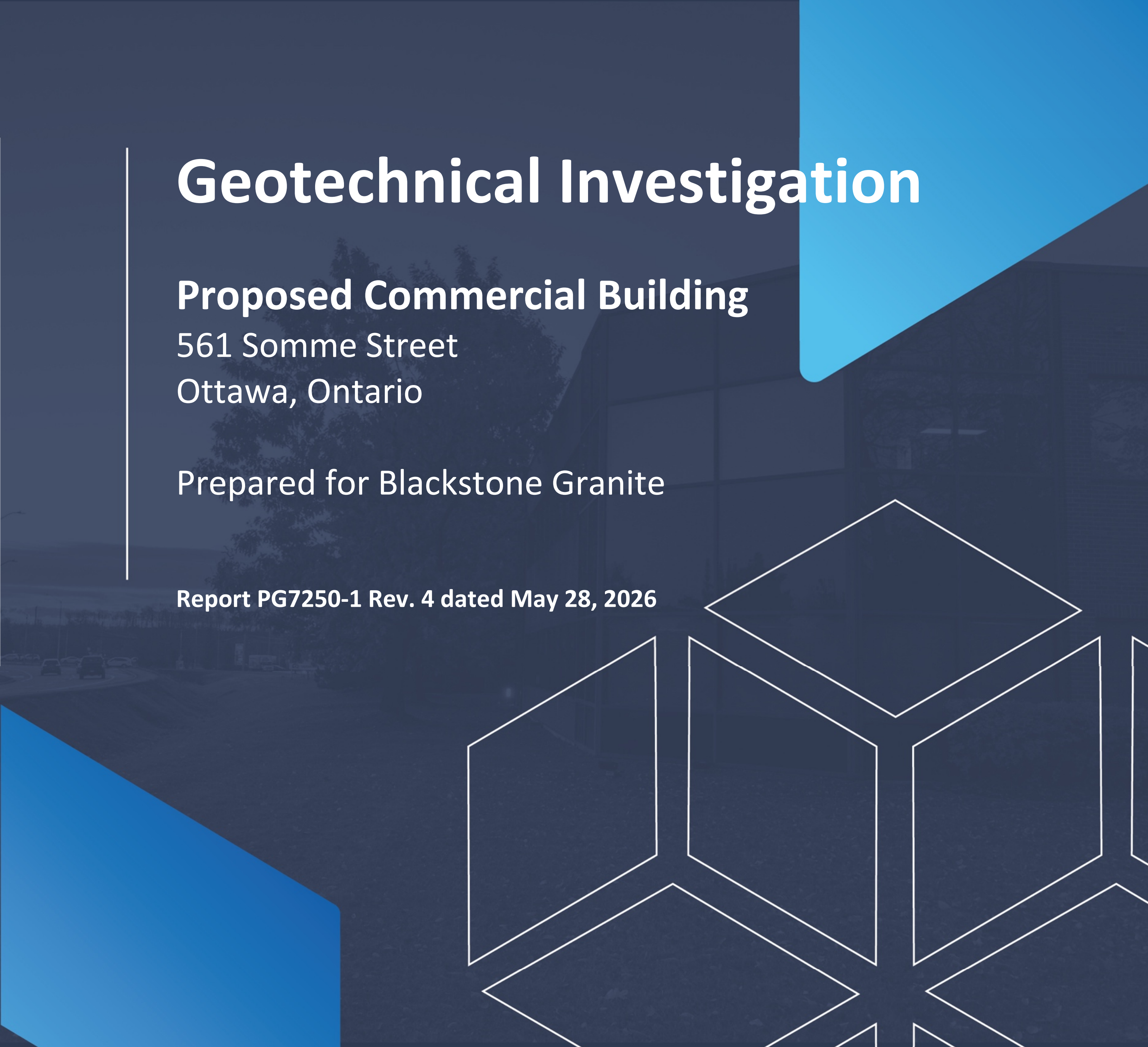
PATERSON GROUP



Geotechnical Investigation

Proposed Commercial Building

561 Somme Street
Ottawa, Ontario

Prepared for Blackstone Granite

Report PG7250-1 Rev. 4 dated May 28, 2026

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Blackstone Granite to conduct a geotechnical investigation for the proposed commercial building to be located at 561 Somme Street in the City of Ottawa (refer to Figure 1 - Key Plan in Appendix 2 of this report for the general site location).

The objectives of the geotechnical 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 the 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.

2.0 Proposed Development

Based on the available drawings, it is understood that the proposed development will consist of a 2-storey commercial building with a slab-on-grade and an approximate footprint of 2,800 m^2.

The proposed building will be surrounded by asphalt-paved access lanes, loading areas, and vehicle parking areas with landscaped margins.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the geotechnical investigation was carried out on September 9th, 2024, and consisted of a total of 4 boreholes sampled to a maximum depth of 6.8 m below ground surface. The borehole locations were distributed in a manner to provide general coverage of the proposed development, taking into consideration underground utilities and site features.

Previous field investigations performed in the area also included 2 boreholes, BH 3 by Paterson in December 2019 and borehole B2-2 by others in October 2008.

The locations of the boreholes are shown in Drawing PG7250-1-Test Hole Location Plan included in Appendix 2.

The boreholes were advanced using a track-mounted drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer.

Sampling and In Situ Testing

The borehole samples were recovered from the auger flights and using a 50 mm diameter split-spoon sampler. The samples were initially classified on-site, placed in sealed plastic bags, and transported to our laboratory. The depths at which the auger and split-spoon samples were recovered from the boreholes are shown as AU and SS, 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.

Groundwater

Two (2) flexible standpipe piezometers and 1 monitoring well were installed at select borehole locations to allow for groundwater level monitoring. The groundwater observations are discussed in Section 4.3 and are presented in the Soil Profile and Test Data sheets in Appendix 1.

3.2 Field Survey

The borehole locations, and the ground surface elevations at each borehole location, were surveyed by Paterson using a GPS unit with reference to a geodetic datum. The locations of the boreholes, and ground surface elevation at each borehole location, are presented in Drawing PG7250-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Review

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity, and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Section 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is currently vacant and consists of a gravel substrate. The site is bordered by Somme Street to the north, undeveloped land to the east, an aggregate quarry to the south, and a commercial property to the west.

The subject site is relatively level at an approximate geodetic elevation of 90 m. However, there is a slope at the southern end of the site which extends down to about geodetic elevation 86 m.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the site consists of fill and organic silt overlying the bedrock. The fill encountered generally consists of very loose to dense, brown silty sand to silty clay with varying amounts of gravel, cobbles, organics, and concrete, extending to approximate depths of 3.7 to 6.8 m below the ground surface.

A 0.4 m thick deposit of organic silt was encountered underlying the fill at boreholes BH 1-24 and BH 2-24, extending to approximate depths of 4.5 to 5.3 m below the ground surface, respectively. The organic silt was further underlain by silty sand and glacial till.

Within the recent boreholes, practical refusal to augering was encountered at depths ranging from 4.9 m to 6.7 m below the existing ground surface.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profile encountered at each borehole location.

Bedrock

Based on available geological mapping, the bedrock at the subject site consists of interbedded sandstone and dolomite of the March Formation.

4.3 Groundwater

Groundwater levels were recorded at each piezometer and monitoring well location on September 16, 2024, with additional water level readings done on July 4, 2025, March 26, 2026 and April 13, 2026. The measured groundwater levels are presented in Table 1 below, and on the Soil Profile and Test Data sheets are presented in Appendix 1.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Level (m)	Groundwater Elevation (m)	Recording Date
BH 1-24	90.60	Dry	-	Sept. 16, 2024
BH 2-24*	90.68	4.68	86.0	Sept. 16, 2024
		2.86	87.8	July 4, 2025
		2.81	87.87	March 26, 2026
		2.58	88.10	April 13, 2026
BH 3-24	91.15	Blocked	-	Sept. 16, 2024

Note: Ground surface elevations at borehole locations were surveyed by Paterson and are referenced to a geodetic datum.

* Denotes groundwater monitoring well.

Based on groundwater level readings completed by Paterson, the groundwater table is expected to be range from approximate 2.5 to 4.5 m below the existing ground surface, taking into consideration seasonal variation. As noted in table 1 above, groundwater was periodically measured at borehole BH 2-24 between September, 2024, and April, 2026. Groundwater levels are subject to seasonal fluctuations, therefore, the groundwater levels could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. Foundation support for the proposed building is recommended to consist of conventional spread footings bearing on the existing fill material which has undergone a successful ground improvement program using deep dynamic compaction.

Given the presence of silty clay within the fill material, a permissible grade restriction will be required for the proposed commercial building where the silty clay is present below the building footprint. The permissible grade raise recommendations are further discussed in Section 5.3.

Also, due to the presence of the slope at the southern end of the site, a slope stability analysis has been conducted to determine the Limit of Hazard Lands for development. This is discussed further in Section 6.8.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and any fill containing significant amounts of deleterious or organic materials should be stripped from under the proposed building and other settlement-sensitive structures.

However, it is anticipated that the existing fill within the proposed building footprint, free of deleterious material and significant amounts of organics, can be left in place below the proposed building slab-on-grade, outside of the lateral support zones for the footings. In this case, it is recommended that the existing fill layer be proof-rolled with several passes of a vibratory drum roller, under dry conditions and above freezing temperatures, and which is approved by Paterson personnel at the time of construction. Any poor-performing areas noted during the proof-rolling operation should be removed and replaced with an approved fill.

Engineered Fill Placement

Engineered fill used for grading beneath the proposed building, where required, should consist 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 and paved areas should be compacted to at least 98% of the material's standard Proctor maximum dry density (SPMDD).

