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HIGHWAY 7 EASTBOUND SHERLING TRANSIT BUS STOP

Geotechnical Design Report

Client Name: Urban Systems Ltd.
Date: May 9, 2024
File: 43376

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1. INTRODUCTION

As requested, Thurber Engineering Ltd. (Thurber) has prepared this Geotechnical Report for the Highway 7 Eastbound Sherling Transit Bus Stop Project.

It is a condition of this report that Thurber's performance of its 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 a new bus stop along Highway 7, east of Sherling Avenue. The project description below is based on the 50% Detailed Design Drawings (Design Drawings) by Urban Systems Ltd. (Urban Systems) dated December 15, 2023.

The bus stop is proposed adjacent to the eastbound lane of Highway 7, immediately east of Sherling Avenue. The project includes construction of a new bus stop pullout, 3 m wide sidewalk from Sherling Avenue to the bus stop, utility pole relocations and changes to the Highway 7 and Sherling Avenue intersection.

The intersection of Sherling Avenue and Highway 7 is relatively flat, except for the ditch on the south side of Highway 7. Grades increase by about 1 to 2 m toward private industrial facilities south of the project site. A two-block high, Lock Block retaining wall provides grade separation between the highway and private property directly south of the highway ditch.

Several existing below grade utilities are present on site, including:

- 168 mm diameter intermediate pressure gas line,
- 900 mm diameter Metro Vancouver Haney No. 2 watermain,
- 1500 mm diameter concrete storm sewer in the ditch south of Highway 7, and
- Underground electric service.

Record drawings for the 1500 storm sewer (Delcan Project No. 04843-0112, dated May 05, 2011) show expanded polystyrene (EPS), 1.2 m high by 1.8 m wide, on both sides of the storm sewer. The top of EPS is about 1.5 to 2 m below the surface of Highway 7 or about elevation (El.) 1.0 m.

The proposed bus stop will approximately match the existing grade of Highway 7. The sidewalk extends over the road shoulder, resulting in a new embankment slope up to approximately 0.8 m above existing grade.

The existing Highway 7 pavement structure will be retained as much as possible. Some new full-depth pavement structure is expected where the existing pork-chop island will be removed at the southeast corner of the intersection. Milling and overlay are planned to tie the new bus stop to the existing pavement. The bus stop pullout will be a concrete pavement. Design recommendations for the concrete pavement structure are provided by Thurber under a separate cover.

3. INVESTIGATIONS

3.1 Drilling Investigation

Thurber completed a geotechnical investigation on Highway 7 consisting of two auger test holes (AH24-01 and AH24-02) on January 30, 2024. A seismic cone penetration tests (SCPT) was also advanced adjacent to AH24-01. A BC OneCall ticket request was submitted before drilling to notify utility owners of our intention to drill. Quadra Utility Locating was retained to scan the proposed test hole locations for conductive utilities. The test holes were advanced in the westbound lanes of Highway 7 due to utility conflicts in the eastbound lanes.

Southland Drilling advanced the auger test holes to approximately 9.1 m depth. Dynamic cone penetration tests (DCPTs) were completed at the auger holes to provide an indication of the relative in situ density of the soils. Schwartz Soil-Tech Inc. was retained to advance SCPT at AH24-01 to refusal at approximately 20.9 m.

The soil and groundwater conditions were logged in the field by Thurber personnel. Soil samples were collected for visual identification, moisture content determination, Atterberg Limits and gradation analysis at our laboratory. All test holes were backfilled in accordance with BC groundwater protection regulations. Test hole locations are shown on Drawing 43376-1 in Appendix A.

3.2 Hydro Vac Utility Locates

Thurber attended site on March 11, 2024 during a hydro-vacuuming operation by Urban Systems to prelocate the 1500 mm storm sewer on the south side of Highway 7. The soil conditions were logged by Thurber field personnel at two hydro-vacuum holes to the invert depth of the storm sewer.

3.3 Falling Weight Deflectometer Testing

Tetra Tech Canada was retained to complete Falling Weight Deflectometer (FWD) testing along the Highway 7 alignment. The pavement structure thicknesses measured in the test holes 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 B.

Based on the back-calculated pavement moduli, the effective structural number (SN_{Eff}) of the existing pavement was calculated using the 1993 AASHTO Guide for Design of Pavement Structures procedure.

3.4 Visual Pavement Review

Thurber visited the site on March 14, 2023 to complete a visual review the existing pavement. Our review was generally limited to the extents of pavement covered by the project. Specifically, this included the northbound and eastbound turn-lane of Sherling Avenue (i.e. around the Sherling Avenue crosswalk, south of Highway 7) and outside lane of Highway 7 (i.e. to about 70 m east of Sherling Avenue).

Key pavement distress indicators observations at approximate locations are summarized below:

- Low and moderate severity transverse cracking near the Sherling Avenue crosswalk and on Highway 7.
- Moderate to high severity ravelling in the northbound and eastbound turn-lane lane of Sherling Avenue and outside lane of Highway 7.
- Joint cracking at utility trenches near the Sherling Avenue crosswalk.

The pavement condition in other lanes (e.g. Highway 7 inside lane or centre lane) is not addressed in this report. Representative photos of pavement distress indicators are provided in Appendix C.

3.5 Laboratory Testing

3.5.1 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 (5th 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 D.

3.5.2 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.

3.5.3 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.

3.5.4 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. The percent passing the No. 200 sieve procedure is a simplified gradation test to determine the fines content of soils. One sieve analysis 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 D.

4. SURFICIAL GEOLOGY

The Geological Survey of Canada map “Surficial Geology Map 1484A, New Westminster, British Columbia” maps Highway 7 at Sherling Avenue as Fraser River Sediments (Fc), expected to overbank silty to silt clay loam up to 2 m thick, overlying deltaic and distributary channel fill sandy to silt loam between 10 m and 40 m thick with fine to medium sand and minor silt beds.

5. SOIL AND GROUNDWATER CONDITIONS

5.1 Drilling Investigation

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

The soil conditions encountered at the test holes generally comprise 150 mm of asphalt, over dense silty gravelly sand to about 1 m depth. Underlying the fill was soft to firm silt with varying sand and organic content. Trace to some peat was noted to about 3 m depth. Sand and silty sand was encountered at about 16 m depth prior to SCPT refusal at about 21 m. The SCPT profile and site shear wave velocity measurements are included in Appendix E.

Groundwater was interpreted at SCPT24-01 to be at approximately 1.6 m below grade. The depth of groundwater is expected to vary with seasonal rainfall and surface drainage conditions.

5.2 Hydro Vac Utility Locates

The soil conditions encountered at the hydro-vacuum holes are summarized in Table. 5.2 below. The soils at the hydro-vacuum holes are expected to be representative of trench backfill over the 1500 mm storm pipe.

Table 5.2: Soil Conditions Observed During at Hydro-Vacuum Holes

Test Hole	Depth (m)	Soil Description / Notes
HV24-01	0 – 0.2	TS – Organic Silt and Sand, medium to fine sand, firm, brown, moist to wet (Topsoil).
	0.2 – 1.0	SM/GM – Sand and Gravel, some silt to silty, trace cobble, sub-angular to sub-rounded gravel, compact to dense, brown, moist to wet (Fill).
HV24-02	0 – 0.2	TS – Organic Silt and Sand, medium to fine sand, firm, brown, moist to wet (Topsoil).
	0.2 – 0.6	SM/GM – Sand and Gravel, some silt, trace cobble, sub-angular to sub-rounded gravel, compact to dense, brown, moist to wet (Fill).
	0.6 – 0.7	GP/GM – Gravel, sandy, trace to some silt, angular to sub-angular gravel, compact to dense, grey, moist to wet (Fill).

*Note: HV = Hydro Vac

6. 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)
- Ministry Standard Specifications for Highway Construction (Standard Specifications)
- AASHTO 1993 Guide for the Design of Pavement Structures
- Canadian Foundation Engineering Manual (5th Edition)
- Ministry Technical Circular T-01/15 Pavement Structure Design Guidelines

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

The site soils are expected to be liquefiable (refer to Section 7.2). Accordingly, Site Class F is considered appropriate per Table 4.1 of CSA S6-19. However, per the Supplement, the liquefaction potential of soils using a simplified stress-based method of analysis can be completed using peak ground acceleration (PGA) adjusted for the site using non-liquefied soil properties.

Based on Table 4.1 in CSA S6-19, Site Class E is considered appropriate for the non-liquefied site condition based on the site having more than 3 m of soil with a moisture content greater than forty percent.

The average shear wave velocity measured to about 20 m depth (at SCPT refusal) was approximately 144 m/s. Larger shear wave velocities may be present between 20 and 30 m. However, we expect that the average shear wave velocity for the top 30 m of the site (Vs_{30}) would be between 140 – 180 m/s, which is consistent with a Site Class E condition.

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 E are presented in Table 8.1

Table 7.1: Summary of Peak Ground Acceleration Values (NBCC 2015) for Highway 7 at Sherling Avenue – Site Class E

Earthquake Return Period	Peak Ground Acceleration Value
1:475	0.23
1:975	0.26
1:2,475	0.30

7.2 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 1.6 m depth was assumed in the assessment based on the groundwater observed during the geotechnical investigation. The soils below about 2.5 m depth are generally expected to be liquefiable. Atterberg Limits tests on the silt soils to about 2.5 m indicate a plasticity index (PI) greater than twelve percent. Accordingly, the silt above 2.5 m is expected to be non-liquefiable.

8. GEOTECHNICAL DISCUSSION AND RECOMMENDATIONS

8.1 General

The soils underlying Highway 7 near Sherling Street are predominately soft to firm silts with varying sand content and some organic silt and peat soils near the ground surface. Sand and silty sand was encountered at about 16 m depth prior to SCPT refusal at about 21 m. At the existing Highway 7 road surface, about 150 mm of asphalt is expected over approximately 750 mm of silty gravelly sand fill. Groundwater is expected at about 1.6 m below Highway 7.

Organic rich soils and possibly some peat deposits may exist below the existing utilities on site. These soils are susceptible to settlement under increased loads which can induce utility settlement. To reduce the potential for post-construction settlement the proposed grade increases should cause zero net load. This will require removing up to approximately 0.7 m of existing fill and natural soils below proposed shoulder widening and replacing it with white pumice.

8.2 Site Preparation

Subgrade preparation, engineered fill gradation / quality and placement requirements must be in accordance with Sections 200 and 201 of the current Ministry Standard Specifications for Highway Construction document, CSA S6-19 and the 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 soils 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. 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.

8.3 Suitability of Cut Materials for Reuse in Fills

There will generally be limited opportunity to reuse materials on this project. Silty gravelly sand fill was encountered beneath the existing asphalt at the auger holes. Gradation analysis on this material shows that it has a fines content of about twenty-five percent. We do not recommend reusing this material as subbase as it is expected to drain poorly.

The silty composition of the existing fill requires that moisture control will be critical to produce an acceptable product for reuse. Provided that this occurs, consideration can be given to reusing the existing silty gravelly sand as subgrade fill.

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. However, should the contractor propose to reuse materials, they should provide a plan on how they will manage and process excavated material proposed for reuse.

8.4 Embankment Stability

8.4.1 Static Stability

Limit-equilibrium slope stability analyses were completed on representative cross-sections of the Highway 7 embankment. While the embankment is of limited height, the stability analyses were completed given the presence of existing infrastructure at the site. The soil and groundwater conditions used in the analyses were inferred from the geotechnical investigation.

Thurber assessed the slope stability based on a ‘Typical’ degree of understanding and a ‘Typical’ consequence factor provided in 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 approximately 0.8 m over measured levels (i.e. standing water at the toe of the embankment) to account for possible future water level increases.

