



Foundation Investigation and Design Report

EARLTON REST AREA UPGRADES, HIGHWAY 11, EARLTON, ONTARIO, GWP 5114-24-00,
ASSIGNMENT 5023-E-0007, WORK ITEM 05

07 February 2025

GEOCRES NO.: 31M12-001

Location	Coordinates (Latitude, Longitude in °)
Earlton Rest Area, Highway 11, Earlton, Ontario	47.697249, -79.788337

Distribution:

- 1 PDF & 1 Copy – Ministry of Transportation, Ontario (Northeast Region)
- 1 PDF & 1 Copy - Ministry of Transportation, Ontario (Foundations Section)
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PART A – FOUNDATION INVESTIGATION REPORT

**EARLTON REST AREA UPGRADES, MINISTRY OF TRANSPORTATION, ONTARIO,
GWP 5114-24-00, ASSIGNMENT 5023-E-0007, WORK ITEM 05**

1. Introduction

As part of Assignment 5023-E-0007, Work Item Order 05, GHD Limited (GHD) was retained by the Ministry of Transportation, Ontario (MTO), to provide foundation investigation and engineering services for a new rest area facility at Earlton Rest Area, located in Earlton, Ontario (see the Key Plan on Drawing 1). Herein, GHD provides factual information about the subsurface and groundwater conditions at the proposed rest area facility as well as foundation recommendations and construction considerations (including Notice to Contractor and NSSPs, as applicable). A Foundation Drawing consisting of borehole locations and soil strata profile is also prepared and provided in Drawing 1.

The Terms of Reference (TOR) and the scope of work for this project are identified within the agreement of services as amended between MTO and GHD for Consultant's Assignment Number 5023-E-0007, Work Item Order 05. The work has been carried out in accordance with the requirements of *Guideline for Foundation Engineering Services, Version 3.0, April 2022*, prepared by the MTO.

2. Site Description

The existing Earlton Rest Area is located along Highway 11, in Earlton, Ontario. The existing facility consists of a gated entrance loop driveway leading to two toilet enclosures, garbage disposals, picnic benches and green landscaped areas with trees.

The proposed 24/7 custom-build heated facility will be a single storey building founded on shallow footings with interior and exterior slab on grade. It will have at a minimum, two unobstructed-view building egress points, CCTV local monitoring, a clear building exterior, a universal washroom, a barrier-free washroom, a utility room, and a waiting area with benches. A drinking water well is planned to the northwest of the proposed building. Septic tank and septic bed are planned to the southeast and northeast of the proposed building, respectively.

The general grade at the site is flat and is mostly covered by existing pavement (asphalt) and topsoil.

General site conditions are shown in Photograph 1 presented in **Appendix A**.

3. Investigation Procedures

For the proposed building and septic bed, the geotechnical fieldwork was carried out between November 4, 2024 and November 5, 2024, during which four (4) foundation boreholes designated as Boreholes ET-BH01A-24, ET-MW01-24 to ET-MW03-24 were advanced to depths ranging from 1.7 m to 6.9 m below ground surface and seven (7) pavement boreholes, designated as Boreholes ET-BH04-24 and ET-BH10-24, were advanced to depths ranging from 2.2 m to 3.2 m below ground surface. Please note that this report only discusses the findings from foundation boreholes designated as Boreholes ET-BH01A-24, ET-MW01-24 to ET-MW03-24.

Prior to the start of fieldwork, utility clearance procedures were carried out through Ontario One Call and MTO locates, and fieldwork notification was sent to MTO Northeast Region. A project specific Health and Safety as well as Traffic Protection Plans were prepared before commencement of the fieldwork. In addition, the borehole locations were marked by GHD staff prior to drilling. All drilling activity, soil sampling and logging, and backfilling of boreholes were conducted under the full-time supervision of an experienced GHD geotechnical staff.

The boreholes were advanced using a truck-mounted drill rig, equipped with 200 mm outer diameter hollow stem augers, supplied, and operated by Landcore Drilling from Chelmsford, Ontario. The drilling operations are

shown in Photographs 2 to 4 presented in **Appendix A**. Soil samples were obtained at 0.75 m depth intervals to a depth of 5 m below existing ground surface and at 1.5 m depth intervals below a depth of 5 m below existing ground surface. Soil samples were obtained using a 50 mm outer-diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedures described in ASTM D1586¹. Bedrock was cored using NQ sized diamond coring bit and wireline coring setup. Where very soft to firm cohesive deposits were encountered, in-situ field vane shear tests were attempted using an MTO 'N'-size vane to assess the strength characteristics of these soils in accordance with ASTM D2573². Soil samples obtained from the boreholes were inspected in the field immediately upon retrieval for type, texture, and color. All retrieved samples from the investigation were sealed in clean plastic bags and transported to the GHD laboratory in Peterborough, Ontario for further visual examination, and geotechnical laboratory tests.

Boreholes ET-MW01-24 to ET-MW03-24 were converted to groundwater monitoring wells and remaining boreholes were backfilled with bentonite and sealed at the top with compacted auger cuttings and cold-patch asphalt as required, in accordance with Ontario Regulation 903 (as amended).

Surveying of the as-drilled borehole locations was conducted, which provided northing and easting in MTM NAD 83 (Zone 12) coordinates. The vertical and horizontal accuracy of the survey was 25 mm and 15 mm, respectively. The ground surface elevations are referenced to Geodetic datum. The coordinates and ground surface elevation are presented below in Table 3.1, on the borehole records and on Drawing 1.

Table 3.1 **Borehole Locations and Elevations**

Structure & Location	Borehole Number	Borehole Coordinates MTM ZONE 13, NAD 83(CSRS)v6		Borehole Depth (m)	Ground Surface Elevation (m)	End of Borehole Elevation (m)
		Northing, m (Latitude, °)	Easting, m (Longitude, °)			
Earlton Rest Area	ET-BH01A-24	5284949.0 (47.697250)	395783.1 (-79.787748)	1.7	263.4	261.7
	ET-MW01-24	5284948.4 (47.697240)	395809.3 (-79.787398)	6.9	264.6	257.7
	ET-MW02-24	5284960.4 (47.697354)	395769.9 (-79.787921)	1.8	263.1	261.3
	ET-MW03-24	5284926.1 (47.697043)	395786.9 (-79.787702)	2.3	263.6	261.3

Classification testing (i.e., water content, Atterberg limits and grain size distribution) was carried out on selected soil samples. Unconfined compressive strength (UCS) testing was carried out on selected rock samples. All laboratory tests were conducted in accordance with MTO and/or American Society for Testing Materials (ASTM) standards, as appropriate.

4. Site Geology and Subsurface Conditions

4.1 Regional Geology

The site is located within the physiographic region known as the James Shield Region, as delineated in *The Physiography Regions Map of Canada* (Bostock, 1967)³. The surficial soils in proximity to the site generally

¹ ASTM D1586-08a – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of the soil.

² ASTM D2573-15 Standard Test Method for Field Vane Shear Test in Saturated Fine-Grained Soils

³ Physiographic Regions of Canada. 1254A. Scale 1:5M compiled by H.S. Bostock. 1967. Geological Survey of Canada.

consist of silty clayey glaciolacustrine soils as per *Northern Ontario Surficial Geology mapping*⁴. The majority of the region is characterized by ground moraine and glaciolacustrine plains, surrounded by dikes⁴. As per *Bedrock Geology Mapping of Ontario*⁵, The bedrock at this site consists of sandstone, shale, dolostone, siltstone rocks of the Lower Silurian Age.

4.2 Subsurface Conditions

Details of the subsurface soil and groundwater conditions as encountered in the boreholes advanced during the geotechnical investigation and the results of the laboratory tests carried out on selected soil samples are presented on the borehole records provided in **Appendix B**. The *Notes on Borehole and Test Pit Reports* are also included in **Appendix B** to assist in the interpretation of the borehole records. Rock core photographs are included in **Appendix C**. The results of the geotechnical laboratory testing are contained in **Appendix D**. The results of in-situ field tests (i.e., SPT “N” values), as presented on the borehole records and in the sub-sections of Section 4.2 are uncorrected.

The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling, observations of drilling progress, the results of the Standard Penetration Tests and in-situ vane shear tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations; however, the factual data presented in the borehole records governs any interpretation of the site conditions.

The general subsurface conditions consist of topsoil, underlain by very loose to compact non-cohesive fill material consisting of silty sand and stiff cohesive fill material consisting of sandy silty clay. Below the soil overburden, Dolomite/Limestone bedrock was encountered.

Detailed descriptions of subsurface conditions are provided in the following sections of this report. The subsurface conditions are described in accordance with the Ontario Ministry of Transportation (MTO) Guideline for Foundation Engineering Services Version 3.0 (April 2022).

4.2.1 Topsoil

All boreholes encountered topsoil immediately at ground surface ranging in thickness from about 280 mm to 457 mm.

4.2.2 Fill Material

Underlying the topsoil in all boreholes, non-cohesive fill material consisting of silty sand and cohesive fill material consisting of sandy silty clay was encountered to bottom depths ranging from about 1.5 m to 2.3 m below existing ground surface (bottom Elevations 262.3 m to 261.3 m).

The SPT “N” values recorded in the non-cohesive fill ranged from 3 blows to 21 blows per 0.3 m of penetration, indicating that the non-cohesive fill encountered in the boreholes has a very loose to compact relative density. The non-cohesive fill material also consisted of low to high plasticity fines.

The SPT “N” value recorded in the cohesive fill was 9 blows per 0.3 m of penetration, suggesting that the cohesive fill encountered in the boreholes has a stiff consistency.

Grain size distribution testing was conducted on six representative samples of the fill material and the results are presented on Figures D-1 and D-2 in **Appendix D**. Atterberg Limits testing was conducted on six representative samples of the fill material and the results are presented on Figures D-3 and D-4 in **Appendix D**. The liquid limits ranged from 16% to 40%, the plastic limit ranged from 12% to 23% and the plasticity index

⁴ Ontario Geological Survey, Ministry of Northern Development and Mines, and Northeast Science and Information Section, Ministry of Natural Resources 2005. Digital Northern Ontario Engineering Geology Terrain Study (NOEGTS); Ontario Geological Survey, Miscellaneous Release-Data 160

⁵ Ontario Geological Survey 2011. 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release-Data 126-Revision 1

ranged from 3% to 17%. The water content measured on samples of the fill material ranged from approximately 10% to 33%.

4.2.3 Bedrock

Below the soil overburden, bedrock was encountered to the drilled depths of boreholes. Rock core photographs are included in **Appendix C**. This bedrock was classified as orangish brown to grey Dolomite/Limestone.

Bedrock was identified as slightly weathered (W2) to moderately weathered (W3), and medium strong (R3). Rock strength category was established based on visual inspection through physical assessment and the Unconfined Compression Test (UCS) test results. The Total Core Recovery (TCR) ranged from approximately 80% to 98% and the Solid Core Recovery (SCR) ranged from 40% to 98%. The Rock Quality Designation (RQD) ranged from 18% to 93%.

A laboratory uniaxial compressive strength (UCS) test was carried out on one (1) select rock samples extracted from the cores. The compressive strength was estimated as 45 MPa and the test result is presented in **Appendix D**.

4.2.4 Groundwater

Wet spoon encountered during drilling and the groundwater level in the open boreholes was measured upon completion of drilling each borehole and are summarized below.

Table 4.1 Groundwater Levels

Borehole Number	Wet Spoon Encountered Depth during Drilling (m)	Wet Spoon Encountered Elevation during Drilling (m)	Water Level Depth (m)	Water Level Elevation (m)	Date of Observation (Measurement)
ET-BH01A-24	--	--	Dry*	--	November 5, 2024
ET-MW01-24	--	--	2.3*	262.3	November 4, 2024
			2.9^	261.7	November 4, 2024
			3.0	261.6	December 3, 2024
			3.0	261.6	December 4, 2024
ET-MW02-24	--	--	Dry*	--	November 5, 2024
			Dry^	--	November 5, 2024
			1.7	261.4	December 3, 2024
			1.7	261.4	December 4, 2024
ET-MW03-24	--	--	2.1*	261.5	November 5, 2024
			Dry^	--	November 5, 2024
			2.1	261.5	December 3, 2024
			2.1	261.5	December 4, 2024

*Note: at completion of drilling

^Note: after well installation

The stabilized groundwater level ranged from Elevation 261.6 m to 261.4 m. It should be noted that the groundwater level at the site will fluctuate with seasonal changes, periods of precipitation, and temperature and should be expected to be higher during wet periods of the year.