Non-specified existing fill, along with site-excavated soil, can be used as general landscaping fill where settlement of the ground surface is of minor concern. This material should be placed in 300 mm lifts and at least compacted by the tracks of the spreading equipment to minimize voids.

Ground Improvement – Deep Dynamic Compaction

Ground improvement will be required at the subject site in order to sufficiently compact and densify the existing fill soils for foundation support of the proposed building.

Ground improvement programs are based on the level of density and the depth of improved soil required. The most appropriate ground improvement method for the proposed development at this site is considered to be deep dynamic compaction, which uses a heavy weight dropped repeatedly from a crane, and which is effective for compacting loose soils to significant depths.

Ground improvement programs are completed by design-build contractors. Accordingly, a detailed design submittal should be provided for Paterson's review and comment prior to the commencement of the ground improvement operations.

Vibration Considerations

Construction operations can be the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels should be incorporated into the construction operations to maintain, as much as possible, a cooperative environment with the users of the neighbouring sites.

The following could be sources of vibrations: ground improvement, compactor, dozer, crane, truck traffic, etc. Vibrations caused by deep dynamic compaction or other construction operations could be the cause or the source of detrimental vibrations on the nearby buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters are used to determine the permissible vibrations, namely, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz).

It should be noted that these guidelines are for today's construction standards. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, it is recommended that a pre-construction survey be completed to minimize the risks of claims during or following the construction of the proposed buildings.

Fill Placement

Fill used for grading beneath the building area 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 proposed building area 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 exterior 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.

5.3 Foundation Design

Bearing Resistance Values

Footings bearing on an undisturbed, existing fill bearing surface which has been adequately improved using deep dynamic compaction can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa.** A geotechnical resistance factor of 0.5 was applied to the above-noted bearing resistance value at ULS. Higher bearing resistance values may be applicable following consultation with the specialized ground improvement contractor.

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 prior to the placement of concrete for footings.

Footings bearing on an undisturbed soil and designed using the bearing resistance values provided above will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

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 the fill material bearing media when a plane extending down and out from the bottom edges of the footing, at a minimum of 1.5H:1V, passes only through in situ soil or engineered fill of the same or higher capacity as that of the bearing medium.

Permissible Grade Raise Recommendations

A permissible grade raise restriction of **2.0 m** above existing site conditions is recommended for the subject site. This permissible grade raise restriction is for the existing conditions at the subject site. Following ground improvement using deep dynamic compaction, the permissible grade raise restriction can be increased to **2.5 m.**

If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post-construction total and differential settlements. Provided sufficient time is available to induce the required settlements, consideration could be given to surcharging the subject site.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class X_D**. A higher seismic site class, such as Class **X_C**, may be achievable for this site. However, a site-specific shear wave velocity test would be required to accurately determine the applicable seismic site classification for the foundation design of the proposed building, as presented in Table 4.1.8.4.A of the Ontario Building Code (OBC) 2024.

5.5 Slab on Grade Construction

With the removal of all topsoil and fill containing significant amounts of deleterious or organic materials, the existing fill following proof-rolling is considered to be an acceptable subgrade on which to backfill for slab on grade construction.

The proof-rolling program should consist of a vibratory drum roller completing several passes over the existing fill subgrade, which should be observed and approved by Paterson. Any poor performing areas in the subgrade should be removed and reinstated with an engineered fill such as OPSS Granular A, Granular B Type II with a maximum particle size of 50 mm.

It is recommended that the upper 200 mm sub-floor fill consists of OPSS Granular A crushed stone. All backfill materials within the footprint of the proposed building should be placed in a maximum of 300 mm thick loose layers and compacted to at least 98% of the SPMDD.

5.6 Pavement Design

The proposed pavement structures for car-only parking areas, heavy truck parking areas and access lanes are presented in Tables 2 and 3 below.

Table 2 - Recommended Pavement Structure – Driveways and Access Lanes

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 II material placed over in situ fill	

Table 3 - Recommended Pavement Structure - Access Lanes and Heavy Truck Parking Areas

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
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ, soil or OPSS Granular B II material placed over in situ fill	

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 II material. The pavement granular base and subbase should be placed in a maximum of 300 mm thick lifts and compacted to a minimum of 99% of the material's SPMDD using suitable vibratory equipment.

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.

6.0 Design and Construction Precautions

6.1 Foundation Backfill

Since the proposed building will be immediately surrounded by walkways, it is recommended that the exterior of the foundation walls be backfilled with free-draining, non frost susceptible fill such as OPSS Granular B Type I or II granular material.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are recommended to be insulated against the deleterious effects of frost action. Generally, a minimum 1.5 m thick soil cover, or an equivalent combination of soil cover and foundation insulation, should be provided in this regard.

Exterior unheated footings, such as isolated piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure, and require additional protection, such as soil cover of 2.1 m, or an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e., unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. A flatter slope is required for excavation below the groundwater level. Excavations below the groundwater level should be cut back at a maximum slope of 1.5H:1V.

The subsoil at this site is considered to be mainly a Type 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. 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

Bedding and backfill materials should be in accordance with the most recent material specifications and standard detail drawings from the department of public works and services, infrastructure services branch of the City of Ottawa.

A minimum of 150 mm of OPSS Granular A should be placed for bedding of private sewer or water pipes when placed on a soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe, should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in a maximum of 225 mm thick lifts and compacted to 98% of the SPMDD.

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) and above the cover material, should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in a maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material’s SPMDD. All cobbles larger than 200 mm in their longest direction should be segregated from re-use as trench backfill.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavation should be low to moderate and controllable using open sumps. The contractor should be prepared to direct water away from all subgrades, regardless of the source, to prevent disturbance to the founding medium.

Groundwater Control for Building Construction

Under the current regulations enacted by the Ministry of Environment, Conservation and Parks (MECP), any dewatering in excess of 50,000 L/day requires a registration on the Environmental Activity and Sector Registry (EASR), provided that dewatering is related to construction. If the dewatering is not related to construction, a Permit to Take Water obtained from the MECP will be required.

In the event that an EASR is required to facilitate dewatering of the proposed development, a minimum of 3 to 4 weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan, to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. Should a Permit to Take Water be required, a minimum of 5 to 6 months should be allotted for completion of the permit, due to the minimum review period imposed by the MECP.

Impacts to Neighbouring Properties

It is not anticipated that the proposed building will be founded below the long-term groundwater level. Accordingly, short-term groundwater lowering during construction, and long-term groundwater lowering following construction, is not anticipated. Therefore, adverse effects are not anticipated for neighboring properties as a result of groundwater lowering.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site 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.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures using 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 the founding level.

Trench excavations and pavement construction are also difficult activities to complete during freezing conditions without introducing frost into the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (GU – General Use cement) would be appropriate for this site. The chloride content and pH of the sample indicate that they are not a significant factor in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a non-aggressive to slightly aggressive corrosive environment.

6.8 Slope & Global Stability Assessment

Paterson completed a field review of the slope along the southern property boundary of the site, as part of the current investigation. A global stability analysis was also required for the proposed retaining walls, which are greater than 1 m in height.

The field review generally consisted of observing surface conditions along the length of the slope face identifying the presence of vegetation, erosion and other features associated with slope stability.

The top of slope alignment was determined in the field by Paterson personnel based on our field observations and recorded using a high-precision handheld GPS unit.

Topographic surface elevations were measured along the slope to analyze the slope stability using SLIDE, a computer program for two-dimensional slope stability analysis. Overall, 1 slope cross-section (Section A-A’) throughout the above-noted location was analyzed as part of the slope stability analysis, and 1 location (Section B-B’) was analyzed for the global stability analysis of the proposed retaining walls.

Based on the results of our field observations and slope stability analysis, a Limit of Hazard Lands was assigned from the top of the slope for the above-noted cross-section A-A. The cross-section locations and associated Limit of Hazard Lands setbacks are presented on Drawing PG7250-1 – Test Hole Location Plan in Appendix 2.

Field Observations

The slope observed at the southern end of the site was observed to have an approximate incline ranging between 2H:1 to 1H:1V. The slope was noted to range between 4 m and 6 m in height. No signs of erosion, distress or sloughing were observed throughout the slope surface at the time of our field review.

Slope & Global Stability Analyses

The slope and global stability analysis was modelled using SLIDE, a computer program which permits a two-dimensional slope stability analysis calculating several methods including the Bishop’s method and the Morgenstern-Price Method, which are widely accepted slope and global stability analysis methods. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to forces 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 subsurface soil and groundwater conditions, a factor of safety greater than 1.0 is generally required for the failure risk to be considered acceptable.

A minimum factor of safety of 1.5 is generally recommended for conditions where the slope or wall failure would compromise permanent structures. An analysis considering seismic loading was also completed. A horizontal acceleration of 0.20 g was considered for the sections for the seismic loading condition. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

One (1) slope cross-section (Section A-A') was studied as the worst-case scenario for the slope. The cross-section location is presented in Drawing PG7250-1 – Test Hole Location Plan in Appendix 2. This cross-section selected for analysis represents the worst-case scenario, as it is the area with the greatest slope height and gradient, and is also the location nearest to the proposed building. Cross-section B-B' for the global stability analysis was studied as the greatest height of the proposed retaining wall.

It should be noted that details of the slope height and slope angle at the cross-section locations are presented in Figures 2 through 7 in Appendix 2, which are based on the topographic data obtained during the field investigation, as well as the available topographic data.

