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THURBER ENGINEERING LTD.

H7/H11 Truck Re-Routing Intersection Improvements

Supplemental Geotechnical Report

Client Name: Urban Systems Ltd.
Date: October 13, 2023
File: 35221

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THURBER ENGINEERING LTD.

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1. INTRODUCTION

As requested, Thurber Engineering Ltd. (Thurber) has prepared this supplemental Geotechnical Report for the H7/H11 Mission Truck Re-Routing Intersections Improvements Project. This report should be read in conjunction with our original Geotechnical Report for this project initially issued in March 2023 and finalized on October 12, 2023 (the initial Geotechnical Report).

It is a condition of this letter that the performance of Thurber's professional services is subject to the attached Statement of Limitations and Conditions.

2. PROJECT DESCRIPTION

The Ministry of Transportation and Infrastructure (the Ministry) is planning modifications to address the impacts of heavy vehicle traffic in Downtown Mission. These improvements are planned at the intersection of Glasgow Avenue and Horne Street, and at the intersection of Highway 7 and Murray Street.

Improvements along Highway 7 are proposed to change the inside westbound lane at Murray Street to left turn only. The works generally extend between Murray Street and Catherwood Street, including highway widening above the existing road embankment up to over 8 m high. A more detailed description of the proposed work in included in our initial Geotechnical Report.

Our initial Geotechnical Report identified stability concerns for the south embankment slope of Highway 7 near Catherwood Street. This slope extends onto property owned by the BC Transportation Financing Authority (BCTFA, PID: 023-768-894), approximately between Sta. 103+30 and 103+70. Our report also recommended full-depth pavement reconstruction along Highway 7 to achieve a 20-year pavement design life.

At the time of our initial Geotechnical Report, the Highway 7 embankment slope south of Catherwood Street was not included in the project scope. The Ministry also preferred a 50 mm mill and overlay instead of a full depth asphalt repair along Highway 7. The 50 mm mill and overlay was not intended to achieve a 20-year pavement design life.

Following review of our initial Geotechnical Report, the Ministry requested that Thurber complete a supplemental assessment of the Highway 7 embankment slope south of Catherwood Street and is considering rehabilitating the existing Highway 7 pavement to a 20-year design life. The proposed pavement rehabilitation has also been extended to immediately east of Catherwood Street, to include rehabilitation of an existing "dip" in the Highway 7 pavement in this area.

This report presents the results of the supplemental geotechnical investigation and analysis completed since the issuance of our initial Geotechnical Report.

The project also includes upgrades to the Glasgow Avenue and Horne Street intersection, which are described with geotechnical design recommendations in our initial Geotechnical Report.

3. INVESTIGATION

3.1 Drilling Investigation

Thurber completed a supplemental geotechnical investigation on Highway 7 consisting of three hand augers (HA23-01A/B to HA23-02) on August 11, 2023 and a mud rotary test hole (MRH23-01) on August 14, 2023. Before drilling, a BC OneCall ticket request was submitted to notify utility owners of our intention to drill. Quadra Utility Locating were retained to scan the proposed test hole locations for conductive utilities before drilling.

Thurber retained Downrite Drilling to advance the mud rotary test hole to approximately 15.9 m. Standard Penetration Tests (SPTs) were completed at approximately 1.5 m intervals to evaluate the in-situ density of the soils. A standpipe piezometer was installed to 8.2 m depth.

The soil and groundwater conditions were logged in the field by Thurber personnel. Soil samples were collected at selected intervals for visual identification, moisture content determination, Atterberg limits tests and gradation analyses at our laboratory. All test holes were backfilled in accordance with BC groundwater protection regulations.

Test hole locations are shown on Drawing 35221-1A in Appendix A.

3.2 Site Review

Thurber visited the site on August 11, 2023 to view the condition of the slope south of Highway 7 on the BCTFA property. During the site visit, the following observations of surface geotechnical features were noted.

The Highway 7 embankment slope near Catherwood Street is generally heavily vegetated with brush, blackberries and trees. Soil conditions observable at the slope face were noted to be loose silty sand.

The slope generally appears to be over-steepened to the east of the existing building at 33433 North Railway Avenue (Sentinel Storage). The surveyed cross-sections indicate that the slope

angle varies between approximately 1.5H:1V and 1.9H:1V. Based on our site observations, we expect that some areas of the slope are locally steeper in the order of 1H:1V to 1.5H:1V.

Some possible localized previous shallow sloughing was noted near Sta. 103+60. East of Sta. 103+65, the slope ties into an existing slope which runs perpendicular to Highway 7 around the parking lot at 33560 1st Avenue.

3.3 Visual Pavement Assessment

On August 22, 2023, Thurber completed a visual pavement assessment. Various pavement distress indicators were observed, including low to high severity cracking, low to high severity rutting, localized moderate severity ravelling and a pothole. Key observations at approximate stationing are summarized below:

- Sta. 101+30 to 102+90 (westbound lane): moderate to high severity longitudinal wheel path cracking, nearly continuous;
- Sta. 102+10 (westbound lane): moderate severity alligator cracking, about 6 m^2 and a severe pothole;
- Sta. 103+70 (westbound lane): moderate severity alligator cracking, about 6 m^2;
- Sta. 100+95 to 103+60 (eastbound lane): moderate severity bleeding;
- Sta. 101+30 to 101+40 (eastbound lane): moderate severity longitudinal wheel path cracking;
- Sta. 101+30 to 101+65 (eastbound lane): moderate to high severity rutting;
- Sta. 101+60 to 101+95 (eastbound lane): localized moderate to high severity transverse cracking;
- Sta. 102+45 (eastbound lane): high severity longitudinal wheel path cracking, about 5 m long;
- Sta. 103+25 to 103+55 (eastbound lane): moderate to high severity longitudinal wheel path cracking; and
- Sta. 103+20 to 103+75 (eastbound lane): moderate to high severity transverse cracking (localized)

The observed longitudinal wheel path cracking, alligator cracking and rutting are likely indicators of inadequate pavement structure and poor pavement drainage. This is consistent with the findings of the Falling Weight Deflectometer (FWD) testing completed for the initial Geotechnical Report. The traverse cracking may be caused by, among other things, frost action on the pavement soils or reflection cracking from underlying asphalt layers.

Representative photos of pavement distress indicators are provided in Appendix B.

3.4 Laboratory Testing

3.4.1 Soil Classification

All samples were subject to routine soil classification in our laboratory. Classifications are based on visual and tactile assessment of samples in general accordance with the Canadian Foundation Engineering Manual (4th Edition). Soil samples are further classified under the Unified Soil Classification System (USCS) per ASTM D2487, and the group symbols are reported in the comments column of the test hole logs in Appendix C.

3.4.2 Moisture Content Determination

Thurber completed moisture content testing on all samples in general accordance with ASTM D4959. The results of the moisture content testing are presented on the appended test hole logs.

3.4.3 Atterberg Limits

Atterberg Limits tests were completed in accordance with ASTM 4318 on select soil samples. The liquid and plastic limits are reported on the test hole logs. The Atterberg Limit test results are presented in Appendix D.

3.4.4 Sieve Analyses and Percent Passing No. 200 Sieve

Sieve analyses and percent passing the No. 200 sieve tests were completed in accordance with ASTM C136 and C117, respectively, on selected samples. The percent passing the No. 200 sieve procedure is a simplified gradation test to determine the fines content of soils.

The results of sieve analyses are included in Appendix D. This included three sieve analyses on samples collected during Thurber's November 2022 investigation to evaluate the suitability of existing granular soil for reuse during construction. Where only percent passing No. 200 sieve tests were completed, these results are shown on the test hole logs in Appendix C.

4. AERIAL PHOTOGRAPHS

Thurber obtained aerial photographs between 1930 and 2016 from the UBC Geographic Information Centre. In general, the Highway 7 alignment has been unchanged since prior to 1930. A historical ravine appears on both sides of Highway 7 near the current-day alignment of Catherwood Street since before 1930. This ravine was gradually infilled with development of the

area. It is unclear if water within the ravine flowed by pipe under Highway 7 or if a historical bridge crossed the ravine.

By the 1970s, the ravine at Highway 7 appears to have been mostly infilled. North Railway Avenue was constructed by 1978 and slopes around Highway 7, south of Catherwood Street, were regraded at this time. This appears to have been the most recent significant change to surface conditions at the project site, prior to construction of the first phase of the Sentinel Storage building around 2008.

5. SURFICIAL GEOLOGY

The Geological Survey of Canada map “Surficial Geology Map 1485A, Mission, British Columbia” maps Highway 7 at Catherwood Street as Sumas Drift Advance Glaciofluvial Deposits (Sj), expected to include gravel and sand up to 40 m thick, proglacial channel fill, floodplain and deltaic sediments.

The surficial geology map shows North Railway Avenue as the approximate transition from Sumas Drift to Fraser River sediments, which include silty clay loam, silt loam, silty clay and minor organic sediments, up to 10 m thick, overlying estuarine fine sand and clayey silt or channel and floodplain sand and gravel.

6. SOIL AND GROUNDWATER CONDITIONS

The soil conditions encountered during the drilling investigation are summarized below. The test hole logs in Appendix C provide a detailed description of the conditions encountered and should be used in preference to the generalized description below.

The soil conditions encountered at MRH23-01 generally comprise 100 mm of asphalt, over approximately 1 m of firm sandy silt, over loose to dense sand and gravel to approximately 7.6 m depth. Underlying the sand and gravel is very stiff silty clay and sand to approximately 9.1 m depth, over very stiff to hard silt to the end of the test hole at approximately 15.9 m. The soil conditions are similar to those at nearby test hole TH22-05 drilled in November 2022, which included approximately 150 mm of asphalt, over compact to dense sand and gravel to approximately 7.6 m, where TH22-05 was terminated.

The hand augers (HA23-01A through HA23-02) encountered sand with varying amounts of silt and gravel up to about 1.5 m below the embankment slope surface.

Our understanding of the site conditions on the BCTFA property was supplemented by geotechnical information from a previous investigation for the Sentinel Storage building at 33433 North Railway Avenue (by others). Based on this information, we expect that dense sand and silty sand (till-like) deposits are present at the Highway 7 embankment toe on the BCTFA property. This is consistent with geological mapping of the area and soil conditions encountered at test holes along Highway 7.

Groundwater in the standpipe piezometer at MRH23-01 was measured at 4.7 m below grade on September 06, 2023. The depth of groundwater is expected to vary with seasonal rainfall and surface drainage conditions.

