

Foundation Investigation and Design Report

Lateral Sewers

*Highway 400 Widening, from North of King Road to
South of Lloydtown-Aurora Road, King City, Ontario*

MTO Agreement No. 2017-E-0016-015, G.W.P. 2835-02-00

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Certificate of Analysis Report No. R6976890

PART A

FOUNDATION INVESTIGATION REPORT LATERAL SEWERS

HIGHWAY 400 WIDENING, FROM NORTH OF KING ROAD TO
SOUTH OF LLOYDTOWN-AURORA ROAD, KING CITY, ONTARIO
MTO AGREEMENT NO. 2017-E-0016-015, G.W.P. 2835-02-00

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services in support of the detail design of the widening of Highway 400 from north of King Road to south of 16th Sideroad, and from north of 16th sideroad to south of Lloydtown-Aurora Road (i.e., from King Road to Lloydtown-Aurora Road), as part of MTO Agreement No. 2017-E-0016, Assignment #15.

This report addresses the foundation investigation carried out for eight proposed lateral storm sewer crossings below the northbound or southbound lanes of Highway 400 (designated as Lateral Sewers 1 to 8), at the locations shown on Drawings 1 and 2. The purpose of this investigation is to establish the subsurface conditions at the proposed lateral sewer locations based on borehole drilling and geotechnical laboratory testing on selected samples.

This report was developed based on information from the current foundation investigation, supplemented with relevant information from Golder's previous foundation investigations carried out within the project limits. The results of the relevant previous foundation investigations are presented in the following report:

- **MTO GEOCREs 30M15-308:** "Foundation Investigation and Design Report, High Fill Embankments and Deep Cut, Highway 400 Widening from North of King Road to South Canal Bank Road, Regional Municipality of York, G.W.P. 2835-02-00", Golder Report Number 09-1111-0018-12, dated March 4, 2016.
- **MTO GREOCRES 30M13-214:** "Foundation Investigation and Design Report, Culverts from Station 13+375 to Station 22+500, Highway 400 Widening from North of King Road to South Canal Bank Road, Regional Municipality of York, G.W.P. 2835-02-00", Golder Report Number 09-1111-0018-10, dated December 1, 2015.

2.0 PROJECT DESCRIPTION

Highway 400 is to be widened from north of King Road to south of 16th Sideroad, and from north of 16th sideroad to south of Lloydtown-Aurora Road (i.e. from King Road to Lloydtown-Aurora Road). The proposed work will bridge the gaps between the adjacent widenings previously and currently being constructed. As part of the proposed highway widening, eight lateral sewers will be constructed using conventional open cut methods.

In general, the topography in the area of the overall project site consists of rolling terrain covered by agricultural fields and densely treed areas, with commercial facilities located along Highway 400.

3.0 INVESTIGATION PROCEDURES

3.1 Previous Investigation (GEOCREs 30M13-217 and 30M13-214)

As outlined in GEOCREs 30M13-217 and 30M13-217, foundation investigations were carried out for various high fill and deep cut embankments and culverts. As part of the previous foundation investigations, six boreholes (designated as Boreholes F1-8, C33-3, C33-4, C34-1, C34-2 and F4-7) were advanced in the vicinity of Lateral Sewers 4, 6, 7, and 8, at the locations shown on Drawing 1. Copies of the borehole records are provided in Appendices D, F, G, and H.

The borehole locations and ground surface elevations were surveyed by Callon Dietz Incorporated, Ontario Land Surveyors. The borehole locations (in MTM NAD 83 Zone 10 northing and easting coordinates and latitude and

longitude), the ground surface elevations (referenced to Geodetic datum), and borehole depths are summarized below.

Lateral Sewer ID	Borehole	Location (MTM NAD 83, Zone 10)		Ground Surface Elevation (m)	Borehole Depth (m)
		Northing, m (Latitude, °)	Easting, m (Longitude, °)		
Lateral Sewer 4	F1-8	4867489.2 (43.94736)	298953.1 (-79.5728)	302.8	6.7
Lateral Sewer 6	C33-3	4869908.4 (43.96914)	298583.5 (-79.5775)	335.6	15.9
	C33-4	4869917.6 (43.96922)	298597.4 (-79.5773)	330.1	12.8
Lateral Sewer 7	C34-1	4870213.4 (43.97188)	298485.5 (-79.5787)	321.7	11.1
	C34-2	4870212.1 (43.97187)	298502.6 (-79.5785)	326.2	17.4
Lateral Sewer 8	F4-7	4870896.0 (43.978028)	298414.2 (-79.5795)	316.3	12.8

3.2 Current Investigation

The field work for the current foundation investigation was carried out in November 2020 and between October 2021 and December 2021. At that time, a total of twelve boreholes, designated as Boreholes LS1-1, LS1-2, LS2-1, LS2-2, LS3-1, LS3-2, LS4-1, LS5-1, LS5-2, LS6-2, LS7-1, and C34-5), were advanced in the vicinity of the then-proposed sewer laterals, at the locations shown on Drawing 1. The borehole records are provided in Appendices A to I.

The field investigation was carried out using a D-50T track-mounted drilling rig, supplied and operated by Walker Drilling Inc. of Utopia, Ontario, a CME-75 track mounted drilling rig supplied and operated by 3D-Drilling of Whitchurch-Stouffville, Ontario, and Marika track-mounted drilling rig supplied and operated by Drilltech Drilling of Newmarket, Ontario. The boreholes were advanced using 210 mm outside diameter continuous flight hollow stem augers. Soil samples were obtained from the boreholes at approximately 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 SPT procedures (ASTM D1586). The split-spoon samplers used in the investigation limit the maximum particle size that can be sampled and tested to about 35 mm. Therefore, particles or objects that may exist within the soils that are larger than this dimension would not be sampled or represented in the grain size distributions.

The groundwater conditions in the open boreholes were observed during and immediately following the drilling operations. The boreholes were backfilled to ground surface in general accordance with Ontario Regulation 903 (as amended), and the boreholes advanced through asphalt were sealed at ground surface with cold patch asphalt.

The field work was observed on a full-time basis by a member of Golder's engineering staff, who located the boreholes, arranged for the clearance of underground utilities, directed the drilling, sampling and in situ testing operations, logged the boreholes, and examined and cared for the samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's geotechnical laboratory in Mississauga, Ontario where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO LS and/or ASTM standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected samples.

Select soil samples were submitted to a specialist analytical laboratory under chain of custody procedures for testing of conductivity / resistivity, pH and chemical analysis of sulphate and chloride content, to assess the potential for the soil to cause deterioration to buried concrete and corrosion to steel.

The borehole locations and the ground surface elevations were surveyed by Golder using a Trimble Geo7X with a minimum vertical and horizontal accuracy of 0.1 m. The borehole locations and elevations are referenced relative to MTM NAD 83 (Zone 10) northing and easting coordinates and to geodetic datum (HT2_0 / CGVD 1928:1978), respectively. The borehole locations (including northing/easting and latitude/longitude), ground surface elevations, and drilled depths are summarized below.

Lateral Sewer ID	Borehole No.	MTM NAD 83 (Zone 10)		Ground Elevation (m)	Drilled Depth (m)
		Northing, m (Latitude, °)	Easting, m (Longitude, °)		
Lateral Sewer 1	LS1-1	4865694.4 (43.931216)	299287.7 (-79.568658)	304.9	9.8
	LS1-2	4865679.4 (43.931081)	299265.1 (-79.568939)	304.8	9.8
Lateral Sewer 2	LS2-1	4866076.2 (43.934653)	299220.6 (-79.569497)	306.6	9.8
	LS2-2	4866065.9 (43.934560)	299192.4 (-79.569848)	303.9	9.8
Lateral Sewer 3	LS3-1	4866480.4 (43.938290)	299187.3 (-79.569916)	307.0	9.8
	LS3-2	4866492.9 (43.938403)	299155.3 (-79.570315)	309.2	9.8
Lateral Sewer 4	LS4-1	4867511.0 (43.947565)	298976.3 (-79.572556)	305.6	9.8
Lateral Sewer 5	LS5-1	4867908.5 (43.951142)	298943.4 (-79.572971)	313.3	9.8
	LS5-2	4867883.4 (43.950916)	298920.7 (-79.573253)	314.7	9.8
Lateral Sewer 7	C34-5	4870187.1 (43.971648)	298506.6 (-79.578440)	326.8	9.8
Lateral Sewer 8	LS7-1	4870906.8 (43.978126)	298440.8 (-79.579268)	316.7	9.8
N/A ¹	LS6-2	4870574.9 (43.975138)	298457.5 (-79.579055)	317.7	9.8

Note: 1. The lateral sewer at this location has been removed from the design.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The sections of Highway 400 included in this project traverse the three physiographic regions known as South Slope, Oak Ridges Moraine and Simcoe Lowlands, according to *The Physiography of Southern Ontario (Chapman and Putman, 1984)*¹. The South Slope is present at the southern portion of the project length, extending south from about 2 km north of King Road. The Oak Ridge Moraines is present through the centre portion of the project length, extending from about 2 km north of King Road to about 2 km south of Lloydtown-Aurora Road. The Simcoe Lowlands is present at the northern portion of the project length, extending north from about 2 km south of Lloydtown-Aurora Road.

Lateral Sewers 1 and 2 are located within the South Slope physiographic region and Lateral Sewers 3 to 8 are located within the Oak Ridges Moraine physiographic region.

¹ Chapman, L.J. and Putnam, D.F. 1984. The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P. 2715, Scale 1:600,000.

The South Slope predominately consists of sandy silt to silty sand till deposits, which is generally comprised of unsorted and un-stratified glacial sediment mixtures of any or all of clay, silt, sand, gravel, cobble, and boulders. The Oak Ridges Moraine predominately consists of sand and gravel, although in the King Township area these soils are often overlain by till. It is understood that during grading for the initial construction of Highway 400 through this area, deep cuts exposed up to about 10 m of till overlying the sand and gravel deposits.

4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during the previous foundation investigations and the current foundation investigation are presented on the borehole records in Appendices A to I. The results of the geotechnical laboratory tests from the previous and current foundation investigations are also presented in Appendices A to H. The results of the analytical laboratory tests from the current foundation investigation are presented in Appendix J.

The results of the in situ field tests (i.e., SPT “N”-values) as presented on the borehole records and in Section 4.2 are uncorrected. The stratigraphic boundaries shown on the borehole records and on the cross-sections in Appendices A to H are inferred from non-continuous sampling, observations of drilling progress and the borehole results. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change and moreover, the interpreted stratigraphy shown on the drawings in Appendices A to H represent a simplification of the subsurface conditions. Furthermore, subsurface conditions will vary between and beyond the borehole locations.

4.2.1 Lateral Sewer 1

4.2.1.1 Subsoil Conditions

In summary, the subsoil conditions encountered at Lateral Sewer 1 generally consist of non-cohesive and cohesive layers of embankment fill, underlain by a clayey silt till deposit, a silty sand deposit and a lower silt to clayey silt-silt till deposit. A more detailed description of the soil deposits encountered at Lateral Sewer 1 is provided below.

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	SPT “N”-Values (blows/0.3 m)	Laboratory Testing
				Consistency or Relative Density	
Asphalt	LS1-1	0.3	304.9	-	-
Fill – gravelly silty sand to sand ; brown; dry to moist / clayey silt and sand to sandy clayey silt , trace to some gravel; brown; moist	LS1-1, LS1-2	2.2, 2.7	304.8, 304.6	N = 9 - 26 Compact / stiff to very stiff	1 – MH (Figure A-1) 1 – AL (Figure A-2)
Upper till deposit - sandy clayey silt till , trace gravel; brown to grey; moist	LS1-1, LS1-2	2.6, 3.4	301.9, 302.6	N = 8 - 22 Stiff to very stiff	w = 13% - 19% 2 – MH (Figure A-3) 2 – AL (Figure A-4)
Silty sand ; brown; wet	LS1-1, LS1-2	0.7, 1.6	299.3, 299.2	N = 5 Loose	w = 18%
Lower till deposit - silt to sandy clayey silt-silt till , trace gravel; grey; moist to wet	LS1-1, LS1-2	3.4, 2.5	298.6, 297.6	N = 16 - 33 Compact to dense/ very stiff	w = 21% 3 – MH (Figure A-5) 2 – AL (Figure A-6) 1 – Non-Plastic AL

Where:

N = SPT ‘N’-value; number of blows for 0.3 m of penetration

w = Natural moisture content (%)

OC = Organic content (%)

MH = Combined sieve and hydrometer analysis

AL = Atterberg limits test

4.2.1.2 Groundwater Conditions

The observed/recorded water levels in the open boreholes during drilling and following completion of drilling are shown on the Record of Borehole sheets and are summarized below. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date
LS1-1	304.9	6.1	298.8	October 15, 2021 (during drilling and upon completion of drilling)
LS1-2	304.8	6.1	298.7	October 22, 2021 (during drilling)

4.2.2 Lateral Sewer 2

4.2.2.1 Subsoil Conditions

In summary, the subsoil conditions encountered at Lateral Sewer 2 generally consists of non-cohesive and cohesive layers of embankment fill underlain by a silt and sand to clayey silt till deposit which contains a sand interlayer. A more detailed description of the soil deposits encountered at Lateral Sewer 2 is provided below.

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	SPT "N"-Values (blows/0.3 m)	Laboratory Testing
				Consistency or Relative Density	
Asphalt	LS2-1	0.2	306.6	-	-
Clayey organic silt , trace sand; brown; moist	LS2-2	0.7	303.9	N = 6 Firm	w = 16% OC = 9.1%
Fill – sand ; brown, dry / sandy clayey silt , trace gravel; brown/brown to black; moist	LS2-1	2.0	306.4	N = 8 - 18 Compact / stiff	-
Silt and sand of slight plasticity to clayey silt till , trace to some sand, trace gravel; brown; moist to wet	LS2-1, LS2-2	7.6, 8.8	304.4, 302.9	N = 11 - 35 Compact / Stiff to hard	w = 13% - 23% 7 – MH (Figure B-1) 7 – AL (Figure B-2)
Interlayer - sand ; brown; wet	LS2-1, LS2-2	0.1, 1.2	303.0, 301.7	N = 9 Loose	-

Where:

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = Natural moisture content (%)

OC = Organic content (%)

MH = Combined sieve hydrometer analysis

AL = Atterberg limits test

NP = Non-plastic result

4.2.2.2 Groundwater Conditions

The observed/recorded water levels in the open boreholes during drilling and following completion of drilling are shown on the Record of Borehole sheets and are summarized below. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date
LS2-1	306.6	3.6	303.0	October 23, 2021 (during drilling)
		Dry (>9.8)	Dry (<296.9)	October 23, 2021 (upon completion of drilling)
LS2-2	303.9	0.9	303.0	October 20, 2021 (during drilling)
		2.1	301.8	October 20, 2021 (upon completion of drilling)

4.2.3 Lateral Sewer 3

4.2.3.1 Subsoil Conditions

In summary, the subsoil conditions encountered at Lateral Sewer 3 generally consist of non-cohesive embankment fill / surficial topsoil underlain by a silt to clayey silt till deposit further underlain by a clayey silt deposit in Borehole LS3-1 and a silt to silty gravel and sand deposit in Borehole LS3-2. A more detailed description of the soil deposits encountered at Lateral Sewer 3 is provided below.

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	SPT "N"-Values (blows/0.3 m)	Laboratory Testing
				Consistency or Relative Density	
Asphalt	LS3-2	0.1	309.2	-	-
Fill – silty sand , trace to some gravel; brown to black; moist	LS3-2	0.7	309.1	N = 38 Dense	-
Topsoil	LS3-1	0.1	307.0	-	-
Clayey silt-silt to clayey silt till¹ , trace sand to sandy, trace gravel; brown to grey; moist	LS3-1, LS3-2	7.4, 7.3	306.9, 308.4	N = 6 – 30 Firm to hard	w = 12% - 19% 4 – MH (Figure C-1) 4 – AL (Figure C-2)
Clayey silt , trace sand; grey; moist	LS3-1	2.3	299.5	N = 32 - 38 Hard	w = 17% 1 – MH (Figure C-3) 1 – AL (Figure C-4)
Silty gravel and sand to sandy silt ; brown; moist	LS3-2	1.7	301.1	N = 30, 60 Dense to very dense	w = 3% 1 – MH (Figure C-5)

Where:

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = Natural moisture content (%)

MH = Combined sieve hydrometer analysis

AL = Atterberg limits test

Notes:

1. Auger grinding was encountered while advancing through the till deposit in Borehole LS3-2 between 1.6 m and 2.3 m depth.