The effective and total strength soil parameters used for the static and seismic analyses were chosen based on the subsoil information recovered during the site investigation. The effective and total strength soil parameters used for the analyses are presented in Table 4.

Table 4 – Effective and Total Stress Soil Parameters

Soil Layer	Unit Weight (kN/m^3)	Friction Angle (degrees)	Cohesion (kPa)
Fill	18	32	-
Bedrock	22	-	-

Stable Slope Allowance

The static analysis results at slope cross-section A-A' using the Bishop's method and Morgenstern-Price method are presented in Figures 2 and 4, respectively, in Appendix 2. A factor of safety greater than 1.5 was noted for this analysis case.

The results of the analyses with seismic loading at slope cross-section A-A using the Bishop's method and Morgenstern-Price method are shown in Figures 3 and 5, respectively, presented in Appendix 2. The factor of safety for the slope was noted to be less than 1.1 under seismic condition, therefore, a Stable Slope Allowance setback of 1.6 m is required.

Toe Erosion and Erosion Access Allowance

No erosion or distress associated with erosion was observed at the time of our review, therefore, a toe erosion allowance is not considered to be required. However, as per the City of Ottawa slope stability guidelines, an erosion access allowance of 6 m was applied since a stable slope allowance is required.

Limit of Hazard Lands

The results of the slope stability assessment indicate that a Limit of Hazard Lands setback of **7.6 m,** measured from the top of the slope, should be provided for any proposed development at the subject site. The Limit of Hazard Lands setback line is shown on the attached Drawing PG7250-1 – Test Hole Location Plan in Appendix 2.

Global Stability Analysis

The results of the global stability analysis, presented on Figures 6 and 7 in Appendix 2, indicate that the proposed retaining walls will have factors of safety exceeding 1.5 and 1.1 under static and seismic conditions, respectively. Therefore, the proposed retaining walls will be stable, from a geotechnical perspective.

7.0 Recommendations

It is a requirement for the foundation data provided herein to be applicable that the following materials testing and observation program be performed by the geotechnical consultant.

☐ Review of the Grading Plan, from a geotechnical perspective.

☐ Observation of all bearing surfaces prior to the placement of concrete.

☐ Sampling and testing of the bituminous concrete including mix design reviews.

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

All excess soils, with the exception of engineered crushed stone fill, generated by construction activities that will be transported on-site or off-site should be handled as per ***Ontario Regulation 406/19: On-Site and Excess Soil Management***.

8.0 Statement of Limitations

The recommendations provided herein are in accordance with the present understanding of the project. Paterson requests permission to review the recommendations when the drawings and specifications are completed.

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 pit locations, Paterson requests immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the information provided in this report and determine the suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

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 Blackstone Granite or their agents, is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

Otillia McLaughlin, B. Eng.

LICENSED PROFESSIONAL ENGINEER
May 28, 2026
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Report Distribution:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

PATERSON GROUP

SOIL PROFILE AND TEST DATA

Geotechnical Investigation

561 Somme Street, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 379553.95 **NORTHING:** 5018673.72 **ELEVATION:** 90.60

PROJECT: Proposed Commercial Development

ADVANCED BY: CME-55 Low Clearance Drill

REMARKS:

DATE: September 9, 2024

FILE NO. : **PG7250**

HOLE NO. : **BH 1-24**

■ PEN. RESIST. (BLOWS/0.3m)
DCPT (50mm DIA. CONE)
20 40 60 80

△ REMOULDED SHEAR STRENGTH (kPa)
▲ UNDRAINED SHEAR STRENGTH (kPa)
20 40 60 80

PL (%) WATER CONTENT (%) LL (%)
20 40 60 80

SAMPLE DESCRIPTION		SAMPLE				
GROUND SURFACE	DEPTH / ELEVATION	TYPE AND NO.	RECOVERY (%)	N OR RQD	WATER CONTENT (%)	PIEZOMETER CONSTRUCTION
FILL: Brown silty sand with granular crushed stone and gravel	0.69m [89.91m]	AU 1				
FILL: Brown silty fine sand, with gravel	1.52m [89.08m]	SS 2	42	6-6-9-9 15		
- Trace asphalt below1.52 m depth	2.21m [88.39m]	SS 3	42	8-8-7-10 15		
FILL: Loose grey silty fine sand, with gravel, trace clay and cobbles		SS 4	33	3-1-1-1 2		
		SS 5	25	3-3-2-2 5		
	4.11m [86.49m]	SS 6	50	1-1-1-1 2		
ORGANIC SILT	4.50m [86.10m]					
Brown **SILTY** fine **SAND**, with gravel	4.88m [85.72m]	SS 8	25	4-4-50-/ 54		

End of Borehole

Practical refusal to augering at 4.88 m depth

(Dry - September 16, 2024)

PATERSON GROUP

SOIL PROFILE AND TEST DATA

Geotechnical Investigation

561 Somme Street, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 379585.96 **NORTHING:** 5018691.05 **ELEVATION:** 90.68

PROJECT: Proposed Commercial Development

ADVANCED BY: CME-55 Low Clearance Drill

REMARKS:

DATE: September 9, 2024

FILE NO. : PG7250

HOLE NO. : BH 2-24

SAMPLE DESCRIPTION	DEPTH (m)	ELEVATION (m)
GROUND SURFACE	0.00m	[90.68m]
FILL: Brown silty sand with granular crushed stone and gravel	1.07m	[89.61m]
FILL: Brown silty find sand with gravel, trace clay and topsoil	2.59m	[88.09m]
Fill: Grey silty fine sand with gravel, trace clay and concrete	4.88m	[85.80m]
ORGANIC SILT	5.26m	[85.42m]
GLACIAL TILL: Compact brown silty sand with gravel and shale fragments	5.64m	[85.04m]

End of Borehole

Practical refusal to augering at 5.64 m depth

(GWL at 4.68 m depth - September 16, 2024)
(GWL at 2.86 m depth - July 4, 2025)
(GWL at 2.81 m depth - March 26, 2026)
(GWL at 2.58 m depth - April 13, 2026)

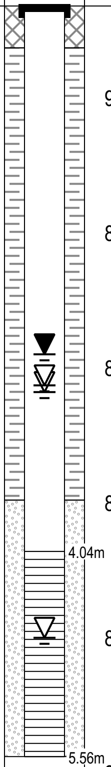
TYPE AND NO.	RECOVERY (%)	N OR RQD	WATER CONTENT (%)
AU 1			
SS 2	67	13-13-6-4 19	
SS 3	83	9-20-18-6 38	
SS 4	67	8-12-7-5 19	
SS 5	33	5-6-12-8 18	
SS 6	58	4-5-3-4 8	
SS 7	75	4-4-8-7 12	
SS 8	66	4-9-50-/ 59	

■ PEN. RESIST. (BLOWS/0.3m)
DCPT (50mm DIA. CONE)
20 40 60 80

△ REMOULDED SHEAR STRENGTH (kPa)
▲ UNDRAINED SHEAR STRENGTH (kPa)
20 40 60 80

PL (%) WATER CONTENT (%) LL (%)
20 40 60 80

MONITORING WELL CONSTRUCTION



PATERSON GROUP

SOIL PROFILE AND TEST DATA

Geotechnical Investigation

561 Somme Street, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 379587.41 **NORTHING:** 5018631.59 **ELEVATION:** 91.15

PROJECT: Proposed Commercial Development

ADVANCED BY: CME-55 Low Clearance Drill

REMARKS:

DATE: September 9, 2024

FILE NO. : PG7250

HOLE NO. : BH 3-24

SAMPLE DESCRIPTION

GROUND SURFACE

SAMPLE DESCRIPTION	Bottom depth [elevation]
FILL: Brown silty sand and gravel	1.45m [89.70m]
FILL: Brown silty sand and gravel, trace clay	2.21m [88.94m]
FILL: Brown silty sand and gravel, some clay, trace asphalt	3.35m [87.80m]
FILL: Brown silty sand, with gravel and shale fragments	4.50m [86.65m]
FILL: Grey silty clay some sand and gravel, trace organics	6.78m [84.37m]

End of Borehole

Practical refusal to augering at 6.78 m depth

TYPE AND NO.	RECOVERY (%)	N OR RQD	WATER CONTENT (%)
AU 1			
SS 2	50	11-11-8-3 19	
SS 3	75	9-5-4-3 9	
SS 4	67	4-2-5-6 7	
SS 5	67	8-13-12-5 25	
SS 6	33	8-10-5-6 15	
SS 7	33	9-5-3-2 8	
SS 8	50	3-1-1-2 2	
SS 9	17	2-3-5-4 8	
SS 10		50-/-/-/ 50/None	

■ PEN. RESIST. (BLOWS/0.3m) DCPT (50mm DIA. CONE) 20 40 60 80

△ REMOULDED SHEAR STRENGTH (kPa)

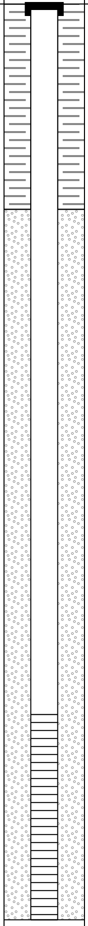
▲ UNDRAINED SHEAR STRENGTH (kPa) 20 40 60 80

PL (%) WATER CONTENT (%) LL (%) 20 40 60 80

DEPTH (m): 1 2 3 4 5 6 7 8 9 10

ELEVATION (m): 91 90 89 88 87 86 85 84 83 82

PIEZOMETER CONSTRUCTION



SOIL PROFILE AND TEST DATA

Geotechnical Investigation

561 Somme Street, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 379645.48 **NORTHING:** 5018681.23 **ELEVATION:** 90.48