4.2.5 Soil Corrosivity Testing

Analytical testing was carried out on a select soil sample recovered from Borehole ET-MW01-24. The soil sample was submitted to ALS of Waterloo, Ontario for corrosivity testing. Detailed analytical laboratory test results are provided on the Certificate of Analysis presented in **Appendix E** and are summarized below.

Table 4.2 Corrosivity Results

Borehole ID	Sample Number	Sample Depth (m)	Sample Elevation (m)	Resistivity (ohm.cm)	pH	Redox Potential (mV)	Sulphides (mg/kg)	Sulphate Concentration (%)
ET-MW01-24	SS2	0.8	263.8	20500	5.97	343	<0.26	<0.002

5. Closure

The fieldwork was supervised by Reza Bay (Field Technician with GHD). This section of the report was prepared by Anuj Choudhari, M.Sc., P.Eng., P.E. (Intermediate Geotechnical Engineer with GHD). Nikol Kochmanová, Ph.D., P.Eng., P.M.P. (Senior Geotechnical Engineer with GHD and MTO Foundations Designated Contact) conducted an independent review of this section of the report.

Sincerely,

GHD Limited



Anuj Choudhari, M.Sc., P.Eng., P.E.
Intermediate Geotechnical Engineer




Nikol Kochmanová, Ph.D., P.Eng., P.M.P.
MTO Foundations Designated Contact, Senior Geotechnical Engineer





PART B – DISCUSSION AND ENGINEERING RECOMMENDATIONS

**EARLTON REST AREA UPGRADES, MINISTRY OF TRANSPORTATION, ONTARIO,
GWP 5144-24-00, ASSIGNMENT 5023-E-0007, WORK ITEM 05**

6. Discussion and Engineering Recommendations

This section of the report provides geotechnical design recommendations for a new rest area facility at Earlington Rest Area, located in Earlington, Ontario (see the Key Plan on Drawing 1).

The design parameters and engineering recommendations have been developed and are based on the interpretation of the factual data obtained from the boreholes advanced during the subsurface investigation. These recommendations presented are intended to provide the designers with sufficient information to assess the feasible foundation alternatives, and to develop approximate costs for the proposed rest area facility and to identify items or issues to be addressed in the Contract Documents. This report is intended for the use of the Ministry of Transportation, Ontario (MTO) for the purpose of designing the proposed rest area facility at the above-mentioned site. It shall not be relied upon for any other purpose or by any other parties, including construction or design-build contractor used for any other purposes or locations. The contractor must make their own interpretation based on the factual data in Part A (Foundation Investigation) of the report. Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project and for which special provisions may be required in the Contract Documents. Those requiring information on the aspects of construction must make their own interpretation of the factual information provided, as such interpretation may affect equipment selection, proposed construction methods, scheduling, and the like.

6.1 Seismic Design Parameters

6.1.1 Seismic Site Classification

This Site may be classified as Site Class X_D in accordance with Table 4.1.8.4.-B of the National Building Code of Canada (NBCC) 2020 Volume 1 or Site Class 'D' in accordance with Table 4.1.8.4-A of the National Building Code of Canada (NBCC) 2015 Volume 1 as well as Table 4.1.8.4.A. of the Ontario Building Code (OBC) 2012 Volume 1, (May 12, 2023, update). The Seismic Site Classification was assessed by corrected average penetration resistance.

6.1.2 Spectral Response Values and Seismic Performance Category

Based on the location of the Site, the reference Site Class D spectral acceleration values are shown below in Table 6.1, which were obtained based on NBCC 2020 Seismic Hazard Tool online ([2020 National Building Code of Canada Seismic Hazard Tool](#)) and procedures included in OBC 2012 Volumes 1 and 2 (May 12, 2023, update).

Table 6.1 Peak Ground Acceleration (PGA) and Speed (PGV) Values and Design Spectral Acceleration (S) Values

Seismic Hazard Values	2% Exceedance in 50 years (2,475-year return period) Site Class D NBC 2020 Seismic Hazard Tool	2% Exceedance in 50 years (2,475-year return period) Site Class D OBC 2012 Volumes 1 and 2 (May 12, 2023, Update)
PGA (g)	0.214	0.147
PGV (m/s)	0.206	0.126
S_a (0.2) (g)	0.357	0.226
S_a (0.5) (g)	0.320	0.159

Seismic Hazard Values	2% Exceedance in 50 years (2,475-year return period)	2% Exceedance in 50 years (2,475-year return period)
	Site Class D NBC 2020 Seismic Hazard Tool	Site Class D OBC 2012 Volumes 1 and 2 (May 12, 2023, Update)
S _a (1.0) (g)	0.186	0.091
S _a (2.0) (g)	0.0875	0.0455
S _a (5.0) (g)	0.0231	0.0117
S _a (10.0) (g)	0.00721	0.00447

6.2 Depth of Frost Penetration

The estimated depth of frost penetration at this Site is 2.2 m, based on Ontario Provincial Standard Drawing (OPSD) 3090.100 (Foundation Frost Penetration Depths for Northern Ontario). Since the footings for the proposed rest area building are planned to be founded above the frost depth, vertical and horizontal thermal insulation will be required to provide protection against frost penetration.

The insulation could consist of either high density extruded Polystyrene (EPS) or Styrofoam. As a general guide, minimum 25 mm of insulation thickness is required for every 0.3 m of depth cover above frost penetration line. The insulation should also extend horizontally, a minimum of equivalent frost protection distance (2.2 m) away from the footing extents. However, the exact thickness, dimensions, insulation type and specifications for the frost protection shall be provided by the proprietary manufacturer based on their site-specific assessment.

6.3 Foundation Design

Based on the available information from 60% General Arrangement Drawings, the proposed rest area building finish floor elevation is at Elevation 263.3 m. The footing bottom elevation is at Elevation 262.7 m. The following Table 6.2 provides the expected subsurface soils, subexcavation depth, proposed subsurface strata along with the estimated factored ultimate limit state (ULS) geotechnical resistance and factored serviceability limit state (SLS) geotechnical resistance (for 25 mm of settlement) for the proposed toilet building. The geotechnical resistance factors should be taken in accordance with Table K-1 of Structural Commentaries (User's Guide – NBCC 2020: Part 4 of Division B). For this site, a resistance factor of 0.5 has been used for providing the factored bearing resistance values. Please note that the groundwater elevation assumed for these calculations was at Elevation 262.7 m.

Table 6.2 Factored ULS and SLS Geotechnical Resistances

Structure	Footing Dimensions (m)	Footing Bottom Elevation (m)	Existing Founding Stratum	Subexcavation Bottom Elevation due to Unsuitable Existing Founding Stratum (m)	Proposed Founding Stratum	Factored ULS Resistance (kPa)	Factored SLS Resistance (kPa) for 25 mm Settlement
Proposed Rest Area Building	0.6 m wide strip footing	262.7	Very Loose to Loose Fill Material (Silty Sand) - Unsuitable	262.2	0.5 m thick Compacted Engineered OPSS.PROV 1010 Granular A or Granular B Type II material	150	Not applicable, this value is more than factored ULS Resistance value
	1.0 m wide strip footing	262.7	Very Loose to Loose Fill Material (Silty Sand) - Unsuitable	262.2		150	Not applicable, this value is more than factored ULS Resistance value

Following inspection and proof rolling at the required footing bottom elevation, if the soils are found to be unsuitable (soft/loose with organics), the unsuitable soils could be subexcavated further until suitable competent soils are encountered. The subexcavated areas can be backfilled with granular material meeting Ontario Provincial Standard Specification (OPSS).PROV 1010 (*Aggregates - Base, Subbase Select Subgrade and Backfill Material*) Granular A or Granular B Type II material requirements, placed and compacted in accordance with OPSS.PROV 501 (*Compacting*), up to the founding elevations.

The subgrade soils may be susceptible to loosening/softening and degradation on exposure to water and construction traffic. If the footing concrete or the subexcavation backfill is not placed within twenty-four (24) hours, the upper loosened/softened soils should again be removed and a concrete working slab having a minimum thickness of 100 mm and a minimum 28-day compressive strength of 20 MPa, shall be placed in the excavation within twenty-four (24) hours of exposure of the founding level to protect the integrity of the subgrade.

The geotechnical resistances and settlement are dependent on the proposed building location, footing dimensions and founding elevations and must be reviewed at detailed design stage if any of the above building parameters differ significantly from those assumed at this stage. The geotechnical resistances provided above are based on assumed depth and dimensions of the proposed building footing and the loading applied perpendicular to the surface of the footings with no eccentricity. Where the load is not applied perpendicular to the surface of the footing and is eccentric from the centreline of the footing, the inclination and eccentricity of the load should be considered in accordance with Section 4.2.4.6 of NBCC 2020 Volume 1.

Resistance to lateral forces or sliding resistance for footings should be calculated in accordance with Commentary K of Structural Commentaries (User's Guide – NBCC 2020: Part 4 of Division B). The following unfactored coefficient of friction, $\tan \delta$ values in Table 6.3 may be used to account for the sliding resistance at different interfaces for design.

Table 6.3 Unfactored Coefficient of Sliding Friction, $\tan \delta$

Interface Type	Unfactored Coefficient of Sliding Friction, $\tan \delta$
Cast-in-situ Concrete and Compacted Engineered OPSS.PROV 1010 Granular A or Granular B Type II Material	0.45
Precast Concrete and Compacted Engineered OPSS.PROV 1010 Granular A or Granular B Type II Material	0.42

6.4 Slab on Grade

It is anticipated that slab-on-grade will be part of the foundation system for the proposed rest area building. Concrete slab-on-grade could be constructed on a properly prepared subgrade.

If any localized soft areas are encountered after excavation to the bottom of the slab on grade, as a mitigative measure (but not fully eliminating the risk of differential settlement), at least the upper 1 m of the unsuitable very loose to loose non-cohesive fill material will need to be excavated out and the excavated surface will have to be heavily proof rolled, to at least 98% Standard Proctor Maximum Dry Density (SPMDD). After proof-rolling and any further localized subexcavation for soft spots, the excavated areas should be backfilled with compacted granular material such as OPSS.PROV 1010 (*Aggregates*) Granular A or Granular B Type II material placed in layers to the underside of the slab-on-grade. The subgrade support immediately beneath the slab should consist of 500 mm of OPSS.PROV 1010 Granular A material compacted to 100% SPMDD.

For groundwater control, subfloor drainage system such as PVC slotted subsurface pipes, interceptor drains, and mole drainage are recommended. Alternative to a permanent subfloor drainage system, the slab on grade can instead be structurally reinforced slab and designed as a watertight tank. This will eliminate the need to install and maintain the subfloor drains. In this case, the slab on grade will have to be designed to resist hydrostatic and uplift pressures. Along with this, vapor barriers underneath the slab on grade could be used to minimize moisture inflow through concrete that is in contact with water or water vapor from a high groundwater table.

For the structural design of the concrete slab-on-grade, a combined modulus of subgrade / granular base reaction coefficient (k) as shown in below table can be used.

Table 6.4 Slab on Grade Subgrade Reaction

Structure	Approximate Slab Dimensions (m)	Finish Floor Elevation (m)	Slab Bottom Elevation (m)	Thickness of Granular Pad below Slab on Grade (m)	Equivalent Subgrade Reaction Coefficient (MPa/m)
Proposed Rest Area Building Slab on Grade	7.1 x 10.2	263.3	263.1	0.5	7.0

6.5 Corrosivity Potential to Buried Concrete and Steel

The results of analytical tests carried out on a sample of the non-cohesive soils are presented in Section 4.2.8 and on the Certificate of Analysis in **Appendix E**. The analytical test results were compared to CSA A23.1 Table 3 (Additional Requirements for Concrete Subjected to Sulphate Attack) to assess the potential severity of sulphate attack on concrete during its service life. The sulphate concentrations measured on the soil sample was less than 0.002%, which is below the moderate degree of exposure (i.e., below the class S3 exposure limits). Therefore, based on the soil sample tested when the designer is selecting the exposure class for the concrete structure, the effects of sulphates from within the non-cohesive soils in contact with the portion of the concrete constructed below the ground surface may not need to be considered. However, given that the surroundings of the proposed rest area building will be exposed to de-icing salt/chemicals, consideration should

be given by the designer to designing the concrete structure for a “C” type exposure class as defined by CSA A23.1 Table 1. It is ultimately up to the designer to determine the appropriate construction materials, including the exposure class and ensuring that all aspects of the CSA A23.1:19 Section 4.1.1 “Durability Requirements” are followed when designed concrete elements.