4.2.3.2 Groundwater Conditions

The observed/recorded water levels in the open boreholes following completion of drilling are shown on the Record of Borehole sheets and are summarized below. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date
LS3-1	307.0	Dry (>9.8)	Dry (<297.2)	December 10, 2021 (upon completion of drilling)
LS3-2	309.2	Dry (>9.8)	Dry (<299.4)	November 29, 2021 (upon completion of drilling)

4.2.4 Lateral Sewer 4

4.2.4.1 Subsoil Conditions

In summary, the subsoil conditions encountered at Lateral Sewer 4 generally consist of non-cohesive and cohesive embankment fill / topsoil underlain by silt and/or by a silt to clayey silt till deposit. A more detailed description of the soil deposits encountered at Lateral Sewer 4 is provided below.

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	SPT "N"-Values (blows/0.3 m)	Laboratory Testing
				Consistency or Relative Density	
Asphalt	LS4-1	0.3	305.6	-	-
Topsoil	F1-8	0.1	302.8		-
Fill – sand , trace to some gravel; brown; moist / clayey silt , some sand to sandy, trace gravel, trace organics; brown; moist to wet	LS4-1	3.1	305.3	N = 11 - 29 Compact / stiff to very stiff	w = 13% 1 – MH (Figure D-1) 1 – AL (Figure D-2)
Silt of slight plasticity to clayey silt till¹ , trace sand to sandy, trace to some gravel; brown to grey; moist	LS4-1, F1-8	6.1, 6.6	301.9, 302.7	N = 7 - 65 Dense / firm to hard	w = 12% - 37% 4 – MH (Figure D-3) 4 – AL (Figure D-4)
Interlayer – silt² , trace to some sand; grey, wet	LS4-1, F1-8	0.3, 2.0	302.2, 300.3	N = 54, 67 Very dense	w = 17% 1 – MH (Figure D-5)

Where:

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = Natural moisture content (%)

MH = Combined sieve hydrometer analysis

AL = Atterberg limits test

Notes:

- The upper portion of the clayey silt till in Borehole F1-8 contains trace rootlets to a depth of 0.6 m. A sand layer was encountered within the silt till deposit in Borehole F1-8 at a depth of 4.1 m. Rock fragments were encountered within the silt till deposit in Borehole LS4-1 at a depth of 4.0 m.
- The silt deposit in Borehole F1-8 is classified as a till deposit on the record of borehole, however based on a review of the gradation results from within the deposit, this deposit is inferred to not be part of the till deposit.

4.2.4.2 Groundwater Conditions

The observed/recorded water levels in the open boreholes during drilling and following completion of drilling are shown on the Record of Borehole sheets and are summarized below. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date
LS4-1	305.6	2.8	302.8	October 13, 2021 (during drilling)
		Dry (>9.8)	Dry (295.9)	October 13, 2021 (upon completion of drilling)
F1-8	302.8	1.2	301.6	December 16, 2010 (upon completion of drilling)

4.2.5 Lateral Sewer 5

4.2.5.1 Subsoil Conditions

In summary, the subsoil conditions encountered at Lateral Sewer 5 generally consist of non-cohesive embankment fill / topsoil underlain by a deposit of clayey silt-silt to clayey silt. A more detailed description of the soil deposits encountered at Lateral Sewer 5 is provided below.

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	SPT "N"-Values (blows/0.3 m)	Laboratory Testing
				Consistency or Relative Density	
Topsoil	LS5-1	0.05	313.3	-	-
Asphalt	LS5-2	0.18	314.7	-	-
Fill – silty sand, trace gravel to silty sand and gravel¹; brown to greyish brown; moist	LS5-2	3.2	314.5	N = 18 - 32 Compact to dense	w = 12%, 13% 1 – MH (Figure E-1)
Clayey silt-silt to clayey silt², trace to some sand, trace gravel; black to brown to grey; moist	LS5-1, LS5-2	9.7, 6.3	313.2, 311.3	N = 6 - 29 Firm to very stiff	w = 17% - 21% OC = 2.1% 5 – MH (Figure E-2) 6 – AL (Figure E-3)

Where:

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = Natural moisture content (%)

MH = Combined sieve hydrometer analysis

M = Sieve analysis for particle size

AL = Atterberg limits test

NP = Non-plastic result

Notes:

1. A 180 mm thick layer of sandy clayey silt fill was encountered within the non-cohesive fill at 1.2 m depth.
2. The upper 0.7 m of deposit contains trace rootlets in Borehole LS5-1 and the upper 0.3 m of the deposit contains organics and rootlets in Borehole LS5-2.

4.2.5.2 Groundwater Conditions

The observed/recorded water levels in the open boreholes during drilling and following completion of drilling are shown on the Record of Borehole sheets and are summarized below. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date
LS5-1	313.3	4.0	309.3	December 10, 2021 (during drilling)
		5.6	307.7	December 10, 2021 (upon completion of drilling)
LS5-2	314.7	9.1	305.6	November 30, 2020 (during drilling)
		Dry (>9.8)	Dry (<305.0)	November 30, 2020 (upon completion of drilling)

4.2.6 Lateral Sewer 6

4.2.6.1 Subsoil Conditions

In summary, the subsoil conditions encountered at Lateral Sewer 6 consist of cohesive embankment fill / topsoil underlain by deposit of silty sand, underlain by a deposit of clayey silt, underlain by a deposit of silt to silt and sand. A more detailed description of the soil deposits encountered at Lateral Sewer 6 is provided below.

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	SPT "N"-Values (blows/0.3 m)	Laboratory Testing
				Consistency or Relative Density	
Asphalt	C33-3	0.2	335.6	-	-
Topsoil	C33-4	0.1	330.1	-	-
Fill – sandy clayey silt¹ , trace gravel; brown; moist	C33-3	5.4	335.4	N = 9 - 41 Stiff to hard	w = 9%, 12% 1 – MH (Figure F-1) 1 – AL (Figure F-2)
Silty sand² , trace gravel; brown, moist	C33-3 and C33-4	1.6, 0.7	330.0	N = 2, 11 Very loose to compact	w = 10%, 21% 1 – MH (Figure F-3)
Clayey silt-silt to clayey silt³ , trace sand, trace gravel; brown, moist	C33-3 and C33-4	1.5, 1.2	328.4, 329.3	N = 4, 14 Firm to stiff	w = 17% - 19% 2 – AL (Figure F-4)
Silt to silt and sand⁴ , trace gravel; brown, moist	C33-3 and C33-4	7.2, 10.8	326.9, 328.1	N = 23 - 64 Compact to very dense	w = 5% - 20% 5 – MH (Figure F-5) 1 – AL (Figure F-6)

Where:

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = Natural moisture content (%)

OC = organic content (%)

MH = Combined sieve hydrometer analysis

AL = Atterberg limits test

Notes:

- The sandy clayey silt fill is classified as clayey silt with sand fill on the record of boreholes for Boreholes C33-3, in accordance with the previous MTO soil classification system. The fill contains trace organics at a depth of 3.8 m and lenses of sand at a depth of 4.6 m in Borehole C33-3.
- The silty sand deposit contains lenses of clayey silt in Borehole C33-3 and contains rootlets to 0.7 m depth in Borehole C33-4.
- The clayey silt-silt deposit in Borehole C33-4 is classified as clayey silt on the record of borehole, in accordance with the previous MTO soil classification system.
- The silt to silt and sand deposit contains lenses of clayey silt in Borehole C33-3 and contains lenses of sandy silt between depths of 6.3 m and 7.2 m in Borehole C33-4.

4.2.6.2 Groundwater Conditions

The observed/recorded water levels in the open boreholes following completion of drilling are shown on the Record of Borehole sheets and are summarized below. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date
C33-3	335.6	Dry (>15.9)	Dry (<319.7)	January 5, 2011 (upon completion of drilling)
C33-4	330.1	Dry (>12.8)	Dry (<317.3)	December 19, 2010 (upon completion of drilling)

4.2.7 Lateral Sewer 7

4.2.7.1 Subsoil Conditions

In summary, the subsoil conditions encountered at Lateral Sewer 7 consist of non-cohesive and cohesive embankment fill underlain by a sandy silt and gravelly sand deposit. An organic silt layer was encountered between the fill and native soils in Borehole C34-5. A more detailed description of the soil deposits encountered at Lateral Sewer 7 is provided below.

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	SPT "N"-Values (blows/0.3 m)	Laboratory Testing
				Consistency or Relative Density	
Asphalt	C34-2, C34-5	0.2	326.2, 326.8	-	-
Topsoil	C34-1	0.2	321.7	-	-
Fill – sandy silt¹ to sand and gravel; brown; moist / clayey silt, trace sand, trace gravel; brown, moist	C34-1, C34-2, C34-5	0.8, 4.3, 4.3	321.5, 326.0, 326.6	N = 7 - 34 Loose to dense / very stiff	w = 9% - 13% 2 – MH (Figure G-1) 1 – Non-Plastic AL
Sandy organic silt; dark brown, moist	C34-5	1.1	322.3	N = 11 Stiff	w = 22% OC = 6.5% 1 – MH (Figure G-2) 1 – AL (Figure G-3)
Sandy silt to gravelly sand²; brown; moist	C34-1, C34-2, C34-5	10.1, 12.9, 4.1	320.7, 321.7, 321.2	N = 12 – >100 Compact to very dense	w = 3% - 20% 6 – MH (Figure G-4)

Where:

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = Natural moisture content (%)

OC = organic content (%)

MH = Combined sieve hydrometer analysis

AL = Atterberg limits test

Notes:

1. The sandy silt fill in Borehole C34-2 contains a clayey silt layer between depths of 1.7 m and 1.9 m.
2. Blowing sand conditions were encountered at about Elevation 309.5 m in Borehole C34-2.

4.2.7.2 Groundwater Conditions

The observed/recorded water levels in the open boreholes following completion of drilling are shown on the Record of Borehole sheets and are summarized below. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date
C34-1	321.7	1.1	320.6	December 1, 2010 (upon completion of drilling)
C34-2	326.2	Dry (>17.4)	Dry (<308.8)	November 30, 2010 (upon completion of drilling)
C34-5	326.8	Dry (>9.8)	Dry (<317.1)	November 12, 2020 (upon completion of drilling)

4.2.8 Lateral Sewer 8

4.2.8.1 Subsoil Conditions

In summary, the subsoil conditions encountered at Lateral Sewer 8 consist of embankment fill containing zones of silty sand underlain by a silt and sand to silt deposit containing zones of clayey silt and an interlayer of clayey silt till. A more detailed description of the soil deposits encountered at Lateral Sewer 8 is provided below.

Deposit/Layer Description	Boreholes	Deposit Thickness (m)	Deposit Surface Elevation (m)	SPT "N"-Values (blows/0.3 m)	Laboratory Testing
				Consistency or Relative Density	
Topsoil	LS7-1	0.1	316.7	-	-
Asphalt	F4-7	0.2	316.3	-	-
Fill – clayey silt , trace gravel, containing zones of silty sand; brown; moist / sand , trace silt; brown; moist	F4-7	4.3	316.1	N = 9 - 29 Stiff / compact	w = 4% - 19% 1 – MH (Figure H-1)
Silt to silty sand¹ , trace gravel; brown; moist	LS7-1, F4-7	9.7, 8.3	316.6, 311.8	N = 3 - 81 Very loose to very dense	w = 14% - 22% 5 – MH (Figure H-2) 1 – AL (Figure H-3) 1 – Non-Plastic AL
Interlayered sandy clayey silt till ; trace gravel; grey; moist	LS7-1	3.1	313.0	N = 9 - 20 Stiff to very stiff	w = 14% 1 – MH (Figure H-4) 1 – AL (Figure H-5)

Where:

N = SPT 'N'-value; number of blows for 0.3 m of penetration

w = Natural moisture content (%)

OC = organic content (%)

MH = Combined sieve hydrometer analysis

AL = Atterberg limits test

Notes:

1. The silt and sand to silt deposit in Borehole F4-7 contains zones of clayey silt.

4.2.8.2 Groundwater Conditions

The observed/recorded water levels in the open boreholes during drilling and following completion of drilling are shown on the Record of Borehole sheets and are summarized below. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date
F4-7	316.3	7.3	309.0	January 13, 2011 (upon completion of drilling)
LS7-1	316.7	6.1	310.6	December 9, 2021 (during drilling)
		6.2	310.5	December 9, 2021 (upon completion of drilling)

4.3 Analytical Testing Results

Nine soil samples were submitted for analysis of parameters used to assess the potential corrosivity of the site soil to steel and concrete. Detailed analytical test results are included in Appendix I and the results are summarized below.

Culvert	Borehole and Sample No.	pH	Resistivity (ohm-cm)	Electrical Conductivity (umho/cm)	Chlorides (µg/g)	Soluble Sulphates (µg/g)
LS1	LS1-1 Sample 7	8.09	940	1070	470	55
LS2	LS2-1 Sample 3	7.58	410	2440	1100	<20
LS3	LS3-1 Sample 2	7.55	770	1300	720	63
	LS3-1 Sample 3	7.95	930	1080	530	50
LS4	LS4-1 Sample 5B	8.03	640	1560	720	<20
LS5	LS5-1 Sample 2	7.62	1,400	691	400	<20
	LS5-2 Sample 6	7.48	1,300	763	440	<20
LS8	LS7-1 Sample 5	7.75	10,000	96	<20	<20
N/A ²	LS6-2 Sample 4	7.53	650	1530	700	<20

Notes:

1. RDL indicates "Reportable Detection Limit" of 20 µg/g.
2. The lateral sewer at this location has been removed from the design.

5.0 CLOSURE

This Foundation Investigation Report was prepared by Mr. Jordan Schaaf, E.I.T., and reviewed by Ms. Anastasia Poliacik, P.Eng., a geotechnical engineer with Golder. Mr. William Cavers, P.Eng., an MTO Foundations Designated Contact and an Associate with Golder, conducted an independent technical and quality control review of the report.

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PART B

FOUNDATION DESIGN REPORT LATERAL SEWERS

HIGHWAY 400 WIDENING, FROM NORTH OF KING ROAD TO SOUTH OF
LLOYDTOWN-AURORA ROAD, KING CITY, ONTARIO
MTO AGREEMENT NO. 2017-E-0016-015, G.W.P. 2835-02-00

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides foundation recommendations for the design of eight proposed lateral storm sewers (designated Lateral Sewers 1 to 8), to be constructed using cut-and-cover construction methods, as part of the Highway 400 Widening from north of King Road to south of 16th Sideroad, and from north of 16th sideroad to south of Lloydtown-Aurora Road (i.e. from King Road to Lloydtown-Aurora Road). The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the current and previous subsurface investigations in the vicinity of the lateral sewers.

This foundation and investigation report with the interpretation and recommendations are for the use of MTO and shall not be used or relied upon for any other purposes 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 of the report. Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project, and for which special provisions may be required in the Contract Documents. Contractors must make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

6.2 Open Cut Installations

6.2.1 Frost Depth

As per Ontario Provincial Standard Drawing (OPSD) 3090.101 (Foundation Frost Penetration Depths for Southern Ontario), the design frost penetration depth at the site is 1.5 m below the existing ground surface. Therefore, the lateral sewers shall be founded a minimum of 1.5 m below final ground surface.

6.2.2 Anticipated Founding Conditions

The anticipated founding conditions along the proposed lateral sewers is summarized in the table below and shown on the stratigraphic profiles on Drawings A-1 to H-1 in Appendix A to H.

Lateral Sewer	Location (Station)	Anticipated Founding Conditions
Lateral Sewer 1	13+280	Stiff to very stiff sandy clayey silt to clayey silt and sand fill
Lateral Sewer 2	13+569	Firm clayey organic silt / stiff sandy clayey silt fill / stiff to very stiff clayey silt till
Lateral Sewer 3	14+054	Firm to hard clayey silt-silt to clayey silt till (auger grinding encountered within till deposit)
Lateral Sewer 4	15+090	Topsoil / Stiff to very stiff clayey silt fill / Firm to very stiff clayey silt till
Lateral Sewer 5	15+486	Compact to dense silty sand and gravel to silty sand fill / Firm to stiff clayey silt-silt to clayey silt
Lateral Sewer 6	17+509	Stiff to hard sandy clayey silt-silt fill / new embankment fill
Lateral Sewer 7	17+821	Compact to dense sandy silt to sand and gravel fill / new embankment fill ¹
Lateral Sewer 8	18+533	Compact sand fill / Compact silt to silty sand

All topsoil and deleterious material must be removed from the founding area (or from within the widened area during construction of new embankments). The existing fill and native soils at the anticipated founding depths are generally considered suitable for supporting the pipes, provided the integrity of the base of the excavation can be maintained during construction.