PROJECT: Proposed Commercial Development

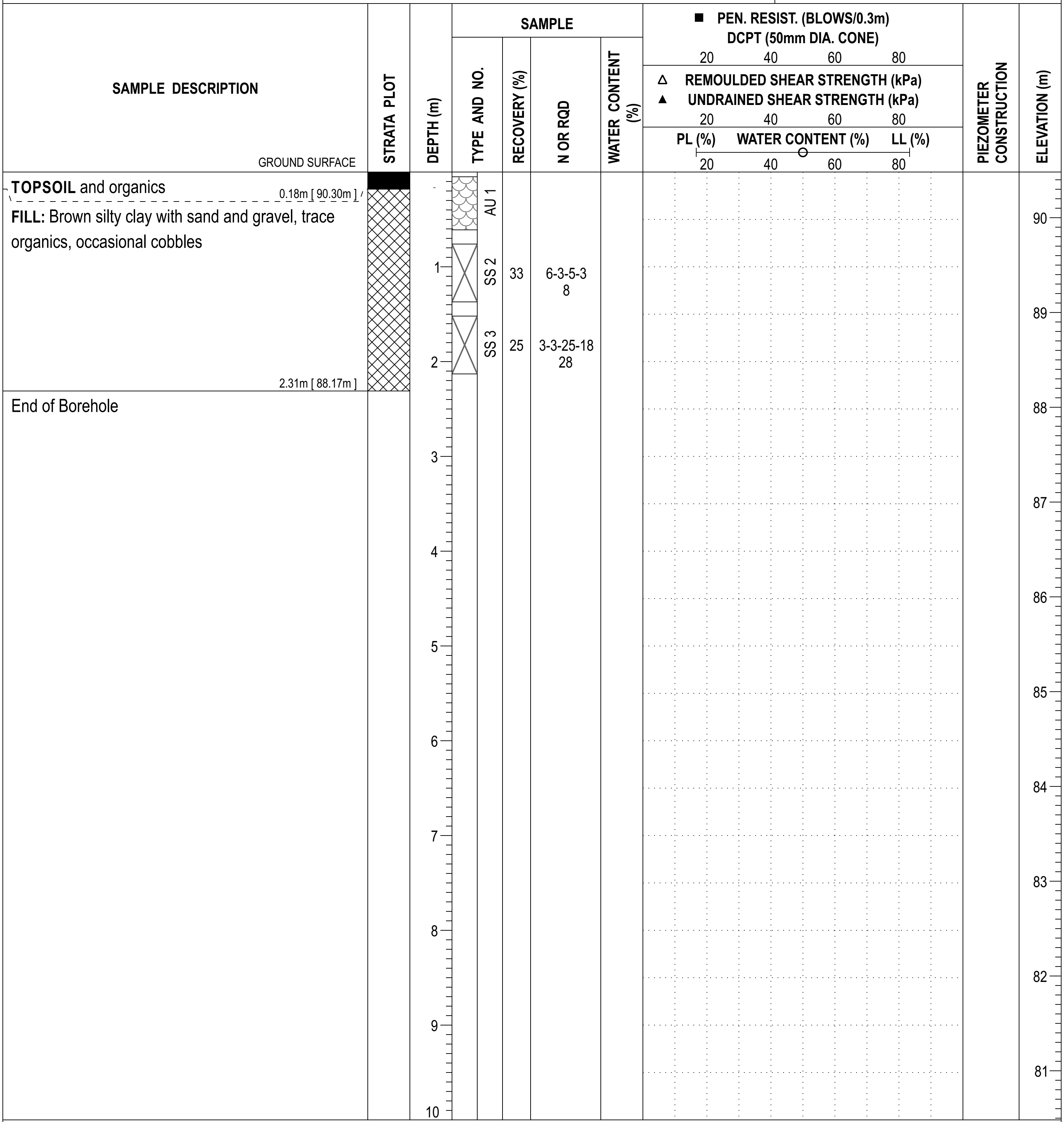
ADVANCED BY: CME-55 Low Clearance Drill

REMARKS:

DATE: September 9, 2024

FILE NO. : PG7250

HOLE NO. : BH 4-24



SAMPLE DESCRIPTION	TYPE AND NO.	RECOVERY (%)	N OR RQD	WATER CONTENT (%)
TOPSOIL and organics 0.18m [90.30m]	AU 1			
FILL: Brown silty clay with sand and gravel, trace organics, occasional cobbles	SS 2	33	6-3-5-3 8	
2.31m [88.17m]	SS 3	25	3-3-25-18 28	
End of Borehole				

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
5123 Hawthorne Road
Ottawa, Ontario

DATUM Ground surface elevations provided by the client.

REMARKS

BORINGS BY CME 55 Power Auger

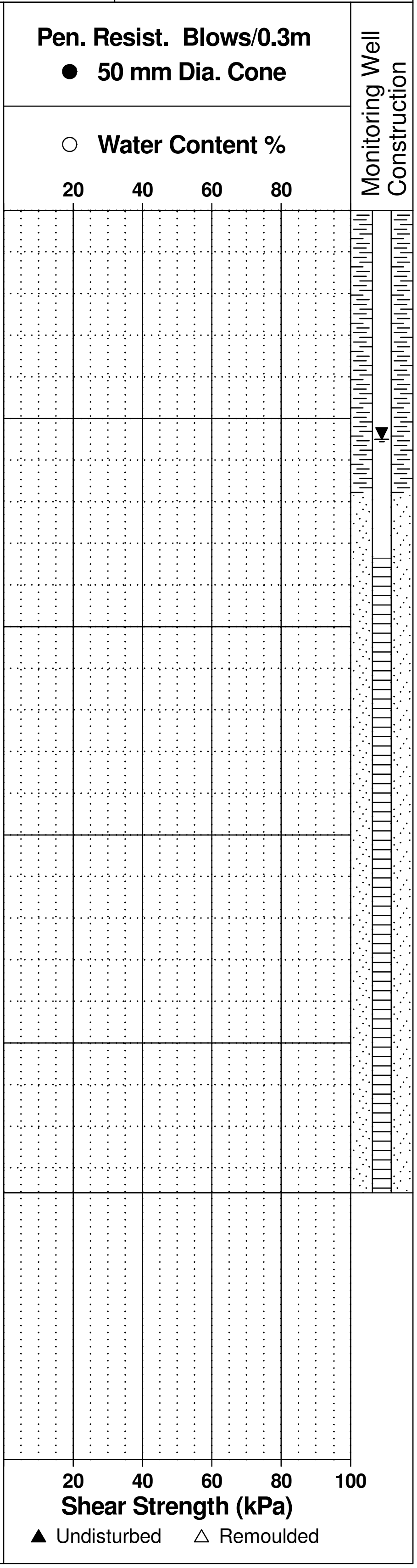
DATE December 10, 2019

FILE NO. PG5306

HOLE NO. BH 3

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE				
FILL: Brown sandy silt, trace organics and plastic	AU	1		
0.60				
FILL: Grey-brown silty sand, some gravel, pieces of asphalt	SS	2	33	13
1.68				
SHALEY FILL	SS	3	54	5
	SS	4	67	50
	SS	5	54	6
3.66				
Loose to compact, brown **SILT,** occasional sand and gravel	SS	6	33	5
	SS	7	100	50+
4.72				
End of Borehole				
(GWL @ 1.10m - Dec. 16, 2019)				

DEPTH (m)	ELEV. (m)
0	89.37
1	88.37
2	87.37
3	86.37
4	85.37



REFERENCE No.: T020556-A1

ENCLOSURE No.: 9

INSPEC·SOL

BOREHOLE No.: B2-2

ELEVATION: 88.57 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: R.W.Tomlinson Ltd.

PROJECT: Geotechnical Investigation

LOCATION: Lot 26 and 27, concession 6, Ottawa, Ontario

DESCRIBED BY: B.Beveridge CHECKED BY: J.Bennett

DATE (START): October 28, 2008 DATE (FINISH): October 28, 2008

LEGEND

☒ SS	Split Spoon
▨ ST	Shelby Tube
◫ RC	Rock Core
▼	Water Level
○	Water content (%)
├─┤	Atterberg limits (%)
● N	Penetration Index based on Split Spoon sample
• N	Penetration Index based on Dynamic Cone sample
△ Cu	Shear Strength based on Field Vane
□ Cu	Shear Strength based on Lab Vane
S	Sensitivity Value of Soil
▲	Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Organic Vapour ppm or %LEL	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	88.57		GROUND SURFACE			%	ppm	N	
		☒	FILL- sand, some gravel, organics, loose, blackish brown, moist						
1.0		☒		☒	SS1	38		8	●
	87.15		End of Borehole Auger Refusal Assumed Bedrock						
2.0									
3.0									
4.0									
5.0									
6.0									
7.0									
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									

NOTES:

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 relative strength of cohesionless soils is the compactness condition, 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.

