patersongroup **memorandum**

consulting engineers

re: **Proposed Retaining Wall Global Stability Analysis**
Proposed Residential Building
1291 Summerville Avenue - Ottawa

to: Concorde Properties - **Mr. Jordan Tannis** – jt@concorde-properties.ca
date: February 15, 2022
file: PG5573-MEMO.02

Further to your request and authorization, Paterson Group (Paterson) has prepared the following geotechnical memorandum to provide a global stability analysis for the proposed retaining wall to be situated east of the proposed residential building. This memorandum should be read in conjunction with Paterson Group Report PG5573-LET.01 Revision 2, dated March 4, 2021.

1.0 Background Information

A four-storey residential building with a partial basement level is to be constructed at the subject site. A retaining wall is proposed to be constructed along the east and north-east property boundaries. Detailed design of the proposed retaining wall is being completed by others and was not available at the time of preparation of the current memorandum. Based on discussions with the client and D.B. Gray Engineering Inc. (Gray) it is understood that the retaining wall construction will consist of cast-in-place concrete with the top 150 mm structurally acting as a curb. Further, Paterson has reviewed the following drawing prepared by Gray:

- ❑ Grading Plan and Erosion & Sediment Control Plan – 1291 Summerville Avenue – Job No. 20102 – Drawing No. C-3, Revision 3 dated October 27, 2021

Based on our review of the above noted drawing, it is understood that the proposed retaining wall will span the entire east property boundary for approximately 40 m, and will have a 90-degree corner and continue to span the north-east property boundary for approximately 11 m. The wall ranges in height from 0.15 to 1.10 m. Retaining walls higher than 1.0 m should be designed by a professional engineer, as per City of Ottawa retaining wall design standards. It should be noted that the thickness of the retaining wall was not available at the time of preparation of the current memorandum, however for purposes of the global stability analysis, a wall thickness of 200 mm will be assumed. It should be further noted that the retaining wall should be designed in accordance with the most recent Canadian Highway and Bridge Design Code (CSA S6:19).

For the purpose of this review, it is assumed that the wall will be backfilled with OPSS Granular B Type II materials, placed within a wedge-shaped zone defined by a line drawn up and back from the back edge of the base block of the wall at an inclination of 1H:1V or a minimum of 1 m behind the back of the wall. It is further assumed that the wall will have a drainage system on the back of the wall with a positive outlet to a storm sewer.

Consideration should be given to a segmental block retaining wall design, which would sustain more differential movement and requires less embedment below finished grade. Paterson has conducted a global stability analysis for a segmental block retaining wall, as well as a concrete retaining wall.

2.0 Global Stability Analysis

The global stability analysis was modeled in SLIDE, a computer program which permits a two-dimensional slope stability analysis calculating several methods including the Bishop's method, which is a widely accepted slope analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to forces favoring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsurface soil and groundwater conditions, a factor of safety greater than 1.0 is generally required for the failure risk to be considered acceptable.

A minimum factor of safety of 1.5 is generally recommended for conditions where the slope failure would contain permanent structures. An analysis considering seismic loading was also completed. A horizontal acceleration of 0.16 g was considered for the sections for the seismic loading condition. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

The retaining wall section was reviewed using the design loading according to (CSA S6:19). The highest retaining wall cross-section located between the building and the adjacent right-of-way was studied as the worst-case scenario. The location of the cross section is indicated on Drawing PG5573-1 – Test Hole Location Plan attached to the end of this report. The parameters in Table 1, on the following page, were used for the slope stability analysis under static and seismic conditions:

Table 1 - Effective Soil Parameters for Stability Analysis			
Soil Layer	**Unit Weight (kN/m^3)**	**Friction Angle (degrees)**	**Cohesion (kPa)**
OPSS Granular B Type II	22	38	0
Brown Silty Sand to Silty Clay Fill	18	30	5
Brown Silty Sand	19	35	1
Brown Silty Clay	17	33	7
Glacial Till	19	35	1

The total strength parameters for seismic analysis were chosen based on the in situ, undrained shear strengths recovered within TP 2 included in the above-noted geotechnical investigation and based on our general knowledge of the subsurface conditions within the area.

