



Foundation Investigation and Design Report

Temporary Protection System, Highway 402 (Eastbound and Westbound) at Highway 40 Overpass and Wawanosh Drain Bridge Structures, City of Sarnia, Ontario, Ministry of Transportation, Ontario GWP 3106-18-00

HIGHWAY 402 AT HIGHWAY 40, SITE NO.: 14X-0338/B1 AND 14X-0338/B2.
HIGHWAY 402 AND WAWANOSH DRAIN, SITE NO.: 14X-0341/B1 AND 14X-0341/B2.

Location	Site No.	Latitude	Longitude
Hwy 402 and Modeland Road Overpass Structures (Hwy 40)	14X-0338/B1	42.990447	-82.343817
	14X-0338/B2	42.990744	-82.343830
Highway 402 & Wawanosh Drain Bridge Structures	14X-0341/B1	42.990527	-82.334680
	14X-0341/B2	42.990780	-82.334425

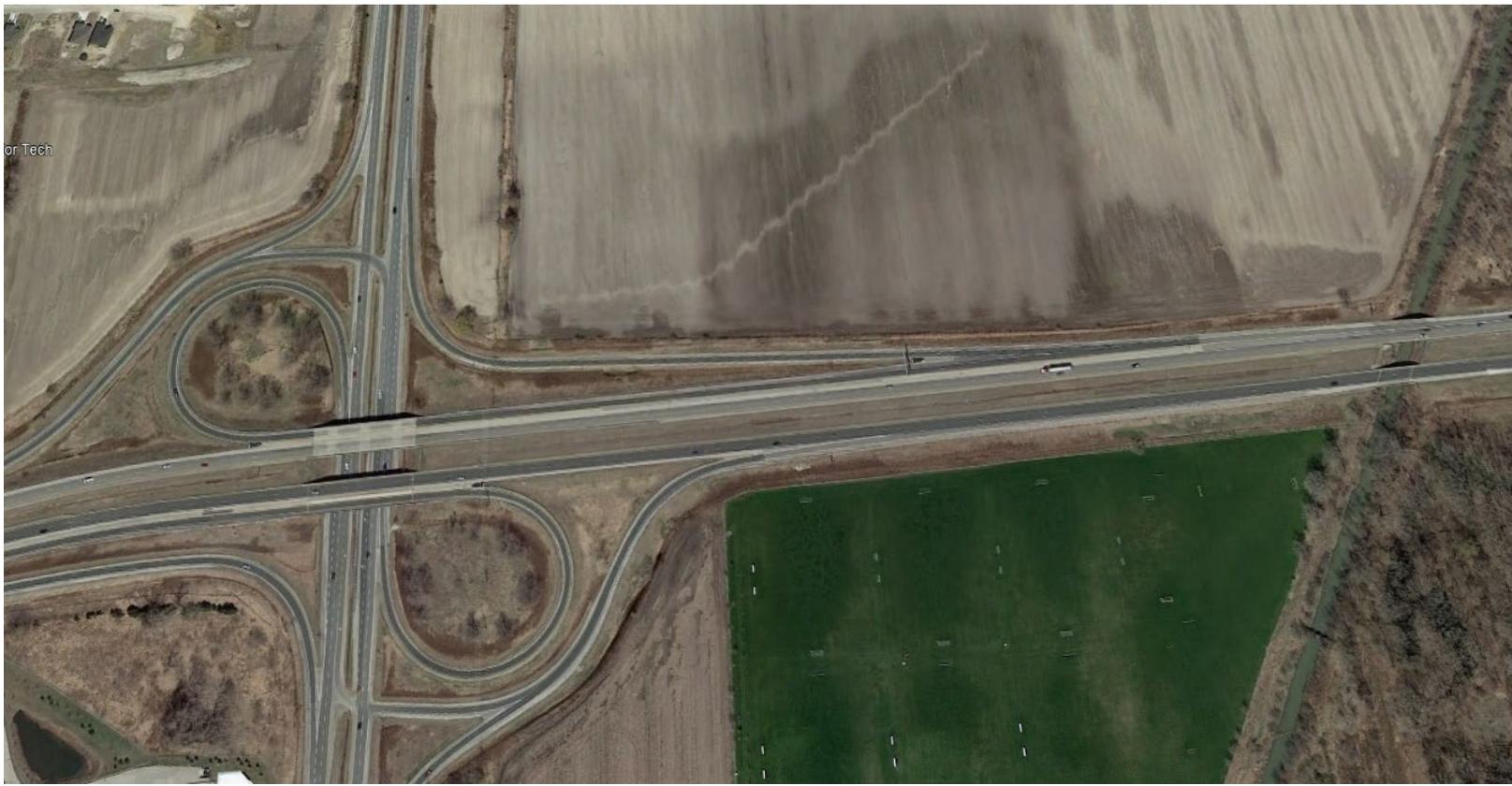
22 September 2023

GEOCRES NO.: 40J16-095

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PART A

FOUNDATION INVESTIGATION REPORT

**TEMPORARY PROTECTION SYSTEM, HIGHWAY 402 (EASTBOUND AND WESTBOUND) AT HIGHWAY
40 OVERPASS AND WAWANOSH DRAIN BRIDGE STRUCTURES, CITY OF SARNIA, ONTARIO
MTO GWP 3106-18-00**

1. Introduction

GHD Limited (GHD) was retained by the Ministry of Transportation, Ontario (MTO), to provide foundation investigation and engineering services for the temporary protection systems associated with the proposed rehabilitation and conversion to semi-integral abutments of four bridge structures as described below, located in the City of Sarnia, Ontario (see the Key Plan on Drawings 1 and 6):

- Two overpass structures on Highway 402 at Highway 40 (Modeland Rd.) eastbound (EB) and westbound (WB) (Site Numbers 14X-0338/B1 and 14X-0338/B2, respectively).
- Two bridge structures on Highway 402 over the Wawanosh Drain EB & WB (Site Numbers 14X-0341/B1 and 14X-0341/B2, respectively).

The purpose of this investigation is to establish the subsurface soil and groundwater conditions at the locations of proposed temporary protection system by means of borehole drilling and geotechnical laboratory testing on selected soil samples.

The Terms of Reference (TOR) and the scope of work for this project are identified within the agreement of services as amended between MTO and GHD for Consultant's Assignment Number 3020-E-0014. The work has been carried out in accordance with the requirements of *Guideline for Foundation Engineering Services, Version 3.0, April 2022*, prepared by the MTO.

2. Site Description

Highway 402 is a major highway in southwestern Ontario, Canada, that extends from London to Sarnia. Two of the key features along this highway are the Highway 40 overpass and Wawanosh Drain bridges, which extend beneath Highway 402 near the city of Sarnia. Further details of the existing structures are provided below:

Highway 402 and Highway 40 Overpass

The existing four span Highway 40 overpass structures were constructed in 1975. Each bridge with an overall length of 72.5 m and deck width of about 22.3 m accommodates two lanes of Highway 402 traffic and a speed change lane which are separated by a raised concrete median. The Highway 40 overpass structures are situated in an urban-setting environment with generally a flat landscape. The areas surrounding the Highway 40 overpass structures are a mix of residential and commercial land uses with vacant farm fields mostly towards the northeast side of the Highway 40 overpass structures.

The embankment slopes between the Highway 40 overpass structures are covered by grass or other vegetation (a grass median) and observed to be stable, with no visible signs of erosion. General site conditions are shown in Photographs 1 to 4 presented in **Appendix A**.

Highway 402 and Wawanosh Drain Bridges

The existing single span Wawanosh Drain bridge structures were constructed in 1975 and are a two-lane structure in each direction (EB and WB). The structures are located on Highway 402, approximately 0.6 km east of Highway 40, over Wawanosh Drain (Perch Creek). The westbound bridge carries two lanes of traffic and one lane of off-ramp traffic with the span length of about 23.8 m and deck width of about 18 m to 18.7 m, while the eastbound bridge carries only two lanes of traffic with the span length of about 23.8 m and deck width of 13.5 m to 13.9 m.

The Wawanosh Drain bridge structures are situated in an urban-setting environment with generally a flat landscape. The areas surrounding the Wawanosh Drain bridge structures are a mix of residential and

commercial land uses with vacant farm fields mostly towards the northeast side of the Highway 40 overpass structures.

The embankment slopes between the Wawanosh Drain bridge structures are covered by grass or other vegetation and observed to be stable, with no visible signs of erosion. There are also signs of pre-existing dykes on either side of Wawanosh Drain based on the Geocres Report. General site conditions are shown in Photographs 5 to 9 presented in **Appendix A**.

3. Investigation Procedures

3.1 Previous Investigation

Highway 402 and Highway 40 Overpass

Geotechnical investigations were previously carried out at this site. As per MTO 40J16-036 Report, dated December 1969, a total of twenty-one sampled boreholes and sixteen dynamic cone penetration tests (Boreholes BH100 through BH116 and BH200 through BH211) were advanced to depths ranging from 2.3 m to 9.6 m below original existing grade. The boreholes were advanced prior to the construction of the overpass structures. Geotechnical laboratory testing was carried out on selected soil samples. The results of this investigation are contained in a report titled *“Foundation Investigation Report for The Proposed Approaches in the vicinity of Modeland Road Interchange CAH #402, Township of Sarnia, County of Lambton, District No. 1 (Chatham, Ontario), WJ 69-F-119, WP 122-65-01, prepared by the Department of Highways Ontario, dated April 21, 1970”* provided in **Appendix B**. It is noted that no borehole location drawings were provided with this report, therefore the historic borehole logs have been used for informational purposes only.

As per MTO GEOCRETS Report 40J16-040, in November 1969 and June 1970, a total of sixteen boreholes (Boreholes 1 through 16) were advanced to depths ranging from 6.8 m to 33.9 m below original existing grade. The boreholes were advanced prior to the construction of the overpass structures. Geotechnical laboratory testing was carried out on selected soil samples. The results of this investigation are contained in a report titled *“Foundation Investigation Report for The Proposed Hwy. #402 Overhead at Modeland Road, District No. 1 (Chatham), WO 70-11046, WP 122-65-03 & 04, prepared by the Department of Highways Ontario, dated July 8, 1970”* provided in **Appendix B**.

Highway 402 and Wawanosh Drain Bridges

A geotechnical investigation was previously carried out at the site. As per MTO GEOCRETS Report 40J16-041, a total of ten boreholes were advanced to depths ranging from 4.9 m to 37.8 m. The previous boreholes were advanced about 1 m to 3 m below the current profile of Highway 402, due to the presence of dykes at the existing bridge abutment locations. Geotechnical laboratory testing was carried out on selected soil samples. The results of this investigation are contained in a report titled *“Foundation Investigation Report for The Proposed Wawanosh Drain Bridge of Hwy. #402, 0.5 Miles East of Modeland Road, District #1 (Chatham), WO 70-11047, WP 122-65-07 & 08, prepared by the Department of Highways Ontario, dated July 15, 1970”* provided in **Appendix B**.

3.2 Current Investigation

The geotechnical fieldwork for this investigation was carried out between April 10 and 18, 2023, during which time twelve boreholes designated as BH5-22 to BH16-22 were advanced to a depth of about 12.8 m below existing ground surface (existing Highway 402 road level). Four (4) boreholes (BH5-22 to BH8-22) were advanced on the Highway 402 at Highway 40 Overpass (two boreholes at each structure) and eight (8) boreholes (BH9-22 to BH15-22) were advanced on Highway 402 at Wawanosh Drain (Perch Creek) bridges (four boreholes at each structure). The boreholes were advanced through the lanes and shoulder of Highway 402 on the eastbound and westbound as shown on Drawings 1 and 6.

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

The boreholes were advanced using a Mobile Drill B57 and B60 truck-mounted drill rig, equipped with continuous flight, hollow stem augers, supplied and operated by Landshark Drilling of Brantford, Ontario. The asphalt and underlying concrete were cored using concrete coring equipment and municipal water supplied by the drilling subcontractor. Soil samples were obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm outer-diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedures described in ASTM D1586¹. Where firm to stiff cohesive deposits were encountered, in-situ field vane shear tests were carried out using an MTO 'N'-size vane to assess the strength characteristics of these soils in accordance with ASTM D2573². Soil samples obtained from the boreholes were inspected in the field immediately upon retrieval for type, texture, and color. All retrieved samples from the investigation were sealed in clean plastic bags and transported to the GHD laboratory in Waterloo for further visual examination, and geotechnical laboratory tests.

No monitoring wells were installed in any of the boreholes; however, groundwater conditions and water levels were observed/measured in the open boreholes during drilling by visual examination of soil samples and drill rods as well as immediately following the completion of the drilling operations at each borehole. The boreholes were backfilled with bentonite and sealed at the top with compacted auger cuttings, in accordance with Ontario Regulation 903 (as amended).

The as-drilled borehole locations and ground surface elevations were obtained using a Leica Global Navigation Satellite System (GNSS). The locations given on the Borehole Records are positioned relative to MTM Coordinates (MTM Zone 11 NAD83) northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The coordinates and ground surface elevation are presented below, on the borehole records and on Drawings 1 and 6.

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

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

Table 3.1 Summary of Current GHD Boreholes

Site Location	Structure Number	Borehole Number	Location	Location (MTM NAD 83, ZONE 11)		Borehole Depth (m)	Ground Surface Elevation (m)	End of Borehole Elevation (m)
				Northing (m)	Easting (m)			
				(Latitude, °)	(Longitude, °)			
Highway 402 and Highway 40 Overpass	14X-0338/B1 (Eastbound Lanes)	BH6-22	Left lane of EB of Highway 402	4761193.9 (42.990444)	317490.5 (-82.344375)	12.8	186.9	174.1
		BH8-22	Left lane of EB of Highway 402	4761194.5 (42.990448)	317571.5 (-82.343382)	12.8	186.9	174.1
	14X-0338/B2 (Westbound Lanes)	BH5-22	Left lane of WB of Highway 402	4761218.1 (42.990662)	317492.4 (-82.344352)	12.8	187.0	174.2
		BH7-22	Left lane of WB of Highway 402	4761218.8 (42.990667)	317572.8 (-82.343365)	12.8	186.9	174.1
Highway 402 and Wawanosh Drain Bridges	14X-0341/B1 (Eastbound Lanes)	BH13-22	Left lane of EB of Highway 402	4761205.1 (42.990532)	318257.5 (-82.334969)	12.8	182.9	170.1
		BH14-22	Left lane of EB of Highway 402	4761204.5 (42.990525)	318308.9 (-82.334339)	12.8	182.8	170.0
		BH15-22	Right Shoulder of Highway 402	4761194.5 (42.990437)	318237.6 (-82.335214)	12.8	182.7	169.9
		BH16-22	Right Shoulder of Highway 402	4761196.8 (42.990457)	318317.8 (-82.33423)	12.8	182.7	169.9
	14X-0341/B2 (Westbound Lanes)	BH9-22	Right Shoulder of Highway 402 Off Ramp	4761242.2 (42.990866)	318284.3 (-82.334639)	12.8	182.7	169.9
		BH10-22	Right Shoulder of Highway 402 Off Ramp	4761241.6 (42.990859)	318331.5 (-82.334061)	12.8	182.6	169.8
		BH11-22	Left lane of WB of Highway 402	4761227.7 (42.990735)	318269.8 (-82.334817)	12.8	182.8	170.0
		BH12-22	Left lane of WB of Highway 402	4761229.0 (42.990745)	318336.8 (-82.333996)	12.8	182.6	169.8

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

4. Site Geology and Subsurface Conditions

4.1 Regional Geology

The Highway 40 overpass and Wawanosh Drain bridge structures are located within physiographic region known as Huron Fringe, which is a subdivision of the St. Clair Clay Plain, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984)³. The surficial soils of the Huron Fringe region in proximity to the site generally consist of peat, muck, sand, gravel, silt and clay, and littoral deposits derived from coarse-textured lacustrine deposits. The depth to the bedrock in the area is in excess of 30 m below ground surface and consists of shale of the Kettle Point Formation.

4.2 Subsurface Conditions – Previous Investigation

As discussed in Section 3.1 previously a geotechnical investigation was carried out from the original ground surface prior to the construction of the structure. The results of previous investigation from GEOCREs No. 40J16-036, 40J16-040 and 40J16-041 are presented in **Appendix B**.

4.2.1 Highway 402 and Highway 40 Overpass

Geotechnical investigations were previously carried out at the site (MTO GEOCREs Report 40J16-036 and 40J16-040) and the boreholes were advanced to depths ranging from 2.3 m to 33.9 m.

Report 40J16-036

The subsurface conditions encountered in boreholes advanced from the original ground surface (approximately Elevation 179 m) are described below. A deposit of silty sand to sand was encountered in the boreholes immediately below the topsoil. The deposit was found at depths ranging between 1.2 and 7.0 m below ground surface. The natural moisture content ranges from 12% to 30%. The SPT “N” values presented on the borehole records range from 4 blows to 20 blows per 0.3 m of penetration, suggesting a very loose to compact state of compactness condition.

Organic silt and clay materials was found below topsoil and the silty sand to sand deposit. It was encountered below the topsoil in some boreholes and extended to a depth of 9 m below ground surface in multiple boreholes. The average natural moisture content of the organic materials was found to be 60%. In-situ vane shear testing was carried out in the boreholes and the undrained shear strength of the organic deposit varied from about 9 kPa to 43 kPa, indicating that the cohesive deposit has a very soft to firm consistency.

The groundwater level measured in the completed boreholes were found to be at or slightly below the ground surface at the time of the field investigation.

Report 40J16-040

The subsurface conditions encountered in boreholes advanced from the original ground surface (approximately Elevation 180 m) consist of organic deposits, clayey silt, and silty clay deposits. The depth of the organic deposit was found to vary between 0.5 and 4.9 m below ground surface. The organic content of the samples was as high as 25% to 29%, the Atterberg limits ranged from 38% to 210% for plastic limit and 77% to 320% for liquid limit. The natural moisture contents ranged from 94% to 242%. The SPT “N” values presented on the borehole records range from 1 blow to 5 blows per 0.3 m of penetration, suggesting a very soft to firm consistency and very loose to loose compactness condition. In-situ vane shear testing was carried out in the boreholes and the undrained shear strength of the organic deposit varied from about 7 kPa to greater than 29 kPa with an average of 19 kPa.

³ Chapman, L.J. and Putman, D.F., 1984, *The Physiography of Southern Ontario*, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.)

A deposit of clayey silt with traces of sand and gravel was encountered underlying the organic deposit and extended to a depth of 13.7 m below ground surface. The average natural moisture content of the organic materials was found to be 20%. The SPT “N” values presented on the borehole records range from 10 blows to 46 blows per 0.3 m of penetration. The vane shear testing strength was measured exceeding 95 kPa within the upper desiccated layers and between Elevation 166.0 m and 168.0 m the in-situ vane shear testing carried out in the boreholes indicates that the undrained shear strength of the deposit varied from 24 kPa to greater than 29 kPa, indicating a firm consistency, while the remainder of the deposit has a stiff to hard consistency.

A deposit of silty clay with trace of sand and gravel was encountered underlying the clayey silt deposit and extended down to the bedrock surface. The average moisture content of the silty clay deposit was found to be about 25%. The SPT “N” values presented on the borehole records range from 5 blows to 28 blows per 0.3 m of penetration. In-situ vane shear testing was carried out in the boreholes and the undrained shear strength of the deposit varied from 24 kPa to greater than 95 kPa. The in-situ field vane tests together with the SPT “N” values indicate that the cohesive deposit has a firm to very stiff consistency.

Shale bedrock of the Kettle Point Formation was encountered at a depth of 32.5 m below ground surface (Elevation 147.0 m).

The groundwater level measured in the completed boreholes were found slightly below the ground surface during the field investigation at a depth ranging between 0.5 m and 0.9 m below ground surface.

4.2.2 Highway 402 and Wawanosh Drain Bridges

Report 40J16-041

A geotechnical investigation was previously carried out at the site (MTO GEOCRE Report 40J16-041) and sixteen boreholes were advanced to depths ranging from 15 m to 37 m below the ground surface at the time of the investigation.

The subsurface conditions encountered in boreholes advanced from the original ground surface (approximately Elevation 180 m) consist of fill material, organic deposit, clayey silt, and silty clay deposits. The depth of the fill material was found to vary from 2.1 to 2.7 mbgs. The fill material was found to consist of clayey silt with some coarse sand and gravel. The average natural moisture content of the fill material materials was found to be 14%. The SPT “N” values presented on the borehole records range from 9 blows to 24 blows per 0.3 m of penetration, suggesting a stiff to very stiff consistency.

The fill material was found to be underlain by a thin layer of organic deposit. The thickness of this layer is estimated to be 1.2 to 1.5 m. The SPT “N” values presented on the borehole records range from 5 blows to 15 blows per 0.3 m of penetration, suggesting a firm to stiff consistency and loose to compact relative density.

A deposit of clayey silt was encountered in the boreholes below the fill materials and the organic materials with a thickness ranging between 12.5 to 14.6 m. The SPT “N” values presented on the borehole records range from 8 blows to 53 blows per 0.3 m of penetration, suggesting a firm to hard consistency. In-situ vane shear testing was carried out in the boreholes and the undrained shear strength of the deposit varied from 24 kPa to greater than 95 kPa.

A deposit of silty clay encountered underlying the clayey silt deposit and extended down to bedrock. The thickness of this layer is estimated to be 16.5 to 18.6 m. In-situ vane shear testing was carried out in the boreholes and the undrained shear strength of the organic deposit varied from about 38 kPa to greater than 95 kPa, indicating that the cohesive deposit has a firm to hard consistency.

Shale bedrock of the Kettle Point Formation was encountered at a depth ranging between 33.0 and 36.0 mbgs (Elevation 148.6 and 146.1 m).

The groundwater level measured in the completed boreholes were found slightly below the ground surface during the field investigation at a depth ranging between 2.1 m and 2.4 m below pre-existing dykes and less than 0.3 m below pre-existing lower ground surface Elevations from 179.5 m to 179.2 m).

4.3 Subsurface Conditions – Current Investigation

Details of the subsurface soil and groundwater conditions as encountered in the boreholes advanced during the geotechnical investigation and the results of the laboratory tests carried out on selected soil samples are presented on the borehole records provided in **Appendix C**. The *Notes on Borehole and Test Pit Reports* are also included in **Appendix C** to assist in the interpretation of the borehole records. The results of the geotechnical laboratory testing are contained in **Appendix D**. The results of in-situ field tests (i.e., SPT “N” values), as presented on the borehole records and in the sub-sections of Section 4 are uncorrected.

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

In summary, the subsurface conditions at boreholes completed in the vicinity of the existing Highway 402 at Highway 40 Overpass and Highway 402 over the Wawanosh Drain bridges consist of a layer of asphalt underlain by a layer of concrete. The concrete is further underlain by granular fill consisting of gravelly sand to gravel and sand, which in turn is underlain by fill material consisting of clayey silt to sandy clayey silt. The fill material is underlain by a deposit consisting of clayey silt with interlayers of sand, in places.

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

4.3.1 Highway 402 and Highway 40 Overpass

4.3.1.1 Asphalt

Boreholes BH5-22 to BH8-22 were advanced through the eastbound and westbound lanes of Highway 402 and encountered an asphalt layer ranging in thickness from 130 mm to 220 mm.

4.3.1.2 Concrete

Underlying the asphalt in all four boreholes (BH5-22 to BH8-22), a layer of reinforced concrete was encountered, ranging in thickness from about 480 mm to 570 mm. The reinforcing steel was encountered in all boreholes at this site.

4.3.1.3 Fill

Underlying the concrete in all four boreholes (BH5-22 to BH8-22), fill material consisting of gravelly sand to gravel and sand with some fines was encountered and extended to depths ranging from 1.5 m to 3.0 m below ground surface (Elevations ranging from 185.5 m and 183.9 m).

The Standard Penetration Test (SPT) “N” values recorded within the granular fill material range from 2 blows to 45 blows per 0.3 m of penetration, indicating a very loose to dense compactness condition.

Grain size distribution testing was conducted on four (4) representative samples of the granular fill and the results are presented on Figure D-1 in **Appendix D**. The water content measured on samples of the granular fill range from approximately 4% to 7%.

The granular fill is underlain by embankment fill consisting of clayey silt to sandy clayey silt. The cohesive fill extends to depths ranging from 7.6 m to 12.2 m below ground surface (Elevations ranging from 179.3 m to 174.8 m).

The Standard Penetration Test (SPT) “N” values recorded within the cohesive fill material range from 0 blows to 18 blows per 0.3 m of penetration. In-situ vane shear testing was carried out in the boreholes and the undrained shear strength of the cohesive fill material varied from 67 kPa to greater than 100 kPa. The in-situ field vane

tests together with the SPT “N” values indicate that the cohesive fill encountered in the boreholes has a firm to very stiff consistency. The water content measured on samples of the fill range from approximately 12% to 20%.

Grain size distribution testing was conducted on four (4) representative samples of the cohesive and non-cohesive fill and the results are shown on Figure D-2 in **Appendix D**. Atterberg limits testing was carried out on ten (10) samples of the cohesive fill and the results had liquid limits ranging from about 25% to 32%, plastic limits ranging from about 13% to 17% and resulting plasticity indices of between about 11% to 15%. These results, which are plotted on a plasticity chart on Figures D-3A & D-3B in **Appendix D**, indicate that the cohesive fill consist of low plasticity clayey silt.

4.3.1.4 Clayey Silt

A cohesive deposit consisting of clayey silt was encountered beneath the cohesive fill in all of the boreholes. All boreholes terminated within the clayey silt at a depth of 12.8 m below ground surface (Elevations ranging from 174.2 m to 174.1 m).

The SPT “N” values recorded within the clayey silt deposit range from 6 blows to 22 blows per 0.3 m of penetration. In-situ vane shear testing was carried out in Borehole BH6-22 and the undrained shear strength of the clayey silt deposit was measured to be greater than 100 kPa. The in-situ field vane tests together with the SPT “N” values indicate that the cohesive deposit encountered in the boreholes has a firm to very stiff consistency. The water content measured on samples of the sandy clayey silt deposit were 13% and 21%.

Grain size distribution testing was conducted on four (4) representative samples of the deposit and the results are shown on Figure D-4 in **Appendix D**. Atterberg limits testing was carried out on five (5) samples of the deposit and the results had liquid limits ranging from about 29% to 33%, plastic limits ranging from about 15% to 18%, and resulting plasticity indices from about 13% to 16%. These results, which are plotted on a plasticity chart on Figures D-5 in **Appendix D**, indicate that the cohesive fill consist of low plasticity clayey silt.

4.3.1.5 Silty Sand (Interlayer)

An interlayer of silty sand was encountered in the clayey silt deposit within Borehole BH7-22 at a depth of 10.7 m below ground surface (Elevation 176.2 m) and extended to a depth of 12.2 m below ground surface (Elevation 174.7 m). The SPT “N” value recorded within the silty sand deposit was measured to be 10 blows per 0.3 m of penetration, suggesting a compact state of compactness. Grain size distribution testing was conducted on four (4) representative samples of the deposit and the results are shown on Figure D-6 in **Appendix D**. The water content measured on a sample of the silty sand was 15%

4.3.2 Highway 402 and Wawanosh Drain Bridges

4.3.2.1 Asphalt

Boreholes BH9-22 to BH16-22 were advanced through the eastbound and westbound lanes and shoulder of Highway 402 and encountered an asphalt layer ranging in thickness from 102 mm to 203 mm.

4.3.2.2 Concrete

Underlying the asphalt in three boreholes (BH12-22 to BH14-22), a layer of concrete was encountered, ranging in thickness from about 203 mm to 508 mm.

4.3.2.3 Fill

Underlying the concrete and asphalt in all of the boreholes, granular fill material consisting of sand to sand and gravel with some fines was encountered and extended to depths ranging from 0.8 m to 1.5 m below ground surface (Elevations ranging from 182.2 m and 181.2 m) except Boreholes BH11-22 and BH14-22, where granular fill material was not encountered.

The Standard Penetration Test (SPT) “N” values recorded within the granular fill material range from 13 blows per 0.3 m of penetration to 76 blows per 0.2 m of penetration, indicating a compact to very dense compactness condition.

Grain size distribution testing was conducted on two (2) representative samples of the granular fill and the results are presented on Figure D-7 in **Appendix D**. The water content measured on samples of the granular fill range from approximately 2% to 15%.

The granular fill is underlain by embankment fill consisting of clayey silt to sandy clayey silt. The cohesive fill extends to depths ranging from 4.6 m to 9.1 m below ground surface (Elevations ranging from 178.1 m to 173.6 m).

The Standard Penetration Test (SPT) “N” values recorded within the cohesive fill material range from 6 blows to 26 blows per 0.3 m of penetration. In-situ vane shear testing was carried out in the boreholes and the undrained shear strength of the cohesive fill material was found to be greater than 100 kPa except in BH10-22 and BH15-22 where the undrained shear test was measured to be 29 kPa and 81 kPa at a depth of 5.3 m and 6.1 m below ground surface, respectively. The in-situ field vane tests together with the SPT “N” values indicate that the cohesive encountered in the boreholes has a firm to very stiff consistency. The water content measured on samples of the cohesive fill range from approximately 6% to 28%.

Grain size distribution testing was conducted on seven (7) representative samples of the cohesive fill and the results are shown on Figure D-8 in **Appendix D**. Atterberg limits testing was carried out on fifteen (15) samples of the cohesive fill and the results had liquid limits ranging from about 24% to 31%, plastic limits ranging from about 12% to 18% and resulting plasticity indices of between about 11% to 17%. These results, which are plotted on a plasticity chart on Figures D-9A & D-9B in **Appendix D**, indicate that the cohesive fill consist of low plasticity clayey silt.

A layer of gravelly sand fill was encountered in Borehole BH15-22 at a depth of 6.9 m below ground surface (Elevation 175.8 m) and extended to a depth of 8.0 m below ground surface (Elevation 174.7 m). The SPT “N” value recorded within the gravelly sand fill was 6 blows and 14 blows per 0.3 m of penetration, suggesting a loose to compact state of compactness. Grain size distribution testing was conducted on one (1) sample of the gravelly sand shown on Figure D-10 in **Appendix D**.

4.3.2.4 Clayey Silt

A cohesive deposit consisting of clayey silt was encountered beneath the cohesive fill in all of the boreholes. All boreholes terminated within the clayey silt at a depth of 12.8 m below ground surface (between Elevation 170.1 m and 169.8 m).

The SPT “N” values recorded within the clayey silt deposit range from 0 blows to 18 blows per 0.3 m of penetration. In-situ vane shear testing was carried out in the boreholes and the undrained shear strength of the cohesive fill material varied from 57 kPa to greater than 100 kPa. The in-situ field vane tests together with the SPT “N” values indicate that the cohesive deposit encountered in the boreholes has a stiff to very stiff consistency. The water content measured on samples of the clayey silt deposit were 11% and 23%.

Grain size distribution testing was conducted on eleven (11) representative samples of the cohesive deposit and the results are shown on Figure D-11A & D-11B in **Appendix D**. Atterberg limits testing was carried out on twenty (20) samples of the deposit and the results had liquid limits ranging from about 29% to 33%, plastic limits ranging from about 14% to 18%, and resulting plasticity indices of between about 11% to 17%. These results, which are plotted on a plasticity chart on Figures D-12A, D-12B & D-12C in **Appendix D**, indicate that the cohesive deposit consist of clayey silt.

4.3.3 Groundwater

The groundwater level in the open boreholes was measured upon completion of drilling each borehole. The water levels measured in the open boreholes are summarized below in Table 4.1.

Table 4.1 Summary of Groundwater Observations

Location	Structure Number	Borehole Number	Water Level Depth (m)	Water Level Elevation (m)	Date of Observation	Remarks
Highway 402 and Highway 40 Overpass	14X-0338/B1 (Eastbound Lanes)	BH6-22	Dry		April 10, 2023	Open boreholes upon completion of drilling
		BH8-22	Dry		April 18, 2023	
	14X-0338/B2 (Westbound Lanes)	BH5-22	Dry		April 18, 2023	
		BH7-22	10.7	176.2	April 11, 2023	
Highway 402 and Wawanosh Drain Bridges	14X-0341/B1 (Eastbound Lanes)	BH13-22	Dry		April 10, 2023	
		BH14-22	10.7	172.1	April 13, 2023	
		BH15-22	Dry		April 12, 2023	
		BH16-22	Dry		April 12, 2023	
	14X-0341/B2 (Westbound Lanes)	BH9-22	10.7	172.0	April 13, 2023	
		BH10-22	Dry		April 13, 2023	
		BH11-22	Dry		April 11, 2023	
		BH12-22	Dry		April 11, 2023	

It should be noted that the groundwater level at the site will fluctuate with seasonal changes, periods of precipitation, and temperature and should be expected to be higher during wet periods of the year.

5. Closure

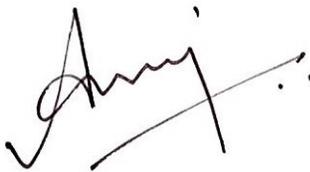
The fieldwork was supervised by Siham Hannan and Brice Zanne, E.I.T. This report was prepared by Madlool Alsabak, E.I.T, and Anuj Choudhari, M.Sc., P.Eng., P.E. Sandra McGaghran, M.Eng., P.Eng., a Senior Geotechnical Engineer with GHD and MTO Foundations Designated Contact conducted a separate independent review of the report.

Sincerely,

GHD Limited



Madlool Alsabak, B.Eng.
Geotechnical Engineer-in-Training



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



Sandra McGaghran, M.Eng., P.Eng.
MTO Foundations Designated Contact, Senior Geotechnical Engineer





PART B

FOUNDATION DESIGN REPORT

**TEMPORARY PROTECTION SYSTEM, HIGHWAY 402 (EASTBOUND AND WESTBOUND) AT HIGHWAY
40 OVERPASS AND WAWANOSH DRAIN BRIDGE STRUCTURES, CITY OF SARNIA, ONTARIO
MTO, GWP 3106-18-00**

6. Discussion and Engineering Recommendations

This section of the report provides geotechnical design recommendations for the proposed temporary protection systems required for rehabilitation and conversion to semi-integral abutments of four bridge structures as described below, located in the City of Sarnia, Ontario, under GWP 3106-18-00.