Compactness Condition	‘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 shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity: $S_t < 2$
Medium Sensitivity: $2 < S_t < 4$
Sensitive: $4 < S_t < 8$
Extra Sensitive: $8 < S_t < 16$
Quick Clay: $S_t > 16$

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 NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, 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, generally recovered using a piston sampler
G - "Grab" sample from test pit or surface materials
AU - Auger sample or bulk sample
WS - Wash sample
RC - Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC% - Natural water 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 at 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)

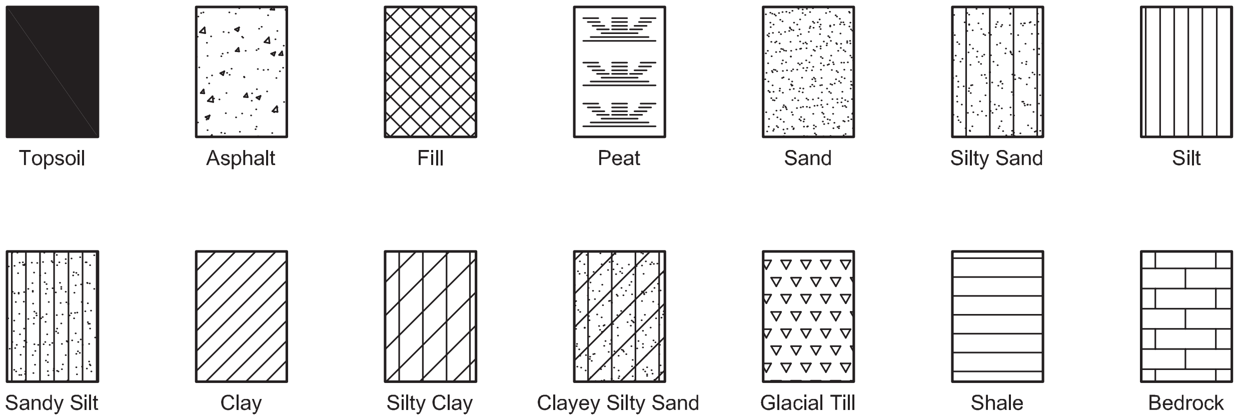
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

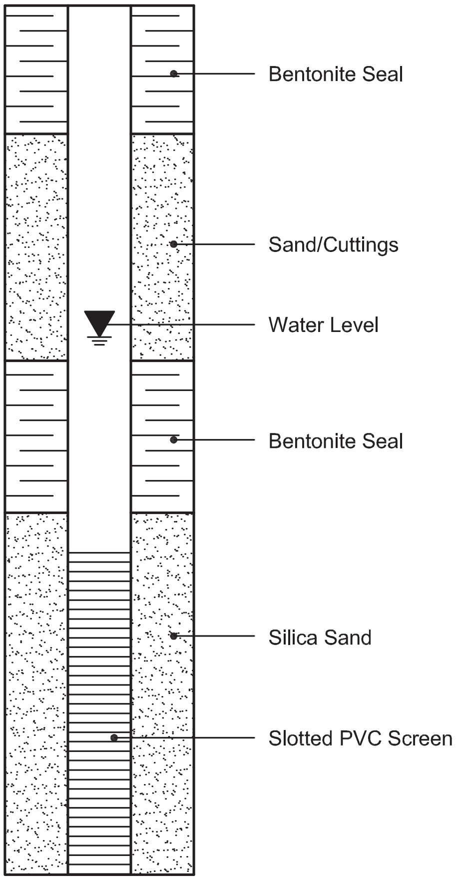
SYMBOLS AND TERMS (continued)

STRATA PLOT

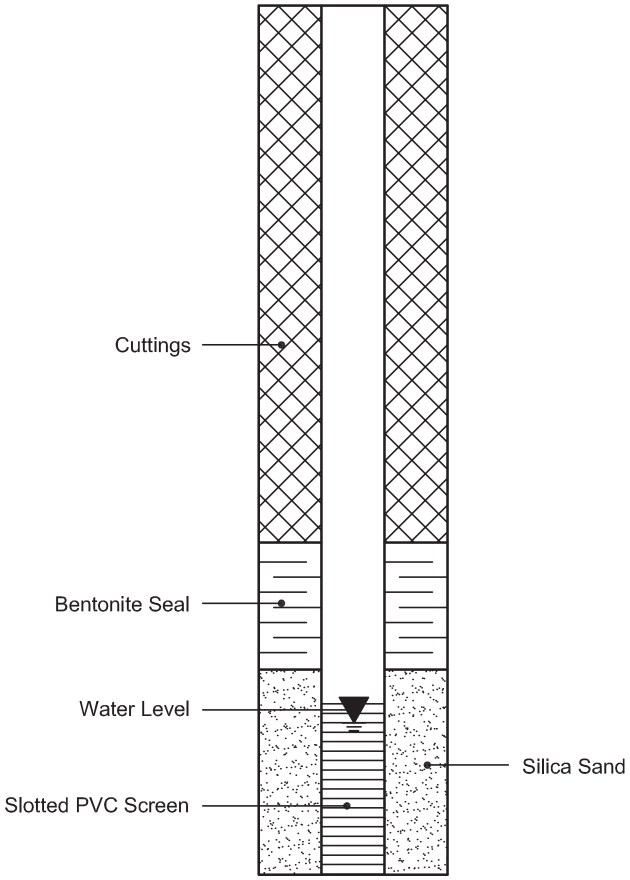


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 13-Sep-2024

Client: **Paterson Group Consulting Engineers (Ottawa)**

Order Date: 10-Sep-2024

Client PO:

Project Description: PG7250

Client ID:		BH2-24-SS3-5'-7'	-	-	-		
Sample Date:		09-Sep-24 09:00	-	-	-	-	-
Sample ID:		2437244-01	-	-	-		
Matrix:		Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	89.6	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	6.96	-	-	-	-	-
Resistivity	0.1 Ohm.m	4.5	-	-	-	-	-
Anions							
Chloride	10 ug/g	17	-	-	-	-	-
Sulphate	10 ug/g	3690	-	-	-	-	-

