THURBER ENGINEERING LTD.

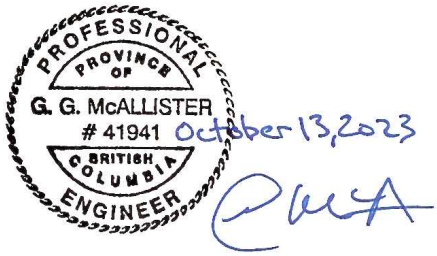
H7/H11 TRUCK ROUTE INTERSECTION IMPROVEMENTS

MISSION, BC
GEOTECHNICAL REPORT

Report

to

Urban Systems Ltd.



Graeme McAllister, M.A.Sc., P. Eng.
Geotechnical Engineer

Thurber Engineering Ltd.
Permit to Practice #1001319

Date: October 12, 2023
File: 35221

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

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APPENDICES

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1. INTRODUCTION

The Ministry of Transportation and Infrastructure (MoTI) 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.

Thurber Engineering Ltd. (Thurber) has prepared this geotechnical report which presents the results of the geotechnical investigation and assessment for the design of the H7/H11 Mission Truck Route Intersection Improvements project.

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

2. PROJECT DESCRIPTION

Improvements at Highway 7 are proposed to include changing the inside westbound lane to left turn only. This change will coincide with approximately 140 m of pavement structure widening to the south of Highway 7 to accommodate a left turn storage bay extension. The road widening will be atop an embankment up to over 8 m high. A concrete barrier will be installed the length of the widening. Asphalt mill and inlay are proposed over existing pavement within the project limits.

The embankment south of Highway 7 slopes down to a developed property at 33433 North Railway Avenue. This property includes a tilt-up warehouse building constructed into the embankment below Highway 7.

At the Glasgow Avenue and Horne Street intersection, improvements include removal of the eastbound channelized right turn lane, from Glasgow Avenue onto Horne Street, and modifying the west curb-line of the south intersection leg to create additional space for turning westbound trucks. Full depth pavement reconstruction is proposed where the existing raised island is to be removed. Asphalt mill and inlay are proposed over existing pavement in the intersection's southwest quadrant.

The surface grade surrounding the Glasgow / Horne intersection is generally flat but the elevation of Glasgow Avenue increases quickly to the north of the intersection for the Canadian Pacific (CP) Railway Overhead Bridge. CP Railway tracks run east-west between the intersection of Glasgow Avenue and Horne Street and the intersection of Highway 7 and Murray Street.

3. INVESTIGATION

3.1 Drilling Investigation

Between November 14 and 18, 2022, Thurber completed a geotechnical investigation at the project site. Before drilling, a BC OneCall ticket request was submitted to notify utility owners of our intention to drill. Western Utility Locators were retained to scan the proposed test hole locations for conductive utilities before drilling.

Thurber retained VanMars Drilling Ltd. to advance ten solid stem auger test holes (TH22-01 through TH22-10) within the project site. The test holes were advanced to depths between 3 m and 9 m at the locations shown on Drawings 35221-1 through 35221-3 in Appendix A. Dynamic cone penetration tests (DCPTs) were completed at seven locations to qualitatively assess the relative consistency of the soil.

The soil and groundwater conditions were logged in the field by Thurber personnel. Soil samples were collected at selected intervals for visual identification and moisture content determination at our laboratory. All test holes were backfilled in accordance with BC groundwater protection regulations. Test holes advanced through the asphalt surface were surface patched with cold mix asphalt.

3.2 Site Review

Thurber visited the site on January 30, 2023 to view the condition of the slope south of Highway 7. Our review was limited to the upper limits of the slope which could be viewed from the Highway 7 public right-of-way. The site was walked, and observations of surface geotechnical features were noted.

The slope south of proposed Highway 7 widening, approximately between Sta. 101+40 and Sta. 101+93, is generally heavily vegetated with brush, blackberries and trees. To east of Sta. 101+93, the embankment slopes down to the existing building at 33433 North Railway Avenue (Sentinel Storage). There is an existing two-block high lock block retaining wall on private property in this area, approximately between Sta. 102+50 and 102+70. The slope appears to be somewhat over-steepened east of the existing retaining wall and around Sta. 102+80.

Near the east end of the project, the existing slope south of Highway 7 appears to be steeper than the approximately 2H:1V (horizontal:vertical) slope shown on the 90% Detailed Design Drawings. There may also be an existing slope failure scarp downslope of Highway 7 near the intersection of Highway 7 and Catherwood Street. This possible failure may coincide with the location of a

historically infilled ravine. Permission to access private property downslope of Highway 7 would be required to better observe the possible slope failure scarp.

3.3 Laboratory Testing

3.3.1 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 B.

3.3.2 Moisture Content Determination

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

3.3.2.1 Sulphate and Chloride Testing

Samples were submitted to CARO Analytical Services for determination of soluble sulphate and chloride content in accordance with CSA A23.2-3B and ASTM C1218. The result of soluble sulphate and chloride content are provided in Appendix C.

3.4 Pavement Assessment

West Coast Road Testing was retained to complete Falling Weight Deflectometer (FWD) testing and Ground Penetrating Radar (GPR) along the alignment. The pavement structure thicknesses measured in the test holes and GPR data were used in conjunction with the FWD results to estimate the stiffness (strength) of the pavement and determine pavement recommendations.

The deflection (Do) measured at the centre of the FWD load plate is a good indicator of overall pavement strength. The deflection at this location is a function of the pavement layer stiffness and the support capacity of the subgrade soil. Since the measured deflection is a function of the applied load and there are slight variations in measured load at each test point, a linear extrapolation of the measured deflection is made to adjust deflection at all test locations to a “standard” load level of 40 kN.

The FWD data was processed to obtain the normalized deflection at the centre of the load plate, and the as-constructed effective pavement modulus (E_P) and subgrade resilient modulus (M_R), in

general accordance with the procedure as outlined in the AASHTO 1993, Part III, Chapter 5. The results of our FWD testing are provided in Appendix D.

4. SURFICIAL GEOLOGY

The Geological Survey of Canada map “Surficial Geology Map 1485A, Mission, British Columbia” indicates that the site is at the transition between two types of surficial deposits. The Glasgow Avenue and Horne Street intersection is mapped as being underlain by postglacial Fraser River Sediments of channelled deposits of sandy loam and loamy sand up to 10 m thick (F_h) overlying channel and floodplain sand and gravel (F_f) and estuarine fine sand and clayey silt between 10 to 150 m thick (F_e).

Highway 7 is mapped 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.

5. SOIL AND GROUNDWATER CONDITIONS

5.1 Highway 7

The soil conditions encountered during the drilling investigation along Highway 7 generally comprise between 150 mm and 250 mm of asphalt, over approximately 150 mm to 570 mm of granular base (sandy gravel, trace to some silt), over subgrade consisting of interlayered silt and sand with varying amounts of gravel to the terminus of the test holes.

Subgrades were inferred to be natural soils, except at TH22-05 where gravelly sand fill extended to the depth of the test hole at approximately 7.6 m. TH22-05 is located in the vicinity of an inferred historically infilled ravine crossing the Highway 7 alignment and the deep fill at this location may be indicative of historical ravine infilling.

The granular base was generally compact to dense. The upper horizon of the subgrade was inferred to be soft to firm / loose to compact, transitioning to dense / stiff with depth.

Groundwater seepage was encountered in five of the seven test holes after drilling. The depth to groundwater ranged from 5.2 to 7.9 m, except at TH22-04 and TH22-07 where groundwater seepage was encountered between 1.2 and 2 m. The shallower groundwater depths were north of the road centreline, within approximately 120 m of Murray Street. The shallow groundwater may represent a perched groundwater condition within a relatively permeable sand layer.

The depth of groundwater is expected to vary with seasonal rainfall and surface drainage conditions.

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5.2 Horne Street and Glasgow Avenue

The soil conditions encountered during the drilling investigation at Horne Street and Glasgow Avenue typically include approximately 125 mm of asphalt, over approximately 180 mm of granular base (sandy gravel, trace to some silt), over silty sand to sand and clayey silt subgrade. Interlayered silt, sand and silty sand / sandy silt were encountered to the terminus of the test holes.

The granular base was generally loose to dense. The upper horizon of the subgrade was inferred to be compact to dense / stiff, transitioning to soft to firm or loose within approximately 0.6 m of the underside of base gravels.

Groundwater seepage was encountered in two of the three test holes after drilling at depths between approximately 2.7 and 5.2 m. The depth of groundwater is expected to vary with seasonal rainfall, surface drainage conditions and possibly with changes in the Fraser River water level.

6. GEOTECHNICAL DESIGN CRITERIA

Consistent with the BC Ministry of Transportation (BC MoTI) 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)
- MoTI Supplement to CHBDC S6-19
- Publication No. FHWA-NHI-10-024 “Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes” November 2009
- 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)

6.1 Degree of Understanding and Consequence Factor

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.

7. SITE SEISMICITY

7.1 Seismic Site Class

We understand that seismic considerations are not applicable to the re-surfacing works proposed at the intersection of Glasgow Avenue and Horne Street. As such, seismic discussion herein is limited to the Highway 7 embankment stability.

Based on the ground conditions encountered during our drilling investigation, the Highway 7 section of the project is expected underlain by predominantly stiff to hard silt or dense sand consistent with Sumas Drift deposits. Accordingly, we recommend that the site be classified as Site Class C as defined in the Canadian Highway Bridge Design Code (CSA S6:19) as a ground profile with a 30 m average shear wave velocity (Vs_{30}) between 360 and 760 m/s.

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 seismic hazard levels, including the 1 in 475-year, 1 in 975-year, and 1 in 2,475-year events.

7.2 Liquefaction

Detailed liquefaction assessment has not been completed as part of this project.

In general, based on the soil and groundwater conditions encountered, we do not expect the embankment slope global stability to be susceptible to liquefaction during a design earthquake, as soils below the depth of encountered groundwater are predominately dense / stiff. Relatively loose sands below an inferred perched water table at TH22-04 and TH22-07, on north side of Highway 7, may be susceptible to localized liquefaction on the north side of highway. The effects of localized liquefaction are expected to be generally limited to the vicinity in which they occur.

8. GEOTECHNICAL DISCUSSION AND RECOMMENDATIONS

8.1 General

Based on the soil conditions encountered and our review of the design drawings, the key geotechnical considerations for this project include the pavement design thickness, given the

relatively soft/loose subgrade soils, slope stability and load transfer considerations for the existing building at 33433 North Railway Avenue.

Further geotechnical discussion and recommendations are provided in the following sections.

8.2 Existing Building Considerations

The building foundation wall at 33433 North Railway Avenue, built into the slope below Highway 7, could be subject to load increases due to:

- Additional fill placement for Highway 7 widening; and/or
- Traffic loads moving closer to the building due to Highway 7 widening

The unfactored horizontal stress increase due to soil surcharge and traffic loading from widening of Highway 7, was estimated at the north foundation wall of the building at 33433 North Railway Avenue at the following locations:

- Sta. 102+20, which is the section showing the largest increase in embankment fill in closest proximity to the building; and

- Sta. 102+80, as requested by the Ministry's retained structural engineer SNC-Lavalin.

Plots provided in Appendix E show the estimated unfactored horizontal stress increase due to road widening at Sta. 102+20 and Sta. 102+80.

The estimated unfactored horizontal stress increase was evaluated only for the additional load due to road widening for this project. Our analyses did not address pre-existing horizontal loads to which the building has been or is being subjected. We understand, the Ministry retained a structural engineer, SNC-Lavalin, to complete a structural analysis of building foundation wall.

Should it be necessary to mitigate load increases at the building foundation wall, consideration can be given to a retaining wall as part of the highway widening. The purpose of the wall would be to transmit load from road widening to depth. We understand that no retaining wall is proposed at this time.

8.3 Site Preparation

Subgrade preparation, engineered fill gradation / quality and placement requirements must be in accordance with Sections 200 and 201 of the current BC MoTI Standard Specifications for Highway Construction document, CSA S6:19 and the BC MoTI Supplement to S6:19 (MoTI Supplement).

Site preparation for new pavement structure should include excavation to expose subgrade that is free of deleterious, soft / loose or otherwise unsuitable soil. Where possible, exposed granular subgrade should be compacted with a large steel drum vibratory roller. A clean-up bucket should be used where the subgrade comprises silt and clay and effort should be used to reduce disturbance and exposure time to surface runoff or precipitation before it is backfilled. All standing water should be drained away to prevent ponding.