7. GEOTECHNICAL DESIGN CRITERIA

Consistent with the Ministry's Geotechnical Design Criteria (Technical Circular T-04-17), the following recommendations have been made with the consideration of the following design guides and codes:

- CSA S6-19 (Canadian Highway Bridge Design Code, CHBDC)
- Ministry Supplement to CHBDC S6-19 (Supplement)
- AASHTO 1993 Guide for the Design of Pavement Structures or AASHTO (2004) ME Pavement (Mechanistic Empirical Pavement Design Method Guide)
- Canadian Foundation Engineering Manual (4th Edition)

We have considered the available information to be acceptable to declare a 'Typical' degree of understanding for the geotechnical design. We have proceeded to use a 'Typical' Consequence Factor for the design of embankments.

8. SITE SEISMICITY

8.1 Seismic Site Class

The soils underlying Highway 7 near Catherwood Street are predominately stiff silts and dense sands and gravels with some softer soils near the ground surface. The SPT N_{60} of the soil profile at MRH23-01 averaged between $15 \leq N_{60} \leq 50$ and the undrained strength of the natural silt and silty clay was estimated to be at least stiff. Based on Table 4.1 in CSA-S6-19 and the range of N_{60} values measured, a Site Class D is considered appropriate for design.

It is possible that additional data below 15.9 m depth (the terminus of MRH23-01) would indicate a seismic site class transitional between Site Class D and C. However, the use of Site Class D is considered reasonable for the present purpose.

Seismic hazard values for the site were obtained from Natural Resources Canada's on-line seismic hazard calculator, which were generated using the Geological Survey of Canada's (GSC) seismic hazard models developed for the 2015 National Building Code of Canada (NBCC 2015).

The seismic hazard calculation provides peak ground acceleration (PGA) and spectral accelerations values for various Site Class C seismic hazard levels, including the 1 in 475-year, 1 in 975-year, and 1 in 2,475-year events. The peak ground accelerations adjusted for Site Class D are presented in Table 8.1

Table 8.1: Summary of Peak Ground Acceleration Values (NBCC 2015) for Highway 7 at Catherwood Street – Site Class D

Earthquake Return Period	Peak Ground Acceleration Value
1:475	0.17
1:975	0.22
1:2,475	0.29

8.2 Liquefaction

The liquefaction potential of the underlying soils was assessed for the 1 in 2,475 year return period seismic hazard. The liquefaction assessment used the simplified stress-based method of analysis in general accordance with Clause 6.14.8.1.3 in the Supplement.

Groundwater level at a depth of 4.7 m below the highway grade was assumed in the assessment based on the groundwater monitoring data at MRH23-01. The loose to compact sand and gravel is expected to be situated above groundwater. Hence, the liquefaction potential of these soils was not assessed. The sand and gravel layer encountered below groundwater to a depth of about 7.6 m is not expected to liquefy based on SPT measurements.

The liquefaction potential of the very stiff to hard silt and silty clay encountered was assessed using published correlations related to Atterberg limits and water content (Bray and Sancio, 2006). The results were plotted on Figure 8.1 which indicate that the silt and silty clay at MRH23-01 is not likely susceptible to liquefaction.

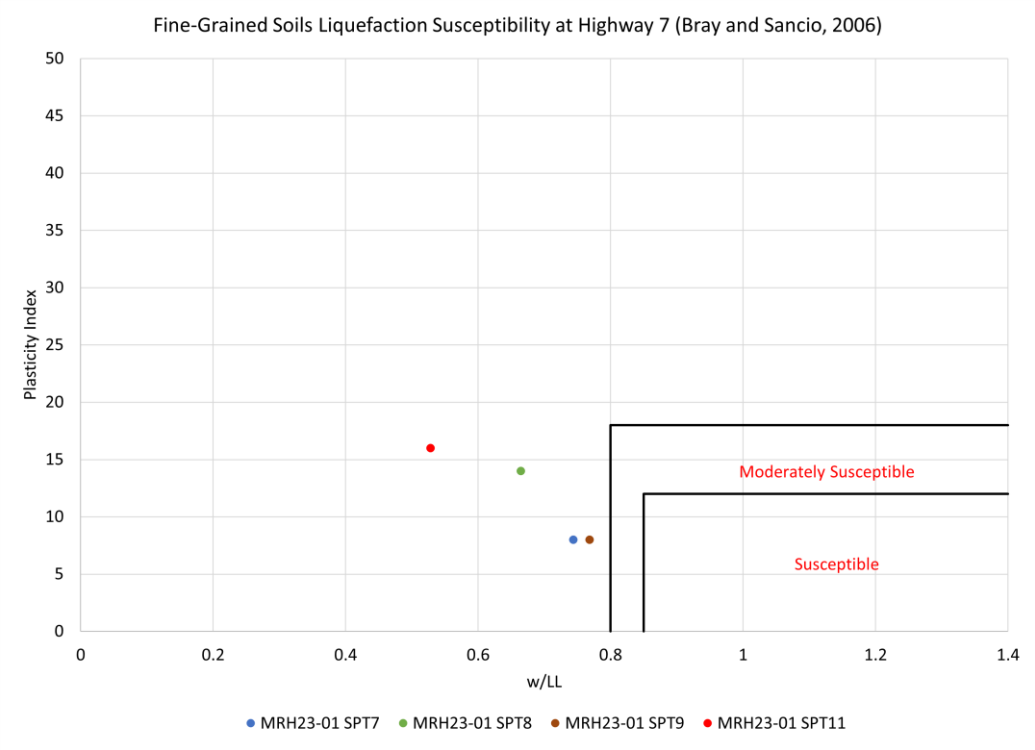


Figure 8.1 Fine-Grained Soil Liquefaction Susceptibility at Highway 7

9. GEOTECHNICAL DISCUSSION AND RECOMMENDATIONS

9.1 General

The soils encountered at Highway 7 near Catherwood Street comprise compact to dense sand and gravel and very stiff silt and silty clay, overlain by loose to compact sand and gravel. The sand and gravel may be fill placed to infill the historical ravine at the site and extends to a depth of about 7.6 m below grade.

Groundwater was measured at 4.7 m below grade in September 2023. This is slightly shallower than the groundwater measurement taken in nearby TH23-05 in November 2022, at 5.8 m below grade.

Based on our assessment, we recommend that the embankment slope of Highway 7 near Catherwood Street be re-graded with imported fill. Recommendations to achieve the required slope stability factor of safety are provided in the following sections.

Sandy silt approximately 1 m thick was present directly below the Highway 7 asphalt near Catherwood Street. This soil is unsuitable as a pavement structure and should be replaced to achieve a 20-year pavement design life for Highway 7.

9.2 Site Preparation

Subgrade preparation, engineered fill gradation / quality and placement requirements must be in accordance with Sections 200 through 202 of the current Ministry Standard Specifications for Highway Construction document, CSA S6-19 and the Ministry Supplement to S6-19.

Site preparation in the Highway 7 embankment slope should follow the recommendations of Section 9.5 of this report. Refer to our initial Geotechnical Report for site preparation recommendations in pavement areas.

9.3 Suitability of Cut Materials for Reuse in Fills

Sand and gravel, some silt to silty of variable thickness was encountered beneath the existing asphalt at most test holes along Highway 7. The silty composition of this material requires that moisture control will be critical to produce an acceptable product for reuse as fill. Provided that this occurs, consideration can be given to reusing the existing silty sand and gravel as subgrade fill beneath new pavement subbase. We do not recommend this material for regrading of Highway 7 embankment slopes.

Moisture control of existing fill will be required from excavation, stockpiling and storage to eventual placement and compaction. Measures such as tarping and air-drying of saturated fill may be required to produce material that can be used for construction. The contractor should provide a plan on how they will manage and process excavated material proposed for reuse.

9.4 Embankment Stability

9.4.1 Static Stability

Limit-equilibrium slope stability analyses were completed on representative cross-sections of the Highway 7 embankment slope through the BCTFA property. The analyses were based on soil and groundwater conditions inferred from the test holes completed at the site.

Thurber assessed the slope stability based on a ‘Typical’ degree of understanding and a ‘Typical’ consequence factor provided in the Ministry’s Supplement to CSA S6-19. Based on the Supplement, the minimum global slope stability factor of safety (FS) under static loading

conditions for permanent slopes is 1.54. Consideration was also given in our stability analyses to raising the interpreted groundwater elevation by 1 m over measured levels to account for potential future increases.

Stability analyses of the existing slope profile at Sta. 103+40 and 103+60 showed slip surfaces with a FS < 1.54. With embankment slopes constructed in accordance with Section 9.5, the slopes exceed the minimum required FS of 1.54.

Representative results of the static slope stability analyses are presented in Appendix E.

9.4.2 Pseudo-Static Stability

We have assumed that the Supplement Section 6.14.2.3 Seismic Performance Criteria applies to the embankment supporting Highway 7. Accordingly, we have based the seismic slope stability analyses on the requirement for Major-Route geotechnical systems to have 50% of the travelled lanes, but not less than one, available for use following ground motions with a return period of at least 475 years. The Supplement goes on to say that permanent embankment deformation can be ignored when the pseudo-static limit equilibrium analysis indicates a FS > 1.3.

Pseudo-static limit equilibrium analyses were carried out using 50% of the Site Class D, 1 in 475-year return period peak ground acceleration. Slip surfaces for the embankment slope reconstructed in accordance with Section 9.5 were found to have a FS > 1.3.

Representative results of seismic slope stability analyses are presented in Appendix E.

9.5 Embankment Slopes

The Highway 7 embankment at the BCTFA property should be constructed in accordance with the Ministry's Standard Specifications. We recommend that the Highway 7 embankment be cleared and grubbed and subgrade at the face and toe of the embankment should be free from deleterious, loose/soft or otherwise unsuitable soils. The subgrade at the toe of the embankment should be horizontal and compacted with a large steel drum vibratory roller where possible. The subgrade should be reviewed prior to fill placement and any sub-excavation operations completed, if required. Following subgrade approval, imported fill should be used to reconstruct the entire embankment slope at 2.25H:1V or flatter to meet the geotechnical design criteria.

We recommend constructing the Highway 7 embankment with crushed gravel consisting of 75 mm minus well-graded base (WGB). Pit run or non-crushed materials are not recommended for

use as embankment fill as they are unlikely to achieve the required soil strength properties for reconstruction of the embankment.

Techniques and sequencing used for construction of sliver fills are critical to reduce the potential for a weak layer between old and new fills. The original ground should be terraced in a continuous series of steps a minimum of 1.5 m wide as the embankment rises, as per Ministry SS201.37. Actual terrace width will be based on depth required to remove loose/soft soils from the slope face, but a minimum depth of 2 m back from the slope face should be expected.

Erosion control measures should be implemented immediately on the final slope configuration to reduce the risk of surface erosion. No permanent cut slopes are expected as part of this project.

9.6 Pavement Recommendations

Considering our site observations described in Section 3.3, in combination with the subsurface soil conditions and FWD measurements at the site, full-depth pavement reconstruction per our initial Geotechnical Report is recommended to achieve a 20-year design life pavement structure. This includes repairs to the existing “dip” in the Highway 7 asphalt around Catherwood Street.