The analytical test results of the soil samples were also compared to Table 2 of the U.S. Criteria for Assessing Ground Corrosion Potential (as derived from Federal Highways Administration (FHWA) 2003) to assess the relative level of corrosion potential on buried steel in contact with soil. The resistivity value measured on the soil sample was 12,800 ohm-cm. It is also noted that the measured pH level was 5.97, suggesting the presence of acidic soils. This overall result is not considered corrosive to grey or ductile iron pipes. Ultimately, it is the designer’s decision to determine the appropriate exposure.

6.6 Excavation and Groundwater Control

Proposed excavations will require removal of the topsoil and existing fill material (silty sand, sandy silty clay). Excavations for the installation of temporary protection systems should be carried out in accordance with the current Ontario Regulation 213/91 and the Occupational Health and Safety Act and Regulations for Construction Projects (OHSA). According to OHSA, the soil classification and corresponding excavation side slopes for the existing fill material to be removed are summarized below in Table 6.5:

Table 6.5 OHSA Soil Classification and Maximum Excavation Side Slopes

Soil Description	Above / Below Groundwater	OHSA Soil Type	Maximum Temporary Excavation Side Slopes
Existing Fill Material (Silty Sand, Sandy Silty Clay)	Above	Type 3	1H:1V
	Below	Type 4	3H:1V

For excavations through multiple soil types, the side slope geometry is governed by the soil with the highest number Type designation.

During construction, stockpiles/equipment/materials should be located a minimum distance of 1.5 m from the top of the excavation or a distance equal to the depth of the excavation, whichever is greater; stockpile heights should be controlled to prevent surcharging the sides of the excavation and/or overall slope. Care must also be taken during excavation to ensure that adequate support is provided for any existing structures, roadways and underground services located adjacent to the excavations. Depending upon the construction procedures adopted by the contractor and the weather conditions at the time of construction, some local flattening of the slopes could be required.

Groundwater observations and measurements were obtained from open boreholes during and upon completion of the drilling operations. Stable groundwater elevations measured in the monitoring wells ranged from Elevations 261.6 m to 261.4 m, with a design groundwater elevation of 261.5 m. Generally, groundwater levels are high during the time of snow melting in spring and heavy rains in summer. Based on the groundwater conditions observed, the anticipated excavation depths for the proposed construction and the properties of the soils encountered, significant groundwater seepage is expected into open excavations during the construction. Depending on rainfall events immediately prior to construction there may be some perched water within the existing fill material. It is anticipated that any groundwater seepage into short-term excavations will be able to be handled using sumps and filtered pumps. Should any excavations require more intensive groundwater control, the use of filtered sumps, or other suitable method of dewatering and/or sheet piling shall be considered, as per inputs from specialty dewatering contractor.

Surface water and runoff should be directed away from the excavation areas to prevent ponding of water that could result in disturbance and weakening of the subgrade. If short-term pumping of groundwater at rates greater than 50,000 L/day and less than 400,000 L/day is required during the construction stage, registration on the Environmental Activity Sector Registry (EASR) must be completed. If water taking in excess of 400,000 litres/day is required, a Permit to Take Water (PTTW) must be obtained. PTTW applications may take up to 90

working days for the Ministry of the Environment, Conservation, and Parks (MECP) to review and approve. Both the EASR registration and PTTW application require a supporting hydrogeological assessment that addresses potential impacts, monitoring and mitigation. The actual rate of groundwater taking performed during construction will be a function of the final design, time of year, and the contractor's schedule, equipment, and techniques. A hydrogeological assessment is recommended to estimate the groundwater taking volumes and rates and assess EASR/PTTW requirements.

6.7 Temporary Protection Systems

The protection systems should be designed and constructed in accordance with OPSS.PROV 539 (*Temporary Protection Systems*), as amended by SSP 105S09 (*Temporary Protection Systems*). The lateral movement of the protection systems should meet Performance Level 2 as specified in OPSS.PROV 539, as amended by SP 105S09, provided that any utilities, if present can tolerate this magnitude of deformation.

It is anticipated that a driven interlocking sheet pile system would be suitable and constructible as the Standard Penetration Test (SPT) "N" values in the subsurface soils are generally less than about 50 blows per 0.3 m of penetration. There is also a potential of encountering rock fragments within the fill material.

Alternatively, a soldier pile and lagging system in conjunction with a sheet pile system is also feasible (i.e., in areas where adequate penetration can be achieved), but it would be necessary to include measures to control any seepage from behind the lagging panels if perched groundwater conditions are present at the time of construction and where the excavation extends below the water table or perched groundwater table. A comparison of various temporary protection system options including advantages, disadvantages, relative costs, and risks/consequences have been provided below in Table 6.6:

Table 6.6 Comparison of Temporary Protection System Options

Options	Advantages	Disadvantages	Relative Cost	Risk / Consequences
Soldier Pile and Lagging	<ul style="list-style-type: none"> • Better able to penetrate cobbles, boulders, or other potential obstructions. • Relatively straightforward construction. 	<ul style="list-style-type: none"> • Longer installation time compared to installation of sheet piles. • Additional measures required to control perched water / surface water seepage through lagging boards to avoid ground loss. 	<ul style="list-style-type: none"> • Higher cost compared to sheet piles walls, especially if obstructions are encountered. 	<ul style="list-style-type: none"> • Low risk that equipment will not penetrate obstructions in order to achieve required depth. • Risk of soil loss behind lagging if seepage not adequately / properly controlled.
Sheet Pile Wall	<ul style="list-style-type: none"> • Relatively straightforward installation provided that obstructions are not encountered. • Easier to remove compared to soldier pile and lagging. • Can also provide for seepage control from perched water conditions. 	<ul style="list-style-type: none"> • Cannot penetrate cobbles and boulders, or obstructions. 	<ul style="list-style-type: none"> • Typically, less expensive than soldier pile and lagging. 	<ul style="list-style-type: none"> • Risk of sheet piles encountering obstructions and not achieving required depth.

The sheet piles or soldier piles will need to extend/be socketed to a sufficient depth below the very loose to loose portion of fill material to provide the necessary passive resistance for the retained soil height, plus any surcharge loads behind the protection system.

While the selection and design of the protection system will be the responsibility of the contractor, the following information is provided to MTO and its designers to aid in assessment of the approximate construction costs. Lateral support to the sheet pile wall or soldier pile wall could be provided in the form of rakers or temporary anchors, if and as required. The tiebacks or rakers/struts must be designed to accommodate the loads applied from the earth pressures, perched water pressure (if present) and surcharge pressures from area, line or point loads as well as the effects of sloping ground behind the protection system. Passive toes restraint to the soldier piles may be determined using conventional passive earth pressure distribution acting over an equivalent width equal to three times the soldier pile socket diameter provided that the soldier piles are separated by more than three times the socket diameter.

Table 6.7 *Lateral Earth Pressure Coefficients and Soil Parameters for Design*

Materials/soils	Bulk Unit Weight (kN/m ³)	Angle of Internal Friction, Φ' (degrees)	Undrained Shear Strength S_u (KPa)	Coefficient of Lateral Earth Pressure		
				Active (K_a)	At-rest (K_0)	Passive (K_p)
Non-cohesive Fill Material (Very loose to compact silty sand)	18	30	--	0.33	0.50	3.00
Cohesive Fill Material (Stiff sandy silty clay)	19	30	50	0.33	0.50	3.00

The total passive resistance below the base of the excavation (i.e., adjacent to the temporary protection system) may be calculated based on the values of K_p indicated above but reduced by an appropriate factor that considers the allowable wall movement in accordance with Figure C6.27 of the Commentary to the CHBDC (2019), to account for the fact that a large strain would be required for mobilization of the full passive pressure. The earth pressure coefficients given above assume that the ground surface behind the roadway protection system is horizontal. If the retained ground is sloping, the lateral earth pressure coefficients must be adjusted to account for the slope based on the equations provided on Figures C6.28 and C6.29 in the Commentary to the CHBDC (2019). It should be noted that the pressure distributions given above are the minimum for the ultimate stress condition; a stiffer design may be required than predicted by these distributions in order to maintain displacements within an acceptable range.

Depending on the time of year, there may be perched water in the fill material. As noted above, if perched water is present and/or where the excavation extends below the groundwater level at the site, it would be necessary to control seepage or include measures to mitigate loss of soil particles through lagging boards if a soldier pile and lagging system is employed.

Consideration could be given to either partial or full removal of the protection system upon completion of construction or each stage of construction (as required). Where possible, full removal of the protection system should be considered to mitigate potential impediments to future rehabilitation/reconstruction work at the structures' site, or to the road structure above. It is recommended that a Non-Standard Special Provision (NSSP) be included in the Contract Documents to alert the Contractor of this condition; such an NSSP is provided in **Appendix F**.

6.8 Obstructions During Installation of Temporary Protection Systems

It is anticipated that rock fragments may be encountered within the fill material while installing the temporary protection systems. The presence of these obstructions may affect the installation of protection system elements. It is recommended that a Notice to Contractor be included in the Contract Documents to warn the Contractor of the possible presence of rock fragments within the overburden soils; a Notice to Contractor is provided in **Appendix F**.

7. Closure

The fieldwork was supervised by Reza Bay (Field Technician with GHD). This section of the report was prepared by Anuj Choudhari, M.Sc., P.Eng., P.E. (Intermediate Geotechnical Engineer with GHD). Nikol Kochmanová, Ph.D., P.Eng., P.M.P. (Senior Geotechnical Engineer with GHD and MTO Foundations Designated Contact) conducted an independent review of this section of the report.

Sincerely,

GHD Limited

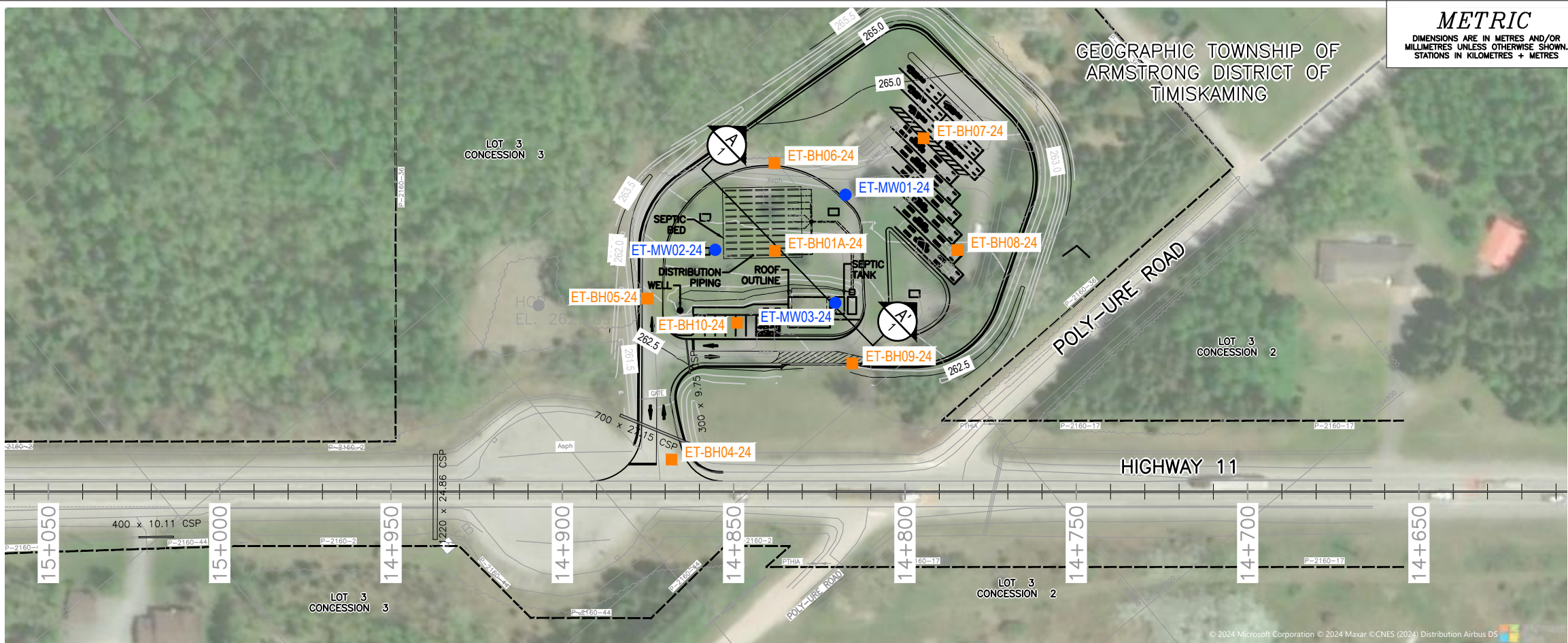


Anuj Choudhari, M.Sc., P.Eng., P.E.
Intermediate Geotechnical Engineer



Nikol Kochmanová, Ph.D., P.Eng., P.M.P.
MTO Foundations Designated Contact, Senior Geotechnical Engineer