- Two bridge structures on Highway 402 at Highway 40 (Modeland Rd.) Overpass eastbound (EB) and westbound (WB) (Site Numbers 14X-0338/B1 and 14X-0338/B2, respectively).
- Two bridge structures on Highway 402 over the Wawanosh Drain EB & WB (Site Numbers 14X-0341/B1 and 14X-0341/B2, respectively).

The discussion and engineering recommendations are based on the interpretation of the factual data obtained from the boreholes advanced during the previous and current subsurface investigations. These recommendations presented are intended to provide the designers with sufficient information to assess the feasible foundation alternatives, and to develop approximate costs for the temporary protection systems. This report is intended for the use of the Ministry of Transportation, Ontario (MTO) for the purpose of designing temporary protection systems at above-mentioned structures. It shall not be relied upon for any other purpose or by any other parties, including construction or design-build contractor used for any other purposes or locations, or by any other parties including the construction or design-build contractor. The contractor must make their own interpretation based on the factual data in Part A (Foundation Investigation) of the report. Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project. Those requiring information on the aspects of construction must make their own interpretation of the factual information provided, as such interpretation may affect equipment selection, proposed construction methods, scheduling, and the like.

The proposed rehabilitation of the overpass and bridge structures will include conversion of the existing conventional abutments to semi-integral abutments, which will require removal of existing crash barrier walls and associated structural connections, along with the full depth removal of asphalt and reinforced concrete approach slabs. Protection systems are required to facilitate the excavations through asphalt, approach slab, granular fill, and upper portion of the clayey silt fill material while maintaining traffic on Highway 402. Although the geometry and design of the protection system is the responsibility of the contractor, based on the 60% design drawings prepared by GHD's structural team, it is anticipated that the temporary protection systems will extend parallel to Highway 402 in stages for driving and overpassing lanes at the overpass and bridge structures.

6.1 Excavation and Groundwater Control

It is understood that the excavations for the rehabilitation of the overpass and bridge structures will extend below Highway 402 grade at Highway 40 to an approximate depth of about 2 m below ground surface (Elevation 185 m at Highway 402/40 and Elevation 181 m at Wawanosh Drain). Proposed excavations will require removal of the asphalt, existing approach slab concrete, granular fill, and upper portion of the cohesive fill material. Excavations for the installation of temporary protection systems should be carried out in accordance with the current Ontario Regulation 213/91 and the Occupational Health and Safety Act and Regulations for Construction Projects (OHSA). According to OHSA, the soil classification and corresponding excavation side slopes for the existing fill and native soils to be removed are summarized below in Table 6.1:

Table 6.1 OHSO Soil Classification and Maximum Excavation Side Slopes

Soil Description	Above / Below Groundwater	OHSO Soil Type	Maximum Excavation Side Slopes
Granular Fill Material	Above	Type 3	1H:1V
	Below	Type 4	3H:1V
Cohesive Fill Material	Above	Type 3	1H:1V
	Below	Type 4	3H:1V

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

During construction, stockpiles/equipment/materials should be located a minimum distance of 1.5 m from the top of the excavation or a distance equal to the depth of the excavation, whichever is greater; stockpile heights should be controlled to prevent surcharging the sides of the excavation and/or overall slope. Care must also be taken during excavation to ensure that adequate support is provided for any existing structures, roadways and underground services located adjacent to the excavations. Temporary excavations (i.e., those which are open for a relatively short time period) should be made with side slopes no steeper than 1 horizontal to 1 vertical (1H:1V) in Type 3 soil. Depending upon the construction procedures adopted by the contractor and the weather conditions at the time of construction, some local flattening of the slopes could be required.

Groundwater observations and measurements were obtained from open boreholes during and upon completion of the drilling operations. Water levels upon completion of the drilling were measured at a depth of 10.7 mbgs (Elevation 176.2 m at Highway 40 and Elevations ranging from 172.1 m to 172.0 m at Wawanosh Drain). Generally, groundwater levels are high during the time of snow melting in spring and heavy rains in summer. Based on the groundwater conditions observed, the anticipated excavation depths for the proposed construction and the properties of the soils encountered, significant groundwater seepage is not expected into open excavations during the construction. Depending on rainfall events immediately prior to construction there may be some perched water within the granular fill material above the cohesive fill. It is anticipated that any groundwater seepage into short-term excavations will be able to be handled using sumps and filtered pumps. Should any excavations require more intensive groundwater control, the use of filtered sumps, or other suitable method of dewatering and/or sheet piling is recommended.

6.2 Temporary Protection Systems

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

It is anticipated that a driven interlocking sheet pile system would be suitable and constructible as the Standard Penetration Test (SPT) “N” values in the granular and cohesive fill are generally less than about 30 blows per 0.3 m of penetration, except at the locations of Boreholes BH6-22, BH9-22 and BH10-22, where SPT “N” values ranging from 45 blows per 0.3 m penetration to 76 blows for 0.2 m penetration were recorded in the granular fill material; however given that there is limited thickness of this dense to very dense fill material the sheet pile system may be successfully installed. Alternatively, a soldier pile and lagging system in conjunction with a sheet pile system is also feasible (i.e., in areas where adequate penetration can be achieved), but it would be necessary to include measures to control any seepage from behind the lagging panels if perched groundwater conditions are present at the time of construction and where the excavation extends below the water table or perched groundwater table. A comparison of various temporary protection system options including advantages, disadvantages, relative costs, and risks/consequences have been provided below in Table 6.2:

Table 6.2 Comparison of Temporary Protection System Options

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

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

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

Table 6.3 Lateral Earth Pressure Coefficients and Soil Parameters for Design

Materials/soils	Bulk Unit Weight (kN/m ³)	Angle of Internal Friction, θ (degrees)	Undrained Shear Strength S_u (KPa)	Coefficient of Lateral Earth Pressure		
				Active (K_a)	At-rest (K_0)	Passive (K_p)
Granular Fill Material (Very loose to loose)	19	30	--	0.30	0.50	3.00
Granular Fill Material (Compact to dense)	20	32	--	0.31	0.47	3.25
Cohesive Fill Material Clayey Silt (Very soft to firm)	19	28	50	0.36	0.53	3.00
Cohesive Fill Material Clayey Silt (Stiff to very stiff)	20	30	100	0.33	0.50	3.00
Native Clayey Silt Deposit (Firm to very stiff)	20	30	80	0.33	0.50	3.00

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

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

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

6.3 Obstructions During Installation of Temporary Protection Systems

It is anticipated that wood/timber fragments, cobble and/or boulder size materials may be encountered within the granular and cohesive fill material and within the cohesive deposit underlying the fill material while installing the temporary protection systems. The presence of these obstructions may affect the installation of protection system elements. It is recommended that a Notice to Contractor be included in the Contract Documents to warn the Contractor of the possible presence of cobbles and/or boulders within the overburden soils; a Notice to Contractor is provided in **Appendix E**.

7. Closure

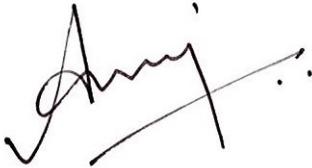
This report was prepared by Madlool Alsabak, E.I.T, and Anuj Choudhari, M.Sc., P.Eng., P.E. Sandra McGaghran, M.Eng., P.Eng., a Senior Geotechnical Engineer with GHD and MTO Foundations Designated Contact conducted a separate independent review of the report.

Sincerely,

GHD Limited



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Geotechnical Engineer-in-Training



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Intermediate Geotechnical Engineer



Sandra McGaghran, M.Eng., P.Eng.
MTO Foundations Designated Contact, Senior Geotechnical Engineer



References

Canadian Geotechnical Society. 2006. Canadian Foundation Engineering Manual (CFEM), 4th Edition. The Canadian Geotechnical Society, BiTech Publisher Ltd., British Columbia.

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

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Kulhawy, F.H. and Mayne, P.W. 1990. Manual on Estimating Soil Properties for Foundation Design. EL6800, Research Project 14936. Prepared for Electric Power Research Institute, Palo Alto, California, U.S

ASTM International:

ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

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

Ontario Provincial Standard Specification:

OPSS.PROV 539 Construction Specification for Temporary Protection Systems

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

Ontario Water Resources Act:

Ontario Regulation 903 Wells (as amended)

Ontario Occupational Health and Safety Act:

Ontario Regulation 213/91 Construction Projects (as amended)

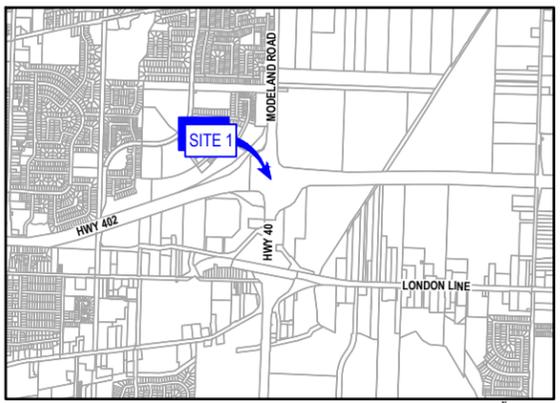
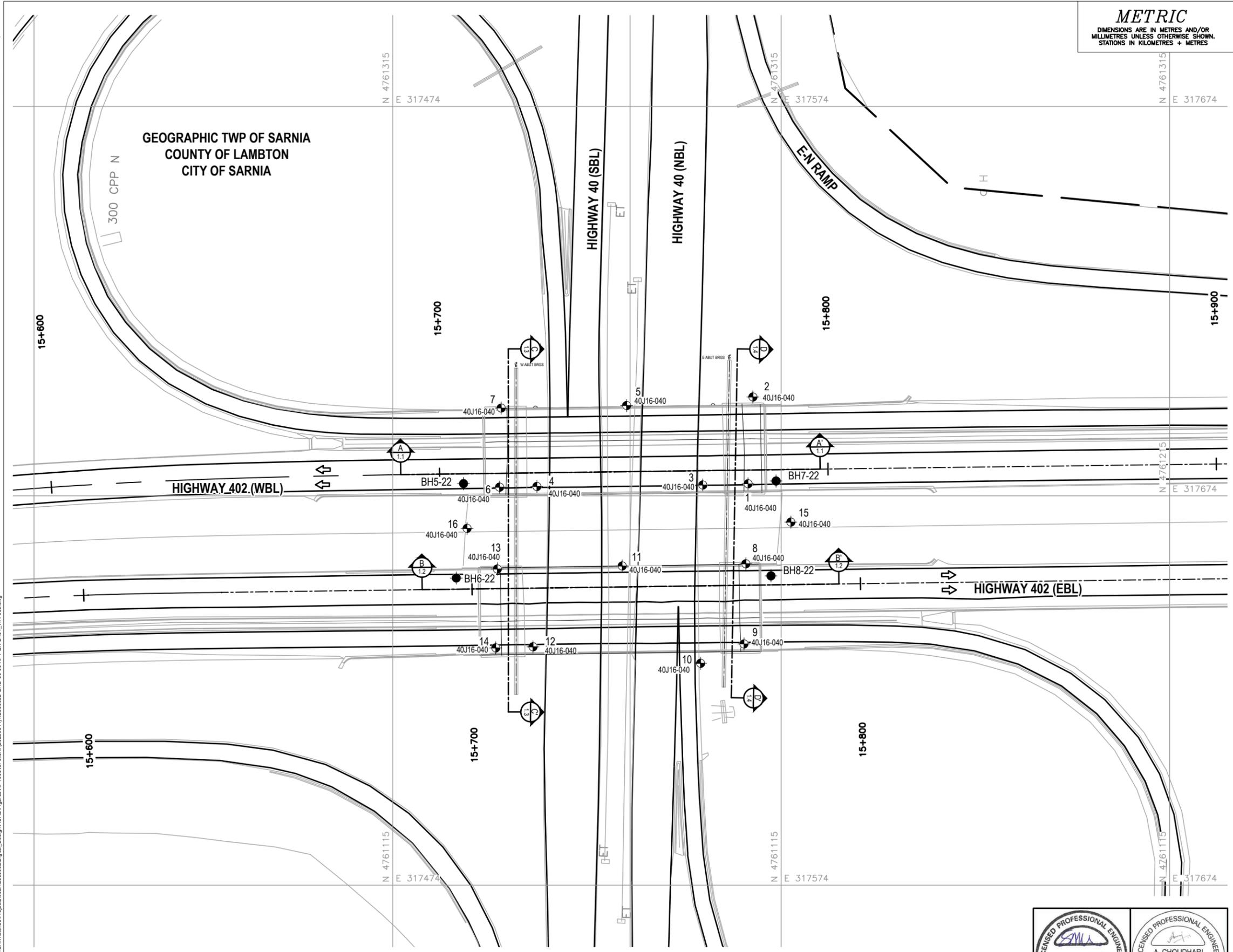
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 MILLIMETRES UNLESS OTHERWISE SHOWN.
 STATIONS IN KILOMETRES + METRES

CONT No.
GWP No. 3106-18-00

HWY 402 / HWY 40 OVERPASS
 BOREHOLE LOCATIONS




SHEET



KEY PLAN
 SCALE 0 375 750 1500 m

LEGEND

- Borehole Location
- Borehole Location Geocres No. 40J16-040

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	Elevation	Northing	Easting
BH5-22	187.0	4761218.1	317492.3
BH6-22	186.9	4761193.9	317490.5
BH7-22	186.9	4761218.8	317572.8
BH8-22	186.9	4761194.5	317571.5
1-40J16-040	180.2	4761218.1	317565.6
2-40J16-040	179.9	4761240.4	317566.9
3-40J16-040	180.6	4761217.8	317553.9
4-40J16-040	179.4	4761217.4	317511.2
5-40J16-040	179.0	4761238.2	317534.4
6-40J16-040	179.5	4761217.2	317501.6
7-40J16-040	179.4	4761237.5	317502.1
8-40J16-040	180.1	4761197.6	317565.0
9-40J16-040	180.1	4761177.0	317564.6
10-40J16-040	180.5	4761172.0	317553.4
11-40J16-040	179.0	4761197.0	317533.2
12-40J16-040	179.5	4761176.2	317510.2
13-40J16-040	179.4	4761196.2	317501.1
14-40J16-040	179.5	4761176.0	317500.7
15-40J16-040	179.8	4761208.3	317576.6
16-40J16-040	179.7	4761206.7	317493.3

NOTES

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The boreholes shown in profile from GEOCREs 40J16-040 are approximate.

Boreholes from GEOCREs 40J16-040 were advanced prior to construction of the overpass.

REFERENCE

Base plans provide in digital format by CALLON DIETZ, drawing file: 402SAR.dwg, received on October 31, 2022.

NO.	DATE	BY	REVISION

Geocres No.: 40J16-095

HWY. 402	PROJECT NO. 12566052	DIST. WEST
SUBM'D. MA	CHKD. AC	DATE: 9.18.2023
DRAWN: AW	CHKD. SMM	APPD. SMM
		SITE: 14X-0338/B1 and 14X-0338/B2
		DWG. 1

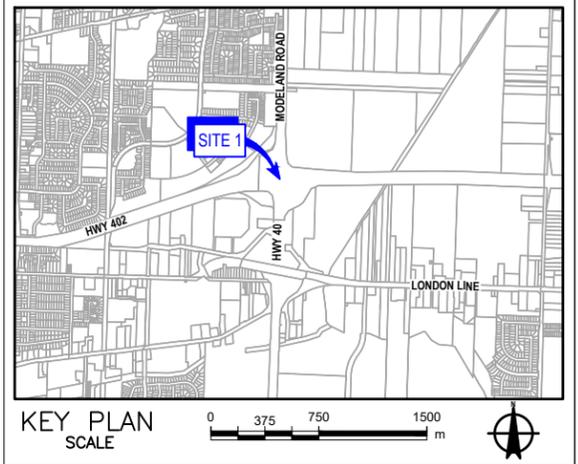
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METRIC
 DIMENSIONS ARE IN METRES AND/OR
 MILLIMETRES UNLESS OTHERWISE SHOWN.
 STATIONS IN KILOMETRES + METRES

CONT No.
 GWP No. 3106-18-00

HWY 402 / HWY 40 OVERPASS
 SOIL STRATA

SHEET



LEGEND

- Borehole Location
- Borehole Location
Geocres No. 40J16-040
- N** Standard Penetration Test Value
- 16** Blows/0.3 m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- REC/%** Recovery

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	Elevation	Northing	Easting
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5-40J16-040	179.0	4761238.2	317534.4
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12-40J16-040	179.5	4761176.2	317579.2
13-40J16-040	179.4	4761196.2	317501.1
14-40J16-040	179.5	4761176.0	317500.7
15-40J16-040	179.8	4761208.3	317576.6
16-40J16-040	179.7	4761206.7	317496.3

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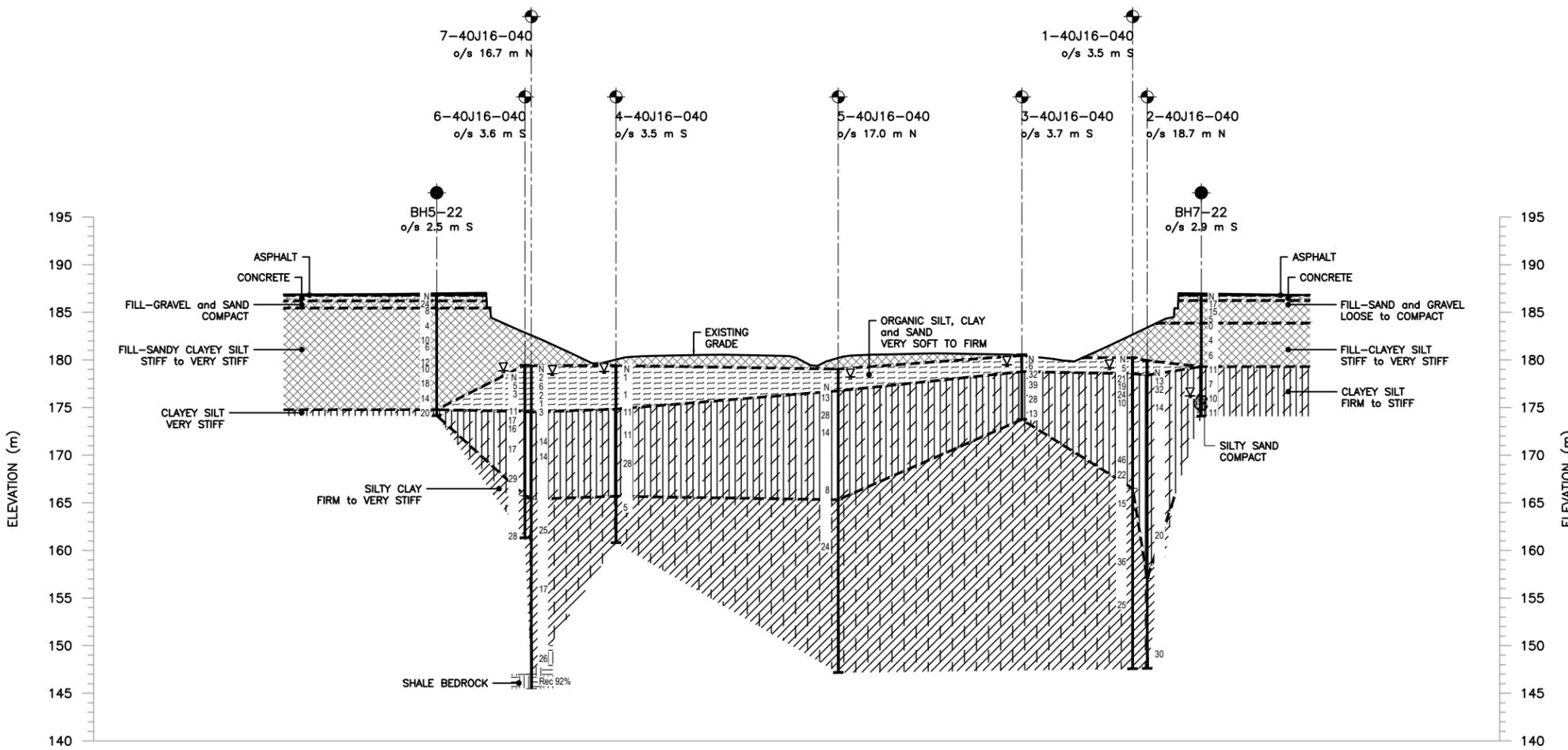
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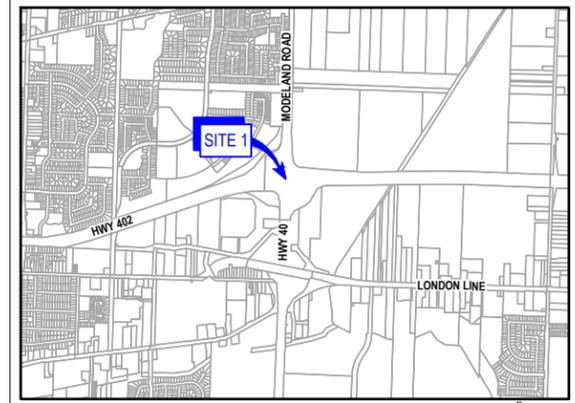
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NO.	DATE	BY	REVISION

Geocres No.: 40J16-095

HWY. 402	PROJECT NO. 12566052	DIST. WEST
SUBMD. MA	CHKD. AC	DATE: 9.18.2023
DRAWN: AW	CHKD. SMM	APPD. SMM





LEGEND

- Borehole Location
- Borehole Location
Geocres No. 40J16-040
- N Standard Penetration Test Value
- 16 Blows/0.3 m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- REC/% Recovery

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13-40J16-040	179.4	4761196.2	317501.1
14-40J16-040	179.5	4761176.0	317500.7
15-40J16-040	179.8	4761208.3	317576.6
16-40J16-040	179.7	4761206.7	317496.3

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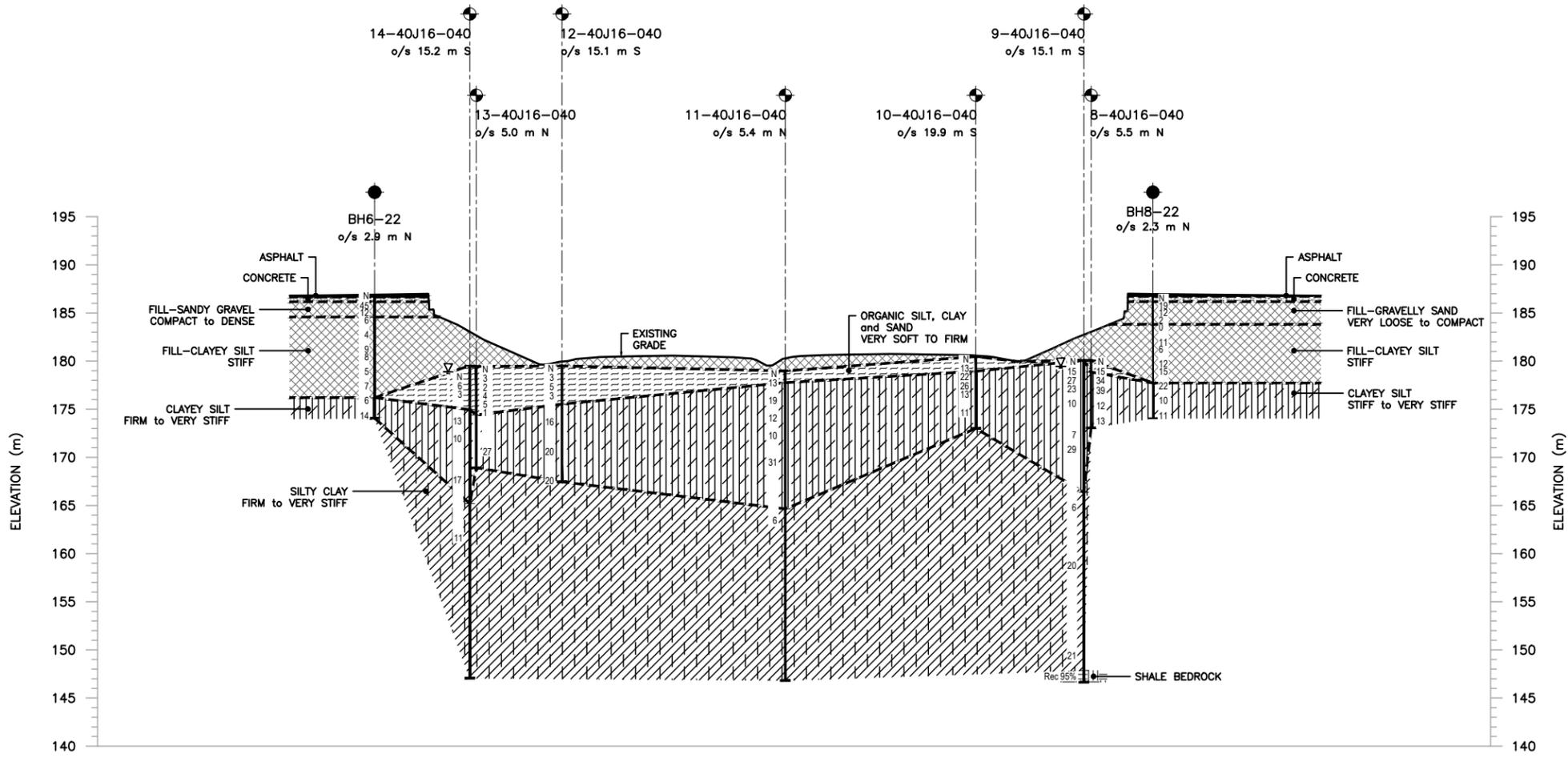
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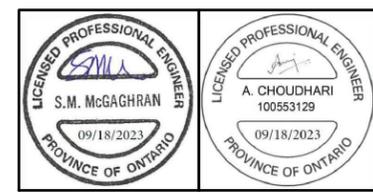
NO.	DATE	BY	REVISION

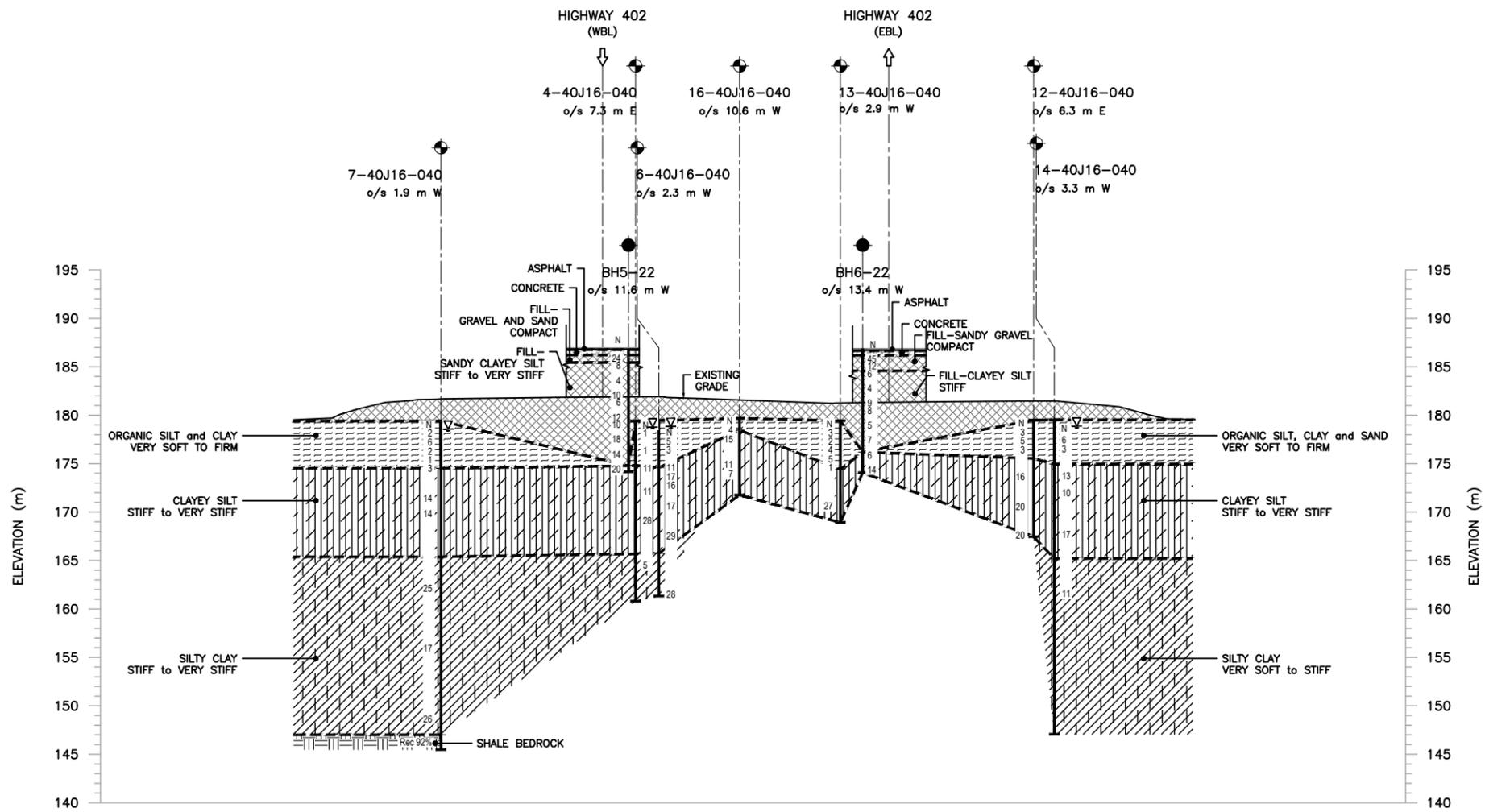
Geocres No.: 40J16-095

HWY. 402	PROJECT NO. 12566052	DIST. WEST
SUBMD. MA	CHKD. AC	DATE: 9.18.2023
DRAWN: AW	CHKD. SMM	APPD. SMM

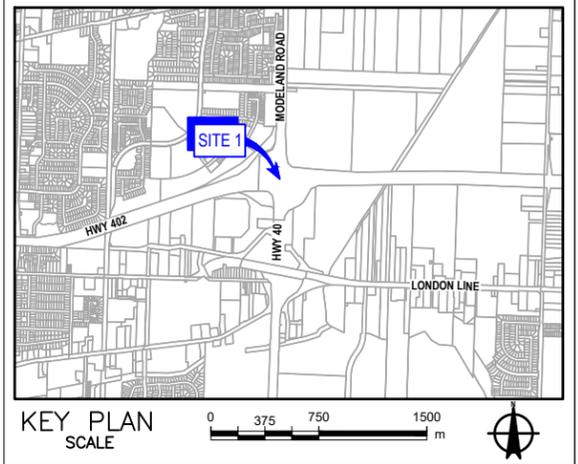


PROFILE B-B'





CROSS SECTION C-C'



LEGEND

- Borehole Location
- Borehole Location Geocres No. 40J16-040
- N** Standard Penetration Test Value
- 16** Blows/0.3 m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- REC/%** Recovery

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	Elevation	Northing	Easting
BH5-22	187.0	4761218.1	317492.3
BH6-22	186.9	4761193.9	317490.5
BH7-22	186.5	4761218.8	317572.8
BH8-22	186.9	4761194.5	317571.5
1-40J16-040	180.2	4761218.1	317565.6
2-40J16-040	179.9	4761240.4	317566.9
3-40J16-040	180.6	4761217.4	317558.9
4-40J16-040	179.4	4761217.4	317611.2
5-40J16-040	179.0	4761238.2	317534.4
6-40J16-040	179.5	4761217.2	317507.6
7-40J16-040	179.4	4761237.5	317502.1
8-40J16-040	180.1	4761197.6	317565.0
9-40J16-040	180.1	4761177.9	317564.6
10-40J16-040	180.3	4761172.0	317634.4
11-40J16-040	179.0	4761197.0	317533.2
12-40J16-040	179.5	4761176.2	317579.2
13-40J16-040	179.4	4761196.2	317501.1
14-40J16-040	179.5	4761176.0	317500.7
15-40J16-040	179.8	4761208.3	317576.6
16-40J16-040	179.7	4761206.7	317496.3

NOTES

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Boreholes from GEOCREs 40J16-040 were advanced prior to construction of the overpass.