The design traffic loads for Highway 7 and 20-year design life pavement structure are provided in the our initial Geotechnical Report.

9.7 Settlement

We anticipate that embankments constructed on very stiff silt or silty clay, or dense sand and gravel, will cause elastic recompression and that the settlements will occur relatively quickly, within about two to three months.

Highway 7 embankment reconstruction will result in filling over the existing storm pipe through the BCTFA property. Based on this pipe being about 3 m below grade near the toe of the embankment (per the design drawings), we estimate that the total ground settlement near the pipe elevation will be less than 30 mm.

Post-construction settlements due to reconstruction of the Highway 7 asphalt dip to match existing grade near Catherwood Street should not exceed 25 mm, provided that the work is completed per the recommendations of this report.

9.8 Construction Considerations

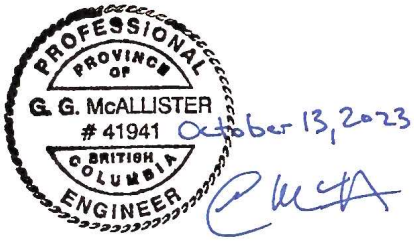
Construction considerations for this project are as described in our initial Geotechnical Report.

10. REFERENCES

Bray, J.D., Sancio, R.B., 2006. Assessment of Liquefaction Susceptibility of Fine-Grained Soils. Journal of Geotechnical and Geoenvironmental Engineering, 132 (9).

11. CLOSURE

We trust this information meets your present needs. If you have any questions, please contact the undersigned at your convenience.



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Geotechnical Engineer

J. Suzanne Powell, Ph.D., P. Eng.
Review Engineer

Date: ***October 13, 2023***
File: ***35221***

Thurber Engineering Ltd.
Permit to Practice #1001319

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client, the BC Ministry of Transportation and Infrastructure (MoTI) and Authorized Users as defined in the MoTI Special Conditions Form H0461d. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Any use which an unauthorized third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any unauthorized third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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APPENDIX A

Drawing 1A – Test Hole Location Plan Drawing 1A

Plotted: September 19, 2023

LEGEND:

- 2022 AUGER TEST HOLE
- 2023 HAND AUGER TEST HOLE
- 2023 MUD ROTARY TEST HOLE

NOTES:
1. AERIAL IMAGERY TAKEN FROM GOOGLE EARTH.
2. TEST HOLE LOCATIONS ARE APPROXIMATE.

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MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

HWY 7 WORK ZONE - TEST HOLE LOCATION PLAN

H7 / H11 MISSION TRUCK ROUTE INTERSECTION IMPROVEMENTS
SUPPLEMENTAL GEOTECHNICAL INVESTIGATION — MISSION, BC

DESIGNED	DRAWN	APPROVED	DATE	SCALE	PROJECT No.	DWG. NO.	REV.
GGM	JL	JSP	SEPT. 14, 2023	1:1000	35221 - **1A**		0

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APPENDIX B

Pavement Distress Photos

Photo 1: High Severity Longitudinal Wheel Path Cracking Near Sta. 101+50 (Westbound)

Photo 2: Moderate Severity Rutting Near Sta. 101+50 (Eastbound)

Photo 3: Moderate Severity Bleeding Near Sta. 101+50 (Eastbound)

Photo 4: Moderate to High Severity Transverse Cracking Near Sta. 103+70 (Eastbound)

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APPENDIX C

Test Hole Logs

SUMMARY LOG

Ministry of Transportation and Infrastructure — British Columbia

Drill Hole #: MRH23-1

Project: **H7/H11 Mission Truck Route Intersection Improvements**

Location: Mission, BC

Prepared by: 35221 Thurber Engineering Ltd.

Logged by: SY Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442632 , 551334 Station/Offset:

Elevation: 22.4 m *Coordinates taken with GPS*

Date(s) Drilled: August 14, 2023

Company: Downwrite Drilling Ltd.

Driller: Ulantrewey

Drill Make/Model: Mobile B54X tracked drill

Drilling Method: Mud Rotary/SPT

Pocket Penetrometer ✕ Shear Strength (kPa) 100 200 300 400

▲SPT "N" (BLOWS/300 mm)▲ Wp% 20 W% 40 60 WL% 80

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING (Drillers Estimate {G % S % F %})	ELEVATION (m)
0				ASPHALT (100 mm thick). 0.1m			22
	S	S1	25.9	ML; SILT, trace to some sand, trace gravel, trace fibrous organics; non plastic silt, fine to coarse sand, sub-rouded gravels, dark-brown, moist, firm.	ML		
1	SPT	SPT1		1.07m			
	S	S2	3.3	SP/GP; SAND and GRAVEL, trace silt; fine to medium grain sand, sub-rounded/sub-angular gravel, 25 mm max, brown-grey, wet, loose to dense.	SP		21
2	SPT	SPT2			SP		
	S	S3	4.9		GP/SP		20
3	SPT	SPT3	11.1		SP-SM		19
4				- dense below 4.0 m depth.			
	SPT	SPT4	9.2		GP-GM/SP-SM	Passing No. 200 Sieve = 5.1%	18
5							
6	SPT	SPT5 SPT5-2	8.9 13.7	- becomes silty	GP-GM SM	Passing No. 200 Sieve = 36.4%	17
7				7.62m			16
	SPT	SPT7	17.1	SC/CL; SAND and silty CLAY; non-plastic to low plasticity, fine grain sand, grey, moist, very stiff. - encounter cobble, 75 mm max at 7.62 m depth.	CL	**Atterberg** (Sa#SPT7): PL:15% LL:23% Passing No. 200 Sieve = 45.0%	15
8							
9				9.14m			14
	SPT	SPT8	20.6	ML; SILT, trace to some clay, some sand; low plasticity, fine grain sand, grey, moist, very stiff to hard.	CL	**Atterberg** (Sa#SPT8): PL:17% LL:31%	13
10							

4.7m ▼

MONITORING WELL

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Legend Installation: Sand; Grout; Cement; Bentonite; Drill Cuttings; Slotted; Slough; Piezometer

Final Depth of Hole: 15.8 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221_MOTI.GPJ MOTI_DATATEMPLATE_REV3.GDT 9/21/23

SUMMARY LOG

Drill Hole #: **MRH23-1**

Ministry of Transportation and Infrastructure

Project: **H7/H11 Mission Truck Route Intersection Improvements**

Location: Mission, BC

Prepared by: 35221
Thurber Engineering Ltd.

Logged by: SY Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442632 , 551334 Station/Offset:

Elevation: 22.4 m *Coordinates taken with GPS*

Date(s) Drilled: August 14, 2023

Company: Downwrite Drilling Ltd.

Driller: Ulantrewey

Drill Make/Model: Mobile B54X tracked drill

Drilling Method: Mud Rotary/SPT

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	MONITORING WELL	ELEVATION (m)
10							ML; SILT, trace to some clay, some sand; low plasticity, fine grain sand, grey, moist, very stiff to hard. *(continued)*				12
11		16.9 ▲		SPT9				CL-ML	**Atterberg** (Sa#SPT9): PL:14% LL:22% Passing No. 200 Sieve = 41.0%		11
12		21.3 ▲		SPT10				ML			10
13											9
14		18.3 ▲		SPT11			13.72m ML; SILT, some clay to clayey, some to trace sand; medium to low plasticity, fine grain sand. grey, moist, very stiff.	CL	**Atterberg** (Sa#SPT11): PL:16% LL:32%		8
15											7
16		17.2 ▲		SPT12			15.85m End of hole at required depth. Hole open to 12.19 m depth. Standpipe piezometer installed between 3.7 m - 8.2 m depth. Upon completion of drilling: Hole backfilled with bentonite chips, drill cuttings and covered with with cold asphalt patch at surface.	CL/ML			6
17											5
18											4
19											3
20											

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Legend Installation: Sand; Grout; Cement; Bentonite; Drill Cuttings; Slotted; Slough; Piezometer

Final Depth of Hole: 15.8 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221_MOTI.GPJ MOTI_DATATEMPLATE_REV3.GDT 9/21/23

Ministry of Transportation and Infrastructure

SUMMARY LOG

Drill Hole #: **HA23-01A**

Project: **H7/H11 Mission Truck Route Intersection Improvements**

Location: Mission, BC

Prepared by: 35221
Thurber Engineering Ltd.

Logged by: DPN Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442626 , 551334 Station/Offset:

Elevation: *Coordinates taken with GPS*

Date(s) Drilled: August 11, 2023

Company:

Driller: Dylan Nash

Drill Make/Model:

Drilling Method: Hand Auger

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
0		5.6		1			SM; silty SAND, some gravel; fine to medium gravel, brown, moist.	SM		0
1							0.91m End of hole at 0.9 m depth. No water observed upon completion of drilling.			1
2										2
3										3
4										4
5										5
6										6
7										7
8										8
9										9
10										

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Legend Installation: Sand; Grout; Cement; Bentonite; Drill Cuttings; Slotted; Slough; Piezometer

Final Depth of Hole: 0.9 m
Depth to Top of Rock:

MOTI-SOIL-REV3 35221_MOTI.GPJ MOTI_DATATEMPLATE_REV3.GDT 9/18/23

Ministry of Transportation and Infrastructure

SUMMARY LOG

Drill Hole #: **HA23-01B**

Project: **H7/H11 Mission Truck Route Intersection Improvements**

Location: Mission, BC

Prepared by: 35221
Thurber Engineering Ltd.

Logged by: DPN Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442626 , 551336 Station/Offset:

Elevation: *Coordinates taken with GPS*

Date(s) Drilled: August 11, 2023

Company:

Driller: Dylan Nash

Drill Make/Model:

Drilling Method: Hand Auger

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
0		4:6		1			SM; gravelly SAND, some silt to silty; brown, moist.	GM/SM		0
		4:5		2				SM		
							0.76m End of hole at 0.8 m depth. No water observed upon completion of drilling.			
1										1
2										2
3										3
4										4
5										5
6										6
7										7
8										8
9										9
10										

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Legend Installation: Sand; Grout; Cement; Bentonite; Drill Cuttings; Slotted; Slough; Piezometer

Final Depth of Hole: 0.8 m
Depth to Top of Rock:

MOTI-SOIL-REV3 35221_MOTI.GPJ MOTI_DATATEMPLATE_REV3.GDT 9/18/23

Ministry of Transportation and Infrastructure

SUMMARY LOG

Drill Hole #: **HA23-02**

Project: **H7/H11 Mission Truck Route Intersection Improvements**

Location: Mission, BC

Prepared by: 35221
Thurber Engineering Ltd.