Stability analyses of the proposed embankment at Sta. 1+80 showed slip surfaces with a FS > 1.54. Representative results of the static slope stability analyses are presented in Appendix F.

8.4.2 Seismic Stability

Seismic slope stability was assessed in general accordance with the Supplement. Post-seismic flow-slide stability checks were completed to confirm stability of the proposed embankment geometry under gravity loading after a seismic event in the event of strain softening or liquefaction of the natural soil. The results of the assessment did not identify any slopes susceptible to flow-slides under a 2,475-year seismic event.

Seismic displacement analyses were carried out using the simplified Newmark-type analyses in general accordance with the Supplement and CSA S6-19. The seismic displacement values were derived by estimating the yield coefficient for the respective slope and applying the results in a Newmark-type model such as Bray and Travasarou (2007).

The estimated range of seismic displacement is in the order of 0.5 and 1 m during a 2,475-year seismic event. However, the yield surface geometry indicates that this displacement is pre-existing condition which is not affected by the proposed bus stop. In other words, the bus stop is not expected to increase seismic displacements. The corresponding slope stability outputs are also presented in Appendix F.

8.5 Embankment Construction

Where sidewalk construction will result in grade raising, the new embankment slope should be constructed in accordance with the Ministry's Standard Specifications.

To achieve the required zero net load increase, we recommend that the existing road shoulder be excavated to at least 0.7 m below the proposed embankment toe. Exposed subgrade should be horizontal and free from deleterious, loose/soft or otherwise unsuitable soils. A large steel drum vibratory roller should be used to compact the subgrade, where possible.

The subgrade should be reviewed prior to fill placement and any sub-excavation operations completed, if required. Following subgrade approval, white pumice fill should be used to reconstruct the entire embankment slope at 2H:1V or flatter. The pumice fill should come up to the underside of the sidewalk gravels or topsoil finished grade. We do not expect pumice below new pavement sections as road pavements should match existing grade.

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 Section 201.37 of the Ministry's Standard Specifications.

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.

8.6 Lightweight Fill

Pumice for lightweight fill is to comprise Garibaldi Pumice dacite (white) pumice which is commonly referred to as 'white pumice' in the Lower Mainland as opposed to red vesicular basalt (red pumice). The white pumice is recommended over the red pumice because it is lighter and will provide a greater unload for the same depth of excavation. Using a heavier pumice will reduce the unload in most areas and increase the applied load in some areas. Garibaldi Pumice is listed in the most recent version of the Ministry's Approved Products List.

We recommend that the contractor provide a methodology for compaction of the light-weight fill, per Ministry Standard Specification 202, and that this methodology be approved by the Ministry Representative and Thurber. The methodology should include test strips at the onset of construction to confirm the pumice placement methodology.

8.7 Non-Woven Geotextile

Non-woven geotextile will be needed to wrap the pumice. This is to reduce the risk of finer material migrating from the surrounding soils into the pumice. Nilex 4551 or an equivalent product approved by the Geotechnical Engineer can be used. The geotextile should be permanently covered with granular sidewalk fill or topsoil. The cover thickness should be confirmed in the development of the detailed design drawings.

8.8 Settlement

We anticipate that embankments constructed with the recommendations of this report will result in a net zero load. Accordingly, the proposed work should not induce post-construction consolidation settlement.

The site soil includes organic silts and some peat which are subject to long-term secondary (creep) settlement due to degradation and structural viscosity of the soil matrix. While the design recommended herein should not increase the potential for long-term secondary settlement at the site, the potential for ongoing secondary settlement exists. As such, some maintenance may be required (e.g. repairs to sidewalk cracks) and a reasonable degree of redundancy should be incorporated into the highway drainage design to accommodate the potential for ongoing long-term secondary settlement.

Temporary dewatering during construction can induce settlement. We recommend that work be completed during periods of low groundwater to reduce the need to dewater the site.

8.9 Settlement Monitoring

Settlement monitoring is recommended during and after construction to monitor the trend and magnitude of settlements at the existing utilities, should any occur. Settlement monitoring is proposed to include the settlement plates comprised of a square plywood board with steel pipe risers. The settlement plates should be spaced at 15 m intervals where grade increases are proposed.

The contractor will need to extend the steel pipe risers on the settlement plates as required to maintain the riser between about 0.3 m and 1.5 m above final ground surface. The date, extension length and number of extensions must be recorded at the time that the riser(s) are added.

Baseline readings must comprise at least three independent sets of readings that show the same elevation. The vertical accuracy of the survey for monitoring settlement gauges should be

+/- 5 mm. Settlement pins should be surveyed at least weekly during construction. The duration of settlement monitoring will depend on the trend of the settlement data. Thurber can provide further input for a settlement monitoring program as part of the tender package.

The utility owner's should confirm if they require additional settlement monitoring during construction.

8.10 Pavement Recommendations

8.10.1 Traffic Loading

We understand that pavement constructed for this project will subject to regular bus traffic and occasional traffic from the Sherling Avenue industrial properties south of Highway 7. We also understand the new pavement will not be subject to the main through traffic of Highway 7. On this basis, we calculated the 20-year design traffic loading, using traffic data provided by Urban Systems.

Two estimated Equivalent Single Axle Loads (ESALs) are summarized below for different possible future traffic loading conditions.

Loading Condition 1: Estimated 20-year design ESALs to be approximately 7,626,000 based on:

- 211 buses per day with an average growth rate of about 3.5%, including Translink Route 171 (community shuttle), Route 701 (40 ft. bus) and Route R3 (60 ft. articulated bus).
- Sherling northbound Average Annual Daily Traffic (AADT) of approximately 500 vehicles with an average growth rate of about 2%
- 20% total trucks for northbound Sherling Avenue (assumed value as no information of truck percentage was available)
- ESALs per bus based on bus weight and assumed number of passengers during operating hours.

The bus capacity during operation is a significant traffic data variable which was not provided to us. In calculation of the ESALs, we have assumed that the buses will be a mix of maximum capacity, seated capacity and empty during peak, shoulder, and off-hours, respectively. The average bus ESALs were approximately 0.2 (Route 171 community shuttle), 1.7 (Route 701, 40 ft. bus) and 5.1 (Route R3, 60 ft. articulated bus). Average 1.0 ESAL per truck and 0.0007 ESALs per vehicle (non-truck factor) were used for northbound Sherling Avenue traffic.

Loading Condition 2: Estimated 20-year design ESALs to be approximately 2,135,000 based on:

- The same assumptions as Loading Condition 1, except the Translink Route R3 (60 ft. articulated bus) has been removed as this is a rapid bus with limited stops. Removal of the R3 articulated bus significantly reduces the traffic loading.

8.10.2 Structural Requirements

The pavement design analysis was carried out using the methodology outlined in the 1993 AASHTO *"Guide for the Design of Pavement Structure"* with traffic inputs as per the Ministry of Transportation and Infrastructure's Technical Circular T-01/15. This analysis was completed to determine the structural requirements to support anticipated traffic volumes.

The AASHTO procedure for the design of flexible pavements determines a required Structural Number that characterizes the structural capacity of the pavement layers, for a given set of inputs. The following inputs specified in the Technical Circular were used in calculating the required structural number in the AASHTO method.

- Design period = 20 years
- Initial serviceability = 4.2
- Terminal serviceability = 2.5
- Reliability level = 90%
- Overall standard of deviation = 0.45
- Mean soil resilient modulus = varies based on FWD testing

The required design Structural Number (SN_{Des}) varied based on the resilient modulus of the subgrade soil estimated from FWD testing and the 20-Year Design ESAL values summarized in Section 8.9.1. The SN_{Des} is provided Appendix B.

8.10.3 Mill and Inlay

The back-calculated SN_{Eff} values from the FWD testing were compared with the required SN_{Des} (Appendix B). In general, the FWD testing found that the existing pavement structure on the Highway 7 outside lane is structurally adequate to support the anticipated future traffic, up to the end of proposed mill and inlay shown on the 50% Design Drawings around Sta. 100+90. East of

Sta. 100+90, the existing Highway 7 outside lane pavement structure would require improvement for Loading Condition 1 but is structurally adequate to support Loading Condition 2.

Where the existing pavement is structurally adequate for future traffic loads, we recommend partial depth removal of 50 mm and replacement of hot mix asphalt (HMA) inlay (mill and inlay). The milled surface should be reviewed prior to new asphalt placement. Areas exhibiting fatigue, or multiple cracking and potholes would require deeper mill and inlay to repair the asphalt and not cause premature deterioration of the HMA inlay.

8.10.4 New Pavement Structure

We understand that areas that are structurally deficient cannot accommodate a mill and overlay because the existing intersection grades must be maintained. As such, to increase the strength of the pavement structure, the structural deficient areas should be fully reconstructed with a new pavement structure.

New pavement structure is recommended to replace the existing porkchop island at the southeast corner of the intersection and east of approximately Sta. 1+90 (if the design is to accommodate Loading Condition 1).

The following pavement structure is recommended to meet design life for Loading Condition 1:

185 mm	Hot Mix Asphalt
300 mm	Well-Graded Base (25 mm)
400 mm	Well-Graded Base (75 mm)

The following pavement structure is recommended to meet design life for Loading Condition 2:

150 mm	Hot Mix Asphalt
200 mm	Well-Graded Base (25 mm)
400 mm	Well-Graded Base (75 mm)

The above pavement structure recommendations are based on positive drainage being provided such that the base and subbase layers do not become saturated or a subdrain is included within the subbase layer. To provide drainage for the new pavement structure replacing the existing pork-chop island at the southeast corner of the intersection, it is recommended new pavement extend to the edge of pavement at this corner.

Asphalt materials will be selected by MoTI pavement engineers. Design recommendations for the rigid concrete bus pad have been provided by Thurber under a separate cover.

8.11 Transition Treatments

Smooth transitions are required in all areas where the new pavement meets the existing pavement. All longitudinal and transverse joints in the new asphalt surface should be staggered between the asphalt lifts. The staggering of the longitudinal joints should be accomplished by offsetting the paving edge in the upper asphalt course by a minimum of 150 mm. Longitudinal joints should be generally placed at lane lines or the centre of travelled lanes.

At the paving limits, the transverse tie-in should be trimmed to a depth of the surface course, full width, to provide a straight clean vertical surface so that the new asphalt material can be placed flush with the top of the existing pavement surface. At all transverse tie-ins to existing pavements, the upper lift of asphalt should extend a minimum of 5 m in length beyond the transverse joint in the lower binder lift.

8.12 Construction Considerations

It is recommended that geotechnical review and testing by qualified personnel be provided during construction. The review and testing should include review of culvert, sewer trench and pavement subgrade conditions, compaction testing of backfill and pavement materials, as well as concrete and asphalt testing.

9. CLOSURE

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

Thurber Engineering Ltd.
Permit to Practice #1001319

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Date: May 9, 2024
File: ***43376***

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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.

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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.

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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.

