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Foundation Investigation and Design Report

White River Maintenance Patrol Yard
White River, Ontario
Agreement No. 5022-E-0037
G.W.P. 5298-19-00

Latitude: 48.593166°, Longitude: -85.270227°

GEOCRES No. 42C11-004

Client Name: Egis Canada Ltd.
Date: March 17, 2025
File: 37466-10

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PART A – FACTUAL INFORMATION

1. INTRODUCTION

This report presents the data obtained from a foundation investigation carried out by Thurber Engineering Ltd (Thurber) at the existing White River Maintenance Patrol Yard in White River, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the proposed maintenance patrol yard and, based on the data obtained, to provide a borehole location plan, record of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber carried out the investigation as a subconsultant to Egis Canada Limited (Egis), under the Ministry of Transportation, Ontario (MTO) Assignment No. 5022-E-0037.

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. SITE DESCRIPTION

The existing maintenance patrol yard is located northeast of the intersection of Highway 17 and Highway 631 in White River, Ontario. In general, the area surrounding the site are undeveloped public lands except for the residential and commercial developments to the north and southwest. An Ontario Province Police detachment immediately southwest of the site.

The ground surface across the site is level, varying between Elev. 381.0 m and 380.0 m, and is higher than the surrounding areas.

3. INVESTIGATION PROCEDURES

The foundation investigation was carried out between July 4 and 7, 2024, consisting of nine boreholes. Photographs taken of the site at the time of the investigation are included in Appendix A.

The borehole locations and elevations were measured relative to identifiable site features and superimposed on the base plan/contour plan provided by Egis. In accordance with the requirements for surveying of foundation boreholes, the survey readings have a vertical and horizontal accuracy of 0.1 m and 0.5 m, respectively. The locations of the boreholes as presented on Drawing 1, and Record of Borehole sheets in Appendix B, are positioned relative to coordinate system MTM NAD 83, Zone 13. The geographic coordinates, ground surface elevations and depths of boreholes prior to termination is summarized in Table 3.1.

Table 3.1: Borehole Details

Borehole	MTM Northing (Latitude, º)	MTM Easting (Longitude, º)	Ground Surface Elevation (m)	Depth of Borehole / DCPT (m)
WR-01	5,384,674.9 (48.593602)	211,077.16 (-85.270695)	380.8	9.5 / --
WR-02	5,384,654.16 (48.593422)	211,123.86 (-85.270058)	380.8	9.8 / --
WR-03	5,384,635.29 (48.593259)	211,166.36 (-85.269477)	381.1	11.3 / 18.3
WR-04	5,384,640.7 (48.593292)	211,061.97 (-85.270894)	381.1	7.8 / --
WR-05	5,384,625.94 (48.593166)	211,110.91 (-85.270227)	380.9	9.8 / --
WR-06	5,384,608.31 (48.592999)	211,049.22 (-85.271059)	380.6	5.6 / --
WR-07	5,384,595.14 (48.592888)	211,103.07 (-85.270326)	380.7	9.3 / --
WR-08	5,384,571.26 (48.592679)	211,137.01 (-85.269861)	380.9	11.3 / 15.4

Boreholes were advanced using a track-mounted CME-55 LC drill rig, which was supplied and operated by Eastern Ontario Diamond Drilling of Hawkesbury, Ontario, using 200 mm outside diameter hollow stem augers and NQ coring. Soil samples were obtained at selected intervals using a split-spoon sampler driven by automatic hammers in general accordance with ASTM D1586[1] Standard Penetration Testing (SPT) procedures. The maximum particle size that can be sampled from the standard split-spoon sampler used in the investigation is limited to 35 mm and therefore, particles that may exist within the soils larger than this dimension would not be recovered or represented in the grain size analyses.

Monitoring wells were installed in Boreholes WR03, WR05, and WR06. Each well consists of a 32 mm inside diameter Schedule 40 PVC pipe with a 3.0 m long slotted screen, enclosed in a column of filtered sand to permit the monitoring of groundwater levels. The bottom of each well was sealed with a well cap. Well installation details, and groundwater level readings are shown on the Record of Borehole sheets.

All boreholes and monitoring wells were abandoned in accordance with O.Reg. 903 (as amended) by backfilling the boreholes with bentonite pellets upon completion of drilling or prior to demobilization from site.

The investigation was supervised by a member of Thurber's technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling, and in situ testing operations, logged the boreholes, and examined and cared for the soil samples. Samples identified in the field were then placed in appropriate containers, labelled, and

[1] ASTM D1586 Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of Soils.

transported to Thurber's geotechnical laboratory where the samples underwent further visual examination.

Select soil samples were subjected to laboratory index and chemical testing in accordance with MTO or ASTM standards, as appropriate.

4. SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

Based on geology terrain and bedrock geology mapping from the Northern Ontario Engineering Geology Terrain (NOEGTS)[2] and Ministry of Northern Development and Mines (MNDM)[3], the site is located within an outwash plain / esker complex / crevasse filling comprised stratified layers of sands and gravels which is underlain by bedrock consists of gneissic tonalite suite ranging from tonalite to granodiorite, foliated to gneissic, with minor supracrustal inclusions. In general, the outwash plain / esker complex / crevasse filling is oriented northeast to southwest.

4.2 General Description of Subsurface Conditions

Details of the soil stratigraphy as encountered during the foundation investigation are presented on Drawing 2 and Record of Borehole sheets in Appendix B. A summary of the stratigraphy is given in the following sections; however, the data presented on the Record of Borehole sheets takes precedence over the summary of the subsurface conditions. In accordance with MTO's Guideline for Foundation Engineering Services[4], descriptions for coarse-grained soils are based on Unified Soil Classification System specified in ASTM D2487[5] while fine-grained soils are described as specified in MTO's Soil Classification Manual.

The results of in-situ testing as presented on the Record of Boreholes sheets and in the following sections are uncorrected. The boundaries between soil deposits on the record of boreholes have been inferred from non-continuous sampling, observation of the progress of drilling, and the results of standard penetration testing. Therefore, the boundaries represent the transitions between soil deposits rather than exact planes of geological change. Variation in the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

In general, the subsurface conditions consist of a layer of sand to sandy silt fill, underlain by a native deposit of sand to silt with sand, over a layer of gravels, cobbles, and boulders.

[2] Ontario Geological Survey. Geology Terrain (NOEGTS). MRD160.
[3] Ontario Geological Survey. 1:250,00 Scale Bedrock Geology of Ontario. MRD126-REV.
[4] MTO's Guideline for Foundation Engineering Services (version 3.0), dated April 2022.
[5] ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

4.3 Asphalt

An asphalt layer was encountered at ground surface with a recorded thickness of 90 mm and 75 mm at Boreholes WR-05 and WR-07, respectively.

It should be noted that a pavement structure is present in the interior of the site; however, boreholes advanced at the perimeter of the site, including Boreholes WR-01 to WR-04, WR-06, WR-08, and WR-09, did not encounter an asphalt layer at ground surface.

4.4 Sand to Sandy Silt Fill

Granular fill consisting of sand, sand with silt and gravel, and sandy silt was encountered at ground surface or beneath the asphalt at all borehole locations. It is noted that organics were presented in the cohesionless fill in Borehole WR-02. In addition, the 100 mm thick silty sand with gravel fill underlying the asphalt layer in Borehole WR-07 contains pieces of asphalt.

In general, the fill extends to depths of 0.2 m to 0.7 m below ground surface (Elev. 380.7 m to 379.9 m); however, at Boreholes WR-02, WR-03 and WR-08 (located on the north and east edge of the site), the fill extends to depths of 3.7 m to 3.9 m below ground surface (Elev. 377.2 m to 376.2 m).

Measured SPT N-values in the sand to sandy silt fill ranged from weight of hammer (0 blows) to 19 blows per 0.3 m penetration, indicating a very loose to compact condition.

The moisture contents of the fill ranged from 2% to 19%. The results of grain size distribution testing carried out on samples of the fill are presented in Figure C1 in Appendix C and are summarized in Table 4.1.

Table 4.1: Grain Size Distribution of Sand to Silty Sand Fill

Soil Particle	Percentage (%)
Gravel	0 – 17
Sand	74 – 88
Fines	4 – 12
Silt	13
Clay	1

4.5 Sand to Silt with Sand

A heterogeneous deposit comprised of sand, sand with silt and gravel, silty sand, sandy silt, and silt with sand was encountered underlying the sand to sandy silt fill in all boreholes, which extends to depths of 2.4 m to 11.3 m below ground surface (Elev. 378.2 m to 369.6 m). Rock fragments were recovered in samples of this deposit in Boreholes WR-03, WR-04, and WR-07 are primarily

at the base of the deposit where it transitions into the underlying layer of gravels, cobbles, and boulders. In general, the thickness of the deposit increases from southwest to northeast. Boreholes WR-01 to WR-03, WR-05, and WR-08 were terminated within this deposit.

SPT N-values measured in the sand to silt deposit ranged from 2 blows to 56 blows per 0.3 m of penetration, indicating a very loose to very dense condition. However, SPT N-values as high as 21 blows for 0.15 m of penetration and 65 blows for 0.23 m of penetration were also recorded at the base of deposit where it is underlain by a layer of gravels, cobbles, and boulders.

The moisture contents of the cohesionless deposit ranged from 1% to 29%. The results of grain size distribution testing carried out on samples of the sand to silt with sand deposit are presented in Figures C2 to C4 in Appendix C and are summarized in Table 4.2.

Table 4.2: Grain Size Distribution of Sand to Silt

Soil Particle	Percentage (%)		
	Sandy Silt to Silt	Sand to Silty Sand	Sand with Silt and Gravel to Silty Sand
Gravel	0 – 1	0 – 2	5 – 30
Sand	15 – 49	54 – 98	46 – 80
Fines	--	1	5
Silt	49 – 80	11 – 43	16 – 26
Clay	0 – 5	0 – 2	1 – 2

4.6 Gravels, Cobbles, and Boulders

A layer of gravels, cobbles, and boulders was encountered underlying the native sand to silt and sand deposit in Boreholes WR-04, WR-06, and WR-07, which extends to borehole termination depths of 5.6 m to 9.3 m below ground surface (Elev. 375.0 m to 371.4 m). Based on the recovered cores from this layer, the particle size ranged from 60 mm (gravel-sized) to 375 mm (boulder-sized). Photographs of the recovered core samples from this deposit are presented in Figures B1 and B2 in Appendix B.

In Borehole WR-06, interlayers of silty sand with gravel up to 0.3 m thick were encountered within the layer. SPT N-values measured in the interlayers were 21 blows per 0.15 m of penetration and 50 blows per 0.08 m of penetration.

The moisture contents of the silty sand interlayer were 1% and 9%. The results of grain size distribution testing carried out on a sample of the interlayer are presented in Figure C5 in Appendix C and are summarized in Table 4.3.

Table 4.3: Grain Size Distribution of Silty Sand with Gravel Interlayer

Soil Particle	Percentage (%)
Gravel	20
Sand	63
Silt	16
Clay	1

4.7 Dynamic Cone Penetration Testing

Dynamic Cone Penetration Tests (DCPTs) were carried out through the bottom of Boreholes WR-03 and WR-08. The refusal of DCPTs is summarized in Table 4.4.

Table 4.4: Dynamic Cone Penetration Testing

Borehole / DCPT	Starting Location	Starting Depth / Elevation (m)	Depth / Elevation to Refusal (m)
WR-03	From bottom of borehole	11.3 / 369.8	18.3 / 362.8
WR-08	From bottom of borehole	11.3 / 369.6	15.4. / 365.5

4.8 Groundwater Conditions

The water levels observed in boreholes upon completion of drilling and in the installed monitoring wells are presented on the record of boreholes and summarized in Table 4.5.

Table 4.5: Water Levels in Boreholes and Monitoring Wells

Borehole	Date of Reading	Depth and Elevation of Groundwater (m)	Remarks
WR-01	2024-07-06	9.3 / 371.5	In open borehole upon completion of drilling.
WR-02	2024-07-05	9.8 / 370.8	In open borehole upon completion of drilling.
WR-03	2024-07-07	9.3 / 371.8	In monitoring well.
WR-04	2024-07-07	6.6 / 374.5	In open borehole upon completion of drilling. (1)
WR-05	2024-07-07	8.9 / 372.0	In monitoring well.
WR-06	2024-07-07	Dry	Monitoring well is dry at a depth of 5.5 m below ground surface (Elev. 375.1 m)
WR-08	2024-07-06	9.3 / 371.6	In open borehole upon completion of drilling.

Notes: 1. Water level reading in open borehole upon completion of drilling are not considered representative of the nature groundwater level due to introduction of water in the borehole during drilling operations.

The water levels measured in the boreholes upon completion of drilling and in monitoring wells are short-term observations and are subject to seasonal fluctuations. In particular, the water

levels may be at a higher elevation during spring and after periods of significant or prolonged precipitation.

4.9 Analytical Laboratory Testing

Selected samples of sandy silt fill, native silty sand, and native sand were submitted for analytical testing for corrosivity parameters and sulphide content. The results of the corrosivity testing are presented in Appendix C and summarized in Table 4.6.

Table 4.6: Results of Corrosivity Testing

Borehole / Sample	Depth / Elevation (m)	Resistivity (ohm-cm)	Electrical Conductivity (µS/cm)	Soluble Sulphate Content (µg/g)	Chloride Content (µg/g)	pH
WR-02 / SS4	2.6 / 378.2	5,560	180	92.0	3,300	8.46
WR-05 / SS5	3.4 / 377.5	6,100	164	8.0	33	9.03
WR-08 / SS6	4.1 / 376.8	9,090	110	3.2	6.6	9.05

5. MISCELLANEOUS

The foundation investigation was supervised on a full-time basis by Kamil Feszak. The Foundation Investigation Report was prepared by Ms. Alysha Kobylinski, P.Eng., and Mr. Christopher Ng, P.Eng. The report was reviewed by Mr. Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations Engineering projects.

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Date: ***March 17, 2025***
File: ***37466-10***

PART B – ENGINEERING DISCUSSION AND RECOMMENDATIONS

6. GENERAL

This report presents interpretation of the subsurface information obtained from the foundation investigation carried out on site and provides foundation design recommendations for the design of the proposed maintenance patrol yard. The foundation discussion and recommendations are based on our understanding of the project and the factual data obtained during the subsurface investigation and are provided to assist the designers with sufficient information on design aspects related to foundations engineering.

The discussions and recommendations are intended for the use of the Ministry of Transportation, Ontario and shall not be used or relied upon by any other parties including the construction or design-build contractor. The contractor undertaking the work must make their own interpretation based on the information presented in the factual sections of the report (Part A of this report). Where comments are made on construction, they are provided to highlight those aspects which could affect the design of the project. Those requiring information on the aspects of construction must make their own interpretations of the data provided as it may affect equipment selection, construction methods, scheduling and the like.

7. PROJECT DESCRIPTION

The proposed maintenance patrol yard consists of the following structures as shown on Drawing 1:

- A Materials Storage Building (MSB),
- A Vehicle Maintenance Garage (VMG) and Office Space, and,
- A Noise Barrier Wall.

The grading details for the Material Storage Building and Vehicle Maintenance Garage are presented in Table 7.1.