Analysis Results

The factor of safety for the concrete retaining wall section was 3.17 for static conditions and 4.57 for seismic conditions. The factor of safety for the segmental block retaining wall section was 2.13 for static conditions and 1.74 for seismic conditions.

Based on these results, both the concrete and segmental block retaining walls are considered to be stable under static and seismic loading and are acceptable from a geotechnical perspective. Therefore, a stable slope allowance is not required. Reference should be made to Figures 1 and 2 attached to the end of this report.

Frost Protection

Due to the rigidity of the concrete retaining wall, a frost protection of 1.8 m is required above the underside of footing (USF) of the retaining wall. Frost protection measures should be taken if less than 1.8 m of soil cover is available for frost protection of the concrete retaining wall. Paterson can provide specific frost protection recommendations, if required.

A segmental block wall requires 300 mm of soil embedment in addition to the engineered fill thickness below the base block. It is expected that sufficient soil cover will be available for adequate frost protection and therefore frost protection is not required for a segmental block wall design.

3.0 Recommendations

It is recommended that the following be completed during the retaining wall construction:

- ❑ Observation of all bearing surfaces prior to backfill or placement of geogrid.
- ❑ 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.
- ❑ 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

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

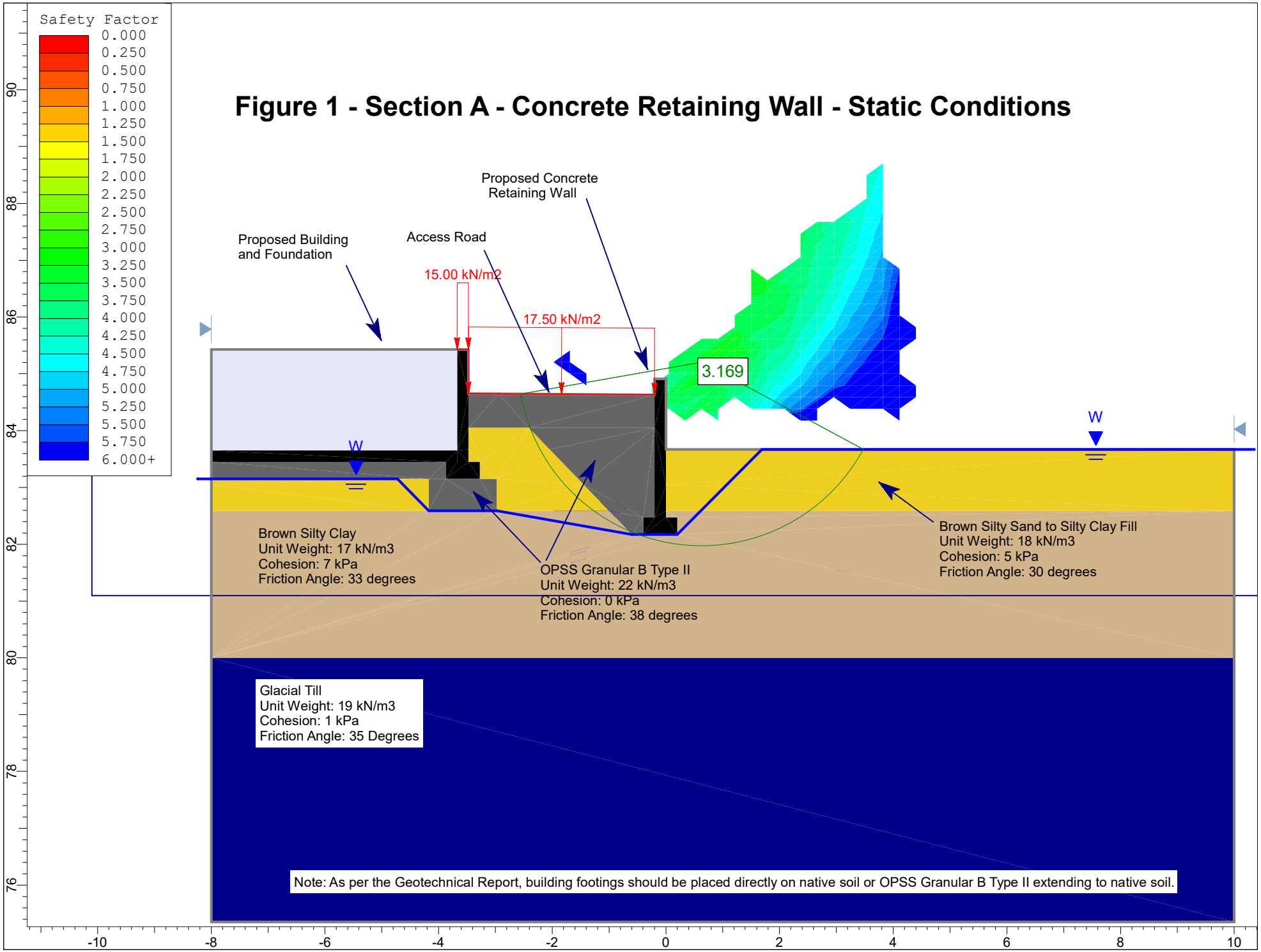
We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

