PATERSON GROUP

memorandum

re: **Retaining Wall Global Stability Review**
Proposed Multi-Storey Building
1815 Montreal Road – Ottawa, Ontario

to: Creative Development Ventures **– Catherine Humphrey –** catherine@creativedevventures.com
cc: CSV Architects **– Lee-Christine Bushey** – bushey@csv.ca
date: October 20, 2023
file: PG6594-MEMO.03

Further to your request and authorization, Paterson Group (Paterson) prepared the current memorandum to provide the results of the global stability analysis for the proposed retaining wall structures to be located at the aforementioned site. This memorandum should be read in conjunction with the Geotechnical Investigation Report (Paterson Group Report PG6594-1 dated May 16, 2023) and Geotechnical Response to City Comment memo (Paterson Group Memo PG6594-MEMO.01 Revision 1 dated October 20, 2023).

The following plan, prepared by McIntosh Perry, was reviewed as part of our global stability analysis:

- ❑ Lot Grading, Drainage, Erosion & Sediment Control Plan – 9-Storey Apartment Building, 1815 Montreal Road – Project No. CCO-23-3469 – Drawing No. C101 - Revision 2 dated October 5, 2023.

The following sections provide a summary of our analysis results and our associated conclusions.

1.0 Proposed Development

Based on the available drawings provided, it is understood that a multi-storey residential building with 2 basement levels below the street grade along Montreal Road. Retaining walls with heights greater than 1 m are proposed to be constructed along the east, west, and north sides of the building.

2.0 Field Observations

Surface Conditions

The southern half of the subject site is currently occupied by an existing 1-storey residential building. The remaining portion of the site is generally undeveloped with mature trees present throughout most of the site.

The site is bordered by residential properties to the east and west, Rothwell Drive to the north and Montreal Road to the south. The ground surface across the site generally slopes downward in a south-north direction from an approximate geodetic elevation of 95 to 90 m.

Subsurface Conditions

Generally, the subsurface profile consists of relatively shallow limestone bedrock at the southern end of the site, dropping off to the north such that at the northern end of the site, the subsurface profile consists of an approximate 1.5 m thickness of fill underlain by a silty clay deposit extending to an approximate depth of 7.4 m. The silty clay deposit was observed to be underlain by a glacial till deposit at the northern end of the ite.

3.0 Global Stability Analysis

Based on the topographic survey data and the lot grading plan provided by the client, 2 cross-sections, considered as the “worse-case” scenario critical location, have been selected for the retaining wall global stability analysis. The locations of the cross-section are shown on the attached Figure 5.

The analysis of global stability was carried out using SLIDE, a computer program that permits a two-dimensional global 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 (FS) of 1.0 represents a condition where the structure 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 static analysis conditions, and a minimum FS of 1.1 is generally recommended for seismic analysis conditions, where the failure of the retaining wall would endanger permanent structures.

It should be noted that the details of the proposed retaining walls, such as the footing configuration and depth of footing, used in this analysis were not available at the time of writing this report, and are based on Paterson’s general knowledge of typical retaining walls commonly used in the industry. The specific details of the retaining walls should be designed by a Professional Engineer and may be constructed with small precast landscaping block systems or large precast concrete retaining wall systems such as Grande Wall, Redi-Rock and Stone Strong. Details of the design of the retaining wall could be provided by Paterson, upon request.

It should also be noted that the global stability analysis was completed under worst-case-scenario by assigning subsurface soils under fully saturated conditions, extending the water table up to ground surface. Further, surcharges of 10 and 2 kN/m^2 were applied

taking consideration of traffic and pedestrian loadings, respectively.

Static Loading Analysis

The effective strength soil parameters used for static analysis were chosen based on the subsoil information obtained from our field investigation and our general knowledge of the geology in the area. The effective strength soil parameters used for static analysis are presented in Table 1 below.

Table 1 – Effective Strength Soil and Material Parameters (Static Analysis)

Soil Layer	Unit Weight (kN/m^3)	Friction Angle (degrees)	Cohesion (kPa)
Existing Fill	17	33	0
Engineered Fill	20	33	0
Silty Clay	18	33	5
Glacial Till	20	38	5

The results of the static loading analysis at Sections A-A and B-B are shown on Figures 1 and 3. The factor of safety were found to exceed 1.5 under static conditions. Accordingly, the proposed retaining wall is considered to be stable under static loading.