We recommend that a proof-roll be completed at the subgrade design elevation below pavement surfaces using a fully loaded single axle dump truck to check for potential soft spots. Soft spots will need to be sub-excavated and replaced with structural fill. Based on the observed soil conditions, sub-excavation of existing soft soils is expected. Where structural fill is placed on a high fines soil, a non-woven geotextile separator can be placed on the subgrade, if necessary, prior to the placement of the fill.

8.4 Cut and Fill Slopes

All embankments should be constructed in accordance with the Ministry's Standard Specifications. The subgrade should be inspected prior to fill placement and any sub-excavation operations completed, if required, per the recommendations of this report. Embankments constructed with granular fill in accordance with this report should be sloped at 2H:1V or flatter. Considerations with respect embankment stability are presented in Section 8.5.

Techniques and sequencing used for embankment construction are critical for fill stability and to reduce the potential for a weak layer between the 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 MoTI Standard Specification 201.37. Erosion control measures should be implemented immediately on the final slope configuration to reduce the risk of surface erosion.

Granular fill for embankment construction should be spread and compacted into the adjoining embankment. We recommend that embankment fill below pavement structures should be 75 mm minus Well-Graded Base (WGB). Pit-run or non-crushed materials is not recommended for use as embankment fill.

Additional recommendations for embankment terracing specific to the Highway 7 slope west of approximately Sta. 101+93 are provided in Section 8.5. No cut slopes are expected as part of this project.

8.5 Slope Stability

8.5.1 Static Stability

Limit-equilibrium slope stability analyses were completed on representative cross-sections in the detailed design drawings. The analyses were based on soil and groundwater conditions inferred from the test holes advanced on Highway 7.

Our expectation is that Highway 7 is a typical consequence road and that we have a typical understanding of the soils and groundwater conditions. Based on the MoTI Supplement, the minimum global slope stability factor of safety (FS) under static loading conditions is 1.54.

A summary of the static slope stability analyses is below. Representative results of the static slope stability analyses are presented in Appendix F.

West of Sta. 101+93

Stability analyses of the cross-section at Sta. 101+80 showed slip surfaces with a FS < 1.54 extending approximately 1.5 m into the widened road section, where the existing embankment is sloped near 2H:1V and is approximately 8.4 m in height. A similar result is expected for Sta. 101+60 where the embankment slope has a similar configuration.

To increase the FS where the slope is being modified west of Sta. 101+93, we recommend that soft / loose soils be excavated and replaced to approximately 2 m back from the face of the slope. The downslope extent of embankment reconstruction will need to be confirmed in the field. To evaluate stability, we have assumed embankment reconstruction extends approximately 6 m downslope. Thurber should review the exposed subgrade prior to embankment reconstruction. Embankment reconstruction should be per Section 8.4.

While the above-recommended embankment reconstruction is expected to eliminate instability through the pavement surface, slip surfaces with a FS < 1.54 are anticipated at the slope face in this area, as shown in Figure F1 in Appendix F at Sta. 101+80. The minimum FS at the slope face is estimated to be approximately 1.48. We expect that these slip surfaces correlate with a risk of ongoing relatively shallow slough-type movement at the slope face. MoTI should maintain the slope face as part of ongoing maintenance efforts, ensuring vegetation is retained to reduce the risk of surficial sloughing. Alternatively, design solutions such as a reinforced soil slope could be explored.

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Sta. 101+93 to Sta. 103+00

Stability analyses of representative cross-sections between the west end of the building at 33433 North Railway Avenue (approximately Sta. 101+93) and Sta. 103+00 generally showed slip surfaces with a FS > 1.54 (Figure F2 in Appendix F). However, analysis of the cross-section at Sta. 102+80 show slip surfaces with a FS < 1.54, where the slope is locally steeper slope at about 2-2.3H:1V (Figure F3 in Appendix F). Based on site observations, we expect this locally steeper slope extends approximately from Sta. 102+70 to about Sta. 102+86.

The slope stability around Sta. 102+80 is not expected to be negatively impacted by the proposed works (i.e., slip surfaces with a FS < 1.54 are considered to be a pre-existing condition). Additionally, no signs of ongoing slope instability, such as tension cracking, sloughing, etc. were observed around Sta. 102+80 at the time of our site review. If slope in vicinity of Sta. 102+80 must meet FS requirements for slope stability, regrading of the slope to 3H:1V in this area is recommended. We expect that this would require regrading on private property.

As noted in Section 3.2, there is an existing lock block retaining wall on private property approximately between Sta. 102+50 and 102+70. Based on the cross section at Sta. 102+60, we do not anticipate that the performance of the lock block retaining wall will be adversely affected by the proposed works, as the wall is generally above a 2H:1V influence line projected down from the road widening. Thurber should be provided with additional cross-sections for review if the retaining wall comes closer to the widened area than shown on Sta. 102+60.

Sta. 103+00 to East End of Project

Stability analyses of representative cross-sections east of Sta. 103+00 showed slip surface with a FS < 1.54. Refer to Figure F4 in Appendix F at Sta. 103+20. Per Section 3.2, Thurber also observed on site a possible existing slope failure scarp downslope of Highway 7, near the intersection of Highway 7 and Catherwood Street.

Based on our stability analyses and site observations, the configuration of the slope south of Highway 7 near Catherwood Street is expected to be subject to further instability towards Highway 7. These comments are preliminary as a comprehensive assessment of the slope would require additional ground survey and observation from the downslope side of the highway embankment, which is private property.

Based on discussions with Urban Systems, we understand that the proposed highway widening will not modify the slope at this location and, as a result, MoTI does not intend to undertake slope

stability improvements in this area as part of this project. Thurber can provide recommendations should MoTI decide to undertake improvements to the slope.

8.6 Seismic Stability

We have assumed that the MoTI 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 MoTI 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 C 475-year return period peak ground acceleration. Slip surfaces with a FS < 1.3 were found to not impact the westbound travel lane, meaning one travel lane should be available for use following ground motions with a return period of at least 475 years. We consider this finding to meet the intent of the MoTI Supplement.

Representative results of seismic slope stability analyses at Sta. 101+80 are presented in Figure F5 in Appendix F.

8.7 Pavement Recommendations

8.7.1 Traffic Loading

Thurber calculated the 20-year design traffic loading, using traffic count data provided by Urban Systems. The estimated design Equivalent Single Axle Loads (EASLs) are summarized below.

Highway 7 – estimated 20-year design EASLs to be approximately 6,250,000 based on:

- Design lane AADT 11,160 (total AADT 18,600 weighted 60% in one direction)
- 1.5% growth
- 8.6% total trucks
- ESALs per vehicle based the distribution of truck traffic provided by Urban Systems and various Lower Mainland weigh-in-motion station data (truck factors)
- 0.0007 ESALs per vehicle (non-truck factor)

Horne Street and Glasgow Avenue Intersection – estimated 20-year design EASLs to be approximately 6,791,000 based on:

- Design Lane AADT 8,743 (based on multiplying PM peak hour intersection volumes by a factor of 11 as recommended by Urban Systems)
- 1.5% growth
- 8.6% total trucks
- 1.0 ESALs per vehicle (truck factor) – a general truck factor was adopted as the truck distribution wasn't available at this location
- 0.0007 ESALs per vehicle (non-truck factor)

8.7.2 New Pavement Structure

Based on the calculated EASLs (Section 8.7.1), a minimum pavement structure consistent with MoTI Type 'B' standard pavement structure would apply:

150 mm	Hot Mix Asphalt (HMA)
300 mm	25 mm minus Well-Graded Base (WGB)
300 mm	Select-Granular Subbase (SGSB)

However, MoTI has indicated that Highway 7 can be considered a high-volume road. The MoTI Technical Circular T-01/15 Pavement Structure Design Guidelines requires high volume roads to be designed with 90% reliability. Our calculations indicate that the above pavement structure is not suitable for a 20-year design life with 90% reliability. The following pavement structure is recommended to meet design life along Highway 7 and at the intersection of Horne Street and Glasgow Avenue:

180 mm	HMA
300 mm	25 mm WGB
300 mm	75 mm WGB

The above pavement structure recommendations are based on positive drainage being provided such that the base and subbase layers do not become saturated.

8.7.3 Existing Pavement Repair

The results of our investigation suggest that the granular base of along Highway 7 and at the intersection of Horne Street and Glasgow Avenue is generally thinner than required for design. This is consistent with observations of asphalt wheel path cracking along Highway 7 and around the intersection of Horne Street and Glasgow Avenue.

The simplest repair option is to mill and overlay the existing pavement. However, the results of the FWD testing suggest that the required thickness of hot-mix asphalt overlay required could present a challenge in raising existing utilities within the roadway, such as valve covers, utility manholes and the curb and gutter systems.

Given the relatively soft subgrade soils encountered near the underside of the existing granular base layer, we expect that full-depth pavement reconstruction would be required to achieve a 20-year pavement design life.

We understand that the horizon year for this project is 2035. If MoTI prefers to delay significant pavement rehabilitation to a later date, a 50 mm mill and inlay could be completed along the project alignment. The mill and inlay will provide a fresh pavement surface and will mitigate some existing pavement distress such as existing wheel path cracking. However, with a 50 mm mill and inlay, it should be expected that the pavement performance will be generally similar to that observed to date. With time, the reappearance of moderate cracking along wheel paths should be expected. As such, the existing asphalt would need to be monitored and repaired as required until full depth asphalt reconstruction can take place.

The milled surface should be reviewed prior to new asphalt placement. Areas of asphalt that exhibit significant cracking upon milling should be identified and repaired.

8.8 Construction Considerations

A pre-condition survey should be carried out by the contractor prior to construction to document the pre-construction condition of nearby buildings and their surroundings. Additionally, it recommended that a program of vibration monitoring be undertaken by the contractor during construction and that the contract documents specify construction vibration limits not to be exceeded.

Unless directed otherwise by the Ministry Representative, construction equipment should work from the existing Highway 7 asphalt surface and light compaction equipment used (i.e. walk behind plate tampers) when constructing the Highway 7 widening. We recommend that materials are not stockpiled on Highway 7.

9. CLOSURE

We trust that this information is sufficient for your needs. If you have any questions or would like to discuss the contents of this report, please contact us.

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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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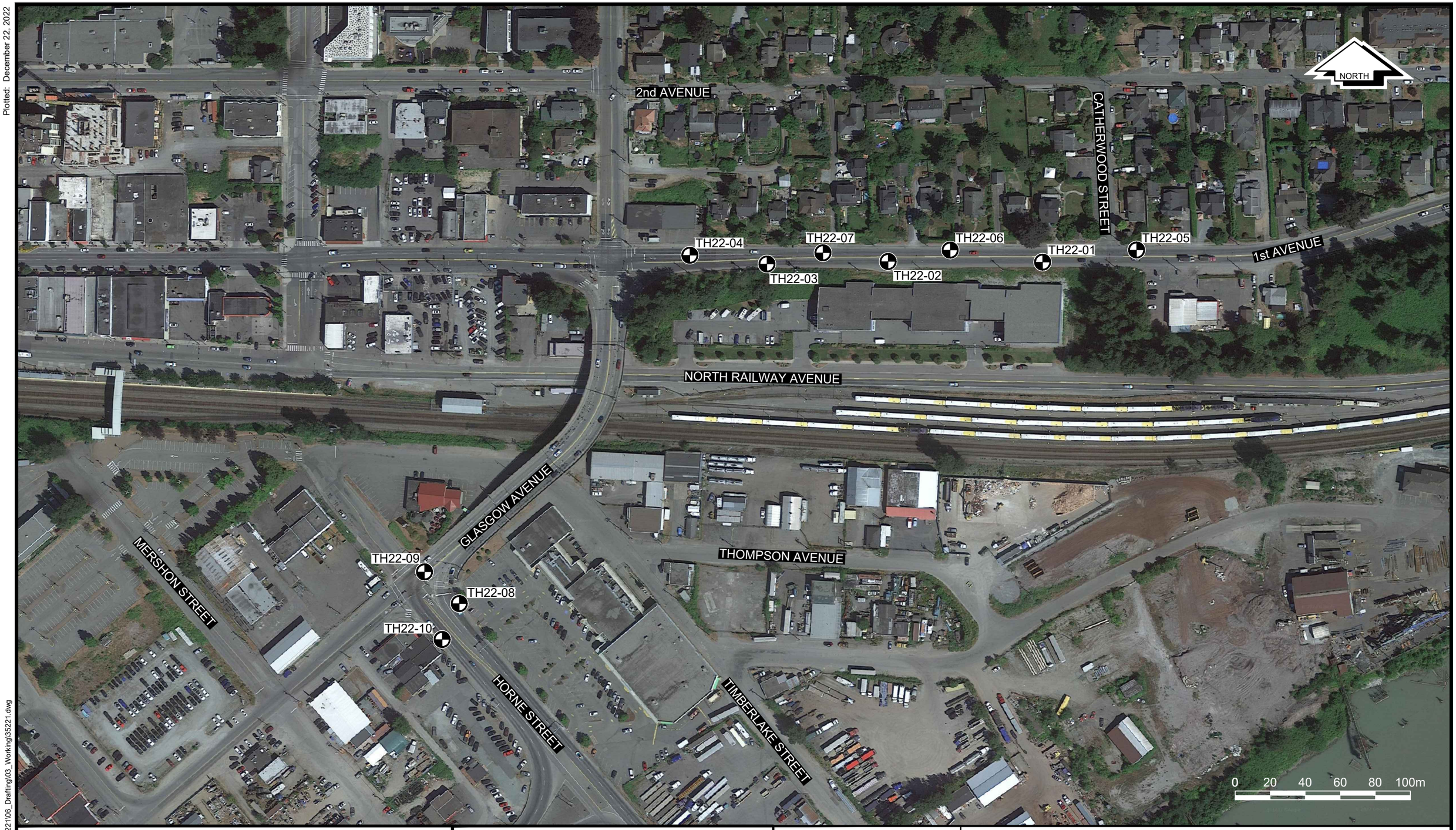
APPENDIX A DRAWINGS

Plotted: December 22, 2022



LEGEND:

TEST HOLE

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

THURBER ENGINEERING LTD.

