**48**		**CH - Inorganic clays of high plasticity**
⧗	**BH89-13**	**TW 3**	**54**	**26**	**29**		**CH - Inorganic clays of high plasticity**
▲	**BH89-13**	**TW 4**	**46**	**26**	**20**		**CL - Inorganic clays of low plasticity**
★	**BH89-13**	**TW 5**	**50**	**23**	**27**		**CL - Inorganic clays of low plasticity**
⊙	**BH89-13**	**TW 6**	**43**	**20**	**23**		**CL - Inorganic clays of low plasticity**

CLIENT	**Tamarack (Queen Street) Corporation**	FILE NO.	**PG1796**
PROJECT	**Geotechnical Investigation - Proposed Residential Development - Queen Street**	DATE	**6 Jun 13**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BH 4B	TW 1	61	28	33		Clays of high plasticity-CH

CLIENT **Taggart Group of Companies**

FILE NO. **PG1796**

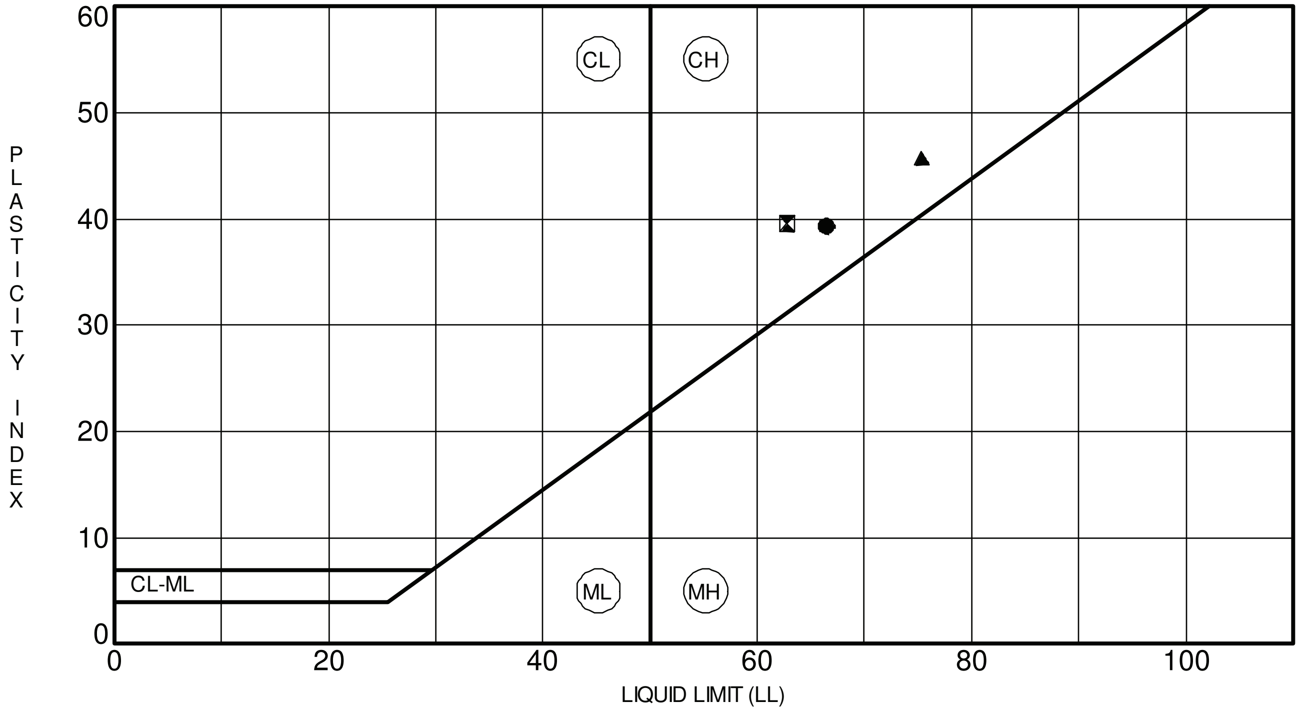
PROJECT **Geotechnical Investigation - Prop. Residential Development-Queen Street**

DATE **21 Jan 09**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



Specimen Identification			LL	PL	PI	Fines	Classification
●	**BH57-13**	**SS 7**	**66**	**27**	**39**		**Inorganic clays of high plasticity**
☒	**BH58-13**	**SS 6**	**63**	**23**	**40**		**Inorganic clays of high plasticity**
▲	**BH67-13**	**SS 6**	**75**	**30**	**46**		**Inorganic clays of high plasticity**

CLIENT **Taggart Group of Companies**
PROJECT **Geotechnical Investigation - Proposed**
Residential Development - Queen Street

FILE NO. **PG1796**
DATE **5 Feb 13**

patersongroup **Consulting Engineers**
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS

Order #: 0905037

Certificate of Analysis

Report Date: 02-Feb-2009
Order Date:27-Jan-2009

Client: **Paterson Group Consulting Engineers**
Client PO: 7712
Project Description: PG1796

	Client ID:	BH4-SS3	-	-	-
	Sample Date:	21-Jan-09	-	-	-
	Sample ID:	0905037-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	65.0	-	-	-
General Inorganics					
pH	0.05 pH Units	8.00	-	-	-
Resistivity	0.10 Ohm.m	45.4	-	-	-
Anions					
Chloride	5 ug/g dry	16	-	-	-
Sulphate	5 ug/g dry	110	-	-	-

Order #: 1246212

Certificate of Analysis

Report Date: 19-Nov-2012
Order Date:14-Nov-2012

Client: **Paterson Group Consulting Engineers**

Client PO: 12734

Project Description: PG1796

	Client ID:	BH44 SS3	BH54 SS4	-	-
	Sample Date:	05-Nov-12	13-Nov-12	-	-
	Sample ID:	1246212-01	1246212-02	-	-
	MDL/Units	Soil	Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	75.2	78.8	-	-
General Inorganics					
pH	0.05 pH Units	7.60	7.30	-	-
Resistivity	0.10 Ohm.m	82.9	36.8	-	-
Anions					
Chloride	5 ug/g dry	<5	76	-	-
Sulphate	5 ug/g dry	54	43	-	-

Order #: 1307087

Certificate of Analysis

Report Date: 14-Feb-2013
Order Date:12-Feb-2013

Client: **Paterson Group Consulting Engineers**
Client PO: 13812
Project Description: PG1796

	Client ID:	BH60-12-SS2	BH70-12-SS4	BH80-12-SS4	-
	Sample Date:	06-Feb-13	05-Feb-13	31-Jan-13	-
	Sample ID:	1307087-01	1307087-02	1307087-03	-
	MDL/Units	Soil	Soil	Soil	-
Physical Characteristics					
% Solids	0.1 % by Wt.	80.4	74.3	92.2	-
General Inorganics					
pH	0.05 pH Units	7.43	7.03	7.70	-
Resistivity	0.10 Ohm.m	16.0	12.6	8.90	-
Anions					
Chloride	5 ug/g dry	284	498	666	-
Sulphate	5 ug/g dry	130	143	483	-

Certificate of Analysis

Report Date: 21-Feb-2013
Order Date:14-Feb-2013

Client: **Paterson Group Consulting Engineers**
Client PO: 13813
Project Description: PG1796

Client ID:		TP1-G1	TP18-G1	TP32-G2	TP42-G1
Sample Date:		18-Dec-12	12-Dec-12	12-Dec-12	19-Dec-12
Sample ID:		1307229-01	1307229-02	1307229-03	1307229-04
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	69.9	89.9	72.8	73.8
General Inorganics					
pH	0.05 pH Units	7.87 [1]	8.03 [1]	7.84 [1]	7.80 [1]
Resistivity	0.10 Ohm.m	65.9	34.8	75.3	42.9
Anions					
Chloride	5 ug/g dry	12 [1]	<5 [1]	8 [1]	33 [1]
Sulphate	5 ug/g dry	18 [1]	303 [1]	16 [1]	67 [1]

Client ID:		TP58-G1	-	-	-
Sample Date:		19-Dec-12	-	-	-
Sample ID:		1307229-05	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	72.8	-	-	-
General Inorganics					
pH	0.05 pH Units	7.61 [1]	-	-	-
Resistivity	0.10 Ohm.m	71.7	-	-	-
Anions					
Chloride	5 ug/g dry	5 [1]	-	-	-
Sulphate	5 ug/g dry	47 [1]	-	-	-

APPENDIX 2

SUPPLEMENTAL MEMORANDUM AND LETTER REPORTS

DESIGN DRAWINGS - DSEL

patersongroup
consulting engineers

memorandum

to:	RVCA - **Ms. Jocelyn Chandler** - jocelyn.chandler@rvca.ca
to:	DSEL - **Mr. Steve Pichette** - spichette@dsel.ca
re:	Additional Geotechnical Considerations regarding North Tributary Toe Erosion, Remedial Slope Program at Section Q and Toe Erosion parameter selected for Cardinal Creek **Cardinal Creek Village Subdivision - Old Montreal Road - Ottawa**
date:	July 10, 2013
file:	PG1796-MEMO.05
from:	David Gilbert

Additional information was requested by RVCA at our meeting on July 9, 2013 regarding our slope stability analysis and limit of hazard lands recommendations. Paterson Group (Paterson) discussed the remaining issues with RVCA and have prepared this memo report to outline our responses. The following items were noted to require clarification by RVCA:

Item 1 - Toe Erosion Allowance of 7 m for Cardinal Creek

As noted in our Report PG1796-2R dated July 5, 2013, the toe erosion allowance determined for our limit of hazard lands setback for the subject slopes along Cardinal Creek was based on the cohesive nature of the soils, the observed current erosional activities and the width and location of the current watercourse. It should be noted that the subject section of Cardinal Creek refers to the east valley corridor wall along Cardinal Creek between approximately 200 m north of Old Montreal Road to the culvert inlet at the Highway 174 crossing. Signs of erosion were noted in areas where the existing watercourse has meandered in close proximity to the toe of the corridor wall. Some minor to moderate sloughing failures were noted in the lower portion of the slopes, leaving some exposed root systems along the slope face. The selection of appropriate toe erosion allowance took into consideration MNR recommendations for stiff cohesive soil slopes where active erosion was observed. The MNR recommendations vary between 5 to 8 m and based on our available soils information and site observations, a toe erosion allowance of 7 m was selected for the slopes along Cardinal Creek, where silty clay was observed at the slope toe. Based on our analysis, a toe erosion allowance of 7 m is still considered appropriate for the subject slopes along Cardinal Creek where silty clay is encountered at the slope toe.

Item 2 - Remedial Slope Program at Section Q

As discussed, several options are under consideration for the remedial slope program at Section Q along the east slope of Cardinal Creek. It is understood that concrete vertical walls will not be approved by the RVCA, therefore, concrete vertical walls will not be considered as an option. The overall objective of the remedial slope program is to provide a stable slope along with an adequate toe erosion protection system. A stable slope can be reinstated by removing the previously failed materials and placing a series of geogrids along with an appropriate granular fill and reinforced topsoil finish to allow vegetation to re-establish and reduce surficial erosion. An adequate toe erosion protection system could consist of rip-rap extended above flood levels or a Scour-Stop^{TM} product or equivalent to allow vegetation to reestablish. These systems can be placed along the slope toe where the watercourse is in contact with the slope toe.

Item 3 - Toe Erosion Allowance for Section X

A slope stability section (Section X) was completed for the side slopes of the north tributary watercourse. Based on our analysis and field observations, the slope was noted to be stable and heavily treed. Bedrock outcrops were noted along the base of the watercourse within the first 75 m of the watercourse running north from the culvert crossing, the remainder of the slope consists of a stiff silty clay. Conservatively, a toe erosion allowance of 5 m was used for our limit of hazard lands setback calculations. However, the toe erosion allowance was applied from the watercourse edge to the slope toe. It should be noted that an additional analysis was completed to verify that a stable slope is still available upon completion of 5 m of erosion occurring at the slope toe. Figures 24C and 24D present the results of our slope stability analysis including 5 m of erosion at the slope toe. Based on our analysis, a stable slope is still available upon completion of 5 m of erosion at the slope toe. Therefore, it is recommended that the toe erosion allowance of 5 m be applied at the slope toe and the current setback lines recommended in Report PG1796-2R dated July 5, 2013 remain unchanged.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

David J. Gilbert, P.Eng.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

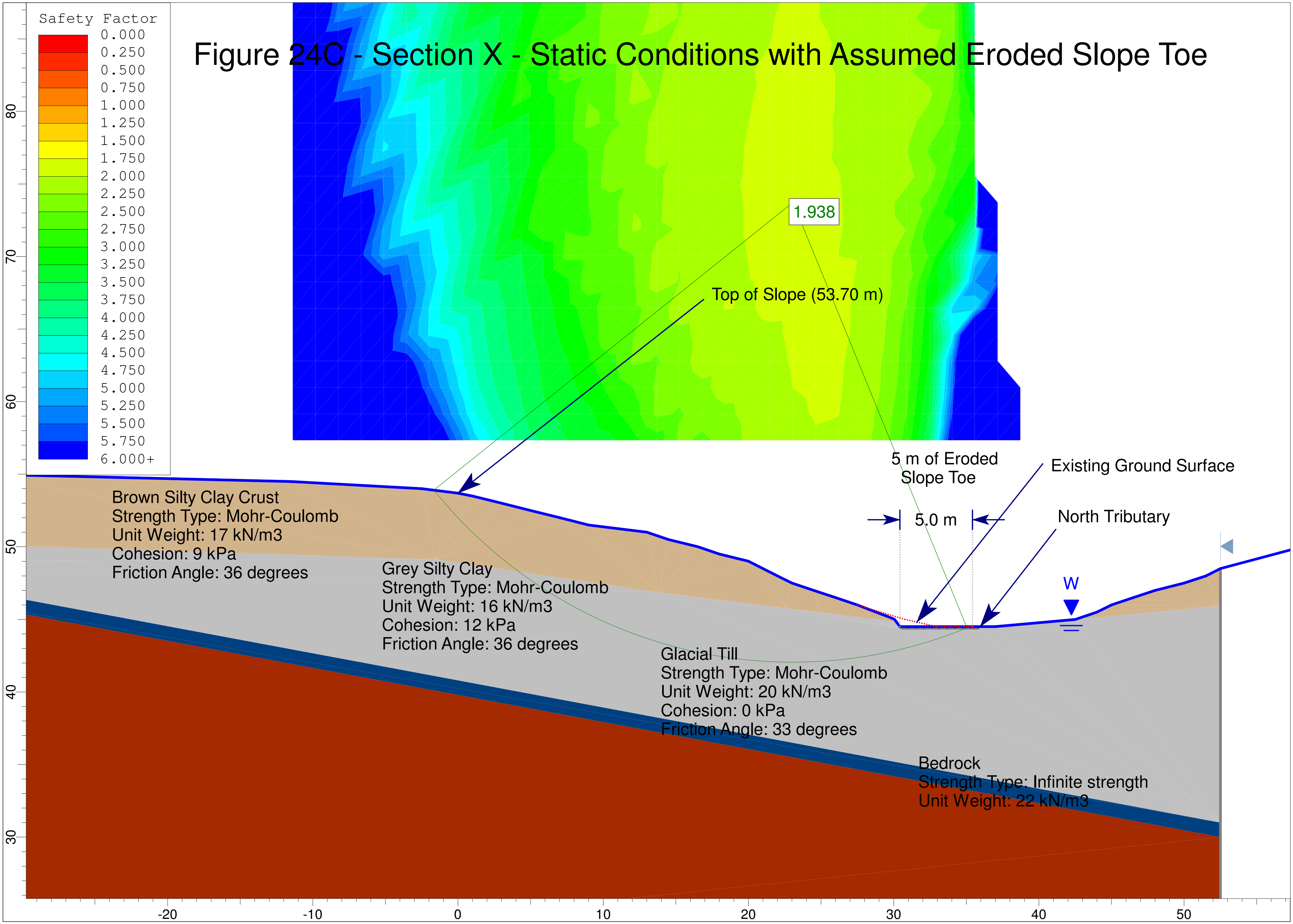


Figure 24C - Section X - Static Conditions with Assumed Eroded Slope Toe

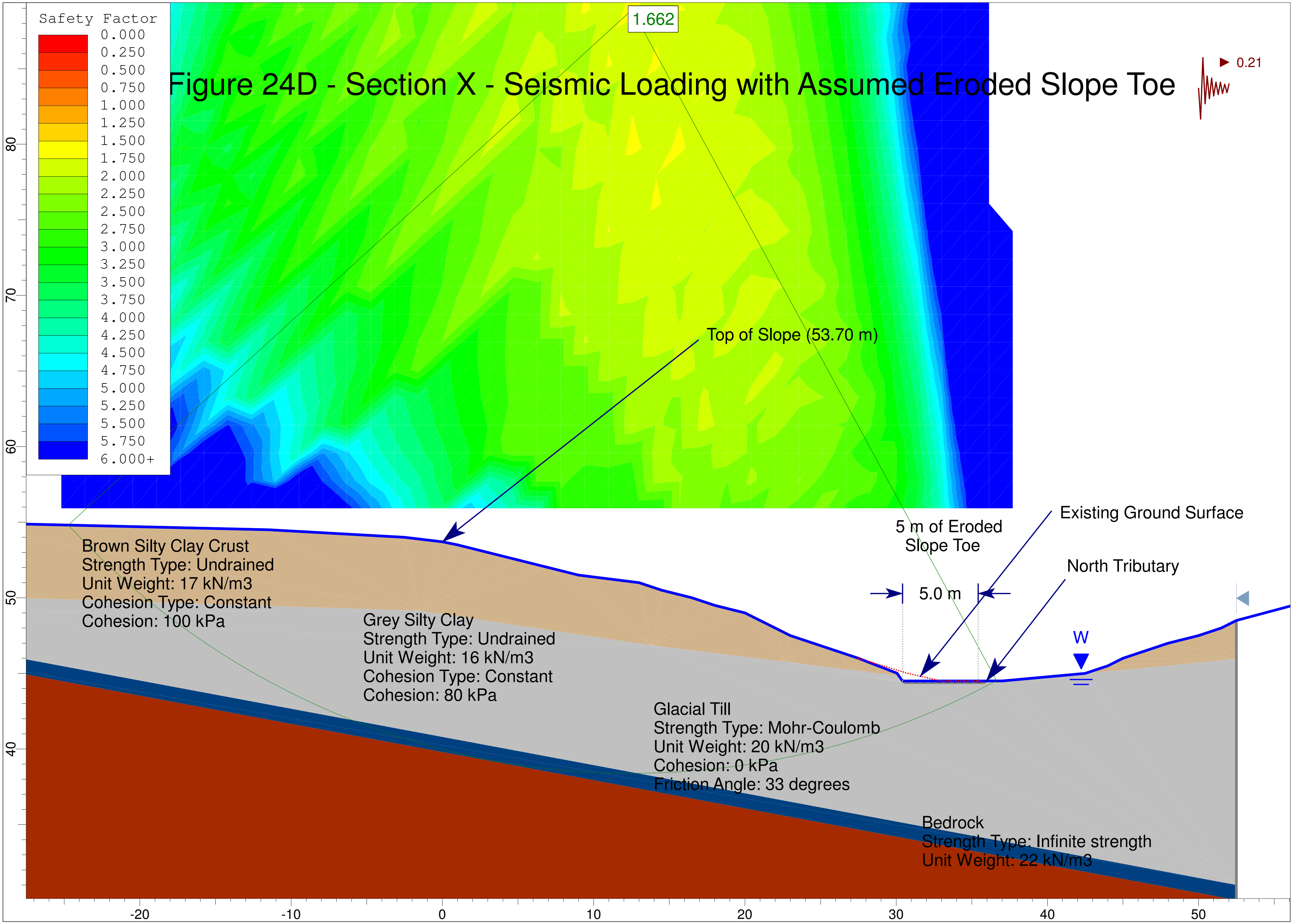


Figure 24D - Section X - Seismic Loading with Assumed Eroded Slope Toe

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Consulting Engineers

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Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
Building Science
Archaeological Services

www.patersongroup.ca

January 27, 2014
File: PG1796-LET.05

Tamarack (Queen Street) Corporation
3187 Albion Road
Ottawa, Ontario
K1V 8Y3

Attention: **Mr. Ted Philips**

Subject: **Proposed North Tributary Realignment at Hydro Corridor**
Cardinal Creek Village
Old Montreal Road - Ottawa

Dear Sir,

Further to your request and authorization, Paterson Group (Paterson) has prepared this letter report to detail our recommended in-filling program for the proposed north tributary realignment to be completed as part of the works required for the adjacent watermain and sewer easement. Also, a slope stability analysis was completed for the proposed slope. The present letter report provides the results of our slope stability analysis and details our recommendations for the in-filling program at the aforementioned location.

1.0 Background Information

The subject slope is located along the hydro corridor easement along the west boundary of the subject site. The slope consists of the north valley wall of the north tributary and is tree and brush covered. Based on observations during a recent site visit, the majority of the subject slope was noted to be stable and sloped between 2H:1V to 3H:1V. However, significant sloughing was noted along the slope toe in the immediate area of the in-filling program due to active erosion by the watercourse. The slope is also located at a bend in the watercourse and downstream of the bend, the watercourse channel has been well defined due to erosional activities.

Topographic mapping of the existing slope was provided by David Schaeffer Engineering Limited along with the proposed finished grading along the sewer and watermain easement. The topographic survey and proposed grading along with the slope stability cross-section location are presented in Drawing PG1796-18 - Slope Stability Location Plan attached.

Based on field observations and nearby borehole information (BH 86-13), the subsurface profile at the slope consists of a brown silty clay crust underlain by a grey, firm to stiff silty clay layer extending to the toe of the slope. The Soil Profile and Test Data sheet for BH 86-13 is attached the present letter report.

2.0 Slope Stability Analysis

Static Conditions

Section GG takes into consideration the existing slope face along with the proposed in-fill soils. It is understood that the proposed slope is to be shaped to a 3H:1V grade. Figure 1A presents our slope stability analysis of the proposed in-filling program under static conditions.

The cross-section was analysed taking into account a groundwater level at ground surface, which represents a worse-case scenario that can be reasonably expected to occur in cohesive soils. The stability analysis assumes full saturation of the soil with groundwater flow parallel to the slope face where a silty clay subsoil profile is encountered along the slope.

The analysis of slope stability was carried out using SLIDE, a computer program that permits a two-dimensional slope stability analysis using several methods, including the Bishop’s method, which is a widely used and accepted analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to those favouring 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 subsoil and groundwater conditions, a factor of safety greater than one is usually required to ascertain than the risks of failure are acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the failure of the slope would endanger permanent structures.

Based on our analysis, the proposed slope is stable under static conditions with a slope stability factor of safety of greater than 1.5. The results of our slope stability analysis at Section GG are presented in Figure 1A attached.

Seismic Loading Condition

An analysis considering seismic loading was also completed at Section GG. A horizontal acceleration of 0.21G was considered for the section for the seismic loading condition. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading. Based on our analysis results, the slope is stable when considering seismic loading. The results of our analysis including seismic loading are presented in Figure 1B attached.

3.0 North Tributary Realignment In-Filling Details

The following in-filling program is recommended for the subject slope:

- ❏ All topsoil and deleterious materials should be removed from the in-filling area.
- ❏ It is recommended that a stepped backslope be provided across the existing slope face. A maximum 600 mm high step is recommended along the backslope.
- ❏ The in-filling material should consist of a workable, brown, stiff silty clay placed under dry conditions and in above freezing temperatures. The silty clay fill should be placed in maximum 300 mm loose lifts and compacted using a sheepsfoot roller making several passes to achieve a minimum 95% of its SPMDD.
- ❏ The finished silty clay surface should be capped with a minimum 150 mm thick layer of topsoil mixed with a hardy grass seed along with an erosion control blanket placed across the exposed slope face. The finished slope surface should be shaped to promote sheet drainage and tie into the existing slope face.
- ❏ The slope toe should be capped with a minimum 600 mm thick layer of rip-rap material lined with a non-woven geotextile liner to eliminate any surficial erosion along the proposed in-filling area. The rip-rap material should extend at least 1 m above the watercourse invert level.

Inspection testing of the above noted program should be completed by the geotechnical consultant. The following items are recommended to be completed during the construction phase:

- ❏ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

- ❏ Observation of all subgrades prior to placing backfilling materials.

- ❏ Periodic observations and/or field density tests to ensure that the specified level of compaction has been achieved.

We trust that the present submission meets your current requirements.

Paterson Group Inc.

David J. Gilbert, P.Eng.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

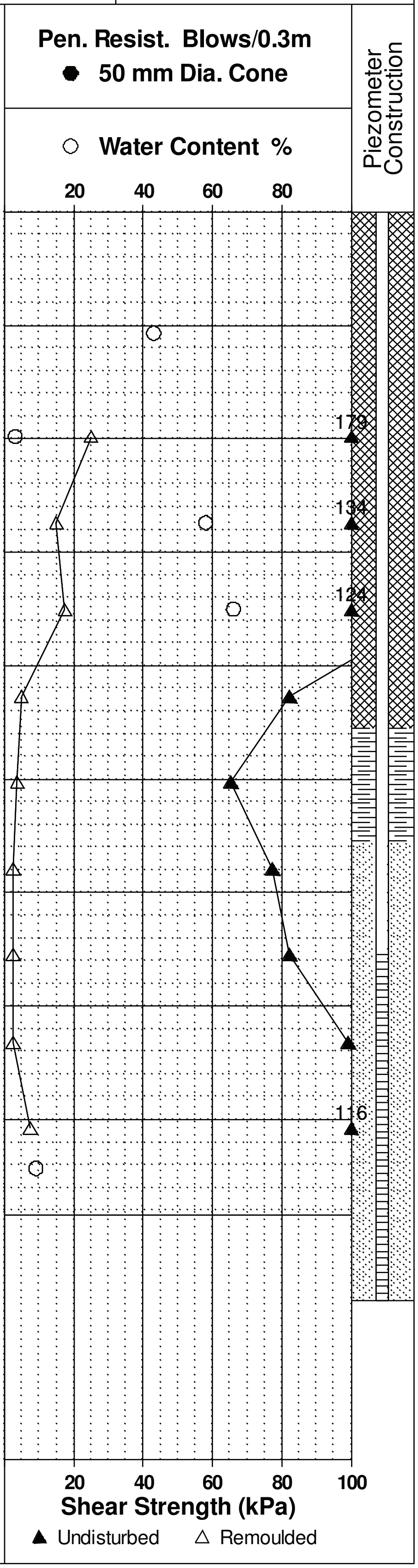
DATE February 14, 2013

FILE NO. PG1796

HOLE NO. BH86-13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.33		SS	1	50	10
		SS	2	100	7
Very stiff to stiff, brown **SILTY CLAY** 8.23					
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders 8.84		SS	3	50	50+
End of Borehole Practical refusal to augering at 8.84m depth					

DEPTH (m)	ELEV. (m)
0	54.08
1	53.08
2	52.08
3	51.08
4	50.08
5	49.08
6	48.08
7	47.08
8	46.08



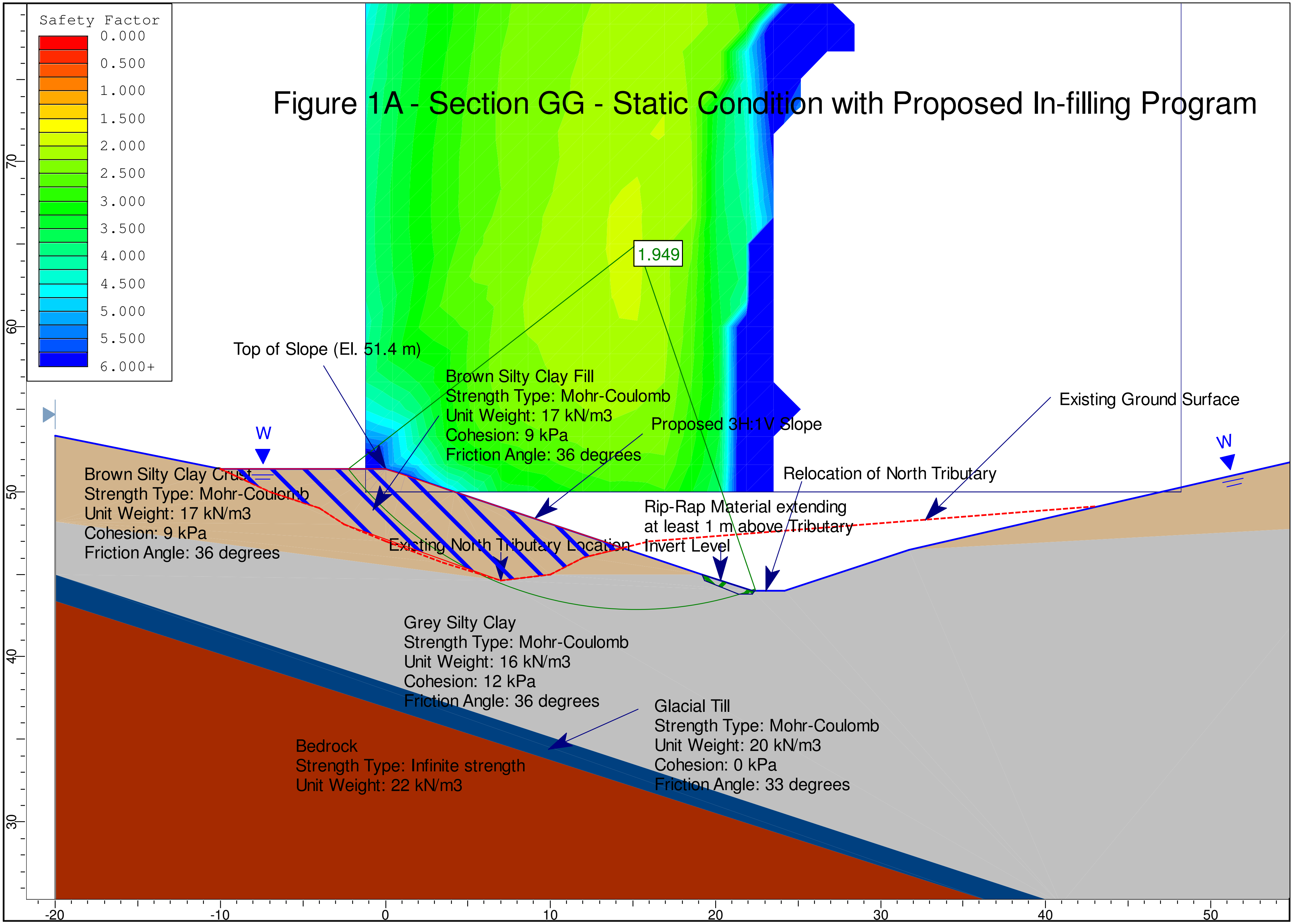


Figure 1A - Section GG - Static Condition with Proposed In-filling Program

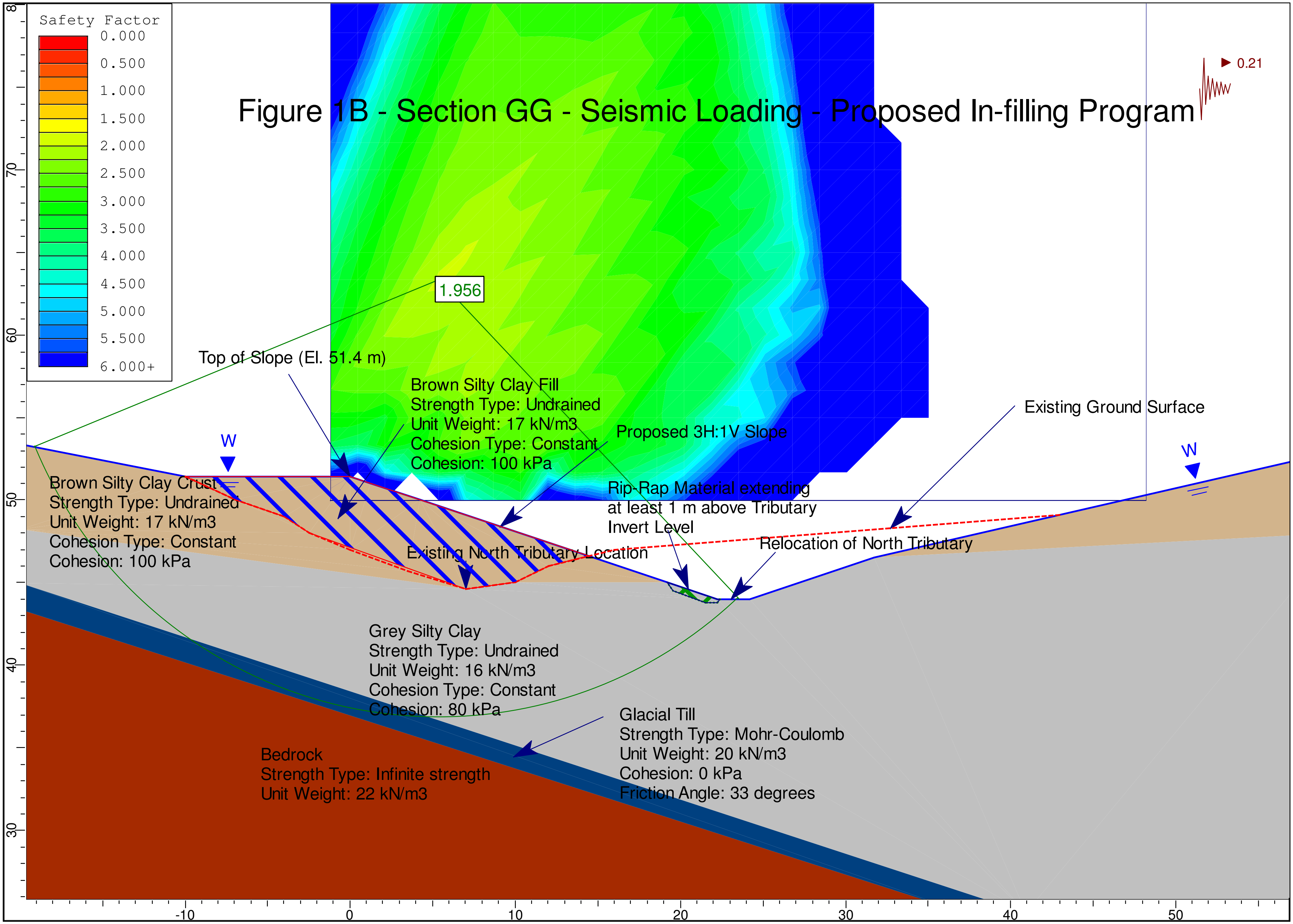
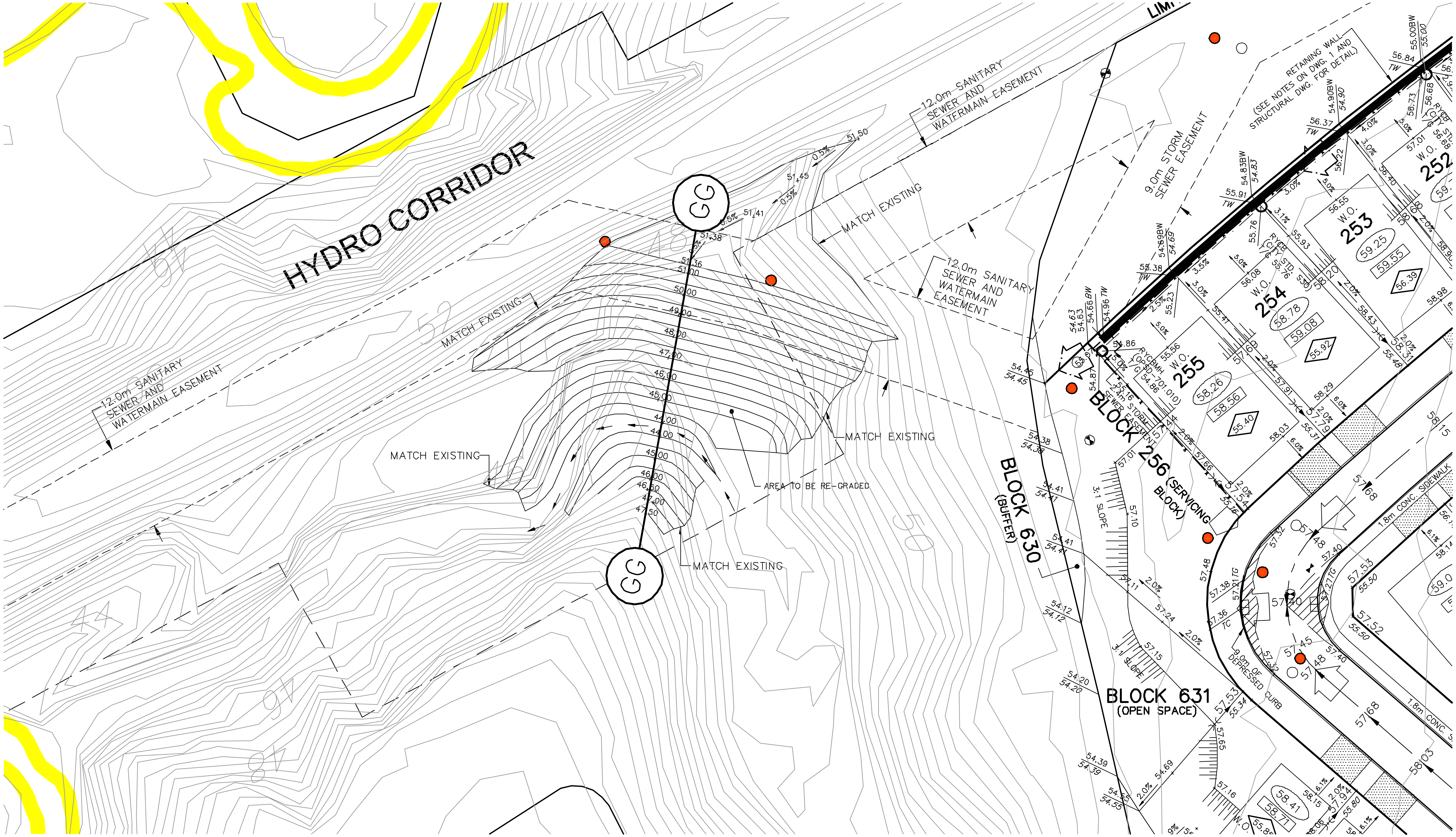


Figure 1B - Section GG - Seismic Loading - Proposed In-filling Program



paterson group
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

Scale:	1:500
Des.:	DG
Dwn:	MPG
Chkd:	DG

TAMARACK (QUEEN STREET) CORP.
GEOTECHNICAL INVESTIGATION
PROPOSED NORTH TRIBUTARY REALIGNMENT
CARDINAL CREEK VILLAGE
OTTAWA, ONTARIO

SLOPE STABILITY LOCATION PLAN

Dwg. No.	PG1796-18
Report No.:	PG1796
Date:	01/2014

patersongroup **memorandum**
consulting engineers

to:	David Schaeffer Engineering Limited - **Ms. Laura Maxwell -** lmaxwell@dsel.ca
re:	Geotechnical Investigation at Cardinal Creek Watermain Crossing **Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	May 1, 2014
file:	PG1796-MEMO.07R
from:	David Gilbert

Paterson Group (Paterson) completed a borehole along the east and west sides of the proposed watermain crossing for Cardinal Creek to determine the subsoils profile at the proposed crossing location. The present memo report provides installation technique recommendations for the proposed watermain crossing. Also, construction precautions are presented for the watermain installation along the existing slope faces.

1.0 Field Observations

Two boreholes extending to a maximum 10 m depth were completed on November 20, 2013 and January 24, 2014 by a local drilling contractor using a track mounted drill rig and portable drill rig. The field programs were supervised by a Paterson field personnel. The borehole locations are presented in Drawing PG1796-14 - Test Hole Location Plan attached.

The subsurface profile encountered at the borehole locations consisted of a topsoil layer overlying a silty clay layer extending to a 6.6 to 9 m depth followed by a glacial till deposit. Practical refusal to dynamic cone penetration testing was encountered at a 12 and 8.4 m depth at BH 90-13 and BH 93-14, respectively. Based on the recovered soil sample's moisture levels, colouring and consistency, the long-term groundwater level is anticipated at a 1 to 1.5 m depth. Specific details of the soil profile encountered at the borehole locations are presented in the attached Soil Profile and Test Data sheets.

2.0 Watermain Installation Technique at Cardinal Creek Crossing

It is understood that consideration is being given to using a directional drilling style of installation for the proposed watermain crossing. Based on our findings, it is should be noted that the soils are conducive to a directional drilling installation. A contractor specializing in these works should be contracted for the proposed crossing installation.

3.0 Watermain Installation along Cardinal Creek Valley Wall Slopes

Based on the plans provided, the slope of the watermain along the west valley corridor wall is approximately 3.5H:1V and the slope of the watermain along the east valley corridor wall is approximately 7H:1V. To eliminate movement during construction and for long-term conditions, a thrust block restraint system is recommended. It is recommended that a thrust block be provided at the top and bottom of each sloped run of watermain. The sizing of thrust blocks required should be provided by the structural engineer.

Thrust blocks resisting lateral loads should be sized on a pro-rata basis and the allowable lateral soil bearing capacity. Those resisting vertical loads should be sized based on the allowable vertical soil bearing capacity. The lateral and vertical bearing capacities of the bearing media expected along the subject section are presented in Table 1.

Table 1
Summary of Allowable Bearing Pressures For Thrust Block Sizing

Bearing Surface	Allowable Bearing Pressure, kPa	
	Lateral	Vertical
Stiff silty clay	60	100
Engineered fill	100	150

The allowable lateral bearing capacities presented are based on a minimum soil cover of 2 m. The allowable vertical bearing pressures presented are provided for the thrust block concrete which is installed on an undisturbed soil bearing surface.

An undisturbed soil bearing surface is free of all topsoil and deleterious materials, such as loose, frozen or disturbed soil and in dry condition prior to the placement of concrete.

The total ultimate friction force exerted on the backfilled pipe in response to longitudinal forces is a function of the trench depth and diameter of the pipe. The following formula is provided:

$$f_{ult} = \pi D H \gamma \tan \delta$$

where:

f_{ult} - Ultimate friction force (kN)
D - Outer diameter of pipe (m)
H - Height of backfill from the centre of pipe (m)
γ - Unit weight of cover material: assume 20 kN/m^3 for engineered fill above groundwater level and 12 kN/m^3 below groundwater level
$\tan \delta$ - Friction factor:
- 0.35 for iron/steel pipe
- 0.40 for concrete pipe
- 0.35 for plastic pipe

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

David J. Gilbert, P.Eng.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

patersongroup

Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Watermain Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

BORINGS BY CME 55 Power Auger

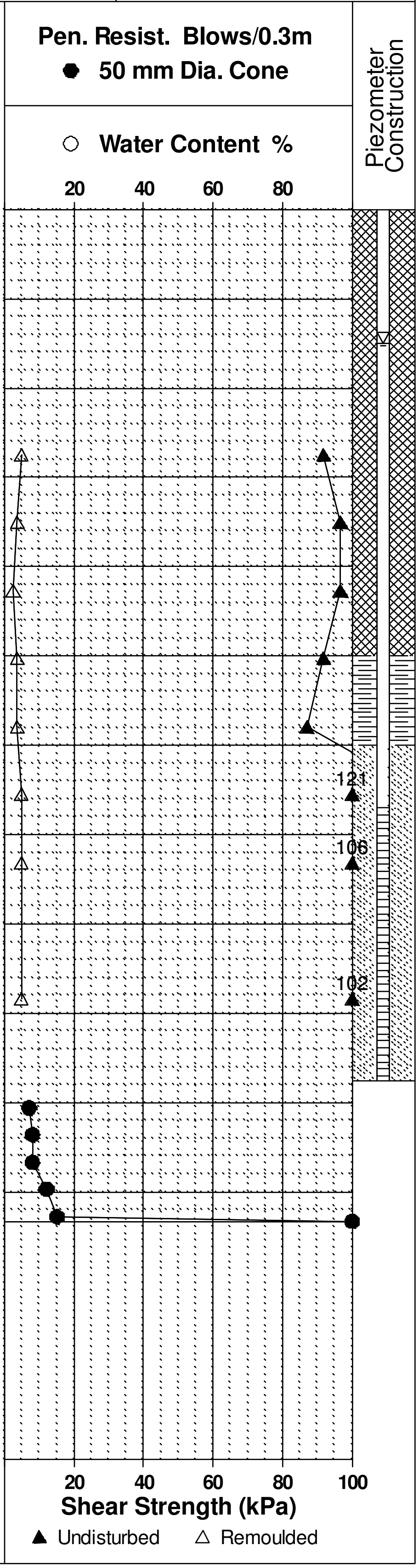
DATE November 22, 2013

FILE NO. PG1796

HOLE NO. BH90-13

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.30	AU	1		
Stiff to very stiff, brown **SILTY CLAY**	SS	2	67	6
	SS	3	100	2
8.99				
GLACIAL TILL: Grey-brown silty clay with sand, gravel, cobbles and boulders 9.75	SS	4	83	4
Dynamic Cone Penetration Test commenced at 9.75m depth.				
Inferred **GLACIAL TILL** 11.33				
End of Borehole Practical DCPT refusal at 11.33m depth. (GWL @ 1.5m depth based on field observations)				

DEPTH (m)	ELEV. (m)
0	44.28
1	43.28
2	42.28
3	41.28
4	40.28
5	39.28
6	38.28
7	37.28
8	36.28
9	35.28
10	34.28
11	33.28



patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Watermain Crossing - Cardinal Creek Village
Ottawa, Ontario

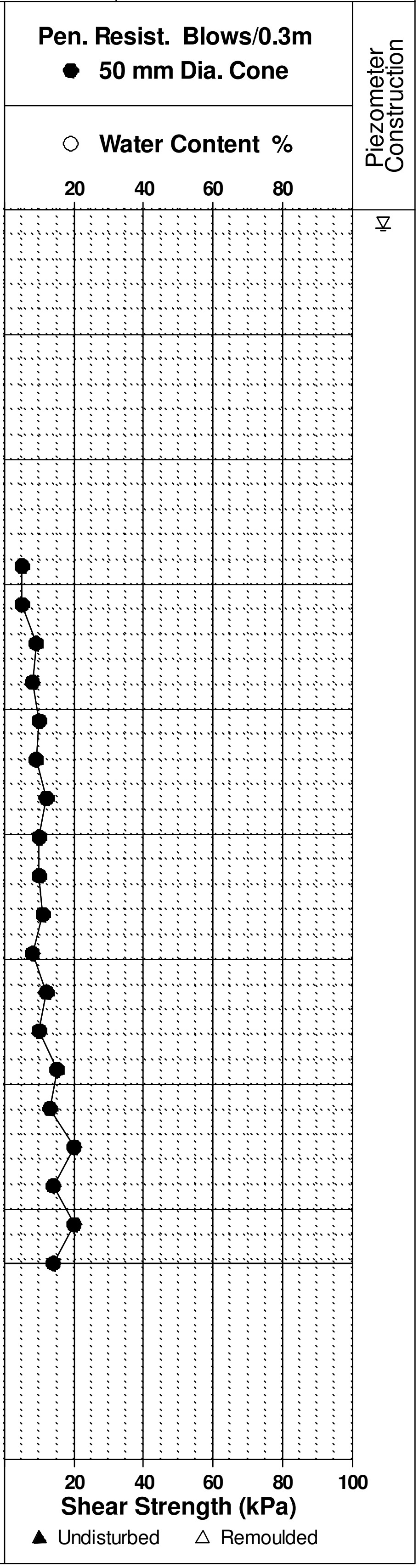
DATUM Approximate geodetic
REMARKS
BORINGS BY Portable Drill
DATE January 24, 2014
FILE NO. PG1796
HOLE NO. BH93-14

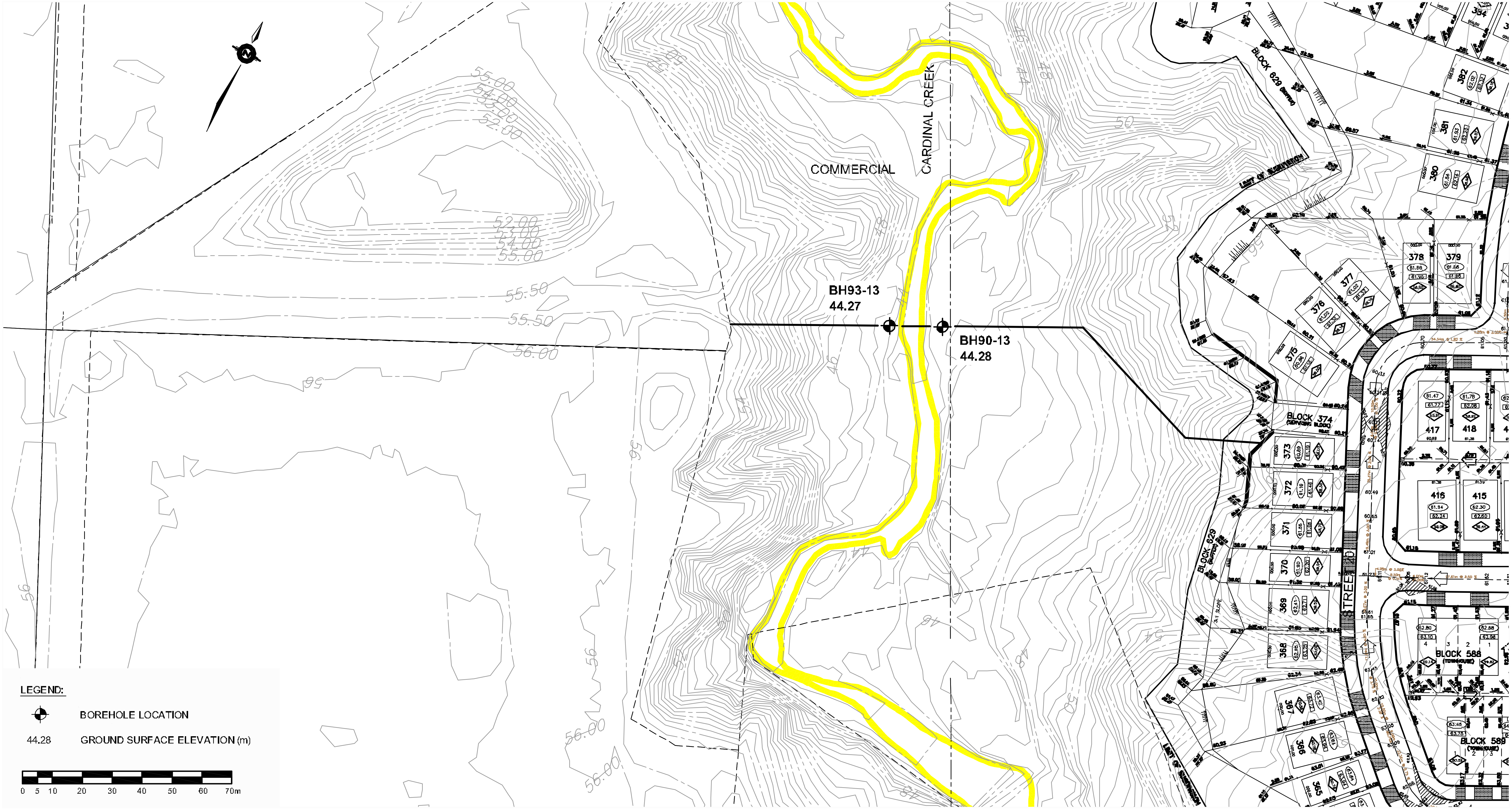
SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	44.27
TOPSOIL 0.20	AU	1				
Very stiff to stiff, brown **SILTY CLAY**	SS	2	0	8		
	SS	3	83	2	1	43.27
2.03	SS	4	62	3		
Dynamic Cone Penetration Test commenced at 2.03m depth.					2	42.27
					3	41.27
Inferred **SILTY CLAY**					4	40.27
					5	39.27
6.60					6	38.27
Inferred **GLACIAL TILL**					7	37.27
8.43					8	36.27

End of Borehole

BH terminated in inferred glacial till at 8.43m depth

(GWL @ 0.15m depth based on field observations)





LEGEND:

⌖	BOREHOLE LOCATION
44.28	GROUND SURFACE ELEVATION (m)

0 5 10 20 30 40 50 60 70m

paterson group
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL

TAMARACK (QUEEN STREET) CORP.

GEOTECHNICAL INVESTIGATION
PROPOSED WATERMAIN CROSSING AT CARDINAL CREEK

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Drawn by: MPG
Checked by: DJG
Date: 04/2014
Scale: 1:1250
Drawing No.: PG1796-11
Report No.: PG1796-MEMO.07R

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patersongroup
consulting engineers

memorandum

to:	David Schaeffer Engineering Limited - **Ms. Laura Maxwell -** lmaxwell@dsel.ca
re:	Geotechnical Considerations - Highway 174 Crossing for SWMP Outlet **Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	February 26, 2014
file:	PG1796-MEMO.09R
from:	David Gilbert

The present memo report has been prepared to outline the geotechnical aspects of the highway crossing required for the proposed stormwater management pond (SWMP) outlet pipe at the aforementioned site. It is understood that a proposed storm pipe is to run parallel to the existing storm pipe below Highway 174 at the northwest corner of the site.

1.0 Background Information

Paterson recently completed a borehole along the south side of the highway crossing to determine the subsoils profile at the proposed crossing location. A borehole (BH 91-13) extending to a 13 m depth was completed on November 22, 2013 and two boreholes (BH 92-14 and BH 92A-14) were completed on January 23, 2014 by a local drilling contractor using a track mounted drill rig and Paterson field personnel supervised by a senior geotechnical engineer. The borehole locations are presented in Drawing PG1796-15 - Test Hole Location Plan attached. The remainder of the borehole and test pit locations in the immediate area did not extend to the invert level of the proposed outlet pipe.

The subsurface profile encountered at BH 91-13 consisted of a topsoil layer overlying a silty clay layer for the full extent of the borehole. Based on the recovered soil sample’s moisture levels, colouring and consistency, the long-term groundwater level is anticipated at a 4 to 5 m depth.

The subsurface profile encountered at BH 92-14 and BH92A-14 consisted of a pavement structure underlain by a fill layer consisting of a silty sand with gravel and trace blast rock. A very stiff to stiff, silty clay layer was encountered underlying the fill layer at BH 92A-14. Specific details of the soil profile encountered at the borehole locations are presented in the attached Soil Profile and Test Data sheets.

2.0 Geotechnical Considerations

It is understood that consideration is being given to using a jack and bore style of installation for the proposed SWMP outlet crossing. Based on our findings, it should be noted that the soils are conducive to a jack and bore installation. It is anticipated that entry and exit pits will be stationed along the north and south sides of Highway 174 at the existing pipe crossing along the subject alignment. The north side of the Highway 174 crossing has limited room available due to the close proximity of the roadway embankment to the Ottawa River. The jack and bore installation will have to be designed with consideration of the limited room available along the north side of the highway. It is recommended that a sediment control and erosion protection system be designed taking into consideration best management practices. A contractor specializing in these works should be contracted for the proposed crossing installation.

It is expected that the native soils will be used as a support for the thrust block and that temporary shoring may be required for the entry and exit pits associated with the jack and bore system. The recommendations below should be considered in design and the following soils parameters can be used for design of the thrust block and temporary shoring system.

Excavation Side Slopes

The side slopes of the shallow excavations anticipated at this site should either be cut back at acceptable slopes or be retained by shoring systems from the start of the excavation until the structure is backfilled.

The excavation side slopes above the groundwater level should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides. Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress. It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides.

Temporary Shoring and Thrust Block Resistance

Temporary shoring may be required to complete the required excavations where insufficient room is available for open cut methods. For design purposes, the temporary system may consist of soldier pile and lagging system or interlocking steel sheet piling. Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be added to the earth pressures described in Table 1. These systems can be cantilevered, anchored or braced. Conventional braced excavation pressure envelopes can also be used by the shoring designer, as applicable. It is further recommended that the toe of the shoring be adequately supported to resist toe failure. The earth pressures acting on the shoring system may be calculated using the parameters presented in Table 1.

For thrust block design, the horizontal load component is resisted by passive earth pressure. Geotechnical parameters for typical backfill materials compacted to 98% of standard Proctor maximum dry density (SPMDD) and placed in 300 mm lift thicknesses are provided in Table 1, along with the associated earth pressure coefficients. For soil above the groundwater level, the “dry” unit weight should be used and below groundwater level the “effective” unit weight should be used. The hydrostatic groundwater pressure should be added to the earth pressure distribution wherever the effective unit weights are used for earth pressure calculations. The parameters provided in Table 1 are unfactored and, in the case of passive earth pressure coefficients, are “ultimate” values. As such, the appropriate factor of safety for working stress design, or resistance factor for limit states design (0.5) should be applied.

Table 1 - Geotechnical Parameters for Temporary Shoring and Thrust Block Design

Material Description	**Unit Weight (kN/m^3)**		**Internal Friction Angle (°) φ'**	**Friction Factor, tan δ**	**Earth Pressure Coefficients**		
	Dry γ_{dr}	**Effective γ'**			**Active K_A**	**At-Rest K_O**	**Passive K_P**
OPSS Granular A Fill (Crushed Stone)	22	13.5	40	0.6	0.22	0.36	4.58
OPSS Granular B Type I Fill (Well-Graded Sand-Gravel)	21.5	13.5	36	0.55	0.26	0.41	3.85
OPSS Granular B Type II Fill (Crushed Stone)	22.5	14	42	0.6	0.2	0.33	5.04
Silty clay	17	7.2	33	0.36	0.3	0.46	3.39

Notes:
- ❑ Properties for fill materials are for condition of 98% of standard Proctor maximum dry density.
- ❑ The earth pressure coefficients provided are for horizontal backfill profile.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.

patersongroup Consulting Engineers

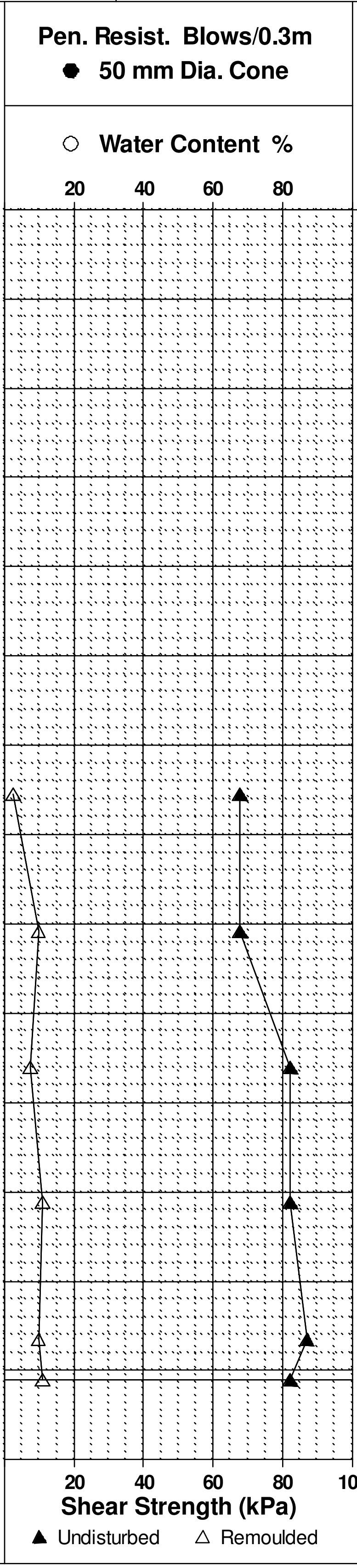
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Highway Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM	Approximate geodetic	**FILE NO.**	**PG1796**
REMARKS		**HOLE NO.**	**BH91-13**
BORINGS BY	CME 55 Power Auger	**DATE**	November 22, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD	0	53.10
	▨					1	52.10
	▨					2	51.10
Inferred **SILTY CLAY**	▨					3	50.10
	▨					4	49.10
	▨					5	48.10
6.10	▨					6	47.10
	▨					7	46.10
	▨					8	45.10
Stiff, grey **SILTY CLAY**	▨					9	44.10
	▨					10	43.10
	▨					11	42.10
	▨					12	41.10
13.11	▨					13	40.10
End of Borehole (BH dry upon completion)							



Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Highway Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

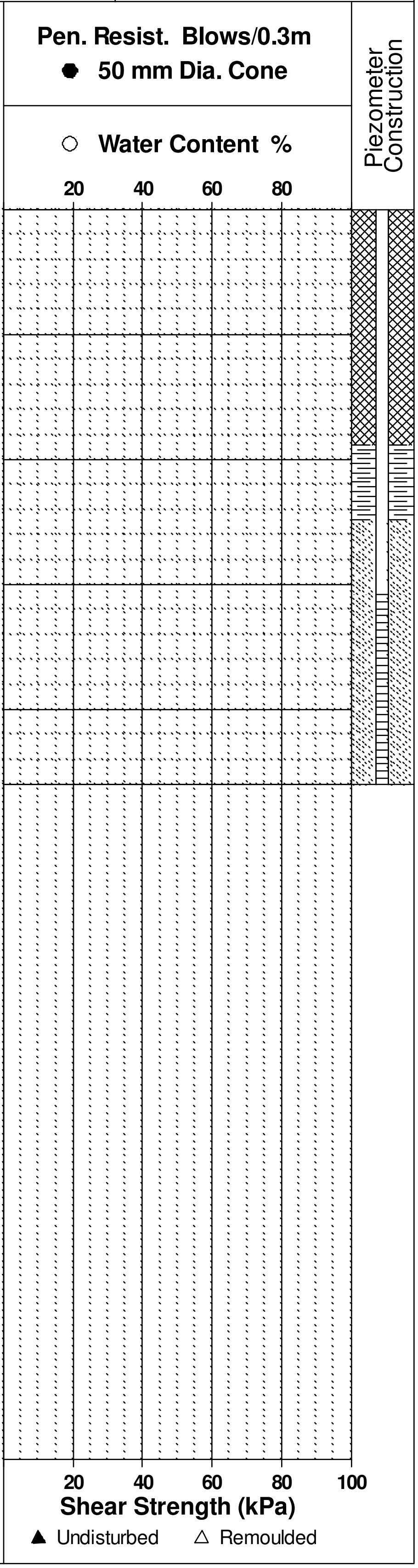
BORINGS BY Geo Probe

DATE January 23, 2014

FILE NO. PG1796

HOLE NO. BH92-14

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	46.79
Asphaltic concrete 0.10	AU	1				
	AU	2				
FILL: Brown silty sand with gravel - trace blast rock by 3.0m depth 4.60	SS	3	89	21		
	SS	4	62	34	1	45.79
	SS	5	67	19	2	44.79
	SS	6	54	16		
					3	43.79
	SS	7	67	35		
	SS	8	4	26	4	42.79
End of Borehole Practical refusal to augering at 4.60m depth.	SS	9	0	50+		



SOIL PROFILE AND TEST DATA

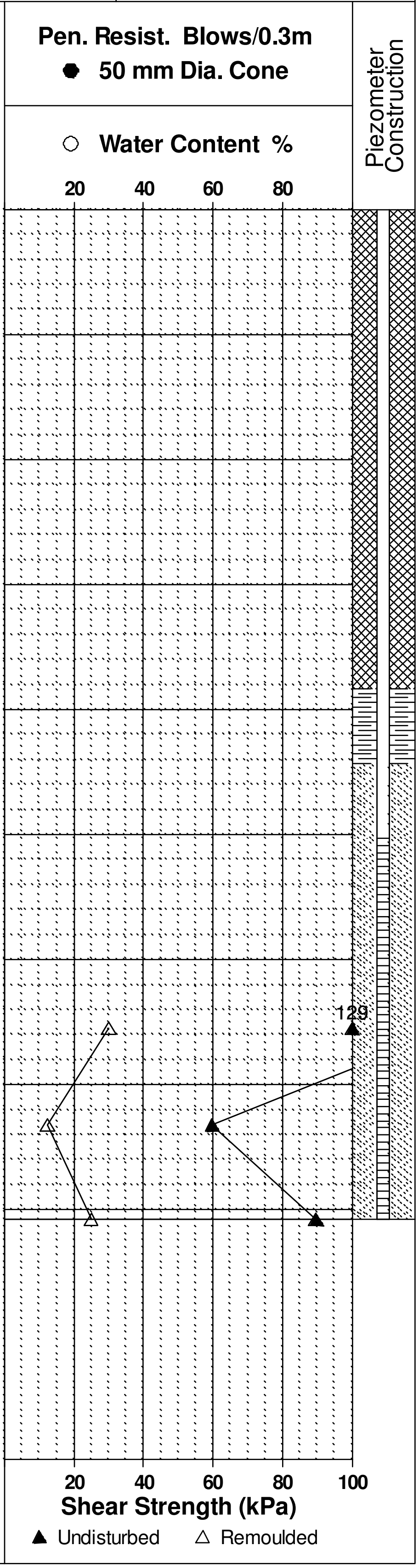
Geotechnical Investigation
Proposed Highway Crossing - Cardinal Creek Village
Ottawa, Ontario

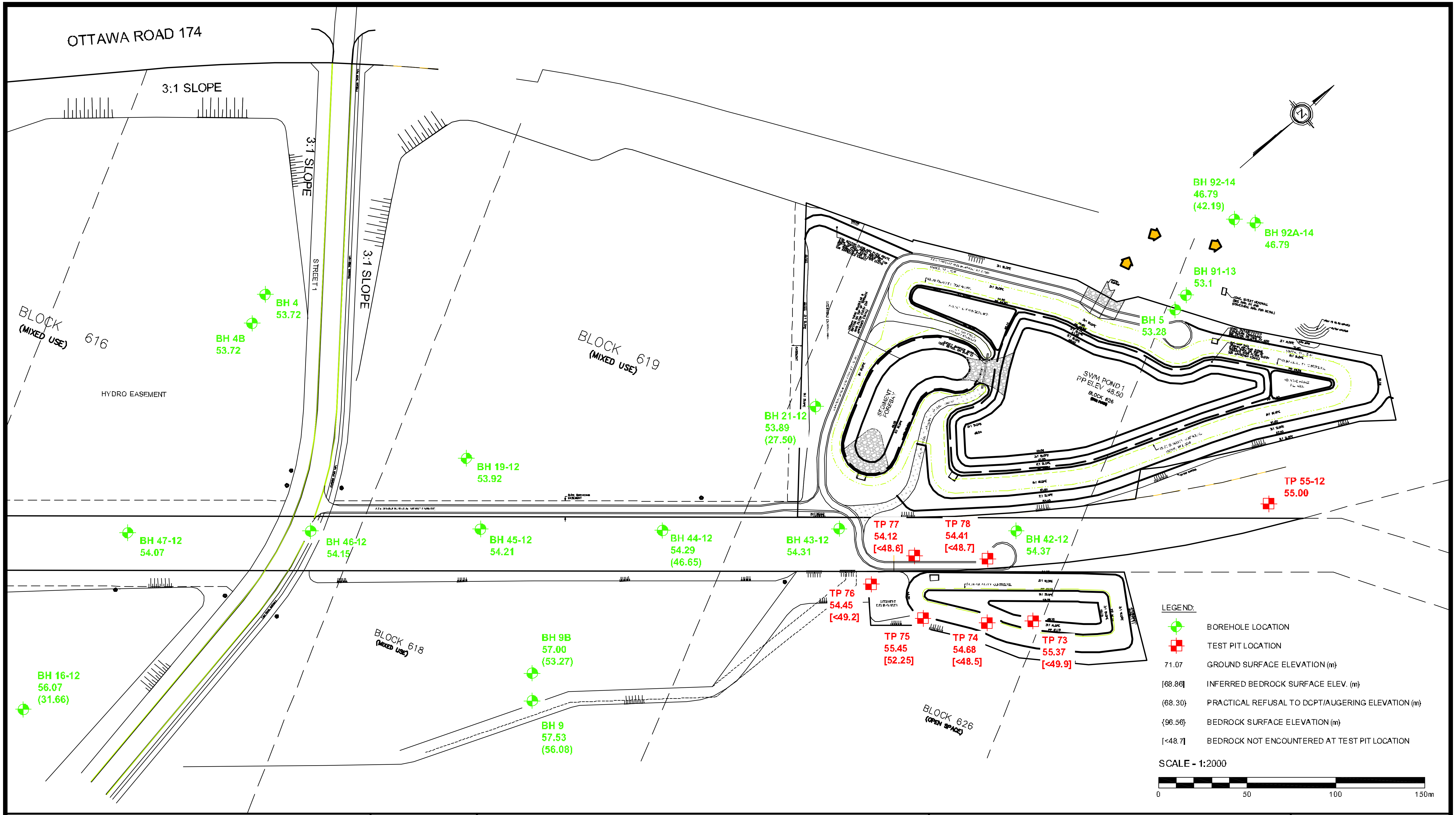
DATUM	Approximate geodetic
REMARKS	
BORINGS BY	Geo Probe
DATE	January 23, 2014
FILE NO.	**PG1796**
HOLE NO.	**BH92A-14**

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
Asphaltic concrete	0.10
FILL: Brown silty sand with gravel - trace blast rock by 3.0m depth	4.57
Very stiff to stiff, brown **SILTY CLAY**	8.08
End of Borehole	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	67	7
SS	2		2

DEPTH (m)	ELEV. (m)
0	46.79
1	45.79
2	44.79
3	43.79
4	42.79
5	41.79
6	40.79
7	39.79
8	38.79





paterson group
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

Scale:	1:2000
Des.:	DG
Dwn:	MPG
Chkd:	DG

TAMARACK (QUEEN STREET) CORP.