Logged by: DPN Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442613 , 551339 Station/Offset:

Elevation: *Coordinates taken with GPS*

Date(s) Drilled: August 11, 2023

Company:

Driller: Dylan Nash

Drill Make/Model:

Drilling Method: Hand Auger

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
0		5.1 10.2		1 2			ML/SM; SAND, some silt to silty, trace to some gravel, trace fibrous organics; brown, moist.	SP-SM ML/SM		0
1		14.4 11.1		8 9			GM/SM; silty SAND and GRAVEL, trace fibrous organics; brown, moist.	SM GM/SM		1
							1.37m 1.52m End of hole at 1.5 m depth. Hole open to 0.9 m depth. No water observed upon completion of drilling.			
2										2
3										3
4										4
5										5
6										6
7										7
8										8
9										9
10										

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Legend Installation: Sand; Grout; Cement; Bentonite; Drill Cuttings; Slotted; Slough; Piezometer

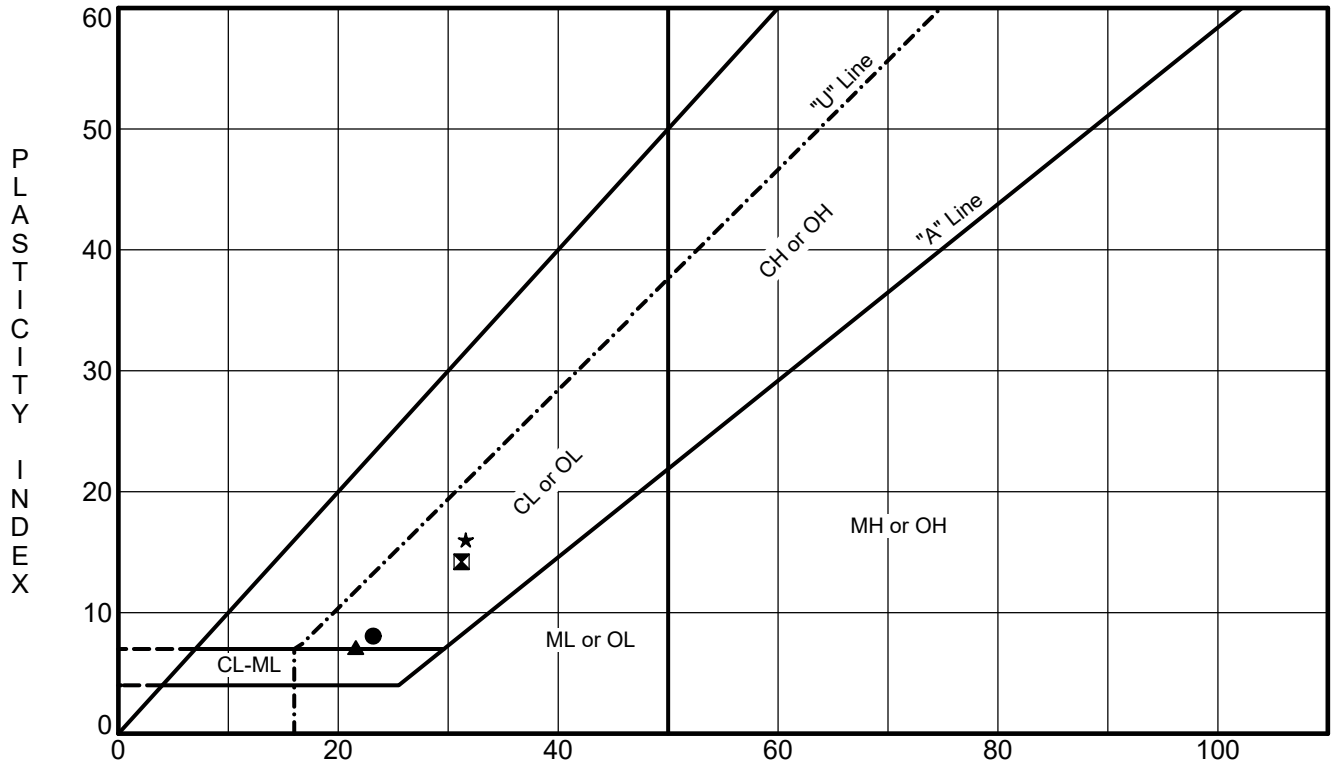
Final Depth of Hole: 1.5 m
Depth to Top of Rock:

MOTI-SOIL-REV3 35221_MOTI.GPJ MOTI_DATATEMPLATE_REV3.GDT 9/18/23

THURBER ENGINEERING LTD.

APPENDIX D

Laboratory Reports



	Specimen Identification		LL	PL	PI	MC%	USCS Classification
●	**MRH23-1, Sa. SPT7**	**7.6 m**	**23**	**15**	**8**	**17.1**	**CL**
⊠	**MRH23-1, Sa. SPT8**	**9.1 m**	**31**	**17**	**14**	**20.6**	**CL**
▲	**MRH23-1, Sa. SPT9**	**10.7 m**	**22**	**14**	**8**	**16.9**	**CL-ML**
★	**MRH23-1, Sa. SPT11**	**13.7 m**	**32**	**16**	**16**	**18.3**	**CL**

THURBER ENGINEERING LTD.

PLASTICITY CHART

PREPARED BY: Thurber Engineering Ltd.
PROJECT: H7/H11 Mission Truck Route Intersection Improvements
LOCATION: Mission, BC **FILE NO.:** 35221

ATTERBERG LIMITS FOR MOTI TEMPLATE 35221_MOTI.GPJ THURBER BC -2017.GDT 9/21/23- THURBER MOM - BC OPERATIONS.GLB

GRADATION ANALYSIS

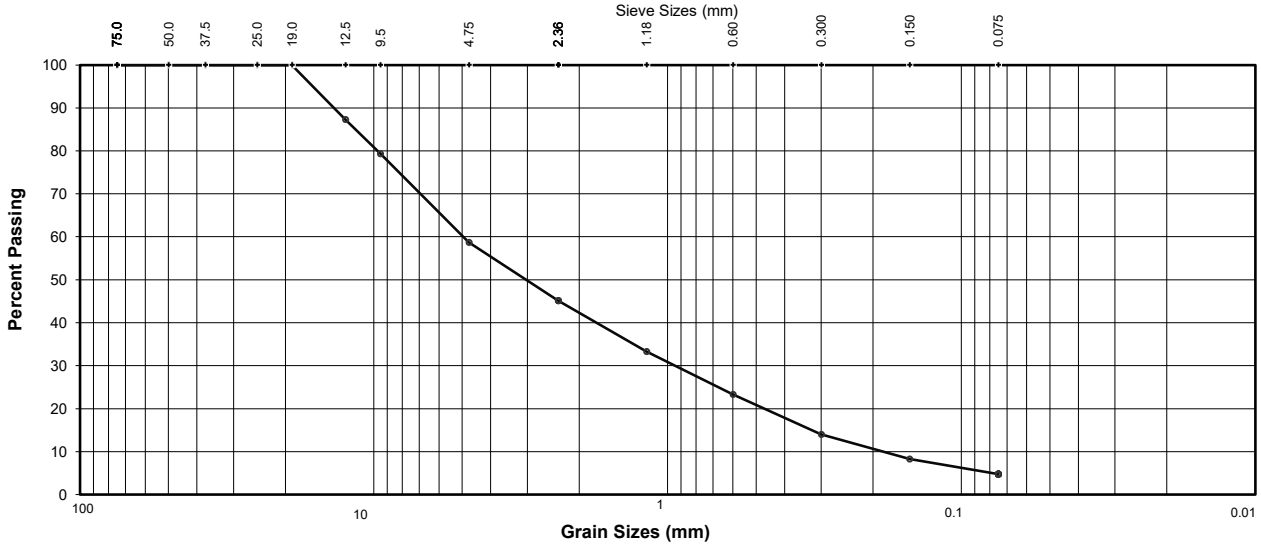
THURBER ENGINEERING LTD.
Suite 2302, 4476 Markham Road, Victoria, BC V8Z 7X8 Phone (250) 727-2201

Client: BC MoTI / Urban Systems Ltd. Project Number: 35221

Project: H7/H11 Mission Truck Route Intersection Improvements Date: 7-Sep-23

Sample Source: TH22-02, Sa 1, 1.5 ft - 2.5 ft
Material Type: Grab
Specification:
Sample Description: brown, SAND and GRAVEL with a trace of fines
Water Content As Received: 0.7%

Date Tested: 1-Sep-23
Sampled by: MWA
Date Sampled: 17-Nov-22
Test Method: ASTM
Series No.:



GRAVEL (FROM SIEVE)				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	75			
	50			
	37.5			
	25	100.0		
	19	100.0		
	12.5	87.3		
	9.5	79.3		
	4.75	58.7		

SAND & FINES (FROM SIEVE & WASH)				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	2.36	45.1		
	1.18	33.3		
	0.6	23.3		
	0.3	14.0		
	0.15	8.3		
	0.075	4.8		

SILT AND CLAY (FROM HYDROMETER)			
Silt			
Clay	-		
Total Fines:	4.8%		

Gravel: 41.3% Percent Crush: N/A
Sand: 53.9% Faces Counted: 0
Fines: 4.8%

Comments:

Checked By: JSH

GRADATION ANALYSIS

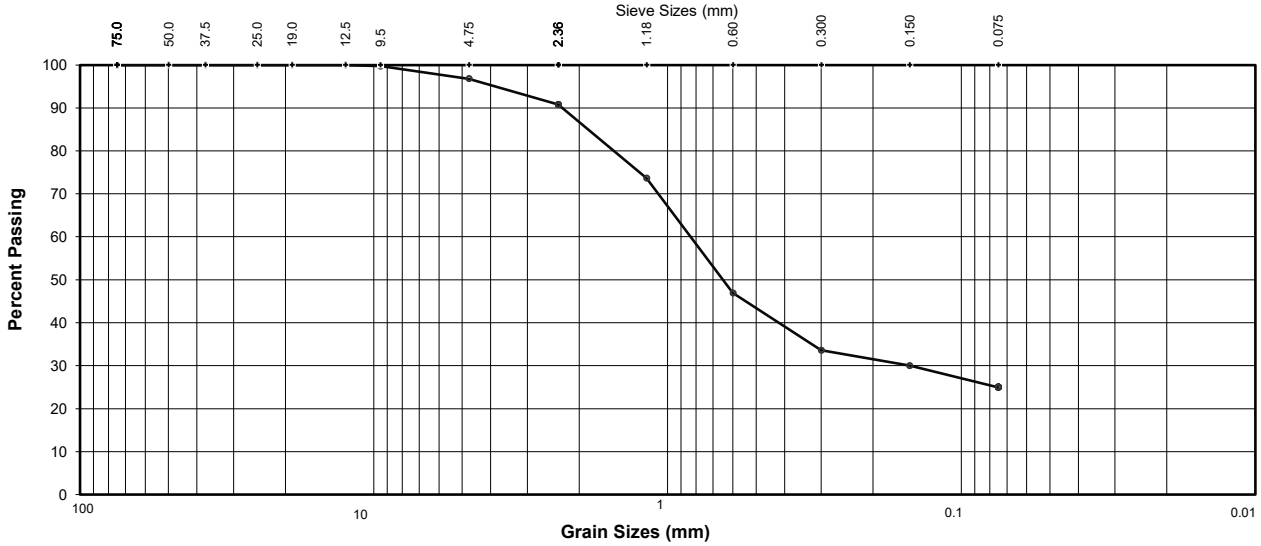
THURBER ENGINEERING LTD.
Suite 2302, 4476 Markham Road, Victoria, BC V8Z 7X8 Phone (250) 727-2201