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

TEST HOLE LOCATION PLAN (KEY PLAN)

H7 / H11 MISSION TRUCK ROUTE
INTERSECTION IMPROVEMENTS

MISSION, BC

DESIGNED	DRAWN	APPROVED	DATE	SCALE	PROJECT No.	DWG. NO.	REV.
MWA	MOM	JSP	DEC. 22, 2022	1:2000	35221 - **1**		0

S:\Data\BST Projects\35xxx\35221\06_Drafting\03_Working\35221.dwg

Plotted: December 22, 2022

LEGEND:

TEST HOLE

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

THURBER ENGINEERING LTD.

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

TEST HOLE LOCATION PLAN
(1st AVENUE WORK ZONE)

H7 / H11 MISSION TRUCK ROUTE
INTERSECTION IMPROVEMENTS

MISSION, BC

DESIGNED	DRAWN	APPROVED	DATE	SCALE	PROJECT No.	DWG. NO.	REV.
MWA	MOM	JSP	DEC. 22, 2022	1:1000	35221 - **2**		0

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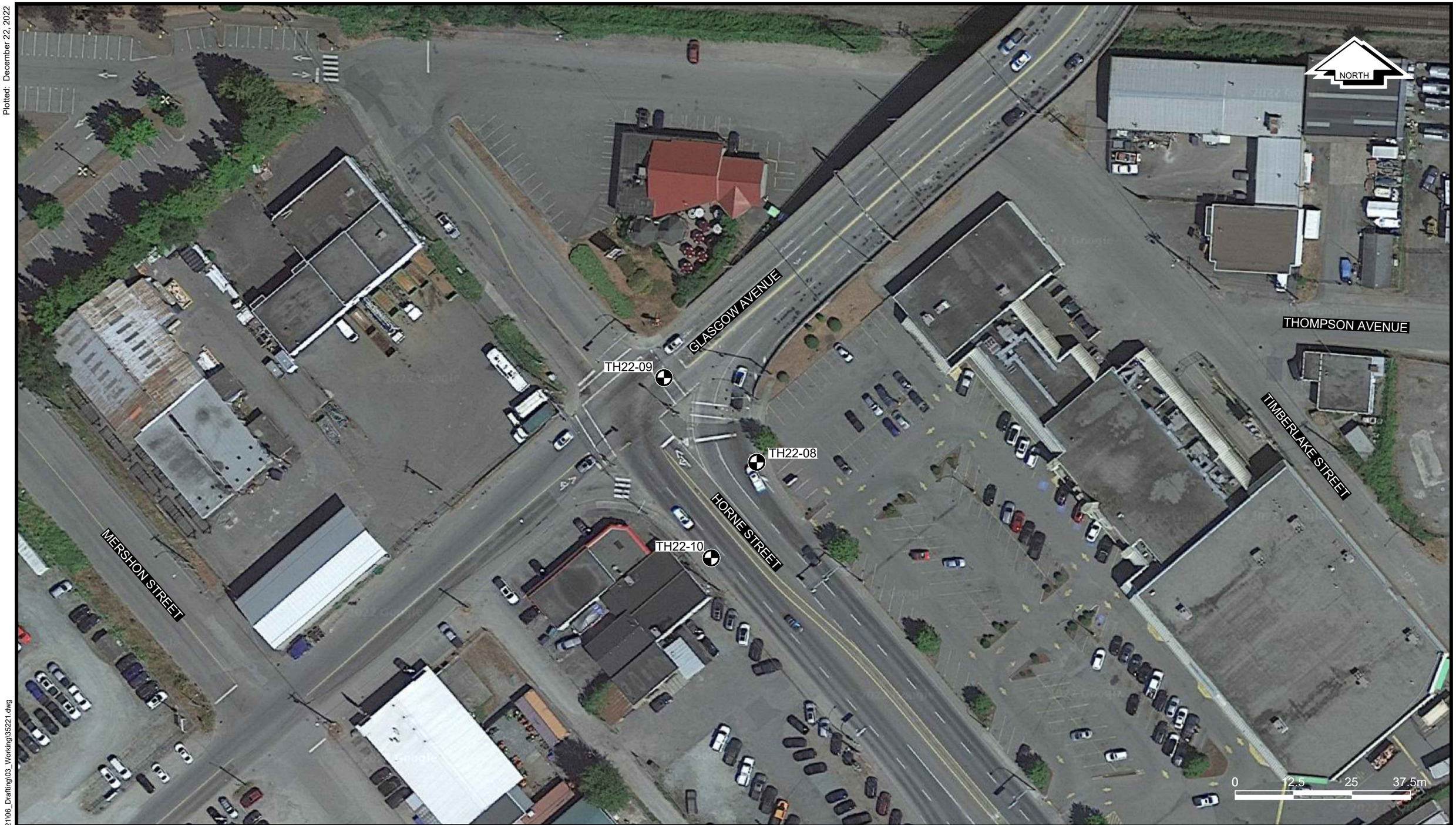
Plotted: December 22, 2022



LEGEND:

TEST HOLE

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

THURBER ENGINEERING LTD.

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

TEST HOLE LOCATION PLAN (GLASGOW AND HORNE WORK ZONE)

H7 / H11 MISSION TRUCK ROUTE
INTERSECTION IMPROVEMENTS — MISSION, BC

DESIGNED	DRAWN	APPROVED	DATE	SCALE	PROJECT No.	DWG. NO.	REV.
MWA	MOM	JSP	DEC. 22, 2022	1:750	35221 - **3**		0

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APPENDIX B TEST HOLE LOGS

Ministry of Transportation and Infrastructure

SUMMARY LOG

Drill Hole #: **TH22-01**

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

Location: Mission, BC

Prepared by: 35221 Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442630 , 551310 Station/Offset:

Elevation: *Coordinates taken with GPS*

Date(s) Drilled: November 16/17, 2022

Company: Vanmars Drilling Ltd.

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); W_P% 20, W% 40 60, W_L% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
0							ASPHALT (250 mm thick).			0
							0.24m			
							GP-GM - SANDY GRAVEL, trace to some silt (FILL); medium to coarse sand; sub-angular to angular, 30 mm max. size gravel, brown, moist, compact.			
							0.46m			
1		29.5		1			ML - SILT, some sand, trace to some gravel, trace organics; 30 mm max. size gravel, brown, moist, loose.	ML		1
							1.28m			
2		5.1		2			SP - SAND, some gravel, trace clay, trace silt; medium to coarse sand; subrounded to sub-angular, 30 mm max. size gravel, brown, moist, compact to dense.	SP		2
							- pocket of grey sand (150 mm thick) at 2.3 m depth			
3		4.8		3				SP		3
	End DCPT, bouncing on probable cobble						- gravelly between 3.5 and 4.0 m depth			
4		10.5		4			3.96m SM - SILTY SAND, trace clay, trace gravel; fine to medium sand; rounded to sub-angular 20 mm max. size gravel, grey, moist.	SM		4
5		15.1		5				SM		5
6										6
7		10.5		6				SP-SM		7
8							- some clay below 8.0 m depth			8
		19.0		7				SP-SC		
9							- fine to coarse sand below 8.8 m depth			9
							9.14m End of hole at 9.2 m depth. Hole open to 8.8 m depth. Water observed at 7.9 m depth.			
10							Upon completion of drilling:			

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: 9.1 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

SUMMARY LOG

Drill Hole #: **TH22-01**

Ministry of Transportation and Infrastructure

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

Location: Mission, BC

Date(s) Drilled: November 16/17, 2022

Company: Vanmars Drilling Ltd.

Prepared by: 35221 Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442630 , 551310 Station/Offset:

Elevation: *Coordinates taken with GPS*

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger

DEPTH (m)	DRILLING DETAILS	✕ Pocket Penetrometer ✕ Shear Strength (kPa) 100 200 300 400 ▲ SPT "N" (BLOWS/300 mm) ▲ W_P% 20 W% 40 60 W_L% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
10							Hole backfilled with bentonite chips, drill cuttings and covered with with cold asphalt patch at surface.			10
11										11
12										12
13										13
14										14
15										15
16										16
17										17
18										18
19										19
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: 9.1 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

Ministry of Transportation and Infrastructure

SUMMARY LOG

Drill Hole #: **TH22-02**

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

Location: Mission, BC

Prepared by: 35221
Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442630 , 551222 Station/Offset:

Elevation: *Coordinates taken with GPS*

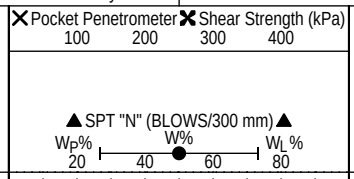
Date(s) Drilled: November 16/17, 2022

Company: Vanmars Drilling Ltd.

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger



DEPTH (m)	DRILLING DETAILS	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
0						ASPHALT (250 mm thick).			0
						0.24m GP-GM - SANDY GRAVEL, trace to some silt (FILL); medium to coarse sand; sub-angular to angular, 30 mm max. size gravel, brown, moist.	GP-GM		
1			1			0.81m ML - SILT, trace to some gravel, trace clay, trace organics; sub-angular to subrounded, 30 mm max. size gravel, dark brown, moist, firm.	ML		1
			2			1.46m ML - SANDY SILT, trace gravel, trace clay, trace organics; fine to coarse sand; sub-angular to angular, 30 mm max. size gravel, loose.	ML		
2			3			2.34m SM- SILTY SAND to SAND, some silt, trace gravel; sub-rounded to sub-angular, 15 mm max. size gravel, light brown, moist, compact to dense. - pockets of red-brown mottling between 2.7 and 3.4 m depth	SM		2
3			4						3
4			5			3.57m SM-ML - SILT and SAND, trace gravel, trace clay, 15 mm max. size gravel, grey, moist, stiff to hard. - transitions CLAY and SILT, hard between 4.5 to 5.0 m depth	SM		4
5	DCPT terminated at target depth		6				CL/ML		5
6						6.1m End of hole at 6.1 m depth. Hole open to 5.5 m depth. No water observed. Upon completion of drilling: Hole backfilled with bentonite chips, drill cuttings and covered with with cold asphalt patch at surface.			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: 6.1 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

SUMMARY LOG

Drill Hole #: **TH22-03**

Ministry of Transportation and Infrastructure

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

Location: Mission, BC

Prepared by: 35221
Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442629 , 551153 Station/Offset:

Elevation: *Coordinates taken with GPS*

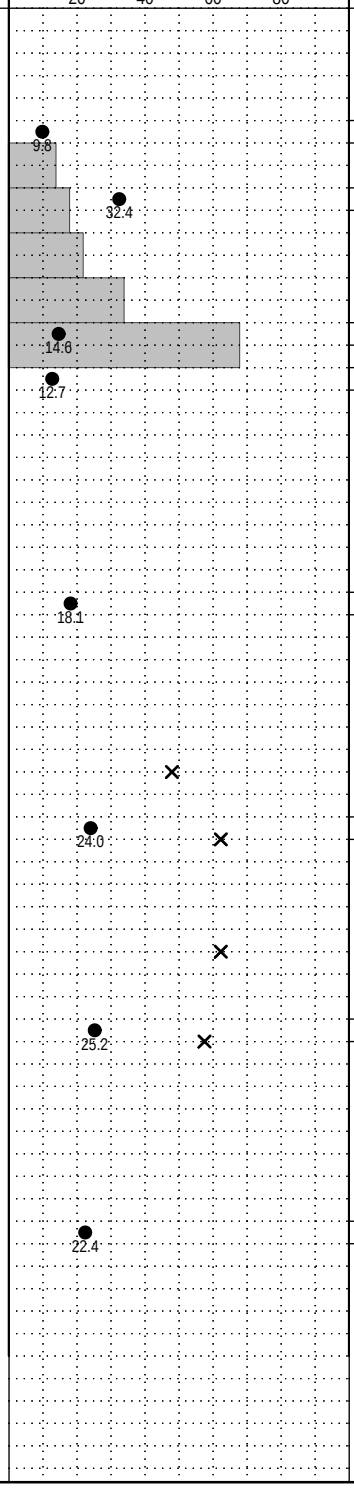
Date(s) Drilled: November 16/17, 2022

Company: Vanmars Drilling Ltd.