GEOTECHNICAL INVESTIGATION
CARDINAL CREEK VILLAGE

OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

Dwg. No. PG1796-15
Report No.: PG3007
Date: 12/2013

11x17

patersongroup **memorandum**
consulting engineers

to:	David Schaeffer Engineering Limited - **Ms. Laura Maxwell -** lmaxwell@dsel.ca
re:	Geotechnical Review of the Proposed SWMP **Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	February 25, 2014
file:	PG1796-MEMO.10R
from:	David Gilbert

Paterson Group (Paterson) has reviewed the drawing prepared by David Schaeffer Engineering Limited for the proposed Storm Water Management Pond 1 (SWMP) to be constructed within the northeast portion of the aforementioned site.

It is our understanding that the proposed SWM Pond 1 will consist of the following:

❏	Pond bottom elevation.	46.0 m
❏	Permanent water elevation.	48.5 m
❏	100 year water elevation.	50.44 m
❏	Elevation of top of pond sidewalls.	51.0 m

From a geotechnical perspective, the construction of the proposed SWM Pond 1 is possible based on the details provided in the construction drawing. The main areas of concern will be:

- ❏ the groundwater infiltration rate within the excavation side slopes and along the bottom of the pond
- ❏ the permeability of the subsoil materials
- ❏ the stability of the excavation side slopes

The proposed SWM Pond 1 will be located in an area where water infiltration will be important to manage during the construction phase. Based on the findings from our investigation, water infiltration rates are anticipated to be low to moderate and could easily be managed during the construction program. Based on the field observations, the long term groundwater level is expected to be between elevations 49 and 50 m. Although, the groundwater level is located above the permanent water level of the SWMP, no hydrostatic uplift issues or significant groundwater in-flow are anticipated.

It is anticipated that a clay liner is not required due to the low permeability of the silty clay soils located within the proposed SWM Pond 1 area. However, bedrock could be encountered along the south wall of the proposed forebay. It is expected that a minimum 60 mil HDPE geomembrane liner or equivalent could be placed across the exposed bedrock surface to ensure water does not infiltrate into the bedrock. It is recommended that the exposed bedrock surface be reviewed by the geotechnical consultant at the time of excavation to confirm if bedrock preparation or a silty clay bedding below the geomembrane liner is required to reduce any significant angular edges across the bedrock surface.

From a geotechnical perspective, the construction of the proposed SWM Pond 1 is possible and its long term performance will depend on the stability of its excavation side slopes. Based on the available drawing of the SWM Pond 1, it appears that the excavation side slopes are between 3H:1V to 5H:1V. From a geotechnical perspective, sidewalls shaped to a 3H:1V to 5H:1V slope are considered to be stable in the long term and are adequate for SWMP construction at the subject site.

The proposed concrete structures can be founded within the firm, grey silty clay. It is recommended that the design of the proposed concrete structures be reviewed from a geotechnical perspective. The following allowable bearing capacities are provided for design purposes and should be confirmed in the field prior to pouring concrete footings:

☐ Firm silty clay. . . . . 75 kPa

Based on our review, the proposed SWM Pond 1 details are acceptable from a geotechnical perspective. Nearby borehole and test pit subsurface profiles are presented in the attached Soil Profile and Test Data sheets for reference purposes. The test hole locations are presented in Drawing PG1796-15 - Test Hole Location Plan attached. It should be noted that TP 73 to TP 78 were completed to delineate the bedrock surface, if encountered. No Soil Profile and Test Data sheets were prepared for TP 73 to TP 78.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 21, 2009

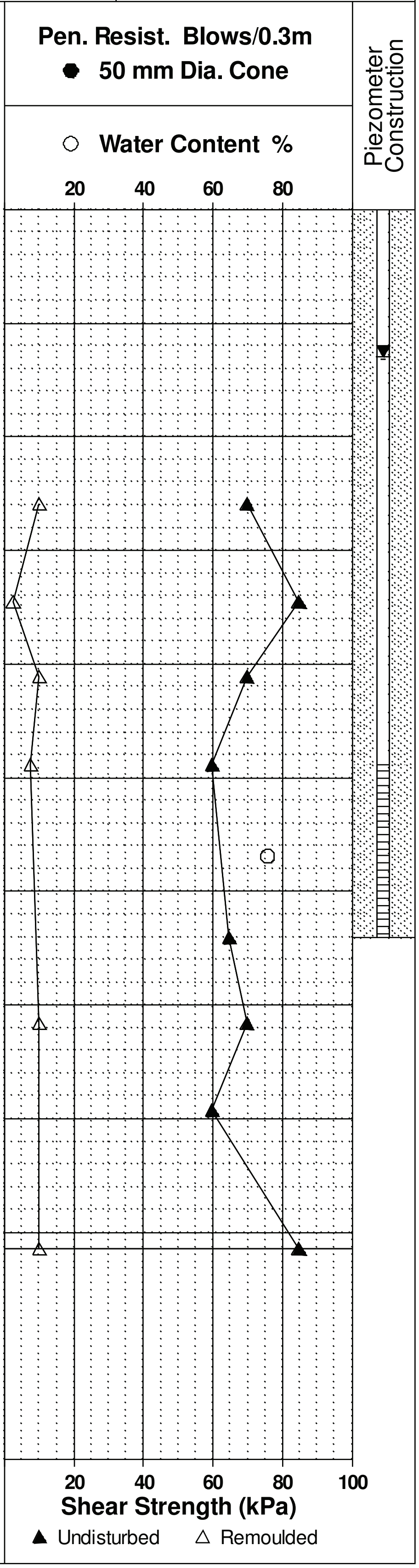
FILE NO. PG1796

HOLE NO. BH 5

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.25
Stiff, brown **SILTY CLAY** - red-brown by 1.4m depth - grey-brown by 2.8m depth - grey by 3.7m depth	9.14
End of Borehole (GWL @ 1.30m-Feb. 3/09)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	62	8
SS	3	100	6
TW	1	62	
TW	2	67	

DEPTH (m)	ELEV. (m)
0	53.28
1	52.28
2	51.28
3	50.28
4	49.28
5	48.28
6	47.28
7	46.28
8	45.28
9	44.28



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.	**FILE NO.** PG1796
REMARKS	**HOLE NO.** BH 9
BORINGS BY CME 55 Power Auger **DATE** January 22, 2009	

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	57.53		
TOPSOIL 0.20		AU	1						
FILL: Brown silty clay with sand and gravel 1.45		SS	2	50	20	1	56.53		
End of Borehole Practical refusal to augering @ 1.45m depth									

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG1796**

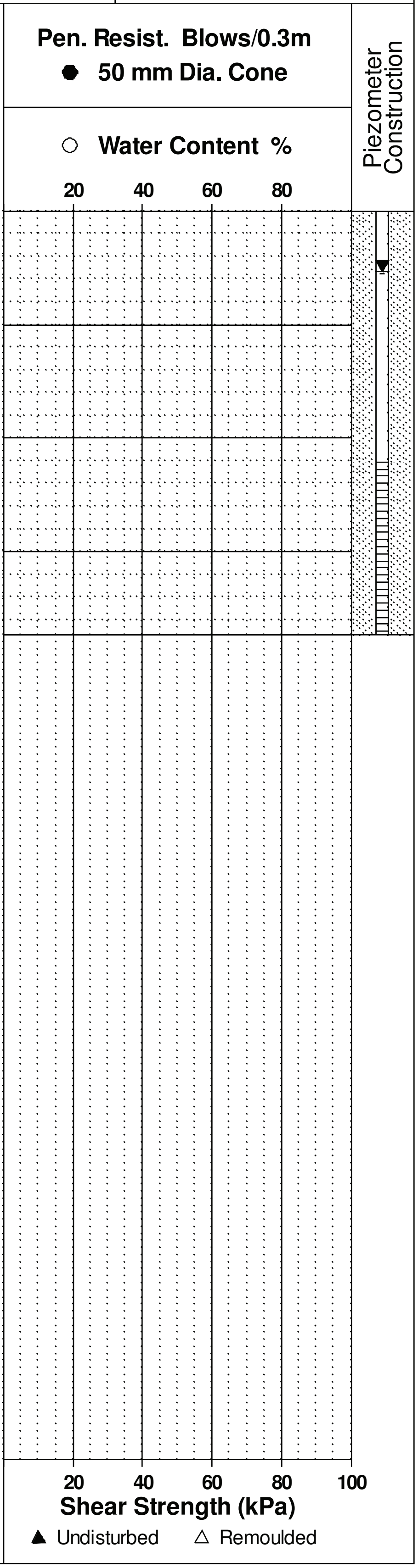
REMARKS

HOLE NO. **BH 9B**

BORINGS BY CME 55 Power Auger

DATE January 22, 2009

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	57.00
TOPSOIL 0.20						
					1	56.00
Very stiff, brown **SILTY CLAY**	SS	1	71	17		
2.29					2	55.00
GLACIAL TILL: Dense, brown silty sand with gravel, cobbles and boulders	SS	2	54	35		
	SS	3	75	50+	3	54.00
3.73						
End of Borehole Practical refusal to augering @ 3.73m depth (GWL @ 0.53m-Feb. 3/09)						



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

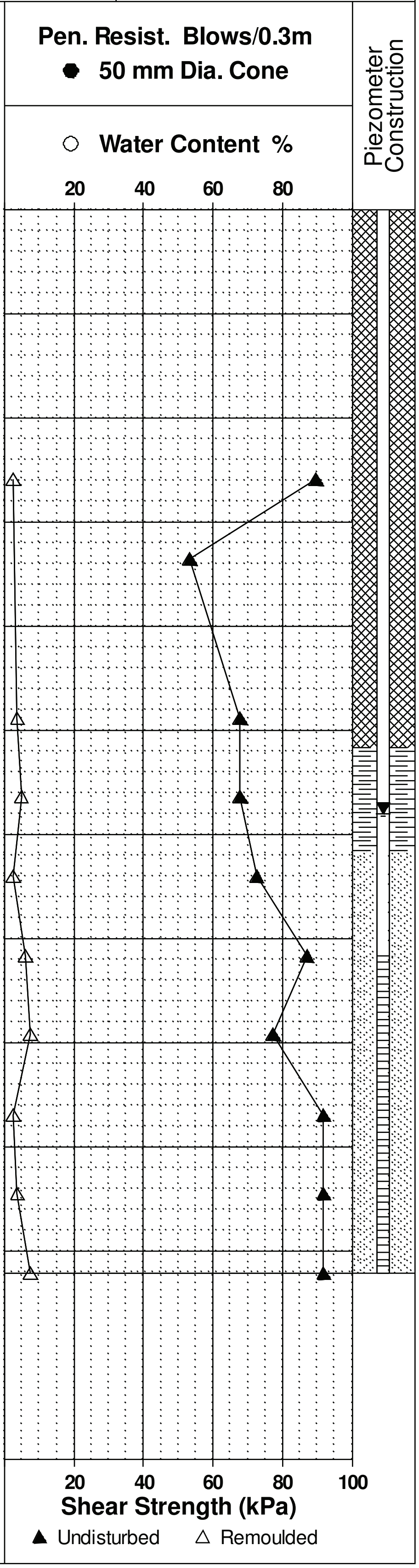
BORINGS BY CME 55 Power Auger

DATE March 30, 2012

FILE NO. PG1796

HOLE NO. BH19-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.92
TOPSOIL 0.20		AU	1				
Very stiff to stiff, brown **SILTY CLAY** - grey by 2.8m depth		SS	2	100	24	1	52.92
		SS	3	100	7		
						2	51.92
						3	50.92
		TW	4	83		4	49.92
						5	48.92
						6	47.92
						7	46.92
						8	45.92
						9	44.92
						10	43.92
10.21							
End of Borehole (GWL @ 5.80m-April 13, 2012)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE April 2, 2012

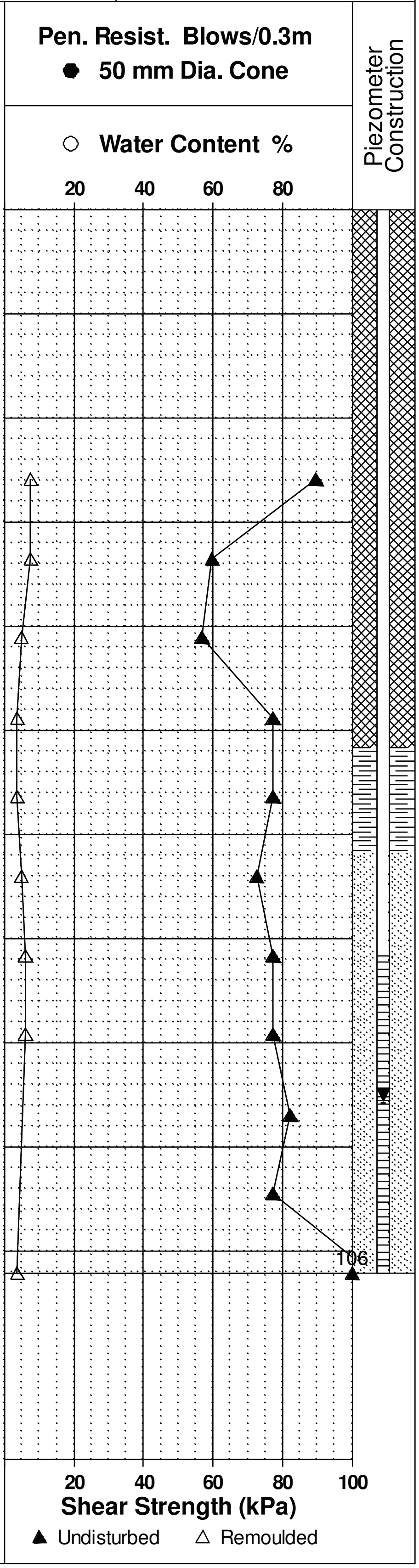
FILE NO. PG1796

HOLE NO. BH21-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	53.89
TOPSOIL 0.25		AU	1				
		SS	2	100	16	1	52.89
		SS	3	100	8		
						2	51.89
Very stiff to stiff, brown **SILTY CLAY** - grey by 3.6m depth						3	50.89
						4	49.89
						5	48.89
						6	47.89
						7	46.89
						8	45.89
						9	44.89
						10	43.89
10.21							

Dynamic Cone Penetration Test commenced at 10.21m depth. Cone pushed to 26.4m depth. Practical cone refusal at 26.39m depth.

(GWL @ 8.55m-April 13, 2012)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

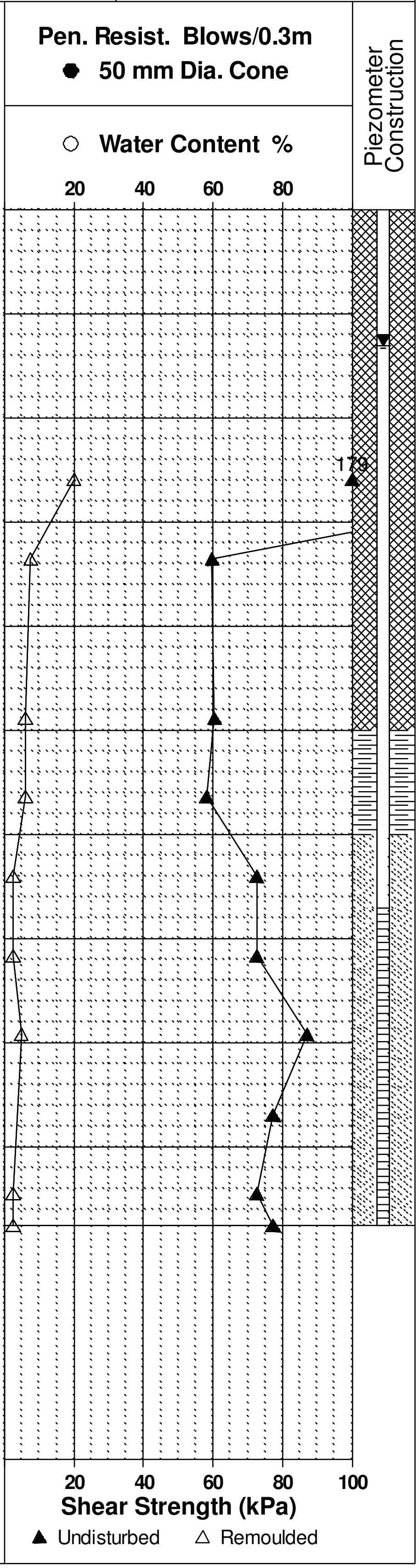
DATE November 5, 2012

FILE NO. PG1796

HOLE NO. BH42-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.33		AU	1		
		AU	2		
Very stiff to stiff, brown **SILTY CLAY** - grey by 4.3m depth		SS	3	100	11
		SS	4	100	10
9.75					
End of Borehole (GWL @ 1.31m-Dec. 6, 2012)					

DEPTH (m)	ELEV. (m)
0	54.37
1	53.37
2	52.37
3	51.37
4	50.37
5	49.37
6	48.37
7	47.37
8	46.37
9	45.37



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

REMARKS

HOLE NO. **BH43-12**

BORINGS BY CME 55 Power Auger

DATE November 5, 2012

SOIL DESCRIPTION

GROUND SURFACE

TOPSOIL 0.23

Very stiff to stiff, brown **SILTY CLAY**

- grey-brown by 3.6m depth

- grey by 6.0m depth

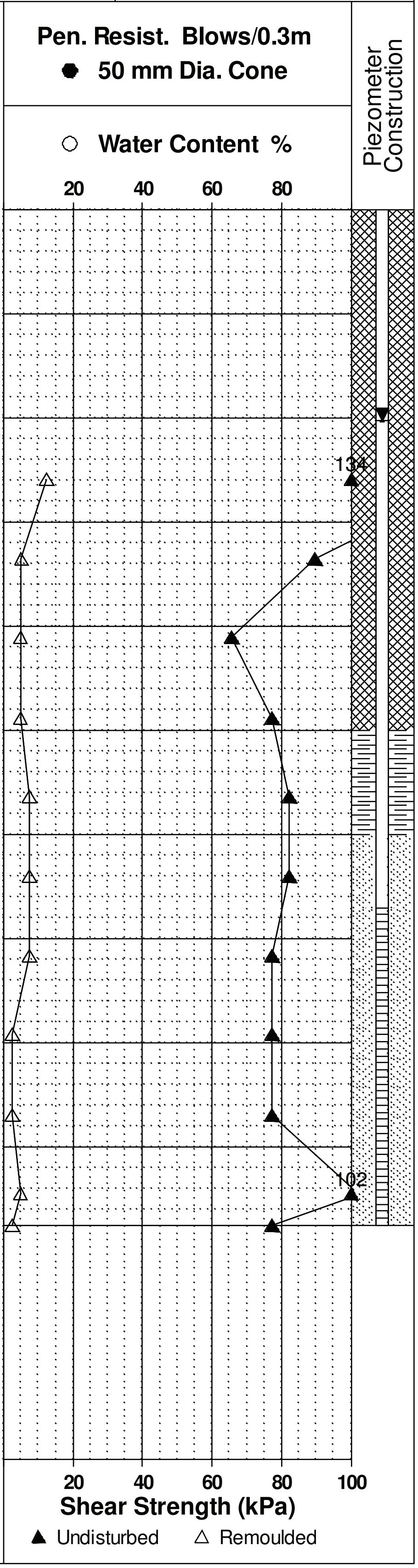
9.75

End of Borehole

(GWL @ 2.02m-Dec. 6, 2012)

SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
AU	2		
SS	3	100	11
SS	4	100	6

DEPTH (m)	ELEV. (m)
0	54.31
1	53.31
2	52.31
3	51.31
4	50.31
5	49.31
6	48.31
7	47.31
8	46.31
9	45.31



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

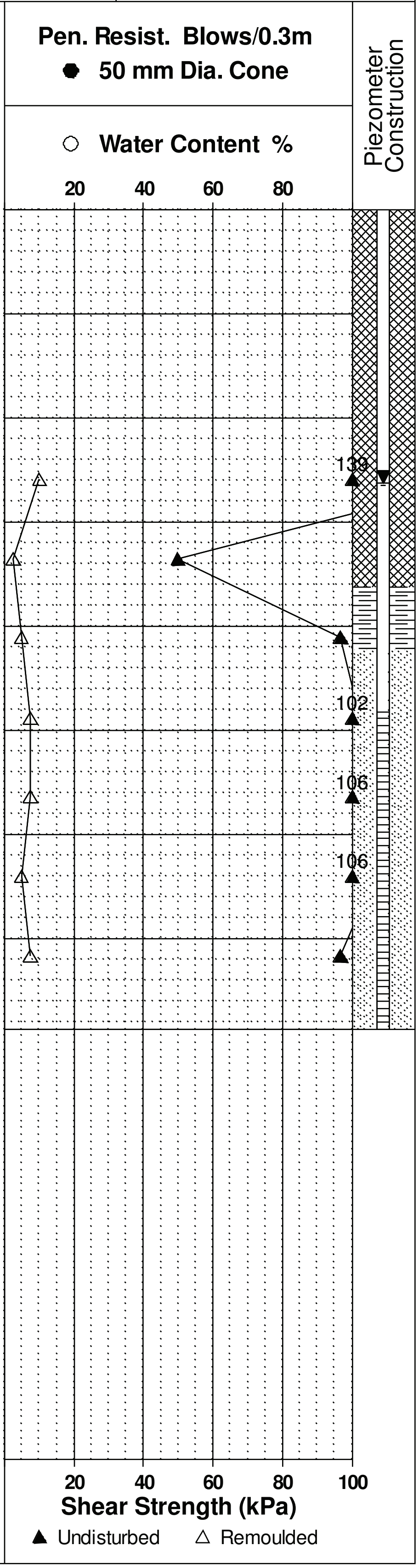
BORINGS BY CME 55 Power Auger

DATE November 5, 2012

FILE NO. PG1796

HOLE NO. BH44-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.29
TOPSOIL 0.41		AU	1				
Very stiff to stiff, brown **SILTY CLAY** - grey by 2.8m depth		SS	2	100	10	1	53.29
		SS	3	100	6	2	52.29
						3	51.29
						4	50.29
						5	49.29
						6	48.29
						7	47.29
7.64 Inferred **BEDROCK** 7.87							
End of Borehole Practical refusal to augering at 7.87m depth (GWL @ 2.62m-Dec. 6, 2012)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

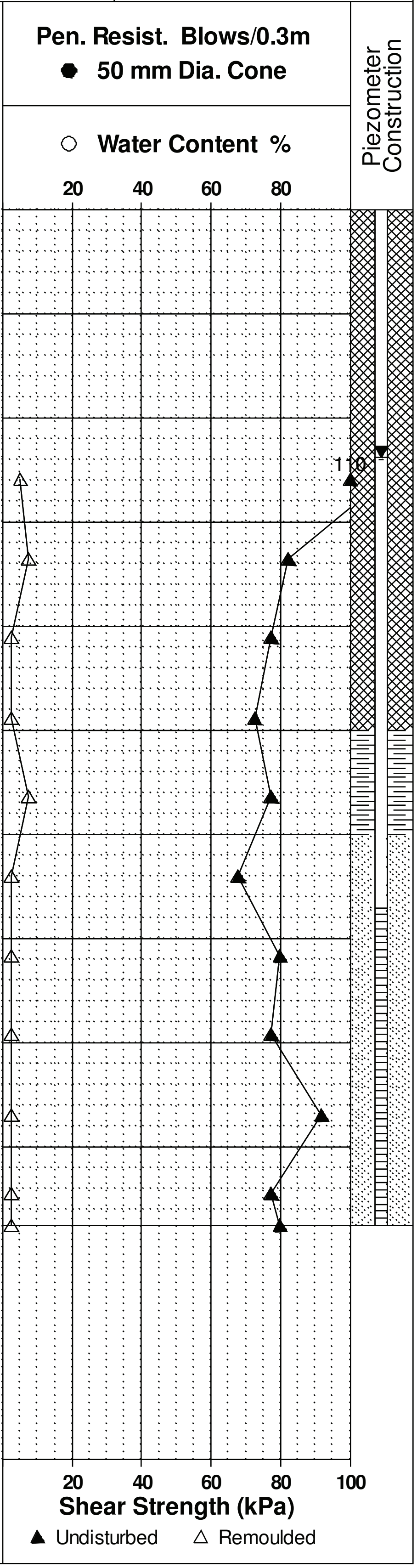
BORINGS BY CME 55 Power Auger

DATE November 6, 2012

FILE NO. **PG1796**

HOLE NO. **BH45-12**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	54.21
TOPSOIL 0.25						
	SS	1	100	11	1	53.21
	SS	2	100	6	2	52.21
					3	51.21
Very stiff to stiff, brown **SILTY CLAY**					4	50.21
					5	49.21
- grey-brown by 5.9m depth					6	48.21
					7	47.21
					8	46.21
					9	45.21
9.75						
End of Borehole (GWL @ 2.38m-Dec. 6, 2012)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

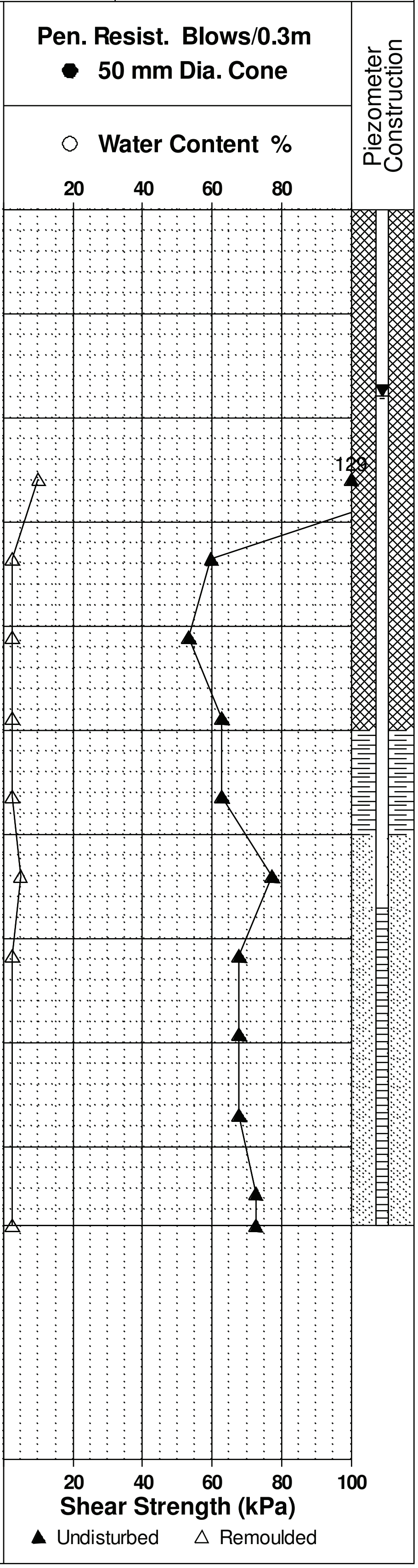
REMARKS

BORINGS BY CME 55 Power Auger

DATE November 6, 2012

HOLE NO. **BH46-12**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.15
TOPSOIL 0.33							
		SS	1	100	9	1	53.15
		SS	2	100	9	2	52.15
						3	51.15
Very stiff to stiff, brown **SILTY CLAY** - grey by 4.3m depth						4	50.15
						5	49.15
						6	48.15
						7	47.15
						8	46.15
						9	45.15
9.75							
End of Borehole (GWL @ 1.79m-Dec. 6, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

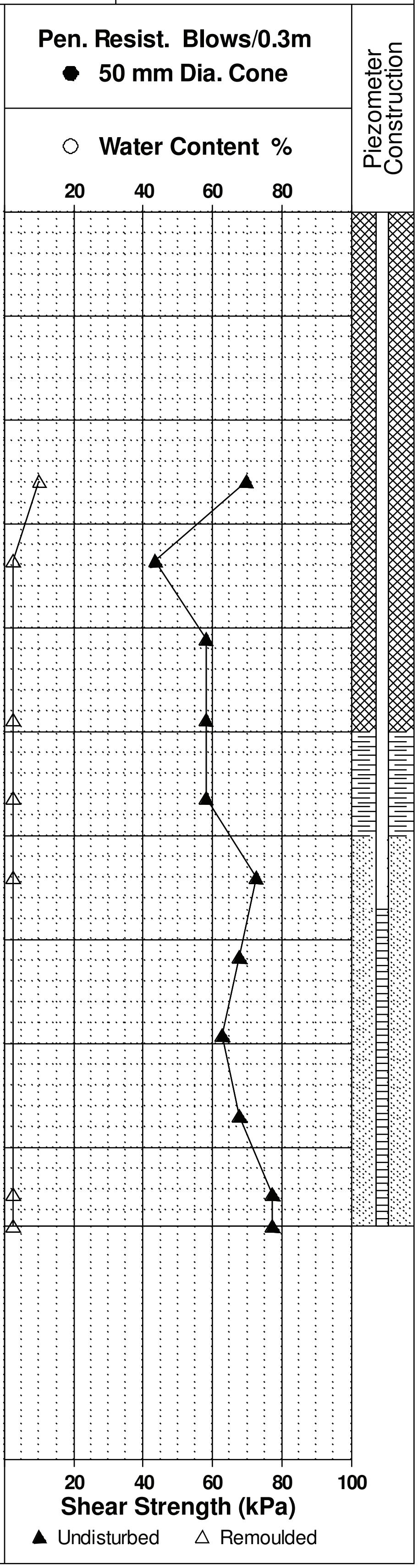
BORINGS BY CME 55 Power Auger

DATE November 6, 2012

FILE NO. PG1796

HOLE NO. BH47-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.07
TOPSOIL 0.25		AU	1				
		SS	2	100	8	1	53.07
		SS	3	100	5		
						2	52.07
						3	51.07
Very stiff to stiff, brown **SILTY CLAY**						4	50.07
- grey by 5.1m depth						5	49.07
						6	48.07
						7	47.07
						8	46.07
						9	45.07
9.75							
End of Borehole (GWL @ 1.29m-Dec. 6, 2012)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Watermain Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

BORINGS BY CME 55 Power Auger

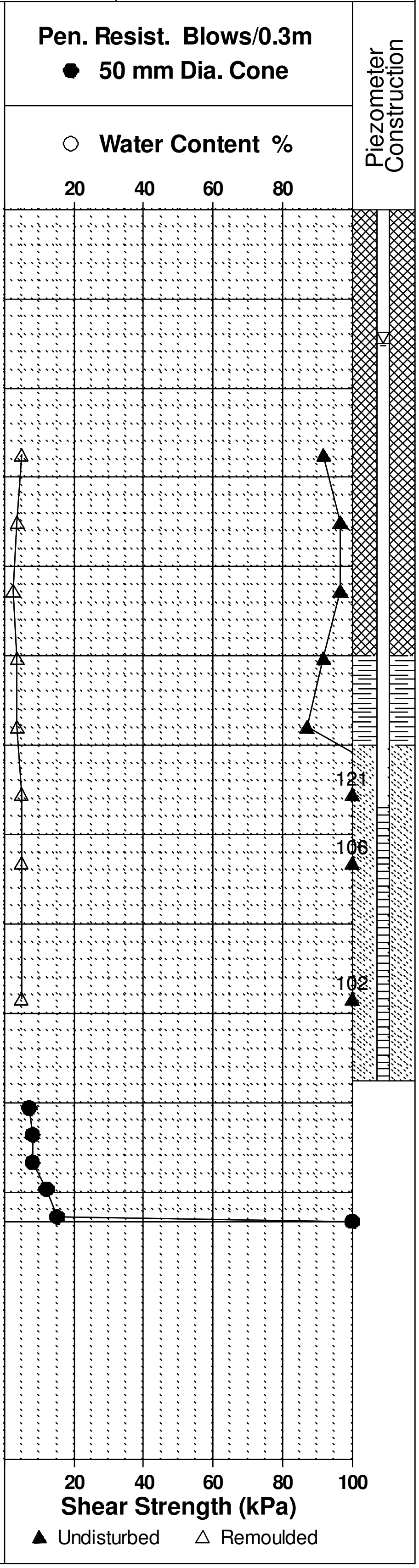
DATE November 22, 2013

FILE NO. PG1796

HOLE NO. BH90-13

SOIL DESCRIPTION	Depth to base (m)	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.30	AU	1		
Stiff to very stiff, brown **SILTY CLAY**	8.99	SS	2	67	6
		SS	3	100	2
GLACIAL TILL: Grey-brown silty clay with sand, gravel, cobbles and boulders	9.75	SS	4	83	4
Dynamic Cone Penetration Test commenced at 9.75m depth. Inferred **GLACIAL TILL**	11.33				
End of Borehole Practical DCPT refusal at 11.33m depth. (GWL @ 1.5m depth based on field observations)					

DEPTH (m)	ELEV. (m)
0	44.28
1	43.28
2	42.28
3	41.28
4	40.28
5	39.28
6	38.28
7	37.28
8	36.28
9	35.28
10	34.28
11	33.28



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Highway Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE November 22, 2013

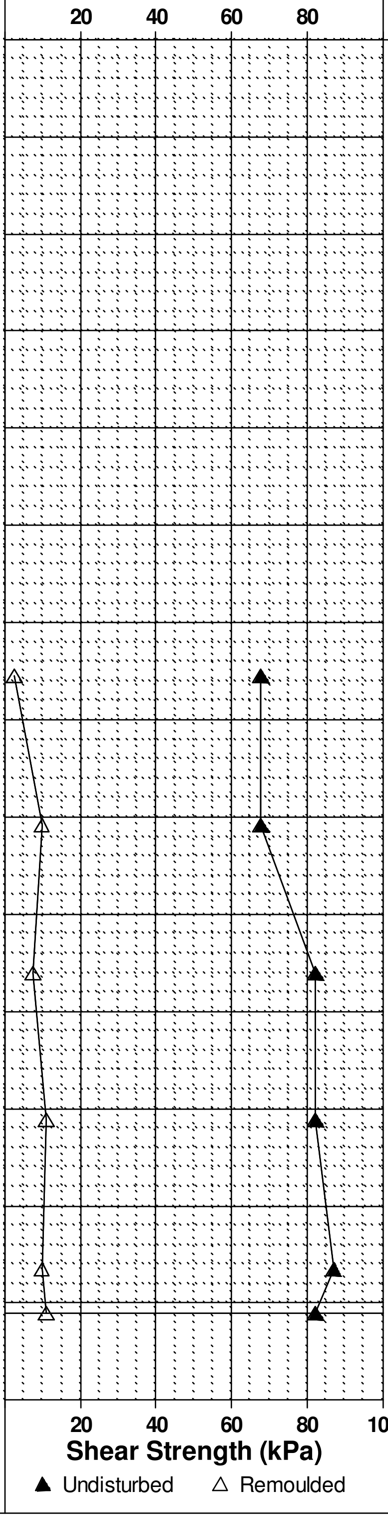
FILE NO. PG1796

HOLE NO. BH91-13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	53.10		
						1	52.10		
						2	51.10		
Inferred **SILTY CLAY**						3	50.10		
						4	49.10		
						5	48.10		
6.10						6	47.10		
						7	46.10		
						8	45.10		
Stiff, grey **SILTY CLAY**						9	44.10		
						10	43.10		
						11	42.10		
						12	41.10		
13.11						13	40.10		

End of Borehole

(BH dry upon completion)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Highway Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

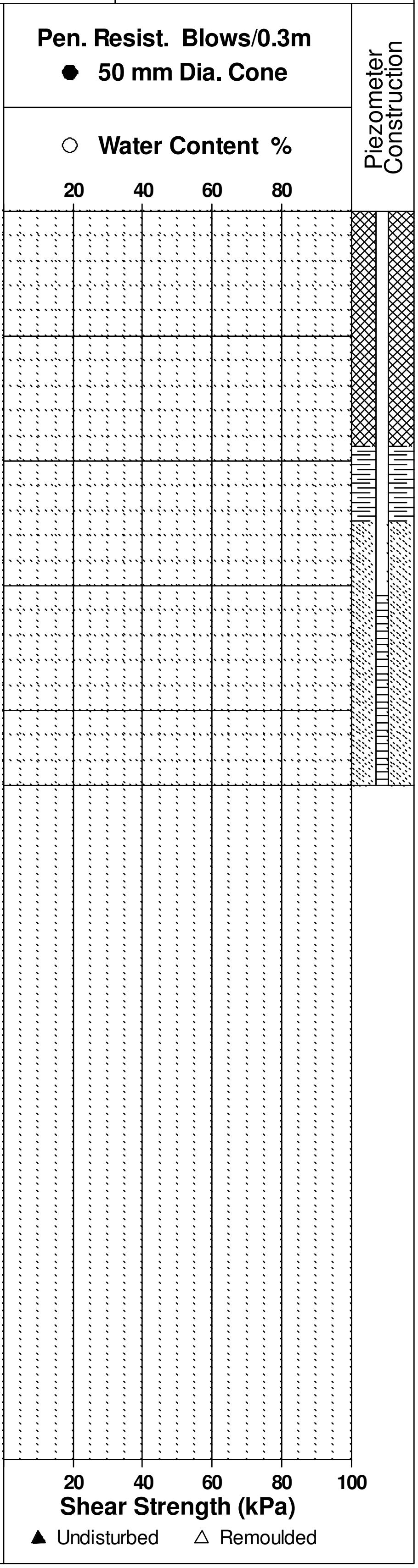
BORINGS BY Geo Probe

DATE January 23, 2014

FILE NO. PG1796

HOLE NO. BH92-14

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
Asphaltic concrete 0.10	AU	1			0	46.79
	AU	2				
	SS	3	89	21		
	SS	4	62	34	1	45.79
	SS	5	67	19		
FILL: Brown silty sand with gravel					2	44.79
- trace blast rock by 3.0m depth	SS	6	54	16		
					3	43.79
	SS	7	67	35		
	SS	8	4	26	4	42.79
4.60	SS	9	0	50+		
End of Borehole Practical refusal to augering at 4.60m depth.						



patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

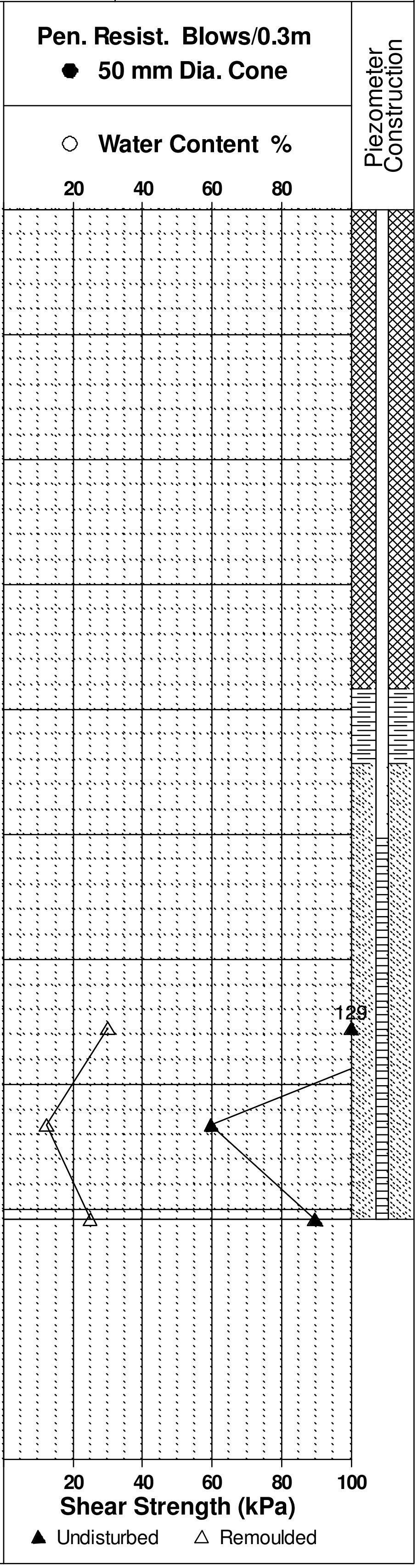
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Highway Crossing - Cardinal Creek Village
Ottawa, Ontario

DATUM Approximate geodetic
REMARKS
BORINGS BY Geo Probe
DATE January 23, 2014

FILE NO. PG1796
HOLE NO. BH92A-14

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	46.79
Asphaltic concrete 0.10						
					1	45.79
FILL: Brown silty sand with gravel - trace blast rock by 3.0m depth					2	44.79
					3	43.79
4.57					4	42.79
Very stiff to stiff, brown **SILTY CLAY**	SS	1	67	7	5	41.79
	SS	2		2	6	40.79
					7	39.79
8.08					8	38.79
End of Borehole						



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

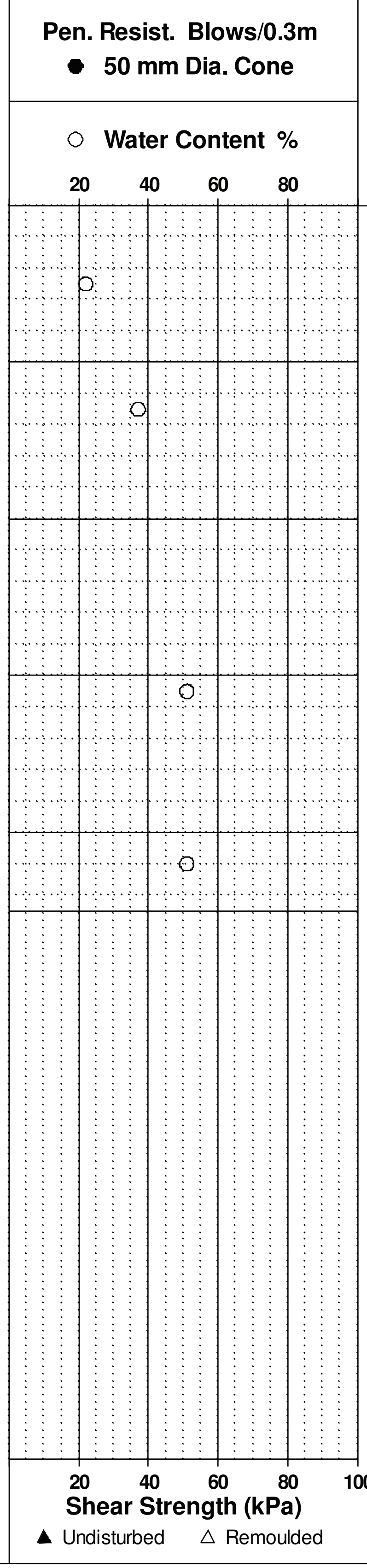
BORINGS BY Backhoe

DATE December 19, 2012

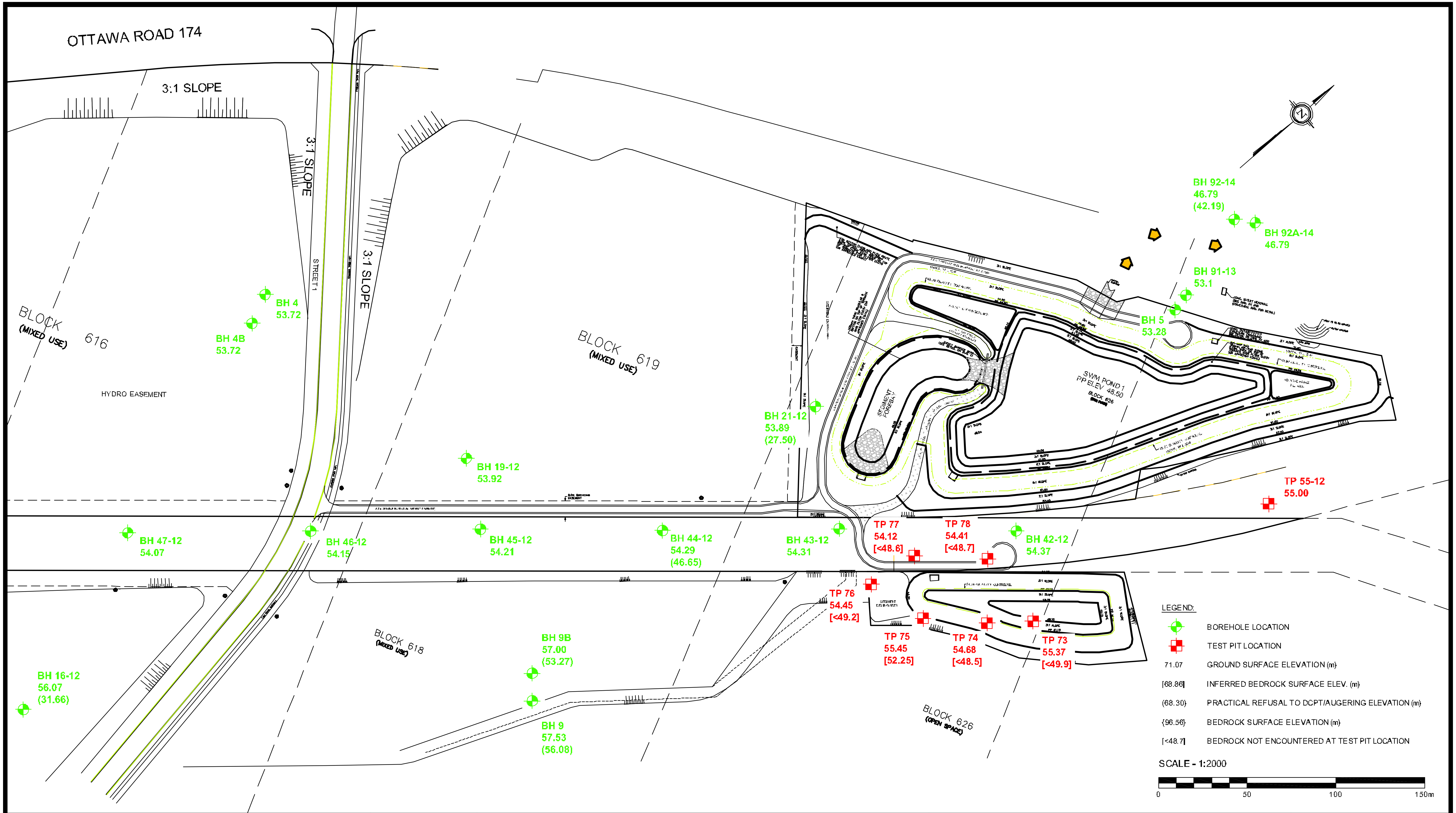
FILE NO. PG1796

HOLE NO. TP55-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	55.00
FILL: Topsoil with organics — 0.10							
FILL: Brown silty sand, trace clay and gravel — 0.70		G	1				
TOPSOIL — 0.85						1	54.00
Hard to very stiff, brown **SILTY CLAY**		G	2				
						2	53.00
		G	3			3	52.00
		G	4			4	51.00
— 4.50							
End of Test Pit TP terminated in very stiff silty clay at 4.50m depth (TP dry upon completion)							



Piezometer Construction



LEGEND:

⊕	BOREHOLE LOCATION
⊞	TEST PIT LOCATION
71.07	GROUND SURFACE ELEVATION (m)
[68.86]	INFERRED BEDROCK SURFACE ELEV. (m)
(68.30)	PRACTICAL REFUSAL TO DCPT/AUGERING ELEVATION (m)
(96.56)	BEDROCK SURFACE ELEVATION (m)
[<48.7]	BEDROCK NOT ENCOUNTERED AT TEST PIT LOCATION

paterson group
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

Scale:	1:2000
Des.:	DG
Dwn.:	MPG
Chkd:	DG

TAMARACK (QUEEN STREET) CORP.

GEOTECHNICAL INVESTIGATION
CARDINAL CREEK VILLAGE

OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

Dwg. No.	**PG1796-15**
Report No.:	PG3007
Date:	12/2013

11x17

patersongroup
consulting engineers

memorandum

to:	David Schaeffer Engineering Limited - **Ms. Laura Maxwell** - lmaxwell@dsel.ca
re:	Geotechnical Considerations - Side Slopes for Temporary Diversion Channel and Stockpile Berm **Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	April 17, 2014
file:	PG1796-MEMO.11R
from:	David Gilbert

Paterson Group (Paterson) has reviewed the following drawings prepared by David Schaeffer Engineering Limited for the proposed temporary diversion channel and berm located at the aforementioned site.

- Grading Plan, Cardinal Creek Village Phase 1, Project No. 11-513-B-1, Sheet No. 30, Revision 1, dated February 7, 2014.
- Grading Plan, Cardinal Creek Village Phase 1, Project No. 11-513-B-1, Sheet No. 36, Revision 1, dated February 7, 2014.
- Grading Plan, Cardinal Creek Village Phase 1, Project No. 11-513-B-1, Sheet No. 42, Revision 1, dated February 7, 2014.
- Grading Plan, Cardinal Creek Village Phase 1, Project No. 11-513-B-1, Sheet No. 48, Revision 1, dated February 7, 2014.

Based on our review, a 4.2 to 5.5 m deep temporary diversion channel (Invert El. 50 to 48.9 m) runs along the north side of the existing Hydro Corridor and outlets to the proposed stormwater management pond (SWMP) located within the northeast portion of the subject site. The temporary diversion channel side slopes will be shaped to a 2H:1V slope. It is understood that the temporary diversion channel will be in use for an estimated 5 year duration. It is further understood that the excavated material from the diversion channel will be stockpiled on the north side of the temporary construction access road bordering the north side of the diversion channel. The excavated material is to be placed to a maximum height of 6.1 m with a 2H:1V sideslope. The temporary diversion channel will be backfilled, once the ultimate diversion channel is completed.

Based on existing subsoils information, the subsoil profile consists of a deep silty clay deposit. The upper portion of the silty clay deposit has been weathered to form a stiff, brown silty clay crust. The long term groundwater level within the subject area is expected between a geodetic elevation of 49 and 50 m.

Recommendations

From a geotechnical perspective, sidewalls shaped to a 2H:1V slope for the temporary diversion channel through the anticipated stiff, brown silty clay are considered to be stable and no further treatments are required.

The 2H:1V side slope designed for the temporary berm is considered stable provided the following program is completed:

- ☐ The excavated, brown silty clay should be placed in maximum 300 mm loose lifts under dry conditions and compacted using a sheepsfoot roller making several passes.
- ☐ Upon completion of the berm, a minimum 150 mm thick layer of topsoil mixed with a hardy grass seed should be placed across the shaped berm face. An erosion control blanket should be placed over the topsoil layer to limit surficial erosion until the vegetation can be established.

It is further recommended that the geotechnical consultant provide periodic inspections during placement activities for the temporary berm.

It should be noted that the diversion channel and berm sideslopes are considered stable under long term conditions. However, if consideration is given to leaving the diversion channel and berm in place permanently, a periodic geotechnical inspection of the diversion channel and berm's side slopes is recommended to ensure that any poor performing areas are assessed and reinstated.

It is understood that a gravel covered access roadway is to be located between the temporary diversion channel and the berm. It is recommended that a minimum 300 mm thick layer of Granular A crushed stone or Granular B Type II compacted to a minimum 98% of its SPMDD be placed. It is possible that the access roadway may require annual maintenance such as regrading and padding in poor performing areas.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Richard Groniger, C. Tech.

David J. Gilbert, P.Eng.

patersongroup
consulting engineers

memorandum

to:	David Schaeffer Engineering Limited - **Ms. Laura Maxwell** - lmaxwell@dsel.ca
re:	Geotechnical Considerations - Clay Liner System for Exposed Bedrock within North Tributary Crossing **Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	April 14, 2014
file:	PG1796-MEMO.12R
from:	David Gilbert

As requested, Paterson Group (Paterson) has prepared the current memo report to provide recommendations regarding a suitable clay liner system to limit water infiltration into exposed bedrock along North Tributary crossing required for the proposed services alignment within Blocks 402 and 632 of the aforementioned site.

Recommendations

To ensure an adequate seal is provided where bedrock is exposed along the north tributary crossing, the following liner system is recommended:

- The bedrock surface where exposed, should be capped with a minimum 500 mm thick layer of workable, brown silty clay placed in maximum 300 mm loose lifts under dry conditions and compacted using a sheepsfoot roller making several passes.
- A non-woven geotextile liner, such as Terrafix 270R or equivalent, should be placed over the silty clay seal area. The pipe bedding and cover material should be placed over the non-woven geotextile liner as per our recommendations in Subsection 6.4 of Paterson Report PG1796-3R dated March 14, 2014.
- A second non-woven geotextile liner, such as Terrafix 270R or equivalent, should be placed over the pipe cover layer followed by a minimum 500 mm thick layer of workable, brown silty clay placed in maximum 300 mm loose lifts under dry conditions and compacted using a sheepsfoot roller making several passes. The silty clay seal should extend at least 2 m beyond the pipe cover material and be approved by the geotechnical consultant at the time of placement.
- It is recommended that a non-woven geotextile liner be placed over the silty clay backfill and capped with a minimum 500 mm thick layer of rip-rap material (200 to 300 mm diameter in longest dimension) placed over the non-woven geotextile liner and extending at least 1 m beyond the geotextile liner edge in all directions.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

D. J. GILBERT
100116130

David J. Gilbert, P.Eng.

patersongroup memorandum

consulting engineers

to:	David Schaeffer Engineering Limited - **Ms. Laura Maxwell** - lmaxwell@dsel.ca
re:	Geotechnical Considerations - Surface Treatments for 3H:1V slope **Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	May 1, 2014
file:	PG1796-MEMO.14
from:	David Gilbert

As requested, Paterson Group (Paterson) has prepared the current memo report to provide geotechnical considerations regarding surface treatments for the finished grading at Blocks 148 and 513 where a 3H:1V slope is present. It should be noted that a 3H:1V slope is considered stable under long-term conditions provided the backfill material is approved by Paterson at the time of construction and placed in accordance with Paterson recommendations. It is expected that the backfill material will consist of previously excavated silty clay to match the excavation sidewalls placed over the approved pipe cover and bedding materials. A workable brown silty clay can be compacted to 95% of its SPMDD under dry conditions using a sheepsfoot roller making several passes and placed in maximum 300 mm loose lifts. Inspections should be completed by Paterson at the time of placement to confirm conformance with our backfilling recommendations.

It is expected that the finished surface materials will consist of granular fill or a grass covered topsoil. It is recommended that a 100 to 150 mm thick layer of topsoil mixed with a hardy seed be covered with an erosional control blanket to limit surficial erosion before vegetation can establish across the exposed slope face. No further treatments are required for a granular fill finish, such as a Granular A crushed stone. However, it is recommended that a minimum 300 mm thick layer of Granular A compacted to 98% of its SPMDD be placed as a granular finished surface within the subject blocks. It is possible that annual maintenance such as regrading and padding may be required in poor performing areas.

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.

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Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
Building Science
Archaeological Services

www.patersongroup.ca

May 28, 2014
File: PG1796-LET.04R

Tamarack (Queen Street) Corporation
3187 Albion Road
Ottawa, Ontario
K1V 8Y3

Attention: **Mr. Ted Philips**

Subject: **Slope Reinstatement Program**
Section Q - Cardinal Creek - Cardinal Creek Village
Old Montreal Road - Ottawa

Dear Sir,

Further to your request and authorization, Paterson Group (Paterson) has prepared this letter report to detail our recommended slope reinstatement program for the east slope along Cardinal Creek. The required remedial work is located at slope stability cross-section Q where a series of slip failures have occurred across the slope face. Section Q was completed as part of our slope stability analysis for limit of hazard lands determination along Cardinal Creek for the proposed Cardinal Creek Village development. The results of our slope stability analysis are presented in Paterson Report PG1796-4 dated May 22, 2014.

1.0 Background Information

The overall objective of the slope reinstatement program is to provide a stable slope along with an adequate toe erosion protection system where Cardinal Creek comes in contact with the slope toe. A site visit by Paterson personnel was recently completed on July 26, 2013. At that time, the subject slope was reviewed to determine a suitable slope reinstatement program. Stantec Geomatics was also on site and provided a topographic survey of the slope surface and current watercourse location along the slope toe. The results of the recent topographic survey are presented in Drawing PG1796-10 - Current Slope Details attached.

Several shallow slip failures were noted along the slope surface at time of our site visit. As well as, a significant sloughed area where significant toe erosion had occurred. Surficial erosion was noted in several locations where rainfall runoff has been concentrated due to the slip failures. Photographs taken at the time of our site visit are attached to the present letter report.

Based on field observations and nearby borehole information (BH 18), the subsurface profile at the slope consists of a brown silty clay crust underlain by a grey, firm to stiff silty clay layer extending to the toe of the slope. The Soil Profile and Test Data sheet for BH 18 (2009) is attached the present letter report.

2.0 Slope Reinstatement Program Details

Generally, the program will consist of removing the previously failed materials and placing a series of geogrids along with an appropriate relatively free draining non-cohesive fill and reinforced topsoil finish to allow vegetation to re-establish and reduce surficial erosion. The toe erosion protection system should consist of rip-rap along the slope toe where the watercourse is in contact with the slope toe. Details of our reinstatement program are presented below and in Drawing PG1796-9 - Slope Reinstatement Program attached.

It should be noted that the slope reinstatement program will take into consideration the proposed regrading work required at the top of slope for the proposed development. It should also be noted that a sediment control and erosion protection system will be designed by others taking into consideration best management techniques. The slope reinstatement program details are outlined below:

- ☐ All topsoil, deleterious materials and previously failed materials should be removed from the reinstatement program area. A minimum 3H:1V stepped backslope should be provided for the proposed reinstatement program. The slope reinstatement area is outlined in Drawing PG1796-10 - Current Slope Details.
- ☐ The slope toe should be excavated and replaced with a minimum 600 mm thick layer of granular fill, such as Granular B Type II, placed over a non-woven geotextile liner and in maximum 300 mm loose lifts, compacted to 95% of its SPMDD. The granular fill layer should be capped with a minimum 600 mm thick layer of rip-rap layer extending to geodetic elevation of 44.5 m as detailed in Drawing PG1796-9 - Slope Reinstatement Program.
- ☐ The slope should be reinstated with a non-cohesive well graded sand fill compacted under dry conditions in maximum 300 mm thick lifts to a minimum 95% of its SPMDD. The reinstated slope face should be sloped to provide a 2H:1V slope. The reinstatement program should provide a minimum geodetic elevation of 57.0 m along the top of slope.

- A series of primary horizontal geogrid reinforcement layers should be placed along the slope face at 0.6 m vertical centres. The primary geogrid layers should consist of a uniaxial geogrid with a minimum long-term design strength (LTDS) of 25 kN/m, except for the lower 4 primary geogrid layers, which should have a LTDS of 45 kN/m. The primary geogrid layers should extend horizontally from the back slope to the reinstated slope face and continuously extend vertically at least 600 mm just below the slope face. The primary geogrid layer should then continue horizontally into the slope face at least 2 m immediately below the overlying primary geogrid layer.
- The slope surface should be capped with a minimum 200 mm thick layer of topsoil mixed with a hardy grass seed. An erosion control blanket should be placed over the entire subject slope surface to along vegetation to establish and limit surficial erosion.

We trust that the present submission meets your current requirements.

Paterson Group Inc.

David J. Gilbert, P.Eng.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Photo No. 1 – Illustrating the slope failure along the north portion of Slope Cross Section Q on the east slope of Cardinal Creek.

Photo No. 2 – Illustrating the slope failure along the south portion of Slope Cross Section Q on the east slope of Cardinal Creek.