The subgrade should be inspected by geotechnical personnel to ensure that all existing topsoil, deleterious material, and softened/loosened soils or other unsuitable materials have been removed. Proof-rolling of the subgrade (using a plate tamper in combination with visual inspection) will be required to identify any softened/loosened zones. Where any softened/loosened zones are present, the unsuitable materials should be sub-excavated and backfilled with granular material meeting OPSS.PROV 1010 (*Aggregates*) Granular 'A' or Granular 'B' Type II, placed and compacted in accordance with OPSS.PROV 501 (*Compacting*) as amended by SP 105S12.

Care will be required to avoid disturbing the base of the excavation during construction which could lead to loss of support of the lateral sewers.

6.2.3 Pipe Bedding, Cover, and Trench Backfill

The bedding, cover, and backfill for the lateral sewers should be compatible with the type and class of pipe, the surrounding subsoil conditions and anticipated loading conditions and should be designed in accordance with OPSD 802.010 (*Flexible Pipe Embedment and Backfill Earth Excavation*) or OPSD 802.030 / 802.031 (*Rigid Pipe Bedding, Cover, and Backfill*) for construction in Type 2 and Type 3 soils, adopting Class B bedding.

6.2.3.1 Bedding and Cover

The bedding and cover material should consist of the material as specified in OPSS.PROV 401 (*Trenching, Backfilling, and Compacting*). Clear stone should not be used as bedding or cover material. Bedding shall consist of OPSS.PROV1010 (*Aggregates*) Granular 'A' or OPSS 1359 (*Unshrinkable Fill*) unshrinkable fill. All bedding and cover material should be placed in loose lifts and uniformly compacted to at least 98% of the material's Standard Proctor Maximum Dry Density (SPMDD), in accordance with OPSS.PROV 501 (*Compacting*), as amended by SP 105S22.

6.2.3.2 Trench Backfill

The existing fill and native site soils are geotechnically suitable for reuse as trench backfill, provided they are free of topsoil, organic material or other deleterious materials. If water contents of the site soils at the time of construction are too high, or if there is a shortage of suitable in-situ material, then an approved imported material which meets the requirements for OPSS.PROV 1010 (*Aggregates*), Select Subgrade Material (SSM) could be used.

The backfill should be placed and compacted in accordance with OPSS 501 (*Compacting*). Backfilling operations during cold weather should avoid inclusions of frozen lumps of material, snow and ice, and backfilling with fine grained (i.e., silts and/or clays) materials should not be undertaken.

The design frost depth in the area is estimated to be 1.5 m below ground surface, as interpreted from OPSD 3090.101 (*Frost Penetration Depths for Southern Ontario*). To avoid undue differential movements of the ground surface adjacent to and over the trench due to frost action, the general backfill materials should match as practically as possible to the native or fill materials exposed in the trench walls between the design frost depth and the underside of the subbase. If imported granular materials are used as backfill within the frost penetration depth, frost tapers should be provided between the design frost penetration depth and the underside of the

subbase, in accordance with OPSD 802.010 (*Flexible Pipe Embedment and Backfill Earth Excavation*) or OPSD 802.030 / 802.031 (*Rigid Pipe Bedding, Cover, and Backfill*).

Settlement of the compacted trench backfill should be anticipated, and the majority of such settlement should take place within about 6 months following the completion of trench backfilling operations. This settlement will be reflected at the ground surface and may be compensated for, where necessary, by placing additional granular material as required. Alternatively, if the asphalt binder course is placed shortly following the completion of trench backfilling operations in these areas, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of binder asphalt or by padding.

6.3 Construction Considerations

6.3.1 Excavations

All excavations should be carried out in accordance with the guidelines outlined in the Occupational Health and Safety Act and Regulations (OHSA), with local regulations, and as outlined in OPSS.PROV 401 (*Trenching, Backfilling and Compacting*). According to OHSA, the soil classification and corresponding excavation side slopes of the soils anticipated to be excavated are provided below. However, depending upon the construction procedures adopted by the contractor, actual groundwater seepage conditions, the success of the contractor's groundwater control methods and weather conditions at the time of construction, some flattening and/or blanketing of the slopes may be required.

Soil Description	Above/Below Groundwater	OHSA Soil Type	Maximum Foundation Excavation Side Slopes
Existing fill	Above	Type 3	1 Horizontal : 1 Vertical
	Below	Type 4	3 Horizontal : 1 Vertical
Cohesive native site soils	Above	Type 2	1 Horizontal : 1 Vertical to within 1.2 m of the bottom of the excavation
	Below	Type 3	1 Horizontal : 1 Vertical
Non-cohesive native site soils	Above	Type 3	1 Horizontal : 1 Vertical
	Below	Type 4	3 Horizontal : 1 Vertical

Excavated material must be stockpiled at a distance away from the excavation equal to or greater than the depth of the open cut excavation through the overburden. Where sufficient space is not available to stockpile the excavated material at the site, off-site disposal of the excavated material intended for reuse would need to be arranged. 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. Care should be taken to direct surface water runoff away from the open excavations.

Standard excavating equipment, such as backhoes, should be adequate for excavation of the lateral sewer trenches. Trench excavations should be made in accordance with OPSS.PROV 401 (*Trenching, Backfilling and Compacting*).

6.3.2 Temporary Protection Systems

Where the side slopes of excavations are required to be steepened to limit the extent of the excavation, some form of trench support will be required. The excavations could be carried out using a vertically unsupported

excavation (using a properly engineered prefabricated support system for personnel protection, certified by an experienced engineer) in open areas which can tolerate lateral movement of the soil deposits; or by a supported excavation (discussed below) if in close proximity to adjacent structures or underground services where restriction of lateral movements is required. It must be emphasized that a prefabricated support system (trench liner box) provides protection for construction personnel but does not provide any lateral support for adjacent excavation walls, underground services or existing structures. It is imperative that underground services and existing structures adjacent to the trench excavations be accurately located prior to construction and adequate support provided where required. Steepened excavations should be left open for as short a duration as possible and completely backfilled at the end of each working day.

The selection and design of the temporary protection system will be the responsibility of the contractor. Driven, interlocking sheet pile systems are considered feasible at these sites. Alternatively, soldier pile and lagging systems may be implemented; however, if this type of system is used it would be necessary to control groundwater seepage or include measures to mitigate loss of soil particles through the lagging boards. The sheet piles or soldier piles would have to be driven to sufficient depth to provide the necessary passive resistance for the retained soil height, including any surcharge loads behind the protection system within at least a 1H:1V zone relative to the base of the excavation. Lateral support to the sheet piles or soldier piles could be provided in the form of struts, rakers or temporary anchors.

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

For consideration, the temporary protection system design should be based on trapezoid-shaped apparent earth pressure distributions using the design parameters given below. The system must be designed to accommodate the loads applied from earth pressures, water pressures and surcharge pressures from area, line or point loads, as well as the effects of sloping ground behind the system. The loading from construction equipment as well as any material stockpiles within a distance defined by a 1 horizontal to 1 vertical line drawn from the bottom of the excavation to the existing ground surface should be included as a surcharge in the design of the temporary protection system.

Stratigraphic Unit	Unit Weight of Material, γ (kN/m ³)	Angle of Internal Friction, ϕ (°)	Coefficients of Static Lateral Earth Pressure ¹		
			Active, K_o	At Rest, K_a	Passive ² , K_p
Existing fill	20	30	0.33	0.50	3.00
Stiff organic silt	17	24	0.42	0.59	2.37
Firm to very stiff clayey silt-silt to clayey silt	19	30	0.33	0.50	3.00
Hard clayey silt	19	32	0.31	0.47	3.25
Loose to compact silty to sand	19	30	0.33	0.50	3.00
Compact to very dense silt to sand	20	33	0.29	0.46	3.39
Very dense silty gravel and sand	21	35	0.27	0.43	3.69
Glacial till	21	35	0.27	0.43	3.69

Notes:

1. The coefficients of static lateral earth pressure are based on a horizontal surface adjacent to the excavation. If sloped surfaces are expected, the coefficients showed need to be corrected accordingly.
2. The total passive resistance below the base of the excavation (i.e., within the shored excavation and / or adjacent to the temporary protection system) may be calculated based on the value of K_p indicated above but reduced by an appropriate factor that considers the allowable wall movement in accordance with Figure C6:16 of the CHBDC (2019) to account for the fact that a large strain would be required for mobilization of the full passive resistance.

The designer should use the information in Section 4.2 to infer the design groundwater level for the section of temporary protection system wall being designed.

It is recommended that the temporary protection system be fully removed upon completion of construction or each stage of construction (as required) to mitigate potential impediments to future rehabilitation/reconstruction work on the highway. If the temporary protection system is left in place, it should be cut off at or below frost depth, not less than 1.5 m below the pavement surface.

6.3.3 Groundwater and Surface Water Control

The approximate depth to groundwater below the lateral sewer founding elevations are summarized in the table below. Depending on the time of year of construction, perched groundwater conditions may be present within the upper fill layers. Based on the observed groundwater conditions, groundwater / perched water inflow into excavations for the sewers and shafts can likely be controlled by pumping from sumps at the base of the excavations.

Lateral Sewer	Location (Station)	Approximate depth to groundwater below founding depth
Lateral Sewer 1	13+280	4 m
Lateral Sewer 2	13+569	1 m
Lateral Sewer 3	14+054	>5 m
Lateral Sewer 4	15+090	1 m
Lateral Sewer 5	15+486	3 m
Lateral Sewer 6	17+509	>5 m
Lateral Sewer 7	17+821	2 m
Lateral Sewer 8	18+533	3 m

Water takings in excess of 50,000 L/day are regulated by the Ministry of the Environment Conservation and Parks (MECP). Certain takings of groundwater and stormwater for construction dewatering purposes with a combined total less than 400,000 L/day qualify for self-registration on the MECP's Environmental Activity and Sector Registry (EASR). Registry on the EASR replaces the need to obtain a Permit to Take Water (PTTW) for water taking and a Section 53 approval for discharge of water to the environment. A "Water Taking Plan" and a "Discharge Plan" are required by the MECP if water is taken in accordance with an EASR. In all cases, discharge under the EASR must be in accordance with a Discharge Plan (to be developed by a qualified professional). The Contractor will be responsible for obtaining any required discharge approvals. A Category 3 PTTW would be required for water takings in excess of 400,000 L/day.

Dewatering operations must be in accordance with OPSS.PROV 517 (*Dewatering*) and MTO's SP 517F01 (*Temporary Flow Passage System*). Given the apparent lack of infrastructure in the vicinity of the site and considering the foundation soils consist predominantly of competent till soils, a preconstruction condition survey is not considered to be required. As such, the fill-in in Table A of SP 517F01 should indicate that the preconstruction survey distance is "not applicable". However, it is recommended that the design engineer have a minimum of 5 years' experience in designing systems of similar nature and scope to the required work and therefore the fill-in in Table A of SP 517F01 should indicate "Yes" for the "Design Engineer Requirements". The remaining fill-ins of SP 517F01 should be provided by the drainage (hydrotechnical) engineer.

The contractor is responsible for the assessment and design of dewatering requirements, which depends on their chosen sequence of operations, method of temporary open cut excavation, as well as on the method and procedure for construction/operation/maintenance and decommissioning.

Surface water and storm water should be directed away from open excavation areas to prevent ponding of water that could result in disturbance and weakening of the founding soils and/or affect construction, as applicable. In particular, the existing drainage paths at the existing embankment toes may need to be diverted and/or controlled to avoid saturating / eroding the construction zone and excavation footprints which could lead to instability during or after construction.

6.3.4 Corrosion Assessment and Protection

The results of analytical testing on nine soil samples are summarized in Section 4.3 and the analytical laboratory test reports are included in Appendix I. The potential for sulphate attack and corrosion are discussed below, however it is ultimately up to the designer to determine the appropriate construction materials, including exposure class and ensuring that all aspects of CSA A23.1 Section 4.1.1 "Durability Requirements" are followed when designing concrete elements.

The analytical test results for sulphate were compared to CSA A23.1 Table 3 (*"Additional requirements for concrete subjected to sulphate attack"*) to assess the potential severity of sulphate attack on concrete during its service life. The sulphate concentration measured on the submitted soil samples are less than 0.1%, which is below the Moderate degree of exposure (i.e. below the Class S-3 exposure limits) and the degree of sulphate attack is considered 'Negligible' according to Table 7.2 in MTO's *Gravity Pipe Design Guidelines* (2014). Therefore, based on the soil samples tested, when the designer is selecting the exposure class for concrete structures, the effects of sulphates from within the site soils in contact with any portion of the proposed structures constructed below the ground surface may not need to be considered. However, given the proximity of the sewers to de-icing salt, consideration should be given by the designer to designing for a "C" type exposure class as defined by CSA A23.1 Table 1.

According to MTO's *Gravity Pipe Design Guidelines* (2014), the pH is not considered detrimental to steel durability as it is less than a pH of 8.5.

The resistivity measured in the tested soil samples generally ranged from 410 ohm-cm to 1,400 ohm-cm indicating that the soil corrosiveness is generally "severe" ($R < 2,000$ ohm-cm), as per Table 3.2 of MTO's *Gravity Pipe Design Guidelines* (2016), and therefore some level of corrosion protection should be applied to the lateral sewers. It is noted that one soil sample (Borehole LS7-1 Sample 5) measured a resistivity of 10,000 ohm-cm, indicating the soil corrosiveness of this sample is "very low" ($10,000$ ohm-cm $< R < 6,000$ ohm-cm).

7.0 CLOSURE

This Foundation Design Report was prepared by Ms. Anastasia Poliacik, P.Eng., a geotechnical engineer with Golder. Mr. William Cavers, P.Eng., an Associate with Golder and MTO Foundations Designated Contact, conducted an independent quality control review of the report.

Signature Page

Golder Associates Ltd.



Anastasia Poliacik, P.Eng.
Geotechnical Engineer



William Cavers, P.Eng.
MTO Foundations Designated Contact, Associate

AMP/WC/ljv

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<https://golderassociates.sharepoint.com/sites/21998g/deliverables/wo15-hwy400wideninglloydton/10.lateralsewers/5.final/1786658-wo15rev02022'05'12fidr-hwy400widening-lloydton-ls.docx>

REFERENCES

Canadian Standards Association (CSA). 2014. "Concrete materials and methods of concrete construction / Test methods and standard practices for concrete" (CSA A23.1-14/A23.2-14).

Ministry of Transportation, Ontario. 2014. *Gravity Pipe Design Guidelines*.

Ontario Occupational Health and Safety Act and Regulation for Construction Projects (Regulation 213, as amended).

ASTM International

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

Ontario Provincial Standard Specifications (OPSS)

OPSS.PROV 401 Construction Specification for Trenching, Backfilling, and Compacting

OPSS.PROV 501 Construction Specification for Compacting

OPSS.PROV 517 Construction Specification for Dewatering of Pipeline, Utility and Associated Structure Excavation

OPSS.PROV 539 Construction Specification for Temporary Protection Systems

OPSS.PROV 1010 Construction Specification for Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material

OPSS.PROV 1359 Construction Specification for Unshrinkable Fill

Ontario Water Resources Act

Ontario Regulation 903 Wells (as amended)

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

MINISTRY OF TRANSPORTATION, ONTARIO

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>200	>8
COBBLES	Not Applicable	75 to 200	3 to 8
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
FINES	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY COMPONENTS^{1,2}

Percentage by Mass	Modifier
> 35	Use 'and' to combine primary and secondary component (<i>i.e.</i> , SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (<i>i.e.</i> , some sand)
≤ 10	trace (<i>i.e.</i> , trace fines)

1. Only applicable to components not described by Primary Group Name.

2. Classification of Primary Group Name based on Unified Soil Classification System (ASTM D2487) for coarse-grained soils; fine-grained soils described per current MTO Soil Classification System.

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (*q_t*), porewater pressure (*u*) and sleeve friction (*f_s*) are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC / SC	Rock core / Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample
OD / ID	Outer Diameter / Inner Diameter
HSA / SSA	Hollow-Stem Augers / Solid-Stem Augers

SOIL TESTS

w	water content
PL, w _p	plastic limit
LL, w _L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D _R	relative density (specific gravity, G _s)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
Y	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

COARSE-GRAINED SOILS

Compactness¹

Term	SPT 'N' (blows/0.3m) ²
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

- Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grain size. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.
- SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

FINE-GRAINED SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N' ^{1,2} (blows/0.3m)
Very Soft	< 12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	> 200	> 30

- SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
- SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

LIST OF SYMBOLS

MINISTRY OF TRANSPORTATION, ONTARIO

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)

σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ . Unit weight symbol is γ .
where $\gamma = \rho \cdot g$ (i.e., mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_L or LL	liquid limit
w_P or PL	plastic limit
I_P or PI	plasticity index = $(w_L - w_P)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_P) / I_P$
I_C	consistency index = $(w_L - w) / I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
$C_{a(e)}$	secondary compression index
C_a	rate of secondary compression
$C_{a(e)}$	modified secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
c'	effective cohesion
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q or q'	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1
2

$\tau = c' + \sigma' \tan \phi'$
shear strength = (compressive strength)/2

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING CLASSIFICATION

Fresh (W1): no visible sign of rock material weathering.