Owen Canton, E.I.T.

Faisal I. Abou-Seido, P.Eng.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5.750
6.000+
Figure 1 - Section A - Concrete Retaining Wall - Static Conditions
Proposed Concrete Retaining Wall
Proposed Building and Foundation
Access Road
15.00 kN/m2
17.50 kN/m2
3.169
W
W
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 7 kPa
Friction Angle: 33 degrees
OPSS Granular B Type II
Unit Weight: 22 kN/m3
Cohesion: 0 kPa
Friction Angle: 38 degrees
Brown Silty Sand to Silty Clay Fill
Unit Weight: 18 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Glacial Till
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 Degrees
Note: As per the Geotechnical Report, building footings should be placed directly on native soil or OPSS Granular B Type II extending to native soil.
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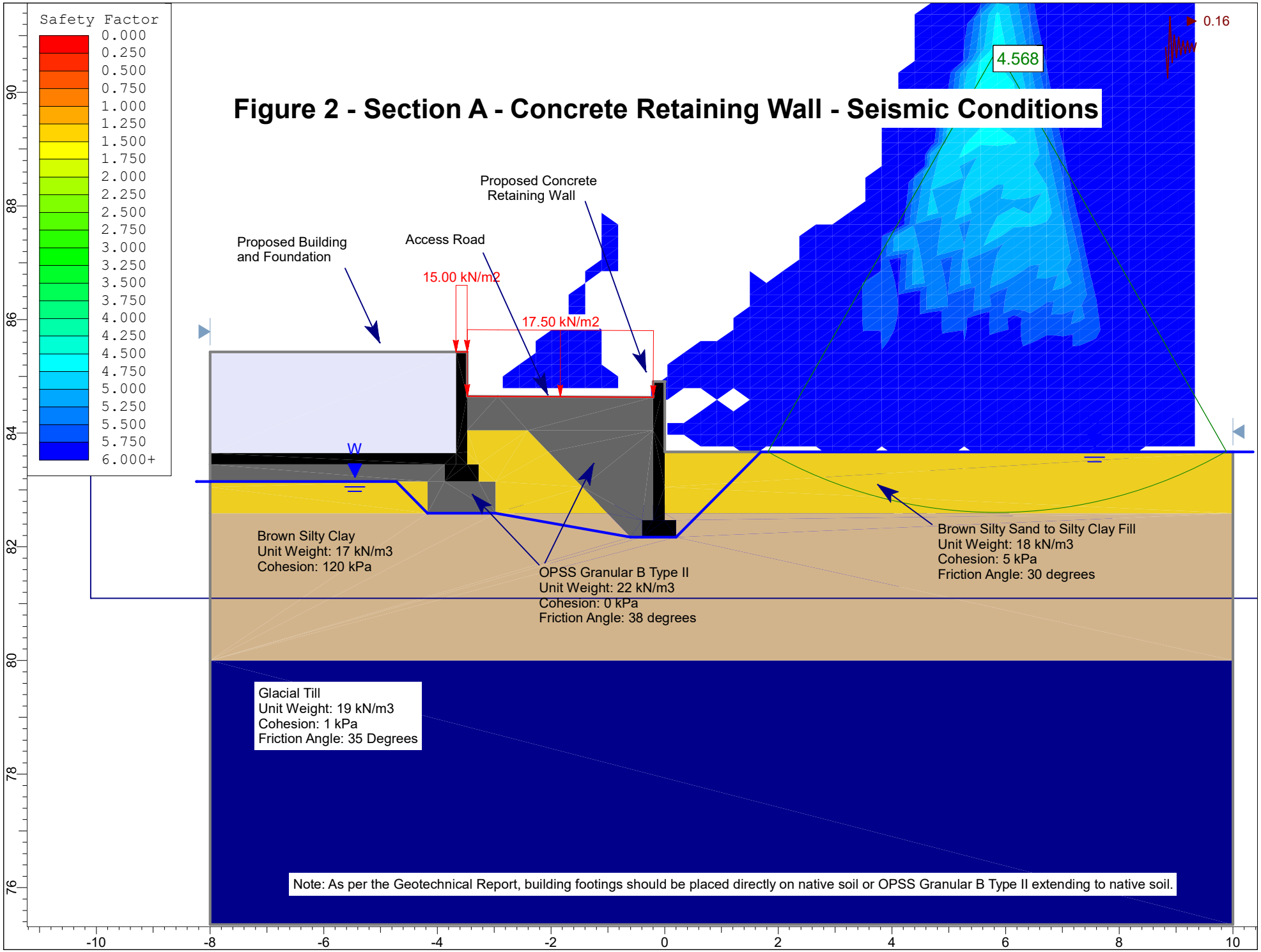