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger



DCPT Refusal at 2.4 m depth: Bouncing

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}
0				ASPHALT (225 mm thick).		
				0.23m GP-GM - SANDY GRAVEL, trace to some silt (FILL); medium to coarse sand; sub-angular to angular, 30 mm max. size gravel, brown, moist.		
0.73m		1			SM/GM	
1				SM/GM - SAND and GRAVEL, trace to some fines, trace organics; sub-rounded to sub-angular, 20 mm max. size gravel, brown, moist, compact.		
1.02m		2			ML	
				ML - SANDY SILT, trace to some gravel, trace clay, trace organics; sub-rounded to sub-angular, 20 mm max. size gravel, brown, moist, stiff.		
1.71m		3			SM	
2				SM - SILTY, GRAVELLY SAND, trace to some clay, brown, slightly mottled, wet, very dense.		
2.44m		4			SM	
				SP - SAND, trace to some fines, trace gravel; fine to medium sand; sub-rounded to sub-angular, 10 mm max. size gravel, grey, moist.		
3.35m		5			ML	
3				ML - CLAYEY SILT, trace gravel; sub-angular to angular, 10 mm max. size gravel, grey, moist.		
4						
4.98m		6			CL	
5				CL - SILTY CLAY, trace to some sand, trace gravel; angular to sub-rounded, 10 mm max. size gravel.		
6						
7.47m		7			CL	
7				SP-SM - SILTY SAND to SAND, some silt, trace clay, grey, moist to wet.		
8		8			SP-SM	
9.14m						
9				End of hole at 9.2 m depth. Hole open to 5.5 m depth. Water observed at 5.2 m depth. Upon completion of drilling:		
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: 9.1 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

SUMMARY LOG

Drill Hole #: **TH22-03**

Ministry of Transportation and Infrastructure

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

Location: Mission, BC

Date(s) Drilled: November 16/17, 2022

Company: Vanmars Drilling Ltd.

Prepared by: 35221 Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442629 , 551153 Station/Offset:

Elevation: *Coordinates taken with GPS*

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger

DEPTH (m)	DRILLING DETAILS	✕ Pocket Penetrometer ✕ Shear Strength (kPa) 100 200 300 400 ▲ SPT "N" (BLOWS/300 mm) ▲ W_P% 20 W% 40 60 W_L% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
10							Hole backfilled with drill cuttings and filter sand and covered with with cold asphalt patch at surface.			10
11										11
12										12
13										13
14										14
15										15
16										16
17										17
18										18
19										19
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: 9.1 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

SUMMARY LOG

Drill Hole #: **TH22-04**

Ministry of Transportation and Infrastructure

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

Location: Mission, BC

Prepared by: 35221 Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442634 , 551109 Station/Offset:

Elevation: *Coordinates taken with GPS*

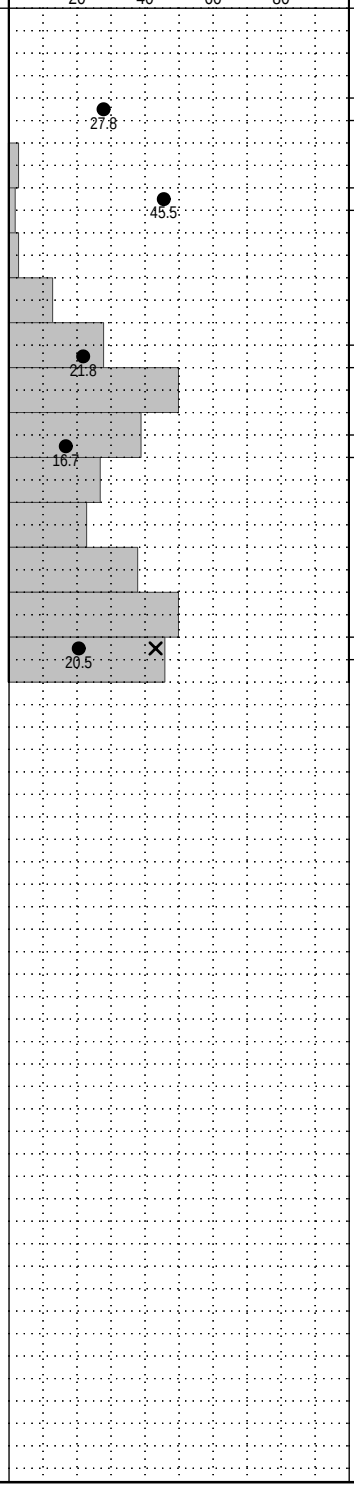
Date(s) Drilled: November 16/17, 2022

Company: Vanmars Drilling Ltd.

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger



DEPTH (m)	DRILLING DETAILS	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
0						ASPHALT (200 mm thick).			0
						0.2m GP-GM - SANDY GRAVEL, trace to some silt (FILL); medium to coarse sand; sub-angular to angular, 30 mm max. size gravel, brown, moist.			
			1			0.61m	SM		
1			2			SM-ML - GRAVELLY SILT and SAND to SANDY, GRAVELLY SILT, trace organics; sub-rounded to sub-angular, 15 mm max. size gravel, dark brown, moist, mild organic smell, soft to firm.	ML		1
						1.52m SP- SAND trace silt to silty, trace to some clay, trace gravel, trace organics; sub-rounded to sub-angular, 50 mm max. size gravel, grey, moist to wet, loose to dense.	SP-SM		
2			3						2
						2.8m SM/ML - SANDY SILT to SILTY SAND, trace gravel; fine to medium sand; sub-rounded to sub-angular, 10 mm max. size gravel, grey, moist to wet, compact to dense. - medium to coarse sand; 35 mm max. size gravel between 3.1 and 3.7 m depth	SM		
3			4						3
						4.21m CL- SILTY, SANDY CLAY, trace gravel; fine sand; sub-rounded to sub-angular, 10 mm max. size gravel, grey, moist, very stiff to hard.	CL		
4	DCPT terminated at target depth		5			4.57m End of hole at 4.6 m depth. Water observed at 1.2 m depth. Upon completion of drilling: Hole backfilled with drill cuttings and covered with with cold asphalt patch at surface.			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: 4.6 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

SUMMARY LOG

Drill Hole #: **TH22-05**

Ministry of Transportation and Infrastructure

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

Location: Mission, BC

Prepared by: 35221 Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442637 , 551364 Station/Offset:

Elevation: *Coordinates taken with GPS*

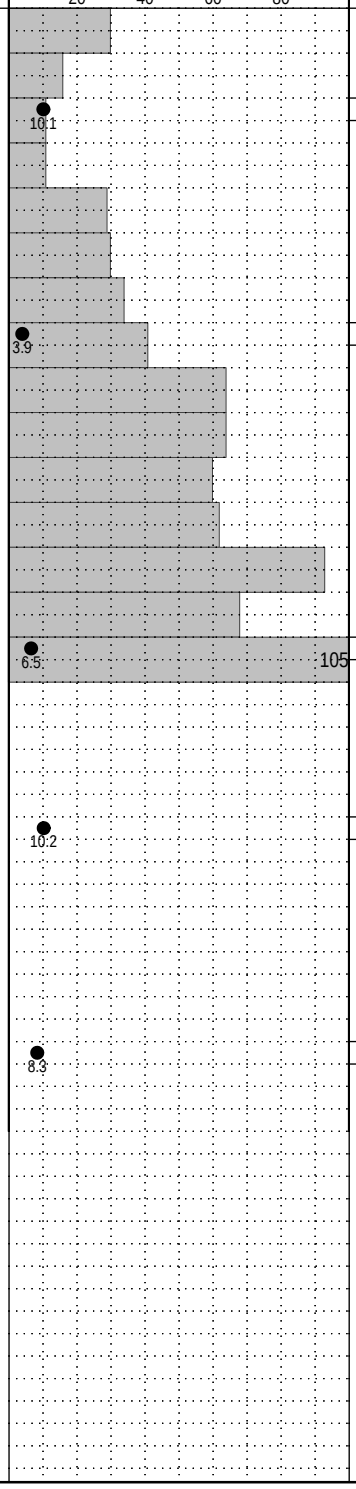
Date(s) Drilled: November 17/18, 2022

Company: Vanmars Drilling Ltd.

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger



DEPTH (m)	DRILLING DETAILS	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING (Drillers Estimate {G % S % F %})	DEPTH (m)
0						ASPHALT (150 mm thick). 0.15m			0
						GP-GM - SANDY GRAVEL, trace to some silt (FILL); medium to coarse sand; sub-angular to angular, 25 mm max. size gravel, brown, moist, dense. 0.3m	SP-SM		
1			1			SP - GRAVELLY SAND, trace fines, (FILL); medium to coarse sand; sub-angular to angular, 15 mm max.size gravel, brown, moist, compact to very dense.			1
2			2				SP		2
						- very dense below 2.4 m depth			
3									3
4	DCPT Refusal at 4.6 m depth		3			- wet below 4.1 m depth	SP		4
5						5.18m			5
			4			SM - GRAVELLY SAND, trace silt to silty; 40 mm max. size gravel, grey, moist to wet.	SM		
6									6
7			5				SM		7
						7.62m			
8						End of hole at 7.6 m depth. Hole open to 5.8 m depth. Water observed at 5.4 m depth. Upon completion of drilling: Hole backfilled with drill cuttings and covered with with cold asphalt patch at surface.			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: 7.6 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

SUMMARY LOG

Drill Hole #: **TH22-06**

Ministry of Transportation and Infrastructure

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

Location: Mission, BC

Prepared by: 35221
Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442637 , 551258 Station/Offset:

Elevation: *Coordinates taken with GPS*

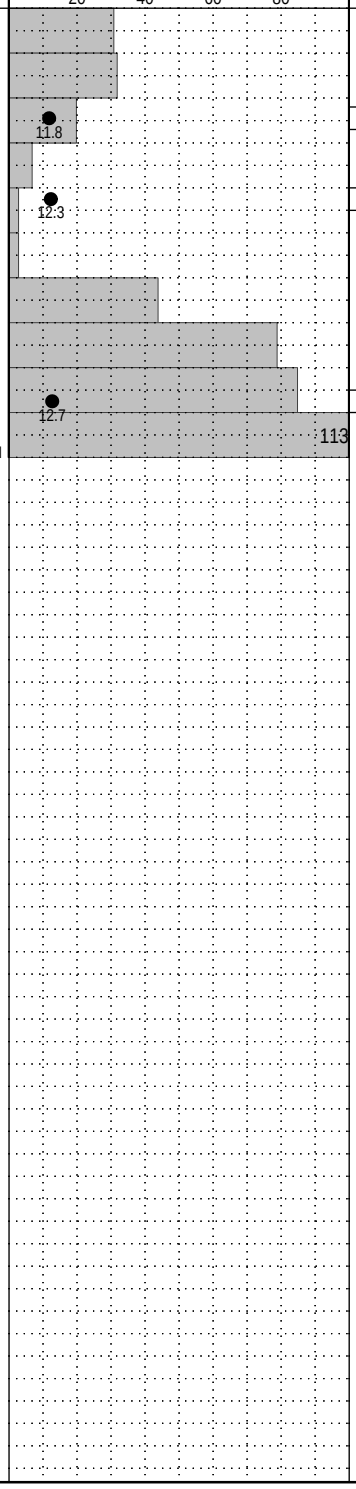
Date(s) Drilled: November 17/18, 2022

Company: Vanmars Drilling Ltd.