Table 7.1: Grading Details

Structure	Existing Grade (m)	Proposed Exterior Grade (m)	Grade Raise (m)	Final Finished Elevation (m)
Materials Storage Building	380.5 to 381.2	380.4 to 381.8	Up to 1.2	381.8
Vehicle Maintenance Garage	380.6 to 381.2	381.4 to 382.0	0.8 to 1.4	382.0

Note: 1. Elevations are based on 100% Design grading and erosion, and sediment control plan dated November 13, 2024.

8. SEISMIC CONSIDERATIONS

8.1 Seismic Site Classification

The 2020 National Building Code of Canada seismic hazard data is based on the sixth-generation seismic model developed by the Natural Resources Canada (NRCAN)[6]. In accordance with Section 4.1.8.4 of the Ontario Building Code (OBC)[7], the selection of the seismic site classification is based on the nature of soil deposit within the upper 30 m of the stratigraphy.

Although the foundation investigation does not extend 30 m below the founding level, the site has been assessed based on the standard penetration resistance values in accordance with Table 4.1.8.4.B of the OBC. The site-specific design spectral response acceleration, $S(T)$, peak ground acceleration, PGA, and peak ground velocity, PGV, for the associated structure and seismic site classification for 2% exceedance in 50 years (2,475-year return period) are presented in Appendix D and summarized in Table 8.1.

Table 8.1: Seismic Hazard Values

Seismic Hazard Values	2% Exceedance in 50 years Material Storage Building
Seismic Site Class	**D**
$S(0.2)$ (g)	0.121
$S(0.5)$ (g)	0.122
$S(1.0)$ (g)	0.070
$S(2.0)$ (g)	0.031
$S(5.0)$ (g)	0.007
$S(10.0)$ (g)	0.002
PGA (g)	0.070
PGV (m/s)	0.068

8.2 Potential for Liquefaction

Liquefaction is a phenomenon whereby seismically induced shaking generates shear stresses within the soil under undrained conditions. These stresses tend to densify the soil which may lead to potentially large surface deformations, and under undrained conditions generate excess pore water pressures that can lead to sudden temporary losses in strength. Where existing static shear stresses are present, the loss of strength can lead to significant lateral movements (analogous to slope failure) often referred to as “lateral spreading” or under certain conditions

[6] *2020 National Building Code of Canada Seismic Hazard Tool*
https://www.earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/nbc2020-cnb2020-en.php
[7] 2024 Ontario Building Code. Ministry of Municipal Affairs and Housing, Toronto.

even catastrophic failure of slopes often referred to as “flow slides”. Lateral spreading and flow slide often accompany liquefaction along rivers and other shorelines.

Based on the relative density of the fill and native soils and the site-specific PGA, the soils at this site are considered to have a low potential for liquefaction during a seismic event.

9. BUILDING AND GARAGE

9.1 Shallow Foundations

9.1.1 Frost Protection

All footings of unheated buildings and exterior footings should be provided with a minimum of 2.4 m of conventional soil cover for frost protection, in accordance with OPSD 3090.100. Consideration could be given to the use of an equivalent thickness of insulation installed around the perimeter of the footings as frost protection; however, for the purposes of this report, it is assumed footings will be provided with conventional soil cover for frost protection.

9.1.2 Founding Elevations

Based on the results of the foundation investigation and the proposed grade raise, the proposed Materials Storage Building, and Vehicle Maintenance Garage may be supported on conventional spread footings founded on compacted granular fill, over loose to compact native sand to silt with sand. Prior to the construction of the spread footings, all loose material should be sub-excavated and replaced with compacted granular material as outlined in Sections 9.4 and 9.5.

Table 9.1 is a summary of the existing ground surface elevation, elevation of compact native soils, proposed founding elevation, and associated founding condition.

Table 9.1: Founding Elevations and Founding Conditions

Structure	Existing Ground Surface Elevation (1) (m)	Founding Elevation Below Depth of Frost Penetration (m)	Founding Condition
Materials Storage Building	380.5 to 381.2	377.9 (south) to 379.5 (north)	0.5 m of compacted Granular ‘A’, ‘B’ Type II over compact silty sand fill and native silty sand
Vehicle Maintenance Garage	380.6 to 381.2	379.5	0.5 m of compacted Granular ‘A’, ‘B’ Type II over existing compact to sand silty sand fill and native sand to silty sand

Note: 1. Elevations are based on 100% Design grading and erosion, and sediment control plan dated November 13, 2024.

9.1.3 Geotechnical Resistances

Based on the founding elevation and condition presented in Table 9.1, the factored ultimate and serviceability geotechnical resistances for footings constructed on properly prepared subgrade presented in Table 9.2 may be used for design.

Table 9.2: Footing Dimensions and Factored Geotechnical Resistances

Structure	Footing Dimension (m)	Factored Ultimate Geotechnical Resistance (kPa)	Factored Serviceability Geotechnical Resistance for 25 mm of Settlement (kPa)
Materials Storage Building Push Wall	2.1 wide by 69 long (exterior)	350 (1)	250 (2)
	2.8 wide by 69 long (interior)	400 (1)	200 (2)
Vehicle Maintenance Garage	1.5 by 1.5 square	450 (1)	300 (1)
	1.6 by 1.6 square	450 (1)	300 (1)
	1.9 by 1.9 square	475 (1)	225 (1)
	2.0 by 2.0 square	475 (1)	225 (1)
	0.6 m strip	375 (1)	325 (1)
	1.0 m strip	400 (1)	225 (1)

Notes: 1. Assumes a uniformly distributed load is applied on the founding soils.
2. Assumes a triangular distributed load is applied on the founding soils where the maximum load is at the toe of the footing and zero load at the heel.

It should be noted that the factored ultimate and serviceability geotechnical resistances are dependent on the footing dimension and founding elevation and as such, the geotechnical resistances should be reviewed if the footing dimensions and founding elevation differ from those specified in Table 9.2. Unless otherwise indicated, the factored geotechnical resistances provided above are based on load applied concentrically to the centreline/centroid of the footing, as shown on Figure 6.4 of the Canadian Highway Bridge Design Code, CHBDC (2019)[8]. Where a load is applied eccentrically from the centreline/centroid of the footing, the pressure distribution at Ultimate Limits States (ULS) and Serviceability Limits States (SLS) and the eccentricity limit of the footing should be taken into consideration in accordance with Section 6.10.5 of the CHBDC (2019) and its Commentary. Once the structural design is substantially complete, the structural engineer should verify with Thurber whether the factored ultimate and serviceability geotechnical resistances provided above require revision based on any load eccentricity and/or inclination.

[8] 2019 Canadian Highway Bridge Design Code, S6:19. Canadian Standard Associate (CSA), Mississauga.

9.2 Resistance to Lateral Loads

Resistance to lateral loads (i.e., sliding resistance) between the concrete footing and the subgrade should be calculated in accordance with Section 6.10.4 of the CHBDC (2019). Table 9.3 presents the unfactored coefficient of friction that may be used for design.

Table 9.3: Coefficient of Friction Between Footing and Subgrade

Footing and Subgrade Interface	Coefficient of Friction, $tan\phi'$
Cast-in-place footing on compacted Granular 'A', 'B' Type II over loose to compact native sand to silty sand	0.55

9.3 Lateral Earth Pressures

The following static at-rest and active lateral earth pressure coefficients may be used for the design of the push wall associated with the Material Storage Building.

Table 9.4: Coefficient of Lateral Earth Pressures

Material	Unit Weight (kN/m^3)	Coefficient of Static Lateral Earth Pressures	
		At Rest, K_o	Active, K_a
De-icing Salt	13	0.72 (1)	0.72 (1)
Sand	16	0.69 (1)	0.69 (1)

Note: 1. Assumes the material is stored at a positive inclination at the angle of repose.

9.4 Sub-Excavation, Subgrade Inspection, and Grading

All topsoil/organic matter, loose/soft fill or native soils, or other deleterious materials should be removed from the area of the spread footings and grade raise. In addition, all native sandy silt to silt with sand encountered at the base of excavations should be removed.

Based on the subsurface investigation, the depths of excavation for the footings (including 0.5 m of compacted granular) are anticipated to range from about 2.9 m to 3.5 m. In general, the excavation is expected to extend to Elev. 377.9 m to 379.5 m at the Material Storage Building and to Elev. 378.5 m to 379.6 m at the Vehicle Maintenance Garage.

All excavations should be carried out in accordance with the guidelines outlined in the Occupational Health and Safety Act (OHSA) for Construction Projects (O.Reg. 213 as amended). The existing loose to compact fill and native sand to silt with sand are classified as Type 3 soils and therefore, temporary excavations should be made with side slopes of 1H:1V or flatter.

The exposed subgrade should be proof-rolled and be inspected by qualified geotechnical personnel. Any softened/loosened or poorly performing areas of the subgrade should be sub-excavated and replaced with compacted engineered fill as directed by qualified geotechnical personnel.

Site grading should be carried out in accordance with OPSS.PROV 206.

9.5 Engineered Fill

Imported granular material meeting the specification of OPSS.PROV 1010, Granular 'A', or 'B' Type I or II will be required in the areas of the Material Storage Building, and Vehicle Maintenance Garage, and may be used as engineered fill elsewhere on site. All imported fills should be approved by qualified geotechnical personnel at their source prior to importing them to site.

The imported granular fill shall extend at least 1 m beyond the footprint of the Material Storage Building, and Vehicle Maintenance Garage.

Beyond the area described above, the existing fill and native soil containing less than 25% fines by mass (i.e., soil particles less than 75 µm) and free of topsoil, organic matter, or other deleterious material may be reused on site as engineered fill. The existing fill and native soils to be reused as engineered fill must be approved by qualified geotechnical personnel prior to placement. Adjustment of the water contents of the soils may be required prior to placement. Soils above their estimated optimum water content for compaction will require drying or mixing with drier material, and soils below their estimated optimum water content for will require wetting or mixing with wetter material prior to placement.

Following the proof-rolling and approval of the subgrade, the engineered fill should be placed in accordance with OPSS.PROV 501 as amended by Special Provision 105S22. The engineered fill should be placed in maximum 200 mm loose lifts and compacted to 100% of the materials Standard Proctor Maximum Dry Density (SPMDD). Placement of engineered fill, and in situ density testing should be completed under full-time inspection by qualified geotechnical personnel.

The final surface of the engineered fill should be protected from construction traffic, as necessary, and should be sloped to provide positive drainage for surface water during construction. If the engineered fill is left exposed during periods of wet and/or freezing weather, consideration should be given to placing a sacrificial soil cover to protect the final subgrade.

Subject to the fines content of the engineered fill, settlement of the engineered fill should be expected upon the completion of site grading and as such, footings and floor slabs should be constructed after the settlement is complete. As a general guide, settlement of Granular 'A' and 'B' Type I and II may require up to 2 weeks to complete after placement.

9.6 Stability of Stockpiles in Material Storage Building

Stability analyses were carried out for the critical section of the sand and salt stockpiles in the Material Storage Building, which was determined to be in the north-south direction in conjunction with the fill slope at the north limit of the property.

Two-dimensional limit equilibrium slope stability analyses were carried out using the commercially available program Slide2 (version 9.0), developed by Rocscience Inc., employing the Morgenstern-Price method of analysis. Morgenstern-Price is a general method of slices which is based on equilibrium of forces and moments acting on each side of soil mass above the potential failure surface. The Factor of Safety is defined as the ratio of the forces tending to resist the failure to the driving forces tending to cause failure. For the purpose of analysis, the Factor of Safety is equal to the inverse of the product of the consequence factor, Ψ, and the ultimate geotechnical resistance factor, ϕ_{gu} (i.e., $FoS = 1/(\Psi \cdot \phi_{gu})$).

Accordingly, the following minimum Factors of Safety have been used for assessment of the stability of stockpiles in the Material Storage Building:

- 1.5 for permanent conditions;
- 1.3 for temporary conditions; and,
- 1.1 for seismic conditions.

Based on 100% Design structural drawings and MTO's Maintenance Patrol Yard Design Guidelines[9], details of the sand and salt stockpiles in the Material Storage Building are presented in Table 9.5.

Table 9.5: Details of Stockpiles in Material Storage Building

Stockpile Material	Sand	Salt
Unit Weight (kN/m^3)	16	13
Angle of Repose (^{o})	34	32
Height of Push Wall (m)	6.0	6.0
Max. Permitted Height of Stockpile along Push Wall (m)	5.7	5.7
Estimated Height at the Center of Stockpile (m)	11.1	9.3
Width of Storage Area (m)	16.0	11.5
Length of Storage Area (m)	49.0	49.0

The results of analyses are presented in Figures E1 to E4 in Appendix E and summarized in Table 9.6. pyramidical

[9] Maintenance Patrol Yard Design Guidelines. Ministry of Transportation, Ontario. December 2023.

Table 9.6: Results of Stability Analyses for Stockpiles in Material Storage Building

Factor of Safety (FOS)	Stockpile Material	
	Sand	Salt
Permanent Condition	1.6	1.8
Temporary Condition	1.6[1]	1.8[1]
Seismic Condition	1.5	1.6

Note: 1. Due to the absence of fine-grained soils, the FOS for the Temporary Condition is equal to the FOS for the permanent condition.

Based on the results of analyses, the stability of the sand and salt stockpiles meets the minimum required Factors of Safety for permanent, temporary, and seismic conditions.

9.7 Settlement of Native Soils and Engineered Fill

To estimate the magnitude of settlement due to the proposed grade raise of about up to about 1.4 m and loading from the sand and salt stockpiles in the Material Storage Building (up to about 11.1 m and 9.3 m high, respectively), settlement analyses were carried out using the commercially available program Settle3 (version 5.0), developed by Rocscience Inc. The results of the settlement analysis are presented on Table 9.7.

The estimated settlement of the existing sand fill and native sand to silty sand is expected to occur during the placement of engineered fill. However, as indicated in Section 9.5, the settlement of engineered fill may require up to 2 weeks to complete following the completion of fill placement.

Table 9.7: Result of Settlement Analysis

	Material Storage Building	Vehicle Maintenance Garage
Grade Raise (m)	Up to 1.2	0.8 to 1.4
Slab Load (kPa)	--	12
Sand Stockpile (kPa)	Up to 180	--
Salt Stockpile (kPa)	Up to 120	--
Immediate Settlement (mm)	0 to 35	0 to 15
Consolidation Settlement (mm)	--	--
Total Settlement (mm)	0 to 35	0 to 15
Post-Construction Settlement (mm)	Less than 25	Less than 25

Additional quantities of engineered fill should be allowed to compensate for the volume of ground loss resulting from the settlement.

9.8 Slab-on-Grade / Pavement Structure

Prior to the construction of the slab-on-grade, the exposed subgrade should be inspected by qualified geotechnical personnel, and remedial work should be carried out on loosened areas as directed.

The final lift of engineered fill immediately below the slab-on-grade should consist of a minimum 200 mm thick OPSS.PROV 1010 Granular 'A' and compacted to 100% of its SPMDD in accordance with OPSS.PROV 501, as amended by Special Provision 105S22.

The subgrade reaction in Table 9.8 may be used for the design of slab-on-grades.