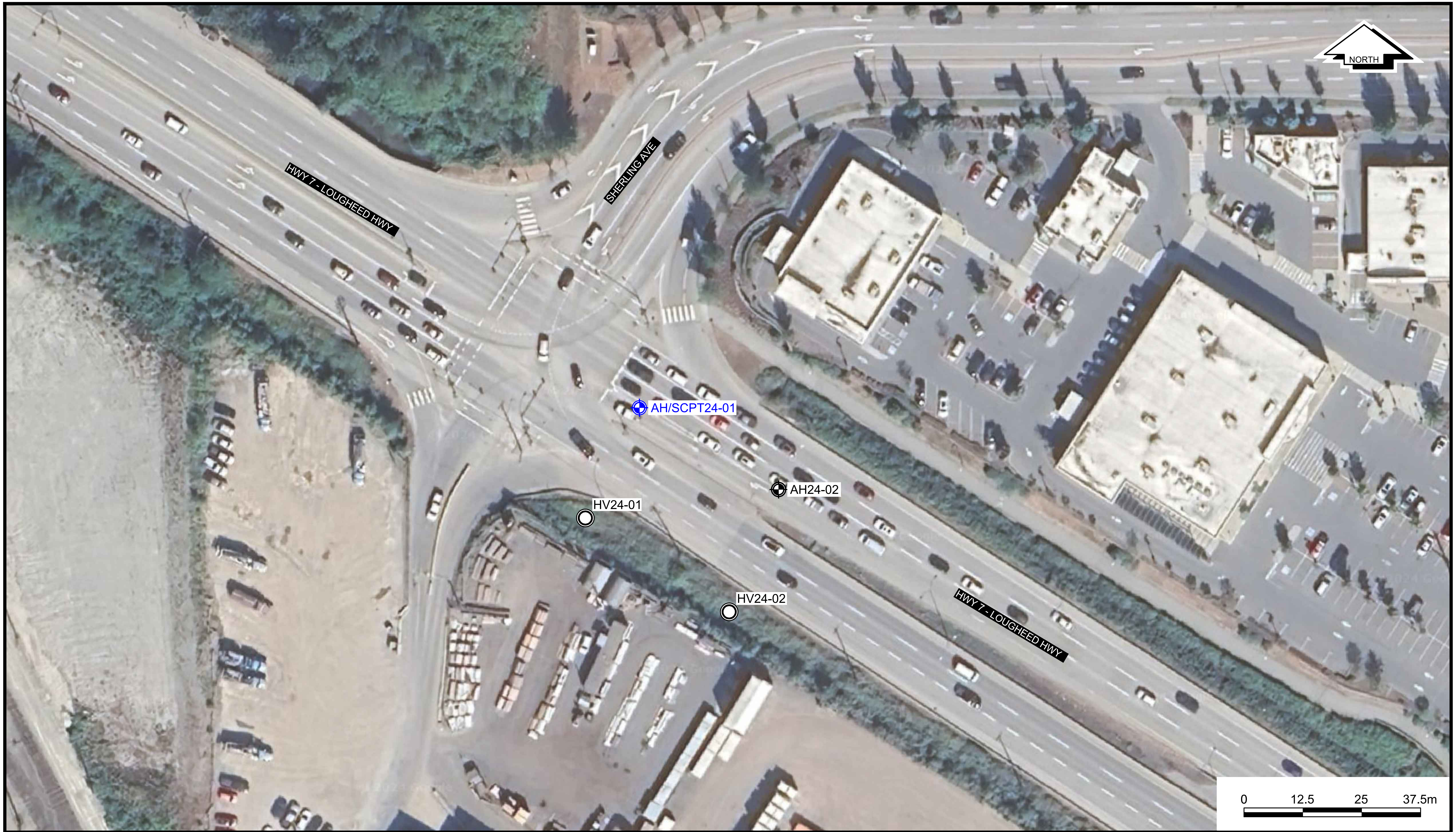
APPENDIX A

Drawing 43376-1 – Test Hole Location Plan

Plotted: April 2, 2024

This copyrighted drawing forms part of a Thurber report and its use is subject to Thurber's Statement of Limitations and Conditions

43376_TH LOCATION PLAN.dwg



LEGEND:

- ⊕ TEST HOLE (SOLID STEM AUGER)
- ⊕ TEST HOLE (SOLID STEM AUGER / SEISMIC CONE PENETRATION TEST)
- ○ TEST HOLE (HYDROVAC)

NOTES:

1. AERIAL IMAGE TAKEN FROM GOOGLE EARTH.
2. TEST HOLE LOCATIONS ARE APPROXIMATE.

THURBER ENGINEERING LTD.

URBAN SYSTEMS LTD.

TEST HOLE LOCATION PLAN

HWY 7 AND SHERLING AVE BUS STOP

PORT COQUITLAM, BC

DESIGNED	DRAWN	APPROVED	DATE	SCALE	PROJECT No.	DWG. NO.	REV.
DPN	JL/MOM		APR. 02, 2024	1:750	43376 -	1	-

THURBER ENGINEERING LTD.

APPENDIX B

FWD Results

LOADING CONDITION 1

Highway 7 Bus Stop East of Sherling Avenue

Job Location: Port Coquitlam

Job Number: 43376

Station* (m)	Direction	Lane	Layer Thickness		Normalized Deflection	FWD Test results				SN_{ol}	Required Asphalt Overlay	Remaining Life
			Asphalt	Base+Subbase		M_R	E_P	SN_{Eff}	SN_{Des}			
			(mm)	(mm)	(μm)	(MPa)	(MPa)	(mm)	(mm)	(mm)	(mm)	(ESALs)
5.+	EB	Outside Lane	150	750	179	21	1546	246	158	-88	0	274,446,337
25.+	EB	Outside Lane	150	750	245	19	1021	214	166	-48	0	51,815,573
50.+	EB	Outside Lane	150	750	461	16	427	160	174	14	36	0
75.+	EB	Outside Lane	150	750	459	17	420	159	171	12	30	0
100.+	EB	Outside Lane	150	750	453	18	420	159	169	10	25	0
125.+	EB	Outside Lane	150	750	456	18	414	159	169	10	26	0
150.+	EB	Outside Lane	150	750	457	19	402	157	165	8	21	0
175.+	EB	Outside Lane	150	750	521	18	344	149	169	20	50	0

**Stations are measured from Sherling Avenue intersection signal towards eastbound direction*

THURBER

LOADING CONDITION 2

Highway 7 Bus Stop East of Sherling Avenue

Job Location: Port Coquitlam

Job Number: 43376

Station (m)	Direction	Lane	Layer Thickness		Normalized Deflection	FWD Test results				SN_{ol}	Required Asphalt Overlay	Remaining Life
			Asphalt (mm)	Base+Subbase (mm)	(µm)	M_R (MPa)	E_P (MPa)	SN_{Eff} (mm)	SN_{Des} (mm)	(mm)	(mm)	(ESALs)
5.+	EB	Outside Lane	150	750	179	21	1546	246	133	-113	0	279,937,569
25.+	EB	Outside Lane	150	750	245	19	1021	214	140	-74	0	57,306,805
50.+	EB	Outside Lane	150	750	461	16	427	160	148	-12	0	1,819,165
75.+	EB	Outside Lane	150	750	459	17	420	159	145	-14	0	2,279,311
100.+	EB	Outside Lane	150	750	453	18	420	159	143	-16	0	2,731,619
125.+	EB	Outside Lane	150	750	456	18	414	159	143	-16	0	2,631,627
150.+	EB	Outside Lane	150	750	457	19	402	157	140	-17	0	3,113,036
175.+	EB	Outside Lane	150	750	521	18	344	149	143	-6	0	813,093

**Stations are measured from Sherling Avenue intersection signal towards eastbound direction*

THURBER ENGINEERING LTD.

APPENDIX C

Pavement Review Photo Log

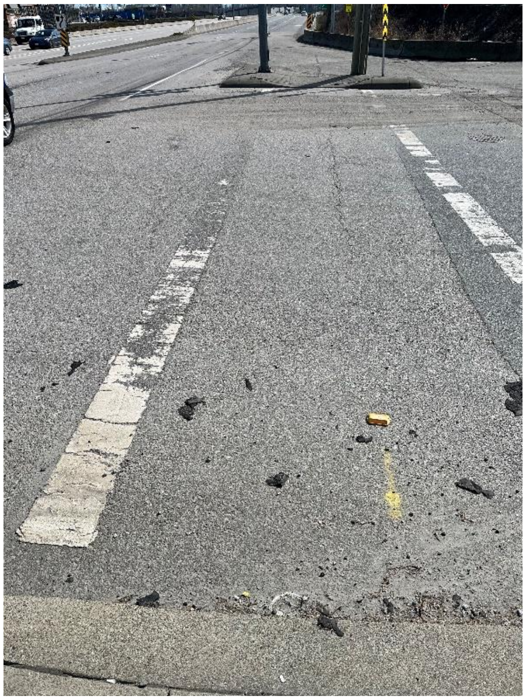


Photo 1: Moderate Severity Traverse Cracking At Sherling Avenue Crosswalk (EB Hwy &)

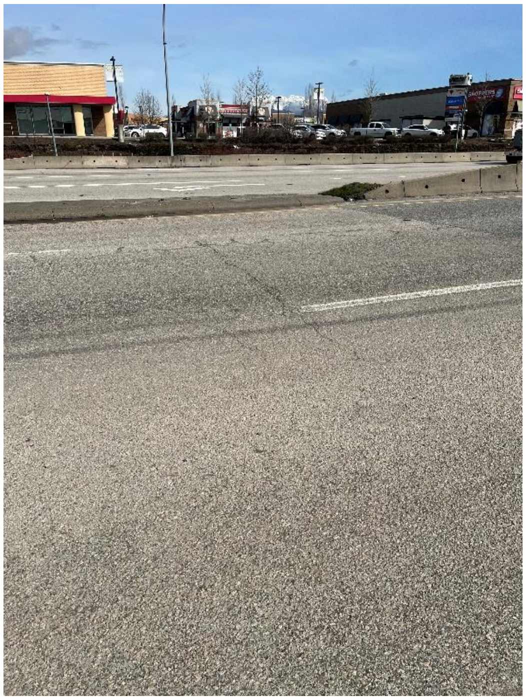


Photo 2: Moderate to Low Severity Traverse Cracking Near Sta. 100+90 (EB Hwy 7)

Photo 3: Low Severity Traverse Cracking Near Sta. 101+00 (Eastbound Hwy 7)

Photo 4: Moderate to High Severity Raveling at EB Turn Lane (NB Sherling Ave)

APPENDIX D

Test Hole Logs and Laboratory Results

BRITISH COLUMBIA Ministry of Transportation and Infrastructure

SUMMARY LOG

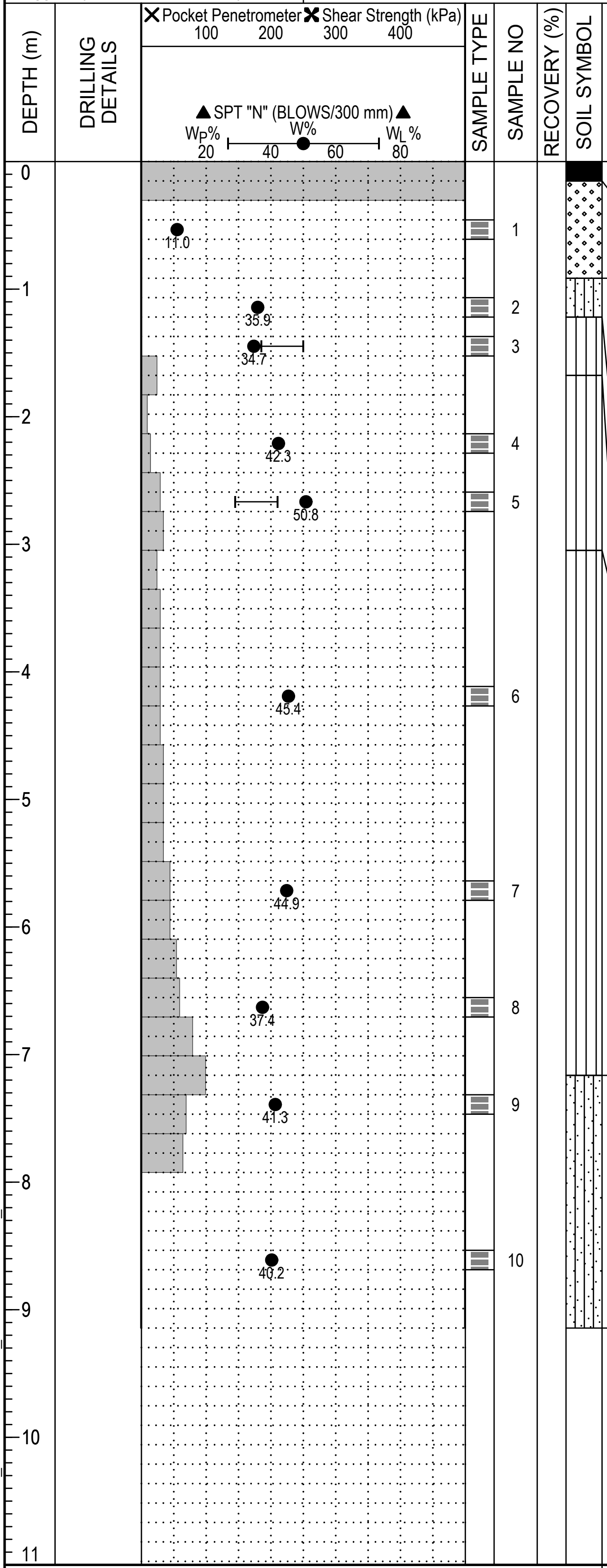
Drill Hole #: **AH24-01**

Prepared by: 43376
Thurber Engineering Ltd.