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger



DEPTH (m)	DRILLING DETAILS	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
0						ASPHALT (200 mm thick).			0
						0.2m GP-GM - SANDY GRAVEL, trace to some silt (FILL); medium to coarse sand; sub-angular to angular, 20 mm max. size gravel, brown, moist, dense.			
1			1			0.67m	SM/GM		1
						SM/GM - SILTY SAND and GRAVEL, trace to some gravel, trace organics; sub-rounded to sub-angular, 30 mm max. size gravel, brown, moist, loose to compact.			
2			2			1.16m SM - SILTY SAND to SAND, some silt, trace to some gravel, trace clay; 30 mm max. size gravel, light brown, moist, loose to very dense. - brown-red mottled below 1.7 m depth - dense to very dense below 1.8 m depth	SM		2
3	DCPT terminated at target depth		3			3.05m End of hole at 3.1 m depth. No water observed. Upon completion of drilling: Hole backfilled with drill cuttings and covered with with cold asphalt patch at surface.	SM		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: 3.0 m
Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

SUMMARY LOG

Drill Hole #: **TH22-07**

BRITISH COLUMBIA — Ministry of Transportation and Infrastructure

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

Location: Mission, BC

Date(s) Drilled: November 17/18, 2022

Company: Vanmars Drilling Ltd.

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger

Prepared by: 35221 Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442635 , 551185 Station/Offset:

Elevation: *Coordinates taken with GPS*

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); W_P% 20 — W% — W_L% 40 60 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
0							ASPHALT (200 mm thick).			0
							0.2m			
							GP-GM - SANDY GRAVEL, trace to some silt (FILL); medium to coarse sand; sub-angular to angular, 30 mm max. size gravel, brown, moist.			
							0.46m			
1		12.3		1			SM/GM - SILTY SAND and GRAVEL, trace organics; sub-rounded to sub-angular, 40 mm max. size gravel, brown, moist.	SM/GM		1
							- red brown mottled below 1.7 m depth - wet below 1.8 m depth			
2		17.1		2				SM		2
							2.44m			
		12.8		3			SM - SILTY SAND, trace gravel, trace clay; angular, 30 mm max. size gravel, grey, moist to wet.	SM		
3							3.05m			3
							End of hole at 3.1 m depth. Water observed at 2.0 m depth. Upon completion of drilling: Hole backfilled with drill cuttings and covered with with cold asphalt patch at surface.			
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: 3.0 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

SUMMARY LOG

Drill Hole #: **TH22-08**

Ministry of Transportation and Infrastructure

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

Location: Mission, BC

Prepared by: 35221
Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442435 , 550977 Station/Offset:

Elevation: *Coordinates taken with GPS*

Date(s) Drilled: November 17/18, 2022

Company: Vanmars Drilling Ltd.

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger

DEPTH (m)	DRILLING DETAILS	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
0						ASPHALT (125 mm thick). 0.12m			0
						GP-GM - SANDY GRAVEL, trace to some silt (FILL); medium to coarse sand; sub-angular to angular, 25 mm max. size gravel, brown, moist, compact. 0.3m	SM		
1			1			SM - SILTY SAND, trace to some gravel; 30 mm max. size gravel, brown, moist, compact to dense. 0.81m	CL/ML		1
2			2			CL/ML - SILT and CLAY, trace to some gravel; 20 mm max. size gravel, mottled grey, moist, firm. 1.46m			2
			3			SM/ML - SAND and SILT, trace gravel, trace clay; 10 mm max. size gravel, mottled grey, moist, loose.	SM		
3						3.05m			3
						End of hole at 3.1 m depth. Hole open to 2.7 m depth. No water observed. Upon completion of drilling: Hole backfilled with drill cuttings and covered with with cold asphalt patch at surface.			
4									4
5									5
6									6
7									7
8	DCPT terminated at target depth								8
9									9
10									

11.3
30.7
23.0

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: 3.0 m
Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

SUMMARY LOG

Drill Hole #: **TH22-09**

Ministry of Transportation and Infrastructure

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

Location: Mission, BC

Prepared by: 35221
Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442453 , 550958 Station/Offset:

Elevation: *Coordinates taken with GPS*

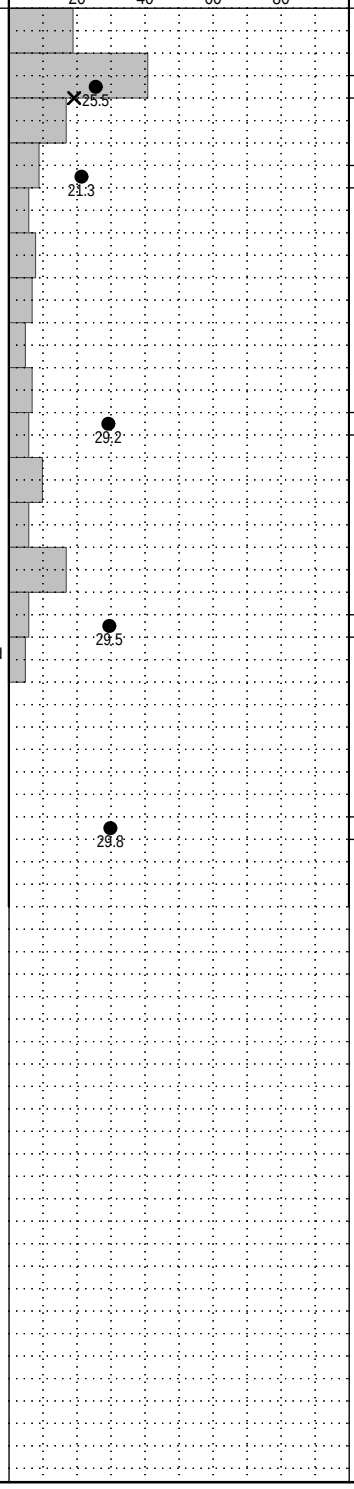
Date(s) Drilled: November 17/18, 2022

Company: Vanmars Drilling Ltd.

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger



DEPTH (m)	DRILLING DETAILS	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*	DEPTH (m)
0						ASPHALT (125 mm thick). 0.12m			0
						GP-GM - SANDY GRAVEL, trace to some silt (FILL); medium to coarse sand; sub-angular to angular, 30 mm max. size gravel, brown, moist, compact to dense. 0.3m	ML		
1			1			ML - SANDY, CLAYEY SILT, trace to some gravel; 30 mm max. size gravel, brown, moist, stiff. 0.91m	ML		1
2			2			ML - SANDY SILT, trace gravel, trace clay, light brown, moist, soft to firm			2
3			3			ML - SANDY SILT to SILTY SAND, trace gravel; sub-angular to sub-rounded, 10 mm max. size gravel, mottled brown, moist, firm to stiff. 2.51m	ML		3
4	DCPT terminated at target depth		4			- wet below 4.0 m depth	SM		4
5			5				SP-SM		5
6						SM - SILTY SAND; grey, moist. 5.94m End of hole at 6.1 m depth. 6.1m Hole open to 4.6 m depth. No water observed. Upon completion of drilling: Hole backfilled with drill cuttings and covered with with cold asphalt patch at surface.			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: 6.1 m
Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

SUMMARY LOG

Drill Hole #: **TH22-10**

Ministry of Transportation and Infrastructure — BRITISH COLUMBIA

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

Location: Mission, BC

Prepared by: 35221 Thurber Engineering Ltd.

Logged by: MWA Reviewed by: GGM

Datum: Alignment:

Northing/Easting: 5442415 , 550968 Station/Offset:

Elevation: *Coordinates taken with GPS*

Date(s) Drilled: November 17/18, 2022

Company: Vanmars Drilling Ltd.

Driller: Keegan Bydeweg

Drill Make/Model: B53 Truck Mounted

Drilling Method: Solid Stem Auger

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); W_P% 20 — W% 40 60 — W_L% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	DEPTH (m)
0							ASPHALT (125 mm thick). 0.12m			0
							GP-GM - SANDY GRAVEL, trace to some silt (FILL); medium to coarse sand; sub-angular to angular, 50 mm max. size gravel, brown, moist, loose. 0.3m	SM		
1		27.1		1			SM - SILTY SAND to SAND, trace to some silt, trace to some gravel; 30 mm max. size gravel, brown, moist, compact to dense. 0.73m	CL/ML		1
		31.7		2			CL/ML - SILT and CLAY, trace sand, trace gravel; sub-angular to sub-rounded, 10 mm max. size gravel, light brown, moist, soft to firm. 1.46m			
2		26.0		3			SM/ML - SILT and SAND, trace gravel; sub-angular to sub-rounded 10 mm max. size gravel, mottled brown, moist, loose.	SM/ML		2
3							SM - SILTY SAND to SAND, some silt, trace gravel; sub-rounded to angular, 10 mm max-size gravel, brown, moist to wet, loose. 3.0m			3
4		31.3		4			SM - SILTY SAND, trace gravel; 5 mm max.size gravel, grey, wet, very loose to compact. 3.96m	SM		4
5		27.4		5			- poor recovery below 5.2 m depth	SP-SM		5
6	DCPT terminated at target depth						End of hole at 6.1 m depth. 6.1m Hole open to 5.2 m depth. Water observed approximately between 5.2 and 6.1 m depth, hole collapsed before reading. Upon completion of drilling: Hole backfilled with drill cuttings and covered with with cold asphalt patch at surface.			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: 6.1 m

Depth to Top of Rock:

MOTI-SOIL-REV3 35221.GPJ MOTI_DATATEMPLATE_REV3.GDT 22-12-22

THURBER

APPENDIX C CARO ANALYTICAL TEST RESULTS

CERTIFICATE OF ANALYSIS

REPORTED TO	Thurber Engineering Ltd. (Vancouver) 900 - 1281 West Georgia Street Vancouver, BC V6E 3J7		
ATTENTION	Graeme McAllister	**WORK ORDER**	22L0040
PO NUMBER		**RECEIVED / TEMP**	2022-12-01 10:30 / 9.2°C
PROJECT	35221	**REPORTED**	2022-12-06 13:50
PROJECT INFO		**COC NUMBER**	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

By engaging our services, you are agreeing to CARO Analytical Service's Standard Terms and Conditions outlined here: https://www.caro.ca/terms-conditions

If you have any questions or concerns, please contact me at fkhan@caro.ca

Authorized By:

Firoza Khan
CSR

TEST RESULTS

REPORTED TO	Thurber Engineering Ltd. (Vancouver)	**WORK ORDER**	22L0040
PROJECT	35221	**REPORTED**	2022-12-06 13:50

Analyte	Result	RL	Units	Analyzed	Qualifier
TH-F@3'-3.5' (22L0040-01) | Matrix: Soil | Sampled: 2022-11-17					
General Parameters					
Sulfate, Water-Soluble	< 0.050	0.050	%	2022-12-05	
Chloride, Water-Soluble	**0.032**	0.002	%	2022-12-06	

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Thurber Engineering Ltd. (Vancouver)	**WORK ORDER**	22L0040
PROJECT	35221	**REPORTED**	2022-12-06 13:50

Analysis Description	Method Ref.	Technique	Accredited	Location
Chloride, Water Soluble in Soil	ASTM C1218-17	Hot Water Extraction / Hot Water Extraction		Richmond
Sulfate, Water-Soluble in Soil	CSA A23.2-3B / CSA A23.2-2B	Extraction (HCl) / Gravimetry (Barium Sulfate Precipitation)		Richmond

Glossary of Terms:

RL	Reporting Limit (default)
%	Percent
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
ASTM	ASTM International Test Methods
CSA	Canadian Standards Association Chemical Test Methods

General Comments:

The results in this report apply to the received samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Thurber Engineering Ltd. (Vancouver)	**WORK ORDER**	22L0040
PROJECT	35221	**REPORTED**	2022-12-06 13:50