APPENDIX 2

FIGURE 1 – KEY PLAN

FIGURES 2 TO 7 – SLOPE STABILITY ANALYSIS SECTIONS

DRAWING PG7250-1 - TEST HOLE LOCATION PLAN

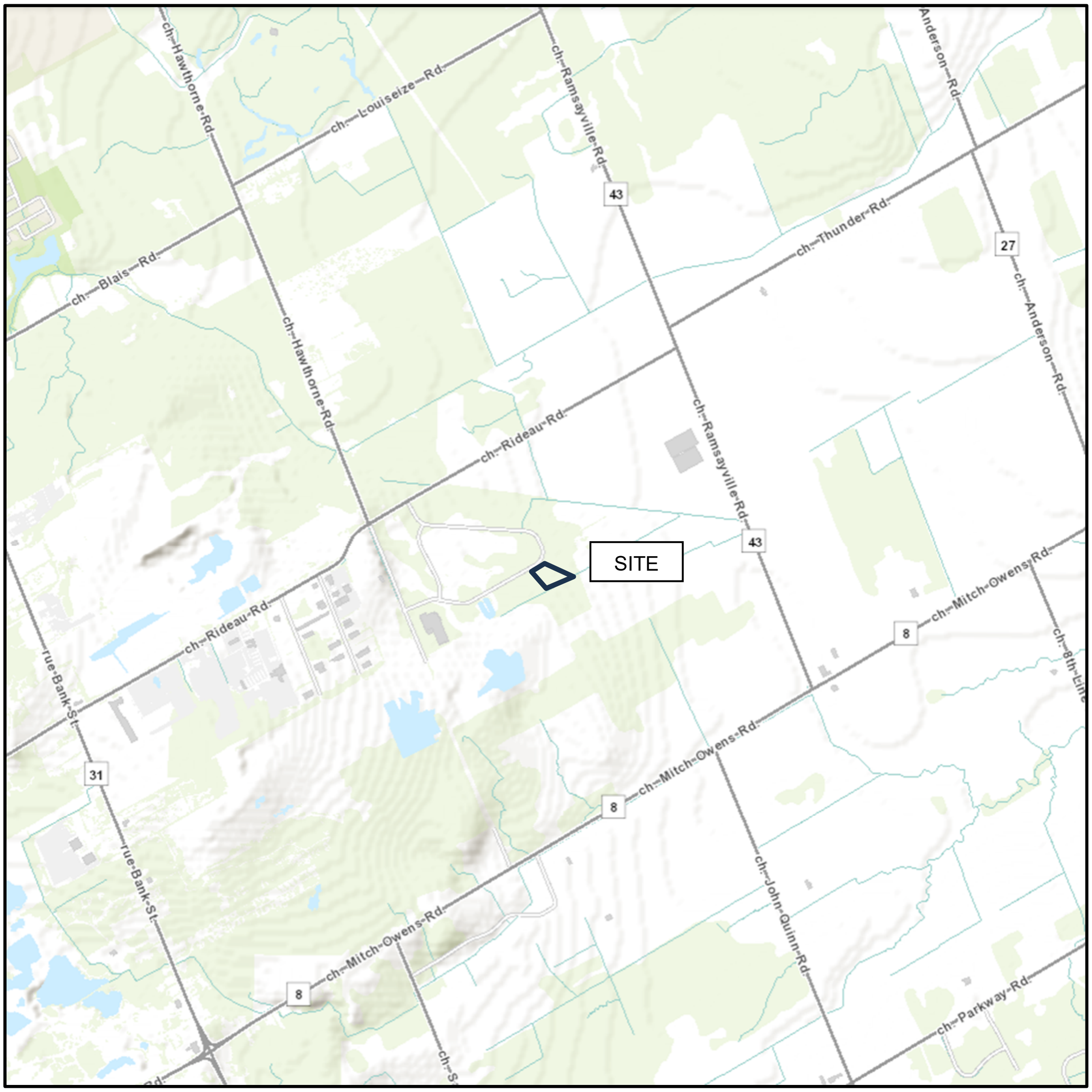


FIGURE 1

KEY PLAN

PATERSON
GROUP

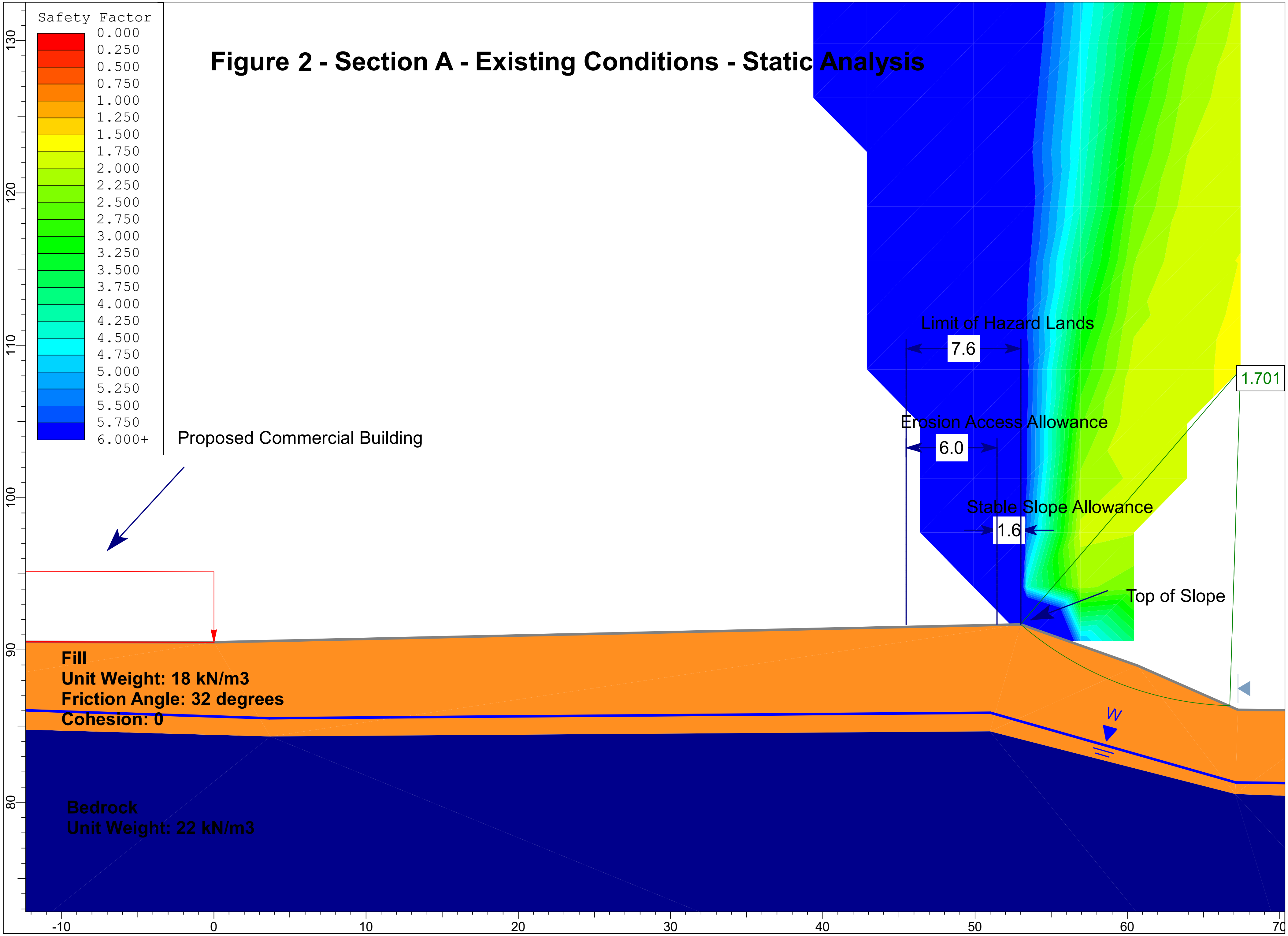


Figure 2 - Section A - Existing Conditions - Static Analysis

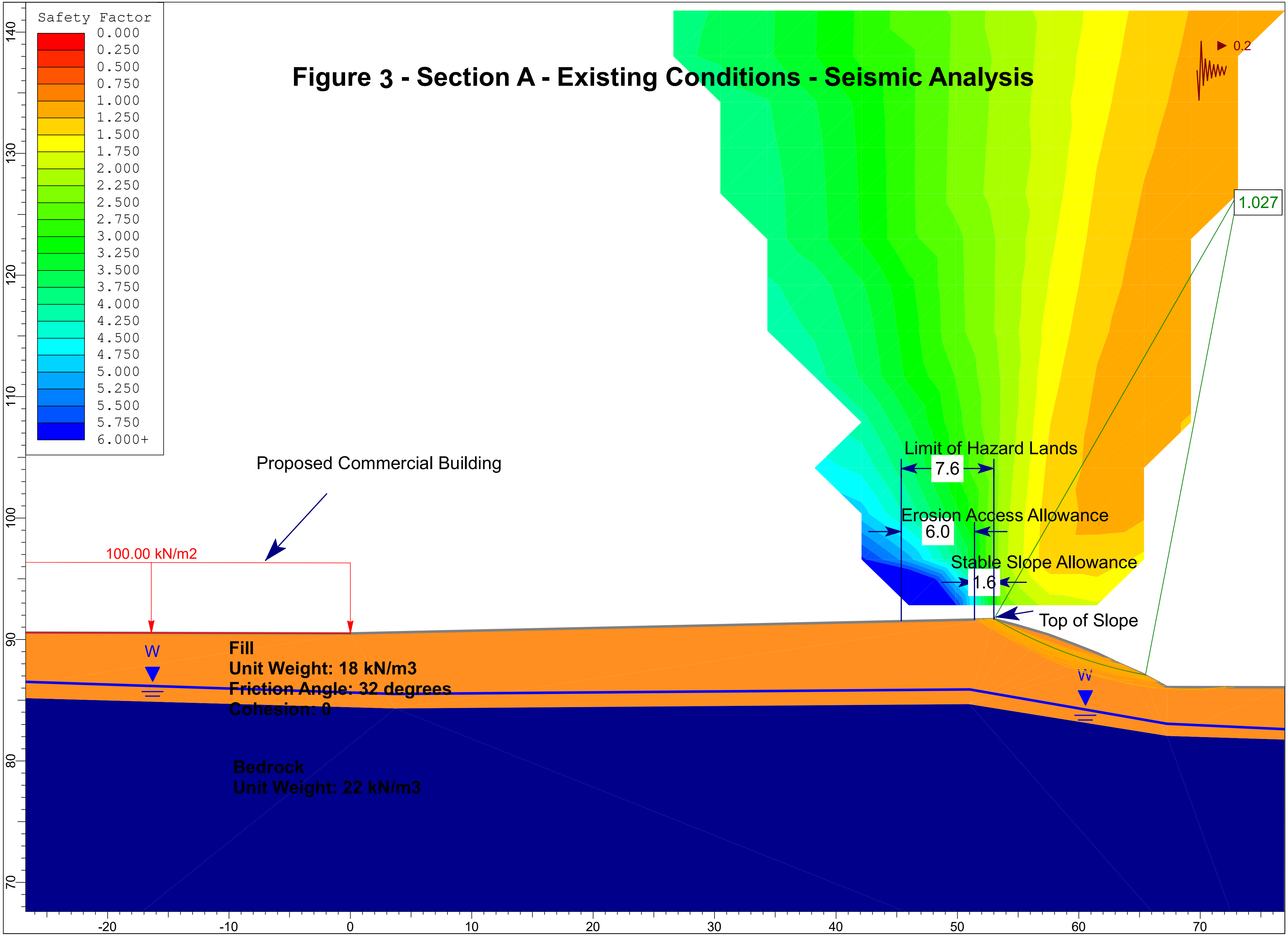


