Foundation Investigation and Design Report – Overhead Signs - Highway 4 Widening from Clinton Line to New Talbotville Bypass and New Talbotville Bypass from Highway 4 to Highway 3 at Ron McNeil Line

Highway 3 Township of Southwold,
County of Elgin, ON
West Region

GWP 3042-22-00

Latitude 42.815854

Longitude -81.239097

Geocres No. 40I14-226

Prepared for:

Ministry of Transportation, Ontario (MTO), West Region

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For
G.W.P. 3042-22-00
Overhead Signs

Highway 4 widening from Clinton Line to New Talbotville Bypass and New Talbotville Bypass from Highway 4 to Highway 3 at Ron McNeil Line
West Region, Township of Southwold, County of Elgin, Ontario

1.0 INTRODUCTION

Stantec has been retained by the Ministry of Transportation Ontario (MTO) to provide preliminary and detailed design services for the Highway 4 widening from Clinton Line to the new Talbotville Bypass and for the new Talbotville Bypass from Highway 4 to Highway 3 at Ron McNeil Line (GWP 3042-22-00), and for the Highway 3 widening from Ron McNeil Line to Centennial Avenue (GWP 3041-22-00).

As part of the GWP 3042-22-00 new Talbotville Bypass from Highway 4 to Highway 3 at Ron McNeil Line, the following new structures are proposed:

- CNR Talbotville Overhead - Two (2) Single Span Bridges with about 300 m long approach embankment on both sides of bridges,
- Ron McNeil Line Interchange Overpass - Two Span Bridge with approach embankments, and
- Lindsay Creek Culvert (formerly Dodd's Creek Culvert).

As part of the GWP 3041-22-00 Highway 3 Twinning from Ron McNeil Line to Centennial Avenue, the following new structures, including two existing culverts replacement, are proposed:

- Wellington Road Interchange Underpass – New Two Span Bridge with approach embankments
- Kettle Creek WBL Bridge – New Three Span Bridge
- 05X-0266/C0 Underhill Drain Culvert – New Culvert Construction Under the proposed Highway Twinning
- 05X-0268/C0 – Existing CSP Culvert replacement & New Culvert Construction Under the proposed Highway Twinning
- Noise Walls (Station between 13+100 and 11+100, south side of the existing Highway 3 & between Station12+400 and 13+600 on both sides of Highway 3)
- Deep Cuts (between Stations 13+650 and 15+050, north of the existing Highway 3)

Eighteen (18) Overhead Signs and three (3) Storm Water Management Ponds (SWMPs) were also planned at the early stage of the project. As per the preliminary design, three (3) Storm Water Management Ponds were eliminated, and four (4) structural culverts were added at the Ron McNeil Line interchange area. During the design stage, several sign locations were shifted and two (2) new signs were also added.

This Foundation Investigation Report has been prepared specifically and solely for the proposed overhead signs. Other project foundations engineering components are reported under separate cover.

The terms of reference for the foundation investigation work scope were provided in the MTO's RFP (Request for Proposal) and addenda. The MTO Guideline for Foundation Engineering Services V.3.0 is also considered for the borehole termination depth based on the clarifications provided during the bid phase.

2.0 SITE DESCRIPTION

2.1 SITE LOCATION

The project consists of widening of Highway 4 from Clinton Line to Talbotville Bypass and new Talbotville bypass from Highway 4 to Highway 3 at Ron McNeil Line in the Town of Southwold, Ontario. As part of the project, seven (7) overhead signs were planned in the preliminary design stage and the overhead sign foundation investigation was carried out for the sign locations determined during preliminary design. Subsequent changes were made through the design process and after completion of the overhead sign foundation investigation. Following consultation with MTO regarding the available information at the locations of new overhead signs, a supplementary investigation was carried out for one of the new signs. The details of the proposed signs and the changes are provided below in Table 2.1.

Table 2.1: Proposed Overhead Sign Locations

Proposed Station	Location	Anticipated New Structure Type	Comments
16 + 030	Highway 4 Southbound	RAB – Overhead Sign	New sign
15 + 570		RAB – Overhead Sign	Same as the preliminary design
11 + 197	Talbotville Bypass Eastbound	G105 - Cantilever	Same as the preliminary design
12 +222		G103 – Overhead Sign	Moved approximately 15 m east of the preliminary design location after completion of foundation investigation
13 + 760	Talbotville Bypass Westbound	G105 - Cantilever	Moved approximately 60 m east of the preliminary design location after completion of foundation investigation
13 + 255		G101 & G113 – Overhead Sign	Moved approximately 10 m east of the preliminary design location after completion of foundation investigation
10 +725		RAB – Overhead Sign	New sign
10 + 250		RAB – Overhead Sign	Moved approximately 50 m east of the preliminary design location after completion of foundation investigation

The locations of the signs are shown on Drawing Nos. 1 to 7 in Appendix A.

2.2 GENERAL SITE DESCRIPTION

At the project site, Highway 4 is an undivided freeway with one lane (and paved shoulders) in each direction. Highway 4 is planned to be widened from Clinton Line to the new Talbotville Bypass. The widened highway will have two lanes in each direction. The orientation of Highway 4 is north-south.

At the project site, Talbotville Bypass is planned to provide access to Highway 3 from Highway 4. Talbotville Bypass will be a divided freeway, with two lanes (with paved shoulders) in each direction, divided by a grass median. The orientation of Talbotville Bypass will be approximately northwest-southeast. The Orientation of Highway 3 is approximately east-west.

Within the project limit, Highway 4 has been constructed almost at grade. The elevation of the travelled surface of the existing highway varies from approximately 241 m at the north limit (Clinton Line) to approximately 238.5 m at the location of Talbotville Bypass to approximately 236.5 m at the south end (approximately 350 m south of Talbotville Bypass).

Within the project limit, Talbotville Bypass will be mostly constructed on an embankment. The elevation of the travelled surface of the bypass will vary from approximately 240 m at the west limit (Highway 4) to approximately 250.5 m at the location of CNR overhead to approximately 238.5 m at Ron McNeil Line. The embankment will be up to approximately 10 m higher than the surrounding ground.

The overall topography surrounding the site is relatively flat to gently rolling/sloping.

The surrounding lands generally consist of open fields and industrial/commercial properties.

2.3 GEOLOGICAL INFORMATION

The site is located within the physiographic region of Mount Elgin Ridges, as delineated in the Physiography of Southern Ontario (Chapman and Putnam, 1983). According to the Ontario Department of Mines Preliminary Geological Maps 238 (Pleistocene Geology of The St. Thomas Area, West Half) and P.606 (Pleistocene Geology of The St. Thomas Area, East Half), the site subsurface conditions are generally characterized by lacustrine deposits of silt, silty sand and clay, Port Stanley silty clay to clayey silt till and modern alluvium deposits of gravel, sand, and silt along watercourses. As per the Ontario Geological Survey Map 2441 (Geological Highway Map Southern Ontario), the bedrock within the project area is described as grey limestone of the Dundee Formation. Based on the Ontario Department of Mines Preliminary Geological Map P. 482 (St. Thomas Sheet), the bedrock depths at the proposed CNR overhead site is estimated to be about 85 m below the original ground surface (o.g.).

3.0 REVIEW OF PREVIOUS INVESTIGATIONS

A review of MTO GEOCRES database identified the following reports within the project limits:

GEOCRES Reference No. 40I14-070

A foundation investigation report dated September 17, 1971, was available for the proposed crossing at CNR spur overhead and St. Thomas Expressway.

The report was referenced as follows:

> Foundation Investigation Report
> For Proposed Crossing at
> CNR Spur Overheads and St. Thomas Expressway
> Twps. Of Southwold; County of Elgin
> W.O. 71-11068 - W.P. 89-69-05 & 06

The investigation included a total of eight (8) sampled boreholes (BH No. 1 to 8), advanced to depths ranging from approximately 10.4 m to 30.2 m below grade (corresponding to approximately elevations 229.8 m to 210.1 m) and eight (8) dynamic cone penetration tests carried out adjacent to each borehole advanced in July 1971.

The boreholes encountered a deep stratum of stiff to hard clayey silt with some sand and trace gravel immediately below the topsoil. Except the top 2 m, the stratum had a moisture content that was at or below the Plastic Limit. The undrained shear strength of the stratum generally decreased with depth, being in excess of 240 kPa at approximate elevation 237.8 m and about 190 kPa at approximate elevation 213.4 m. The deposit appeared to be highly over-consolidated.

Groundwater levels were observed at elevations ranging from approximately 231 m to 218.1 m.

Following shifts in the alignment of the St. Thomas Expressway at the CNR overhead, five (5) additional borings (BH No.11 to 15) were advanced to a depth of approximately 5 m below grade at this site, which reported similar subsoil conditions as those indicated above.

For reference, copies of the Borehole Location Plan, stratigraphical profile, borehole records and laboratory test results are included in Appendix B.

GEOCRES Reference No. 40I14-35

A foundation investigation report dated August 13, 1973, was available for the proposed crossing at St. Thomas Expressway and County Road #52.

The report was referenced as follows:

> Foundation Investigation Report
> For Proposed Crossing at
> St. Thomas Expressway and County Road #52
> Twps. Of Southwold; Co. of Elgin
> District #2 (London)
> W.O. 73-11021 - W.P. 89-69-07

The investigation included a total of three (3) sampled boreholes (BH No. 1 to 3), advanced to depths of approximately 18.8 m, 15.7 and 24.8 m below grade (corresponding to approximately elevations 218.4 m, 221.4 m and 212.7 m) and six (6) dynamic cone penetration tests advanced in May 1973.

The boreholes encountered a deep stratum of very stiff to hard clayey silt to silty clay with small amounts of sand and trace gravel. Occasional pockets and/or thin seams of silt were also noted, and sand partings were inferred to be present within this deposit. Except within the top 2 m, the stratum had a moisture content that was at or below the Plastic Limit. Based on the N-values obtained, the undrained shear strength of the stratum was inferred to be higher than approximately 100 kPa everywhere and as high as 240 kPa.

The boreholes were dry upon completion. However, it was noted in the report that due to the relatively impermeable nature of the soils encountered and short duration of the fieldwork, groundwater levels at the site could not be established conclusively but were inferred to be well below the elevation of the proposed structure footing at the time (i.e., approximately Elevation 234 m). It was noted that the randomly distributed silt seams and/or sand partings could be water bearing.

For reference, copies of the Borehole Location Plan, stratigraphic profile, borehole records and laboratory test results are included in Appendix B.

<u>GEOCRES Reference No. 40I14-033</u>

A foundation investigation report dated September 12, 1973, was available for Culverts No. 1, 4, 5, 6 and 7 for the proposed St. Thomas Expressway. The proposed Culvert No. 1 was planned approximately 1 km west of Wonderland Road and approximately 200 m north of the new Talbotville Bypass. The report was referenced as follows:

> Foundation Investigation Report
> For Proposed St. Thomas Expressway
> Culverts No. 1, 4, 5, 6 and 7
> Twp. Of Southwold and Yarmouth
> County of Elgin
> District No. 2 (London)
> W.O. 73-11019- W.P. 89-69-01

The investigation included two (2) boreholes (C1-1 and C1-2) advanced to a depth of approximately 9.6 m below grade (corresponding to approximate elevation 227 m and 227.3 m) in June 1973.

The boreholes encountered a deposit of very stiff to hard clayey silt with some sand and trace gravel. In Borehole C1-1, a 1.8 m thick layer of dense to very dense sand underlain by silt was embedded in the clayey silt deposit.

Groundwater levels were not established in any of the boreholes.

For reference, copies of the Borehole Location Plan, stratigraphy along the culvert, borehole records and laboratory test results are included in Appendix B.

4.0 INVESTIGATION PROCEDURES

4.1 FIELD INVESTIGATION

The foundation investigation for the overhead signs along Highway 4 and Talbotville Bypass initially consisted of a total of seven (7) boreholes (based on the preliminary design), designated as Boreholes BH No. Sign 1-6 and 8. As referenced in a preceding section, changes were made to the preliminary overhead sign locations during the design stage and following completion of the field work. These changes have been summarized in Table 2.1. In this respect, some of the boreholes have been advanced at a distance from the latest sign locations. In addition, Boreholes DCC-1, DCC-2, DCC-3 (advanced for Lindsay Creek Culvert as part of the same project), Borehole CNR-EMB9 (advanced for the CNR overhead as part of the same project) and Borehole SWMP1-BH1 and BH3 (advanced for stormwater management pond 1 as part of the same project) have been considered to provide subsurface information at the overhead sign locations. Following consultation with MTO, a supplementary foundation investigation, consisting of BH No. Sign 11, was subsequently carried out at the location of one of the new signs where no previous information was available. The locations of these boreholes are shown on Drawing Nos. 1 to 6 in Appendix A.

Prior to carrying out the investigation, Stantec contacted public utility authorities, private locaters and MTO to mark and clear the borehole locations of public, private and MTO-owned utilities.

The boreholes were advanced using CME 55 track-mounted drill rigs equipped for soil sampling between the dates of January 10, 2024 and March 10, 2025. The boreholes were advanced using continuous flight hollow and solid stem augers. Borehole Sign 1 was advanced to a depth of approximately 7.5 m below grade, boreholes Sign 2 to Sign 6, Sign 8 and Sign 11 were advanced to a depth of approximately 8.2 m below grade. Boreholes DCC1 to DCC3 and CNR-EMB9 were advanced to a depth of approximately 15.9 m below grade and boreholes SWMP1-BH1 and SWMP1-BH3 were advanced to a depth of approximately 11.3 m below grade.

The subsurface stratigraphy encountered in each borehole was recorded in the field by an experienced Stantec field technician. Standard Penetration Tests (SPT) were carried out in the drilled holes and split spoon samples were collected at regular intervals (0.75 m interval for the shallow depth / critical zone and

1.5 m interval to a depth of 15.8 m below ground surface to meet the typical MTO subsurface investigation sampling requirements) in accordance with ASTM D1586. All recovered SPT samples were returned to our Markham laboratory for detailed classification and testing. A pocket penetrometer was also used to estimate the strength/consistency of clayey soil samples at the site.

Groundwater was observed in open boreholes during and upon completion of drilling. Following completion of drilling, a 50 mm diameter groundwater monitoring well, screened over a depth of 4.6 m to 6.1 m below ground surface, was installed in Borehole DCC2. The borehole annulus surrounding the slotted pipe section was backfilled with sand. The remaining annulus was backfilled with bentonite up to the ground surface. Groundwater level measurements in the monitoring well were taken out on March 20 and 27 and May 9, 2024.

After completion of drilling, the boreholes without monitoring wells were backfilled with a mix of bentonite and drill cuttings.

4.2 LOCATION AND ELEVATION SURVEY

The borehole locations and respective ground surface elevations were surveyed by Stantec Geomatics personnel using Trimble R10-2 (horizontal accuracy of 8 mm+0.5 ppm and vertical accuracy of 15 mm+0.5 ppm as per the Trimble GNSS datasheet) to meet the survey accuracy requirements (vertical accuracy of 0.1 m and horizontal accuracy of 0.5 m) of the Guideline for MTO Foundation Engineering Services V2.

Table 3.1 below summarizes the borehole survey information and includes the drilling depth, end of borehole elevation and number of samples recovered for each borehole.

Table 4.1: Borehole Information Summary

Investigation Borehole	MTM Zone 11 Coordinates		Ground surface elevation (m)	Total depth drilled or advanced (m)	End of borehole elevation (m)	Number of soil samples
	Northing	Easting				
BH No. Sign 1	4742446.0	406350.9	239.5	7.5	232.0	10
BH No. Sign 2	4742410.1	406558.2	238.2	8.2	230.0	11
BH No. Sign 3	4742428.9	406548.3	238.0	8.2	229.8	11
BH No. Sign 4	4742624.9	407525.2	237.8	8.2	229.6	10
BH No. Sign 5	4742179.4	408406.1	240.1	8.2	231.9	11
BH No. Sign 6	4741584.7	409224.5	237.8	8.2	229.3	11
BH No. Sign 8	4741469.5	409663.1	200.9	8.2	192.7	11
BH No. Sign 11	4742887.1	406193.4	241.3	8.2	233.1	11
BH DCC 1	4742624.0	407117.6	237.3	15.9	229.6	15
BH DCC 2	4742608.8	407154.4	237.4	15.9	221.5	15
BH DCC 3	4742591.2	407191.9	237.3	15.9	221.5	14
CNR-EMB 09	4742180.1	408425.8	239.7	15.9	223.9	14
SWMP1-BH1	4742459.3	406444.4	238.7	11.3	227.4	12
SWMP1-BH3	4742511.5	406645.5	238.7	11.3	227.4	12

4.3 LABORATORY TESTING

All samples were taken to Stantec's Markham laboratory where they were subjected to a detailed visual and tactile examination. The geotechnical laboratory testing program completed on the borehole samples is summarized in Table 3.2. Some soil samples from boreholes were tested for pH, soluble sulphate content, chloride content, and resistivity.

Table 4.2: Laboratory Testing Program

Laboratory Test Type	Number of Tests
Moisture Content	177
Gradation Analysis	36
Atterberg Limits	36
Chemical Analysis	8

Samples remaining after testing will be placed in storage for a period of one year after issue of the final report. After the storage period, the samples will be discarded unless we are directed otherwise by MTO.

5.0 SUBSURFACE CONDITIONS

5.1 FRAMEWORK & OVERVIEW

The detailed soil and groundwater conditions encountered in the boreholes and the results of the in-situ and laboratory testing are shown on the Borehole Records included in Appendix C. An explanation of the symbols and terms used to describe the Borehole Records is also provided in Appendix C. The results of the geotechnical laboratory testing are presented on Figures D1 to D3 contained in Appendix D.

A borehole location plan is provided on Drawing Nos.1 to 7 in Appendix A.

The stratigraphic boundaries on the borehole records and the strata plot are inferred from non-continuous sampling and therefore represent transitions between soil types rather than exact boundaries between geological units. The subsurface conditions will vary between and beyond the borehole locations.

5.2 OVERBURDEN

5.2.1 Overhead Sign at Station 16+030 (Highway 4 Southbound)

Borehole Sign 11 was advanced for the overhead sign at station 16+030 along Highway 4 southbound.

A summary of subsurface conditions encountered in the borehole and the laboratory test results are provided below in Table 5.1.

Table 5.1: Summary of Subsurface Soil Conditions at Borehole No. Sign 11

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
BH No. Sign 11	FILL: SILTY SAND with Gravel	0	0.4	241.3	240.9	23 (Compact)	N/A	w=17%
	FILL: CLAYEY SILT	0.4	1.5	240.9	239.9	7 (Firm)	-	w=18%
	CLAYEY SILT TILL	1.5	8.2	239.9	233.1	8-28 (Stiff to Very Stiff)	-	w= 11% to 21% W_l=26% W_p=12% & 11% PI= 14% & 15% Laboratory results on Figure Nos. D1 & D2

The laboratory test results are also illustrated on the borehole records in Appendix D.

5.2.2 Overhead Signs at Stations 15+570 (Highway 4 Southbound)

Borehole Sign 1 was advanced for the overhead sign at station 15+570 along Highway 4 southbound. Borehole SWMP1-BH1 was advanced approximately 70 m east of this sign.

A summary of subsurface conditions encountered in the borehole and the laboratory test results are provided below in Table 5.2.

Table 5.2: Summary of Subsurface Soil Conditions at Borehole No. Sign 1 and SWMP1-BH1.

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
BH No. Sign 1	FILL: SILTY SAND with Gravel	0	0.3	239.5	239.2	12 (Compact)	N/A	w=17%
	FILL: CLAYEY SILT	0.3	1.4	239.2	238.1	5 (Firm)	Su_{pp} = 150	w=20%
	CLAYEY SILT TILL	1.4	7.5	238.1	232.0	14-22 (Stiff to Very Stiff)	210<Su_{pp}<270	w= 14% to 15% W_l=15% W_p=28% PI= 13% Laboratory results on Figure Nos. D1 & D2
SWMP1-BH1	Topsoil	0	0.3	238.7	238.4	N/A	N/A	w=27%
	SILTY CLAY	0.3	1.5	238.4	237.3	6 and 13 (Firm to Stiff)	190<Su_{pp}<210	w= 17% & 18% W_l=36% W_p=16% PI= 20% Laboratory results on Figure Nos. D1 & D2
	CLAYEY SILT TILL	1.5	11.3	237.3	227.4	15 – 28 (Stiff to Very Stiff)	190<Su_{pp}<240	w= 13% to 16% W_l=31% W_p=14% PI= 17% Laboratory results on Figure Nos. D1 & D2

Notes:

Su_{pp} = Undrained Shear Strength interpreted from pocket penetrometer tests, supplementary information only

The laboratory test results are also illustrated on the borehole records in Appendix D.

5.2.3 Overhead Sign at Station 10+250 (Talbotville Bypass Westbound)

Borehole Nos. Sign 2 & 3 were advanced for the overhead sign at station 10+250 along Talbotville Bypass westbound. Borehole SWMP1-BH3 was advanced approximately 160 m northeast of this sign.

A summary of subsurface conditions encountered in the boreholes and the laboratory test results are provided below in Table 5.3.

Table 5.3: Summary of Subsurface Soil Conditions at BH No. Sign 2&3 and SWMP1-BH3.

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
BH No. Sign 2	Topsoil	0	0.2	238.2	238.0	N/A	N/A	N/A
	CLAYEY SILT TILL	0.2	8.2	238.0	230.0	7-38 (Firm to Hard)	80<Su_{pp}<240	w=13 % to 17% W_l= 34% to 41% W_P =14% to 17% PI= 19% to 24% Laboratory results on Figure Nos. D1 & D2
BH No. Sign 3	Topsoil	0	0.1	238.0	237.9	N/A	N/A	w=37%
	CLAYEY SILT TILL	0.1	8.2	237.9	229.8	7-22 (Firm to Very Stiff)	110<Su_{pp}<240	w=14% to 16% W_l= 32% to 36% W_P= 15% to 16% PI= 17% to 20% Laboratory results on Figure Nos. D1 & D2
SWMP-BH3	Topsoil	0	0.1	238.7	238.6	N/A	N/A	w=33%
	SILTY CLAY	0.1	2.2	238.6	237.5	12 to 21 (Stiff to Very Stiff)	210<Su_{pp}<240	w= 15% W_l=37% W_p=15% PI= 22% Laboratory results on Figure Nos. D1 & D2
	CLAYEY SILT TILL	2.2	11.3	237.5	227.4	16 – 30 (Very Stiff to hard)	190<Su_{pp}<240	w= 13% to 16% W_l=33% W_p=15% PI= 18% Laboratory results on Figure Nos. D1 & D2

Notes:

Su_{pp} = Undrained Shear Strength interpreted from pocket penetrometer tests, supplementary information only

The laboratory test results are also illustrated on the borehole records in Appendix D.

5.2.4 Overhead Sign at Station 10+750 (Talbotville Bypass Westbound)

The overhead sign at station 10+750 along Talbotville Bypass westbound was added to the to the scope during design stage. Boreholes DCC1, DCC2 & DCC3 (advanced for the Lindsay Drain culvert as part of the same project) were advanced approximately 50 m east of this overhead sign location. Given the consistency of subsurface conditions within the project site, these boreholes have been considered for the design of this overhead sign.

A summary of subsurface conditions encountered in the borehole and the laboratory test results are provided below in Table 5.4.

Table 5.4: Summary of Subsurface Soil Conditions in BH DCC1, DCC2 & DCC3.

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
DCC1	Topsoil	0	0.2	237.3	237.1	N/A	N/A	N/A
	FILL: CLAYEY SILT	0.2	0.9	237.1	236.5	8 (Stiff)	N/A	w=25%
	SILTY CLAY	0.9	1.4	236.5	235.9	7 (Firm)	Su_{pp}=65	w=22% & 26%
	CLAYEY SILT TILL	1.4	15.9	235.9	221.4	19 to 28 (Very stiff)	210<Su_{pp}<240	w=13% to 16% w_L=28-34% w_p= 16-19% PI=12-16% Laboratory results on Figure Nos. D1 & D2
DCC2	Topsoil	0	0.2	237.4	237.2	N/A	N/A	w= 25%
	FILL: CLAYEY SILT	0.2	1.0	237.2	236.4	7 to 9 (Firm)	N/A	w= 16%
	CLAYEY SILT TILL	1.0	15.9	236.4	221.5	13-45 (Very Stiff to Hard)	160<Su_{pp}<240	w=6% to 16% w_L=27-30% w_p= 16-17% PI=11-13%

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
								Laboratory results on Figure Nos. D1 & D2
DCC 3	Topsoil	0	0.2	237.2	237.0	N/A	N/A	N/A
	CLAY	0.2	1.4	237.0	235.9	4-7 (Firm)	Su_{pp}=120	w=22% & 28% W_l= 54% W_P= 22% PI= 32% Laboratory results on Figure Nos. D1 & D2
	CLAYEY SILT TILL	1.4	15.9	235.9	221.5	16-84 (Very Stiff to Hard)	175<Su_{pp}<240	w=9% to 18% W_l= 20-34% W_P= 13-15% PI = 7-19% Laboratory results on Figure Nos. D1 & D2

Notes:

Su_{pp} = Undrained Shear Strength interpreted from pocket penetrometer tests, supplementary information only

The laboratory test results are also illustrated on the borehole records in Appendix D.

5.2.5 Overhead Sign at Station 11+197 (Talbotville Bypass Eastbound)

Borehole Sign 4 was advanced for the overhead sign at Station 11+197 along Talbotville Bypass Eastbound.

A summary of subsurface conditions encountered in the borehole and the laboratory test results are provided below in Table 5.5.

Table 5.5: Summary of Subsurface Soil Conditions at BH No. Sign 4.

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
BH No. Sign 4	Topsoil	0	0.1	237.8	238.7	N/A	N/A	N/A
	CLAYEY SILT TILL	0.1	8.2	238.7	229.6	7-20 (Firm to Very Stiff)	110<Su_{pp}<190	w=14%-21% W_l= 32%-36% W_P= 15%-16% PI = 17%-20% Laboratory results on Figure Nos. D1 & D2

Notes:

Su_{pp} = Undrained Shear Strength interpreted from pocket penetrometer tests, supplementary information only

The laboratory test results are also illustrated on the borehole records in Appendix D.

5.2.6 Overhead Sign at Station 12+222 (Talbotville Bypass Eastbound)

Borehole No. Sign 5 was advanced for the overhead sign at Station 12+222 along Talbotville Bypass eastbound. Borehole CNR-EMB9 was also advanced approximately 20 m east of this overhead sign.

A summary of subsurface conditions encountered in the boreholes and the laboratory test results are provided below in Table 5.6.

Table 5.6: Summary of Subsurface Soil Conditions at BH No. Sign 5 & CNR-EMB 09.

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
BH No. Sign 5	Topsoil	0	0.2	240.1	239.9	N/A	N/A	N/A
	CLAYEY SILT TILL	0.2	2.6	239.9	237.5	3-10 (Firm to Stiff)	110<Su_{pp}<241	w=16% to 23% W_l= 32% W_P =17% PI =15% Laboratory results on Figure Nos. D1 & D2
	Silty Sand	2.6	3.7	237.5	236.4	25 & 35 (Compact to dense)	N/A	w=15%

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
								Laboratory results on Figure No. D3
	CLAYEY SILT TILL	3.7	8.2	236.4	231.8	13-20 (Stiff to Very Stiff)	110<Su_{pp}<241	w=13% to 17% Laboratory results on Figure Nos. D1 & D2
CNR-EMB 09	Topsoil	0	0.2	237.9	237.7	N/A	N/A	W-41.9%
	CLAYEY SILT TILL	0.2	14.8	237.7	224.9	14-34 (Stiff to Hard)	190<Su_{pp}<241	w=12 to 16% W_l= 31-32% W_P= 16% PI = 15-16% Laboratory results on Figure Nos. D1 & D2
	CLAYEY SILT	14.8	15.9	224.9	223.9	17 (Very Stiff)	N/A	w= 17% W_l= 28% W_P= 14% PI = 14% Laboratory results on Figure Nos. D1 & D2

Notes:

Su_{pp} = Undrained Shear Strength interpreted from pocket penetrometer tests, supplementary information only

The laboratory test results are also illustrated on the borehole records in Appendix D.

5.2.7 Overhead Sign at Station 13+255 (Talbotville Bypass Westbound)

Borehole No. Sign 6 was advanced for the overhead sign at Station 13+255 along Talbotville Bypass westbound. This overhead sign was moved approximately 10 m to the east following completion of the field work.

A summary of subsurface conditions encountered in the borehole and the laboratory test results are provided below in Table 5.7.

Table 5.7: Summary of Subsurface Soil Conditions at BH No. Sign 6.

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
BH No. Sign 6	FILL: SILTY SAND with Gravel	0	0.3	237.5	237.2	N/A	N/A	N/A
	CLAYEY SILT TILL	0.3	8.2	237.2	229.3	11-23 (Stiff to Very Stiff)	160<Su_{pp}<241	w=13% to 16% W_l= 24% & 29% W_p= 13% &15% PI= 11% & 14% Laboratory results on Figure Nos. D1 & D2

Notes:

Su_{pp} = Undrained Shear Strength interpreted from pocket penetrometer tests, supplementary information only

The laboratory test results are also illustrated on the borehole records in Appendix D.

5.2.8 Overhead Sign at Station 13+760 (Talbotville Bypass Westbound)

Borehole No. Sign 8 was advanced for the overhead sign at Station 13+760 along Talbotville Bypass westbound. This overhead sign was moved approximately 60 m to the east following completion of the field work.

A summary of subsurface conditions encountered in the borehole and the laboratory test results are provided below in Table 5.8.

Table 5.8: Summary of Subsurface Soil Conditions at BH No. Sign 8.

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
BH No. Sign 8	FILL: SANDY SILT to SILTY SAND	0	0.8	200.9	200.1	5 (Loose)	N/A	w=28%
	CLAYEY SILT TILL	0.8	5.5	200.1	195.4	10 – 22 (Stiff to very stiff)	160<Su_{pp}<241	w=15%-18% W_l=31% Wp=15% PI = 16% Laboratory results on Figure Nos. D1 & D2
	SAND with SILT	5.5	6.8	195.4	194.1	11 & 22 (Compact)	N/A	w=18% to 22%

Borehole	Soil Type	Depth (m)		Elevation (m)		Range of SPT N-values (Compactness/ Consistency)	Range of Su from Field Tests (kPa)	Laboratory Test Results
		From	To	From	To			
								Laboratory results on Figure No. D3
	CLAYEY SILT TILL	6.8	7.5	194.1	193.4	24 (Very stiff)	Su_{pp}=190	w=15%
	SILTY SAND	7.5	8.2	193.4	192.7	32 (Dense)	N/A	w=16%

Notes:

Su_{pp} = Undrained Shear Strength interpreted from pocket penetrometer tests, supplementary information only

The laboratory test results are also illustrated on the borehole records in Appendix D.

5.3 BEDROCK

Bedrock was not encountered to the termination depth of the boreholes.

5.4 GROUNDWATER CONDITIONS

The summary of groundwater conditions measured in the boreholes during/upon completion of drilling is provided below in Table 5.9.