Logged by: DPN Reviewed by: GGM

Project: **Hwy 7 EB / Sherling Ave. Bus Stop**
Location: Port Coquitlam, BC
Datum: NAD83-UTM
Northing/Easting: 5455606.8 , 518797.1
Elevation:
Alignment:
Station/Offset:
Coordinates taken with GPS

Date(s) Drilled: January 30, 2024
Company: Southland Drilling / Schwartz
Driller:
Drill Make/Model:
Drilling Method: Auger/SCPT/DCPT



SOIL DESCRIPTION

ASPHALT (150 mm thick). — 0.15m

SW - gravelly SAND, silty, trace fibrous organics; medium to fine sand, sub-angular gravel, brown-grey, moist. — 0.91m

SM/OL - SAND and SILT, some gravel, some fibrous organics, trace organic silt, trace clay; medium to coarse sand, sub-angular gravel, grey-brown, moist, firm. — 1.22m

ML/OL - SILT, sandy, trace to some peat, trace to some organic silt, trace clay; fine to coarse sand, brown-grey, moist to wet, soft to firm. — 1.68m

OL/OH - SILT, sandy, trace to some peat, trace to some organic silt, trace clay; fine to coarse sand, brown-grey, moist to wet, soft to firm. — 3.05m

ML/OL - SILT, some sand, trace clay, trace fibrous organics; fine to coarse sand, brown-grey, moist to wet, firm.

- stiff below 6.1 m depth. — 7.16m

SW/ML - SAND and SILT, trace clay; fine to coarse sand, brown-grey, wet, stiff.

- SILT pocket between 8.5 m and 8.7 m depth. — 9.14m

End of hole at required depth.
Hole open to 4.6 m depth.
Water observed at 2.3 m depth upon completion of drilling.
Hole backfilled with drill cuttings and patched cold mix asphalt.

SAMPLE NO	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*
1	SM	**Sieve** (Sa#1) G:46% S:28% F:26%
2	SM/OL	
3	OL/ML	**Atterberg** (Sa#3): PL:37% LL:50%
4	ML/OL	
5	OL/OH	**Atterberg** (Sa#5): PL:29% LL:42%
6	OH/OL	
7	ML/OL	
8	OL/ML	
9	SM/ML	
10	OL/SM	**Sieve** (Sa#10) G:- S:-, F:43%

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:

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

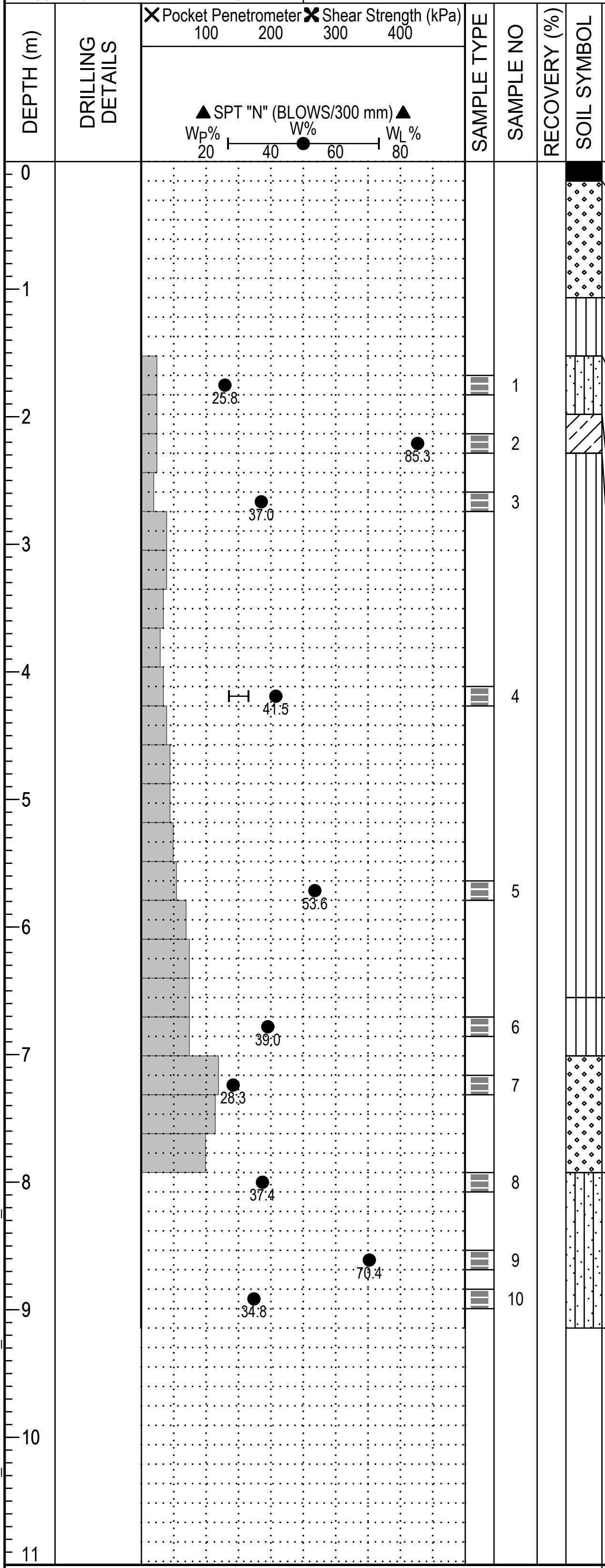
SUMMARY LOG

Drill Hole #: **AH24-02**

Prepared by: 43376
Thurber Engineering Ltd.
Logged by: DPN Reviewed by: GGM

Project: **Hwy 7 EB / Sherling Ave. Bus Stop**
Location: Port Coquitlam, BC
Datum: NAD83-UTM
Northing/Easting: 5455589.4 , 518826.7
Elevation:
Alignment:
Station/Offset:
Coordinates taken with GPS

Date(s) Drilled: January 30, 2024
Company: Southland Drilling / Schwartz
Driller:
Drill Make/Model:
Drilling Method: Auger/SCPT/DCPT



SAMPLE NO	W%	CLASSIFICATION	COMMENTS TESTING Drillers Estimate *{G % S % F %}*
1	25.8	SM/ML	
2	85.3	OH	
3	37.0	ML/OL	
4	41.5	ML/OL	**Atterberg** (Sa#4): PL:27% LL:33%
5	53.6	OH	
6	39.0	ML	
7	28.3	SM	**Sieve** (Sa#7) G:- S:-, F:28%
8	37.4	ML	
9	70.4	OH	
10	34.8	ML	

SOIL DESCRIPTION

ASPHALT (150 mm thick). — 0.15m

SW - SAND, gravelly, some silt to silty, trace fibrous organics; medium to fine sand, sub-angular gravel, brown-grey, moist. — 1.07m

ML/OL - SILT, some peat, some fibrous organics, some organic silt, trace sand; fine sand, brown, moist, soft. — 1.52m

SM/ML - SAND and SILT, trace to some clay, trace organic silt, trace gravel; medium to fine sand, sub-angular to sub-rounded gravel, grey-brown, moist to wet, firm. — 1.98m

OH - SILT, some clay to clayey, some organic silt, some fibrous organics; dark brown, moist, firm. — 2.29m

ML/OL - SILT, some fibrous organics, trace to some clay, trace to some sand; fine sand, grey, moist to wet, soft.
- firm below 3.0 m depth.

- stiff below 4.6 m depth

— 6.55m

ML - SILT, trace sand, trace clay; fine sand, grey, moist to wet, stiff. — 7.01m

SW - SAND, some silt; fine to medium sand, grey, wet, compact. — 7.92m

ML - SILT, sandy to SILT and SAND; fine to coarse sand, brown-grey, wet, stiff to very stiff.

- zone of volcanic ash between 8.5 m and 8.7 m depth.