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4.000
4.250
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5.250
5.500
5.750
6.000+
0.16
4.568
Figure 2 - Section A - Concrete Retaining Wall - Seismic Conditions
Proposed Concrete
Retaining Wall
Proposed Building
and Foundation
Access Road
15.00 kN/m2
17.50 kN/m2
W
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 120 kPa
OPSS Granular B Type II
Unit Weight: 22 kN/m3
Cohesion: 0 kPa
Friction Angle: 38 degrees
Brown Silty Sand to Silty Clay Fill
Unit Weight: 18 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Glacial Till
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 Degrees
Note: As per the Geotechnical Report, building footings should be placed directly on native soil or OPSS Granular B Type II extending to native soil.
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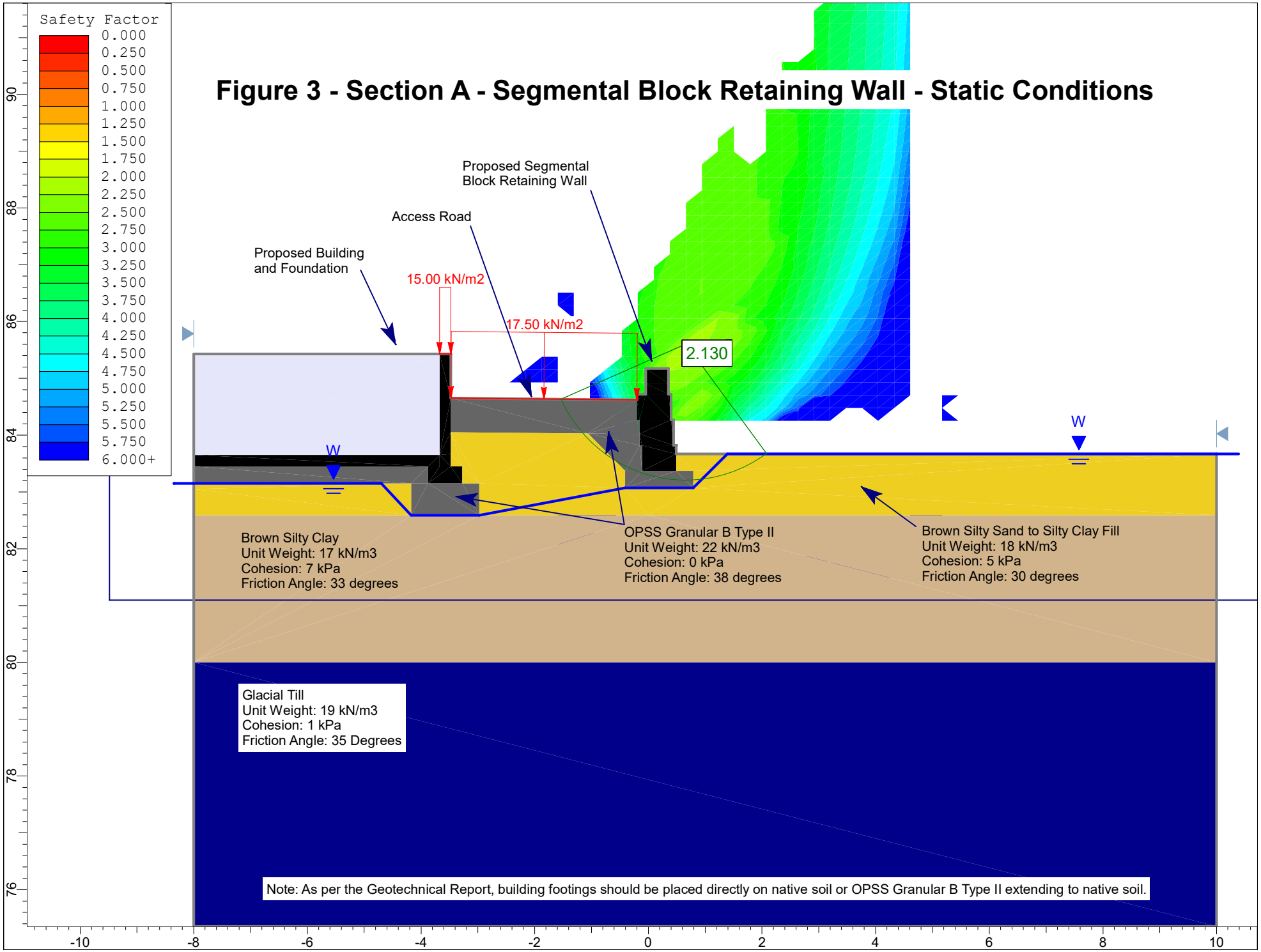
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6.000+
Figure 3 - Section A - Segmental Block Retaining Wall - Static Conditions
Proposed Segmental
Block Retaining Wall
Access Road
Proposed Building
and Foundation
15.00 kN/m2
17.50 kN/m2
2.130
W
W
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 7 kPa
Friction Angle: 33 degrees
OPSS Granular B Type II
Unit Weight: 22 kN/m3
Cohesion: 0 kPa
Friction Angle: 38 degrees
Brown Silty Sand to Silty Clay Fill
Unit Weight: 18 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Glacial Till
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 Degrees
Note: As per the Geotechnical Report, building footings should be placed directly on native soil or OPSS Granular B Type II extending to native soil.