Table 5.9: Summary of Groundwater Conditions in Boreholes Advanced for the Overhead Signs

Proposed Station	Location	Borehole	Measured Groundwater during/upon Completion of Drilling		Comments
			Depth (m)	Elevation (m)	
16 + 030	Highway 4 Southbound	Sign 11	Dry	Dry	Color change at a depth of 3.8 m
15 + 570		Sign 1	Dry	Dry	Color change at a depth of 4.6 m
		SWMP1-BH1	Dry	Dry	Color change at a depth of 1.5 m
11 + 197	Talbotville Bypass Eastbound	Sign 4	Dry	Dry	Color change at a depth of 2.3 m
12 +222		Sign 5	7.0	233.1	-
		CNR-EMB9	Dry	Dry	Color change at a depth of 3.0 m
13 + 760	Talbotville Bypass Westbound	Sign 8	5.5	195.4	Color change at a depth of 3.0 m
13 + 255		Sign 6	Dry	Dry	Color change at a depth of 2.3 m
10 +750		DCC1	Dry	Dry	Color change at a depth of 3.0 m
		DCC2	2.1	235.3	Color change at a depth of 3.0 m
		DCC3	Dry	Dry	Color change at a depth of 2.3 m
10 + 250		Sign 2	Dry	Dry	Color change at a depth of 2.3 m
		Sign 3	Dry	Dry	Color change at a depth of 2.3 m
		SWMP1-BH3	Dry	Dry	Color change at a depth of 2.2 m

Groundwater levels at the site will be subject to fluctuations due to seasonal changes, snowmelt, and precipitation events. The water levels should be expected to be higher during the spring season and during and following periods of heavy precipitation or snow melt.

5.5 CHEMICAL ANALYSIS

Eight (8) soil samples were forwarded to AGAT Laboratories to be tested for pH, soluble sulphate content, chloride content, electrical conductivity, resistivity, and redox potential. The test results are provided in Table 5.10 below.

Table 5.10: Results of Chemical Analysis

Proposed Station	Location	Borehole	Sample No.	Depth (m)	pH	Chloride (µg/g)	Sulphate (µg/g)	Resistivity (Ohm-cm)
16 + 030	Highway 4 Southbound	Sign 11	SS5	3.3	7.35	1490	40	418
15 + 570		Sign 1	SS2	0.76	8.56	602	49	187
11 + 197	Talbotville Bypass Eastbound	Sign 4	SS2	0.76	8.52	957	68	4830
12 +222		Sign 5	SS2	0.76	8.09	6	65	4780
13 + 760	Talbotville Bypass Westbound	Sign 8	SS3	1.52	8.29	61	9	4460
13 + 255		Sign 6	SS2	0.76	8.15	380	13	1560
10 +750		DCC2	SS3	1.52	8.40	17	24	5430
10 + 250		Sign 2	SS3	1.52	8.62	8	14	5810
		Sign 3	SS2	0.76	8.75	21	26	5920

6.0 MISCELLANEOUS

The field work was carried out under the supervision of Harpreet Singh, EIT, Alireza Ghadamgahi, EIT, Muhammed Cuned, Geotechnical Technician, Taylor Koson, Field Supervisor, Kirby Lales, EIT and Akshat Shukla, EIT under the direction of Gwangha Roh, P. Eng., Ph.D.

Utility locates were arranged by Stantec staff prior to initiation of drilling.

The drilling equipment was supplied and operated by DBW Drilling based in North York, Ontario, and London Soil, London, Ontario.

The borehole locations and elevations were surveyed by Stantec's Geomatics division based in London.

Geotechnical laboratory testing was carried out at Stantec's laboratory in Markham, Ontario.

This report was prepared by Harpreet Singh, EIT and Roshan Rashed, P.Eng., and reviewed by Gwangha Roh, P. Eng., Ph.D., and Raymond Haché, M.Sc., P.Eng., Designated Principal MTO Foundation Contact.

7.0 CLOSURE

A subsurface investigation is a limited sampling of a site. The subsurface conditions described herein are based on information obtained at the specific borehole locations. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately to assess the additional information.

Respectfully Submitted,

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FOUNDATION INVESTIGATION AND DESIGN REPORT
For
G.W.P. 3042-22-00
Overhead Signs

Highway 4 widening from Clinton Line to New Talbotville Bypass and New Talbotville Bypass from Highway 4 to Highway 3 at Ron McNeil Line
West Region, Township of Southwold, County of Elgin, Ontario

8.0 DISCUSSIONS AND ENGINEERING RECOMMENDATIONS

8.1 PROJECT DESCRIPTION AND BACKGROUND

8.1.1 Scope Purpose and Description

This project involves preliminary and detailed design of the Highway 4 widening from Clinton Line to the new Talbotville Bypass and new Talbotville Bypass from Highway 4 to Highway 3 at Ron McNeil Line (GWP 3042-22-00), and the Highway 3 widening from Ron McNeil Line to Centennial Avenue (GWP 3041-22-00).

This foundation investigation and design report has been prepared specifically for the proposed new overhead signs. Other project foundations engineering components are reported under separate covers.

8.2 OVERHEAD SIGN FOUNDATION DESIGN

8.2.1 Overview

The project includes a total of eight (8) overhead signs. Table 8.1 summarizes the location and support type for each of the proposed signs with reference to the borehole(s) advanced at the respective sign location. As referenced in a preceding section, changes were made to the location of some of the overhead signs through the design process. Where applicable, the changes have also been included in the table.

Table 8.1: Proposed Sign Details

Proposed Station	Anticipated Structure Type	Borehole ID	Comments
Highway 4 Southbound			
16+030	Overhead Sign	BH SIGN 11	-
15+570	Overhead Sign	BH SIGN 1 SWMP1-BH1	-
Talbotville Bypass Eastbound			
11+197	Cantilever	BH SIGN 4	-

Proposed Station	Anticipated Structure Type	Borehole ID	Comments
12+222	Overhead Sign	BH SIGN 5 CNR-EMB9BH	Moved approximately 15 m east of the preliminary design location after completion of foundation investigation.
Talbotville Bypass Westbound			
13+760	Cantilever	BH SIGN 8	Moved approximately 60 m east of the preliminary design location after completion of foundation investigation.
13+255	Overhead Sign	BH SIGN 6	Moved approximately 10 m east of the preliminary design location after completion of foundation investigation.
10+725	Overhead Sign	BH DCC1 BH DCC2 BH DCC3	Added following completion of the foundation investigation.
10+250	Overhead Sign	BH SIGN 2 BH SIGN 3 SWMP1-BH3	Moved approximately 50 m east of the preliminary design location after completion of foundation investigation

8.2.2 Frost Penetration

In accordance with OPSD 3090.101, the design frost penetration depth for foundations, f, can be taken as 1.2 m. This depth should be considered in the design of the overhead sign supports.

8.2.3 Design Parameters

The recommended design parameters for the proposed overhead sign foundations are provided in Table E-1, Foundation Design Parameters for Overhead Signs, included in Appendix E of this report.

To estimate the horizontal subgrade modulus, k_s, along the length of the caisson or pile, the following equations may be used.

For cohesionless materials:

$$k_s = n_h . \frac{z}{b}$$

Where

n_h is the coefficient of horizontal subgrade reaction provided in Table E-1.
z is the depth below ground surface in meters
b is the pile width in meters

For cohesive materials:

$$k_s = \frac{67\, S_u}{b}$$

Where

S_u is the soil shear strength provided in the Table E-1.
b is the pile width in meters

The "degree of site and prediction model understanding" may be considered as "Typical Understanding" as per Section 6.5 of the Commentary on CSA S6-19, Canadian Highway Bridge Design Code (CHBDC), (S6.1-19).

8.2.4 Passive Lateral Earth Pressure

The unfactored passive lateral earth pressure, Pp (kPa), may be calculated using the following equations:

$$P_p = k_p \gamma z \qquad \text{Above the groundwater table}$$
$$P_p = k_p(\gamma z_w + \gamma'(z - z_w)) \qquad \text{Below the groundwater table}$$

Where:

K_p	is the passive earth pressure coefficient;
γ	is the total unit weight (kN/m^3);
γ'	is the effective unit weight below the groundwater level (kN/m^3);
z	is the depth below the ground surface (m); and
z_w	is the depth to the groundwater level (m).

The passive resistance should be neglected within the frost penetration depth, which is 1.2 m below ground surface.

A resistance factor of 0.5 should be applied to the calculated lateral resistance in order to obtain the factored lateral geotechnical resistance at Ultimate Limit States (ULS).

Sloping Ground

For a sloping ground condition, the coefficient of passive earth pressure (Kp) may be calculated using the following equation.

$$K_p = \cos\theta \left(\frac{\cos\theta + (cos^2\theta - cos^2\Phi)^{0.5}}{\cos\theta - (cos^2\theta - cos^2\Phi)^{0.5}} \right)$$

Where:

K_p	is the passive earth pressure coefficient;
Φ	is the angle of internal friction (degrees); and
θ	is the critical cross slope within a radius of 4.5 ft around the shaft (degrees)

8.2.5 Caisson Foundation for Overhead Signs

Foundations for sign supports should be designed in accordance with the requirements in MTO's Sign Support Manual (MTO, 2019). The Sign Support Manual includes standard foundation designs for each sign type as follows:

- Cantilever Static Sign Supports, Section 3 and Standard Drawings SS118-3, SS118-4 and SS118-5.
- Tri-Chord Static Sign Supports, Section 4 and Standard Drawings SS118-3, SS118-4 and SS118-5.

According to the MTO Sign Support Manual, the standard foundations for cantilever or tri-chord signs consist of caisson foundations with lengths ranging from 5.0 m to 7.5 m below the frost depth and diameters ranging from 1.2 m to 1.5 depending on the Type and class.

The standard foundation design provided in the Sign Support Manual does not apply to sites where the bedrock is at or near the surface, the footings will be located in rockfill, or where exceptionally soft/loose soils are present within the foundations zone. These conditions were not encountered in the boreholes advanced at the sign locations.

The standard sign foundation designs presented in the MTO Sign Support Manual have been developed based on the minimum soil conditions as outlined below:

- Case 1 (Cohesionless Soils): Competent soils of uniform composition with a minimum internal friction angle of 28 degrees within the upper 2/3 of the caisson below the frost zone and 30 degrees within the lower third of the caisson below the frost zone.
- Case 2 (Cohesive Soils): Clay soil with a minimum undrained shear strength of 25 kPa within the upper 2/3 of the caisson below the frost zone and a minimum undrained shear strength of 50 kPa within the lower third of the caisson below the frost zone.

A site-specific sign support foundation design is required for signs where the soil conditions do not meet the minimum requirements outlined above. The soil conditions encountered in the boreholes advanced at the locations of the proposed sign locations should be compared to the standard design requirements outlined above to determine whether a standard or site-specific design is required at each foundation location. A site-specific sign support foundation design may also be carried out by the structural engineer to optimize the standard foundation design using the design soil parameters provided in Table E.1 included in Appendix E. The subsurface stratigraphy encountered in the boreholes advanced for the overhead signs was relatively uniform and consisted of stiff to very stiff cohesive soils. In this respect, the standard case 2 referenced above is anticipated to be applicable to most overhead signs, with the exceptions of those locations where cohesionless materials were encountered below frost depth. These locations are as follows:

- Borehole Sign 5: compact to dense silty sand was encountered from 2.6 m to 3.7 m below grade
- Borehole Sign 8: compact sand with silt was encountered from 5.5 m to 6.8 m below grade and dense silty sand was encountered from 7.5 m to 8.2 m below grade

Table E.1 in Appendix E identifies the overhead signs where the subsurface conditions meet MTO standard design criteria indicated above.

For the signs that will be founded within the embankment side slopes, the coefficient of lateral earth pressure adjusted for a 2H:1V slope ($k_{p2:1}$) provided in Table E.1 in Appendix E should be used in design to account for the reductions in the passive resistance due to sloping ground conditions. Consideration can also be given to the use of an RSS wall or large diameter CSP to protect the sign foundation elements located within the embankment side slopes.

For the signs that will be located within the proposed new embankment, sign supports design should be done with consideration of new fill material properties. In general, an internal friction angle higher than 30 degrees can be expected for the compacted granular embankment fill materials. Typical embankment cross sections along Highway 4 and Talbotville Bypass are included in Appendix F for reference.

8.3 CEMENT TYPE AND CORROSION PROTECTION

The results of the analytical tests on samples of the native soils are presented in Section 5.0 and Appendix D.

As per the MTO Structural Manual (2021) section 2.8.5, concrete is considered subject to sulphate attack when

- Water-soluble sulphate (SO_4) content of the adjacent soil is equal to or greater than 0.10%; or,
- Sulphate (SO_4) in groundwater is equal to or greater than 150 mg/L.

When concrete is identified as subject to sulphate attack, the concrete shall be resistant to sulphate attack. Based on the test results, concrete will not be subject to sulphate attack for this culvert replacement site (water-soluble sulphate in soil samples <0.10% which is equivalent to 1000μg/g).

The analytical test results were also compared to Table 7.2 of the U.S. Federal Highway Administration Publication No. FHWA-NHI-14-007 (2015) Criteria for Assessing Ground Corrosion Potential for the potential attack on buried steel. The results are provided below in Table 8.2.

Table 8.2: Results of Corrosion Potential Assessment (FHWA-NHI-14-007)

Station	Borehole No	Sample No.	Depth (m)	Corrosion Potential
Highway 4 Southbound				
16+030	Sign 11	SS5	3.3	Aggressive
15+570	Sign 1	SS2	0.76	Aggressive
Talbotville Bypass Eastbound				
11+197	Sign 4	SS2	0.76	Aggressive
12+222	Sign 5	SS2	0.76	Non- Aggressive
Talbotville Bypass Westbound				
13+760	Sign 8	SS3	1.52	Non- Aggressive
13+255	Sign 6	SS2	0.76	Aggressive
10+725	DCC2	SS3	1.52	Non- Aggressive
10+250	Sign 2	SS3	1.52	Non- Aggressive
	Sign 3	SS2	0.76	Non- Aggressive

Based on the results of the samples tests consideration should be given by the designer to designing for a “C” type exposure class as defined by CSA A23.1 Table 1.

It should be noted that the final selection of exposure class and corrosion mitigation measures should be a decision of the design engineer who takes into account all design considerations including CSA A23.1 Section 4.1.1 durability requirements.

8.4 CONSTRUCTION CONSIDERATIONS

Construction of the sign support foundations should be in accordance with OPSS.PROV 915 (Construction Specifications for Sign Support Structures) and OPSS.PROV 903 (Construction Specifications for Deep Foundations).

The soils encountered in the boreholes advanced at the locations of the overhead signs consisted predominantly of cohesive soils ranging from clayey silt to clay. Cohesionless fill soils comprising silty sand with gravel and localized native silty sand to sand with silt soils were encountered in some of the boreholes at shallow depths (i.e., boreholes Sign 1, Sign 5, Sign 6, Sign 8 and Sign 11). Groundwater is also anticipated to be encountered within the anticipated installation depths of the sign foundations at several borehole locations. Where wet, the cohesionless soils are expected to run or flow into the holes drilled for the sign support foundations, a provision should be included for the use of temporary liners and/or drilling fluids to reduce the potential for sidewall instability and ground loss during drilling/concrete placement. The use of tremie methods for placement of concrete should be considered where the foundations extend below groundwater level.

Cobbles and boulders were not encountered in the boreholes but may be present in the till soils encountered in the boreholes. In this respect, the construction equipment and procedures used must be suitable for penetrating and/or removing cobbles and boulders (if encountered) during drilling of the holes for the foundations of overhead sign supports.

9.0 SPECIFICATIONS

The following specifications are referenced in this report:

Table 9.1: Specifications Referenced in Report

Document	Title
OPSD 3090.101	Foundation Frost Depths for Southern Ontario
OPSS.PROV 903	Construction Specifications for Deep Foundations
OPSS.PROV 915	Construction Specifications for Sign Support Structures

10.0 REFERENCES

ASTM. 1999. Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586). ASTM International, West Conshohocken, PA.

ASTM. 2000. Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM D2487). ASTM International, West Conshohocken, PA.

CHBDC. 2019. Canadian Highway Bridge Design Code. Canadian Standards Association, Mississauga, Ontario.

Ministry of Transportation Ontario (MTO). 2019. Sign Support Manual, Ministry of Transportation, Provincial Highways Management Division, Highway Standards Branch, Bridge Office.

Ministry of Transportation Ontario (MTO). 2020 Guideline for MTO Foundation Engineering Services V2.

11.0 CLOSURE

A soil investigation is a limited sampling of a site. The conclusions given herein are based on information gathered at the specific borehole locations. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information and its effects on the above recommendations.

We trust the information presented herein meets your present requirements. Should you have any questions or require additional information, please do not hesitate to contact us.

This report was prepared by Roshan Rashed, P.Eng., and reviewed by Gwangha Roh, P. Eng., Ph.D., and Raymond Haché, M.Sc., P.Eng., Designated Principal MTO Foundation Contact.

Respectfully submitted,

STANTEC CONSULTING LTD.

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APPENDIX A

A.1 DRAWING NOS. 1 TO 7 – BOREHOLE LOCATION PLAN

MINISTRY OF TRANSPORTATION, ONTARIO
PR-D-707 88-05
Printed: Apr 01, 2025
DRAWING NAME: 165001308_Overhead Signs_Borehole Locations_250401.dwg
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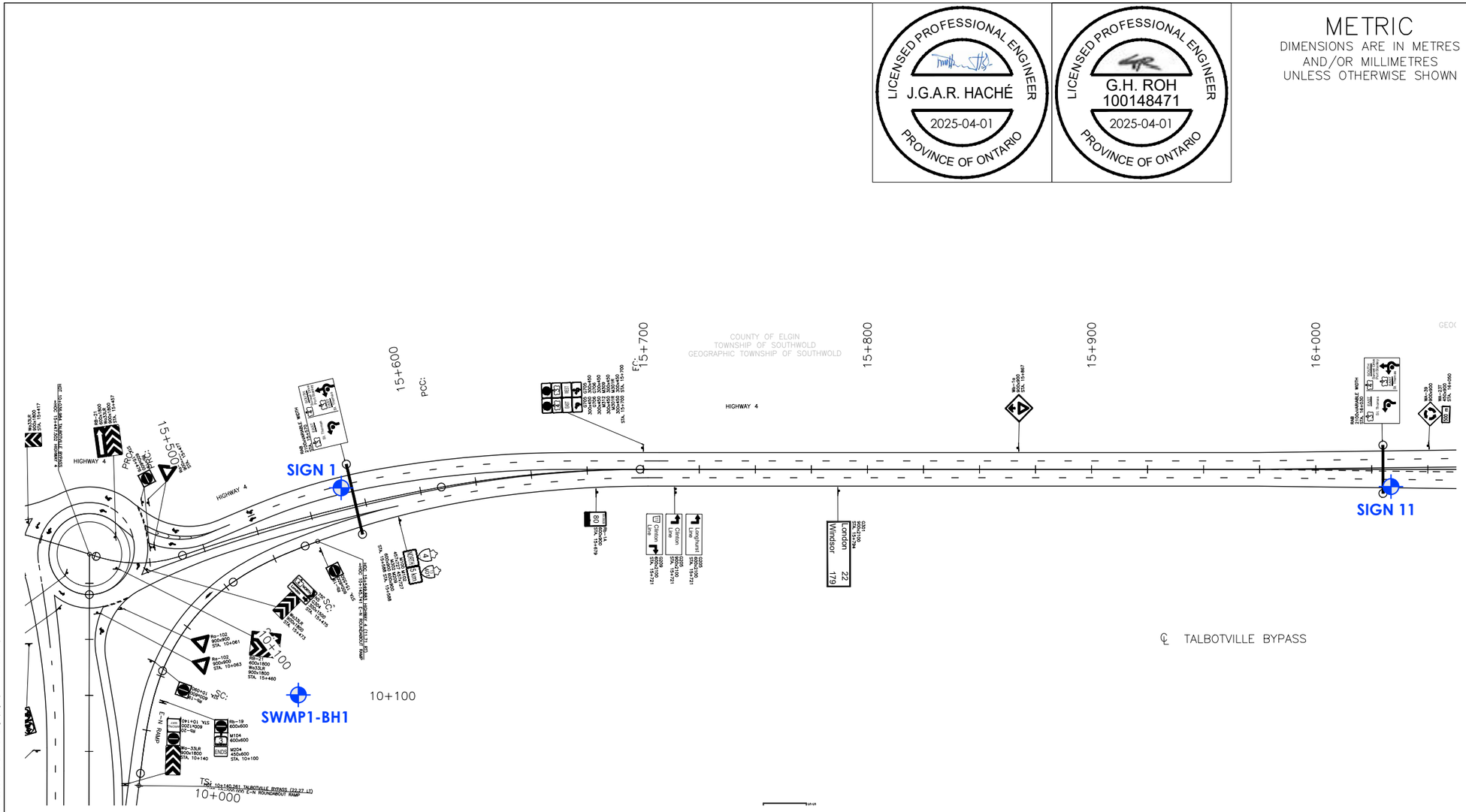


℄ TALBOTVILLE BYPASS

SCALE
20m 0 20 40m

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
J.G.A.R. HACHÉ
2025-04-01
PROVINCE OF ONTARIO

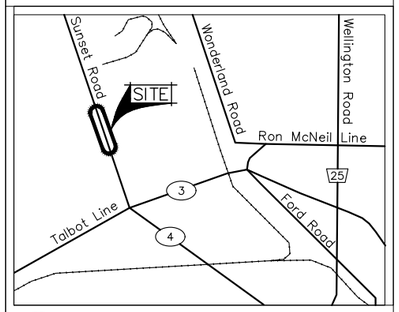
LICENSED PROFESSIONAL ENGINEER
G.H. ROH
100148471
2025-04-01
PROVINCE OF ONTARIO

PLATE No
CONT 2025-3007
WP 3042-22-00

SIGNS
STA 10+000 TO STA 10+150
BOREHOLE LOCATIONS PLAN

SHEET
–

Stantec



KEY PLAN
1 km 0 1 2 km

LEGEND

Borehole (Stantec, 2025)

No	ELEV	MTM ZONE 11 COORDINATES NORTH	EAST
SIGN 1	239.5	4 742 446.0	406 350.9
SIGN 2	238.2	4 742 410.1	406 558.2
SIGN 3	238.0	4 742 428.9	406 548.3
SIGN 4	237.8	4 742 624.9	407 525.2
SIGN 5	240.1	4 742 179.4	408 406.1
SIGN 6	237.5	4 741 584.7	409 224.5
SIGN 8	200.9	4 741 469.5	409 663.1
SIGN 11	241.3	4 742 887.7	406 193.4
DCC1	237.3	4 742 624.0	407 117.6
DCC2	237.4	4 742 609.0	407 154.4
DCC3	237.3	4 742 591.0	407 191.9
CNR-EMB9	239.7	4 742 180.1	408 425.8
SWMP1-BH1	238.7	4 742 459.0	404 444.4
SWMP1-BH2	239.0	4 742 521.0	406 528.9
SWMP1-BH3	238.7	4 742 511.0	406 645.5
SWMP1-BH4	239.9	4 742 590.0	406 728.5

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

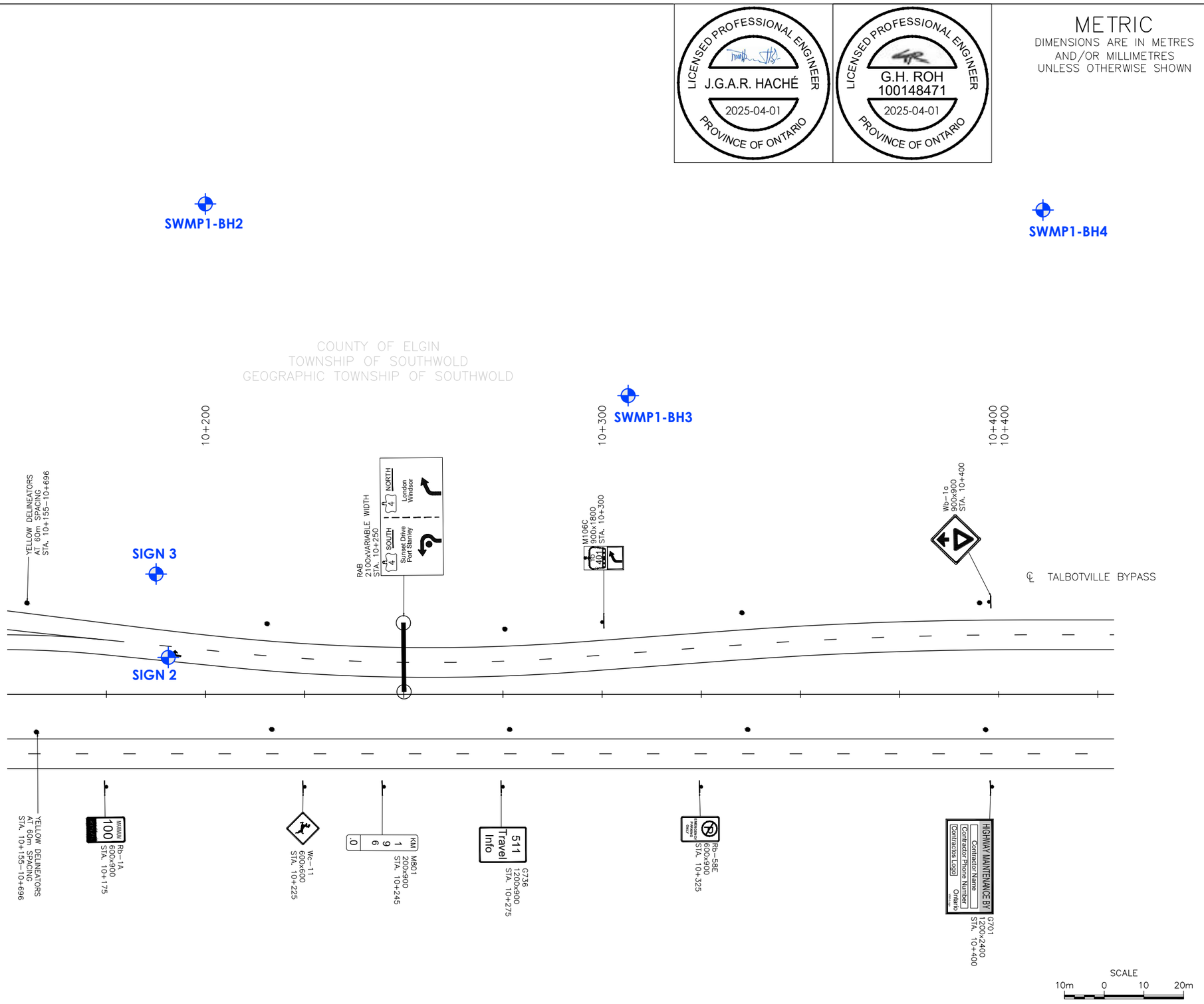
REVISIONS

DATE	BY	DESCRIPTION

GEOCRES No 40I14-226

HWY No			DIST
SUBM'D RR	CHECKED	DATE 2025-04-01	SITE
DRAWN GBB	CHECKED	APPROVED	DWG 1

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05



LICENSED PROFESSIONAL ENGINEER
J.G.A.R. HACHÉ
2025-04-01
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
G.H. ROH
100148471
2025-04-01
PROVINCE OF ONTARIO

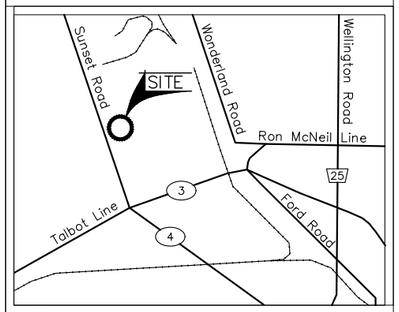
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No
CONT 2025–3007
WP 3042–22–00

SIGNS
STA 10+150 TO STA 10+400
BOREHOLE LOCATIONS PLAN

SHEET
–

Stantec



LEGEND

Borehole (Stantec, 2025)

No	ELEV	MTM ZONE 11 COORDINATES NORTH	EAST
SIGN 1	239.5	4 742 446.0	406 350.9
SIGN 2	238.2	4 742 410.1	406 558.2
SIGN 3	238.0	4 742 428.9	406 548.3
SIGN 4	237.8	4 742 624.9	407 525.2
SIGN 5	240.1	4 742 179.4	408 406.1
SIGN 6	237.5	4 741 584.7	409 224.5
SIGN 8	200.9	4 741 469.5	409 663.1
SIGN 11	241.3	4 742 887.7	406 193.4
DCC1	237.3	4 742 624.0	407 117.6
DCC2	237.4	4 742 609.0	407 154.4
DCC3	237.3	4 742 591.0	407 191.9
CNR–EMB9	239.7	4 742 180.1	408 425.8
SWMP1–BH1	238.7	4 742 459.0	404 444.4
SWMP1–BH2	239.0	4 742 521.0	406 528.9
SWMP1–BH3	238.7	4 742 511.0	406 645.5
SWMP1–BH4	239.9	4 742 590.0	406 728.5

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102–2 of Form 100.