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 19, 2009

FILE NO. PG1796

HOLE NO. BH18

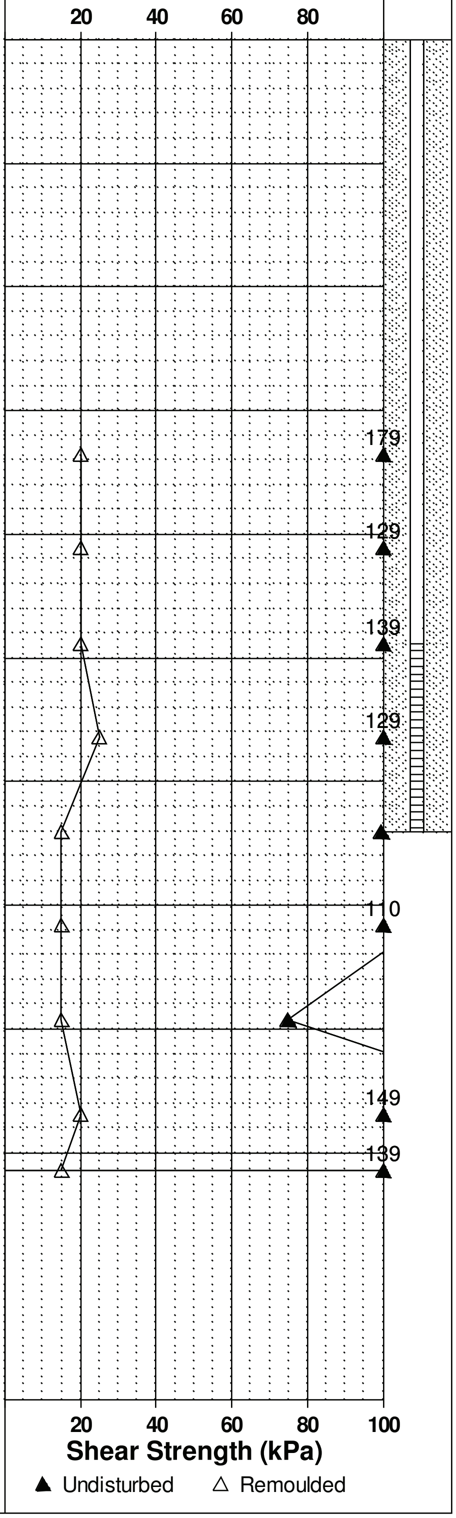
SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.25 25mm Topsoil	AU	1		
	SS	2	50	8
	SS	3	83	8
	SS	4	58	7
Very stiff to stiff, brown **SILTY CLAY** - grey-brown by 4.9m depth - grey by 6.6m depth				
9.14 End of Borehole (Piezometer blocked - Feb. 3/09)				

DEPTH (m)	ELEV. (m)
0	54.83
1	53.83
2	52.83
3	51.83
4	50.83
5	49.83
6	48.83
7	47.83
8	46.83
9	45.83

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

○ Water Content %

Piezometer Construction



SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

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

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2 / (D10 \times D60)$
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)

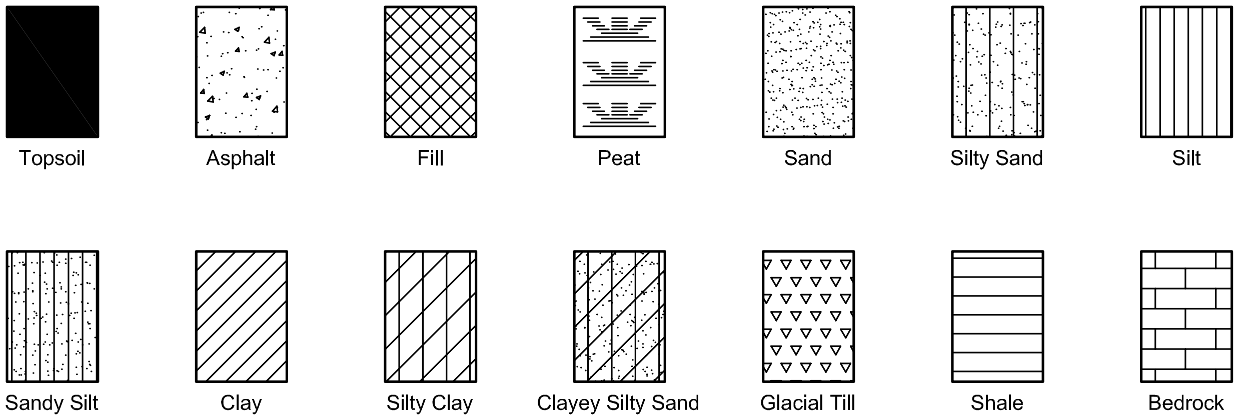
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

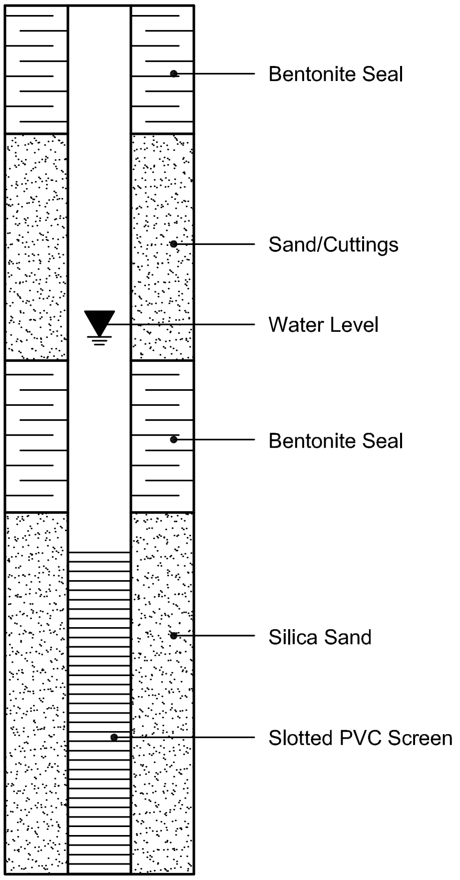
SYMBOLS AND TERMS (continued)

STRATA PLOT

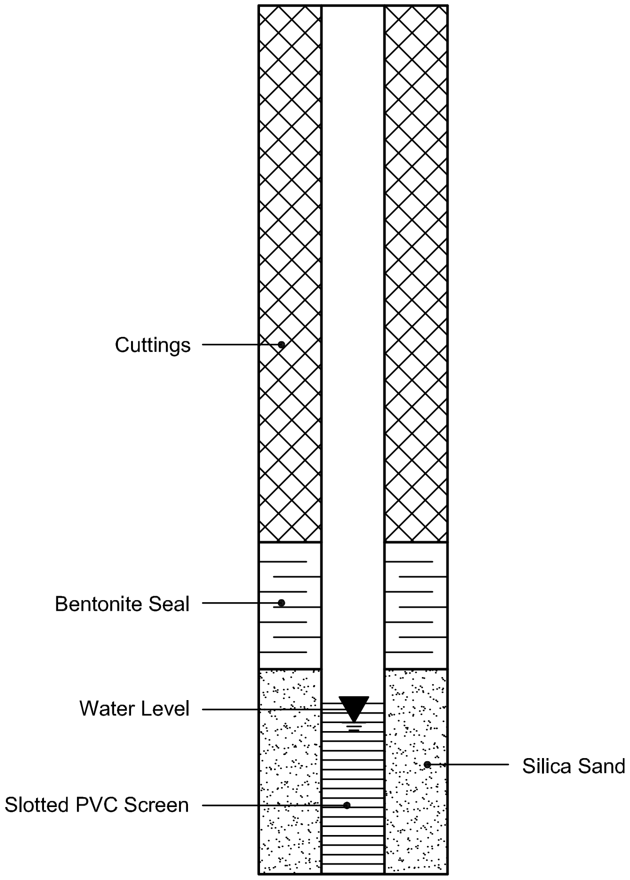


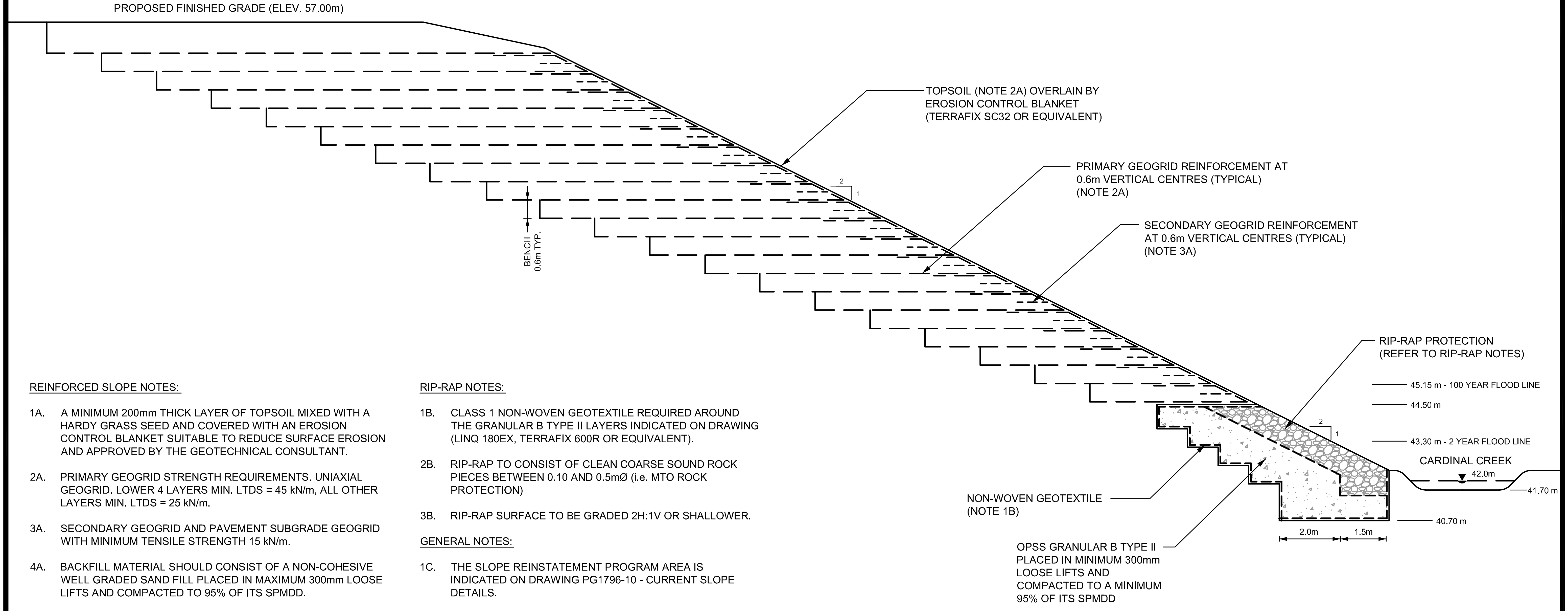
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





REINFORCED SLOPE NOTES:

1A. A MINIMUM 200mm THICK LAYER OF TOPSOIL MIXED WITH A HARDY GRASS SEED AND COVERED WITH AN EROSION CONTROL BLANKET SUITABLE TO REDUCE SURFACE EROSION AND APPROVED BY THE GEOTECHNICAL CONSULTANT.

2A. PRIMARY GEOGRID STRENGTH REQUIREMENTS. UNIAXIAL GEOGRID. LOWER 4 LAYERS MIN. LTDS = 45 kN/m, ALL OTHER LAYERS MIN. LTDS = 25 kN/m.

3A. SECONDARY GEOGRID AND PAVEMENT SUBGRADE GEOGRID WITH MINIMUM TENSILE STRENGTH 15 kN/m.

4A. BACKFILL MATERIAL SHOULD CONSIST OF A NON-COHESIVE WELL GRADED SAND FILL PLACED IN MAXIMUM 300mm LOOSE LIFTS AND COMPACTED TO 95% OF ITS SPMDD.

5A. FINISHED SLOPE SURFACE SHOULD BE GRADED TO A 2H:1V SLOPE WITH TOP OF SLOPE EXTENDING TO A GEODETIC ELEVATION OF 57.00m.

SCALE - 1:125

0 1 2 3 4 5 10m

RIP-RAP NOTES:

1B. CLASS 1 NON-WOVEN GEOTEXTILE REQUIRED AROUND THE GRANULAR B TYPE II LAYERS INDICATED ON DRAWING (LINQ 180EX, TERRAFIX 600R OR EQUIVALENT).

2B. RIP-RAP TO CONSIST OF CLEAN COARSE SOUND ROCK PIECES BETWEEN 0.10 AND 0.5mØ (i.e. MTO ROCK PROTECTION)

3B. RIP-RAP SURFACE TO BE GRADED 2H:1V OR SHALLOWER.

GENERAL NOTES:

1C. THE SLOPE REINSTATEMENT PROGRAM AREA IS INDICATED ON DRAWING PG1796-10 - CURRENT SLOPE DETAILS.

2C. THE EXCAVATION WITHIN THE SLOPE REINSTATEMENT PROGRAM AREA SHOULD BE EXTENDED TO REMOVE ALL PREVIOUSLY FAILED MATERIALS ACROSS THE SLOPE FACE.

3C. NO DREDGING OR EXCAVATION OF RIVER BED MATERIALS TO BE UNDERTAKEN. THE NEAR-SHORE BED MATERIALS CONSIST OF RECENT SILTY CLAY ALLUVIUM.

paterson group
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

Scale:	1:125
Des.:	RG
Dwn:	CPB
Chkd:	DG

TAMARACK (QUEEN STREET) CORPORATION
EAST SLOPE OF CARDINAL CREEK AT CROSS-SECTION Q
CARDINAL CREEK VILLAGE
OTTAWA, ONTARIO

SLOPE REINSTATEMENT PROGRAM

Dwg. No.	PG1796-9
Report No.:	PG1796
Date:	08/2013

LEGEND:

🟧	TOE EROSION PROTECTION SYSTEM
🟪	SLOPE REINSTATEMENT PROGRAM
×42.85	EXISTING GROUND SURFACE ELEVATIONS PROVIDED BY STANTEC GEOMATICS (m)
57.50	PRELIMINARY PROPOSED GRADES PROVIDED BY DAVID SHAEFFER ENGINEERING LIMITED (m)

NO.	REVISIONS	DATE	INITIAL

patersongroup
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SCALE: 1:300
DESIGN: RG
DRAWN: CPB
CHECKED: DG
DATE: 08/2012

EAST SLOPE OF CARDINAL CREEK
AT CROSS-SECTION Q
CARDINAL CREEK VILLAGE
OTTAWA, ONTARIO

DWG. NO. PG1796-10

TAMARACK (QUEEN STREET) CORPORATION

CURRENT SLOPE DETAILS

A1

patersongroup

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Geological Engineering
Materials Testing
Building Science
Archeological Services

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June 6, 2014
File: PG1796-LET.07

Taggart Construction
3187 Albion Road
Ottawa, Ontario
K1V 8Y3

Attention: **Mr. Mike Taggart**

Subject: **Retaining Wall Design**
Cardinal Creek Village - Phase 1
Old Montreal Road - Ottawa

Dear Sir,

As requested, Paterson Group Inc. (Paterson) completed a retaining wall design for the proposed residential development Cardinal Creek Village to be located along Old Montreal Road, in the City of Ottawa. A stone strong retaining wall system has been designed for the subject site due to site constraints and grading requirements. Details of retaining wall system are presented below and are depicted in the attached drawing and figures.

The proposed grading of the walls has been provided by David Schaeffer Engineering Limited. The following grading plans were reviewed as part of our retaining wall design:

❏ Project No. 11-513 B-1: Sheet No. 26, 27, 31 and 33 - Grading Plan - Revision 2 dated May 1, 2014.

Based on our review, a retaining wall system is required along the rear lot lines of Lots 9 to 46, 94 to 96, Blocks 123 to 125. The retaining wall heights vary between 0.3 to 5 m. A 0.3 to 2.3 m high retaining wall is required along the east side of Mashkig Avenue.

Stone Strong Retaining Wall System

Based on the existing grades and proposed grading at the subject lots, a gravity retaining wall is recommended to provide a sufficient retaining wall system, which allows for work below grade within the backyards without interference from geogrid liners. A Stone Strong retaining wall system is recommended due to the site constraints and wall height required.

Design details and recommendations for the Stone Strong retaining wall construction are presented in Table 1 and in Drawing PG1796-20 - Stone Strong Gravity SRW Details attached to the present report. Fencing is required along the top of the stone strong walls. To accommodate the required fencing, a fence post hole sleeve within the top of the stone strong wall has been designed. Details for a fence post hole sleeve are provided in Figure 1 attached. The type of fence has a bearing on the installation requirements. Chain link fences and others of a "flow-through" configuration, as well as, guide rails will not impart significant wind loads on the wall. Privacy fences can impart significant lateral loads on the wall and require sufficient embedment for the fence to be essentially self-supporting.

The proposed stone strong retaining wall has been checked for global stability and has an adequate factor of safety in excess of the required 1.5 for static conditions and 1.1 for seismic loading conditions. The internal and exterior failure modes of the retaining wall sections have been designed with similar factors of safety provided. The applicable seismic design incorporates a PGA of 0.32, as per the Ontario Building Code OBC 2014.

Geotechnical field review must be completed at the time of excavation, prior to placing the granular bedding layer, to assess the bearing medium under the proposed wall. A bearing resistance value at serviceability limit states, or allowable bearing pressure, of **150 kPa**, and/or a factored bearing resistance value at ULS of 225 kPa, is required. The bearing medium at the subgrade level for the retaining wall should consist of an undisturbed, stiff to very stiff silty clay.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

It is recommended that the geotechnical consultant conduct field reviews of the subgrade for the base of the wall, and testing or visual observations of the compaction methods for the base and backfill during wall construction. Construction notes to be followed during construction for the proposed Stone Strong retaining wall system are presented in Figure 2 attached. It is further recommended that all bedding and backfill materials be placed under dry conditions and in above freezing temperatures. Precautions should be taken to ensure that the bedding material does not freeze before placement of the retaining wall blocks, which could lead to detrimental movement within the retaining wall, once the frost leaves the bedding material.

We trust the current submission meets your immediate requirements.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David Gilbert, P.Eng

Attachments:

❏ Table 1 - Design Tables for Stone Strong SRW
❏ Drawing PG1796-20 - Stone Strong Gravity SRW Details
❏ Figure 1 - Fence Post Sleeve Details - Stone Strong SRW
❏ Figure 2 - Stone Strong SRW Construction Notes

TABLE 1 - SCHEMATIC STONE STRONG WALL DESIGN TABLE
Cardinal Creek Village - Old Montreal Road, Ottawa, ON

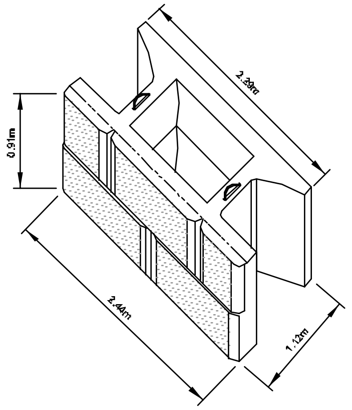
Gross Height (m)	0.91	1.37	1.83	2.29	2.74	3.20	3.66	4.11	4.57	5.03	5.48
Net Height (m)	0.41	0.87	1.33	1.79	2.24	2.70	3.16	3.61	4.07	4.53	4.98
Course 6										6T / 3T	24T
Course 5								6T / 3T	24T	24-62	24-62
Course 4						6T / 3T	24T	24	24	24	24
Course 3				6T / 3T	24T	24	24	24	24	24	24
Course 2		6T / 3T	24T	24	24	24	24-62	24-62	24-62	24-62	24-62
Course 1	24T	24	24	24	24-62	24-62	24-86	24-86	24-86	24-86	24-86

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

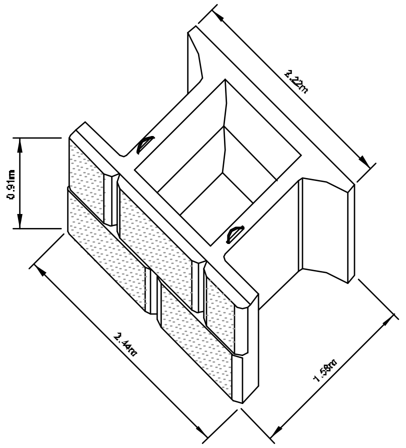
Notes:
1. Stone Strong wall units have the following nominal dimensions:

3 / 3T	Face: 0.46 m H x 0.60 m W	Depth: 1.12 m	24-62	Face: 0.91 m H x 2.44 m W	Depth: 1.58 m
6 / 6T	Face: 0.46 m H x 1.22 m W	Depth: 1.12 m	24-86	Face: 0.91 m H x 2.44 m W	Depth: 2.18 m
24 / 24T	Face: 0.91 m H x 2.44 m W	Depth: 1.12 m	Dual Face	Face: 0.46 m H x 2.44 m W	Depth: 0.71 m

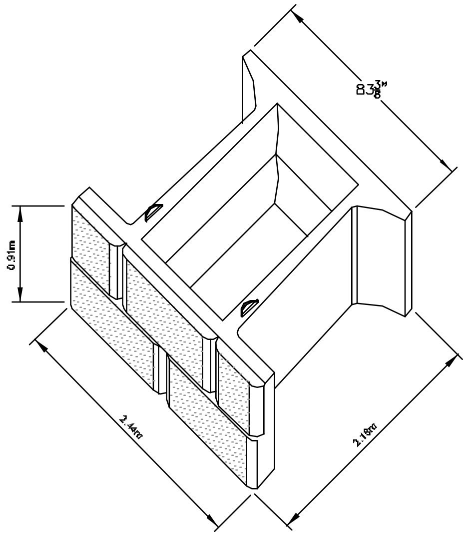
2. Wall heights are provided along top of this table for each of the wall assemblies. Net wall heights are maximum exposed height with 0.5 m embedment, the minimum embedment for this project.
3. The block units should be filled and backfill placed and compacted at the level of the top of the unit prior to placing the next course of units. The block units are to be pulled forward to engage the alignment loops on the unit below before placing the infill material.
4. The walls can be topped with a Dual Face (DF) block course, in lieu of a conventional top course block to allow for upper grade to match to the finished side of the Dual Face course. Top blocks are generally used to facilitate installation of fences or guards/railings.
5 All wall sections are designed using OBC 2012 seismic loading (PGA=0.32).



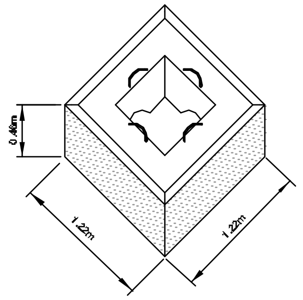
STONE STRONG 24 SF UNIT
CHISELLED GRANITE FACE



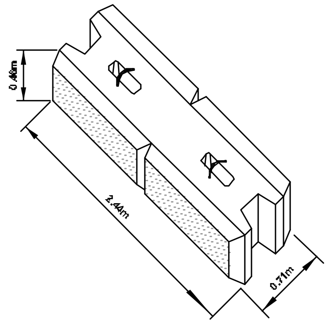
STONE STRONG 24-62 UNIT



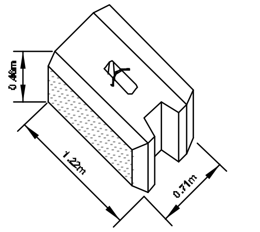
STONE STRONG 24-86 UNIT



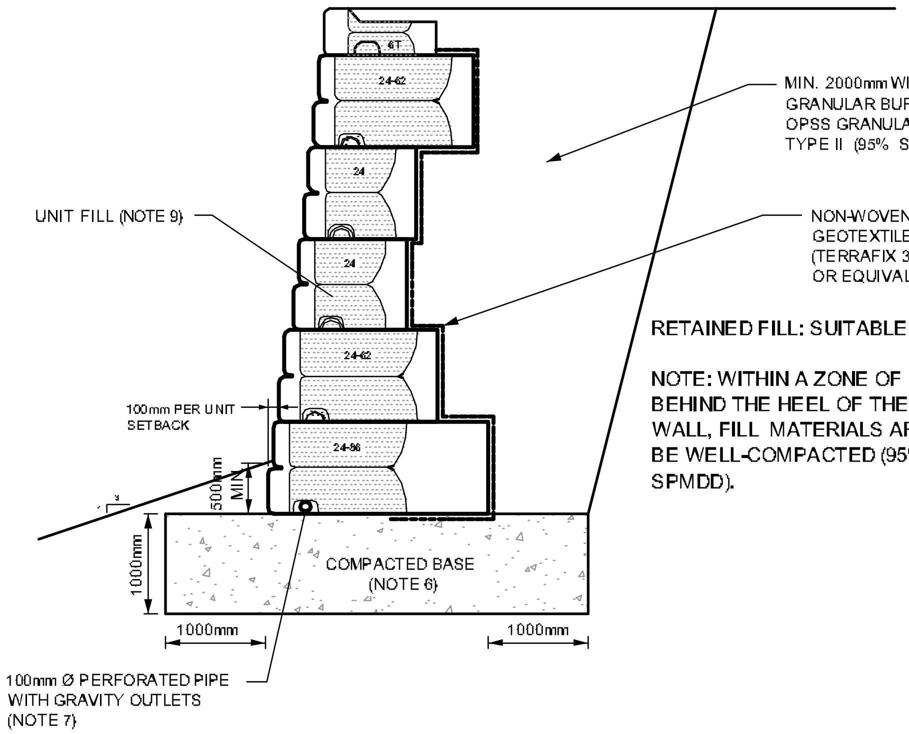
STONE STRONG 90° CORNER UNIT



STONE STRONG DUAL FACE UNIT



STONE STRONG DUAL FACE HALF UNIT

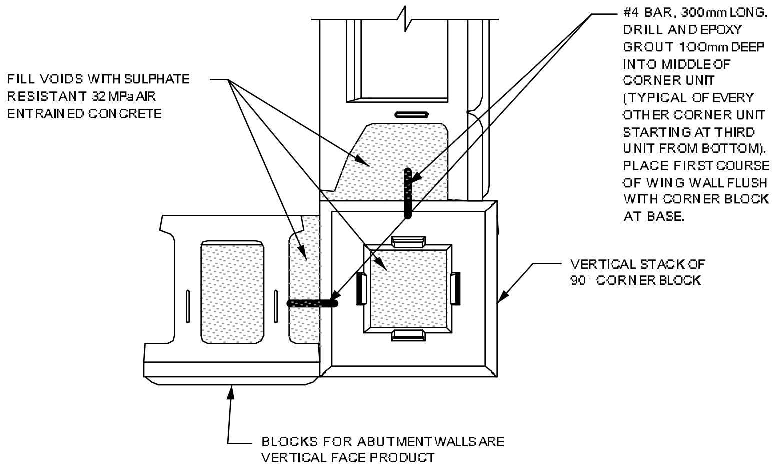


RETAINED FILL: SUITABLE SOIL

NOTE: WITHIN A ZONE OF 1H:1V BEHIND THE HEEL OF THE WALL, FILL MATERIALS ARE TO BE WELL-COMPACTED (95% SPMDD).

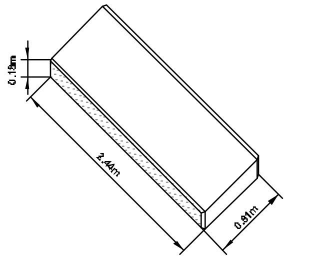
5.03m HIGH STONE STRONG GRAVITY WALL

SCALE - 1:75

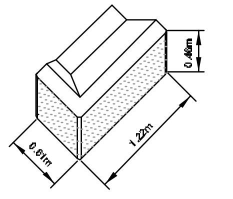


90° CORNER TIEBACK FOR WALL TEE

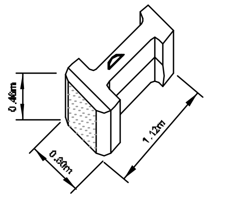
NOT TO SCALE



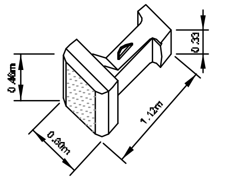
STONE STRONG CAP STEP BLOCK



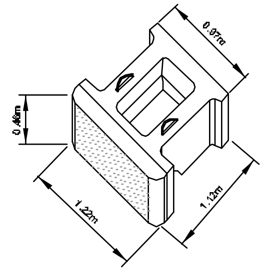
STONE STRONG END UNIT



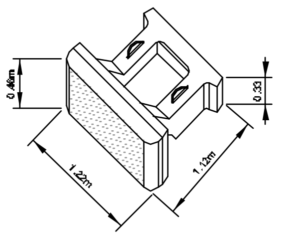
STONE STRONG 3 SF UNIT



STONE STRONG 3 SF TOP UNIT



STONE STRONG 6 SF UNIT



STONE STRONG 6 SF TOP UNIT

paterson group
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

Scale:	AS SHOWN
Des.:	DJG
Dwn:	BA
Chkd:	DJG

TAGGART CONSTRUCTION

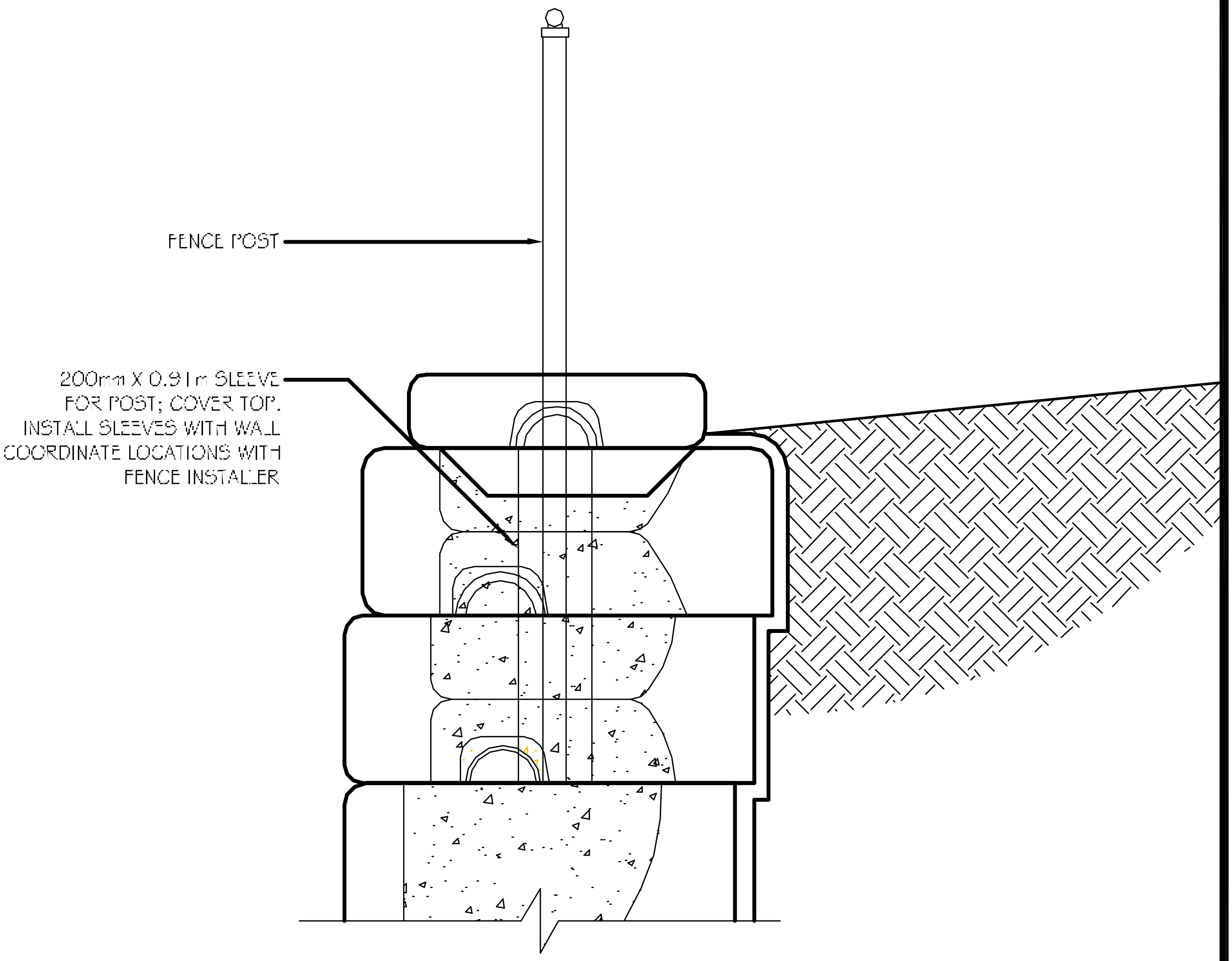
PROPOSED RESIDENTIAL DEVELOPMENT
CARDINAL CREEK VILLAGE

OTTAWA, ONTARIO

STONE STRONG GRAVITY SRW DETAIL

Dwg. No. PG1796-20
Report No.: PG3147-LET.07
Date: 06/2014

11x17



paterson group
consulting engineers
154 Colonnade Road, Ottawa, Ontario K2E 7J5

TAGGART CONSTRUCTION
FENCE POST SLEEVE DETAIL - STONE STRONG SRW
CARDINAL CREEK VILLAGE
OTTAWA, ONTARIO

Figure No.:		Scale:
FIGURE 1		**1:20**
Date:	**Drawn:**	**Approved:**
06/2014	**DP**	**DJG**

NOTES:

1. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR UTILITY CLEARANCES AND CONSTRUCTION SITE SAFETY. PATERSON GROUP SHALL NOT BE RESPONSIBLE FOR MEANS OR METHODS OF CONSTRUCTION OR FOR SAFETY OF WORKERS OR OF THE PUBLIC.

2. THIS DESIGN IS BASED ON THE FOLLOWING SOIL PROPERTIES:

PROPERTY	RETAINED FILL	FOUNDATION MEDIUM
FRICTION ANGLE - ϕ	40°	33°
UNIT WEIGHT - γ	22 kN/m3	17 kN/m3
COHESION - C	0	10 kPa
SOIL TYPE	OPSS GRANULAR B TYPE II &/OR BLAST ROCK	SILTY CLAY

MATERIAL PROPERTIES ARE BASED ON SITE EVALUATION BY PATERSON GROUP AND DISCUSSIONS WITH CONTRACTOR. SEISMIC LOADING WAS EVALUATED ACCORDING TO THE CURRENT ONTARIO BUILDING CODE WITH A PEAK GROUND ACCELERATION VALUE OF 0.16. A 12 kPa LIVE LOAD WAS CONSIDERED FOR THESE WALLS.

3. FOUNDATION DESIGN DATA AND SUBSOIL PROFILES ENCOUNTERED AT THE TEST PIT LOCATIONS ARE PRESENTED IN PATERSON GROUP REPORT PG1796-LET.07 DATED JUNE 6, 2014. THE WALL BASE DESIGN ASSUMES A BEARING RESISTANCE AT SLS OF 150 kPa. THE SITE GEOTECHNICAL ENGINEER SHOULD OBSERVE THE BEARING CONDITIONS AND ADJUST THE THICKNESS OF THE GRANULAR BASE TO ACCOMMODATE THE SITE CONDITIONS, IF NECESSARY.

4. WALL GEOMETRY AND GRADE ELEVATIONS ABOVE AND BELOW THE WALL SHOULD CONFORM WITH GRADING. IF ACTUAL SITE GRADES VARY SIGNIFICANTLY FROM THOSE SHOWN OR IF THE BACK SLOPE DOES NOT CONFORM, INSTALLATION SHALL NOT PROCEED UNTIL THE WALL DESIGN IS VERIFIED OR MODIFIED IN THE APPLICABLE AREA.

5. PRECAST UNITS SHALL BE STONE STRONG RETAINING WALL UNITS MANUFACTURED UNDER LICENSE FROM STONE STRONG SYSTEMS. UNITS SHALL HAVE A MOLDED GRANITE FACE. THE BLOCKS MAY BE STAINED IN PLACE TO ACHIEVE THE DESIRED COLOR.

6. THE WALL BASE SHALL CONSIST OF A MINIMUM OF 1000mm OF OPSS GRANULA A CRUSHED STONE OR OPSS GRANULAR B TYPE II. THE WALL BASE SHALL BE PLACED AS REQUIRED TO PROVIDE ADEQUATE SUPPORT TO THE WALL FOR THE SPECIFIED BEARING RESISTANCE (NOTE 3). THE BASE SHALL BE COMPACTED SO AS TO PROVIDE A LEVEL AND HARD SURFACE ON WHICH TO PLACE THE FIRST COURSE OF UNITS. GRANULAR BASE MATERIAL SHALL BE COMPACTED TO A MINIMUM 98% OF STANDARD PROCTOR MAXIMUM DRY DENSITY (SPMDD). THE BASE SHALL BE SMOOTHED TO ENSURE COMPLETE CONTACT OF RETAINING WALL UNIT WITH BASE. SURFACE OF GRANULAR BASE MAY BE DRESSED WITH FINER AGGREGATE TO AID LEVELING. ENSURE GRADATION OF DRESSING MATERIAL IS SUCH AS TO PRECLUDE LOSS OF FINES INTO BASE. THE THICKNESS OF DRESSING LAYER SHOULD NOT EXCEED 3 TIMES THE MAXIMUM PARTICLE SIZE USED. THE CONTRACTOR MAY SUBSTITUTE CONCRETE WITH A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 20 MPa AND AIR ENTRAINMENT FOR THE GRANULAR BASE MATERIAL.

7. INSTALL 100mm DIAMETER PERFORATED PIPE DRAIN UNDER LOWER COURSE OF WALL (OR ALTERNATIVELY BEHIND HEEL OF WALL). PROVIDE CLEAR STONE SURROUND TO PROTECT PIPE FROM CLOGGING AND DAMAGE. PROVIDE OUTLETS THROUGH WALL BASE LAYER AT LOW AREAS, NO FURTHER APART THAN 30m ON CENTRES.

8. WALL IS DESIGNED FOR MINIMUM 0.5m TOE EMBEDMENT. THESE CONDITIONS WILL BE EVALUATED BY THE GEOTECHNICAL ENGINEER DURING PREPARATION FOR WALL CONSTRUCTION IN EACH AREA. WHERE GRANULAR BEDDING WILL NOT BE SUFFICIENT THE USE OF CONCRETE BEDDING MAY BE REQUIRED.

9. UNIT FILL SHALL BE OPSS GRANULAR B TYPE II OR ALTERNATIVE GRANULAR MATERIAL MEETING THE SATISFACTION OF THE GEOTECHNICAL ENGINEER. UNIT FILL SHALL FILL CAVITIES WITHIN AND BETWEEN THE UNITS, AND MAY EXTEND BEHIND THE FACING UNITS FOR THE CONTRACTOR'S CONVENIENCE.

10. BACKFILL MATERIAL SHALL BE APPROVED BY THE SITE GEOTECHNICAL ENGINEER PRIOR TO USE AND SHOULD CONSIST OF OPSS GRANULAR B TYPE II BUFFER OF MINIMUM 2.0m WIDTH. ALL FILL WITHIN A 1H:1V ZONE UP AND BACK FROM THE HEEL SHOULD ALSO BE COMPACTED. BACKFILL SHALL BE PLACED IN MAXIMUM 300mm LOOSE LIFTS AND COMPACTED TO A MINIMUM OF 95% OF SPMDD. MOISTURE CONTENT SHOULD BE CONTROLLED AND MAINTAINED WITHIN -3 TO +4 PERCENT OF OPTIMUM.

11. ENSURE EACH COURSE IS COMPLETELY FILLED AND BACKFILL IS PLACED TO THE SAME LEVEL PRIOR TO PROCEEDING TO NEXT COURSE. ENSURE ADJACENT UNITS ARE IN CONTACT SO THAT UNIT FILL MAY NOT ESCAPE THROUGH THE JOINT BETWEEN UNITS. GAPS GREATER THAN 6mm BETWEEN UNITS (AT THE FACE) SHALL NOT BE ALLOWED. AT INTERSECTIONS WITH STRUCTURES, CUT UNITS TO OBTAIN A NEAT FIT, AS DIRECTED. PULL BLOCK UNITS FORWARD TO ENGAGE THE ALIGNMENT LOOPS ON THE UNIT BELOW BEFORE INFILLING IN ALL CASES.

12. MAINTAIN TEMPORARY GRADES TO DIVERT SURFACE WATER AWAY FROM THE RETAINING WALL EXCAVATION. SLOPE FINAL BACKFILL TO PROVIDE POSITIVE DRAINAGE AND TO ELIMINATE PONDING.

patersongroup
consulting engineers
154 Colonnade Road, Ottawa, Ontario K2E 7J5

TAGGART CONSTRUCTION

STONESTRONG SRW CONSTRUCTION NOTES
CARDINAL CREEK VILLAGE
OTTAWA, ONTARIO

Figure No.:		Scale:
FIGURE 2		N.T.S.
Date:	Drawn:	Approved:
06/2014	BA	DJG

patersongroup

consulting engineers

memorandum

to:	DSEL - **Mr. Steve Pichette** - spichette@dsel.ca
c.c.:	DSEL - **Mr. Matt Wingate** - mwingate@dsel.ca Taggart Group **- Mr. Ted Phillips** - tphillips@taggart.ca
re:	Geotechnical Review **Cardinal Creek Village Subdivision - Old Montreal Road - Ottawa**
date:	March 27, 2013
file:	PG1796-MEMO.04
from:	Carlos P. Da Silva

Further to your request, Paterson Group (Paterson) reviewed the available geotechnical information and carried out a site inspection for the former railway culvert crossing and the proposed watermain crossing across Cardinal Creek which form part of the aforementioned new development.

Former Railway Culvert Crossing

The existing concrete culvert was constructed over 80 years ago and consists of cast in place concrete box culvert structure with wing walls. The surface of the concrete is pitted and worn from erosion over a significant period. Efflorescence was noted in several interior cracks due to moisture penetration over the years.

Structurally, the culvert appears to be sound and over designed to handle the dynamic loading of loaded trains. The concrete culvert has a narrow span and is slightly arched for rigidity. At the present time, the culvert does not receive any train traffic loading other than the occasional traffic from hydro inspection vehicles since the rail alignment is also a hydro corridor. The culvert is in need of maintenance to prolonge its life cycle which would consist of crack repair and resurfacing of the pitted surface including the wing walls.

The proposed site servicing will be crossing perpendicular to the existing culvert within the soil cover. From a geotechnical perspective, it is expected that any services crossing the concrete culvert will be placed in an excavated open trench with adequate soil cover for frost protection. Consideration may be given to surrounding the piping material with rigid insulation for additional frost protection for the portion directly over the culvert. Lightweight fill (EPS blocks) may be considered for additional frost protection if insufficient soil cover is available.

Trenchless Crossing of Cardinal Creek

It is our understanding that a trenchless watermain crossing is proposed for Cardinal Creek between Old Montreal Road and the existing former railway crossing. Based on the available geotechnical information at the approximate crossing location, the subsoil will consist of a very stiff to stiff silty clay deposit overlying a compact glacial till followed by bedrock. At the creek crossing, a minimum of 3 m of pipe cover will be required. It is expected that the crossing elevation will have the pipe invert at approximately 40.2 m.

At the proposed crossing elevation, the subsoil will consist of a glacial till deposit. Depending on the composition of the glacial till deposit and the frequency of boulders, two options can be considered:

☐ Directional drilling
☐ Horizontal bore

Although both options will avoid any adverse effects to the existing creek, the advantage of the directional drilling program is the shallower depths of the entry and exit pits. Both options will be effective in the installation of a 400 mm in diameter watermain.

In bouldery soils, the effectiveness of directional drilling is diminished and may not be possible. Consideration will be given to a horizontal bore under these conditions. In any case, once the proposed alignment is finalized, boreholes will be drilled to confirm the subsoil conditions.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

Carlos P. Da Silva, P.Eng.

LICENSED PROFESSIONAL ENGINEER
C. P. DA SILVA
PROVINCE OF ONTARIO

patersongroup

Consulting Engineers

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Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
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Archaeological Services

www.patersongroup.ca

June 19, 2014
File: PG1796-LET.06R

Tamarack (Queen Street) Corporation
3187 Albion Road
Ottawa, Ontario
K1V 8Y3

Attention: **Mr. Ted Phillips**

Subject: **Geotechnical Investigation**
Proposed Service Alignment Along Hydro Corridor
Cardinal Creek Vilage - Old Montreal Road - Ottawa

Dear Sir,

Paterson Group (Paterson) was commissioned by the Tamarack (Queen Street) Corporation to conduct a geotechnical investigation for the proposed service alignment located between Trim Road and Cardinal Creek, in the City of Ottawa, Ontario. It is understood that the proposed service alignment will provide services for the proposed residential development, Cardinal Creek Village. The following letter report presents our findings and recommendations.

1.0 Field Investigation

The fieldwork for this investigation took place on January 19 and 20, 2009, November 9, 13, 2012 and February 4, 13, 14, 2013, and consisted of advancing eleven (11) boreholes to depths varying between 8.8 and 31.3 m. The boreholes were put down using a track-mounted auger drill rig operated by a crew of two. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from our geotechnical division. The drilling procedure consisted of augering to the required depths, sampling and testing the overburden at selected locations.

The test hole locations were selected by Paterson personnel to provide a general coverage of the site. The locations of the test holes in the field and the ground surface elevation at each test hole locations were determined by Stantec Geomatics. It is understood that the elevations were referenced to geodetic datum. The locations and ground surface elevations of the test holes are shown on Drawing PG1796-19 - Test Hole Location Plan attached to the present letter.

2.0 Field Observations

The subject alignment consists of a former railway line, which is currently grass covered along the majority of the alignment. The ground surface along the subject alignment slopes downward 4 to 5 m in the area of the Cardinal Creek crossing. Also, the existing ground surface along the alignment over the Cardinal Creek crossing is approximately 9 m above the watercourse level. An approximately 5 m wide concrete box culvert is located at the Cardinal Creek crossing. The embankment side slopes were noted to be grass covered and consist of a silty sand with gravel fill material.

Generally, the subsurface profile encountered at the borehole locations consists of topsoil and/or fill overlying stiff to very stiff silty clay deposit. Practical refusal to DCPT was encountered at a 31.3 m depth at BH 52-12. Reference should be made to the Soil Profile and Test Data Sheets attached to this letter report.

Based on field observations, moisture levels and colour of the recovered soil samples, and groundwater levels (GWLs) measured in the flexible standpipes installed in all boreholes, the long-term groundwater level is expected between 4 to 5 m depth. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

3.0 Geotechnical Assessment

Temporary Side Slopes

For excavations to depths of approximately 4 m, the excavation side slopes should be stable in the short term at 1H:1V for soils encountered at the borehole locations. The lowermost 1.2 m can be vertical provided the material consists of stiff in situ silty clay. Flatter slopes could be required for deeper excavations or for excavation below the groundwater level. Where such side slopes are not permissible or practical, temporary shoring should be used. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects. It is assumed that the excavations will be completed within the confines of a fully-braced steel trench box or other acceptable shoring system.

The slope cross-sections recommended above are for temporary slopes. Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by "cut and cover" methods and excavations will not be left open for extended periods of time.

Groundwater Control

The contractor should be prepared to direct water away, regardless of the source, from all bearing surfaces and subgrades to prevent disturbance to the founding medium.

It is expected that the flow of groundwater into the excavation should be low for majority of the subject alignment. The groundwater flow through the sides of the excavation should be controllable using open sumps and pumps.

The soil subgrade may be affected by the presence of groundwater. It is recommended that the bedding be placed as soon as possible to reduce the disturbance to the subgrade due to construction traffic (equipment and workers).

It is understood that a Category 3 PTTW has been obtained for the service excavation work along the subject alignment.

Pipe Bedding and Backfill Requirements

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the soft to firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extent at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

It should generally be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

To reduce long-term lowering of the groundwater level, clay seals should be placed in the service trenches. The clay seals should be at least 1.5 m long (in the trench direction) and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, sub-bedding and cover material. The barriers should consist of relatively dry silty clay placed in maximum 225 mm thick lifts and compacted to a minimum 95% of its SPMDD. The clay seals should be placed at the site boundaries and at strategic locations every 60 to 100 m in the service trenches.

Thrust Blocks and Maintenance Holes

Thrust blocks resisting lateral loads should be sized on a pro-rata basis and the allowable lateral soil bearing capacity. Those resisting vertical loads should be sized based on the allowable vertical soil bearing capacity. The lateral and vertical bearing capacities of the bearing media expected along the subject section are presented in Table 1.

Table 1 - Summary of Allowable Bearing Pressures For Thrust Block Sizing

Bearing Surface	Allowable Bearing Pressure (kPa)	
	Lateral	Vertical
Undisturbed, stiff silty clay	100	150
Engineered fill	100	150

The allowable lateral bearing capacities presented in Table 1 are based on a minimum soil cover of 2 m. The allowable vertical bearing pressures are provided on the assumption that the thrust block concrete is placed against undisturbed soil bearing surfaces.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil have been removed in the dry prior to the placement of concrete.

Maintenance holes or chambers should be founded on silty clay or engineered fill. The maintenance holes or chambers should be designed using the allowable bearing pressures presented in Table 1. Engineered fill under maintenance holes or chambers should consist of OPSS Granular A (crushed stone) or Granular B Type II material placed in maximum 300 mm thick layer and compacted to a minimum of 98% of the SPMDD.

Winter Construction

The subsurface soil conditions mainly consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

It is expected that this project will be completed prior to winter conditions. If winter construction is considered for this assignment, the following precautions should be considered.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw or insulated tarpaulins or other suitable means. The base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as sufficient soil cover is provided to prevent freezing at the subgrade level.

The trench excavations should be completed in a manner to avoid the introduction of frozen materials, snow or ice into the trenches. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving during construction. Also, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure.

4.0 Culvert Condition Assessment

A cast-in-place concrete box culvert running in a north-south direction below the existing embankment along the hydro corridor was reviewed by Paterson. The concrete culvert is approximately 5 m wide and is slightly arched for rigidity. It is expected that the concrete box culvert was constructed in the early 1900s for the former railway overpass of Cardinal Creek. Based on a topographical survey completed by Stantec Geomatics, the top of the culvert at the south inlet side is at a geodetic elevation of 45.8 m and the invert level is at 41.8 m. A recent site visit was completed by Paterson to assess the existing conditions of the culvert crossing of Cardinal Creek along the subject services alignment. Photographs of the culvert conditions observed during our recent site visits are attached to the present letter report.

Significant deterioration of the culvert ceiling and sidewalls were noted at the culvert ends. The wingwalls at the north and south ends of the culvert are severely deteriorated and partially removed. Several fractures were noted along the top of the culvert where efflorescence was noted to be occurring. The thickness of the top and sidewalls of the culvert were noted to vary between 0.7 to 1 m. The concrete face within the culvert structure was noted to be only minorly spalled and intact for the majority of the culvert. Overall, the sidewalls and top of the culvert were noted to be performing adequately taking into consideration the age of the structure.

It is understood that the proposed service installation includes a 400 mm diameter watermain (approx. invert elevation 47.3 m) and a 675 mm diameter sanitary sewer (approx. invert elevation 48.5 m) to be installed over the existing culvert structure. It is further understood that the services will be installed using an open cut excavation technique. Both services will be placed within a 13 m long steel casing and a rigid insulation layer will be placed below the services.

Overall, the culvert appears to be structurally sound based on our review and it is expected that the open cut method of excavation will provide a stress relief during construction due to the soil load removal above the culvert structure. It is further expected that the culvert structure will respond satisfactorily to the added stress and vibrations that the construction equipment will place on the culvert. It is recommended that a periodic monitoring program be completed by Paterson of the culvert structure to review the structure's response to the construction activities during service installation along the crossing. Due to the deteriorated conditions noted at the ends of the culvert, a maintenance program is required to prolong the structure's life cycle, including crack repairs and resurfacing the culvert surface and replacing of the wing walls.

5.0 Slope Stability Analysis

A slope stability analysis was completed for the north and south faces of the existing slope along the Cardinal Creek crossing and for the south embankment face along the ravine containing the north tributary.

The analysis of the stability of the slope was carried out using SLIDE, a computer program which permits a two-dimensional slope stability analysis using several methods including the Bishop's method, which is a widely used and accepted analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to those favoring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsoil and groundwater conditions, a factor of safety greater than one is usually required to ascertain the risks of failure are acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the failure of the slope would endanger permanent structures.

An analysis considering seismic loading was also completed. A horizontal seismic acceleration, K_h, of 0.16G was considered for the analyzed sections. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

North and South Slope at Cardinal Creek Crossing

The slope stability analysis was completed using topographical mapping, as well as, a recent site visit to review slope condition by Paterson personnel. The slope faces were observed to be stable with some undercutting noted at the base of the slope where the inlet wing walls are no longer present. It should be noted that a slope section (Section BB) was completed along the crossing embankment. The cross-section location is presented in Drawing PG1796-19 - Test Hole Location Plan attached.

The results of our analysis are presented in Figures 1 to 4 attached. The slope stability factors of safety were found to be less than 1.5 for the north and south face of the crossing. However, it should be noted that the proposed services are located well beyond the failure slip circles with factors of safety less than 1.5 and located within a stable zone of the crossing. No setbacks or additional slope stability measures are required for the subject slopes based on our review. However, it is recommended that where the slope face is removed during the service installation program, the slope face should be reinstated with silty sand with gravel fill placed in maximum 300 mm loose lifts and compacted to at least 95% of its SPMDD. The slope face should be capped with a 150 to 200 mm thick layer of topsoil mixed with a hardy grass seed. Where removed, the slope face should be re-shaped to a maximum 3H:1V slope.

South Slope at North Tributary Ravine

The slope stability analysis was completed using topographical mapping, as well as, a site visit to review slope condition by Paterson personnel. The upper slope face along the hydro corridor was noted to be stable and treed. An approximately 5 to 8 m wide plateau was noted between the hydro corridor embankment and the lower slope face along the north tributary watercourse. The lower slope face was noted to be undergoing active erosion along the majority of the slope face, where the north tributary watercourse is located in close proximity to the slope face. An approximately 2 to 3 m high near vertical exposed face was observed where previous slumping failures had occurred due to the erosional action of the watercourse.

The results of our slope stability analysis are presented in Figures 5 and 6. Based on our analysis, several failure slip circles with factors of safety of less than 1.5 are present along the upper and lower slope faces. However, it should be noted that the proposed services are located well beyond the failure slip circles with factors of safety less than 1.5 and located within a stable zone of the embankment.

To ensure that active erosion is limited along the lower slope face where the watercourse is in contact with the bank face, it is recommended that a minimum 600 to 800 mm thick layer of rip-rap material (minimum 300 to 600 mm in their longest dimension) be placed over a non-woven geotextile liner, such as Terrafix 360R or equivalent, placed over the slope toe extending at least 2 m along the base of the watercourse and at least 1 m up the bank face. It should be noted that the north tributary realignment work is to be completed immediately upstream of the subject area. It is recommended that the rip-rap area noted above extend downstream at least 20 m from the alignment work area to ensure that erosional activities due to the watercourse are limited in the realignment area.

6.0 Recommendations

It is a requirement for the design data provided in the report to be applicable that a materials testing and observation program be performed by the geotechnical consultant. The points below are the recommended testing procedures:

- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials placed.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

A report to confirm that the construction program has been completed in general accordance with our recommendations could be issued, upon demand, following the completion of a the materials testing and observation program by the geotechnical consultant.

7.0 Statement of Limitations

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

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

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

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Faisal Abou-Seido, B. Eng.

David J. Gilbert, P.Eng.

Attachments

- ☐ Soil Profile and Test Data sheets
- ☐ Photographs of Culvert Structure
- ☐ Figures 1 to 6 - Slope Stability Sections
- ☐ Drawing PG1796-19 - Test Hole Location Plan

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

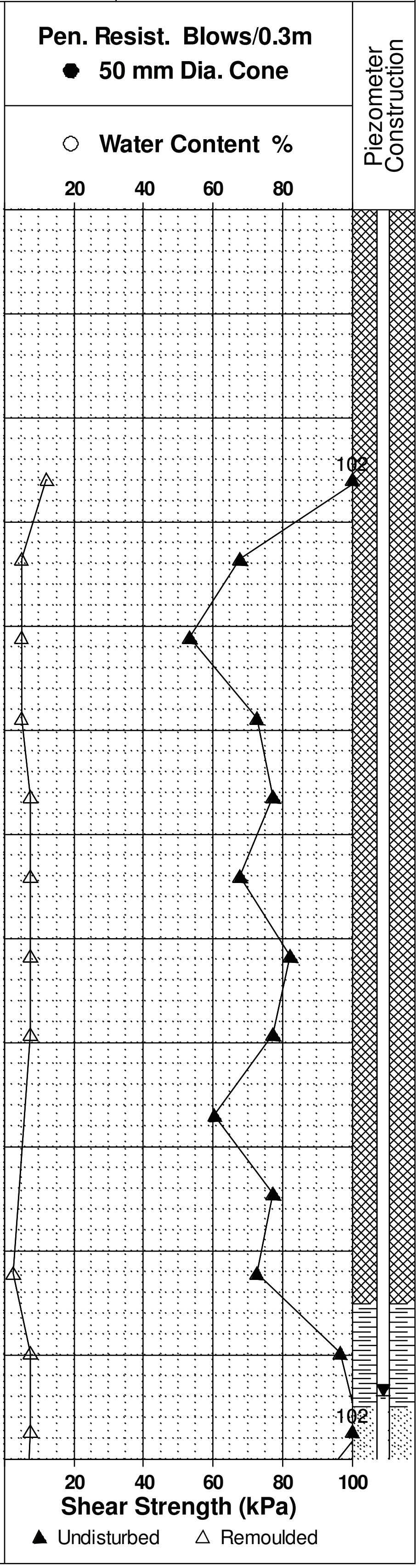
BORINGS BY CME 55 Power Auger

DATE November 9, 2012

FILE NO. **PG1796**

HOLE NO. **BH52-12**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	51.86
TOPSOIL 0.28	AU	1				
	AU	2				
	SS	3	100	8	1	50.86
	SS	4	100	6	2	49.86
					3	48.86
					4	47.86
					5	46.86
Very stiff to stiff, brown **SILTY CLAY**						
					6	45.86
- grey by 6.6m depth						
					7	44.86
					8	43.86
					9	42.86
					10	41.86
					11	40.86
					12	39.86



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

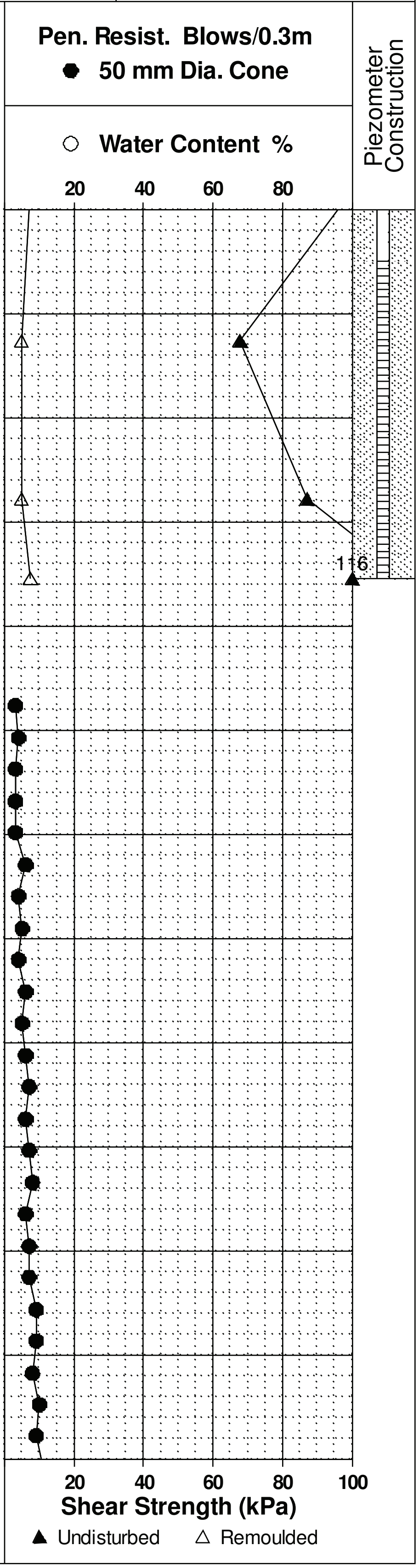
DATE November 9, 2012

FILE NO. PG1796

HOLE NO. BH52-12

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE				
Stiff, grey **SILTY CLAY**	TW	5	100	
	TW	6	100	
15.54				
Dynamic Cone Penetration Test commenced at 15.54m depth. Cone pushed to 16.5m depth.				