Seismic Loading Analysis

The total strength soil parameters used for seismic analysis were also chosen based on the subsoil information obtained from our field investigation and our general knowledge of the geology in the area. A horizontal acceleration of 0.16g was applied to the retaining wall. The strength soil parameters used for seismic analysis are presented in Table 2 below.

Table 2 – Total Strength Soil and Material Parameters (Seismic Analysis)

Soil Layer	Unit Weight (kN/m^3)	Friction Angle (degrees)	Undrained Shear Strength (kPa)
Fill	17	33	0
Engineered Fill	20	33	0
Silty Clay	18	0	60
Glacial Till	20	38	5

The results of the seismic loading analysis at Section A-A and B-B are shown on the attached Figures 2 and 4. The factor of safety was found to exceed 1.1 under seismic conditions. Accordingly, the proposed retaining wall is considered to be stable under seismic loading.

4.0 Conclusions and Recommendations

As a result of a global stability analysis performed using SLIDE, the proposed retaining walls at the subject site greater than 1 m in height were analyzed and had factors of safety exceeding 1.5 under static conditions and 1.1 under seismic conditions. **As such, the subject retaining walls are considered stable from a global stability perspective.**

It is highly recommended that proper drainage system, such as perforated pipe, be provided at the rear of the retaining walls to prevent the hydrostatic pressure build-up behind the retaining walls. The retaining walls should also be backfilled with free-draining granular backfill such as OPSS Granular B Type II and should be placed in maximum 300 loose lifts and compacted to a minimum 98% of the material's SPMDD.

It is further recommended that the following is considered to complete during construction of the retaining walls.

- ❑ Observation of all subgrades prior to placing backfilling materials.
- ❑ Observation of the drainage system prior to backfilling.
- ❑ Field density tests to ensure the specified level of compaction was achieved.
- ❑ Periodic observation of the retaining wall installation, especially at the first course.

We trust that the current submission meets your immediate requirements.

Paterson Group Inc.

Sok Kim

Scott S. Dennis, P.Eng.

Attachments:

- ❒ Figure 1 – Section A-A – Static Conditions
- ❒ Figure 2 – Section A-A – Seismic Conditions
- ❒ Figure 3 – Section B-B – Static Conditions
- ❒ Figure 4 – Section B-B – Seismic Conditions.
- ❒ Figure 5 – Site Plan – Section A-A and Section B-B