REVISIONS	DATE	BY	DESCRIPTION

GEOCRES No 40I14–226

HWY No			DIST
SUBM'D RR	CHECKED	DATE 2025–04–01	SITE
DRAWN GBB	CHECKED	APPROVED	DWG 2

DRAWING NAME: 165001308_Overhead Signs_Borehole Locations_250401.dwg
CREATED BY: GBB MODIFIED:
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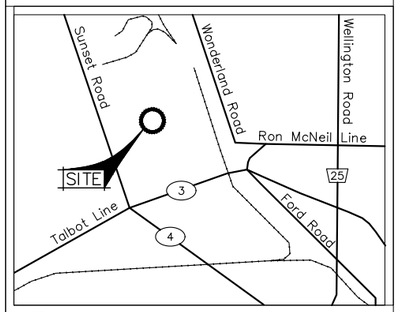
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No
CONT 2025-3007
WP 3042-22-00

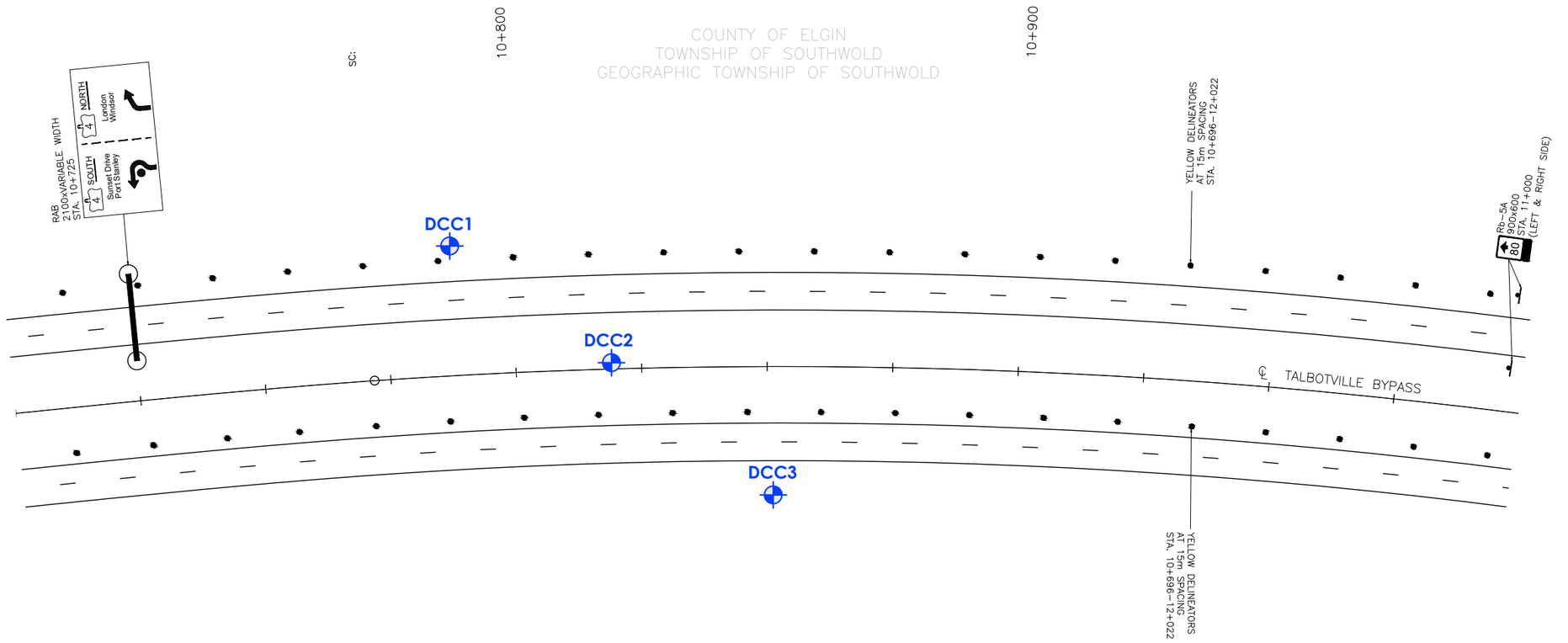
SIGNS
STA 10+700 TO 11+000
BOREHOLE LOCATIONS PLAN

SHEET
–

Stantec



KEY PLAN
1 km 0 1 2 km



SCALE
10m 0 10 20m

LEGEND

Borehole (Stantec, 2025)

No	ELEV	MTM ZONE 11 COORDINATES NORTH	EAST
SIGN 1	239.5	4 742 446.0	406 350.9
SIGN 2	238.2	4 742 410.1	406 558.2
SIGN 3	238.0	4 742 428.9	406 548.3
SIGN 4	237.8	4 742 624.9	407 525.2
SIGN 5	240.1	4 742 179.4	408 406.1
SIGN 6	237.5	4 741 584.7	409 224.5
SIGN 8	200.9	4 741 469.5	409 663.1
SIGN 11	241.3	4 742 887.7	406 193.4
DCC1	237.3	4 742 624.0	407 117.6
DCC2	237.4	4 742 609.0	407 154.4
DCC3	237.3	4 742 591.0	407 191.9
CNR-EMB9	239.7	4 742 180.1	408 425.8
SWMP1-BH1	238.7	4 742 459.0	404 444.4
SWMP1-BH2	239.0	4 742 521.0	406 528.9
SWMP1-BH3	238.7	4 742 511.0	406 645.5
SWMP1-BH4	239.9	4 742 590.0	406 728.5

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REVISIONS			
	DATE	BY	DESCRIPTION

GEOCRES No 40I14-226

HWY No			DIST
SUBM'D RR	CHECKED	DATE 2025-04-01	SITE
DRAWN GBB	CHECKED	APPROVED	DWG 3

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CREATED BY: GBB MODIFIED:
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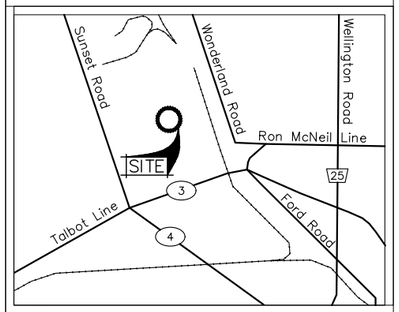
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

PLATE No
CONT 2025-3007
WP 3042-22-00

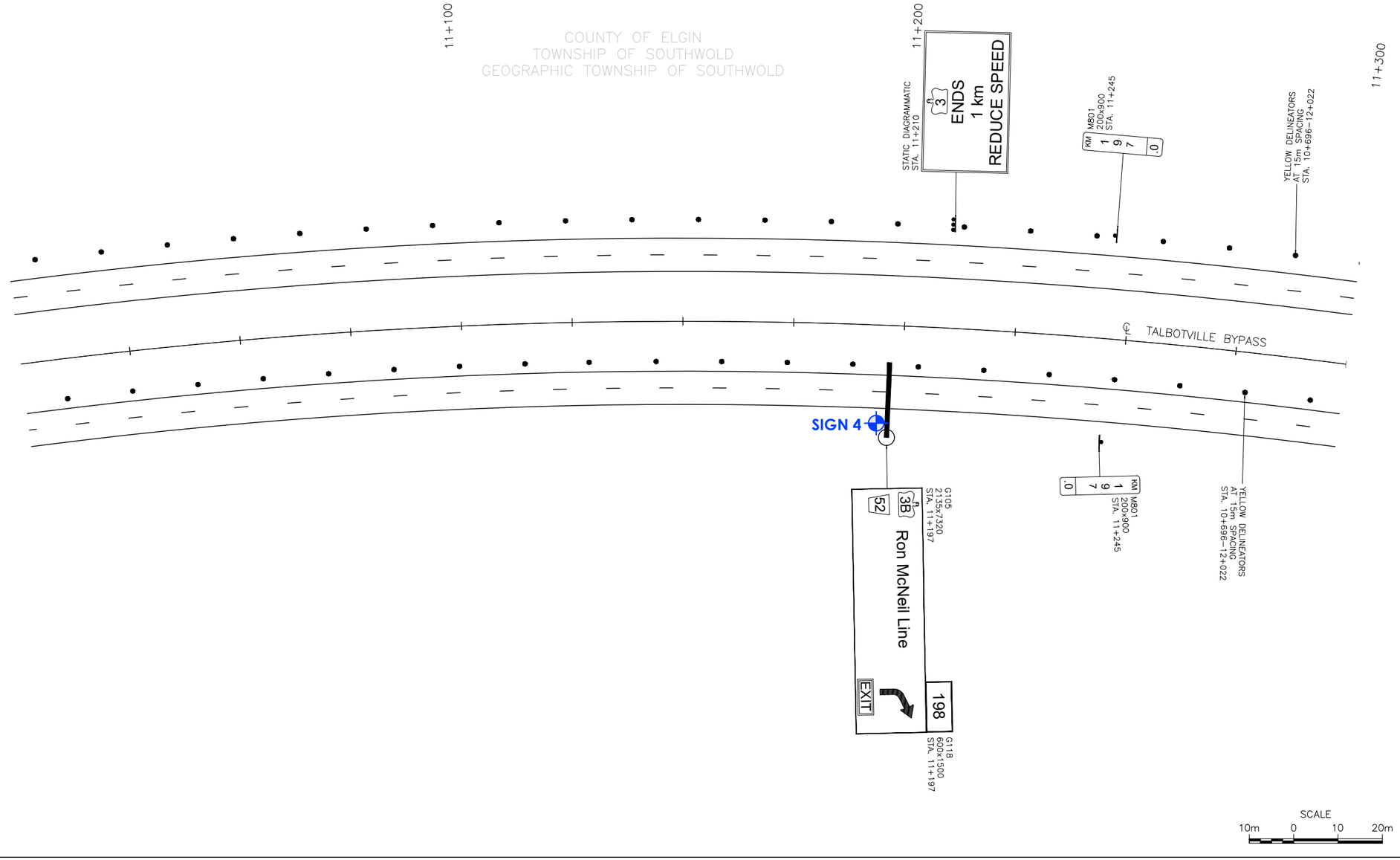
SIGNS
STA 11+000 TO 11+300
BOREHOLE LOCATIONS PLAN

SHEET
–

Stantec



KEY PLAN
1 km 0 1 2 km



SCALE
10m 0 10 20m

LEGEND

Borehole (Stantec, 2025)

No	ELEV	MTM ZONE 11 COORDINATES NORTH	EAST
SIGN 1	239.5	4 742 446.0	406 350.9
SIGN 2	238.2	4 742 410.1	406 558.2
SIGN 3	238.0	4 742 428.9	406 548.3
SIGN 4	237.8	4 742 624.9	407 525.2
SIGN 5	240.1	4 742 179.4	408 406.1
SIGN 6	237.5	4 741 584.7	409 224.5
SIGN 8	200.9	4 741 469.5	409 663.1
SIGN 11	241.3	4 742 887.7	406 193.4
DCC1	237.3	4 742 624.0	407 117.6
DCC2	237.4	4 742 609.0	407 154.4
DCC3	237.3	4 742 591.0	407 191.9
CNR-EMB9	239.7	4 742 180.1	408 425.8
SWMP1-BH1	238.7	4 742 459.0	404 444.4
SWMP1-BH2	239.0	4 742 521.0	406 528.9
SWMP1-BH3	238.7	4 742 511.0	406 645.5
SWMP1-BH4	239.9	4 742 590.0	406 728.5

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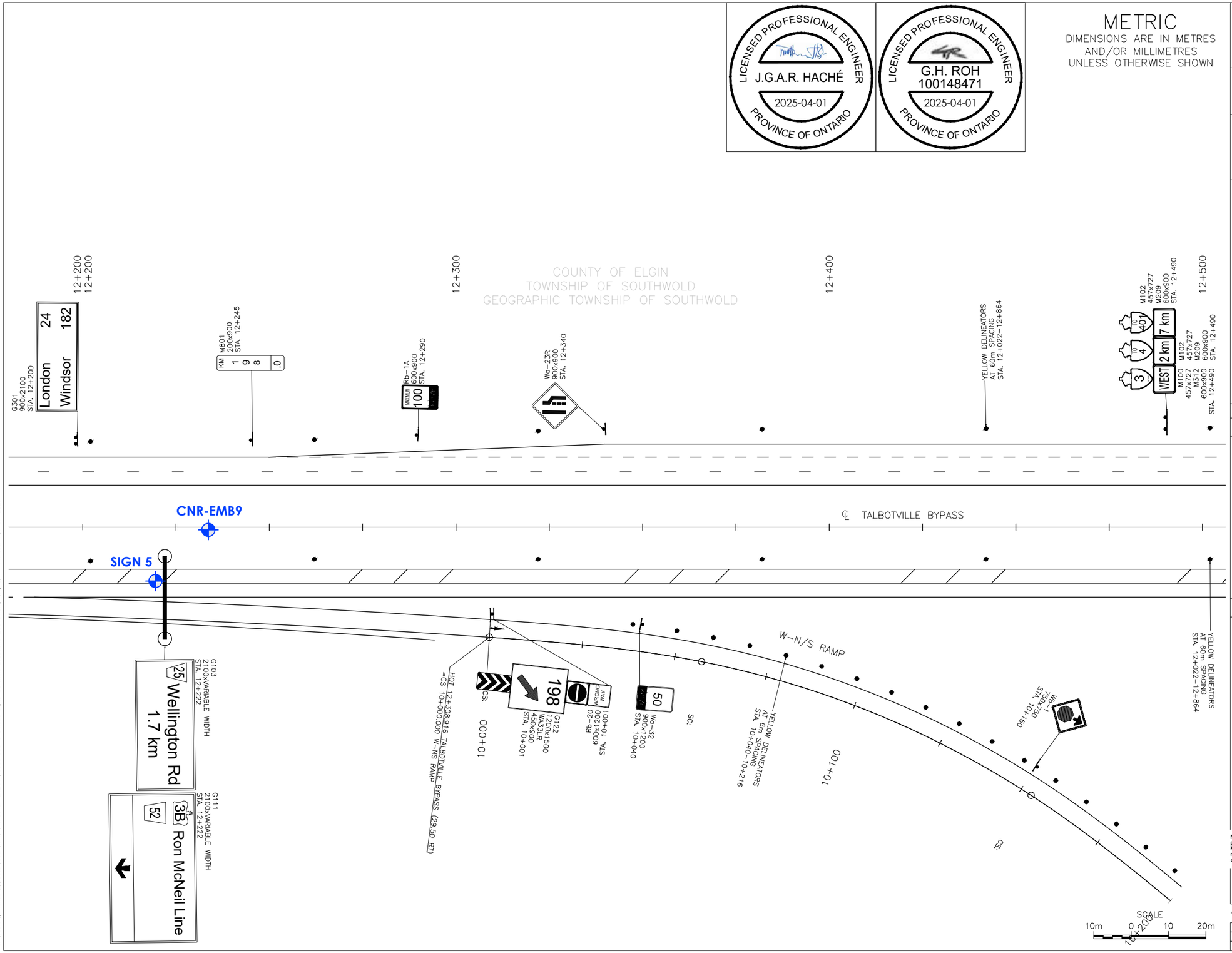
REVISIONS	DATE	BY	DESCRIPTION

GEOCRES No 40I14-226

HWY No			DIST
SUBM'D RR	CHECKED	DATE 2025-04-01	SITE
DRAWN GBB	CHECKED	APPROVED	DWG 4

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05



LICENSED PROFESSIONAL ENGINEER
J.G.A.R. HACHÉ
2025-04-01
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
G.H. ROH
100148471
2025-04-01
PROVINCE OF ONTARIO

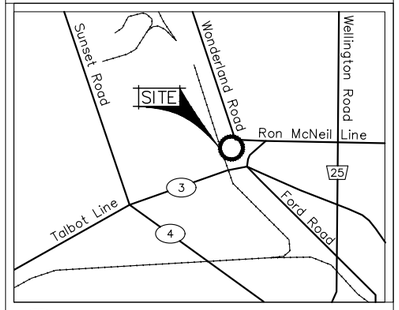
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

PLATE No
CONT 2025-3007
WP 3042-22-00

SIGNS
STA 12+200 TO 12+500
BOREHOLE LOCATIONS PLAN

SHEET
–

Stantec



KEY PLAN
1 km 0 1 2 km

LEGEND

Borehole (Stantec, 2025)

No	ELEV	MTM ZONE 11 COORDINATES NORTH	EAST
SIGN 1	239.5	4 742 446.0	406 350.9
SIGN 2	238.2	4 742 410.1	406 558.2
SIGN 3	238.0	4 742 428.9	406 548.3
SIGN 4	237.8	4 742 624.9	407 525.2
SIGN 5	240.1	4 742 179.4	408 406.1
SIGN 6	237.5	4 741 584.7	409 224.5
SIGN 8	200.9	4 741 469.5	409 663.1
SIGN 11	241.3	4 742 887.7	406 193.4
DCC1	237.3	4 742 624.0	407 117.6
DCC2	237.4	4 742 609.0	407 154.4
DCC3	237.3	4 742 591.0	407 191.9
CNR-EMB9	239.7	4 742 180.1	408 425.8
SWMP1-BH1	238.7	4 742 459.0	404 444.4
SWMP1-BH2	239.0	4 742 521.0	406 528.9
SWMP1-BH3	238.7	4 742 511.0	406 645.5
SWMP1-BH4	239.9	4 742 590.0	406 728.5

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REVISIONS	DATE	BY	DESCRIPTION

GEOCRES No 40I14-226

HWY No			DIST
SUBM'D RR	CHECKED	DATE 2025-04-01	SITE
DRAWN GBB	CHECKED	APPROVED	DWG 5

DRAWING NAME: 165001308_Overhead Signs_Borehole Locations_250401.dwg
CREATED BY: GBB MODIFIED:
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MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

LICENSED PROFESSIONAL ENGINEER
J.G.A.R. HACHÉ
2025-04-01
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
G.H. ROH
100148471
2025-04-01
PROVINCE OF ONTARIO

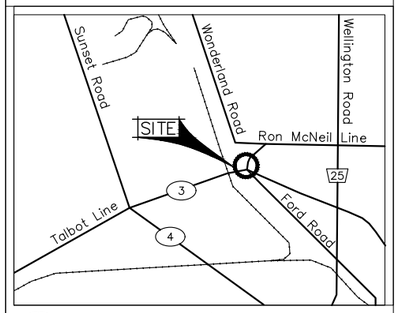
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No
CONT 2025-3007
WP 3042-22-00

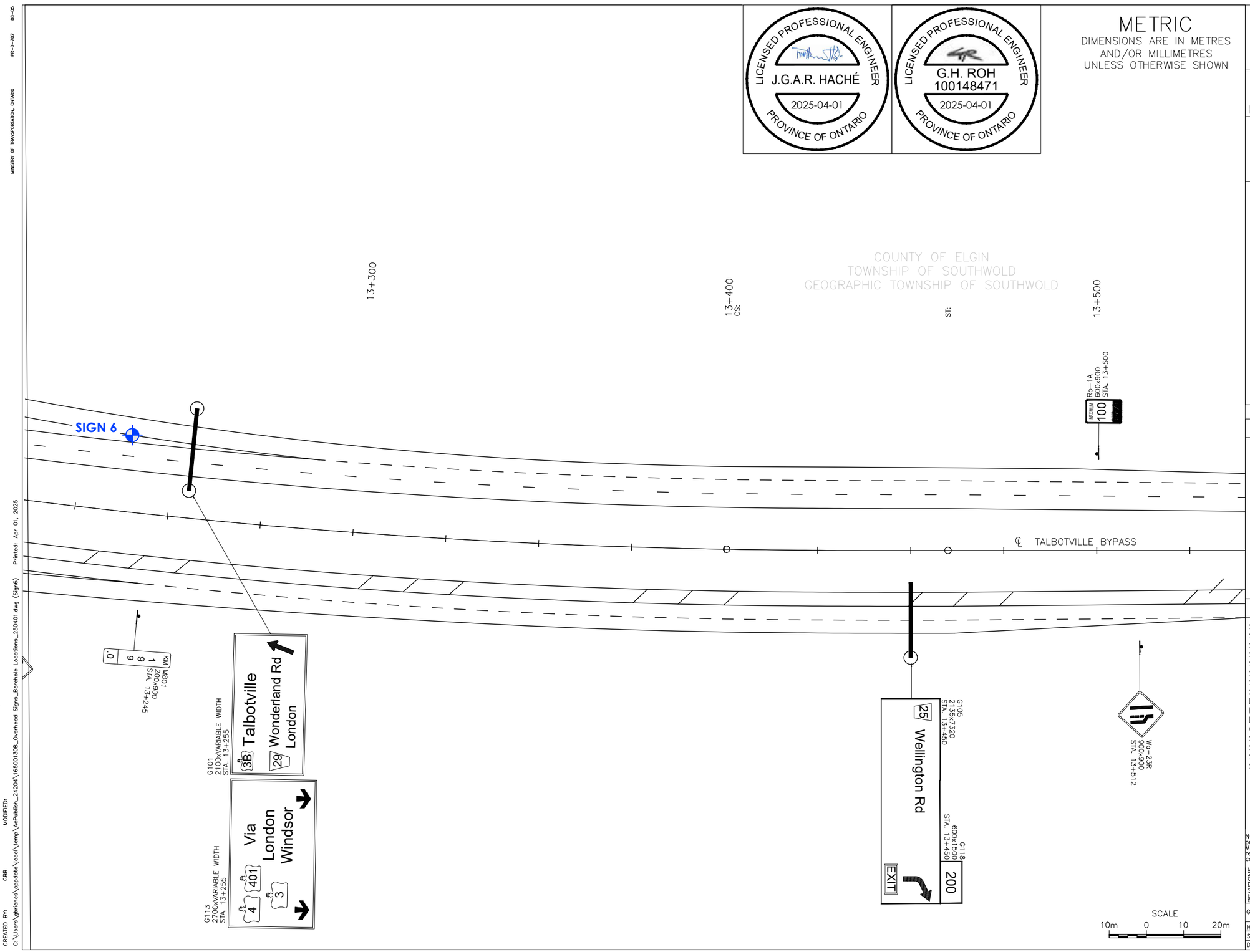
SHEET
–

SIGNS
STA 12+225 TO 12+525
BOREHOLE LOCATIONS PLAN

Stantec



KEY PLAN
1 km 0 1 2 km



SCALE
10m 0 10 20m

LEGEND
Borehole (Stantec, 2025)

No	ELEV	MTM ZONE 11 COORDINATES NORTH	EAST
SIGN 1	239.5	4 742 446.0	406 350.9
SIGN 2	238.2	4 742 410.1	406 558.2
SIGN 3	238.0	4 742 428.9	406 548.3
SIGN 4	237.8	4 742 624.9	407 525.2
SIGN 5	240.1	4 742 179.4	408 406.1
SIGN 6	237.5	4 741 584.7	409 224.5
SIGN 8	200.9	4 741 469.5	409 663.1
SIGN 11	241.3	4 742 887.7	406 193.4
DCC1	237.3	4 742 624.0	407 117.6
DCC2	237.4	4 742 609.0	407 154.4
DCC3	237.3	4 742 591.0	407 191.9
CNR-EMB9	239.7	4 742 180.1	408 425.8
SWMP1-BH1	238.7	4 742 459.0	404 444.4
SWMP1-BH2	239.0	4 742 521.0	406 528.9
SWMP1-BH3	238.7	4 742 511.0	406 645.5
SWMP1-BH4	239.9	4 742 590.0	406 728.5

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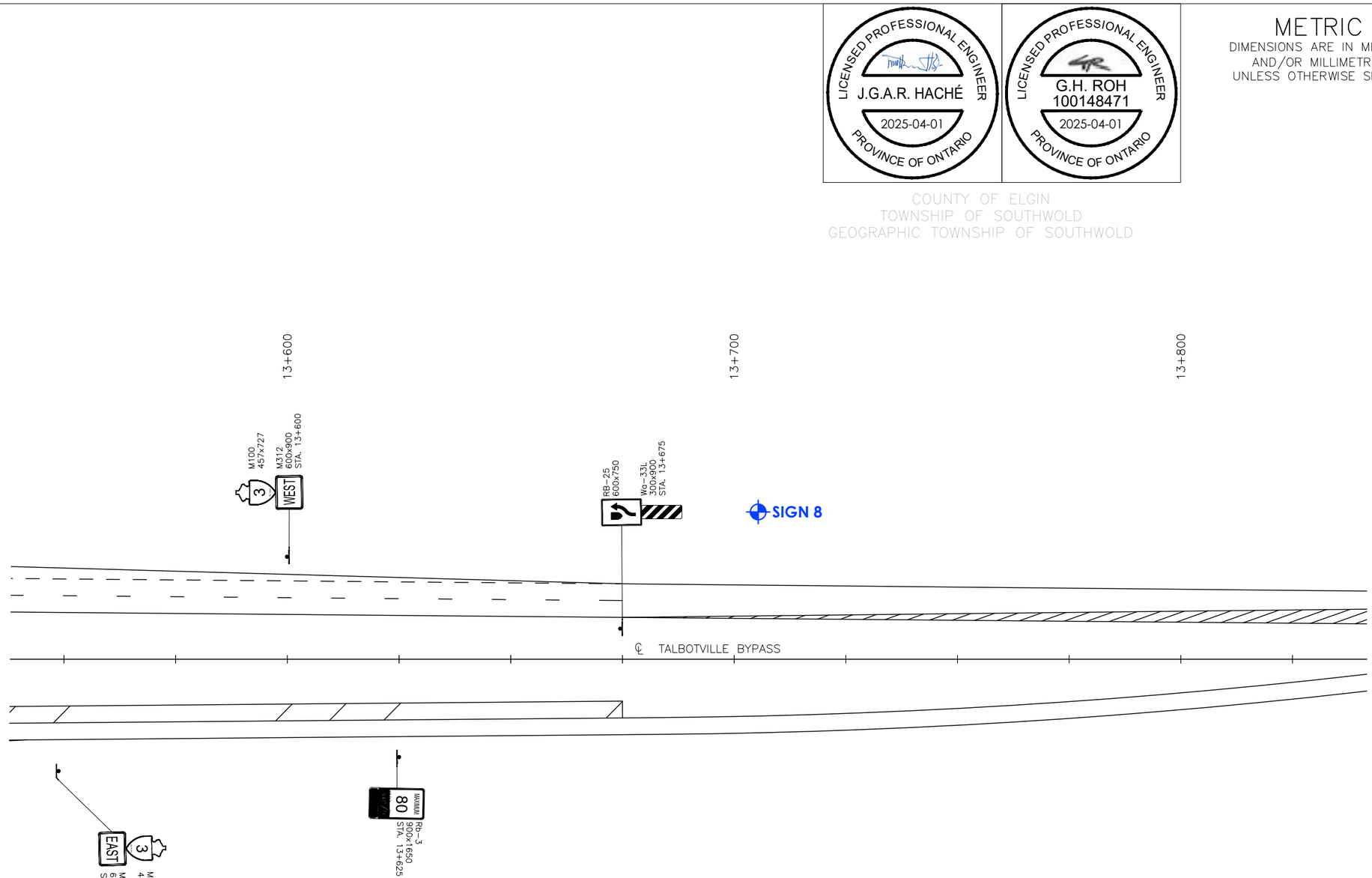
REVISIONS	DATE	BY	DESCRIPTION

GEOCRES No 40I14-226

HWY No			DIST
SUBM'D RR	CHECKED	DATE 2025-04-01	SITE
DRAWN GBB	CHECKED	APPROVED	DWG 6

DRAWING NAME: 165001308_Overhead Signs_Borehole Locations_250401.dwg
CREATED BY: GBB MODIFIED:
C:\Users\gbrones\appdata\local\temp\AcPublish_24204\165001308_Overhead Signs_Borehole Locations_250401.dwg (Sign6) Printed: Apr 01, 2025

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05



LICENSED PROFESSIONAL ENGINEER
J.G.A.R. HACHÉ
2025-04-01
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
G.H. ROH
100148471
2025-04-01
PROVINCE OF ONTARIO

COUNTY OF ELGIN
TOWNSHIP OF SOUTHWOLD
GEOGRAPHIC TOWNSHIP OF SOUTHWOLD

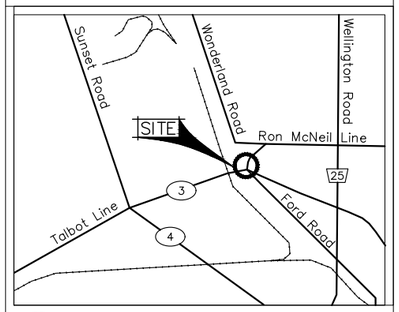
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No
CONT 2025-3007
WP 3042-22-00

SIGNS
STA 12+225 TO 12+525
BOREHOLE LOCATIONS PLAN

SHEET
–

Stantec



LEGEND
Borehole (Stantec, 2025)

No	ELEV	MTM ZONE 11 COORDINATES NORTH	EAST
SIGN 1	239.5	4 742 446.0	406 350.9
SIGN 2	238.2	4 742 410.1	406 558.2
SIGN 3	238.0	4 742 428.9	406 548.3
SIGN 4	237.8	4 742 624.9	407 525.2
SIGN 5	240.1	4 742 179.4	408 406.1
SIGN 6	237.5	4 741 584.7	409 224.5
SIGN 8	200.9	4 741 469.5	409 663.1
SIGN 11	241.3	4 742 887.7	406 193.4
DCC1	237.3	4 742 624.0	407 117.6
DCC2	237.4	4 742 609.0	407 154.4
DCC3	237.3	4 742 591.0	407 191.9
CNR-EMB9	239.7	4 742 180.1	408 425.8
SWMP1-BH1	238.7	4 742 459.0	404 444.4
SWMP1-BH2	239.0	4 742 521.0	406 528.9
SWMP1-BH3	238.7	4 742 511.0	406 645.5
SWMP1-BH4	239.9	4 742 590.0	406 728.5

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REVISIONS			
DATE	BY	DESCRIPTION	

GEOCRES No 40I14-226

SCALE
10m 0 10 20m

HWY No			DIST
SUBM'D RR	CHECKED	DATE 2025-04-01	SITE
DRAWN GBB	CHECKED	APPROVED	DWG 7

DRAWING NAME: 165001308_Overhead Signs_Borehole Locations_250401.dwg
CREATED BY: GBB MODIFIED:
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APPENDIX B

B.1 AVAILABLE GEOCRES INFORMATION

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 40I14-70

DIST. 2 REGION

W.P. No. 89-69-05

CONT. No.

W. O. No.

STR. SITE No. 5-212

HWY. No. 3N

LOCATION PROPOSED CROSSING AT CNR

No. OF PAGES - 1

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FORM OD--MT - 126 (REV 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO.
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 71-11068 LOCATION Co-Ord's 557,826 N. 339,591 E. ORIGINATED BY P.P.
W.P. 89-69-05 & 06 BORING DATE July 22, 1971 COMPILED BY P.P.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
788.1	Ground level.					
0.0	Clayey silt, some sand, trace of gravel.		1	SS	29	
			2	TW	PH	780
			3	SS	27	
	Very stiff to hard.		4	SS	70/6"	770
			5	SS	34	
			6	TW	PH	760
			7	SS	34	
			8	TW	PH	750
			9	SS	40	
			10	TW	PH	740
			11	SS	22	
			12	TW	PH	730
			13	SS	29	
			14	TW	PH	720
			14A	SS	33	710
			15	TW	PH	700
689.1						690
99.0	End of borehole.					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH P S F
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
2000 4000

End of cone test.

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_o w w_1
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
134	1 13 49 37
140	
142	
136.5	
133	3 9 43 45
	▼ 715.6'
131	

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OD-M[illegible] 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 71-11068 LOCATION Co-Ord's 557,929 N. 339,505 E. ORIGINATED BY P.P.
W.P. 89-69-05 & 06 BORING DATE July 23, 1971 COMPILED BY H.S.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
787.0	Ground level.					
	Clayey silt, some sand, trace of gravel. Very stiff to hard.		1	SS	25	
			2	TW	PH	780
			3	SS	20	
			4	TW	PH	770
			5	SS	41	
			6	SS	65/6"	760
			7	TW	PH	
748.0			8	SS	53	750
39.0	End of borehole.					
						740

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100
SHEAR STRENGTH PSF
○ UNCONFINED ◆ FIELD VANE
● QUICK TRIAXIAL × LAB VANE
2000 4000

End of cone test.

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
10 20 30

BULK DENSITY γ PCF	REMARKS GR.SA.SI.CL.
134.5	
138	3 7 53 37
140	▼ 755.5

20
15 ⊹ 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 71-11068 LOCATION Co-Ord's 557,920 N. 339,456 E. ORIGINATED BY P.P.
W.P. 89-69-05 & 06 BORING DATE July 26, 1971 COMPILED BY H.S.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger. CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
787.0	Ground level.					
	Clayey silt, some sand, trace of gravel. Hard.		1	SS	34	
			2	TW	PH	780
			3	SS	32	
			4	TW	PH	770
			5	SS	93/6"	
			6	SS	67	760
			7	TW	PH	
			8	SS	65	750
740.5			9	SS	67	740
46.5	End of borehole.					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
20 40 60 80 100
SHEAR STRENGTH P.S.F
○ UNCONFINED ✦ FIELD VANE
● QUICK TRIAXIAL × LAB VANE
2000 4000

End of cone test.

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_p
WATER CONTENT ——— w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

135.5
140
138

REMARKS

GR SA SI CL
5 12 51 32

▼ 748.5

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OD-MT 126 (REV 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 71-11068 LOCATION Co-Ord's 558,019 N. 339,370 E. ORIGINATED BY P.P.
W.P. 89-69-05 & 06 BORING DATE July 27, 1971 COMPILED BY H.S.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger. CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE
787.9	Ground level.					
	Clayey silt, some sand, trace of gravel.		1	SS	17	
			2	SS	27	
			3	SS	35	780
			4	SS	27	
			5	SS	25	
	Very stiff to hard.		6	SS	25	
			7	SS	27	770
			8	SS	33	
			9	SS	24	760
753.9			10	SS	40	
34.0	End of borehole.					750

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
2000 4000

End of cone test.