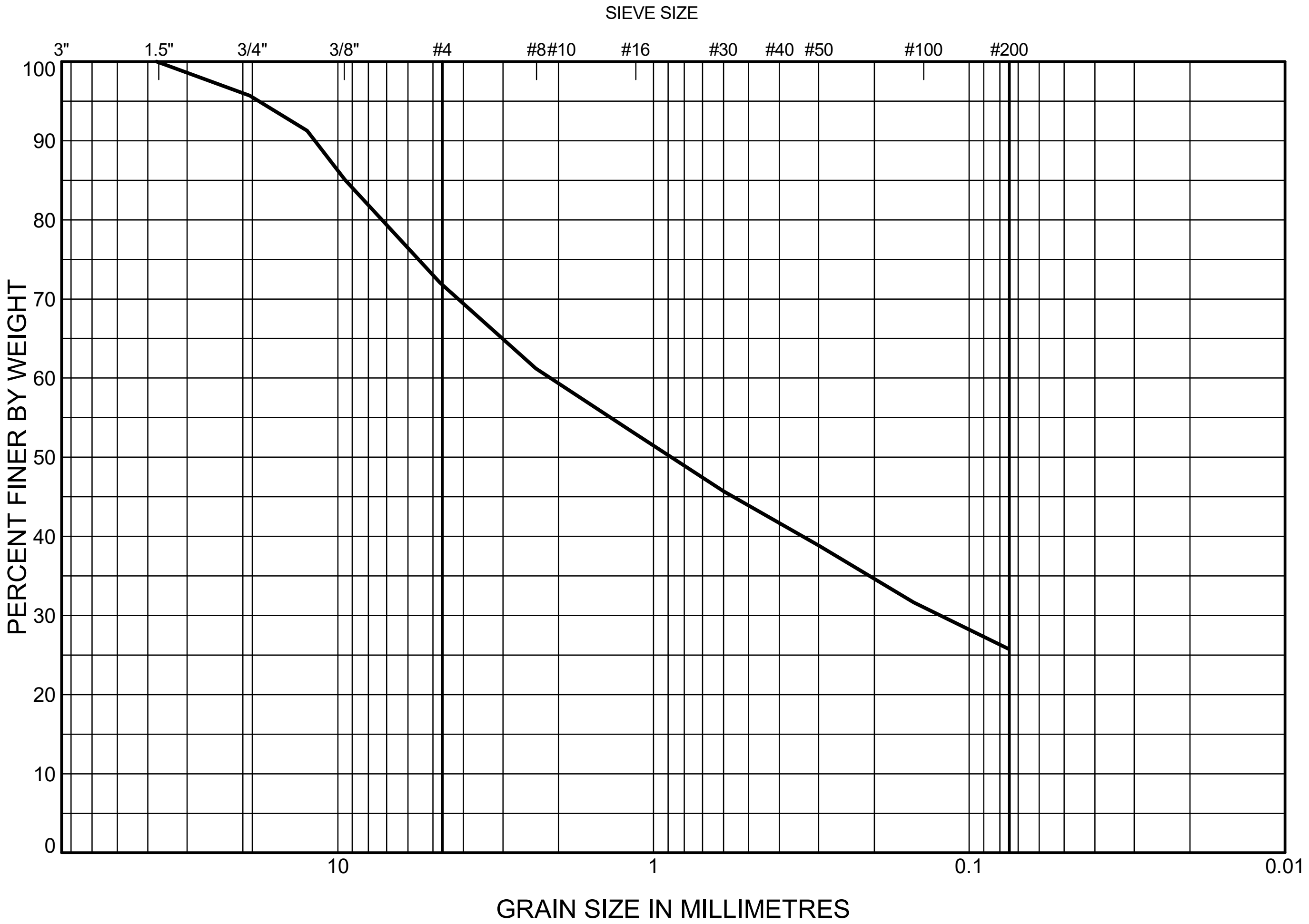
— 9.14m

End of hole at required depth.
Hole open to 4.3 m depth.
Water observed at 2.1 m depth upon completion of drilling.
Hole backfilled with drill cuttings and patched cold mix asphalt.

Final Depth of Hole: 9.1 m
Depth to Top of Rock:

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



GRAVEL		SAND			SILT
coarse	fine	coarse	medium	fine	

Sample Location: **AH24-01**
Sample: 1
Sample Depth: 0.46 - 0.61 m
Date Sampled: January 30, 2024
Sampled By: DPN
Date Received: February 5, 2024
Date Tested: March 27, 2024
Tested By: KM
Test Method: ASTM C136 and C117
Specification:

Gravel	**27.9%**
Sand	**46.3%**
Fines	**25.8%**
Moisture Content	**11.0%**

D10	
D30	**0.123**
D60	**2.124**
Cu	
Cc	

Sieve Size		Percent Passing
inches	mm	
3	75	
1.5	37.5	**100.0**
0.75	19	**95.7**
0.375	9.5	**85.1**
#4	4.75	**72.1**
#8	2.36	**61.2**
#16	1.18	**53.3**
#30	0.6	**45.7**
#50	0.3	**38.9**
#100	0.15	**31.7**
#200	0.075	**25.8**

Description: Silty, gravelly SAND (SM).

Comments:

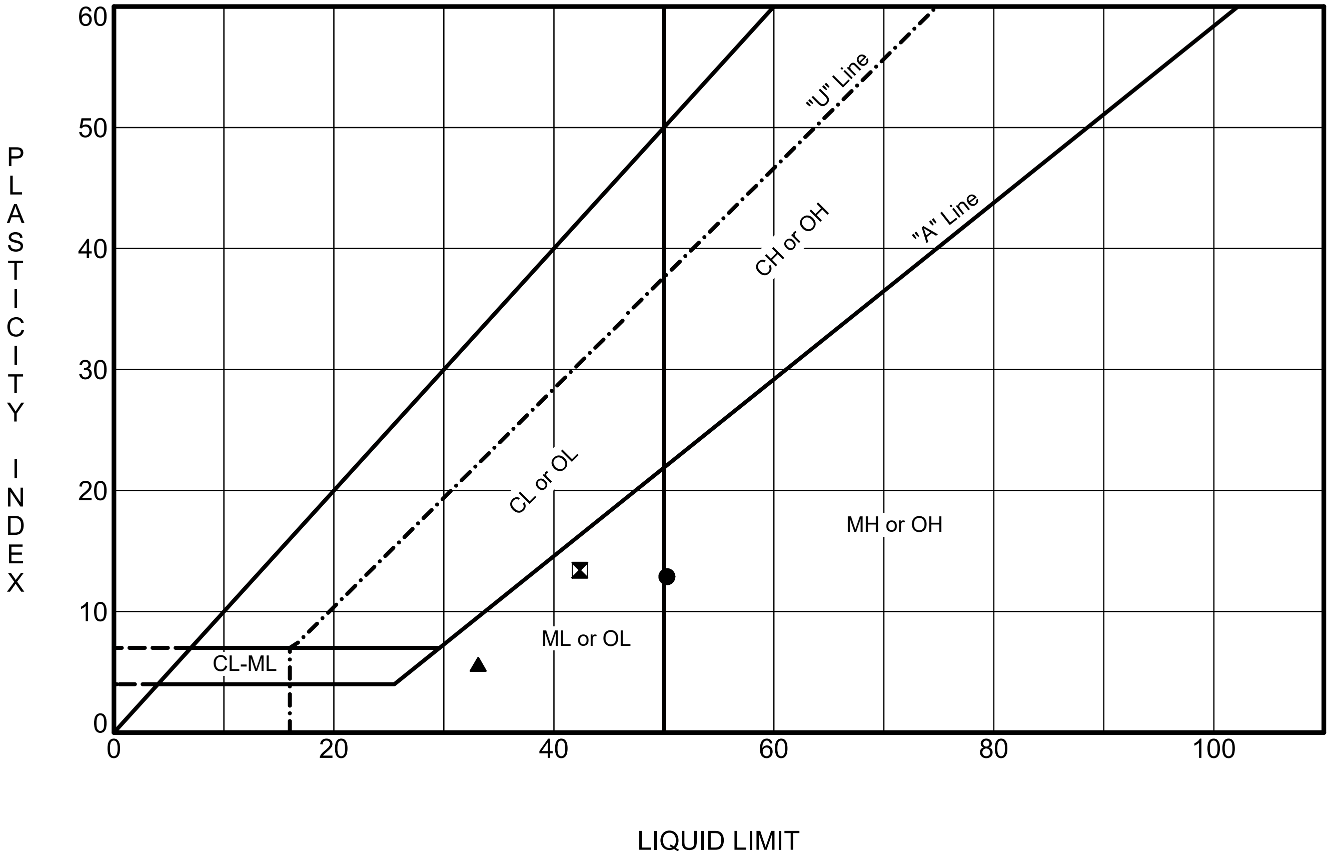
THURBER

Thurber Engineering Ltd.
#900 - 1281 West Georgia Street
Vancouver, BC V6E 3J7
Telephone: (604) 684-4384
Fax: (604) 684-5124

GRAIN SIZE DISTRIBUTION

CLIENT: Urban Systems Ltd.
PROJECT: Hwy 7 EB / Sherling Ave. Bus Stop

FILE NO.: 43376



	Specimen Identification		LL	PL	PI	MC%	USCS Classification
●	**AH24-01, Sa. 3**	**1.4 m**	**50**	**37**	**13**	**34.7**	**OL/ML**
☒	**AH24-01, Sa. 5**	**2.6 m**	**42**	**29**	**13**	**50.8**	**OL/OH**
▲	**AH24-02, Sa. 4**	**4.1 m**	**33**	**27**	**6**	**41.5**	**ML/OL**

THURBER ENGINEERING LTD.

PLASTICITY CHART

CLIENT: Urban Systems Ltd.

PROJECT: Hwy 7 EB / Sherling Ave. Bus Stop

FILE NO.: 43376

ATTERBERG LIMITS 43376.GPJ THURBER BC -2017.GDT 24-3-28- THURBER - BC OPERATIONS_2024.GLB

APPENDIX E

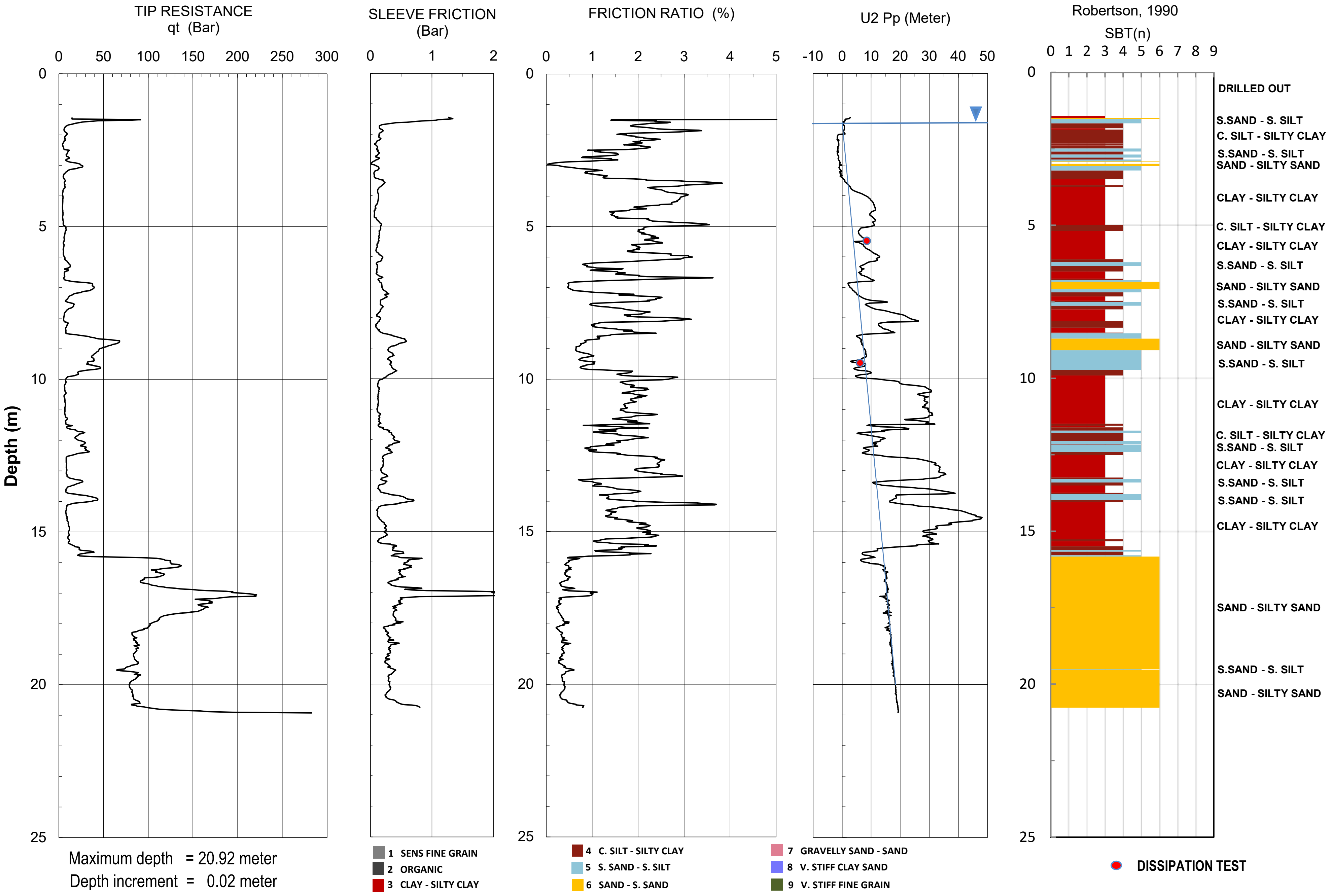
SCPT Profile and Shear Wave Velocity Measurements