Figure 3 - Section A - Existing Conditions - Seismic Analysis

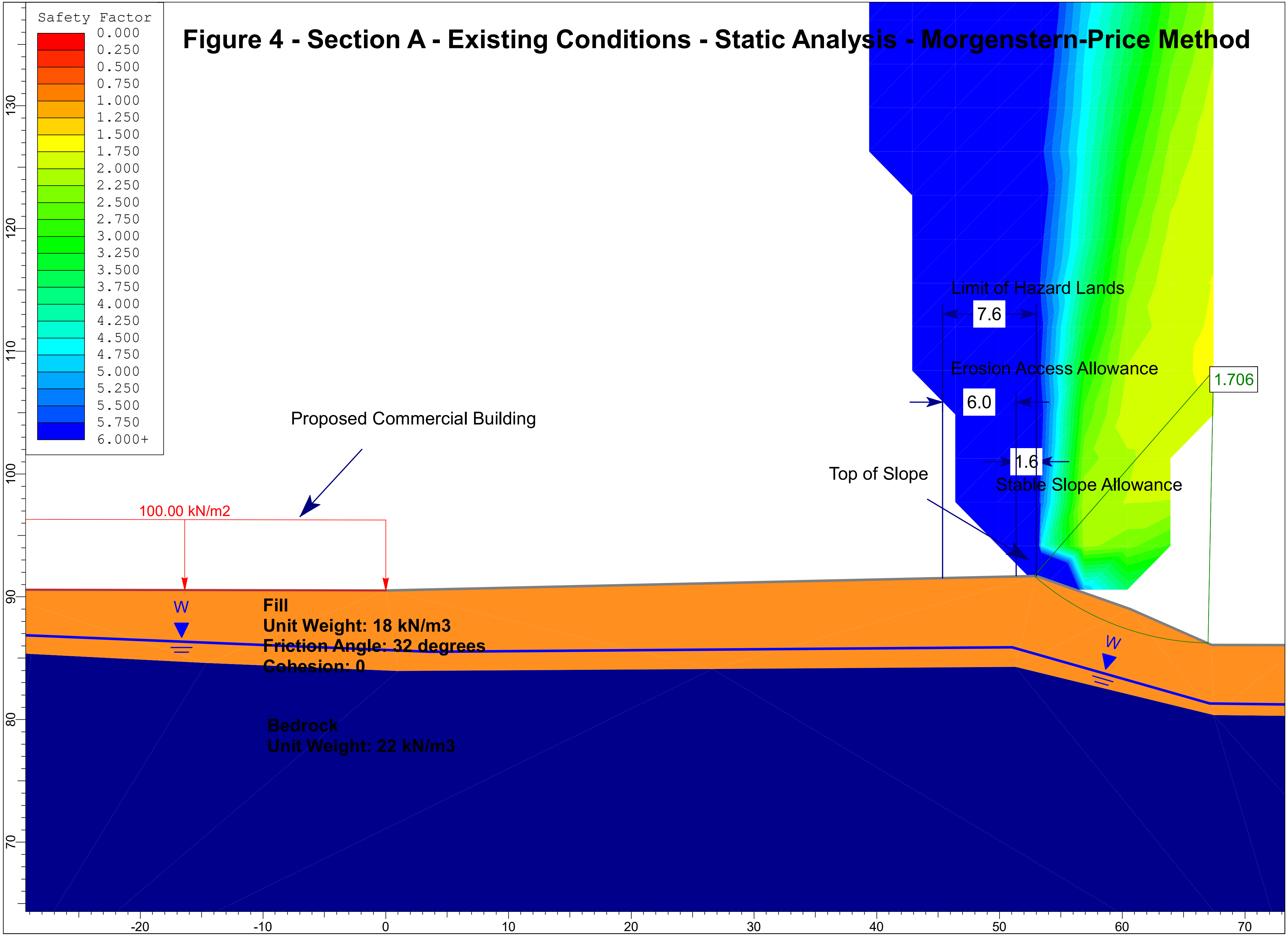


Figure 4 - Section A - Existing Conditions - Static Analysis - Morgenstern-Price Method

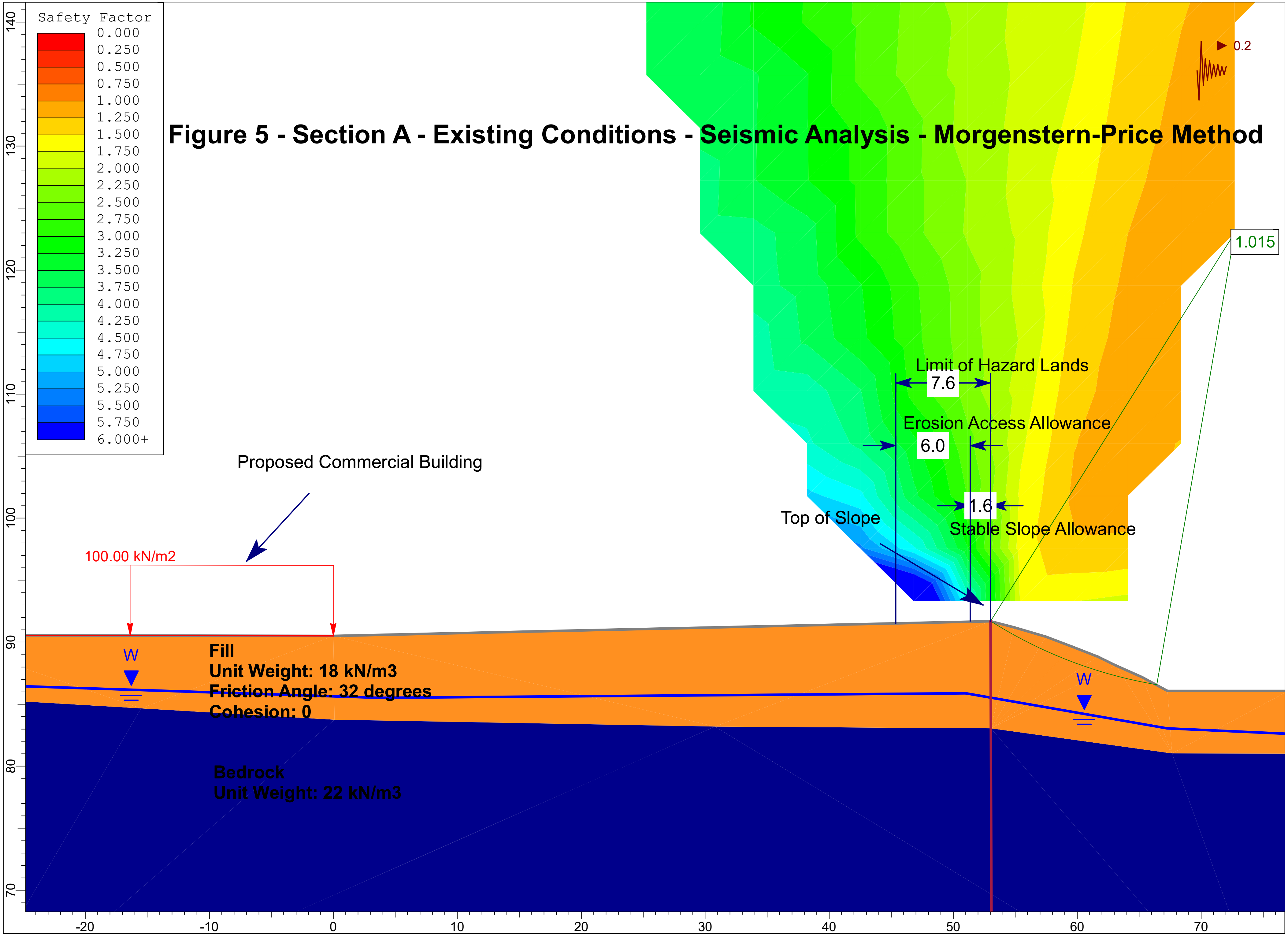


Figure 5 - Section A - Existing Conditions - Seismic Analysis - Morgenstern-Price Method