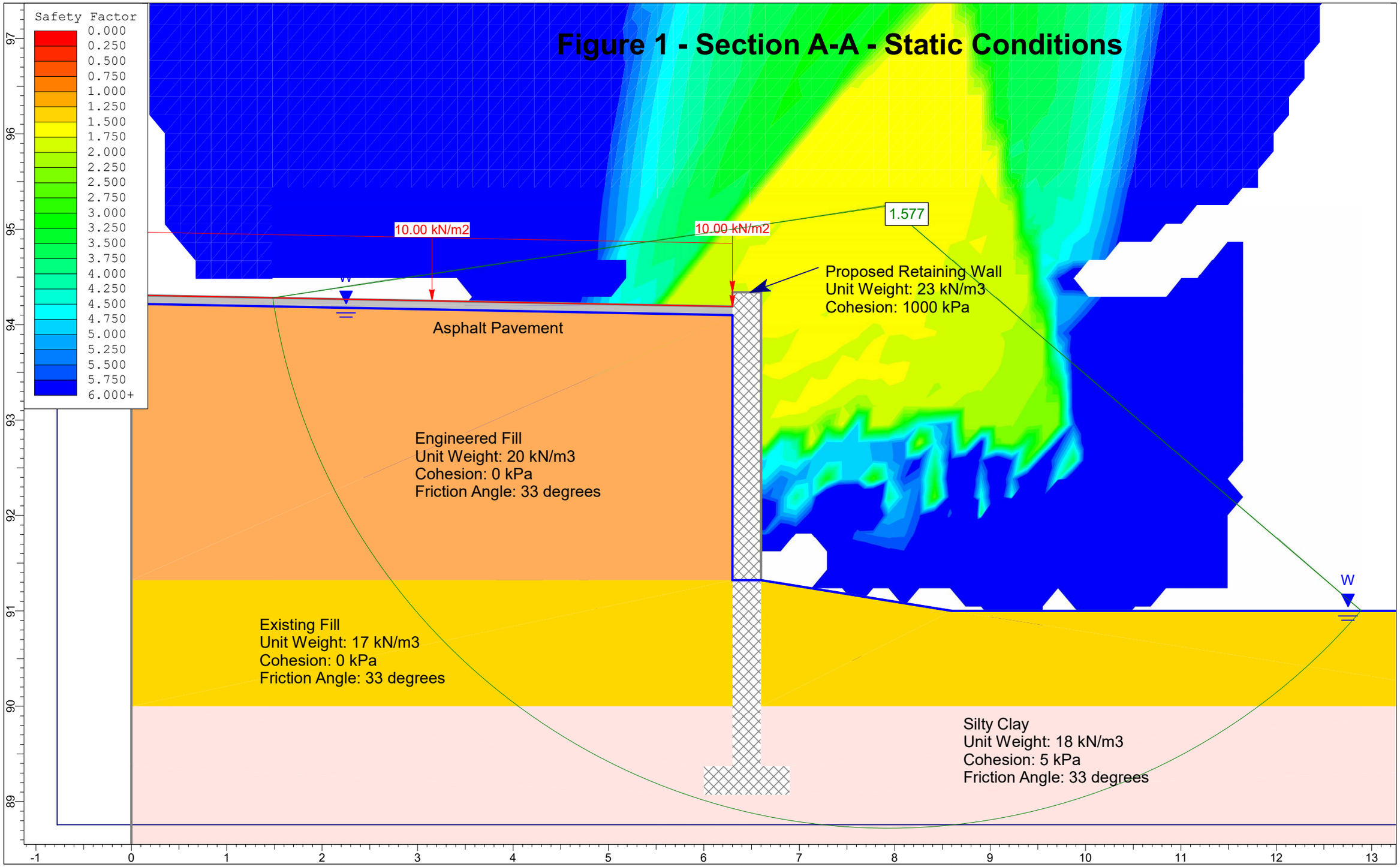
Figure 1 - Section A-A - Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
10.00 kN/m2
10.00 kN/m2
1.577
Proposed Retaining Wall
Unit Weight: 23 kN/m3
Cohesion: 1000 kPa
Asphalt Pavement
Engineered Fill
Unit Weight: 20 kN/m3
Cohesion: 0 kPa
Friction Angle: 33 degrees
Existing Fill
Unit Weight: 17 kN/m3
Cohesion: 0 kPa
Friction Angle: 33 degrees
Silty Clay
Unit Weight: 18 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
W
W
97
96
95
94
93
92
91
90
89
-1
0
1
2
3
4
5
6
7
8
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11
12
13