Table 9.8: Modulus of Subgrade Reaction

Modulus of Subgrade Reaction for compacted Granular 'A' (MPa/m)
20

The slab-on-grade should be structurally separated from the foundation walls and columns and sawcut control joints should be provided at regular intervals and along column lines to minimize shrinkage cracking and to allow for any differential settlement of the floor slab. Where the slab-on-grade is overlying perimeter strip footings, a construction joint should be included to accommodate potential differential settlement.

Where the slab-on-grade / pavement structure is at or above the level of the exterior grade, subfloor and perimeter drainage are not required.

10. SITE SERVICING

10.1 Installation of Underground Services

Based on the 100% Design site servicing plan dated November 13, 2024, the invert of the watermain and sanitary sewer for the Vehicle Maintenance Garage will be at Elev. 379.55 m and 379.59 m, respectively, and that the invert of the sanitary sewer manholes MH2 and MH3 west of the Vehicle Maintenance Garage will be below Elev. 377.89 m and 378.44 m, respectively. As such, the site services will be founded within the native silty sand to silt with sand deposit and the gravel, cobble, and boulder layer, which is suitable for the support of the site services provided that the integrity of the base can be confirmed and maintained during construction.

Trench excavations must be carried out in accordance with the latest version of O.Reg. 213.

Trench excavation for site servicing will extend through the existing loose to compact sand to silty sand fill and into the loose to compact native silty sand to silt with sand deposit, both of which are classified as Type 3 soil in accordance with Occupational Health and Safety Act for Construction Projects (OHSA). As such, the side slopes of the open cut excavation should be constructed at 1H:1V or flatter.

In addition, cobbles and boulders may be encountered during the trench excavation and as such, the equipment and procedures employed by the Contractor must be able to dislodge, remove, or otherwise penetrate through such obstructions.

Based on water levels measured in monitoring wells and observations in open boreholes upon completion of drilling, it is anticipated that the trench excavation west of the proposed Vehicle Maintenance Garage will be above the groundwater table.

The subgrade should be inspected by qualified geotechnical personnel to ensure that all topsoil/organic materials, softened/loosened soils, or other unsuitable materials have been removed. Proof-rolling of the subgrade (by a plate tamper in combination with visual inspection) will be required to identify any softened/loosened zones. Where softened/loosened zones are present, sub-excavation is required to remove the unsuitable materials, and backfilled with Granular 'A' or 'B' Type II compacted in accordance with OPSS.PROV 501 (as amended by Special Provision 105S22) to at least 98% of the material's SPMDD.

Disturbance of the base of the excavation should be avoided to prevent the loss of support for the watermain and sanitary sewer. Any materials that are disturbed by construction at the base of excavation should be removed and replaced with additional bedding material and/or compacted Granular 'A' or 'B' Type II.

10.2 Bedding, Cover, and Trench Backfill

The bedding, cover, and backfill materials for the watermain and sanitary sewer installation should be compatible with the type and class of pipe, the surrounding soil conditions, and the anticipated loading conditions. The installation should be constructed in accordance with OPSD 802.031 for construction of Class C bedding in Type 3 soils.

10.2.1 Bedding and Cover

The bedding and cover materials should consist of materials as specified in OPSS.PROV 401. Clear stone should not be used as bedding or cover material. Bedding shall consist of Granular 'A' or OPSS 1359 unshrinkable backfill. All bedding and cover material should be placed in loose lifts and uniformly compacted to at least 98% of the material's SPMDD.

10.2.2 Trench Backfill

The existing fill and native soils on site may be used for trench backfill, provided they are free of topsoil, organic matter, or other unsuitable materials. Based on the measured water contents, the existing fill and native soils are generally below their estimated optimum water content for compaction and as such, water may be applied as needed to achieve the degree of compaction required. Alternatively, imported materials meeting the specification of OPSS.PROV 1010 Granular 'A', 'B' Type I or II, or Select Subgrade Material (SSM) may be used as trench backfill. All imported fills should be approved by qualified geotechnical personnel at their source prior to importing them to site.

The trench backfill should be placed and compacted in accordance with OPSS.PROV 501 (as amended) and to at least 95% of the material's SPMDD. Backfilling operations during cold weather should avoid inclusions of frozen lumps of material, snow and ice.

10.3 Settlement of Trench Backfill

Settlement of the compacted trench backfill should be anticipated, with the majority of such settlement occurring within 6 months following the completion of the backfilling operations. The settlement will be reflected at the ground surface and may be compensated for by placing additional granular material, as required. Alternatively, if the asphalt binder course is placed shortly following the completion of the backfilling operations, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing additional thickness of binder asphalt or by padding.

11. NOISE BARRIER WALL

Foundation engineering parameters for the design of footing for the proposed noise barrier wall are provided in Table F1 in Appendix F. For the purposes of design, the soil layers presented in Table F1 have been simplified from the detailed stratigraphic descriptions presented on the Record of Borehole sheets.

Resistances within the upper 2.4 m below proposed ground surface should be neglected to account for frost action within the depth of frost penetration as interpreted from OPSD 3090.100. In accordance with Figure C6.27 of the CHBDC (2019), passive resistance below the depth of frost penetration should be reduced by an appropriate factor considering the allowable wall movement.

12. CONSTRUCTION CONSIDERATIONS

12.1 Obstructions

As indicated in Section 10.1, cobbles and boulders may be encountered during excavations for footings and trenches for the installation of site servicing and as such, the equipment and procedures employed by the Contractor must be able to dislodge, remove, or otherwise penetrate through such obstructions. A Non-Standard Special Provision has been included in Appendix G to address the presence of obstructions in the native soils.

12.2 Control of Groundwater and Surface Water

Based on the water levels measured in monitoring wells and observations in open boreholes upon completion of drilling, the footing and trench excavations are anticipated to be above the groundwater table. However, groundwater levels may fluctuate in response to significant rain events and snowmelt and, where required, groundwater can be controlled by pumping from properly filtered sumps located at the base of the excavation.

Surface water should be directed away from the footing and trench excavations to prevent ponding of water that could result in disturbance and weakening of the founding soils.

13. CORROSION ASSESSMENT

In reference to the MTO Gravity Pipe Design Guideline, Table 13.1 summarizes the corrosion potential, the degree of sulphate attack on concrete, as well as the impact of pH levels on the durability of concrete of samples of the fill and native soils from the site. However, it should be noted that effects of de-icing salts/chemicals should be considered when selecting construction materials and/or corrosion mitigation measures.

Table 13.1: Corrosion Assessment of Fill and Native Soils

Borehole / Sample No.	Soil Type	Resistivity (ohm-cm) / Corrosion Potential (1)	Sulphate Concentration (µg/g) / Degree of Sulphate Attack on Concrete (2)	pH level / Impact on Durability of Concrete (3)
WR-02 / SS4	Sandy Silt Fill	5,560 Low	92.0 Negligible	8.46 Not Detrimental
WR-05 / SS5	Native Silty Sand	6,100 Very Low	8.0 Negligible	9.03 Detrimental
WR-08 / SS6	Native Sand	9,090 Very Low	3.2 Negligible	9.05 Detrimental

Notes: 1. According to Table 3.2 of the Gravity Pipe Design Guideline.
2. According to Table 7.2 of the Gravity Pipe Design Guideline.
3. According to Section 7.1.1 of the Gravity Pipe Design Guideline.

14. CLOSURE

The Foundation Design Report was prepared by Ms. Alysha Kobylinski, P.Eng., and Mr. Christopher Ng, P.Eng. The report was reviewed by Mr. Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Alysha Kobylinski, P.Eng.,
Geotechnical Engineer

Christopher Ng, P.Eng.,
Associate, Senior Geotechnical Engineer

Jason Lee, M.Sc.(Eng.), P.Eng.,
Partner, Senior Geotechnical Engineer
Designated MTO Contact

Date: ***March 17, 2025***
File: ***37466-10***

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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

2. COMPLETE REPORT

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

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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.

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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

- Site Photographs

Photograph #1 – At Borehole WR-01 looking east towards sand domes (July 2024)

Photograph #2: Top of north slope near Borehole WR-02 looking northwest (July 2024)

Photograph #3 – Toe of north slope looking east (July 2024)

Photograph #4: At Borehole WR-04 looking east (July 2024)

Photograph #5 – At Borehole WR-05 looking at south entrance to east sand dome (July 2024)

Photograph #6 – At Borehole WR-05 looking at east sand dome (July 2024)

Photograph #7 – At Borehole WR-06 looking south behind site office (July 2024)

Photograph #8 – At Borehole WR-08 looking east towards vehicle maintenance garage and site office (July 2024)

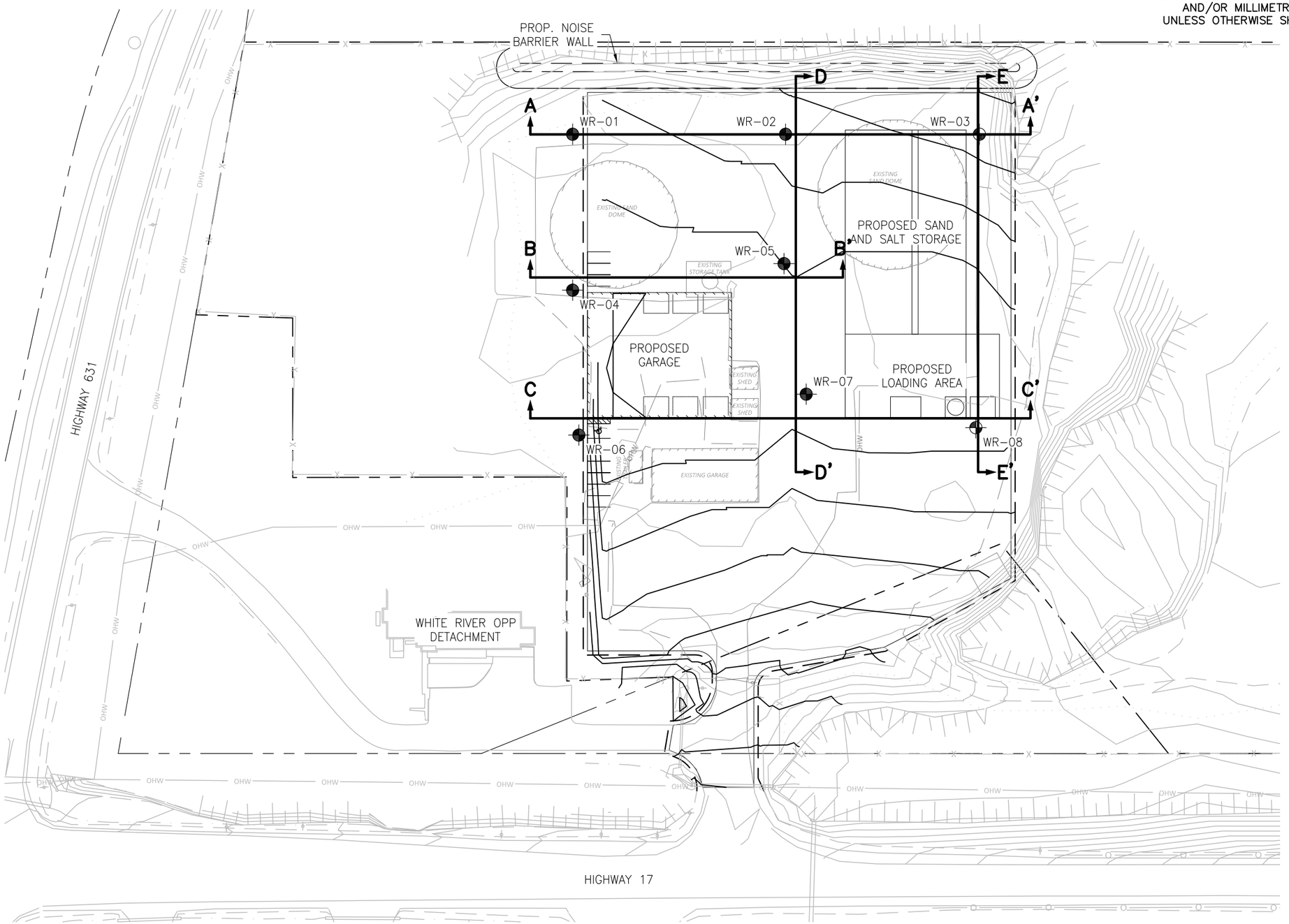
APPENDIX B

- Borehole Locations and Soil Strata Drawings
- Record of Borehole Sheets
- Photographs of Gravel, Cobble, and Boulder Cores

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



PLAN

20 0 20 40m

SCALE 1:1000

CONT No
GWP No 5298-19-00

SHEET

WHITE RIVER MAINTENANCE PATROL YARD
BOREHOLE LOCATIONS PLAN

THURBER

KEYPLAN

	LEGEND
⊕	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
WR-01	380.8	5 384 674.9	211 077.2
WR-02	380.8	5 384 654.2	211 123.9
WR-03	381.1	5 384 635.3	211 166.4
WR-04	381.1	5 384 640.7	211 062.0
WR-05	380.9	5 384 625.9	211 110.9
WR-06	380.6	5 384 608.3	211 049.2
WR-07	380.7	5 384 595.1	211 103.1
WR-08	380.9	5 384 571.3	211 137.0

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
3) Coordinate system is MTM NAD 83 Zone 13.