REFERENCE

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NO.	DATE	BY	REVISION

Geocres No.: 40J16-095

HWY. 402	PROJECT NO. 12566052	DIST. WEST
SUBM'D. MA	CHKD. AC	DATE: 9.18.2023
DRAWN: AW	CHKD. SMM	APPD. SMM
		SITE: 14X-0338/B1 and 14X-0338/B2
		DWG. 4



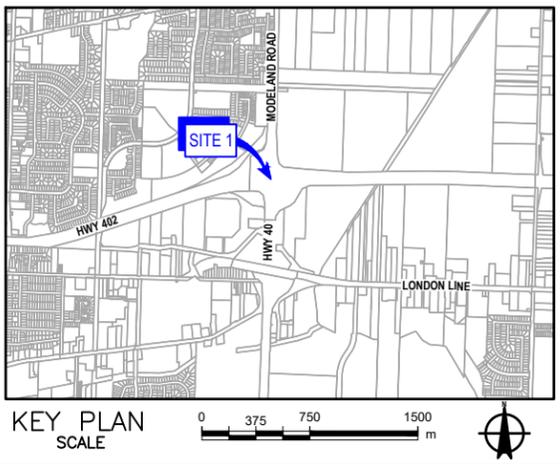
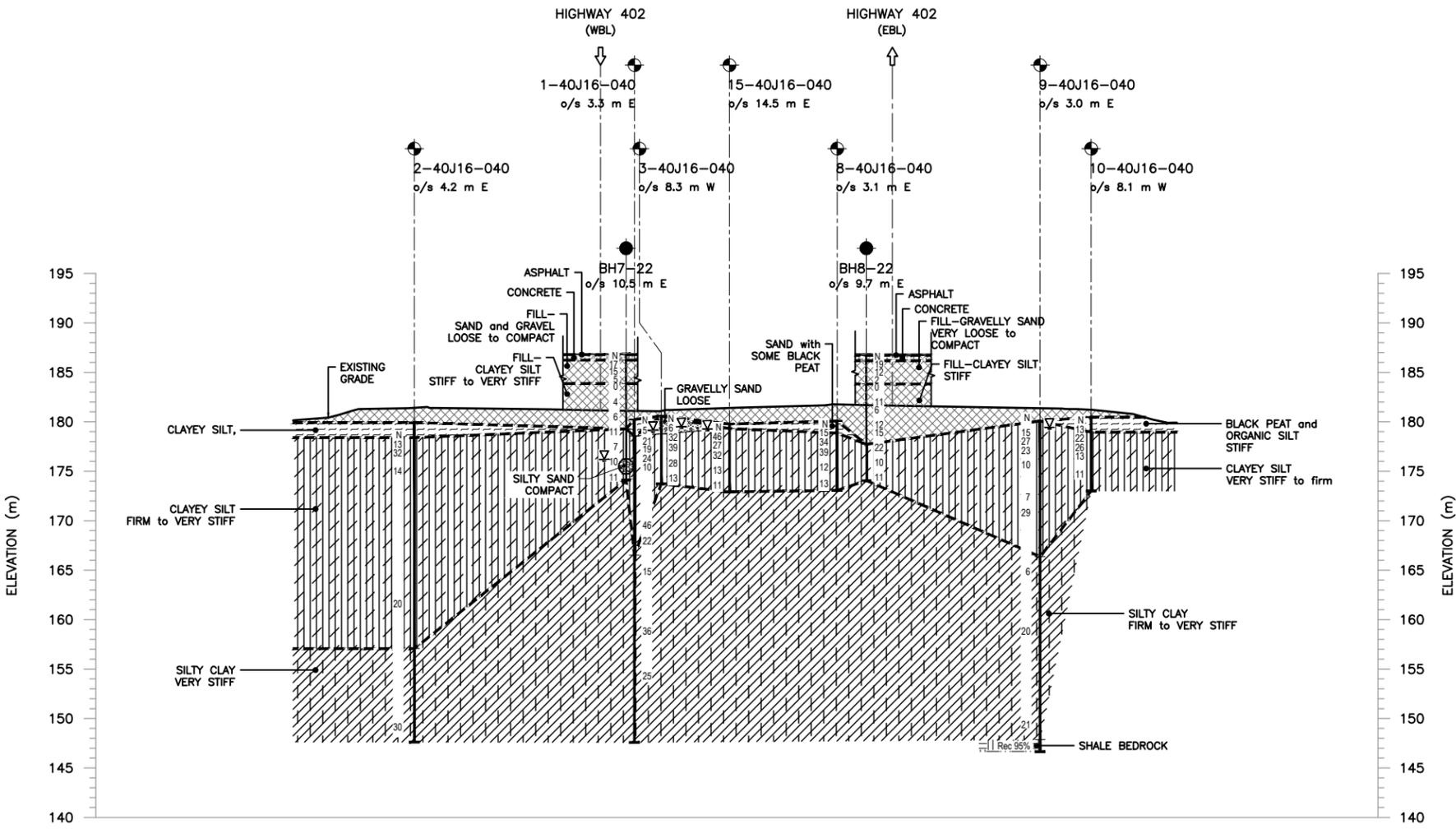
METRIC
 DIMENSIONS ARE IN METRES AND/OR
 MILLIMETRES UNLESS OTHERWISE SHOWN.
 STATIONS IN KILOMETRES + METRES

CONT No.
 GWP No. 3106-18-00

HWY 402 / HWY 40 OVERPASS
 SOIL STRATA




SHEET



LEGEND

- Borehole Location
- Borehole Location
Geocres No. 40J16-040
- Standard Penetration Test Value
- Blows/0.3 m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- REC/%
Recovery

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	Elevation	Northing	Easting
BH5-22	187.0	4761218.1	317492.3
BH6-22	186.9	4761193.9	317490.5
BH7-22	186.5	4761218.8	317572.8
BH8-22	186.9	4761194.5	317491.5
1-40J16-040	180.2	4761218.1	317565.6
2-40J16-040	179.9	4761240.4	317566.9
3-40J16-040	180.6	4761217.4	317558.9
4-40J16-040	179.4	4761217.4	317611.2
5-40J16-040	179.0	4761238.2	317534.4
6-40J16-040	179.9	4761217.2	317501.6
7-40J16-040	179.4	4761237.5	317502.1
8-40J16-040	180.1	4761197.6	317565.0
9-40J16-040	180.1	4761177.6	317566.6
10-40J16-040	180.3	4761172.0	317553.4
11-40J16-040	179.0	4761197.0	317533.2
12-40J16-040	178.5	4761176.2	317519.2
13-40J16-040	179.4	4761196.2	317501.1
14-40J16-040	178.5	4761176.0	317500.7
15-40J16-040	178.8	4761208.3	317526.6
16-40J16-040	179.7	4761206.7	317496.3



NOTES

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NO.	DATE	BY	REVISION

Geocres No.: 40J16-095

HWY. 402	PROJECT NO. 12566052	DIST. WEST
SUBM'D. MA	CHKD. AC	DATE: 9.18.2023
DRAWN: AW	CHKD. SMM	APPD. SMM

METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES

CONT No.
GWP No. 3106-18-00

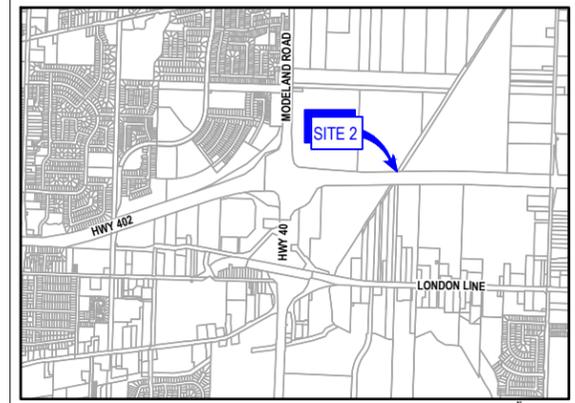


CON 7
LOT 14

HWY 402 / WAWANOSH DRAIN BRIDGE
BOREHOLE LOCATIONS



GEOGRAPHIC TWP OF SARNIA
COUNTY OF LAMBTON
CITY OF SARNIA



KEY PLAN
SCALE 0 375 750 1500 m

LEGEND

- Borehole Location
- Borehole Location
- Geocres No. 40J16-041

BOREHOLE CO-ORDINATES
(MTM ZONE 11)

NO	Elevation	Northing	Easting
BH9-22	182.7	4761242.2	318284.3
BH10-22	182.6	4761241.6	318331.5
BH11-22	182.8	4761227.7	318269.8
BH12-22	182.6	4761229.0	318336.8
BH13-22	182.9	4761205.1	318257.5
BH14-22	182.8	4761204.5	318308.9
BH15-22	182.7	4761194.5	318237.6
BH16-22	182.7	4761196.8	318317.8
1-40J16-041	182.1	4761229.2	318282.9
2-40J16-041	182.4	4761216.6	318274.3
3-40J16-041	182.0	4761228.1	318319.8
4-40J16-041	182.1	4761215.4	318312.3
5-40J16-041	182.2	4761247.5	318292.9
6-40J16-041	181.8	4761243.7	318327.5
7-40J16-041	182.0	4761195.2	318297.1
8-40J16-041	181.7	4761194.0	318261.6
9-40J16-041	179.5	4761217.5	318332.1
10-40J16-041	179.8	4761216.5	318264.2

NOTES

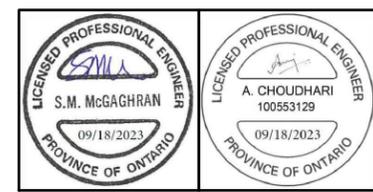
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REFERENCE

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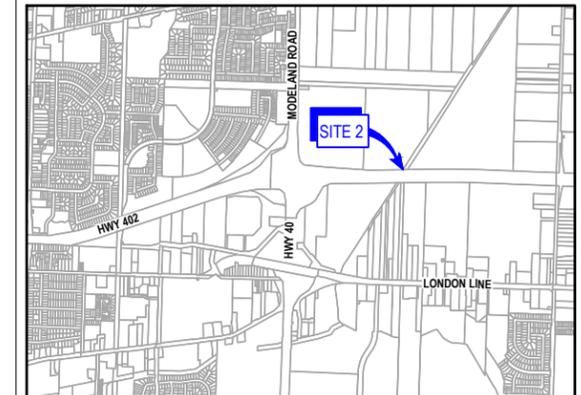
NO.	DATE	BY	REVISION

Geocres No.: 40J16-095			
HWY. 402	PROJECT NO. 12566052	DIST. WEST	
SUBM'D. MA	CHKD. AC	DATE: 9.18.2023	SITE: 14X-0341/B1 and 14X-0341/B2
DRAWN: AW	CHKD. SMM	APPD. SMM	DWG. 6

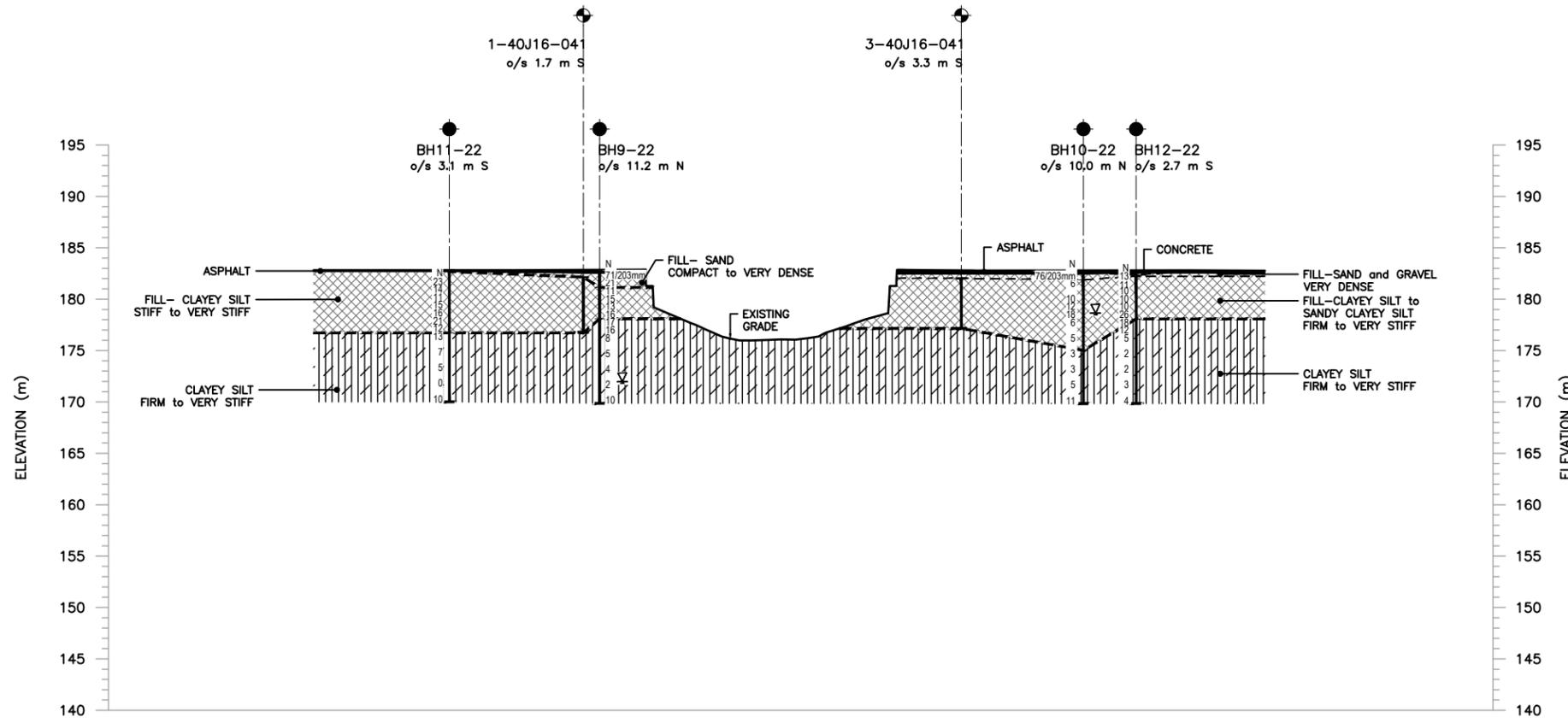


PLAN SCALE 0 7.5 15 30 Meters

CON 7
LOT 14



KEY PLAN
 SCALE 0 375 750 1500 m



PROFILE E-E'



LEGEND

- Borehole Location
- Borehole Location
Geocres No. 40J16-041
- Standard Penetration Test Value
- Blows/0.3 m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling

BOREHOLE CO-ORDINATES
 (MTM ZONE 11)

NO	Elevation	Northing	Easting
BH9-22	182.7	4761242.2	318284.3
BH10-22	182.6	4761241.6	318331.5
BH11-22	182.8	4761227.7	318269.8
BH12-22	182.6	4761229.0	318356.8
BH15-22	182.9	4761205.1	318292.5
BH14-22	182.8	4761204.5	318308.9
BH15-22	182.7	4761194.5	318297.6
BH16-22	182.7	4761196.8	318311.8
1-40J16-041	182.1	4761228.2	318292.9
2-40J16-041	182.4	4761216.6	318274.3
3-40J16-041	182.0	4761228.1	318319.8
4-40J16-041	182.1	4761215.4	318312.3
5-40J16-041	182.2	4761247.5	318292.9
6-40J16-041	181.8	4761243.7	318327.5
7-40J16-041	182.0	4761195.5	318297.1
8-40J16-041	181.7	4761194.0	318291.6
9-40J16-041	179.5	4761217.5	318332.1
10-40J16-041	179.8	4761216.5	318264.2

NOTES

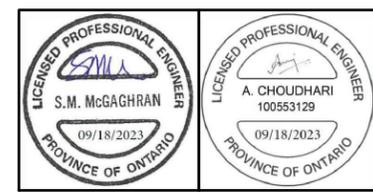
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REFERENCE

Base plans provide in digital format by CALLON DIETZ, drawing file: 402SAR.dwg, received on October 31, 2022.



NO.	DATE	BY	REVISION

Geocres No.: 40J16-095

HWY. 402	PROJECT NO. 12566052	DIST. WEST
SUBM'D. MA	CHKD. AC	DATE: 9.18.2023
DRAWN: AW	CHKD. SMM	APPD. SMM

METRIC
 DIMENSIONS ARE IN METRES AND/OR
 MILLIMETRES UNLESS OTHERWISE SHOWN.
 STATIONS IN KILOMETRES + METRES

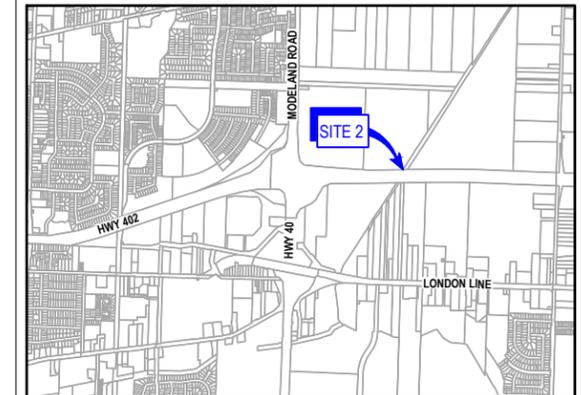
CONT No.
 GWP No. 3106-18-00



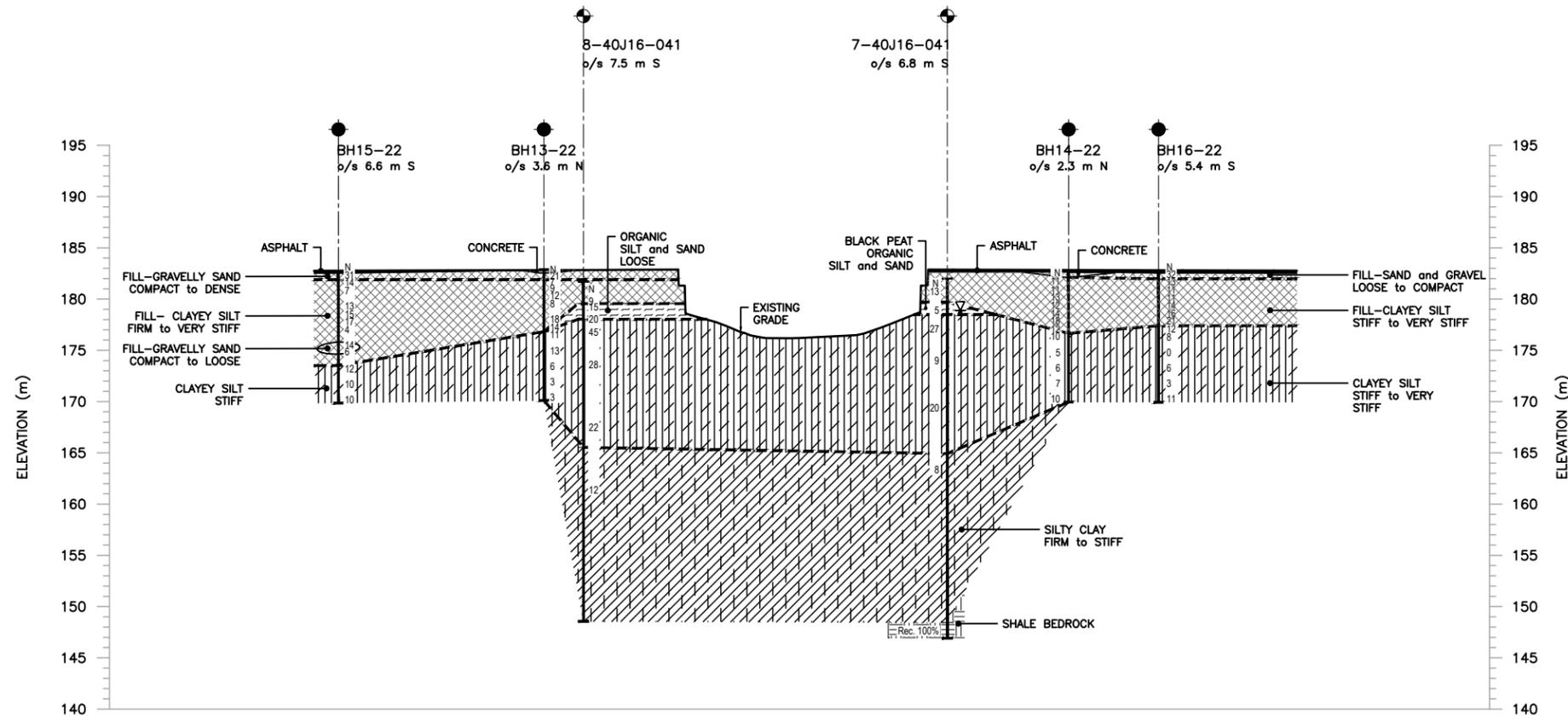
HWY 402 / WAWANOSH DRAIN BRIDGE

SHEET

SOIL STRATA



KEY PLAN
 SCALE 0 375 750 1500 m



PROFILE F-F'



LEGEND

- Borehole Location
- Borehole Location
Geocres No. 40J16-041
- Standard Penetration Test Value
- Blows/0.3 m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- Recovery

BOREHOLE CO-ORDINATES
 (MTM ZONE 11)

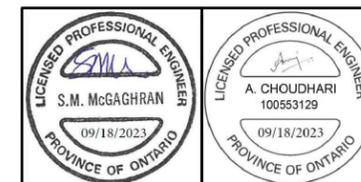
NO	Elevation	Northing	Easting
BH5-22	182.7	4761242.2	318284.3
BH10-22	182.6	4761241.6	318331.5
BH11-22	182.8	4761227.7	318269.8
BH12-22	182.6	4761225.0	318356.8
BH13-22	182.9	4761205.1	318292.5
BH14-22	182.8	4761204.5	318308.9
BH15-22	182.7	4761194.5	318297.6
BH16-22	182.7	4761186.9	318317.8
1-40J16-041	182.1	4761228.2	318292.9
2-40J16-041	182.4	4761216.6	318274.3
3-40J16-041	182.0	4761228.1	318319.8
4-40J16-041	182.1	4761215.4	318312.3
5-40J16-041	182.2	4761247.5	318292.9
6-40J16-041	181.8	4761243.7	318327.5
7-40J16-041	182.0	4761196.5	318297.1
8-40J16-041	181.7	4761194.0	318291.6
9-40J16-041	179.5	4761217.5	318332.1
10-40J16-041	179.8	4761216.5	318264.2

NOTES

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REFERENCE

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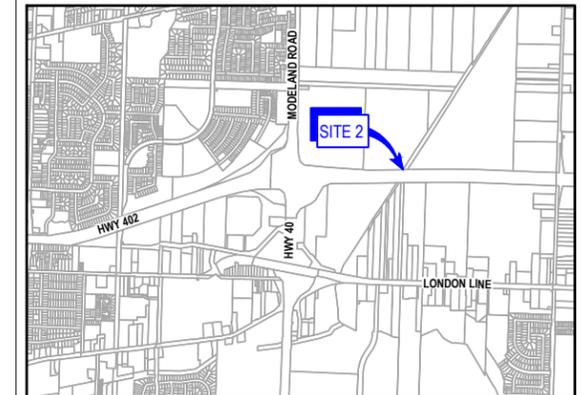


NO.	DATE	BY	REVISION

Geocres No.: 40J16-095

HWY. 402	PROJECT NO. 12566052	DIST. WEST
SUBMD. MA	CHKD. AC	DATE: 9.18.2023
DRAWN: AW	CHKD. SMM	APPD. SMM

SITE: 14X-0341/B1 and 14X-0341/B2
 DWG. 8



KEY PLAN
 SCALE 0 375 750 1500 m

LEGEND

- Borehole Location
- Borehole Location
Geocres No. 40J16-041
- Standard Penetration Test Value
- Blows/0.3 m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- Recovery

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	Elevation	Northing	Easting
BH9-22	182.7	4761242.2	318284.3
BH10-22	182.6	4761241.6	318331.5
BH11-22	182.8	4761227.7	318269.8
BH12-22	182.6	4761225.0	318356.8
BH13-22	182.9	4761205.1	318292.5
BH14-22	182.8	4761204.5	318308.9
BH15-22	182.7	4761194.5	318237.6
BH16-22	182.7	4761186.9	318317.8
1-40J16-041	182.1	4761228.2	318292.9
2-40J16-041	182.4	4761216.6	318274.3
3-40J16-041	182.0	4761228.1	318319.8
4-40J16-041	182.1	4761215.4	318312.3
5-40J16-041	182.2	4761247.5	318292.9
6-40J16-041	181.8	4761243.7	318327.5
7-40J16-041	182.0	4761196.5	318297.1
8-40J16-041	181.7	4761194.0	318261.6
9-40J16-041	179.5	4761217.5	318332.1
10-40J16-041	179.8	4761216.5	318264.2

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Boreholes from GEOCREs 40J16-041 were advanced prior to construction of the bridge.

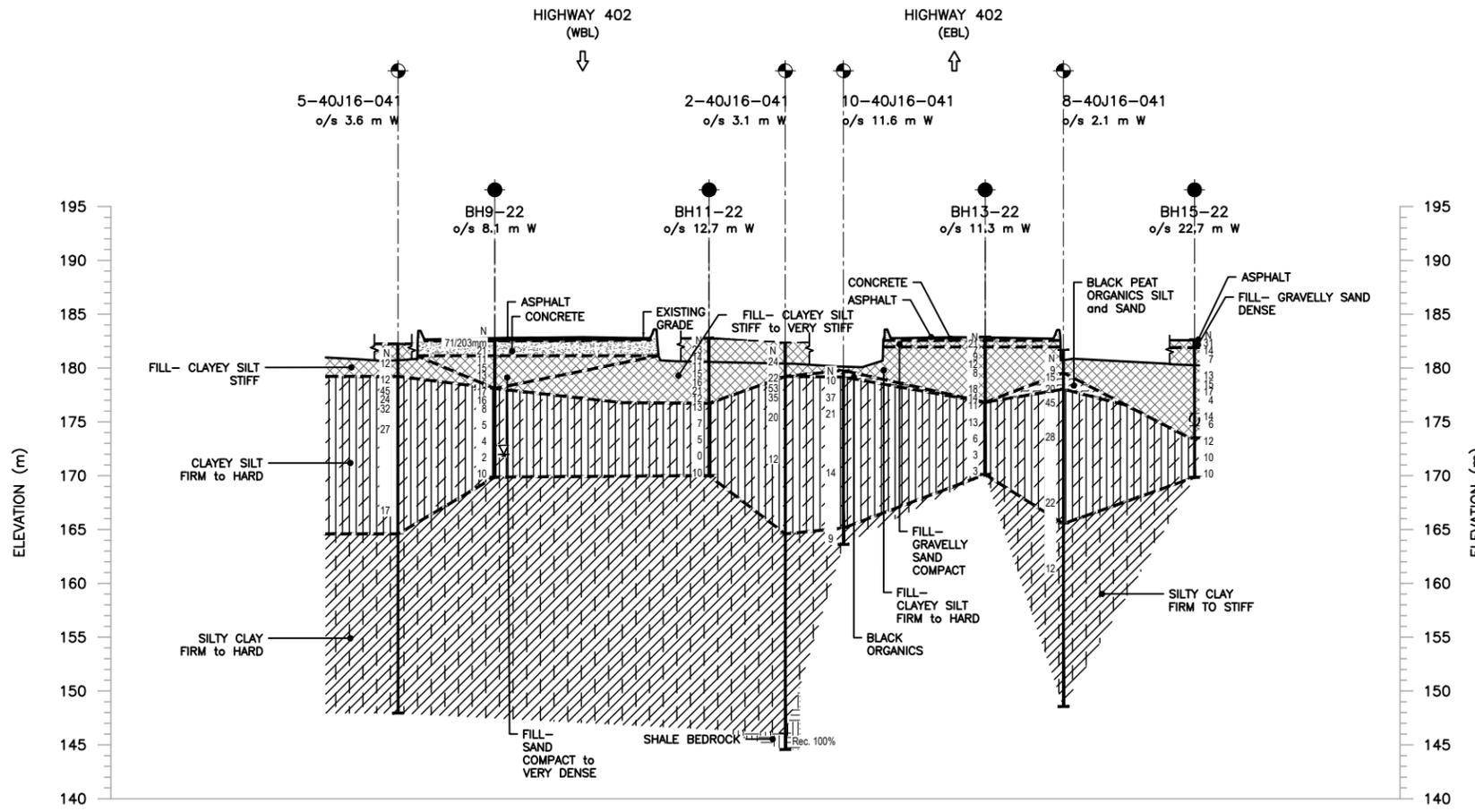
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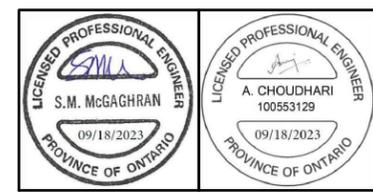
NO.	DATE	BY	REVISION

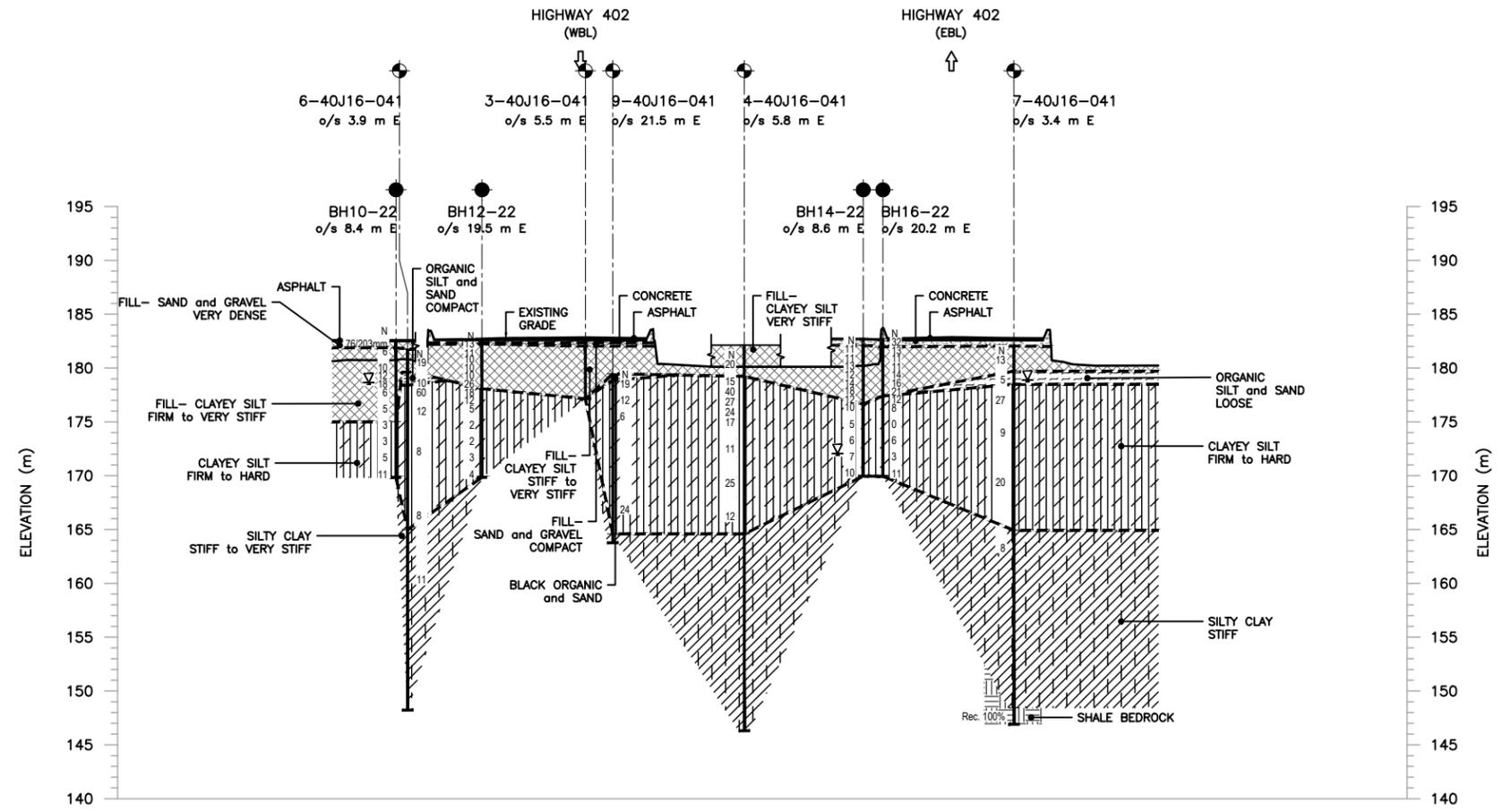
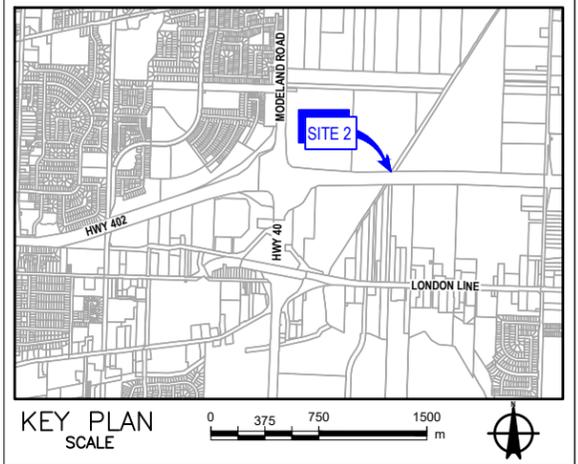
Geocres No.: 40J16-095

HWY. 402	PROJECT NO. 12566052	DIST. WEST
SUBMD. MA	CHKD. AC	DATE: 9.18.2023
DRAWN: AW	CHKD. SMM	APPD. SMM



CROSS SECTION G-G'





CROSS SECTION H-H'



LEGEND

-  Borehole Location
-  Borehole Location
Geocres No. 40J16-041
- N** Standard Penetration Test Value
- 16** Blows/0.3 m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
-  WL upon completion of drilling
- REC/%** Recovery

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	Elevation	Northing	Easting
BH5-22	182.7	4761242.2	318284.3
BH10-22	182.6	4761241.6	318331.5
BH11-22	182.8	4761227.7	318269.8
BH12-22	182.6	4761225.0	318356.8
BH13-22	182.9	4761205.1	318292.5
BH14-22	182.8	4761204.5	318308.9
BH15-22	182.7	4761194.5	318297.6
BH16-22	182.7	4761186.9	318311.8
1-40J16-041	182.1	4761228.2	318292.9
2-40J16-041	182.4	4761216.6	318274.3
3-40J16-041	182.0	4761228.1	318319.8
4-40J16-041	182.1	4761215.4	318312.3
5-40J16-041	182.2	4761247.5	318292.9
6-40J16-041	181.8	4761243.7	318327.5
7-40J16-041	182.0	4761195.5	318297.1
8-40J16-041	181.7	4761194.5	318292.1
9-40J16-041	179.5	4761217.5	318332.1
10-40J16-041	179.8	4761216.5	318264.2

NOTES

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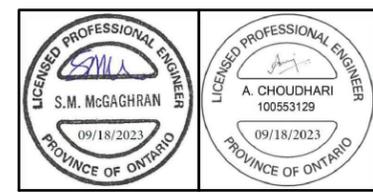
REFERENCE

Base plans provide in digital format by CALLON DIETZ, drawing file: 402SAR.dwg, received on October 31, 2022.