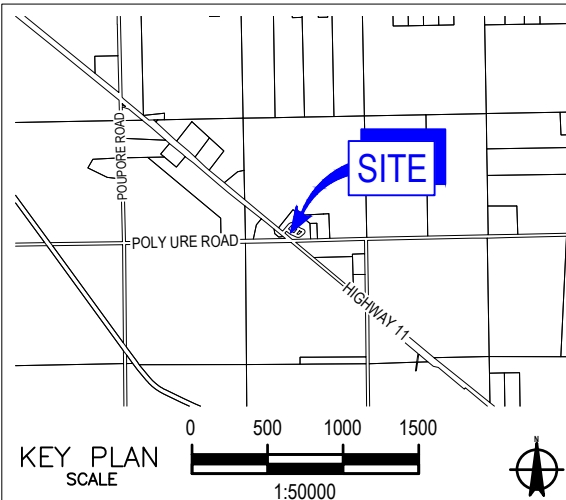




CONT No.2025-5007
GWP No. 5114-24-00



EARLTON REST AREA UPGRADES,
EARLTON, ON
BOREHOLE LOCATIONS/SOIL STRATA



LEGEND

- Foundation Borehole with Monitoring Well Location (GHD, 2024)
- Pavement Borehole Location (GHD, 2024)
- N Standard Penetration Test Value
- 16 Blows/0.3 m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL on December 4, 2024

BOREHOLE CO-ORDINATES NAD 83 (CSRS) MTM ZONE 12			
No.	Elevation (m)	Northing (m)	Easting (m)
ET-BH01A-24	263.40	5284949.048	395783.058
ET-MW01-24	264.60	5284948.400	395809.341
ET-MW02-24	263.05	5284960.442	395769.860
ET-MW03-24	263.56	5284926.105	395786.866
ET-BH04-24	261.48	5284921.626	395720.929
ET-BH05-24	262.96	5284962.243	395745.573
ET-BH06-24	264.13	5284968.801	395799.359
ET-BH07-24	265.13	5284946.478	395837.446
ET-BH08-24	264.59	5284915.106	395824.132
ET-BH09-24	262.98	5284909.388	395779.392
ET-BH10-24	262.55	5284940.075	395761.109

NOTES

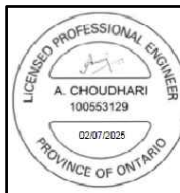
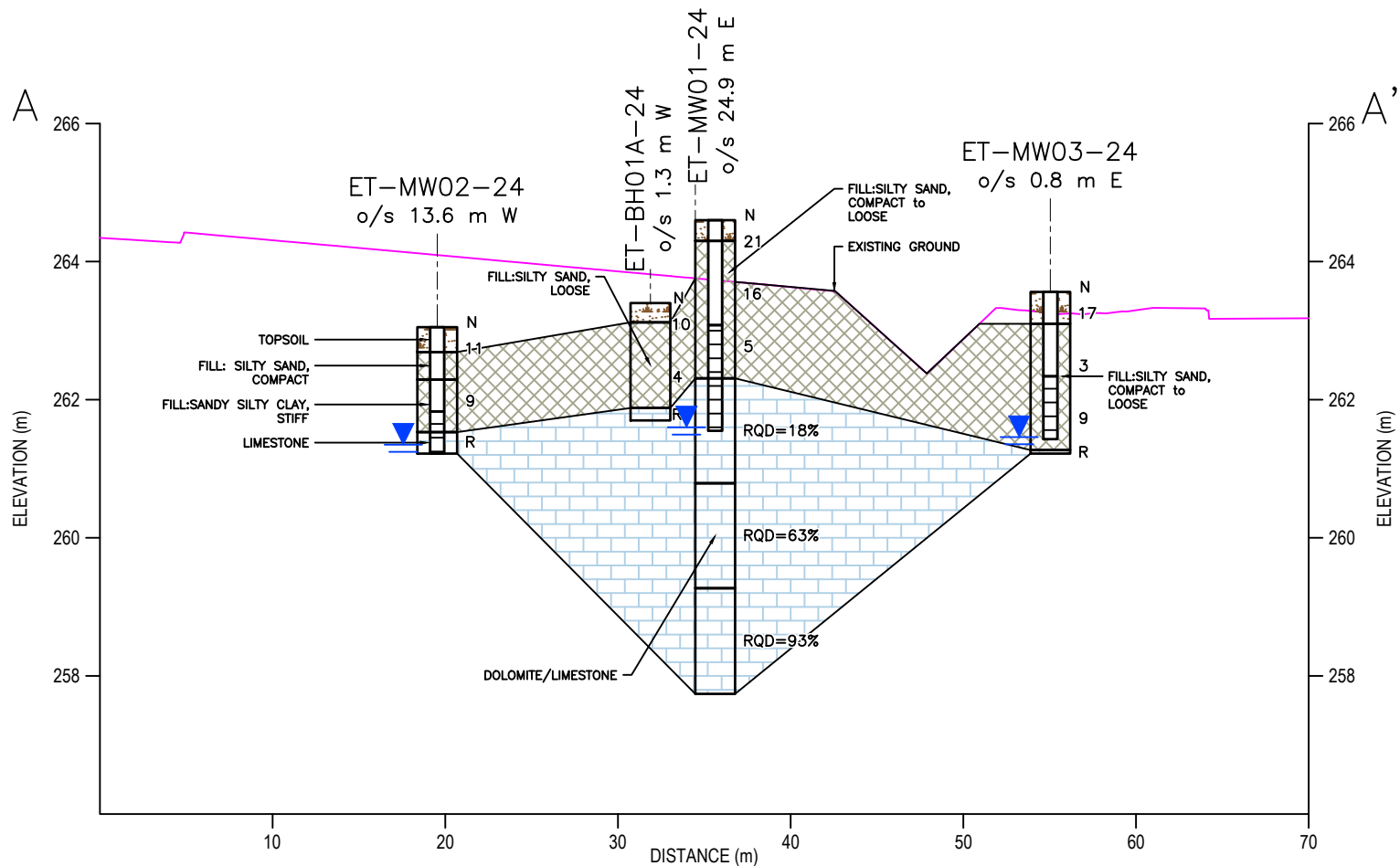
This drawing is for subsurface information only. The proposed and existing features are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the contract documents.

The boundaries between soil strata has been established only at borehole locations. Between boreholes, the boundaries are assumed from geological evidence.

REFERENCE

Base plans provided in digital format, drawing file:
12646941-GHD-XX-XX-DRG-CI-D004, dated November 2024

A	12.11.2024	AC	ISSUED FOR REVIEW	
B	02.07.2025	AC	ISSUED FOR FINAL APPROVAL	
NO.	DATE	BY	REVISION	
Geocres No.: 31M12-001				
HWY. 11		PROJECT NO. 12646941		DIST. NORTHEAST
SUBM'D. RG/AC		CHKD. AC	DATE: 02.07.2025	SITE: EARLTON REST AREA UPGRADES
DRAWN: AW		CHKD. NK	APPD. NK	DWG. 1



References

Bowles, J.E. 1984. Physical and Geotechnical Properties of Soils, Second Edition, McGraw Hill Book Company, New York.

Canadian Geotechnical Society. 2023. Canadian Foundation Engineering Manual (CFEM), 5th Edition. The Canadian Geotechnical Society, BiTech Publisher Ltd., British Columbia.

Canadian Highway Bridge Design Code (CHBDC (2019)) and Commentary on CAN/CSA-S6-19. Canadian Standard Association. (CSA) Group.

Kulhawy F.H. and Mayne P.W. 1990, Manual on Estimating Soil Properties for Foundation Design, EL-6800, Research Project 1493-6. Prepared for Electric Power Research Institute, Palo Alto, California.

Unified Facilities Criteria, U.S. Navy. 1986. NAVFAC Design Manual 7.02, Soil Mechanics, Foundations and Earth Structures, Alexandria, Virginia.

Ontario Provincial Standard Specification:

- OPSS.PROV 501, Construction Specification for Compacting
- OPSS.PROV 539, Construction Specification for Temporary Protection Systems
- OPSS.PROV 1010, Material Specification for Aggregates - Base, Subbase Select Subgrade, and Backfill Material

Standard Special Provisions:

- SSP 105S09, Special Provision – Amendment to OPSS 539, November 2014

Ontario Provincial Standard Drawing:

- OPSD 3090.100, Foundation Frost Penetration Depths for Northern Ontario

Appendices

Appendix A

Site Photographs



**Photograph 1: General Site Location
(October 28th, 2024)**



**Photograph 2: Drilling Setup at Borehole ET-MW01-24
(November 4th, 2024)**



Site Photographs
Earlton Rest Area, Earlton, ON



**Photograph 3: Drilling Setup at Borehole ET-MW02-24
(November 5th, 2024)**



**Photograph 4: Drilling Operations at Borehole ET-MW03-24
(November 5th, 2024)**



Site Photographs
Earlton Rest Area, Earlton, ON

Appendix B

GHD Borehole Records



Notes on Borehole and Test Pit Reports

Soil description :

Each subsurface stratum is described using the following terminology. The relative density of granular soils is determined by the Standard Penetration Index ("N" value), while the consistency of clayey soils is measured by the value of undrained shear strength (Cu).

Classification (Unified system)			
Clay	< 0.002 mm		
Silt	0.002 to 0.075 mm		
Sand	0.075 to 4.75 mm	fine	0.075 to 4.25 mm
		medium	0.425 to 2.0 mm
		coarse	2.0 to 4.75 mm
Gravel	4.75 to 75 mm	fine	4.75 to 19 mm
Cobbles	75 to 300 mm	coarse	19 to 75 mm
Boulders	>300 mm		

Terminology	
"trace"	1-10%
"some"	10-20%
adjective (silty, sandy)	20-35%
"and"	35-50%

Relative density of granular soils	Standard penetration index "N" value (BLOWS/ft – 300 mm)
Very loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Consistency of cohesive soils	Undrained shear strength (Cu)	
	(P.S.F)	(kPa)
Very soft	<250	<12
Soft	250-500	12-25
Firm	500-1000	25-50
Stiff	1000-2000	50-100
Very stiff	2000-4000	100-200
Hard	>4000	>200

Rock quality designation	
"RQD" (%) Value	Quality
<25	Very poor
25-50	Poor
50-75	Fair
75-90	Good
>90	Excellent

STRATIGRAPHIC LEGEND			
Sand	Gravel	Cobbles & boulders	Bedrock
Silt	Clay	Organic soil	Fill

Samples:

Type and Number

The type of sample recovered is shown on the log by the abbreviation listed hereafter. The numbering of samples is sequential for each type of sample.

SS: Split spoon

ST: Shelby tube

AG: Auger

SSE, GSE, AGE: Environmental sampling

PS: Piston sample (Osterberg)

RC: Rock core

GS: Grab sample

Recovery

The recovery, shown as a percentage, is the ratio of length of the sample obtained to the distance the sampler was driven/pushed into the soil

RQD

The "Rock Quality Designation" or "RQD" value, expressed as percentage, is the ratio of the total length of all core fragments of 4 inches (10 cm) or more to the total length of the run.