Figure 6 - Section B - Global Stability - Static Analysis

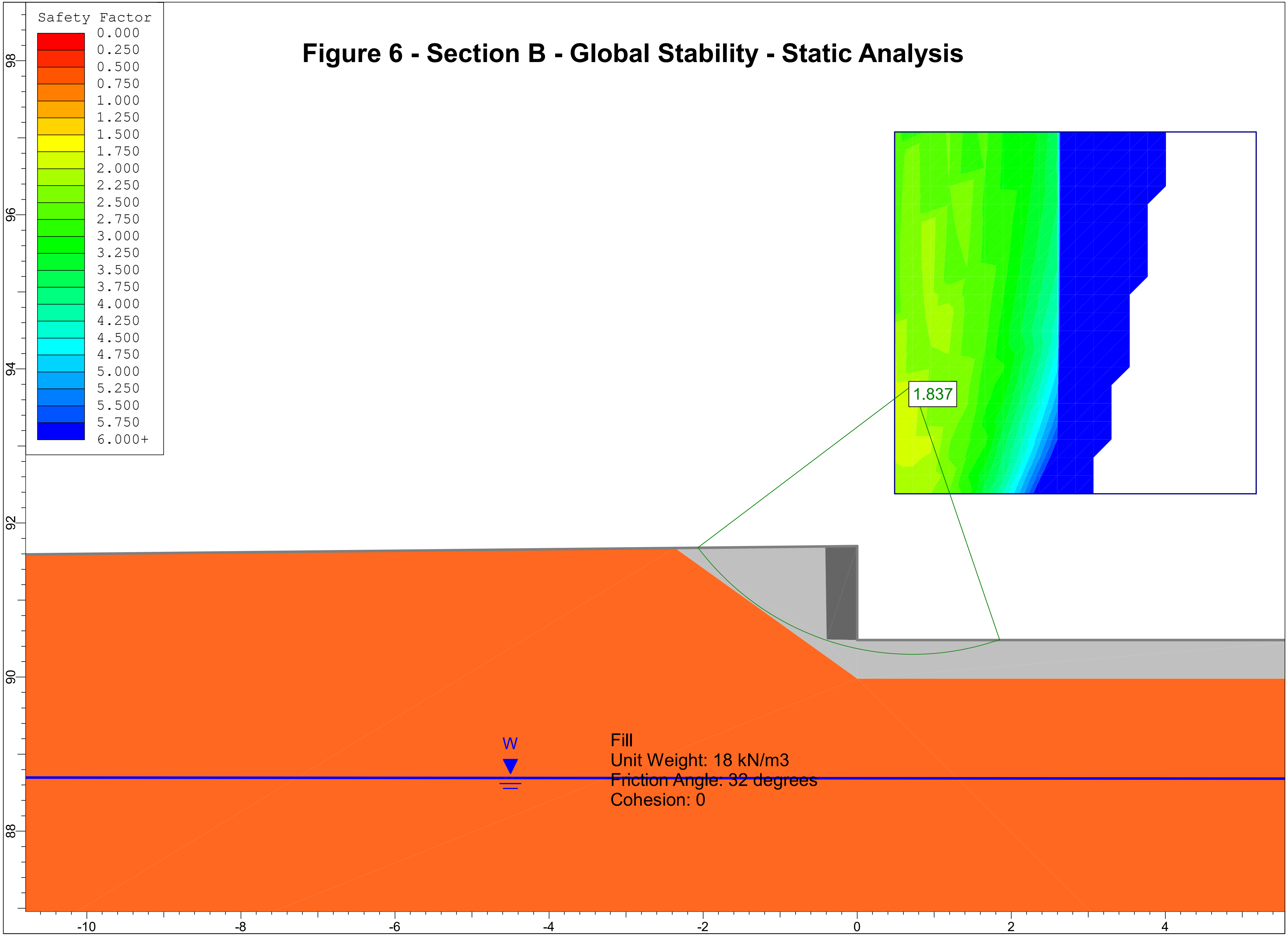
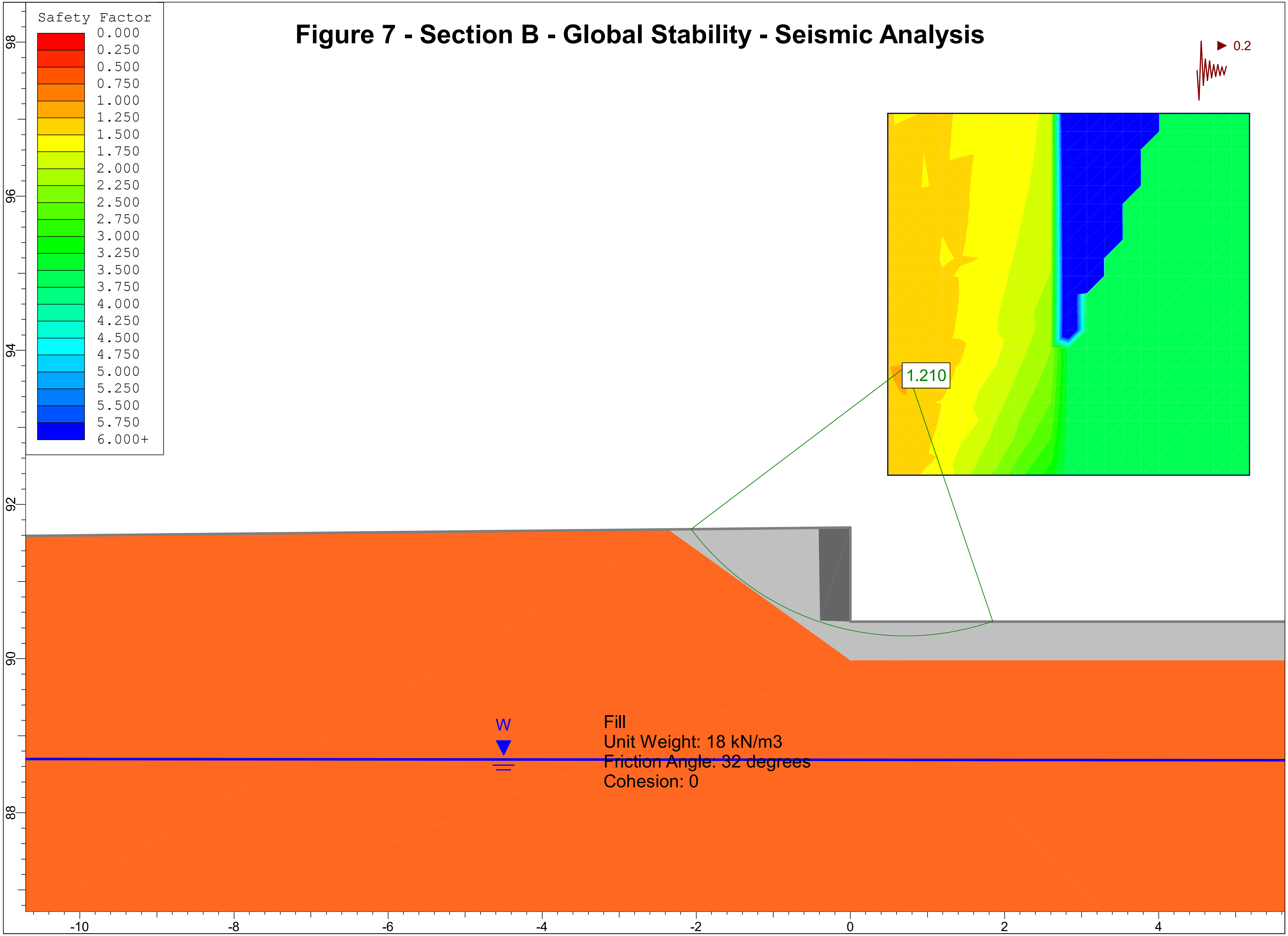
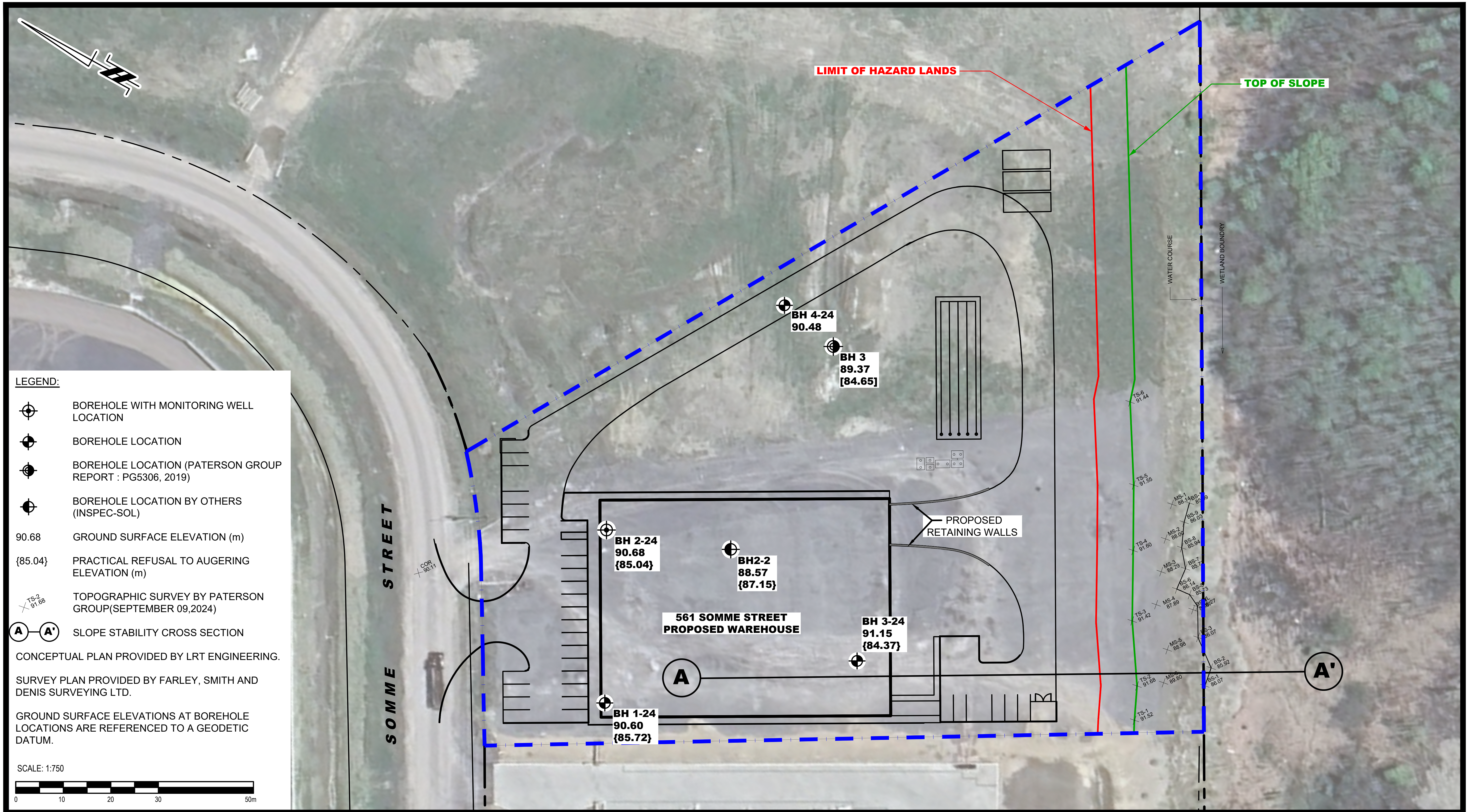


Figure 7 - Section B - Global Stability - Seismic Analysis





LEGEND:

⊕	BOREHOLE WITH MONITORING WELL LOCATION
⊕	BOREHOLE LOCATION
⊕	BOREHOLE LOCATION (PATERSON GROUP REPORT : PG5306, 2019)
⊕	BOREHOLE LOCATION BY OTHERS (INSPEC-SOL)
90.68	GROUND SURFACE ELEVATION (m)
{85.04}	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)
TS-2 91.68	TOPOGRAPHIC SURVEY BY PATERSON GROUP(SEPTEMBER 09,2024)
A—A'	SLOPE STABILITY CROSS SECTION

CONCEPTUAL PLAN PROVIDED BY LRT ENGINEERING.

SURVEY PLAN PROVIDED BY FARLEY, SMITH AND DENIS SURVEYING LTD.

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:750

0 10 20 30 50m

PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
1	UPDATED CONCEPTUAL PLAN	02/09/2025	OM

BLACKSTONE GRANITE
GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
561 SOMME STREET
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:750
Date: 09/2024
Drawn by: GK
Report No.: PG7250-1
Checked by: OM
Dwg. No.: PG7250-1
Approved by: SD
Revision No.: 1

p:\autocad drawings\geotechnical\pg72xx\pg7250\pg7250- 1 test hole location plan (rev.01).dwg

11x17