Client: BC MoTI / Urban Systems Ltd. Project Number: 35221

Project: H7/H11 Mission Truck Route Intersection Improvements Date: 7-Sep-23

Sample Source: TH22-05, Sa 1, 2.0 ft - 2.5 ft
Material Type: Grab
Specification:
Sample Description: brown, silty SAND with a trace gravel
Water Content As Received: 5.8%

Date Tested: 1-Sep-23
Sampled by: MWA
Date Sampled: 17-Nov-22
Test Method: ASTM
Series No.:



GRAVEL (FROM SIEVE)				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	75			
	50			
	37.5			
	25			
	19			
	12.5	100.0		
	9.5	99.7		
	4.75	96.8		

SAND & FINES (FROM SIEVE & WASH)				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	2.36	90.8		
	1.18	73.6		
	0.6	46.9		
	0.3	33.6		
	0.15	30.0		
	0.075	25.0		

SILT AND CLAY (FROM HYDROMETER)			
Silt			
Clay	-		
Total Fines:	25.0%		

Gravel: 3.2% Percent Crush: N/A
Sand: 71.8% Faces Counted: 0
Fines: 25.0%

Comments:

Checked By: JSH

GRADATION ANALYSIS

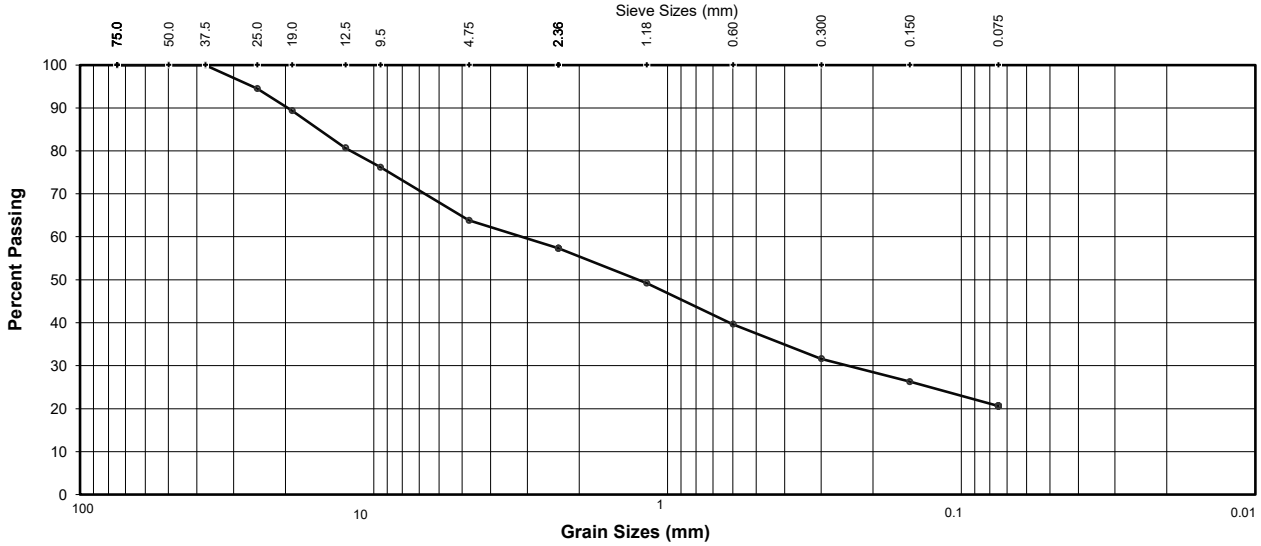
THURBER ENGINEERING LTD.
Suite 2302, 4476 Markham Road, Victoria, BC V8Z 7X8 Phone (250) 727-2201

Client: BC MoTI / Urban Systems Ltd. Project Number: 35221

Project: H7/H11 Mission Truck Route Intersection Improvements Date: 7-Sep-23

Sample Source: TH22-07, Sa 1, 2.5 ft - 3.0 ft
Material Type: Grab
Specification:
Sample Description: brown, silty SAND and GRAVEL
Water Content As Received: 9.5%

Date Tested: 1-Sep-23
Sampled by: MWA
Date Sampled: 17-Nov-22
Test Method: ASTM
Series No.:



GRAVEL (FROM SIEVE)				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	75			
	50			
	37.5	100.0		
	25	94.5		
	19	89.4		
	12.5	80.7		
	9.5	76.2		
	4.75	63.8		

SAND & FINES (FROM SIEVE & WASH)				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	2.36	57.4		
	1.18	49.2		
	0.6	39.7		
	0.3	31.6		
	0.15	26.3		
	0.075	20.6		

SILT AND CLAY (FROM HYDROMETER)			
Silt			
Clay	-		
Total Fines:	20.6%		

Gravel: 36.2% Percent Crush: N/A
Sand: 43.2% Faces Counted: 0
Fines: 20.6%

Comments:

Checked By: JSH

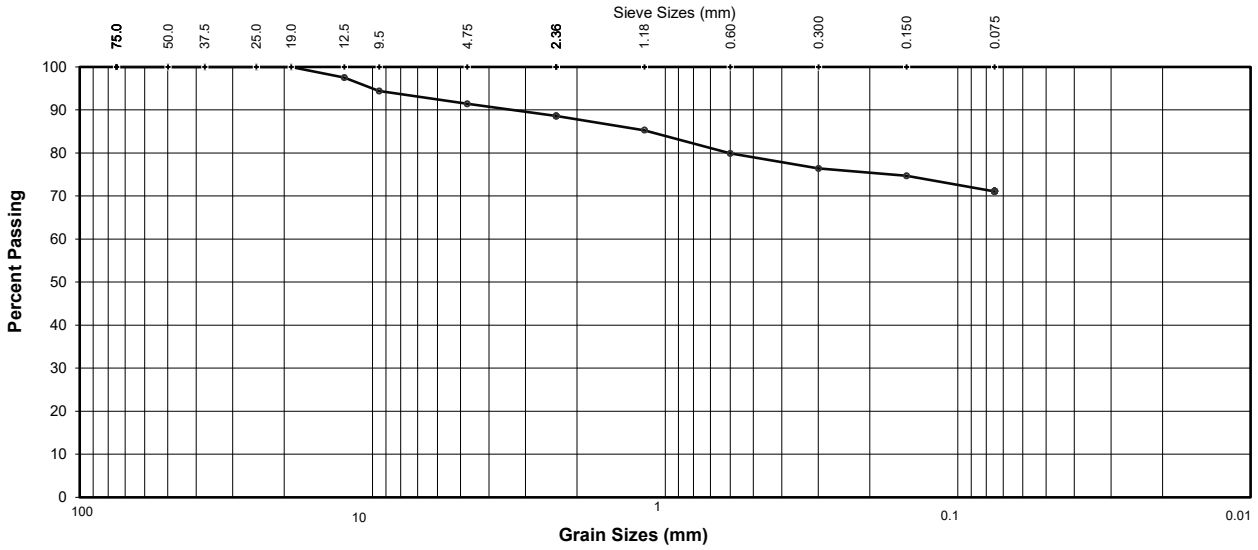
GRADATION ANALYSIS

THURBER ENGINEERING LTD.
Suite 900, 1281 West Georgia Street, Vancouver, BC V6E 3J7 Phone (604) 684 4384

Client: BC MoTI / Urban Systems Ltd. Project Number: 35221

Project: H7/H11 Mission Truck Route Intersection Improvements Date: 24-Aug-23

Sample Source:	MRH23-1, S1, 0.3 - 0.5 m	**Date Tested:**	22-Aug-23
Material Type:	Grab	**Sampled by:**	YS
Specification:	ASTM C136 and C117	**Date Sampled:**	14-Aug-23
Sample Description:	sandy SILT, trace of gravel (ML)	**Test Method:**	ASTM
Water Content As Received:	25.9%	**Series No.:**	



GRAVEL (FROM SIEVE)				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	75			
	50			
	37.5			
	25			
	19	100.0		
	12.5	97.5		
	9.5	94.4		
	4.75	91.4		

SAND & FINES (FROM SIEVE & WASH)				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	2.36	88.6		
	1.18	85.3		
	0.6	79.9		
	0.3	76.4		
	0.15	74.7		
	0.075	71.1		

SILT AND CLAY (FROM HYDROMETER)			
Silt	-		
Clay	-		
Total Fines:	-		

Gravel:	8.6%	Percent Crush:	N/A
Sand:	20.3%	Faces Counted:	N/A
Fines:	71.1%		

Comments:

Checked By: KM

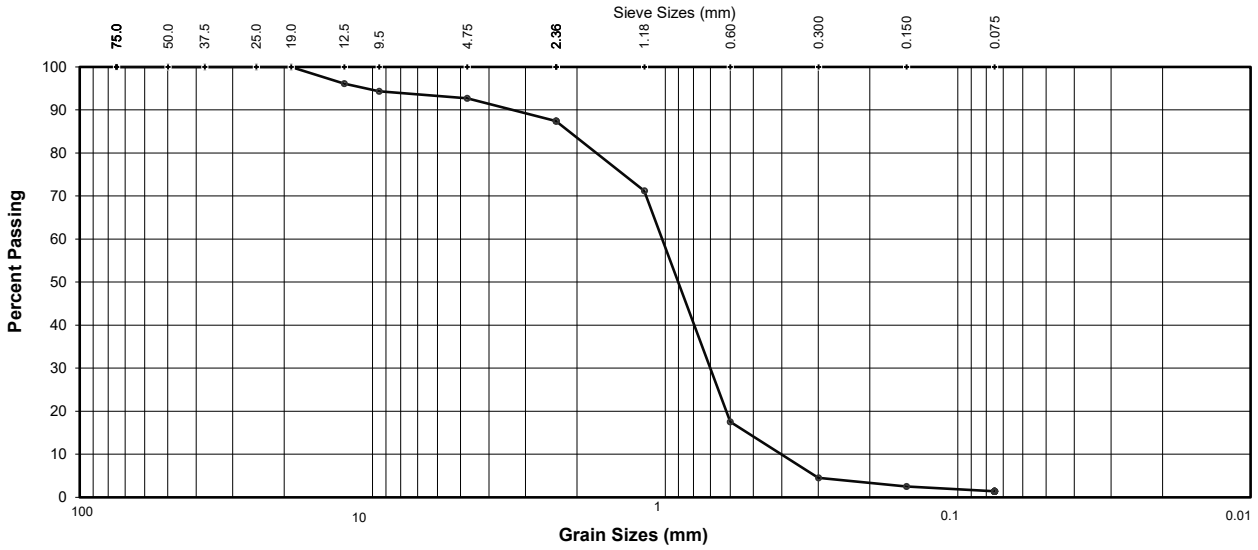
GRADATION ANALYSIS

THURBER ENGINEERING LTD.
Suite 900, 1281 West Georgia Street, Vancouver, BC V6E 3J7 Phone (604) 684 4384