IN-SITU TESTS:

N: Standard penetration index

Nc: Dynamic cone penetration index

k: Permeability

R: Refusal to penetration

Cu: Undrained shear strength

ABS: Absorption (Packer test)

Pr: Pressure meter

LABORATORY TESTS:

I_p: Plasticity index

H: Hydrometer analysis

A: Atterberg limits

C: Consolidation

O.V.: Organic vapor

W_i: Liquid limit

GSA: Grain size analysis

w: Water content

CS: Swedish fall cone

W_p: Plastic limit

γ: Unit weight

CHEM: Chemical analysis

Ministry of Transportation Ontario

RECORD OF BOREHOLE No ET-BH01A-24

1 OF 1

METRIC

G.W.P. NO. 5114-24-00

LOCATION Earlton Rest Area, Earlton, ON P0J 1E0 Northing: 5284949.048, Easting: 395783.058(NAD83(CSRS)v6 / MTM zone 12)

DIST Northeast

HWY 11

BOREHOLE TYPE Hollow Stem Auger (200 mm O.D.)

DRILLING RIG TYPE Truck Mounted Drill Rig

DATUM Geodetic

DATE 2024.11.05 - 2024.11.05

LATITUDE 47.69724993

LONGITUDE -79.78774751

ORIGINATED BY RB

COMPILED BY AC

CHECKED BY NK

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED △ FIELD VANE ● QUICK TRIAXIAL □ REMOULDED Δ3 NUMBER REFER TO SENSITIVITY	PLASTIC LIMIT WP ----- MOISTURE CONTENT (%)	NATURAL MOISTURE CONTENT W ----- MOISTURE CONTENT (%)	LIQUID LIMIT WL -----	Unit Weight γ (kN/m3)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
263.4								20 40 60 80 100	20 40 60				GR SA SI CL
263.1	TOPSOIL (280 mm)												
0.3	FILL: SILTY SAND, some clay, some to trace gravel, contains rootlets and high plasticity fines, dark brown, moist, loose		SS1			10	263			26			13 41 27 19 LL=40% PL=23% PI=17%
			SS2			4	262			18			3 49 35 13 LL=19% PL=13% PI=6%
261.9													
1.5	LIMESTONE/DOLOSTONE, broken rock fragments, orangish brown, moist		SS3			R				10			
261.7	END OF BOREHOLE at 1.7 m.												
1.7	Termination Note: Auger and spoon refusal at 1.7 m .						261						
							260						
							259						

Created with OpenGround for Project Number 12646941 Template: CLN-MTO-CA-GEO-MST-BHN / Strip Set: CLN-MTO-Soil2 4/2/25






RECORD OF BOREHOLE No ET-MW01-24

1 OF 3 METRIC

G.W.P. NO. 5114-24-00 LOCATION Earleton Rest Area, Earleton, ON P0J 1E0 Northing: 5284948.4, Easting: 395809.341(NAD83(CSRS)v6 / MTM zone 12)

DIST Northeast HWY 11 BOREHOLE TYPE Hollow Stem Auger (200 mm O.D.)/NQ DRILLING RIG TYPE Truck Mounted Drill Rig




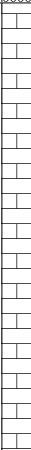







DATUM Geodetic DATE 2024.11.04 - 2024.11.04 LATITUDE 47.69724041 LONGITUDE -79.78739754 ORIGINATED BY RB COMPILED BY AC CHECKED BY NK


SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT WP	NATURAL MOISTURE CONTENT W	LIQUID LIMIT WL	Unit Weight γ (kN/m3)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPA ○ UNCONFINED △ FIELD VANE ● QUICK TRIAXIAL □ REMOULDED Δ3 NUMBER REFER TO SENSITIVITY									
264.6								20	40	60	80	100		20	40	60	GR SA SI CL
264.3 0.3	TOPSOIL (305 mm)																
	FILL: SILTY SAND, some gravel, some clay, contains rootlets and low plasticity fines, dark brown to brown, moist, compact to loose		SS1		21									23			
			SS2		16												
262.3 2.3	End of Overburden. Refer to next page for Bedrock.		SS3		5									14			13 51 26 10 LL=17% PL=12% PI=5%




2 OF 3

G.W.P. NO.	5114-24-00	LOCATION	Earlton Rest Area, Earlton, ON P0J 1E0 Northing: 5284948.4, Easting: 395809.341(NAD83(CSR)S)v6 / MTM zone 12)						ORIGINATED BY	RB
DIST	Northeast	HWY	11	BOREHOLE TYPE	Hollow Stem Auger (200 mm O.D.)/NQ Coring	DRILLING RIG TYPE	Truck Mounted Drill Rig	COMPILED BY	AC	
DATUM	Geodetic	DATE	2024.11.04 - 2024.11.04	LATITUDE	47.69724041	LONGITUDE	-79.78739754	CHECKED BY	NK	

SOIL PROFILE			Run Number	'N' or RQD	Core Recovery %		GROUNDWATER CONDITIONS	ELEVATION SCALE	Analysis	Fracture Index (#/Interval)	Strength Data		Water Volume Lost Per Run (L)
ELEV	DESCRIPTION	STRAT PLOT			Total	Solid					Strength Index	Weathering Index	
DEPTH													
264.6													
	Start of Bedrock Log. <i>Refer to previous page for Overburden Details.</i>							264					
													
	DOLOMITE/LIMESTONE, orangish brown to grey Run 1: moderately weathered (W3), medium strong (R3) Joints at (2.65, 2.67, 2.70, 2.72, 2.75, 2.80, 2.87, 2.95, 2.98, 3.00, 3.05, 3.08, 3.15, 3.23m) Fragments (2.29 - 2.62 m)		Run 1	18	80	40		262		>25	R3	W3	
										7.00			
										7.00			
										0.00			
260.8	Run 2: slightly weathered (W2), medium strong (R3) Joints: 3.86, 3.91, 4.83- 4.90, 4.93, 5.11m Fragments (4.17 - 4.22m)		Run 2	63	92	53		261			R3	W2	
										2.00			
										2.00			
										0.00			
3.8								260					





RECORD OF BOREHOLE No ET-MW01-24

3 OF 3 METRIC

G.W.P. NO.5114-24-00

LOCATIONEarlton Rest Area, Earlton, ON P0J 1E0 Northing: 5284948.4, Easting: 395809.341(NAD83(CSRS)v6 / MTM zone 12)

DISTNortheast

HWY11

DATUMGeodetic

BOREHOLE TYPEHollow Stem Auger (200 mm O.D.)/NQ Coring

DRILLING RIG TYPETruck Mounted Drill Rig

DATE2024.11.04 - 2024.11.04

LATITUDE47.69724041

LONGITUDE-79.78739754

ORIGINATED BYRB

COMPILED BYAC

CHECKED BYNK

SOIL PROFILE		STRAT PLOT	Run Number	'N' or RQD	Core Recovery %		GROUNDWATER CONDITIONS	ELEVATION SCALE	Analysis	Fracture Index (#/Interval)	Strength Data		Water Volume Lost Per Run (L)	
ELEV	DEPTH				DESCRIPTION	Total					Solid	Strength Index		Weathering Index
264.6														
259.3 5.3		Run 2: slightly weathered (W2), medium strong (R3) Joints: 3.86, 3.91, 4.83. 4.90, 4.93, 5.11m Fragments (4.17 - 4.22m)	Run 3	93	98	98		259		3.00	R3	W2		
										1.00				
										0.00				
										2.00				
										1.00				
										0.00				
257.7 6.9		END OF BOREHOLE at 6.9 m.						258		0.00				
		Notes: - Water level at 3.0 m (Elevation: 261.6 m) on December 3, 2024; - Water level at 3.0 m (Elevation: 261.6 m) on December 4, 2024.						257						
								256						
								255						

Created with OpenGround for Project Number 12646941 Template: CLN-MTO-CA-GEO-MST-BHN / Strip Set: CLN-MTO-Rock2 4/2/25

Ministry of Transportation Ontario

RECORD OF BOREHOLE

No ET-MW02-24

1 OF 1

METRIC

G.W.P. NO. 5114-24-00

LOCATION Earlton Rest Area, Earlton, ON P0J 1E0 Northing: 5284960.442, Easting: 395769.86(NAD83(CSRS)v6 / MTM zone 12)

ORIGINATED BY RB

DIST Northeast

HWY 11

BOREHOLE TYPE Hollow Stem Auger (200 mm O.D.)

DRILLING RIG TYPE Truck Mounted Drill Rig

COMPILED BY AC


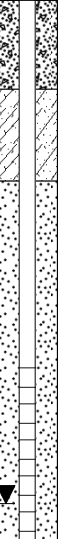


DATUM Geodetic

DATE 2024.11.05 - 2024.11.05

LATITUDE 47.69735426

LONGITUDE -79.78792095

CHECKED BY NK

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED △ FIELD VANE ● QUICK TRIAXIAL □ REMOULDED Δ3 NUMBER REFER TO SENSITIVITY	PLASTIC LIMIT WP ----- MOISTURE CONTENT (%)	NATURAL MOISTURE CONTENT W ○ MOISTURE CONTENT (%)	LIQUID LIMIT WL -----	Unit Weight γ (kN/m3)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
263.1								20 40 60 80 100	20 40 60				GR SA SI CL
262.7 0.4	TOPSOIL (356 mm) FILL: SILTY SAND, some gravel, some clay, contains rootlets, dark brown, moist, compact		SS1		11		263			○25			
262.3 0.8	SANDY SILTY CLAY, trace gravel, brown, moist, stiff		SS2		9		262			┌─○20─┐			1 35 37 27 LL=28% PL=14% PI=14%
261.5 1.5	LIMESTONE/DOLOSTONE, broken rock fragments, orangish brown, moist		SS3		R					○11			
261.2 1.8	END OF BOREHOLE at 1.8 m. Notes: - Water level at 1.7 m (Elevation: 261.4 m) on December 3, 2024; - Water level at 1.7 m (Elevation: 261.4 m) on December 4, 2024.						261						
							260						
							259						

Created with OpenGround for Project Number 12646941 Template: CLN-MTO-CA-GEO-MST-BHN / Strip Set: CLN-MTO-Soil2 4/2/25

Ministry of Transportation Ontario

RECORD OF BOREHOLE

No ET-MW03-24

1 OF 1

METRIC

G.W.P. NO. 5114-24-00

LOCATION Earleton Rest Area, Earleton, ON P0J 1E0 Northing: 5284926.105, Easting: 395786.866(NAD83(CSRS)v6 / MTM zone 12)

ORIGINATED BY RB

DIST Northeast

HWY 11

BOREHOLE TYPE Hollow Stem Auger (200 mm O.D.)