LIQUID LIMIT —— w_L
PLASTIC LIMIT - —— w_P
WATER CONTENT —— w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS

GR. SA. SI. CL.

2 14 49 35

▼ 757.9'

15 20 10 5 % STRAIN AT FAILURE

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 71-11068 LOCATION Co-Ord's 558,163 N. 339,320 E. ORIGINATED BY P.P.
W.P. 89-69-05 & 06 BORING DATE July 27, 1971 COMPILED BY H.S.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE
788.3	Ground level.					
0.0	Clayey silt, some sand, trace of gravel.		1	SS	16	
			2	TW	PH	
			3	SS	47	780
			4	TW	PH	
			5	SS	55	
	Very stiff to hard.					770
			6	TW	PH	
			7	SS	55	
						760
			8	TW	PH	
			9	SS	40	
						750
			10	TW	PH	
						740
			11	SS	69	
						730
			12	TW	PH	
						720
			13	SS	34	
						710
706.8			14	SS	50	
81.5	End of borehole.					700

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH P.S.F
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
2000 4000

End of cone test.

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F	REMARKS GR. SA. SI. CL.
136	
135	
139	
140	2 13 51 34
133	
	▼ 723.3
	0 9 41 50

20
15 ✛ 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 71-11068 LOCATION Co-Ord's 558,074 N. 339,402 E. ORIGINATED BY P.P.
W.P. 89-69-05 & 06 BORING DATE July 26, 1971 COMPILED BY H.S.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger. CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE
788.4	Ground level.					
0.0	Clayey silt, some sand, trace of gravel. Very stiff to hard.		1	SS	26	
			2	SS	48	
			3	SS	51	780
			4	TW	PH	
			5	SS	65	
						770
			6	TW	PH	
			7	SS	55	
						760
			8	TW	PH	
			9	SS	56	
						750
746.9 41.5	End of borehole.					740

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
2000 4000

End of cone test.

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_1 w w_2
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
136	1 12 49 38
141	
140	

▼ = 754.4'

20
15 ⊹ 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 71-11068 LOCATION Co-Ord's 558,080 N. 339,453 E. ORIGINATED BY P.P.
W.P. 89-69-05 & 06 BORING DATE July 26, 1971 COMPILED BY H.S.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger. CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE
787.8	Ground level.					
0.0	Clayey silt, some sand, trace of gravel. Stiff to hard.		1	SS	12	
			2	SS	34	
			3	SS	31	780
			4	SS	31	
			5	SS	31	
			6	SS	29	
			7	SS	35	770
			8	SS	28	
			9	SS	34	760
			10	SS	25	
748.8			11	SS	27	750
39.0	End of borehole.					740

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
2000 4000

End of cone test.

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
10 20 30

BULK γ DENSITY P.C.F.

REMARKS
GR.SA.SI.CL.
2 14 51 33

752.8

20
15 ⊹ 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 71-11068 LOCATION Co-ord's 557, 988 N. 339, 33. E. ORIGINATED BY P.P.
W.P. 89-69-05 & 06 BORING DATE July 26, 1971 COMPILED BY P.P.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger. CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAY PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
788.0	Ground level.					
0.0	Clayey silt, some sand, trace of gravel. Stiff to hard.		1	SS	13	
			2	TW	PH	780
			3	SS	26	
			4	TW	PH	770
			5	SS	36	
			6	TW	PH	760
			7	SS	43	
			8	SS	57	750
			9	SS	50	740
729.0			10	SS	35	730
59.0	End of borehole.					720

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
2000 4000

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
WATER CONTENT % 10 20 30

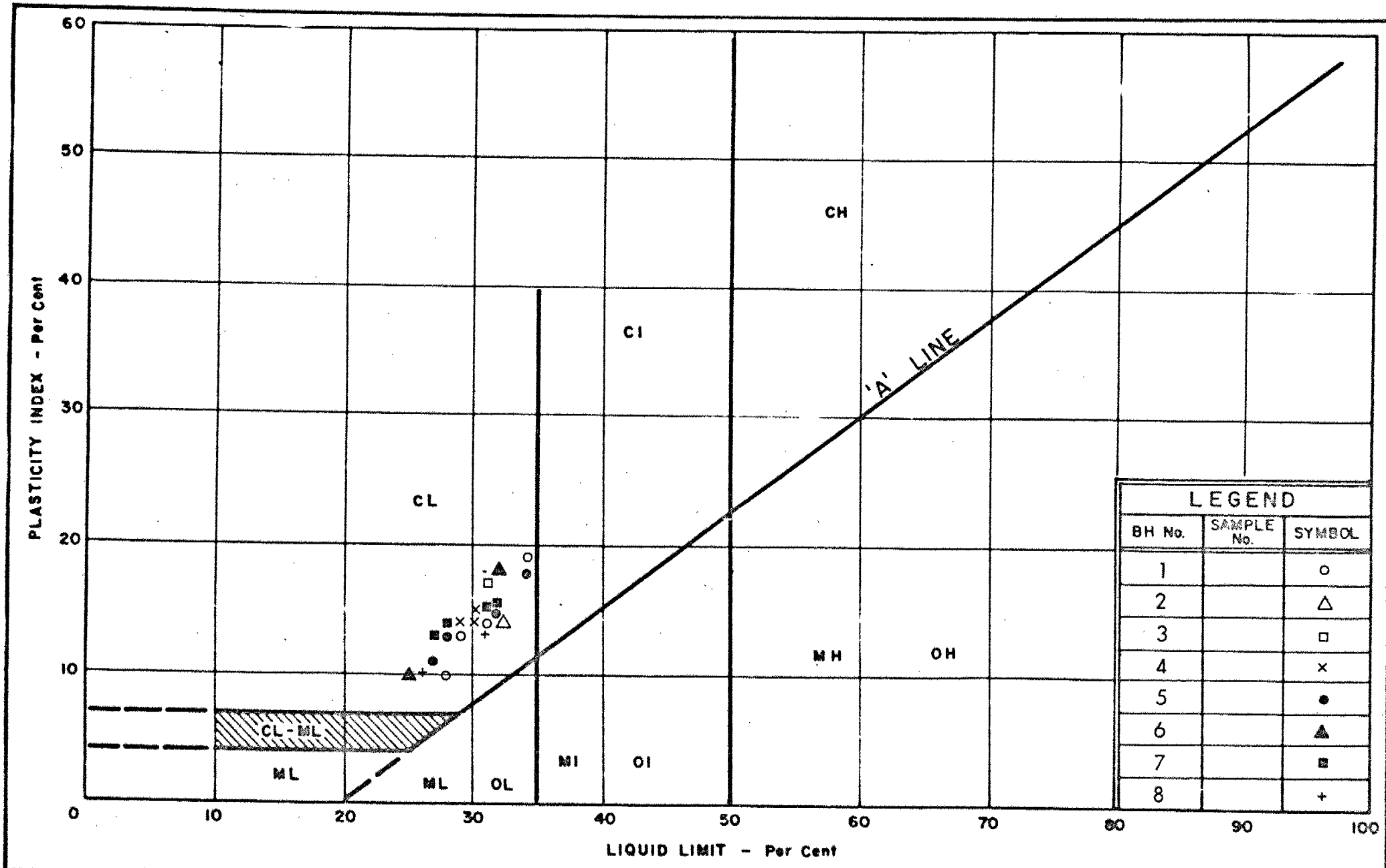
BULK DENSITY γ P.C.F.

REMARKS GR. SA. SI. CL.

139 3 14 53 30

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-252
REVISED JUL 1966



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

CLAYEY SILT, SOME SAND, TRACE OF GRAVEL

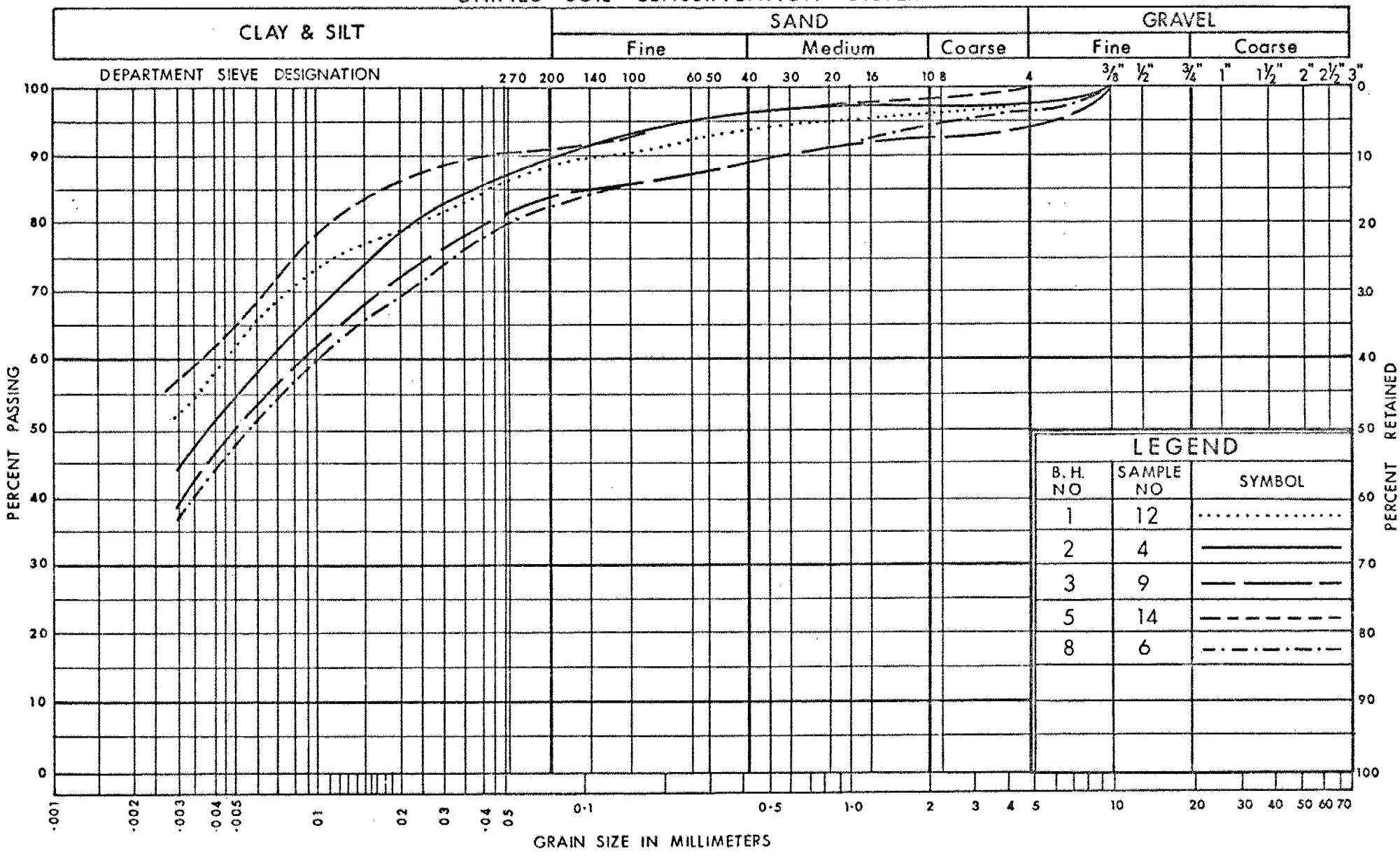
W.P. No. 89-69-05 & 06

JOB No. 71-11068

FIG. NO. 1

FORM OD-MT-
REV. AUG. 1971

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

ONTARIO

DESIGN SERVICES BRANCH

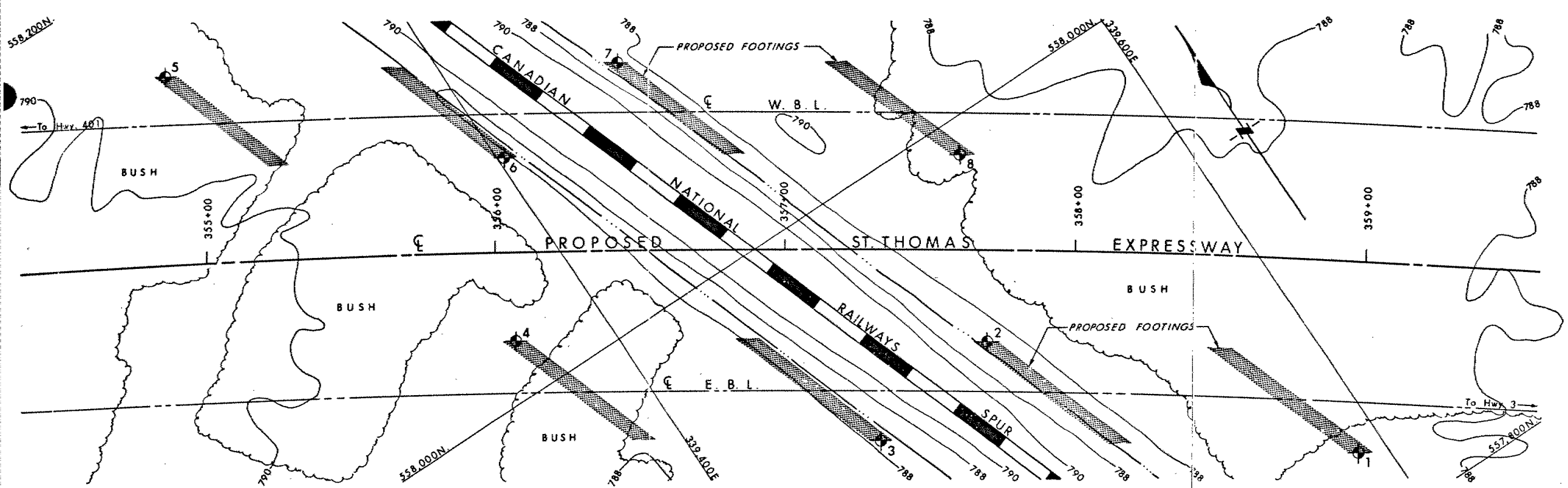
GRAIN SIZE DISTRIBUTION

CLAYEY SILT, SOME SAND, TRACE OF GRAVEL

W.P. No. 89-69-05 & 06

JOB No. 71-11068

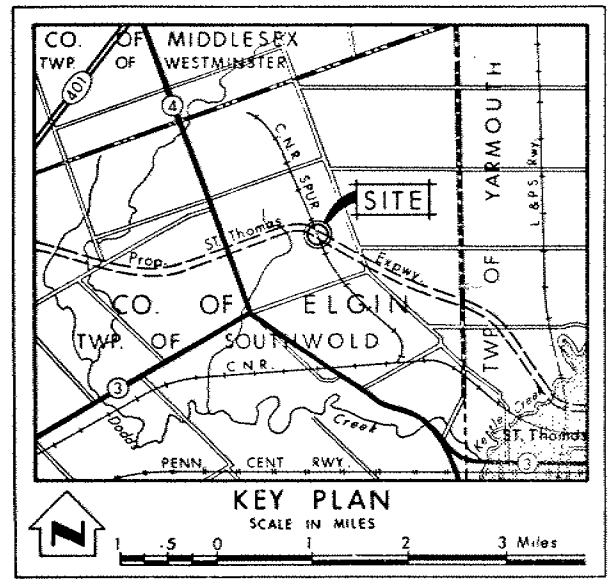
FIG. Nº 2



PLAN

SCALE

20 10 0 20 40FT.



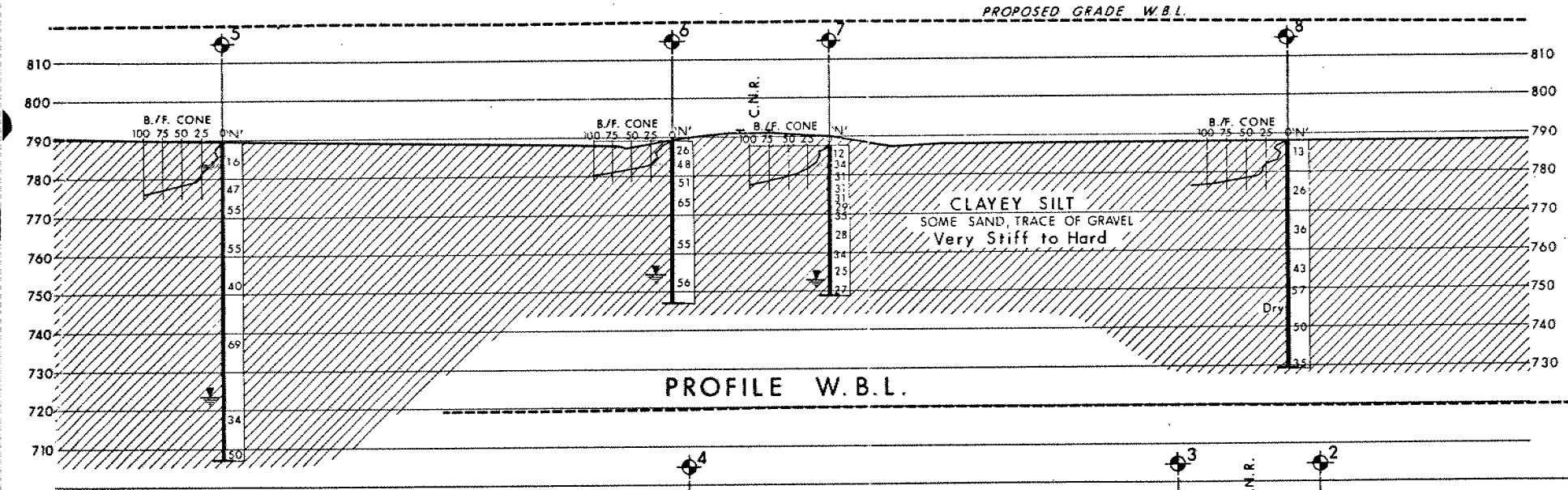
KEY PLAN

SCALE IN MILES

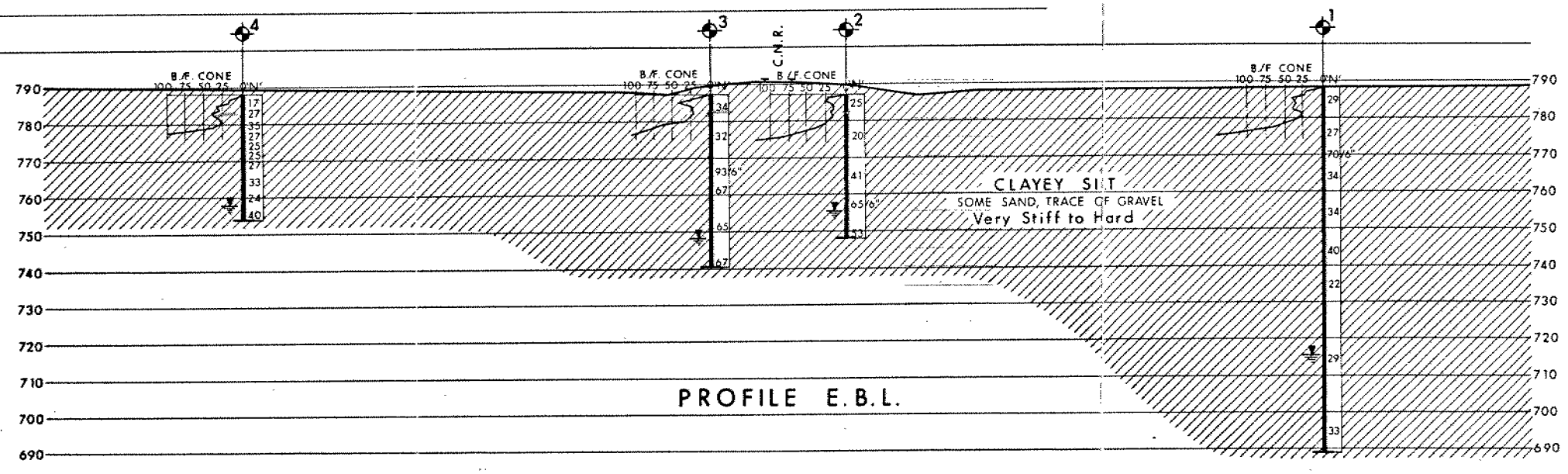
LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. July 1971

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	788.1	557,826	339,591
2	787.0	557,929	339,505
3	787.0	557,920	339,456
4	787.9	558,019	339,370
5	788.3	558,163	339,320
6	788.4	558,074	339,402
7	787.8	558,080	339,453
8	788.0	557,988	339,533



PROFILE W.B.L.



PROFILE E.B.L.

PROFILES

SCALE

20 10 0 20 40FT.

— NOTE —

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATION OFFICE

C. N. R. SPUR LINE

HIGHWAY NO. Prop. ST. THOMAS EXPWY. DIST. NO. 2
CO. ELGIN
TWP. SOUTHWOLD LOT 42 & 43 CON. E.S.T.R.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. P.P.	CHECKED	W.P. NO 89-69-05&06	DRAWING NO 71-11068A
DRAWN	CHECKED	JOB NO. 71-11068	
DATE Aug 31, 1971		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 11

JOB 71-11068 — LOCATION Co-ords. 558,021 N; 339,473 E. — ORIGINATED BY LJH

W.P. 89-69-05/06 — BORING DATE Nov. 7, 1973 — COMPILED BY LJH

DATUM Geodetic — BOREHOLE TYPE Cont. Flight Auger — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
787.5	Ground Level					
0.0	Clayey silt, some sand, trace of gravel		1	SS	20	
			2	SS	19	780
	Very Stiff					
	Hard		3	SS	26	
771.0			4	SS	35	
16.5	End of Borehole					770

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P — W — W_L
WATER CONTENT %

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

774 ▽

OFFICE REPORT SOIL EXPLORATION

20
15 ◇ S % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 12

JOB 71-11068 — LOCATION Co-ords. 558,098 N; 339,398 E. — ORIGINATED BY LJH

W.P. 89-69-05/06 — BORING DATE Nov. 8, 1973 — COMPILED BY LJH

DATUM Geodetic — BOREHOLE TYPE Cont. Flight Auger — CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY γ P.C.F.	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT %		GR. SA. SI. CL.
788.2	Ground Level									
0.0	Clayey silt, some sand traces of gravel. Very Stiff to Hard		1	SS	28	780				
			2	SS	54					
			3	SS	33					
771.7			4	SS	45					Hole Dry
16.5	End of Borehole					770				

OFFICE REPORT — SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS–ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 13

JOB 71-11068 — LOCATION Co-ords. 558,208 N; 339,405 E. — ORIGINATED BY LJH

W.P. 89-69-05/06 — BORING DATE Nov. 7, 1973 — COMPILED BY LJH

DATUM Geodetic — BOREHOLE TYPE Cont. Flight Auger — CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (W_P — W — W_L) WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
789.0	Ground Level									
0.0	Clayey silt, some sand, traces of gravel.		1	SS	11					
			2	SS	10					
						780				
	Stiff to Hard		3	SS	30					▼ 776.5
772.5			4	SS	38					
16.5	End of Borehole					770				

OFFICE REPORT / SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 14

JOB 71-11068 — LOCATION Co-ords. 558,263 N; 339,337 E. — ORIGINATED BY LJH

W.P. 89-69-05/06 — BORING DATE Nov. 8, 1973 — COMPILED BY LJH

DATUM Geodetic — BOREHOLE TYPE Cont. Flight Auger — CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	WATER CONTENT %	γ P.C.F.	GR.SA.SI.CL.
789.4	Ground Level									
0.0	Clayey silt, some sand, traces of gravel. Very Stiff to Hard		1	SS	9	780				
			2	SS	23					
			3	SS	30					
772.9			4	SS	52					Hole Dry
16.5	End of Borehole					770				

OFFICE REPORT SOIL EXPLORATION

20
15 ○ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 15

JOB 71-11068 — LOCATION Co-ords. 558,286 N; 339,400 E. — ORIGINATED BY LJH

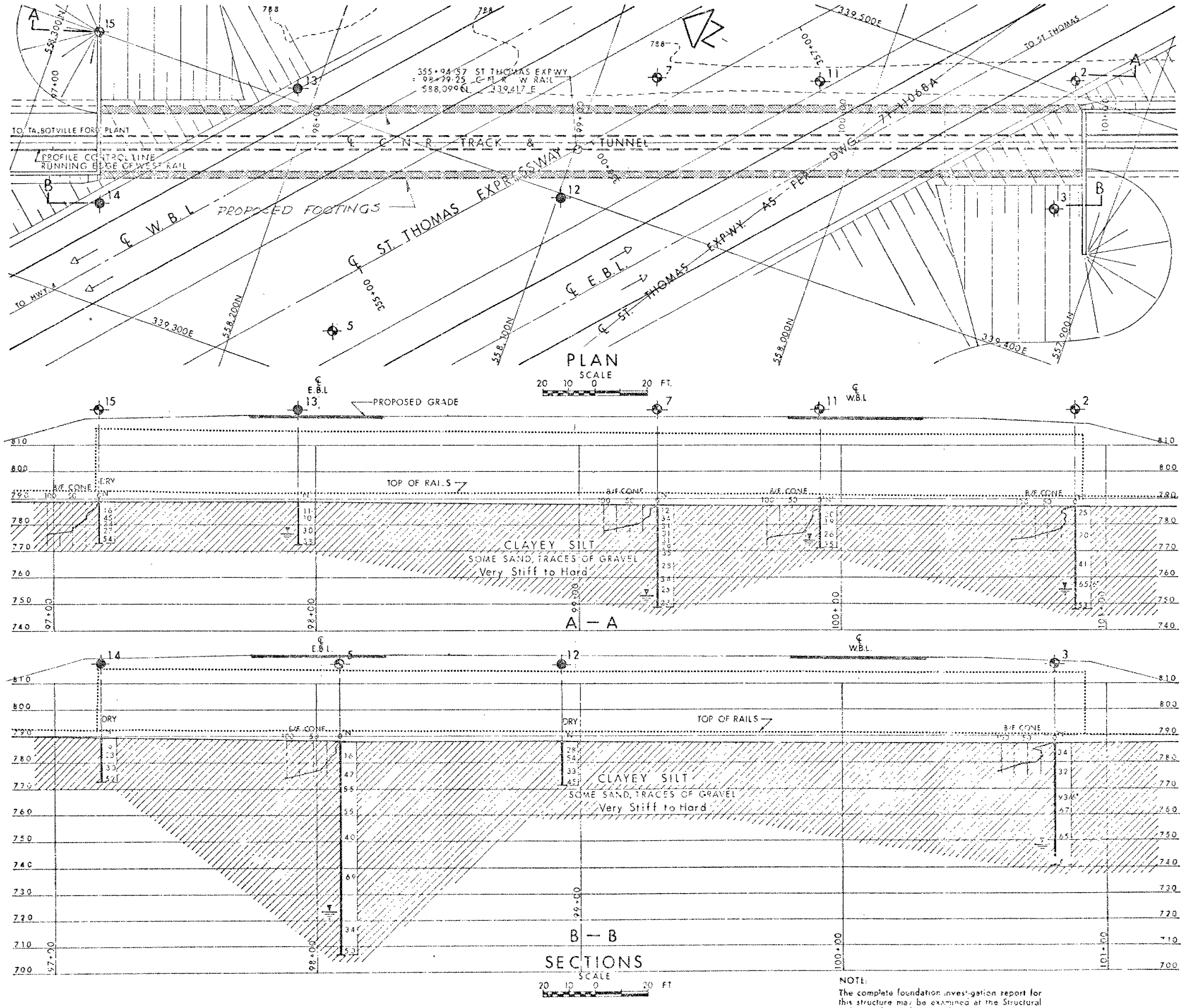
W.P. 89-69-05/06 — BORING DATE November 7, 1973 — COMPILED BY LJH

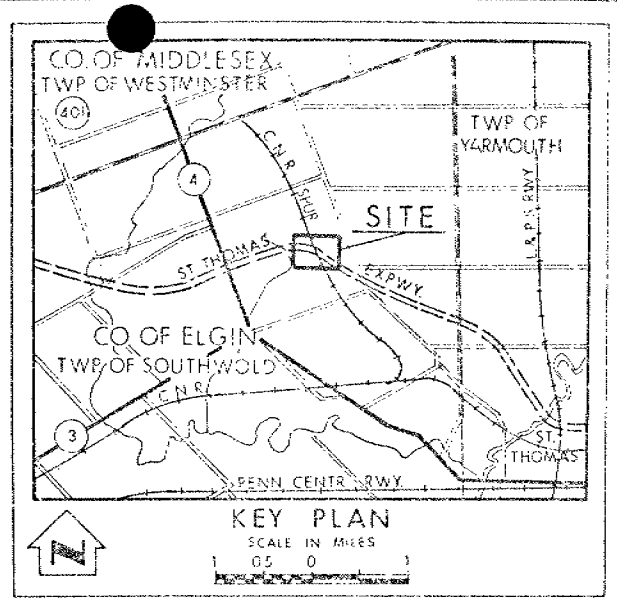
DATUM Geodetic — BOREHOLE TYPE Cont. Flight Auger — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W / W_P W W_L / WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
789.3	Ground Level									
0.0	Clayey silt, some sand, traces of gravel.		1	SS	16	780				
			2	SS	45					
			3	SS	24					
	Very Stiff to Hard		4	SS	27					
772.8			5	SS	54					Hole Dry
16.5	End of Borehole					770				

20
15 ⊹ 5 % STRAIN AT FAILURE
10

OFFICE REPORT — SOIL EXPLORATION





LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Level's established at time of field investigation July 1971, July 1973

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST	
2	787.0	557,929	339,505	July 71
3	787.0	557,920	339,456	
5	786.3	558,163	339,320	
7	787.8	558,080	339,453	
11	787.5	558,031	339,473	
12	788.2	558,078	339,398	
13	789.0	558,208	339,405	July 73
14	789.4	558,263	339,337	
15	789.3	558,286	339,400	

— NOTE —
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE:
The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the LONDON District Office.

REF. NO. PENCO 3802-97-109

REVISIONS

DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

C.N.R. SPUR LINE OVERPASS

HIGHWAY NO. PROP ST. THOMAS EXPWY. DIST. NO. 2
CO. ELGIN
TWP. SOUTHWOLD LOT 42 & 43 CON. E.S.T.R.

BORE HOLE LOCATIONS & SOIL STRATA

SURVD J. H.	CHECKED	TWP. NO. 89-29-05-25	DRAWING NO. 71-11068B
DRAWN DL. J.	CHECKED	W.O. NO. 71-11068	
DATE 22 NOV. 1973		SITE NO.	BRIDGE DRAWING NO.
APPD.		CONT. NO.	

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

~~40 I - 183~~

TO: Mr. A. P. Watt, (2)
Regional Structural Planning Eng.,
Southwestern Region,
London, Ontario.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: August 13, 1973.

OUR FILE REF.

IN REPLY TO AUG 28 1973

SUBJECT:

40I14-35
GEOCRES No.

FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at St. Thomas
Expressway and County Road #52
Twp. of Southwold, Co. of Elgin
District #2 (London)
W.O. 73-11021 -- W.P. 89-69-07

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attch.
c.c. E. J. Orr
B. R. Davis
A. Rutka
A. Wittenberg
L. E. Walker
B. J. Giroux
J. R. Roy
G. A. Wrong
B. A. Singh

Foundations Files ✓
Documents

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 1

JOB 73-11021 — LOCATION Co-ords. 15,556,624 N; 1,340,915 E. — ORIGINATED BY LJH

W.P. 89-69-07 — BORING DATE May 18, 1973 — COMPILED BY LJH

DATUM Geodetic — BOREHOLE TYPE Hollow Stem Auger & Cone — CHECKED BY TDS

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 — SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w — WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
777.7	Ground Level									
0.0	Brown / Grey		1	SS	27	770				0 13 47 40
			2	SS	27					
			3	SS	36	760				
	Clayey silt to silty clay, some sand, traces of gravel. Occasional thin seams or pockets of silt.		4	SS	33					4 15 48 33
			5	SS	33	750				
			6	SS	43					
	Very Stiff to Hard		7	SS	33	740				
			8	SS	31					
			9	SS	30	730				
			10	SS	40					
			11	SS	26	720				Hole Dry
716.2			12	SS	24					1 19 45 35
61.5	End of Borehole					710				

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT — SOIL EXPLORATION

777

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 2

JOB 73-11021 — LOCATION Co-ords. 15,556,715 N; 1,340,955 E. — ORIGINATED BY LJH

W.P. 89-69-01 — BORING DATE May 18, 1973 — COMPILED BY LJH

DATUM Geodetic — BOREHOLE TYPE Hollow Stem Auger & Cone — CHECKED BY MC

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w (w_P w w_L) WATER CONTENT % (10 20 30)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
777.8	Ground Level									
	Brown / Grey		1	SS	31	770				
			2	SS	26					3 10 54 33
	Clayey silt to silty clay, some sand, traces of gravel. Occasional thin seams or pockets of silt.		3	SS	27	760				
			4	SS	25					
			5	SS	26	750				
			6	SS	25					
	Very Stiff to Hard		7	SS	36	740				
			8	SS	37					0 9 55 36
			9	SS	36	730				
726.3			10	SS	45					Hole Dry
51.5	End of Borehole					720				

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 3

JOB 73-11021 — LOCATION Co-ords. 15,556,767 N; 1,341,045 E — ORIGINATED BY L.J.H.

W.P. 89-69-07 — BORING DATE May 22, 1973 — COMPILED BY L.J.H.

DATUM GEODETIC — BOREHOLE TYPE HOLLOW STEM AUGER AND CONE — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
779.3	GROUND LEVEL					
0.0	Brown Grey		1	SS	45	770
			2	SS	48	
	Clayey silt to silty clay, some sand,		3	SS	31	760
			4	SS	25	
	traces of gravel		5	SS	15	
			6	SS	26	750
	occasional thin seams		7	SS	43	
	or pockets of silt,		8	SS	26	740
	Very Stiff to Hard		9	SS	26	
			10	SS	19	730
			11	SS	18	
			12	SS	27	720
			13	SS	26	710
697.8			14	SS	30	700
81.5	END OF BOREHOLE					690

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w (w_P — w — w_L)
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS	GR. SA. SI. CL.
	2 31 53 32
	1 18 47 34
	3 9 56 32
HOLE DRY.	3 32 40 25

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT — SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 4

JOB 73-11021 LOCATION Co-ords. 15,556,642N; 1,340,891E ORIGINATED BY L.J.H.

W.P. 89-69-07 BORING DATE May 22, 1973 COMPILED BY L.J.H.

DATUM GEODETIC BOREHOLE TYPE CONE TEST CHECKED BY [illegible]

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100; SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE				
777.3	GROUND LEVEL									
0.0						770				
764.0										
13.0	END OF CONE TEST					760				

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 5

JOB 73-11021 — LOCATION Co-ords.. 15556694.38N; 1340978.19E — ORIGINATED BY L.J.H.

W.P. 89-69-07 — BORING DATE May 22, 1973 — COMPILED BY L.J.H.

DATUM GEODETIC — BOREHOLE TYPE CONE TEST — CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100; SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT w_L; PLASTIC LIMIT w_P; WATER CONTENT w; w_P w w_L; WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
778.2	GROUND LEVEL									
0.0						770	772			
763.3										
14.9	END OF CONE TEST					760				

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT — SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 6

JOB 73-11021 — LOCATION Co-ords. 15556788.65N; 1341022.06E — ORIGINATED BY L.J.H.

W.P. 89-69-07 — BORING DATE May 18, 1973 — COMPILED BY L.J.H.

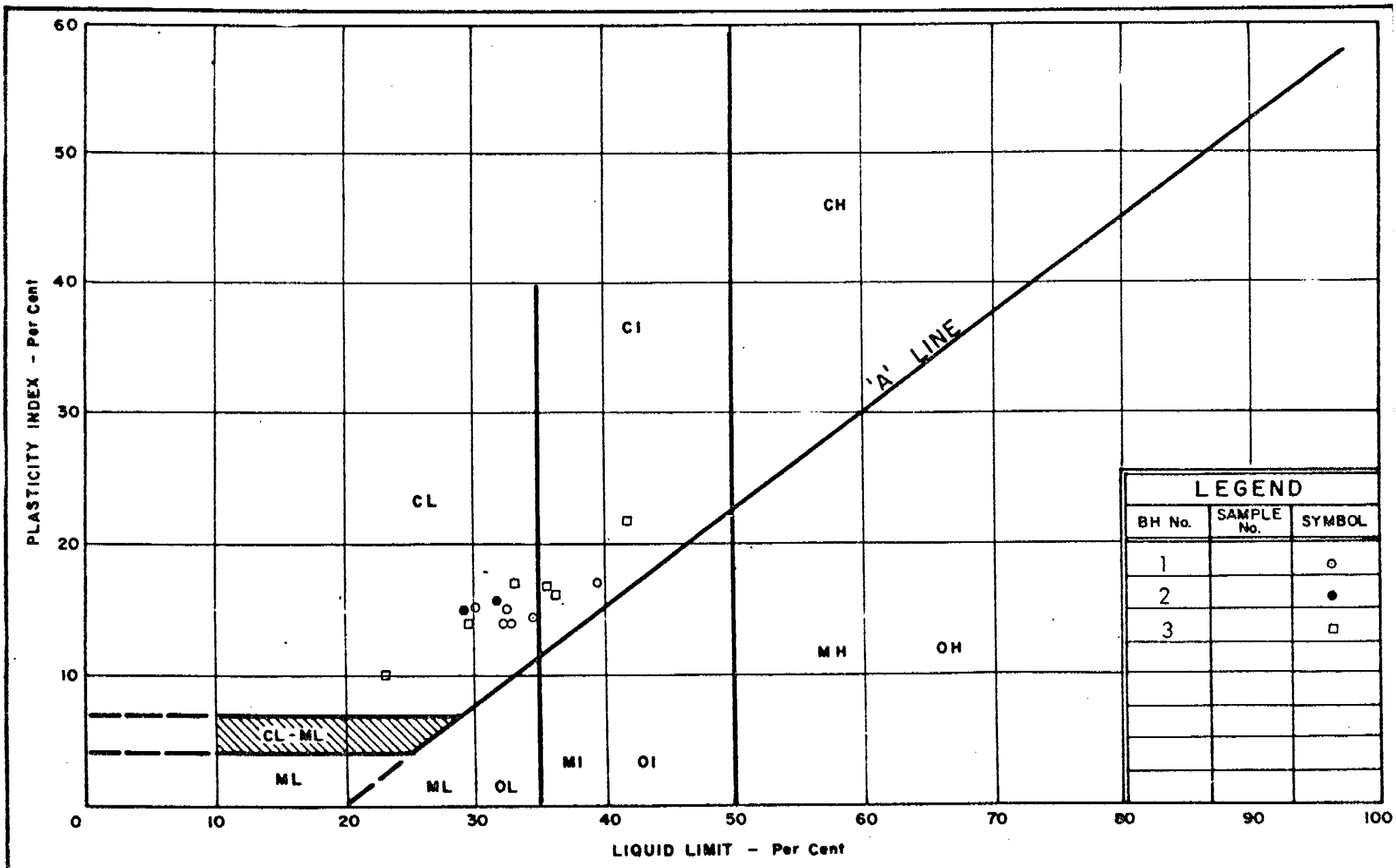
DATUM GEODETIC — BOREHOLE TYPE CONE TEST — CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 — SHEAR STRENGTH P.S.F. o UNCONFINED + FIELD VANE • QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w — w_P w w_L — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
779.4	GROUND LEVEL									
768.5						770				
10.9	END OF CONE TEST					760				

OFFICE REPORT — SOIL EXPLORATION

20 / 15 ◇ 5 / 10 % STRAIN AT FAILURE

REVISED JULY 1966



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

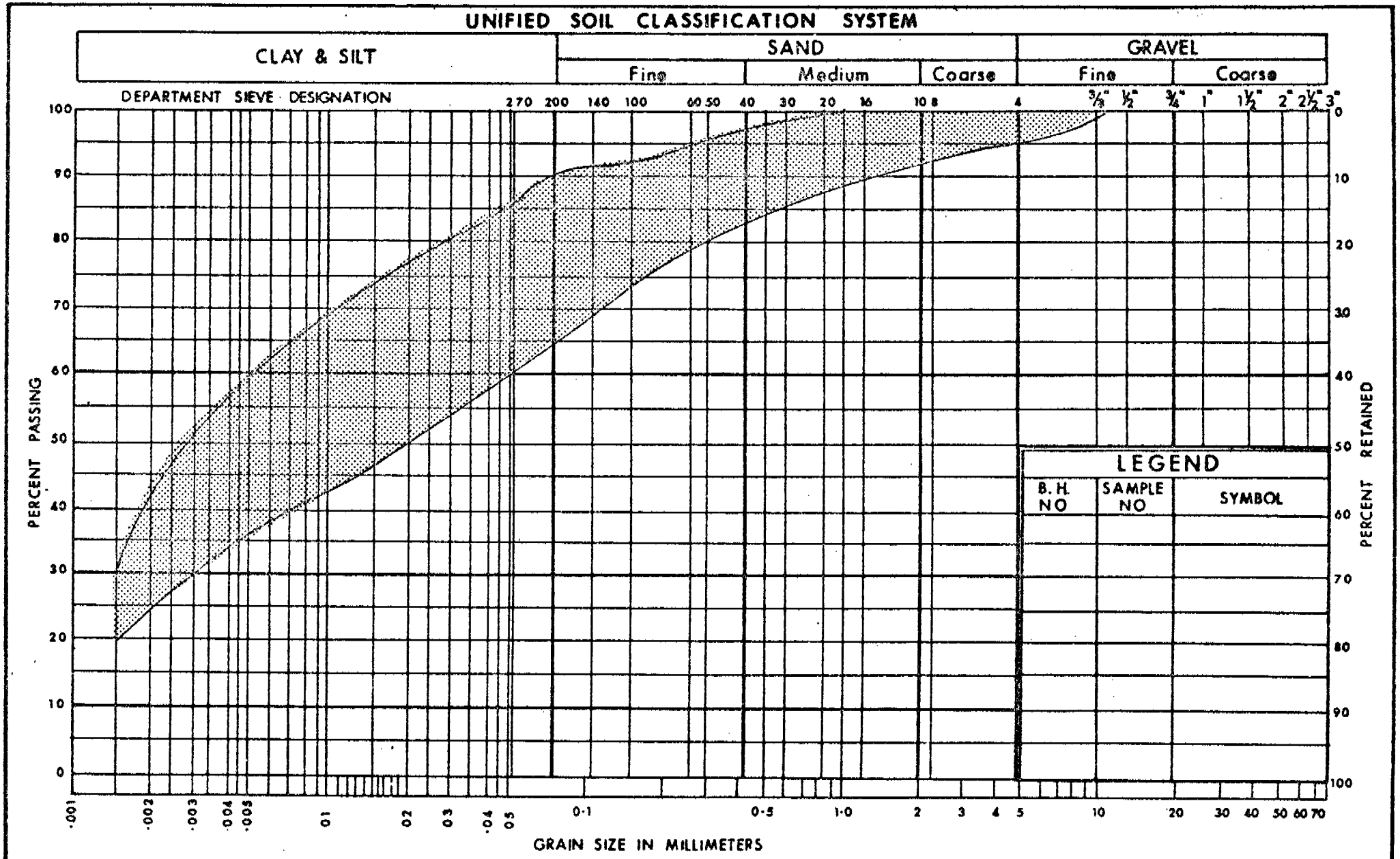
CLAYEY SILT TO SILTY CLAY

W.P. No. 89-69-07

JOB No. 73-11021

FIG. 1

FORM OD-MT-17
REV. AUG. 197

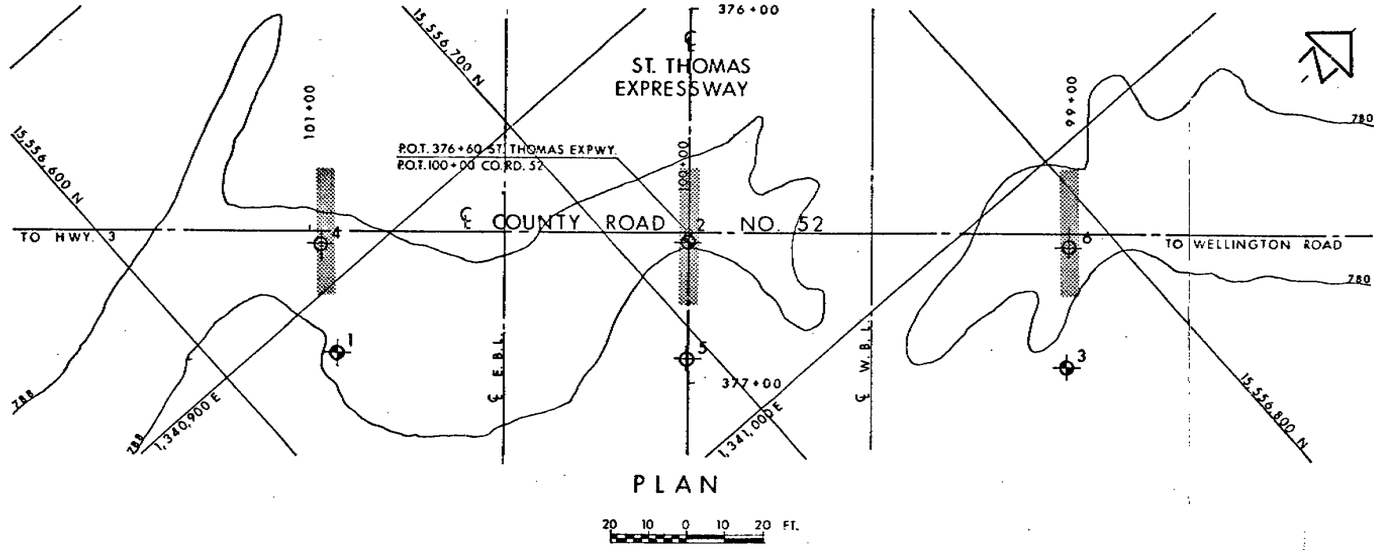


DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO
DESIGN SERVICES BRANCH

GRAIN SIZE DISTRIBUTION

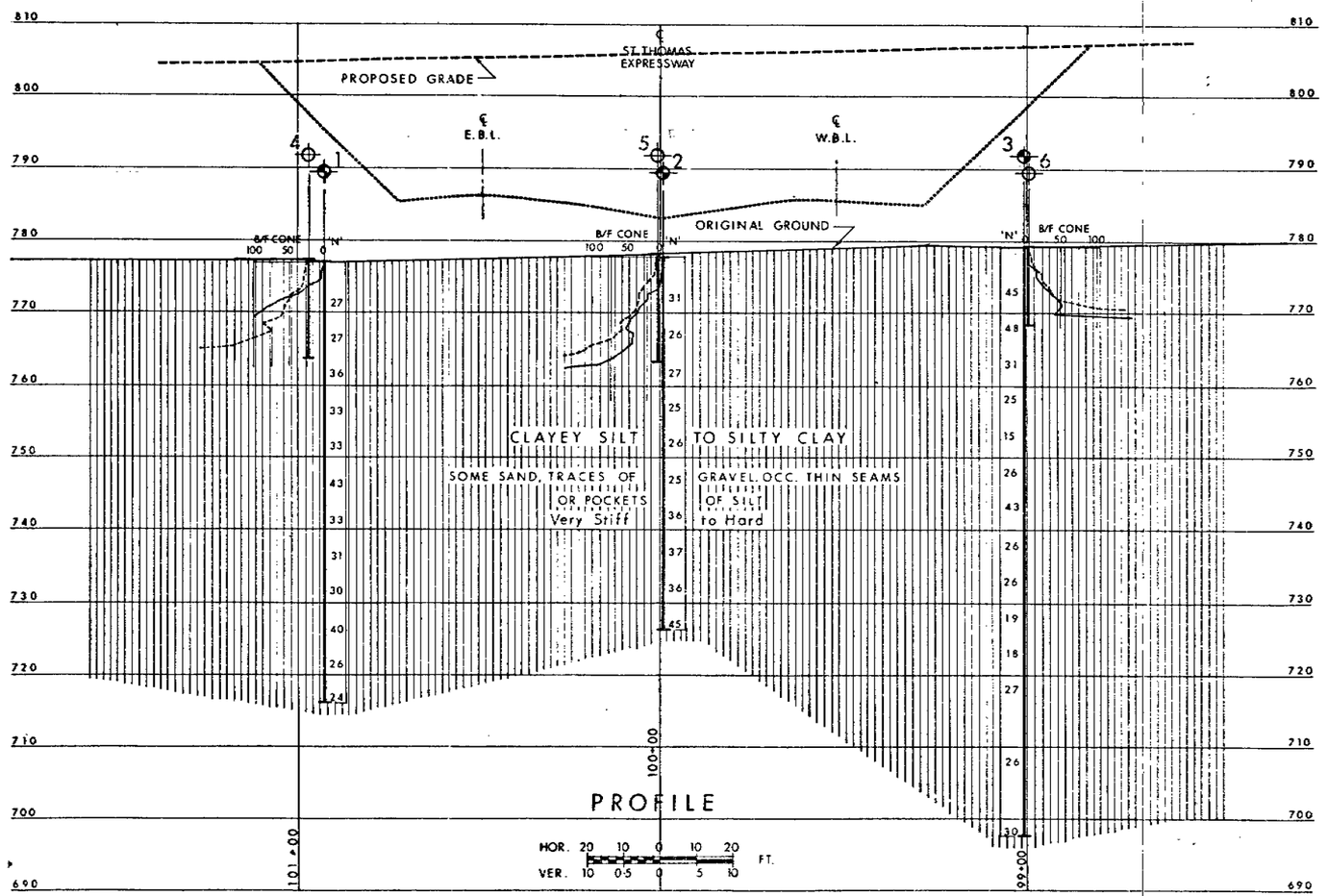
CLAYEY SILT TO SILTY CLAY

W.P. No. 89-69-07
JOB No. 73-11021
FIG.2

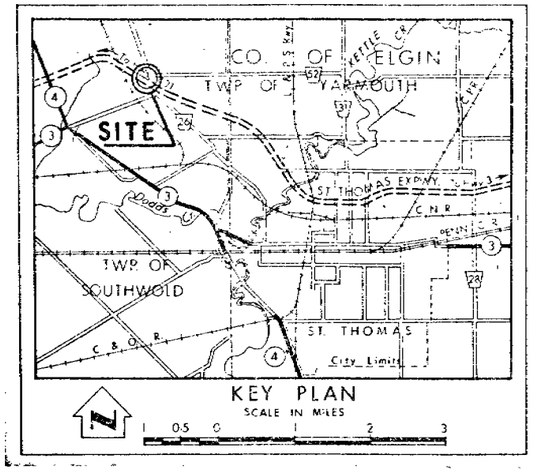


PLAN

20 10 0 10 20 FT.



PROFILE



LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. Holes Dry May 1973

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	777·7	15,556,624	1,340,915
2	777·8	15,556,715	1,340,955
3	779·3	15,556,767	1,341,045
4	777·3	15,556,642	1,340,891
5	778·2	15,556,694	1,340,978
6	779·4	15,556,789	1,341,022

— NOTE —

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence

REVISIONS

DATE	BY	DESCRIPTION

REGISTERED PROFESSIONAL ENGINEER A. PRAKASH PROVINCE OF ONTARIO

REF. No FENCO 3802-87-03

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

COUNTY ROAD NO. 52

HIGHWAY NO PROP. ST. THOMAS EXPWY. DIST. NO. 2
CO. ELGIN
TWP. SOUTHWOLD LOT CON

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD A. P.	CHECKED	W.P. NO. 89-69-47	DRAWING NO. 73-11021A
DRAWN OL. J.	CHECKED	W.O. NO 73-11021	
DATE 20 AUG 1973		SITE NO.	BRIDGE DRAWING NO
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40J14-33

DIST. 2 REGION Southwestern

W.P. No. 89-69-01

CONT. No. 78-96

W. O. No.

STR. SITE No.

HWY. No.

LOCATION Proposed St. Thomas Expressway

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 2

REMARKS: documents to be unfolded before microfilming

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS–ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº C1-1

JOB 73-11019 — LOCATION Co-ords. 15,558,786 N; 1,536,588 E. — ORIGINATED BY LJH

W.P. 89-69-01 — BORING DATE June 4, 1973 — COMPILED BY LJH

DATUM Geodetic — BOREHOLE TYPE Auger & Cone Test — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W / WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR SA SI CL
776.2	Ground Level									
0.0	Clayey silt some sand, trace of gravel. Brown — Grey		1	SS	18	770				
	Very Stiff		2	SS	28					
762.2										
14.0	Sand, some clayey silt, trace of gravel, Dense to Very Dense. Brown — Grey		3	SS	33	760				
755.2			4	SS	103					6 73 (21
21.0	Clayey silt, some sand, trace of gravel. Hard, Grey		5	SS	53	750				1 14 49 36
744.7			6	SS	49					
31.5	End of Borehole					740				

NOTE: Groundwater level not established.

OFFICE REPORT — SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº C1-2

JOB 73-11019 — LOCATION Co-ord's N. 15,558,532; E. 1,336,884 — ORIGINATED BY L.J.E.

W.P. 89-69-01 — BORING DATE June 4, 1973 — COMPILED BY L.J.E.

DATUM Geodetic — BOREHOLE TYPE Auger & Core Test — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (W_P — W — W_L) / WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL
777.0	Ground Level									
0.0	Brown / Grey — Clayey silt, some sand, trace of gravel. Very stiff		1	SS	21	770				1 15 58 26
			2	SS	26					
			3	SS	26	760				
			4	SS	26					
			5	SS	29	750				4 11 49 36
745.5			6	SS	26					
31.5	End of Borehole					740				

NOTE: Groundwater level not established

OFFICE REPORT — SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

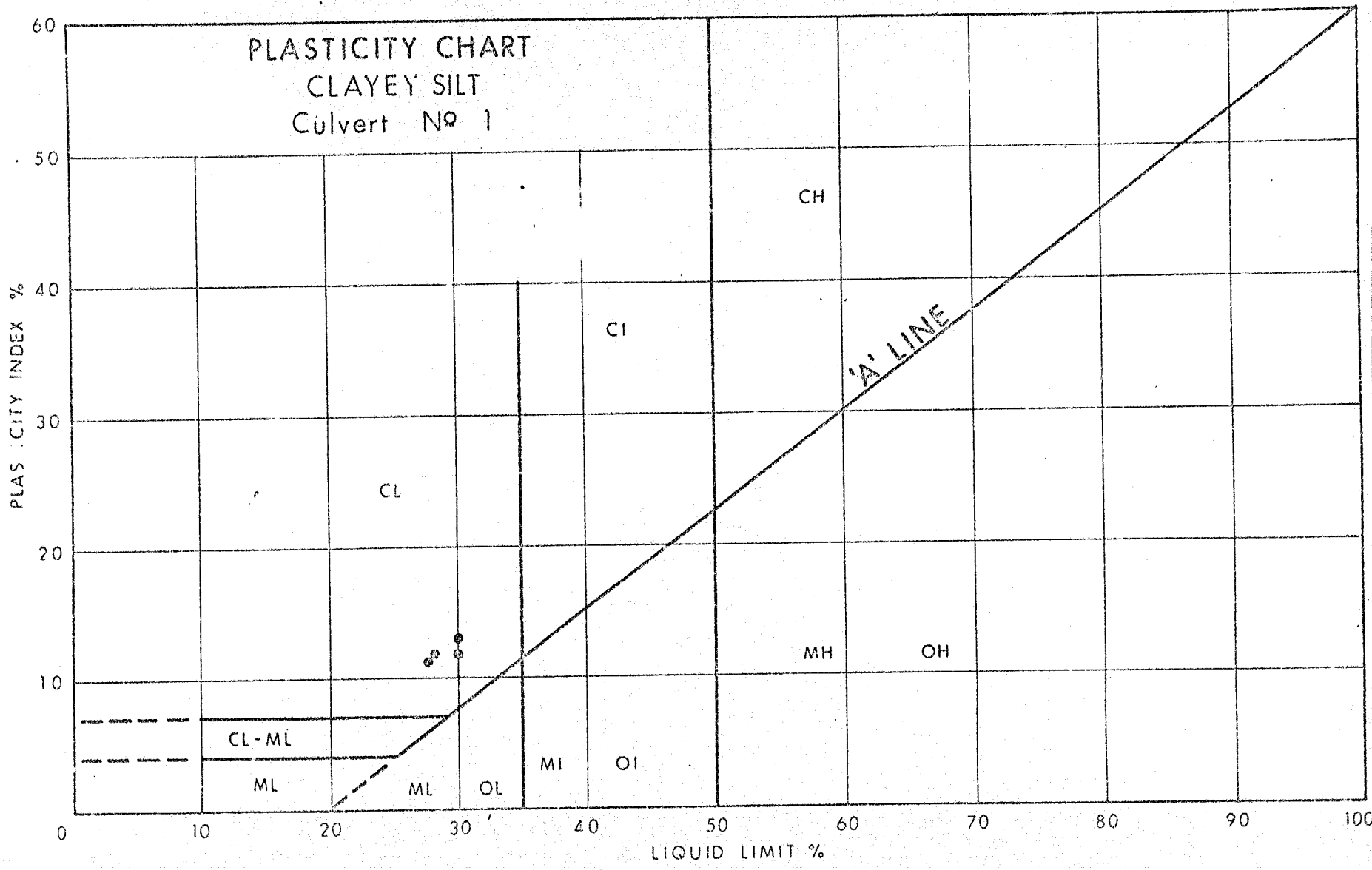
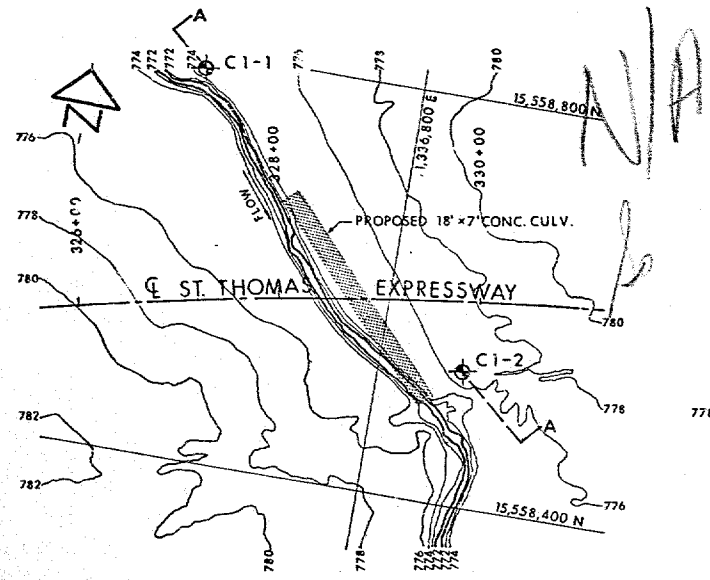
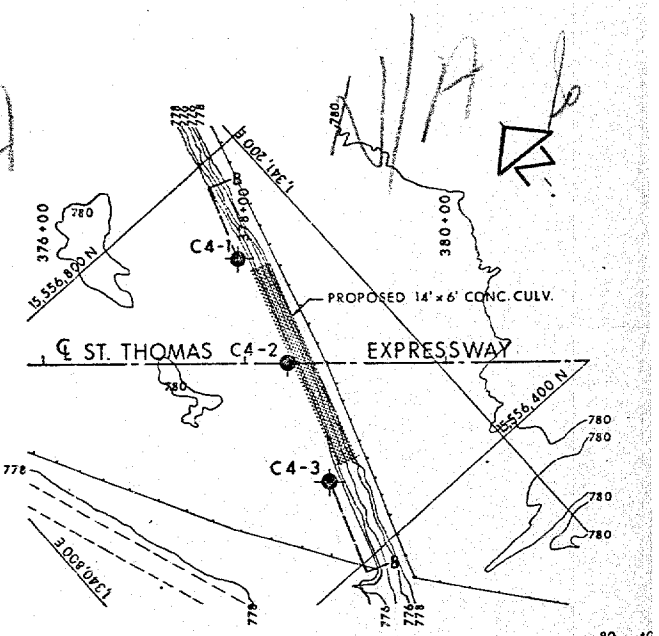


FIG. 1

W.O. 73-11019

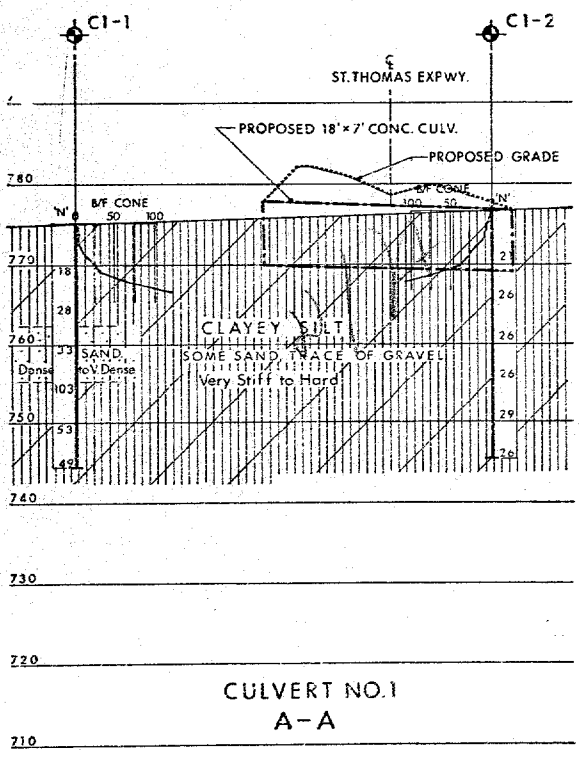


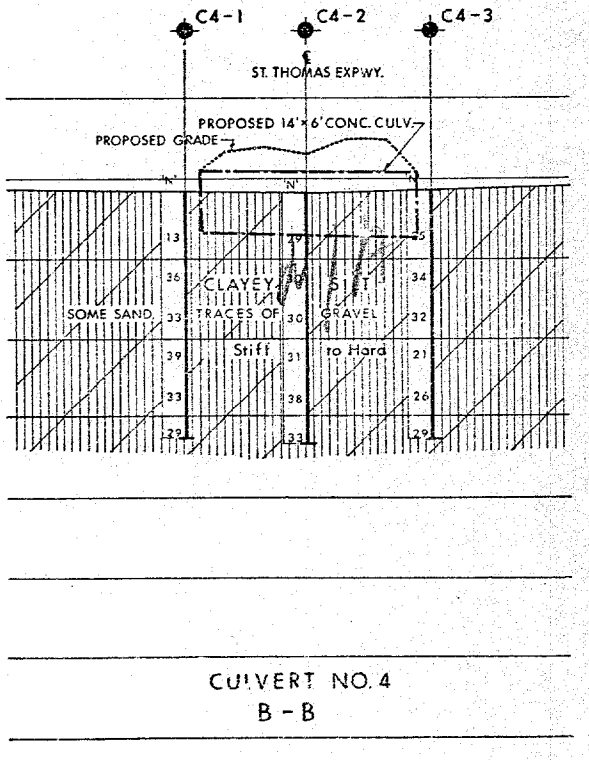


PLANS

CULVERT NO.1

CULVERT NO.4





CULVERT NO.1
A–A

CULVERT NO.4
B–B

SECTIONS

SCALE

HOR. 80 40 0 40 80 FT.