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2L0112										
Blank (B2L0112-BLK1)				Prepared: 2022-12-01, Analyzed: 2022-12-05						
Sulfate, Water-Soluble	< 0.050	0.050	%							
General Parameters, Batch B2L0294										
Blank (B2L0294-BLK1)				Prepared: 2022-12-03, Analyzed: 2022-12-06						
Chloride, Water-Soluble	< 0.002	0.002	%							

CERTIFICATE OF ANALYSIS

REPORTED TO	Thurber Engineering Ltd. (Vancouver) 900 - 1281 West Georgia Street Vancouver, BC V6E 3J7		
ATTENTION	Graeme McAllister	**WORK ORDER**	22K3570
PO NUMBER		**RECEIVED / TEMP**	2022-11-30 15:20 / 5.2°C
PROJECT	35221	**REPORTED**	2022-12-08 14:15
PROJECT INFO		**COC NUMBER**	No#

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If you have any questions or concerns, please contact me at fkhan@caro.ca

Authorized By:

Firoza Khan
CSR

TEST RESULTS

REPORTED TO	Thurber Engineering Ltd. (Vancouver)	**WORK ORDER**	22K3570
PROJECT	35221	**REPORTED**	2022-12-08 14:15

Analyte	Result	RL	Units	Analyzed	Qualifier
TH-D@3'-3.5' (22K3570-01) | Matrix: Soil | Sampled: 2022-11-17					
General Parameters					
Sulfate, Water-Soluble	< 0.050	0.050	%	2022-12-05	
Chloride, Water-Soluble	**0.017**	0.002	%	2022-12-06	
TH-D@8.5'-9' (22K3570-02) | Matrix: Soil | Sampled: 2022-11-17					
General Parameters					
Sulfate, Water-Soluble	< 0.050	0.050	%	2022-12-05	
Chloride, Water-Soluble	**0.016**	0.002	%	2022-12-06	
TH-F@9.5'-10' (22K3570-03) | Matrix: Soil | Sampled: 2022-11-17					
General Parameters					
Sulfate, Water-Soluble	< 0.050	0.050	%	2022-12-05	
Chloride, Water-Soluble	**0.010**	0.002	%	2022-12-06	

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Thurber Engineering Ltd. (Vancouver)	**WORK ORDER**	22K3570
PROJECT	35221	**REPORTED**	2022-12-08 14:15

Analysis Description	Method Ref.	Technique	Accredited	Location
Chloride, Water Soluble in Soil	ASTM C1218-17	Hot Water Extraction / Hot Water Extraction		Richmond
Sulfate, Water-Soluble in Soil	CSA A23.2-3B / CSA A23.2-2B	Extraction (HCl) / Gravimetry (Barium Sulfate Precipitation)		Richmond

Glossary of Terms:

RL	Reporting Limit (default)
%	Percent
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
ASTM	ASTM International Test Methods
CSA	Canadian Standards Association Chemical Test Methods

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APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Thurber Engineering Ltd. (Vancouver)	**WORK ORDER**	22K3570
PROJECT	35221	**REPORTED**	2022-12-08 14:15

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- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B2L0112										
Blank (B2L0112-BLK1)				Prepared: 2022-12-01, Analyzed: 2022-12-05						
Sulfate, Water-Soluble	< 0.050	0.050	%							
General Parameters, Batch B2L0294										
Blank (B2L0294-BLK1)				Prepared: 2022-12-03, Analyzed: 2022-12-06						
Chloride, Water-Soluble	< 0.002	0.002	%							
Duplicate (B2L0294-DUP1)				**Source: 22K3570-01**	Prepared: 2022-12-03, Analyzed: 2022-12-06					
Chloride, Water-Soluble	0.018	0.002	%		0.017			6		

THURBER

APPENDIX D FWD TEST RESULTS

THURBER

H7/H11 Mission Truck Route

Job Location: Mission (Highway 7)

Job Number: 35221

Station (m)	Direction	Lane	Normalized Deflection (µm)	FWD Test results	
				M_R (MPa)	E_P (MPa)
100+84	EB	TI	202	32	1724
100+90	EB	EBL	224	24	5069
100+99	EB	TI	213	35	1397
101+20	EB	EBL	300	22	1623
101+50	EB	EBL	317	17	1463
101+80	EB	EBL	265	20	1504
102+10	EB	EBL	562	15	442
102+40	EB	EBL	367	18	763
102+70	EB	EBL	590	11	462
103+00	EB	EBL	425	16	635
103+30	EB	EBL	485	15	538
103+60	EB	EBL	215	25	1487
101+00	WB	TL	290	28	819
101+10	WB	WBL	463	23	429
101+30	WB	TL	176	25	2222
101+40	WB	WBL	659	15	332
101+60	WB	TL	248	29	1186
101+70	WB	WBL	367	23	720
101+90	WB	CL	249	33	1202
102+00	WB	WBL	445	22	574
102+20	WB	CL	573	17	369
102+30	WB	WBL	327	21	967
102+50	WB	CL	182	39	1405
102+60	WB	WBL	303	27	823
102+80	WB	CL	243	20	1794
102+90	WB	WBL	277	20	1140
103+10	WB	CL	307	22	1259
103+20	WB	WBL	256	29	1183
103+40	WB	CL	319	26	1329
103+50	WB	WBL	321	27	1067
103+70	WB	CL	177	21	12154
103+80	WB	WBL	239	29	3103

TI	Turn-in Lane
EBL	East Bound Lane
WBL	West Bound Lane
CL	Centre Line
TL	Turning Lane

THURBER

H7/H11 Mission Truck Route

Job Location: Horne Street and Glasgow Ave

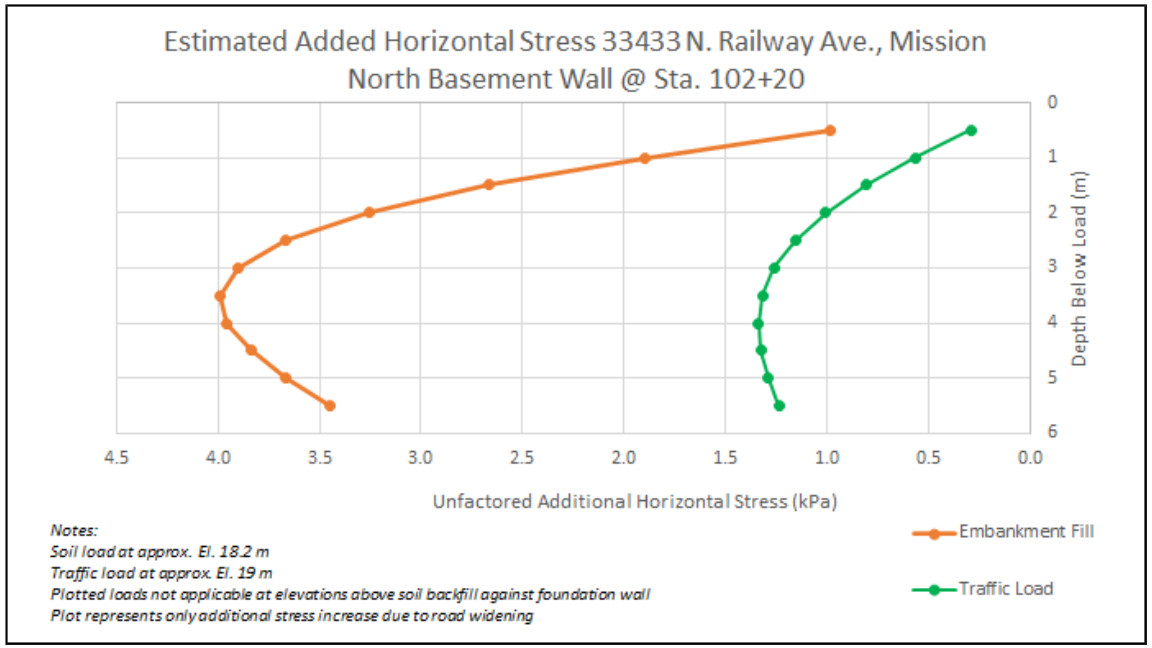
Job Number: 35221

Station (m)	Street Name	Direction	Lane	Normalized Deflection (μm)	FWD Test results M_R (MPa)	FWD Test results E_P (MPa)
300+11	Horne Street	EB	EBL	489	13	2579
300+30	Horne Street	EB	EBL	1027	11	728
300+50	Horne Street	EB	OL	280	26	3655
300+60	Horne Street	EB	IL	320	22	2772
300+70	Horne Street	EB	OL	412	19	1944
300+80	Horne Street	EB	IL	335	22	2348
300+90	Horne Street	EB	OL	633	14	852
301+00	Horne Street	EB	IL	330	24	1978
301+10	Horne Street	EB	OL	737	15	521
300+00	Horne Street	WB	Through	107	22	43859
300+20	Horne Street	WB	Through	167	20	23302
300+40	Horne Street	WB	Through	100	32	32467
300+65	Horne Street	WB	OL	386	21	1517
300+70	Horne Street	WB	Through	200	18	17592
300+75	Horne Street	WB	IL	381	21	1792
300+85	Horne Street	WB	OL	584	18	694
300+90	Horne Street	WB	Through	511	17	1695
300+95	Horne Street	WB	IL	455	19	1157
301+05	Horne Street	WB	OL	537	17	890
200+05	Glasgow Avenue	NB	NBL	324	25	2309
200+25	Glasgow Avenue	NB	NBL	306	22	3187
200+45	Glasgow Avenue	NB	NBL	252	21	7355
200+60	Glasgow Avenue	NB	NBL	296	21	4728
200+15	Glasgow Avenue	SB	SBL	297	26	4394
200+35	Glasgow Avenue	SB	SBL	277	21	6171
200+55	Glasgow Avenue	SB	SBL	351	26	2144
200+67	Glasgow Avenue	SB	SBL	331	29	1784

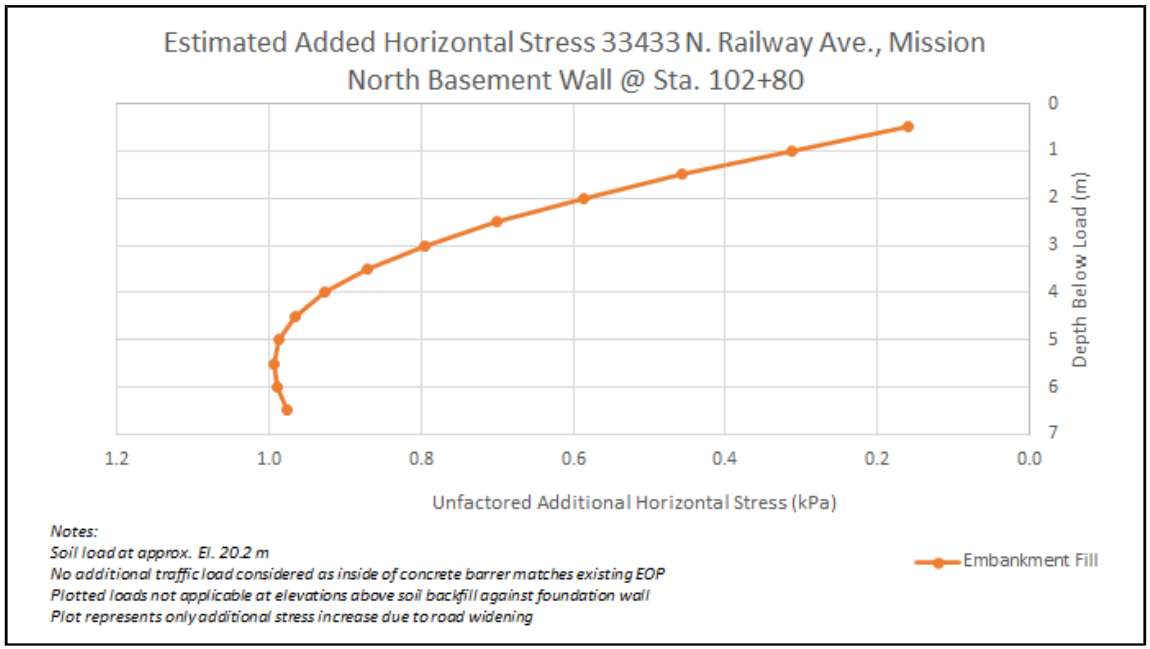
OL	Outside Lane
IL	Inside Lane
Through	Through Lane
NBL	North Bound Lane
SBL	South Bound Lane