Thurber Engineering

Operator: Schwartz Soil Technical
Sounding: SCPT24 - 01
Cone ID: DPG1428

Date: Jan 30, 2024
Site: Hwy 7 / Sherling Ave
Thurber project no: 43376

Schwartz SOIL TECH



Maximum depth = 20.92 meter
Depth increment = 0.02 meter

Schwartz
SOIL TECH

SHEAR WAVE VELOCITY DATA

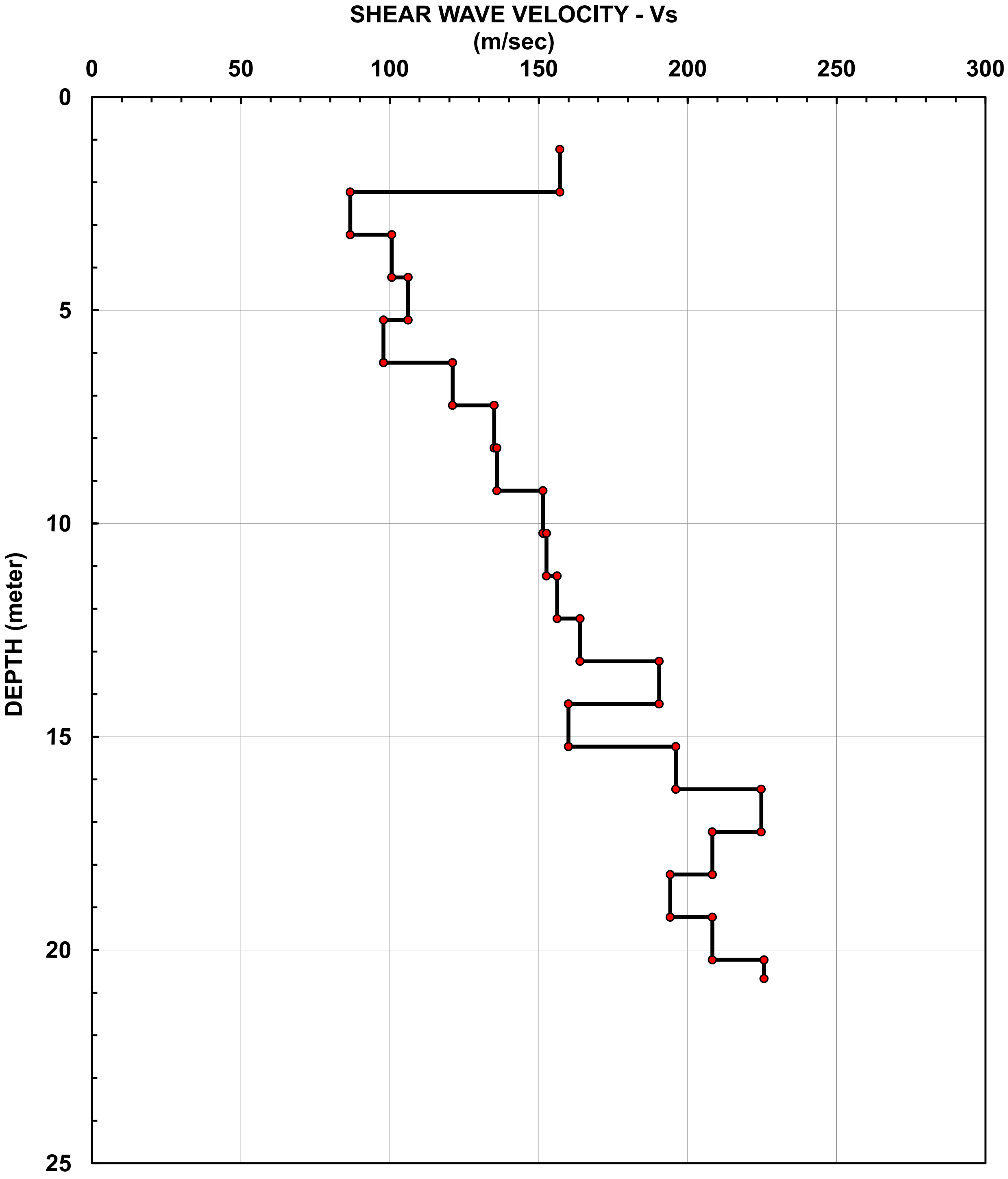
Client: Thurber Engineering
Test: SCPT24 - 01
Site: Hwy 7 / Sherling Ave
Port Coquitlam, BC

Date: Jan 30, 2024
Cone ID: 1428
Source offset: 0.32 m
Source: Impact Brackets

Cone tip Depth (m)	Geophone Depth (m)	Wave Path Length (m)	Wave Path Interval (m)	Wave Travel Time interval (ms)	Interval Velocity (m/sec)
1.48	1.23	1.27			
			0.98	6.25	157
2.48	2.23	2.25			
			0.99	11.45	87
3.48	3.23	3.25			
			1.00	9.90	101
4.48	4.23	4.24			
			1.00	9.40	106
5.48	5.23	5.24			
			1.00	10.20	98
6.48	6.23	6.24			
			1.00	8.25	121
7.48	7.23	7.24			
			1.00	7.40	135
8.48	8.23	8.24			
			1.00	7.35	136
9.48	9.23	9.24			
			1.00	6.60	151
10.48	10.23	10.24			
			1.00	6.55	153
11.48	11.23	11.23			
			1.00	6.40	156
12.48	12.23	12.23			
			1.00	6.10	164
13.48	13.23	13.23			
			1.00	5.25	190
14.48	14.23	14.23			
			1.00	6.25	160
15.48	15.23	15.23			
			1.00	5.10	196
16.48	16.23	16.23			
			1.00	4.45	225
17.48	17.23	17.23			
			1.00	4.80	208
18.48	18.23	18.23			
			1.00	5.15	194
19.48	19.23	19.23			
			1.00	4.80	208
20.48	20.23	20.23			
			0.44	1.95	226
20.92	20.67	20.67			

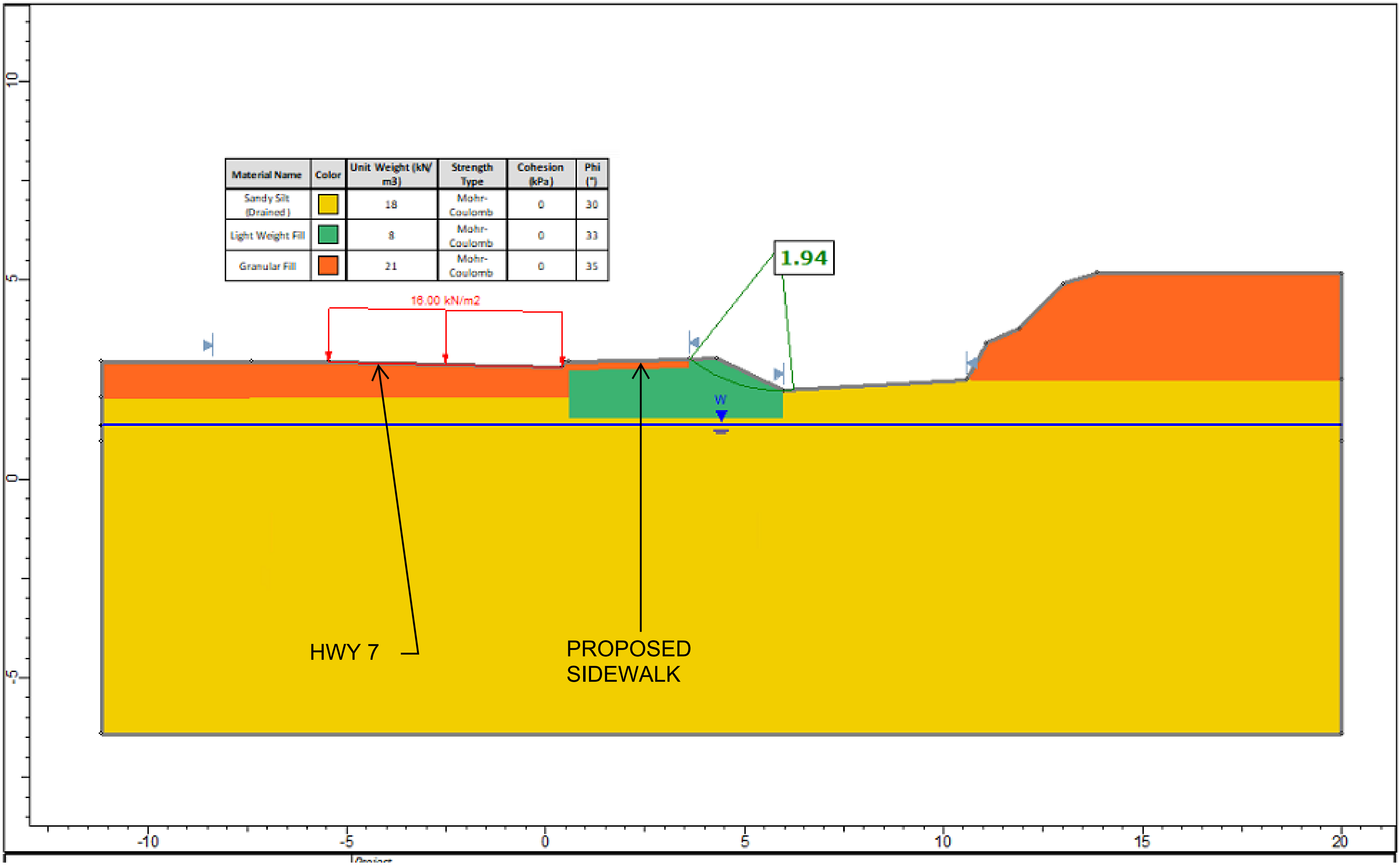
SHEAR WAVE VELOCITY PROFILE

Client:	**Thurber Engineering**	**Date:**	**Jan 30, 2024**
Test:	**SCPT24 - 01**	**Cone ID:**	**1428**
Site:	**Hwy 7 / Sherling Avenue**	**Source offset:**	**0.32 m**
	Port Coquitlam, BC	**Source:**	**Impact Brackets**



APPENDIX F

Representative Slope Stability Figures



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Sandy Silt (Drained)	🟨	18	Mohr-Coulomb	0	30
Light Weight Fill	🟩	8	Mohr-Coulomb	0	33
Granular Fill	🟧	21	Mohr-Coulomb	0	35