VER. 10 5 0 5 10

APPENDIX C

C.1 SYMBOLS AND TERMS USED ON BOREHOLE RECORDS

C.2 BOREHOLE RECORDS

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Rootmat	- vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
Topsoil	- mixture of soil and humus capable of supporting vegetative growth
Peat	- mixture of visible and invisible fragments of decayed organic matter
Till	- unstratified glacial deposit which may range from clay to boulders
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 minerals, shrinkage cracks, etc.
Fissured	- having cracks, and hence a blocky structure
Varved	- composed of regular 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

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils:
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on page 3. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Shear Strength		Approximate SPT N-Value
	kips/sq.ft.	kPa	
Very Soft	<0.25	<12.5	<2
Soft	0.25 - 0.5	12.5 - 25	2-4
Firm	0.5 - 1.0	25 - 50	4-8
Stiff	1.0 - 2.0	50 – 100	8-15
Very Stiff	2.0 - 4.0	100 - 200	15-30
Hard	>4.0	>200	>30

ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	*Very Poor Quality*
25-50	*Poor Quality*
50-75	*Fair Quality*
75-90	*Good Quality*
90-100	*Excellent Quality*

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	*Crushed*
Severely Fractured	*Shattered or Very Blocky*
Fractured	*Blocky*
Moderately Jointed	*Sound*
Intact	*Very Sound*

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run. RQD is determined in accordance with ASTM D6032.

SCR (Solid Core Recovery) denotes the percentage of solid core (cylindrical) retrieved from a borehole of any orientation. All pieces of solid (cylindrical) core are summed and divided by the total length of the core run (It excludes all portions of core pieces that are not fully cylindrical as well as crushed or rubble zones).

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock with respect to discontinuity and bedding spacing:

Spacing (mm)	Discontinuities	Bedding
>6000	*Extremely Wide*	-
2000-6000	*Very Wide*	*Very Thick*
600-2000	*Wide*	*Thick*
200-600	*Moderate*	*Medium*
60-200	*Close*	*Thin*
20-60	*Very Close*	*Very Thin*
<20	*Extremely Close*	*Laminated*
<6	-	*Thinly Laminated*

Terminology describing rock strength:

Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

STRATA PLOT

Strata plots symbolize the soil or 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 Gravel | Sand | Silt | Clay | Organics | Asphalt | Concrete | Fill | Igneous Bedrock | Meta-morphic Bedrock | Sedi-mentary Bedrock

SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT

measured in standpipe, piezometer, or well

inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

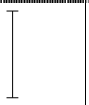
Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to '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 one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

RECORD OF BOREHOLE No Sign1

1 OF 1 **METRIC**

W.P. 3041-22-00 LOCATION Southwold, Ontario N:4742446.0 E:406350.9 ORIGINATED BY KT

DIST West HWY Hwy 4 BOREHOLE TYPE Hollow Stem Auger COMPILED BY HS

DATUM Geodetic DATE 2024.03.07 - 2024.03.07 LATITUDE 42.81504 LONGITUDE -81.2582 CHECKED BY GR

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
239.5	Road Shoulder										
0.0 / 239.2	SILTY SAND with gravel (FILL) Compact Brown Moist		1	SS	12		239	○	○		
0.3	CLAYEY SILT, trace to some sand, trace gravel (FILL) Firm to stiff		2	SS	5			○	○		
238.1	Brown Moist		3	SS	15		238	●	⊢●⊣		1 16 47 37
1.4	CLAYEY SILT (CL), some sand, trace gravel (TILL) Stiff to very stiff Brown Moist		4	SS	22		237	○	○		
			5	SS	18		236	○	○		
			6	SS	16		235	○	○		
	Grey below 4.6 m		7	SS	14			●	⊢●⊣		1 14 44 41
			8	SS	17		234	○	○		
			9	SS	18		233	○	○		
232.0			10	SS	21			○	○		
7.5	END OF BOREHOLE Borehole open and dry upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No Sign2

1 OF 1 **METRIC**

W.P. 3041-22-00 LOCATION Southwold, Ontario N:4742410.1 E:406558.2 ORIGINATED BY KL

DIST West HWY Hwy 4 BOREHOLE TYPE Hollow Stem Auger COMPILED BY HS

DATUM Geodetic DATE 2024.01.10 - 2024.01.10 LATITUDE 42.81469 LONGITUDE -81.25568 CHECKED BY GR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
238.2	Cultivated Farmland										
238.0	150 mm TOPSOIL										
0.2	CLAYEY SILT TILL (CL), some sand, trace gravel (TILL) Firm to hard Brown Moist		1	SS	7		238				0 14 50 36
			2	SS	19		237				
			3	SS	38		236				
	Grey below 2.3 m		4	SS	25						5 12 46 37
			5	SS	21		235				
			6	SS	17		234				
			7	SS	20		233				2 10 50 37
			8	SS	17						
			9	SS	18		232				
			10	SS	15		231				
230.0			11	SS	17		230				
8.2	END OF BOREHOLE Borehole open and dry upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No Sign3

1 OF 1 **METRIC**

W.P. 3041-22-00 LOCATION Southwold, Ontario N:4742428.9 E:406548.3 ORIGINATED BY KT

DIST West HWY Hwy 4 BOREHOLE TYPE Hollow Stem Auger COMPILED BY HS

DATUM Geodetic DATE 2024.01.11 - 2024.01.11 LATITUDE 42.81486 LONGITUDE -81.25579 CHECKED BY GR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
238.0	Cultivated Farmland										
237.9 / 0.1	100 mm TOPSOIL										
	CLAYEY SILT (CL), some sand, trace gravel (TILL) Brown Moist Firm to very stiff		1	SS	7		237				
			2	SS	12						
			3	SS	22		236				2 13 45 39
	Grey below 2.3 m		4	SS	19						
			5	SS	18		235				
			6	SS	16		234				
			7	SS	19		233				
			8	SS	21						2 14 47 37
			9	SS	16		232				
			10	SS	19		231				
			11	SS	20		230				
229.8 / 8.2	END OF BOREHOLE Borehole open and dry upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No Sign4

1 OF 1 **METRIC**

W.P. 3041-22-00 LOCATION Southwold, Ontario N:4742624.9 E:407525.2 ORIGINATED BY AS

DIST West HWY Hwy 4 BOREHOLE TYPE Hollow Stem Auger COMPILED BY HS

DATUM Geodetic DATE 2024.02.23 - 2024.02.23 LATITUDE 42.81649 LONGITUDE -81.24382 CHECKED BY GR

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.8	Cultivated Farmland										
237.7 0.1	100 mm TOPSOIL										
	CLAYEY SILT (CL), some sand, trace gravel (TILL), Firm to very stiff Brown Moist		1	SS	7		237				
			2	SS	20						
			3	SS	20		236				3 12 48 37
	Grey Below 2.3 m		4	SS	17						
			5	SS	13		235				
			6	SS	12		234				
			7	SS	12		233				3 10 47 40
			8	SS	19						
			9	SS	15		232				
							231				
229.6			10	SS	18		230				
8.2	END OF BOREHOLE Borehole open and dry upon completion of drilling.										

+ ^{3}, × ^{3}: Numbers refer to Sensitivity ○ $^{3\%}$ STRAIN AT FAILURE

RECORD OF BOREHOLE No Sign5

1 OF 1 **METRIC**

W.P. 3041-22-00 LOCATION Southwold, Ontario N:4742179.4 E:408406.1 ORIGINATED BY AG

DIST West HWY Hwy 3 BOREHOLE TYPE Hollow Stem Auger COMPILED BY HS

DATUM Geodetic DATE 2024.10.16 - 2024.10.16 LATITUDE 42.81236281 LONGITUDE -81.23312711 CHECKED BY GR

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
240.1	Grass										
240.0	200 mm TOPSOIL										
239.9 0.2	CLAYEY SILT (CL), some sand, trace gravel (TILL) Firm to hard Brown Moist		1	SS	3		240				
			2	SS	4		239				
			3	SS	10						1 14 47 38
237.5							238				
2.6	SILTY SAND (SM), trace clay Compact to dense Brown Moist to wet		4	SS	35						
236.4			5	SS	25		237				0 71 23 6
3.7	CLAYEY SILT (CL), some sand, trace gravel (TILL) Stiff to very stiff Grey Moist		6	SS	13		236				
			7	SS	15						
			8	SS	16		235				
			9	SS	17		234				
			10	SS	18	▽	233				
			11	SS	20						
231.9							232				
8.2	END OF BOREHOLE Borehole open and water measured at 7.0 m upon completion of drilling.										

+ ³, × ³: Numbers refer to Sensitivity ○ ³% STRAIN AT FAILURE

RECORD OF BOREHOLE No Sign6

1 OF 1 **METRIC**

W.P. 3041-22-00 LOCATION Southwold, Ontario N:4741584.7 E:409224.5 ORIGINATED BY MC

DIST West HWY Hwy 3 BOREHOLE TYPE Hollow Stem Auger COMPILED BY HS

DATUM Geodetic DATE 2024.06.26 - 2024.06.26 LATITUDE 42.80689905 LONGITUDE -81.2232323 CHECKED BY GR

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.5	Road Shoulder										
0.0 / 237.2	SILTY SAND with gravel (FILL) Compact Brown to dark brown Moist		1	SS	16		237		○		
0.3	CLAYEY SILT (CL), some sand, trace gravel (TILL), Stiff to very stiff Brown Moist		2	SS	11				○		
			3	SS	18		236		⊖		6 14 45 35
	Grey below 2.3 m.		4	SS	16		235		○		
			5	SS	14				○		
			6	SS	13		234		○		
			7	SS	20		233		⊖		0 6 58 36
			8	SS	14		232		○		
			9	SS	16				○		
			10	SS	22		231		○		
			11	SS	23		230		○		
229.3											
8.2	END OF BOREHOLE Borehole open and dry upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No Sign8

1 OF 1 **METRIC**

W.P. 3041-22-00 LOCATION Southwold, Ontario N:4741469.5 E:409663.1 ORIGINATED BY MC

DIST West HWY Hwy 3 BOREHOLE TYPE Hollow Stem Auger COMPILED BY RR

DATUM Geodetic DATE 2024.06.26 - 2024.06.26 LATITUDE 42.805457 LONGITUDE -81.217933 CHECKED BY GR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
200.9	Topsoil										
0.0	SANDY SILT to SILTY SAND, trace organics and rootlets (FILL) Loose Dark brown		1	SS	5				○		
200.1											
0.8	Moist										
	CLAYEY SILT (CL), some sand, trace gravel (TILL) Stiff to very stiff Brown with grey staining Moist		2	SS	10		200		○		
			3	SS	14		199		○		
			4	SS	17				⊢○⊣		2 15 45 38
	Grey below 3 m		5	SS	22		198		○		
			6	SS	17		197		○		
			7	SS	13		196		○		
195.4						▽					
5.5	SAND with SILT (SP-SM), trace gravel and clay Compact Brown Wet		8	SS	11				○		0 95 4 1
			9	SS	22		195		○		
194.1											
6.8	CLAYEY SILT, trace to some sand, trace gravel (TILL) Very stiff Grey		10	SS	24		194		○		
193.4											
7.5	Moist to wet										
	SILTY SAND, trace to some clay Dense Grey		11	SS	32		193		○		
192.7											
8.2	Wet										
	END OF BOREHOLE										
	Groundwater level and cave-in measured at approximately 5.5 m and 5.6 m below grade, respectively, upon completion of drilling.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No Sign 11

1 OF 1 **METRIC**

W.P. 3041-22-00 LOCATION Southwold, Ontario N:4742887.1 E:406193.4 ORIGINATED BY AS

DIST West HWY Hwy4 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KL

DATUM Geodetic DATE 2025.03.10 - 2025.03.10 LATITUDE 42.81902826 LONGITUDE -81.26004996 CHECKED BY GR

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 (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
241.3	Gravel Shoulder										
0.0 / 240.9	SILTY SAND with gravel (FILL) Compact Brown Moist		1	SS	23		241				
0.4	CLAYEY SILT, trace to some sand, trace to some gravel (FILL) Firm		2	SS	7						
239.9	Brown to grey Moist		3	SS	8		240				
1.5	CLAYEY SILT (CL), trace to some sand, trace to some gravel (TILL) Stiff to very stiff Brown Moist		4	SS	12		239				1 13 53 33
			5	SS	21		238				
	Grey below 3.8 m		6	SS	18						
			7	SS	28		237				
			8	SS	20		236				1 13 52 34
			9	SS	22		235				
			10	SS	23		234				
233.1			11	SS	23						
8.2	END OF BOREHOLE Borehole open and dry upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CNR-EMB9 1 OF 1 METRIC

W.P. 3041-22-00 LOCATION CNR Overhead, Southwold, Ontario N: 4742180.1 E: 408425.8 ORIGINATED BY HS

DIST West HWY Hwy 3 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KL

DATUM Geodetic DATE 2024.05.14 - 2024.05.15 LATITUDE 42.81236663 LONGITUDE -81.23288586 CHECKED BY RR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
239.7											
239.6 / 0.1	150 mm TOPSOIL										
0.2	CLAYEY SILT (CL), trace to some sand, trace gravel (TILL) Stiff to very stiff (SS1 soft) Brown to grey Moist		1	SS	3		239		○		
			2	SS	16				⊣●		1 13 46 40
			1	TW			238				
			3	SS	23		237		○		PP = 4.5 TSF
	Grey below 3.0 m		4	SS	19				⊣●		0 12 43 44 PP = 4.5 TSF
			5	SS	18		236		○		PP = 4.0 TSF
			6	SS	17		235		○		PP = 4.5 TSF
			7	SS	14		234		○		PP = 4.5 TSF
			2	TW					⊣●		Consolidation Test
			8	SS	34		233		○		PP = 4.5 TSF
			9	SS	19		232		⊣●		2 17 47 34 PP = 3.5 TSF
							231				
			10	SS	22		230		○		
			11	SS	26		229		○		
			12	SS	18		228		○		
			13	SS	20		227		○		
224.9							226				
14.8	CLAYEY SILT (CL), trace sand, trace gravel Very stiff Grey Moist to wet		14	SS	17		225		○		1 2 65 32 PP = 2.0 TSF
223.9							224				
15.9	END OF BOREHOLE Borehole open and dry on completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No DCC1

1 OF 1

METRIC

W.P. 3041-22-00 LOCATION Lindsay Creek Drain, St. Thomas, Ontario N: 4742624 E:407117.6 ORIGINATED BY AS

DIST West HWY Hwy 3 BOREHOLE TYPE Hollow Stem Auger COMPILED BY RR

DATUM Geodetic DATE 2024.02.22 - 2024.02.23 LATITUDE 42.81654 LONGITUDE -81.2488 CHECKED BY GR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) SA SI CL
237.3	Grass										
237.0	180 mm TOPSOIL										
0.2	CLAYEY SILT, trace to some sand (FILL)		1	SS	8		237				
236.5	Stiff										
0.9	Dark brown/black Moist		2	SS	7		236				PP = 125 kPa
235.9	SILTY CLAY, trace sand and gravel										
1.4	Firm Dark brown Moist		3	SS	19						PP > 450 kPa
	CLAYEY SILT (CL), some sand, trace gravel (TILL) Very stiff Brown Moist Grey below 3 m		4	SS	28		235				1 11 44 44 PP > 450 kPa
			5	SS	28		234				PP > 450 kPa
			6	SS	28						PP > 450 kPa
			7	SS	22		233				PP > 450 kPa
			8	SS	22		232				PP > 450 kPa
	Inferred cobbles/boulder based on rock fragments in SS9		9	SS	20		231				PP = 400 kPa
			10	SS	22		230				3 14 46 37 PP = 400 kPa
			11	SS	24		229				PP > 450 kPa
			12	SS	24		228				PP > 450 kPa
			13	SS	23		227				PP > 450 kPa
			14	SS	21		226				0 10 50 39 PP > 450 kPa
			15	SS	24		225				PP > 450 kPa
221.4							224				
15.9	END OF BOREHOLE Borehole open and dry upon completion.						223				
							222				

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO 165001308_MTO_HWY3-TWINNING_20241127.GPJ ONTARIO MTO.GDT 12/3/24

RECORD OF BOREHOLE No DCC2

1 OF 2

METRIC

W.P. 3041-22-00 LOCATION Lindsay Creek Drain, St. Thomas, Ontario N: 4742609 E:407154.4 ORIGINATED BY AS

DIST West HWY Hwy 3 BOREHOLE TYPE Hollow Stem Auger COMPILED BY RR

DATUM Geodetic DATE 2024.02.22 - 2024.02.27 LATITUDE 42.8164 LONGITUDE -81.2484 CHECKED BY GR

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) SA SI CL
237.4	Grass				
237.2 0.0	200 mm TOPSOIL				
0.2	CLAYEY SILT, trace sand, trace rootlets (FILL) Firm Brown Moist	1	SS	7	
236.4 1.0	300 mm thick silty sand layer at the top of SS2	2	SS	9	PP = 125 kPa
	CLAYEY SILT (CL), some sand, trace gravel (TILL) Very stiff to hard Brown Moist	3	SS	24	2 13 44 41 PP > 450 kPa
		4	SS	27	PP > 450 kPa
	Grey below 3 m	5	SS	24	PP > 450 kPa
		6	SS	20	2 15 49 34 PP > 450 kPa
		7	SS	16	PP > 450 kPa
		8	SS	18	PP > 450 kPa
		9	SS	19	PP > 450 kPa
		10	SS	22	PP = 325 kPa
		11	SS	13	PP > 450 kPa
		12	SS	23	8 13 45 34 PP = 400 kPa
		13	SS	45	
		14	SS	25	PP > 450 kPa
		15	SS	21	PP > 450 kPa
221.5 15.9	END OF BOREHOLE Monitoring well installed in borehole, screened from approximately 4.6 m to 6.1 m below grade.				

ELEVATION SCALE: 237, 236, 235, 234, 233, 232, 231, 230, 229, 228, 227, 226, 225, 224, 223, 222

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

Continued Next Page

+3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

RECORD OF BOREHOLE No DCC2

2 OF 2

METRIC

W.P. 3041-22-00 LOCATION Lindsay Creek Drain, St. Thomas, Ontario N: 4742609 E:407154.4 ORIGINATED BY AS

DIST West HWY Hwy 3 BOREHOLE TYPE Hollow Stem Auger COMPILED BY RR

DATUM Geodetic DATE 2024.02.22 - 2024.02.27 LATITUDE 42.8164 LONGITUDE -81.2484 CHECKED BY GR

SOIL PROFILE			SAMPLES			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 (%) SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Groundwater level recorded in monitoring well at approximately 5.5 m, 5 m and 2.1 m below grade on March 20, March 27 and May 9, 2024, respectively.										

+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No DCC3

1 OF 1 **METRIC**

W.P. 3041-22-00 LOCATION Lindsay Creek Drain, St. Thomas, Ontario N: 4742591 E:407191.9 ORIGINATED BY KL

DIST West HWY Hwy 3 BOREHOLE TYPE Hollow Stem Auger COMPILED BY RR

DATUM Geodetic DATE 2024.01.10 - 2024.01.10 LATITUDE 42.81623 LONGITUDE -81.2479 CHECKED BY GR

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 (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) SA SI CL
237.3	Grass										
237.2	150 mm TOPSOIL										
237.1 / 0.2	CLAY (CH), some sand Firm Brown Moist		1	SS	4		237				
			2	SS	7						0 15 43 42 PP = 250 kPa
235.9							236				
1.4	CLAYEY SILT (CL), some sand, trace gravel (TILL) Very stiff to hard Brown Moist SS3 contains trace rock fragments Grey below 2.3 m		3	SS	22						PP = 350 kPa
			4	SS	19		235				PP > 450 kPa
			5	SS	21		234				2 14 47 37 PP > 450 kPa
			6	SS	15						PP > 450 kPa
	SS7 contains sand seams		7	SS	16		233				PP = 425 kPa
							232				
			8	SS	20		231				4 13 47 35 PP > 450 kPa
			9	SS	22		230				PP > 450 kPa
							229				
			10	SS	31		228				PP > 450 kPa
	clayey silt (CL-ML) layer from 10.7 m to 11.2 m		11	SS	84		227				2 8 71 19
			12	SS	34		226				PP > 450 kPa
			13	SS	24		225				PP = 450 kPa
			14	SS	23		224				PP = 350 kPa
221.5							223				
15.9	END OF BOREHOLE Borehole caved in to 14.9 m below grade and was dry on completion.						222				

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No SWMP1-BH1 1 OF 1 METRIC

W.P. 3041-22-00 LOCATION Southwold, Ontario N:4742459.3 E:406444.4 ORIGINATED BY TK

DIST West HWY Hwy 4 BOREHOLE TYPE Hollow Stem Auger COMPILED BY RR

DATUM Geodetic DATE 2024.01.11 - 2024.01.11 LATITUDE 42.81514 LONGITUDE -81.25706 CHECKED BY GR

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 (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
238.7	Grass										
238.5 0.0	250 mm TOPSOIL		1	SS	6						
0.3	SILTY CLAY (CI), some sand, trace gravel Firm to stiff Brown Moist		2	SS	13		238				2 16 39 43
237.3											
1.5	CLAYEY SILT (CL), some sand, trace gravel (TILL) Stiff to very stiff Grey Moist		3	SS	24		237				
			4	SS	15		236				
			5	SS	15						
	SS6 contains rock fragments		6	SS	18		235				
			7	SS	18		234				2 16 39 43
			8	SS	19		233				
	SS9 contains rock fragments		9	SS	28		232				
			10	SS	23		231				
			11	SS	17		230				
			12	SS	28		229				
227.4							228				
11.3	END OF BOREHOLE Borehole open and dry upon completion.										

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No SWMP1-BH3 1 OF 1 METRIC

W.P. 3041-22-00 LOCATION Southwold, Ontario N:4742511.5 E:406645.5 ORIGINATED BY TK

DIST West HWY Hwy 4 BOREHOLE TYPE Hollow Stem Auger COMPILED BY RR

DATUM Geodetic DATE 2024.01.11 - 2024.01.11 LATITUDE 42.81559 LONGITUDE -81.25459 CHECKED BY GR

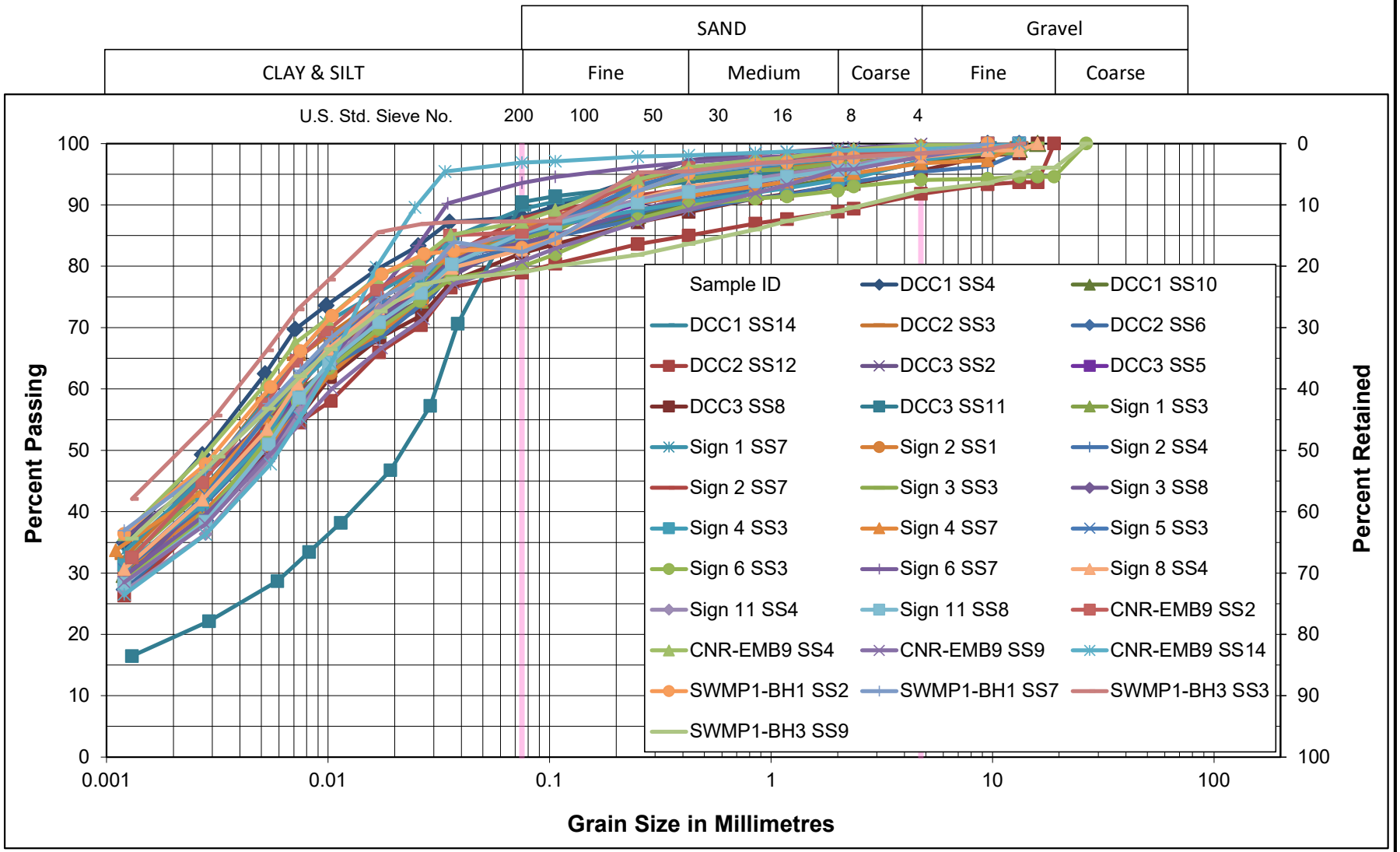
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
238.7	Grass										
238.6	130 mm TOPSOIL										
238.6 / 0.1	SILTY CLAY (CI), some sand, trace gravel Stiff to very stiff Brown to grey Moist		1	SS	12		238	○ 20 40 60 80 100	○ 20 40 60		
			2	SS	15			○	○		
			3	SS	21		237	○	○		2 13 36 49
236.5 / 2.2	CLAYEY SILT (CL), some sand, trace gravel (TILL) Very stiff to hard Grey Moist SS4 contains rock fragments		4	SS	30		236		○		
			5	SS	19				○		
			6	SS	19		235		○		
			7	SS	18		234		○		
			8	SS	19		233		○		
			9	SS	16				○		8 16 35 42
							232				
			10	SS	19		231		○		
							230				
			11	SS	26		229		○		
							228				
227.4 / 11.3	END OF BOREHOLE Borehole open and dry upon completion.		12	SS	30				○		

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

APPENDIX D

D.1 LABORATORY TEST RESULTS

Unified Soil Classification System



Stantec

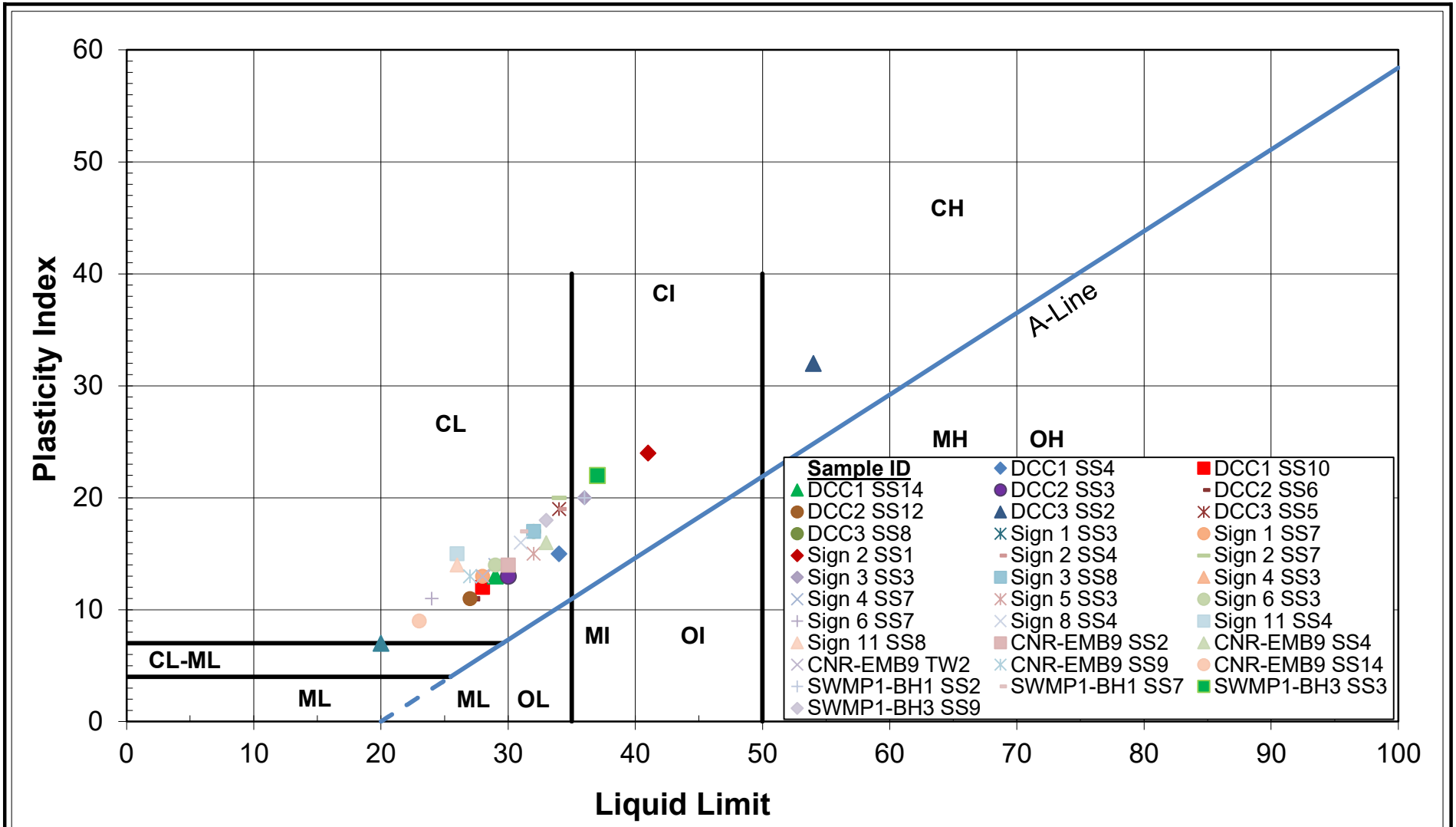
CLAYEY SILT to SILTY CLAY TO CLAY TILL (CL-ML, CL, CI, CH)