NO.	DATE	BY	REVISION

Geocres No.: 40J16-095

HWY. 402	PROJECT NO. 12566052	DIST. WEST
SUBM'D. MA	CHKD. AC	DATE: 9.18.2023
DRAWN: AW	CHKD. SMM	APPD. SMM



Appendices

Appendix A

Site Photographs



**Photo 1: Highway 402 and Highway 40 Overpass
(April 11th, 2023)**



**Photo 2: Drilling operations at Borehole, BH7-22 – Highway 402 Westbound Lane
(April 11th, 2023)**



Site Photographs

Highway 402 Over Highway 40 and Wawanosh Drain Bridge Overpass, Sarnia, ON



Photo 3: Drilling operations at Borehole, BH7-22 – Highway 402 Westbound Lane, looking north (April 11th, 2023)



Photo 4: Drilling operations at Borehole, BH6-22 – Highway 402 Eastbound Lane (April 11th, 2023)



Site Photographs

Highway 402 Over Highway 40 and Wawanosh Drain Bridge Overpass, Sarnia, ON



**Photo 5: Highway 402 and Wawanosh Drain Overpass
(April 13th, 2023)**



**Photo 6: Drilling set up at Borehole, BH15-22 – Highway 402 Eastbound Lane
(April 12th, 2023)**



Site Photographs

Highway 402 Over Highway 40 and Wawanosh Drain Bridge Overpass, Sarnia, ON



**Photo 7: Drilling set up at Borehole, BH16-22 – Highway 402 Eastbound Lane
(April 12th, 2023)**



**Photo 8: Drilling set up at Borehole, BH14-22 – Highway 402 Eastbound Lane, looking west
(April 12th, 2023)**



Site Photographs

Highway 402 Over Highway 40 and Wawanosh Drain Bridge Overpass, Sarnia, ON



**Photo 9: Drilling set up at Borehole, BH10-22 – Highway 402 Westbound Lane, looking east
(April 13th, 2023)**



Site Photographs

Highway 402 Over Highway 40 and Wawanosh Drain Bridge Overpass, Sarnia, ON

Appendix B

Previous Investigation

**GEOCRES Nos. 40J16-036, 40J16-040 &
40J16-041**

G.I.-30 SEPT. 1976

GEOCREs No. 40J16-36

DIST. 1 REGION _____

W.P. No. 122-65-01

CONT. No. 75-027

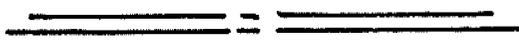
W. O. No. _____

STR. SITE No. _____

HWY. No. 402

LOCATION Modeland Road,
Interchange

No. of PAGES - _____



OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 100

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 66 + 00 150' Lt. Hwy. 402 ORIGINATED BY AP
 W.P. 122-65-01 BORING DATE December 11, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY /

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	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
			NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		w_p	w	w_L		
588.4	Ground Level												
0.0	Silty sand to sand, some clay & organics.		1	SS	6								
			2	TW	PM								
578.4	Loose		3	SS	4	580							
10.0	Organic silt, clay		4	TW	PM		q					98	
	Layers of peat and sand		5	SS	9			+ 2.1					
			6	TW	PM	570	q	+ 1.7					
	Soft to stiff		7	SS	5			+ 1.9					
			8	TW	PM			+ 3.0					
560.9			9	SS	3	560							
27.5	End of Borehole												

0 41 49 10

GR. SA. CL.

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 102

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 68 + 00 @ Hwy. 402 ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 15, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY [Signature]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ	REMARKS
			NUMBER	TYPE	BLOWS / FOOT		1000	2000	W _p	W	W _L		
589.0	Ground Level												
0.0	Silty fine sand with some clay		1	SS	4	580							0 48 42 10
580.5	Loose		2	SS	4								
8.5	Organic silt, clay		3	SS	4	570	+ 2.7						
	Layers of peat and sand		4	TW	PH								
	Soft to firm		5	SS	5								
			6	TW	PM								
564.5	Clayey silt - hard		7	SS	39								
24.5	End of Borehole					560							

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 103

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 68 + 00 150' Lt. Hwy. 402 ORIGINATED BY AP
 W.P. 122-65-01 BORING DATE December 12, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY [Signature]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ	REMARKS	
			NUMBER	TYPE		1000	2000	W _p	W	W _L			P.C.F.
588.4	Ground Level												
0.0	Organic silt, clay,	[Stratigraphic Plot]	1	SS	5							586.4	▼
	Layers of peat and sand		2	SS	4	580						90	
			3	TW	PM		q						
			4	SS	4		+ 6.0						
	Soft to firm		5	TW	PM	570	p					114	
			6	SS	5		+ 5.0						
			7	TW	PM		+						
						560	+ 5.0						
556.9	Sand & gravel. V. dense		8	SS	61								
31.5	End of Borehole												
					550								

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 104

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 69 + 00 150' Lt. Hwy. 402 ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 15, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY PP

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	1000	2000	w_p	w		
588.4	Ground Level											
0.0	Organic silt		1	SS	2							
	Layers of silty sand		2	SS	2							
			3	SS	2	580						
			4	SS	2							
			5	SS	2		+s12.0					
	Very soft to firm		6	TW	PH	570	+s6.0					
			7	TW	PH		+s7.5				98	
			8	SS	31	560	+s12.0				97	
556.9	clayey silt hard											
31.5	End of Borehole											
						550						

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 105

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 70 + 00 150' Lt. Hwy. 402 ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 15, 1969 COMPILED BY PP
 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	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE	1000	2000	w_p — w — w_L 25 50 75			
589.0	Ground Level											
0.0	Sandy silt with traces											
585.0	of clay.											
4.0	Organic silt, clay	1	SS	3								
	Layers of sand	2	SS	4								
		3	SS	2	580							
		4	SS	2								
		5	SS	2								
	Soft				570		+ s3.0					
		6	TW	PH			+ s3.3					
		7	TW	PH			p + s2.7					
560.5												
28.5	Sand & gravel				560							
557.5	Dense	8	SS	16								
31.5	End of Borehole											
					550							

0 22 68 10

83.5

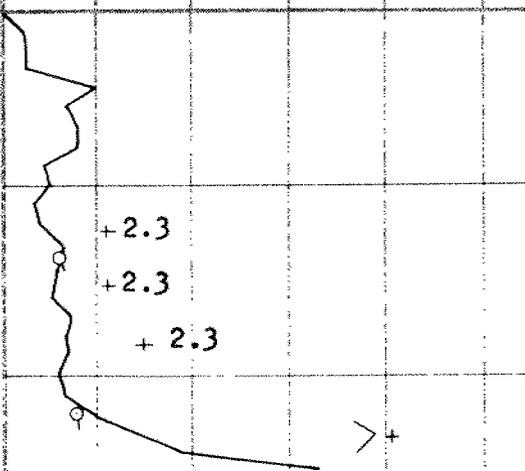
DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 108

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 81 + 00 100' Rt. Hwy. 402 ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 16, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	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	
			NUMBER	TYPE	BLOWS / FOOT		20	40	60	80				100
588.9	Ground Level													
0.0	Fine sand													
583.9	Compact		1	SS	20									
5.0	Organic silt, Layers of peat and sand.		2	SS	5									
			3	SS	3	580								
			4	TW	PM									
	Very soft to firm		5	SS	5									
566.9			6	TW	PM	570								
22.0	Clayey silt													
564.4	Hard		7	SS	45									
24.5	End of Borehole					560								



0 50 44 6

104

98

GR. SA. SI. CL.

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 109

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 82 + 00 100' Lt. Hwy. 402 ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 16, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY PP

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY P.C.F.	REMARKS	
			NUMBER	TYPE	BLOWS / FOOT		1000	2000	w_p	w	w_L			
588.4	Ground Level													
0.0	Organic silt		1	SS	10	580								
	Layers of peat and sand		2	SS	2									0 45 50 5
	Traces of clay		3	SS	2									
	Soft to stiff		4	SS	2									
			5	SS	2		570							
565.4			6	TW	PM							130	0 46 44 10	
23.0	Sand with layers of clayey silt		7	SS	20	560								
561.9														
26.5	End of Borehole													

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

WATER CONTENT %
 25 50 75

GR SA SIL CL

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 110

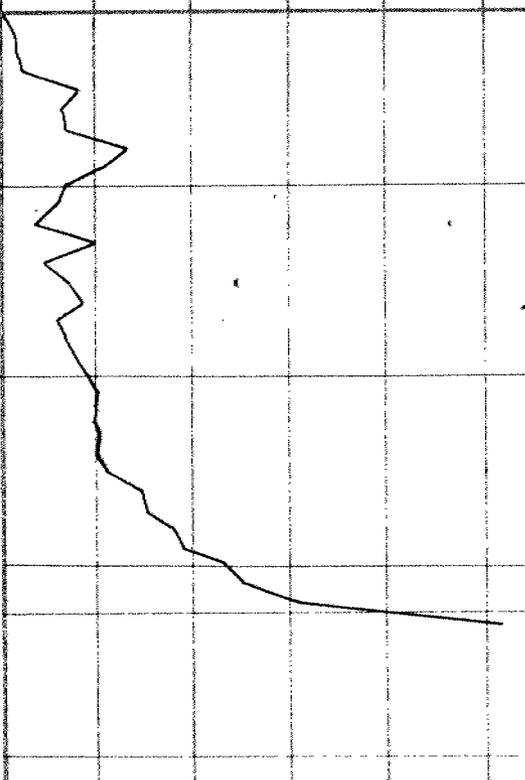
FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 82 + 00 100' Rt. Hwy. 402 ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 16, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY [Signature]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _p WATER CONTENT ——— W			BULK DENSITY Y P.C.F.	REMARKS
			NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	W _p	W	W _L		
588.9	Ground Level															
0.0	Silty sand to sand Loose to compact	[Strat. Plot]	1	SS	16											
			2	SS	9											
			3	SS	6											
			4	TW	PM											
			5	SS	6											
			6	TW	PM											
565.9	Organic silt, clay, Layers of sand	[Strat. Plot]	7	SS	5											
23.0																
558.9	Firm	[Strat. Plot]	8	SS	26											
557.4	Clayey silt															
31.5	End of Borehole															

SHEAR STRENGTH P.S.F.
 ○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL x LAB. VANE

WATER CONTENT %
 25 50 75



0 84 (16)

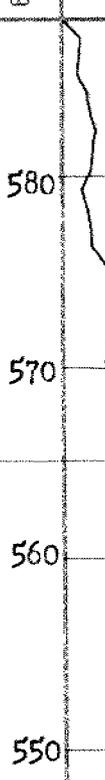
DEPARTMENT OF HIGHWAYS- ONTARIO
 MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 111

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 83 + 00 100' Lt. Hwy. 402 ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 16, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY [Signature]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ P.C.F.	REMARKS
			NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	W _P	W	W _L		
588.1	Ground Level															
0.0	Fine Sand															
583.1	Loose		1	SS	7											
5.0	Organic silt, clay		2	SS	2											
	Layers of peat and sand		3	SS	3	580										
	Very soft to soft		4	SS	2											
			5	SS	3											
568.6	Clayey silt with some sand		6	TW	PM	570										
19.5																
565.1																
23.0	End of Borehole															
						560										
						550										



0 72 22 6

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 114

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 67 + 00 160' Lt. Hwy. 402 ORIGINATED BY AP
 W.P. 122-65-01 BORING DATE December 11, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY [Signature]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	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	
			NUMBER	TYPE	BLOWS / FOOT		1000	2000	w_p	w	w_L			GR.
588.4	Ground Level													
0.0	Organic silt, clay		1	TW	PM		o					99	584.4 ∇	
			2	SS	8		+ 4.7							
	Layers of peat and sand.		3	TW	PM	580	o					122	0 23 67 10	
			4	SS	4		+ 4.0							
			5	TW	PM		+ 6.0					118		
			6	SS	2	570	o		+ 2.8					
			7	TW	PM		+					99		
			8	SS	9		+ 5.0					o		
560.4	Very soft to stiff		9	TW	PM	560	o		+ 2.3			132	0 60 29 11	
28.0	End of Borehole													
						550								

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 115

FOUNDATION SECTION

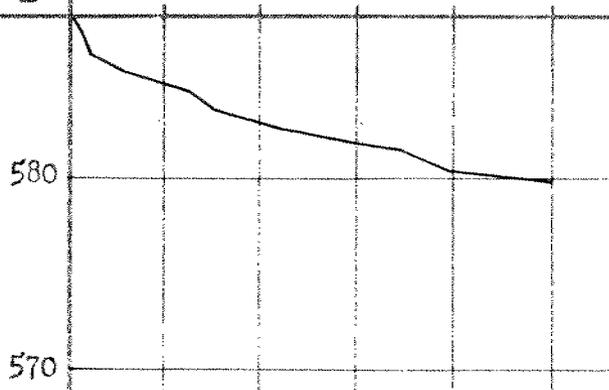
JOB 69-F-119 LOCATION Sta. 79 + 00 @ Hwy. 402 ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 17, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT	PLASTIC LIMIT — w_p	WATER CONTENT — w	WATER CONTENT %		
588.4	Ground Level														
0.0															
579.6															
8.8	End of Cone Test														

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

LIQUID LIMIT — w_L
 PLASTIC LIMIT — w_p
 WATER CONTENT — w
 WATER CONTENT %

BULK DENSITY
 γ
 P.C.F. GR. SA. SI. CL.



DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 116

FOUNDATION SECTION

JOB 69-F-119

LOCATION Sta. 77 + 00 @ Hwy. 402

ORIGINATED BY PP

W.P. 122-65-01

BORING DATE December 17, 1969

COMPILED BY PP

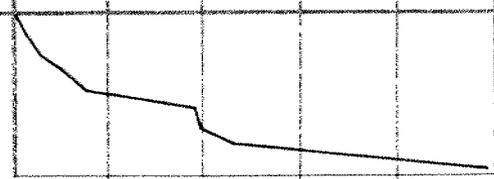
DATUM Geodetic

BOREHOLE TYPE Cone Test Only

CHECKED BY [Signature]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES		BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W		BULK DENSITY P.C.F.	REMARKS GR. SA. SI. CL.
			NUMBER	TYPE			20	40	60	80	100	W _P	W _L		
588.4	Ground Level														
0.0															
500.2						580									
8.2	End of Cone Test														

SHEAR STRENGTH P.S.F.
 ○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL x LAB. VANE



DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 200

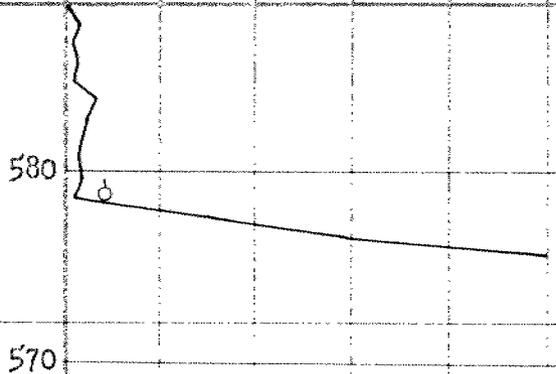
FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 416 + 60 125' Lt. Modeland Rd. ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 17, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY PP

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w	BULK DENSITY P.C.F.	REMARKS
			NUMBER	TYPE	BLOWS/FOOT		20	40	60	80			
588.5	Ground Level												
0.0	Organic material, Layers of sand		1	SS	2								
580.5	Very soft		2	SS	2								
8.0	Clayey silt with some sand & traces of gravel.		3	TW	PM	580						96	
			4	TW	PM								
572.0	Stiff to hard		5	SS	72								
16.5	End of Borehole					570							

SHEAR STRENGTH P.S.F.
 ○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL x LAB. VANE

WATER CONTENT %
 25 50 75

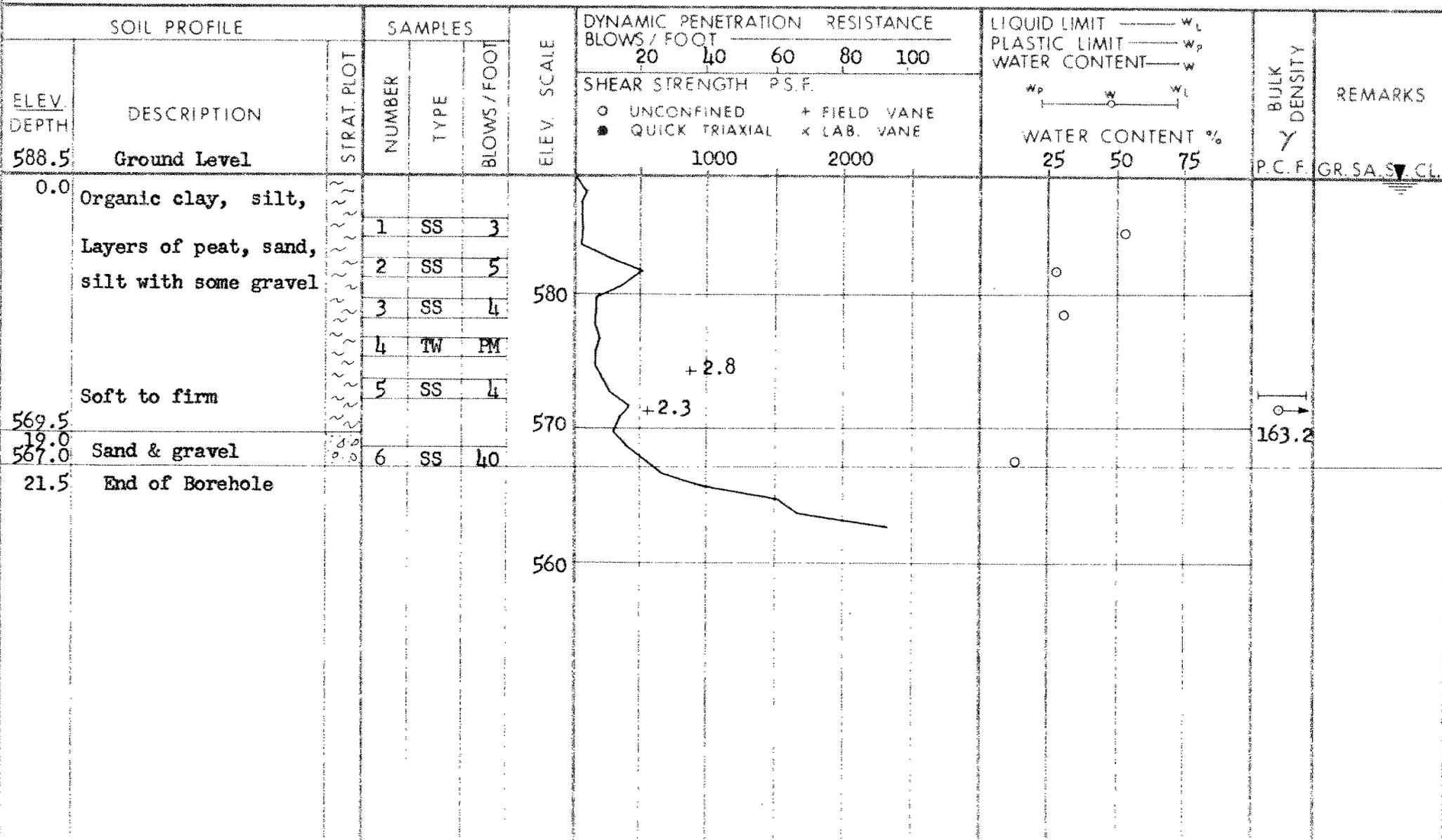


DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 201

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 418 + 55 125' Lt. Modeland Rd. ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 17, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY slc



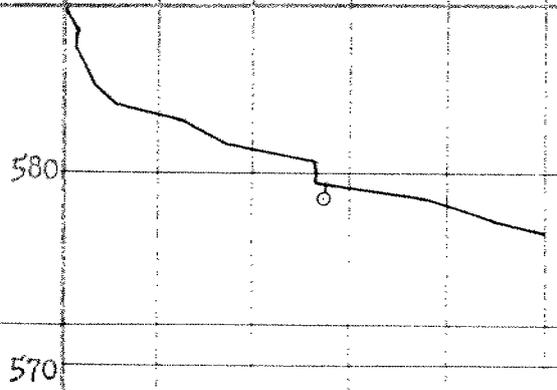
DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 202

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 59 + 00 200' Lt. Hwy. 402 ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE Dec. 18, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY PP

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w_L			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT ——— w_p					
					20	40	60	80	100	WATER CONTENT ——— w						
					SHEAR STRENGTH P S F					WATER CONTENT %						
					○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					w_p	w	w_L				
					1000 2000					25	50	75	P.C.F.	GR. SA. SI. CL.		
588.5	Ground Level															
0.0	Layers of organic material and sand	1	SS	7												
583.5	Clayey silt with some sand & traces of gravel	2	SS	29												
5.0		3	TW	PH												
		4	SS	16												
		5	SS	18												
572.0	Stiff to very stiff															
16.5	End of Borehole															



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DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 204

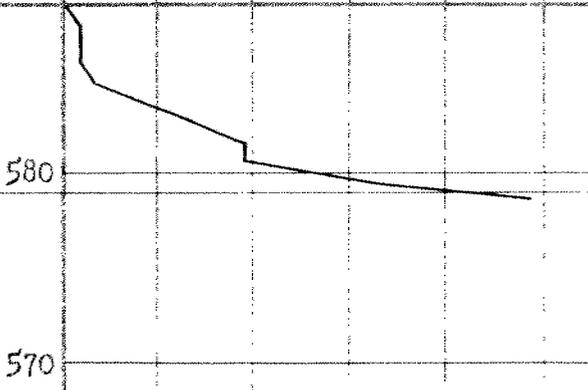
FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 57 + 00 200' Lt. Hwy. 402 ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 18, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY PP

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	20	40	60	80	100	WATER CONTENT %		
588.5	Ground Level													
0.0	Probably organics													
584.5	Probably clayey silt													
4.0														
579.0			1	SS	35	580								
9.5	End of Borehole													
						570								

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

1000 2000



P.C.F. GR. SA. SI. CL.

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

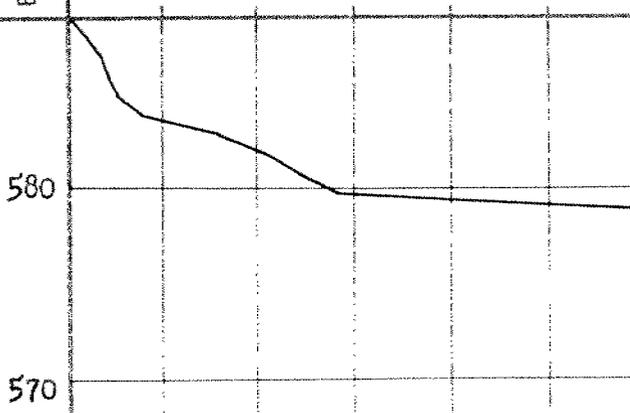
RECORD OF BOREHOLE No. 205

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 418 + 55 520' Lt. Modeland Rd. ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 18, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY PP

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w	BULK DENSITY γ	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	20	40	60				80	100
588.5	Ground Level													
0.0	Probably organic material and clayey silt													
578.5														
10.0	End of Cone Test													

SHEAR STRENGTH P.S.F.
 ○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL x LAB. VANE



DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

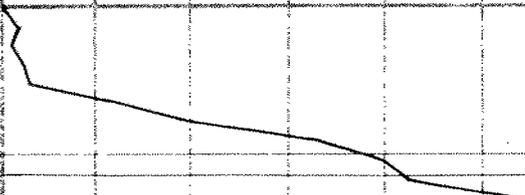
RECORD OF BOREHOLE No. 206

FOUNDATION SECTION

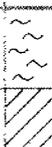
JOB 69-F-119 LOCATION Sta. 423 + 00 115' Lt. Modeland Rd. ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 18, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY _____

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	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT %				
588.5	Ground Level														
0.0	Layers of organics and sand														
4.0	Clayey silt.	1	SS	22											
581.0	Hard	2	SS	41											10 27 47 16
7.5	End of Borehole				580										
					570										

SHEAR STRENGTH P.S.F.
 ○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL < LAB. VANE



STRAT. PLOT



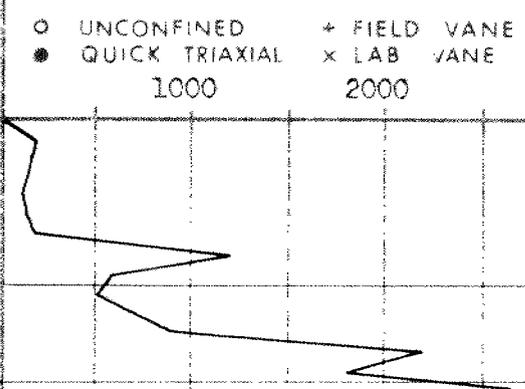
DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 208

FOUNDATION SECTION

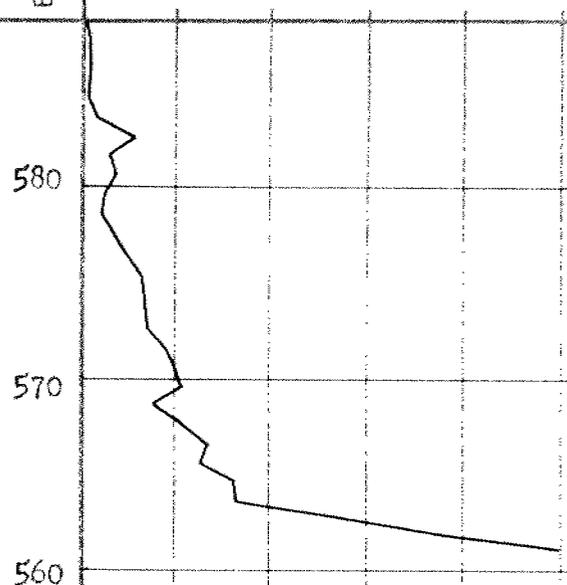
JOB 69-F-119 LOCATION Sta. 427 + 80 75' Lt. Modeland Rd. ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 13, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY PP

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	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
			NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT % w_p ——— w ——— w_L				
588.5	Ground Level															
0.0	Sandy silt traces of clay Very loose		1	SS	4											
582.0			2	SS	30											
6.5	Clayey silt with some sand and traces of gravel		3	SS	28	580										
575.0			4	SS	49											
13.5	End of Borehole					570										2 26 47 25



DEPARTMENT OF HIGHWAYS- ONTARIO		RECORD OF BOREHOLE No. 209		FOUNDATION SECTION
MATERIALS & TESTING OFFICE				
JOB <u>69-F-119</u>	LOCATION <u>Sta. 425 + 80 175' Lt. Modeland Rd.</u>	ORIGINATED BY <u>PP</u>		
W.P. <u>122-65-01</u>	BORING DATE <u>December 18, 1969</u>	COMPILED BY <u>PP</u>		
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Cone Test Only</u>	CHECKED BY <u>HL</u>		

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W	BULK DENSITY γ	REMARKS	
			NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100				SHEAR STRENGTH PS F.
588.5	Ground Level														
0.0	Probably organic material and layers of silt & silty clay														
560.8															
27.7	End of Cone Test														



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

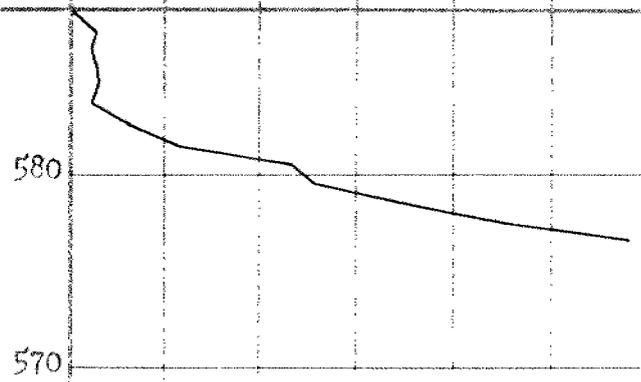
RECORD OF BOREHOLE No. 210

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 427 + 80 175' Lt. Modeland Rd. ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 19, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cone Test only CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w	BULK DENSITY γ	REMARKS				
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	20	40	60	80				100	WATER CONTENT %	P.C.F.	GR.
588.5	Ground Level																
0.0	Probably organic material																
	layers of sand and clayey silt																
576.5																	
12.0	End of Cone Test																

SHEAR STRENGTH P.S.F.
 ○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL x LAB VANE



DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

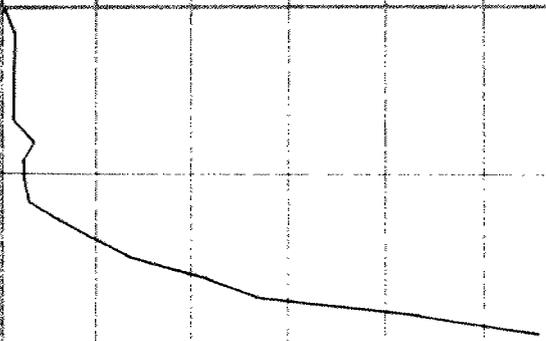
RECORD OF BOREHOLE No. 211

FOUNDATION SECTION

JOB 69-F-119 LOCATION Sta. 423 + 00 175' Lt. Modeland Rd. ORIGINATED BY PP
 W.P. 122-65-01 BORING DATE December 19, 1969 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY PP

SOIL PROFILE		STRAT. PLOT	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		NUMBER	TYPE		20	40	60	80	100	WATER CONTENT %					
588.5	Ground Level															
0.0	Clayey silt with organics and sand.		1	SS	5											
576.5	Firm to stiff		2	SS	10											
12.0	Clayey silt with some sand & traces of grav.		3	SS	33											
572.0																
16.5	End of Borehole															

SHEAR STRENGTH P.S.F.
 ○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL x LAB VANE



580.7 ∇

GR. SA. SI. CL.

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 40J16-40

DIST. 1 REGION

W.P. No. 122-65-03/04

CONT. No. 75-027

W. O. No.

STR. SITE No. 14-338

HWY. No. 402

LOCATION Modeland Rd.

Overpass

No of PAGES -



OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

DEPARTMENT OF HIGHWAYS- ONTARIO
 MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 70-11046 LOCATION STA. 62 + 88, 33 Ft. Lt. of 6 ORIGINATED BY A.K.B.
 W.P. 122-65-0304 BORING DATE June 17-18, 1970 COMPILED BY A.K.B.
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		1000	2000	W _P	W	W _L		
591.3	Ground Level											
588.8	Black peat, seams of organic sand, silt	1	SS	5	590							
585	Sand clay, firm.	2	TW	PM								
5.5	Clayey silt, Traces of sand & gravel stiff to hard grey	3	SS	21								
		4	SS	19								
		5	SS	24	580							
		6	SS	10								
		7	TW	PM	570						133	
		8	SS	46	560							
		9	SS	22	550							
546.3												
45.0	Silty clay, traces of sand and gravel stiff to hard grey	10	SS	15	540							
		11	TW	PM	530						128	
		12	SS	36	520							
		13	SS	25	510							
					490							
484.2	Probable bedrock											
107.1	End of borehole											

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.2 (69-F-104)

FOUNDATION SECTION

JOB 70-11046

LOCATION STA 62+ 94 105' Lt

ORIGINATED BY A.P.

W.P. 122-65-03604

BORING DATE Nov. 18-20, 1969

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH.	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
						1000	2000	10	20	30		
590.3	Ground Level				590							
585.3	Clayey silt Traces of organics	1	TW PH									
5.0		2	SS 13									
		3	SS 32	580								2-20-47-30
		4	TW PH									
	Clayey silt with some sand & traces of gravel	5	SS 14									
		6	TW PH	570							129	2-16-48-34
		7	TW PH									
		8	TW PH	560								
	firm to very stiff	9	TW PH									
		10	TW PH	550							134	1-16-47-36
		11	TW PH	540								
		12	SS 20	530								
515.3												
75.0	Silty clay with some sand traces of gravel very stiff				520							
		13	TW PH	510							127	1-9-50-40
		14	SS 30	490								
484.3	Prob. Bedrock											
106.0	End of borehole											

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 70-11046 LOCATION STA 62 + 46, 33Ft. Lt of # ORIGINATED BY A.K.B.
 W.P. 122-85-03-04 BORING DATE June 19, 1970 COMPILED BY A.K.B.
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ	REMARKS	
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS/FOOT	SHEAR STRENGTH P.S.F.		WATER CONTENT %				
						1000	2000	10	20	30			
592.5	Ground Level												
0.0	Gravelly sand (Road Base)		1	SS	6								
586.5			2	SS	32								
6.0	Clayey silt with traces of sand & gravel		3	SS	39	580							
	Hard to stiff		4	SS	28								
570.0			5	SS	13	570							
22.5	End of borehole												

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 70-11046 LOCATION Sta. 61 + 11 34 FT. Lt. of 8 ORIGINATED BY A.K.B.
 W.P. 122-65-03404 BORING DATE June 4-8, 1970 COMPILED BY A.K.B.
 DATUM Geodetic BOREHOLE TYPE C.M.E. Auger CHECKED BY [Signature]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	10	20	30		
588.6	Ground Level															
0.0	Seams of black peat, organic sand silt and clay. numerous shells very soft		1	SS 1												0-90-(10)
			2	TW Pm												118
			3	SS 1												
573.6			4	TW PH												73
15.0	Clayey silt, traces of sand & gravel, stiff to very stiff		5	SS 11												77
	Brown and Grey		6	TW PH												132
			7	SS 11												133
			8A	TW PH												
			8	SS 28												
			9	TW PH												133
543.6																
45.0	Silty clay, traces of sand and gravel stiff, grey		10	SS 5												
			11	TW PH												127
527.6																128
61.0	End of borehole															

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 70-11046 LOCATION STA 60 + 80, 34 Ft. Lt. of 9 ORIGINATED BY T.P.
 W.P. 122-65-03404 BORING DATE June 8-9, 1970 COMPILED BY A.K.B.
 DATUM Geodetic BOREHOLE TYPE C.M.E. Auger CHECKED BY [Signature]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ	REMARKS		
			NUMBER	TYPE	BLOWS / FOOT		1000	2000	10	20	30			P.C.F.	GR.
588.8	Ground Level														
0.0	Organic Silt & Clay with pockets of black peat & sand numerous shells very soft to stiff	[Strat. Plot]	1	SS										0-89-(11)	
			2	SS	5										
			3	SS	3	580									
			4	TW	PH		a	p							
572.8	16.0 Clayey silt with traces of sand & gravel stiff to very stiff brown & grey	[Strat. Plot]	5	SS	11									38-53-(9)	
			6	SS	17	570									
			7	SS	16										
			8	TW	PH			b							
			9	SS	17	560									
			10	TW	PH										
			11	SS	29	550									
543.8	45.0 Silty clay with traces of sand & gravel. Firm to very stiff grey	[Strat. Plot]	12	TW	PM	540								116	
															115
529.3			13	SS	28	530									
59.5	End of borehole														

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 70-11046

LOCATION STA 60 +.83, 100 FT Lt. of ϕ

ORIGINATED BY A.K.B.