DRILLING RIG TYPE Truck Mounted Drill Rig

COMPILED BY AC

DATUM Geodetic

DATE 2024.11.05 - 2024.11.05

LATITUDE 47.69704307

LONGITUDE -79.78770157

CHECKED BY NK

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED △ FIELD VANE ● QUICK TRIAXIAL □ REMOULDED Δ3 NUMBER REFER TO SENSITIVITY	PLASTIC LIMIT WP ----- MOISTURE CONTENT (%)	NATURAL MOISTURE CONTENT W ○-----○ MOISTURE CONTENT (%)	LIQUID LIMIT WL -----	Unit Weight γ (kN/m3)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
263.6								20 40 60 80 100	20 40 60				GR SA SI CL
263.1	TOPSOIL (457 mm)		SS1		17					○33			
0.5	FILL: SILTY SAND, some gravel, some clay, contains rootlets and low plasticity fines, dark brown to brown, moist, compact to loose						263						10 54 25 11 LL=17% PL=14% PI=3%
			SS2		3					■5			
							262						
			SS3		9					■2			11 52 27 10 LL=16% PL=13% PI=3%
261.3													
2.3	LIMESTONE/DOLOSTONE, broken rock fragments, orangish brown, moist		SS4		R								
261.2	END OF BOREHOLE at 2.3 m.						261						
2.3	Termination Note: Auger and spoon refusal at 2.3 m . Notes: - Water level at 2.1 m (Elevation: 261.5 m) on December 3, 2024; - Water level at 2.1 m (Elevation: 261.5 m) on December 4, 2024.												
							260						
							259						

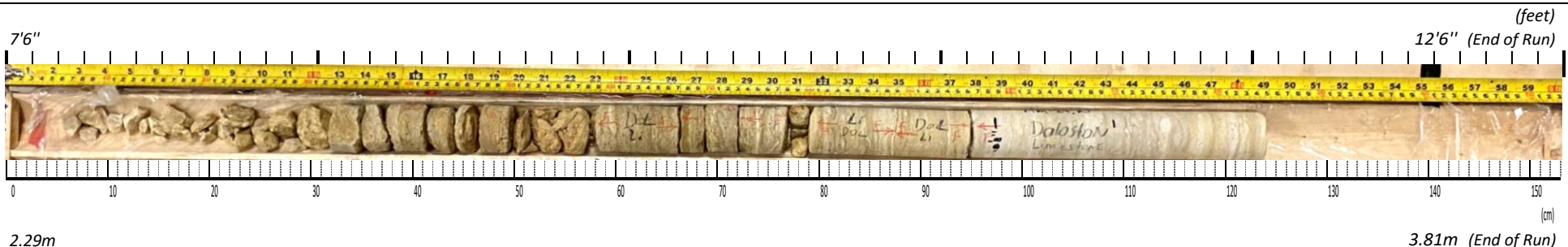
Created with OpenGround for Project Number 12646941 Template: CLN-MTO-CA-GEO-MST-BHN / Strip Set: CLN-MTO-Soil2 4/2/25

Appendix C

Rock Core Photographs

Borehole No.:	ET-MW01-24	Sample No.:	Run 1
Depth, m:	2.29m - 3.81m (7'6" - 12'6")	Date Sampled:	November 4, 2024

Description: Dolomite/Limestone, Moderately weathered (W3), Medium strong (R3)	Total Core Recovery: 80%	RQD: 18%	SCR: 40%
--	--------------------------	----------	----------



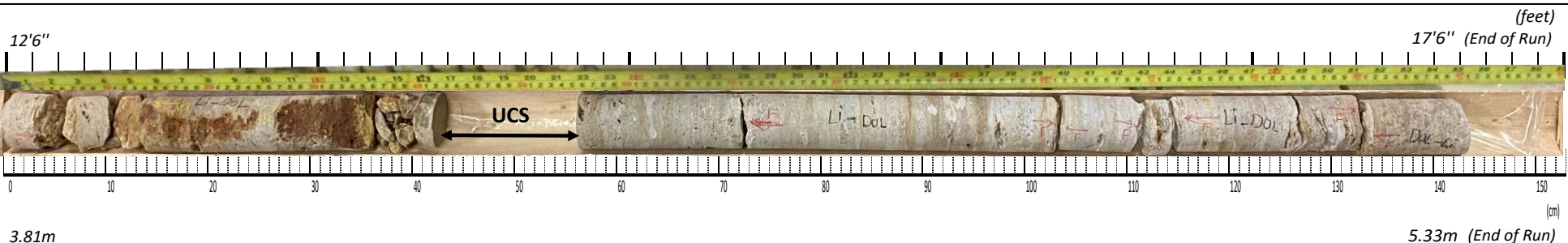
Joints: (2.65, 2.67, 2.70, 2.72, 2.75m) 2.80m 2.87m (2.95, 2.98, 3.00, 3.05, 3.08, 3.15, 3.23m)

Fragments (2.29 - 2.62 m)

Fracture Index:	>25	7	7	0	n/a
-----------------	-----	---	---	---	-----

Borehole No.:	ET-MW01-24	Sample No.:	Run 2
Depth, m:	3.81m - 5.33m (12'6" - 17'6")	Date Sampled:	November 4, 2024

Description: Dolomite/Limestone, Slightly weathered (W2), Medium strong (R3)	Total Core Recovery: 92%	RQD: 63%	SCR: 53%
--	--------------------------	----------	----------



Joints: 3.86m 3.91m

4.83m 4.90, 4.93m 5.11m

Fragments (4.17 - 4.22m)

Fracture Index:	2	2	0	3	1
-----------------	---	---	---	---	---

ROCK CORE PHOTO LOG
Earlton Rest Area Upgrades
MTO

Prepared by:

F. Ng

Scale : As shown

Checked by:

Michael Braverman

Project No.: 12646941 6.0.6.1



Borehole No.:

ET-MW01-24

Sample No.:

Run 3

Depth, m:

5.33m - 6.86m (17'6" - 22'6")

Date Sampled:

November 4, 2024

Description:

Dolomite/Limestone, Slightly weathered (W2), Medium strong (R3)

Total Core Recovery:

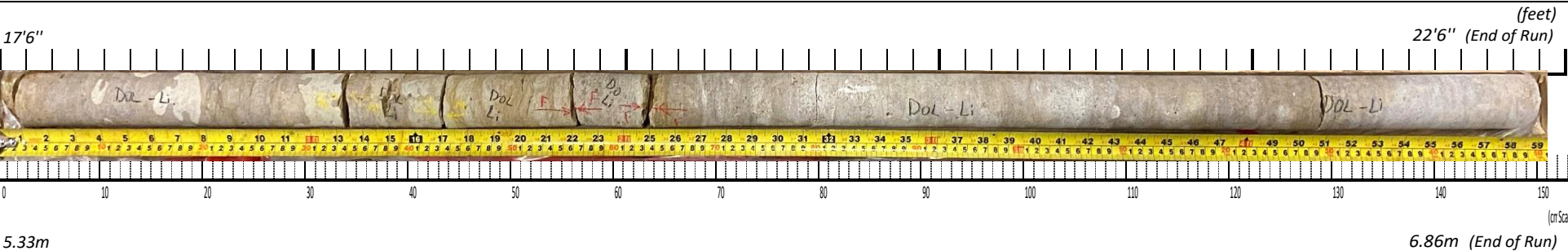
98%

RQD:

93%

SCR:

98%



Joints:

5.76m

5.89m

5.97m

(5°)

(5°)

Fracture Index:

0

2

1

0

0

ROCK CORE PHOTO LOG

Earlton Rest Area Upgrades

MTO

Prepared by:

F. Ng

Checked by:

Michael Braverman

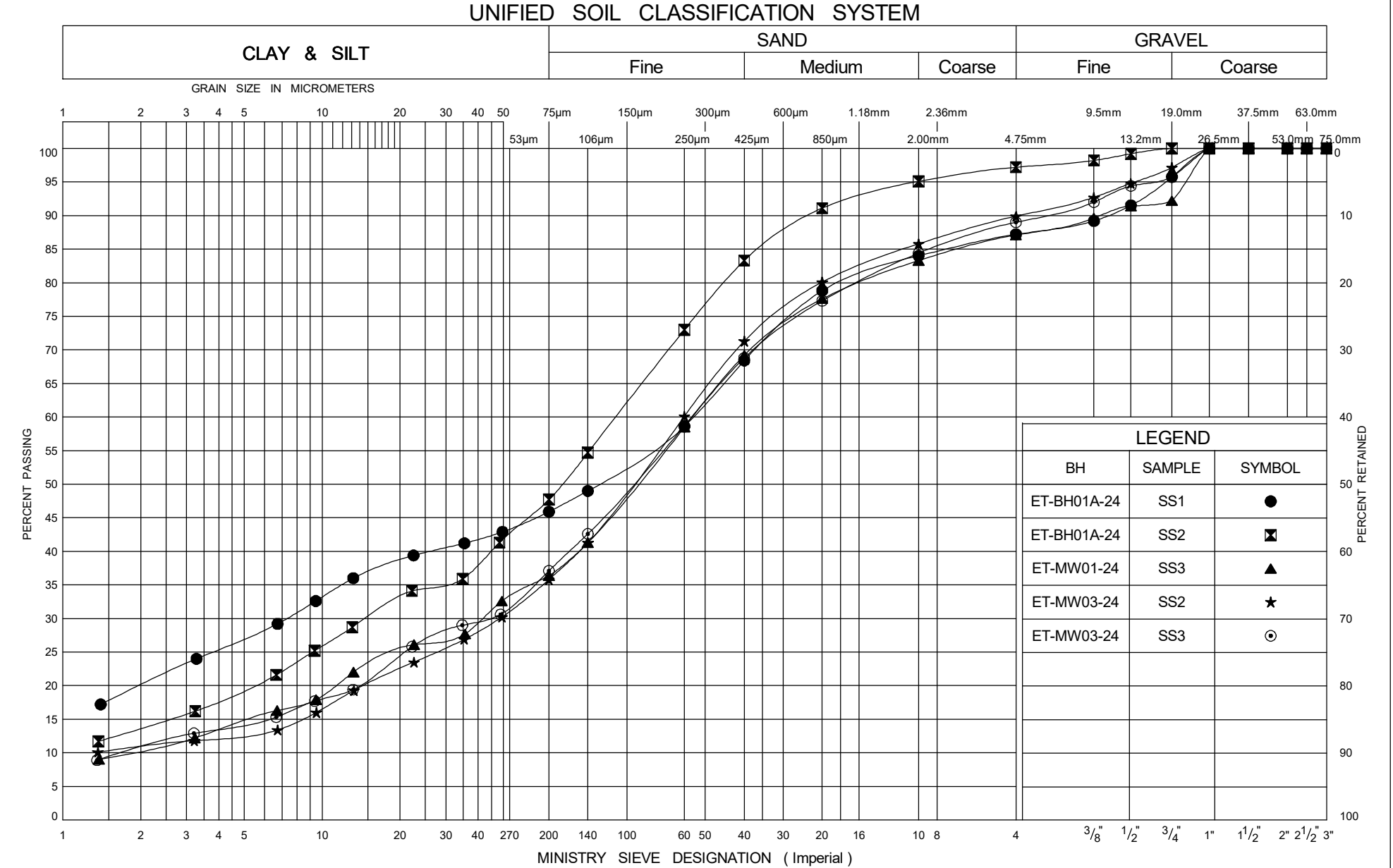
Scale : As shown

Project No.: 12646941 6.0.6.1



Appendix D

Geotechnical Laboratory Test Results



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

SILTY SAND FILL

Project Name: Earlington Rest Area

Project No.: 12646941

G.W.P. No.: 5114-24-00

Assignment No.: 5023-E-0007 Work Item 05

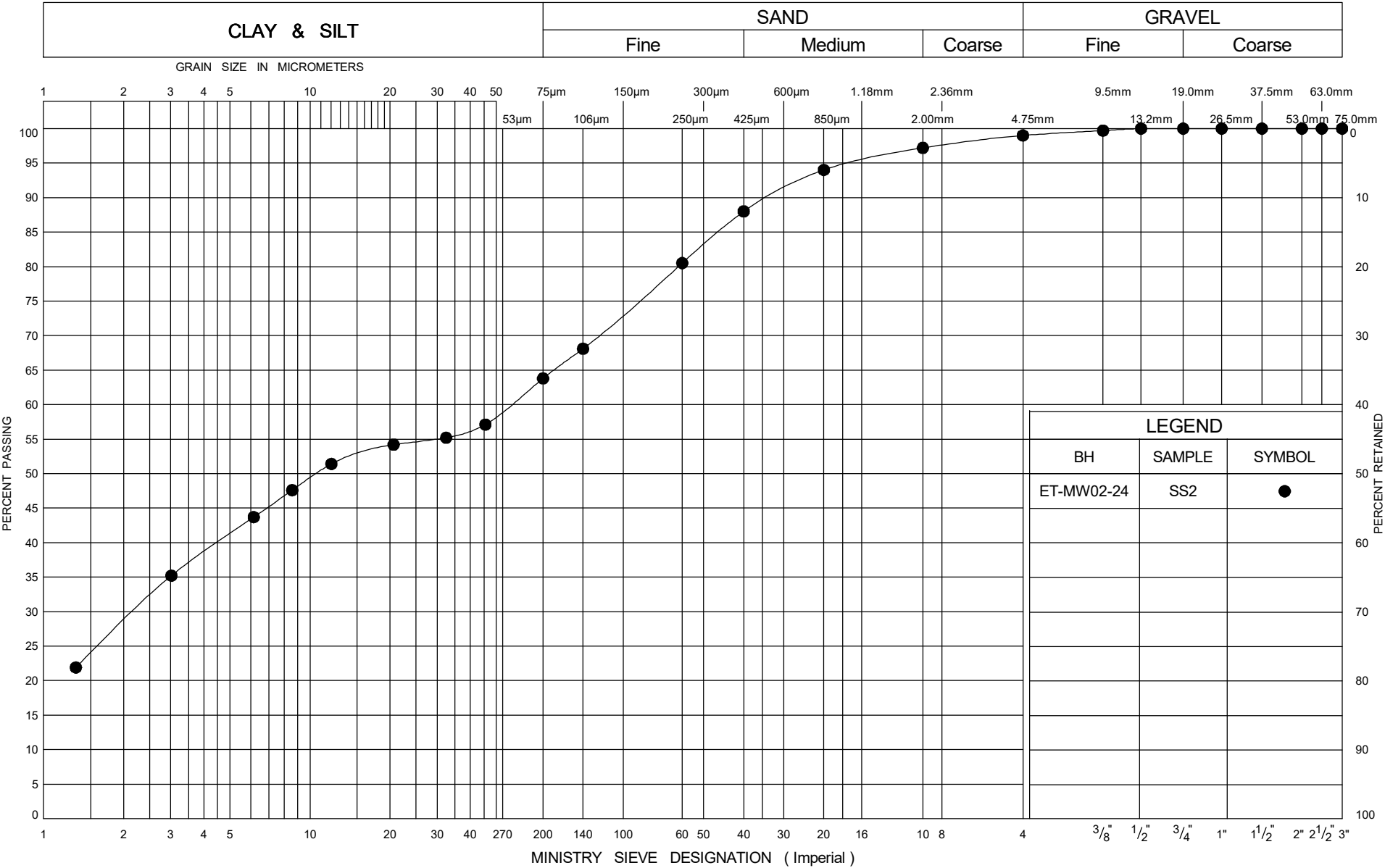
Prepared by: AW
Checked by: NK/AC

Date: November 26, 2024

Figure No.: D-1

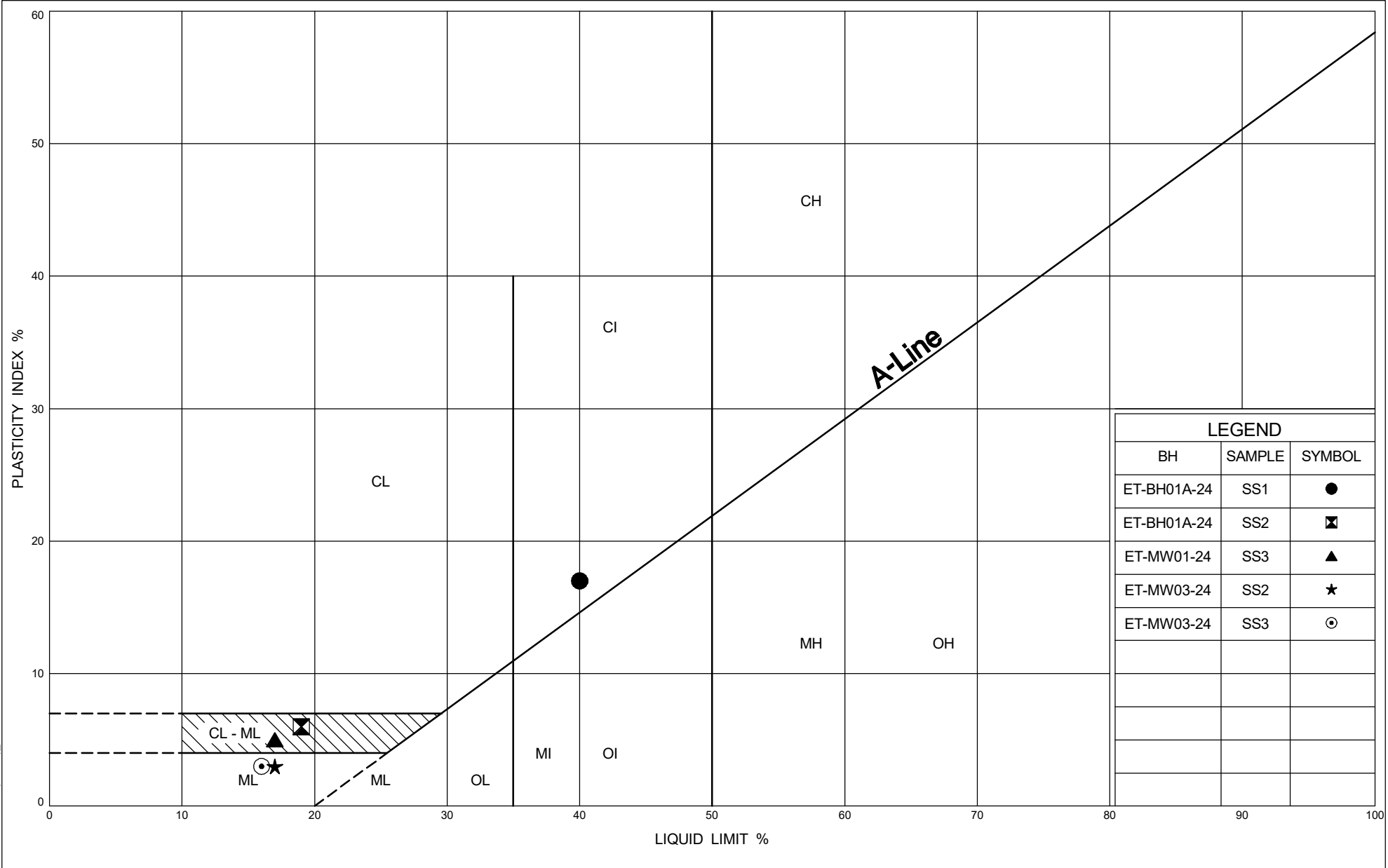
ONTARIO MOT GRAIN SIZE (TITLE)_10_V01_12646941 FOR LAB.GPJ ONTARIO MOT.GDT 26/11/24

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
SANDY SILTY CLAY FILL

Project Name: Earilton Rest Area	Project No.: 12646941
G.W.P. No.: 5114-24-00	
Assignment No.: 5023-E-0007 Work Item 05	
Prepared by: AW Checked by: NK/AC	Date: November 26, 2024 Figure No.: D-2



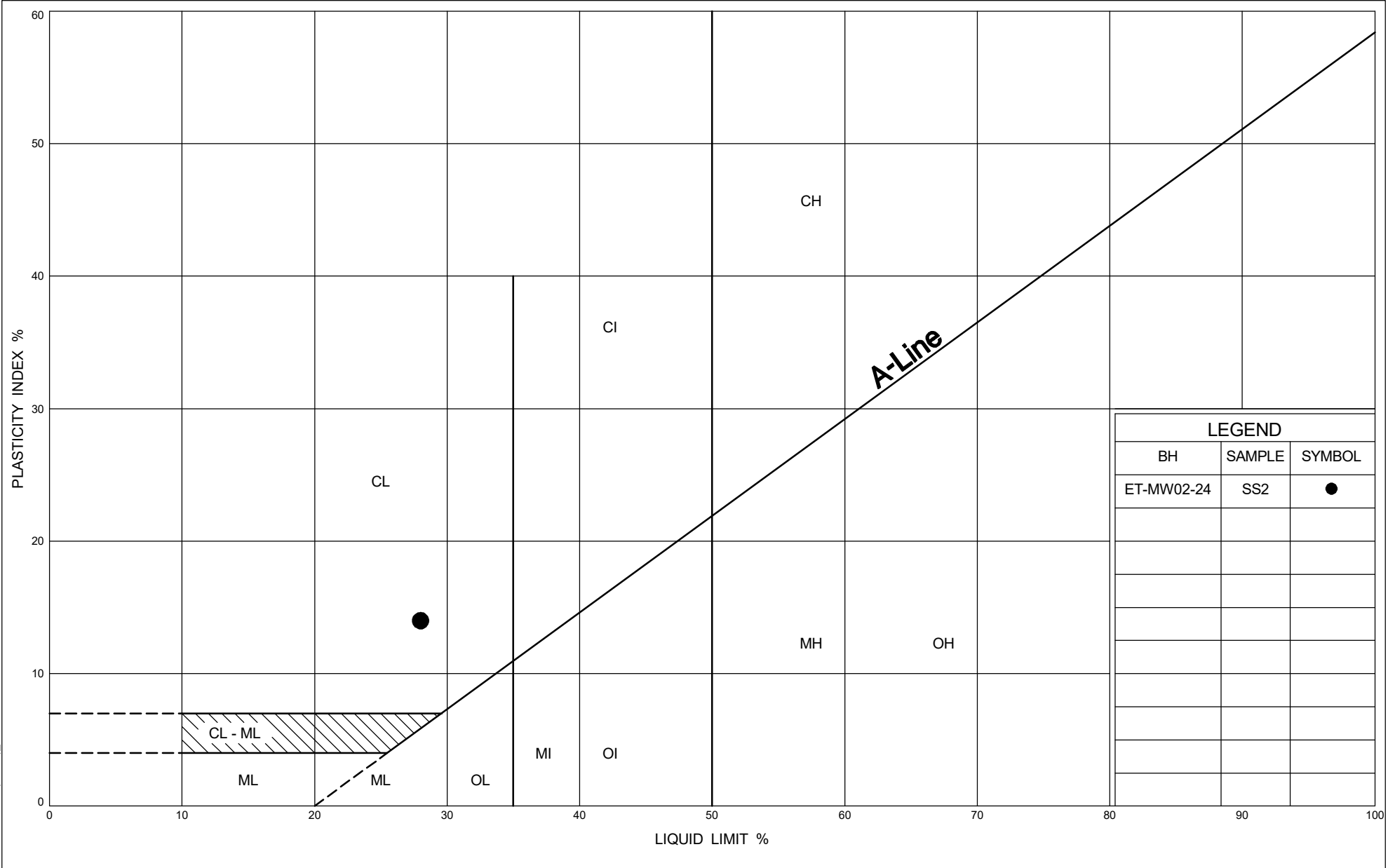
LEGEND		
BH	SAMPLE	SYMBOL
ET-BH01A-24	SS1	●
ET-BH01A-24	SS2	▣
ET-MW01-24	SS3	▲
ET-MW03-24	SS2	★
ET-MW03-24	SS3	⊙



Ministry of
Transportation

PLASTICITY CHART
SILTY SAND FILL-FINES

Project Name: Earlton Rest Area	Project No.: 12646941
G.W.P. No.: 5114-24-00	
Assignment No.: 5023-E-0007 Work Item 05	
Prepared by: AW Checked by: NK/AC	Date: November 26, 2024 Figure No.: D-3





**Uniaxial Compressive Strength of Intact Rock Core Specimens
(ASTM D7012 - Method C)**

CLIENT: Ministry of Transportation **LAB No.:** WLT 1154

PROJECT/ SITE: Earlton Rest Area Upgrades **PROJECT No.:** 12646941

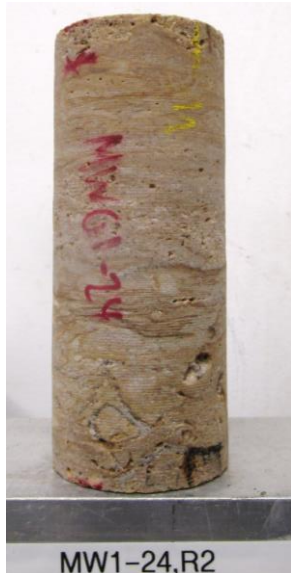
Borehole No.: ET-MW01-24 **Sample ID:** Run 2

Depth: 4.23- 4.39 m (13'10"-14'5") **Date Sampled:** November 4, 2024

Lithological Description: Dolomite

Initial Specimen Parameters	
Diameter, mm	44.5
Height, mm	109.5
Height-to-Diameter Ratio	2.5
Volume, cm ³	170.5
Mass, g	423.1
Bulk Density, kg/m ³	2482
Moisture Condition	As-received
Moisture Content, %	4.1

Maximum Applied Load, kN	70.5
Compressive Strength, MPa	45.3



REMARKS: _____

PERFORMED BY: F.Ng **DATE:** November 18, 2024

VERIFIED BY: Michael Braverman **DATE:** November 19, 2024

Appendix E

Corrosivity Test Results

CERTIFICATE OF ANALYSIS

Work Order	: WT2433570	Page	: 1 of 2
Client	: GHD Limited	Laboratory	: ALS Environmental - Waterloo
Contact	: Jennifer Balkwill	Account Manager	: Rick Hawthorne
Address	: 455 Phillip Street Waterloo ON Canada N2L 3X2	Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: 604 748 3661	Telephone	: +1 519 886 6910
Project	: 12646941-6.0.6.1	Date Samples Received	: 11-Nov-2024 09:20
PO	: 735-012186	Date Analysis	: 11-Nov-2024
		Commenced	
		Issue Date	: 18-Nov-2024 17:20
C-O-C number	: 23-1100558		
Sampler	: RUSHABH		
Site	: ----		
Quote number	: 12646941-6.0.6.1		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Greg Pokocky	Manager - Inorganics	Inorganics, Waterloo, Ontario
Josphin Masihi	Analyst	Centralized Prep, Waterloo, Ontario



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
 LOR: Limit of Reporting (detection limit).
 Measurement Uncertainty: The reported uncertainties in this report are expanded uncertainties calculated using a coverage factor of 2, which gives a level of confidence of approximately 95%.
 Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Unit	Description
%	percent
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram
mV	millivolts
ohm cm	ohm centimetres (resistivity)
pH units	pH units

>: greater than.