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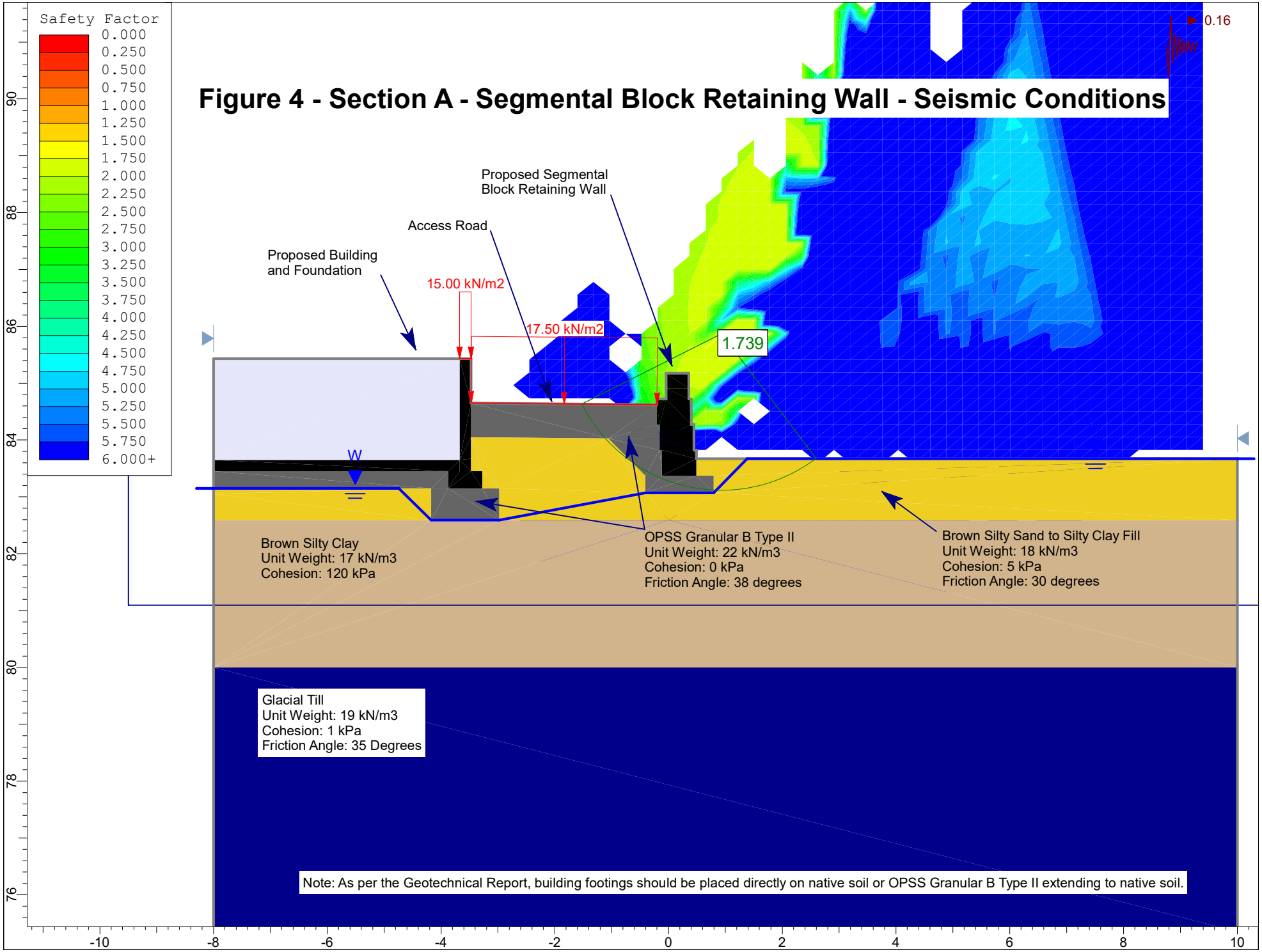
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3.000
3.250
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3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
Figure 4 - Section A - Segmental Block Retaining Wall - Seismic Conditions
Proposed Segmental
Block Retaining Wall
Access Road
Proposed Building
and Foundation
15.00 kN/m2
17.50 kN/m2
1.739
W
Brown Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 120 kPa
OPSS Granular B Type II
Unit Weight: 22 kN/m3
Cohesion: 0 kPa
Friction Angle: 38 degrees
Brown Silty Sand to Silty Clay Fill
Unit Weight: 18 kN/m3
Cohesion: 5 kPa
Friction Angle: 30 degrees
Glacial Till
Unit Weight: 19 kN/m3
Cohesion: 1 kPa
Friction Angle: 35 Degrees
Note: As per the Geotechnical Report, building footings should be placed directly on native soil or OPSS Granular B Type II extending to native soil.