THURBER

APPENDIX E UNFACTORED HORIZONTAL STRESS FIGURE



Notes:
Soil load at approx. El. 18.2 m
Traffic load at approx. El. 19 m
Plotted loads not applicable at elevations above soil backfill against foundation wall
Plot represents only additional stress increase due to road widening



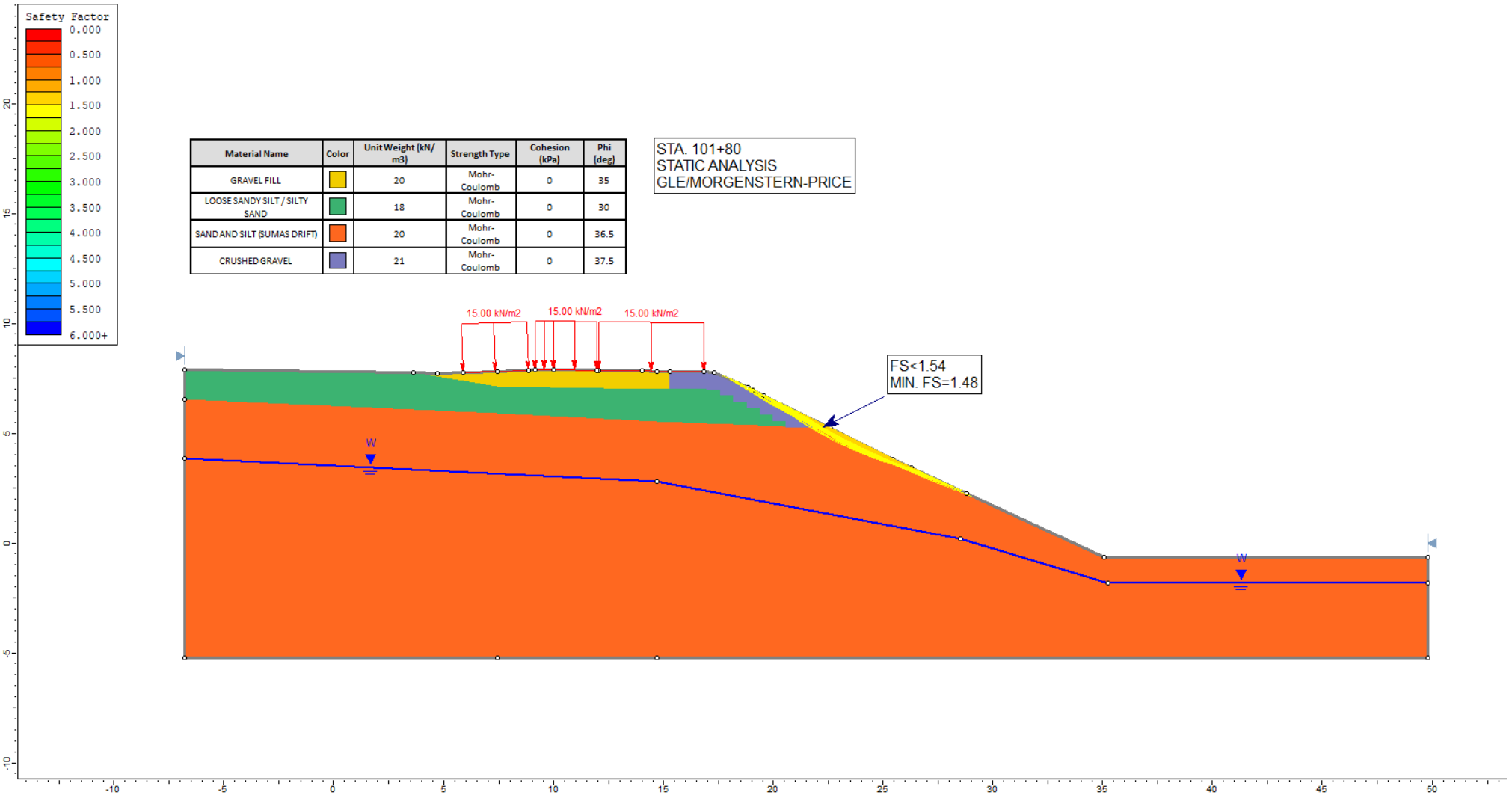
Notes:
Soil load at approx. El. 20.2 m
No additional traffic load considered as inside of concrete barrer matches existing EOP
Plotted loads not applicable at elevations above soil backfill against foundation wall
Plot represents only additional stress increase due to road widening

The proposed concrete barrier at Sta. 102+80 is shown on the 90% design cross-sections in line with the existing edge of pavement. Therefore, we expect that wheel loads cannot come any closer to the basement wall than existing conditions allow for. On this basis, no additional traffic load is shown at Sta. 102+80.

LEGEND / NOTES		CLIENT NAME: URBAN SYSTEMS LTD.	DRAWN BY: GGM	DATE: 2023-03-21
	THURBER	DRAWING TITLE: UNFACTORED HORIZONTAL STRESS AT STA. 102+20 AND 102+80	DESIGNED BY: GGM	SCALE: -
		PROJECT NAME AND LOCATION: H7/H11 TRUCK ROUTE INTERSECTION IMPROVEMENTS MISSION, BC	APPROVED BY: JSP	PROJECT No.: 35221
			DRAWING / FIGURE No.: E1	REV.: 0

THURBER

APPENDIX F SLOPE STABILITY FIGURES



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
GRAVEL FILL		20	Mohr-Coulomb	0	35
LOOSE SANDY SILT / SILTY SAND		18	Mohr-Coulomb	0	30
SAND AND SILT (SUMAS DRIFT)		20	Mohr-Coulomb	0	36.5
CRUSHED GRAVEL		21	Mohr-Coulomb	0	37.5

STA. 101+80
STATIC ANALYSIS
GLE/MORGENSTERN-PRICE

LEGEND / NOTES

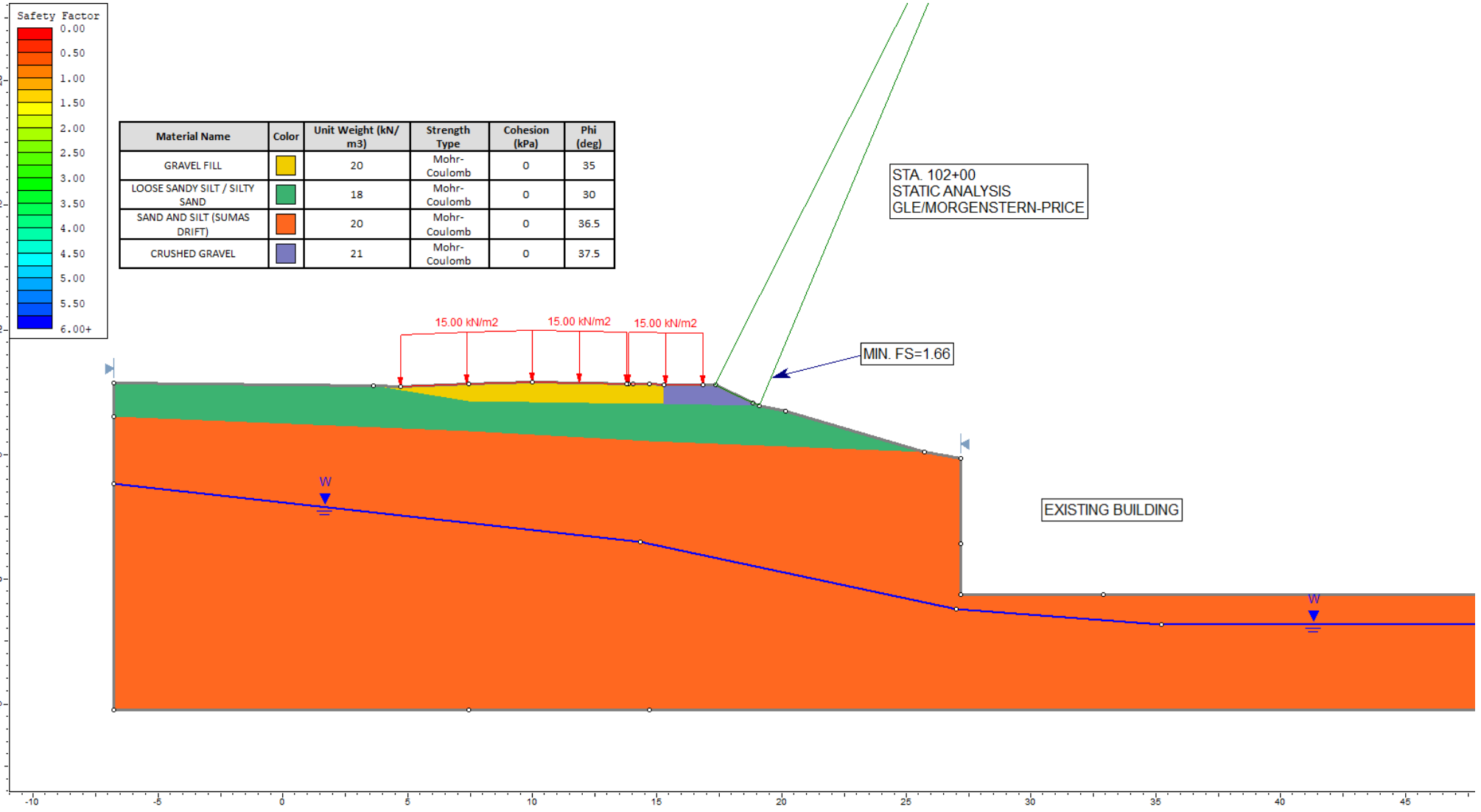
THURBER

CLIENT NAME: URBAN SYSTEMS LTD.

DRAWING TITLE: REPRESENTATIVE STATIC SLOPE STABILITY ANALYSIS AT STA. 101+80

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

DRAWN BY	DATE
GGM	2023-03-21
DESIGNED BY	SCALE
GGM	-
APPROVED BY	PROJECT No.
JSP	35221
DRAWING / FIGURE No.	REV.
F1	0



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
GRAVEL FILL		20	Mohr-Coulomb	0	35
LOOSE SANDY SILT / SILTY SAND		18	Mohr-Coulomb	0	30
SAND AND SILT (SUMAS DRIFT)		20	Mohr-Coulomb	0	36.5
CRUSHED GRAVEL		21	Mohr-Coulomb	0	37.5

LEGEND / NOTES

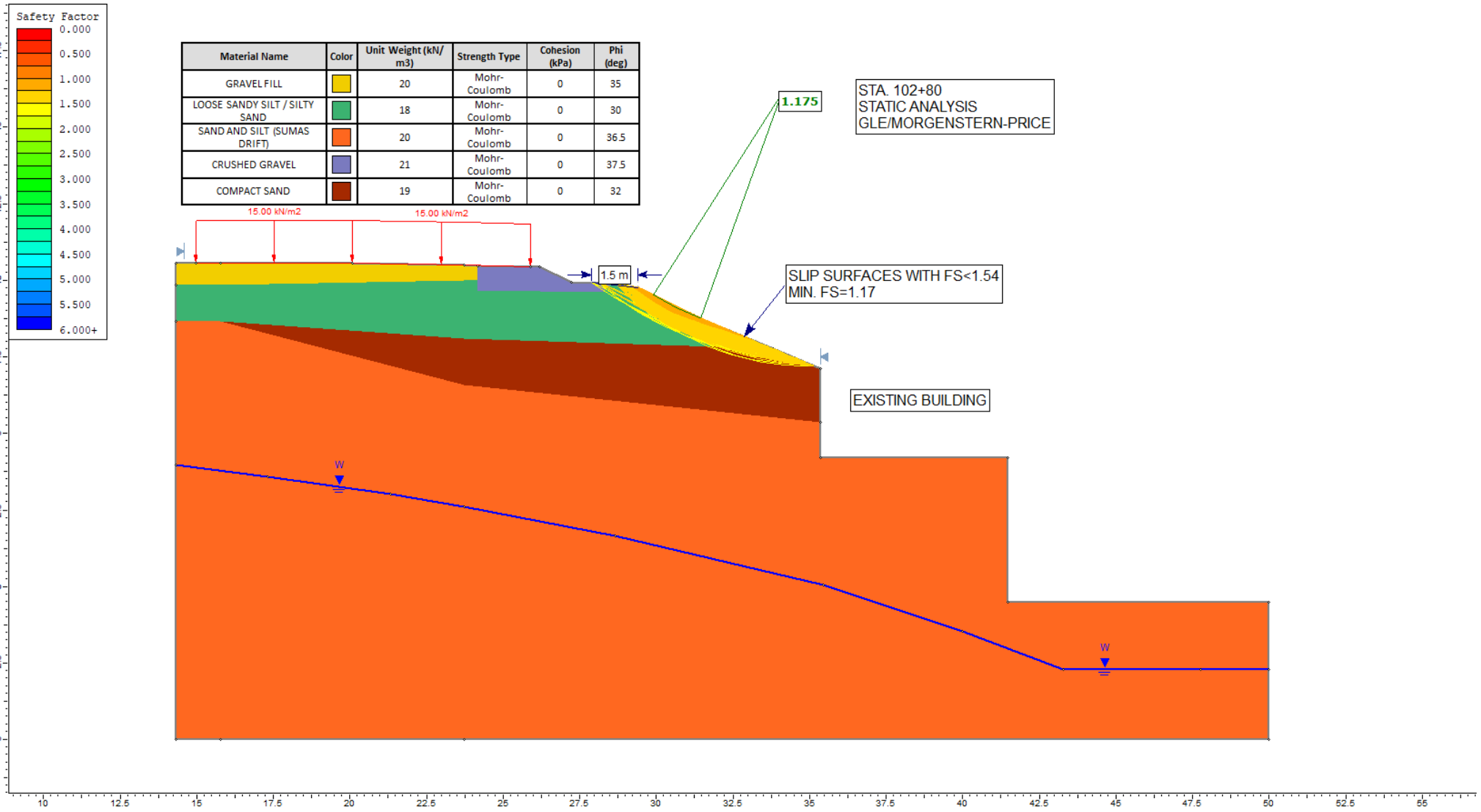
THURBER

CLIENT NAME: URBAN SYSTEMS LTD.