Slightly Weathered (W2): discoloration indicates weathering of rock mass material on discontinuity surfaces. **Less than 5%** of rock mass is altered or weathered.

Moderately Weathered (W3): less than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Highly Weathered (W4): more than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Completely Weathered (W5): 100% of the rock mass is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact.

Residual Soil (W6): all rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole, a discontinuity with a 90° angle is horizontal.

Description and Notes

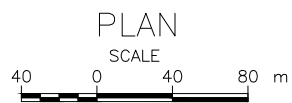
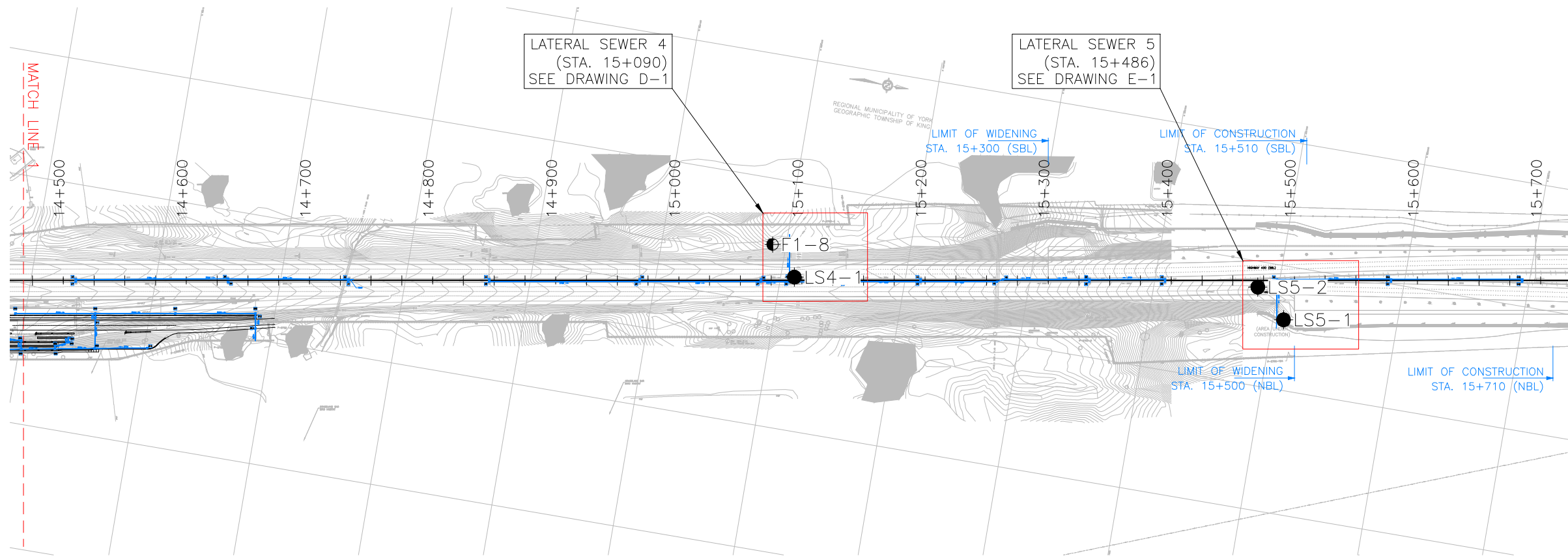
An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

AXJ Axial Joint	KV Karstic Void
BD Bedding	K Slickensided
BC Broken Core	LC Lost Core
CC Continuous Core	MB Mechanical Break
CL Closed	PL Planar
CO Contact	PO Polished
CU Curved	RO Rough
CT Coated	SA Slightly Altered
FLT Fault	SH Shear
FOL Foliation	SM Smooth
FR Fracture	SR Slightly Rough
GO Gouge	SY Stylolite
IN Infilled	UN Undulating
IR Irregular	VN Vein
JN Joint	VR Very Rough

ISRM Intact Rock Material Strength Classification

Grade	Description	Approx. Range of Uniaxial Compressive Strength (MPa)
R0	Extremely weak rock	0.25 – 1.0
R1	Very weak rock	1.0 – 5.0
R2	Weak rock	5.0 – 25
R3	Medium strong rock	25 – 50
R4	Strong rock	50 -100
R5	Very strong rock	100 -250
R6	Extremely strong rock	>250

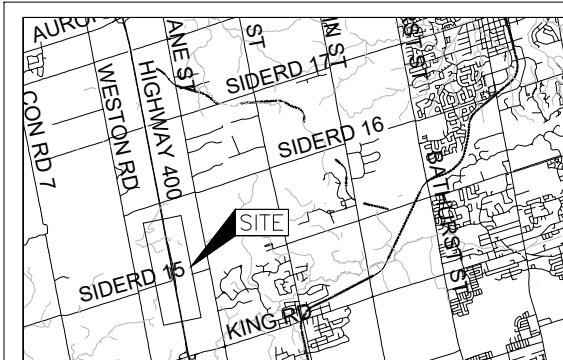


CONT No.
WP No.



HIGHWAY 400 WIDENING
LATERAL SEWERS
INDEX PLAN



SHEET



KEY PLAN
SCALE

2 0 2 4 km

LEGEND

-  Borehole Current Investigation
 Borehole - Previous Investigation

BOREHOLE CO-ORDINATES (MTM NAD83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
F1-8	302.8	4867489.2	298953.1
LS1-1	304.9	4865694.4	299287.7
LS1-2	304.8	4865679.4	299265.1
LS2-1	306.6	4866076.2	299220.6
LS2-2	303.9	4866065.9	299192.4
LS3-1	306.6	4866480.4	299187.3
LS3-2	309.2	4866492.9	299155.3
LS4-1	305.6	4867511.0	298976.3
LS5-1	312.9	4867908.5	298943.4
LS5-2	313.8	4867883.4	298920.7



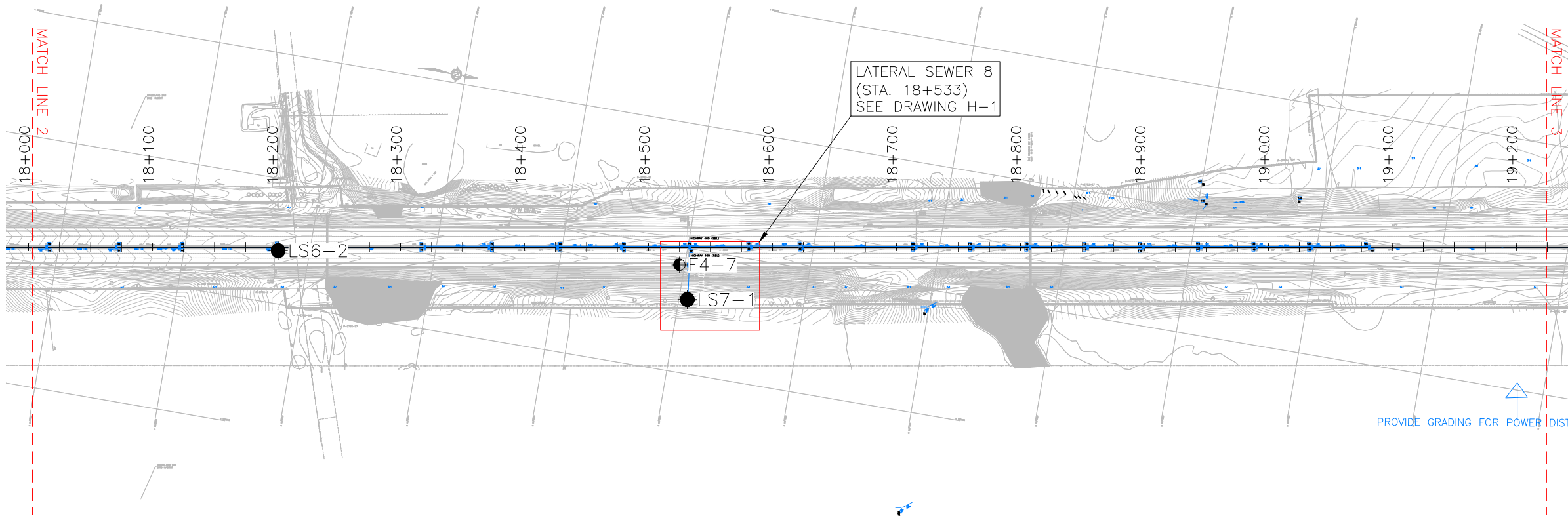
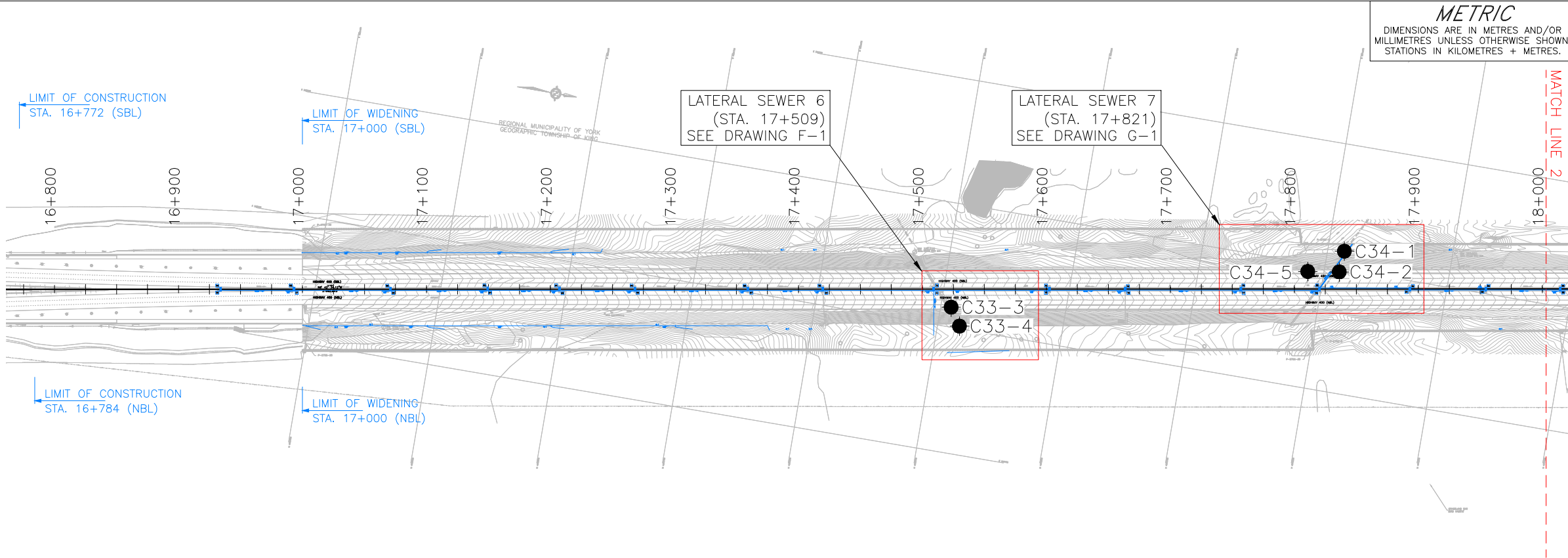
NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

REFERENCE

Base plan provided in digital format by MH, drawing file no. X117116615Base (1).dwg, received June 15, 2021.
Topography plan provided in digital format by MH, drawing file no. X117116615Contours.dwg, received June 2, 2021.
Proposed Sewer provided in digital format by MH, drawing file no. x117116615Design.dwg, received February 9, 2022.

NO.	DATE	BY	REVISION	
Geocres No. 30M13-243				
HWY. 400		PROJECT NO. 1786658		DIST. .
SUBM'D. AMP		CHKD. AMP	DATE: 03/17/2022	SITE:
DRAWN: DD		CHKD. WC	APPD. WC	DWG. 1

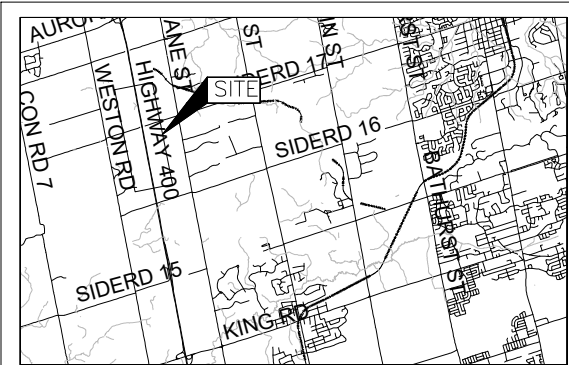


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No.

HIGHWAY 400 WIDENING
LATERAL SEWERS
INDEX PLAN

SHEET



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

- Borehole Current Investigation
- Borehole - Previous Investigation

BOREHOLE CO-ORDINATES (MTM NAD83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
C33-3	335.6	4869908.4	298583.5
C33-4	330.1	4869917.6	298597.4
C34-1	321.7	4870213.4	298485.5
C34-2	326.2	4870212.1	298502.6
C34-5	326.8	4870187.1	298506.6
F4-7	316.3	4870896.0	298414.2
LS6-2	317.6	4870574.9	298457.5
LS7-1	316.3	4870906.8	298440.8



NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

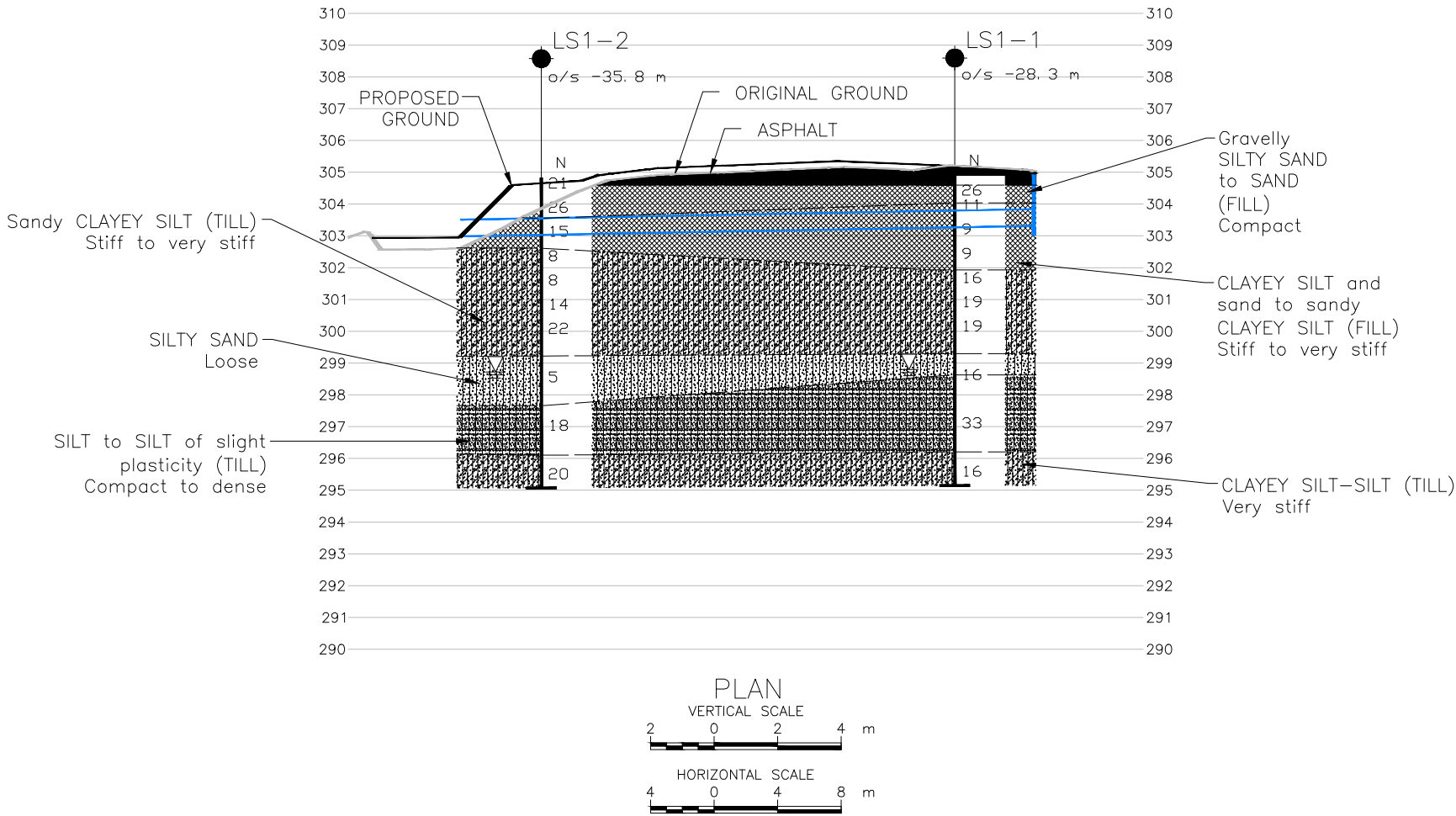
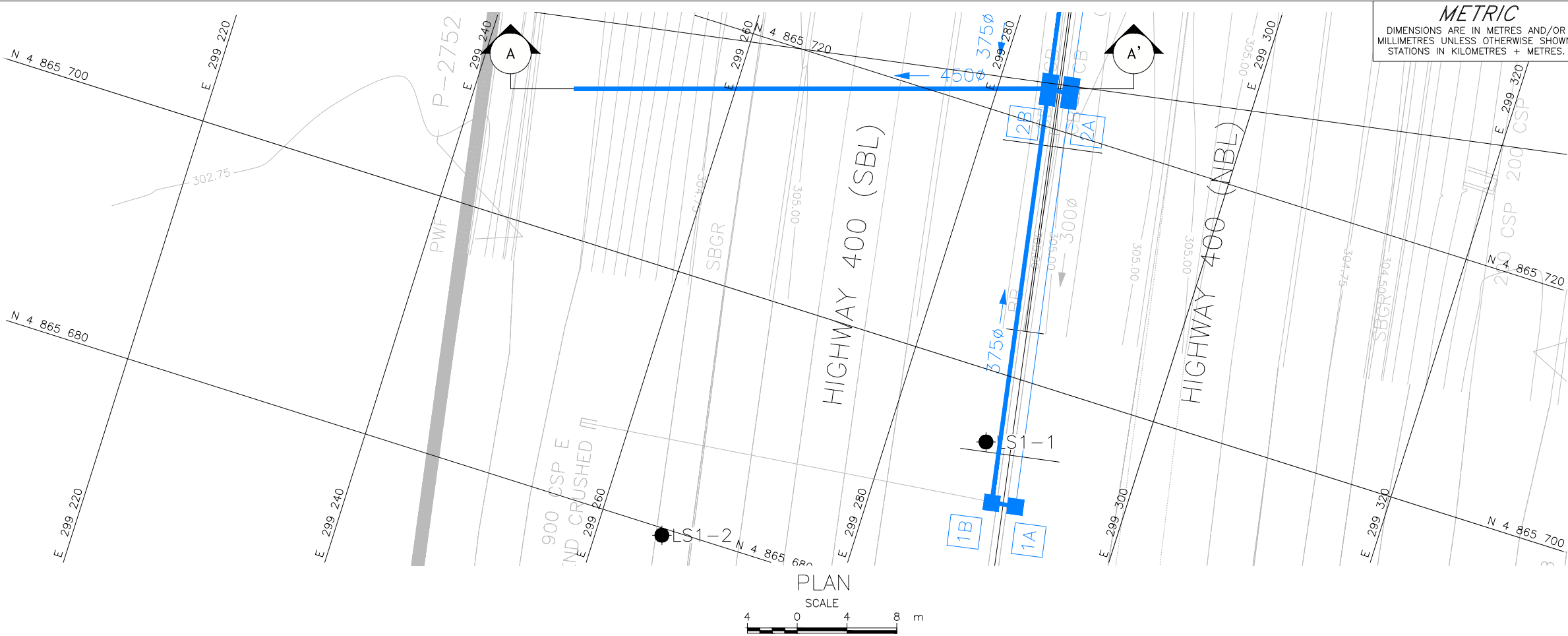
REFERENCE

Base plan provided in digital format by MH, drawing file no. X117116615Base (1).dwg, received June 15, 2021.
Topography plan provided in digital format by MH, drawing file no. X117116615Contours.dwg, received June 2, 2021.
Proposed Sewer provided in digital format by MH, drawing file no. x117116615design.dwg, received February 17, 2022.

NO.	DATE	BY	REVISION
Geocres No. 30M13-243			
HWY. 400		PROJECT NO. 1786658	
SUBM'D. AMP		CHKD. AMP	DATE: 03/17/2022
DRAWN: DD		CHKD. WC	APPD. WC
		DIST. .	
		SITE: .	
		DWG. 2	

APPENDIX A

Lateral Sewer 1 at Station 13+280



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

CONT No.
WP No.

HIGHWAY 400 WIDENING
LATERAL SEWER 1 (STA. 13+280)
BOREHOLE LOCATION AND SOIL STRATA

KEY PLAN SCALE 0 2 4 km

Borehole Current Investigation

Standard Penetration Test Value

Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)

WL upon completion of drilling/during drilling

BOREHOLE CO-ORDINATES (MTM NAD83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
LS1-1	304.9	4865694.4	299287.7
LS1-2	304.8	4865679.4	299265.1



NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

Base plan provided in digital format by MH, drawing file no. X117116615Base (1).dwg, received June 15, 2021.
Topography plan provided in digital format by MH, drawing file no. X117116615Contours.dwg, received June 2, 2021.
Proposed Sewer provided in digital format by MH, drawing file no. x117116615design.dwg, received February 9, 2022 and x117116615Profiles.dwg, received February 14, 2022.

NO.	DATE	BY	REVISION
Geocres No. 30M13-243			
HWY. 400		PROJECT NO. 1786658	
SUBM'D. AMP	CHKD. AMP	DATE: 03/17/2022	SITE:
DRAWN: DD/SA	CHKD. WC	APPD. WC	DWG. A-1

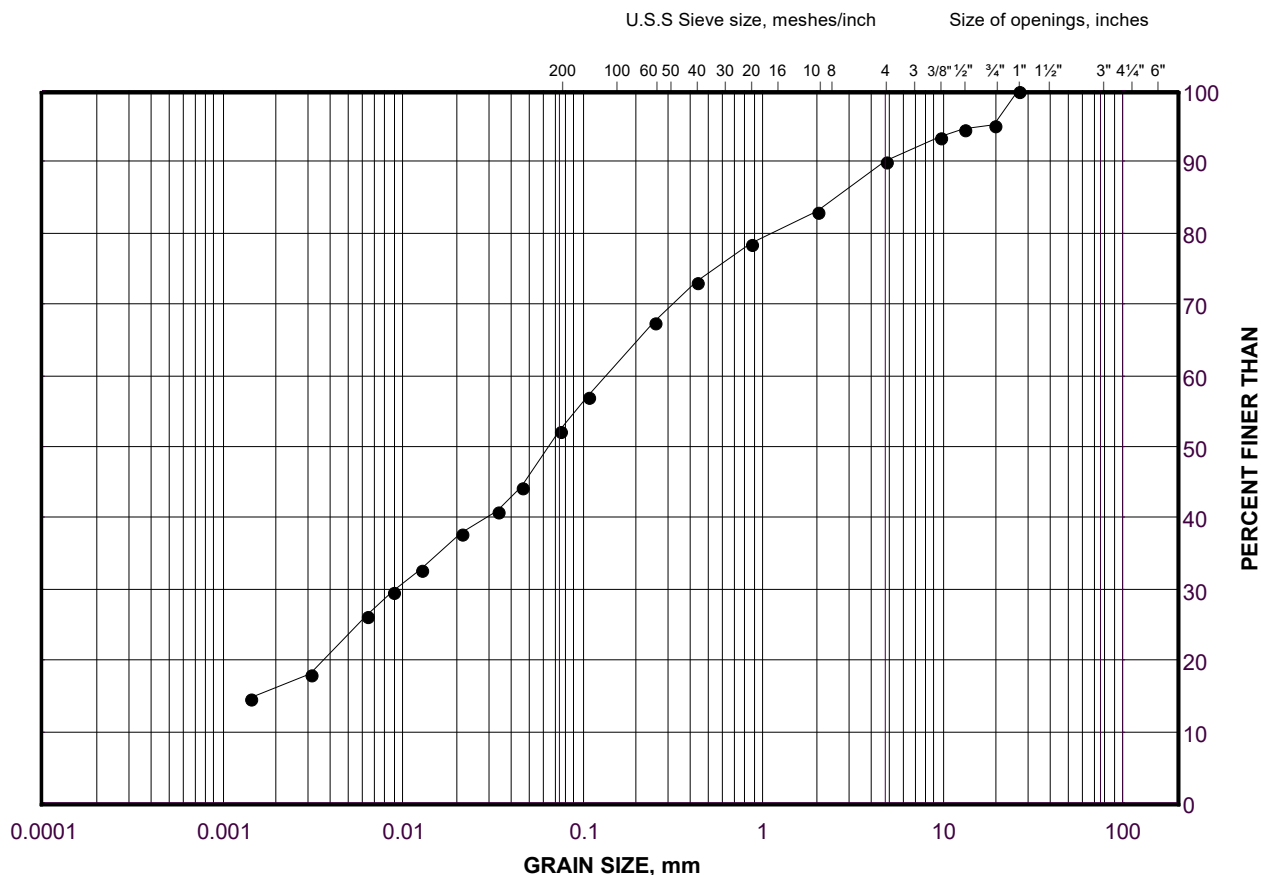
PROJECT 1786658 (W015)			RECORD OF BOREHOLE No LS1-1			SHEET 1 OF 1			METRIC				
G.W.P. 2385-02-00			LOCATION N 4865694.4; E 299287.7 MTM NAD 83 ZONE 10 (LAT. 43.931216; LONG. -79.568658)			ORIGINATED BY SC							
DIST Central HWY 400			BOREHOLE TYPE Power Auger; 200 mm O.D. Solid Stem Augers			COMPILED BY KJC							
DATUM CGVD28 / HT2 0 (Geodetic)			DATE October 14 and 15, 2021			CHECKED BY AMP							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
304.9	GROUND SURFACE												
0.0	ASPHALT (300 mm)												
0.3	SAND (SP) (FILL)		1	SS	26								
304.0	Compact Brown Dry		2A	SS	11								
0.9	Sandy CLAYEY SILT (CL), trace gravel (FILL)		2B										
	Stiff Brown Moist		3	SS	9								
	- No Sample Recovery from Sample 4		4	SS	9								
301.9	Sandy CLAYEY SILT (CL), trace gravel (TILL)		5	SS	16								
3.0	Stiff to very stiff Brown Moist		6	SS	19								
			7	SS	19								
299.3	SILTY SAND (SM)		8A										
5.6	Brown Wet		8B	SS	16								
298.6	SILT (ML) of slight plasticity, some sand (TILL)		9	SS	33								
6.3	Compact to dense Grey Moist to wet		10	SS	16								
296.2	CLAYEY SILT-SILT (CL-ML) (TILL), some sand												
8.7	Very stiff Grey Moist												
295.2	END OF BOREHOLE												
9.8	NOTES:												
	1. Water encountered at a depth of 6.1 m below ground surface (Elev. 298.8 m) during drilling.												
	2. Water measured in open borehole at a depth of 6.1 m below ground surface (Elev. 298.8 m) upon completion of drilling.												
	3. Borehole open upon completion of drilling.												

PROJECT		1786658 (W015)		RECORD OF BOREHOLE		No LS1-2		SHEET 1 OF 1		METRIC						
G.W.P.		2385-02-00		LOCATION		N 4865679.4; E 299265.1 MTM NAD 83 ZONE 10 (LAT. 43.931081; LONG. -79.568939)		ORIGINATED BY		SC						
DIST		Central HWY 400		BOREHOLE TYPE		Power Auger; 200 mm O.D. Solid Stem Augers		COMPILED BY		KJC						
DATUM		CGVD28 / HT2 0 (Geodetic)		DATE		October 22, 2021		CHECKED BY		AMP						
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								
304.8	GROUND SURFACE															
0.0	Gravelly SILTY SAND (SM) (FILL) Compact Brown Moist		1	SS	21											
303.5			2A	SS	26											
1.3	CLAYEY SILT (CL/SC) and sand, trace to some gravel (FILL) Stiff to very stiff Brown Moist		3	SS	15											
302.6																
2.2	Sandy CLAYEY SILT (CL), trace gravel (TILL) Stiff to very stiff Brown to grey Moist - Grey below 3.0 m depth		4	SS	8											
			5	SS	8											
			6	SS	14											
			7	SS	22											
299.2																
5.6	SILTY SAND (SM) Loose Brown Wet		8	SS	5											
297.6																
7.2	SILT (ML), some sand, trace gravel (TILL) Compact Grey Wet		9	SS	18											
296.1																
8.7	CLAYEY SILT-SILT (CL-ML), some sand, trace gravel (TILL) Very stiff Grey Wet		10	SS	20											
295.1																
9.8	END OF BOREHOLE															
NOTES:																
1. Water encountered at a depth of 6.1 m below ground surface (Elev. 298.7 m) during drilling.																

GRAIN SIZE DISTRIBUTION

CLAYEY SILT (CL/SC) and sand (FILL)

FIGURE A-1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

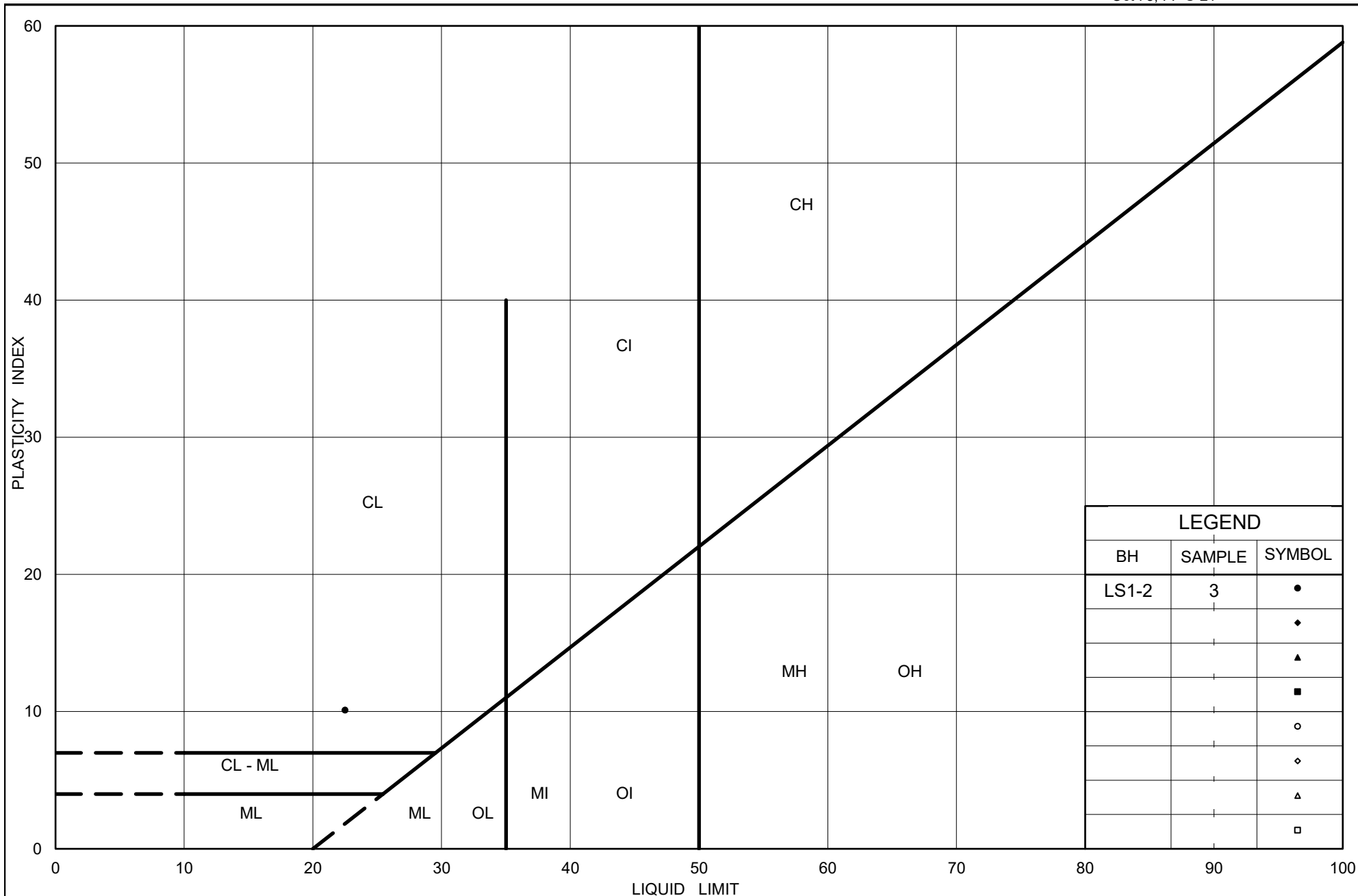
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	LS1-2	3	303.0