Ministry of Transportation (MTO)

Highway 4 Widening and New Talbotville Bypass - Overhead Signs

Figure No. D1

Project No. 165001308



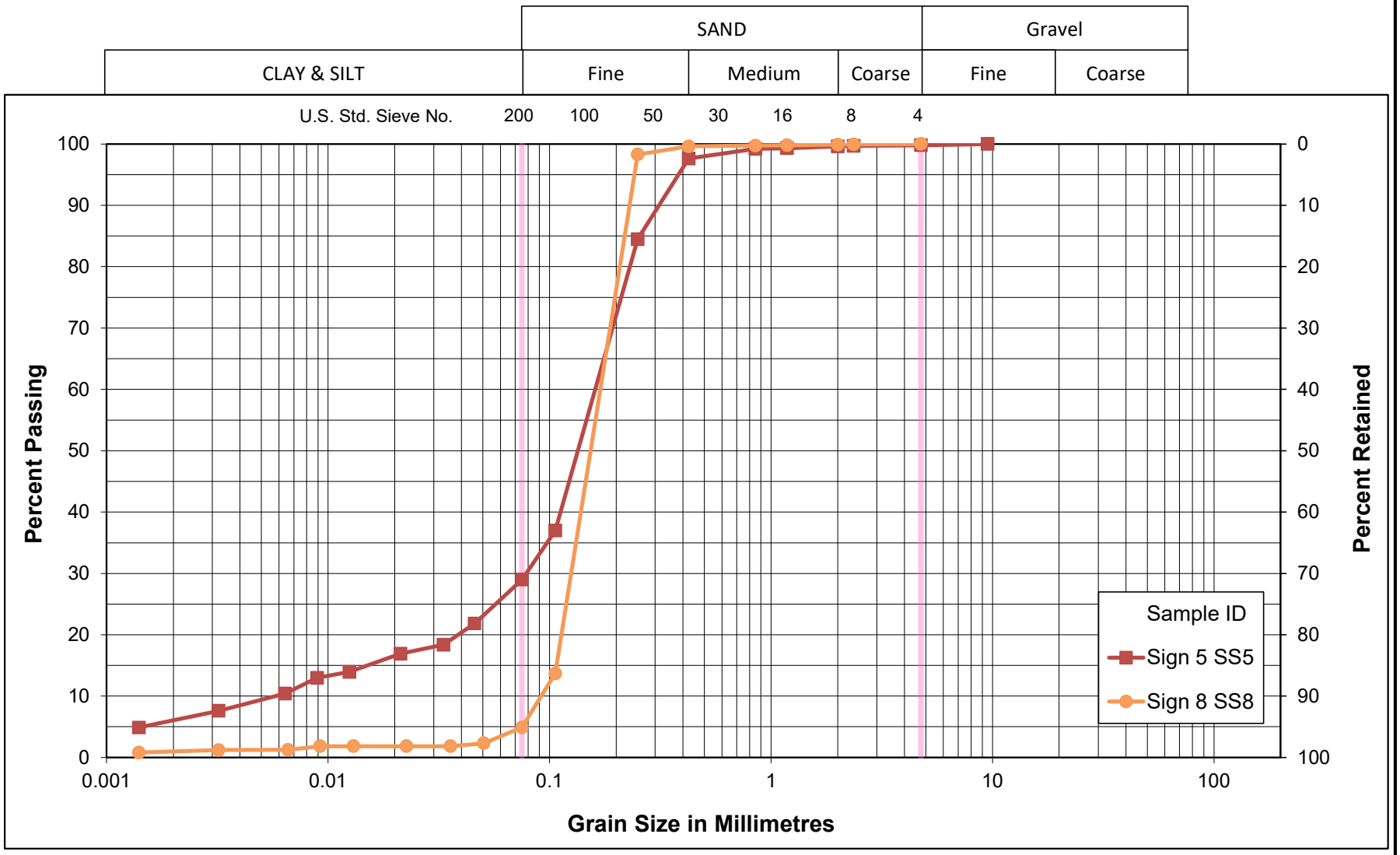
CLAYEY SILT to SILTY CLAY TO CLAY TILL (CL-ML, CL, CI, CH)

Ministry of Transportation (MTO)
Highway 4 Widening and New Talbotville Bypass - Overhead Signs

Figure No. D2

Project No. 165001308

Unified Soil Classification System



Stantec

Silty SAND (SM)

Ministry of Transportation (MTO)

Highway 4 Widening and New Talbotville Bypass - Overhead Signs

Figure No. D3

Project No. 165001308

AGAT Laboratories

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FAX (403)735-2771
http://www.agatlabs.com

CLIENT NAME: STANTEC CONSULTING LTD
300-675 Cochrane Drive
MARKHAM, ON L3R0B8
(905) 444-7777

ATTENTION TO: Bahram Siavash

PROJECT: 165001308.551.102

AGAT WORK ORDER: 24T149317

ROCK ANALYSIS REVIEWED BY: Ali Reza Khosh Kish, Report Writer

SOIL ANALYSIS REVIEWED BY: Sukhwinder Randhawa, Inorganic Team Lead

DATE REPORTED: May 18, 2024

PAGES (INCLUDING COVER): 7

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

*Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
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- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.
- For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.

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Certificate of Analysis

AGAT WORK ORDER: 24T149317

PROJECT: 165001308.551.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

(284-137) Sulfide (CGY)

DATE RECEIVED: 2024-05-10

DATE REPORTED: 2024-05-18

SAMPLE DESCRIPTION:				DCC2-SS3	KCBA1-SS12	KCBA2-SS11	KCBP1-SS12	KCBP2-SS5
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2024-05-09	2024-05-09	2024-05-09	2024-05-09	2024-05-09
Parameter	Unit	G / S	RDL	5850929	5850950	5850951	5850952	5850953
Sulfide	%		0.01	0.01	0.06	<0.01	0.02	0.08

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 24T149317

PROJECT: 165001308.551.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2024-05-10

DATE REPORTED: 2024-05-18

		SAMPLE DESCRIPTION:		DCC2-SS3	KCBA1-SS12	KCBA2-SS11	KCBP1-SS12	KCBP2-SS5
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2024-05-09	2024-05-09	2024-05-09	2024-05-09	2024-05-09
Parameter	Unit	G / S	RDL	5850929	5850950	5850951	5850952	5850953
Chloride (2:1)	µg/g		2	17	12	10	13	18
Sulphate (2:1)	µg/g		2	24	290	281	93	90
pH (2:1)	pH Units		NA	8.40	8.16	8.14	8.85	8.58
Electrical Conductivity (2:1)	mS/cm		0.005	0.184	0.573	0.277	0.181	0.205
Resistivity (2:1) (Calculated)	ohm.cm		1	5430	1750	3610	5520	4880
Redox Potential 1	mV		NA	216	208	247	243	223
Redox Potential 2	mV		NA	221	210	245	245	232
Redox Potential 3	mV		NA	218	208	244	243	232

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

5850929-5850953 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.

Analysis performed at AGAT Toronto (unless marked by *)

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Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T149317

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Rock Analysis

RPT Date: May 18, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(284-137) Sulfide (CGY)															
Total Sulfur	5850929	5850929	0.01	0.01	19.5%	< 0.01	104%	80%	120%						
Sulfate	5853092		<0.01	<0.01	0.0%	< 0.01	108%	80%	120%						

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.
Duplicate/ Replicate NA: Results are less than 10X the RDL and RPD will not be calculated

(284-137) Sulfide (CGY)															
Sulfate	5850929	5850929	<0.01	<0.01	0%	< 0.01		80%	120%						

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.
Duplicate/ Replicate NA: Results are less than 10X the RDL and RPD will not be calculated

(284-000) Re-Work (CGY)															
Total Sulfur	5856796		0.11	0.12	6.3%	< 0.01	107%	90%	110%						

Certified By:

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CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T149317

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: May 18, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Chloride (2:1)	5856796		<2	<2	NA	< 2	95%	70%	130%	96%	80%	120%	96%	70%	130%
Sulphate (2:1)	5856796		1480	1480	0.0%	< 2	96%	70%	130%	97%	80%	120%	NA	70%	130%
pH (2:1)	5856856		6.20	6.53	5.2%	NA	98%	80%	120%						
Electrical Conductivity (2:1)	5856856		0.339	0.371	9.0%	< 0.005	96%	80%	120%						
Redox Potential 1	5850929					NA	100%	90%	110%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.
Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.

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Method Summary

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T149317

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Rock Analysis			
Total Sulfur	MIN-283-12001	ASTM E1915; ASTM E1019; ASTM D5373	LECO
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential 1	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 2	INOR-93-6066	ASTM G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 3	INOR-93-6066	ASTM G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE

AGAT Laboratories

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Ph.: 905.712.5100 · Fax: 905.712.5122 · Toll Free: 800.856.6261

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 19.4, 18.3, 18.9
AGAT WO #: 24T149317
Lab Temperature:
Notes: 1 Boy

Client Information:
Company: Stantec Consulting Ltd.
Contact: Bahram Siavash
Address: 300-675 Cochran Drive West Tower
Phone: 905-479-9345 Fax: 905-474-9889
Project: 165001308.551.102 PO:
AGAT Quotation #:
Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements:
☐ Regulation 153/09 (reg. 511 Amend.) — Table ____ (Indicate one) ☐ Ind/Com ☐ Res/Park ☐ Agriculture — Soil Texture (check one) ☐ Coarse ☐ Fine
☐ Sewer Use — Region ____ (Indicate one) ☐ Sanitary ☐ Storm
☐ Regulation 558 ☐ CCME ☐ Other (specify) ☐ Prov. Water Quality Objectives (PWQO) ☐ None

Turnaround Time Required (TAT) Required*
Regular TAT
☑ 5 to 7 Working Days
Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day
OR
Date Required (Rush surcharges may apply): ____
*TAT is exclusive of weekends and statutory holidays

Invoice To:
Same: Yes ☑ No ☐
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) ☐ Yes ☐ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Legend Matrix
GW Ground Water **O** Oil
SW Surface Water **P** Paint
SD Sediment **S** Soil

Report Information – reports to be sent to:
1. Name: Bahram Siavash
   Email: Bahram.Siavash@stantec.com
2. Name: Kirby Lales
   Email: kirby.lales@stantec.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ EC ☐ FOC ☐ NO3/NO2 ☐ CN- ☐ Cr+6- ☐ N- Total ☐ SAR ☐ Hg ☐ pH	Nutients: ☐ TP ☐ NO2 ☐ NH3 ☐ NO2 ☐ TKN ☐ NO3/NO2	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	TCLP:	Sewer Use	Corrosivity Pckg (pH, Redox Potential	sulphates and sulphides contents,	chlorides contents and resistivity)
DCC2 -SS3	2024-05-09			1	6'																	X	X	X
KCBA1-SS12	2024-05-09			1	46'																	X	X	X
KCBA2-SS11	2024-05-09			1	41'																	X	X	X
KCBP1-SS12	2024-05-09			1	36'																	X	X	X
KCBP2-SS5	2024-05-09			1	11'																	X	X	X

Samples Relinquished by (print name & sign):	Date/Time	Samples Received by (Print name & sign):	Date/Time
		T Khan	May 10 10:15
Samples Relinquished by (print name & sign):	Date/Time	Samples Received by (Print name & sign):	Date/Time

Pink Copy – Client
Yellow + Golden Copy – AGAT
White Copy – AGAT

Page ____ of ____
NO:

Document ID: DIV-78-1511.006
Date Issued: July 20, 2011

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(905) 444-7777

ATTENTION TO: Bahram Siavash

PROJECT: 165001308.551.102

AGAT WORK ORDER: 24T152603

ROCK ANALYSIS REVIEWED BY: Ali Reza Khosh Kish, Report Writer

SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganic Team Lead

DATE REPORTED: May 29, 2024

PAGES (INCLUDING COVER): 7

VERSION*: 1

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*Notes

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- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.
- For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.

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Certificate of Analysis

AGAT WORK ORDER: 24T152603

PROJECT: 165001308.551.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

(284-137) Sulfide (CGY)

DATE RECEIVED: 2024-05-21

DATE REPORTED: 2024-05-29

SAMPLE DESCRIPTION:				Sign 3-SS2	Sign **2**-SS3	Sign 1-SS2	Sign **4**-SS2
SAMPLE TYPE:				Soil	Soil	Soil	Soil
DATE SAMPLED:				2024-05-17	2024-05-17	2024-05-17	2024-05-17
Parameter	Unit	G / S	RDL	5872329	5872353	5872354	5872355
Sulfide	%		0.01	<0.01	<0.01	0.01	<0.01

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

AGAT Laboratories

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CALGARY, ALBERTA
CANADA T2E 7P7
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FAX (403)735-2771
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 24T152603

PROJECT: 165001308.551.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2024-05-21

DATE REPORTED: 2024-05-29

		SAMPLE DESCRIPTION:		Sign 3-SS2	Sign **2**-SS3	Sign 1-SS2	Sign **4**-SS2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil
		DATE SAMPLED:		2024-05-17	2024-05-17	2024-05-17	2024-05-17
Parameter	Unit	G / S	RDL	5872329	5872353	5872354	5872355
Chloride (2:1)	µg/g		2	21	8	602	957
Sulphate (2:1)	µg/g		2	26	14	49	68
pH (2:1)	pH Units		NA	8.75	8.62	8.56	8.52
Electrical Conductivity (2:1)	mS/cm		0.005	0.169	0.172	5.35	0.207
Resistivity (2:1) (Calculated)	ohm.cm		1	5920	5810	187	4830
Redox Potential 1	mV		NA	244	195	222	242
Redox Potential 2	mV		NA	248	196	219	246
Redox Potential 3	mV		NA	242	192	224	242

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

5872329-5872355 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

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Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T152603

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Rock Analysis

RPT Date: May 29, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(284-137) Sulfide (CGY)															
Total Sulfur	5872329	5872329	<0.01	<0.01	0.0%	< 0.01	106%	80%	120%						
Sulfate	5866626	5866626	<0.01	<0.01	0.0%	< 0.01	88%	80%	120%						

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.
Duplicate/ Replicate NA: Results are less than 10X the RDL and RPD will not be calculated

(284-137) Sulfide (CGY)															
Sulfate	5872329	5872329	<0.01	<0.01	0.0%	< 0.01		80%	120%						

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.
Duplicate/ Replicate NA: Results are less than 10X the RDL and RPD will not be calculated

Certified By:

AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T152603

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: May 29, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Chloride (2:1)	5872329	5872329	21	21	0.0%	< 2	94%	70%	130%	97%	80%	120%	95%	70%	130%
Sulphate (2:1)	5872329	5872329	26	25	3.9%	< 2	95%	70%	130%	100%	80%	120%	97%	70%	130%
pH (2:1)	5872329	5872329	8.75	8.63	1.4%	NA	101%	80%	120%						
Electrical Conductivity (2:1)	5872329	5872329	0.169	0.139	19.5%	< 0.005	94%	80%	120%						
Redox Potential 1	5872329						100%	90%	110%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:

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Method Summary

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T152603

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential 1	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 2	INOR-93-6066	ASTM G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 3	INOR-93-6066	ASTM G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE

AGAT Laboratories
5835 Coopers Avenue
Mississauga, Ontario
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com
Ph.: 905.712.5100 · Fax: 905.712.5122 · Toll Free: 800.856.6261

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 25.3 | 26.0 | 23.1
AGAT WO #: 24T152603
Lab Temperature:
Notes: no ice - 1 box

Client Information:

Company: Stantec Consulting Ltd.
Contact: Bahram Siavash
Address: 300W-675 Cochrane Drive West Tower
Markham, ON L3R 0B8
Phone: 905-479-9345 Fax: 905-474-9889
Project: 165001308.551.102 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements:

☐ Regulation 153/09 (reg. 511 Amend.)
Table ____ *Indicate one*
☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture *(check one)*
☐ Coarse ☐ Fine

☐ Sewer Use
Region ____ *Indicate one*
☐ Sanitary ☐ Storm

☐ Regulation 558
☐ CCME
☐ Other *(specify)*
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
☑ 5 to 7 Working Days
Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day
OR
Date Required (Rush surcharges may apply):
**TAT is exclusive of weekends and statutory holidays*

Invoice To:

Same: Yes ☑ No ☐
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) ☐ Yes ☐ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a Record of Site Condition? ☐ Yes ☐ No

Legend Matrix

GW Ground Water **O** Oil
SW Surface Water **P** Paint
SD Sediment **S** Soil

Report Information – reports to be sent to:

1. Name: Bahram Siavash
   Email: Bahram.Siavash@stantec.com
2. Name: Kirby Lales
   Email: kirby.lales@stantec.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6- ☐ SAR ☐ NO_3/NO_2 ☐ N- Total ☐ Hg ☐ pH	Nutients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_3	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	TCLP:	Sewer Use	Corrosivity Pckg (pH, Redox Potential	sulphates and sulphides contents	chlorides contents and resistivity)
Sign 3-SS2	2024-05-17			1	2.5'-5'																	X	X	X
Sign2 ~~Sign 4~~-SS3	2024-05-17			1	5'-7'																	X	X	X
Sign1-SS2	2024-05-17			1	2.5'-5'																	X	X	X
Sign4 ~~Sign 5~~-SS2	2024-05-17			1	2.5'-5'																	X	X	X

Samples Relinquished by (print name & sign): | Date/Time | Samples Received by (Print name & sign): Amy Jin | Date/Time May 21 24 10:30 am

Samples Relinquished by (print name & sign): | Date/Time | Samples Received by (Print name & sign): | Date/Time

Pink Copy – Client
Yellow + Golden Copy – AGAT
White Copy – AGAT

Page ____ of ____
NO:

Document ID: DIV-78-1511.006
Date Issued: July 20, 2011

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: STANTEC CONSULTING LTD
300-675 Cochrane Drive
MARKHAM, ON L3R0B8
(905) 444-7777

ATTENTION TO: Bahram Siavash

PROJECT: 165001308.551.102

AGAT WORK ORDER: 24T162759

SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganic Team Lead

DATE REPORTED: Jun 21, 2024

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.
- For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 24T162759

PROJECT: 165001308.551.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Inorganic Chemistry (Soil)

DATE RECEIVED: 2024-06-14

DATE REPORTED: 2024-06-21

				SAMPLE DESCRIPTION:	Sign 7 - SS3	Sign 9 - SS4
				SAMPLE TYPE:	Soil	Soil
				DATE SAMPLED:	2024-06-14 10:00	2024-06-14 10:00
Parameter	Unit	G / S	RDL		5936289	5936306
Sulphate (2:1)	µg/g		2		44	18
pH (2:1)	pH Units		NA		8.55	8.57
Electrical Conductivity (2:1)	mS/cm		0.005		0.161	0.169

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

5936289-5936306 EC, pH and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

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5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD
AGAT WORK ORDER: 24T162759
PROJECT: 165001308.551.102
ATTENTION TO: Bahram Siavash
SAMPLING SITE:
SAMPLED BY:

Soil Analysis

RPT Date: Jun 21, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Soil)															
Sulphate (2:1)	5936670		86	87	1.2%	< 2	100%	70%	130%	100%	80%	120%	98%	70%	130%
pH (2:1)	5941190		7.76	7.70	0.8%	NA	96%	80%	120%						
Electrical Conductivity (2:1)	5941190		0.203	0.188	7.7%	< 0.005	109%	80%	120%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Certified By:

AGAT Laboratories

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Method Summary

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T162759

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE

AGAT Laboratories

Have feedback? Scan here for a quick survey!

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only

Work Order #: 24T162759

Cooler Quantity: 1 boy

Arrival Temperatures: 25.3 | 25.5 | | |

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes: no ice

Report Information:

Company: Stantec Consulting Ltd.
Contact: Bahram
Address: 300-675 Cochrane Drive West Tower
Markham, ON, L3R 0B8
Phone: 905-479-9345 Fax: 905-944-9889
Reports to be sent to:
1. Email: Bahram.Siavash@stantec.com
2. Email: Maged.Abdel-Mesih@stantec.com / HARPREET.SINGH@STANTEC.COM

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Regulation 406
Table (Indicate One)

☐ Regulation 558

☐ CCME

☐ Sewer Use ☐ Sanitary ☐ Storm
(Region)

☐ Prov. Water Quality Objectives (PWQO)

☐ Other
(Indicate One)

Is this submission for a **Record of Site Condition**? ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 165001308.551.102
Site Location:
Sampled By:
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC Y/N	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	VOC	PAHs	PCBs	PCBs: Aroclors ☐	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs TCLP:	O. Reg 406: Regulation 406 SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	O. Reg 406: Regulation 406 Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Corrosivity: ☐ Moisture ☐ Sulphide	pH value	Conductivity	Soluble Sulphates				Potentially Hazardous or High Concentration (Y/N)
1. Sign 7 - SS3	14-6-24	10 AM AM/PM	1		5'-7'													☑	☑	☑				
2. Sign 9 - SS4	14-6-24	10 AM AM/PM	1		7.5'-9.5'													☑	☑	☑				
3.		AM/PM																☑	☑	☑				
4.		AM/PM																						
5.		AM/PM																						
6.		AM/PM																						
7.		AM/PM																						
8.		AM/PM																						
9.		AM/PM																						
10.		AM/PM																						
11.		AM/PM																						

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
			Tiffany Persaud		
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

24 JUN 14 5:03 PM

Page _____ of _____

N°:

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

AGAT Laboratories

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CLIENT NAME: STANTEC CONSULTING LTD
300-675 Cochrane Drive
MARKHAM, ON L3R0B8
(905) 444-7777

ATTENTION TO: Bahram Siavash

PROJECT: 165001308.551.102

AGAT WORK ORDER: 24T219442

ROCK ANALYSIS REVIEWED BY: Jewel Shibu, Lab Supervisor

SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganic Team Lead

DATE REPORTED: Nov 18, 2024

PAGES (INCLUDING COVER): 7

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

*Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
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- All reportable information is available on request from AGAT Laboratories, in accordance with ISO/IEC 17025:2017, ISO/IEC 17025:2005 (Quebec), DR-12-PALA and/or NELAP Standards.
- This document is signed by an authorized signatory who meets the requirements of the MELCCFP, CALA, CCN and NELAP.
- For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.

AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 24T219442

PROJECT: 165001308.551.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

(284-137) Sulfide (CGY)

DATE RECEIVED: 2024-11-11

DATE REPORTED: 2024-11-18

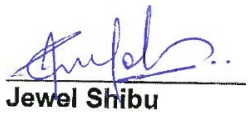
			SAMPLE DESCRIPTION:	SIGN 5 (SS2)
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2024-11-08 11:00
Parameter	Unit	G / S	RDL	6308709
Sulfide	%		0.01	<0.01

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

6308709 Sulfide is a calculated parameter and is non-accredited. The parameters that are components of the calculation are accredited.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:



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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 24T219442

PROJECT: 165001308.551.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2024-11-11

DATE REPORTED: 2024-11-18

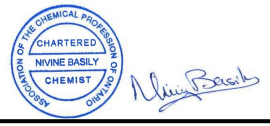
			SAMPLE DESCRIPTION:	SIGN 5 (SS2)
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2024-11-08 11:00
Parameter	Unit	G / S	RDL	6308709
Chloride (2:1)	µg/g		2	6
Sulphate (2:1)	µg/g		2	65
pH (2:1)	pH Units		NA	8.09
Electrical Conductivity (2:1)	mS/cm		0.005	0.209
Resistivity (2:1) (Calculated)	ohm.cm		1	4780
Redox Potential 1	mV		NA	427
Redox Potential 2	mV		NA	425
Redox Potential 3	mV		NA	427

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

6308709 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T219442

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Rock Analysis

RPT Date: Nov 18, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(284-137) Sulfide (CGY)															
Total Sulfur	6313174	6313174	<0.01	<0.01	NA	< 0.01	101%	80%	120%						
Sulfate	6308709	6308709	0.01	0.01	NA	< 0.01	115%	80%	120%						

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.
Duplicate/ Replicate NA: Results are less than 10X the RDL and RPD will not be calculated

Certified By:

Jewel Shibu

AGAT Laboratories

2910 12TH STREET NE
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CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T219442

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Nov 18, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Chloride (2:1)	6313174		4	4	NA	< 2	94%	70%	130%	101%	80%	120%	94%	70%	130%
Sulphate (2:1)	6313174		3	3	NA	< 2	96%	70%	130%	106%	80%	120%	99%	70%	130%
pH (2:1)	6308709	6308709	8.09	8.04	0.7%	NA	102%	80%	120%						
Electrical Conductivity (2:1)	6308709	6308709	0.209	0.245	15.9%	< 0.005	101%	80%	120%						
Redox Potential 1	6308709						100%	90%	110%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:

AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
http://www.agatlabs.com

Method Summary

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T219442

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential 1	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 2	INOR-93-6066	ASTM G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 3	INOR-93-6066	ASTM G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE

AGAT Laboratories

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L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com

Ph.: 905.712.5100 · Fax: 905.712.5122 · Toll Free: 800.856.6261

Chain of Custody Record

Laboratory Use Only
Arrival Temperature: 16.8
AGAT WO #: 24T219442
Lab Temperature:
Notes: no ice, box

Client Information:

Company: Stantec Consulting Ltd.
Contact: Bahram Siavash
Address: 300W-675 Cochran Drive West Tower
Markham, ON L3R 0B8
Phone: 905-479-9345 Fax: 905-474-9889
Project: 165001308.551.102 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements:

☐ Regulation 153/09 (reg. 511 Amend.)
Table ____ Indicate one
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (check one)
☐ Coarse ☐ Fine

☐ Sewer Use
Region ____ Indicate one
☐ Sanitary
☐ Storm

☐ Regulation 558
☐ CCME
☐ Other (specify)
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
☑ 5 to 7 Working Days
Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day
OR
Date Required (Rush surcharges may apply):
*TAT is exclusive of weekends and statutory holidays

Invoice To:

Same: Yes ☑ No ☐
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) ☐ Yes ☐ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Legend Matrix

GW Ground Water **O** Oil
SW Surface Water **P** Paint
SD Sediment **S** Soil

Report Information – reports to be sent to:

1. Name: Kirby Lales
   Email: Kirby.Lales@Stantec.com
2. Name: Maged Abdel Mesih
   Email: Maged.Abdel-Mesih@stantec.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6 ☐ SAR ☐ NO_3/NO_2 ☐ N-Total ☐ Hg ☐ pH	Nutients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_3	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	TCLP:	Sewer Use	Corrosivity Pckg (pH, Redox Potential	sulphates and sulphides contents	chlorides contents and resistivity)
SIGN 5 (SS2)	2024-11-08	11:00 AM		1	2.5'-4.5'																		X	X	X

Samples Relinquished by (print name & sign): Date/Time
Samples Received by (Print name & sign): Tiffany Date/Time: Nov 11 11:30 AM
Samples Relinquished by (print name & sign): Date/Time
Samples Received by (Print name & sign): Date/Time

Pink Copy – Client
Yellow – Golden Copy – AGAT
White Copy – AGAT

Page ____ of ____
NO:

Document ID: DIV-78-1511.006
Date Issued: July 20, 2011

AGAT Laboratories

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http://www.agatlabs.com

CLIENT NAME: STANTEC CONSULTING LTD
300-675 Cochrane Drive
MARKHAM, ON L3R0B8
(905) 444-7777

ATTENTION TO: Bahram Siavash

PROJECT: 165001308.551.102

AGAT WORK ORDER: 25T257123

ROCK ANALYSIS REVIEWED BY: Jewel Shibu, Lab Supervisor

SOIL ANALYSIS REVIEWED BY: Chuandi Zhang, Inorganic Supervisor

DATE REPORTED: Mar 13, 2025

PAGES (INCLUDING COVER): 7

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

*Notes

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information is available on request from AGAT Laboratories, in accordance with ISO/IEC 17025:2017, ISO/IEC 17025:2005 (Quebec), DR-12-PALA and/or NELAP Standards.
- This document is signed by an authorized signatory who meets the requirements of the MELCCFP, CALA, CCN and NELAP.
- For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.

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Certificate of Analysis

AGAT WORK ORDER: 25T257123

PROJECT: 165001308.551.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

(284-137) Sulfide (CGY)

DATE RECEIVED: 2025-03-11

DATE REPORTED: 2025-03-13

				SAMPLE DESCRIPTION:	Sign**11**-SS5
				SAMPLE TYPE:	Soil
				DATE SAMPLED:	2025-03-10 16:00
Parameter	Unit	G / S	RDL	6574351	
Sulfide	%		0.01	0.01	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

6574351 Sulfide is a calculated parameter and is non-accredited. The parameters that are components of the calculation are accredited.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

Jewel Shibu

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 25T257123

PROJECT: 165001308.551.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2025-03-11

DATE REPORTED: 2025-03-13

			SAMPLE DESCRIPTION:	Sign**11**-SS5
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2025-03-10 16:00
Parameter	Unit	G / S	RDL	6574351
Chloride (2:1)	µg/g		2	1490
Sulphate (2:1)	µg/g		2	40
pH (2:1)	pH Units		NA	7.35
Electrical Conductivity (2:1)	mS/cm		0.005	2.39
Resistivity (2:1) (Calculated)	ohm.cm		1	418
Redox Potential 1	mV		NA	363
Redox Potential 2	mV		NA	366
Redox Potential 3	mV		NA	378

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

6574351 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.
Dilution required, RDL has been increased accordingly.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

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Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 25T257123

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

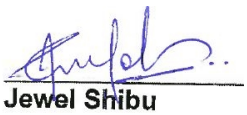
SAMPLED BY:

Rock Analysis

RPT Date: Mar 13, 2025			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(284-137) Sulfide (CGY)															
Total Sulfur	6574351	6574351	0.01	0.01	5.7%	< 0.01	100%	80%	120%						
Sulfate	6519695	6519695	0.05	0.05	0.0%	< 0.01	113%	80%	120%						

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.
Duplicate/ Replicate NA: Results are less than 10X the RDL and RPD will not be calculated

Certified By:



Jewel Shibu

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Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 25T257123

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Mar 13, 2025			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Chloride (2:1)	6574351	6574351	1490	1480	0.7%	< 2	98%	70%	130%	98%	80%	120%	NA	70%	130%
Sulphate (2:1)	6574351	6574351	40	39	2.5%	< 2	100%	70%	130%	94%	80%	120%	90%	70%	130%
pH (2:1)	6574351	6574351	7.35	6.46	12.9%		111%	80%	120%						
Electrical Conductivity (2:1)	6574351	6574351	2.39	2.49	4.1%	< 0.005	99%	80%	120%						
Redox Potential 1	6574351		NA	NA	NA		100%	90%	110%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.
Duplicate NA: results are under 5X the RDL and will not be calculated.
Matrix spike: Spike level < native concentration. Matrix spike acceptance limits do not apply.