GEOCRES No. 42C11-004

LICENSED PROFESSIONAL ENGINEER C.C. NG 10086170 Mar. 17, 2025 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J.P.K. LEE 10086735 Mar. 17, 2025 PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION

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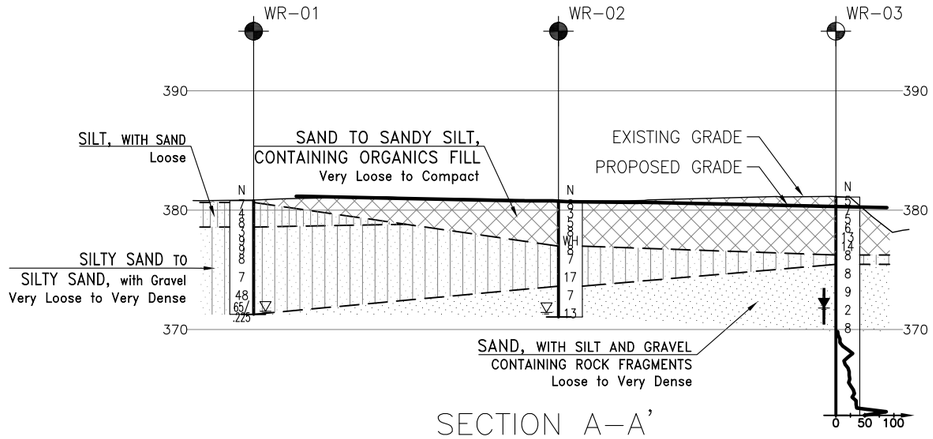

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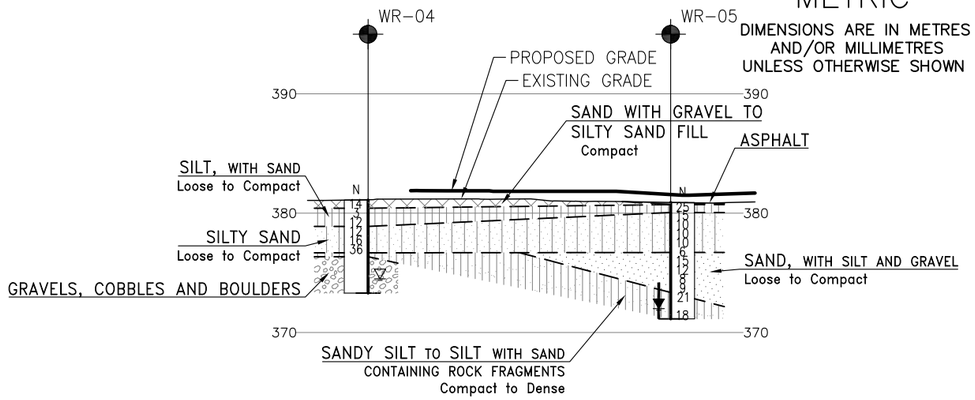

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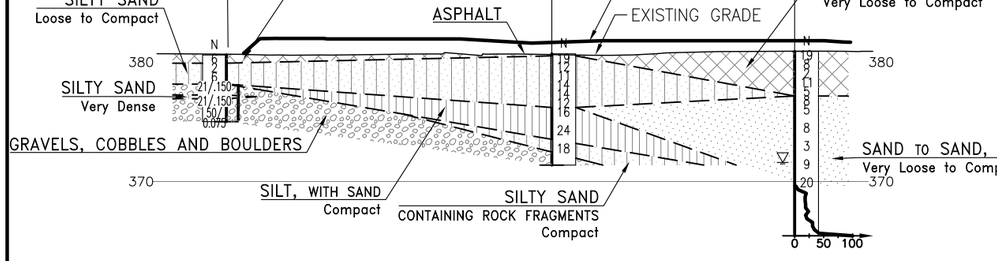

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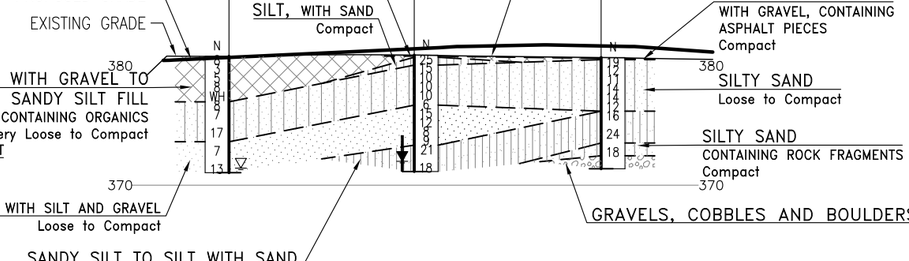
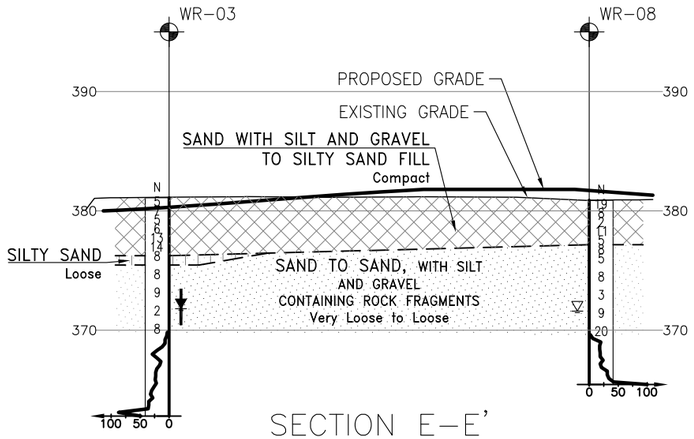


SECTION D–D'



SECTION E–E'

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
GWP No 5298-19-00

WHITE RIVER MAINTENANCE PATROL YARD
SOIL STRATA

SHEET

THURBER

KEYPLAN

LEGEND

⊕	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
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▽	Water Level Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
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WR-03	381.1	5 384 635.3	211 166.4
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WR-05	380.9	5 384 625.9	211 110.9
WR-06	380.6	5 384 608.3	211 049.2
WR-07	380.7	5 384 595.1	211 103.1
WR-08	380.9	5 384 571.3	211 137.0

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GEOCRES No. 42C11-004

LICENSED PROFESSIONAL ENGINEER
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J.P.K. LEE
10086735
Mar. 17, 2025
PROVINCE OF ONTARIO

20 0 20 40m H 1:1000
10 0 10 20m V 1:500

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	AK	CHK	CN	CODE	LOAD
DRAWN	MFA	CHK	AK	SITE	STRUCT

DATE MAR 2025
DWG 2

FILENAME: H:\Drafting\37000\37466\TED-37466-PLPR-WR.dwg
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SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS:

Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of fragments of decayed organic matter
Till	unstratified glacial deposit which may include particles ranging in sizes from clay to boulder
Fill	material below the surface identified as placed by humans (excluding buried services)

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

Desiccated	having visible signs of weathering by oxidization of clay materials, shrinkage cracks, etc.
Fissured	having cracks, and hence a blocky structure
Varved	composed of alternating layers of silt and clay
Stratified	composed of alternating successions of different soil types, e.g. silt and sand
Layer	> 75 mm in thickness
Seam	2 mm to 75 mm in thickness
Parting	< 2 mm in thickness

RECOVERY:

For soil samples, the recovery is recorded as the length of the soil sample recovered.

N-VALUE:

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. For samples where insufficient penetration was achieved and N-value cannot be presented, the number of blows are reported over the sampler penetration in metres (e.g. 50/0.15).

DYNAMIC CONE PENETRATION TEST (DCPT):

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to an "A" size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone 0.3 m into the soil. The DCPT is used as a probe to assess soil variability.

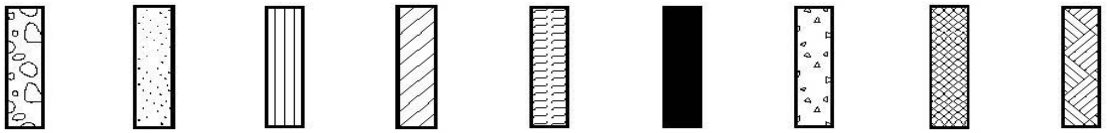
WATER LEVELS:

Water level upon completion of drilling

Water level in monitoring well / piezometer

Monitoring well / piezometer screen

STRATA PLOT:
Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders Cobbles Gravels | Sands | Silts | Clays | Organics | Asphalt | Concrete | Fill | Bedrock

TEXTURING CLASSIFICATION OF SOILS

Classification	**Particle Size**
Boulders	Greater than 200 mm
Cobbles	75 – 200 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75 mm
Silt	0.002 – 0.075 mm
Clay	Less than 0.002 mm

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

Descriptive Term	**Undrained Shear Strength (kPa)**
Very Soft	Less than 12
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

NOTE: Clay sensitivity is defined as the ratio of the undisturbed strength over the remolded strength.

SAMPLE TYPES

SS	Split spoon samples
TW	Thin-wall tube / Shelby Tube
DP	Direct push sample
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ etc.	Rock core sample obtained with the use of standard size diamond coring equipment

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

Descriptive Term	**SPT "N" Value**
Very Loose	Less than 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note - W_L= Liquid Limit

Ministry of Transportation
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THURBER

RECORD OF BOREHOLE No WR-01 1 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 674.9 E 211 077.2 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers COMPILED BY AK

DATUM Geodetic DATE 2024.07.06 - 2024.07.06 LATITUDE 48.593602 LONGITUDE -85.270695 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
380.8	GROUND SURFACE										
0.0	**SAND**, with gravel, containing rootlets Loose Dark Brown Moist (FILL)		1	SS	7				○ ○		
0.2	**SILT**, with sand Loose Brown Moist		2	SS	4		380		○		
			3	SS	8		379		○		0 40 59 1
378.6											
2.2	Silty **SAND** Very Loose to Loose Grey Moist		4	SS	3		378		○		
			5	SS	9				○		
			6	SS	9		377		○		0 87 11 2
			7	SS	8		376		○		
			8	SS	7		375		○		
373.6							374				
7.2	Silty **SAND**, with gravel Dense to Very Dense Grey Moist		9	SS	48		373		○		28 46 25 1
	Auger grinding at a depth of 8.2 m										
			10	SS	65/ 0.225	▽	372		○		
371.3											
9.5	END OF BOREHOLE AT DEPTH OF 9.5 m. NOTES:										

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No WR-01 2 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 674.9 E 211 077.2 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers COMPILED BY AK

DATUM Geodetic DATE 2024.07.06 - 2024.07.06 LATITUDE 48.593602 LONGITUDE -85.270695 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%) (20 40 60)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page										
	1. Water level at depth of 9.3 m below ground surface upon completion of drilling. 2. Borehole backfilled with soil cuttings to ground surface.										

UNIT WEIGHT: γ kN/m³

SHEAR STRENGTH kPa: O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE

WATER CONTENT (%): w_P (PLASTIC LIMIT), w (NATURAL MOISTURE CONTENT), w_L (LIQUID LIMIT)

REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No WR-02 1 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 654.2 E 211 123.9 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers COMPILED BY AK

DATUM Geodetic DATE 2024.07.05 - 2024.07.05 LATITUDE 48.593422 LONGITUDE -85.270058 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
380.8	GROUND SURFACE										
0.0	**SAND**, with gravel Loose Brown		1	SS	8				○		
380.3	0.5 Moist 380.1 (FILL)										
0.7	Sandy **SILT** Loose Brown Moist (FILL)		2	SS	3		380		○		
	Sandy **SILT**, containing organics Very Loose to Loose Brown Moist (FILL)		3	SS	5		379		○		
			4	SS	8		378		○		1 48 49 2
377.0			5	SS	WH				○		
3.8	Silty **SAND** Loose to Compact Brown Moist		6	SS	8		377		○		
			7	SS	7		376		○		5 78 16 1
							375				
			8	SS	17		374		○		
373.6											
7.2	**SAND**, with silt and gravel Loose to Compact Grey Moist to Wet		9	SS	7		373		○		15 80 5 (SI+CL)
							372				
			10	SS	13	▽			○		
371.0											
9.8	END OF BOREHOLE AT A DEPTH										

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No WR-02 2 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 654.2 E 211 123.9 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers COMPILED BY AK

DATUM Geodetic DATE 2024.07.05 - 2024.07.05 LATITUDE 48.593422 LONGITUDE -85.270058 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	OF 9.8 m. NOTES: 1. Water level at depth of 9.4 m below ground surface upon completion of drilling. 2. Borehole backfilled with soil cuttings to ground surface.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No WR-03 1 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 635.3 E 211 166.4 ORIGINATED BY KF

DIST Northeast HWY BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AK

DATUM Geodetic DATE 2024.07.05 - 2024.07.05 LATITUDE 48.593259 LONGITUDE -85.269477 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
381.1	GROUND SURFACE						381				
0.0	**SAND**, with silt and gravel Loose Dark Brown Moist		1	SS	5			○	○		17 74 9 (SI+CL)
380.3	(FILL)						380				
0.8	**SAND** Loose to Compact Brown Moist (FILL)		2	SS	7			○	○		
			3	SS	5		379		○		
			4	SS	6				○		8 88 4 (SI+CL)
			5	SS	13		378		○		
			6	SS	14		377		○		
376.2			7	SS	8				○		
4.9	Silty **SAND** Loose Brown Moist						376		○		
375.5											
5.6	**SAND**, with silt and gravel, containing rock fragments Loose Greyish Brown Moist to Wet		8	SS	8		375		○		
			9	SS	9		374		○		30 65 5 (SI+CL)
	Wet below a depth of 9.1 m		10	SS	2		373				
							372		○		

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No WR-03 2 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 635.3 E 211 166.4 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AK

DATUM Geodetic DATE 2024.07.05 - 2024.07.05 LATITUDE 48.593259 LONGITUDE -85.269477 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
369.8	**SAND**, with silt and gravel, containing rock fragments Loose Greyish Brown Wet		11	SS	8		371 370 369 368 367 366 365 364 363	UNCONFINED ○ FIELD VANE + QUICK TRIAXIAL ● LAB VANE ×	w_P w w_L		
11.3	End of borehole and start of DCPT										
362.8											
18.3	END OF DCPT AT A DEPTH OF 18.3 m. Monitoring well installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.05 m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2024.07.06	9.3	371.8
2024.07.07	9.3	371.8

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No WR-04 1 OF 1 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 640.7 E 211 062.0 ORIGINATED BY KF

DIST Northeast HWY BOREHOLE TYPE HWT Casing/HQ Coring COMPILED BY AK

DATUM Geodetic DATE 2024.07.07 - 2024.07.07 LATITUDE 48.593292 LONGITUDE -85.270894 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: UNCONFINED (O), FIELD VANE (+), QUICK TRIAXIAL (●), LAB VANE (×) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
381.1	GROUND SURFACE						381				
0.0	**SAND**, with gravel Compact Brown Moist (FILL)		1	SS	14						
0.2 / 380.4							380				
0.7	Silty **SAND** Compact Light Brown Moist (FILL)		2	SS	3						0 15 80 5 Non-Plastic
	SILT, with sand Loose to Compact Light Brown Moist		3	SS	12		379				
378.9											
2.2	Silty **SAND** Compact Grey Moist		4	SS	12		378				
			5	SS	16						0 67 32 1
376.7			6	SS	36		377				
376.6 / 4.4											
4.5	**SILT**, with sand, containing rock fragments Dense Grey Moist		1	RC	-						
	GRAVELS, COBBLES and **BOULDERS** RC1 (4.6 m to 5.0 m) - Gravels up to 60 mm - 1 x 90 mm Cobble		2	RC	-		376				
	RC2 (5.0 m to 6.2 m) - Gravels up to 75 mm - 2 x 100 mm Cobble - 1 x 180 mm Cobble					▽	375				
	RC3 (6.2 m to 7.8 m) - Gravels up to 75 mm - 1 x 90 mm Cobble - 1 x 95 mm Cobble - 1 x 100 mm Cobble - 1 x 120 mm Cobble - 1 x 320 mm Boulder		3	RC	-		374				
373.3											
7.8	END OF BOREHOLE AT A DEPTH OF 7.8 m. NOTES: 1. Water level at a depth of 6.6 m below ground surface upon completion of drilling. 2. Borehole backfilled with soil cuttings and holeplug to ground surface.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No WR-05 1 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 625.9 E 211 110.9 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers COMPILED BY AK

DATUM Geodetic DATE 2024.07.04 - 2024.07.04 LATITUDE 48.593166 LONGITUDE -85.270227 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
380.9	GROUND SURFACE										
0.0	**ASPHALT:** (90 mm)										
0.1											
0.2	**SAND**, with gravel Compact Brown Moist (FILL)		1	SS	25						0 49 49 2
380.1											
0.8	**SILT**, with sand Compact Light Brown Moist		2	SS	15		380				
	Silty **SAND** Loose to Compact Light Grey Moist		3	SS	10		379				1 54 43 2
			4	SS	10		378				
			5	SS	10						
376.7			6	SS	6		377				
4.2	**SAND**, with silt and gravel Loose to Compact Grey Moist		7	SS	15		376				16 79 5 (SI+CL)
			8	SS	12		375				
			9	SS	8						
			10	SS	9		374				
373.4											
7.5	Sandy **SILT** Compact Grey Moist		11	SS	21		373				
							372				
			12	SS	18						0 40 59 1
371.1											
9.8	END OF BOREHOLE AT A DEPTH										