DRAWING TITLE: REPRESENTATIVE STATIC SLOPE STABILITY ANALYSIS AT STA. 102+00

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

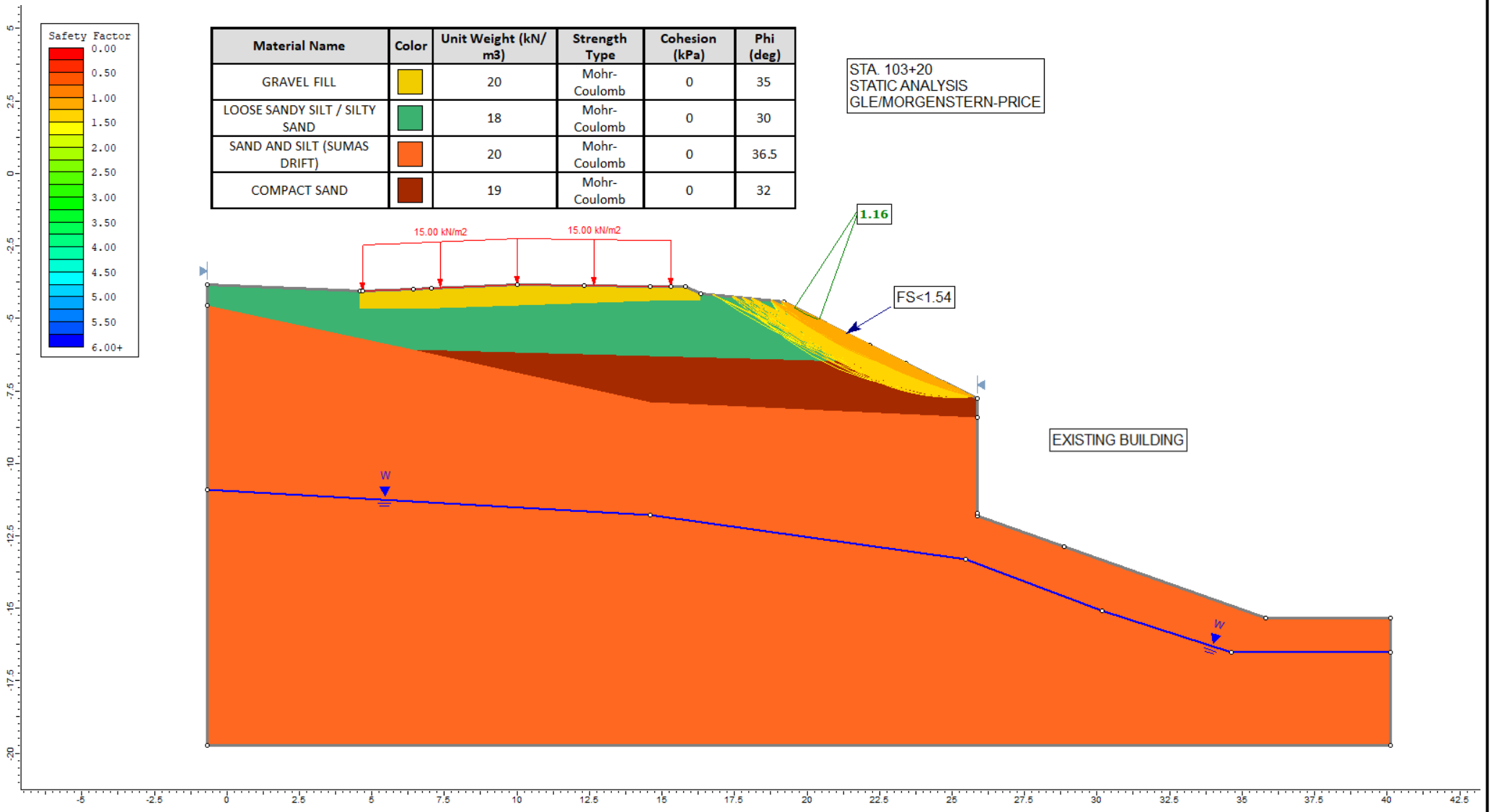
DRAWN BY	DATE
GGM	2023-03-21
DESIGNED BY	SCALE
GGM	-
APPROVED BY	PROJECT No.
JSP	35221
DRAWING / FIGURE No.	REV.
F2	0



LEGEND / NOTES		CLIENT NAME: URBAN SYSTEMS LTD.	DRAWN BY: GGM	DATE: 2023-03-21	
	THURBER	DRAWING TITLE: REPRESENTATIVE STATIC SLOPE STABILITY ANALYSIS AT STA. 102+80	DESIGNED BY: GGM	SCALE: -	
		PROJECT NAME AND LOCATION: H7/H11 TRUCK ROUTE INTERSECTION IMPROVEMENTS MISSION, BC	APPROVED BY: JSP	PROJECT No.: 35221	
			DRAWING / FIGURE No.: F3	REV.: 0	

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
GRAVEL FILL		20	Mohr-Coulomb	0	35
LOOSE SANDY SILT / SILTY SAND		18	Mohr-Coulomb	0	30
SAND AND SILT (SUMAS DRIFT)		20	Mohr-Coulomb	0	36.5
COMPACT SAND		19	Mohr-Coulomb	0	32

STA. 103+20
STATIC ANALYSIS
GLE/MORGENSTERN-PRICE



LEGEND / NOTES

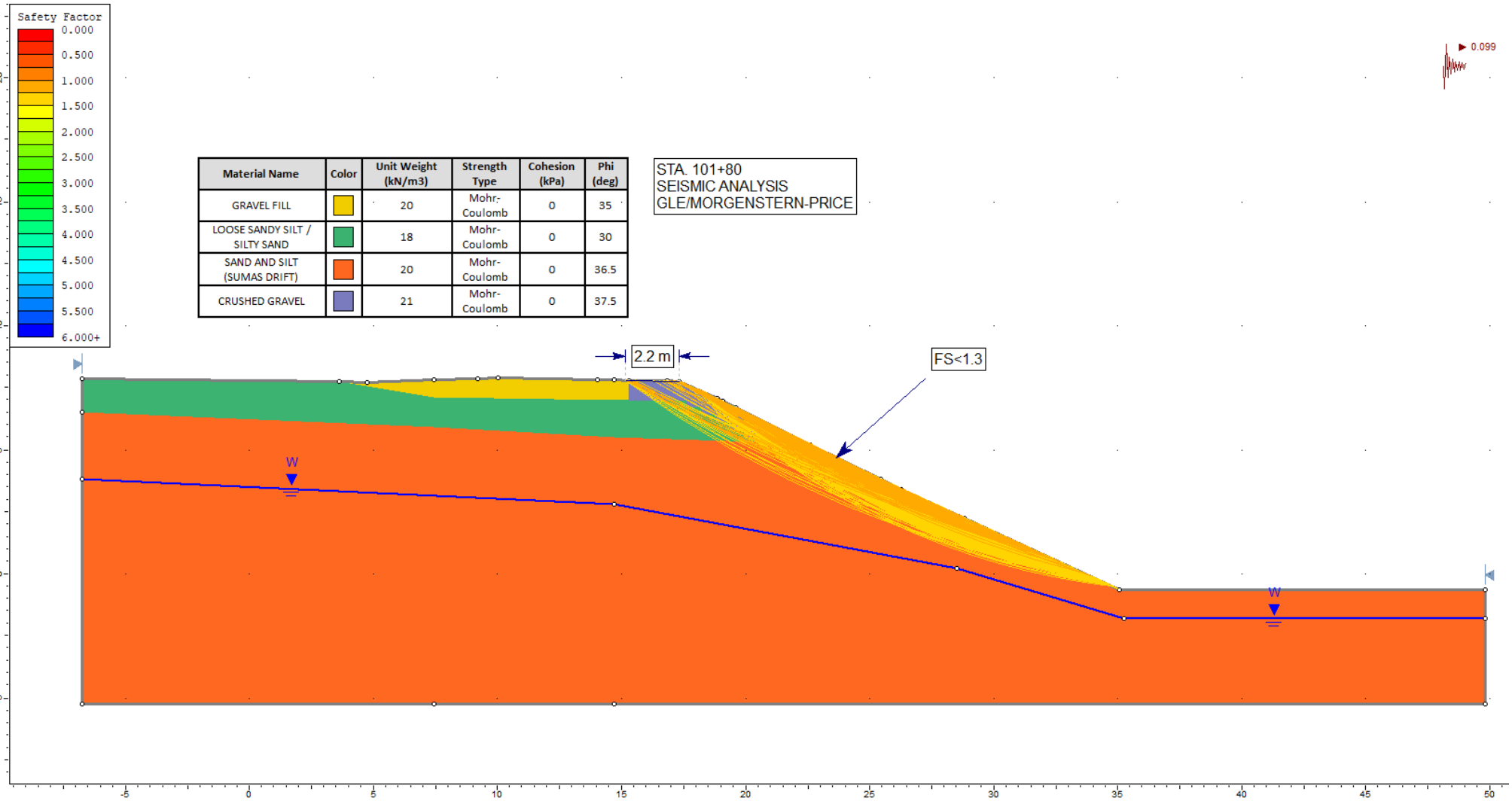
THURBER

CLIENT NAME: URBAN SYSTEMS LTD.

DRAWING TITLE: REPRESENTATIVE STATIC SLOPE STABILITY ANALYSIS AT STA. 103+20

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

DRAWN BY	DATE
GGM	2023-03-23
DESIGNED BY	SCALE
GGM	-
APPROVED BY	PROJECT No.
JSP	35221
DRAWING / FIGURE No.	REV.
F4	0



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
GRAVEL FILL		20	Mohr-Coulomb	0	35
LOOSE SANDY SILT / SILTY SAND		18	Mohr-Coulomb	0	30
SAND AND SILT (SUMAS DRIFT)		20	Mohr-Coulomb	0	36.5
CRUSHED GRAVEL		21	Mohr-Coulomb	0	37.5

STA. 101+80
SEISMIC ANALYSIS
GLE/MORGENSTERN-PRICE

LEGEND / NOTES

THURBER

CLIENT NAME: URBAN SYSTEMS LTD.		DRAWN BY: GGM	DATE: 2023-03-21
DRAWING TITLE: REPRESENTATIVE SEISMIC SLOPE STABILITY ANALYSIS AT STA. 101+80		DESIGNED BY: GGM	SCALE: -
PROJECT NAME AND LOCATION: H7/H11 TRUCK ROUTE INTERSECTION IMPROVEMENTS MISSION, BC		APPROVED BY: JSP	PROJECT No.: 35221
		DRAWING / FIGURE No.: F5	REV.: 0