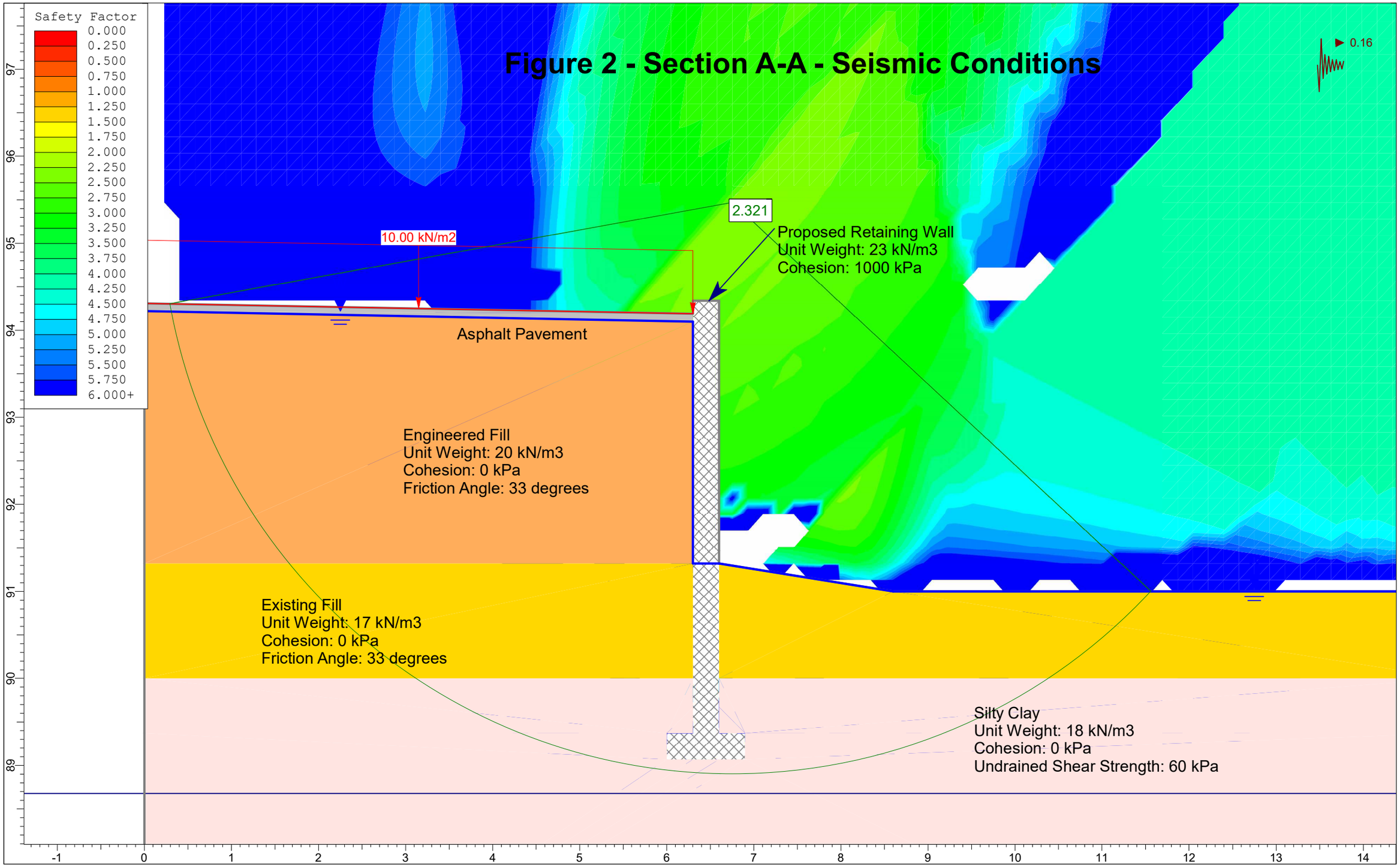
Figure 2 - Section A-A - Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
2.321
10.00 kN/m2
Proposed Retaining Wall
Unit Weight: 23 kN/m3
Cohesion: 1000 kPa
Asphalt Pavement
Engineered Fill
Unit Weight: 20 kN/m3
Cohesion: 0 kPa
Friction Angle: 33 degrees
Existing Fill
Unit Weight: 17 kN/m3
Cohesion: 0 kPa
Friction Angle: 33 degrees
Silty Clay
Unit Weight: 18 kN/m3
Cohesion: 0 kPa
Undrained Shear Strength: 60 kPa
97
96
95
94
93
92
91
90
89
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