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No WR-05 2 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 625.9 E 211 110.9 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers COMPILED BY AK

DATUM Geodetic DATE 2024.07.04 - 2024.07.04 LATITUDE 48.593166 LONGITUDE -85.270227 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60	γ kN/m^3	GR SA SI CL
	Continued From Previous Page										
	OF 9.8 m. Monitoring well installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.05 m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2024.07.04 8.9 372.0 2024.07.07 8.9 372.0										

SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No WR-06 1 OF 1 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 608.3 E 211 049.2 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers COMPILED BY AK

DATUM Geodetic DATE 2024.07.04 - 2024.07.04 LATITUDE 48.592999 LONGITUDE -85.271059 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
380.6	GROUND SURFACE										
0.0	Silty **SAND** Loose Grey Moist		1	SS	6				○		0 86 13 1
379.9	(FILL)						380				
0.7	Silty **SAND** Loose Grey Moist		2	SS	2				○		2 60 38 0
			3	SS	6		379		○		
378.2	Auger refusal at a depth of 2.4 m		4	SS	21/				○ ○		
2.4	**GRAVELS, COBBLES** and **BOULDERS** RC1 (2.4 m to 3.4 m) - Gravels up to 75 mm - 1 x 80 mm Cobble - 1 x 380 mm Boulder		1	RC	0.150 -		378				
377.2											
3.4	Silty **SAND**, with gravel Very Dense Grey Moist		5	SS	21/ 0.150				○		
376.9							377		○		20 63 16 1
3.7	**GRAVELS, COBBLES** and **BOULDERS** RC2 (3.7 m to 4.9 m) - Gravels up to 75 mm - 1 x 160 mm Cobble - 1 x 190 mm Cobble - 1 x 280 mm Boulder		2	RC	-						
			6	SS	50/		376				
	RC3 (5.0 m to 5.6 m) - Gravels up to 75 mm - 1 x 90 mm Cobble - 1 x 130 mm Cobble		3	RC	0.075 -						
375.0											
5.6	END OF BOREHOLE AT A DEPTH OF 5.6 m. Monitoring well installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.05 m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2024.07.05	Dry	-
2024.07.07	Dry	-

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No WR-07 1 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 595.1 E 211 103.1 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers/HQ Coring COMPILED BY AK

DATUM Geodetic DATE 2024.07.05 - 2024.07.05 LATITUDE 48.592888 LONGITUDE -85.270326 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
380.7	GROUND SURFACE										
0.0	**ASPHALT:** (75 mm)										
0.1											
0.2	Silty **SAND**, with gravel, containing asphalt pieces Compact Brown Moist (FILL)		1	SS	19				○		9 63 26 2
			2	SS	12		380		○ ○		
	Silty **SAND** Compact Brown to Grey Moist		3	SS	11		379		○		
			4	SS	14		378		○		
			5	SS	14				○		0 76 23 1
			6	SS	12		377		○		
376.2											
4.5	**SILT**, with sand Compact Grey Moist		7	SS	16		376		○		0 35 64 1
			8	SS	24		375		○		
373.5							374				
7.2	Silty **SAND**, containing rock fragments Compact Grey Moist Auger refusal at depth of 7.9 m		9	SS	18		373		○		
372.5											
8.2	**GRAVELS, COBBLES** and **BOULDERS** RC1 (8.0 m to 9.3 m) - Gravels up to 45 mm - 1 x 200 mm Cobble - 1 x 375 mm Boulder		1	RC	-		372				
371.4											
9.3	END OF BOREHOLE AT A DEPTH OF 9.3 m.										

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No WR-07 2 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 595.1 E 211 103.1 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers/HQ Coring COMPILED BY AK

DATUM Geodetic DATE 2024.07.05 - 2024.07.05 LATITUDE 48.592888 LONGITUDE -85.270326 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	NOTES: 1. Water level not measured upon completion of drilling due to introduction of water for coring. 2. Borehole backfilled with soil cuttings to ground surface.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No WR-08 1 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 571.3 E 211 137.0 ORIGINATED BY KF

DIST Northeast HWY BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AK

DATUM Geodetic DATE 2024.07.06 - 2024.07.06 LATITUDE 48.592679 LONGITUDE -85.269861 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
380.9	GROUND SURFACE										
0.0	**SAND**, with gravel Compact Dark Brown Moist		1	SS	19				○		
380.2	(FILL)										
0.7	**SAND**, with silt Very Loose to Loose Grey Moist (FILL)		2	SS	8		380		○		13 75 12 (SI+CL)
			3	SS	2		379		○		
378.7											
2.2	Silty **SAND** Loose to Compact Brown Moist (FILL)		4	SS	11		378		○		
			5	SS	5				○		8 84 8 (SI+CL)
377.2											
3.7	**SAND** Loose Brown Moist		6	SS	8		377		○		
			7	SS	5		376		○		1 98 1 (SI+CL)
			8	SS	8		375		○		
373.7							374				
7.2	**SAND**, with silt Very Loose to Loose Grey Moist		9	SS	3		373		○		0 87 12 1
			10	SS	9	▽	372		○		1 76 22 1
							371				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S2 2020LIBRARY(MTO).GLB SOIL-37466.GPJ 10/18/24

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No WR-08 2 OF 2 METRIC

GWP# 5298-19-00 LOCATION White River Patrol Yard; MTM 83-13: N 5 384 571.3 E 211 137.0 ORIGINATED BY KF

DIST Northeast HWY _____ BOREHOLE TYPE 200 mm O.D. Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AK

DATUM Geodetic DATE 2024.07.06 - 2024.07.06 LATITUDE 48.592679 LONGITUDE -85.269861 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	WATER CONTENT (%) (PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	SAND, with silt Compact Grey Moist										
369.6			11	SS	20		370				
11.3	End of borehole and start of DCPT						369				
							368				
							367				
365.5							366				
15.4	END OF DCPT AT A DEPTH OF 15.4 m. NOTES: 1. Water level at a depth of 9.3 m below ground surface upon completion of drilling. 2. Borehole backfilled with soil cuttings to ground surface.										

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100

WATER CONTENT (%): 20 40 60

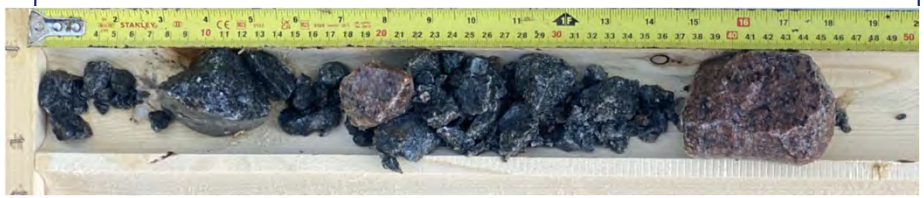
$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

ONTMT4S2 2020LIBRARY(MTO).GLB SOIL-37466.GPJ 10/18/24

Borehole WR-04 RC1 – Gravel and Cobbles

Cored between 4.6 m and 5.0 m



- Gravels up to 60 mm
- 1 x 90 mm Cobble

Borehole WR-04 RC2 – Gravels and Cobbles

Cored between 5.0 m and 6.2 m

- Gravels up to 75 mm
- 2 x 100 mm Cobbles
- 1 x 180 mm Cobbles

Borehole WR-04 RC3 – Gravels, Cobbles and Boulder

Cored between 6.2 m and 7.8 m

- Gravels up to 75 mm
- 1 x 90 mm Cobble
- 1 x 95 mm Cobble
- 1 x 100 mm Cobble
- 1 x 120 mm Cobble
- 1 x 320 mm Boulder

Borehole WR-06 RC1 and RC2 – Gravels, Cobbles, and Boulder

Cored between 2.4 m and 3.4 m

- Gravels up to 75 mm
- 1 x 80 mm Cobble
- 1 x 380 mm Boulder

- Gravels up to 75 mm
- 1 x 160 mm Cobble
- 1 x 190 mm Cobble
- 1 x 280 mm Boulder

Cored between 3.7 m and 4.9 m

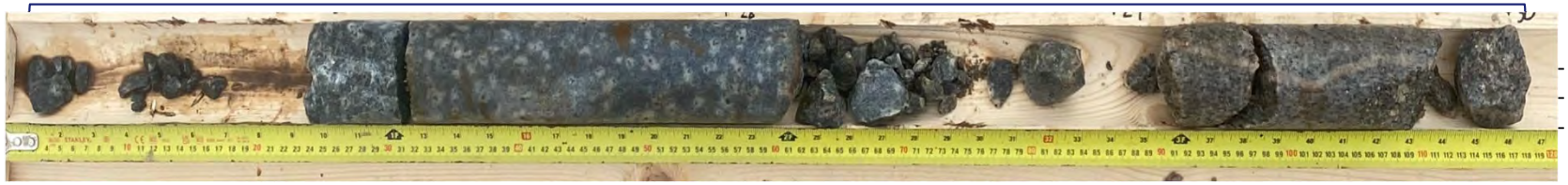
Borehole WR-06 RC3 – Gravels, Cobble, and Boulder

Cored between 5.0 m and 5.6 m

- Gravels up to 75 mm
- 1 x 90 mm Cobble
- 1 x 130 mm Cobble

Borehole WR-07 RC1 – Gravels, Cobble, and Boulder

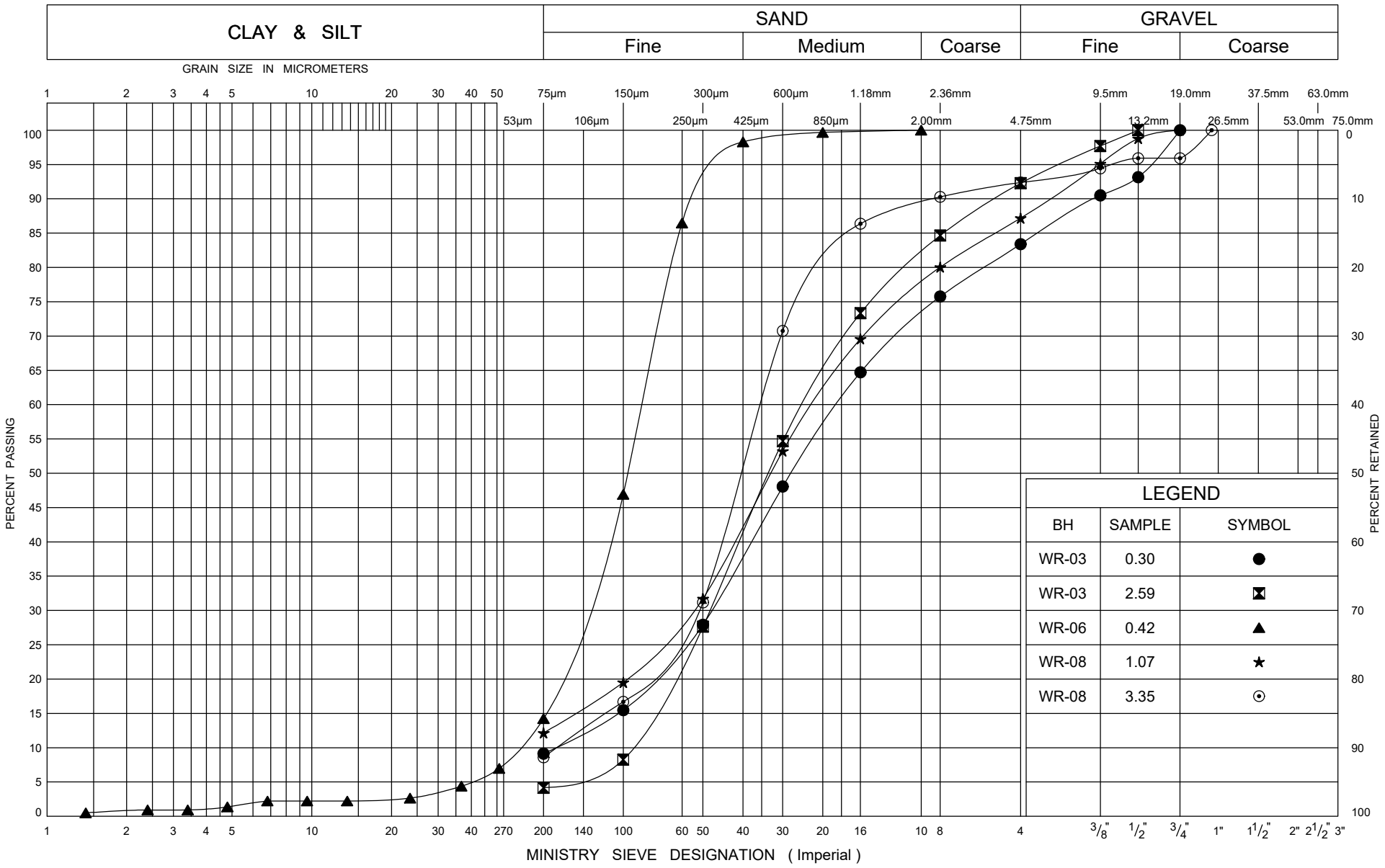
Cored between 8.0 m and 9.3 m



- Gravels up to 45 mm
- 1 x 200 mm Cobble
- 1 x 375 mm Boulder

APPENDIX C

- Results of Geotechnical Laboratory Testing
- Results of Corrosivity Testing (SGS for Thurber)