Client: BC MoTI / Urban Systems Ltd. Project Number: 35221

Project: H7/H11 Mission Truck Route Intersection Improvements Date: 24-Aug-23

Sample Source:	MRH23-1, SPT2, 1.8 - 2.1 m	**Date Tested:**	22-Aug-23
Material Type:	SPT	**Sampled by:**	YS
Specification:	ASTM C136 and C117	**Date Sampled:**	14-Aug-23
Sample Description:	SAND, traces of silt and gravel (SP)	**Test Method:**	ASTM
Water Content As Received:	1.9%	**Series No.:**	



GRAVEL (FROM SIEVE)				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	75			
	50			
	37.5			
	25			
	19	100.0		
	12.5	96.1		
	9.5	94.3		
	4.75	92.7		

SAND & FINES (FROM SIEVE & WASH)				
Sieve No.	Opening (mm)	Percent Passing	Gradation Limits Max	min
	2.36	87.4		
	1.18	71.2		
	0.6	17.5		
	0.3	4.5		
	0.15	2.5		
	0.075	1.4		

SILT AND CLAY (FROM HYDROMETER)			
Silt	-		
Clay	-		
Total Fines:	-		

Gravel:	7.3%	Percent Crush:	N/A
Sand:	91.3%	Faces Counted:	N/A
Fines:	1.4%		

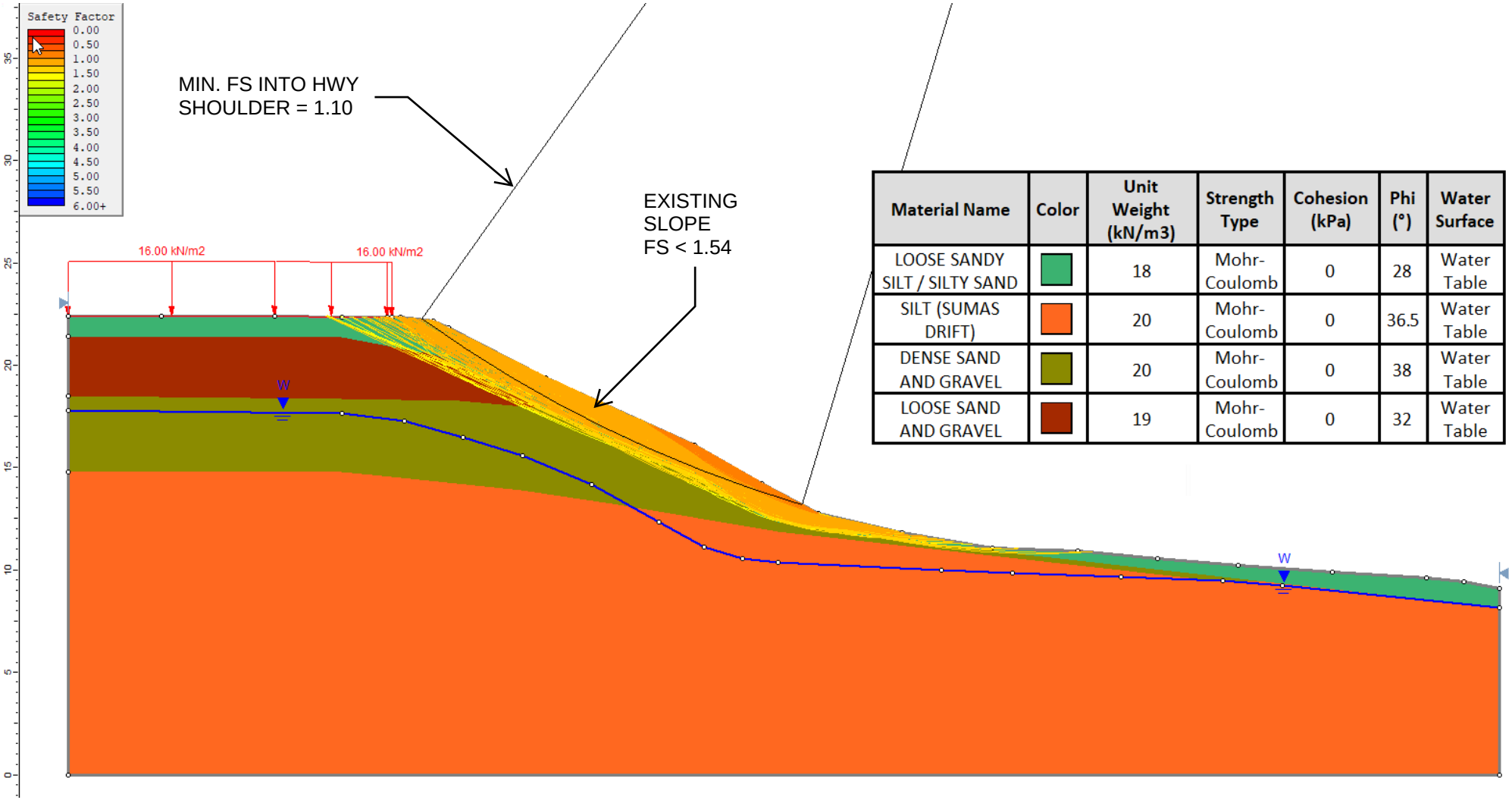
Comments:

Checked By: KM

THURBER ENGINEERING LTD.

APPENDIX E

Slope Stability Figures



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
LOOSE SANDY SILT / SILTY SAND		18	Mohr-Coulomb	0	28	Water Table
SILT (SUMAS DRIFT)		20	Mohr-Coulomb	0	36.5	Water Table
DENSE SAND AND GRAVEL		20	Mohr-Coulomb	0	38	Water Table
LOOSE SAND AND GRAVEL		19	Mohr-Coulomb	0	32	Water Table

GLE/Morgenstern-Price Analysis

LEGEND / NOTES

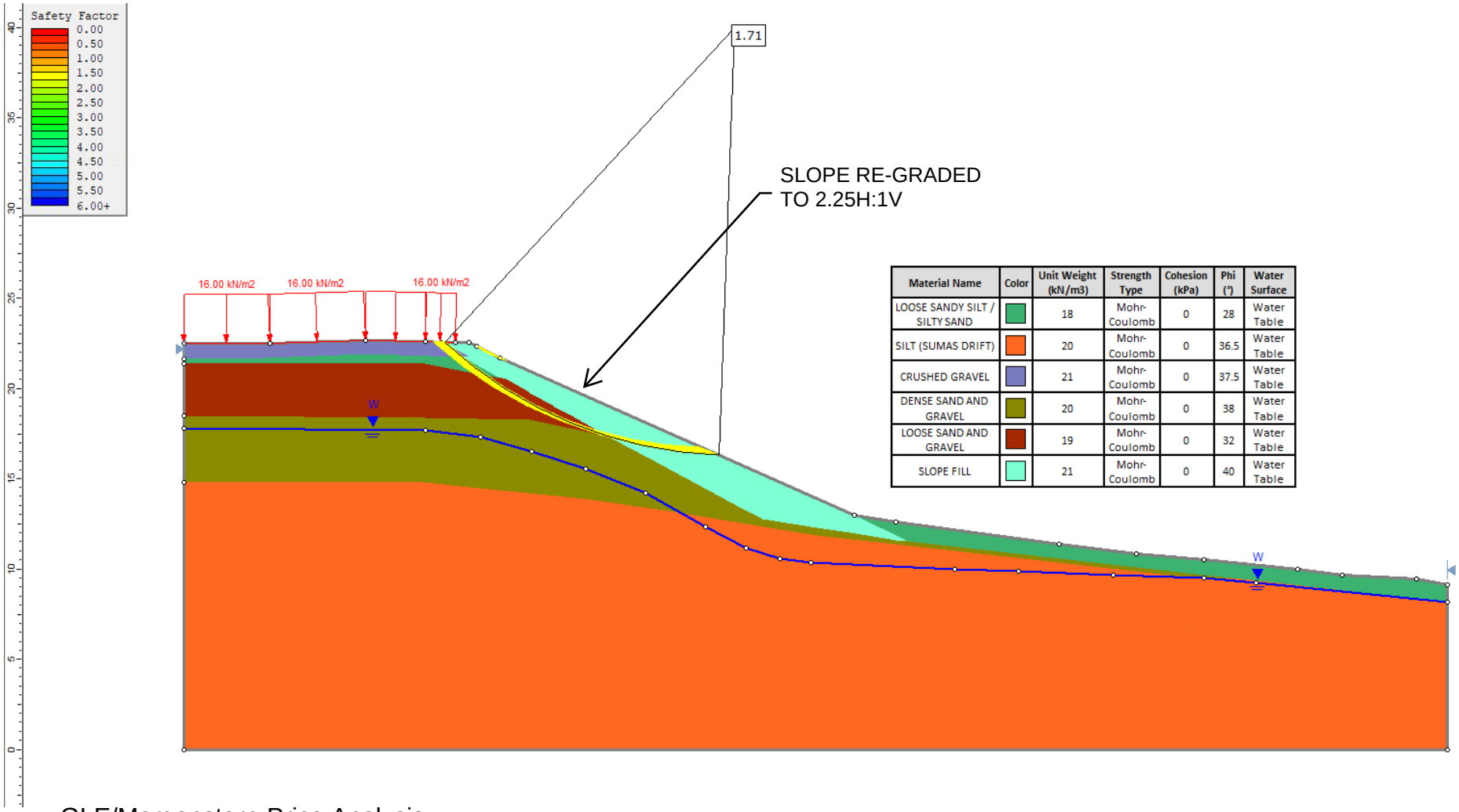
THURBER

CLIENT NAME: URBAN SYSTEMS LTD.