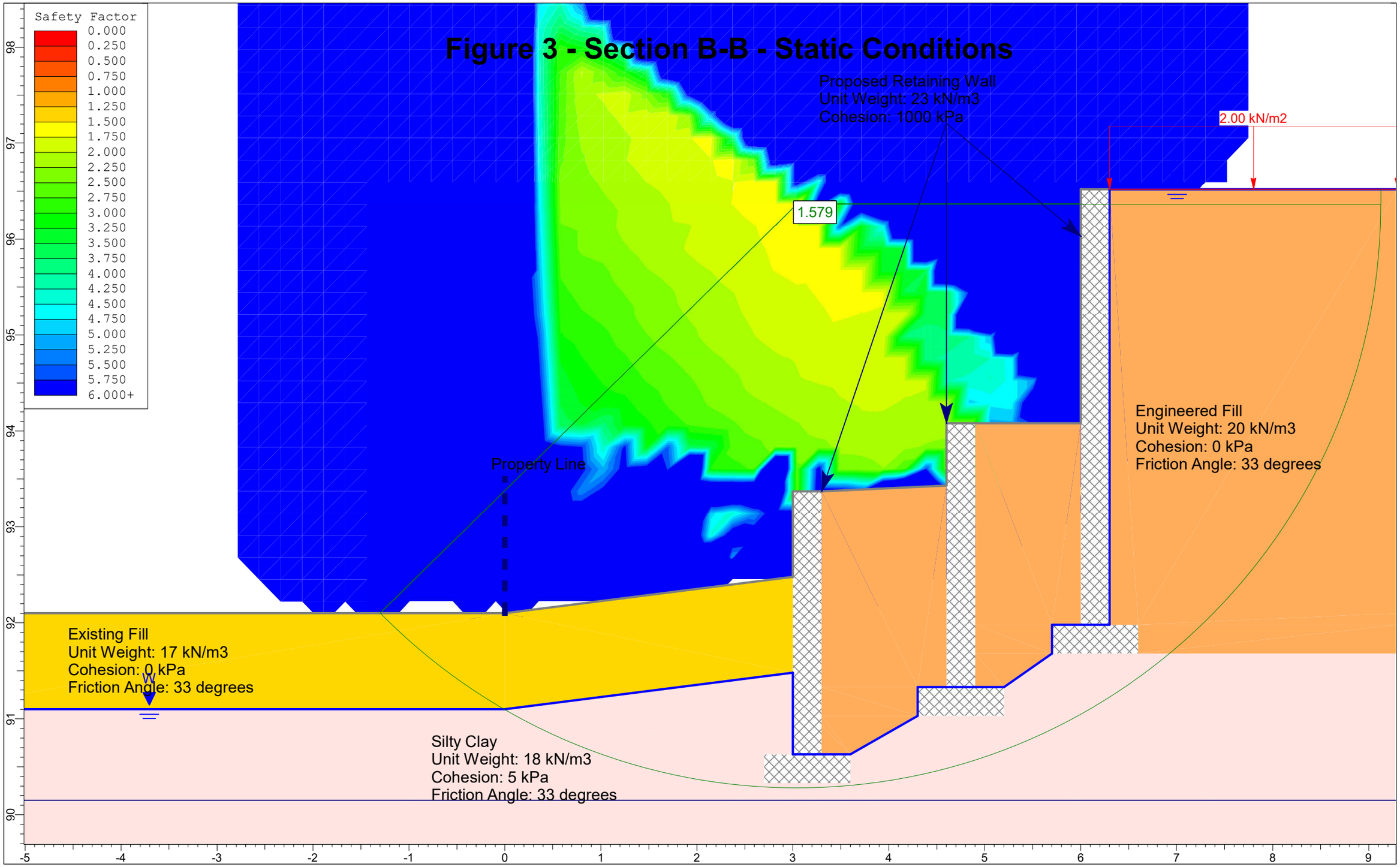
Figure 3 - Section B-B - Static Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Proposed Retaining Wall
Unit Weight: 23 kN/m3
Cohesion: 1000 kPa
2.00 kN/m2
1.579
Property Line
Engineered Fill
Unit Weight: 20 kN/m3
Cohesion: 0 kPa
Friction Angle: 33 degrees
Existing Fill
Unit Weight: 17 kN/m3
Cohesion: 0 kPa
Friction Angle: 33 degrees
Silty Clay
Unit Weight: 18 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
98
97
96
95
94
93
92
91
90
-5
-4
-3
-2
-1
0
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9