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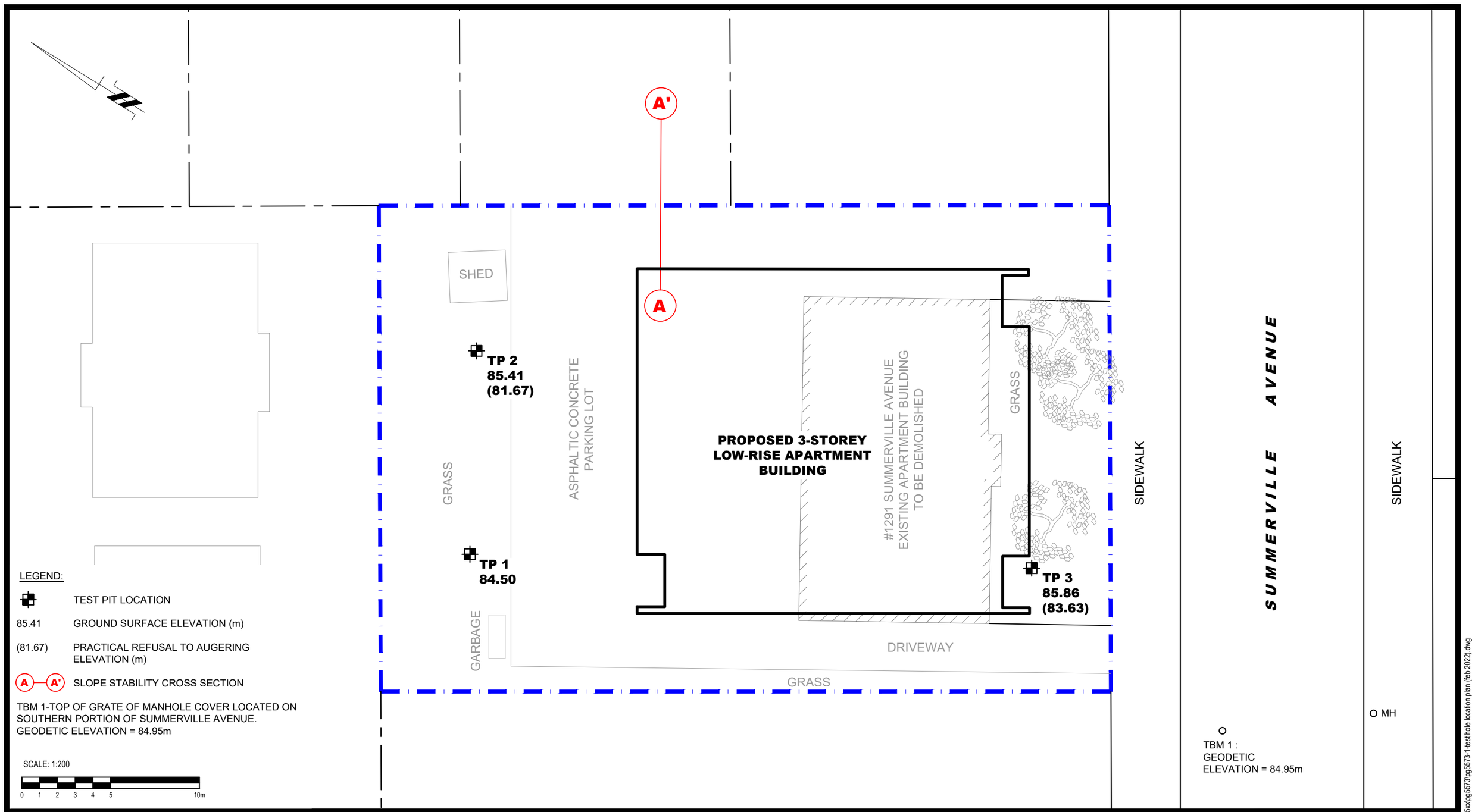

LEGEND:

	TEST PIT LOCATION
85.41	GROUND SURFACE ELEVATION (m)
(81.67)	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)
A — A'	SLOPE STABILITY CROSS SECTION

TBM 1-TOP OF GRATE OF MANHOLE COVER LOCATED ON SOUTHERN PORTION OF SUMMERVILLE AVENUE.
GEODETIC ELEVATION = 84.95m

SCALE: 1:200

0 1 2 3 4 5 10m

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NO.	REVISIONS	DATE	INITIAL

CONCORDE PROPERTIES
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL BUILDING
1291 SUMMERVILLE AVENUE
OTTAWA, ONTARIO

Title:
TEST HOLE LOCATION PLAN

Scale: 1:200	Date: 01/2022
Drawn by: YA	Report No.: PG5573-MEMO.02
Checked by: DP	Dwg. No.: PG5573-1
Approved by: DJG	Revision No.:

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