<: less than.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

WT2433570-001

Sub-Matrix: Soil/Solid

(Matrix: Soil/Solid)

Client sample ID: 12646941/ET-MW1-24/SS-2/2.5-4.5

Client sampling date / time: 11-Nov-2024 08:00

Analyte	CAS Number	Result	LOR	Unit	Method/Lab	Prep Date	Analysis Date	QCLot
Physical Tests								
Conductivity (1:2 leachate)	----	48.7	5.00	µS/cm	E100-L/WT	15-Nov-2024	15-Nov-2024	1761802
Moisture	----	22.7	0.25	%	E144/WT	-	11-Nov-2024	1761026
Oxidation-reduction potential [ORP]	----	343	0.10	mV	E125/WT	13-Nov-2024	14-Nov-2024	1763641
pH (1:2 soil:CaCl2-aq)	----	5.97	0.10	pH units	E108A/WT	15-Nov-2024	15-Nov-2024	1767301
Resistivity	----	20500	100	ohm cm	EC100R/WT	-	15-Nov-2024	-
Inorganics								
Sulfides, acid volatile	----	<0.26	0.26	mg/kg	E396-L/WT	11-Nov-2024	11-Nov-2024	1760967
Leachable Anions & Nutrients								
Chloride, soluble ion content	16887-00-6	<5.0	5.0	mg/kg	E236.CI/WT	15-Nov-2024	15-Nov-2024	1768913
Sulfate, soluble ion content	14808-79-8	<20	20	mg/kg	E236.SO4/WT	15-Nov-2024	15-Nov-2024	1768912

Please refer to the General Comments section for an explanation of any result qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WT2433570	Page	: 1 of 7
Client	: GHD Limited	Laboratory	: ALS Environmental - Waterloo
Contact	: Jennifer Balkwill	Account Manager	: Rick Hawthorne
Address	: 455 Phillip Street Waterloo ON Canada N2L 3X2	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 604 748 3661	Telephone	: +1 519 886 6910
Project	: 12646941-6.0.6.1	Date Samples Received	: 11-Nov-2024 09:20
PO	: 735-012186	Issue Date	: 18-Nov-2024 17:20
C-O-C number	: 23-1100558		
Sampler	: RUSHABH		
Site	: ----		
Quote number	: 12646941-6.0.6.1		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] 12646941/ET-MW1-24/SS-2/2.5-4.5	E396-L	11-Nov-2024	11-Nov-2024	14 days	0 days	✓	11-Nov-2024	7 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] 12646941/ET-MW1-24/SS-2/2.5-4.5	E236.Cl	11-Nov-2024	15-Nov-2024	30 days	4 days	✓	15-Nov-2024	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] 12646941/ET-MW1-24/SS-2/2.5-4.5	E236.SO4	11-Nov-2024	15-Nov-2024	30 days	4 days	✓	15-Nov-2024	28 days	0 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] 12646941/ET-MW1-24/SS-2/2.5-4.5	E100-L	11-Nov-2024	15-Nov-2024	30 days	4 days	✓	15-Nov-2024	30 days	4 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] 12646941/ET-MW1-24/SS-2/2.5-4.5	E144	11-Nov-2024	----	----	----		11-Nov-2024	----	1 days	
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] 12646941/ET-MW1-24/SS-2/2.5-4.5	E125	11-Nov-2024	13-Nov-2024	180 days	2 days	✓	14-Nov-2024	180 days	3 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] 12646941/ET-MW1-24/SS-2/2.5-4.5	E108A	11-Nov-2024	15-Nov-2024	30 days	4 days	✓	15-Nov-2024	30 days	4 days	✓



Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1760967	1	10	10.0	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1761802	1	19	5.2	5.0	✓
Moisture Content by Gravimetry	E144	1761026	1	19	5.2	5.0	✓
ORP by Electrode	E125	1763641	1	20	5.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1767301	1	10	10.0	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1768913	1	12	8.3	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1768912	1	12	8.3	5.0	✓
Laboratory Control Samples (LCS)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1760967	1	10	10.0	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1761802	2	19	10.5	10.0	✓
Moisture Content by Gravimetry	E144	1761026	1	19	5.2	5.0	✓
ORP by Electrode	E125	1763641	1	20	5.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1767301	1	10	10.0	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1768913	2	12	16.6	10.0	✓
Water Extractable Sulfate by IC	E236.SO4	1768912	2	12	16.6	10.0	✓
Method Blanks (MB)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1760967	1	10	10.0	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1761802	1	19	5.2	5.0	✓
Moisture Content by Gravimetry	E144	1761026	1	19	5.2	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1768913	1	12	8.3	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1768912	1	12	8.3	5.0	✓



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L ALS Environmental - Waterloo	Soil/Solid	CSSS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl ₂ Extraction) - As Received	E108A ALS Environmental - Waterloo	Soil/Solid	MECP E3530	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode. This method is equivalent to ASTM D4972 and is acceptable for topsoil analysis.
ORP by Electrode	E125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Oxidation Reduction Potential (ORP) is reported as the oxidation-reduction potential of the platinum metal-reference electrode employed in the analysis, measured in mV.
Moisture Content by Gravimetry	E144 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Water Extractable Chloride by IC	E236.Cl ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Water Extractable Sulfate by IC	E236.SO ₄ ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S2J	This analysis is carried out in accordance with the method described in APHA 4500 S2-J. After extraction the Acid Volatile Sulphide is determined colourimetrically.
Resistivity Calculation for Soil Using E100-L	EC100R ALS Environmental - Waterloo	Soil/Solid	APHA 2510 B	Soil Resistivity (calculated) is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions



Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 ALS Environmental - Waterloo	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl ₂ - As Received for pH	EP108A ALS Environmental - Waterloo	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Preparation of ORP by Electrode	EP125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Field-moist sample is extracted in a 1:2 ratio with DI water and then analyzed by ORP meter.
Anions Leach 1:10 Soil:Water (Dry)	EP236 ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	5 grams of dried soil is mixed with 50 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.
Distillation for Acid Volatile Sulfide in Soil	EP396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S ₂ J	Acid Volatile Sulfide is determined by colourimetric measurement on a sediment sample that has been treated with hydrochloric acid within a purge and trap system, where the evolved hydrogen sulfide gas is carried into a basic solution by argon gas for analysis.

QUALITY CONTROL REPORT

Work Order	: WT2433570	Page	: 1 of 5
Client	: GHD Limited	Laboratory	: ALS Environmental - Waterloo
Contact	: Jennifer Balkwill	Account Manager	: Rick Hawthorne
Address	: 455 Phillip Street Waterloo ON Canada N2L 3X2	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 604 748 3661	Telephone	: +1 519 886 6910
Project	: 12646941-6.0.6.1	Date Samples Received	: 11-Nov-2024 09:20
PO	: 735-012186	Date Analysis Commenced	: 11-Nov-2024
C-O-C number	: 23-1100558	Issue Date	: 18-Nov-2024 17:20
Sampler	: RUSHABH		
Site	: ---		
Quote number	: 12646941-6.0.6.1		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Greg Pokocky	Manager - Inorganics	Waterloo Inorganics, Waterloo, Ontario
Josphin Masihi	Analyst	Waterloo Centralized Prep, Waterloo, Ontario



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 1761026)											
WT2433131-010	Anonymous	Moisture	----	E144	0.25	%	15.3	15.4	0.427%	20%	----
Physical Tests (QC Lot: 1761802)											
WT2433441-002	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	1.10 mS/cm	1060	3.61%	20%	----
Physical Tests (QC Lot: 1763641)											
WT2433191-001	Anonymous	Oxidation-reduction potential [ORP]	----	E125	0.10	mV	360	356	1.12%	25%	----
Physical Tests (QC Lot: 1767301)											
TY2412953-001	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.26	7.25	0.138%	5%	----
Inorganics (QC Lot: 1760967)											
EO2409996-001	Anonymous	Sulfides, acid volatile	----	E396-L	0.25	mg/kg	<0.25	<0.25	0	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 1768912)											
WT2433568-001	Anonymous	Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	47	43	4	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 1768913)											
WT2433568-001	Anonymous	Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg	740	684	7.88%	30%	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Soil/Solid

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1761026)						
Moisture	----	E144	0.25	%	<0.25	----
Physical Tests (QCLot: 1761802)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Inorganics (QCLot: 1760967)						
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	<0.20	----
Leachable Anions & Nutrients (QCLot: 1768912)						
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	----
Leachable Anions & Nutrients (QCLot: 1768913)						
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	<5.0	----



Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Soil/Solid

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1761026)									
Moisture	----	E144	0.25	%	50 %	99.4	90.0	110	----
Physical Tests (QCLot: 1761802)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1410 µS/cm	96.9	90.0	110	----
Physical Tests (QCLot: 1767301)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Inorganics (QCLot: 1760967)									
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	100 mg/kg	89.0	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1768912)									
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	1000 mg/kg	97.6	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1768913)									
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	1000 mg/kg	99.5	80.0	120	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

					Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method			Low	High	Qualifier
Physical Tests (QCLot: 1761802)									
QC-1761802-003	RM	Conductivity (1:2 leachate)	----	E100-L	3310 µS/cm	102	70.0	130	----
Physical Tests (QCLot: 1763641)									
QC-1763641-001	RM	Oxidation-reduction potential [ORP]	----	E125	475 mV	97.3	90.0	110	----
Leachable Anions & Nutrients (QCLot: 1768912)									
QC-1768912-003	RM	Sulfate, soluble ion content	14808-79-8	E236.SO4	170 mg/kg	85.2	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1768913)									
QC-1768913-003	RM	Chloride, soluble ion content	16887-00-6	E236.Cl	402 mg/kg	89.4	70.0	130	----





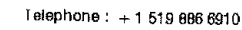
COC Number: 23 - 1100558

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Canada Toll Free: 1 800 668 9878

SOL-73

Work Order Reference
WT2433570

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JAN 2023 FRO

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white-report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

SOL-173

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Appendix F

NSSP and Notice to Contractor

PROTECTION SYSTEM – Item No.

Special Provision

Amendment to OPSS 539, November 2014

593.07.02 Removal of Protection Systems

Subsection 539.07.02 of OPSS 539 is deleted in its entirety and replaced with the following:

Protection systems shall be removed from the right-of-way unless it is specified in the Contract Documents that the protection system may be left in place.

Where piles are left in place, the top(s) shall be removed to at least 1.0 m below the finished grade or ground level or ditch bottom.

The method and sequence of removal shall be such that there shall be no damage to the new work, and existing work being protected.

All disturbed areas shall be restored to an equivalent or better condition than existing prior to the commencement of construction.

Obstructions

Notice to Contractor

The Contractor shall be alerted to the potential presence of rock fragments and/or obstructions within the fill material.

Consideration of the presence of these obstructions must be made in the selection of appropriate equipment and procedures for open cut excavations, and installation of temporary protection systems.