DEPTH (m)	ELEV. (m)
12	39.86
13	38.86
14	37.86
15	36.86
16	35.86
17	34.86
18	33.86
19	32.86
20	31.86
21	30.86
22	29.86
23	28.86
24	27.86



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

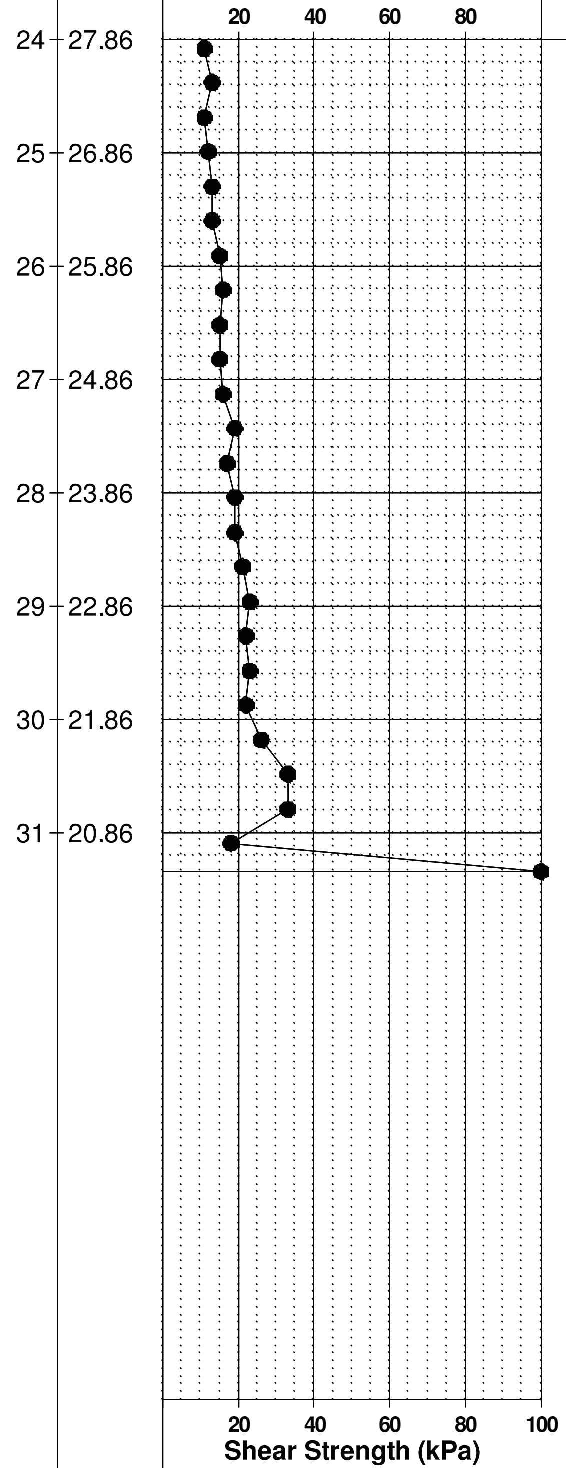
FILE NO. **PG1796**

REMARKS

HOLE NO. **BH52-12**

BORINGS BY CME 55 Power Auger **DATE** November 9, 2012

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									
31.34									
End of Borehole Practical cone refusal at 31.34m depth. (GWL @ 11.39m-Dec. 6, 2012)									



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

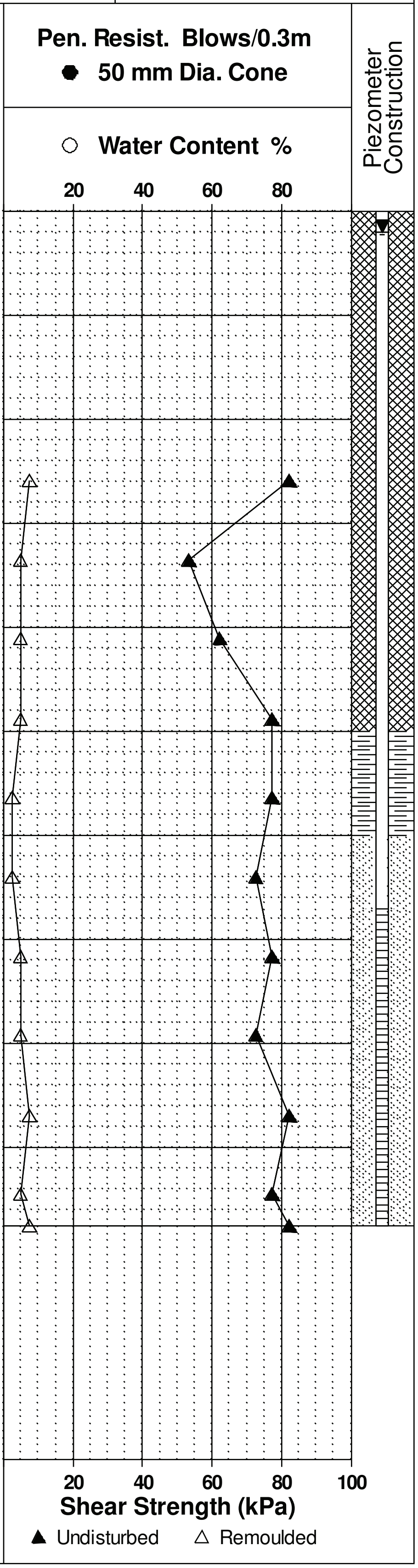
BORINGS BY CME 55 Power Auger

DATE November 12, 2012

FILE NO. PG1796

HOLE NO. BH53-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	54.10
TOPSOIL 0.20		AU	1				
		AU	2				
		SS	3	100	10	1	53.10
		SS	4	100	6	2	52.10
						3	51.10
Very stiff to stiff, brown **SILTY CLAY**							
						4	50.10
- grey-brown by 4.3m depth							
						5	49.10
						6	48.10
						7	47.10
						8	46.10
						9	45.10
9.75							
End of Borehole							
(GWL @ 0.20m-Dec. 6, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

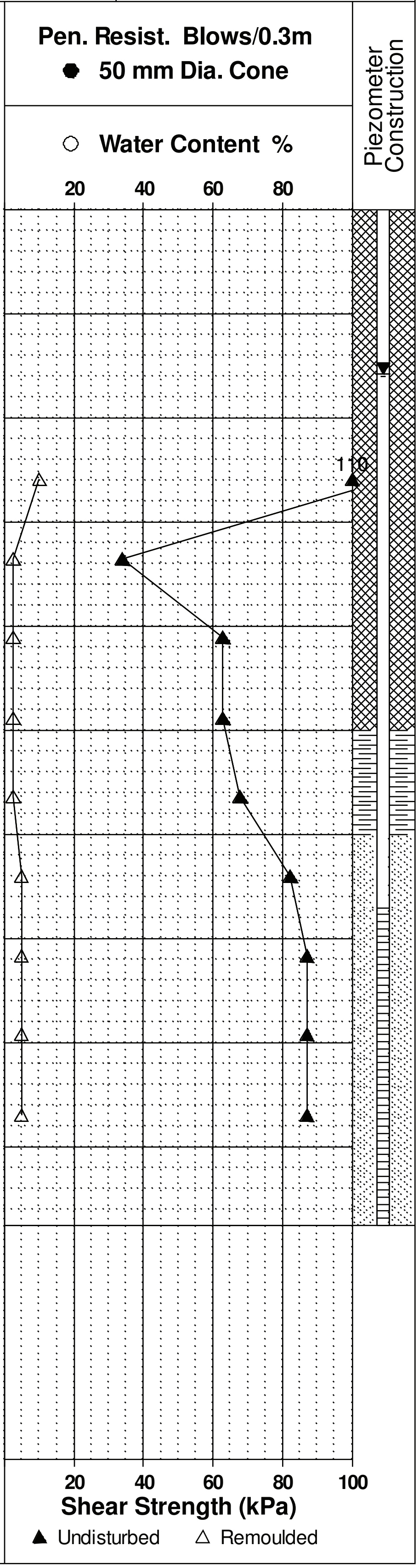
REMARKS

HOLE NO. **BH54-12**

BORINGS BY CME 55 Power Auger

DATE November 13, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	54.79
TOPSOIL 0.30	AU	1				
	AU	2				
Very stiff to stiff, brown **SILTY CLAY**	SS	3	100	8	1	53.79
	SS	4	100	7	2	52.79
					3	51.79
					4	50.79
					5	49.79
					6	48.79
- grey by 7.4m depth					7	47.79
					8	46.79
9.75					9	45.79
End of Borehole						
(GWL @ 1.58m-Dec. 6, 2012)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

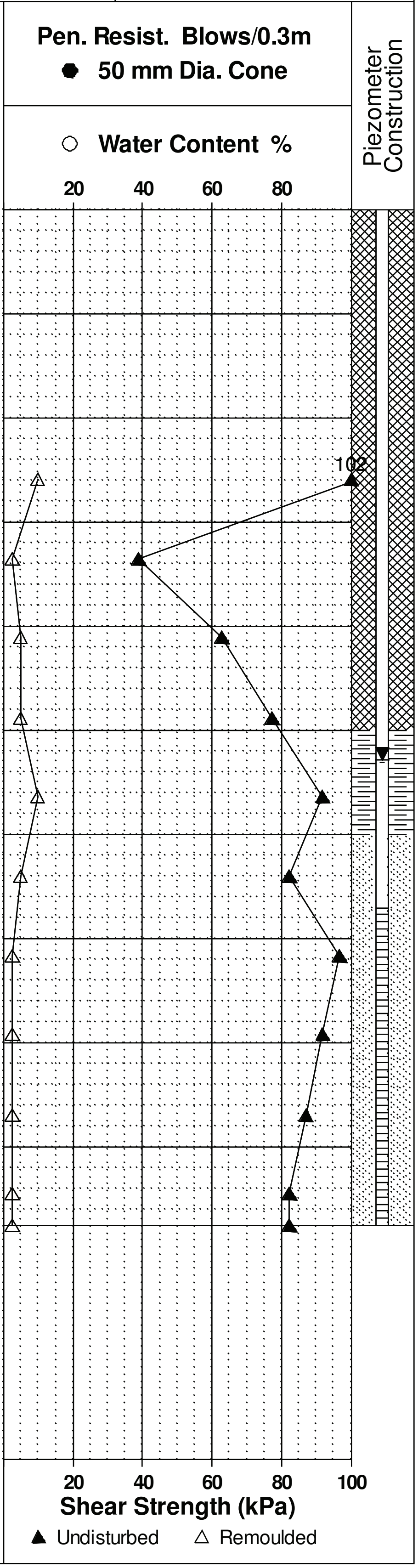
BORINGS BY CME 55 Power Auger

DATE November 9, 2012

FILE NO. PG1796

HOLE NO. BH55-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	54.62
TOPSOIL 0.28		AU	1				
		AU	2				
		SS	3	100	6	1	53.62
		SS	4	100	7		
						2	52.62
						3	51.62
Very stiff to stiff, brown **SILTY CLAY**						4	50.62
- grey-brown by 5.1m depth						5	49.62
						6	48.62
						7	47.62
						8	46.62
						9	45.62
9.75							
End of Borehole (GWL @ 5.28m-Dec. 6, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

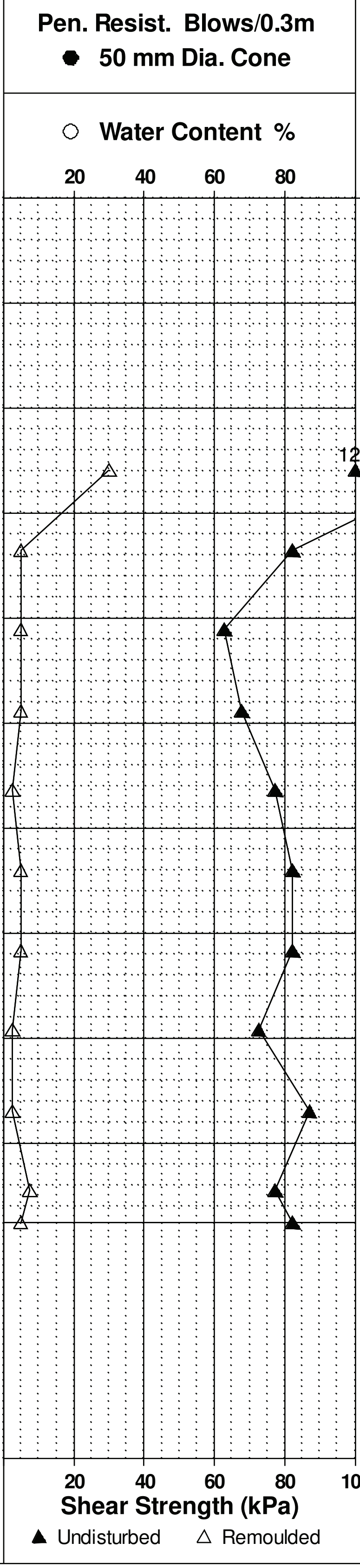
REMARKS

HOLE NO. **BH56-12**

BORINGS BY CME 55 Power Auger

DATE November 13, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	54.02	
TOPSOIL 0.30								
		SS	1	100	10	1	53.02	
		SS	2		7	2	52.02	
						3	51.02	
Very stiff to stiff, brown **SILTY CLAY**						4	50.02	
						5	49.02	
						6	48.02	
						7	47.02	
- grey by 7.4m depth						8	46.02	
						9	45.02	
9.75 End of Borehole								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE February 4, 2013

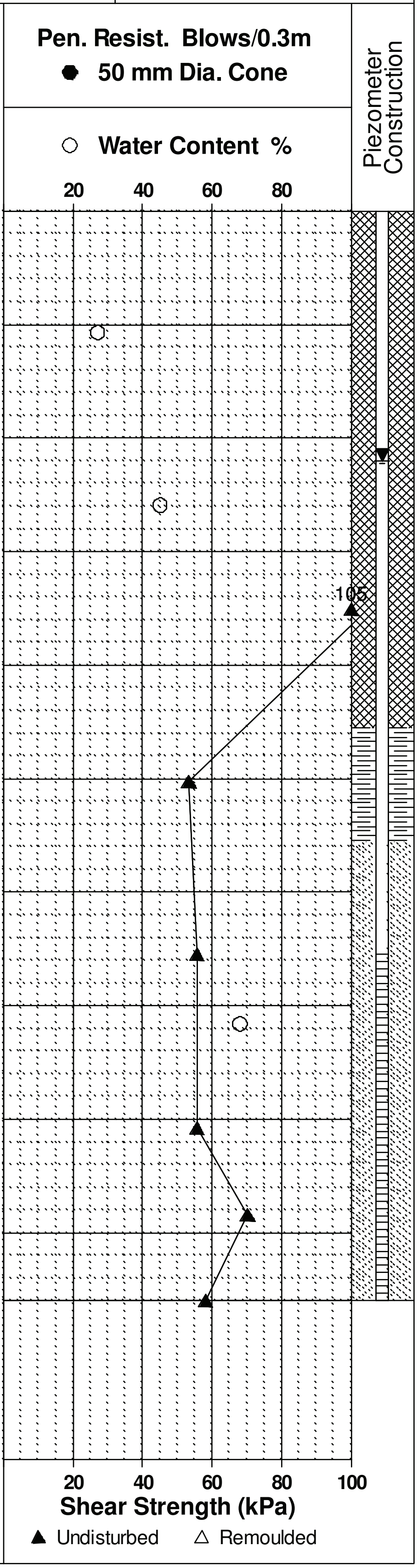
FILE NO. PG1796

HOLE NO. BH57-12

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
Asphaltic concrete	0.15
FILL: Crushed stone with sand	0.41
FILL: Brown silty sand with gravel	0.69
Very stiff to stiff, brown **SILTY CLAY** - grey by 5.2m depth	9.60
End of Borehole (GWL @ 2.20m-Mar. 27, 2013)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
AU	2		
SS	3	100	18
SS	4	83	17
SS	5	100	8
SS	6	100	2
SS	7	100	W
SS	8	100	W

DEPTH (m)	ELEV. (m)
0	54.83
1	53.83
2	52.83
3	51.83
4	50.83
5	49.83
6	48.83
7	47.83
8	46.83
9	45.83



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

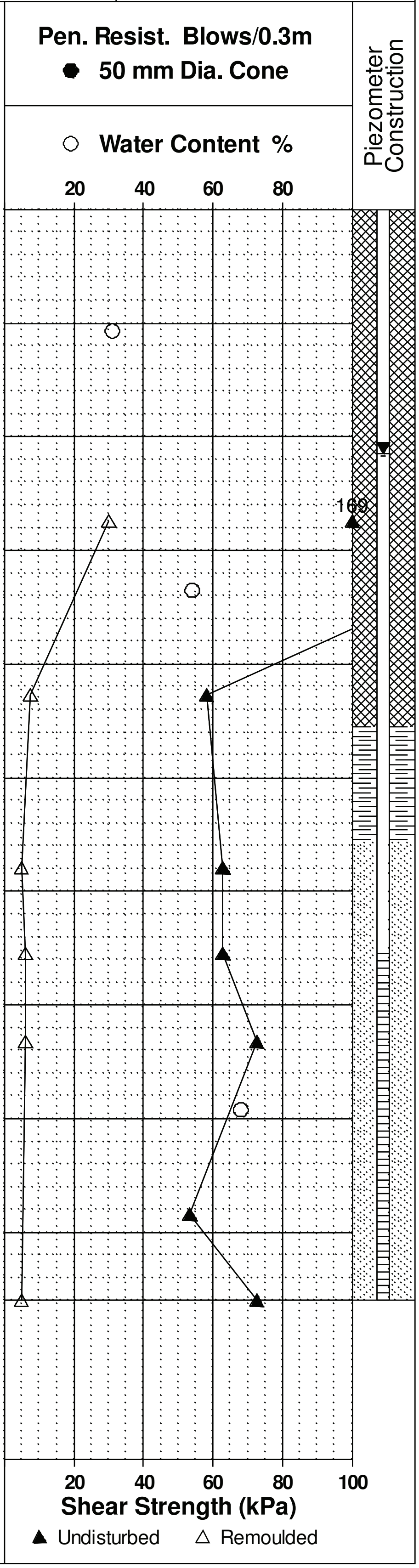
DATE February 4, 2013

FILE NO. PG1796

HOLE NO. BH58-12

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
Asphaltic concrete 0.18				
FILL: Crushed stone with sand 0.41	AU	1		
FILL: Brown silty sand with gravel 0.69	AU	2		
Very stiff to stiff, brown **SILTY CLAY**	SS	3	58	21
	SS	4	100	7
	SS	5	100	4
- grey-brown by 3.7m depth				
	SS	6	100	2
	SS	7	100	W
- grey by 8.3m depth				
9.60				
End of Borehole				
(GWL @ 2.15m-Mar. 27, 2013)				

DEPTH (m)	ELEV. (m)
0	56.13
1	55.13
2	54.13
3	53.13
4	52.13
5	51.13
6	50.13
7	49.13
8	48.13
9	47.13



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG1796**

REMARKS

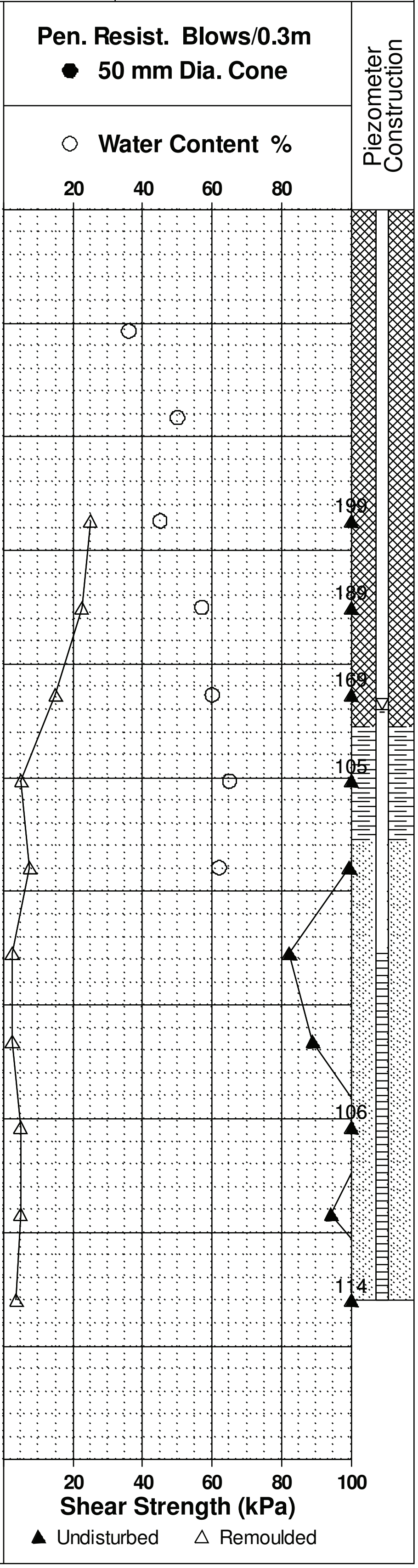
HOLE NO. **BH84-13**

BORINGS BY CME 55 Power Auger

DATE February 14, 2013

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
Very stiff to stiff, brown **SILTY CLAY**	AU	1		
	SS	2	50	9
	SS	3	100	10
- stiff to very stiff and grey by 5.9m depth				
9.60				
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 13.4m depth.				

DEPTH (m)	ELEV. (m)
0	55.37
1	54.37
2	53.37
3	52.37
4	51.37
5	50.37
6	49.37
7	48.37
8	47.37
9	46.37
10	45.37
11	44.37



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE February 14, 2013

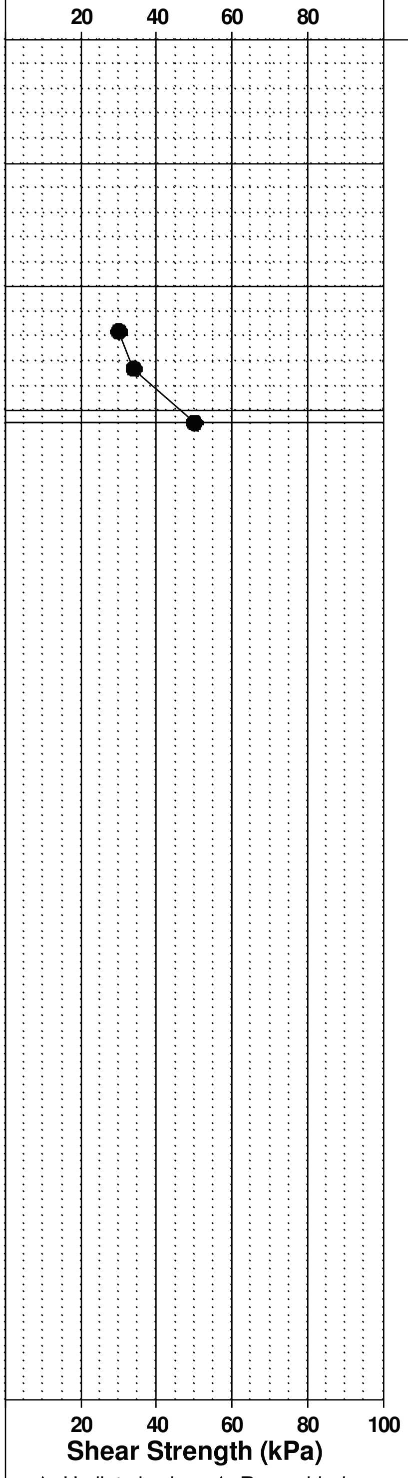
FILE NO. PG1796

HOLE NO. BH84-13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			
GROUND SURFACE						11	44.37	
						12	43.37	
						13	42.37	
						14	41.37	
14.10								
End of Borehole Practical DCPT refusal at 14.10m depth (GWL @ 4.4m depth based on field observations)								

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

○ Water Content %



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG1796

REMARKS

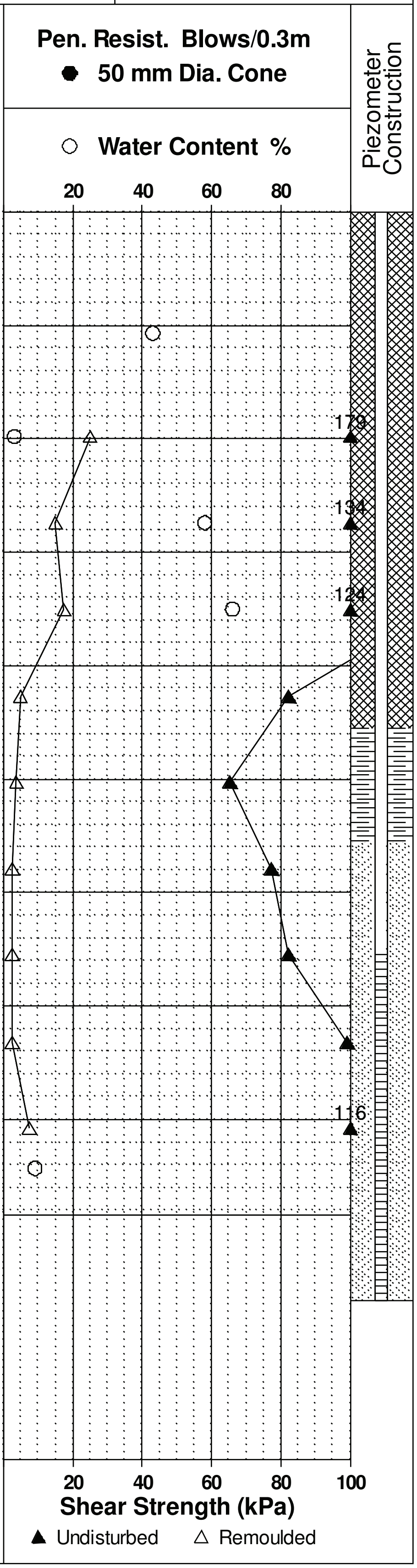
HOLE NO. BH86-13

BORINGS BY CME 55 Power Auger

DATE February 14, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL (to 0.33)	■	SS	1	50	10
Very stiff to stiff, brown **SILTY CLAY** (to 8.23)	▨	SS	2	100	7
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles, boulders (to 8.84)	^^^	SS	3	50	50+
End of Borehole Practical refusal to augering at 8.84m depth					

DEPTH (m)	ELEV. (m)
0	54.08
1	53.08
2	52.08
3	51.08
4	50.08
5	49.08
6	48.08
7	47.08
8	46.08



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 20, 2009

FILE NO. PG1796

HOLE NO. BH 2

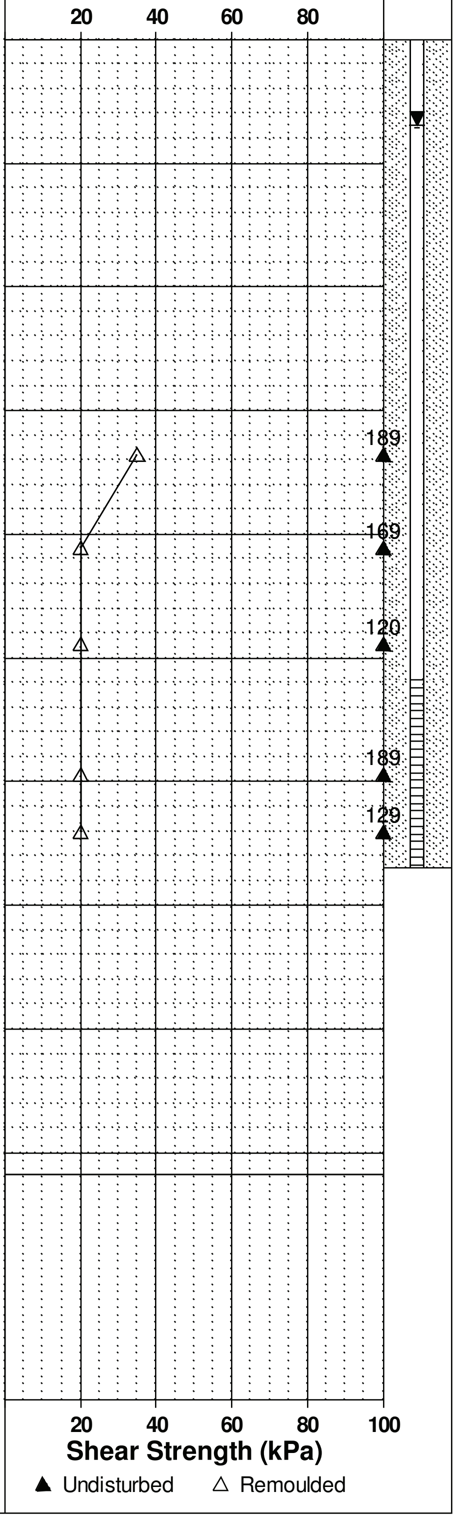
SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
TOPSOIL	0.04
Very stiff, brown **SILTY CLAY** - grey-brown by 2.2m depth	6.71
GLACIAL TILL: Grey-brown silty clay with sand, gravel, cobbles and boulders	9.17
End of Borehole (GWL @ 0.69m-Feb. 3/09)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	75	10
SS	3	100	13
SS	4	100	6
SS	5	38	33
SS	6	67	41
SS	7	0	50+
SS	8	0	50+

DEPTH (m)	ELEV. (m)
0	60.07
1	59.07
2	58.07
3	57.07
4	56.07
5	55.07
6	54.07
7	53.07
8	52.07
9	51.07

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

○ Water Content %



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Queen Street
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG1796

REMARKS

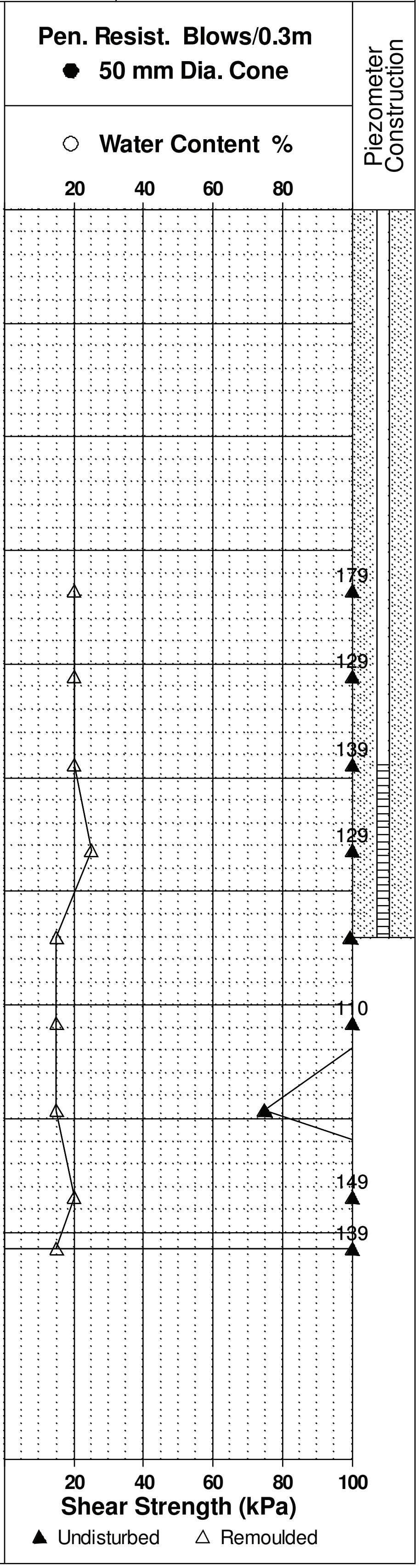
HOLE NO. BH18

BORINGS BY CME 55 Power Auger

DATE January 19, 2009

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.25				
25mm Topsoil	AU	1		
	SS	2	50	8
	SS	3	83	8
	SS	4	58	7
Very stiff to stiff, brown **SILTY CLAY**				
- grey-brown by 4.9m depth				
- grey by 6.6m depth				
9.14				
End of Borehole				
(Piezometer blocked - Feb. 3/09)				

DEPTH (m)	ELEV. (m)
0	54.83
1	53.83
2	52.83
3	51.83
4	50.83
5	49.83
6	48.83
7	47.83
8	46.83
9	45.83



SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

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

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu - Uniformity coefficient = D60 / D10

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

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

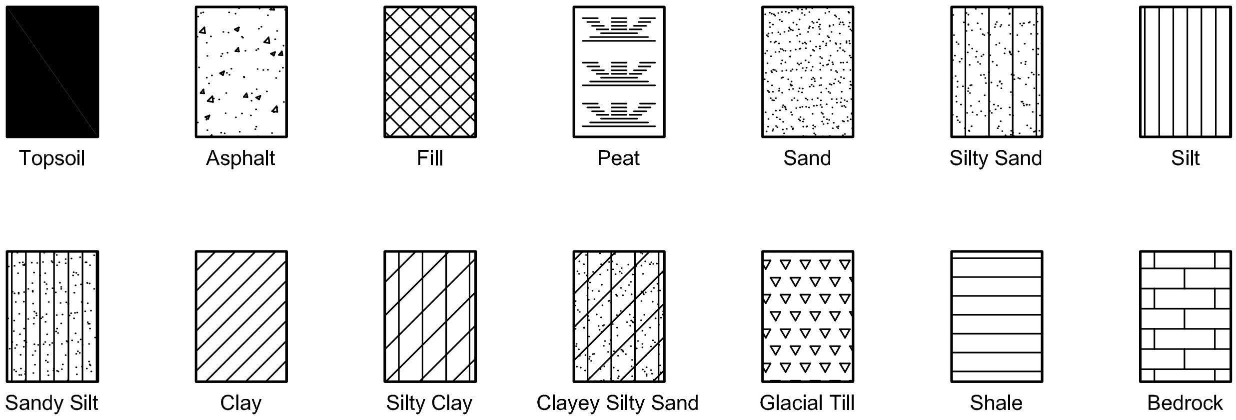
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

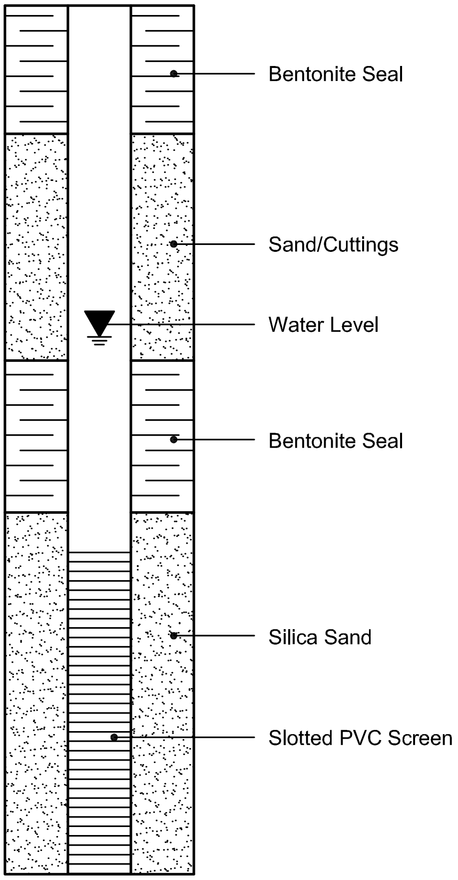
SYMBOLS AND TERMS (continued)

STRATA PLOT

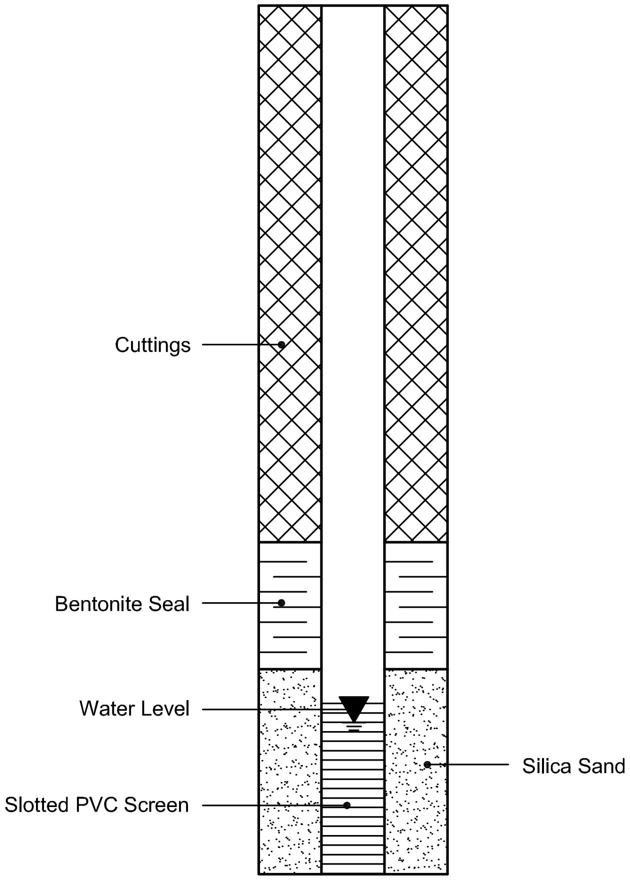


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Site Photographs of Culvert at Hydro Crossing for Cardinal Creek

Photo 1 - South face of culvert on July 9, 2013.

Photo 2 – South face of the box culvert on April 29, 2014. An open span of 5 m was measured at the south face of the box culvert.

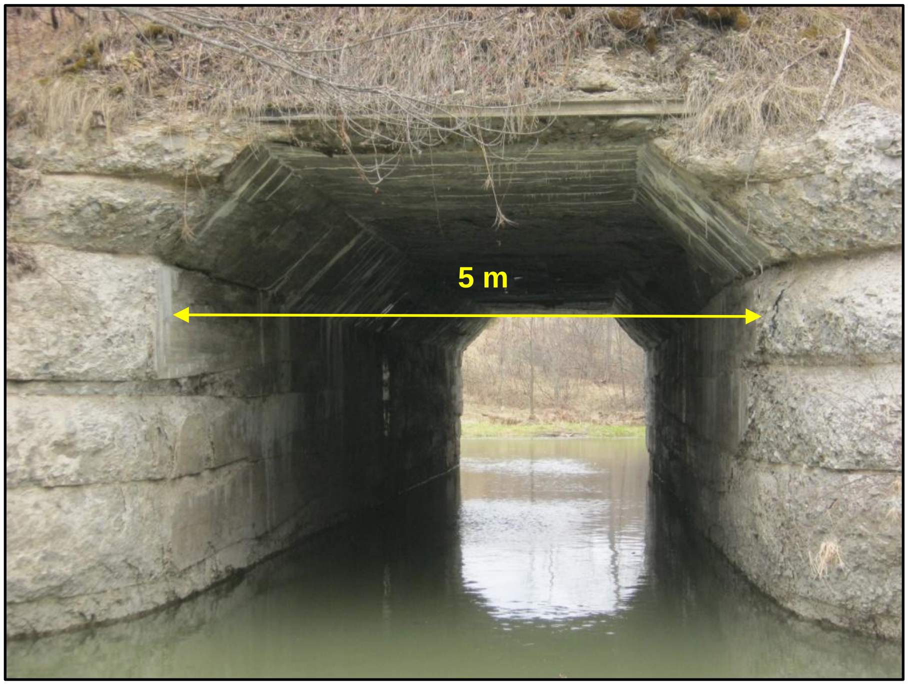


Photo 3 – South culvert face and remains of east wing wall on April 29, 2013. Concrete along wing wall noted to be heavily deteriorated and approximately 0.6 to 0.9 m thick. Exposed rebar and railway line noted along top of south culvert face.

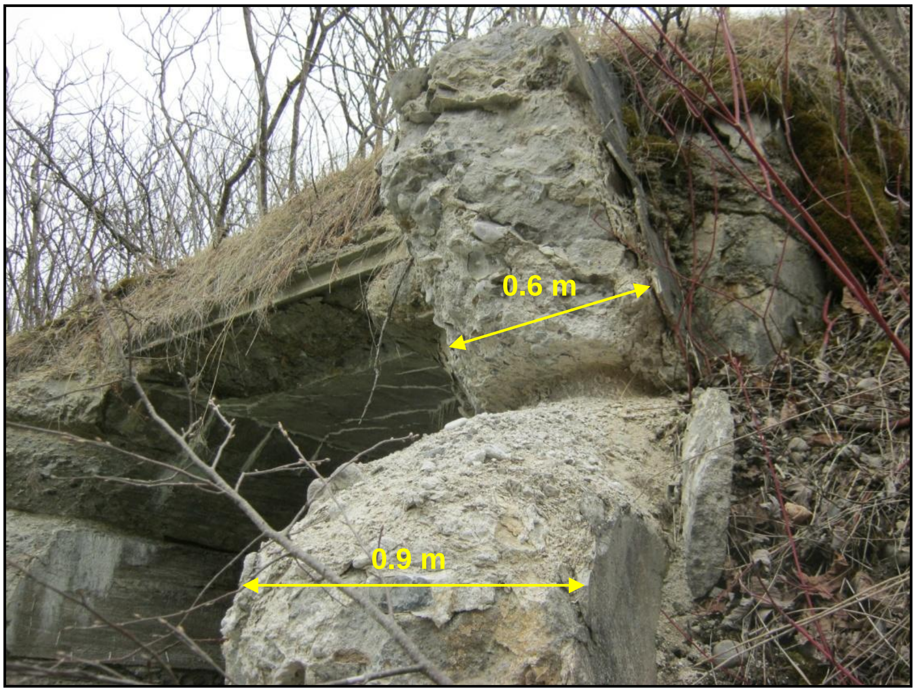


Photo 4 – Ceiling of box culvert at south entrance on April 29, 2014.

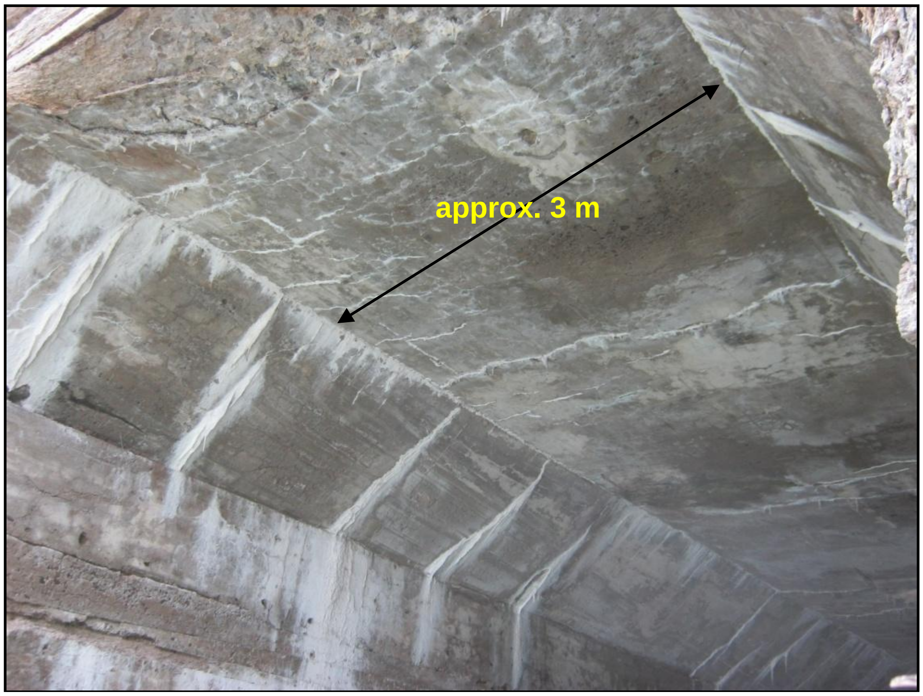


Photo 5 – North culvert face on April 29, 2013. Side wall noted to be approximately 1 m thick.

Photo 6 – Ceiling of box culvert at north entrance on April 29, 2014.

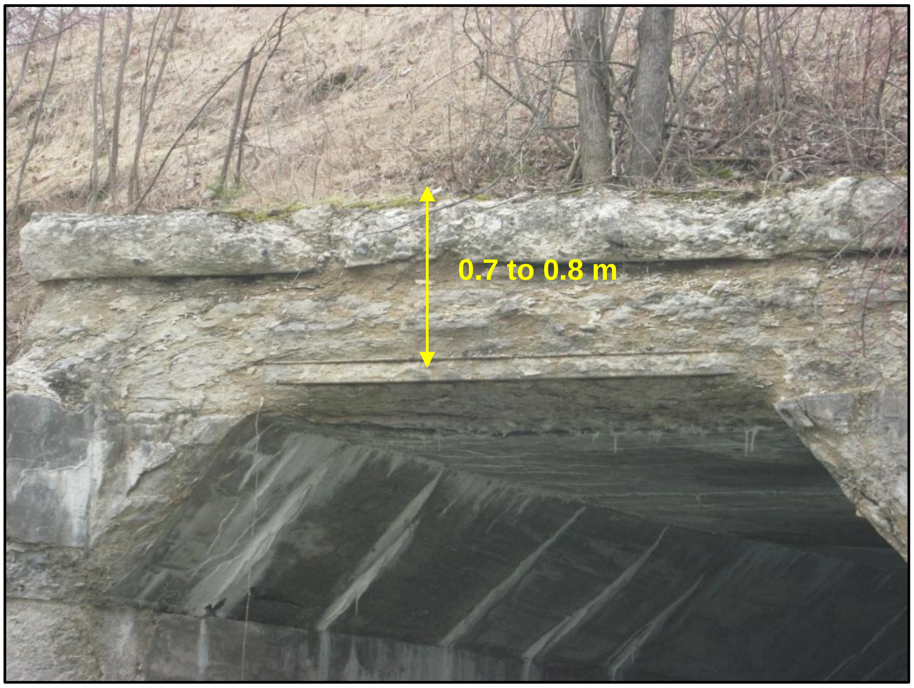


Photo 7 – Ceiling of box culvert at north entrance on April 29, 2014.

Photo 8 – Face of west wing wall at north face of the box culvert on April 29, 2014.

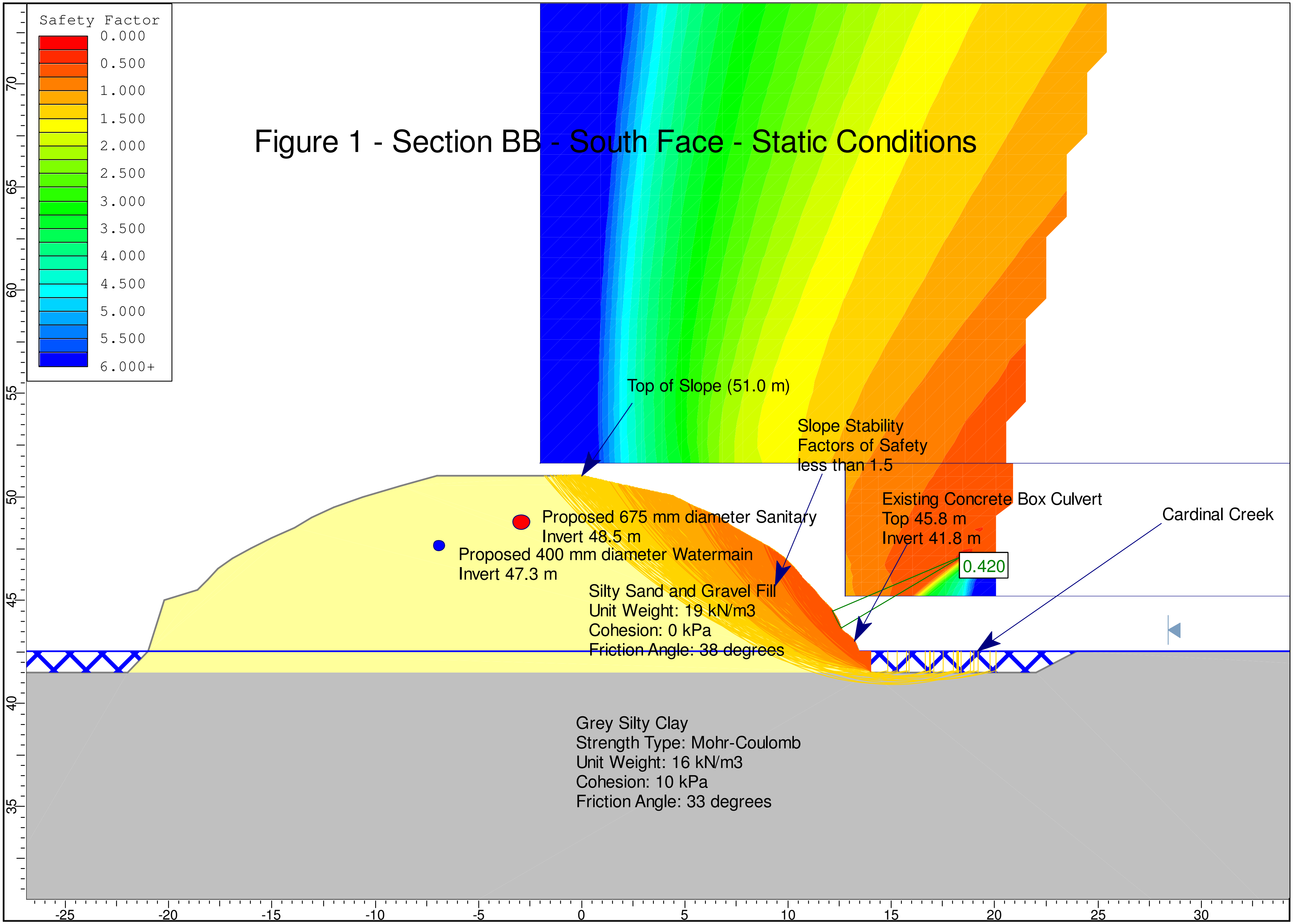


Figure 1 - Section BB - South Face - Static Conditions

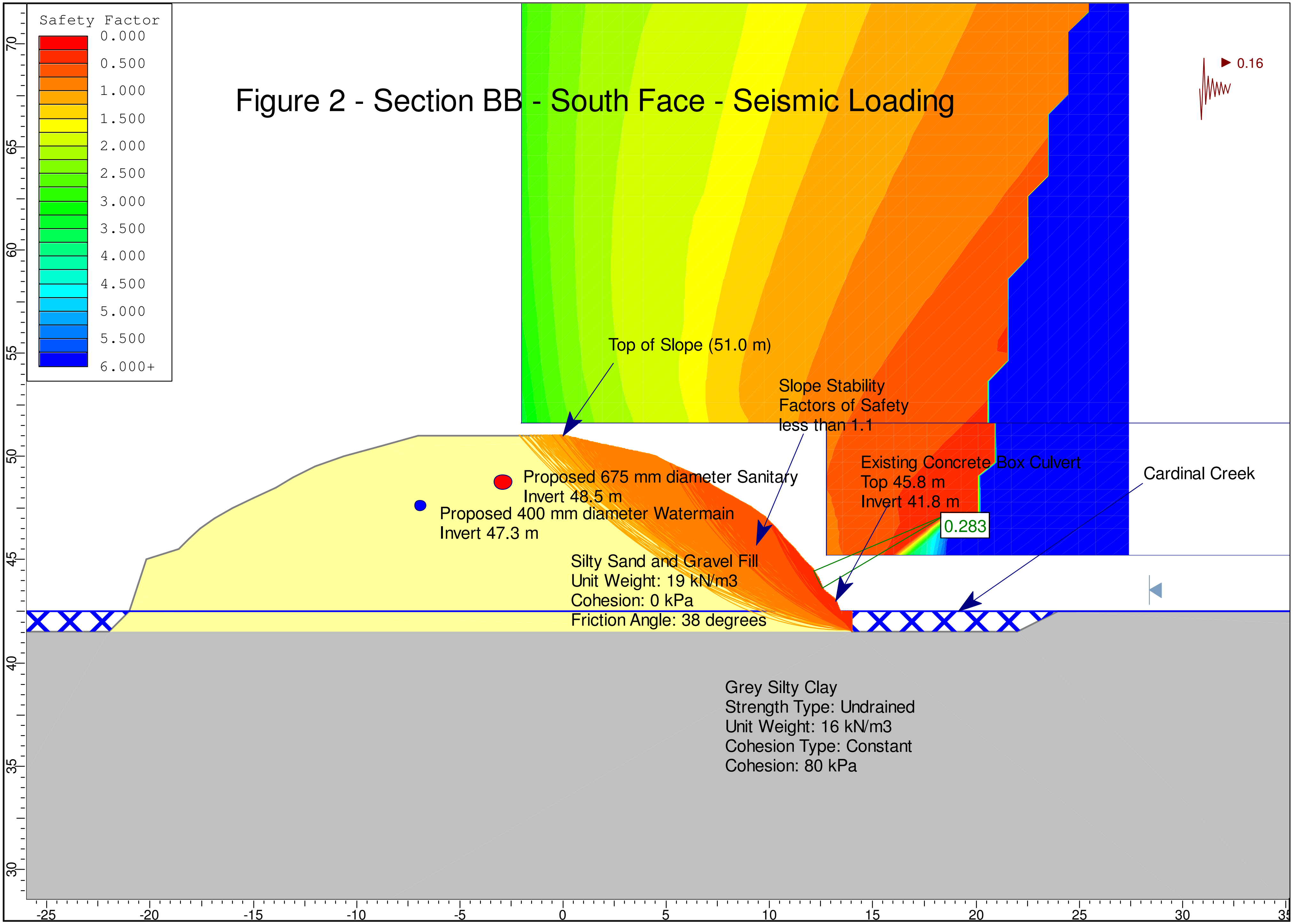


Figure 2 - Section BB - South Face - Seismic Loading

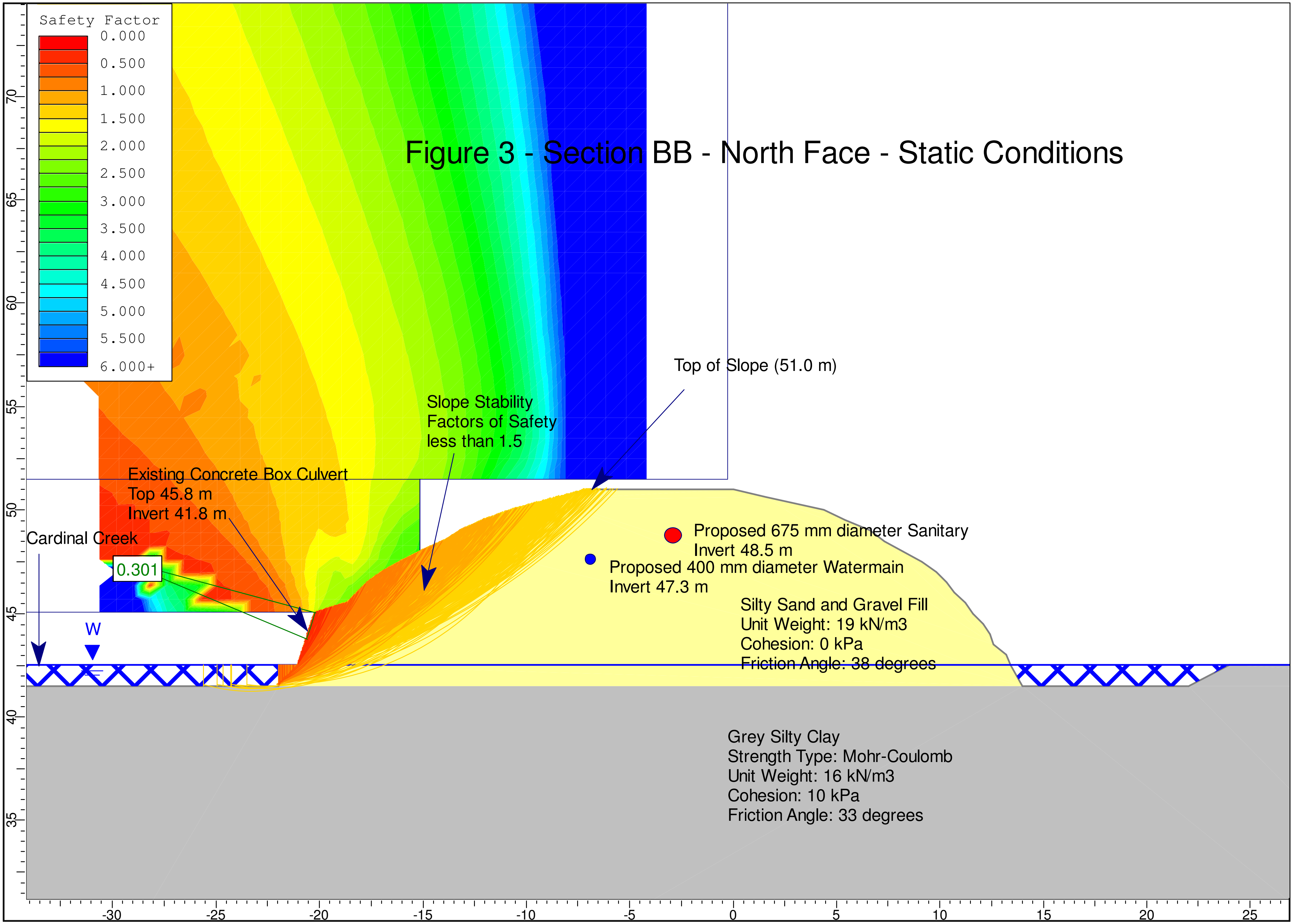


Figure 3 - Section BB - North Face - Static Conditions

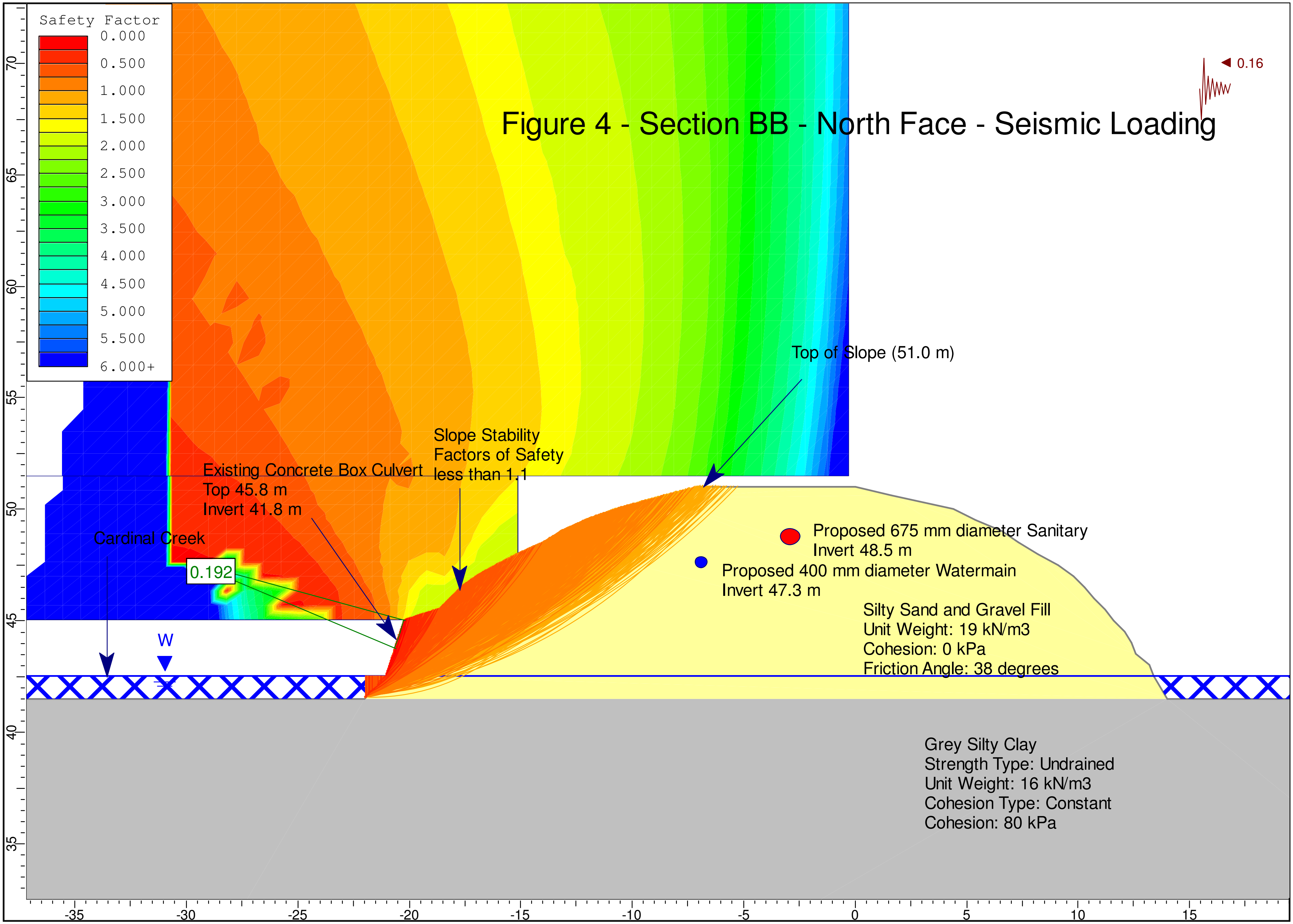


Figure 4 - Section BB - North Face - Seismic Loading

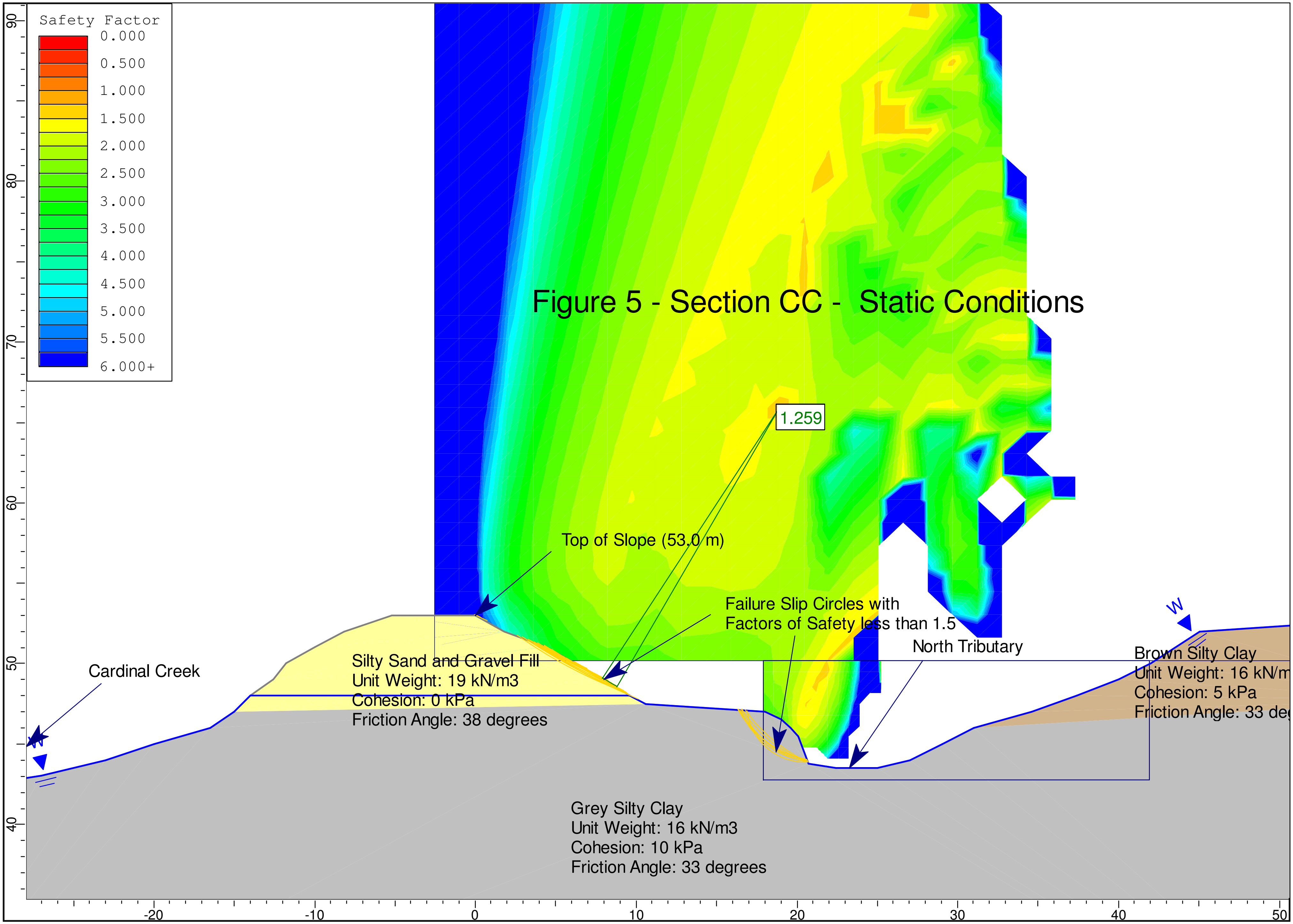


Figure 5 - Section CC - Static Conditions

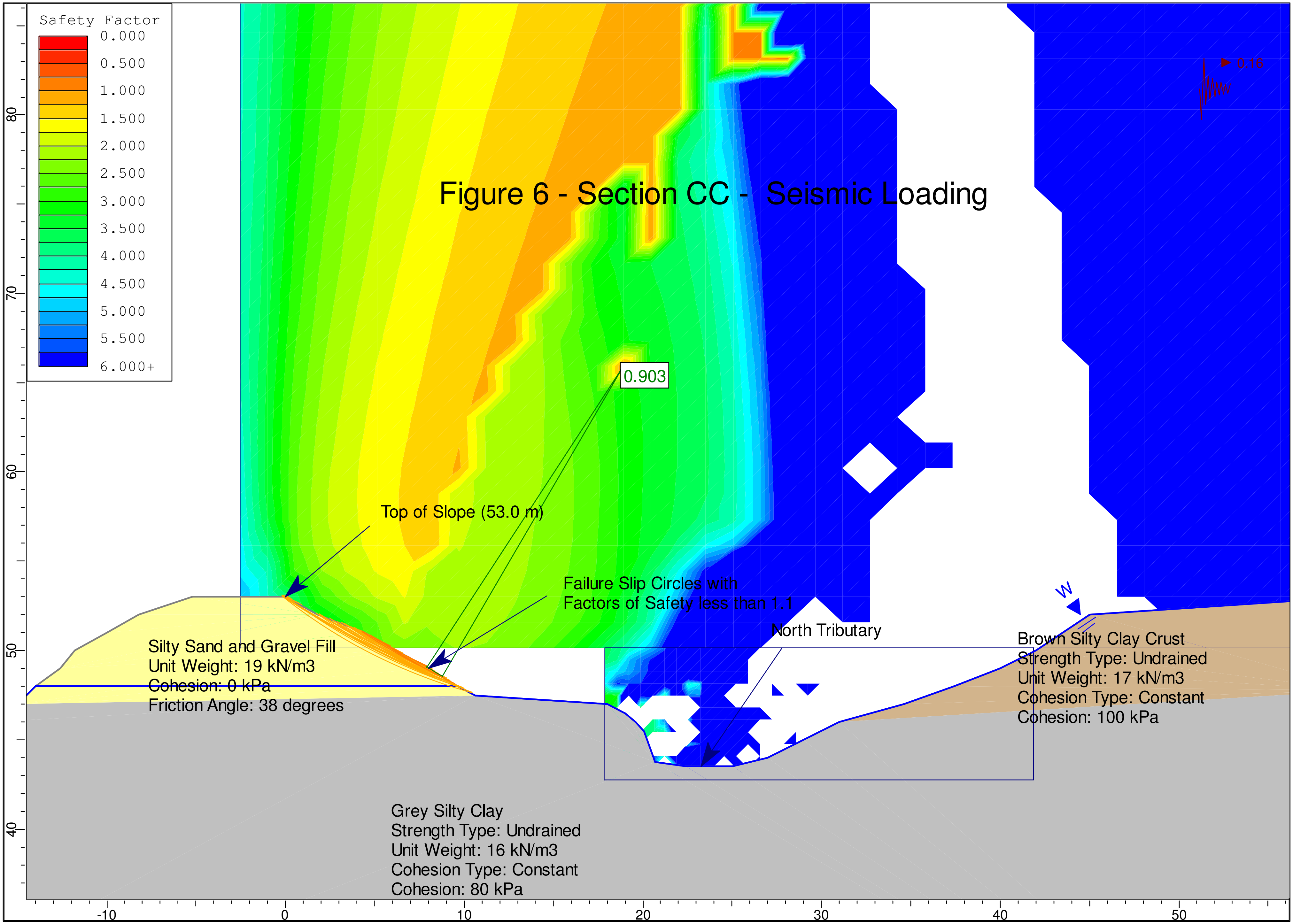
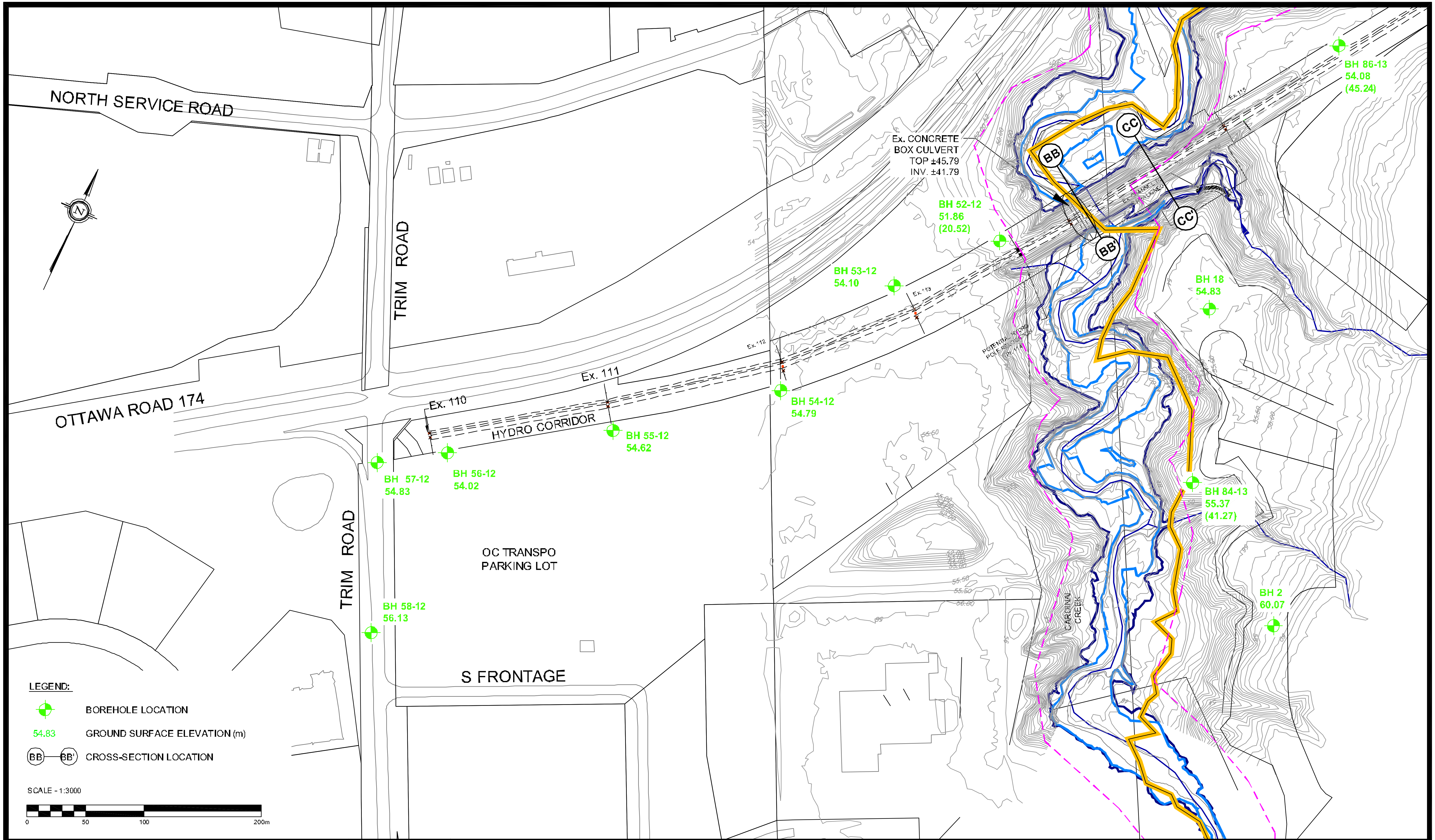


Figure 6 - Section CC - Seismic Loading



paterson group
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

Scale:	1:3000
Des.:	AVS
Dwn:	MPG
Chkd:	AJT

TAMARACK (QUEEN STREET) CORP.