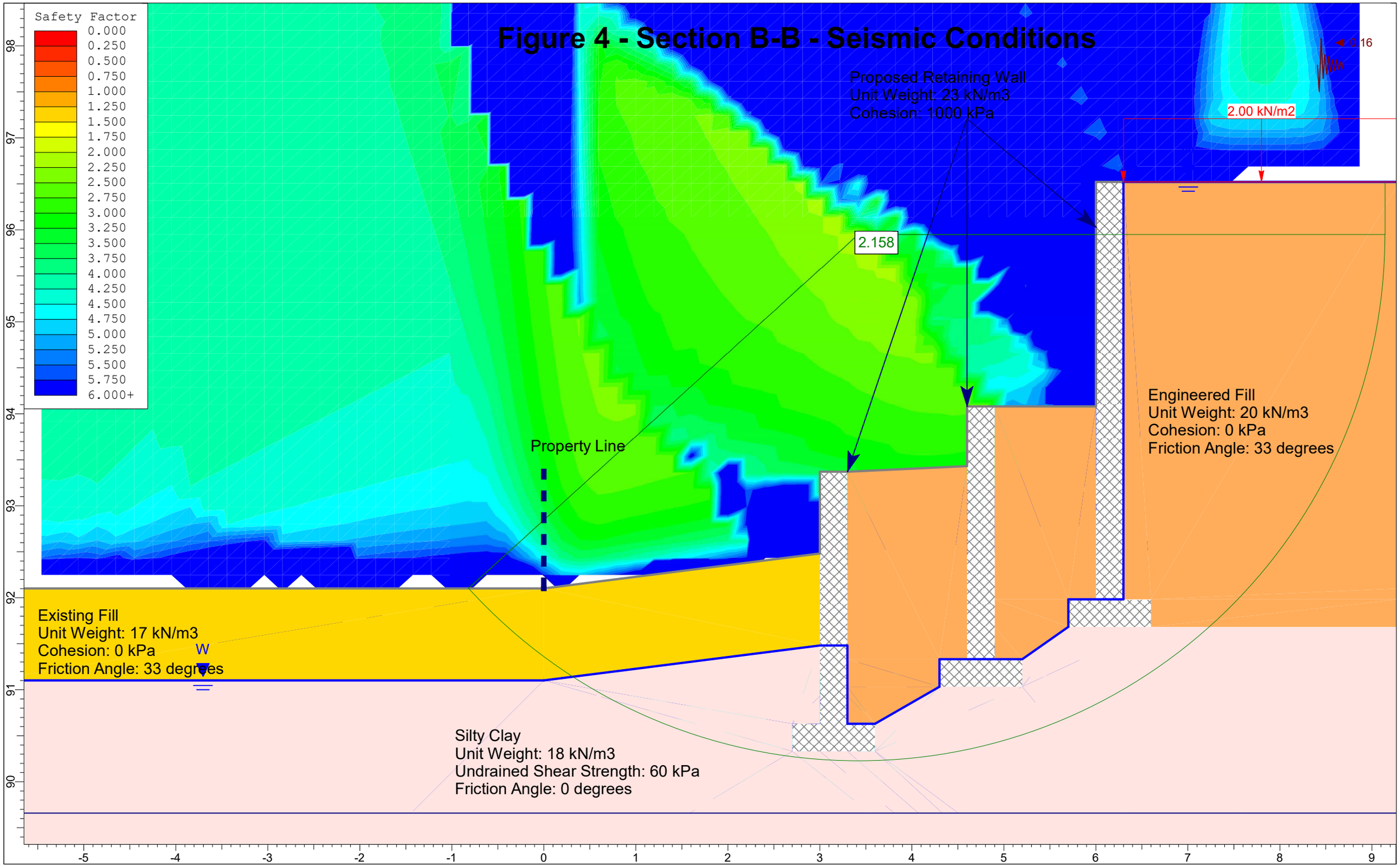
Figure 4 - Section B-B - Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Proposed Retaining Wall
Unit Weight: 23 kN/m3
Cohesion: 1000 kPa
2.00 kN/m2
0.16
2.158
Property Line
Engineered Fill
Unit Weight: 20 kN/m3
Cohesion: 0 kPa
Friction Angle: 33 degrees
Existing Fill
Unit Weight: 17 kN/m3
Cohesion: 0 kPa
Friction Angle: 33 degrees
W
Silty Clay