W.P. 122-65-03404

BORING DATE June 4-5, 1970

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Pendrill & Washboring BX casing

CHECKED BY *[Signature]*

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ	REMARKS				
			NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	10	20	30			P.C.F.	GR.	SA.	SI.
588.6	Ground level																			
572.6 16.0	Organic silt & clay numerous shells pockets of black peat and sand V. Soft to firm	[Strat. Plot]	1	SS	2															
			2	SS	6															
			3	SS	2															
			4	SS	1															
			5	SS	3															
542.6 46.0	Clayey silt with traces of sand & gravel Stiff to very stiff Brown and Grey	[Strat. Plot]	6	TW PH																
			7	SS	14															
			8	SS	14															
			9	TW PM																
482.3 106.3 477.3 111.3	Silty clay with traces of sand and gravel stiff to very stiff grey	[Strat. Plot]	10	TW PM																
			11	SS	25															
			12	TW PM																
			13	SS	17															
			14	TW PM																
480	Shale Bedrock																			
477.3	End of borehole																			

DEPARTMENT OF HIGHWAYS- ONTARIO
 MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 70-11046 LOCATION STA. 62 & 85, 34Ft. RT. of \emptyset ORIGINATED BY A.K.B.
 W.P. 122-65-03-04 BORING DATE June 19, 1970 COMPILED BY A.K.B.
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY JK

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		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.	WATER CONTENT %					
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE	1000	2000	10	20	30	GR. SA. SI. CL.	
590.8	Ground Level												
0.0	Sand with some black peat		1	SS	15	590							
586.8			2	SS	34								
4.0			3	SS	39	580							
			4	SS	12								
			5	SS	13	570							
567.8	Clayey silt with Traces of sand & Gravel. Hard to stiff Brown & Grey												
23.0	End of borehole												

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 70-11046 LOCATION STA 62 + 82, 101 Ft. Rt of \emptyset ORIGINATED BY A.K.B.
W.P. 122-65-03+04 BORING DATE June 10-11, 1970 COMPILED BY A.K.B.
DATUM Geodetic BOREHOLE TYPE Washboring, BX and AX casings CHECKED BY *[Signature]*

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		1000	2000	10	20	30		
590.8	Ground Level											
0.0	Oxidized	1	SS	15								
		2	SS	27								
	clayey silt with traces of sand & gravel	3	SS	23	580							
		4	SS	10								
	very stiff to firm	5	TW	Pm	570						129	
	brown and grey	6	SS	7							128	
		7	SS	29	560							
		8	TW	PM	550						136	
545.8												
45.0		9	SS	6	540							
	Silty clay with traces of sand & gravel	10	TW	PM	530						128	
	firm to very stiff	11	SS	20	520							
	grey	12	TW	PM	510							
		13	SS	21	490							
485.1												
105.7	Shale bedrock	14	RC	REC.								
481.1												
109.7	End of borehole											

DEPARTMENT OF HIGHWAYS- ONTARIO MATERIALS & TESTING OFFICE	RECORD OF BOREHOLE No. 10	FOUNDATION SECTION
JOB <u>70-11046</u>	LOCATION <u>STA 62 +45 117 Ft. Rt of ϕ</u>	ORIGINATED BY <u>T.P.</u>
W.P. <u>122-65-13 & 04</u>	BORING DATE <u>June 19, 1970</u>	COMPILED BY _____
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>C.M.E. Auger</u>	CHECKED BY <u>[Signature]</u>

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	NUMBER	TYPE	BLOWS / FOOT		1000	2000	w_p	w	w_L			
592.1	Ground level												
0.0	Black Peat & Organic silt--stiff clayey silt with trace of sand & gravel V. Stiff to firm	1	SS	13	590								
587.1		2	SS	22									
5.0		3	SS	26									
		3A	SS	13	580								
		4	TW	PH								130	
		5	SS	11									
567.6		6	TW	PH	570						130		
24.5	End of borehole												

DEPARTMENT OF HIGHWAYS- ONTARIO
 MATERIALS & TESTING OFFICE
 JOB 70-11046
 W.P. 122-65-03404
 DATUM Geodetic

RECORD OF BOREHOLE No. 11

FOUNDATION SECTION

LOCATION STA 61 + 81, 34 Ft. Rt of \emptyset
 BORING DATE June 16-17, 1970
 BOREHOLE TYPE C.M.E. Auger

ORIGINATED BY T.P.
 COMPILED BY A.K.B.
 CHECKED BY *[Signature]*

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	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 GR. SA. SI. CL.
			NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL 1000	+ FIELD VANE x LAB. VANE 2000	10	20		
587.2	Ground Level											
0.0 - 583.2	Black peat & Org. silt		1	SS	13							
4.0	Clayey silt with traces of sand & gravel very stiff to firm brown & grey		2	TW	PH	580		+ 2000				136
			3	SS	19							
			4	TW	PH							131
			5	SS	12	570						
			6	TW	PH							131
			7	SS	10							
			8	TW	PH	560						138 140
			9	SS	31							
			10	TW	PH	550						131
540.2 - 47.0		Silty clay with traces of sand & gravel: firm to very stiff, grey		11	SS	6	540					
			12	TW	PH	530						130 130
			13	TW	PH	520						
					510							
					490							
481.7	Probable bedrock											
105.5	End of borehole											

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 12

FOUNDATION SECTION

JOB 70-11046 LOCATION STA 61 + 05 100 Ft., RT. of E ORIGINATED BY T.P.
W.P. 122-65-03-04 BORING DATE June 18, 1970 COMPILED BY _____
DATUM Geodetic BOREHOLE TYPE C.M.E. Auger CHECKED BY SK

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		BLOWS/FOOT	1000	2000	10	20			30
588.9	Ground Level												
0.0	Black peat with seams of organic clay, silt & sand - very soft to firm		1	SS	3								
			2	SS	5								
			3	SS	3								
575.9			4	TW	PM								
13.0	Clayey silt with traces of sand & gravel V. stiff to stiff Brown and grey		5	TW	PM								
			6	SS	16								
			7	TW	PM								
			8	SS	20								
			9	TW	PH								
549.4			10	SS	20								
39.5	End of borehole												

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.13

FOUNDATION SECTION

JOB 70-11046 LOCATION STA 60 + 76, 34 Ft. Rt of \emptyset ORIGINATED BY T.P.
W.P. 122-65-03-04 BORING DATE June 18, 1970 COMPILED BY
DATUM Geodetic BOREHOLE TYPE C. M.E. Auger CHECKED BY

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
						1000	2000	10	20	30	P.C.F.	GR. SA. SI. CL.	
588.7	Ground Level												
0.0	Black peat with seams of organic silt clay and sand very soft to soft		1	SS	3								
			2	SS	2								
			3	SS	4								
			4	SS	5						100		
			5	SS	1						242		
512.2	Clayey silt with traces of sand & gravel Hard to stiff		6	TW	PM	570		0.3620				134	
16.5			7	TW	PM								
			8	SS	27	560							
			9	TW	PH							139	
554.2													
34.5	End of borehole												

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 14

FOUNDATION SECTION

JOB 70-11046 LOCATION STA 60 + 73, 100 Ft. Rt of \emptyset ORIGINATED BY T.P.
W.P. 122-65-03E04 BORING DATE June 12-15 1970 COMPILED BY
DATUM Geodetic BOREHOLE TYPE C.M.E. Auger CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT					LIQUID LIMIT PLASTIC LIMIT WATER CONTENT			BULK DENSITY	REMARKS		
			NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W _L	W _P	W			P.C.F.	GR.
589.0	Ground Level																	
0.0	Seams of black peat organic silt clay & sand very soft to firm		1	TW	PM													0 94 (6)
			2	SS	6													
			3	SS	3	580												
574.0			4	TW	PM													
			5	TW	PH													
15.0	Clayey silt with traces of sand and gravel very stiff		6	SS	13	570												129
			7	TW	PH													131
			8	SS	10													
			9	TW	PH	560												136
			10	SS	17	550												
542.0			11	TW	PM	540												
47.0	Silty clay with traces of sand and gravel very soft to stiff Grey		12	SS	11	530												
			13	TW	PH	510												
						490												
1065	End of borehole probably bedrock																	

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 15

FOUNDATION SECTION

JOB 70-11046

LOCATION STA 64 + 40

ORIGINATED BY A.K.B.

W.P. 122-65-03-04

BORING DATE June 18, 1970

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY *[Signature]*

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		SHEAR STRENGTH P.S.F.		WATER CONTENT %					
						1000	2000	10	20	30	P.C.F. GR. SA. SI. CL.		
589.8	Ground Level												
588.3	Black Organics												
1.5	Clayey silt with traces of sand & gravel Hard to stiff Brown to grey		1	SS	46								
			2	SS	27								
				3	SS	32	580						
				4	SS	13							
				5	SS	11	570						
567.3	End of borehole												
22.5													

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 16

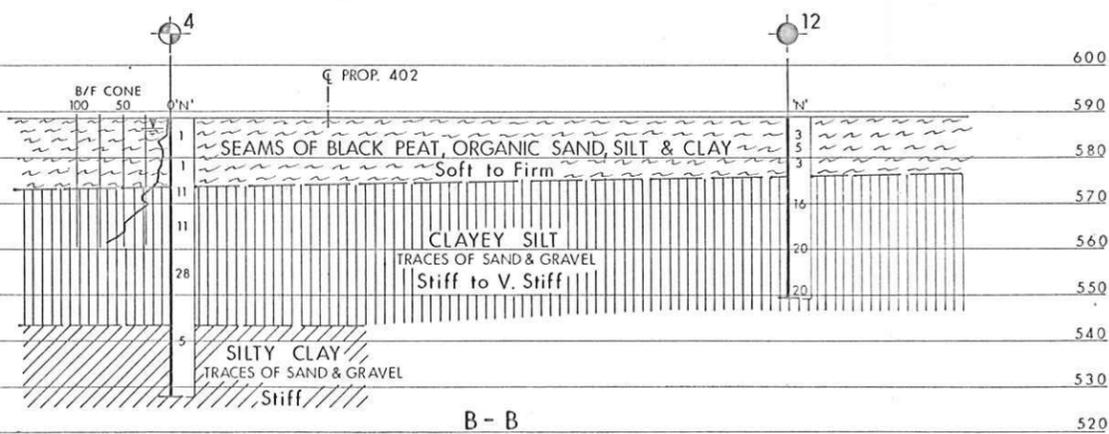
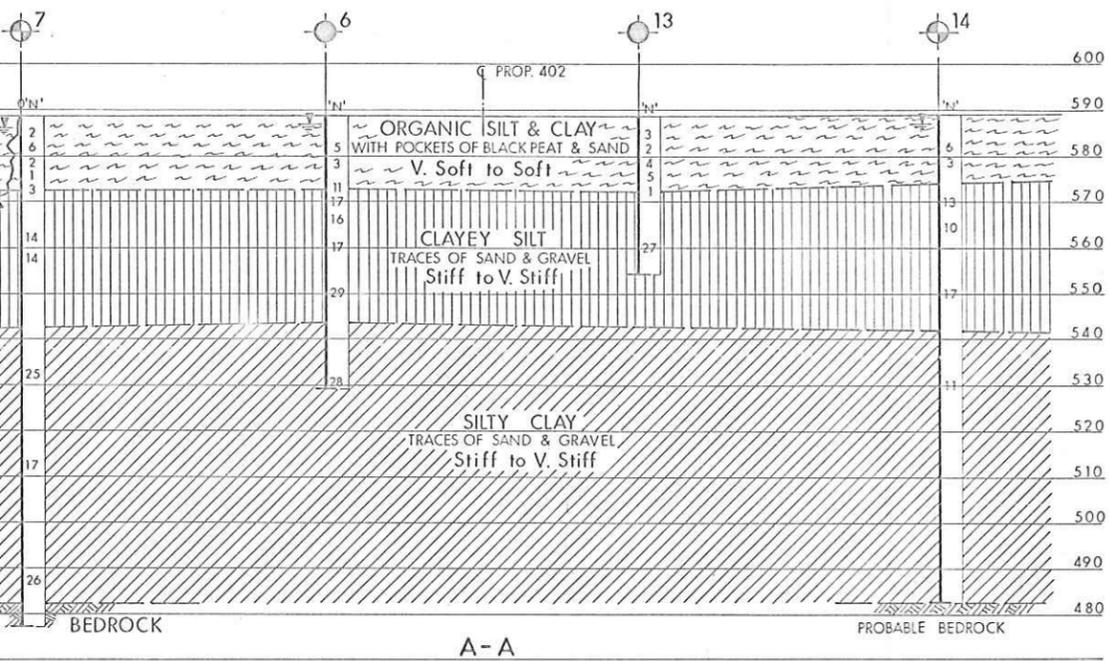
FOUNDATION SECTION

JOB 70-11046
W.P. 122-65-03-04
DATUM Geodetic

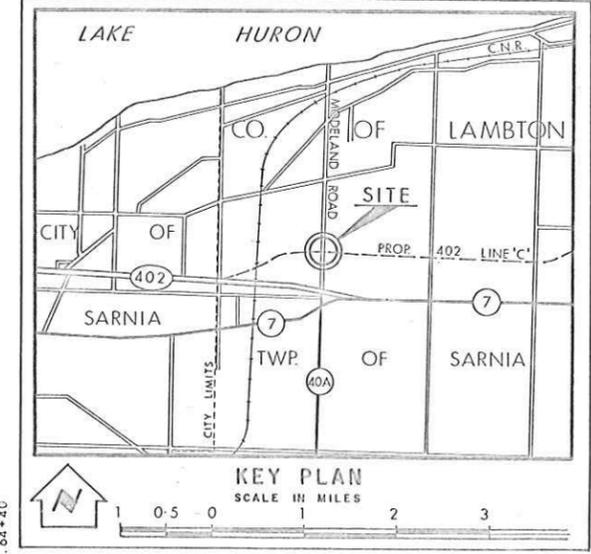
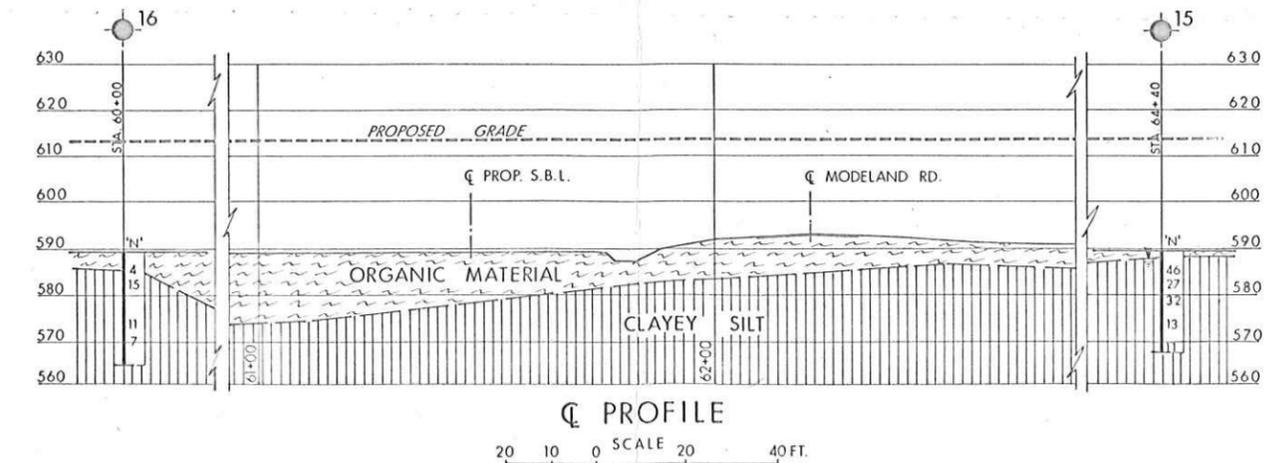
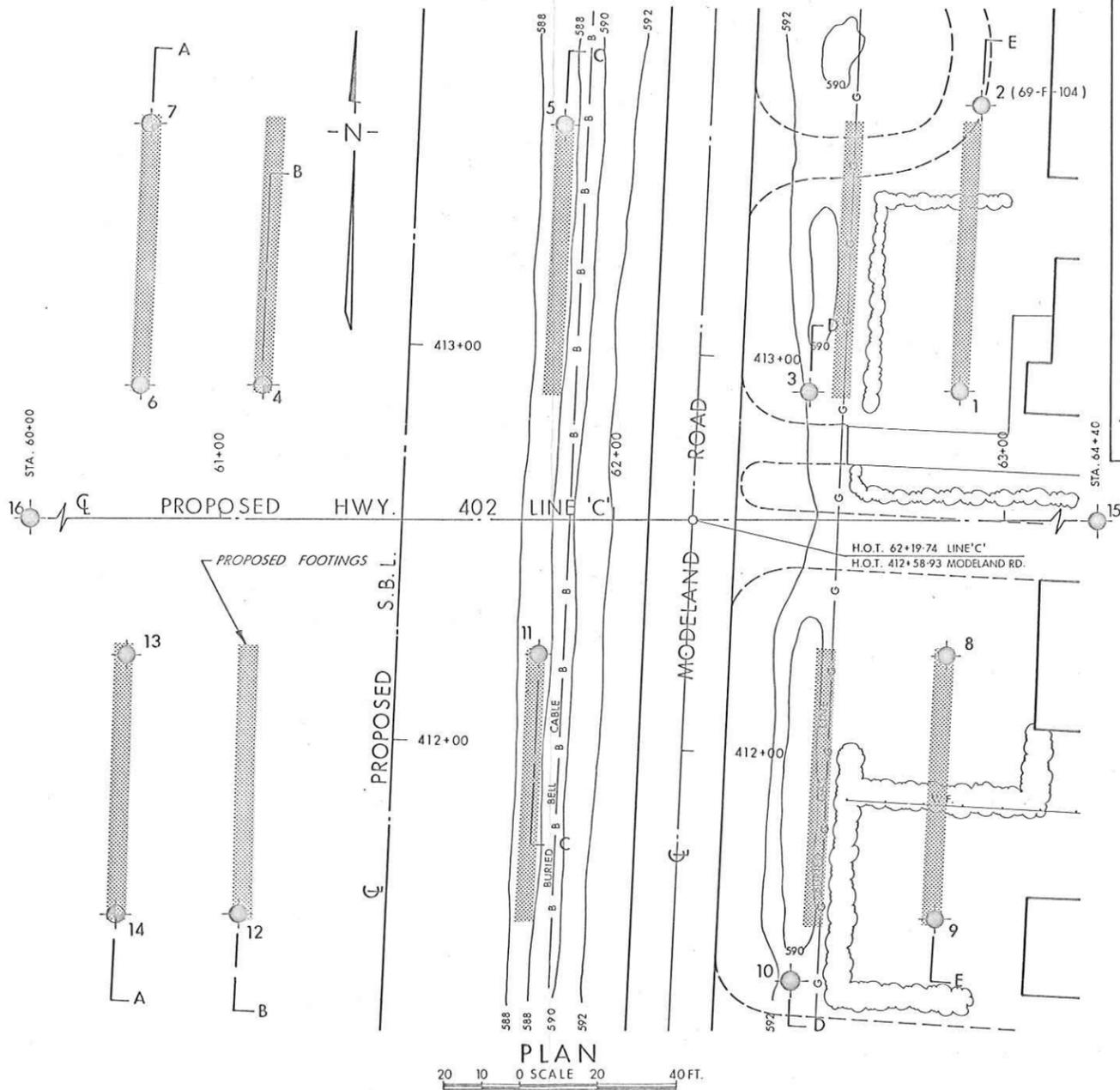
LOCATION STA 60 + 00
BORING DATE June 19, 1970
BOREHOLE TYPE C.M.E. Auger

ORIGINATED BY T.P.
COMPILED BY AE
CHECKED BY SA

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
						1000	2000	10	20	30			
589.5	Ground Level -												
0.0	black peat & organic clay, soft												
585.5			1	SS	4								
4.0	Clayey silt with traces of sand & gravel		2	SS	15								
			3	TW	PH	580		> 2000					
			4	TW	PH							131	
	Stiff		5	SS	11								
			6	SS	7	570							
563.5			7	TW	PH							131 133	
26.0	End of borehole												



SECTIONS
20 10 0 SCALE 20 40 FT.



LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, JUNE 1970

NOTE - Water Levels in Bore Holes 2, 8, 10, 11, 12, 13 & 16 not established at time of field investigation.

NO.	ELEVATION	STATION	OFFSET
1	591.3	62+88	33' LT.
2	590.3	62+94	105' LT.
3	592.5	62+46	33' LT.
4	588.6	61+11	34' LT.
5	587.4	61+87	100' LT.
6	588.8	60+80	34' LT.
7	588.6	60+83	100' LT.
8	590.8	62+85	34' RT.
9	590.8	62+82	101' RT.
10	592.1	62+45	117' RT.
11	587.2	61+81	34' RT.
12	588.9	61+05	100' RT.
13	588.7	60+76	34' RT.
14	589.0	60+73	100' RT.
15	589.8	64+00	☐
16	589.5	60+00	☐

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

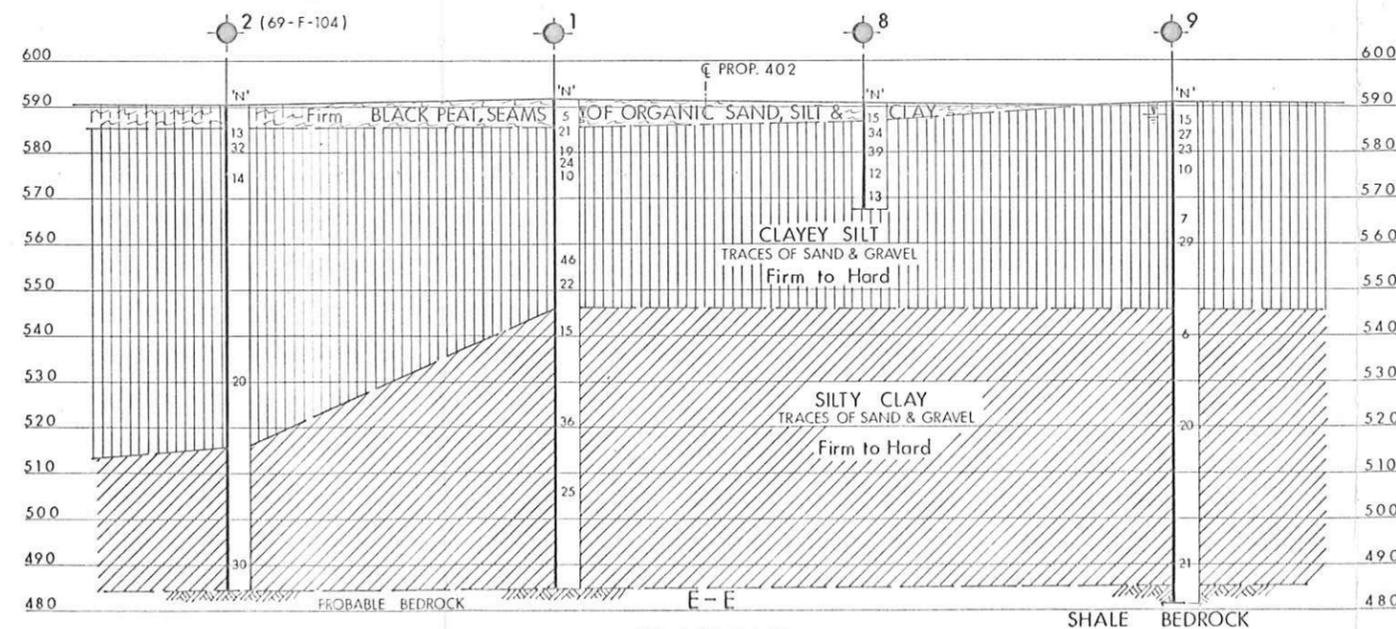
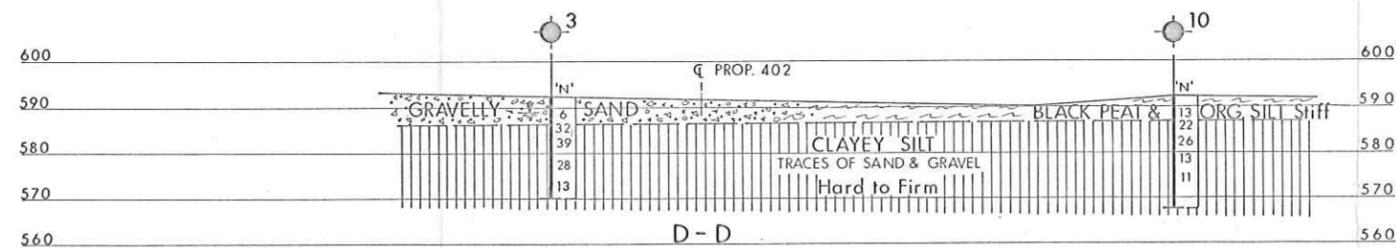
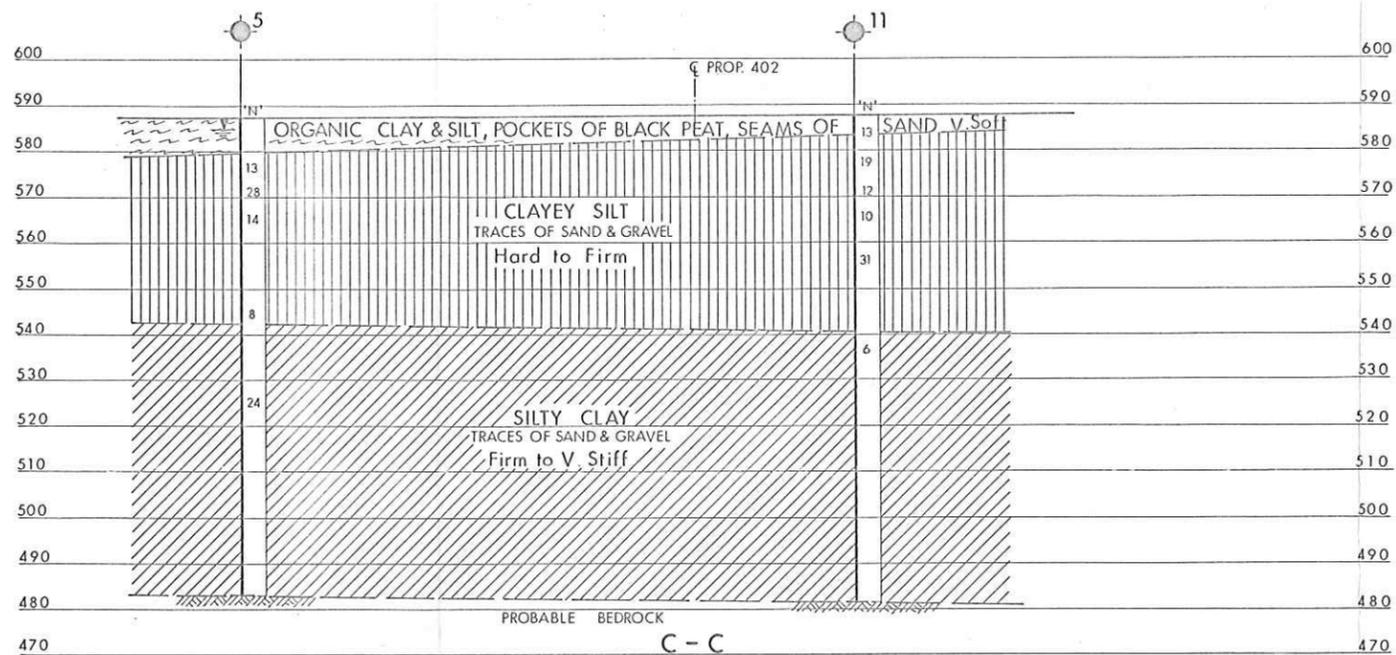
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

MODELAND ROAD

KING'S HIGHWAY NO. 402 LINE 'C' DIST. NO. 1
CO. LAMBTON
TWP. SARNIA LOT 15 & 16 CON. 7

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. A.B.	CHECKED ✓	W.P. NO. 122-65-03 & 04	M.B.T. DRAWING NO.
DRAWN S.O.	CHECKED ✓	JOB NO. 70-11046	70-11046 A
DATE 7 JULY 1970	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>A. J. ...</i>	CONT. NO.		



SECTIONS



SEE DRAWING NO 70-11046A

KEY PLAN
SCALE IN MILES

LEGEND

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

NO.	ELEVATION	STATION	OFFSET

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 HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

MODELAND ROAD

KING'S HIGHWAY NO. 402 LINE 'C' DIST. NO. 1
CO. LAMBTON
TWP. SARNIA LOT CON.

SECTIONS C-C, D-D, E-E & SOIL STRATA

SUB'D 1 B	CHECKED <input checked="" type="checkbox"/>	W.P. NO. 122-65-03&04	M.B.T. DRAWING NO.
DRAWN 5.0	CHECKED <input checked="" type="checkbox"/>	JOB NO. 70-11046	70-11046 B
DATE 7 JULY 1970	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>A. Williams</i>	PRINCIPAL FOUNDATION ENGINEER	CONT. NO.	