GEOTECHNICAL INVESTIGATION
PROP. SERVICE ALIGNMENT ALONG HYDRO CORRIDOR
OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

Dwg. No.
PG1796-19
Report No. PG1796
Date: 05/2014

11x17

patersongroup **memorandum**
consulting engineers

to:	David Schaeffer Engineering Limited - **Ms. Laura Maxwell** - lmaxwell@dsel.ca
re:	Geotechnical Considerations - Service Impacts on Neighbouring Buildings **Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	July 24, 2014
file:	PG1796-MEMO.13R
from:	David Gilbert

As requested, Paterson Group (Paterson) has prepared the current memo report to provide geotechnical considerations for the services placed in close proximity to the residential buildings to be constructed at the aforementioned site. It should be noted that our review took into consideration the potential undermining of adjacent footings if future repairs to the services are required. Also, we assessed the potential excavation support techniques required for future service repairs. The section drawings prepared by David Schaeffer Engineering Limited (DSEL) attached to the current memo report were provided for review from a geotechnical perspective.

Based on our review of the provided drawings, the majority of the sections are not indicative of any issues from a geotechnical perspective with respect to long-term maintenance of the proposed services. It is anticipated that temporary excavation for the services will be supported by trench boxes and where required due to service depth, trench boxes will be stacked. It should be noted that the overburden soils and anticipated backfill materials will be adequately supported by trench boxes and it is anticipated that excavations can be completed within the roadway right-of-way and within the service easement.

Sufficient distance is provided between the proposed services and building footings and the footing's lateral support zone will not be negatively impacted due to the anticipated excavation side slopes, bedrock elevation and proposed USF level of the adjacent buildings. However, the alignment represented by Section 18-18 is expected to cause a conflict for the adjacent footings, unless a foundation support program is implemented.

Recommended Foundation Support Program

Based on the location and depth of the proposed storm sewer, the storm sewer will be located within the proposed building's lateral support zone and most likely the area below the proposed building will be disturbed during placement of the sewer line and for excavations associated with future repairs. To ensure that long-term maintenance can be completed without detrimental effects to the adjacent building, the following program is recommended:

☐ Step 1 - Upon completion of the storm sewer placement, a workable, brown silty clay backfill placed under dry conditions and approved by the geotechnical consultant at the time of placement is considered acceptable for reuse within the proposed building footprint. The silty clay backfill should be placed in maximum 300 mm loose lifts and compacted using a sheepsfoot roller making several passes to achieve a minimum 95% of its SPMDD.

☐ Step 2 - At the time of house construction, a lean concrete in-filled trench should be extended below footing level to an elevation of 51.0 m along the west foundation wall of the proposed building. The near vertical, zero entry trench should extend at least 300 mm beyond the footing face and be in-filled with a minimum 15 MPa lean concrete to underside of footing level. The trench should extend at least 3 m along the west portion of the north and south foundation walls.

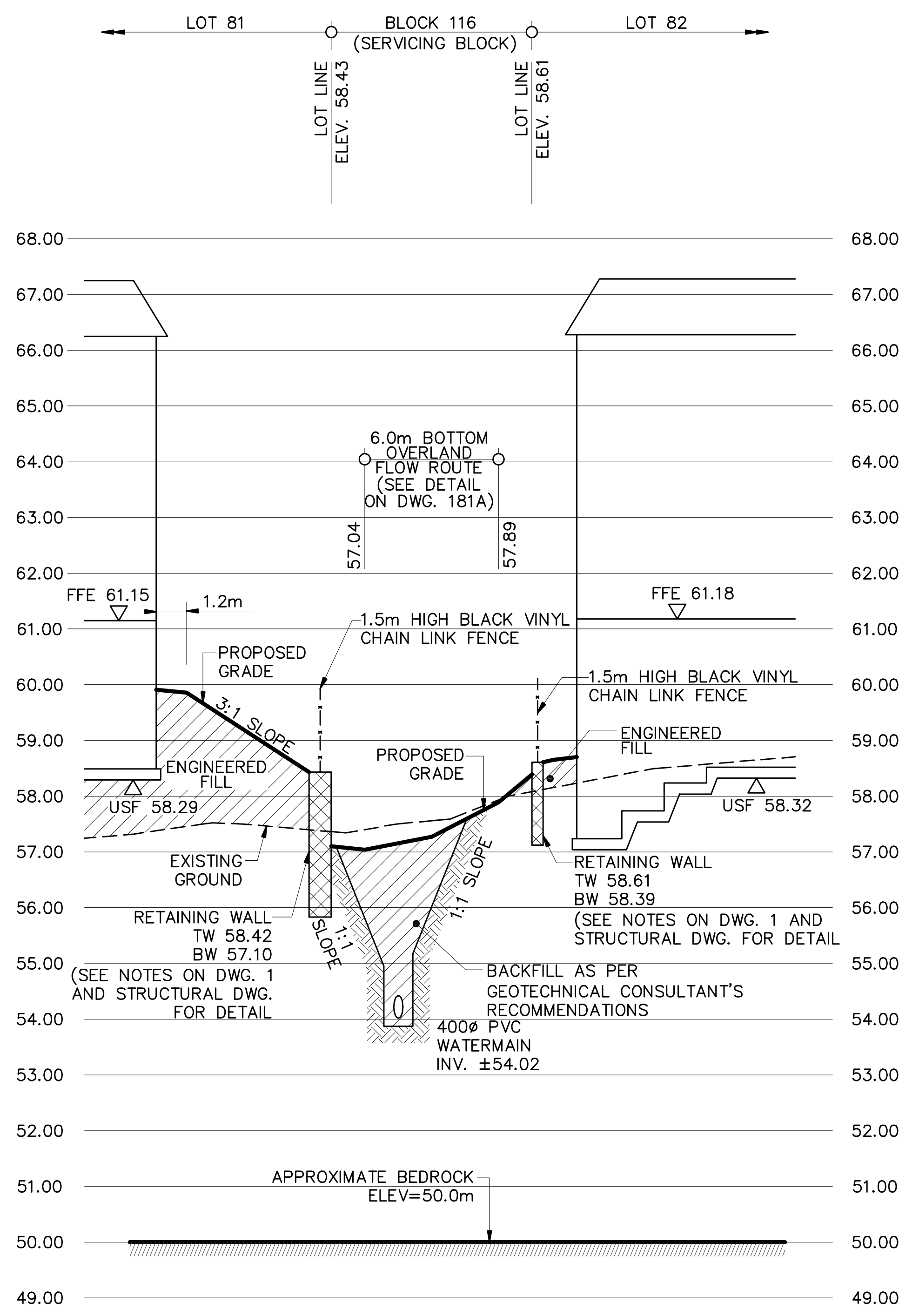
We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

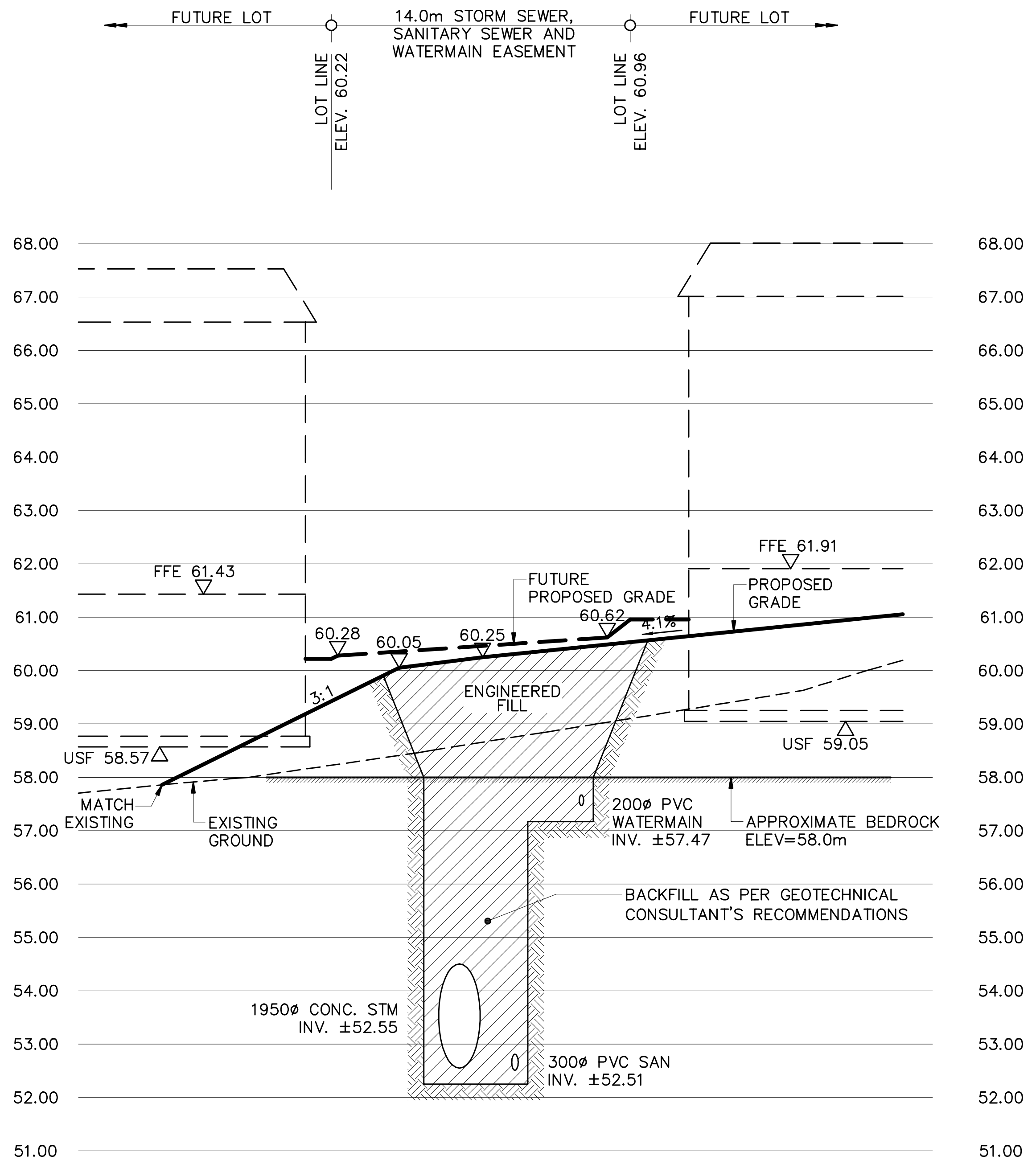
David J. Gilbert, P.Eng.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO



SECTION 15–15

SCALE HOR. 1:250
VER. 1:100



SECTION 16–16

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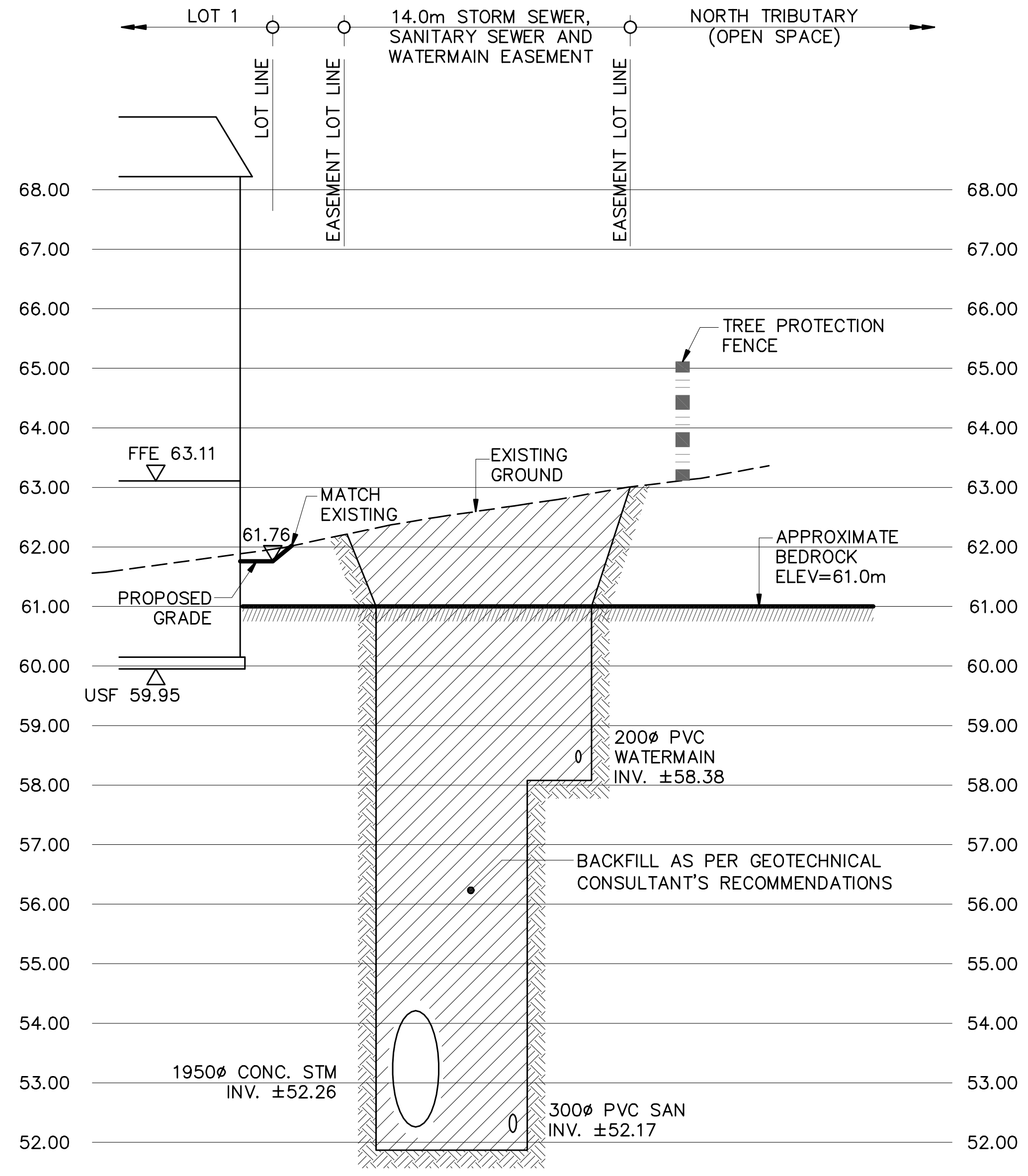

SECTION 17–17

SCALE HOR. 1:250
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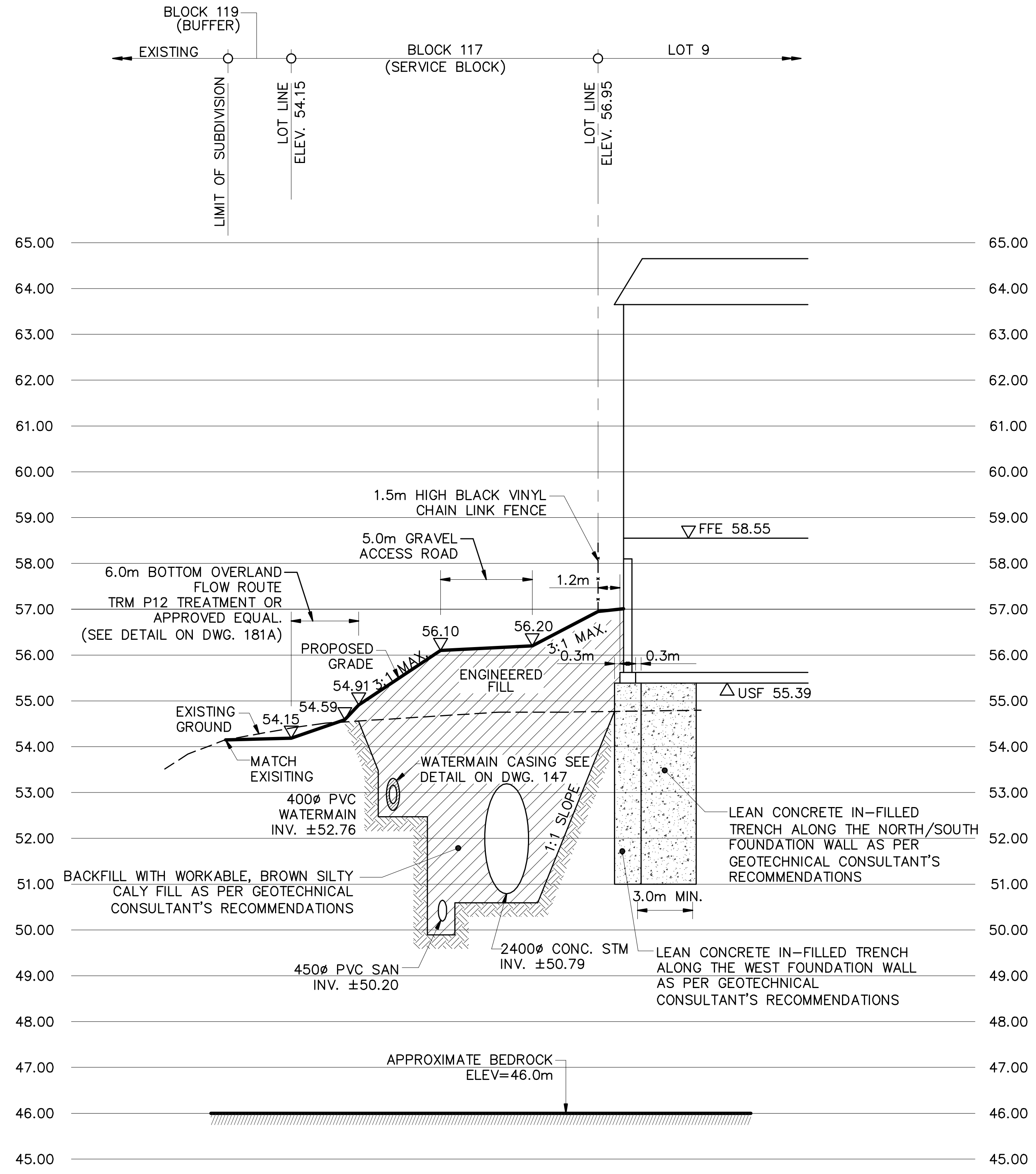
NOTE RE: U/G SERVICING IN NORTH TRIBUTARY
FOR GEOTECHNICAL RECOMMENDATIONS ON UNDERGROUND SERVICING IN NORTH TRIBUTARY, REFER TO THE MEMO OF PG1796–MEMO.12R, PREPARED BY PATERSON GROUP, FOR DETAIL



SECTION 18–18

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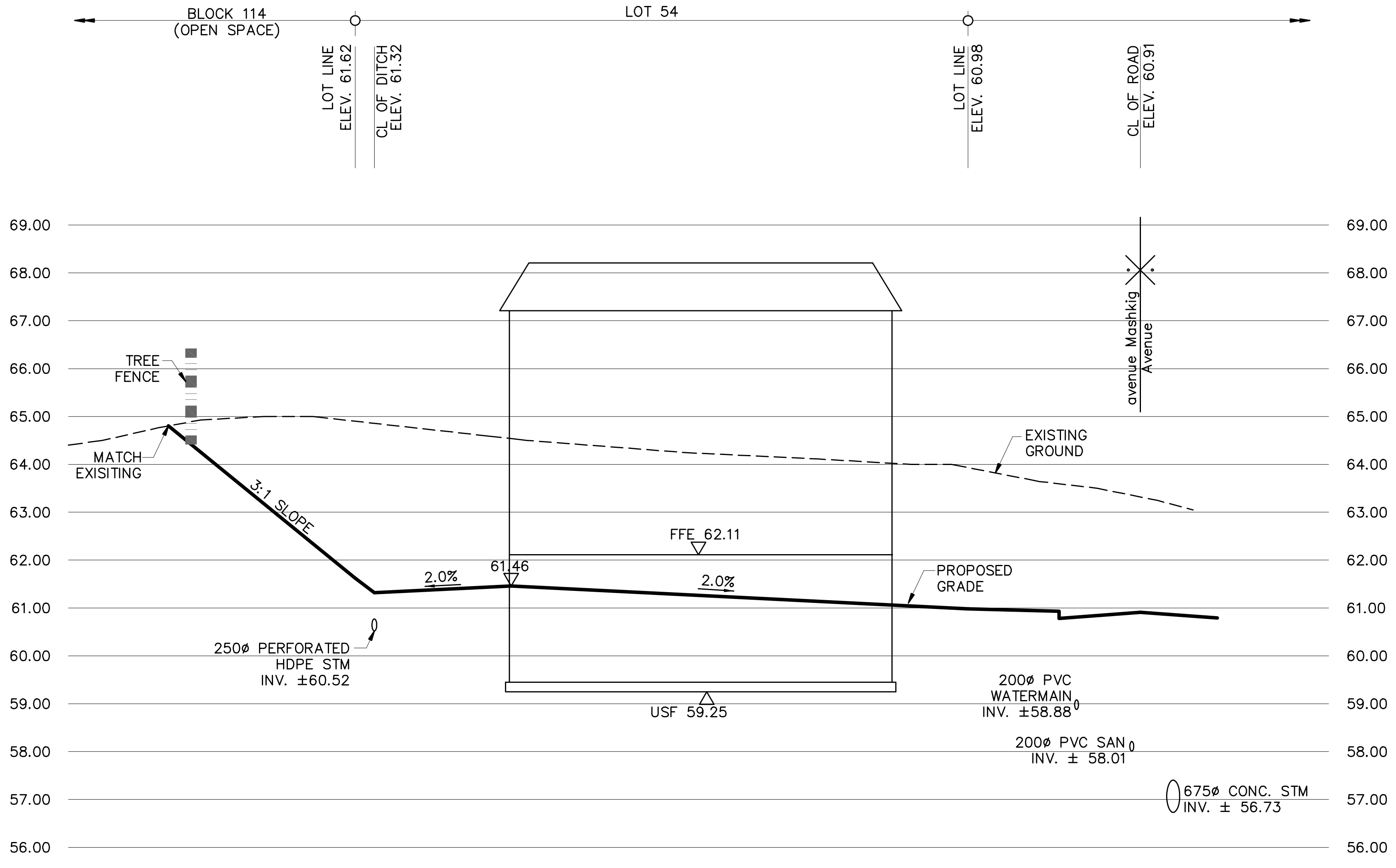


SECTION 19–19

SCALE HOR. 1:250
VER. 1:100

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161611900–111 RECEIVED ON JULY 6, 2012 AND PROJECT No. 16162924–111 RECEIVED ON OCTOBER 24, 2013 AND NOVEMBER 29, 2013

LEGAL INFORMATION

CALCULATED M–PLAN PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161613098–132 RECEIVED ON JUNE 27, 2014.

PRE–SERVICING SUBMISSION FOR PHASE 1A ONLY 14–07–17

ELEVATION NOTE

ELEVATIONS HEREON ARE GEODETIC AND ARE DERIVED FROM THE CAN–NET VRS NETWORK.

No.	DATE	BY	DESCRIPTION	BY
4.	14–07–17	Z.L.	PRE–SERVICING SUBMISSION FOR PHASE 1A	
3.	14–05–27	Z.L.	3rd SUBMISSION	
2.	14–05–01	Z.L.	2nd SUBMISSION	
1.	14–02–07	Z.L.	1st SUBMISSION	

CITY OF OTTAWA

PROJECT No. 11–513 B–1

Z. LI
14-07-17

CROSS SECTIONS

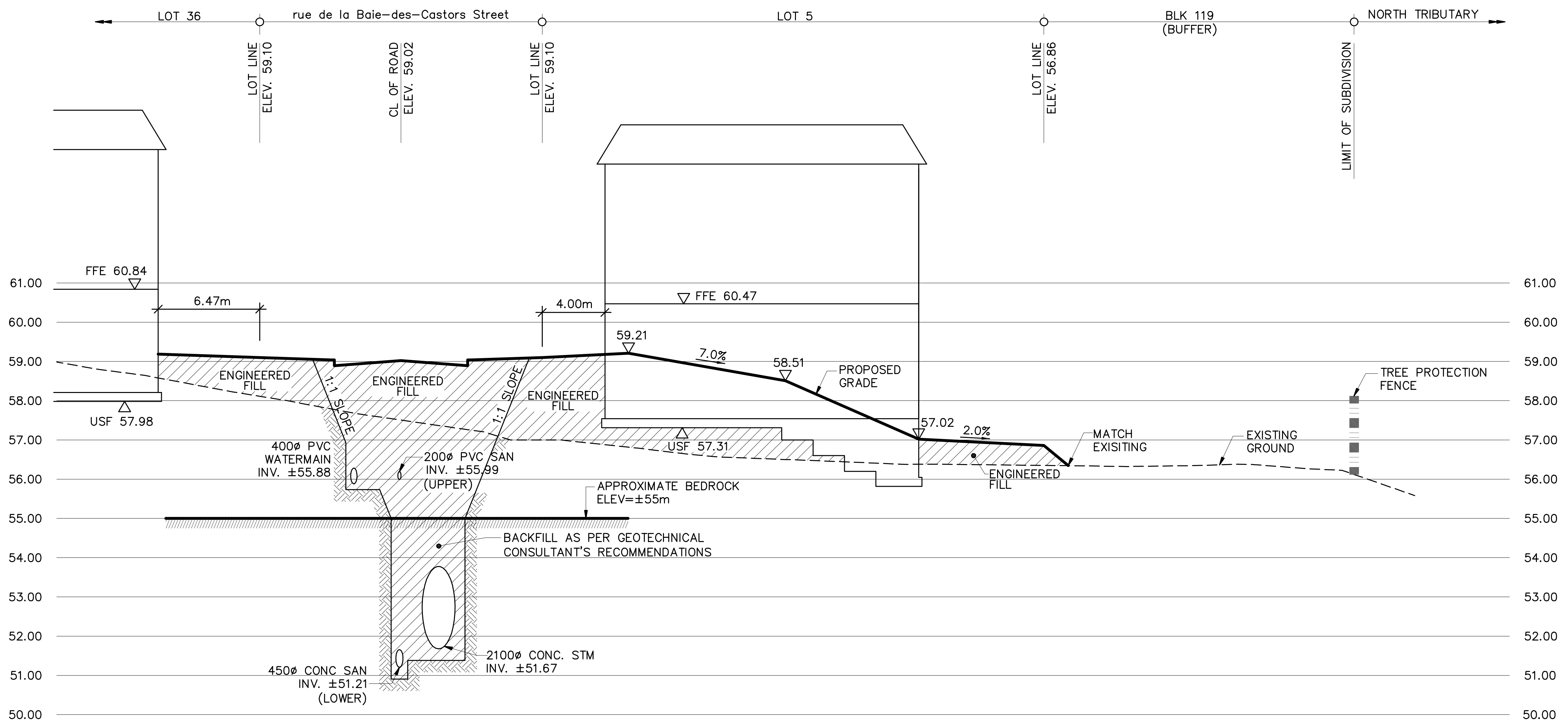
TAMARACK
(CARDINAL CREEK)
CORPORATION

CARDINAL CREEK VILLAGE PHASE 1A

david schaeffer engineering ltd

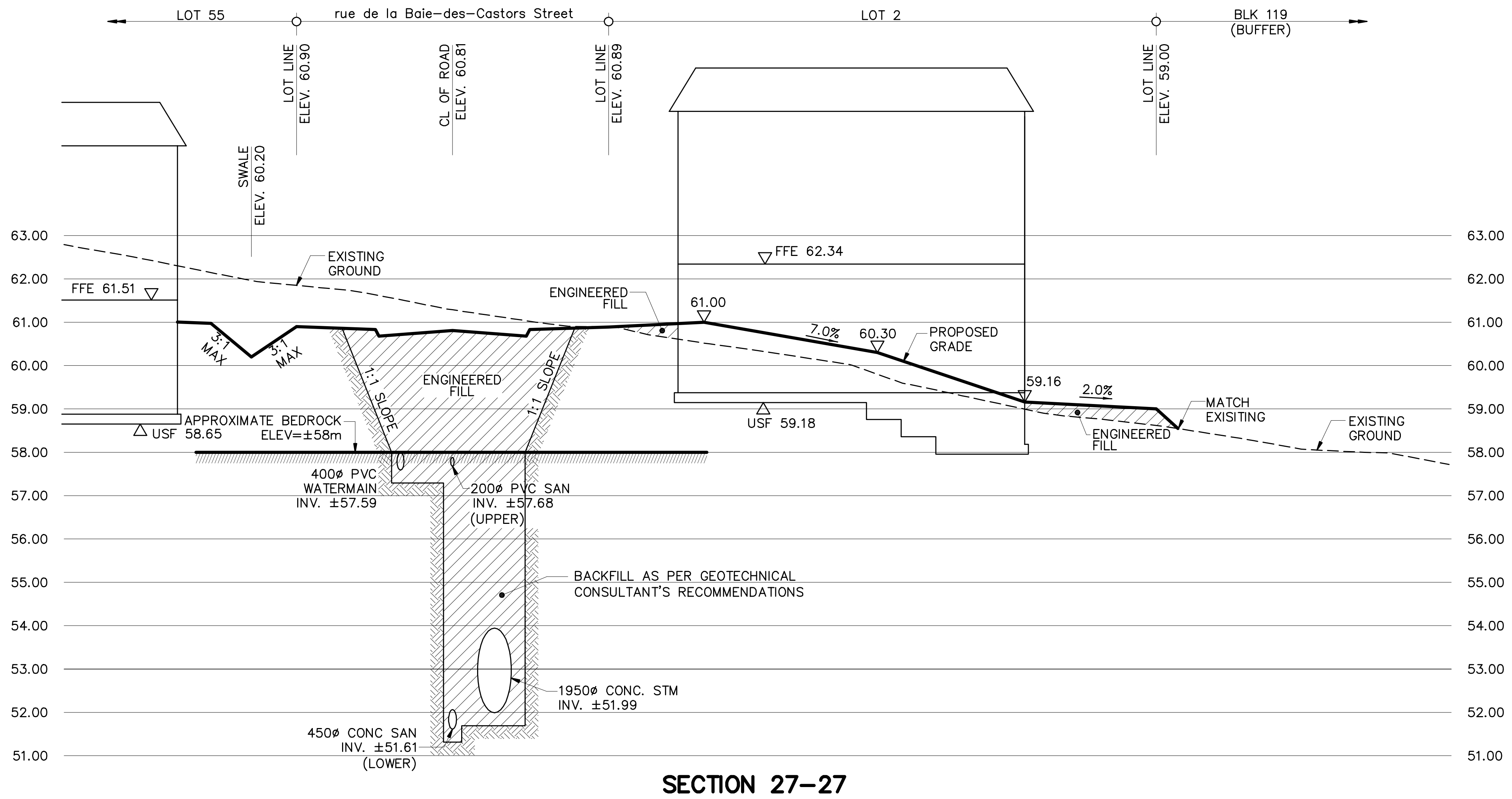
120 Iber Road, Unit 203
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

DRAWN BY: W.L./H.P.	CHECKED BY: K.M.	DRAWING NO.	SHEET NO.
DESIGNED BY: K.M.	CHECKED BY: Z.L.		189A
SCALE: AS SHOWN	DATE: FEBRUARY 2014		



SECTION 26-26

SCALE HOR. 1:250
VER. 1:100



SECTION 27-27

SCALE HOR. 1:250
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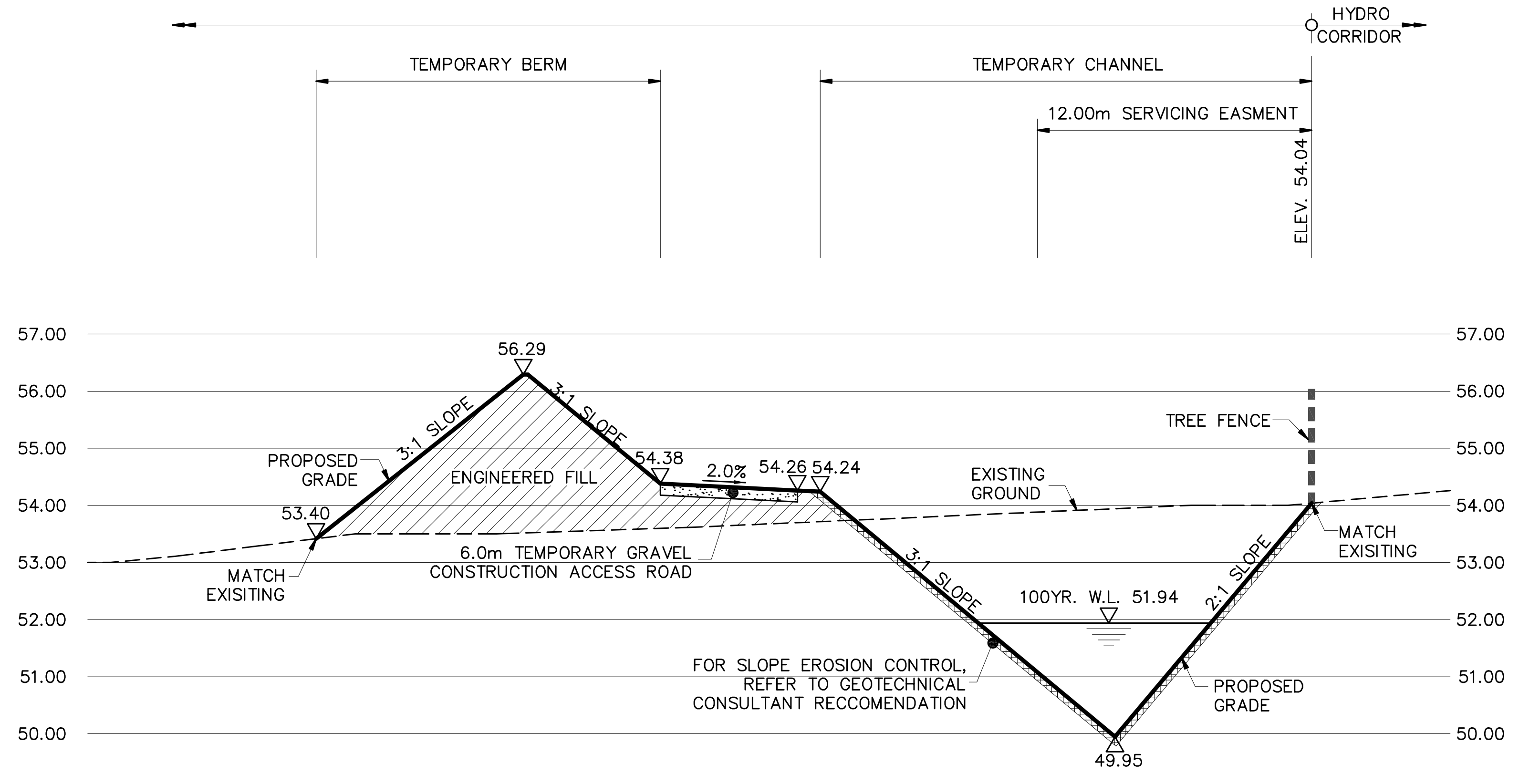
NOTE RE: LOT 1 TO 8 FRONTING
rue de la Baie-des-Castors Street

BASED ON BEDROCK REMOVAL FOR UNDERGROUND SERVICING, LEAN CONCRETE MAY BE REQUIRED TO SUPPORT BUILDING FOUNDATION ON SOUND BEDROCK, WHICH TO BE FIELD REVIEWED AND EVALUATED BY GEOTECHNICAL CONSULTANT PRIOR TO PLACEMENT OF BUILDING FOUNDATIONS.



SECTION 20-20

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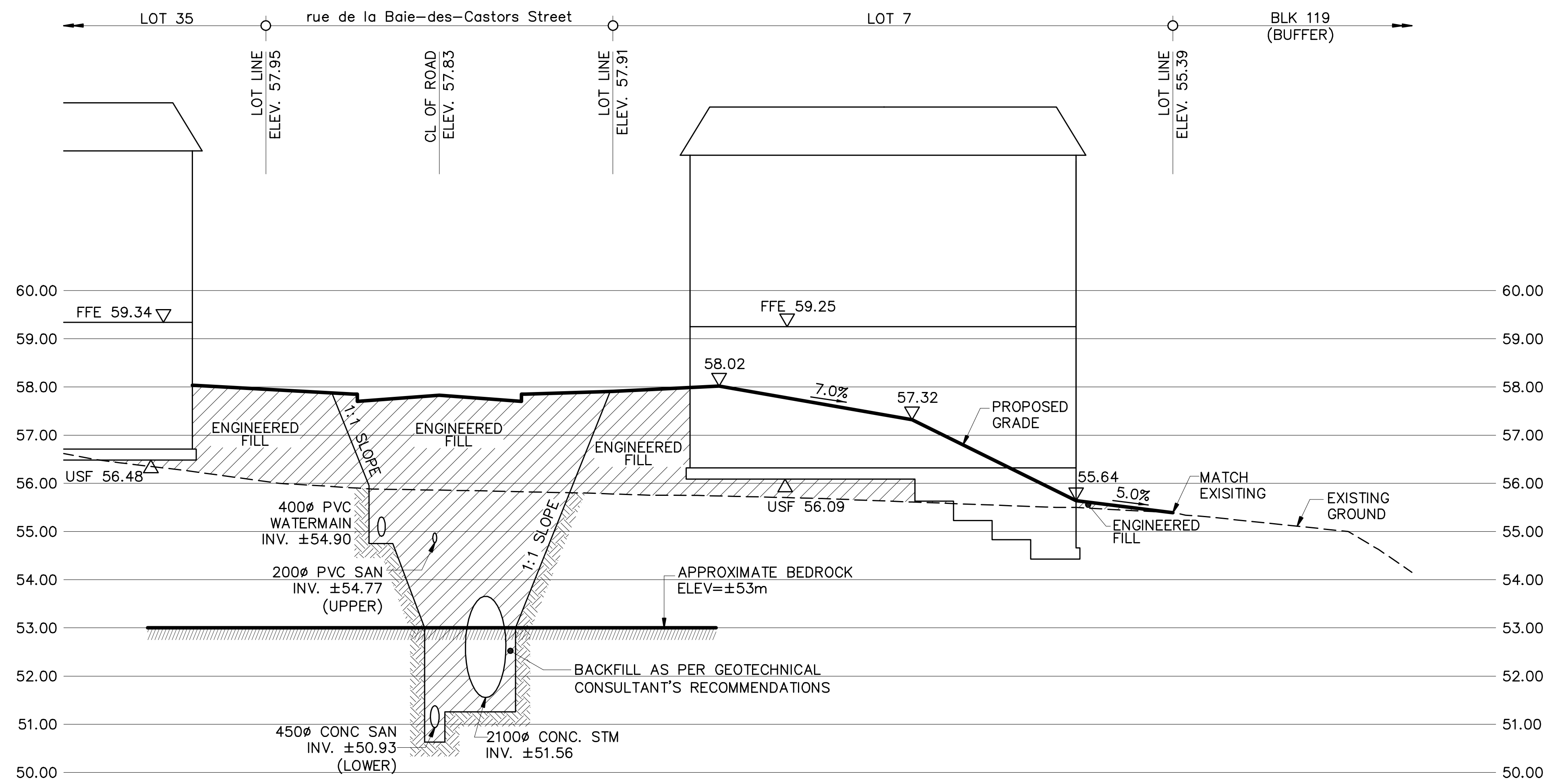
VER. 1:100



SECTION 25-25

SCALE HOR. 1:250
VER. 1:100

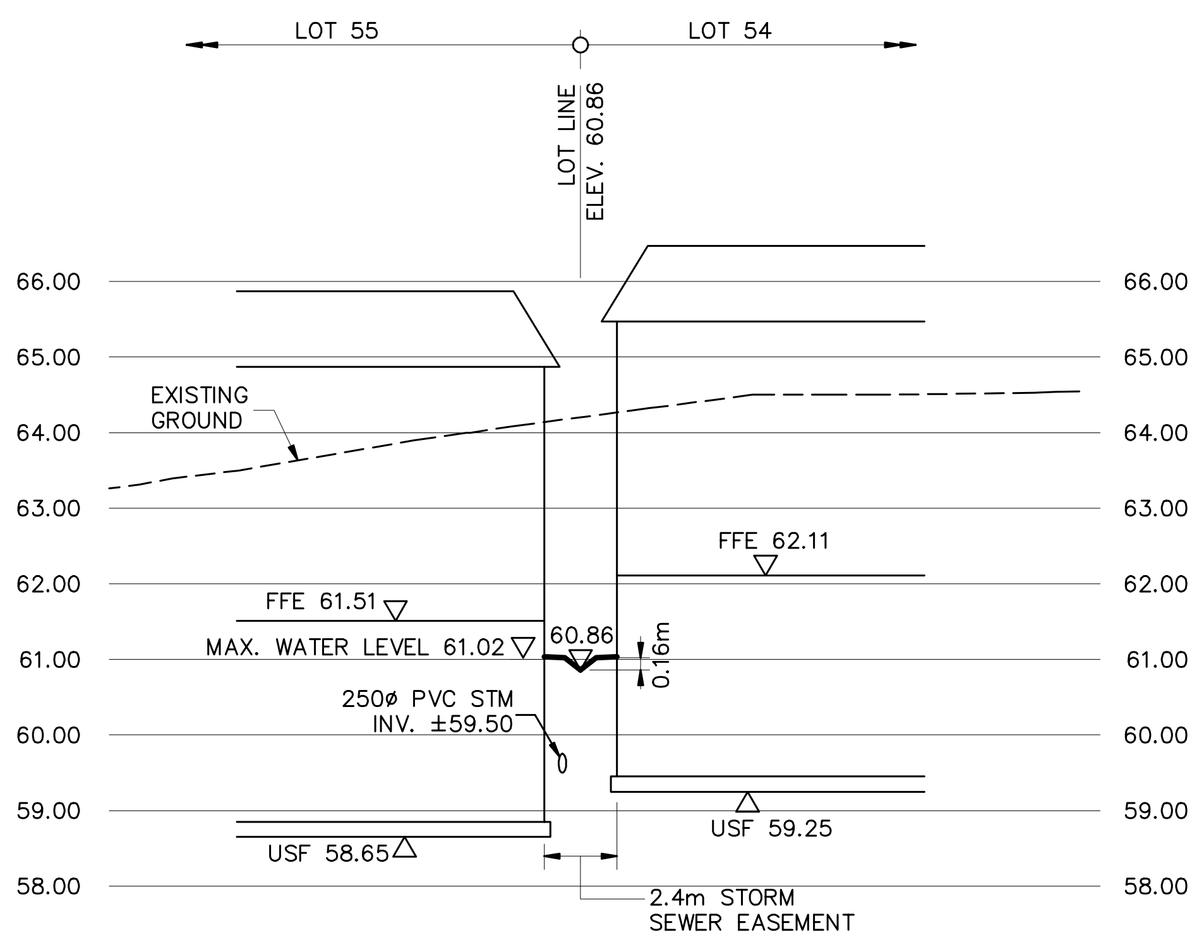
TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161611900-111 RECEIVED ON JULY 6, 2012 AND PROJECT No. 16162924-111 RECEIVED ON OCTOBER 24, 2013 AND NOVEMBER 29, 2013

LEGAL INFORMATION

CALCULATED M-PLAN PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161613098-132 RECEIVED ON JUNE 27, 2014.

PRE-SERVICING SUBMISSION FOR PHASE 1A ONLY 14-07-17



SECTION 21-21

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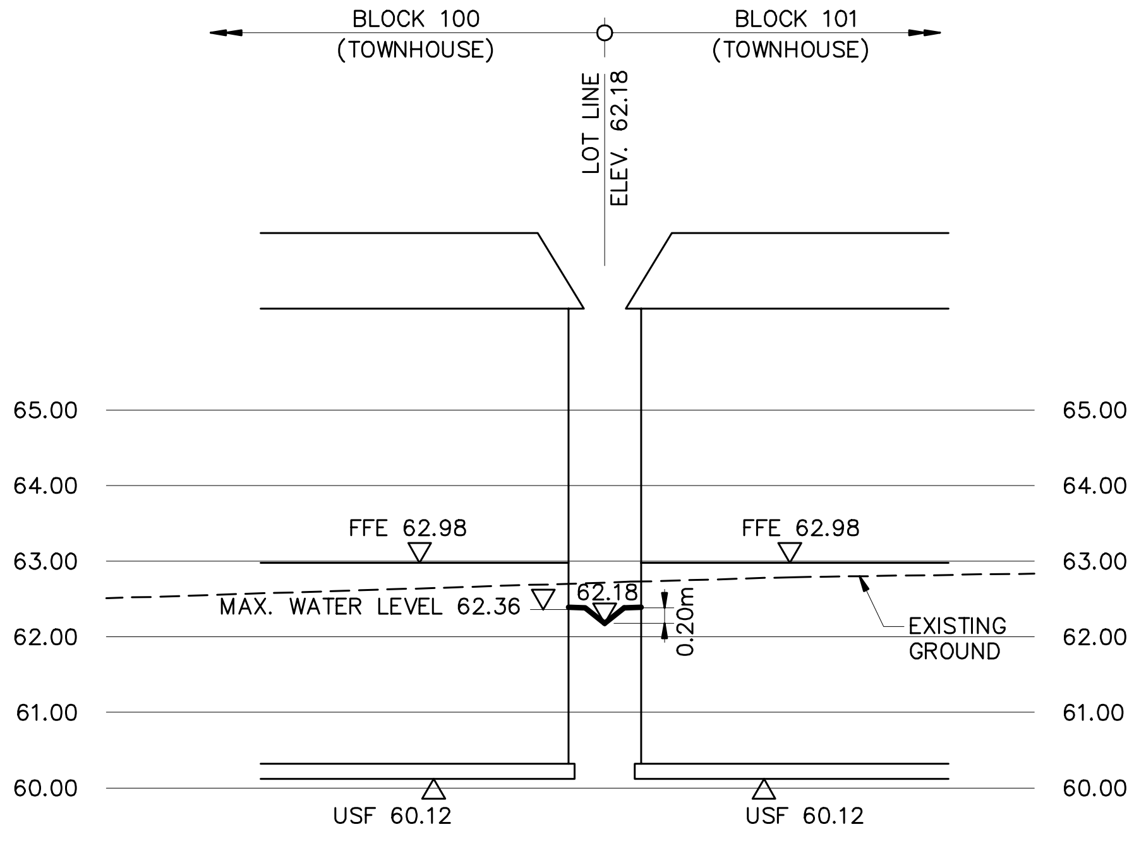
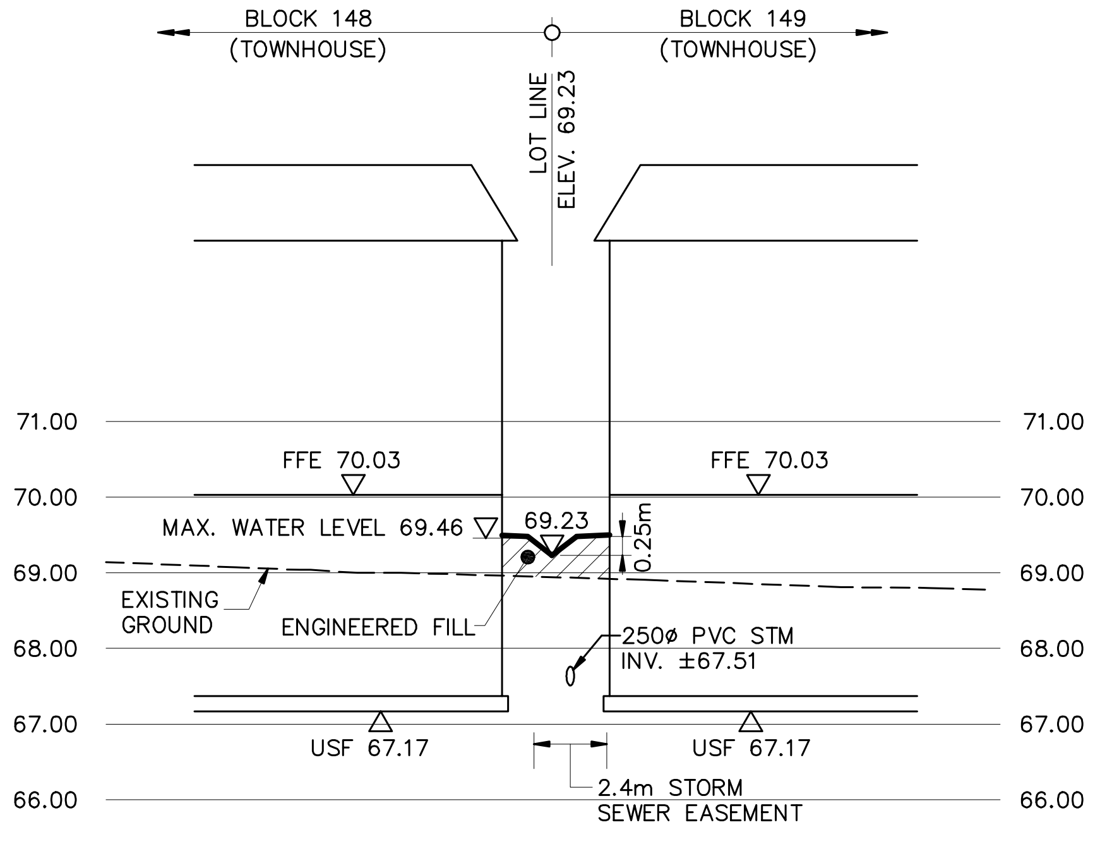


SECTION 22-22

SCALE HOR. 1:250
VER. 1:100



SECTION 23-23

SCALE HOR. 1:250
VER. 1:100

ELEVATION NOTE

ELEVATIONS HEREON ARE GEODETIC AND ARE DERIVED FROM THE CAN-NET VRS NETWORK.

No.	DATE	BY	DESCRIPTION	BY
4.	14-07-17	Z.L.	PRE-SERVICING SUBMISSION FOR PHASE 1A	
3.	14-05-27	Z.L.	3rd SUBMISSION	
2.	14-05-01	Z.L.	2nd SUBMISSION	
1.	14-02-07	Z.L.	1st SUBMISSION	

CITY OF OTTAWA

Z. LI
14-07-17

PROJECT No. 11-513 B-1

CROSS SECTIONS

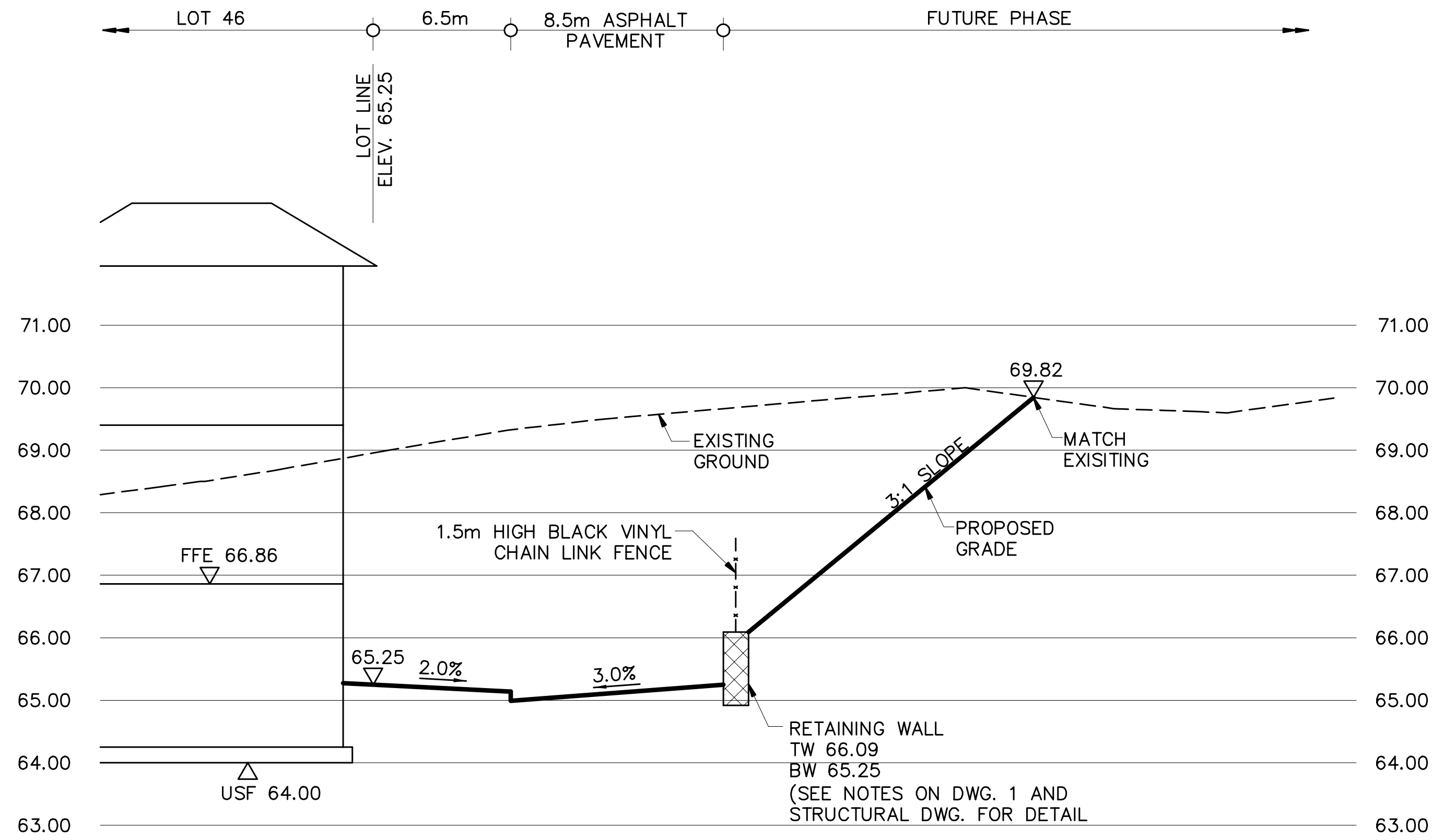
TAMARACK
(CARDINAL CREEK)
CORPORATION

CARDINAL CREEK VILLAGE PHASE 1A

david schaeffer engineering ltd

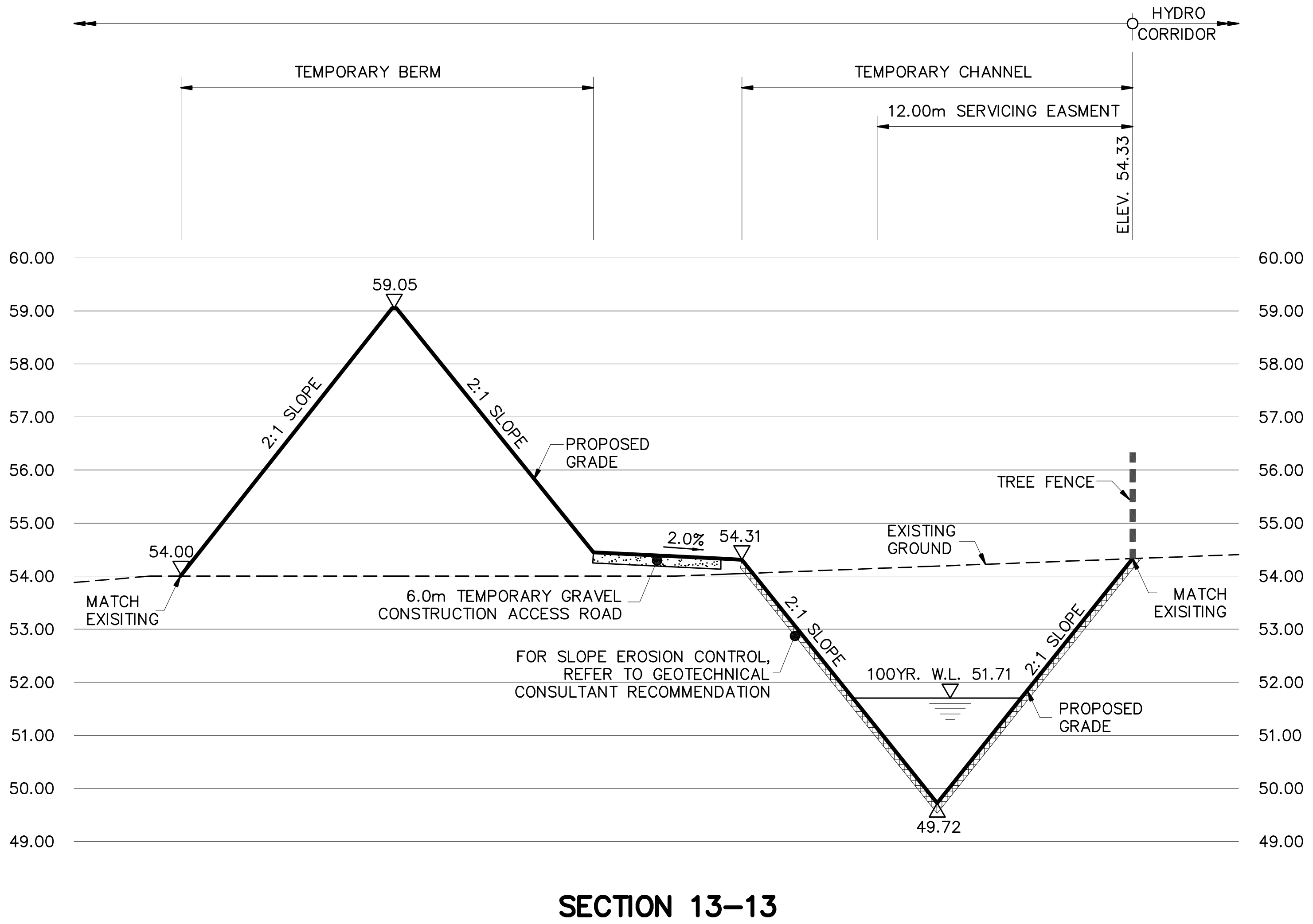
120 Iber Road, Unit 203
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

DRAWN BY: W.L./H.P.	CHECKED BY: K.M.	DRAWING NO.	SHEET NO.
DESIGNED BY: K.M.	CHECKED BY: Z.L.		189B
SCALE: AS SHOWN	DATE: FEBRUARY 2014		



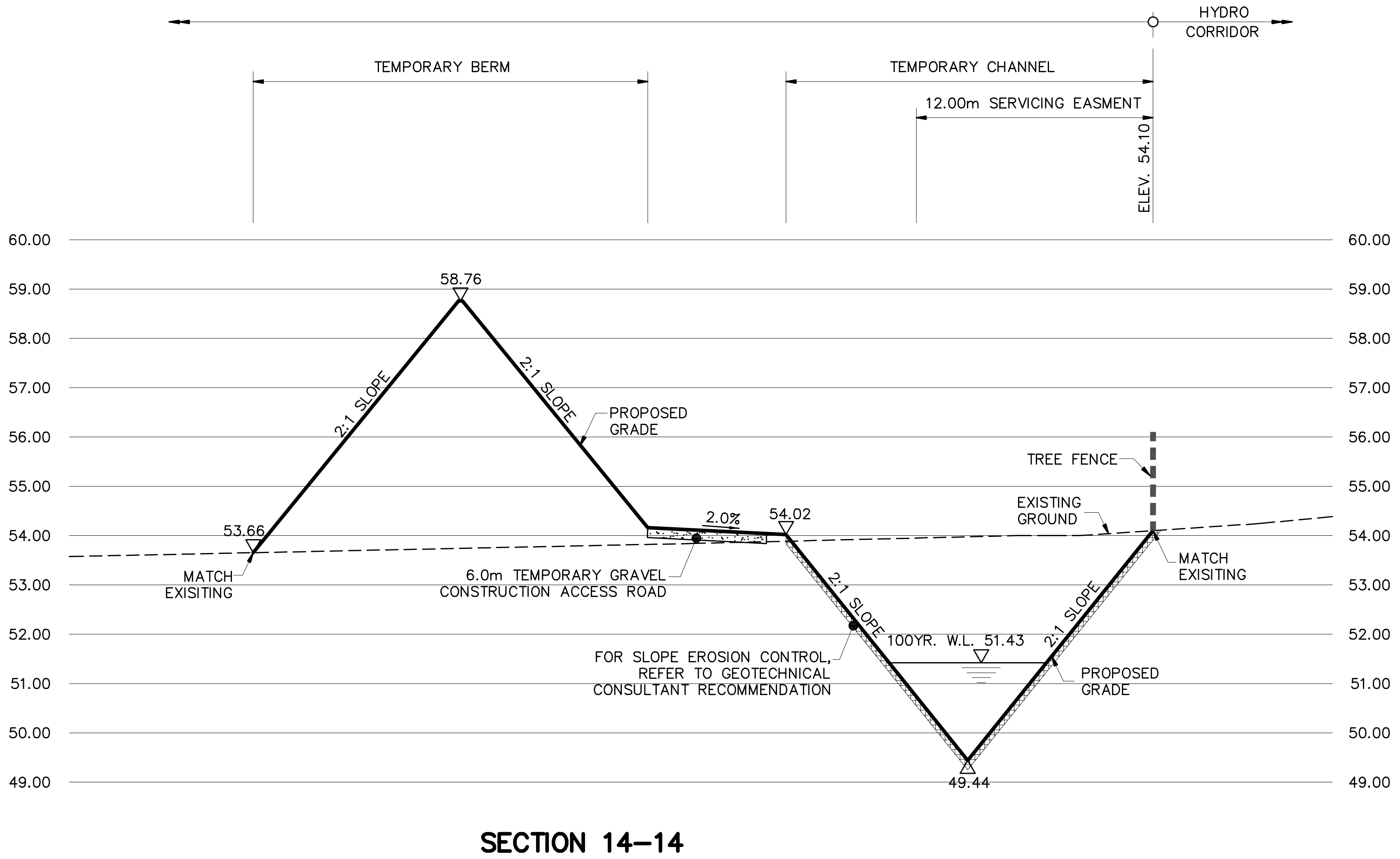
SECTION 12–12

SCALE HOR. 1:250
VER. 1:100



SECTION 13–13

SCALE HOR. 1:250
VER. 1:100



SECTION 14–14

SCALE HOR. 1:250
VER. 1:100

NOTES:

– ALL TOPSOIL AND DELETERIOUS MATERIALS SHOULD BE REMOVED FROM IN–FILLING AREA.