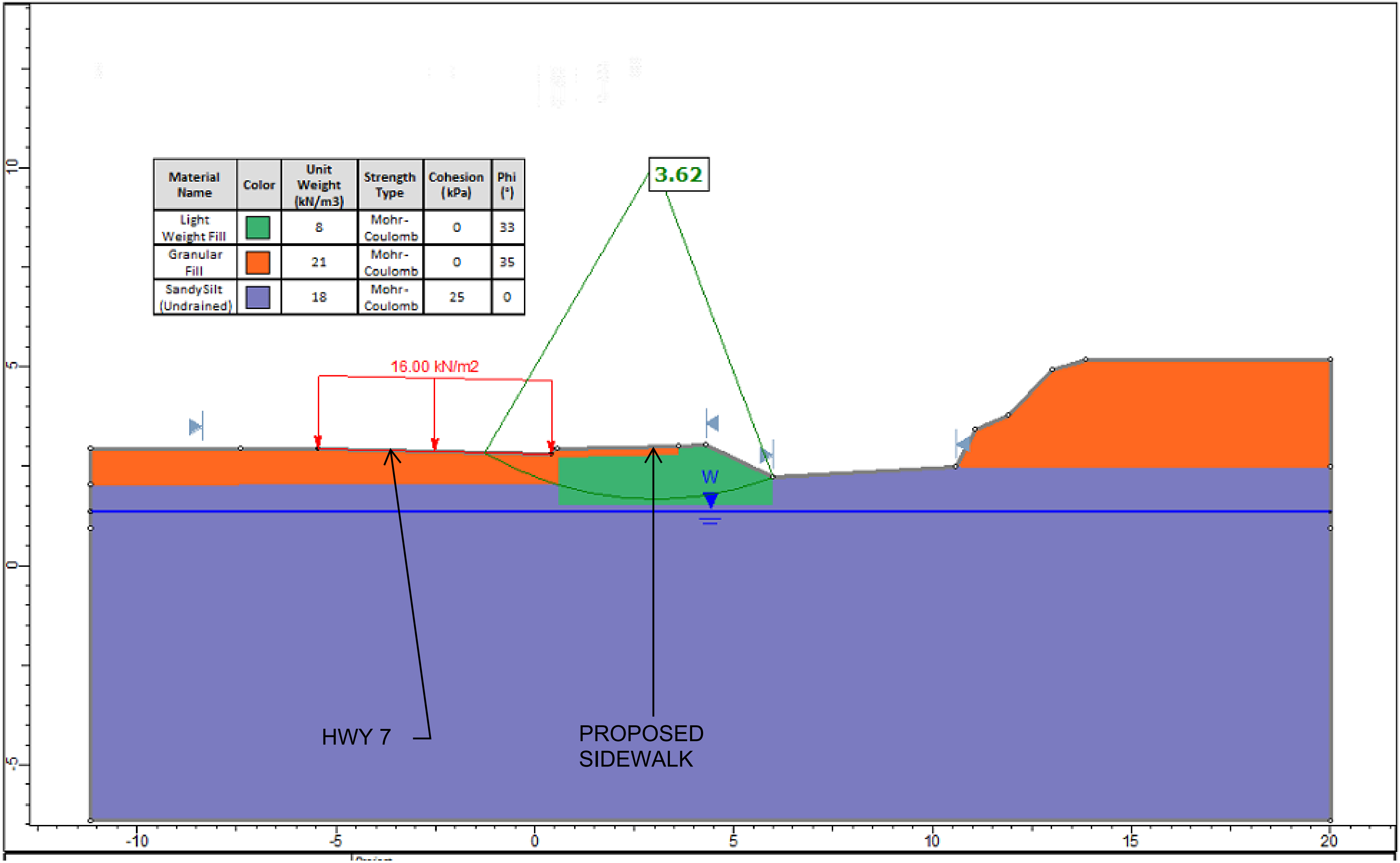
LEGEND / NOTES

ALL DIMENSIONS ARE IN METRES

ANALYSIS SHOWS LONG-TERM DRAINED CONDITIONS

THURBER

CLIENT NAME	URBAN SYSTEMS LTD
DRAWING TITLE	STATIC STABILITY (DRAINED) - STA. 1+80
PROJECT NAME AND LOCATION	HIGHWAY 7 AND SHERLING AVENUE BUS STOP PORT COQUITLAM, BC
DRAWN BY	GGM
DATE	2024-04-02
DESIGNED BY	GGM
SCALE	-
APPROVED BY	JSP
PROJECT No.	43376
DRAWING / FIGURE No.	F1
REV.	0



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Light Weight Fill	🟩	8	Mohr-Coulomb	0	33
Granular Fill	🟧	21	Mohr-Coulomb	0	35
SandySilt (Undrained)	🟪	18	Mohr-Coulomb	25	0

LEGEND / NOTES

ALL DIMENSIONS ARE IN METRES

THURBER

CLIENT NAME
URBAN SYSTEMS LTD

DRAWING TITLE
STATIC STABILITY (UNDRAINED) - STA. 1+80

PROJECT NAME AND LOCATION
HIGHWAY 7 AND SHERLING AVENUE BUS STOP
PORT COQUITLAM, BC

DRAWN BY
GGM

DATE
2024-04-02

DESIGNED BY
GGM

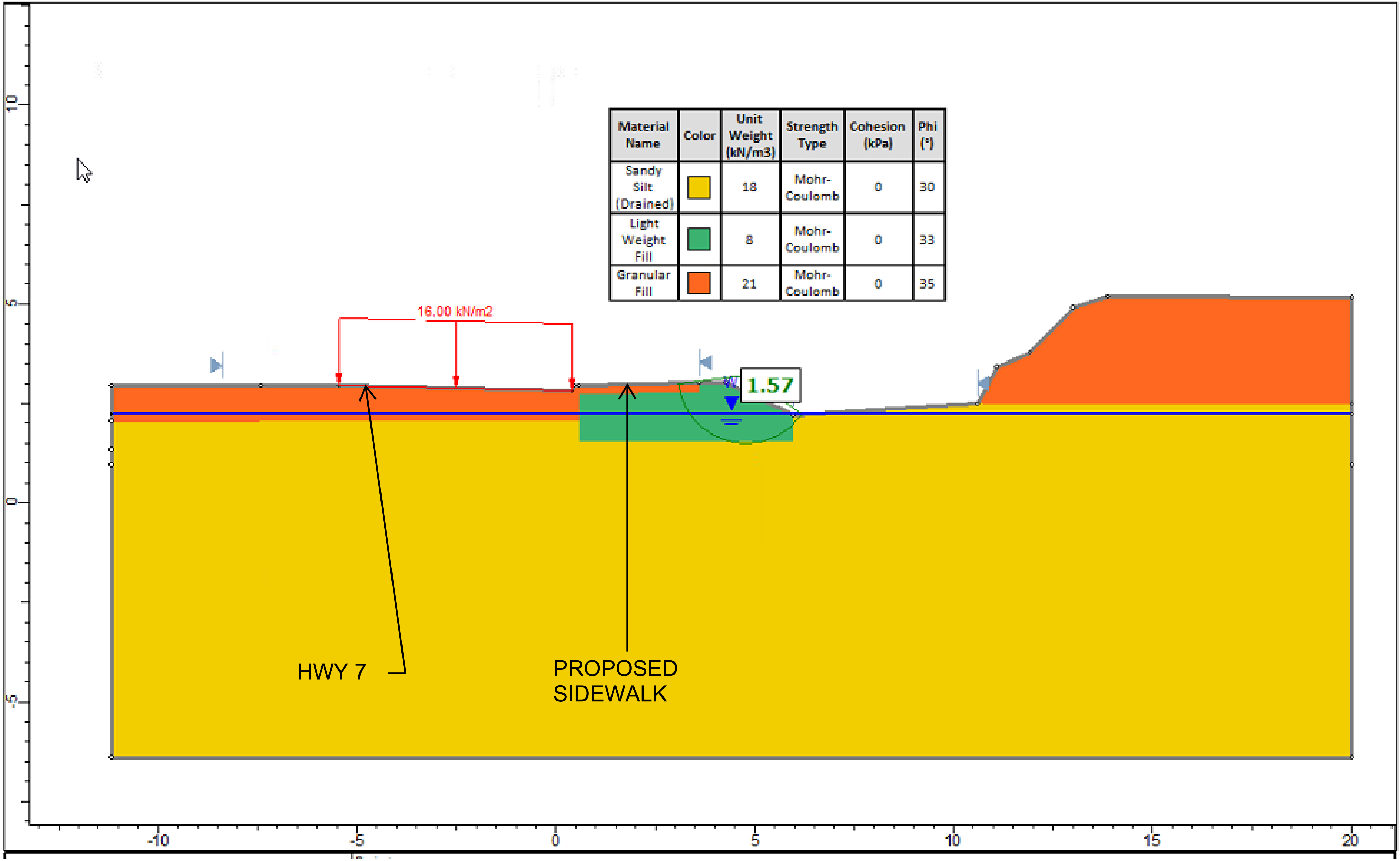
SCALE
-

APPROVED BY
JSP

PROJECT No.
43376

DRAWING / FIGURE No.
F2

REV.
0



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Sandy Silt (Drained)	🟨	18	Mohr-Coulomb	0	30
Light Weight Fill	🟩	8	Mohr-Coulomb	0	33
Granular Fill	🟧	21	Mohr-Coulomb	0	35

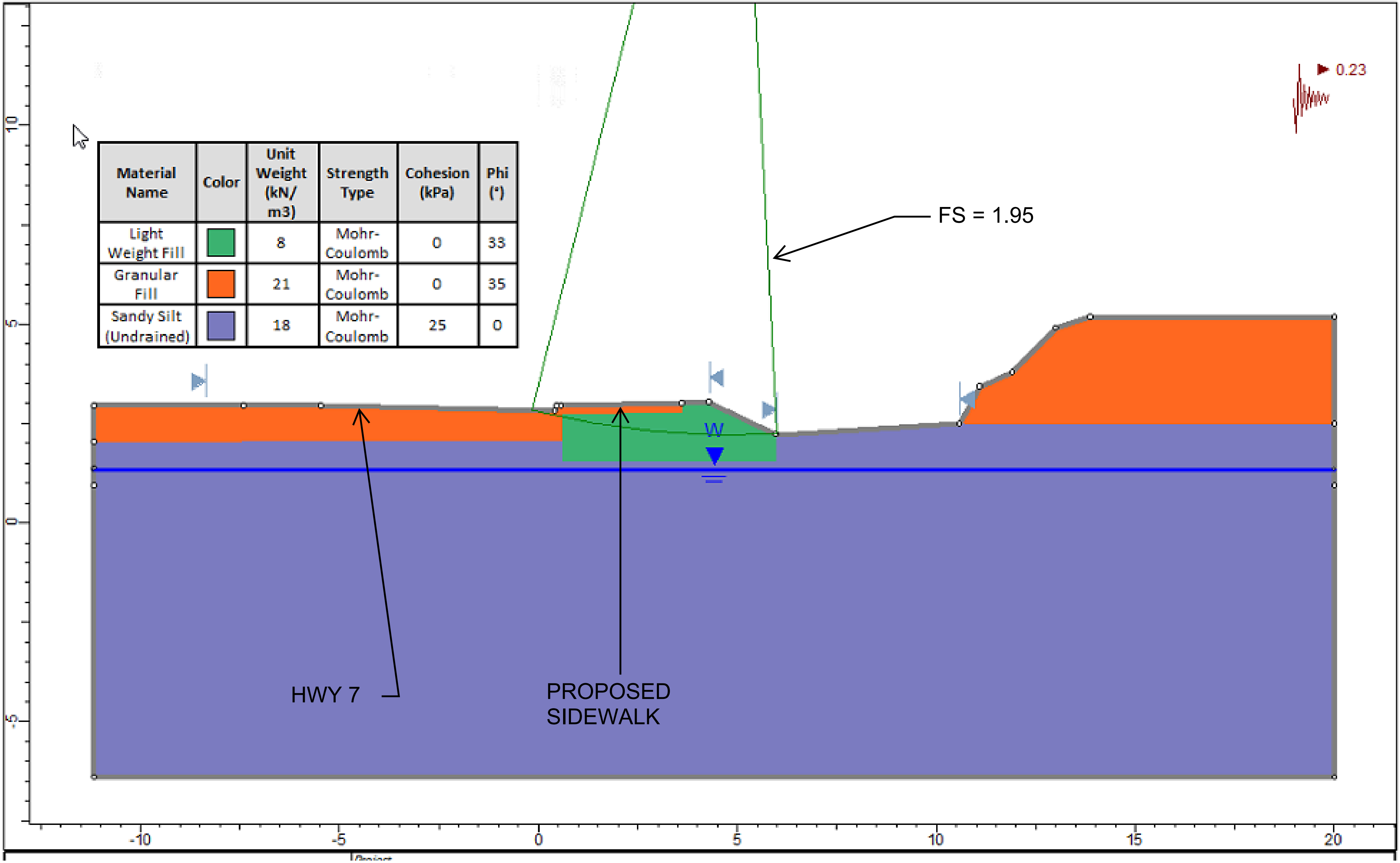
LEGEND / NOTES

ALL DIMENSIONS ARE IN METRES

ANALYSIS SHOWS LONG-TERM DRAINED CONDITIONS

THURBER

CLIENT NAME URBAN SYSTEMS LTD		DRAWN BY GGM	DATE 2024-04-02
DRAWING TITLE STATIC STABILITY - RAISED WATER TABLE (DRAINED) - STA. 1+80		DESIGNED BY GGM	SCALE -
PROJECT NAME AND LOCATION HIGHWAY 7 AND SHERLING AVENUE BUS STOP PORT COQUITLAM, BC		APPROVED BY JSP	PROJECT No. 43376
		DRAWING / FIGURE No. F3	REV. 0