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

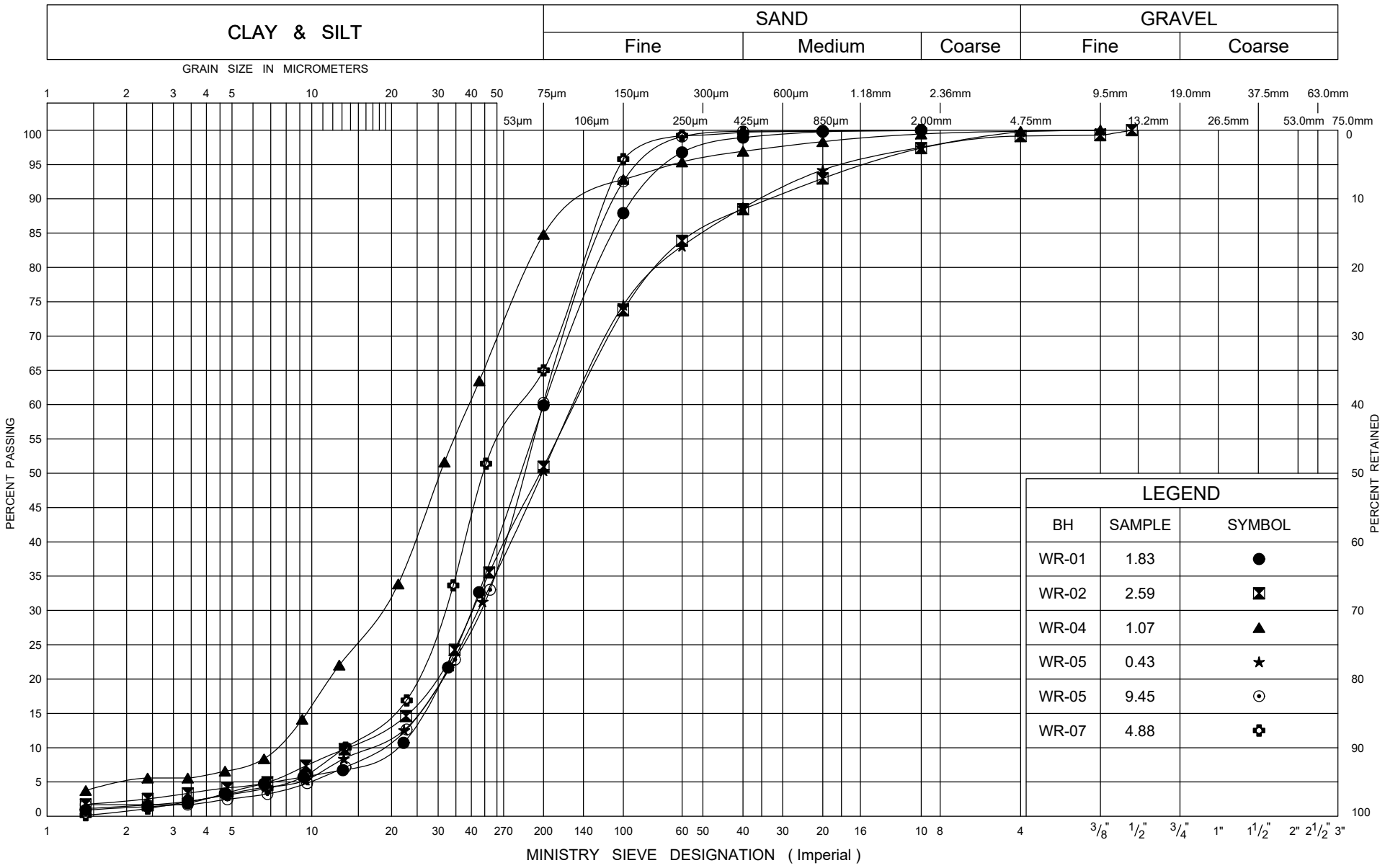
SAND to SILTY SAND FILL

FIG No C1

GWP# 5298-19-00

White River Patrol Yard

ONTARIO MOT GRAIN SIZE 2 SOIL-37466.GPJ ONTARIO MOT.GDT 10/16/24



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

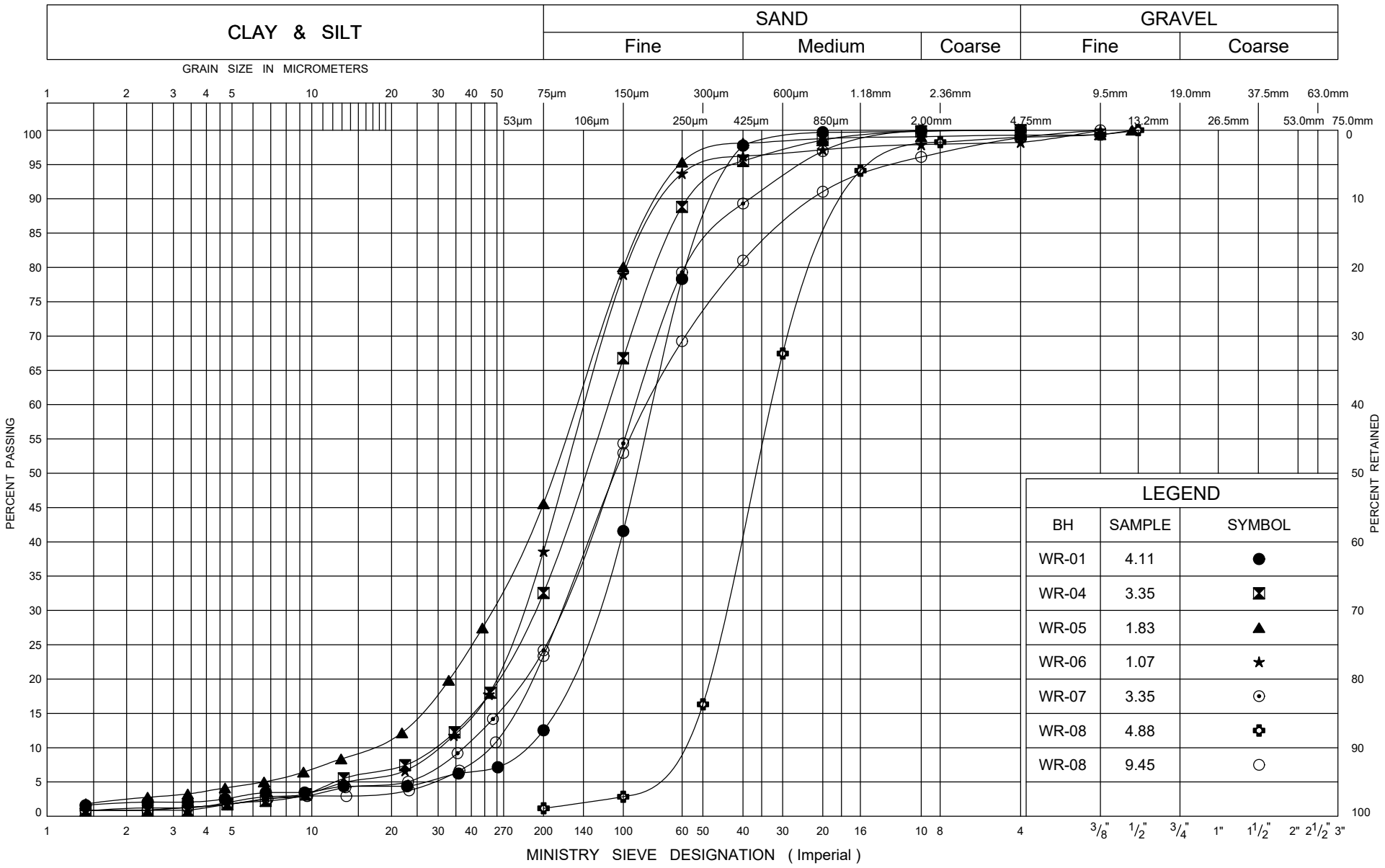
SANDY SILT to SILT

FIG No C2

GWP# 5298-19-00

White River Patrol Yard

ONTARIO MOT GRAIN SIZE 2 SOIL-37466.GPJ ONTARIO MOT.GDT 9/23/24



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GRAIN SIZE DISTRIBUTION

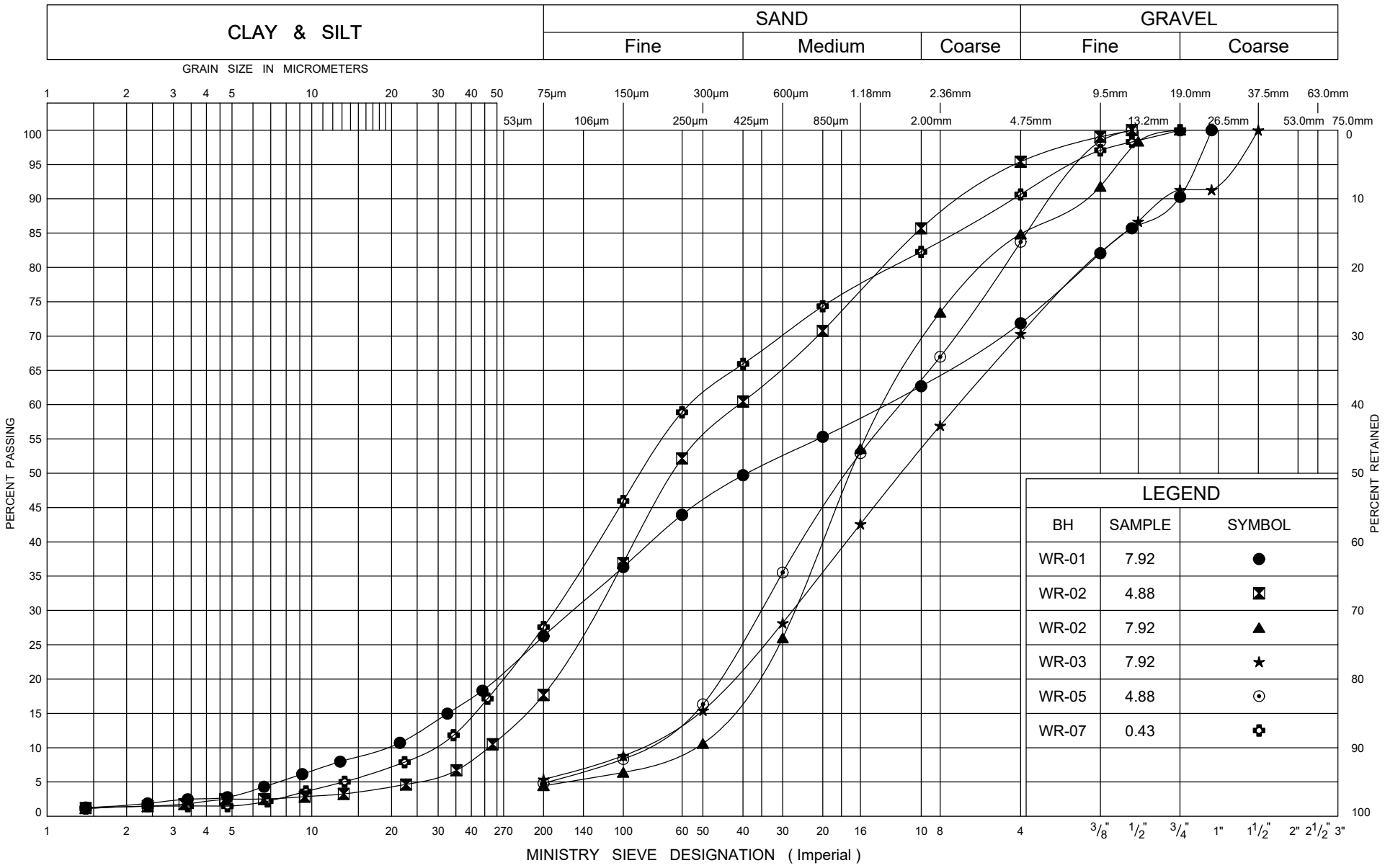
SAND to SILTY SAND

FIG No C3

GWP# 5298-19-00

White River Patrol Yard

ONTARIO MOT GRAIN SIZE 2 SOIL-37466.GPJ ONTARIO MOT.GDT 9/23/24



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

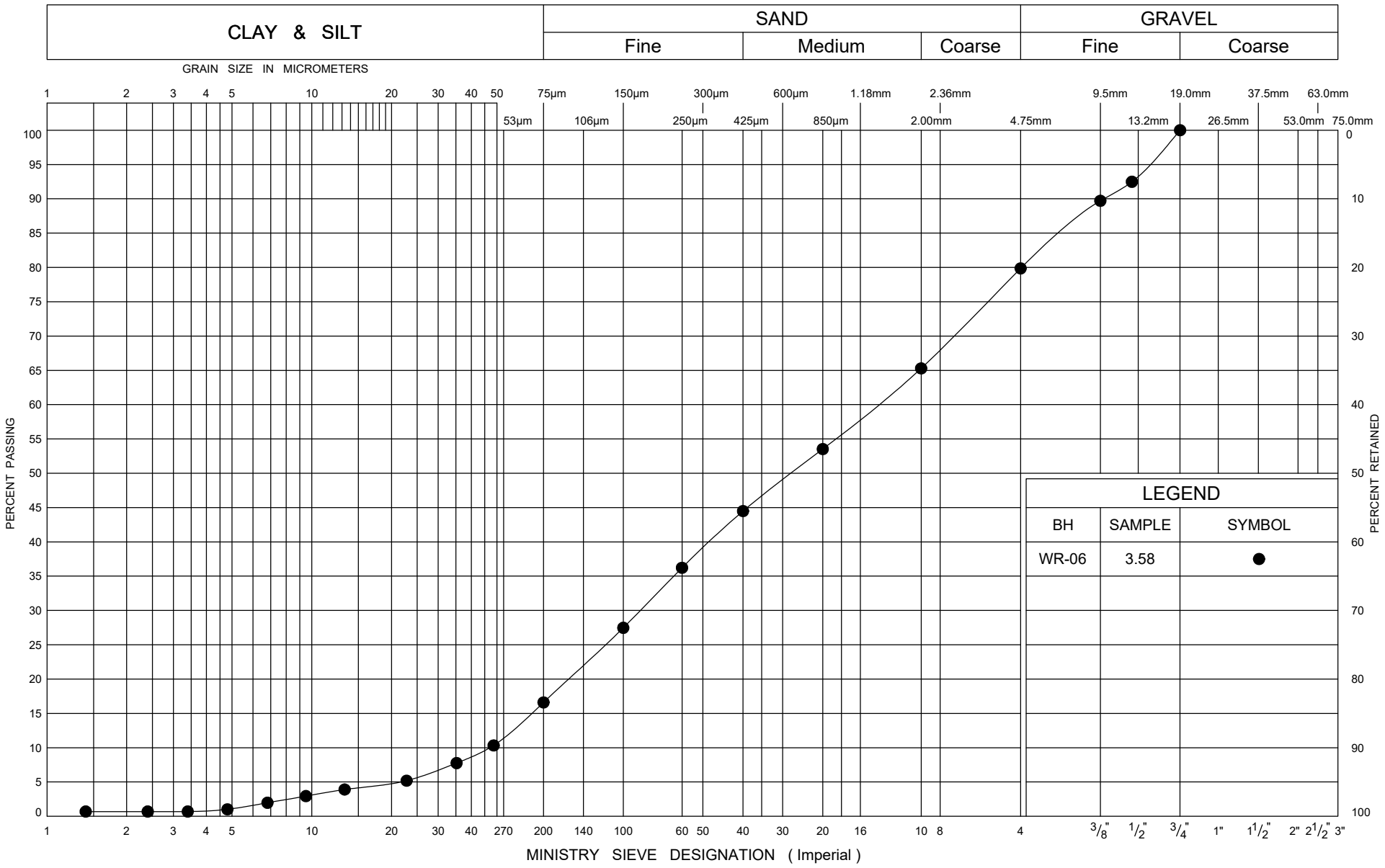
SAND with Silt and Gravel to SILTY SAND

FIG No C4

GWP# 5298-19-00

White River Patrol Yard

ONTARIO MOT GRAIN SIZE 2 SOIL-37466.GPJ ONTARIO MOT.GDT 10/16/24



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND with Gravel (Interlayer)

FIG No C5

GWP# 5298-19-00

White River Patrol Yard

ONTARIO MOT GRAIN SIZE 2 SOIL-37466.GPJ ONTARIO MOT.GDT 10/16/24

FINAL REPORT

CA40150-AUG24 R1

37466, North Bay

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Thurber Engineering Ltd.
Address	1908 Ironoak Way, Suite 202 Cambridge, ON L6H 0N1. Canada
Contact	Alysha Kobylinski
Telephone	226-748-9593
Facsimile	
Email	akobylinski@thurber.ca
Project	37466, North Bay
Order Number	
Samples	Soil (3)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2143
Facsimile	705-652-6365
Email	brad.moore@sgs.com
SGS Reference	CA40150-AUG24
Received	08/22/2024
Approved	08/28/2024
Report Number	CA40150-AUG24 R1
Date Reported	08/28/2024

COMMENTS

Temperature of Sample upon Receipt: 9 degrees C
Cooling Agent Present:yes
Custody Seal Present:yes

Chain of Custody Number:n/a

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

Client: Thurber Engineering Ltd.
Project: 37466, North Bay
Project Manager: Alysha Kobylinski
Samplers: Kamil F. / Essan A.