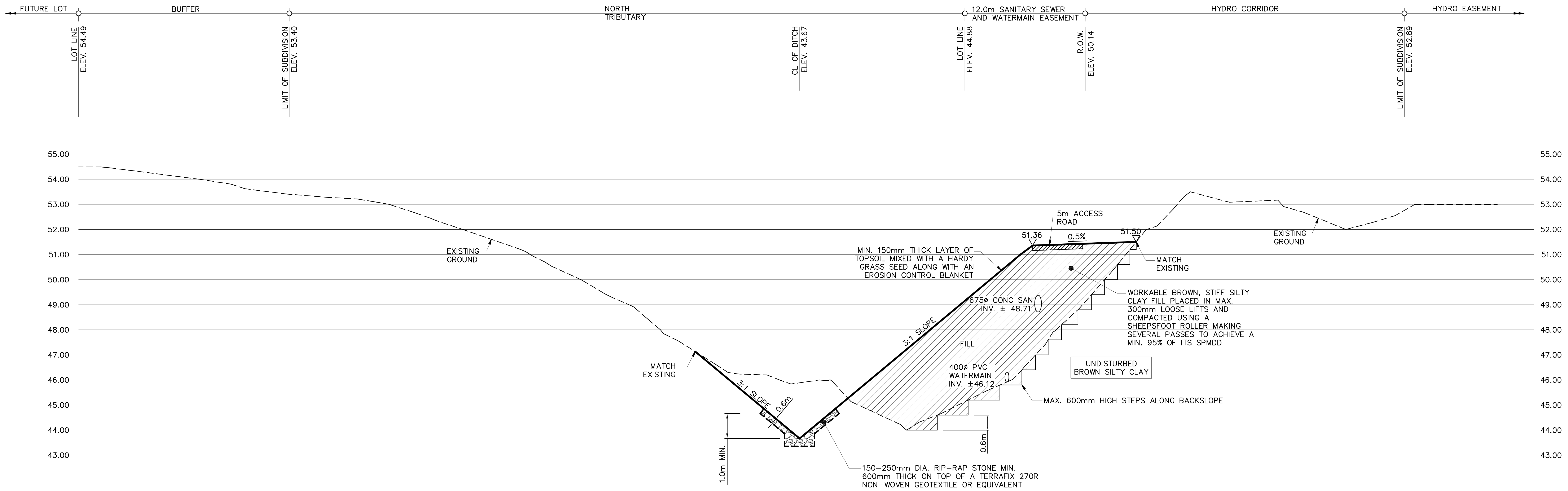
TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161611900–111 RECEIVED ON JULY 6, 2012 AND PROJECT No. 16162924–111 RECEIVED ON OCTOBER 24, 2013 AND NOVEMBER 29, 2013

LEGAL INFORMATION

CALCULATED M–PLAN PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161613098–132 RECEIVED ON JUNE 27, 2014.

PRE–SERVICING SUBMISSION FOR PHASE 1A ONLY 14–07–17



SECTION 9–9

SCALE HOR. 1:250
VER. 1:100

ELEVATION NOTE

ELEVATIONS HEREON ARE GEODETIC AND ARE DERIVED FROM THE CAN–NET VRS NETWORK.

No.	DATE	BY	DESCRIPTION	BY
4.	14–07–17	Z.L.	PRE–SERVICING SUBMISSION FOR PHASE 1A	
3.	14–05–27	Z.L.	3rd SUBMISSION	
2.	14–05–01	Z.L.	2nd SUBMISSION	
1.	14–02–07	Z.L.	1st SUBMISSION	

Ottawa CITY OF OTTAWA

PROJECT No. 11–513 B–1

Z. LI
14-07-17

CROSS SECTIONS

© DSEL

TAMARACK
(CARDINAL CREEK)
CORPORATION

CARDINAL CREEK VILLAGE PHASE 1A

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DRAWN BY: W.L./H.P.	CHECKED BY: K.M.	DRAWING NO.	SHEET NO.
DESIGNED BY: K.M.	CHECKED BY: Z.L.		189
SCALE: AS SHOWN	DATE: FEBRUARY 2014		

patersongroup **memorandum**
consulting engineers

to:	David Schaeffer Engineering Ltd - **Ms. Laura Maxwell** - lmaxwell@dsel.ca
re:	Geotechnical Considerations - Exterior Structures over Retaining Walls **Phase 1A - Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	July 18, 2014
file:	PG1796-MEMO.16
from:	Richard Groniger

Further to your request, Paterson Group (Paterson) has prepared the current memo report to detail recommendations from a geotechnical perspective for construction of exterior structures within lots where retaining wall structures are required at the aforementioned site.

The proposed grading of the walls has been provided by David Schaeffer Engineering Limited. The following grading plans were reviewed as part of our retaining wall design:

- ☐ Project No. 11-513 B-1: Sheet No. 26, 27, 28, 31, 33, 34, 39 and 40 - Grading Plan - Revision 4 dated July 17, 2014.

Based on our review, a retaining wall system is required along the side and/or rear lot lines of Lots 9 to 34, 37 to 46, 81, 82, 83, Block 96, 109, 110, 111 and 112. The retaining wall heights vary between 0.3 to 5 m.

Prior to the construction of any proposed exterior structure, such as in-ground or aboveground swimming pools, hot tubs, future additions or exterior decks, within lots with a retaining wall structure over 1 m in height, an engineer specializing in retaining wall design should review the existing retaining wall to confirm what is required for the construction of the proposed exterior structure. Based on the exterior structure proposed and the review findings, setback limits may be required for the proposed exterior structure.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Richard Groniger, C. Tech.

David J. Gilbert, P.Eng

Paterson Group Inc.

Head Office and Laboratory
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St. Lawrence Office
993 Princess Street - Suite 102
Kingston, Ontario K7L 1H3
Tel: (613) 542-7381
Fax: (613) 542-8399

patersongroup
consulting engineers

memorandum

to:	David Schaeffer Engineering Ltd - **Ms. Laura Maxwell** - lmaxwell@dsel.ca
re:	Geotechnical Review of Clay Seals **Phase 1A - Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	July 18, 2014
file:	PG1796-MEMO.17
from:	Richard Groniger

Further to your request, Paterson Group (Paterson) has prepared the current memo report upon review of the clay seals presented on the following drawings prepared by David, Schaeffer Engineering Limited:

❑ Project No. 11-513 B-1: Sheets No. 81, 82, 83, 84, 89, 93, 94, 95, 97, 114, 115, 116, 117 and 118 - Plan and Profile - Revision 4 dated July 17, 2014.

Based on our review, the location of the clay seals presented on the above noted drawings are acceptable from a geotechnical perspective.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

Richard Groniger, C. Tech.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng

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patersongroup
consulting engineers

memorandum

to:	City of Ottawa - **Mr. Jacek Taracha** - jacek.taracha@ottawa.ca
re:	Geotechnical Considerations - Construction Phasing Issue **Cardinal Creek Village Phase 1 - Old Montreal Road - Ottawa**
date:	August 6, 2014
file:	PG1796-MEMO.19
from:	Carlos P. Da Silva

Further to our meeting this morning, Paterson Group (Paterson) would like provide the following geotechnical comments for the aforementioned site to address the items outlined by Mr. Jacek Taracha with the City of Ottawa.

Construction Phasing Issue

It is understood that the proposed roadways will be completed in Phase 1 of the development and storm sewers will not be in place until a later phase. Therefore, the recommended pavement structure sub-drain stubs will not be connected to storm sewers until the later phases are completed. It is further understood that the proposed roadway section will be utilized as a construction access lane and no public access will be permitted until the recommended drainage system is connected to storm sewers.

In our opinion, the roadway pavement structure will not be adversely affected until the proper drainage is installed.

We trust this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

Carlos P. Da Silva, P.Eng.

LICENSED PROFESSIONAL ENGINEER
C. P. DA SILVA
PROVINCE OF ONTARIO

patersongroup
consulting engineers

memorandum

to:	David Schaeffer Engineering Limited - **Ms. Laura Maxwell** - lmaxwell@dsel.ca
re:	Geotechnical Slope Stability Review - Temporary Storm Water Management Facility **Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	August 13, 2014
file:	PG1796-MEMO.20
from:	Richard Groniger

As requested, Paterson Group (Paterson) has reviewed the placement of the temporary stormwater management facility (SWMF) located at the rear of Lots 1 to 8 along the proposed Rue De La Baie-des-Castors Street. It is our understanding that the SWMF has been constructed to manage the stormwater encountered during the construction of the municipal services prior to the construction of permanent SWMF Pond 1.

Geotechnical Review

Based on our site inspection on August 12, 2014 and conversation with representatives from Taggart Construction Limited, the temporary SWMF was placed outside the zone of influence of the proposed residential dwellings along the east side of the north tributary. The construction of Cell 1 located at the rear of Lot 5 and Lot 6 was excavated through a very stiff brown silty clay to a maximum depth of 1 m. The excavated material was used to provide a berm to a maximum height of 900 mm above original ground surface along the perimeter of the excavation and lined with plastic. A narrow swale was constructed to direct the storm water runoff from Cell 1 to Cell 2. Cell 2 was excavated to a maximum depth of 1 m and terminated on the bedrock surface at the rear of Lot 1 and Lot 2. It is our understanding that the narrow swale and Cell 2 will be lined with plastic to minimize the migration of stormwater within the overburden soils. Cell 2 outlets into a swale lined with a geotextile and rip-rap to direct the stormwater to the base of the north tributary.

Based on our findings, the slope stability is not negatively impacted by the existing temporary SWMF at the rear of Lot 1 to Lot 8 from a geotechnical perspective. The existing temporary SWMF is also in compliance with our 6 m geotechnical set back limits from the top of slope.

Recommendations

It is recommended that Paterson be notified if any alterations to the existing temporary SWMF are being considered.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
C. P. DA SILVA
PROVINCE OF ONTARIO

Richard Groniger, C. Tech.

Carlos P. Da Silva, P.Eng.

Photographs – August 12, 2014

Photograph No. 1 – Photograph of the temporary retention pond 1 (Cell 1) located at the rear of Lots 5 and 6.

Photograph No. 2 – Photograph of the temporary retention pond 2 (Cell 2) located at the rear of Lots 1 and 2.

patersongroup **memorandum**
consulting engineers

to:	David Schaeffer Engineering Limited - **Ms. Laura Maxwell** - lmaxwell@dsel.ca
re:	Geotechnical Design Summary Details **Cardinal Creek Village - Old Montreal Road - Ottawa**
date:	September 19, 2014
file:	PG1796-MEMO.24
from:	David Gilbert

Further to your request and authorization, Paterson Group (Paterson) prepared the current memorandum to provide the geotechnical design summary details for the proposed buildings at the Cardinal Creek Village residential development. The following memorandum should be read in conjunction with Paterson Report PG1796-4 Revision 1 dated September 19, 2014.

Relevant design information is presented in Table 1 - Summary of Design Details for the subject blocks and lots. The relevant design information includes the following:

- ❑ Legal lot/block number and civic address.
- ❑ Lot specific bearing resistance values at SLS and ULS as a function of founding elevation, grade raise, footing sizes and accounting for the effects of long term groundwater lowering.
- ❑ Existing grade elevation.
- ❑ Proposed finished grade elevation.
- ❑ Maximum allowable grade raise.
- ❑ Proposed USF elevation.
- ❑ Tree and aboveground swimming pool setback recommendations.

Grading Plan Review

Paterson reviewed the following grading plans prepared by David Schaeffer Engineering Ltd. regarding the aforementioned residential development:

- ❑ Project No. 11-513 B-1: Sheets No. 25, 26, 27, 28, 31, 32, 33, 34, 39, 40 and 56A - Grading Plan - Revision 6 dated September 16, 2014.

Based on our review, the grading for the majority of the lots and blocks is acceptable from a geotechnical perspective. Permissible grade raise exceedances were noted at five building lots based on our previous permissible grade raise recommendations. However, based on review of the available soils information at the specific lots, the proposed grades are acceptable from a geotechnical perspective and no lightweight fill is required for the construction of the proposed buildings.

The bearing resistance values provided for footings placed over an undisturbed, glacial till, silty clay or engineered fill bearing surface take into consideration a 0.5 m long term groundwater lowering and are provided in Table 1 attached. The footings designed with the provided bearing resistance values at SLS should have a total and differential settlement of 25 and 20 mm, respectively.

The bearing surface should be verified at the time of construction on a lot by lot basis to confirm the bearing resistance values provided are applicable.

Development over Ravine Areas and Drainage Ditches

The existing ravine areas and drainage ditches will be backfilled in areas as part of the proposed development. The ravine areas and drainage ditches, regardless of whether a roadway or building is constructed above, are recommended to be backfilled by the following methodology:

- Remove all topsoil and deleterious fill.
- Provide benching in existing sideslopes at a maximum 2H:1V profile with a maximum 500 mm high step.
- Backfill in maximum 300 mm thick loose lifts and compact to 98% of the SPMDD.
- The backfill material should consist of engineered fill below the building footprints and roadways.
- Alternatively, a workable, brown silty clay can be used below the proposed roadways and landscaped areas. It is recommended that the silty clay be placed under dry conditions In maximum 300 mm loose lifts and compacted using a sheepsfoot roller making several passes.
- The backfilling procedure should be reviewed and approved by Paterson personnel at the time of placement.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng

Table 1 - Summary of Design Details - Cardinal Creek Village - Phase 1A and 1B

Legal Lot/ Block Number	Underside of Footing Elevation (m)	Bearing Resistance Value at SLS (kPa)	Factored Bearing Resistance Value at ULS (kPa)	Original GS Front (m)	Proposed GS Front (m)	Original GS Rear (m)	Proposed GS Rear (m)	Permissible Grade Raise (m)	Above Permissible Grade Raise Front (m)	Above Permissible Grade Raise Rear (m)	Minimum Thickness LWF in Garage and Front Porch (m)	LWF Surrounding Building	Tree Setback Requirement (m)	Swimming Pool Setback Requirement (m)
Lot 1	59.95	500	750	62.18	62.15	60.50	60.77	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 2	59.18	500	750	60.85	61.73	59.00	60.00	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 3	58.49	150	225	59.50	60.78	58.00	59.31	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 4	57.86	150	225	58.25	60.45	57.00	58.62	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 5	57.31	150	225	56.90	59.63	56.35	57.93	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 6	56.70	150	225	56.23	59.29	56.00	57.17	3.00	**0.06**	n/a	n/a	n/a	n/a	n/a
Lot 7	56.09	150	225	55.78	58.41	55.50	56.41	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 8	55.51	150	225	55.50	58.13	55.25	55.75	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 9	55.39	150	225	55.20	58.08	54.80	55.62	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 10	55.91	150	225	55.25	58.34	54.80	56.14	3.00	**0.09**	n/a	n/a	n/a	n/a	n/a
Lot 11	56.38	150	225	55.50	59.03	55.00	56.61	3.00	**0.53**	n/a	n/a	n/a	n/a	n/a
Lot 12	56.84	150	225	56.40	59.32	55.00	57.07	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 13	57.24	150	225	57.00	59.90	55.30	57.47	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 14	57.63	150	225	57.40	60.17	55.40	57.86	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 15	58.10	150	225	57.50	60.76	55.50	58.33	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 16	58.62	500	750	57.80	61.05	55.95	58.85	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 17	59.14	150	225	58.90	61.80	56.50	59.37	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 18	59.61	150	225	59.10	62.09	56.75	59.84	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 19	60.08	500	750	60.00	62.73	57.00	60.31	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 20	60.56	500	750	60.40	63.02	56.65	60.79	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 21	60.97	500	750	61.00	63.63	57.00	61.19	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 22	61.37	500	750	61.55	63.91	58.30	61.59	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 23	61.76	500	750	62.50	64.43	60.50	61.99	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 24	61.64	500	750	65.50	63.52	67.50	63.84	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 25	61.17	500	750	65.00	63.24	66.60	63.40	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 26	60.72	500	750	63.75	62.69	65.50	62.95	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 27	60.20	500	750	62.40	62.28	64.30	62.41	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 28	59.62	150	225	61.00	61.48	62.50	61.82	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 29	59.16	150	225	59.00	61.19	61.10	61.41	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 30	58.63	150	225	58.80	60.46	60.25	60.86	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 31	58.09	150	225	58.75	60.17	59.75	60.31	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 32	57.65	150	225	58.75	59.59	59.50	59.85	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 33	57.32	150	225	58.15	59.30	59.00	59.63	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 34	56.90	150	225	56.50	58.53	58.00	59.26	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 35	56.48	150	225	55.60	58.22	56.60	58.84	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 36	57.99	150	225	59.50	60.37	58.00	59.36	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 37	58.47	150	225	61.00	60.58	59.50	59.74	3.00	n/a	n/a	n/a	n/a	n/a	n/a
Lot 38	59.02	500	750	61.80	61.31	60.50	60.18	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 39	59.68	500	750	62.00	61.70	61.20	60.63	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 40	60.24	500	750	63.05	62.54	61.60	61.14	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 41	60.81	500	750	63.50	62.93	62.20	61.67	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 42	61.47	500	750	64.30	63.75	63.40	62.23	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 43	62.14	500	750	65.20	64.17	64.90	62.68	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 44	62.70	500	750	66.50	64.99	66.50	63.17	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 45	63.34	500	750	67.55	65.38	67.00	63.72	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 1 - Summary of Design Details - Cardinal Creek Village - Phase 1A and 1B

Legal Lot/ Block Number	Underside of Footing Elevation (m)	Bearing Resistance Value at SLS (kPa)	Factored Bearing Resistance Value at ULS (kPa)	Original GS Front (m)	Proposed GS Front (m)	Original GS Rear (m)	Proposed GS Rear (m)	Permissible Grade Raise (m)	Above Permissible Grade Raise Front (m)	Above Permissible Grade Raise Rear (m)	Minimum Thickness LWF in Garage and Front Porch (m)	LWF Surrounding Building	Tree Setback Requirement (m)	Swimming Pool Setback Requirement (m)
Lot 46	64.01	500	750	68.30	66.30	68.20	64.19	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 47	63.89	500	750	67.20	65.82	66.50	65.82	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 48	63.04	500	750	67.25	65.04	66.45	65.04	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 49	62.38	500	750	66.50	64.63	65.70	64.63	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 50	61.64	500	750	65.00	63.68	65.30	63.68	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 51	61.00	500	750	64.50	63.28	64.80	63.28	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 52	60.37	500	750	64.25	62.33	64.80	62.33	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 53	59.77	500	750	64.20	61.71	64.60	61.91	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 54	59.25	150	225	63.45	60.90	64.30	61.61	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 55	58.65	150	225	62.00	60.55	63.25	61.11	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 56	65.05	150	225	66.30	67.16	65.60	66.22	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 57	64.74	150	225	65.50	66.91	64.75	65.61	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 58	64.48	150	225	64.50	66.74	64.10	65.35	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 59	64.21	150	225	63.65	66.46	63.00	65.77	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lot 60	64.08	150	225	63.60	66.39	63.00	65.64	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 61	63.88	150	225	63.50	66.13	63.10	65.44	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 62	63.61	150	225	63.40	65.86	63.00	65.17	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 63	63.30	150	225	63.35	65.43	62.95	64.86	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 64	62.97	150	225	63.30	65.20	62.75	64.53	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 65	62.58	150	225	63.00	64.64	62.50	64.14	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 66	62.23	150	225	62.90	64.51	62.30	63.79	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 67	62.03	150	225	62.70	64.32	62.30	63.73	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 68	61.83	150	225	62.75	64.12	62.30	63.39	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 69	60.58	150	225	62.30	62.48	62.00	62.94	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 70	61.19	150	225	62.20	62.28	62.00	62.47	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 71	59.79	150	225	61.46	61.84	61.50	61.99	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 72	59.49	150	225	61.21	61.72	61.80	61.72	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 73	59.22	150	225	61.15	61.40	61.80	61.35	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 74	58.91	150	225	60.61	61.24	94.60	60.98	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 75	59.26	150	225	62.00	61.62	61.90	61.27	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 76	59.62	150	225	61.80	61.84	62.00	61.65	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 77	59.17	150	225	59.50	61.20	58.50	61.37	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 78	58.93	150	225	59.00	61.05	57.75	61.24	3.00	n/a	**0.49**	n/a	n/a	3.00	3.00
Lot 79	58.59	150	225	58.50	60.90	57.10	59.40	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 80	58.45	150	225	58.30	60.80	56.90	59.04	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 81	58.29	150	225	58.50	60.72	56.50	58.18	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 82	58.32	150	225	59.50	60.70	58.50	58.09	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 83	58.59	150	225	60.50	60.86	58.00	58.34	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 84	58.99	150	225	61.10	61.32	59.00	58.74	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 85	59.33	150	225	61.30	61.56	60.00	59.10	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 86	59.84	150	225	61.50	62.13	61.00	59.57	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 87	60.38	150	225	60.59	62.51	61.00	59.86	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 88	60.85	150	225	59.50	63.21	61.75	60.59	3.00	**0.71**	n/a	n/a	n/a	3.00	3.00
Lot 89	61.07	150	225	61.40	63.43	61.40	61.28	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 90	61.07	150	225	62.20	63.75	61.80	61.81	3.00	n/a	n/a	n/a	n/a	3.00	3.00

Table 1 - Summary of Design Details - Cardinal Creek Village - Phase 1A and 1B

Legal Lot/ Block Number	Underside of Footing Elevation (m)	Bearing Resistance Value at SLS (kPa)	Factored Bearing Resistance Value at ULS (kPa)	Original GS Front (m)	Proposed GS Front (m)	Original GS Rear (m)	Proposed GS Rear (m)	Permissible Grade Raise (m)	Above Permissible Grade Raise Front (m)	Above Permissible Grade Raise Rear (m)	Minimum Thickness LWF in Garage and Front Porch (m)	LWF Surrounding Building	Tree Setback Requirement (m)	Swimming Pool Setback Requirement (m)
Lot 91	60.99	150	225	62.30	63.42	61.90	61.81	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 122	64.68	150	225	65.65	66.38	65.90	67.12	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 123	64.79	150	225	65.85	66.50	66.10	67.13	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 124	64.80	150	225	66.11	66.79	66.65	67.15	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 125	65.05	150	225	66.50	66.94	67.00	67.41	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 126	65.27	150	225	67.00	67.28	67.00	67.62	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 127	65.55	150	225	67.31	67.45	67.70	67.90	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 128	65.82	150	225	67.85	67.83	67.75	68.14	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 129	66.03	150	225	67.75	67.99	67.75	68.14	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 130	66.26	150	225	67.95	68.36	68.00	68.50	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 131	66.39	150	225	67.90	68.48	68.00	68.67	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 132	66.48	150	225	67.90	68.53	68.00	68.78	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 133	66.63	150	225	67.85	68.61	68.25	68.99	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Lot 134	67.37	150	225	67.80	68.66	68.30	69.61	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 92-1	61.24	150	225	62.88	63.40	62.50	63.30	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 92-2	61.24	150	225	62.72	63.40	62.50	63.30	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 92-3	61.24	150	225	62.59	63.40	62.20	63.30	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 93-1	62.01	150	225	63.00	63.76	63.00	64.27	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 93-2	62.01	150	225	62.80	63.76	63.00	64.27	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 94-1	62.18	150	225	63.54	64.42	64.60	64.49	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 94-2	62.18	150	225	63.50	64.42	64.45	64.49	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 94-3	62.18	150	225	63.50	64.17	64.55	64.49	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 95-1	62.79	150	225	64.00	64.95	64.50	64.89	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 95-2	62.79	150	225	64.82	64.83	64.30	64.89	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 95-3	62.79	150	225	63.72	64.83	64.30	64.85	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 96-1	63.59	150	225	64.95	65.70	65.30	65.75	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 96-2	63.59	150	225	64.60	65.56	65.00	65.54	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 96-3	63.59	150	225	64.50	65.56	64.90	65.46	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 96-4	63.59	150	225	64.20	65.40	64.50	65.37	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 97-1	63.51	150	225	63.70	65.45	63.50	65.22	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 97-2	63.51	150	225	63.80	65.70	63.60	65.40	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 97-3	63.51	150	225	64.00	65.87	63.70	65.62	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 97-4	63.51	150	225	64.20	65.87	63.80	65.62	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 98-1	62.60	150	225	63.10	64.43	62.70	64.31	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 98-2	62.60	150	225	63.20	64.68	62.80	64.31	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 98-3	62.60	150	225	63.30	64.80	63.10	64.31	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 98-4	62.60	150	225	63.40	64.85	63.20	64.80	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 98-5	62.60	150	225	63.60	64.85	63.30	64.80	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 99-1	61.57	500	750	62.00	63.59	62.50	63.68	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 99-2	61.57	500	750	62.25	63.77	62.60	63.68	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 99-3	61.57	500	750	62.55	63.77	62.65	63.78	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 99-4	61.57	500	750	62.70	63.75	62.60	63.78	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 100-1	59.97	150	225	62.50	62.13	62.60	62.23	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 100-2	59.57	150	225	62.50	62.13	62.60	62.23	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 100-3	59.57	150	225	62.25	61.73	62.50	61.88	3.00	n/a	n/a	n/a	n/a	3.00	3.00

Table 1 - Summary of Design Details - Cardinal Creek Village - Phase 1A and 1B

Legal Lot/ Block Number	Underside of Footing Elevation (m)	Bearing Resistance Value at SLS (kPa)	Factored Bearing Resistance Value at ULS (kPa)	Original GS Front (m)	Proposed GS Front (m)	Original GS Rear (m)	Proposed GS Rear (m)	Permissible Grade Raise (m)	Above Permissible Grade Raise Front (m)	Above Permissible Grade Raise Rear (m)	Minimum Thickness LWF in Garage and Front Porch (m)	LWF Surrounding Building	Tree Setback Requirement (m)	Swimming Pool Setback Requirement (m)
Block 100-4	59.57	150	225	61.95	61.73	62.00	61.88	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 101-1	60.92	150	225	62.20	63.08	62.90	63.18	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 101-2	60.52	150	225	62.20	63.08	62.70	63.18	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 101-3	60.52	150	225	62.20	62.68	62.70	63.01	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 101-4	60.52	150	225	62.20	62.68	62.70	62.78	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 102-1	61.94	150	225	63.40	64.10	63.70	64.20	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 102-2	61.54	150	225	63.30	64.10	63.40	64.20	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 102-3	61.54	150	225	63.10	64.10	63.30	64.00	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 102-4	61.54	150	225	62.90	63.70	63.30	63.80	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 103-1	60.19	150	225	62.30	62.45	62.30	62.17	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 103-2	60.19	150	225	62.30	62.45	62.30	62.17	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 104-1	60.85	150	225	62.40	60.85	62.30	62.69	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 104-2	60.85	150	225	62.40	60.85	62.30	62.69	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 105-1	61.42	150	225	62.40	61.42	62.40	63.32	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 105-2	61.42	150	225	62.40	61.42	62.50	63.32	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 106-1	62.10	150	225	62.70	62.10	62.70	63.36	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 106-2	62.10	150	225	62.70	62.10	62.80	63.36	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 107-1	61.15	150	225	62.80	62.97	62.80	62.98	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 107-2	61.15	150	225	62.50	62.97	62.60	62.98	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 108-1	61.65	150	225	62.50	63.78	62.60	63.20	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 108-2	61.65	150	225	62.60	63.86	62.60	63.20	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 108-3	61.65	150	225	62.70	63.86	62.60	63.20	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 108-4	61.65	150	225	62.60	63.86	62.60	63.20	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 109-1	61.75	150	225	64.30	63.90	64.40	64.06	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 109-2	61.75	150	225	64.00	63.90	64.30	64.06	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 109-3	61.75	150	225	63.80	63.76	64.10	64.06	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 109-4	61.75	150	225	63.60	63.75	63.70	64.06	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 110-1	62.41	150	225	64.90	64.57	65.20	64.67	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 110-2	62.41	150	225	94.60	64.57	64.90	64.67	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 111-1	63.21	150	225	65.70	65.37	65.90	65.47	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 111-2	63.21	150	225	65.30	65.37	65.70	65.47	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 112-1	64.20	150	225	67.00	66.50	67.40	66.31	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 112-2	64.20	150	225	66.50	66.44	67.00	66.31	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 112-3	64.20	150	225	66.30	66.12	66.90	66.31	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 112-4	64.20	150	225	66.00	65.87	66.50	66.31	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 135-1	66.71	150	225	67.80	68.98	67.50	67.30	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 135-2	66.25	150	225	67.75	68.98	67.45	67.30	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 135-3	66.25	150	225	67.75	68.81	67.40	67.27	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 135-4	66.25	150	225	67.70	68.72	67.40	67.33	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 136-1	67.26	150	225	68.00	69.54	67.75	67.54	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 136-2	66.80	150	225	67.90	69.54	67.75	67.54	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 136-3	66.80	150	225	67.90	69.37	67.75	67.43	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 136-4	66.80	150	225	67.80	69.20	67.60	67.25	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 137-1	67.81	150	225	68.44	70.09	68.20	68.15	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 137-2	67.36	150	225	68.44	70.09	68.00	68.15	3.00	n/a	n/a	n/a	n/a	3.00	3.00

Table 1 - Summary of Design Details - Cardinal Creek Village - Phase 1A and 1B

Legal Lot/ Block Number	Underside of Footing Elevation (m)	Bearing Resistance Value at SLS (kPa)	Factored Bearing Resistance Value at ULS (kPa)	Original GS Front (m)	Proposed GS Front (m)	Original GS Rear (m)	Proposed GS Rear (m)	Permissible Grade Raise (m)	Above Permissible Grade Raise Front (m)	Above Permissible Grade Raise Rear (m)	Minimum Thickness LWF in Garage and Front Porch (m)	LWF Surrounding Building	Tree Setback Requirement (m)	Swimming Pool Setback Requirement (m)
Block 137-3	67.36	150	225	68.37	69.92	67.90	67.77	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 137-4	67.36	150	225	68.28	69.76	67.85	67.86	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 138-1	68.11	150	225	68.40	70.36	68.20	68.15	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 138-2	68.11	150	225	68.40	70.36	68.50	68.15	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 139-1	68.32	150	225	68.50	70.74	68.30	68.15	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 139-2	68.32	150	225	68.40	70.74	68.30	68.15	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 139-3	68.32	150	225	68.40	70.66	68.30	68.15	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 140-1	68.52	150	225	68.75	70.84	68.50	68.80	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 140-2	68.52	150	225	68.75	70.84	68.50	68.80	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 141-1	68.58	150	225	69.74	71.05	69.70	69.94	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 141-2	69.02	150	225	69.50	70.99	69.50	69.94	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 141-3	69.02	150	225	69.20	70.99	69.20	69.85	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 142-1	69.40	150	225	70.60	71.75	71.00	71.55	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 142-2	69.20	150	225	70.30	71.29	70.80	71.55	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 142-3	69.20	150	225	70.00	71.29	70.60	71.55	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 142-4	69.20	150	225	69.85	71.12	70.60	71.45	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 143-1	70.19	150	225	70.78	72.63	71.10	71.55	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 143-2	69.68	150	225	70.75	72.29	71.10	71.55	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 143-3	69.68	150	225	70.70	72.29	71.10	71.55	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 143-4	69.68	150	225	70.50	71.96	71.10	71.55	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 144-1	70.68	150	225	70.85	72.91	71.00	71.84	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 144-2	70.68	150	225	70.85	72.91	70.90	71.81	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 145-1	70.30	150	225	70.40	72.69	69.62	70.26	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 145-2	70.30	150	225	70.49	72.94	69.90	70.35	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 145-3	70.30	150	225	70.50	73.18	69.85	70.70	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 145-4	70.95	150	225	70.50	73.18	69.90	70.70	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 146-1	68.23	150	225	68.77	70.08	69.50	70.59	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 146-2	68.23	150	225	68.77	70.25	69.60	70.91	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 146-3	68.23	150	225	68.90	70.25	69.60	71.22	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 146-4	68.86	150	225	69.00	70.41	69.60	71.22	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 147-1	68.05	150	225	68.90	69.81	68.80	70.16	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 147-2	68.05	150	225	69.00	69.81	69.50	70.16	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 148-1	67.17	150	225	68.53	69.22	68.90	69.53	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 148-2	67.17	150	225	68.50	69.39	69.00	69.60	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 148-3	67.17	150	225	68.50	69.39	69.10	69.77	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 148-4	67.81	150	225	68.50	69.54	69.10	69.77	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 149-1	67.25	150	225	68.50	68.73	68.60	69.61	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 149-2	67.17	150	225	68.50	68.82	68.70	69.53	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 149-3	67.17	150	225	68.50	68.82	68.80	69.53	3.00	n/a	n/a	n/a	n/a	3.00	3.00
Block 149-4	67.17		750	68.50	68.99	68.85	69.53	3.00	n/a	n/a	n/a	n/a	3.00	3.00

Notes: Grading information based on the following drawings prepared by DSEL : Project No. 11-513 B-1: Grading Plans - Cardinal Creek Village Phase 1, Sheet No. 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 39, 40, and 56A Revision 6 dated September 16, 2014

APPENDIX 3

FIGURE 1 - KEY PLAN

FIGURES 1A to 17B - SLOPE STABILITY SECTIONS

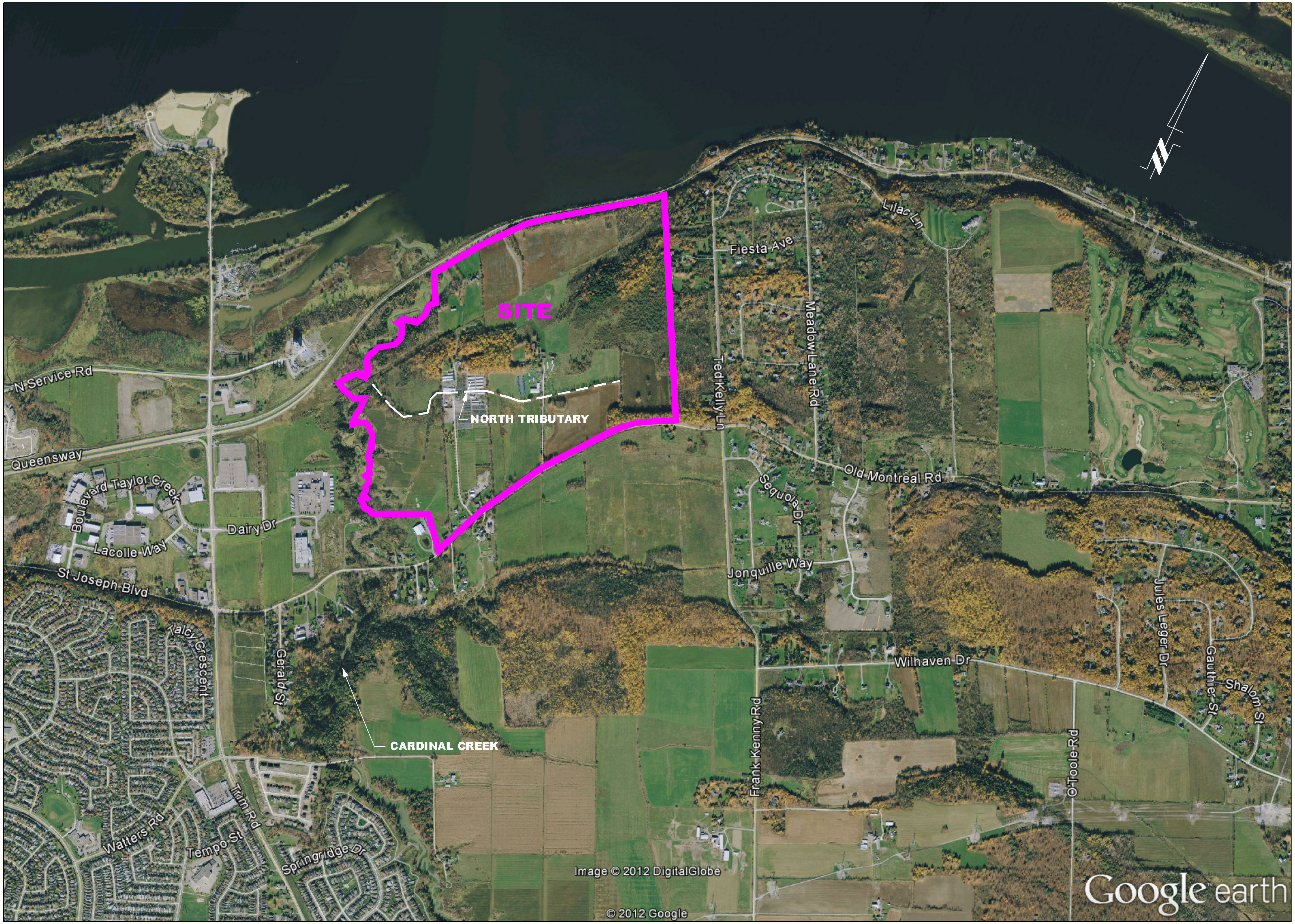
SITE PHOTOGRAPHS OF SLOPE CONDITIONS

DRAWING PG1796-6 - TEST HOLE LOCATION PLAN

DRAWING PG1796-7 - PERMISSIBLE GRADE RAISE AREAS - BUILDINGS

DRAWINGS PG1796-8a and 8b - LIMIT OF HAZARD LANDS

DRAWING PG1796-17 - RECOMMENDED TREE SETBACKS FOR BUILDINGS



Client:

TAMARACK HOMES

Consultant:

paterson group
consulting engineers

Project:

CARDINAL CREEK VILLAGE

OTTAWA, ONTARIO

Drawing:

KEY PLAN

Scale: N.T.S.

Seal:

Date: 03/2014

Drawn by: BA

Checked by: DG

File: PG1796

Drawing No.:

PG1796-FIG.1

p:\autocad drawings\geotechnical\pg17xx\pg1796 - cardinal creek village\pg1796 - january 2014\pg1796-fig1a.dwg