DRAWING TITLE: REPRESENTATIVE STATIC SLOPE STABILITY ANALYSIS AT STA. 103+40

PROJECT NAME AND LOCATION: H7/H11 TRUCK ROUTE INTERSECTION IMPROVEMENTS MISSION, BC

DRAWN BY	DATE
GGM	2023-10-13
DESIGNED BY	SCALE
GGM	-
APPROVED BY	PROJECT No.
JSP	35221
DRAWING / FIGURE No.	REV.
E1	1



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
LOOSE SANDY SILT / SILTY SAND		18	Mohr-Coulomb	0	28	Water Table
SILT (SUMAS DRIFT)		20	Mohr-Coulomb	0	36.5	Water Table
CRUSHED GRAVEL		21	Mohr-Coulomb	0	37.5	Water Table
DENSE SAND AND GRAVEL		20	Mohr-Coulomb	0	38	Water Table
LOOSE SAND AND GRAVEL		19	Mohr-Coulomb	0	32	Water Table
SLOPE FILL		21	Mohr-Coulomb	0	40	Water Table

GLE/Morgenstern-Price Analysis

LEGEND / NOTES

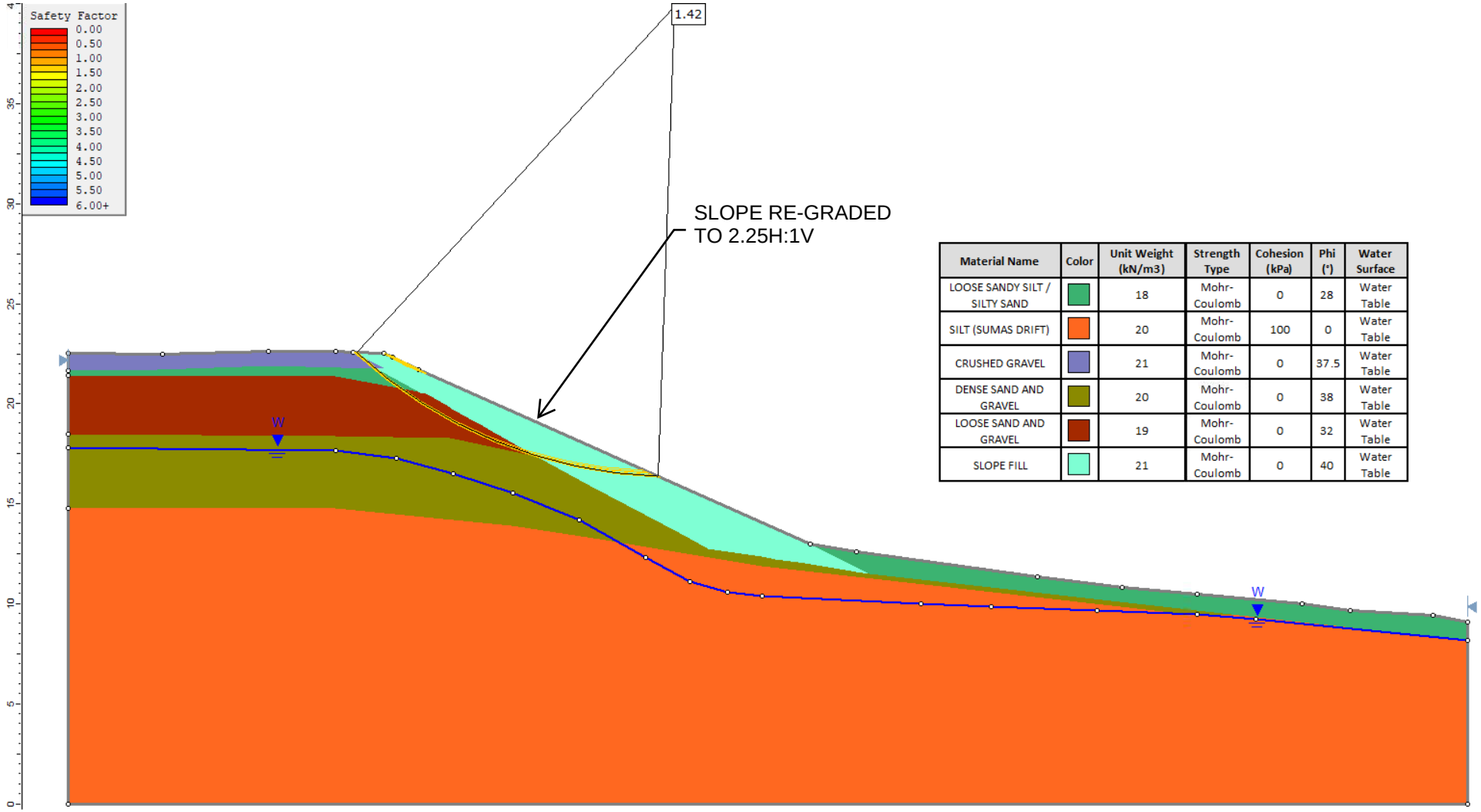
THURBER

CLIENT NAME: URBAN SYSTEMS LTD.

DRAWING TITLE: REPRESENTATIVE STATIC SLOPE STABILITY ANALYSIS AT STA. 103+40

PROJECT NAME AND LOCATION: H7/H11 TRUCK ROUTE INTERSECTION IMPROVEMENTS
MISSION, BC

DRAWN BY	DATE
GGM	2023-10-13
DESIGNED BY	SCALE
GGM	-
APPROVED BY	PROJECT No.
JSP	35221
DRAWING / FIGURE No.	REV.
E2	1



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
LOOSE SANDY SILT / SILTY SAND		18	Mohr-Coulomb	0	28	Water Table
SILT (SUMAS DRIFT)		20	Mohr-Coulomb	100	0	Water Table
CRUSHED GRAVEL		21	Mohr-Coulomb	0	37.5	Water Table
DENSE SAND AND GRAVEL		20	Mohr-Coulomb	0	38	Water Table
LOOSE SAND AND GRAVEL		19	Mohr-Coulomb	0	32	Water Table
SLOPE FILL		21	Mohr-Coulomb	0	40	Water Table

GLE/Morgenstern-Price Analysis
1:475 Site Class D

LEGEND / NOTES

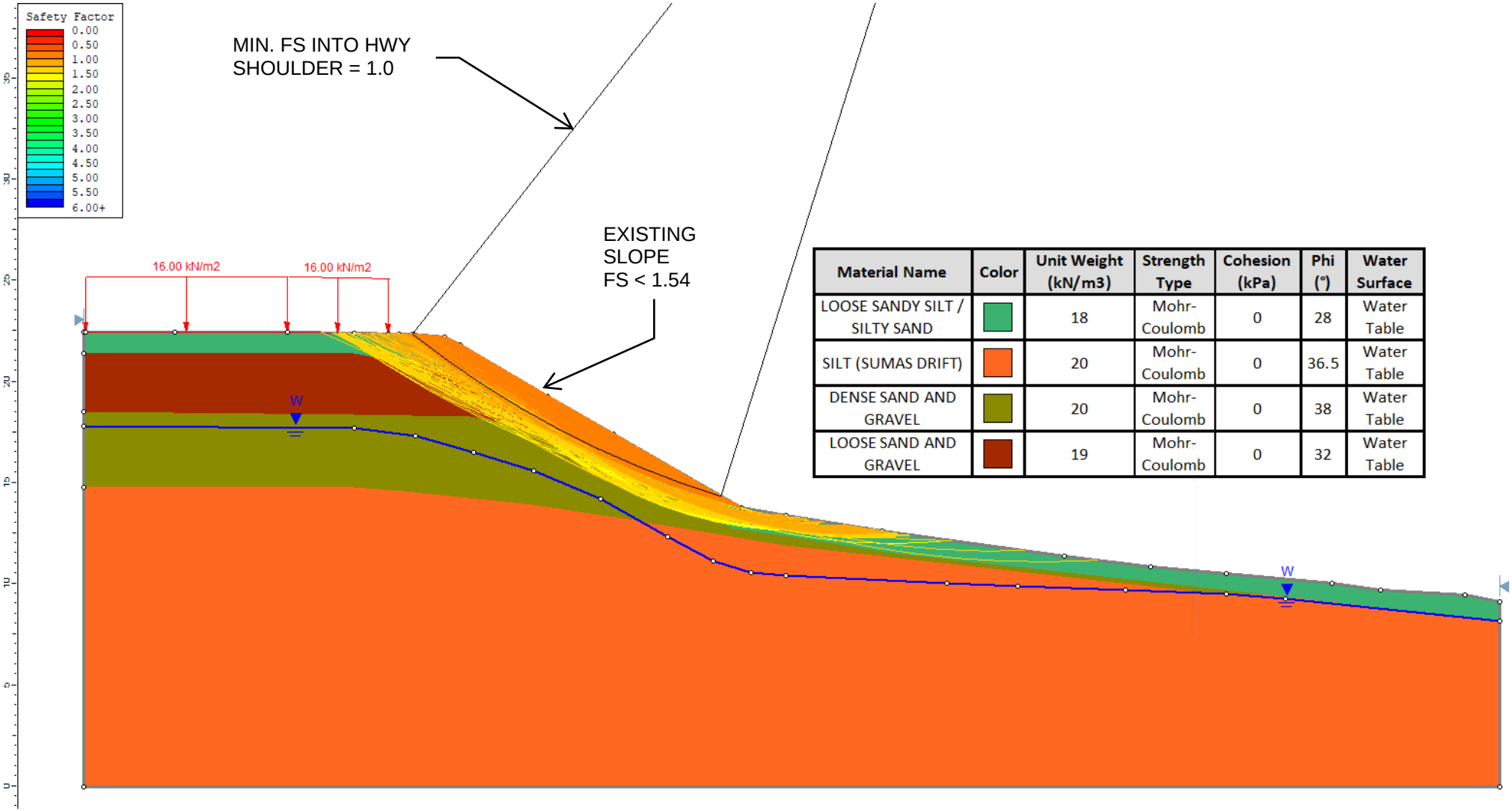
THURBER

CLIENT NAME: URBAN SYSTEMS LTD.