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 40J16-041

DIST. 1 REGION SOUTHWESTERN

W.P. No. 122-65-07 & 08

CONT. No. 75-027

W. O. No. _____

STR. SITE No. 14-341

HWY. No. 402

LOCATION WAWANOSH DRAIN
(E. OF MOPELAND RD.) BRIDGE

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 1

REMARKS: 2 documents to be unfolded before
microfilming

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 70-11047 LOCATION Sta. 86 + 41 o/s 40' Lt. ORIGINATED BY GA
 W.P. 122-65-07 & 08 BORING DATE November 26, 1969 COMPILED BY GA
 DATUM Geodetic BOREHOLE TYPE Dynamic Cone Test CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT					PLASTIC LIMIT — w_p		
						20	40	60	80	100	w_p — w — w_L WATER CONTENT %		γ	
						SHEAR STRENGTH P.S.F.								
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE								
597.6	Top of Fill													
580.0	End of Cone Test													

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 70-11047 LOCATION Sta. 87 + 61 o/s 35' Lt. ORIGINATED BY GA
 W.P. 122-65-07 & 08 BORING DATE November 26, 1969 COMPILED BY GA
 DATUM Geodetic BOREHOLE TYPE Dynamic Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT				
597.2	Top of Fill								
581.2 160	End of Cone Test								

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 70-11047 LOCATION Sta. 87 + 36 o/s 6' Rt. ORIGINATED BY GA
W.P. 122-65-07 & 08 BORING DATE Nov. 27 & 28, 1969 COMPILED BY GA
DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W _P	W	W _L		
597.5	Top of Fill															
0.0	Fill Clayey silt with some sand & traces gravel Very Stiff	[Hatched]	1	SS	20											
588.0			2	SS	15											
9.5			3	SS	40											
			4	SS	27											
	Clayey silt with some sand & traces gravel		5	SS	24											
			6	SS	17											
	Hard to Firm		7	TW	PH											
			8	SS	11											
			9	TW	PH											
			10	SS	25											
			11	TW	PH											
			12	SS	12											
540.0			13	TW	PH											
57.5																
	Silty clay with traces of sand and gravel Firm to Hard	[Hatched]														
480.0	Auger grinding															
117.5	Probably Bedrock End of Borehole	[Hatched]														

20
10-5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 70-11047 LOCATION Sta. 86 + 75 o/s 100' Lt. ORIGINATED BY GA
 W.P. 122-65-07 & 08 BORING DATE Nov. 25 & 26, 1969 COMPILED BY GA
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY JK

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT % 10 20 30				
597.9	Top of Fill														
0.0	Fill														
	Clayey silt with some sand & traces gravel	1	SS	12											
	Stiff														
588.0	O.G.														
9.9		2	SS	12											
		3	SS	45											
		4	SS	24											
	Clayey silt with some sand & traces gravel	5	SS	32											
	Hard to Firm	6	TW	PH										130	
		7	SS	27											
		8	TW	PH										129	
		9	TW	PH										134	
		10	TW	PH											
		11	SS	17											
540.0															
57.9		12	TW	PH										122	0 1 61 38
		13	TW	PH										123	
	Silty clay with traces of sand and gravel														
	Firm to Hard														
		14	TW	PH											
485.4	Auger Grinding														
112.5	End of Borehole Probably bedrock														

20
10 ϕ 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS- ONTARIO
 MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 70-11047 LOCATION Sta. 87 + 86 o/s 86' Lt. ORIGINATED BY AKB
 W.P. 122-65-07 & 08 BORING DATE June 24 - 25, 1970 COMPILED BY AKB
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WATER CONTENT %				
						1000	2000	10	20	30		GR. SA. SI. CL.
596.3	Ground Level											
0.0	Clayey silt Fill. Brown Very Stiff	X	1	SS	19							
589.3												
7.0	Organic silt & sand. Stiff	▽	2	SS	10							
585.3												
11.0			3	SS	60							
	Clayey silt with traces of sand and gravel		4	SS	12							
	Hard to Firm		5	TW	PH						129	
	Grey		6	SS	8							
			7	TW	PM						112 136.5	
			8	SS	8							
541.3												
55.0												
	Silty clay with traces of sand and gravel	/	9	TW	PM						117.5 119.5	
			10	SS	11							
	Stiff to Very Stiff											
	Grey		11	TW	PM						127.5	
486.3	Probable Bedrock	—										
110.0	End of Borehole											

20
 10 — 5 % STRAIN AT FAILURE
 10

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.7

FOUNDATION SECTION

JOB 70-11047
W.P. 122-65-07 & 08
DATUM Geodetic

LOCATION Sta. 86 + 86, 71 Ft. Rt. of ϕ
BORING DATE June 4-9, 1970
BOREHOLE TYPE C.M.E. Auger & Diamond Drilling

ORIGINATED BY T.P.
COMPILED BY A.K.B.
CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		1000	2000	WATER CONTENT % 10 20 30				
597.1	Ground Level												
0.0	Clayey silt fill. Brown Stiff	[X]	1	SS	13							135	
589.6		[X]	2	TW	PM	590							
7.5	Organic silt & sand loose	[Wavy]	3	SS	5	585.6							
11.5	Clayey silt with traces of sand & gr. hard to firm grey	[Diagonal]	4	TW	PH							141	
		[Diagonal]	5	SS	27	580						140	
		[Diagonal]	6	TW	PM								
		[Diagonal]	7	SS	9	570							
		[Diagonal]	8	TW	PM							129	
		[Diagonal]	9	SS	20	560							
		[Diagonal]	10	TW	PM	550						136.5	
541.1		[Diagonal]				540							
56.0	Silty clay with traces of sand & gravel stiff grey	[Diagonal]	11	SS	8	530							
		[Diagonal]	12	TW	PM	520						124	
487.0		[Diagonal]				490							
110.1	shale bedrock	[Hatched]	13	RC	Rec. 100%								
482.0		[Hatched]											
115.1	End of borehole	[Hatched]											

20
10 ϕ 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 70-11047 LOCATION Sta. 85 + 70 73' Rt. of ♂ ORIGINATED BY TP
 W.P. 122-65-07 & 08 BORING DATE June 25 - 29, 1970 COMPILED BY AKB
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		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.		WATER CONTENT %			
						1000	2000					
596.1	Ground Level											
0.0	Clayey Silt Fill											
589.1	Firm		1	SS	9							
7.0	Black Peat		2	SS	15							
	Organic silt & sand											
584.1			3	SS	20							
12.0												
	Clayey silt with traces of sand and gravel		4	SS	45							
			5	TW	PM						133	
	Very stiff to stiff		6	SS	28						132	
			7	TW	PM						131	
			8	SS	22							
543.1												
53.0			9	TW	PM						116	
	Silty clay with traces of sand and gravel										117	
			10	SS	12							
	Firm to Stiff		11	TW	PM						121.5	
			12	TW	PM							
			13	TW	PM						125	
											119	
487.4	Probable Bedrock											
108.7	End of Borehole											

20
15-5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 70-11047 LOCATION Sta. 88 + 00 ORIGINATED BY T.P.
 W.P. 122-65-0708 BORING DATE June 30, 1970 COMPILED BY A.K.B.
 DATUM Geodetic BOREHOLE TYPE C.M.E. Auger CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.		WATER CONTENT %				
						1000	2000	10	20	30			
588.8	Ground Level												
0.0	Black org. & sand												
2.0	Clayey silt with traces of sand & gravel Stiff to firm		1	SS	19								
				2	SS	12							
				3	SS	6							
				4	TW	PM						130.5	
				5	TW	PH						137.5	
				6	SS	24							
540.0													
537.3	Silty clay with sa. & gr.		7	TW	PH						118 116		
51.5	End of borehole												

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

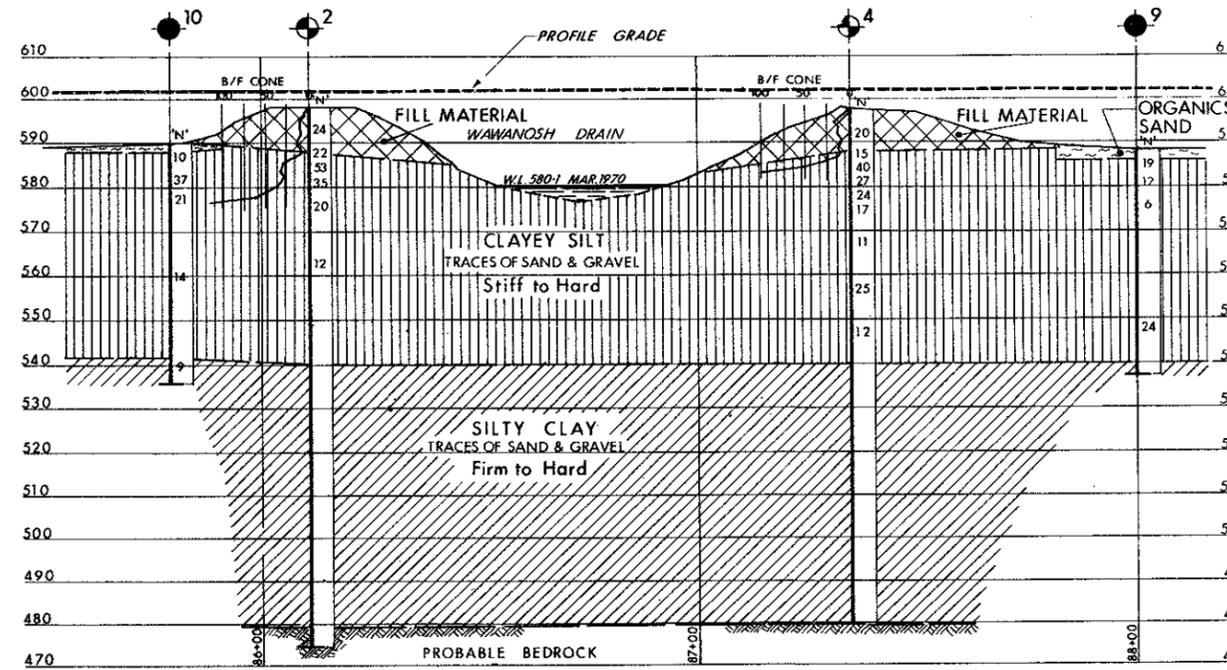
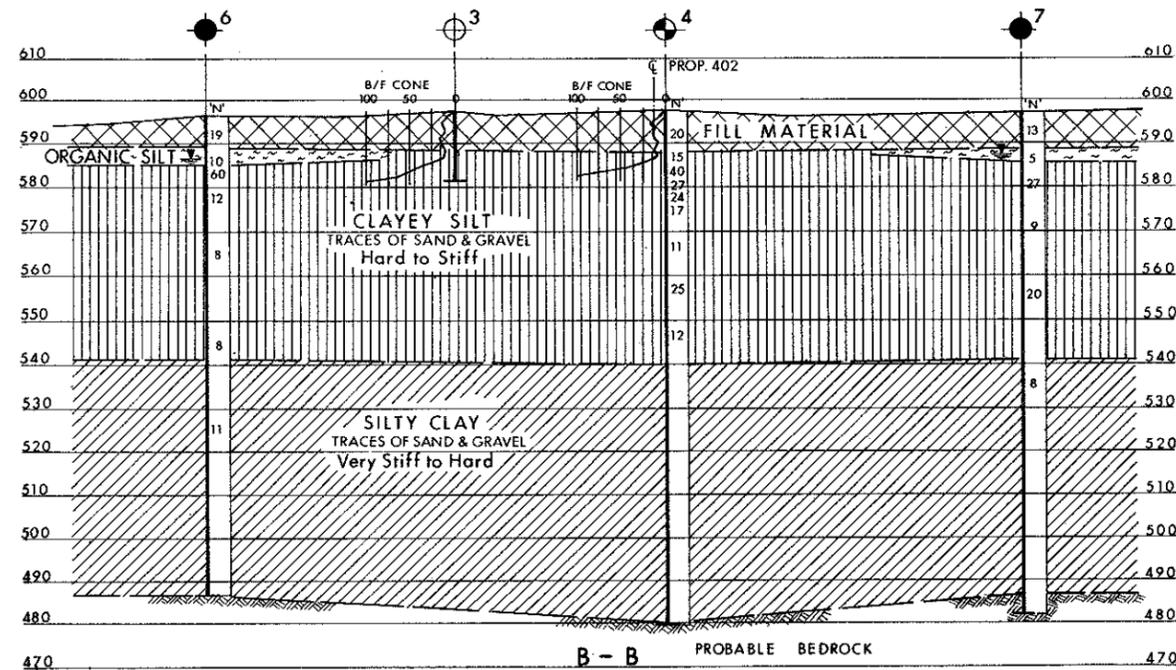
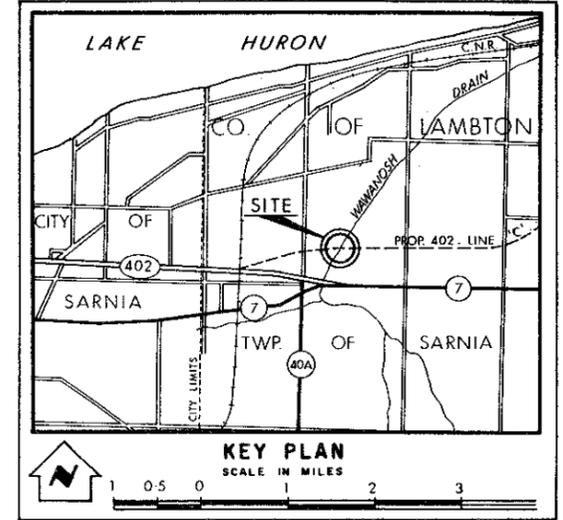
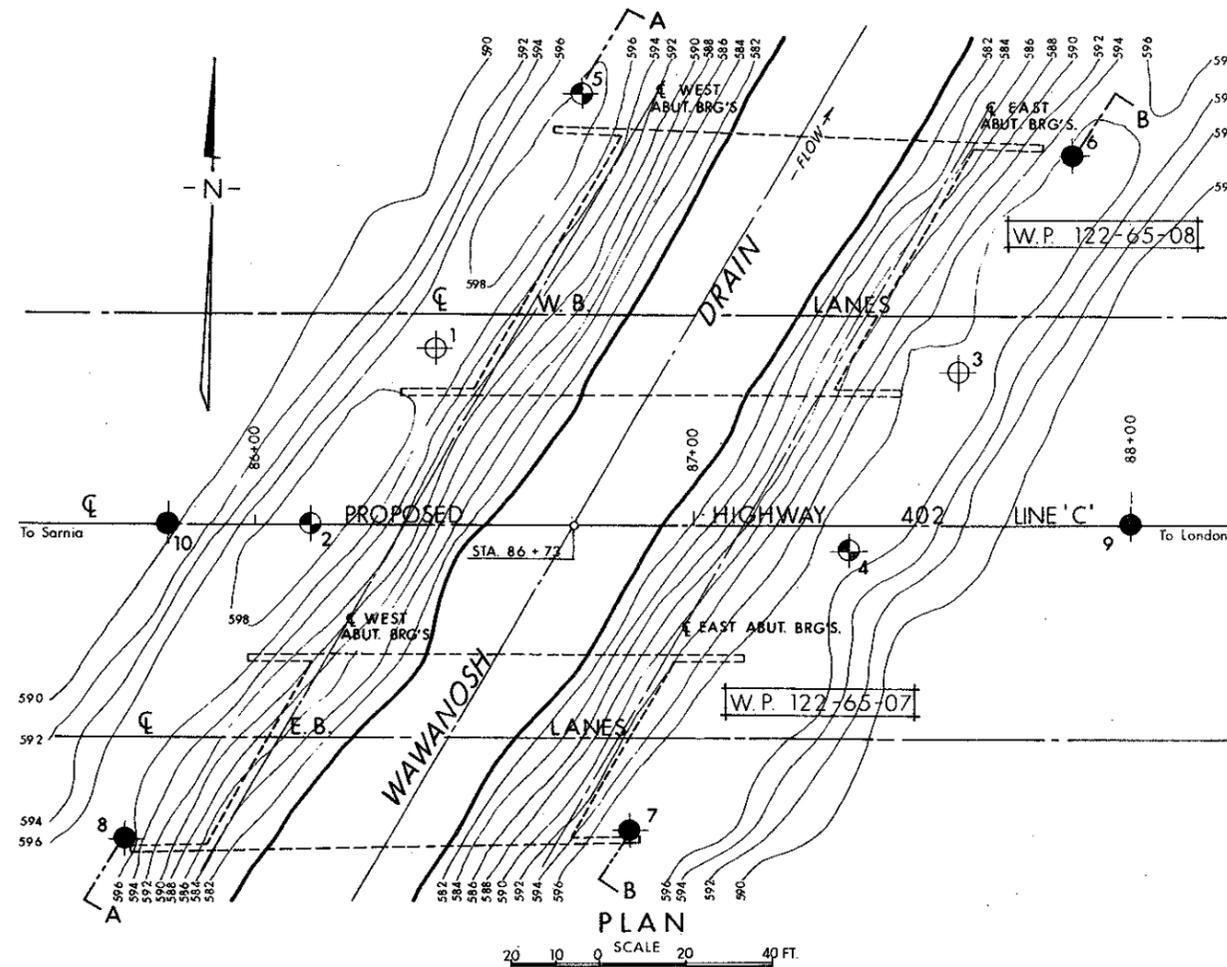
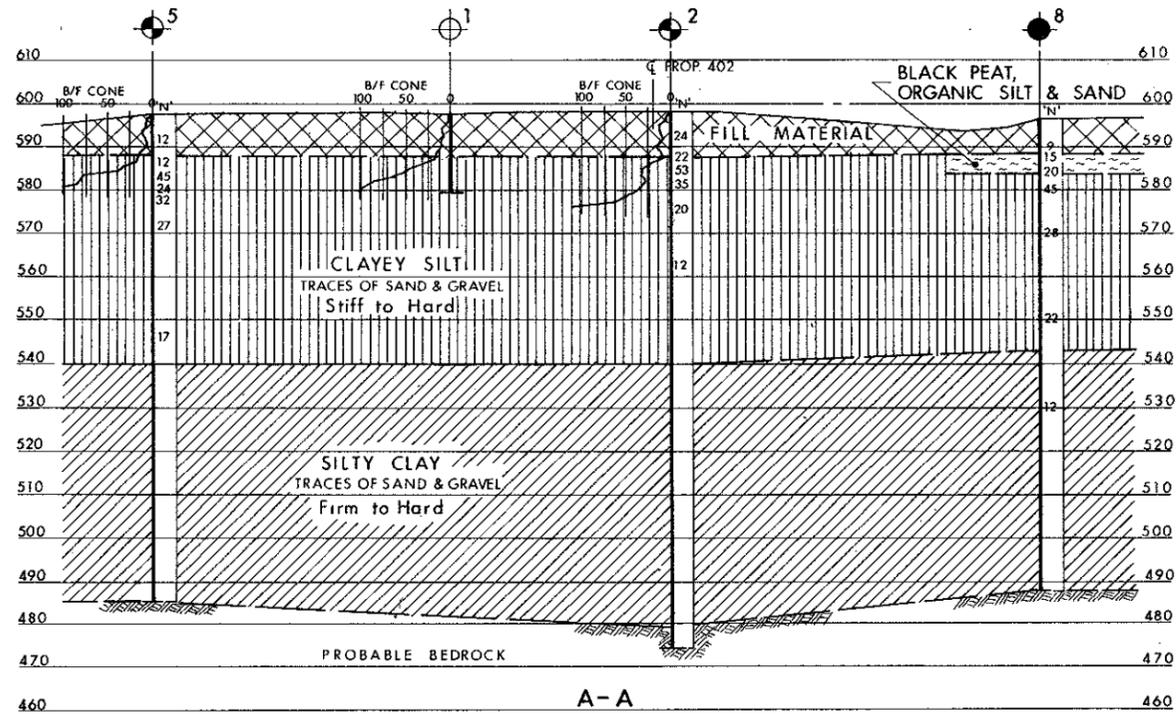
RECORD OF BOREHOLE No.10

FOUNDATION SECTION

JOB 70-11047 LOCATION Sta. 85 + 80 @ ORIGINATED BY TP
 W.P. 122-65-07 & 08 BORING DATE June 30, 1970 COMPILED BY AKB
 DATUM Geodetic BOREHOLE TYPE C.M.E. Auger CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %					
					1000	2000							
589.8	Ground Level												
0.0	Black Organics												
2.0	Clayey silt with traces of sand and gravel Stiff Grey	1	SS	10									
		2	SS	37	580								
		3	SS	21									
		4	TW	PM	570							131.5	
		5	SS	14	560								
		6	TW	PM	550							138	
		7	SS	9	540								
541.8	Silty clay, traces of sand & gravel												
536.8	Firm												
53.0	End of Borehole												

20
15-5 % STRAIN AT FAILURE
10



LEGEND

- Bore Hole
- ⊕ Cone Penetration Hole
- ⊕ Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, JUNE 1970
- WATER LEVELS NOT ESTABLISHED FOR BORE HOLES 2,4,5,8,9&10

NO.	ELEVATION	STATION	OFFSET
1	597.6	86+41	40' LT.
2	598.3	86+13	⊕
3	597.2	87+61	35' LT.
4	597.5	87+36	6' RT.
5	597.9	86+75	100' LT.
6	596.3	87+86	86' LT.
7	597.1	86+86	71' RT.
8	596.1	85+70	73' RT.
9	588.8	88+00	⊕
10	589.8	85+80	⊕

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.

NO.	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

WAWANOSH DRAIN

KING'S HIGHWAY NO. 402 LINE 'C' DIST. NO. 1
CO. LAMBTON
TWP. SARNIA LOT 14 CON. 7

BORE HOLE LOCATIONS & SOIL STRATA

SUB'D. A.B.	CHECKED/	W.P. NO. 122-65-07&08	M.B.T. DRAWING NO.
DRAWN S.O.	CHECKED/	JOB NO. 70-11047	70-11047A
DATE 17 JULY 1970	SITE NO. 14-341	BRIDGE DRAWING NO.	
APPROVED/	CONT. NO. 75-27		14-341-2

NOTE: The complete soil investigation report for this structure may be examined at the Bridge Office and Foundation Office, Downsview, and at the CHATHAM District Office.

Appendix C

Current Investigation

GHD Borehole Records



Notes on Borehole and Test Pit Reports

Soil description :

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

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

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

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

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

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

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

Samples:

Type and Number

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

SS: Split spoon

ST: Shelby tube

AG: Auger

SSE, GSE, AGE: Environmental sampling

PS: Piston sample (Osterberg)

RC: Rock core

NR: No Recovery

GS: Grab sample

Recovery

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

RQD

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

IN-SITU TESTS:

N: Standard penetration index

N_c: Dynamic cone penetration index

k: Permeability

R: Refusal to penetration

Cu: Undrained shear strength

ABS: Absorption (Packer test)

Pr: Pressure meter

LABORATORY TESTS:

I_p: Plasticity index

H: Hydrometer analysis

A: Atterberg limits

C: Consolidation

O.V.: Organic vapor

W_l: Liquid limit

GSA: Grain size analysis

w: Water content

CS: Swedish fall cone

W_p: Plastic limit

NP: non-plastic

y: Unit weight

CHEM: Chemical analysis

RECORD OF BOREHOLE No BH5-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761218.1, Easting: 317492.3, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.18 - 2023.04.18 LATITUDE 42.990662 LONGITUDE -82.344352 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHII - HWY 402-40 AND WAWANOSH\104-FIELDWORK\106-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHII.GPJ
 Library File: 12566052 MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
10.0	FILL - SANDY CLAYEY SILT, trace gravel Stiff to very stiff Brown Moist		9	SS	14													
174.8																		
12.2	CLAYEY SILT, some sand, trace gravel Very stiff Brown to grey Moist		10	SS	20							18						LL=32% PL=16% PI=16%
174.2																		
12.8	END OF BOREHOLE NOTE: 1. Open borehole was dry upon completion of drilling.																	

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH6-22

1 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761193.9, Easting: 317490.5, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.10 - 2023.04.10 LATITUDE 42.990444 LONGITUDE -82.344375 CHECKED BY A.C

File: \\GHDNET\GHD\CAWATER\LO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052 MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE		STRAT PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			"N" VALUES	20	40	60	80						100
186.9	0.0 ASPHALT (220 mm)																
186.7	0.2 CONCRETE (480 mm)																
186.2	0.7 FILL - SANDY GRAVEL, trace fines Compact to dense Brown Moist		1	SS	45	186					4						
			2	SS	12	185											62 31 (7)
184.6	2.3 FILL - CLAYEY SILT, some sand, trace gravel Stiff Brown to dark brown Moist		3	SS	6	184					15						
				VANE		183.5		X									1 20 40 39 LL=30% PL=17% PI=13%
			4	SS	4	183					17						
				VANE		182.5		X									LL=32% PL=17% PI=15%
			5	SS	9	181					15						
			6	SS	8	180					16						
				VANE		179.5		X									LL=32% PL=17% PI=15%
			7	SS	5	179					19						
				VANE		178.5		X									
			8	SS	7	178					18						
				VANE		177.5		X									
						177											

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH6-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761193.9, Easting: 317490.5, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.10 - 2023.04.10 LATITUDE 42.990444 LONGITUDE -82.344375 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052.MTD.LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20	40	60	80	100							
176.2				VANE													
10.7	CLAYEY SILT, some sand, trace gravel Firm to very stiff Brown to grey Moist		9	SS	6												
				VANE													
175																	
174.1			10	SS	14												
12.8	END OF BOREHOLE NOTE: 1. Open borehole was dry upon completion of drilling.																

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH7-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761218.8, Easting: 317572.8, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.11 - 2023.04.11 LATITUDE 42.990667 LONGITUDE -82.343365 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHIL - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHIL.GPJ
 Library File: 12566052 MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
176.2				VANE					×	+							
10.7	SILTY SAND, some gravel, trace clay Compact Grey Moist to wet		9	SS	10	▽	176					15				18 50 25 7	
174.7							175										
12.2	CLAYEY SILT, some sand, trace gravel Stiff Brown to grey Moist		10	SS	11							18					
174.1																	
12.8	END OF BOREHOLE NOTE: 1. Water level at 10.7 m below ground surface (Elevation 176.2 m) upon completion of drilling.																

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH8-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761194.5, Easting: 317571.5, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.18 - 2023.04.18 LATITUDE 42.990448 LONGITUDE -82.343382 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052.MTD.LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
10.0	CLAYEY SILT, some sand, trace gravel Stiff to very stiff Dark brown Moist		10	SS	10													
							176											
							175											
174.1			11	SS	11							22						LL=33% PL=17% PI=16%
12.8	END OF BOREHOLE NOTE: 1. Open borehole was dry upon completion of drilling.																	

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH9-22

1 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761242.2, Easting: 318284.3, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.13 - 2023.04.13 LATITUDE 42.990866 LONGITUDE -82.334639 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI.GPJ
 Library File: 12566052 MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
182.7	ASPHALT (152 mm)																	
182.5	0.2	FILL - SAND, some silt, some clay, trace gravel Compact to very dense Brown Moist		1	SS	71/ 203,mm												5 72 (23)
181.2	1.5	FILL - CLAYEY SILT, some sand, trace gravel Stiff to very stiff Brown Moist		3	SS	11						10						
				4	SS	15						10						
				5	SS	13						16						
				6	SS	16						19						
178.1	4.6	CLAYEY SILT, some sand, trace gravel Firm to very stiff Dark Brown Moist		7	SS	17						11	11					2 18 46 34 LL=31% PL=16% PI=15%
				8	SS	16						15	15					1 21 44 34 LL=29% PL=18% PI=11%
				9	SS	8						20						
					VANE							>100 kPa						
				10	SS	5						21						
					VANE							>100 kPa						
				11	SS	4						23	23					LL=31% PL=17% PI=14%
172.7																		

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH9-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761242.2, Easting: 318284.3, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.13 - 2023.04.13 LATITUDE 42.990866 LONGITUDE -82.334639 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052 MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60
10.0	CLAYEY SILT, some sand, trace gravel Firm to very stiff Dark Brown Moist			VANE					X	+										
			12	SS	2									21						
						VANE														
					13	SS	10								19					
169.9						▽	172													
							171													
							170													
12.8	END OF BOREHOLE																			
	NOTE: 1. Water level at 10.7 m below ground surface (Elevation 174.0 m) upon completion of drilling.																			
																		LL=29% PL=16% PI=13%		

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH10-22

1 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761241.6, Easting: 318331.5, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.13 - 2023.04.13 LATITUDE 42.990859 LONGITUDE -82.334061 CHECKED BY A.C

File: \\GHDNET\GHD\CAWATER\LO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052 MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40					
182.6	ASPHALT (203 mm)													
182.4	FILL - SAND and GRAVEL, trace silt, contains asphalt fragments		1	SS	76/203,mm									
181.8	FILL - CLAYEY SILT, some sand, trace gravel		2	SS	6						15			LL=30% PL=18% PI=12%
	Firm to very stiff			VANE							>100 kPa			
	Brown		3	SS	10						15			
	Moist		4	SS	12						10			LL=32% PL=16% PI=16%
			5	SS	18						18			
			6	SS	6						11			2 18 47 33 LL=26% PL=14% PI=12%
				VANE							X +			
			7	SS	5						21			
				VANE							>100 kPa			
175.0	CLAYEY SILT, some sand, trace gravel		8	SS	3						20			LL=31% PL=17% PI=14%
	Stiff to very stiff			VANE							>100 kPa			
	Dark brown		9	SS	3						21			
	Moist			VANE							>100 kPa			
172.6														

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH10-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761241.6, Easting: 318331.5, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.13 - 2023.04.13 LATITUDE 42.990859 LONGITUDE -82.334061 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\104-FIELDWORK\106-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052.MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						
10.0	CLAYEY SILT, some sand, trace gravel Stiff to very stiff Dark brown Moist			VANE														
			10	SS	5													
						VANE												
			11	SS	11													
169.8																		
172																		
171																		
170																		
12.8	END OF BOREHOLE																	
	NOTE: 1. Open borehole was dry upon completion of drilling.																	

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH12-22

1 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761229.0, Easting: 318336.8, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.11 - 2023.04.11 LATITUDE 42.990745 LONGITUDE -82.333996 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052.MTD.LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
182.6																		
182.5	0.0	ASPHALT (102 mm)																
182.3	0.1	CONCRETE (203 mm)																
182.2	0.3	FILL - SAND and GRAVEL, trace silt	1A								12							
	0.4	Compact Brown Moist	1B	SS	13						14							
		FILL - SANDY CLAYEY SILT, trace gravel	2	SS	11						14							7 26 38 29 LL=29% PL=16% PI=13%
		Stiff to very stiff																
		Brown Moist	3	SS	10						28							
		wood pieces	4	SS	10						14							
			5	SS	10						11							
			6	SS	26						11							
178.0	4.6	CLAYEY SILT, some sand, trace gravel	7	SS	18						13							2 17 43 38 LL=31% PL=16% PI=15%
		Firm to stiff																
		Brown to grey	8	SS	12						13							
		Moist	9	SS	5						20							LL=32% PL=17% PI=15%
				VANE														
			10	SS	2						21							
				VANE														
			11	SS	2						13							3 15 47 35 LL=31% PL=17% PI=14%
172.6																		

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH12-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761229.0, Easting: 318336.8, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.11 - 2023.04.11 LATITUDE 42.990745 LONGITUDE -82.333996 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052.MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60
10.0	CLAYEY SILT, some sand, trace gravel Firm to stiff Brown to grey Moist			VANE																
			12	SS	3								22							
						VANE					X	+								
169.8					13	SS	4							19						LL=30% PL=16% PI=14%
12.8	END OF BOREHOLE																			
	NOTE: 1. Open borehole was dry upon completion of drilling.																			

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH13-22

1 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761205.1, Easting: 318257.5, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.10 - 2023.04.10 LATITUDE 42.990532 LONGITUDE -82.334969 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052 MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
						20	40	60	80	100	20	40	60		GR	SA	SI	CL			
182.9																					
182.8	0.0 ASPHALT (102 mm)																				
182.5	0.1 CONCRETE (254 mm)																				
	0.4 FILL - GRAVELLY SAND, some fines Compact Brown Moist		1	SS	21						5								31 41 (28)		
181.9	1.0 FILL - CLAYEY SILT, some sand, trace gravel Firm to very stiff Brown Moist		2	SS	7							13								LL=26% PL=15% PI=11%	
			3	SS	9							9									
			4	SS	12							12									
			5	SS	8							11									
				VANE																	
			6	SS	18							14									
	contains roots		7	SS	14							16								1 18 43 38 LL=31% PL=17% PI=14%	
176.8	6.1 CLAYEY SILT, some sand, trace gravel Stiff Brown to grey Moist		8	SS	11							17									
			9	SS	13							19								LL=32% PL=18% PI=14%	
		10	SS	6							22										
172.9																					

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH13-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761205.1, Easting: 318257.5, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.10 - 2023.04.10 LATITUDE 42.990532 LONGITUDE -82.334969 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHIL - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHIL.GPJ
 Library File: 12566052.MTD.LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60
10.0	CLAYEY SILT, some sand, trace gravel Stiff Brown to grey Moist			VANE																
			11	SS	3															
						VANE														
170.1			12	SS	3															
12.8	END OF BOREHOLE																			
	NOTE: 1. Open borehole was dry upon completion of drilling.																			

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH14-22

1 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761204.5, Easting: 318308.9, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.13 - 2023.04.13 LATITUDE 42.990525 LONGITUDE -82.334339 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052.MTD.LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60
182.8	ASPHALT (127 mm)																			
182.7	CONCRETE (508 mm)																			
182.2	FILL - CLAYEY SILT, some sand to sandy, trace gravel Stiff to very stiff Brown to dark Moist	[Cross-hatched pattern]	1	SS	11															
			2	SS	11								11						LL=27% PL=16% PI=11%	
			3	SS	13								11							1 30 38 31 LL=24% PL=12% PI=12%
			4	SS	12								18							LL=28% PL=14% PI=14%
			5	SS	14								13							
			6	SS	18								14							
			7	SS	12								19							
			8	SS	10								21							4 17 40 39 LL=31% PL=16% PI=15%
			9	SS	5								22							
			VANE										>100 kPa							
	10	SS	6								22							LL=31% PL=15% PI=16%		
172.8																				

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH14-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761204.5, Easting: 318308.9, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.13 - 2023.04.13 LATITUDE 42.990525 LONGITUDE -82.334339 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052 MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						
10.0	CLAYEY SILT, some sand, trace gravel Stiff to very stiff Brown to grey Moist Auger grinding from 11.3m to 12.2m			VANE					X	+								
			11	SS	7									22				
						VANE												
					12	SS	10								16			
170.0																		
170																		
12.8	END OF BOREHOLE NOTE: 1. Water level at 10.7 m below ground surface (Elevation 174.1 m) upon completion of drilling.																	

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH15-22

1 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761194.5, Easting: 318237.6, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.12 - 2023.04.12 LATITUDE 42.990437 LONGITUDE -82.335214 CHECKED BY A.C

File: \\GHDNET\GHD\CAWATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052.MTD.LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40
182.7	ASPHALT (152 mm)																		
182.5	0.0		1	SS	31														
	0.2		FILL - GRAVELLY SAND, some silt, trace clay Dense Grey to brown																
181.9	0.8		FILL - CLAYEY SILT, some sand, trace gravel Stiff to very stiff Brown to grey Moist	2	SS	14													
				3	SS	7													
				VANE															
				4	SS	13													
				5	SS	15													
			6	SS	17														
			7	SS	4														
			VANE																
175.8	6.9	FILL - GRAVELLY SAND, trace fines Compact to loose Dark brown Moist to wet	8	SS	14														
			9A	SS	6														
174.7	8.0	FILL - CLAYEY SILT, some sand, trace gravel Very stiff Brown to grey Moist	9B	SS															
			VANE																
173.6	9.1	CLAYEY SILT, some sand, trace gravel Stiff Brown to grey Moist	10	SS	12														
172.7		Auger grinding at 9.8 m																	

Continued Next Page

+ 3 Numbers refer to Sensitivity

LL=29% PL=14%
PI=15%

2 22 43 33
LL=29% PL=15%
PI=14%

30 57 (13)

RECORD OF BOREHOLE No BH15-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761194.5, Easting: 318237.6, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.12 - 2023.04.12 LATITUDE 42.990437 LONGITUDE -82.335214 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PH11 - HWY 402-40 AND WAWANOSH\104-FIELD\WORK\106-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PH11.GPJ
 Library File: 12566052.MTD\LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
10.0	CLAYEY SILT, some sand, trace gravel Stiff Brown to grey Moist contains trace rootlets		11	SS	10											2 15 45 38 LL=32% PL=16% PI=16%	
					12	SS	10										
169.9																	
12.8	END OF BOREHOLE																
	NOTE: 1. Open borehole was dry upon completion of drilling.																