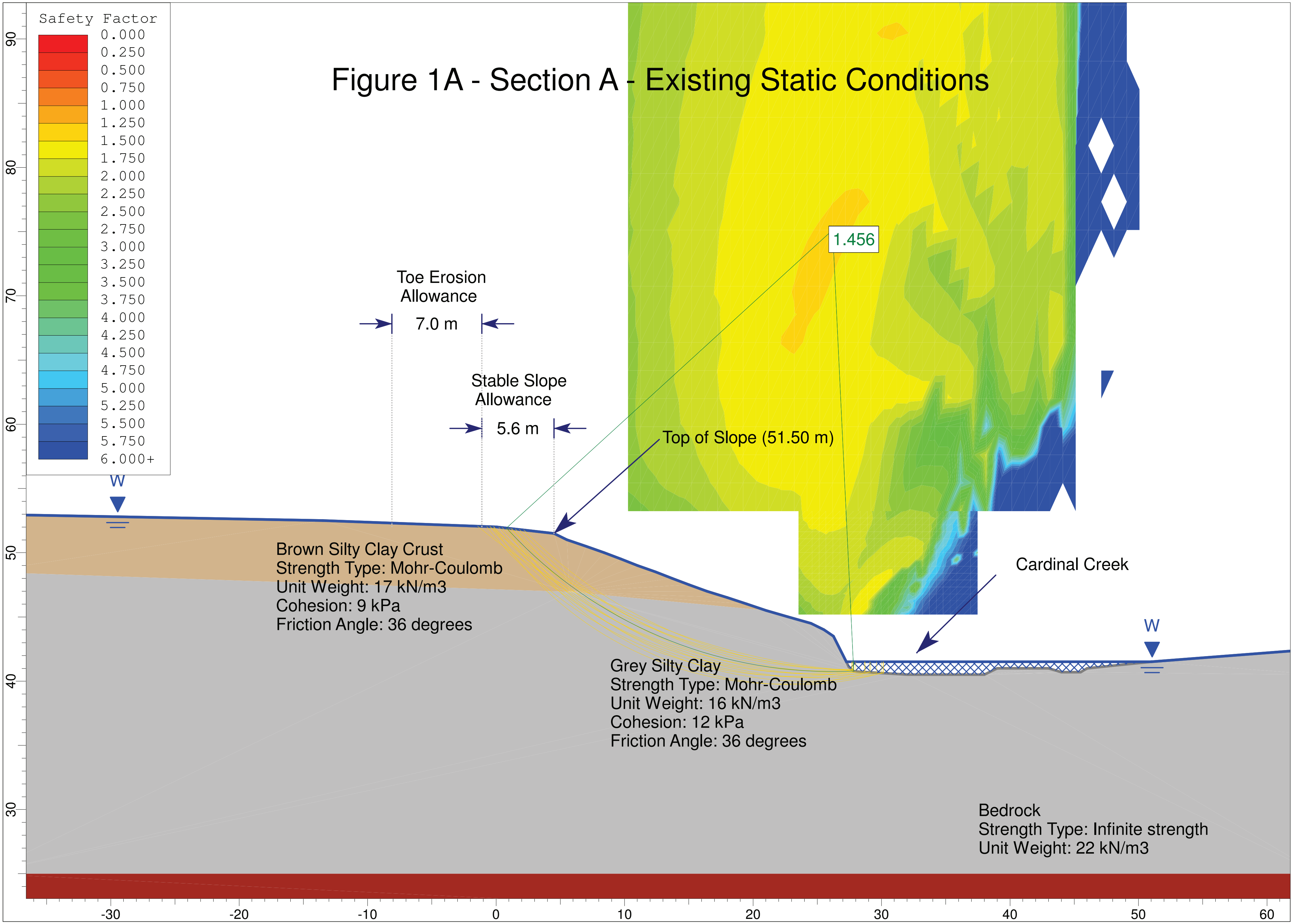


Figure 1A - Section A - Existing Static Conditions

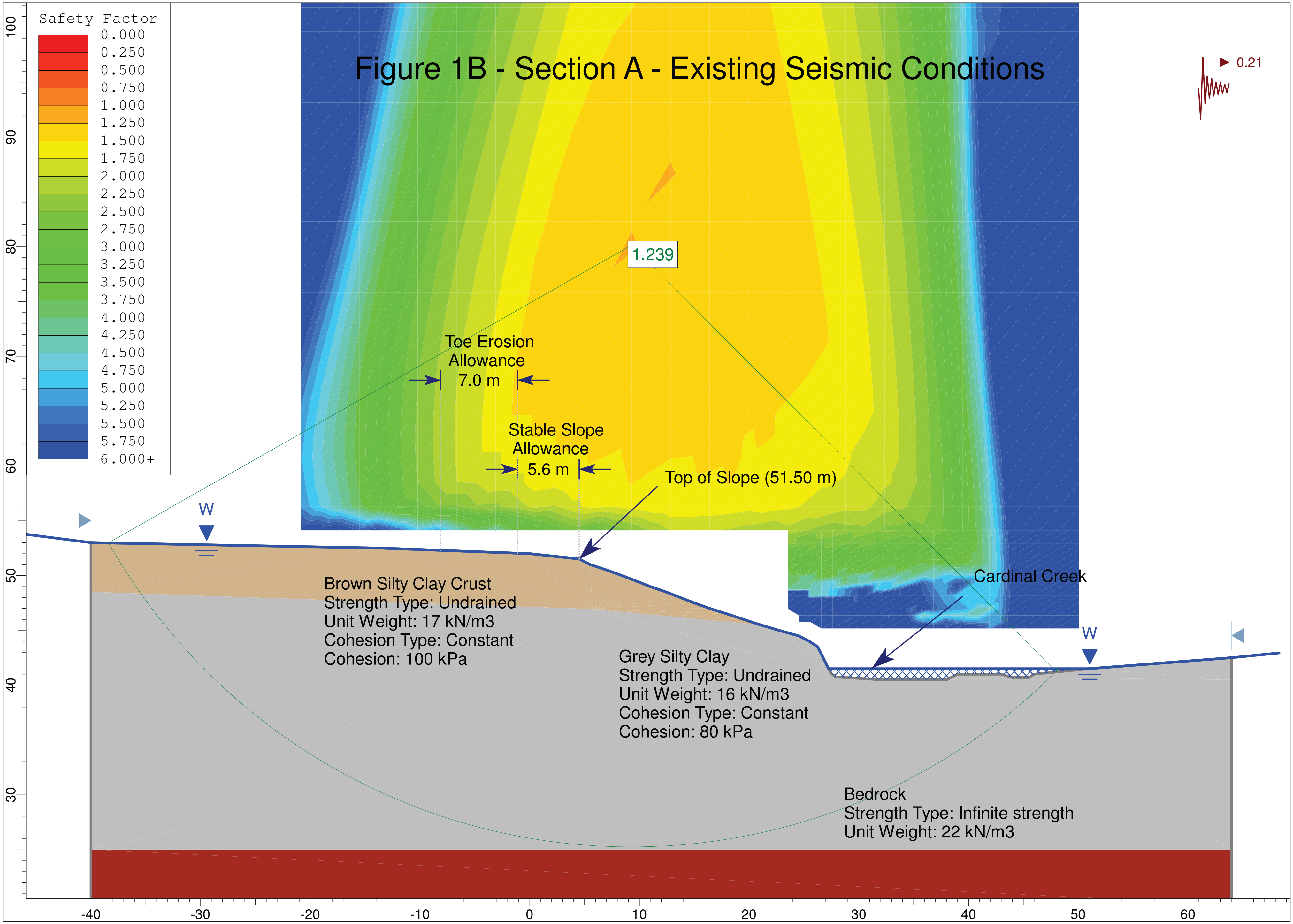


Figure 1B - Section A - Existing Seismic Conditions

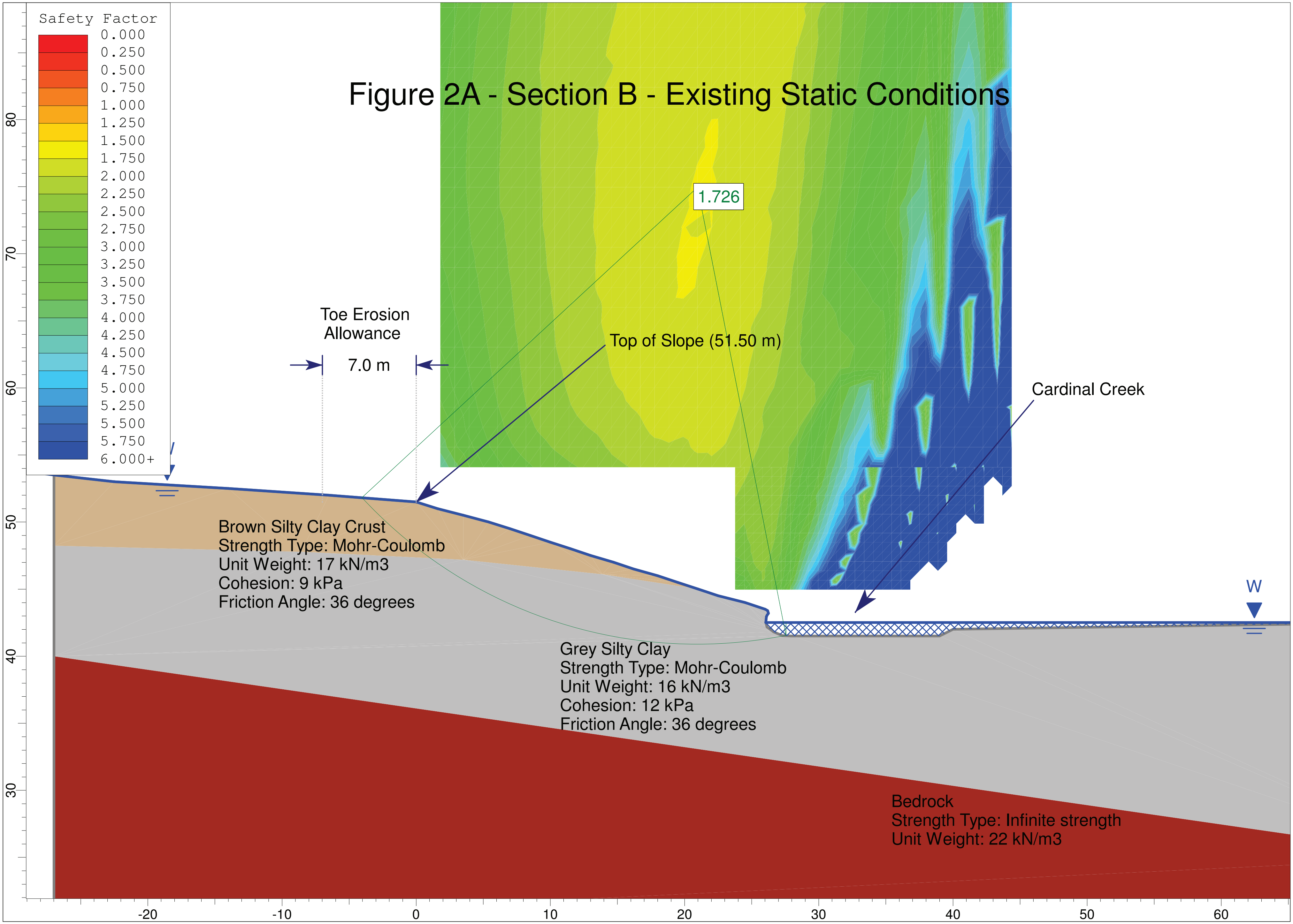


Figure 2A - Section B - Existing Static Conditions

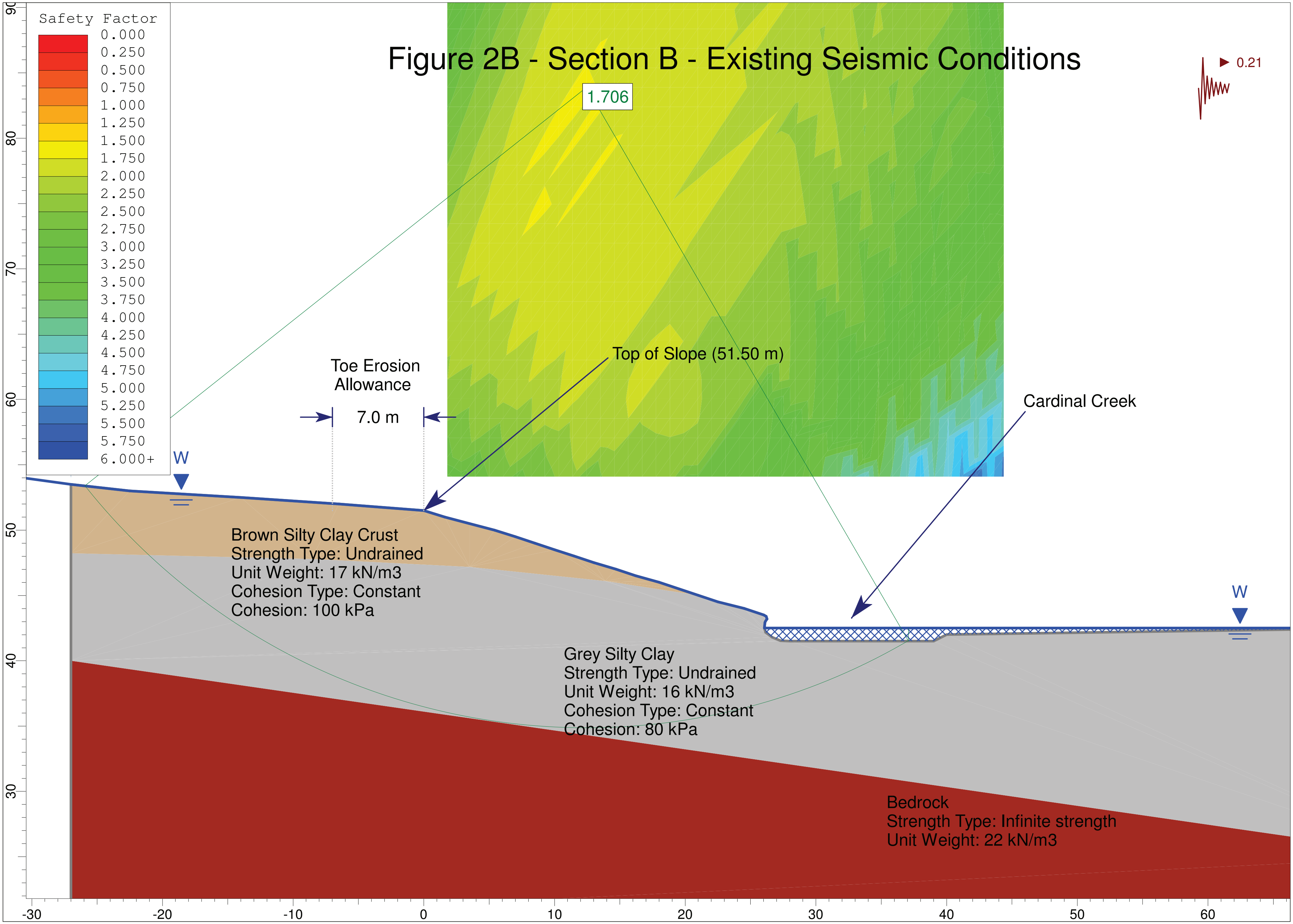


Figure 2B - Section B - Existing Seismic Conditions

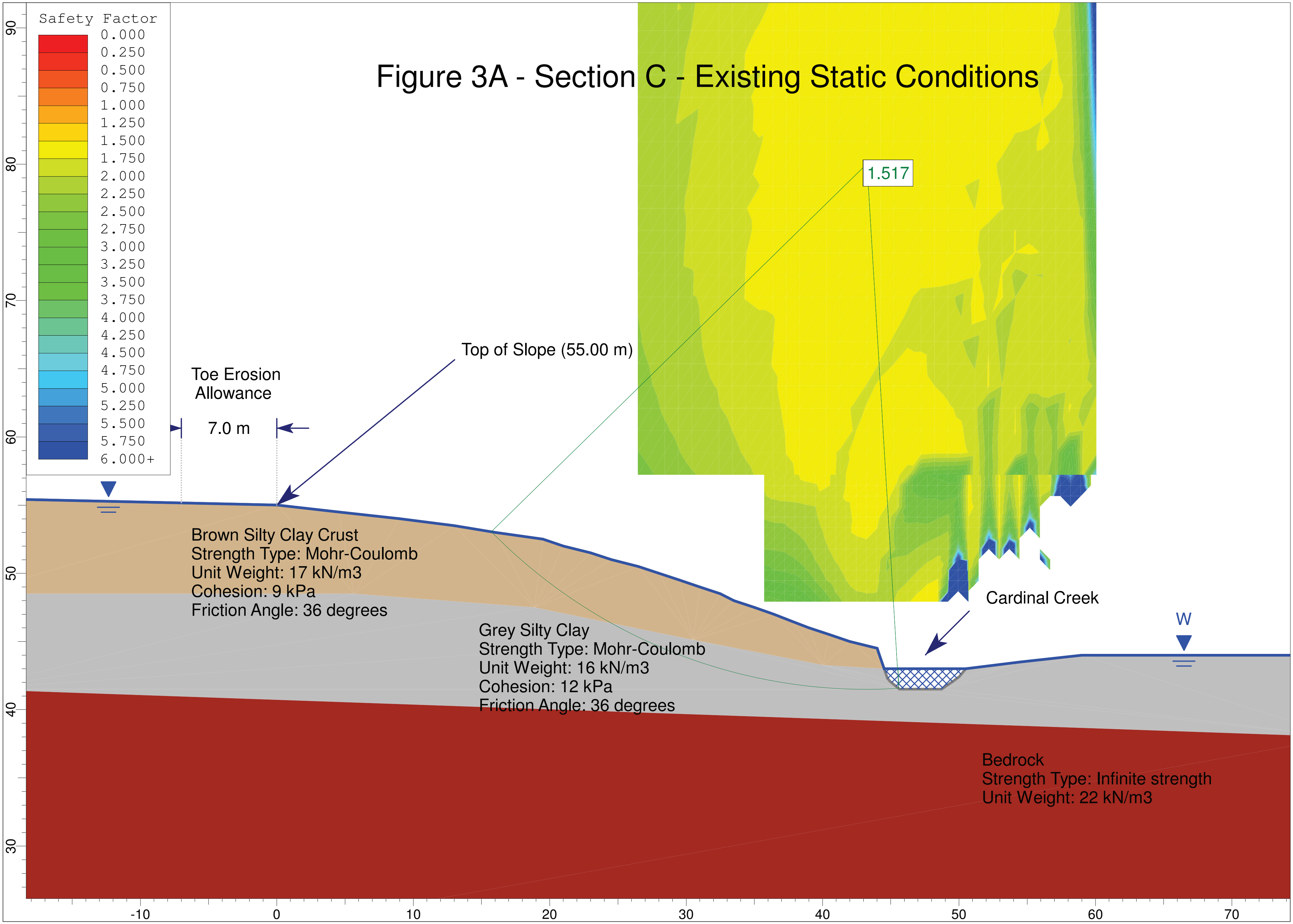


Figure 3A - Section C - Existing Static Conditions

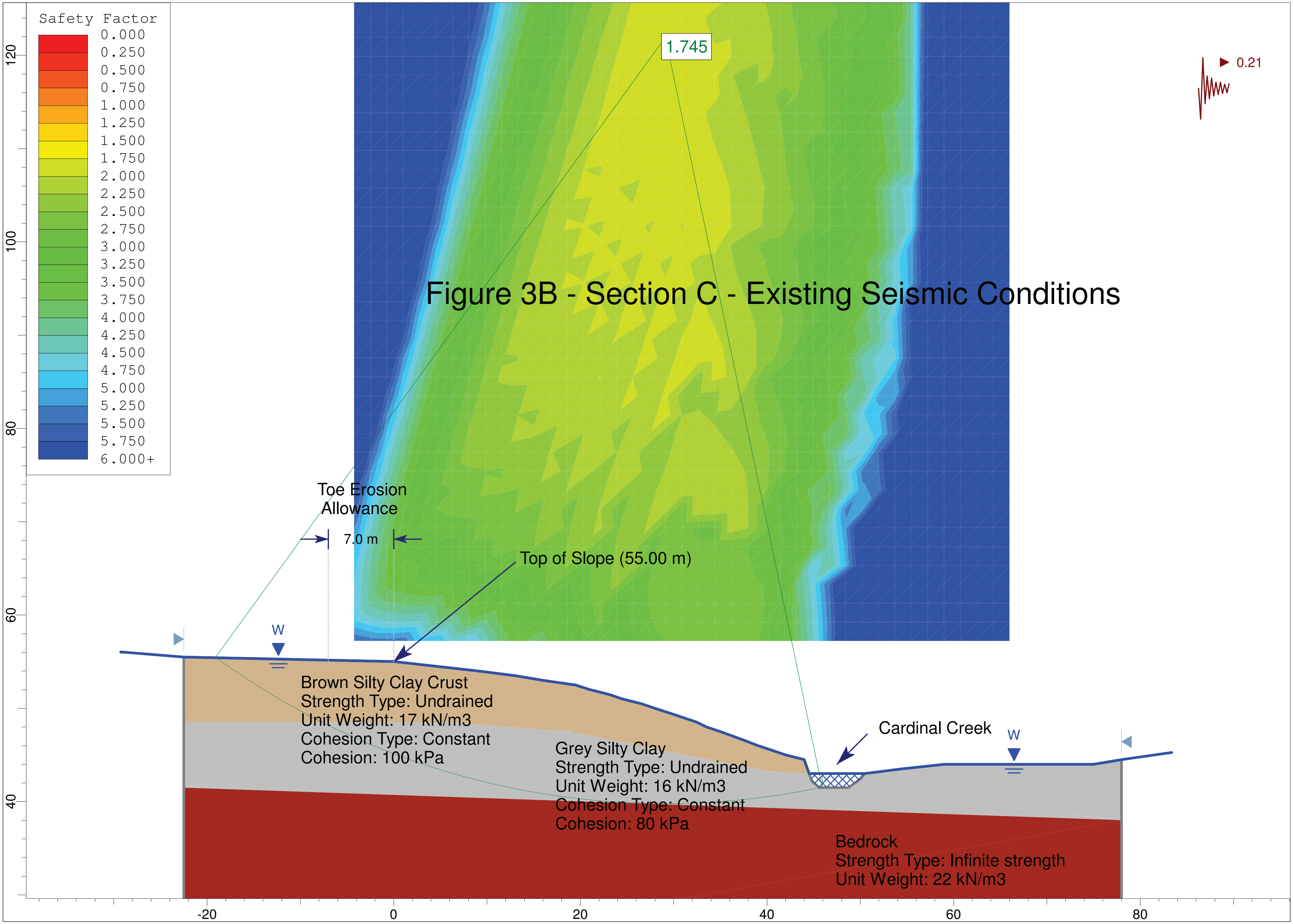


Figure 3B - Section C - Existing Seismic Conditions

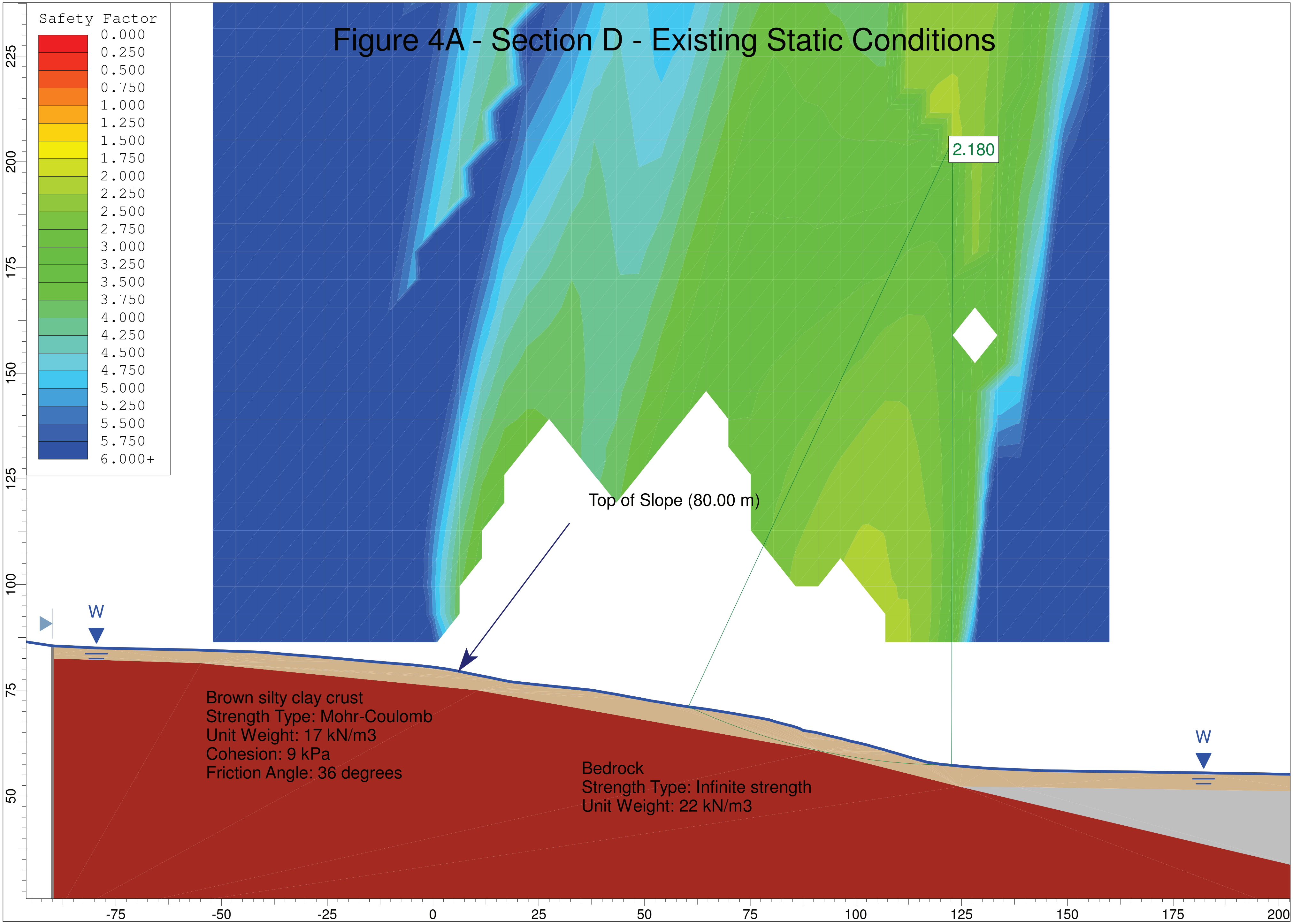


Figure 4A - Section D - Existing Static Conditions

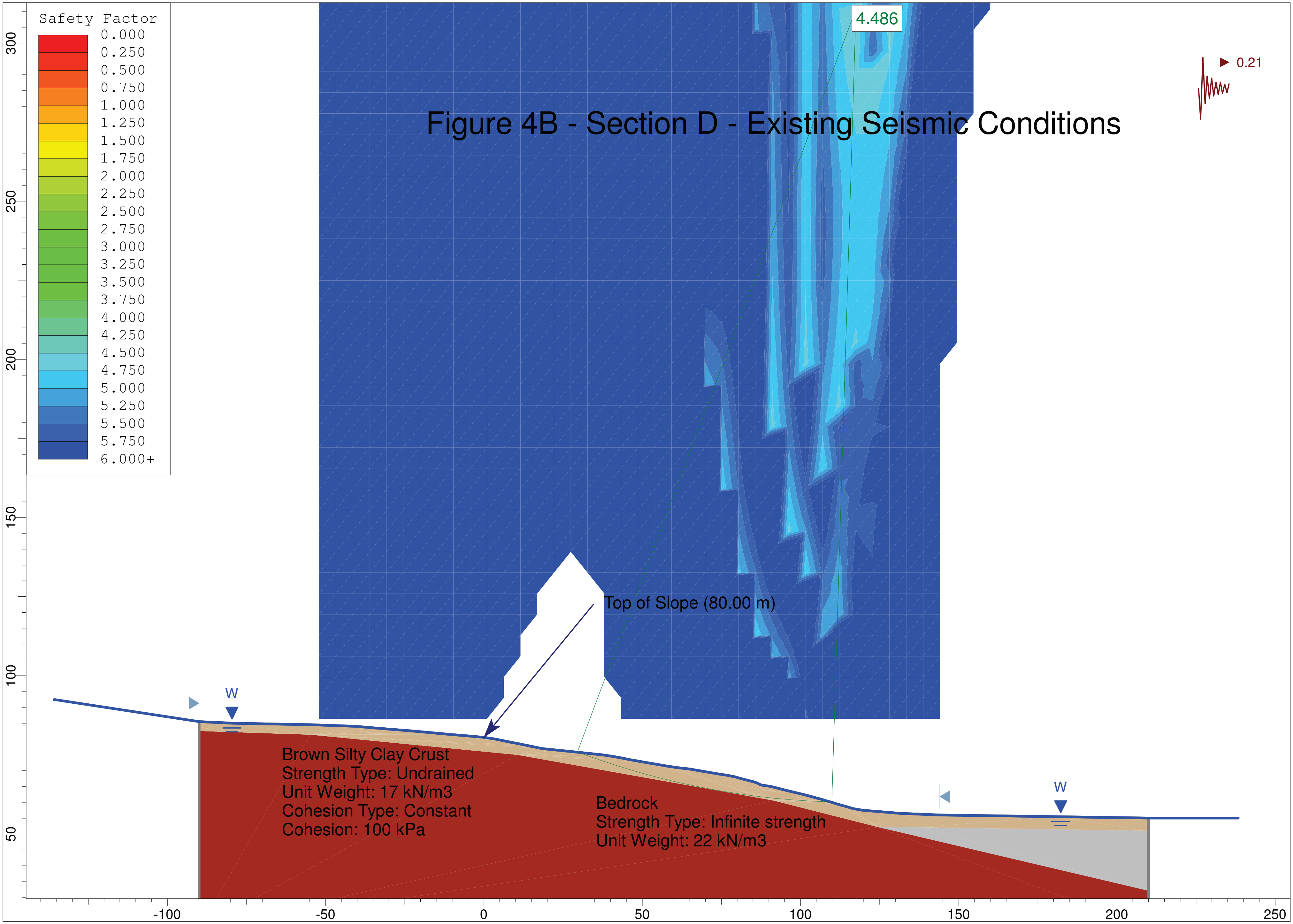


Figure 4B - Section D - Existing Seismic Conditions

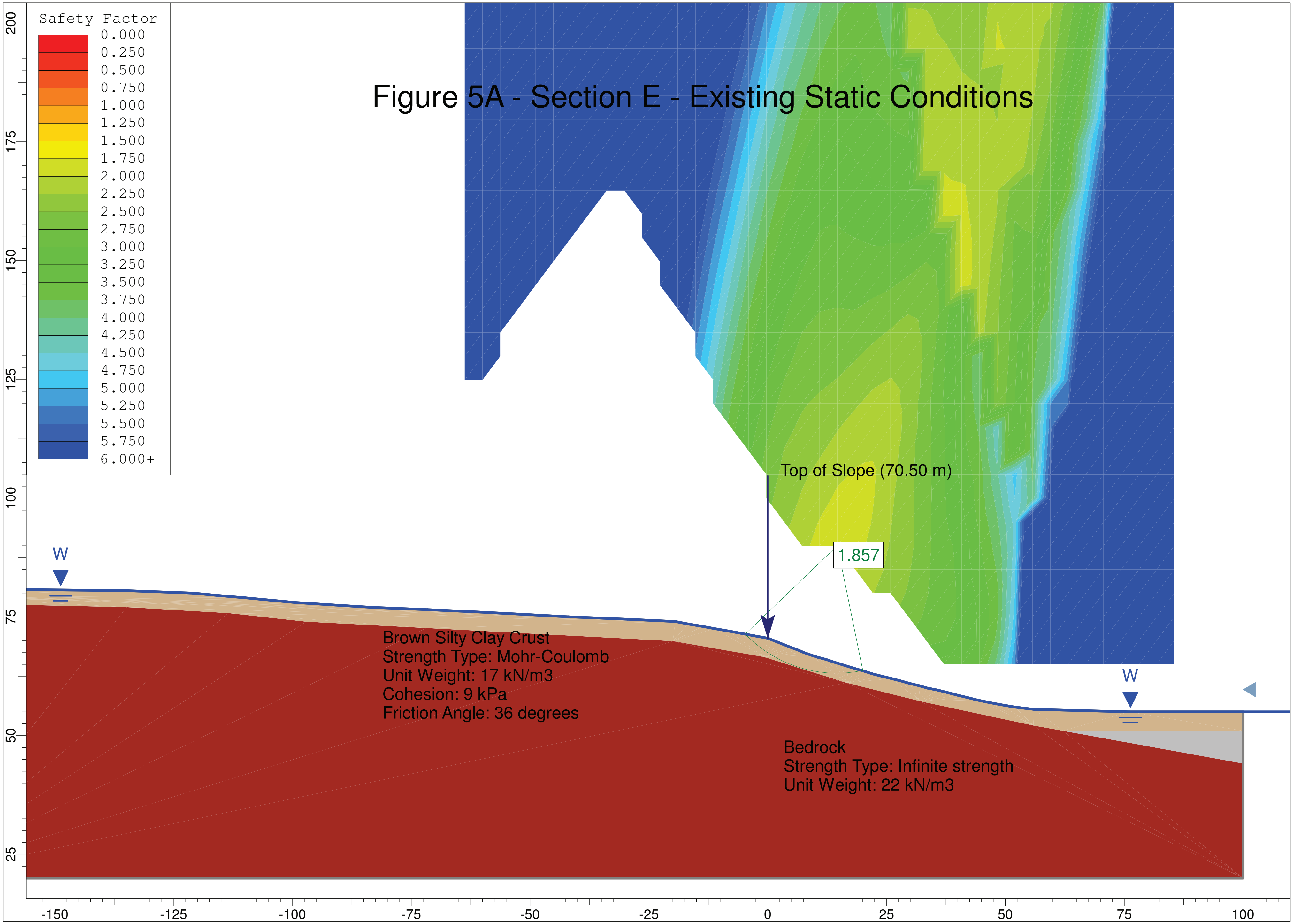
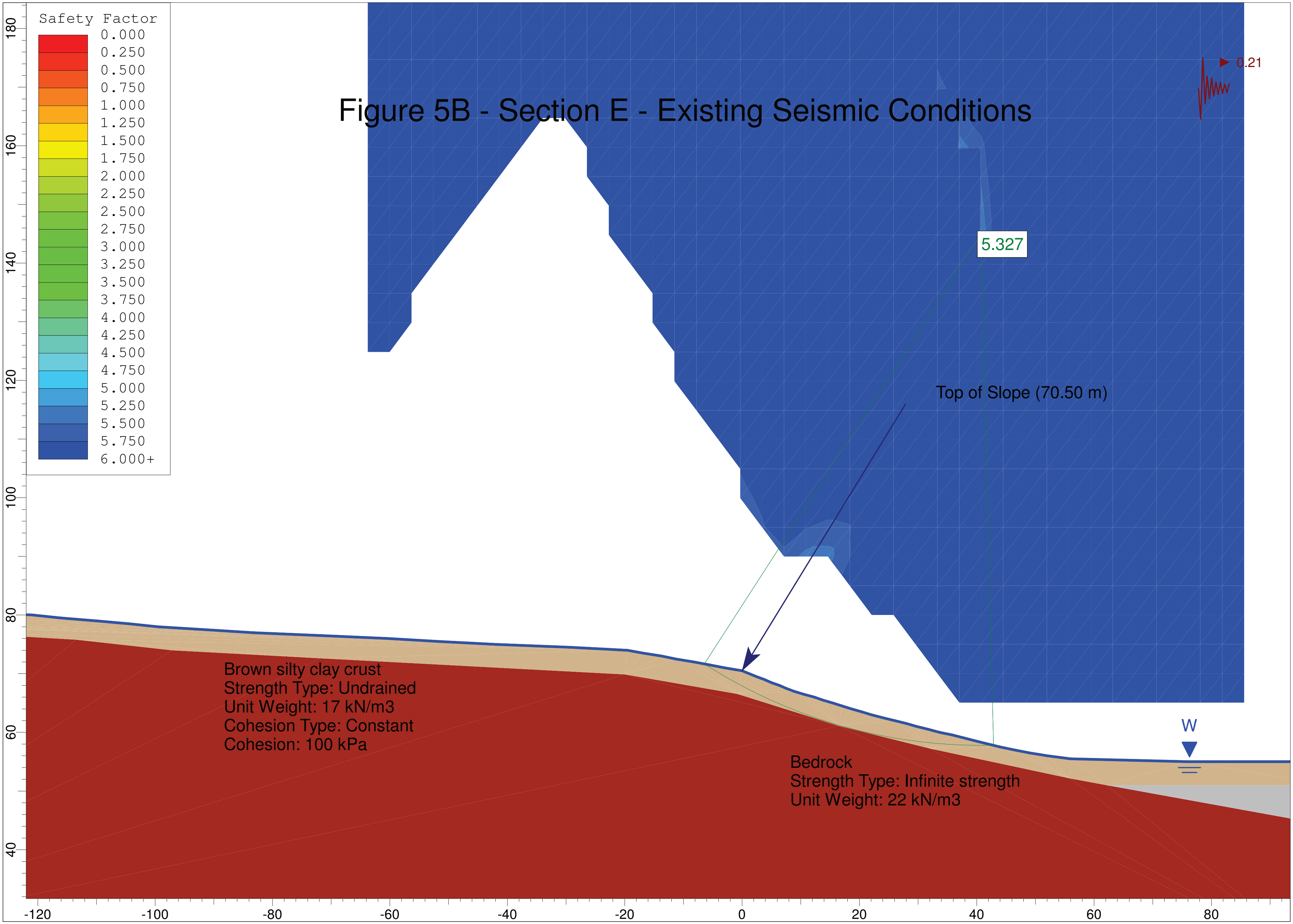