Project Number: 1786658 WO15-LS

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Date: 15-Feb-22



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PLASTICITY CHART

CLAYEY SILT (CL/ SC) and sand (FILL)

Figure No. A-2

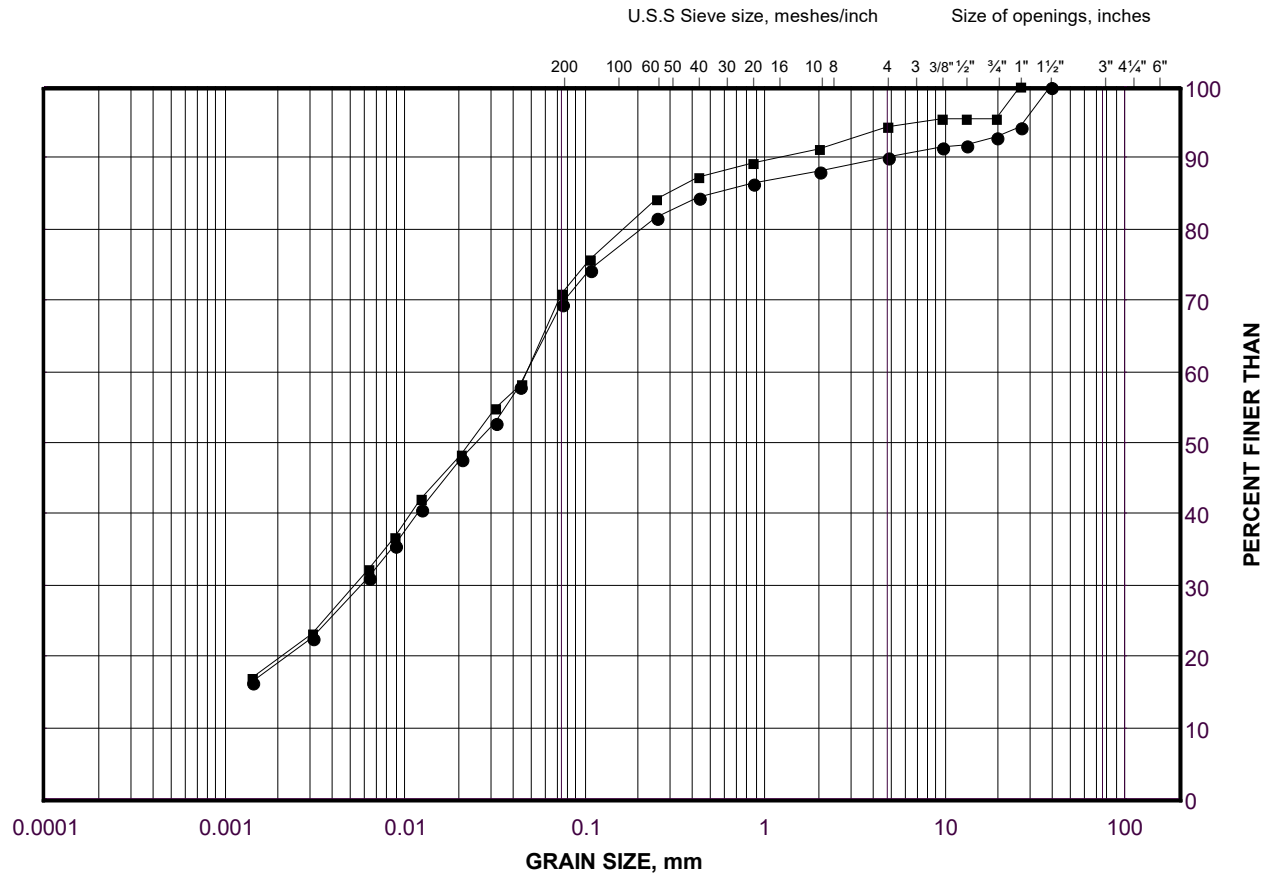
Project No. 1786658-WO15-LS

Checked By: AMP

GRAIN SIZE DISTRIBUTION

Sandy CLAYEY SILT (CL) (TILL)

FIGURE A-3



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

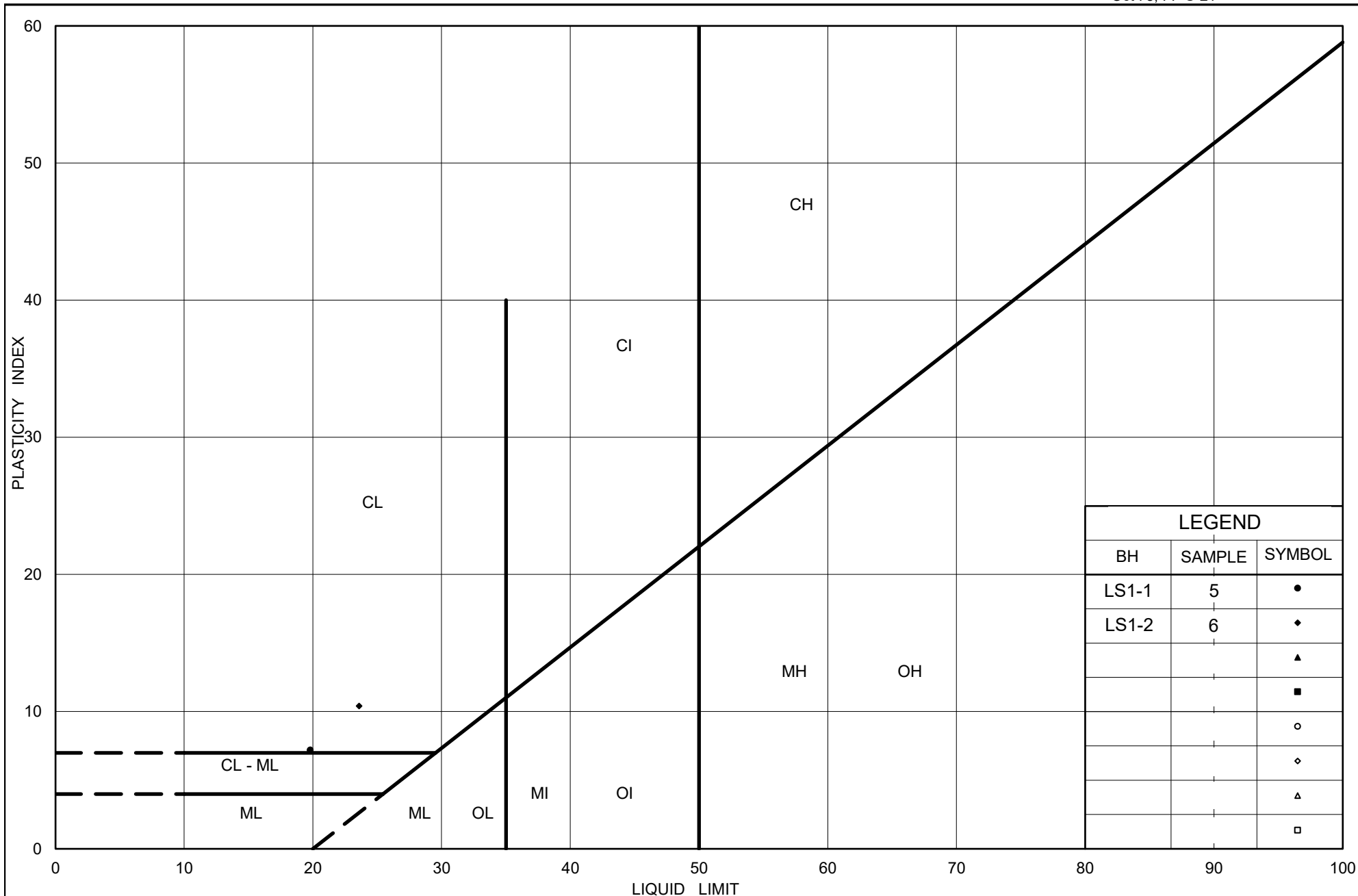
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	LS1-1	5	301.6
■	LS1-2	6	300.7

Project Number: 1786658 WO15-LS

Checked By: AMP

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Date: 15-Feb-22



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PLASTICITY CHART Sandy CLAYEY SILT (CL) (TILL)

Figure No. A-4

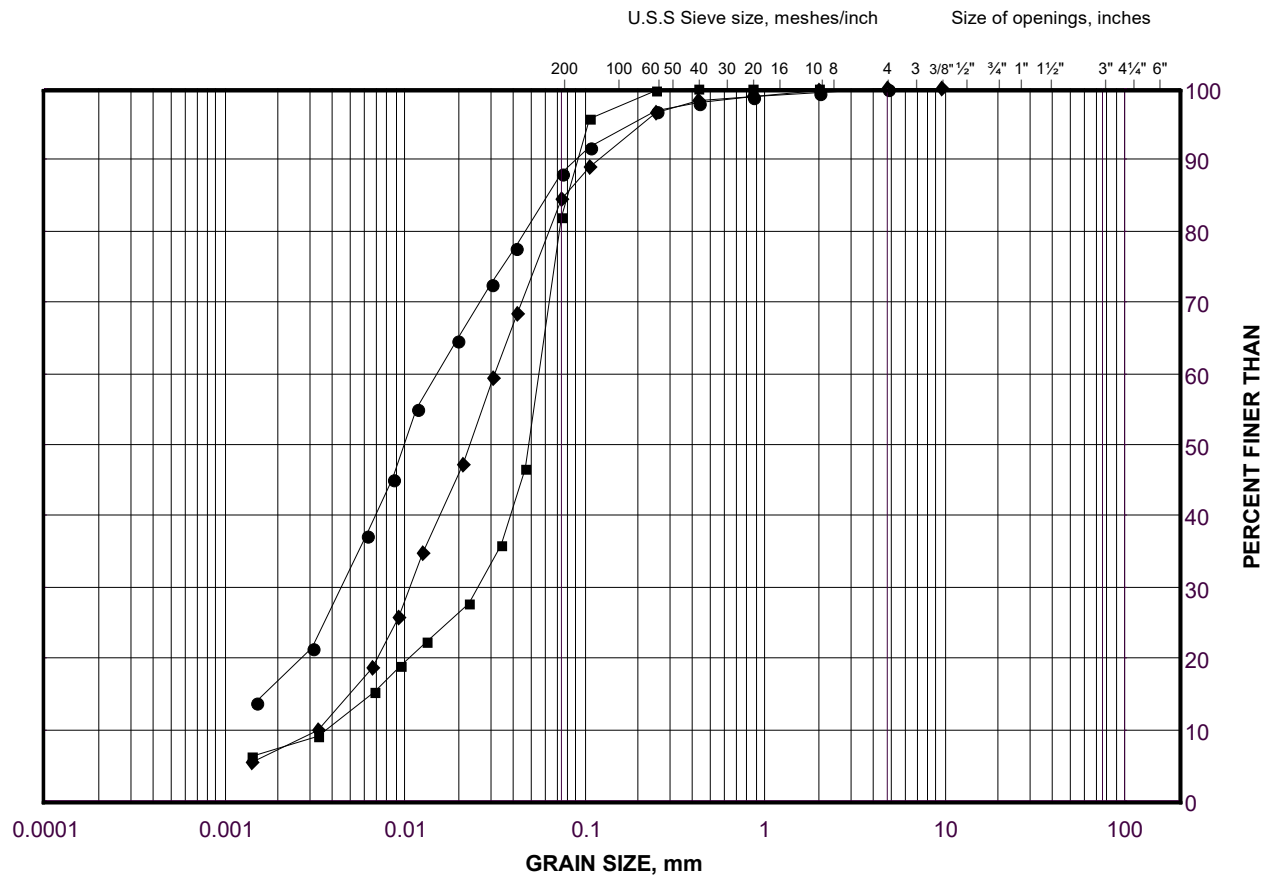
Project No. 1786658 WO15-LS

Checked By: AMP

GRAIN SIZE DISTRIBUTION

SILT (ML) to CLAYEY SILT-SILT (CL-ML) (TILL)

FIGURE A-5



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

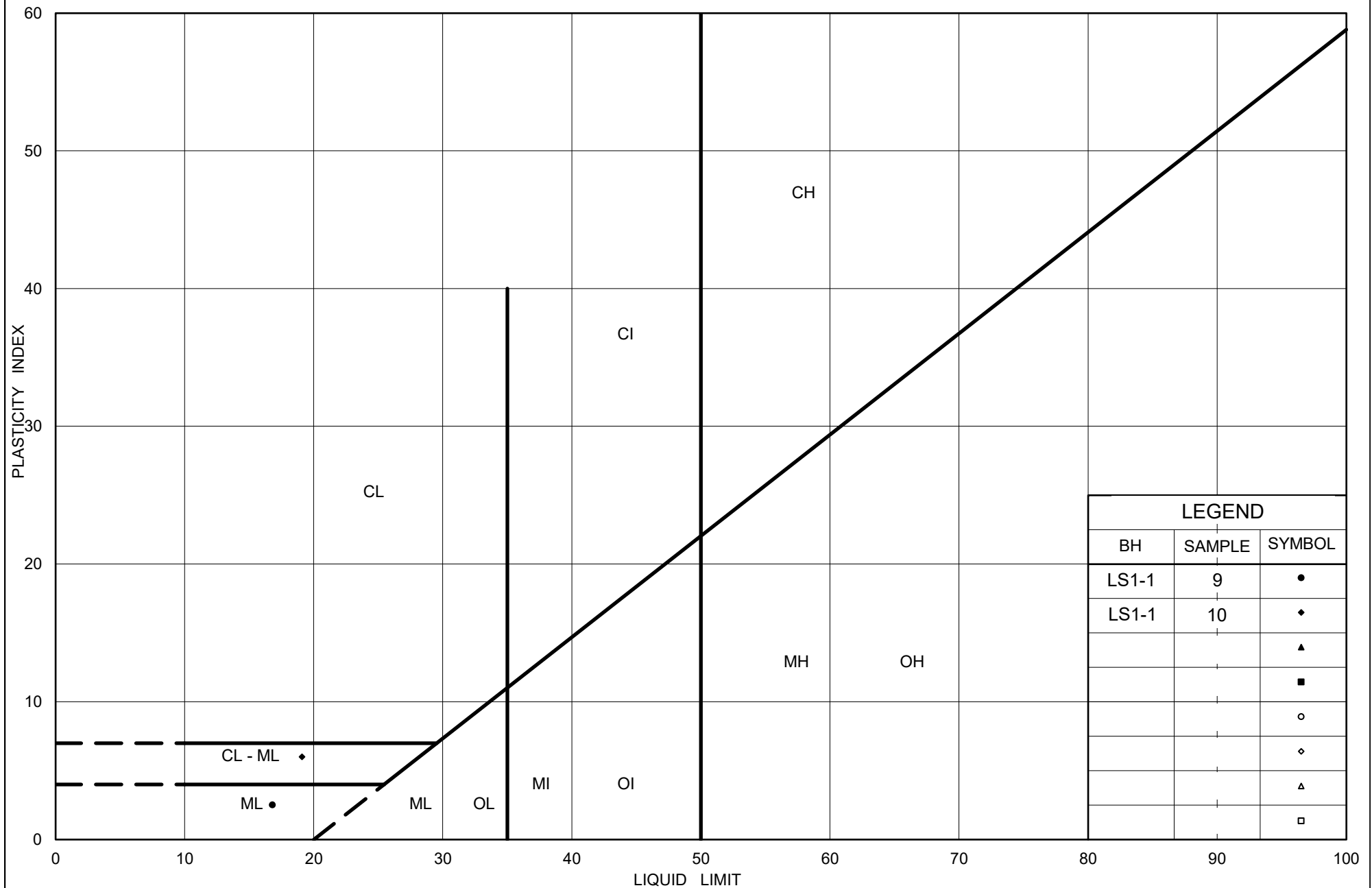
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	LS1-1	10	295.6
■	LS1-2	9	269.9
◆	LS1-1	9	297.0

Project Number: 1786658 WO15-LS

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PLASTICITY CHART SILT (ML) to CLAYEY SILT-SILT (CL-ML) (TILL)

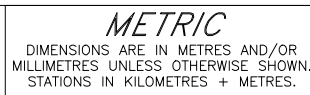
Figure No. A-6

Project No. 1786658 WO15-LS

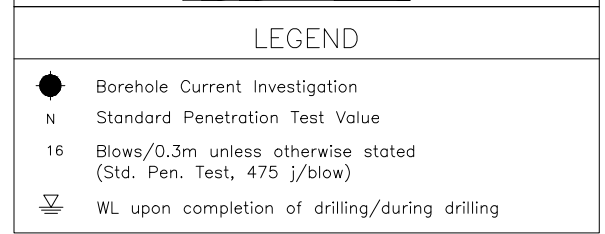
Checked By: AMP

APPENDIX B

Lateral Sewer 2 at Station 23+569



WSP GOLDNER



REFERENCE

Base plan provided in digital format by MH, drawing file no.
X117116615Base (1).dwg, received June 15, 2021.
Topography plan provided in digital format by MH, drawing file no.
X117116615Contours.dwg, received June 2, 2021.
Proposed Sewer provided in digital format by MH, drawing file no.
x117116615design.dwg, received February 9, 2022 and
x117116615Profiles.dwg, received February 14, 2022.