+ 3 Numbers refer to
Sensitivity

RECORD OF BOREHOLE No BH16-22

1 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761196.8, Easting: 318317.8, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.12 - 2023.04.12 LATITUDE 42.990457 LONGITUDE -82.334230 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI.GPJ
 Library File: 12566052 MTD LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
182.7	ASPHALT (203 mm)																	
182.5	FILL - GRAVELLY SAND, some silt, contains asphalt fragments		1	SS	32							15						
181.9	Dense Grey to brown Moist		2	SS	13							15						0 19 44 37 LL=31% PL=14% PI=17%
0.8	FILL - CLAYEY SILT, some sand, trace gravel		3	SS	11							13						
	Stiff to very stiff Brown to grey Moist		4	SS	11							15						LL=31% PL=14% PI=17%
	wood fragments		5	SS	14							12						
			6	SS	16							15						
			7	SS	21							11						
177.4	CLAYEY SILT, some sand, trace gavel		8	SS	12							16						
	Stiff to very stiff Brown to grey Moist		9	SS	8							18						3 17 44 36 LL=29% PL=14% PI=15%
				VANE								>100 kPa						
			10	SS	0							22						LL=31% PL=15% PI=16%
				VANE														
			11	SS	6				X	+		21						
172.7																		

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH16-22

2 OF 2

METRIC

G.W.P. NO. 3105-18-00 LOCATION Hwy 402 / 40 Bridge (Northing: 4761196.8, Easting: 318317.8, MTM Zone 11) ORIGINATED BY S.H
 DIST WEST HWY 402/40 BOREHOLE TYPE Hollow Stem Auger DRILLING RIG TYPE Track Mounted Drill Rig COMPILED BY A.W
 DATUM Geodetic DATE 2023.04.12 - 2023.04.12 LATITUDE 42.990457 LONGITUDE -82.334230 CHECKED BY A.C

File: \\GHDNET\GHD\CA\WATERLOO\PROJECTS\66212566052\TECH\12 FOUNDATIONS\PHI1 - HWY 402-40 AND WAWANOSH\04-FIELDWORK\06-FIELD NOTES AND LOGS\GINT LOGS\12566052 LOGS_PHI1.GPJ
 Library File: 12566052.MTD.LIBRARY.GLB Report: 12566052 BOREHOLE LOG_V01 Date: 3/8/23

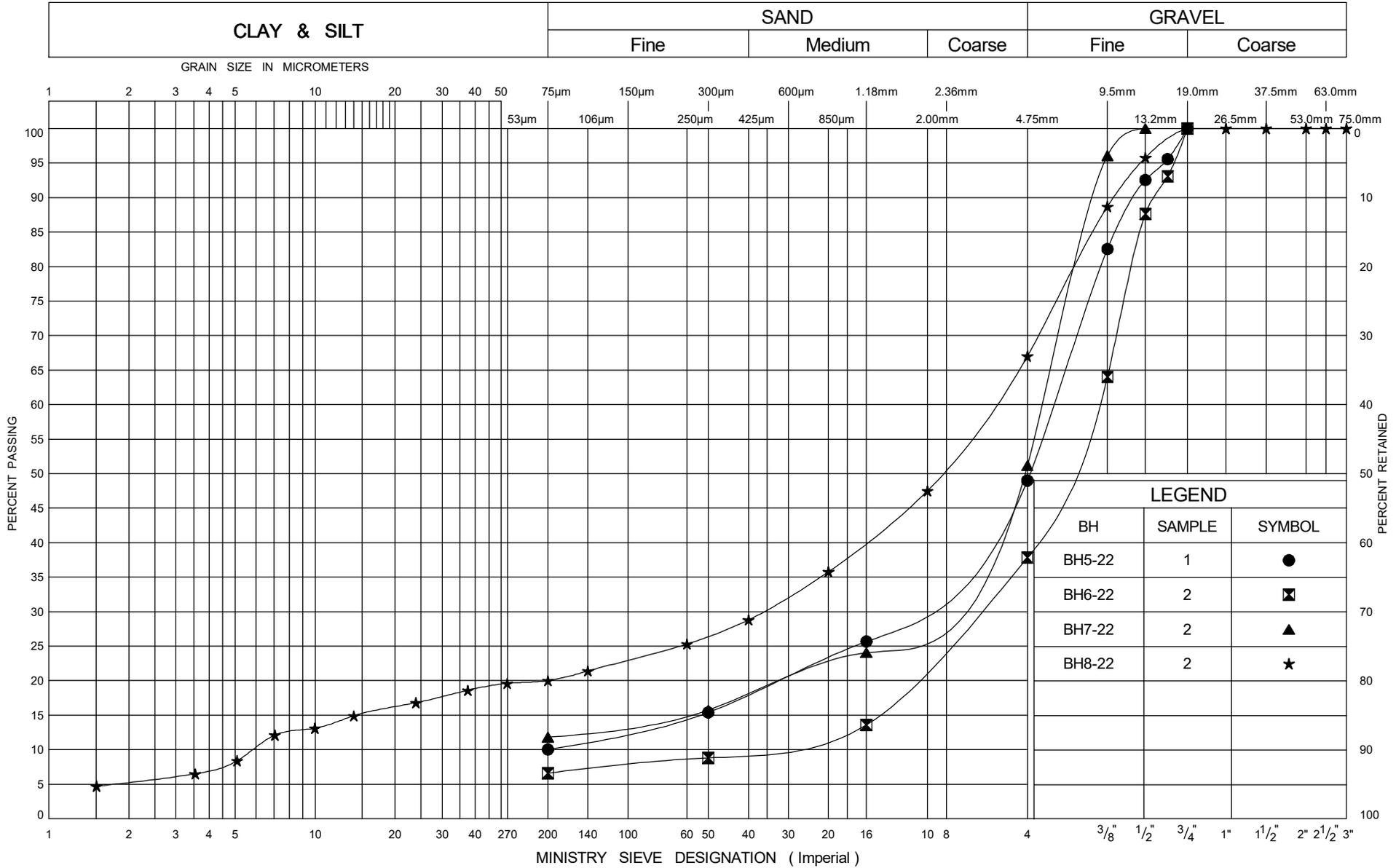
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60
10.0	CLAYEY SILT, some sand, trace gravel Stiff to very stiff Brown to grey Moist			VANE																
			12	SS	3															
						VANE														
			13	SS	11															
169.9							172													
							171													
							170													
12.8	END OF BOREHOLE																			
	NOTE: 1. Open borehole was dry upon completion of drilling.																			

+ 3 Numbers refer to Sensitivity

Appendix D

Geotechnical Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
BH	SAMPLE	SYMBOL
BH5-22	1	●
BH6-22	2	⊠
BH7-22	2	▲
BH8-22	2	★

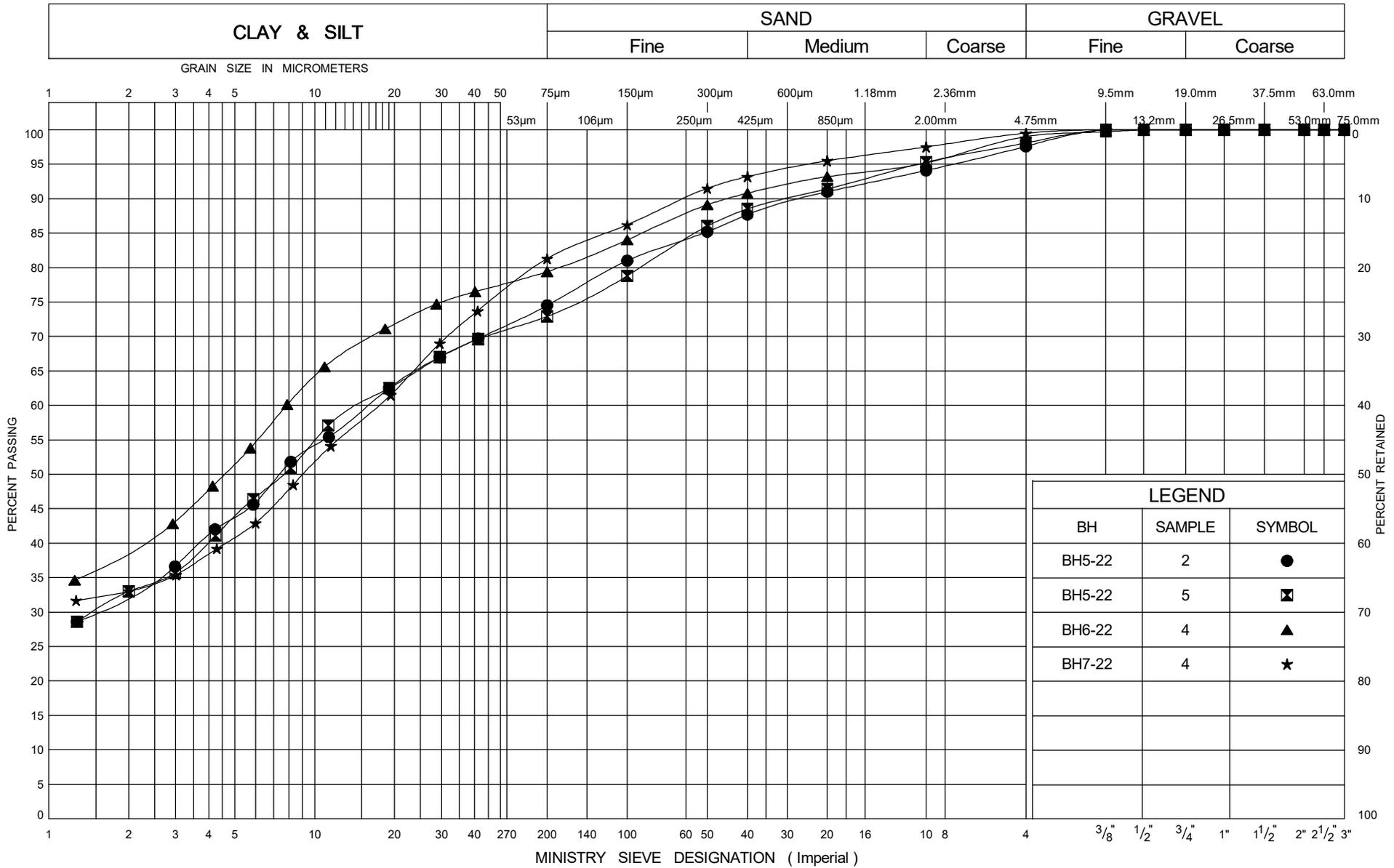


GRAIN SIZE DISTRIBUTION

Fill - Gravelly Sand to Gravel and Sand

Figure:	D-1
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052

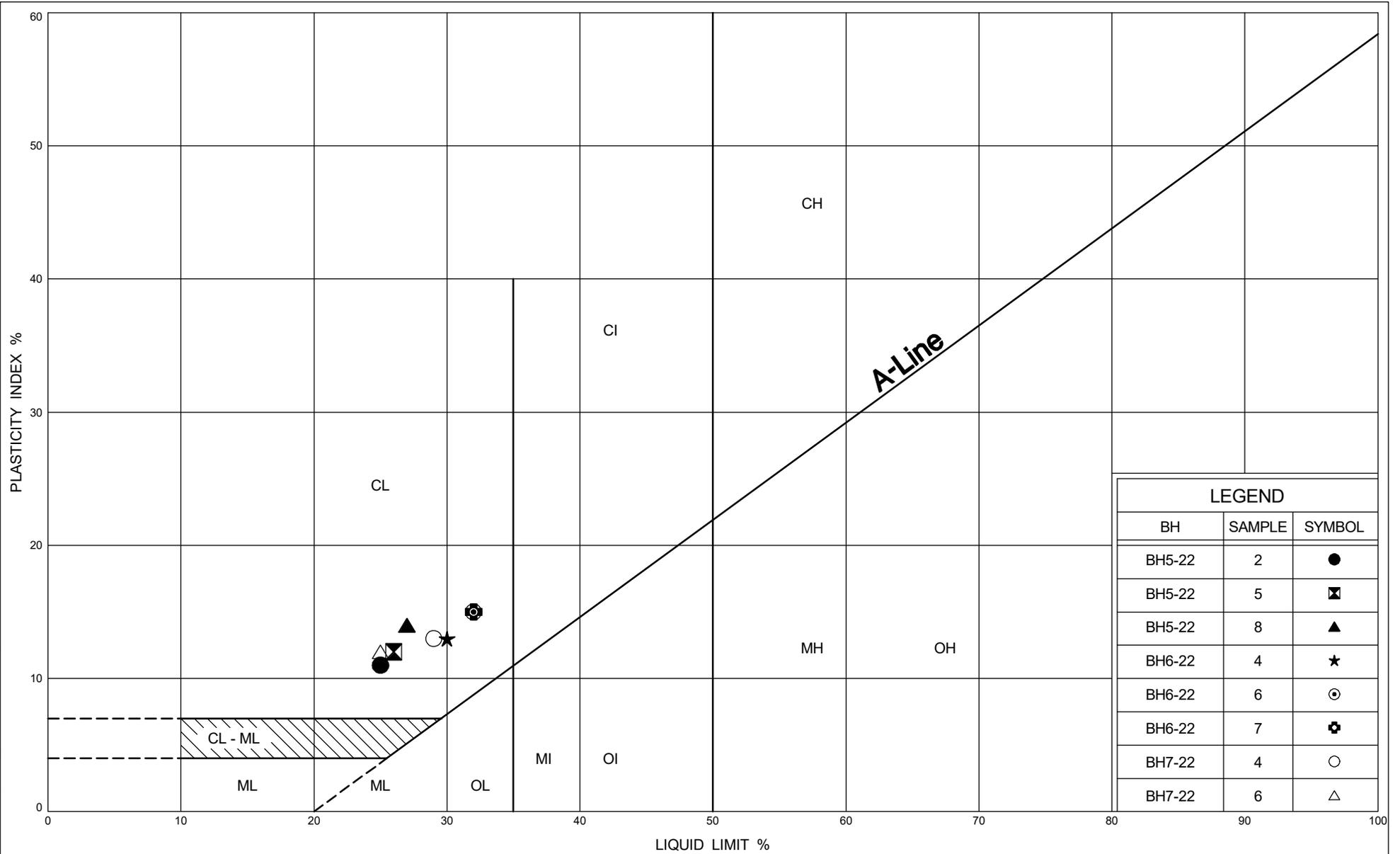
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Fill - Clayey Silt to Sandy Clayey Silt

Figure:	D-2
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052



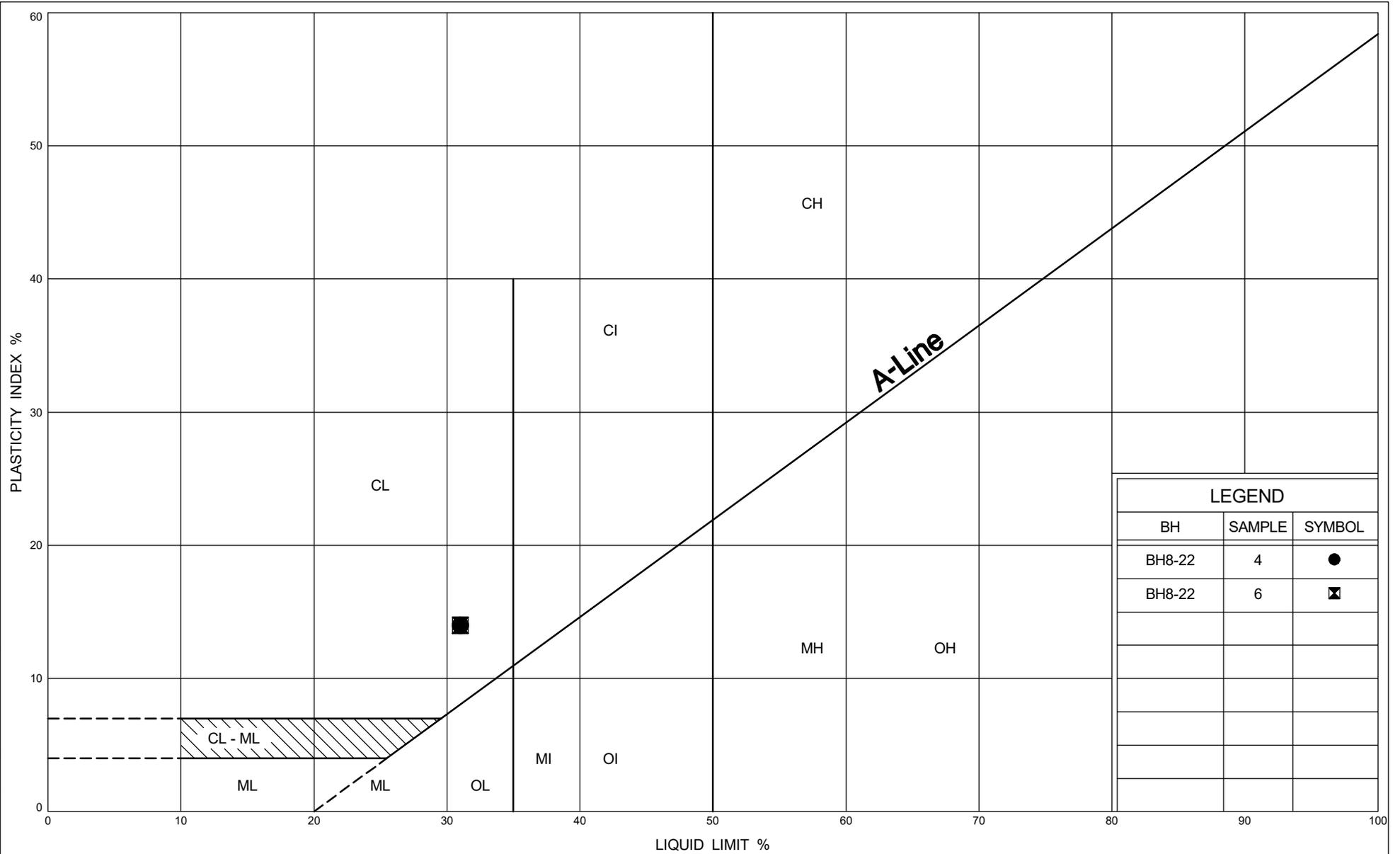
LEGEND		
BH	SAMPLE	SYMBOL
BH5-22	2	●
BH5-22	5	⊠
BH5-22	8	▲
BH6-22	4	★
BH6-22	6	⊙
BH6-22	7	⊕
BH7-22	4	○
BH7-22	6	△



PLASTICITY CHART

Fill - Clayey Silt to Sandy Clayey Silt

Figure:	D-3A
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052



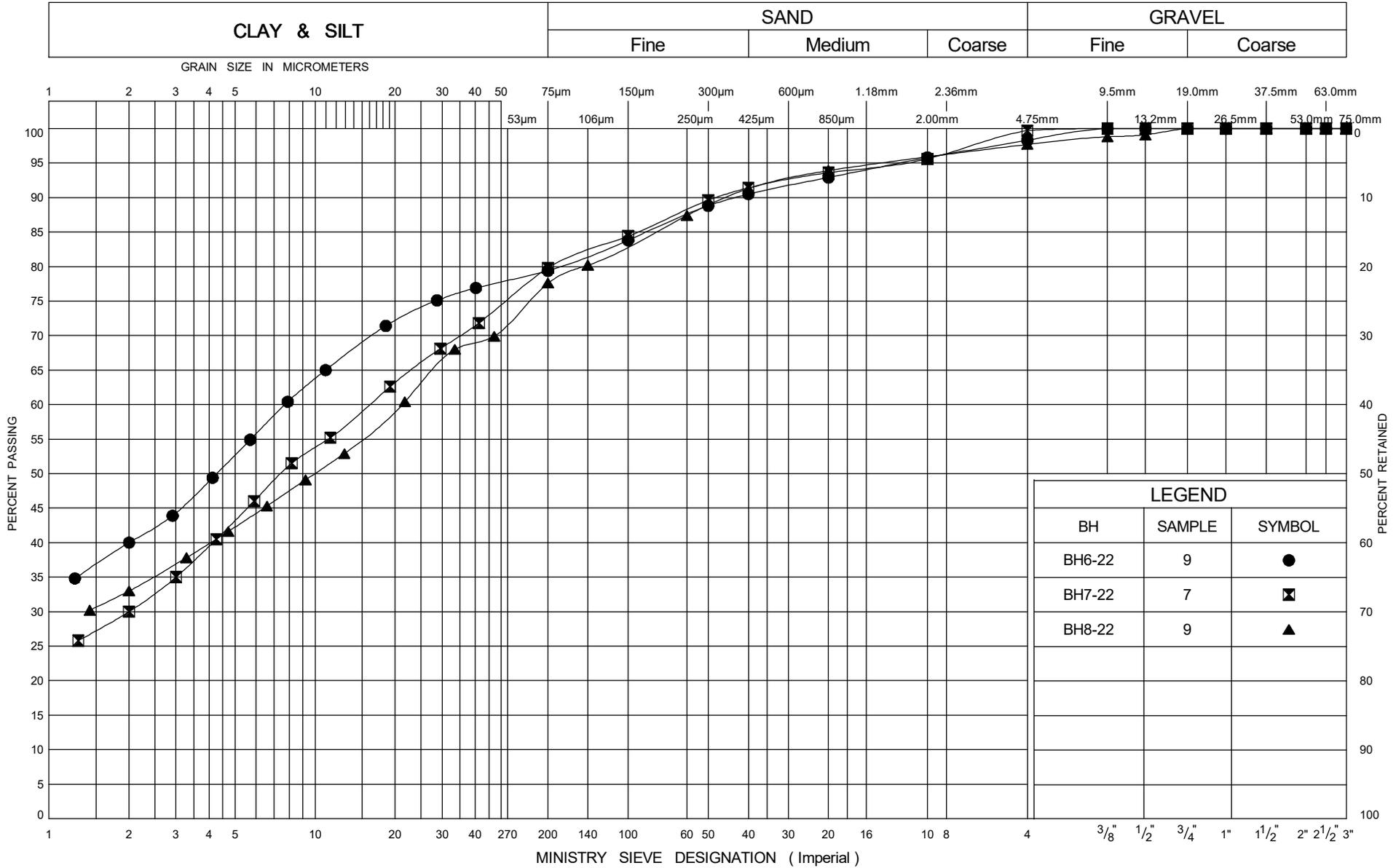
LEGEND		
BH	SAMPLE	SYMBOL
BH8-22	4	●
BH8-22	6	⊠



PLASTICITY CHART
Fill - Clayey Silt to Sandy Clayey Silt

Figure:	D-3B
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052

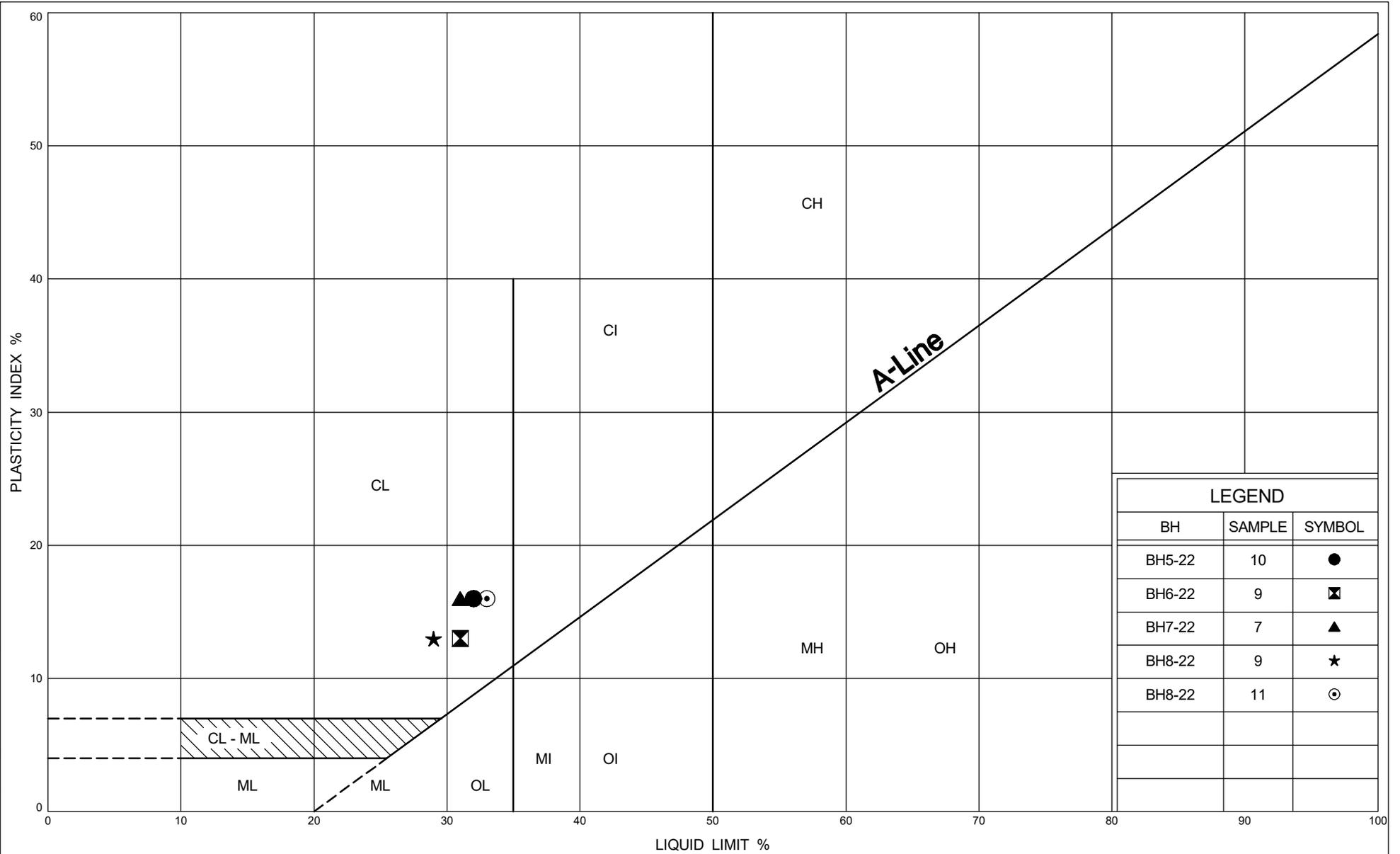
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Clayey Silt

Figure:	D-4
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052



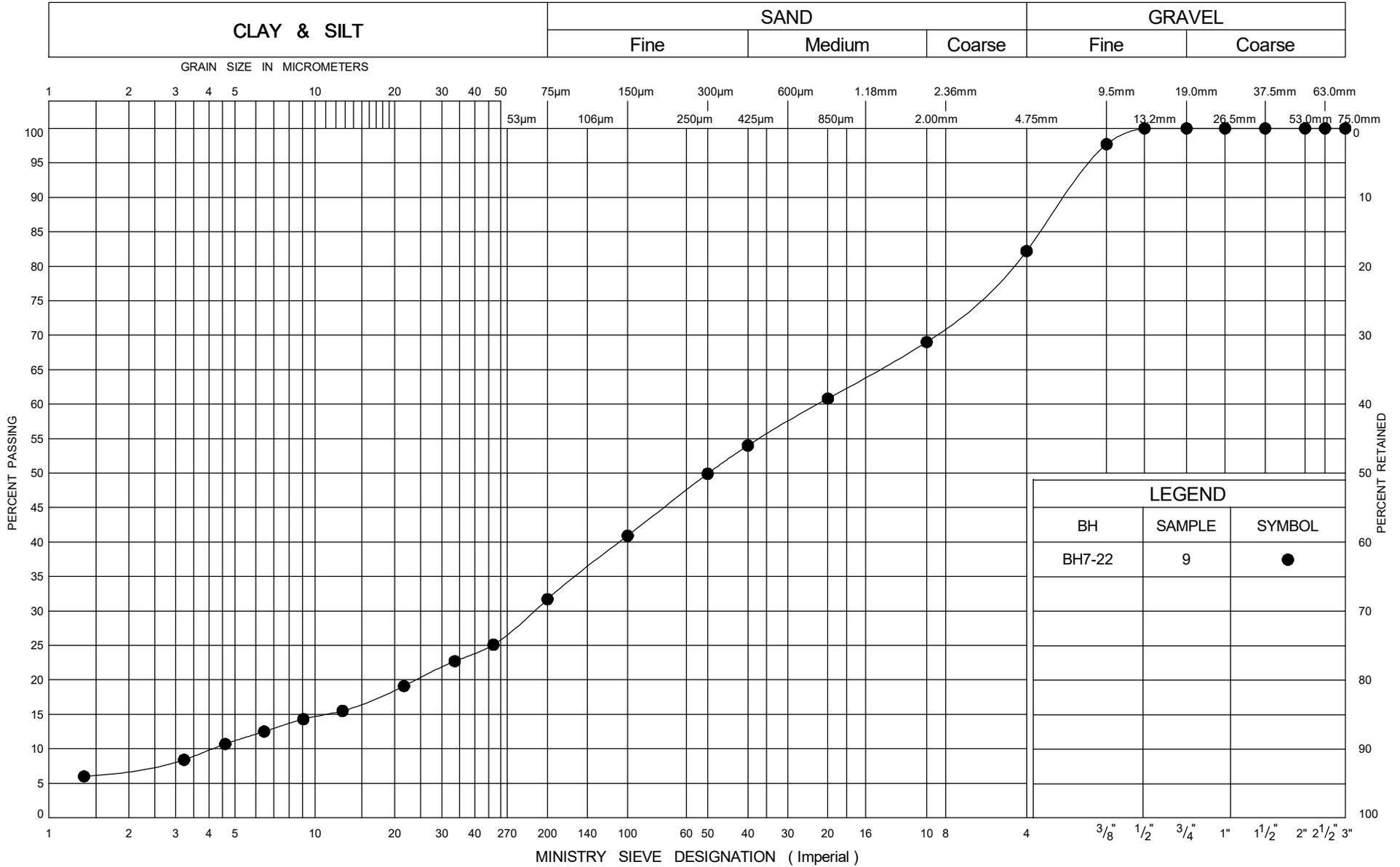
LEGEND		
BH	SAMPLE	SYMBOL
BH5-22	10	●
BH6-22	9	⊠
BH7-22	7	▲
BH8-22	9	★
BH8-22	11	⊙



PLASTICITY CHART
Clayey Silt

Figure:	D-5
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052

UNIFIED SOIL CLASSIFICATION SYSTEM

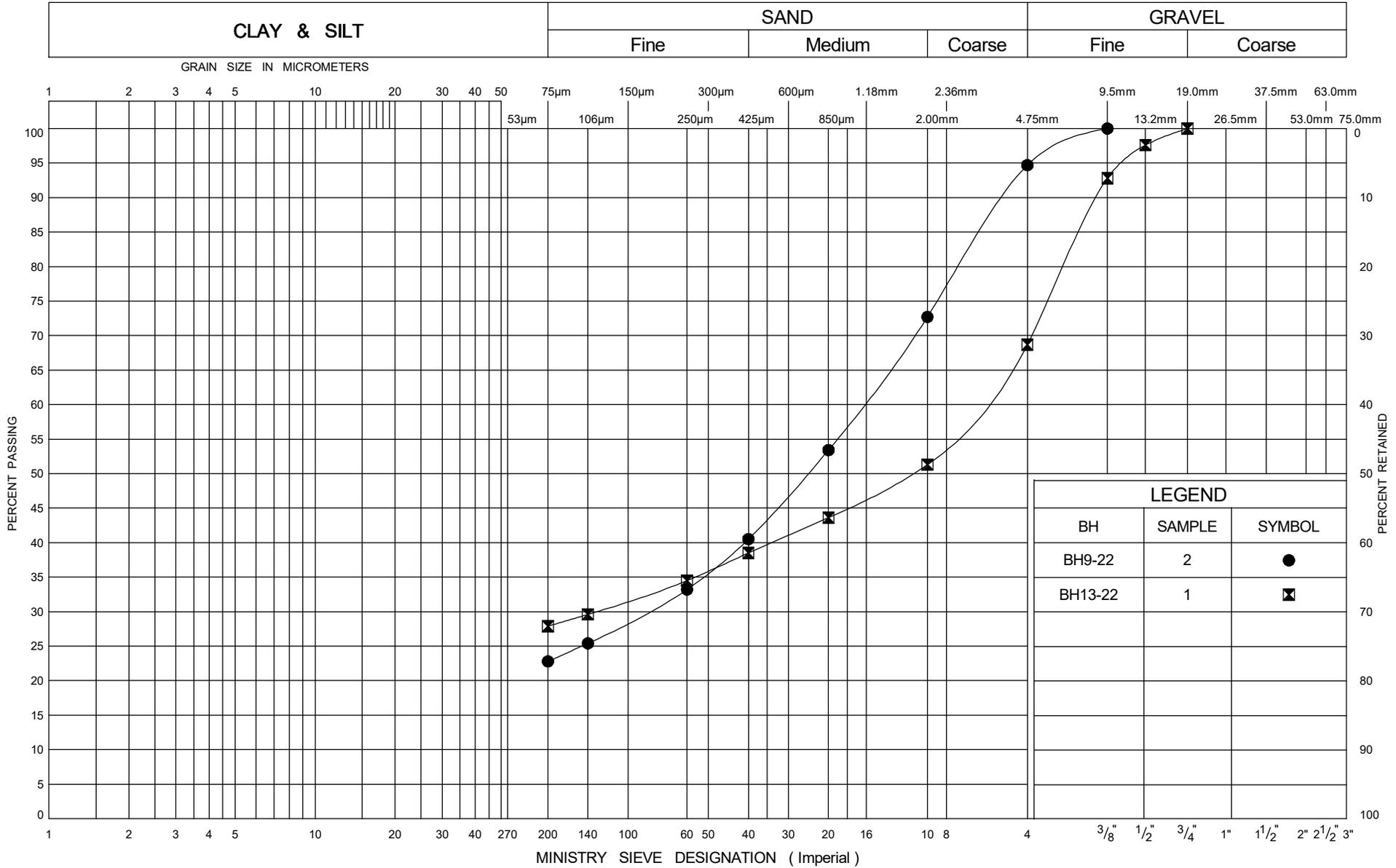


GRAIN SIZE DISTRIBUTION

Silty Sand (Interlayer)