Certified By:

AGAT Laboratories

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Method Summary

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 25T257123

PROJECT: 165001308.551.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential 1	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 2	INOR-93-6066	ASTM G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 3	INOR-93-6066	ASTM G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE

AGAT Laboratories

5835 Coopers Avenue
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L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com

Chain of Custody Record

Ph.: 905.712.5100 · Fax: 905.712.5122 · Toll Free: 800.856.6261

Laboratory Use Only

Arrival Temperature: 20.0
AGAT WO #: 25T257123
Lab Temperature:
Notes: no ice, 1 box

Client Information:

Company: Stantec Consulting Ltd.
Contact: Bahram Siavash
Address: 125 Commerce Valley Drive W., Suite 300
Markham, Ontario L3T 7W4
Phone: 905-479-9345 Fax: 905-474-9889
Project: 165001308.551.102 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements:

☐ Regulation 153/09 (reg. 511 Amend.)
Table ____ Indicate one
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (check one)
☐ Coarse ☐ Fine

☐ Sewer Use
Region ____ Indicate one
☐ Sanitary
☐ Storm

☐ Regulation 558
☐ CCME
☐ Other (specify)
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
☐ 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☑ 2 Working Days
☐ 1 Working Day

OR
Date Required (Rush surcharges may apply):

*TAT is exclusive of weekends and statutory holidays

Invoice To:

Same: Yes ☑ No ☐
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) ☐ Yes ☐ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Legend Matrix

GW Ground Water **O** Oil
SW Surface Water **P** Paint
SD Sediment **S** Soil

Report Information – reports to be sent to:

1. Name: Kirby Lales
   Email: Kirby.Lales@stantec.com
2. Name: Gwangha Roh
   Email: Gwangha.Roh@stantec.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6- ☐ SAR ☐ NO_3/NO_2 ☐ N- Total ☐ Hg ☐ pH	Nutients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_3	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	TCLP:	Sewer Use	Corrosivity Pckg	Sulphates and sulphides contents	Chlorides contents and resistivity
Sign0 - SS5	2025-03-10	4:00pm		1	10'-12'																	X	X	X

Samples Relinquished by (print name & sign):	Date/Time	Samples Received by (Print name & sign):	Date/Time
		Tiffany	Mar 11 9:30am
Samples Relinquished by (print name & sign):	Date/Time	Samples Received by (Print name & sign):	Date/Time

Pink Copy – Client
Yellow + Golden Copy – AGAT
White Copy – AGAT

Page ____ of ____
NO:

Document ID: DIV-78-1511.006

Date Issued: July 20, 2011

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CLIENT NAME: STANTEC CONSULTING LTD
300-675 Cochrane Drive
MARKHAM, ON L3R0B8
(905) 444-7777
ATTENTION TO: Bahram Siavash
PROJECT: 165001308.451.102
AGAT WORK ORDER: 24T175676
ROCK ANALYSIS REVIEWED BY: Jewel Shibu, Lab Supervisor
SOIL ANALYSIS REVIEWED BY: Sukhwinder Randhawa, Inorganic Team Lead
DATE REPORTED: Jul 26, 2024
PAGES (INCLUDING COVER): 7
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

*Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
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- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information is available on request from AGAT Laboratories, in accordance with ISO/IEC 17025:2017, ISO/IEC 17025:2005 (Quebec), DR-12-PALA and/or NELAP Standards.*
- *This document is signed by an authorized signatory who meets the requirements of the MELCCFP, CALA, CCN and NELAP.*
- *For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.*

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Certificate of Analysis

AGAT WORK ORDER: 24T175676

PROJECT: 165001308.451.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

(284-137) Sulfide (CGY)

DATE RECEIVED: 2024-07-19

DATE REPORTED: 2024-07-26

			SAMPLE DESCRIPTION:	Sign 6 - ss2	Sign 8 - ss3	Sign 10 - ss4
			SAMPLE TYPE:	Soil	Soil	Soil
			DATE SAMPLED:	2024-07-18 08:00	2024-07-18 08:00	2024-07-18 08:00
Parameter	**Unit**	**G / S**	**RDL**	**6014595**	**6014598**	**6014599**
Sulfide	%		0.01	<0.01	<0.01	0.01

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

6014595-6014599 Sulfide is a calculated parameter and is non-accredited. The parameters that are components of the calculation are accredited.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

Jewel Shibu

AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 24T175676

PROJECT: 165001308.451.102

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2024-07-19

DATE REPORTED: 2024-07-26

				SAMPLE DESCRIPTION:	Sign 6 - ss2	Sign 8 - ss3	Sign 10 - ss4
				SAMPLE TYPE:	Soil	Soil	Soil
				DATE SAMPLED:	2024-07-18 08:00	2024-07-18 08:00	2024-07-18 08:00
Parameter	**Unit**	**G / S**	**RDL**		**6014595**	**6014598**	**6014599**
Chloride (2:1)	µg/g		2		380	61	11
Sulphate (2:1)	µg/g		2		13	9	9
pH (2:1)	pH Units		NA		8.15	8.29	8.37
Electrical Conductivity (2:1)	mS/cm		0.005		0.641	0.224	0.145
Resistivity (2:1) (Calculated)	ohm.cm		1		1560	4460	6900
Redox Potential 1	mV		NA		321	339	344
Redox Potential 2	mV		NA		328	356	352
Redox Potential 3	mV		NA		330	352	351

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

6014595-6014599 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

AGAT Laboratories

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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T175676

PROJECT: 165001308.451.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Rock Analysis

RPT Date: Jul 26, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(284-137) Sulfide (CGY)															
Total Sulfur	6013796	6013796	<0.01	0.01	NA	< 0.01	96%	80%	120%						
Sulfate	6013805	6013805	<0.01	<0.01	NA	< 0.01	99%	80%	120%						

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.
Duplicate/ Replicate NA: Results are less than 10X the RDL and RPD will not be calculated

Certified By: Jewel Shibu

AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T175676

PROJECT: 165001308.451.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Jul 26, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Chloride (2:1)	6019767		128	131	2.3%	< 2	93%	70%	130%	99%	80%	120%	91%	70%	130%
Sulphate (2:1)	6019767		69	71	2.9%	< 2	96%	70%	130%	100%	80%	120%	100%	70%	130%
pH (2:1)	6016095		7.01	7.41	5.5%	NA	100%	80%	120%						
Electrical Conductivity (2:1)	6016095		0.115	0.098	16.0%	< 0.005	98%	80%	120%						
Redox Potential 1	6014595					NA	100%	90%	110%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Certified By:

AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
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Method Summary

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 24T175676

PROJECT: 165001308.451.102

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential 1	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 2	INOR-93-6066	ASTM G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 3	INOR-93-6066	ASTM G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE

AGAT Laboratories

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Mississauga, Ontario
L4Z 1Y2
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Ph.: 905.712.5100 · Fax: 905.712.5122 · Toll Free: 800.856.6261

Chain of Custody Record

Laboratory Use Only

Arrival Temperature: 24T175676
AGAT WO #: 26.1, 26.3, 26.9
Lab Temperature:
Notes: 1 box, No Ice

Client Information:

Company: Stantec Consulting Ltd
Contact: Bahram
Address: 300W-675 Cochran Drive West Tower, Markham, ON L3R 0B8
Phone: 905-479-9345 Fax: 905-944-9889
Project: 165001308 451 102 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements:

- ☐ Regulation 153/09 (incl. 511 Amend.) — Table ____ (indicate one): ☐ Ind/Com ☐ Res/Park ☐ Agriculture
- Soil Texture (check one): ☐ Coarse ☐ Fine
- ☐ Sewer Use — Region ____ (indicate one): ☐ Sanitary ☐ Storm
- ☐ Regulation 558
- ☐ CCME
- ☐ Other (specify) ____
- ☐ Prov. Water Quality Objectives (PWQO)
- ☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
- ☐ 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
- ☐ 3 Working Days
- ☐ 2 Working Days
- ☐ 1 Working Day

OR

Date Required (Rush surcharges may apply): ____

*TAT is exclusive of weekends and statutory holidays

Invoice To: Same: Yes ☐ No ☐
Company:
Contact:
Address:

Is this a drinking water sample? (potable water intended for human consumption) ☐Yes ☐No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a Record of Site Condition? ☐Yes ☐No

Legend Matrix

GW Ground Water · O Oil
SW Surface Water · P Paint
SD Sediment · S Soil

Report Information – reports to be sent to:

1. Name: Kirby Lales
   Email: Kirby.Lales@Stantec.com
2. Name: Maged Abdel-Mesih
   Email: Maged.Abdel-Mesih@stantec.com

Analysis columns: Metals and Inorganics; Metal Scan; Hydride Forming Metals; Client Custom Metals; ORPs: ☐B-HWS ☐Cl- ☐CN- ☐EC ☐FOC ☐Cr+6 ☐SAR ☐NO_2/NO_3 ☐N-Total ☐Hg ☐pH; Nutrients: ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2; VOC: ☐VOC ☐THM ☐BTEX; CCME Fractions 1 to 4; ABNs; PAHs; Chlorophenols; PCBs; Organochlorine Pesticides; TCLP Metals/Inorganics; TCLP:; Sewer Use; Corrosivity Pckg (pH, Redox Potential, sulphates and sulphides contents, chlorides contents and resistivity)

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Corrosivity Pckg (pH, Redox Potential, sulphates and sulphides contents, chlorides contents and resistivity)
Sign 6 - ss2	july 18	8am		1	2.5-4.5 ft	X
Sign 8 - ss3	july 18	8am		1	5-7 ft	X
Sign 10 - ss4	july 18	8am		1	7.5-9.5 ft	X

Samples Relinquished by (print name & sign): | Date/Time: | Samples Received by (Print name & sign): Anmol · B | Date/Time: 19.7.24

Samples Relinquished by (print name & sign): | Date/Time: | Samples Received by (Print name & sign): | Date/Time: 11:15

Pink Copy - Client
Yellow + Golden Copy - AGAT
White Copy - AGAT

Page ___ of ___
NO:

Document ID: DIV 78 1511.006 · Date Issued: July 20, 2011

APPENDIX E

E.1 DESIGN PARAMETER TABLE

Table E1 - Geotehnical Design Parameters

Station Number	Borehole	Soil Type	Top of Layer (m)	Bottom of Layer (m)	Groundwater depth/ Elevation (m)	γ	γ' [1]	Φ'	S_u	k_0	K_a	$K_{p\ F.G}$	$K_{p\ (2:1)}$ [3]	n_h (kN/m^3)	MTO Standard Case
Highway 4 Southbound															
16+030	BH SIGN 11	FILL: Silty SAND with Gravel (Compact)	0	0.4	3.8/237.5 [2]	21	11.2	30	N/A	0.50	0.33	3.00	1.23	3000	Standard Case 2
		FILL: CLAYEY SILT (Firm)	0.4	1.5		20	10.2	N/A	40	N/A	N/A	N/A	N/A	N/A	
		CLAYEY SILT (CL) TILL (Stiff to very stiff)	1.5	8.2		21	11.2	N/A	120	N/A	N/A	N/A	N/A	N/A	
15+570	BH SIGN 1	FILL: Silty SAND with Gravel (Compact)	0	0.3	4.6/234.9 [2]	21	11.2	30	N/A	0.50	0.33	3.00	1.23	3000	Standard Case 2
		FILL: CLAYEY SILT (Firm to stiff)	0.3	1.4		20	10.2	N/A	30	N/A	N/A	N/A	N/A	N/A	
		CLAYEY SILT (CL) TILL (stiff to very stiff)	1.4	7.5		21	11.2	N/A	100	N/A	N/A	N/A	N/A	N/A	
	SWMP1-BH1	SILTY CLAY (CI) (Firm to stiff)	0.3	1.5	2.2/236.5 [2]	20	10.2	N/A	50	N/A	N/A	N/A	N/A	N/A	
		CLAYEY SILT (CL) TILL (Stiff to very stiff)	1.5	11.3		21	11.2	N/A	120	N/A	N/A	N/A	N/A	N/A	
Talbotville Bypass Eastbound															
11+197	BH SIGN 4	CLAYEY SILT (CL) TILL (Firm)	0	0.8	2.3/235.5 [2]	20	10.2	N/A	40	N/A	N/A	N/A	N/A	N/A	Standard Case 2
		CLAYEY SILT (CL) TILL (stiff to very stiff)	0.8	8.2		21	11.2	N/A	100	N/A	N/A	N/A	N/A	N/A	
12+222	BH SIGN 5	CLAYEY SILT (CL) TILL (Firm to stiff)	0.2	2.6	7/233.1	20	10.2	N/A	30	N/A	N/A	N/A	N/A	N/A	Not Applicable
		Silty SAND (SM) (Compact to dense)	2.6	3.7		21	11.2	32	N/A	0.47	0.31	3.25	1.34	3000	
		CLAYEY SILT (CL) TILL (Stiff to very stiff)	3.7	8.2		21	11.2	N/A	100	N/A	N/A	N/A	N/A	N/A	
	CNR-EMB9	CLAYEY SILT (CL) TILL (Soft)	0.2	0.7	3/236.7 [2]	19	9.2	N/A	20	N/A	N/A	N/A	N/A	N/A	
		CLAYEY SILT (CL) TILL (Very stiff)	0.7	14.8		21	11.2	N/A	120	N/A	N/A	N/A	N/A	N/A	
		CLAYEY SILT (CL) (Very stiff)	14.8	15.9		21	11.2	N/A	100	N/A	N/A	N/A	N/A	N/A	
Talbotville Bypass Westbound															
13+760	BH SIGN 8	FILL: Sandy SILT to Silty SAND (Loose)	0	0.8	5.5/195.4	20	10.2	28	N/A	0.53	0.36	2.77	1.12	2000	Not Applicable
		CLAYEY SILT (CL) TILL (Stiff to very stiff)	0.8	5.5		21	11.2	N/A	100	N/A	N/A	N/A	N/A	N/A	
		SAND with SILT (SP-SM) (Compact)	5.5	6.8		21	11.2	30	N/A	0.50	0.33	3.00	1.23	2000	
		CLAYEY SILT TILL (Very stiff)	6.8	7.5		21	11.2	N/A	150	N/A	N/A	N/A	N/A	N/A	
		Silty SAND (Dense)	7.5	8.2		21.5	11.7	32	N/A	0.47	0.31	3.25	1.34	3000	
13+255	BH SIGN 6	FILL: Silty SAND with Gravel (Compact)	0	0.3	2.3/235.2 [2]	21	11.2	30	N/A	0.50	0.33	3.00	1.23	3000	Standard Case 2
		CLAYEY SILT (CL) TILL (Stiff ot very stiff)	0.3	8.2		21	11.2	N/A	100	N/A	N/A	N/A	N/A	N/A	
10+725	BH DCC1	FILL: CLAYEY SILT (Stiff)	0.2	0.9	3/234.3 [2]	20	10.2	N/A	40	N/A	N/A	N/A	N/A	N/A	Standard Case 2
		SILTY CLAY (Firm)	0.9	1.4		20	10.2	N/A	40	N/A	N/A	N/A	N/A	N/A	
		CLAYEY SILT (CL) TILL (Very stiff)	1.4	15.9		21	11.2	N/A	150	N/A	N/A	N/A	N/A	N/A	
	BH DCC2	FILL: CLAYEY SILT (Firm)	0.2	1	2.1/235.3	20	10.2	N/A	40	N/A	N/A	N/A	N/A	N/A	
		CLAYEY SILT (CL) TILL (Very stiff)	1	15.9		21	11.2	N/A	120	N/A	N/A	N/A	N/A	N/A	
	BH DCC3	CLAY (CH) (Firm)	0.2	1.4	2.3/235 [2]	20	10.2	N/A	30	N/A	N/A	N/A	N/A	N/A	
		CLAYEY SILT (CL) TILL (Very stiff to hard)	1.4	15.9		21	11.2	N/A	120	N/A	N/A	N/A	N/A	N/A	
10+250	BH SIGN 2	CLAYEY SILT (CL) TILL (Firm)	0.2	0.7	2.3/235.9 [2]	20	10.2	N/A	40	N/A	N/A	N/A	N/A	N/A	Standard Case 2
		CLAYEY SILT (CL) TILL (Stiff to hard)	0.7	8.2		21	11.2	N/A	120	N/A	N/A	N/A	N/A	N/A	
	BH SIGN 3	CLAYEY SILT (CL) TILL (Firm)	0.1	0.7	2.3/235.7 [2]	20	10.2	N/A	40	N/A	N/A	N/A	N/A	N/A	
		CLAYEY SILT (CL) TILL (Stiff to very stiff)	0.7	8.2		21	11.2	N/A	100	N/A	N/A	N/A	N/A	N/A	
	SWMP1-BH3	SILTY CLAY (CI) (Stiff to very stiff)	0.1	2.2	2.2/236.5 [2]	21	11.2	N/a	100	N/A	N/A	N/A	N/A	N/A	
		CLAYEY SILT (CL) TILL (Very stiff to hard)	2.2	11.3		21	11.2	N/A	120	N/A	N/A	N/A	N/A	N/A	

Notes:
γ = total unit weight (kN/m3), γ' = effective (submerged) unit weight (kN/m3), ϕ'= effective soil friction angle (°), Su = soil shear strength (kPa), Ko = coefficient of earth pressure at rest, Ka = coefficient of active earth pressure, Kp = coefficient of passive earth pressure, and nh = coefficient of horizontal subgrade reaction. The effective unit weight (γ') should be used below the groundwater level.
N/A Not Applicable

1 The Effective Unit Weight should be used below the groundwater level
2 Groundwater depth inferred from color change from brown to grey
3 Kp (2:1) should be used where signs are located on embankment side slopes.

APPENDIX F

F.1 TYPICAL EMBANKMENT SECTIONS

NOTES:

1. TYPICALS TO BE READ IN CONJUNCTION WITH:
   – OPSD 100 & 200 SERIES. ABBREVIATION LIST IN DRAWING TO SUPERCEDE OPSD 100 SERIES WHEN IN CONFLICT
   – MTOD 503.020 & MTOD 503.021
   – PLANS, PAVEMENT DATA CHART AND DETAILS
2. ALL AREAS WITHIN THE GRADING LIMITS ARE TO BE STRIPPED OF TOPSOIL. (xxmm AVG.)
3. REFER TO STRUCTURAL DRAWINGS FOR DETAILS AROUND STRUCTURES.
4. STEEL BEAM GUIDE RAIL SHALL BE INSTALLED AS INDICATED ELSEWHERE IN THE CONTRACT. WHERE STEEL BEAM GUIDE RAIL IS INDICATED, THE MINIMUM ROUNDING SHALL BE 1.0m WITH 0.5m REQUIRED FROM EDGE OF SHOULDER TO ROUNDING BREAK POINT.
5. PLACE 50mm OF TOPSOIL, SOD / SEED AND MATRIX ON ALL DISTURBED AREAS.
6. PROVIDE A 100mm PERFORATED PIPE SUBDRAIN WHERE INDICATED ON PLAN TO PROVIDE POSITIVE DRAINAGE AS PER SUBDRAIN DETAILS.
7. REMOVE EXIST SUBDRAIN IN ALL AREAS OF CONSTRUCTION INCLUDING AREAS BELOW EXCAVATION.

SUPERELEVATION TABLE														
S%	Pavt	+6	+5	+4	+3	+2	+1	0	−1	−2	−3	−4	−5	−6
T%	SH	−2	−2	−2	−3	−3	−3	−4	−5	−6	−6	−6	−6	−6

ABBREVIATIONS:

EXIST.= EXISTING
LTL = LEFT TURN LANE
MED = MEDIAN
PS = PAVED SHOULDER
PPS = PARTIALLY PAVED SHOULDER
RND = ROUNDING
RTL = RIGHT TURN LANE
SCL = SPEED CHANGE LANE
E% = EXISTING GRADE
MILL = REMOVAL OF ASPHALT PAVEMENT, PARTIAL DEPTH
SSM = SELECT SUBGRADE MATERIAL
SH = SHOULDER

METRIC

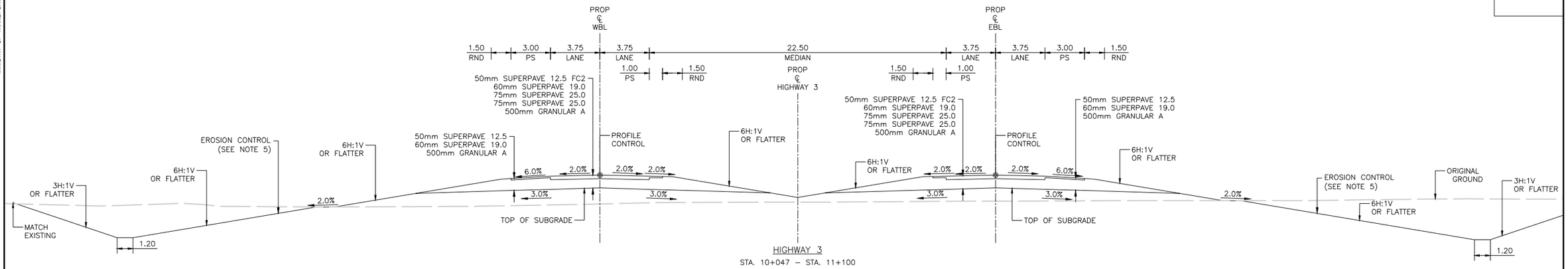
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

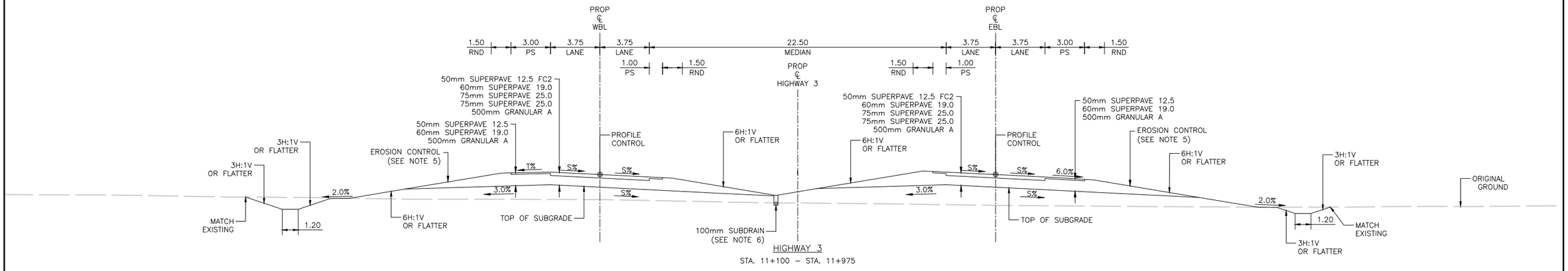
PLATE No
CONT XXXX–XXXX
WP 3042–22–00

TYPICALS
HIGHWAY 3

SHEET
226

Stantec





N.T.S.

MINISTRY OF TRANSPORTATION, ONTARIO
PR-D-707 88-05
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CREATED: August 23, 2024

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No

CONT XXXX–XXXX

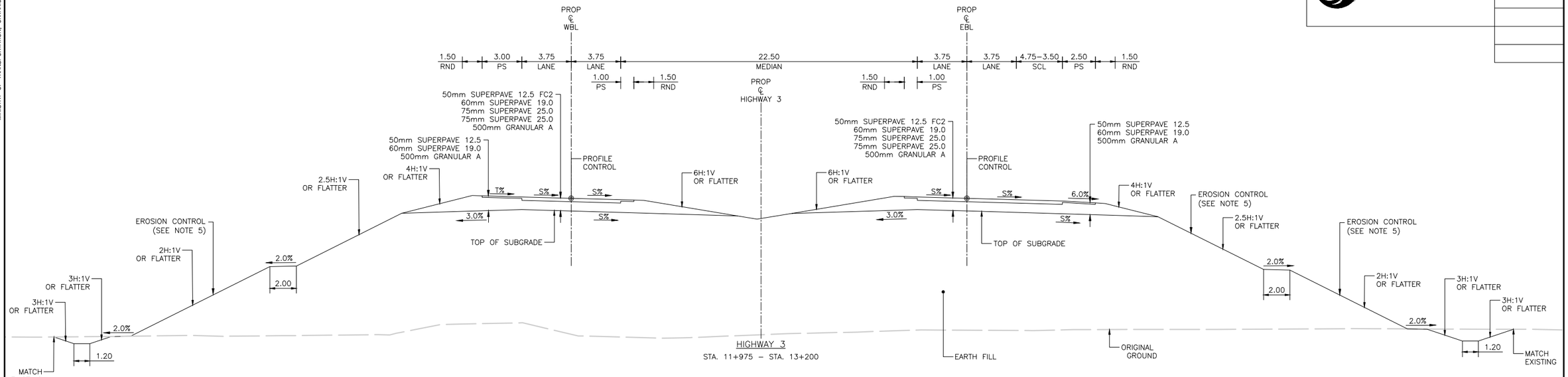
WP 3042–22–00

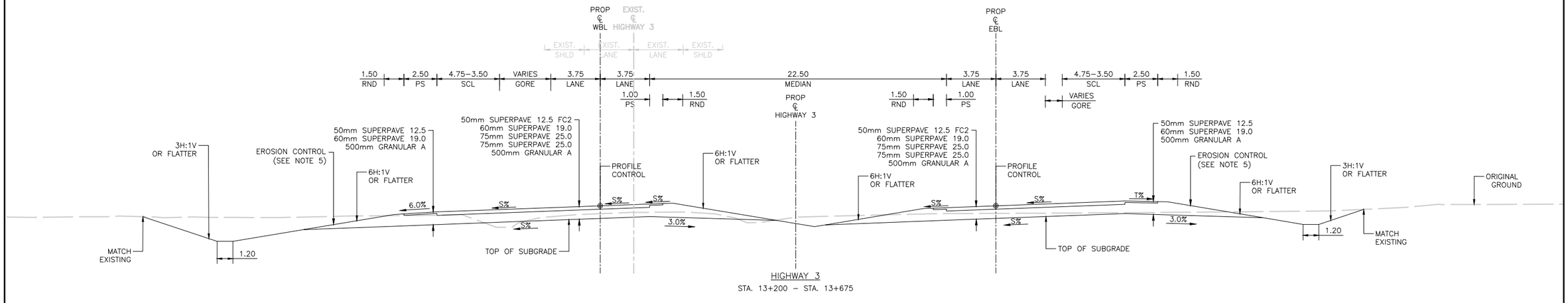
TYPICALS

HIGHWAY 3

SHEET 227

Stantec





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MODIFIED: Friday, August 23, 2024 4:33:23 PM

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No

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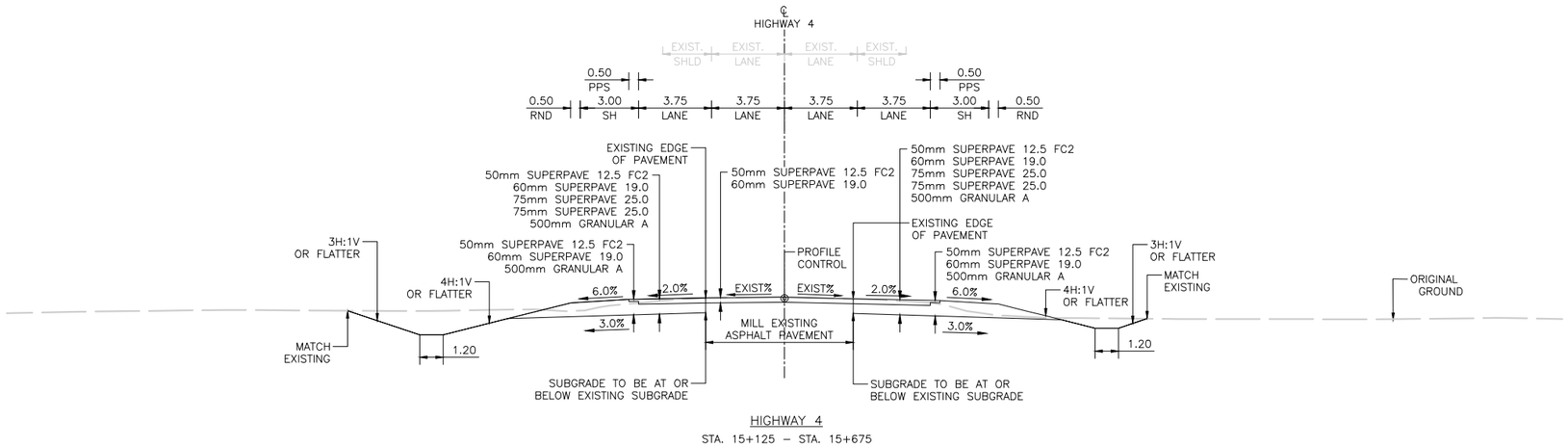
WP 3042–22–00

TYPICALS

HIGHWAY 4

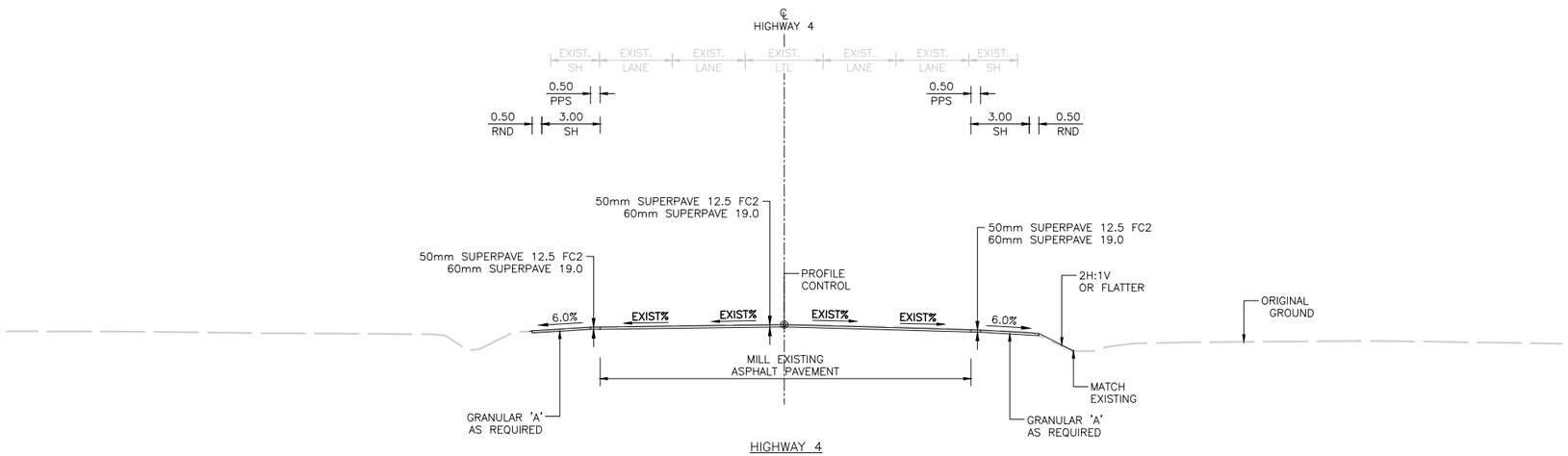
SHEET 228

Stantec



HIGHWAY 4

STA. 15+125 – STA. 15+675



HIGHWAY 4

STA. 15+675 – STA. 16+150

N.T.S.

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