Material Name	Color	Unit Weight (kN/ m3)	Strength Type	Cohesion (kPa)	Phi (°)
Light Weight Fill	🟩	8	Mohr-Coulomb	0	33
Granular Fill	🟧	21	Mohr-Coulomb	0	35
Sandy Silt (Undrained)	🟪	18	Mohr-Coulomb	25	0

LEGEND / NOTES

ALL DIMENSIONS ARE IN METRES

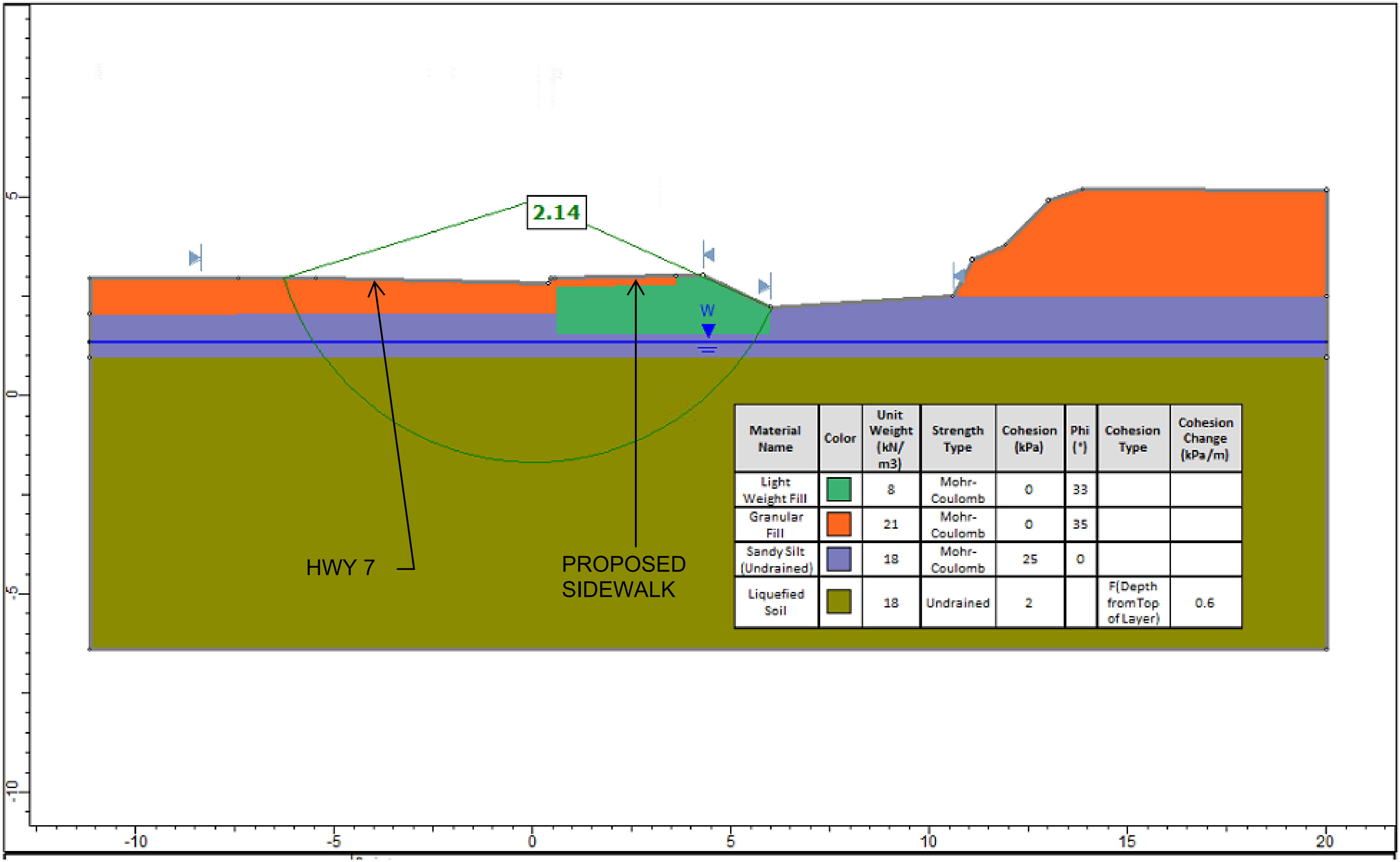
THURBER

CLIENT NAME
URBAN SYSTEMS LTD

DRAWING TITLE
PSEUDO-STATIC STABILITY (475 YEAR) - STA. 1+80

PROJECT NAME AND LOCATION
HIGHWAY 7 AND SHERLING AVENUE BUS STOP
PORT COQUITLAM, BC

DRAWN BY	GGM	DATE	2024-04-02
DESIGNED BY	GGM	SCALE	-
APPROVED BY	JSP	PROJECT No.	43376
DRAWING / FIGURE No.	F4	REV.	0



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Cohesion Change (kPa/m)
Light Weight Fill	🟩	8	Mohr-Coulomb	0	33		
Granular Fill	🟧	21	Mohr-Coulomb	0	35		
Sandy Silt (Undrained)	🟪	18	Mohr-Coulomb	25	0		
Liquefied Soil	🟫	18	Undrained	2		F(Depth from Top of Layer)	0.6

LEGEND / NOTES

ALL DIMENSIONS ARE IN METRES

THURBER

CLIENT NAME
URBAN SYSTEMS LTD

DRAWING TITLE
FLOW SLIDE STABILITY - STA. 1+80

PROJECT NAME AND LOCATION
HIGHWAY 7 AND SHERLING AVENUE BUS STOP
PORT COQUITLAM, BC

DRAWN BY
GGM

DATE
2024-04-02

DESIGNED BY
GGM

SCALE
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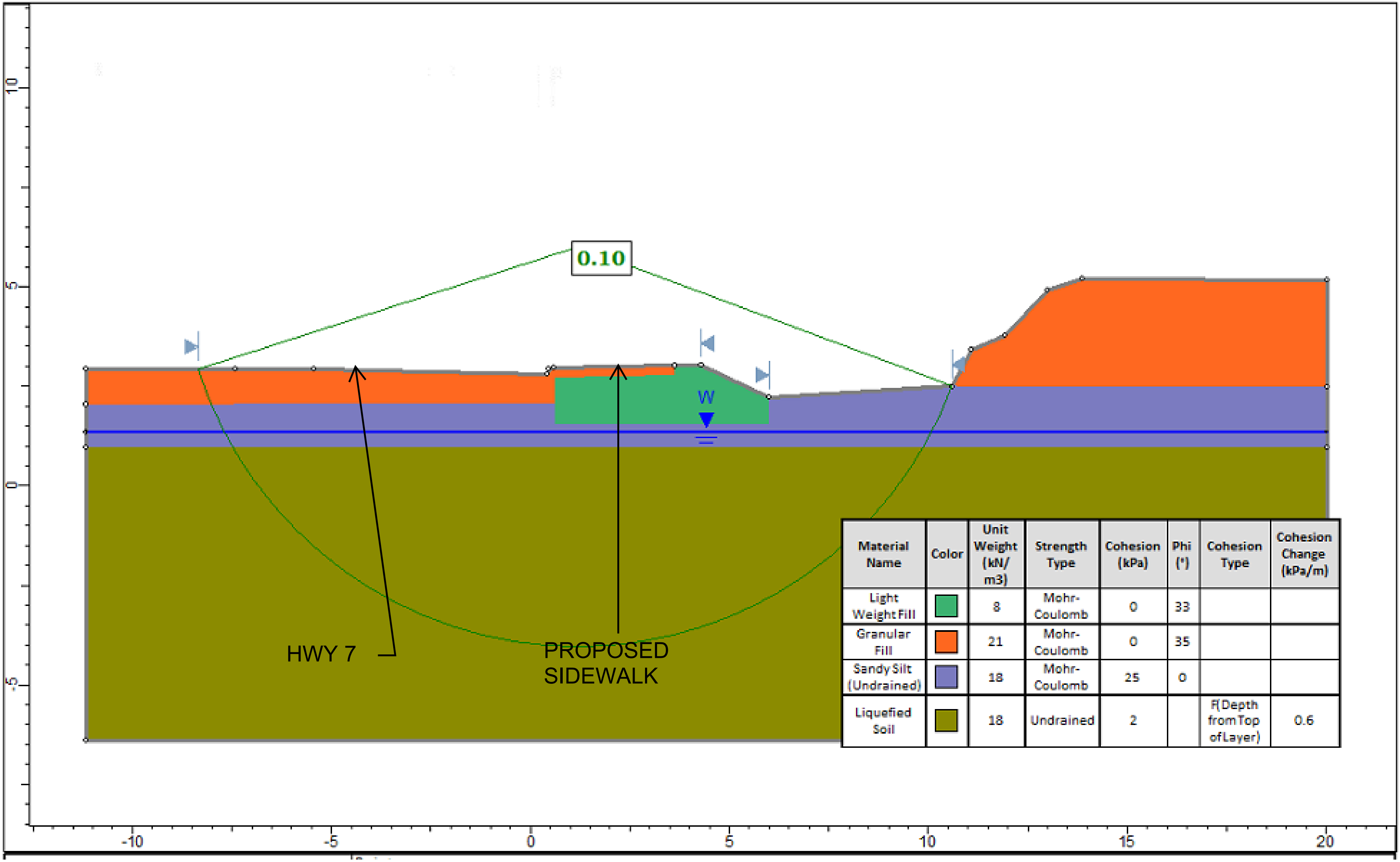
JSP

PROJECT No.
43376

DRAWING / FIGURE No.
F5

REV.
0



Material Name	Color	Unit Weight (kN/ m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Cohesion Change (kPa/m)
Light Weight Fill	🟩	8	Mohr-Coulomb	0	33		
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Liquefied Soil	🟫	18	Undrained	2		F(Depth from Top of Layer)	0.6

LEGEND / NOTES

ALL DIMENSIONS ARE IN METRES

THURBER

CLIENT NAME
URBAN SYSTEMS LTD

DRAWING TITLE
SEISMIC YIELD ACCELERATION - STA. 1+80

PROJECT NAME AND LOCATION
HIGHWAY 7 AND SHERLING AVENUE BUS STOP
PORT COQUITLAM, BC

DRAWN BY
GGM

DATE
2024-04-02

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GGM

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JSP

PROJECT No.
43376

DRAWING / FIGURE No.
F6

REV.
0