MATRIX: SOIL

Sample Number	5	6	7
Sample Name	BH-WR-2 SS#4 7.5-9.5	BH-WR-4 SS#5 10-12	BH-WR-8 SS#6 12.5-14.5
Sample Matrix	Soil	Soil	Soil
Sample Date	06/07/2024	06/07/2024	06/07/2024

Parameter	Units	RL		Result	Result	Result
Corrosivity Index						
Corrosivity Index	none	1		1	4	4
pH	pH Units	0.05		8.46	9.03	9.05
Soil Redox Potential	mV	no		295	282	319
Sulphide (Na2CO3)	%	0.01		< 0.01	< 0.01	< 0.01
Resistivity (calculated)	ohms.cm	-9999		5560	6100	9090
General Chemistry						
Conductivity	uS/cm	2		180	164	110
Metals and Inorganics						
Sulphate	µg/g	0.4		92	5.0	3.2
Other (ORP)						
Chloride	µg/g	0.4		3300	33	6.6

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0513-AUG24	µg/g	0.4	<0.4	9	35	102	80	120	106	75	125
Sulphate	DIO0513-AUG24	µg/g	0.4	<0.4	5	35	105	80	120	97	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0060-AUG24	%	0.01	< 0.01								

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0499-AUG24	uS/cm	2	< 2	0	20	100	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0499-AUG24	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.
Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.
"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.
Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS Industries & Environment - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: Page 1 of 1

Laboratory Information Section - Lab use only

Received By: EO
Received Date: 8/22/24 (mm/dd/yy)
Received Time: 10:40 (hr : min)
Received By (signature):
Custody Seal Present: Yes ☑ No ☐
Custody Seal Intact: Yes ☑ No ☐
Cooling Agent Present: Yes ☑ No ☐ Type: ICE
Temperature Upon Receipt (°C): 4.4.3
LAB LIMS #: CA40150-AUG24

REPORT INFORMATION	INVOICE INFORMATION
Company: Thurber Engineering Ltd.	☑ (same as Report Information)
Contact: Alysha Kobylinski	Company:
Address: 250 Thompson Drive - Unit 3	Contact:
Cambridge, ON	Address:
Phone: 226-748-9593	
Fax: –	Phone:
Email: akobylinski@thurber.ca	Email:

Quotation #: P.O. #:
Project #: 37466 Site Location/ID: North Bay

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days) — TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: 8/30/24

*NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

☐ O.Reg 153/04 ☐ O.Reg 406/19
☐ Table 1 ☐ Res/Park Soil Texture: ☐ Coarse
☐ Table 2 ☐ Ind/Com ☐ Medium/Fine
☐ Table 3 ☐ Agri/Other
☐ Table _____ App. _____
Soil Volume ☐ <350m3 ☐ >350m3

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: _____ ☐ MISA ☐ ODWS Not Reportable *See note

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	M&I: Metals & Inorganics (incl CrVI, CN, Hg pH (B(HWS),EC,SAR,-soil) (Cl, Na-water)	M&I: Full Metals Suite (ICP metals plus B(HWS-soil only) Hg, CrVI	M&I: ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni,Se,Ag,Tl,U,V,Zn	SVOC: PAHs only	SVOC: SVOCs all incl PAHs, ABNs, CPs	PCB: PCBs Total ☐ Aroclor ☐	PHC: F1-F4 + BTEX	PHC: F1-F4 only no BTEX	VOC: VOCs all incl BTEX	VOC: BTEX only	Pest: Pesticides Organochlorine or specify other	Other: Corrosivity Pkg + Sulphide	Other	Other	Other	Other: Sewer Use: Specify pkg:	Other: Water Characterization Pkg General ☐ Extended ☐	SPLP: Specify tests ☐ Metals ☐ VOC ☐ 1,4-Dioxane ☐ OCP ☐ ABN	TCLP: Specify tests ☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit.	COMMENTS:
1	BH-WR-2 SS#4 7.5-9.5	2024-07-06	PM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	Corrosivity Pkg + Sulphide
2	BH-WR-4 SS#5 10-12	2024-07-06	PM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	Corrosivity Pkg + Sulphide
3	BH-WR-8 SS#6 12.5-14.5	2024-07-06	PM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	Corrosivity Pkg + Sulphide
4							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
5							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
6							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
7							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
8							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
9							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
10							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
11							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
12							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Observations/Comments/Special Instructions

Sampled By (NAME): KAMIL F / ESSAN A Signature: Date: ____/____/____ (mm/dd/yy)

Relinquished by (NAME): Signature: Date: ____/____/____ (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.6
Date of Issue: 11 June 2021

Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. {2} Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). {3} Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

APPENDIX D

- 2020 National Building Code of Canada – Seismic Hazard Values

Government of Canada Gouvernement du Canada

Canada.ca › Natural Resources Canada › Earthquakes Canada

2020 National Building Code of Canada Seismic Hazard Tool

This application provides seismic values for the design of buildings in Canada under Part 4 of the National Building Code of Canada (NBC) 2020 as prescribed in Article 1.1.3.1. of Division B of the NBC 2020.

Seismic Hazard Values

User requested values

Code edition	NBC 2020
Site designation X_S	X_D
Latitude (°)	48.593
Longitude (°)	-85.27

Please select one of the tabs below.

NBC 2020 | Additional Values | Plots | API | Background Information

The 5%-damped spectral acceleration ($S_a(T,X)$, where T is the period, in s, and X is the site designation) and peak ground acceleration (PGA(X)) values are given in units of acceleration due to gravity (g, 9.81 m/s^2). Peak ground velocity (PGV(X)) values are given in m/s. Probability is expressed in terms of percent exceedance in 50 years. Further information on the calculation of seismic hazard is provided under the *Background Information* tab.

The 2%-in-50-year seismic hazard values are provided in accordance with Article 4.1.8.4. of the NBC 2020. The 5%- and 10%-in-50-year values are provided for additional performance checks in accordance with Article 4.1.8.23. of the NBC 2020.

See the *Additional Values* tab for additional seismic hazard values, including values for other site designations, periods, and probabilities not defined in the NBC 2020.

NBC 2020 - 2%/50 years (0.000404 per annum) probability

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$
0.121	0.122	0.07	0.0314	0.00731	0.00231	0.0697	0.0684

The log-log interpolated 2%/50 year $S_a(4.0, X_D)$ value is : **0.0104**

▼ Tables for 5% and 10% in 50 year values

NBC 2020 - 5%/50 years (0.001 per annum) probability

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$
0.0671	0.069	0.0383	0.0163	0.00347	0.0011	0.037	0.0357

The log-log interpolated 5%/50 year $S_a(4.0, X_D)$ value is : **0.0051**

NBC 2020 - 10%/50 years (0.0021 per annum) probability

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$
0.0404	0.0413	0.0219	0.00878	0.00171	0.000535	0.0216	0.0199

The log-log interpolated 10%/50 year $S_a(4.0, X_D)$ value is : **0.0025**

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Date modified: 2021-04-06

APPENDIX E

- Results of Stability Analyses of Stockpiles in Material Storage Building

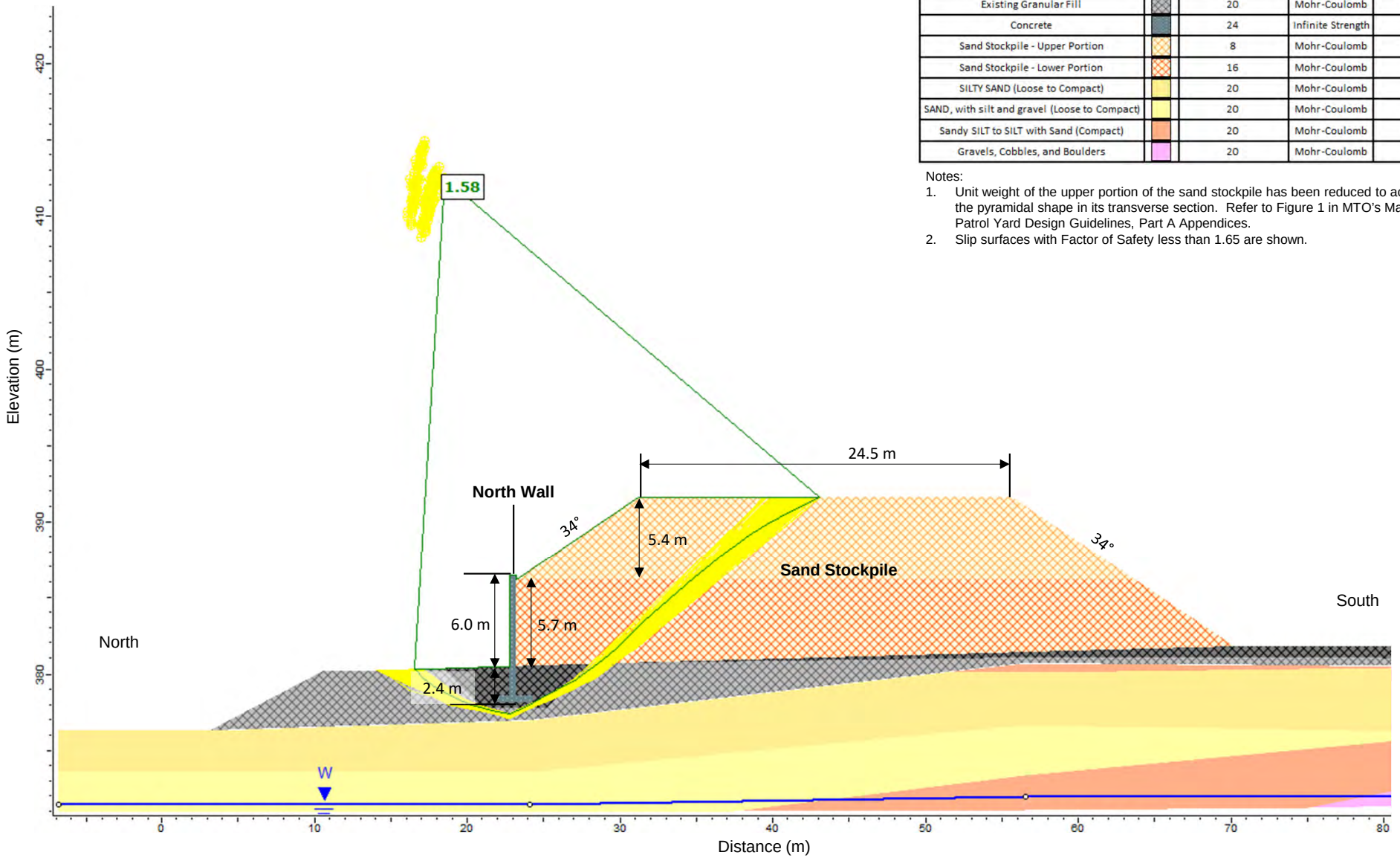
THURBER

G.W.P. 5298-19-00 White River Maintenance Patrol Yard
Stability of Sand Stockpile in Material Storage Building
Permanent / Temporary Conditions

Figure E1

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
New Granular Fill		22	Mohr-Coulomb	0	35
Existing Granular Fill		20	Mohr-Coulomb	0	28
Concrete		24	Infinite Strength		
Sand Stockpile - Upper Portion		8	Mohr-Coulomb	0	34
Sand Stockpile - Lower Portion		16	Mohr-Coulomb	0	34
SILTY SAND (Loose to Compact)		20	Mohr-Coulomb	0	30
SAND, with silt and gravel (Loose to Compact)		20	Mohr-Coulomb	0	30
Sandy SILT to SILT with Sand (Compact)		20	Mohr-Coulomb	0	32
Gravels, Cobbles, and Boulders		20	Mohr-Coulomb	0	35

Notes:
1. Unit weight of the upper portion of the sand stockpile has been reduced to account for the pyramidal shape in its transverse section. Refer to Figure 1 in MTO's Maintenance Patrol Yard Design Guidelines, Part A Appendices.
2. Slip surfaces with Factor of Safety less than 1.65 are shown.



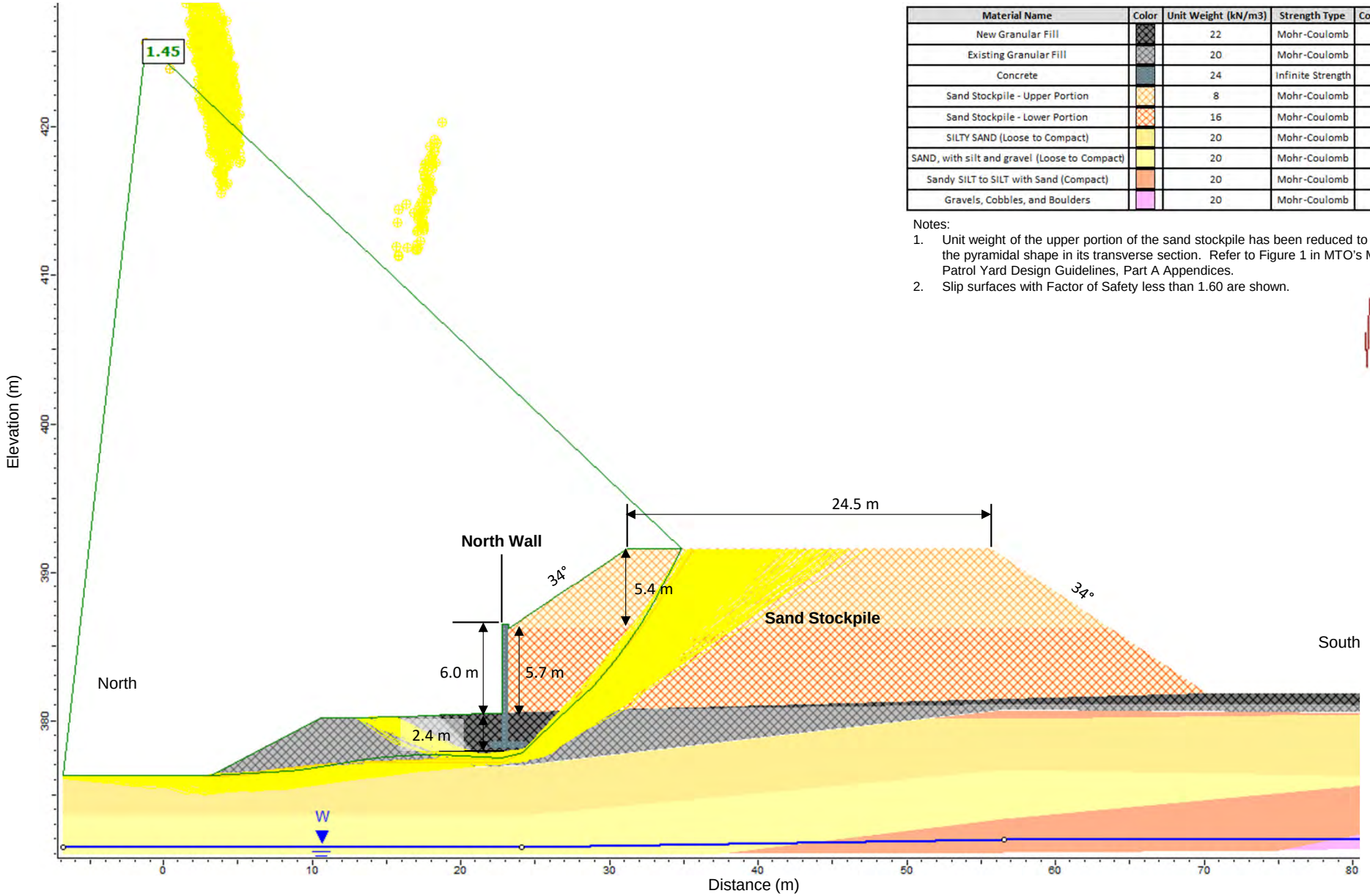
Date: March 2025
Project No.: 37466-10

Analysis By: ACK
Checked By: CN

THURBER

G.W.P. 5298-19-00 White River Maintenance Patrol Yard
Stability of Sand Stockpile in Material Storage Building
Seismic Condition