Unit Weight: 18 kN/m3
Undrained Shear Strength: 60 kPa
Friction Angle: 0 degrees
98
97
96
95
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91
90
-5
-4
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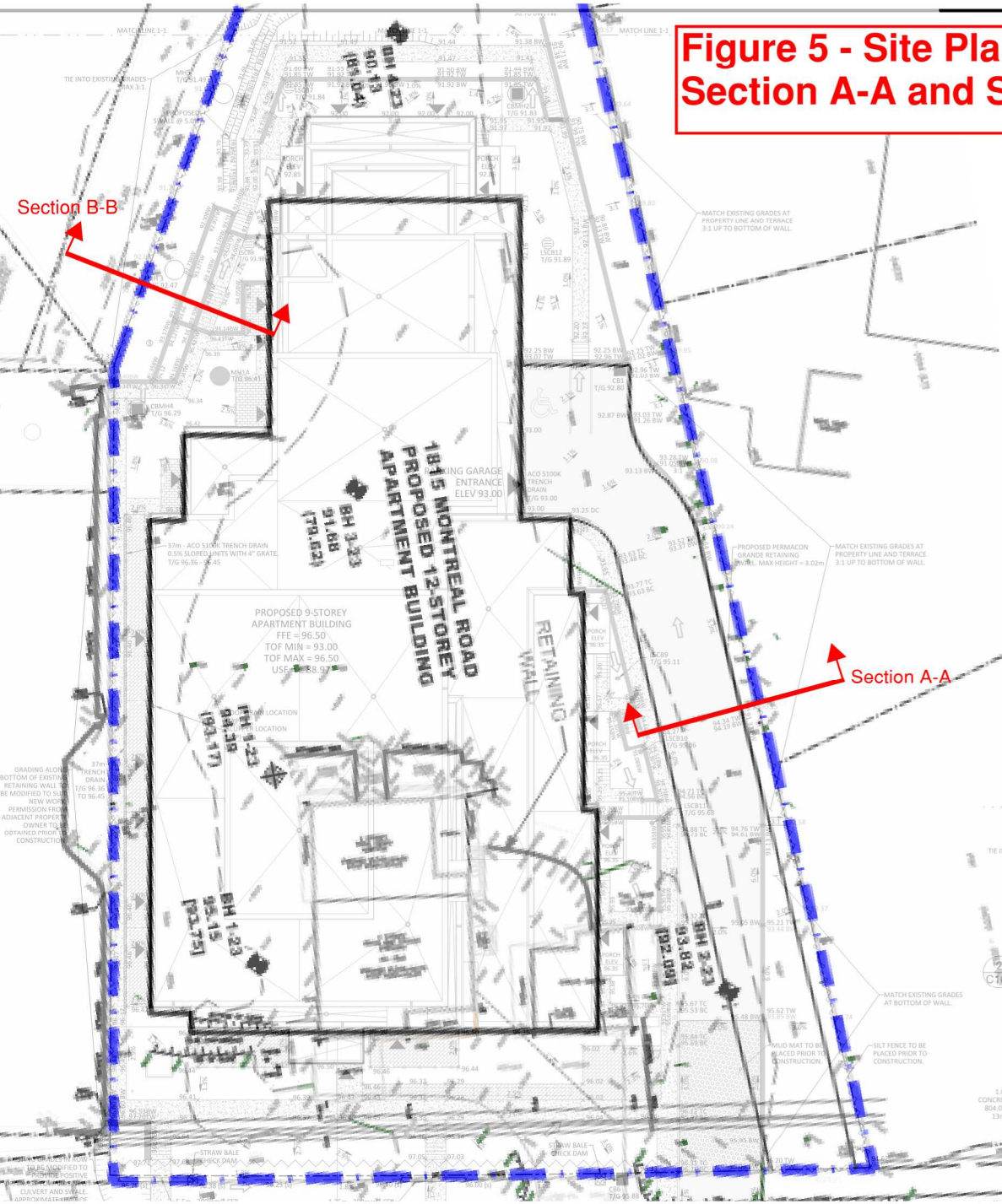
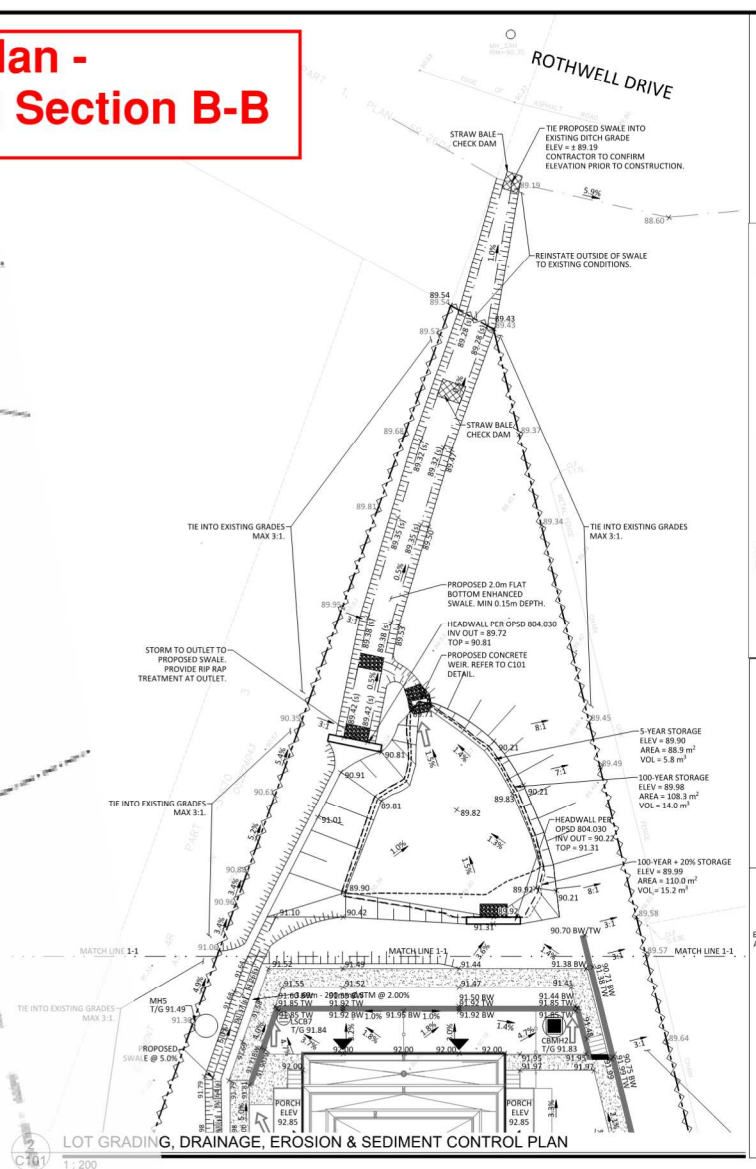
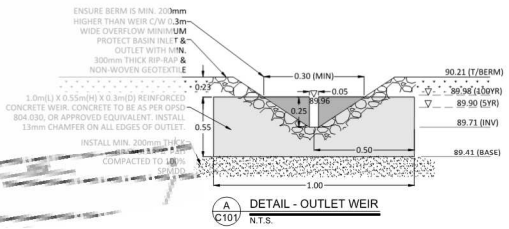
Figure 5 - Site Plan - Section A-A and Section B-B