NO.	DATE	BY	REVISION
Geocres No. 30M13-243			
HWY. 400		PROJECT NO. 1786658	DIST.
SUBM'D. AMP	CHKD. AMP	DATE: 03/17/2022	SITE:
DRAWN: DD	CHKD. WC	APPD. WC	DWG. B—1

PROJECT		1786658 (W015)		RECORD OF BOREHOLE		No LS2-1		SHEET 1 OF 1		METRIC						
G.W.P.		2385-02-00		LOCATION		N 4866076.2; E 299220.6 MTM NAD 83 ZONE 10 (LAT. 43.934653; LONG. -79.569497)		ORIGINATED BY		SC						
DIST		Central HWY 400		BOREHOLE TYPE		Power Auger; 200 mm O.D. Solid Stem Augers		COMPILED BY		KJC						
DATUM		CGVD28 / HT2 0 (Geodetic)		DATE		October 23, 2021		CHECKED BY		AMP						
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								
306.6	GROUND SURFACE															
0.0	ASPHALT (230 mm)															
0.2	SAND (SP) (FILL)		1	SS	18											
305.9	Compact Brown Dry															
0.7	Sandy CLAYEY SILT (CL), trace gravel (FILL)		2	SS	10											
	Stiff Brown to black Moist		3	SS	8											
304.4	CLAYEY SILT (CL), trace to some sand (TILL)		4	SS	11											
2.2	Stiff to hard Brown to grey Moist		5A	SS	16											
	- 130 mm wet sand seam at 3.6 m depth		5B													
			6	SS	17											
			7	SS	21											
			8	SS	12											
			9	SS	35											
			10	SS	22											
296.9	END OF BOREHOLE															
9.8	NOTES:															
	1. Water encountered at a depth of 3.6 m below ground surface (Elev. 303.0 m) during drilling.															
	2. Borehole caved to a depth of 7.8 m below ground surface (Elev. 298.8 m) upon completion of drilling.															
	3. Borehole dry inside augers upon completion of drilling.															

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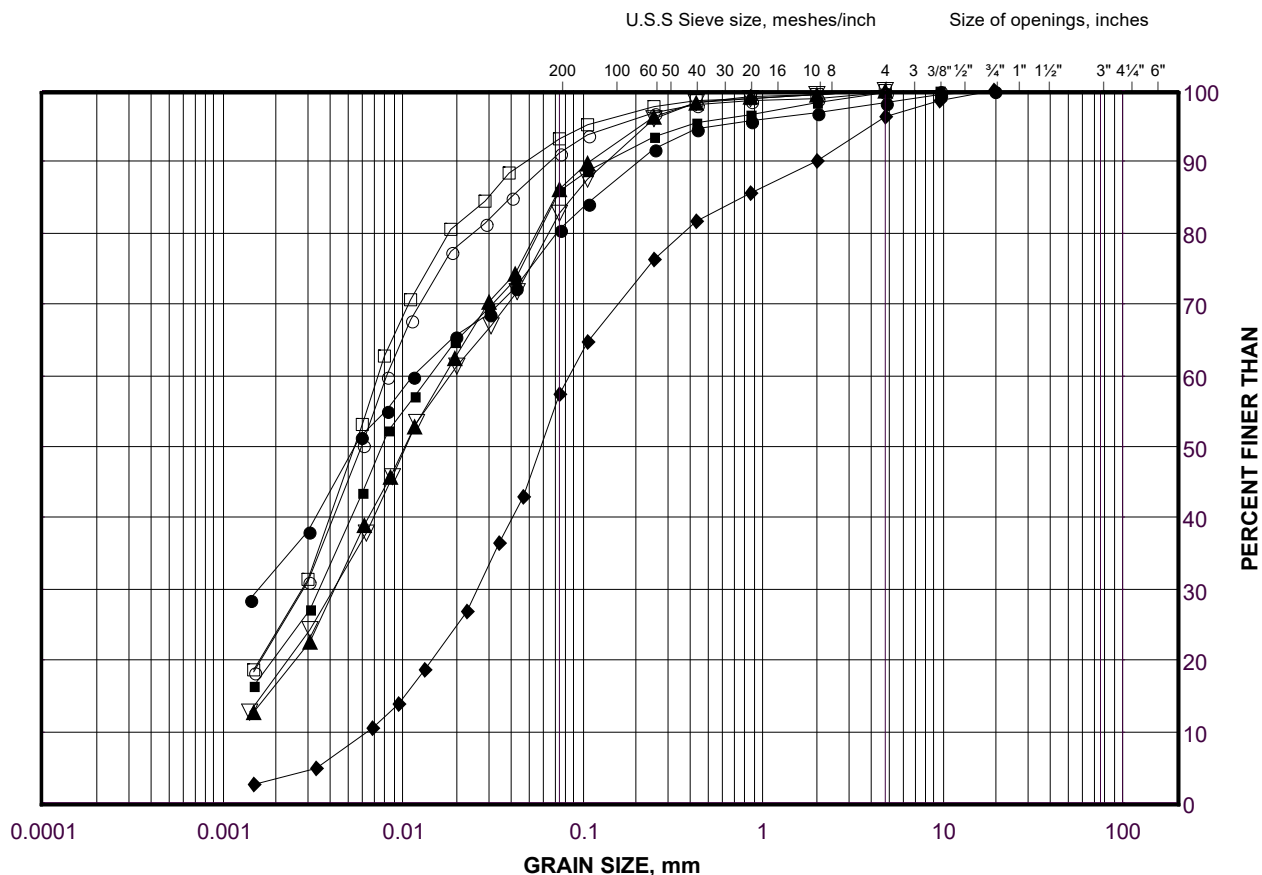
PROJECT		1786658 (W015)		RECORD OF BOREHOLE No LS2-2		SHEET 1 OF 1		METRIC							
G.W.P.		2385-02-00		LOCATION		N 4866065.9; E 299192.4 MTM NAD 83 ZONE 10 (LAT. 43.934560; LONG. -79.569848)		ORIGINATED BY SC							
DIST		Central HWY 400		BOREHOLE TYPE		Power Auger; 200 mm O.D. Solid Stem Augers		COMPILED BY KJC							
DATUM		CGVD28 / HT2 0 (Geodetic)		DATE		October 20, 2021		CHECKED BY AMP							
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							
303.9	GROUND SURFACE														
0.0	Clayey ORGANIC SILT (OH), trace sand Firm Brown Moist		1	SS	6									OC=9.1%	
303.2															
302.9	CLAYEY SILT (CL), trace sand (TILL) Firm to very stiff Brown Moist to wet		2B	SS	18										
1.0			2A												
301.7	SILT (ML) and sand of slight plasticity, trace gravel (TILL) Compact Brown Moist to wet		3	SS	20										3 39 55 3
2.2															
300.5	SAND (SP) Loose Brown Wet		4	SS	9										
300.2	SILT (ML) and sand of slight plasticity, trace gravel (TILL) Brown Wet		5A	SS	15										
3.7			5B												
	CLAYEY SILT (CL), trace to some sand, trace gravel (TILL) Stiff to very stiff Grey Moist		6	SS	14										
			7	SS	21										0 9 68 23
			8	SS	27										
			9	SS	28										
			10	SS	24										2 18 47 33
294.2															
9.8	END OF BOREHOLE														
NOTES: 1. Water encountered at a depth of 0.9 m below ground surface (Elev. 303.0 m) during drilling. 2. Water measured in open borehole at a depth of 2.1 m below ground surface (Elev. 301.8 m) upon completion of drilling															

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GRAIN SIZE DISTRIBUTION

SILT (ML) and sand of slight plasticity to Sandy CLAYEY SILT (CL) (TILL)

FIGURE B-1



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

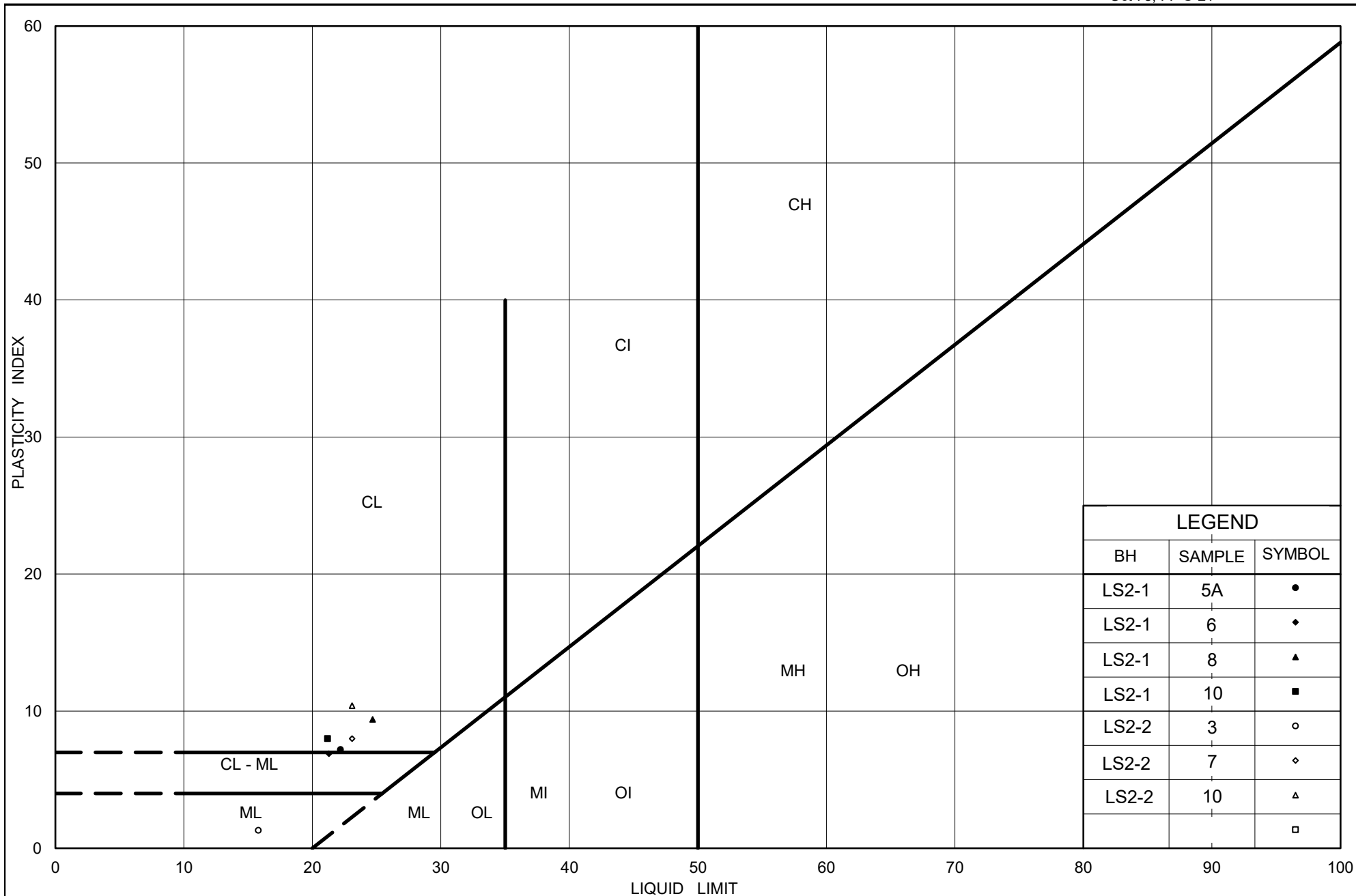
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	LS2-2	10	294.5
■	LS2-1	10	297.1
◆	LS2-2	3	302.1
▲	LS2-1	5A	303.2
▽	LS2-1	6	302.5
○	LS2-2	7	299.0
□	LS2-1	8	300.2

Project Number: 1786658 WO15-LS

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PLASTICITY CHART

SILT (ML) and sand of slight plasticity to Sandy CLAYEY SILT (CL)
(TILL)

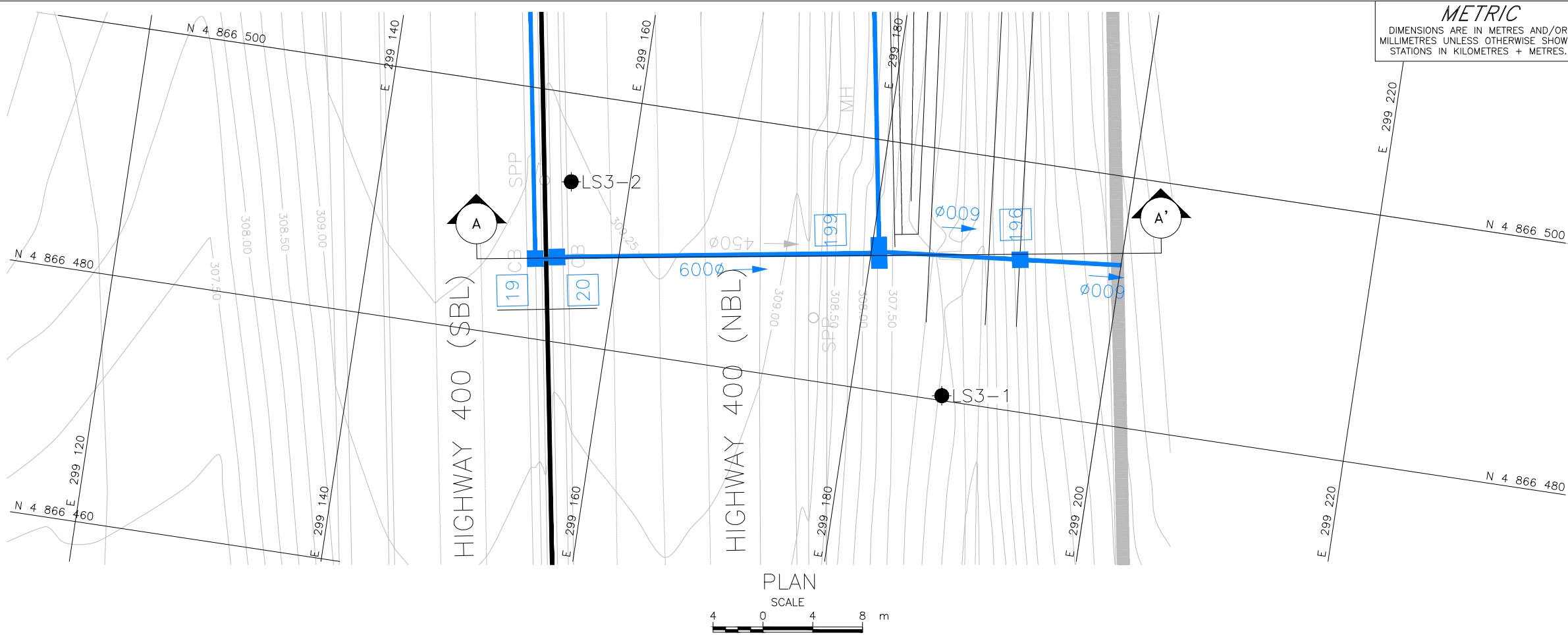
Figure No. B-2

Project No. 1786658 WO15-LS

Checked By: AMP

APPENDIX C

Lateral Sewer 3 at Station 14+054

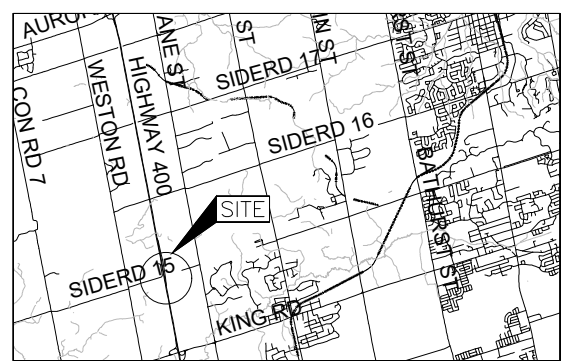


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No.