Figure:	D-6
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052

UNIFIED SOIL CLASSIFICATION SYSTEM

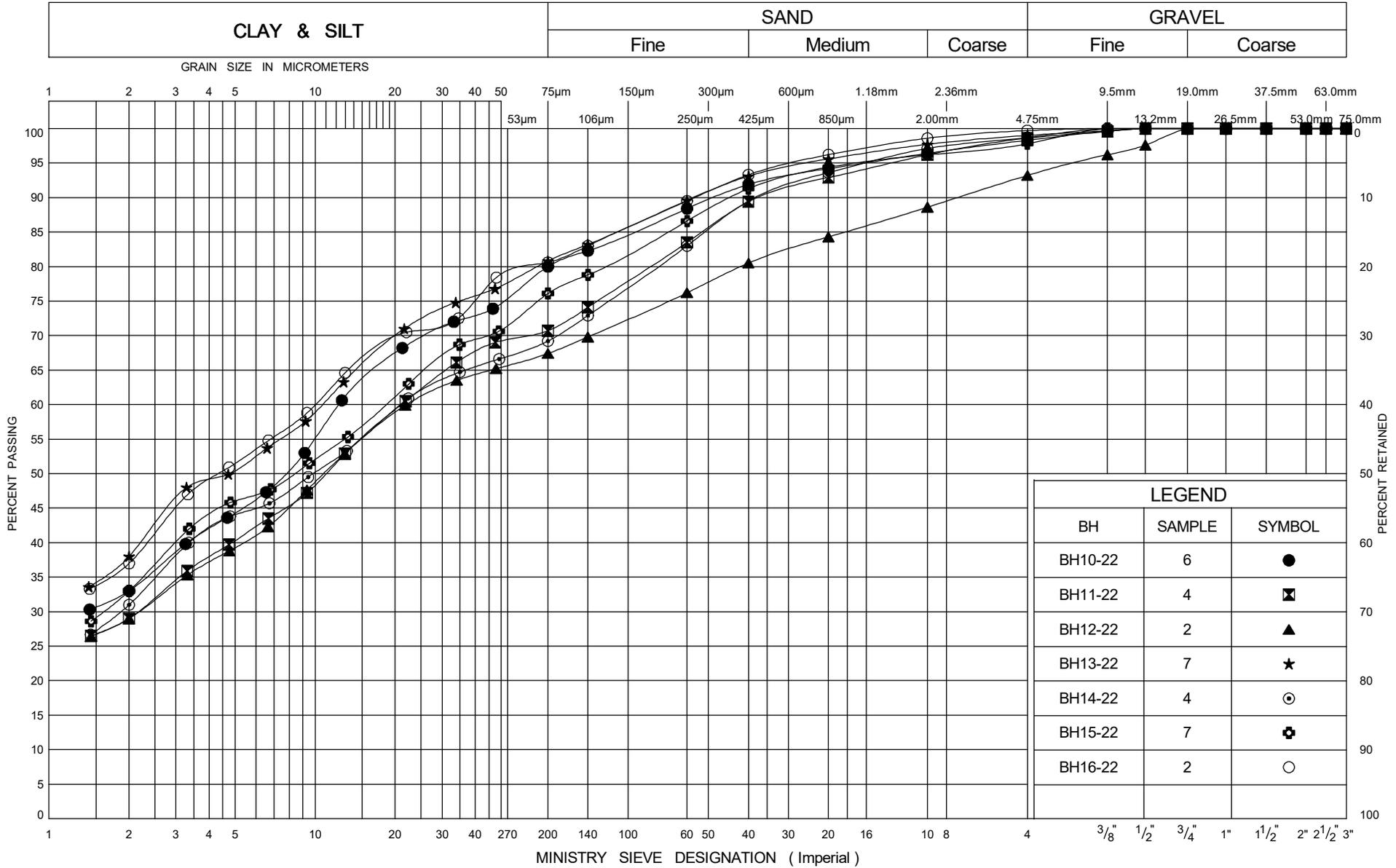


GRAIN SIZE DISTRIBUTION

Fill - Sand, Gravelly Sand

Figure:	D-7
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052

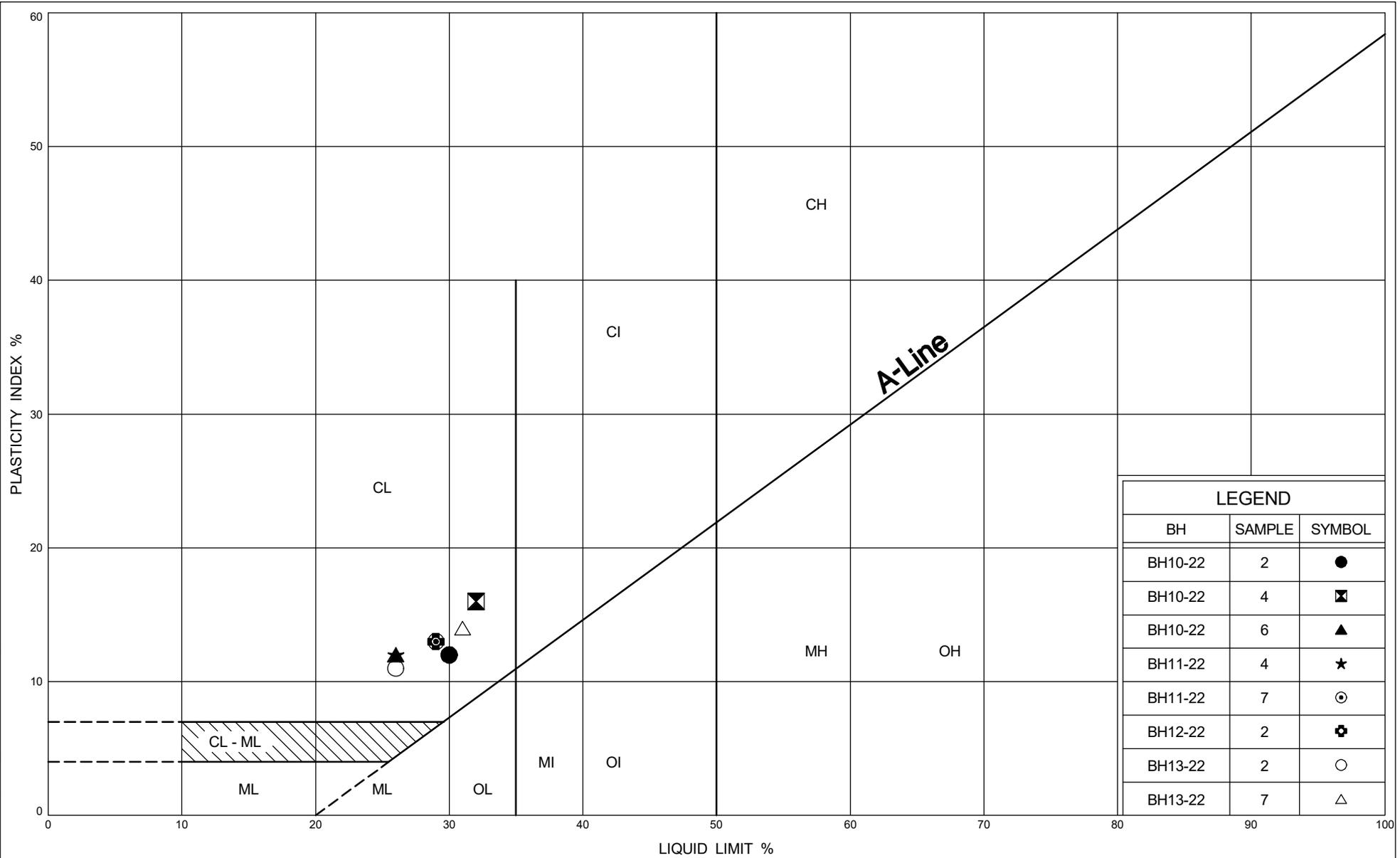
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Fill - Clayey Silt to Sandy Clayey Silt

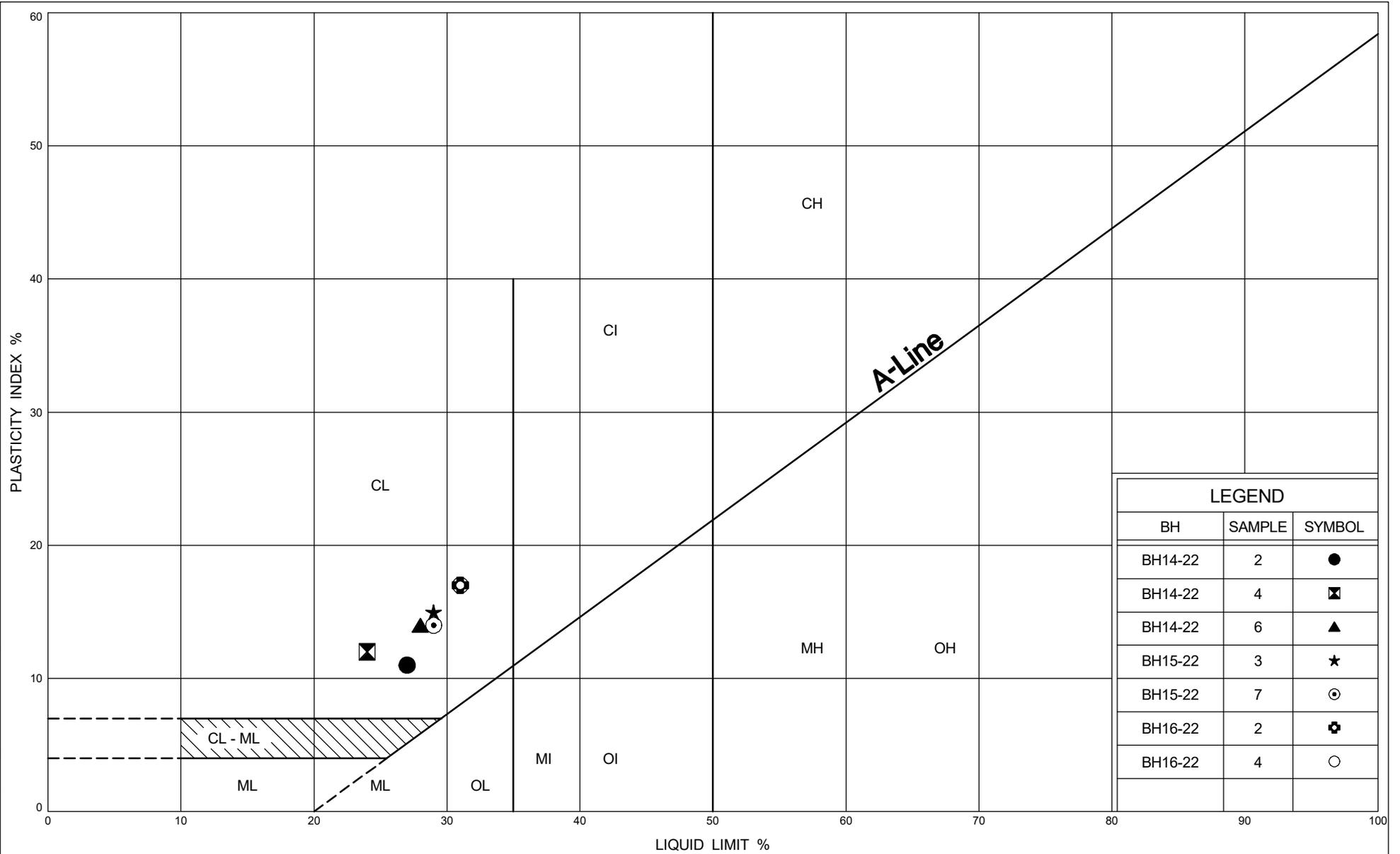
Figure:	D-8
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052



PLASTICITY CHART

Fill - Clayey Silt to Sandy Clayey Silt

Figure:	D-9A
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052

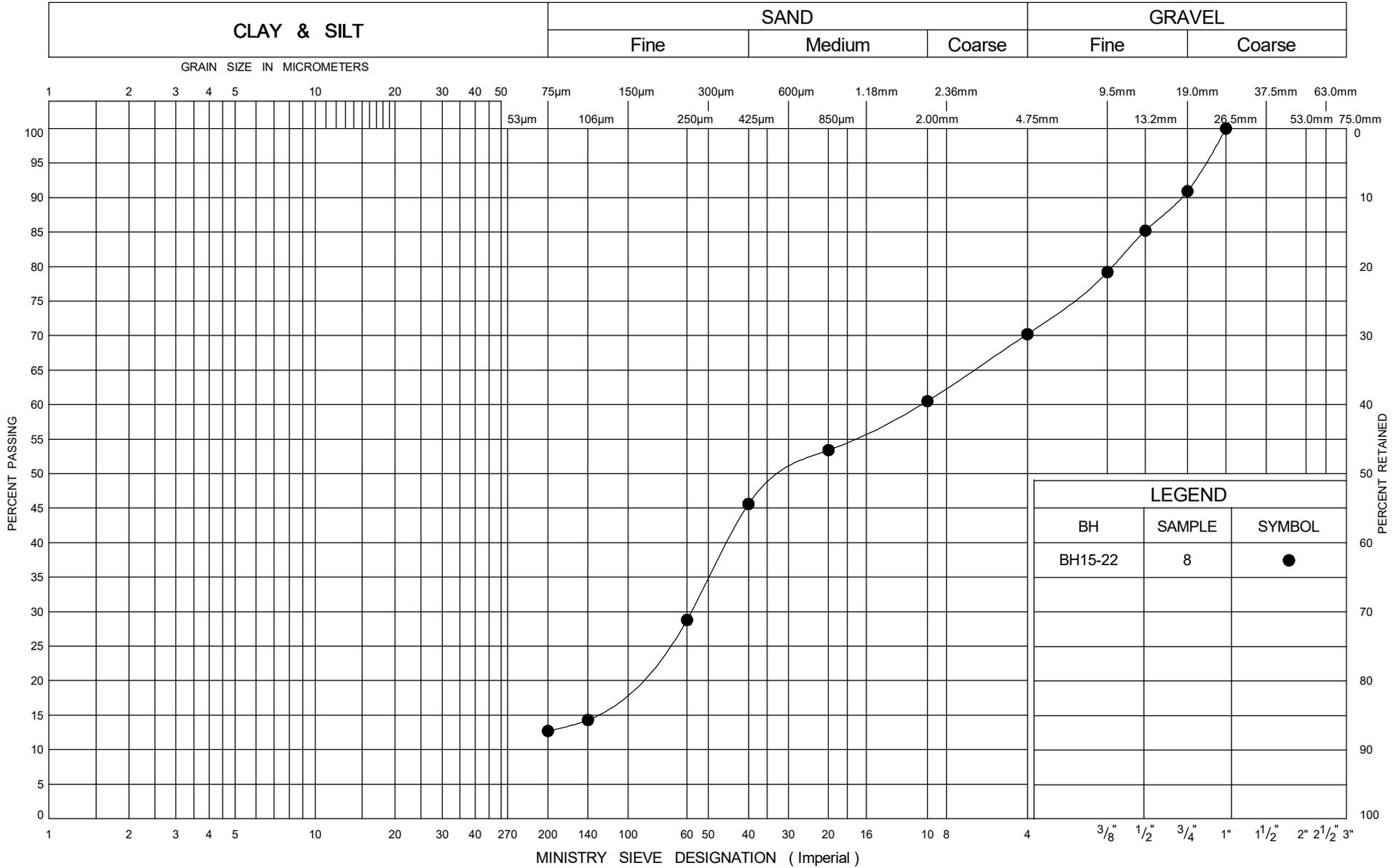


PLASTICITY CHART

Fill - Clayey Silt to Sandy Clayey Silt

Figure:	D-9B
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052

UNIFIED SOIL CLASSIFICATION SYSTEM

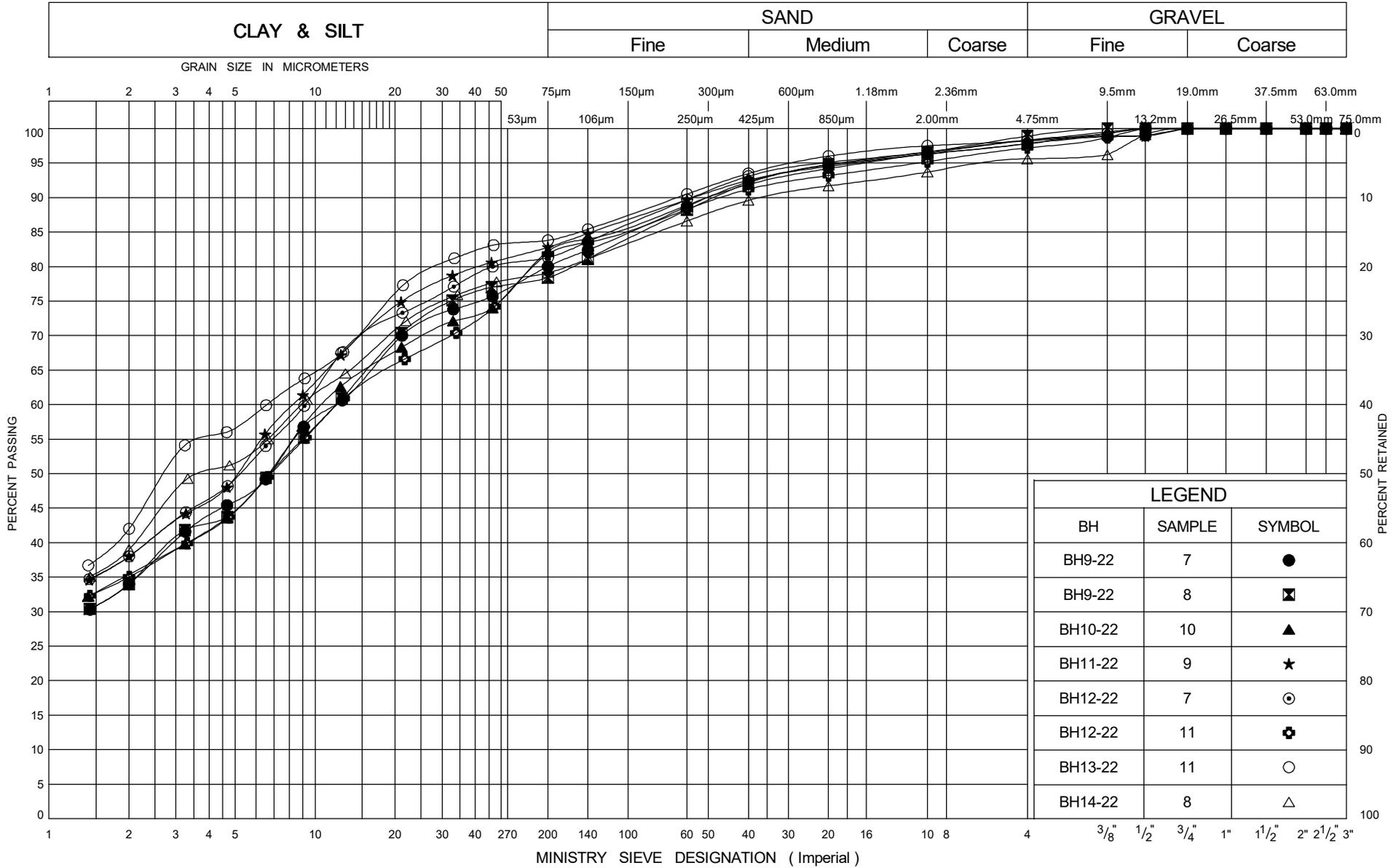


GRAIN SIZE DISTRIBUTION

Fill - Gravelly Sand

Figure:	D-10
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052

UNIFIED SOIL CLASSIFICATION SYSTEM

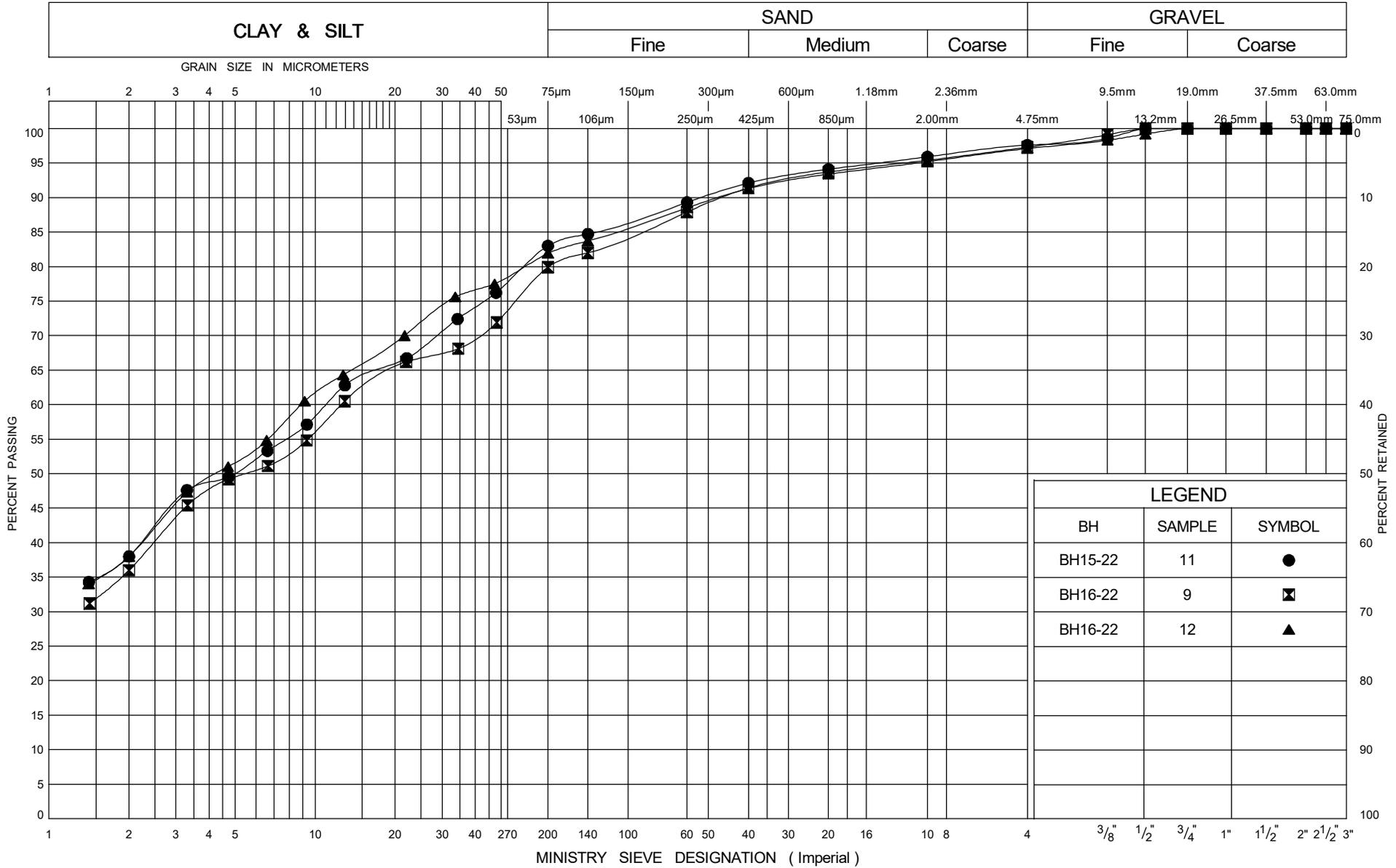


GRAIN SIZE DISTRIBUTION

Clayey Silt

Figure:	D-11A
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052

UNIFIED SOIL CLASSIFICATION SYSTEM

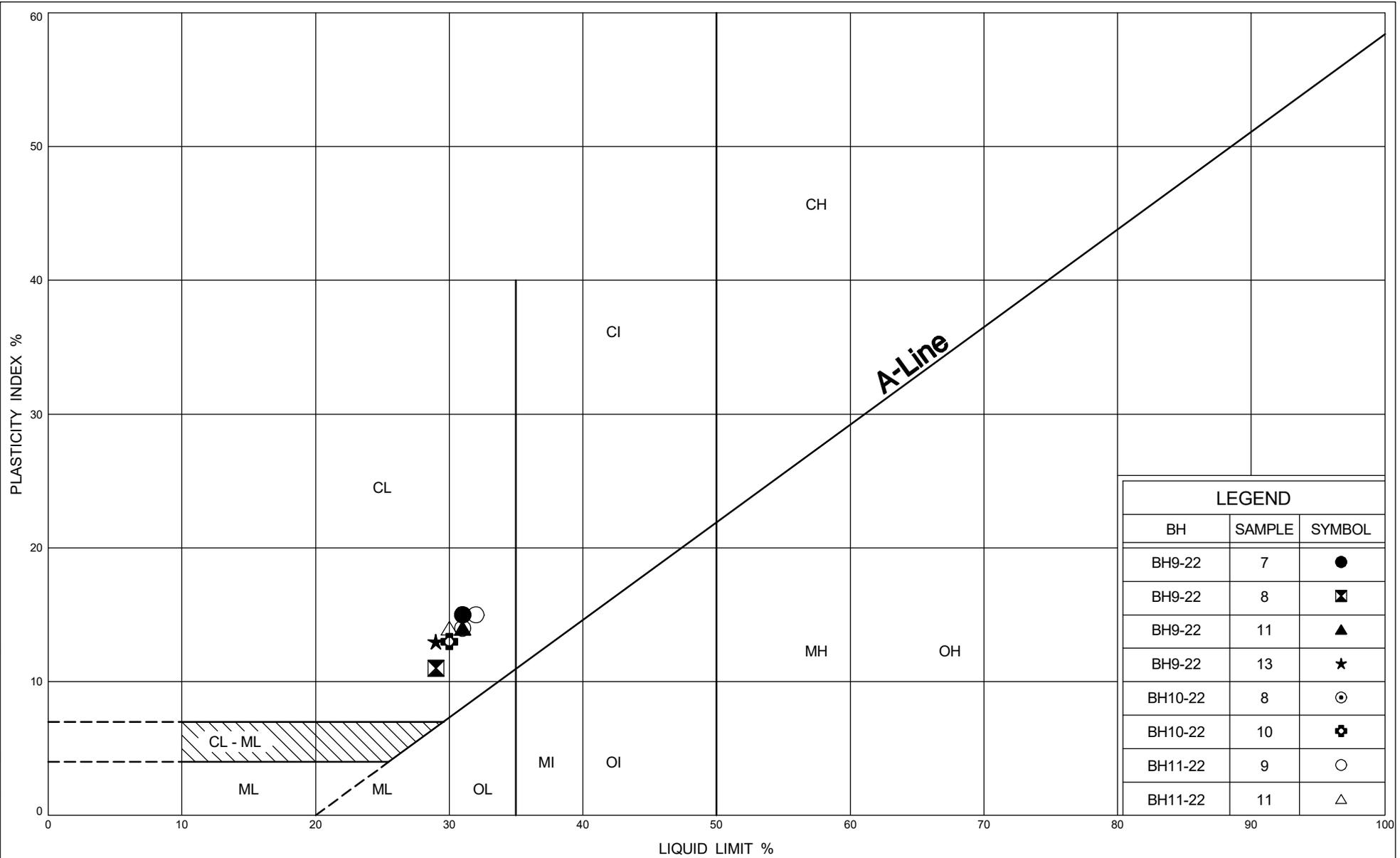


GRAIN SIZE DISTRIBUTION

Clayey Silt



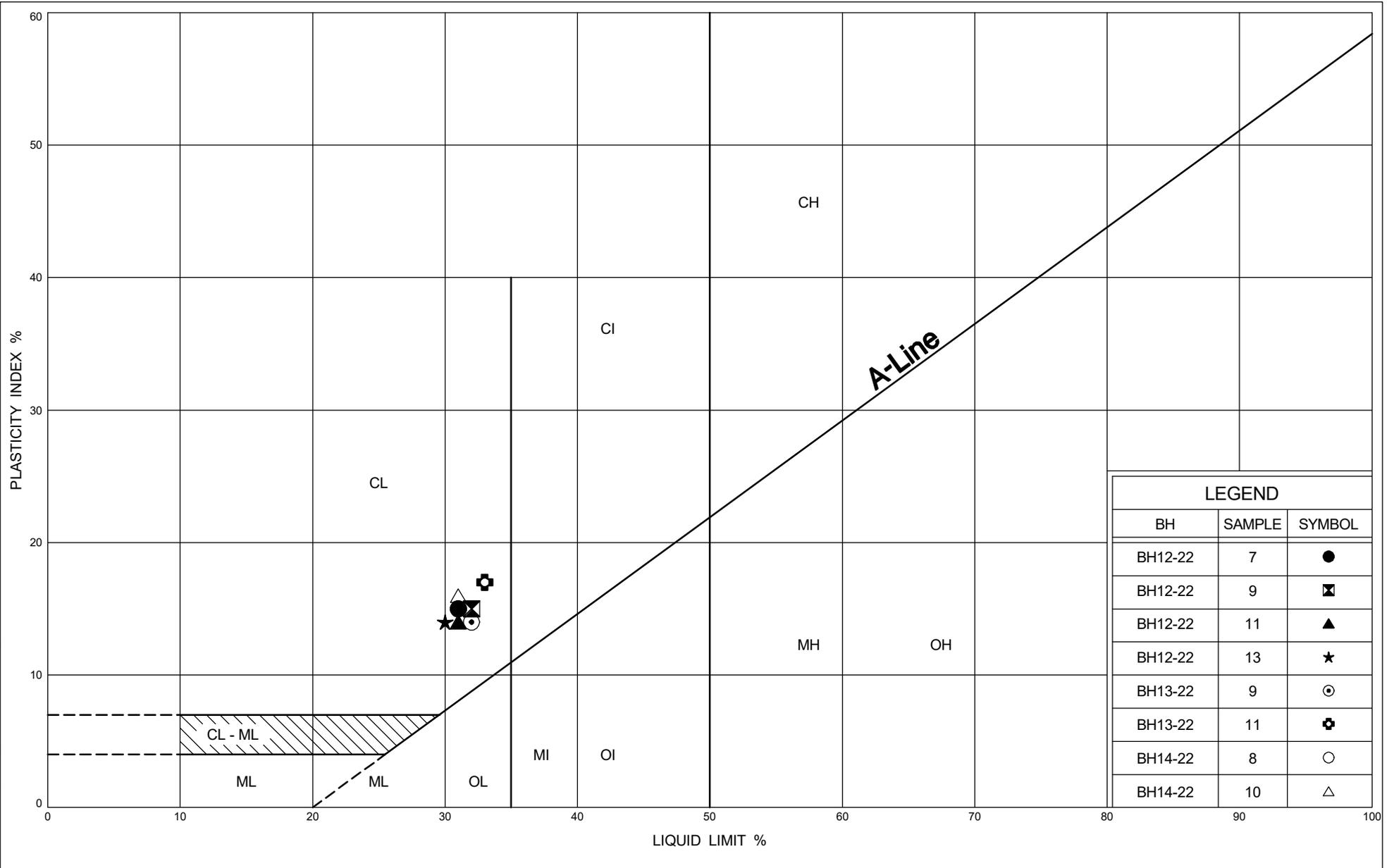
Figure:	D-11B
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052



PLASTICITY CHART

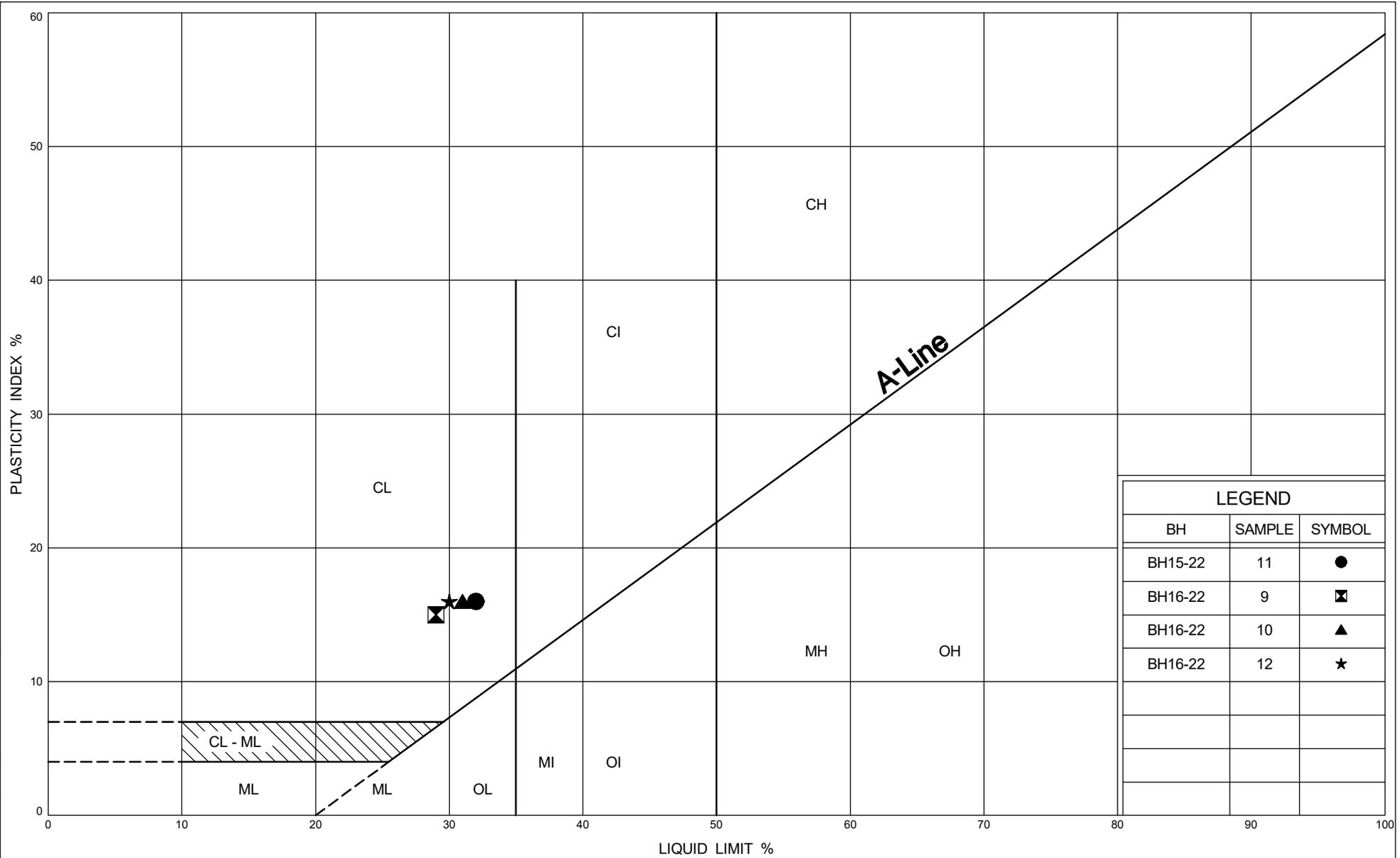
Clayey Silt

Figure:	D-12A
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052



PLASTICITY CHART
Clayey Silt

Figure:	D-12B
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052



PLASTICITY CHART
Clayey Silt

Figure:	D-12C
Project Name:	Highway 402/40 Bridge Rehabilitation
G.W.P. No.:	3105-18-00
GHD Project No.:	12566052

Appendix E

NSSP and Notice to Contractor

PROTECTION SYSTEM – Item No.

Special Provision

Amendment to OPSS 539, November 2014

593.07.02 Removal of Protection Systems

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

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

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

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

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

Obstructions

Notice to Contractor

The Contactor shall be alerted to the potential presence of cobbles, boulders and/or obstructions within the fill material and native deposits.

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