EROSION AND SEDIMENT CONTROL

1. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL, TEMPORARY SEDIMENT CONTROL (GEOSOCK INSERTS WITH AN OVERFLOW UNDER GRATE OR COVER) TO BE IMPLEMENTED DURING CONSTRUCTION ON ALL PROPOSED ROAD CATCHBASINS, REARYARD CATCHBASINS AND CATCHBASIN MANHOLES AND OTHER SEDIMENT TRAPS. NO RECYCLED GEOSOCK MATERIAL SHALL BE PERMITTED FOR USE ON SITE. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.
2. AT THE DISCRETION OF THE PROJECT MANAGER OR MUNICIPAL STAFF, ADDITIONAL SILT CONTROL DEVICES SHALL BE INSTALLED AT DESIGNATED LOCATIONS.
3. FOR SILT FENCE BARRIER, USE OPSD 219.110. GEOTEXTILE FOR SILT FENCE AS PER OPSS 1860, TABLE 3.
4. EXCEPT AS PROVIDED IN PARAGRAPHS 4.1., AND 4.2. BELOW, STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS FEASIBLE IN PORTIONS OF THE SITE WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED, BUT IN NO CASE MORE THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY HAS TEMPORARILY OR PERMANENTLY CEASED.
   4.1. WHERE THE INITIATION OF STABILIZATION MEASURES BY THE 14TH DAY AFTER CONSTRUCTION ACTIVITY TEMPORARILY OR PERMANENTLY CEASE IS PRECLUDED BY SNOW COVER, STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS FEASIBLE.
   4.2. WHERE CONSTRUCTION ACTIVITY WILL RESUME ON A PORTION OF THE SITE WITHIN 21 DAYS FROM WHEN ACTIVITIES CEASED, (E.G. THE TOTAL TIME PERIOD THAT CONSTRUCTION ACTIVITY IS TEMPORARILY CEASED IS LESS THAN 21 DAYS) THEN STABILIZATION MEASURES DO NOT HAVE TO BE INITIATED ON THAT PORTION OF SITE BY THE 14TH DAY AFTER CONSTRUCTION ACTIVITY TEMPORARILY CEASED.
5. SEDIMENT THAT IS ACCUMULATED BY THE TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

GENERA

1. THE ORIGI SUPPLIE ACCURAC INFORMA
2. THIS PLAN AND EASE DERIVED F 22-10-111 PRECISE LO ONLY BE D SUBSEQUE LAND SUR
3. THE CONT APPROVAL
4. THE CONT
5. THE CONT ELEVATION PROTECT A NOT SHOW CONTRACT
6. RESTORE A CONDITION SATISFACT