DRAWING TITLE: REPRESENTATIVE SEISMIC SLOPE STABILITY ANALYSIS AT STA. 103+40

PROJECT NAME AND LOCATION: H7/H11 TRUCK ROUTE INTERSECTION IMPROVEMENTS
MISSION, BC

DRAWN BY	DATE
GGM	2023-10-13
DESIGNED BY	SCALE
GGM	-
APPROVED BY	PROJECT No.
JSP	35221
DRAWING / FIGURE No.	REV.
E3	1



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
LOOSE SANDY SILT / SILTY SAND		18	Mohr-Coulomb	0	28	Water Table
SILT (SUMAS DRIFT)		20	Mohr-Coulomb	0	36.5	Water Table
DENSE SAND AND GRAVEL		20	Mohr-Coulomb	0	38	Water Table
LOOSE SAND AND GRAVEL		19	Mohr-Coulomb	0	32	Water Table

GLE/Morgenstern-Price Analysis

LEGEND / NOTES

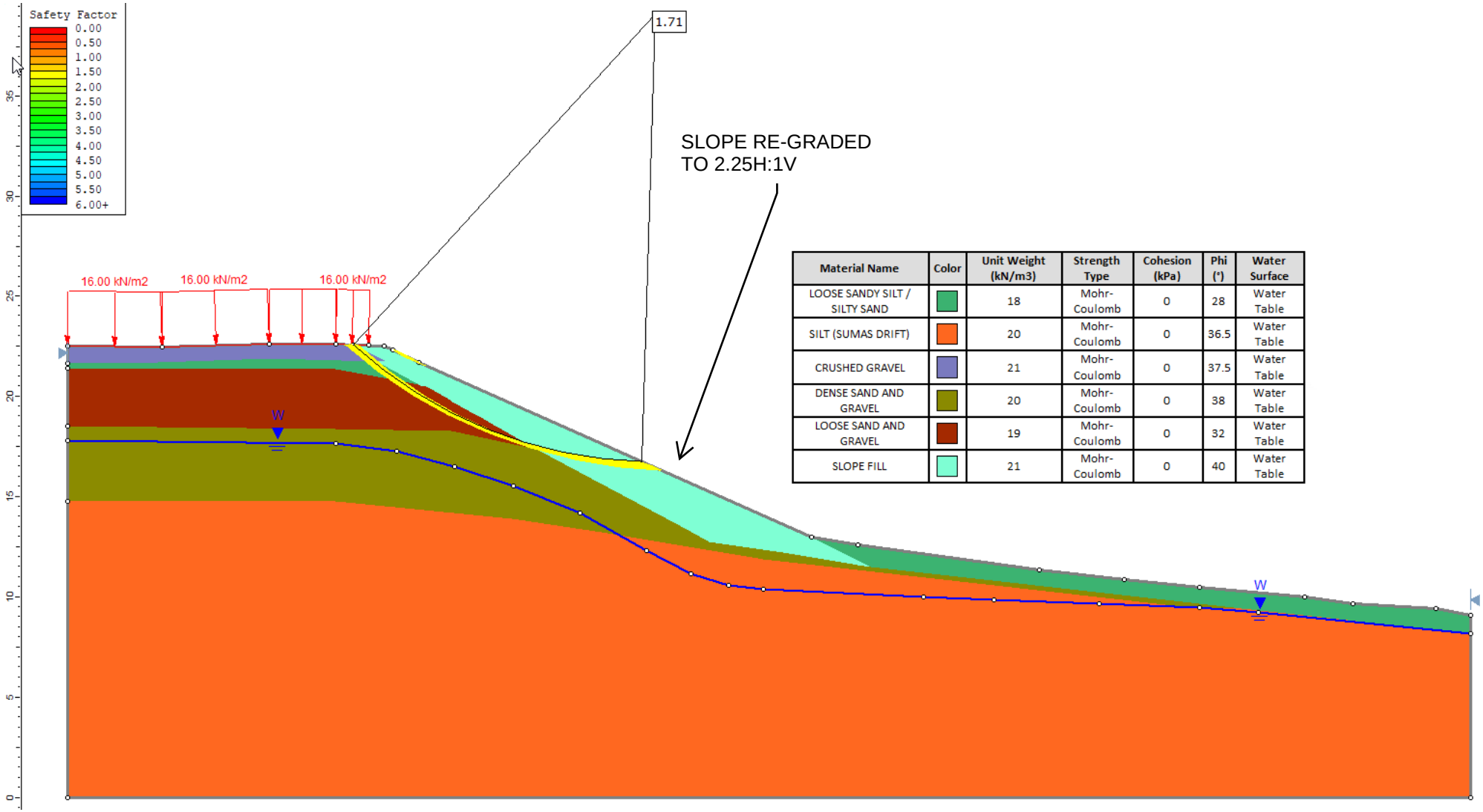
THURBER

CLIENT NAME: URBAN SYSTEMS LTD.

DRAWING TITLE: REPRESENTATIVE STATIC SLOPE STABILITY ANALYSIS AT STA. 103+60

PROJECT NAME AND LOCATION: H7/H11 TRUCK ROUTE INTERSECTION IMPROVEMENTS MISSION, BC

DRAWN BY	DATE
GGM	2023-10-13
DESIGNED BY	SCALE
GGM	-
APPROVED BY	PROJECT No.
JSP	35221
DRAWING / FIGURE No.	REV.
E4	1



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
LOOSE SANDY SILT / SILTY SAND		18	Mohr-Coulomb	0	28	Water Table
SILT (SUMAS DRIFT)		20	Mohr-Coulomb	0	36.5	Water Table
CRUSHED GRAVEL		21	Mohr-Coulomb	0	37.5	Water Table
DENSE SAND AND GRAVEL		20	Mohr-Coulomb	0	38	Water Table
LOOSE SAND AND GRAVEL		19	Mohr-Coulomb	0	32	Water Table
SLOPE FILL		21	Mohr-Coulomb	0	40	Water Table

GLE/Morgenstern-Price Analysis

LEGEND / NOTES

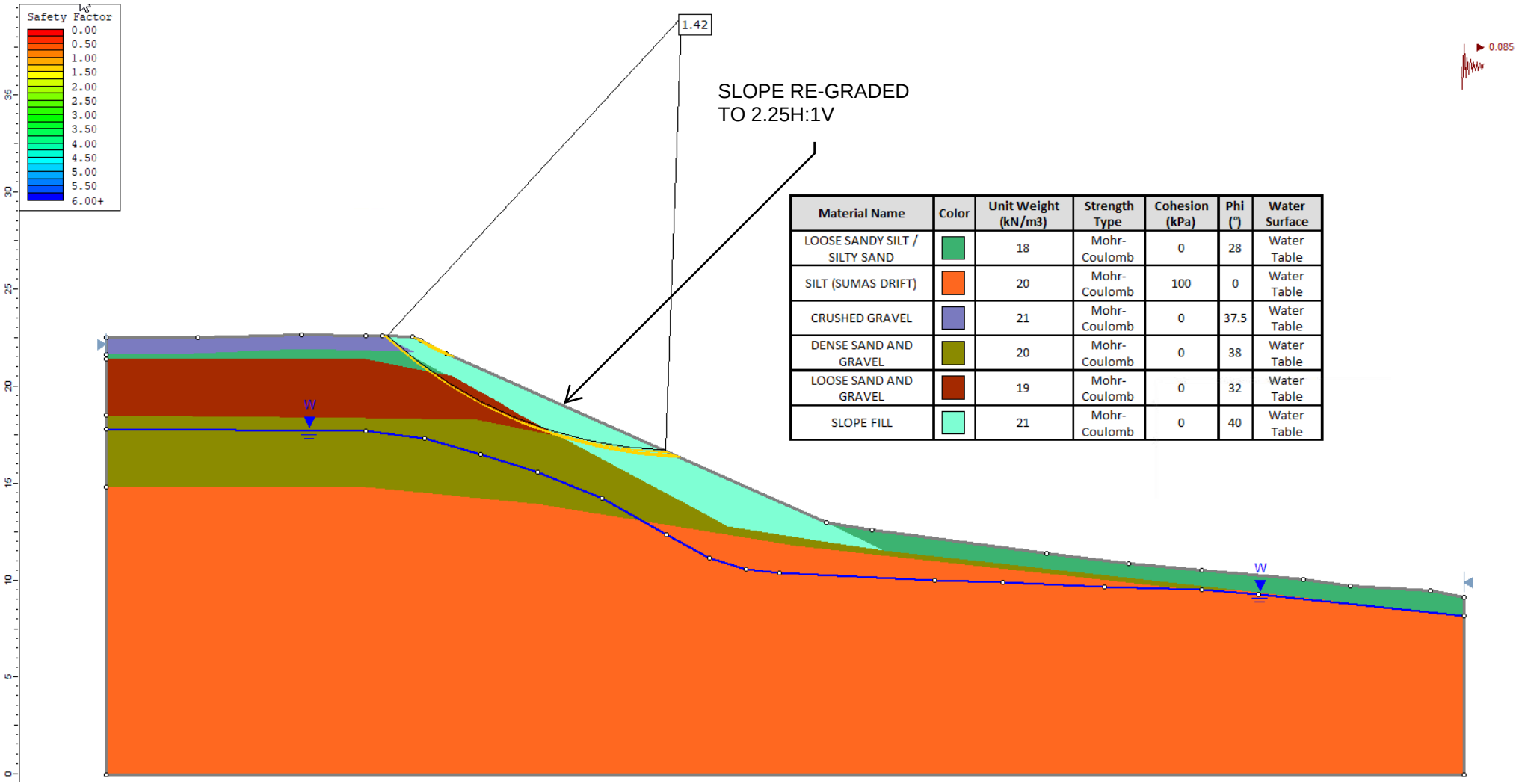
THURBER

CLIENT NAME: URBAN SYSTEMS LTD.

DRAWING TITLE: REPRESENTATIVE STATIC SLOPE STABILITY ANALYSIS AT STA. 103+60

PROJECT NAME AND LOCATION: H7/H11 TRUCK ROUTE INTERSECTION IMPROVEMENTS
MISSION, BC

DRAWN BY	DATE
GGM	2023-10-13
DESIGNED BY	SCALE
GGM	-
APPROVED BY	PROJECT No.
JSP	35221
DRAWING / FIGURE No.	REV.
E5	1



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
LOOSE SANDY SILT / SILTY SAND		18	Mohr-Coulomb	0	28	Water Table
SILT (SUMAS DRIFT)		20	Mohr-Coulomb	100	0	Water Table
CRUSHED GRAVEL		21	Mohr-Coulomb	0	37.5	Water Table
DENSE SAND AND GRAVEL		20	Mohr-Coulomb	0	38	Water Table
LOOSE SAND AND GRAVEL		19	Mohr-Coulomb	0	32	Water Table
SLOPE FILL		21	Mohr-Coulomb	0	40	Water Table

GLE/Morgenstern-Price Analysis
1:475 Site Class D

LEGEND / NOTES

THURBER

CLIENT NAME: URBAN SYSTEMS LTD.

DRAWING TITLE: REPRESENTATIVE SEISMIC SLOPE STABILITY ANALYSIS AT STA. 103+60

PROJECT NAME AND LOCATION: H7/H11 TRUCK ROUTE INTERSECTION IMPROVEMENTS
MISSION, BC

DRAWN BY	DATE
GGM	2023-10-13
DESIGNED BY	SCALE
GGM	-
APPROVED BY	PROJECT No.
JSP	35221
DRAWING / FIGURE No.	REV.
E6	1