Figure E2



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
New Granular Fill		22	Mohr-Coulomb	0	35
Existing Granular Fill		20	Mohr-Coulomb	0	28
Concrete		24	Infinite Strength		
Sand Stockpile - Upper Portion		8	Mohr-Coulomb	0	34
Sand Stockpile - Lower Portion		16	Mohr-Coulomb	0	34
SILTY SAND (Loose to Compact)		20	Mohr-Coulomb	0	30
SAND, with silt and gravel (Loose to Compact)		20	Mohr-Coulomb	0	30
Sandy SILT to SILT with Sand (Compact)		20	Mohr-Coulomb	0	32
Gravels, Cobbles, and Boulders		20	Mohr-Coulomb	0	35

Notes:
1. Unit weight of the upper portion of the sand stockpile has been reduced to account for the pyramidal shape in its transverse section. Refer to Figure 1 in MTO's Maintenance Patrol Yard Design Guidelines, Part A Appendices.
2. Slip surfaces with Factor of Safety less than 1.60 are shown.

Date: March 2025
Project No.: 37466-10

Analysis By: ACK
Checked By: CN

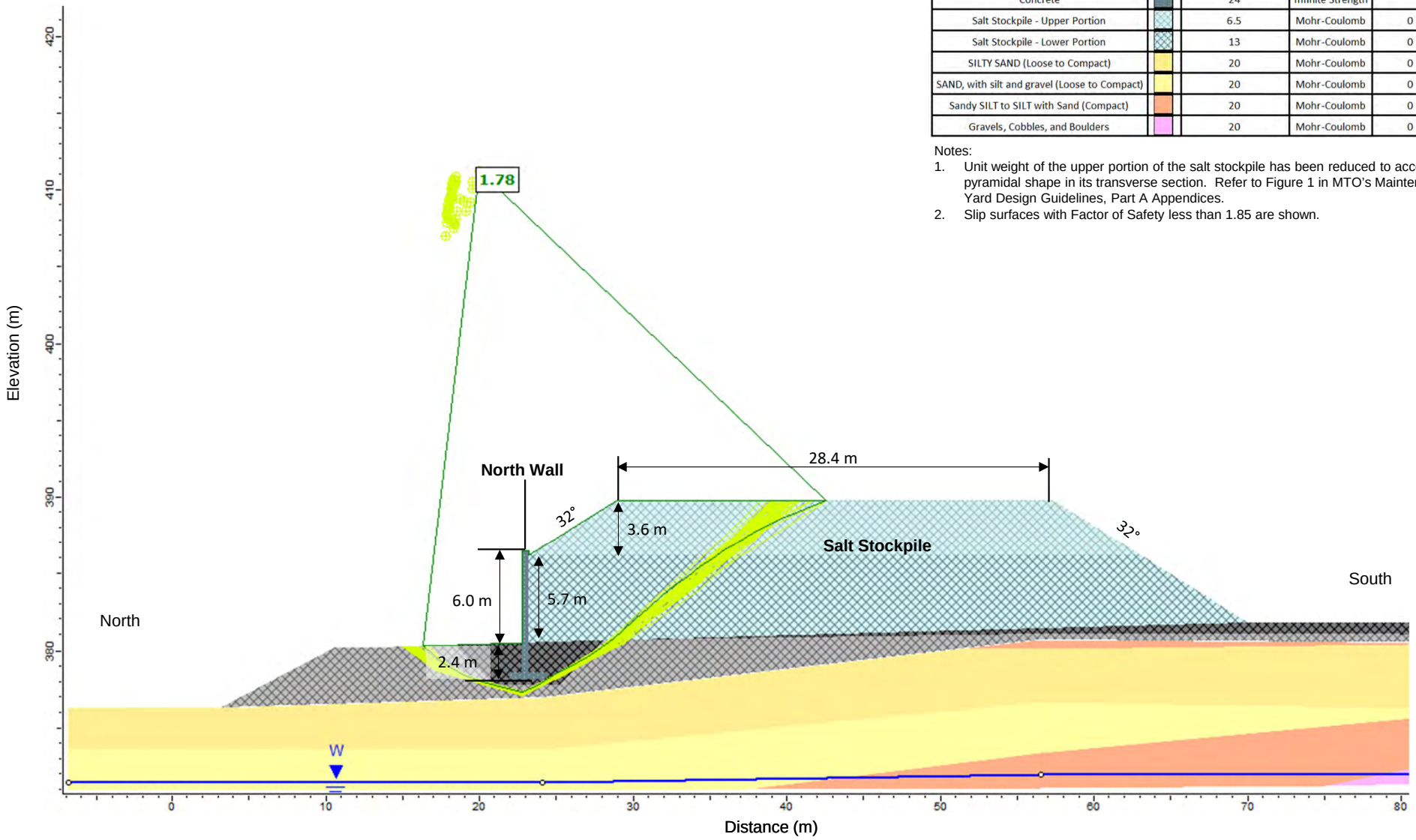
THURBER

G.W.P. 5298-19-00 White River Maintenance Patrol Yard
Stability of Salt Stockpile in Material Storage Building
Permanent / Temporary Conditions

Figure E3

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
New Granular Fill		22	Mohr-Coulomb	0	35
Existing Granular Fill		20	Mohr-Coulomb	0	28
Concrete		24	Infinite Strength		
Salt Stockpile - Upper Portion		6.5	Mohr-Coulomb	0	32
Salt Stockpile - Lower Portion		13	Mohr-Coulomb	0	32
SILTY SAND (Loose to Compact)		20	Mohr-Coulomb	0	30
SAND, with silt and gravel (Loose to Compact)		20	Mohr-Coulomb	0	30
Sandy SILT to SILT with Sand (Compact)		20	Mohr-Coulomb	0	32
Gravels, Cobbles, and Boulders		20	Mohr-Coulomb	0	35

Notes:
1. Unit weight of the upper portion of the salt stockpile has been reduced to account for the pyramidal shape in its transverse section. Refer to Figure 1 in MTO's Maintenance Patrol Yard Design Guidelines, Part A Appendices.
2. Slip surfaces with Factor of Safety less than 1.85 are shown.



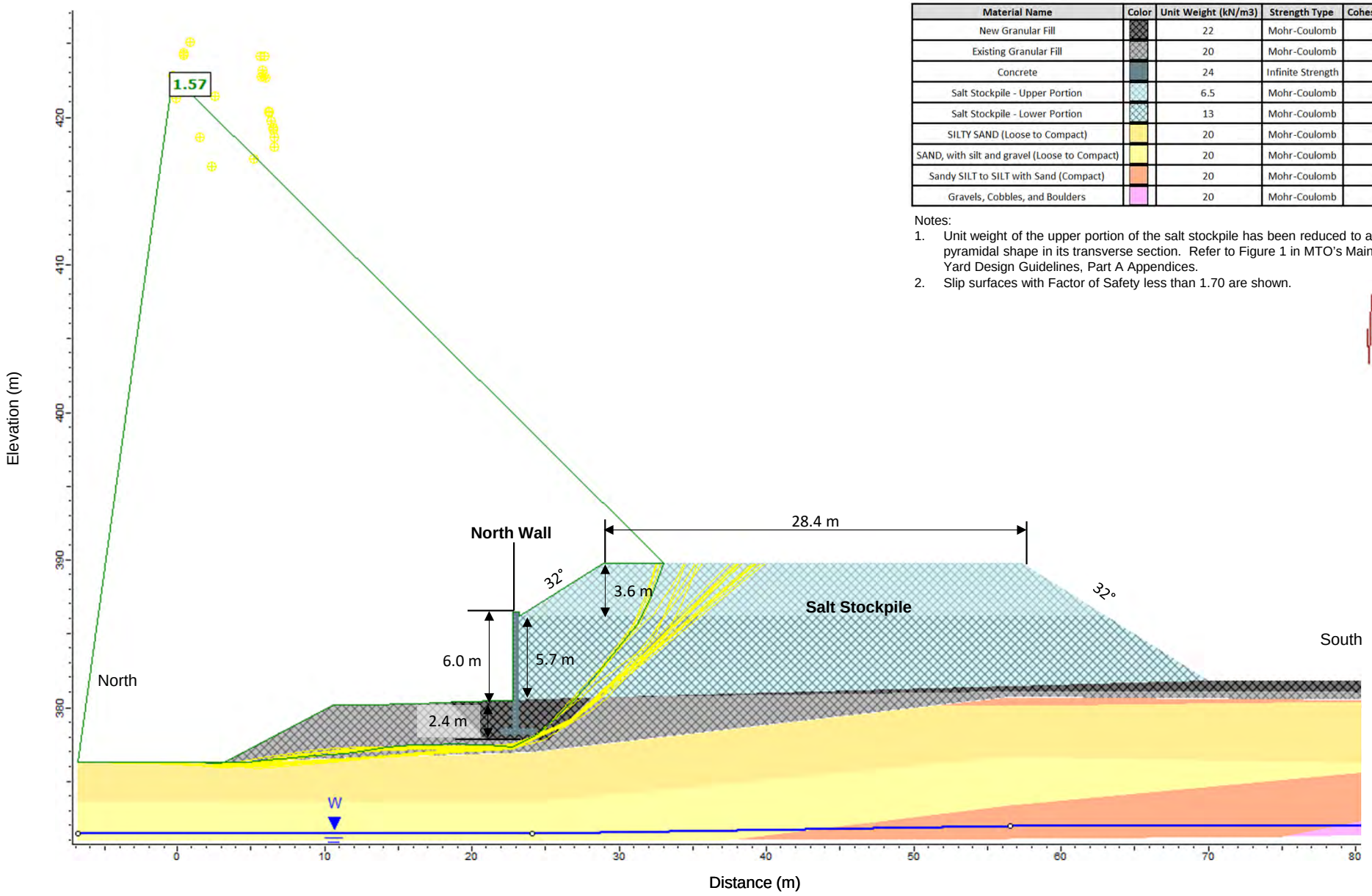
Date: March 2025
Project No.: 37466-10

Analysis By: ACK
Checked By: CN

THURBER

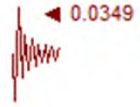
G.W.P. 5298-19-00 White River Maintenance Patrol Yard
Stability of Salt Stockpile in Material Storage Building
Seismic Condition

Figure E4



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
New Granular Fill		22	Mohr-Coulomb	0	35
Existing Granular Fill		20	Mohr-Coulomb	0	28
Concrete		24	Infinite Strength		
Salt Stockpile - Upper Portion		6.5	Mohr-Coulomb	0	32
Salt Stockpile - Lower Portion		13	Mohr-Coulomb	0	32
SILTY SAND (Loose to Compact)		20	Mohr-Coulomb	0	30
SAND, with silt and gravel (Loose to Compact)		20	Mohr-Coulomb	0	30
Sandy SILT to SILT with Sand (Compact)		20	Mohr-Coulomb	0	32
Gravels, Cobbles, and Boulders		20	Mohr-Coulomb	0	35

Notes:
1. Unit weight of the upper portion of the salt stockpile has been reduced to account for the pyramidal shape in its transverse section. Refer to Figure 1 in MTO's Maintenance Patrol Yard Design Guidelines, Part A Appendices.
2. Slip surfaces with Factor of Safety less than 1.70 are shown.



Date: March 2025
Project No.: 37466-10

Analysis By: ACK
Checked By: CN

THURBER

APPENDIX F

- Foundation Engineering Parameters for the Design of Noise Barrier Wall

Table F1: Foundation Engineering Parameter Table for the Design of Noise Barrier Wall

Borehole	Ground Elevation (m)	Soil Deposit	Depth Below Existing Grade (m)	Design Parameters (1)					Depth of Frost Penetration (m)	Depth of Groundwater (m)
				S_u (kPa)	ϕ' (°)	γ (kN/m^3)	γ' (kN/m^3)	K_p (2)		
--	--	New Compacted Engineered Fill	--	--	34	21	12	3.5	2.4	371.8
WR-01	380.8	Loose Sand with gravel Fill	0.0 – 0.2	--	29	20	10	2.9		
		Very Loose to Loose Silt with sand to Silty Sand	0.2 – 7.2	--	28	20	10	2.7		
		Dense to Very Dense Silty Sand with gravel	7.2 – 9.5	--	32	21	11	3.3		
WR-02	380.8	Very Loose to Loose Sand with gravel to Sandy Silt Fill	0.0 – 3.8	--	28	20	10	2.7		
		Loose to Compact Silty Sand to Sand with silt and gravel	3.8 – 9.8	--	30	20	10	3.0		
WR-03	381.1	Loose to Compact Sand to Sand with silt and gravel Fill	0.0 – 4.9	--	30	20	10	3.0		
		Loose Silty Sand to Sand with silt and gravel	4.9 – 11.3	--	30	20	10	3.0		

Design Parameters:

S_u = Undrained shear strength (kPa)

ϕ' = Effective friction angle (°)

γ = Bulk unit weight (kN/m^3)

γ' = Effective unit weight below groundwater level (kN/m^3)

K_p = Passive earth pressure coefficient

Notes: 1) The passive resistance within the depth of frost penetration should be neglected to account for frost action.

2) The total passive resistance may be calculated based on the K_p indicated above but reduced by an appropriate factor that considers the allowable movement of the footing in accordance with Figure C6.27 of the Canadian Highway Bridge Design Code (CHBDC, 2019) to account for large strain required to mobilize full passive resistance.

3) The information provided herein is presented for design purposes only.

APPENDIX G

- Non-Standard Special Provision – Obstructions

OBSTRUCTIONS

Non-Standard Special Provision

The Contractor shall be alerted to the presence of cobbles and boulders within the fill and native soils that may interfere with construction and as such, consideration must be made in the selection of appropriate equipment and procedures for excavations through the obstructions. The Contractor must be prepared to dislodge, remove, or otherwise penetration through the cobbles and boulders.