Figure 5A - Section E - Existing Static Conditions

Figure 5B - Section E - Existing Seismic Conditions



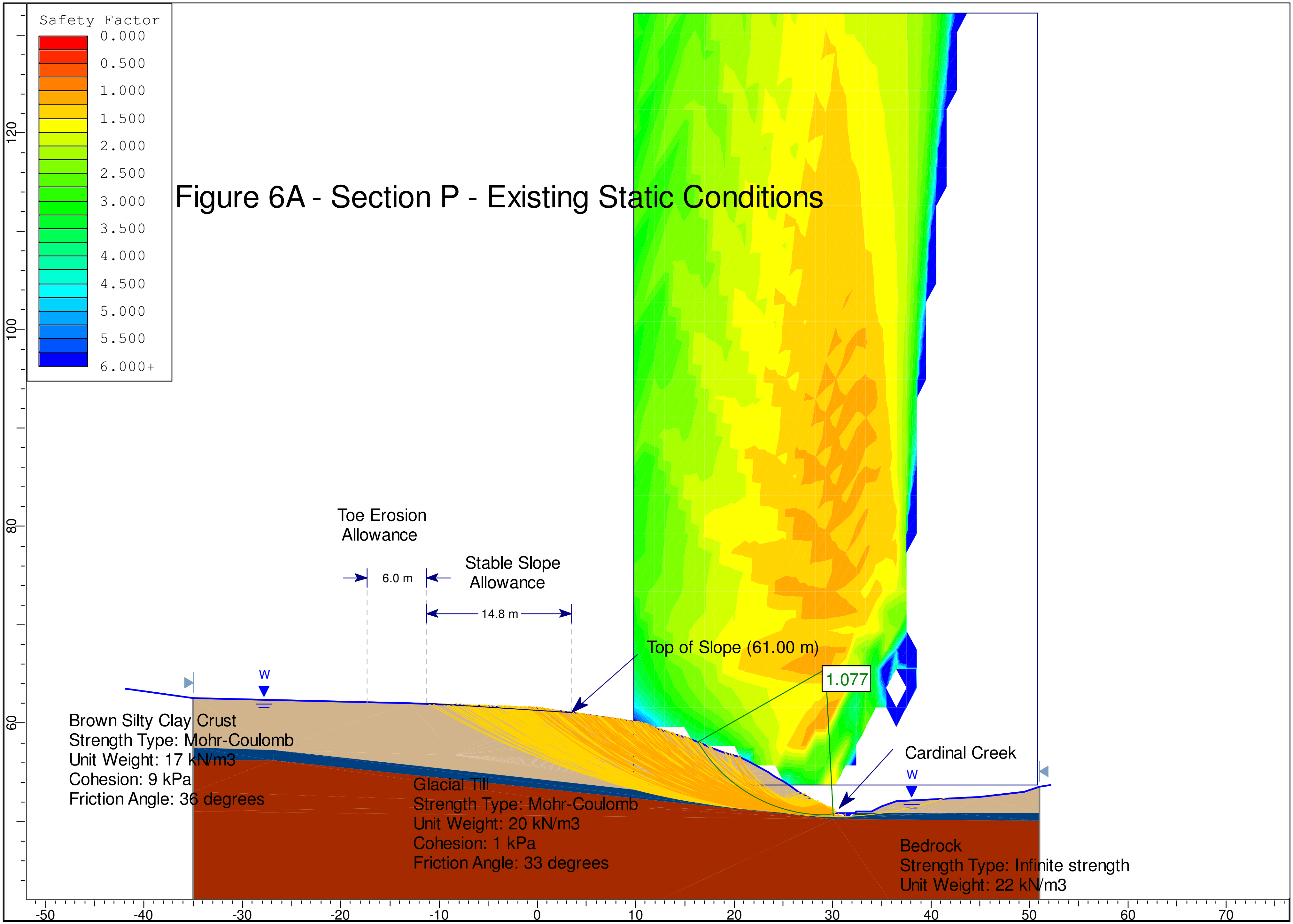


Figure 6A - Section P - Existing Static Conditions

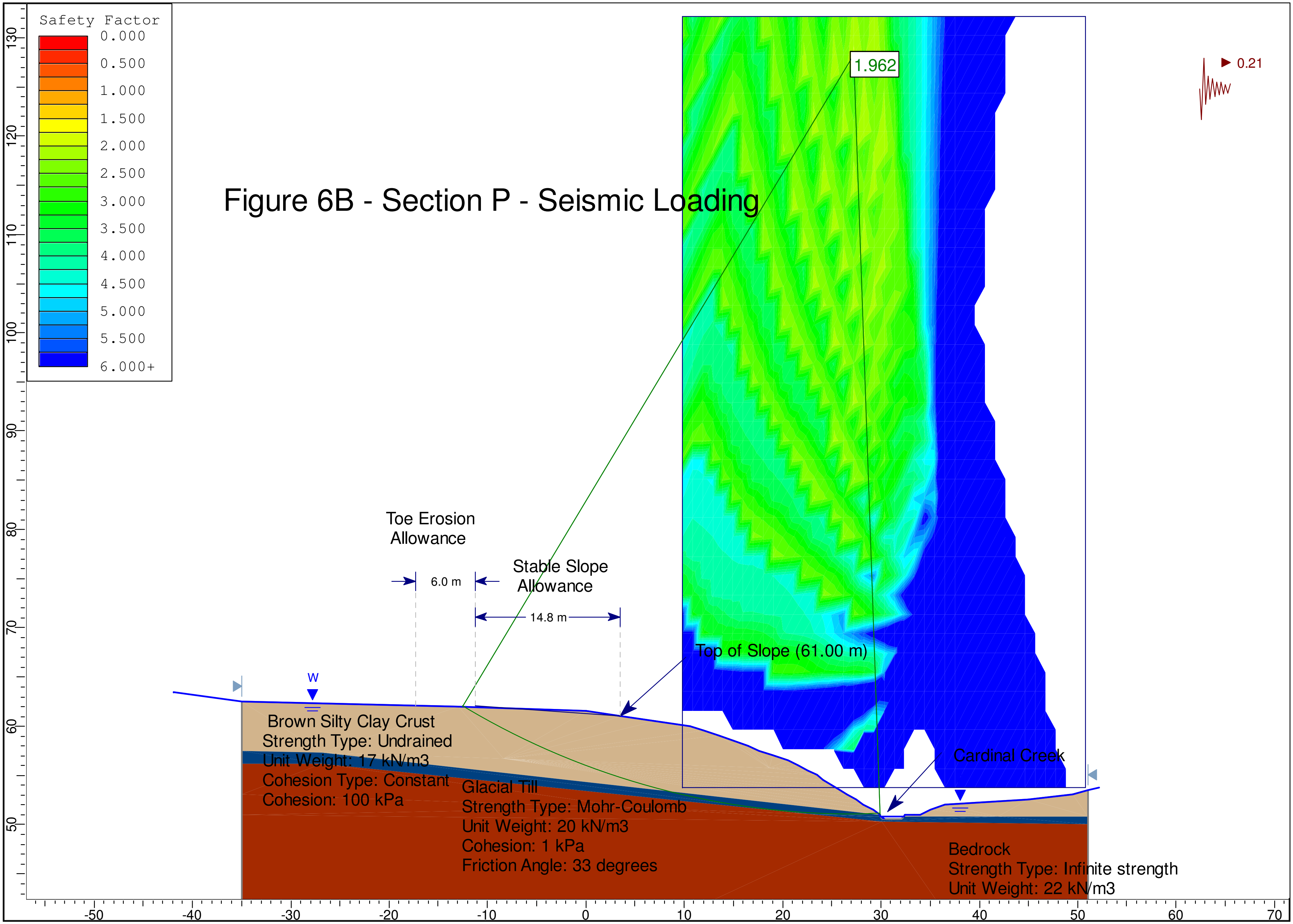


Figure 6B - Section P - Seismic Loading

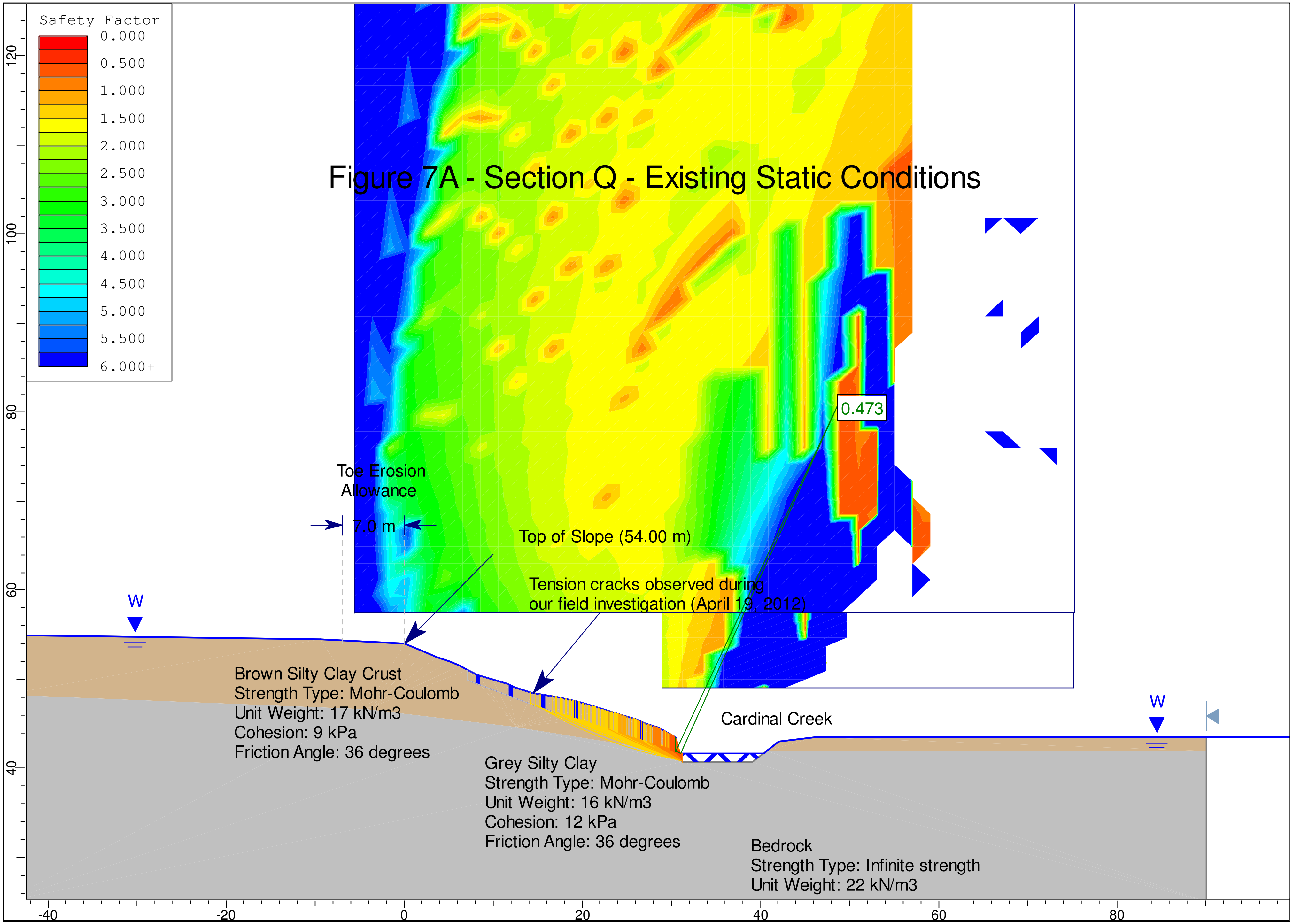


Figure 7A - Section Q - Existing Static Conditions

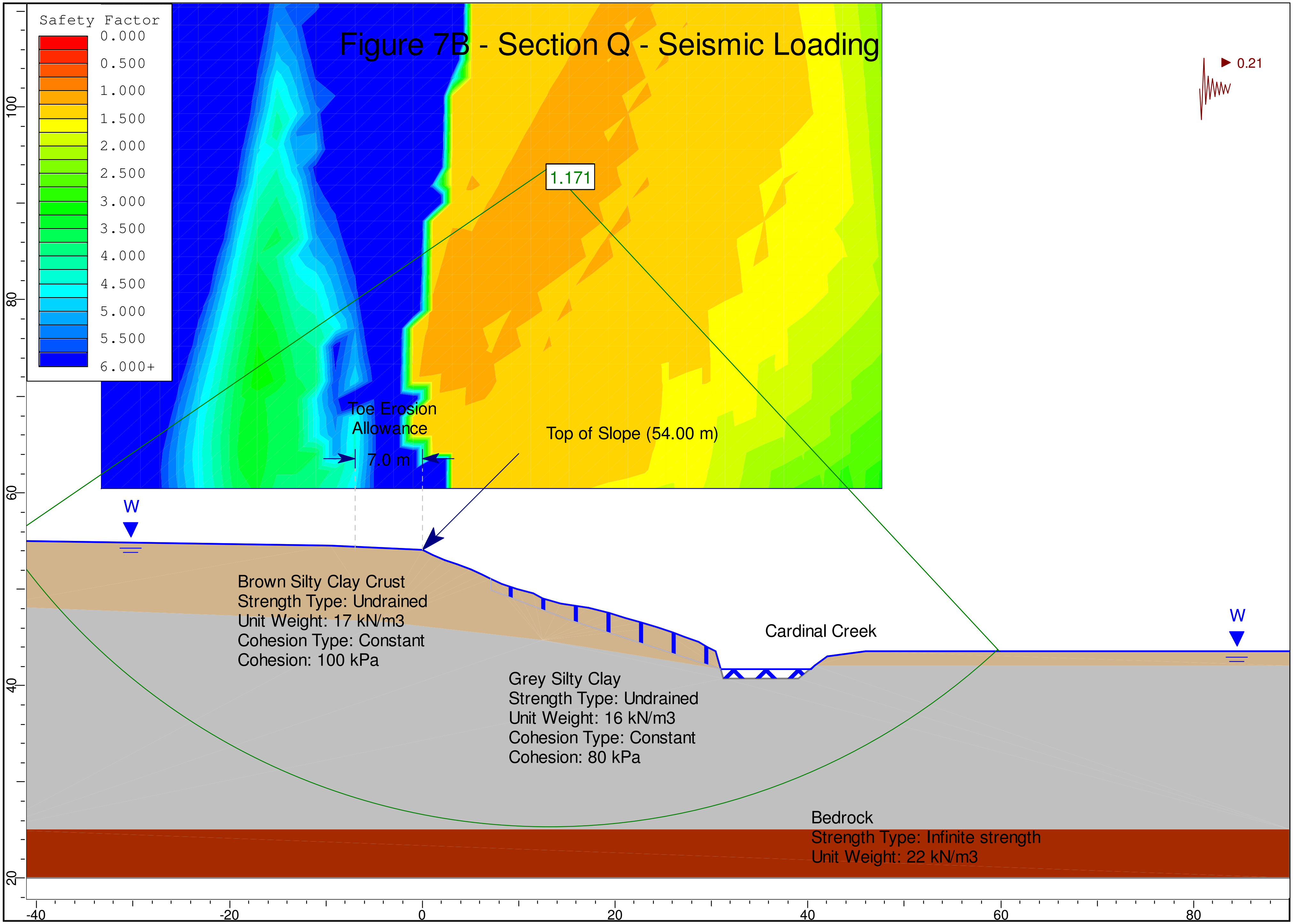


Figure 7B - Section Q - Seismic Loading

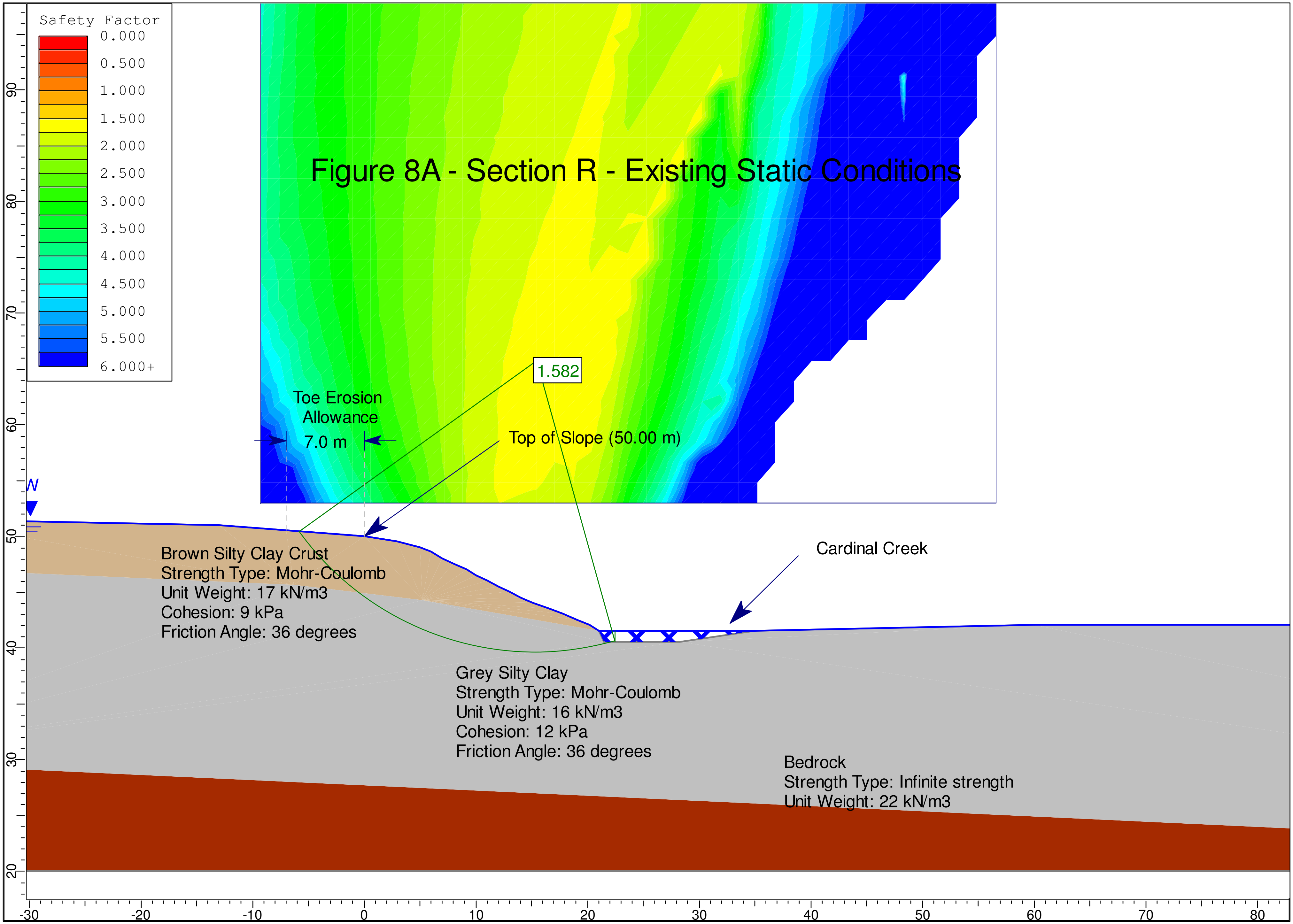


Figure 8A - Section R - Existing Static Conditions

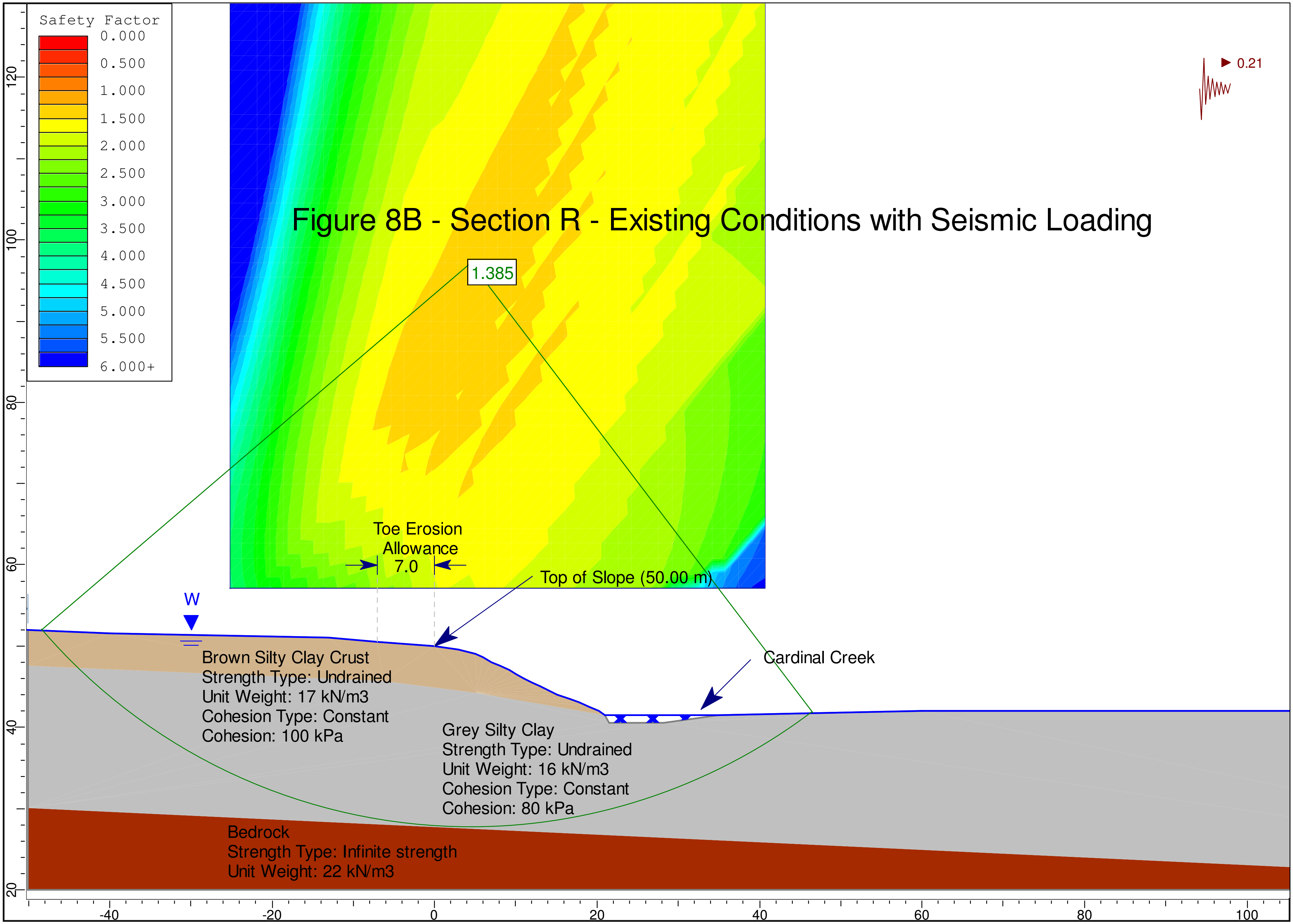


Figure 8B - Section R - Existing Conditions with Seismic Loading

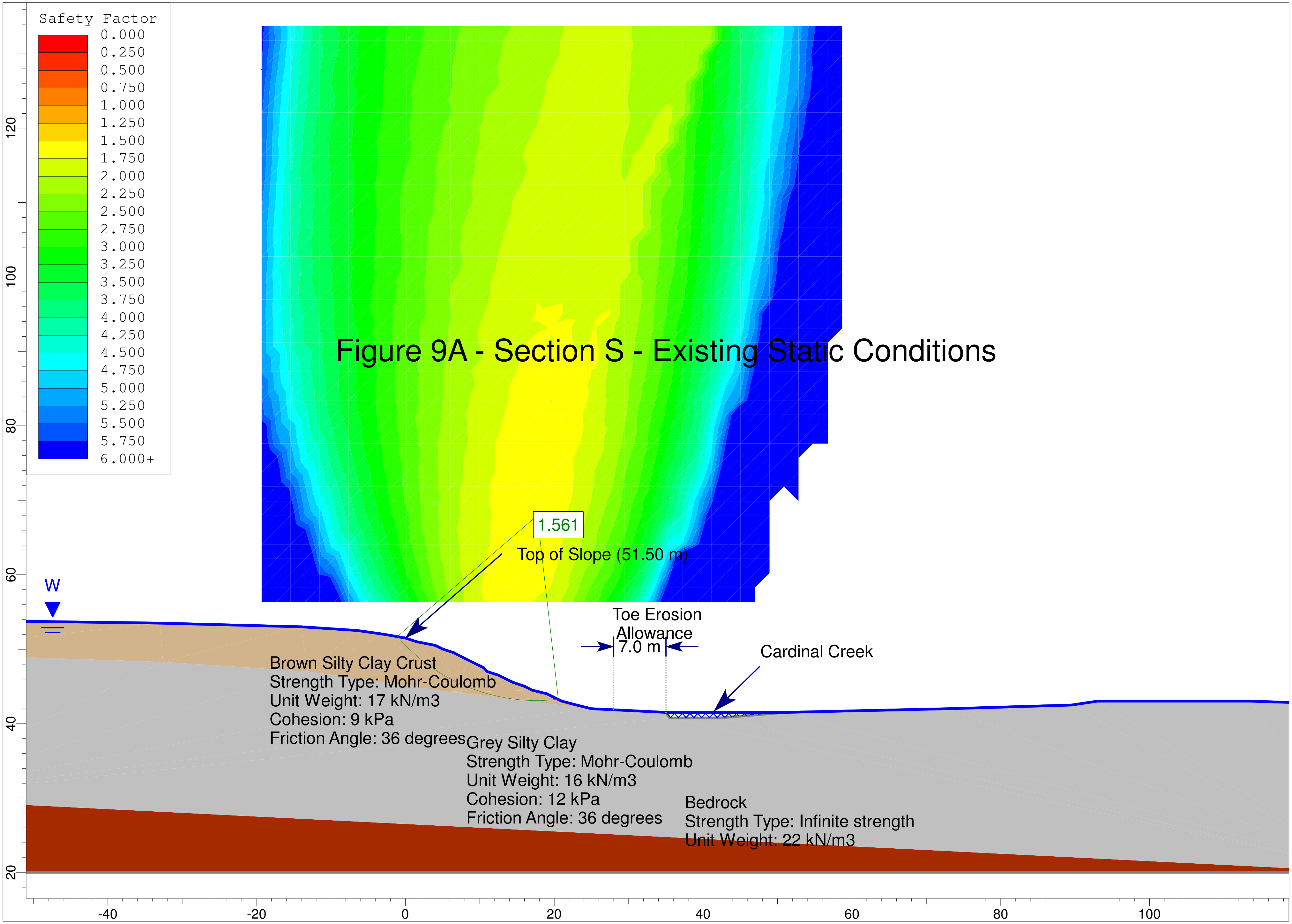


Figure 9A - Section S - Existing Static Conditions

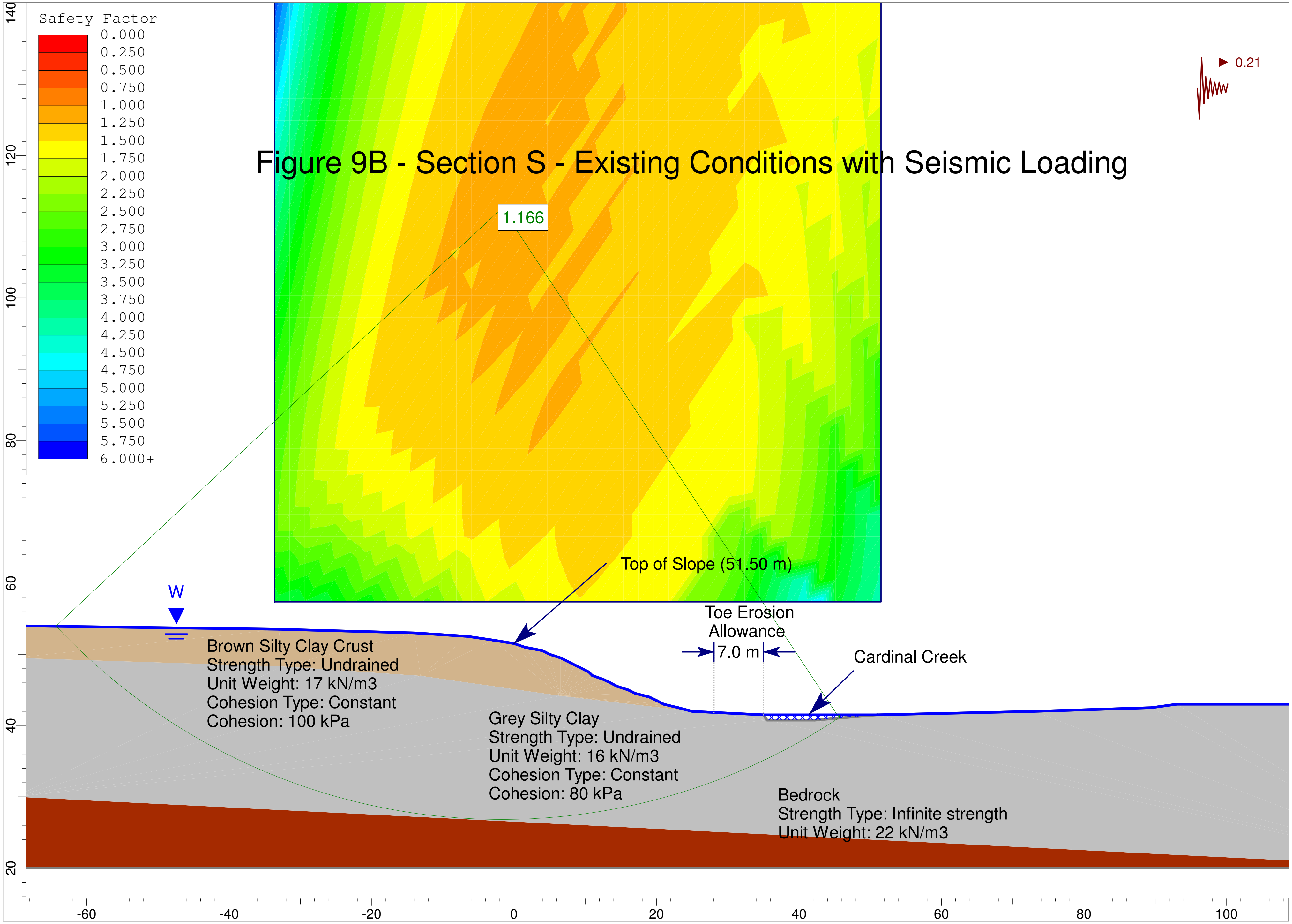


Figure 9B - Section S - Existing Conditions with Seismic Loading

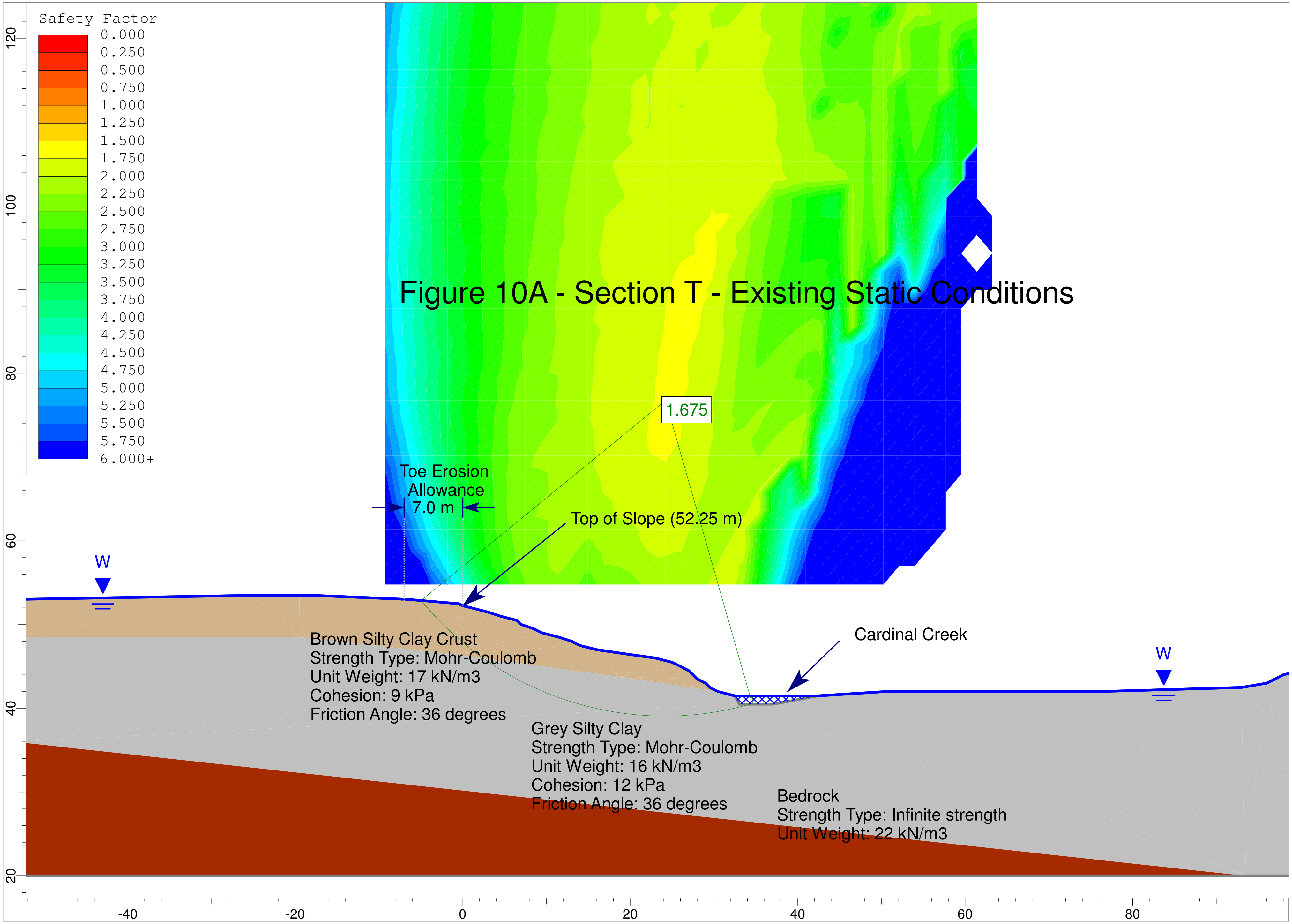


Figure 10A - Section T - Existing Static Conditions

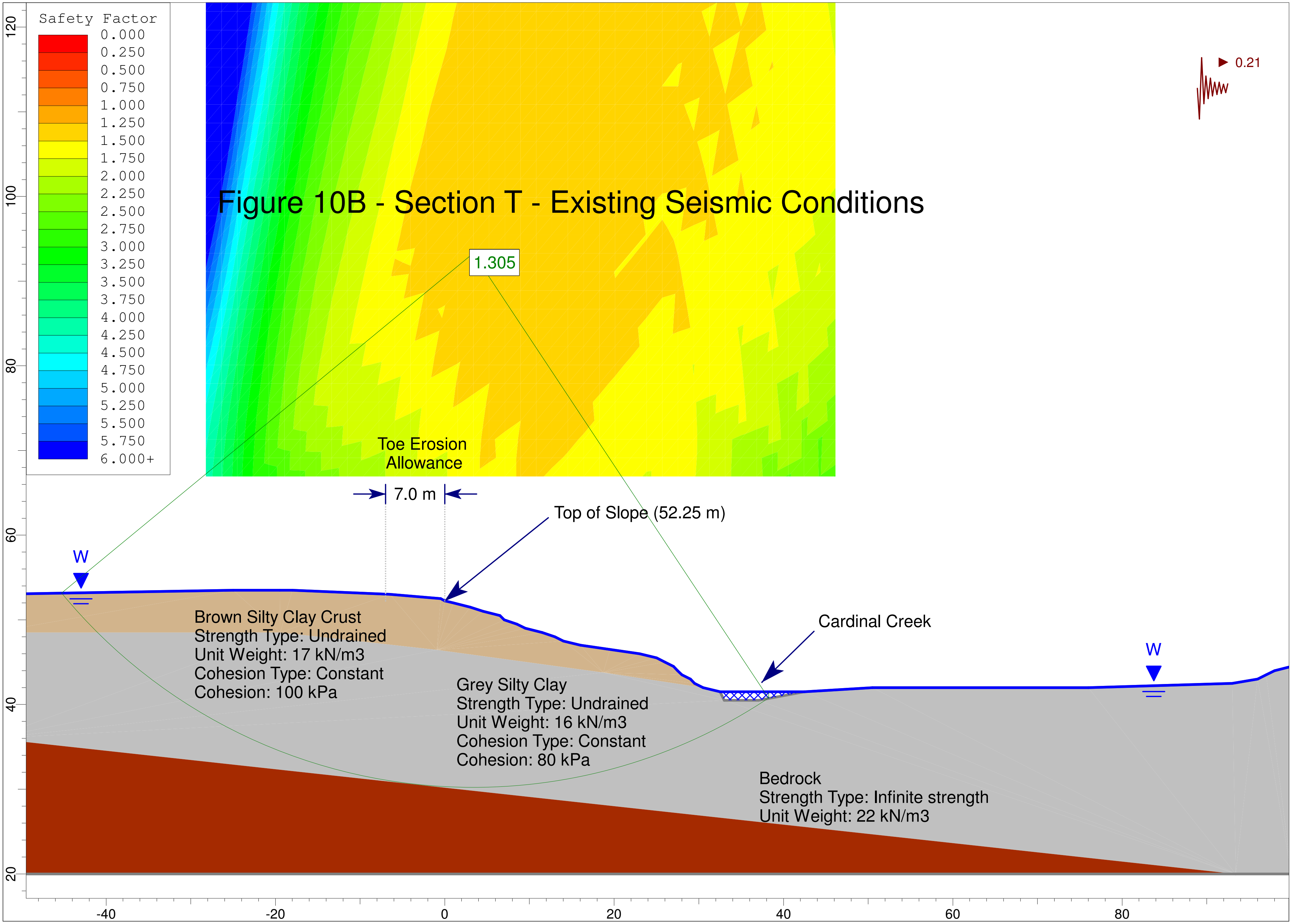


Figure 10B - Section T - Existing Seismic Conditions

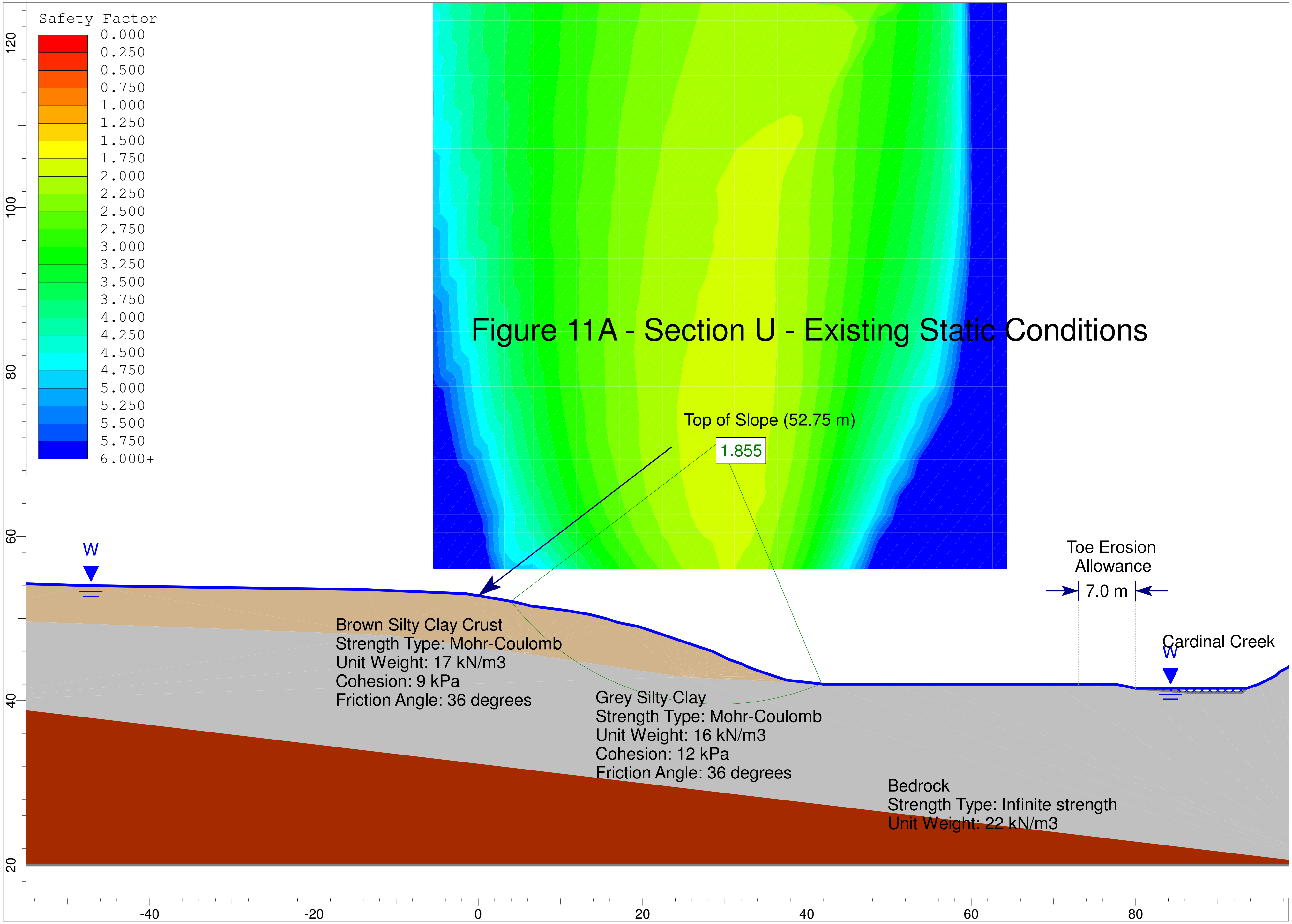


Figure 11A - Section U - Existing Static Conditions

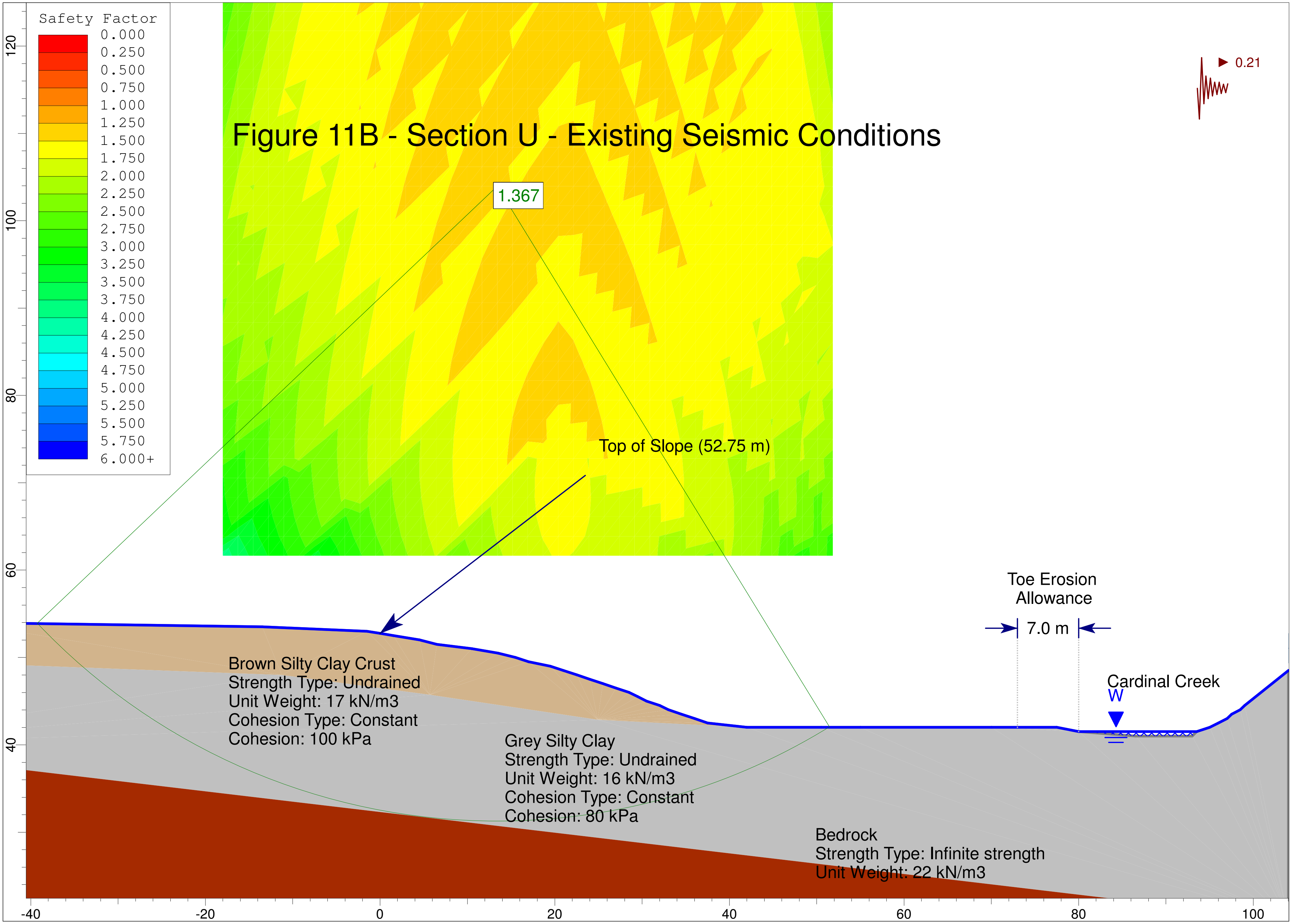


Figure 11B - Section U - Existing Seismic Conditions

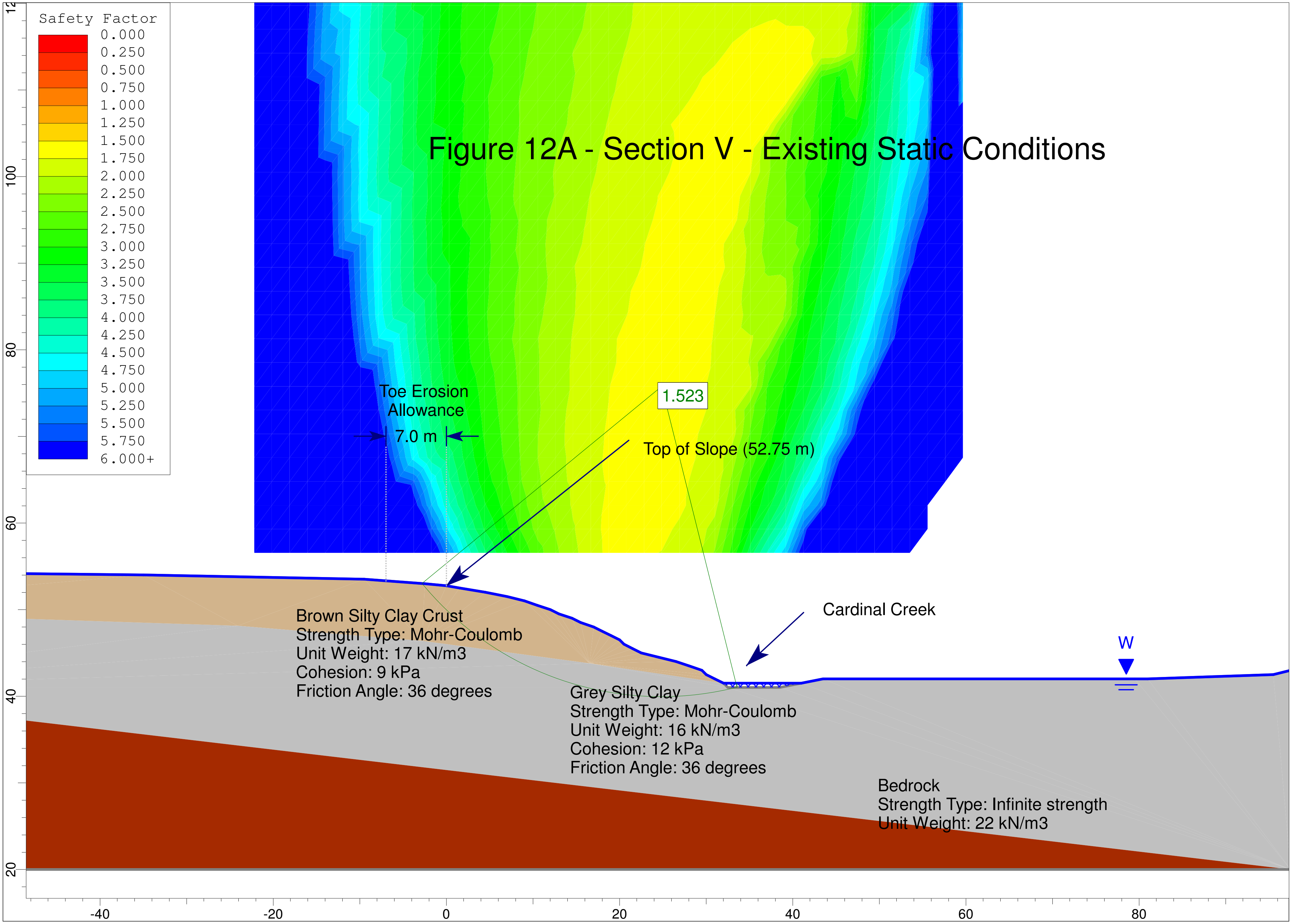


Figure 12A - Section V - Existing Static Conditions

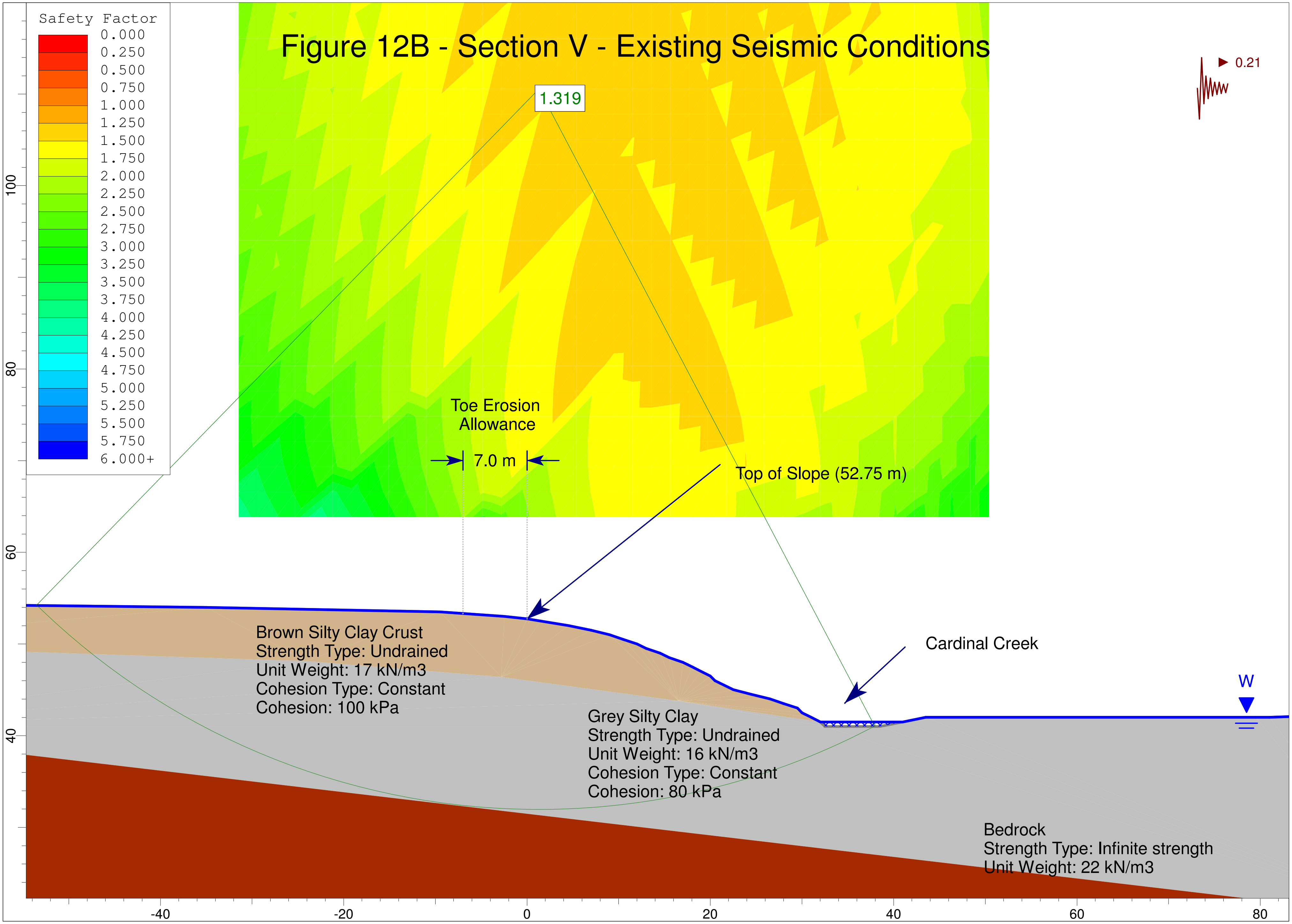


Figure 12B - Section V - Existing Seismic Conditions

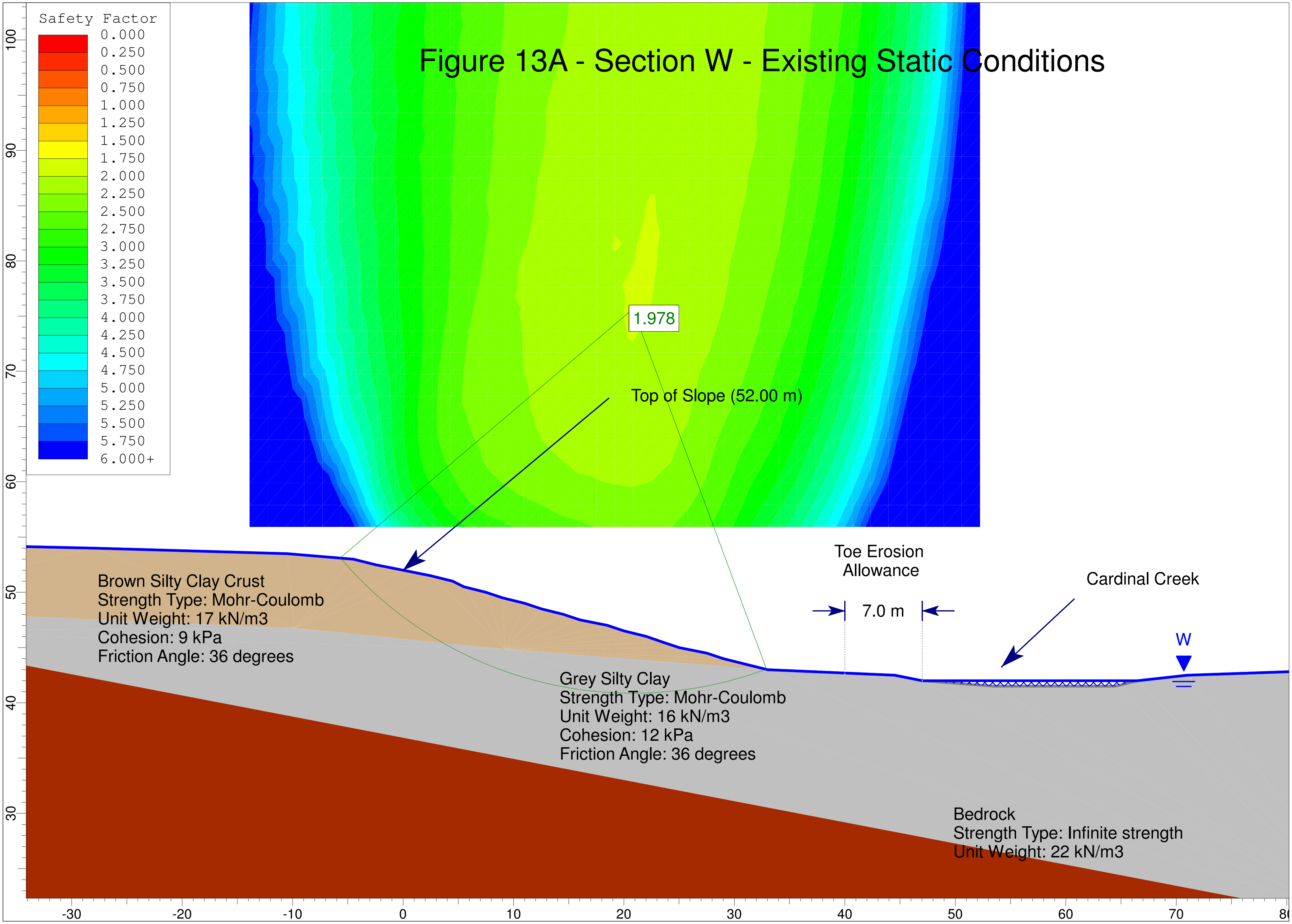


Figure 13A - Section W - Existing Static Conditions

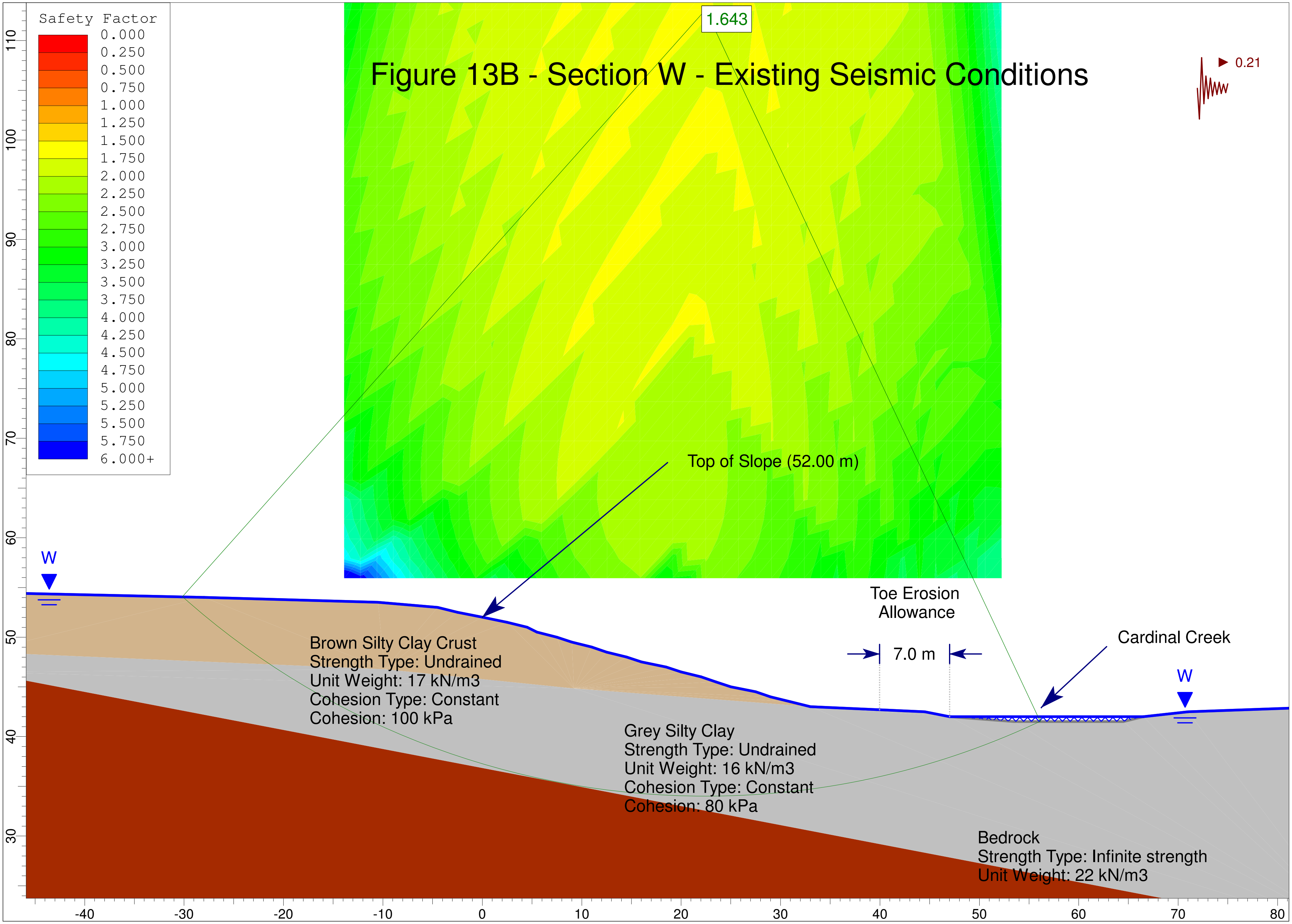


Figure 13B - Section W - Existing Seismic Conditions

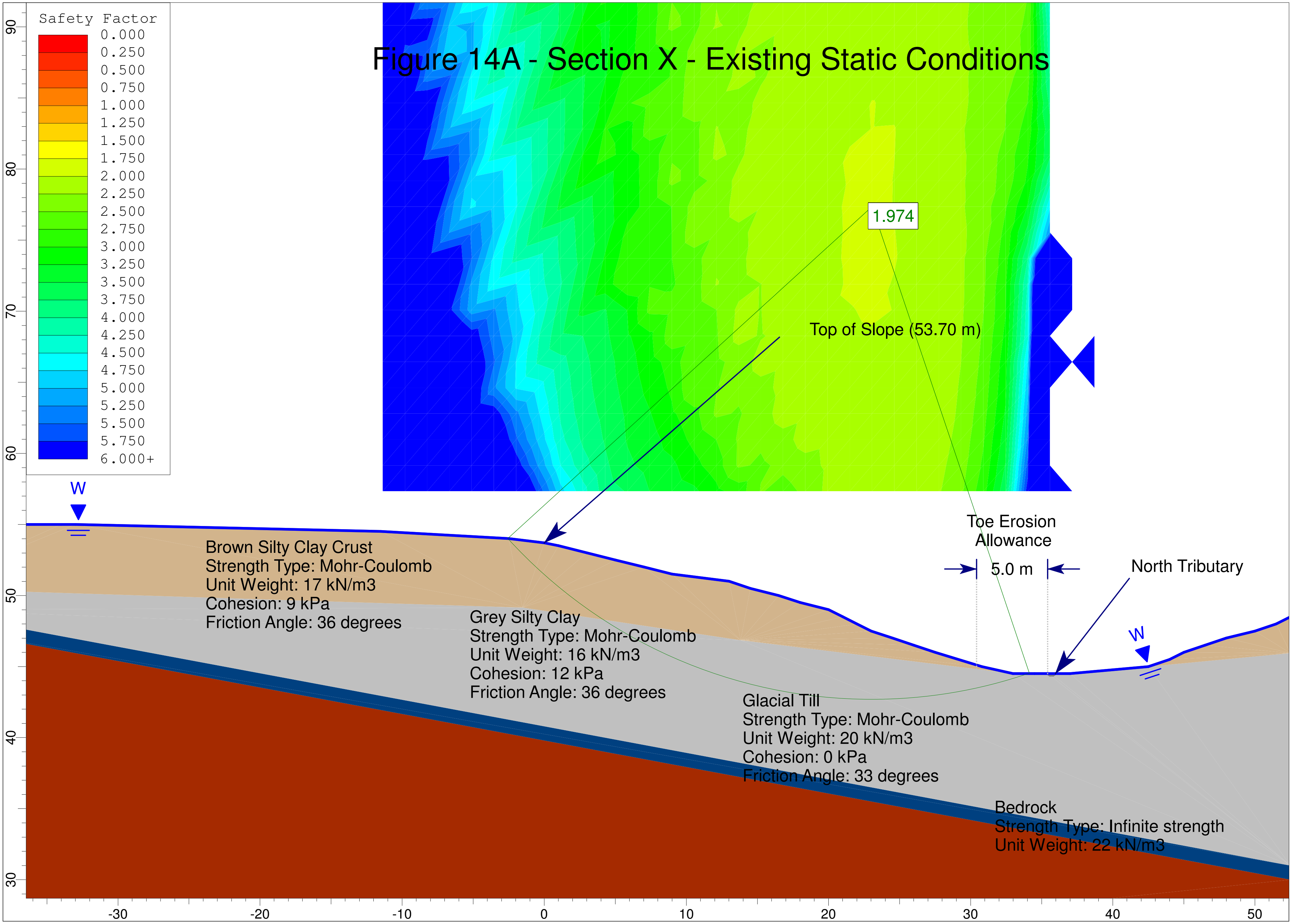


Figure 14A - Section X - Existing Static Conditions

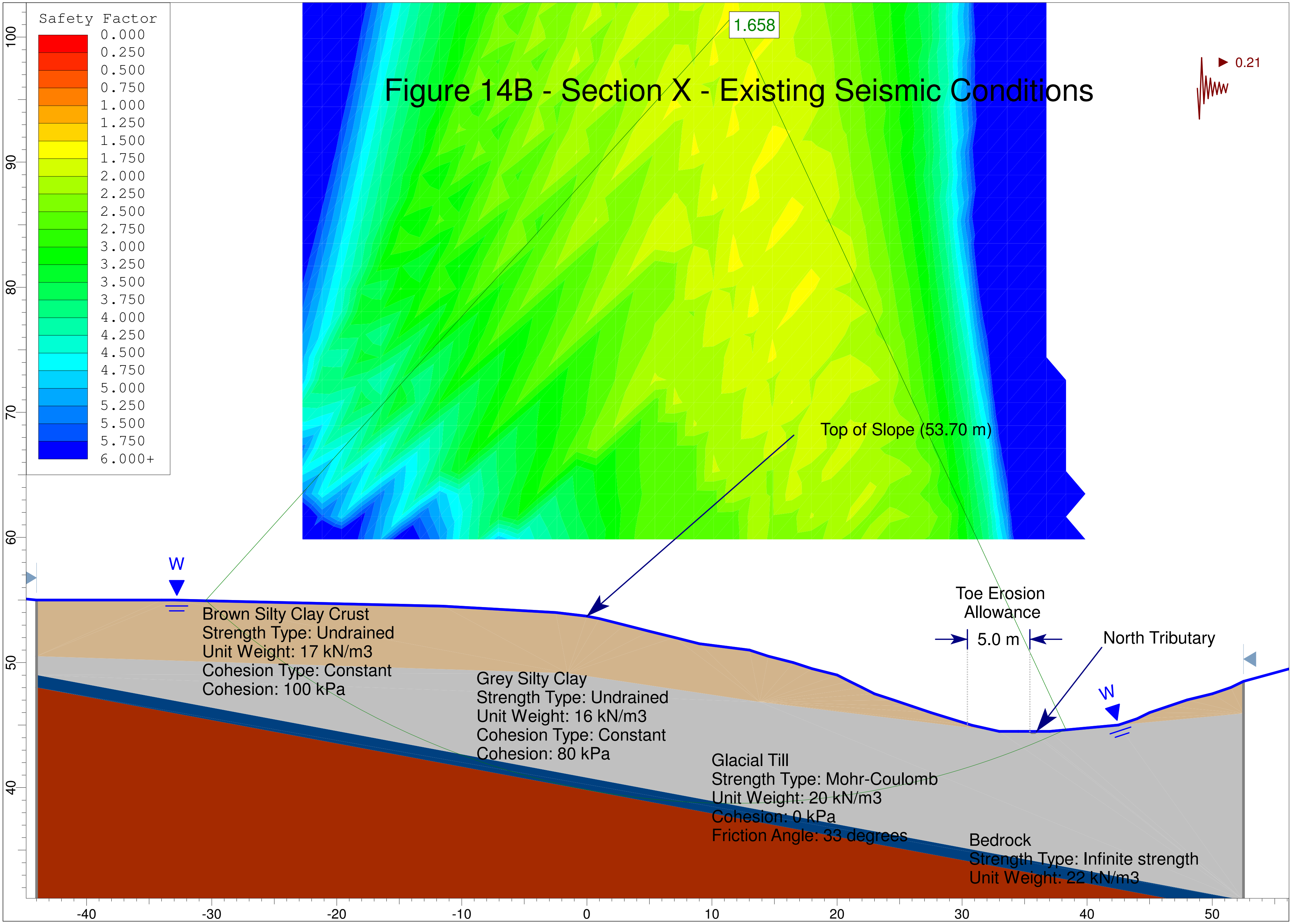


Figure 14B - Section X - Existing Seismic Conditions

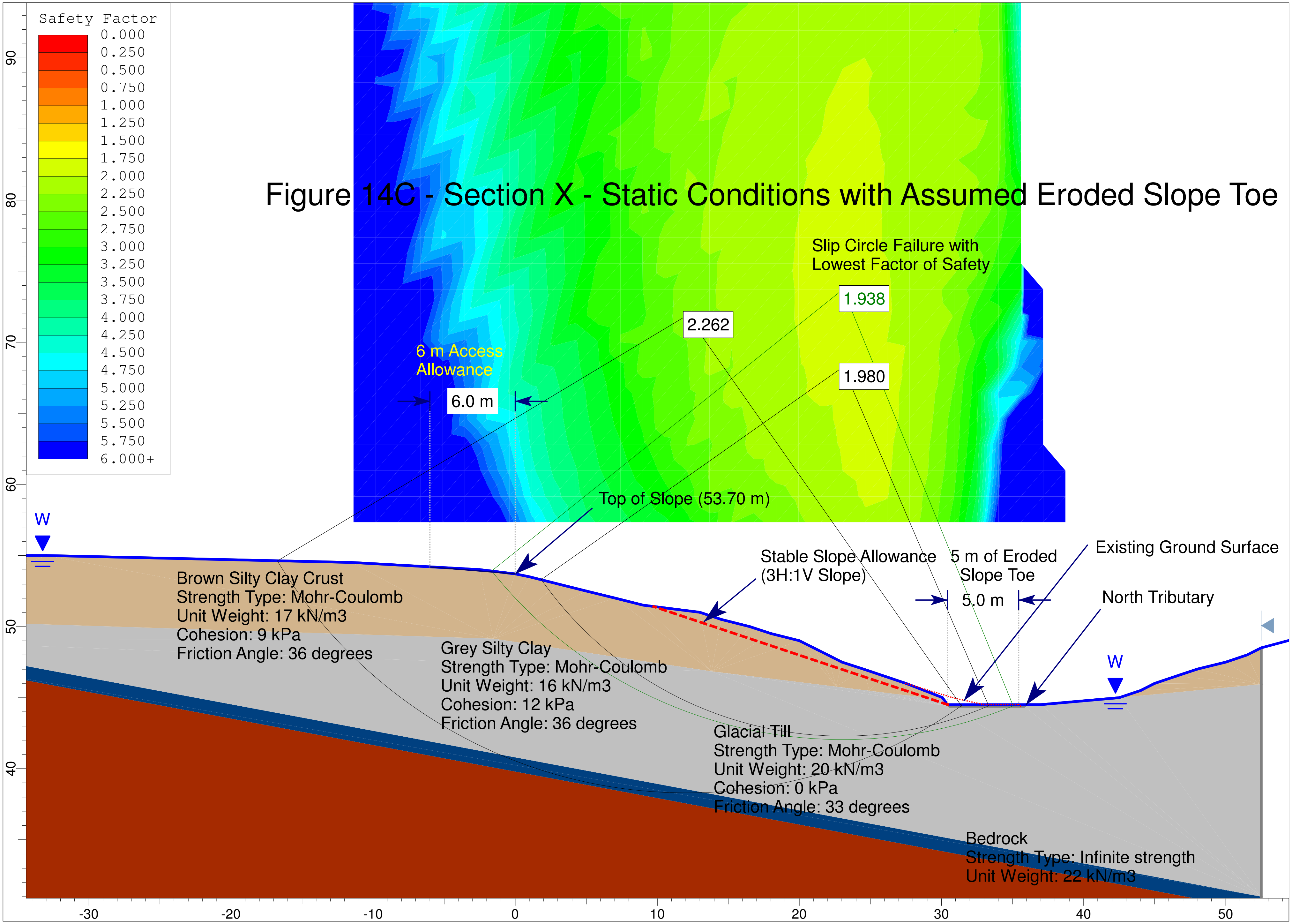


Figure 14C - Section X - Static Conditions with Assumed Eroded Slope Toe

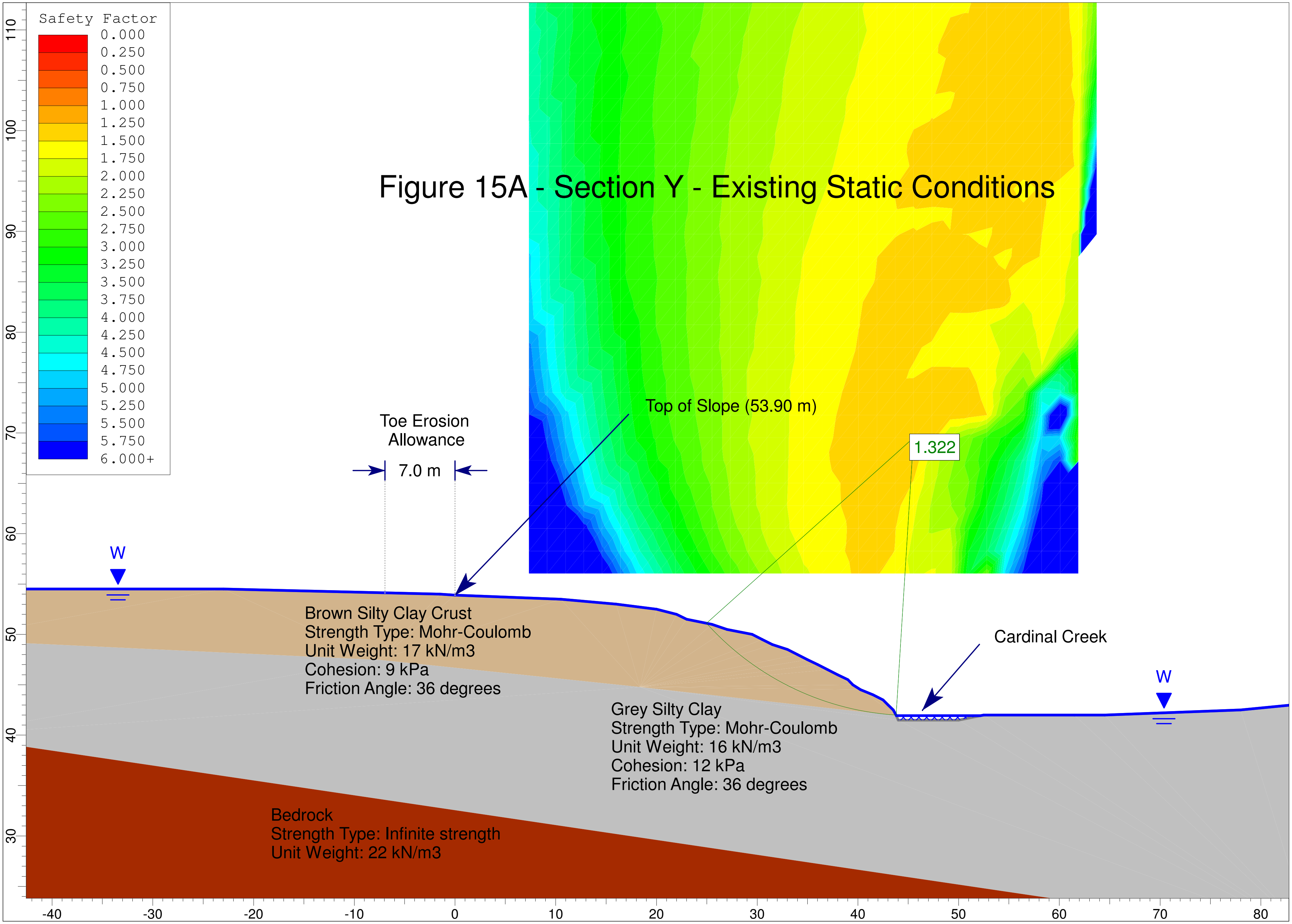


Figure 15A - Section Y - Existing Static Conditions

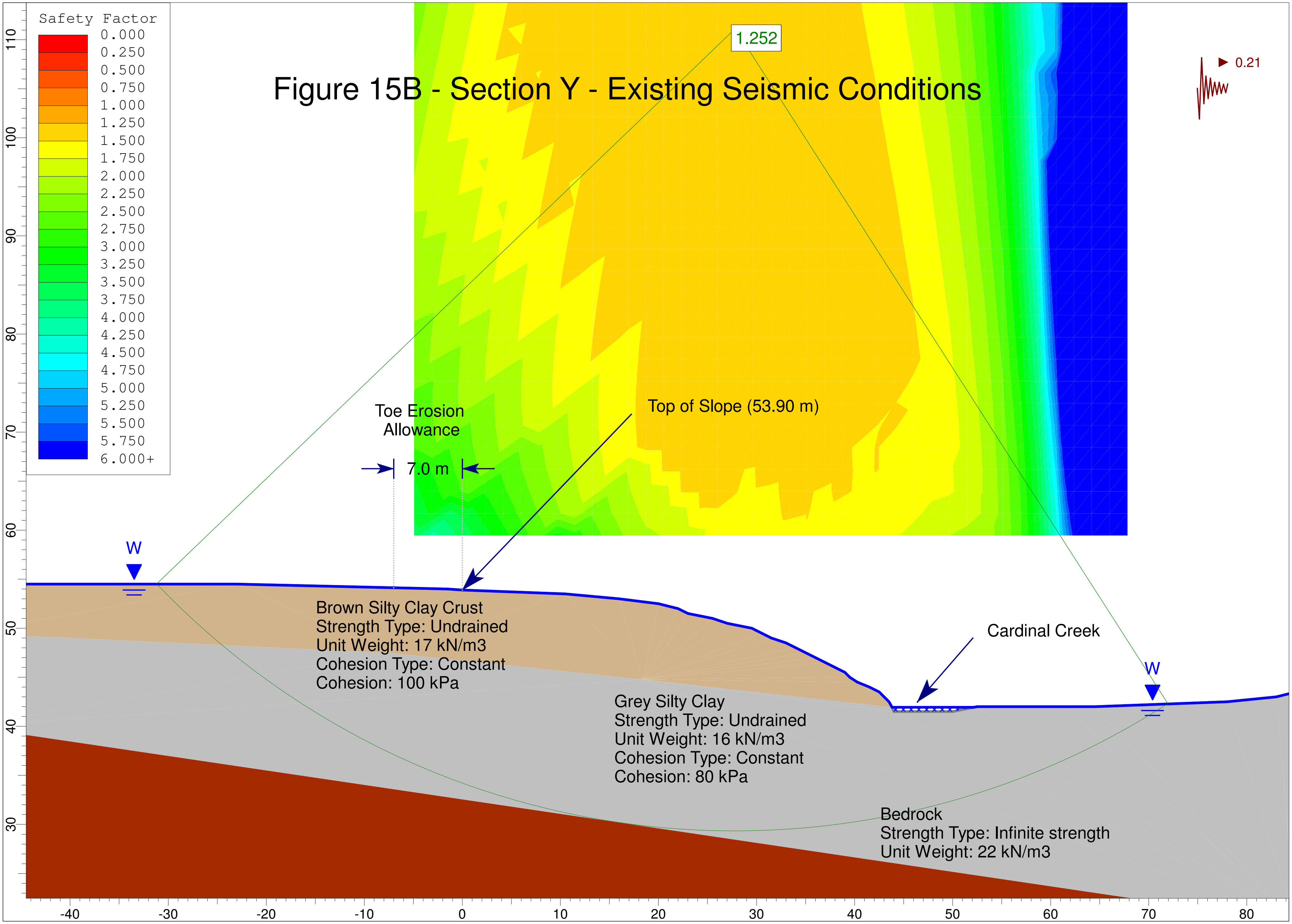


Figure 15B - Section Y - Existing Seismic Conditions

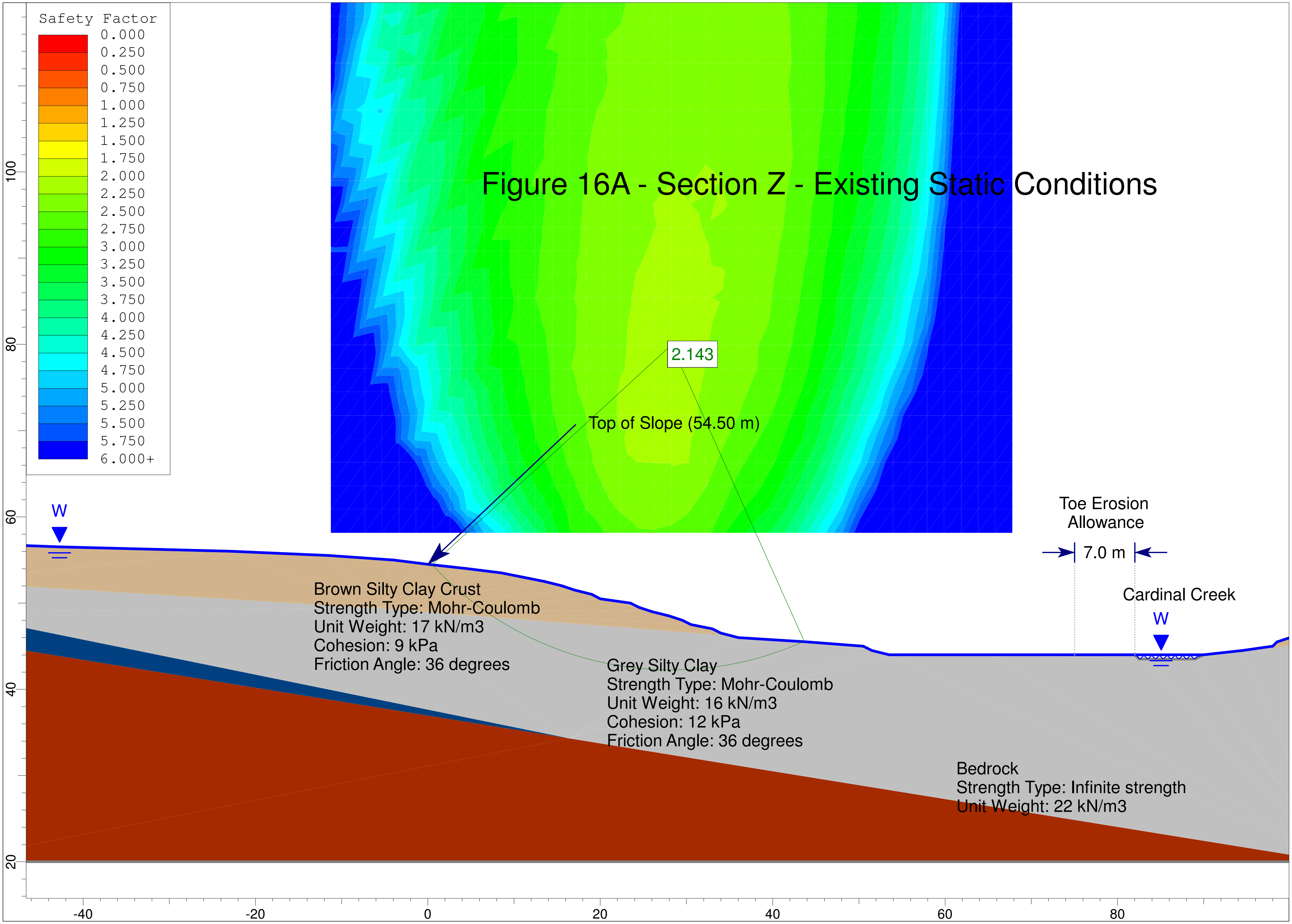


Figure 16A - Section Z - Existing Static Conditions

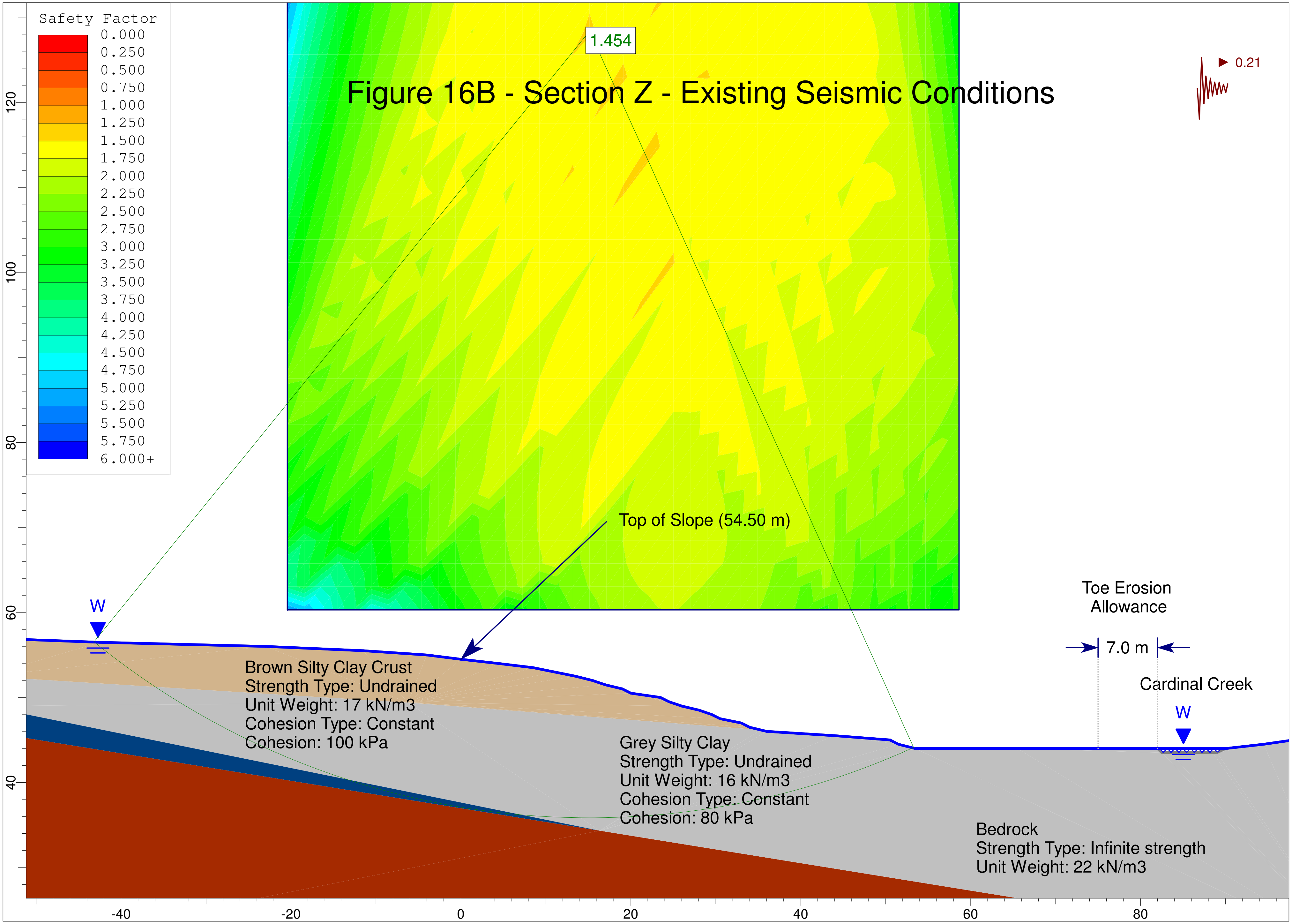


Figure 16B - Section Z - Existing Seismic Conditions

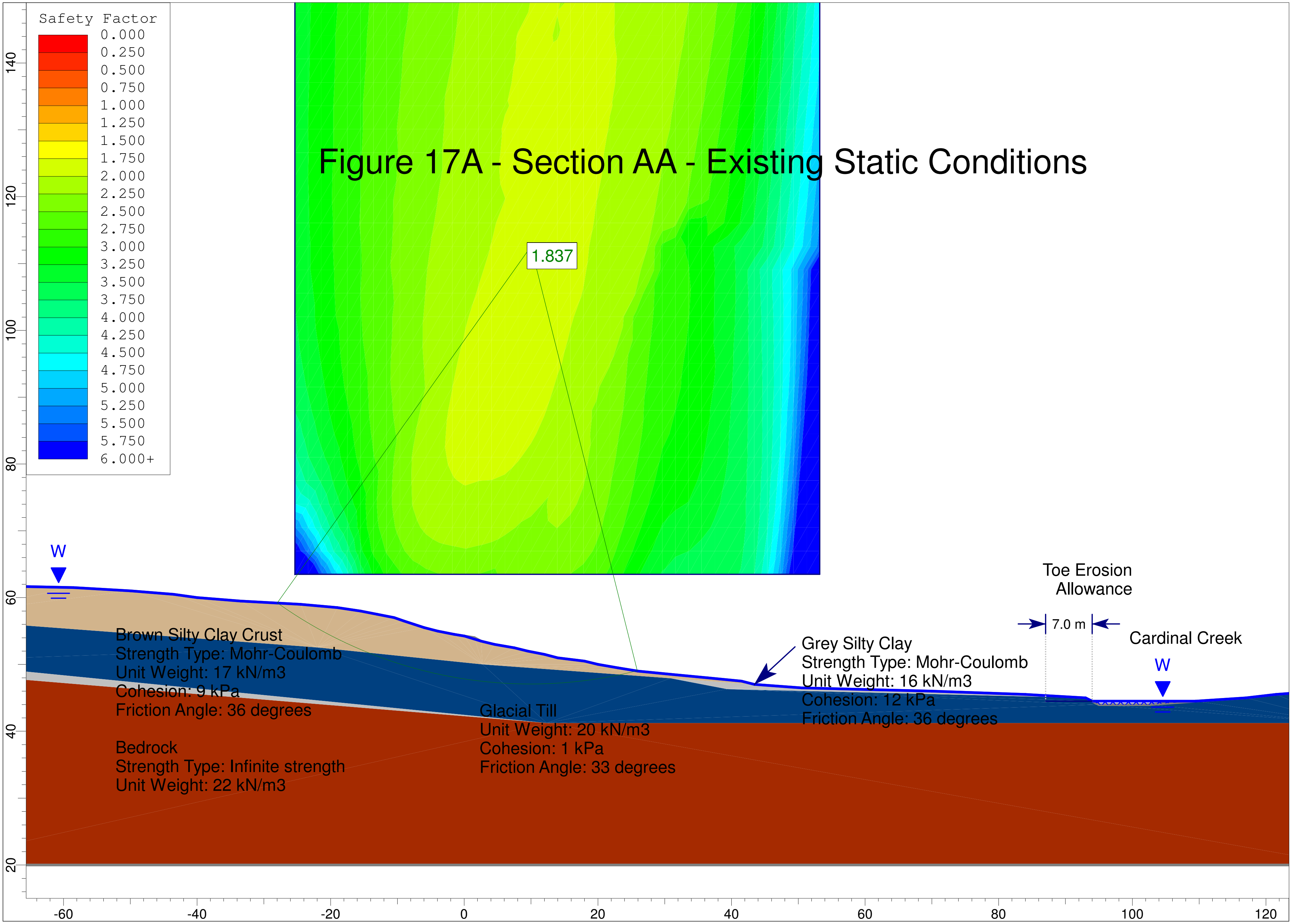


Figure 17A - Section AA - Existing Static Conditions

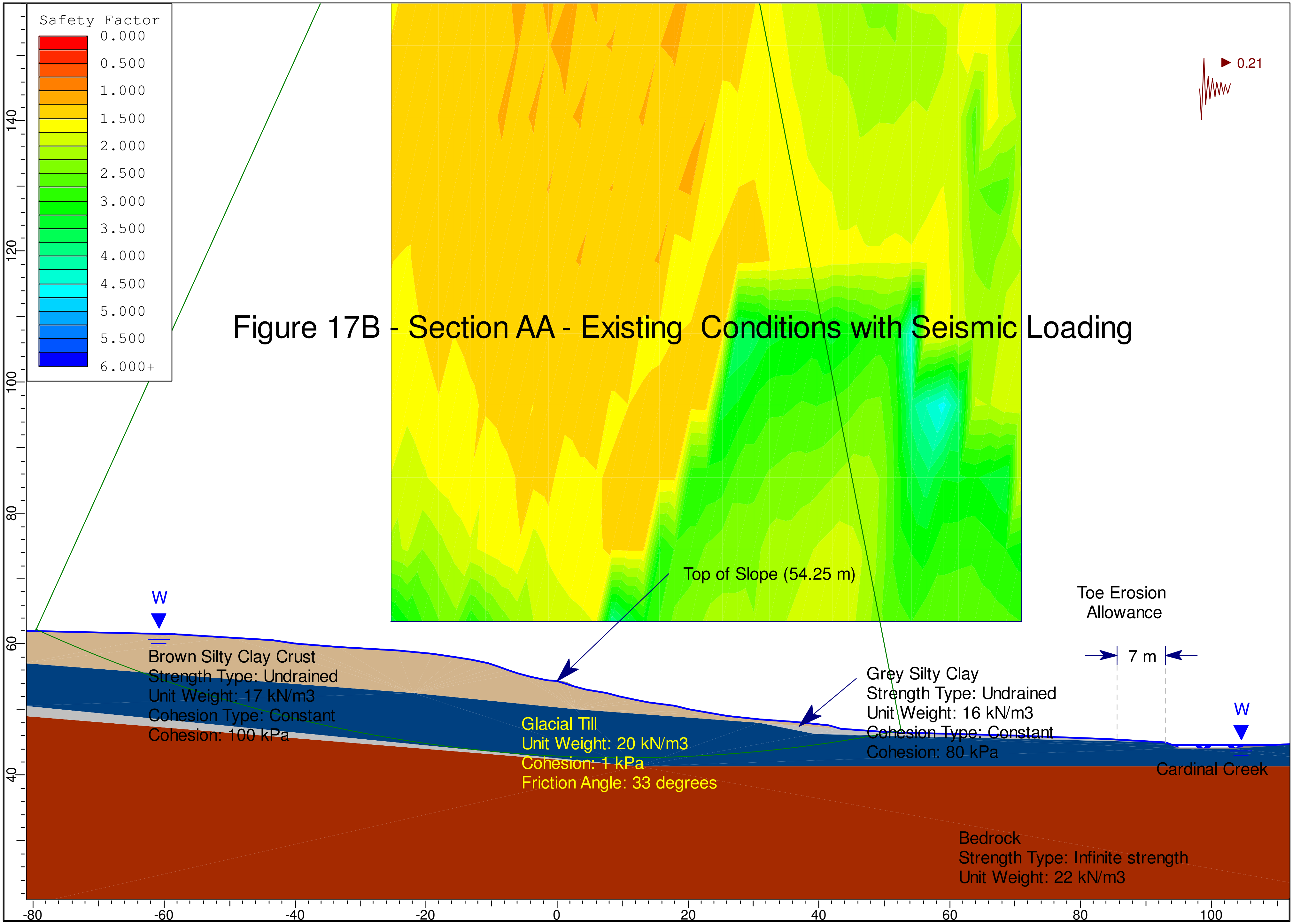


Figure 17B - Section AA - Existing Conditions with Seismic Loading

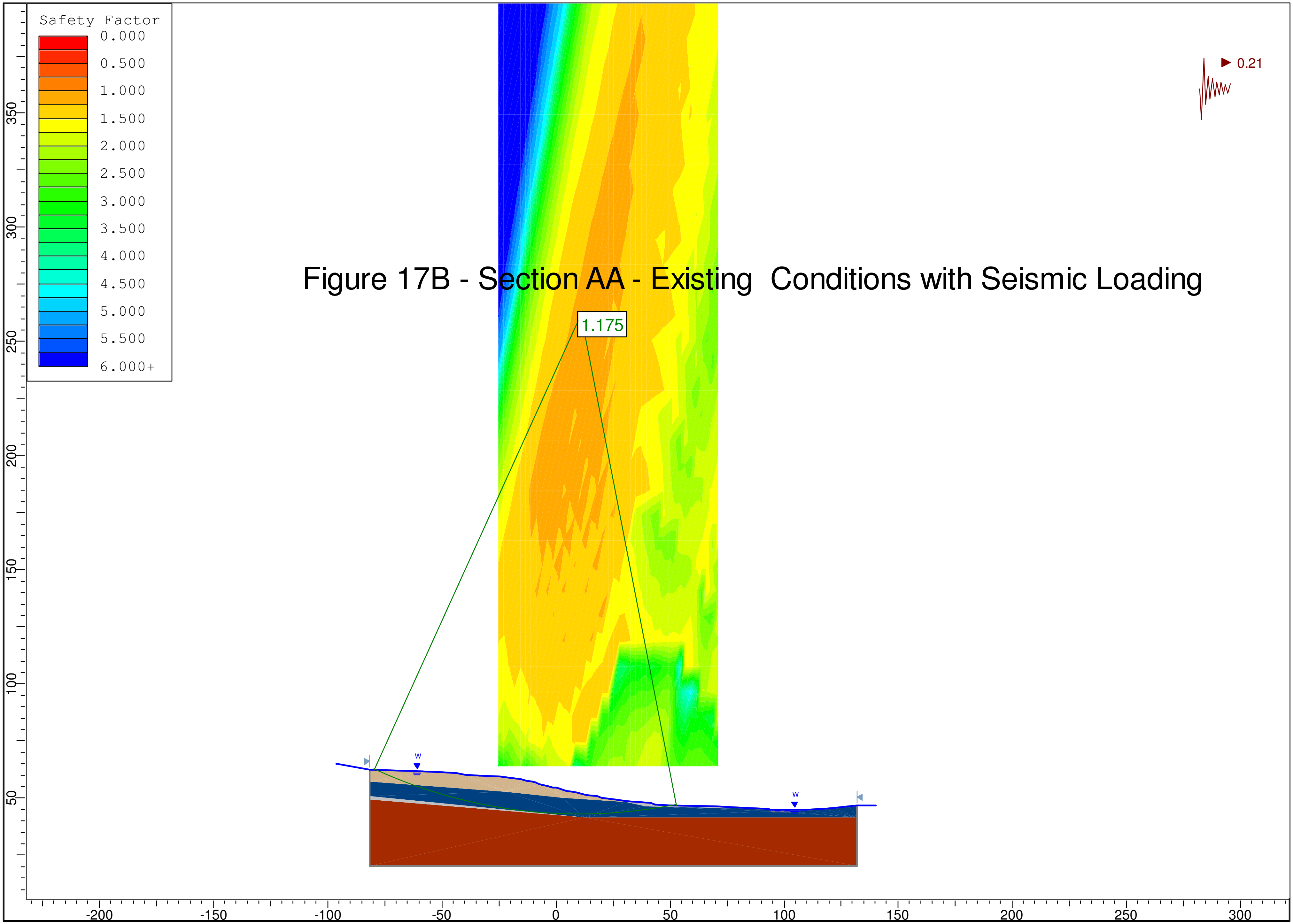


Figure 17B - Section AA - Existing Conditions with Seismic Loading

Site Photographs of Slope Conditions

Photo 1: Photo taken on April 9, 2009 from the east bank of the valley corridor wall along Cardinal Creek looking north (downstream) near Section C.

Photo 2: Photo taken on April 9, 2009 from the east bank of the valley corridor wall along Cardinal Creek looking north (downstream) approximately 150 m south of the former Rail Line.

Photo 3: Photo taken on April 9, 2009 from the east bank of the valley corridor along Cardinal Creek looking north (downstream) near Section B.

Photo 4: Photo taken on April 9, 2009 from the east bank of the valley corridor wall along Cardinal Creek looking north (downstream) near Section A.

Photo 5: Photo taken of bedrock outcrop at Section D.

LEGEND:

🟢	BOREHOLE LOCATION
🟥	TEST PIT LOCATION
71.07	GROUND SURFACE ELEVATION (m)
[68.86]	INFERRED BEDROCK SURFACE ELEVATION (m)
(68.30)	PRACTICAL REFUSAL TO DC/TREFUSAL ELEV ATION (m)
{71.70}	BEDROCK SURFACE ELEVATION (m)
[<48.7]	BEDROCK NOT ENCOUNTERED AT TEST PIT LOCATION

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

NO.	REVISIONS	DATE	INITIAL
6	UPDATED BASE PLAN	22/09/2014	DJG
5	UPDATED BASE PLAN	16/04/2014	DJG
3	TEST PITS ADDED	21/11/2013	DJG
2	UPDATED BASE PLAN	23/08/2013	DJG
1	UPDATED BASE PLAN	24/06/2013	DJG

TAMARACK (QUEEN STREET) CORP.

GEOTECHNICAL INVESTIGATION
CARDINAL CREEK VILLAGE
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Stamp:

Drawn by: MPG
Checked by: DJG
Scale: 1:2500
Date: 03/2014
Report No.: PG1796
Drawing No.: PG1796-6

LEGEND:

▨	UP TO 2m
▨	UP TO 3m
⊕	BOREHOLE LOCATION
▣	TEST PIT LOCATION
71.07	GROUND SURFACE ELEVATION (m)
[68.86]	INFERRED BEDROCK SURFACE ELEVATION (m)
(68.30)	PRACTICAL REFUSAL TO DC/TREFUSAL ELEV ATION (m)
{71.70}	BEDROCK SURFACE ELEVATION (m)
[<48.7]	BEDROCK NOT ENCOUNTERED AT TEST PIT LOCATION

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consulting engineers

154 Colonnade Road South
Ottawa, Ontario, K2E 7J5
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NO.	REVISIONS	DATE	INITIAL
4	UPDATED BASE PLAN	22/09/2014	DJG
3	UPDATED BASE PLAN	09/05/2014	DJG
2	UPDATED BASE PLAN	23/08/2013	DJG
1	UPDATED BASE PLAN	24/06/2013	DJG

TAMARACK (QUEEN STREET) CORP.

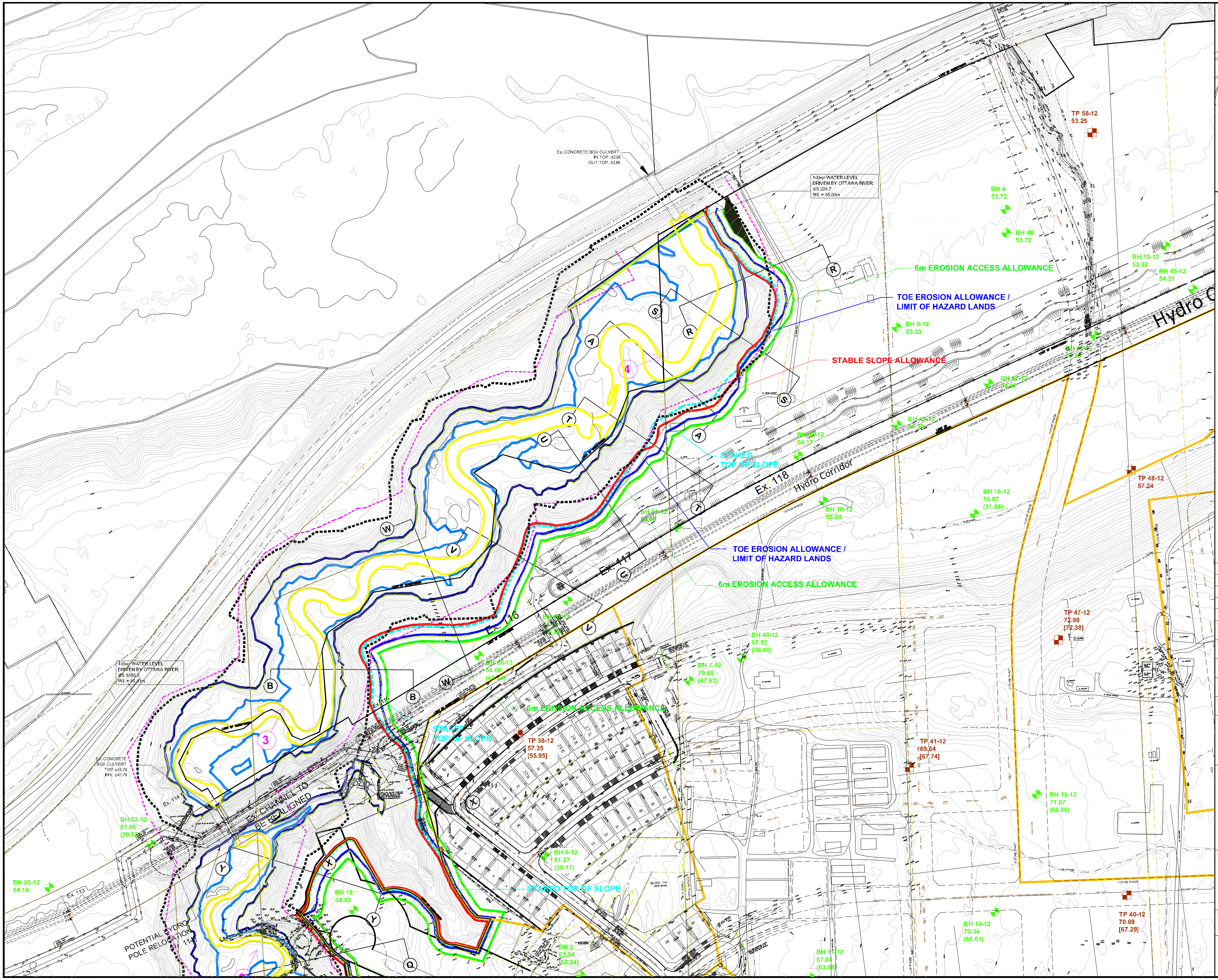
GEOTECHNICAL INVESTIGATION
CARDINAL CREEK VILLAGE
OTTAWA, ONTARIO

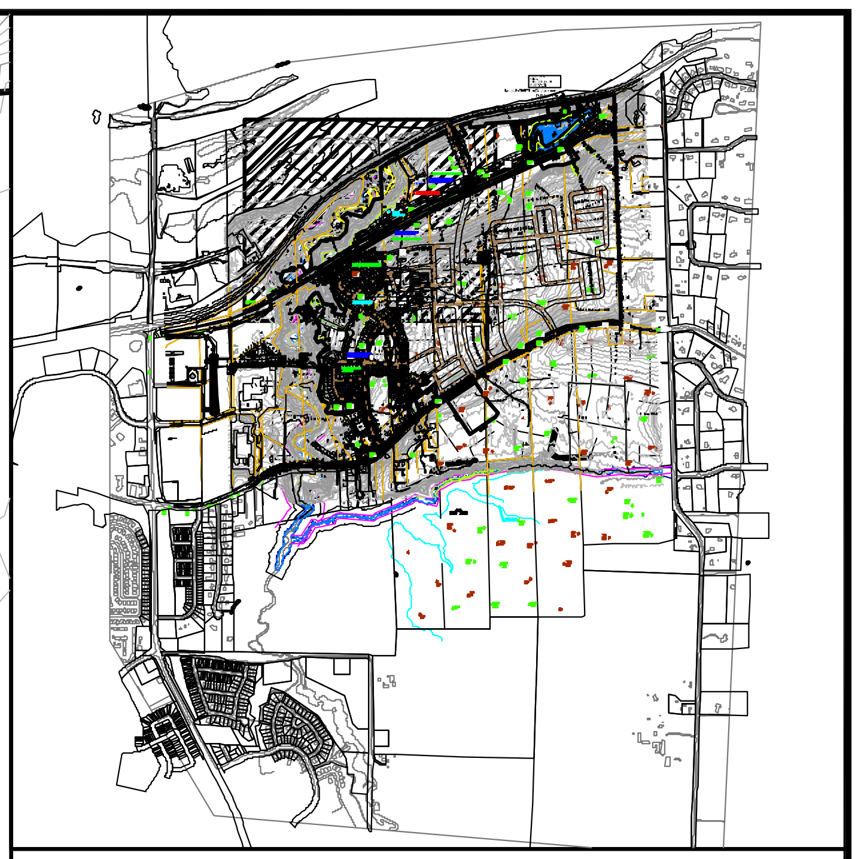
Title:

PERMISSIBLE GRADE RAISE AREAS - BUILDINGS

Stamp:

Drawn by: MPG
Checked by: DJG
Scale: 1:2500
Date: 03/2014
Report No.: PG1796
Drawing No.: PG1796-7





LEGEND:

⊕	BOREHOLE LOCATION
▣	TEST PIT LOCATION
71.07	GROUND SURFACE ELEVATION (m)
[68.86]	INFERRED BEDROCK SURFACE ELEVATION (m)
(68.30)	PRACTICAL REFUSAL TO AUGERING/DCPT ELEVATION (m)
F F	SLOPE CROSS-SECTION FOR SLOPE STABILITY ANALYSIS
9	PHOTOGRAPH TAKEN DURING SITE VISIT - APRIL 18, 2012
12	PHOTOGRAPH TAKEN DURING SITE VISIT - APRIL 9, 2009
----	URBAN GROWTH BOUNDARY
---	STAKED TOP OF SLOPE
—	6m EROSION ACCESS ALLOWANCE
—	TOE EROSION ALLOWANCE / LIMIT OF HAZARD LANDS
—	STABLE SLOPE ALLOWANCE
—	APPROX. 100 YEAR WATER LEVEL (JFSA, MARCH 2013)
—	APPROX. NHWM (2 YR WATER LEVEL) (JFSA, MARCH 2013)
----	30m SETBACK FROM NHWM (DSEL, MARCH 2013)
----	MEANDER BELT WIDTH (PARISH, MARCH 2013 - CARDINAL CREEK BASED ON VALUES FROM GEOMORPHIC SOLUTIONS, 2007)

NO.	DESCRIPTION	DATE
4	UPDATED BASE PLAN	22/09/2014
3	UPDATED BASE PLAN	09/05/2014
2	UPDATED BASE PLAN	14/03/2014
1	UPDATED BASE PLAN	23/08/2013

DESIGNED BY: DG
DRAWN BY: BA
CHECKED BY: DG
SCALE: 1:1500
DATE: 02/2013

CLIENT
TAMARACK (QUEEN STREET) CORPORATION

PROJECT/LOCATION
GEOTECHNICAL INVESTIGATION
CARDINAL CREEK VILLAGE
OTTAWA, ONTARIO

DRAWING
LIMIT OF HAZARD LANDS

DRAWING NO. **PG1796-8A**
REVISION NO. **4**

paterson group
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

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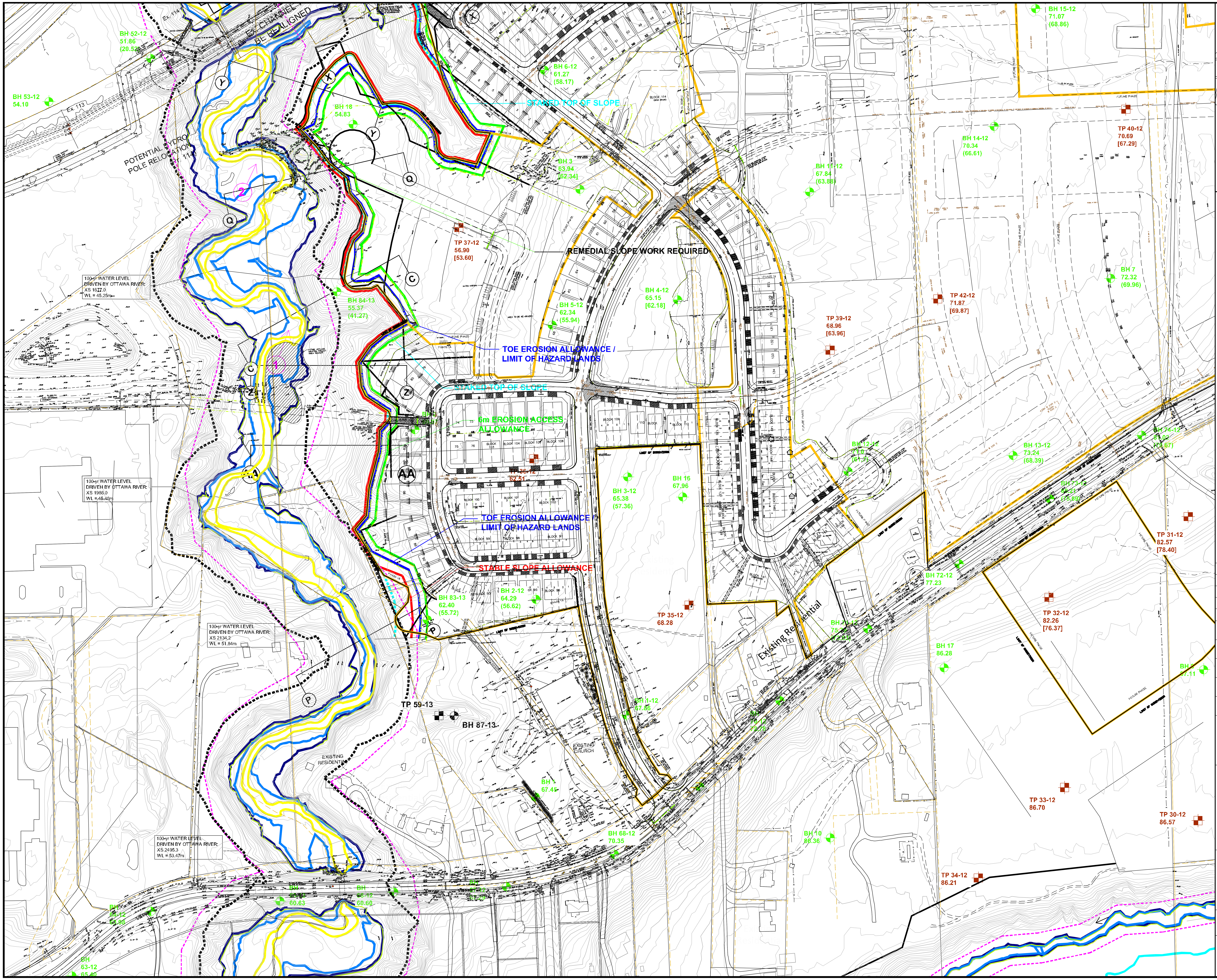

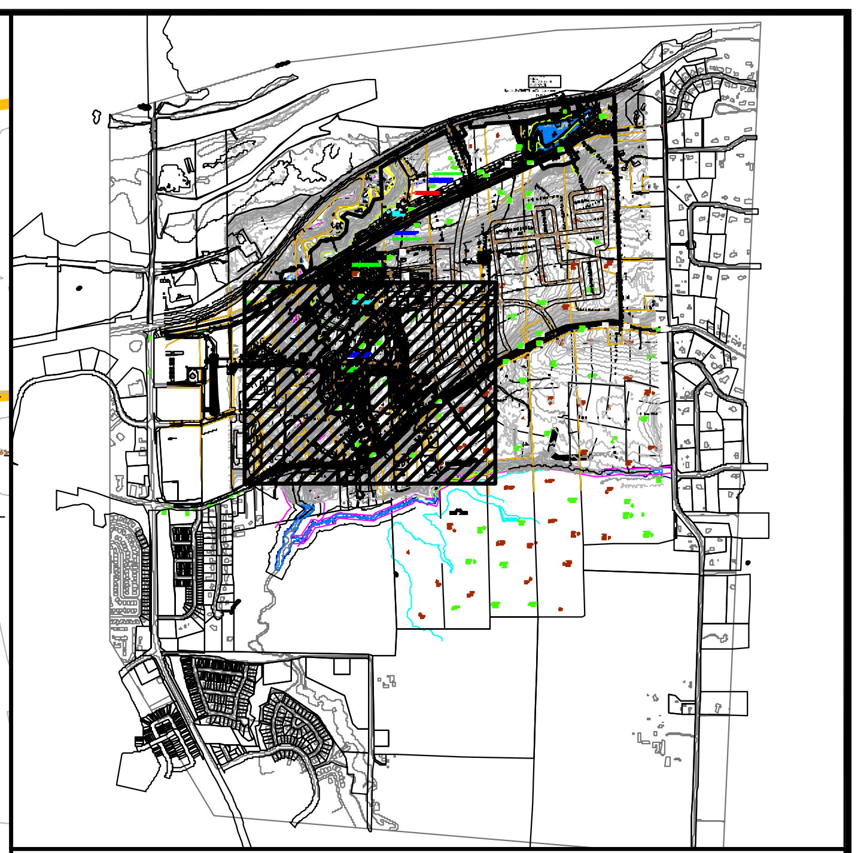

LEGEND:

⊕	BOREHOLE LOCATION
▨	TEST PIT LOCATION
71.07	GROUND SURFACE ELEVATION (m)
[68.86]	INFERRED BEDROCK SURFACE ELEVATION (m)
(68.30)	PRACTICAL REFUSAL TO AUGERING/DCPT ELEVATION (m)
F F	SLOPE CROSS-SECTION FOR SLOPE STABILITY ANALYSIS
⑨	PHOTOGRAPH TAKEN DURING SITE VISIT - APRIL 18, 2012
⑫	PHOTOGRAPH TAKEN DURING SITE VISIT - APRIL 9, 2009
▪▪▪▪	URBAN GROWTH BOUNDARY
▪▪▪	STAKED TOP OF SLOPE
▪▪▪	STAKED LIMIT LINE
▬	6m EROSION ACCESS ALLOWANCE
▬	TOE EROSION ALLOWANCE / LIMIT OF HAZARD LANDS
▬	STABLE SLOPE ALLOWANCE
▬	APPROX. 100 YEAR WATER LEVEL (JFSA, MARCH 2013)
▬	APPROX. NHWM (2 YR WATER LEVEL) (JFSA, MARCH 2013)
▪▪▪▪	30m SETBACK FROM NHWM (DSEL, MARCH 2013)
▪▪▪▪	MEANDER BELT WIDTH (PARISH, MARCH 2013 - CARDINAL CREEK BASED ON VALUES FROM GEOMORPHIC SOLUTIONS, 2007)

NO.	DESCRIPTION	DATE
4	UPDATED BASE PLAN	22/09/2014
3	UPDATED BASE PLAN	09/05/2014
2	UPDATED BASE PLAN	14/03/2014
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DESIGNED BY: DG
DRAWN BY: BA
CHECKED BY: DG
SCALE: 1:1500
DATE: 02/2013

CLIENT

**TAMARACK
(QUEEN STREET)
CORPORATION**

PROJECT/LOCATION

GEOTECHNICAL INVESTIGATION

**CARDINAL CREEK VILLAGE
OTTAWA, ONTARIO**

DRAWING

LIMIT OF HAZARD LANDS

DRAWING NO. **PG1796-8B**
REVISION NO. **4**

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LEGEND:

▨	3m TREE TO BUILDING SETBACK RECOMMENDATION FOR MODERATE WATER DEMAND TREES
⊕	BOREHOLE LOCATION
▣	TEST PIT LOCATION
71.07	GROUND SURFACE ELEVATION (m)
[68.86]	INFERRED BEDROCK SURFACE ELEVATION (m)
(68.30)	PRACTICAL REFUSAL TO DC/TREFUSAL ELEV ATION (m)
{71.70}	BEDROCK SURFACE ELEVATION (m)
[<48.7]	BEDROCK NOT ENCOUNTERED AT TEST PIT LOCATION

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NO.	REVISIONS	DATE	INITIAL
2	UPDATED BASE PLAN	22/09/2014	DJG
1	UPDATED BASE PLAN	9/05/2014	DJG

TAMARACK (QUEEN STREET) CORP.

GEOTECHNICAL INVESTIGATION
CARDINAL CREEK VILLAGE
OTTAWA, ONTARIO

Title:
RECOMMENDED TREE SETBACKS FOR BUILDINGS

Stamp:

Drawn by: MPG
Checked by: DJG
Scale: 1:2500
Date: 03/2014
Report No.: PG1796
Drawing No.: PG1796-17