HIGHWAY 400 WIDENING
LATERAL SEWER 3 (STA. 14+054)
BOREHOLE LOCATION AND SOIL
STRATA

SHEET

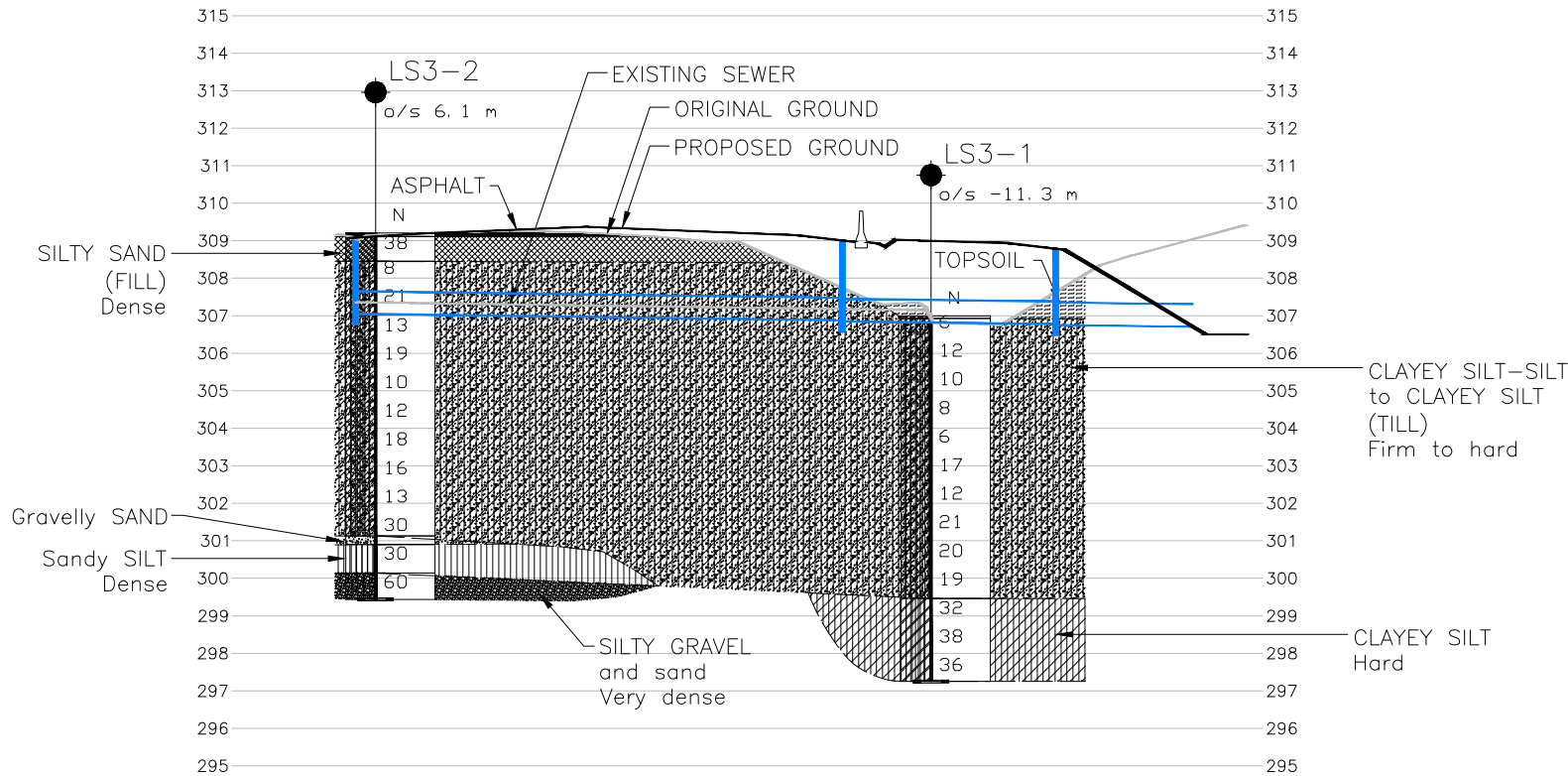


LEGEND

- Borehole Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- ≡ WL upon completion of drilling/during drilling

BOREHOLE CO-ORDINATES (MTM NAD83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
LS3-1	306.6	4866480.4	299187.3
LS3-2	309.2	4866492.9	299155.3



NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

Base plan provided in digital format by MH, drawing file no. X117116615Base (1).dwg, received June 15, 2021.
Topography plan provided in digital format by MH, drawing file no. X117116615Contours.dwg, received June 2, 2021.
Proposed Sewer provided in digital format by MH, drawing file no. x117116615design.dwg, received February 9, 2022 and x117116615Profiles.dwg, received February 14, 2022.

NO.	DATE	BY	REVISION
Geocres No. 30M13-243			
HWY. 400		PROJECT NO. 1786658	DIST. .
SUBM'D. AMP	CHKD. AMP	DATE: 03/17/2022	SITE: .
DRAWN: DD/SA	CHKD. WC	APPD. WC	DWG. C-1

PROJECT 1786658 (W015)			RECORD OF BOREHOLE No LS3-1			SHEET 1 OF 1			METRIC																					
G.W.P. 2385-02-00			LOCATION N 4866480.4; E 299187.3 MTM NAD 83 ZONE 10 (LAT. 43.938290; LONG. -79.569916)			ORIGINATED BY ML																								
DIST Central HWY 400			BOREHOLE TYPE Power Auger; 200 mm O.D. Solid Stem Augers			COMPILED BY KJC																								
DATUM CGVD28 / HT2 0 (Geodetic)			DATE December 10, 2021			CHECKED BY AMP																								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			ELEVATION SCALE			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			SHEAR STRENGTH kPa			WATER CONTENT (%)			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES																									
307.0	GROUND SURFACE																													
0.9	TOPSOIL (75 mm)		1	SS	6																									
	CLAYEY SILT-SILT (CL-ML) to CLAYEY SILT (CL), some sand to sandy, trace gravel (TILL)		2	SS	12																									
	Firm to very stiff		3	SS	10																									
	Brown to grey		4	SS	8																									
	Moist		5	SS	6																									
	- Grey below 2.2 m depth		6	SS	17																									
			7	SS	12																									
			8	SS	21																									
			9	SS	20																									
			10	SS	19																									
299.5	CLAYEY SILT (CL), trace sand		11	SS	32																									
7.5	Hard		12	SS	38																									
	Grey		13	SS	36																									
	Moist																													
297.2	END OF BOREHOLE																													
9.8	NOTE:																													
	1. Borehole open and dry upon completion of drilling.																													

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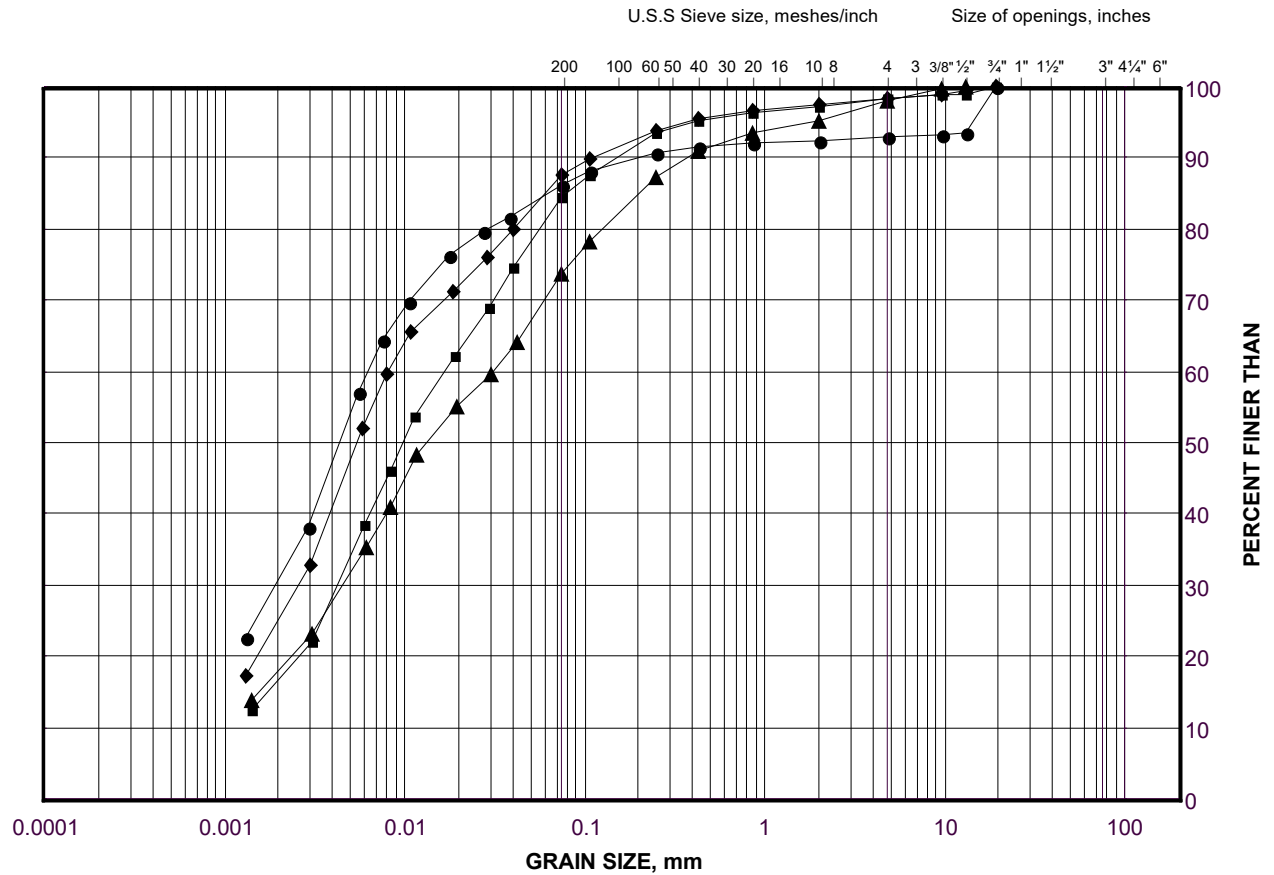
PROJECT		1786658 (W015)		RECORD OF BOREHOLE No LS3-2		SHEET 1 OF 1		METRIC												
G.W.P.		2385-02-00		LOCATION		N 4866492.9; E 299155.3 MTM NAD 83 ZONE 10 (LAT. 43.938403; LONG. -79.570315)		ORIGINATED BY												
DIST		Central HWY 400		BOREHOLE TYPE		Power Auger; 200 mm O.D. Solid Stem Augers		COMPILED BY												
DATUM		CGVD28 / HT2 0 (Geodetic)		DATE		November 29, 2021		CHECKED BY												
								AMP												
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	γ	GR SA SI CL						
309.2	GROUND SURFACE																			
0.0	ASPHALT (100 mm)		1A	SS	38		309													
0.1	SILTY SAND (SM), trace to some gravel (FILL)		1B																	
308.4	Dense Brown to black Moist		2	SS	8		308													
0.8	CLAYEY SILT (CL), trace to some sand, trace gravel (TILL)		3	SS	21									8 6 55 31						
	Stiff to hard Brown to grey Moist		4	SS	13		307													
	- Auger grinding from 1.6 m to 2.3 m		5	SS	19		306													
			6	SS	10		305													
			7	SS	12		304													
			8	SS	18		303							2 11 62 25						
			9	SS	16		302													
			10	SS	13		301													
301.1	Gravelly SAND (SP)		11A	SS	30															
8.3	Brown Moist		11B																	
300.1	Sandy SILT (ML)		12	SS	30		300													
9.1	Dense Brown Moist		13	SS	60									45 41 11 3						
299.4	SILTY GRAVEL (GM/SM) and sand																			
9.8	Very dense Brown Moist																			
	END OF BOREHOLE																			
NOTE:																				
1. Borehole open and dry upon completion of drilling.																				

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GRAIN SIZE DISTRIBUTION

CLAYEY SILT-SILT (CL-ML) to CLAYEY SILT (CL) (TILL)

FIGURE C-1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

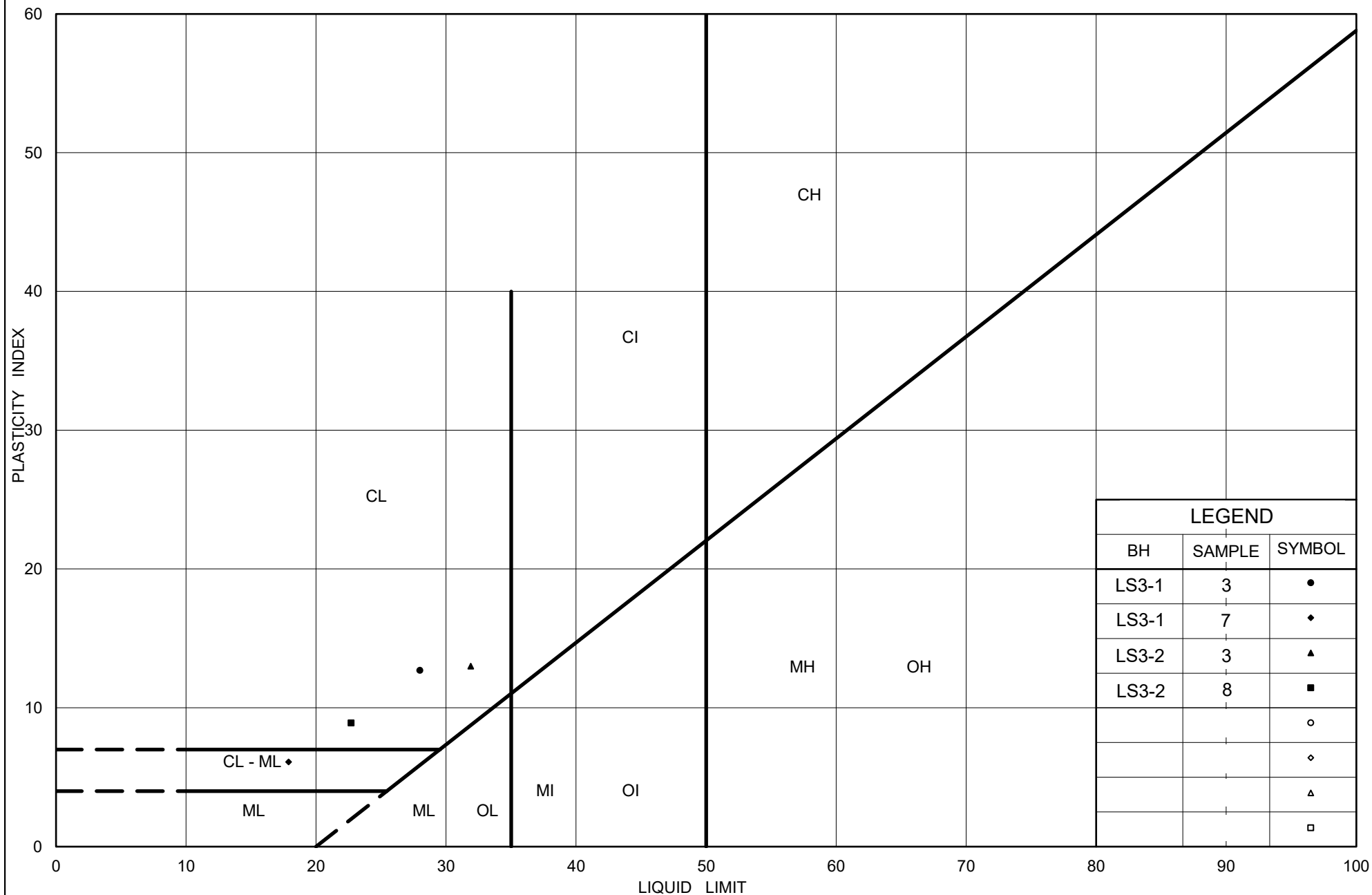
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	LS3-2	3	307.4
■	LS3-1	5	303.2
◆	LS3-2	8	303.6
▲	LS3-1	9	300.1

Project Number: 1786658 WO15-LS

Checked By: AMP

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Date: 15-Feb-22



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PLASTICITY CHART

CLAYEY SILT-SILT (CL-ML) to CLAYEY SILT (CL) (TILL)

Figure No. C-2

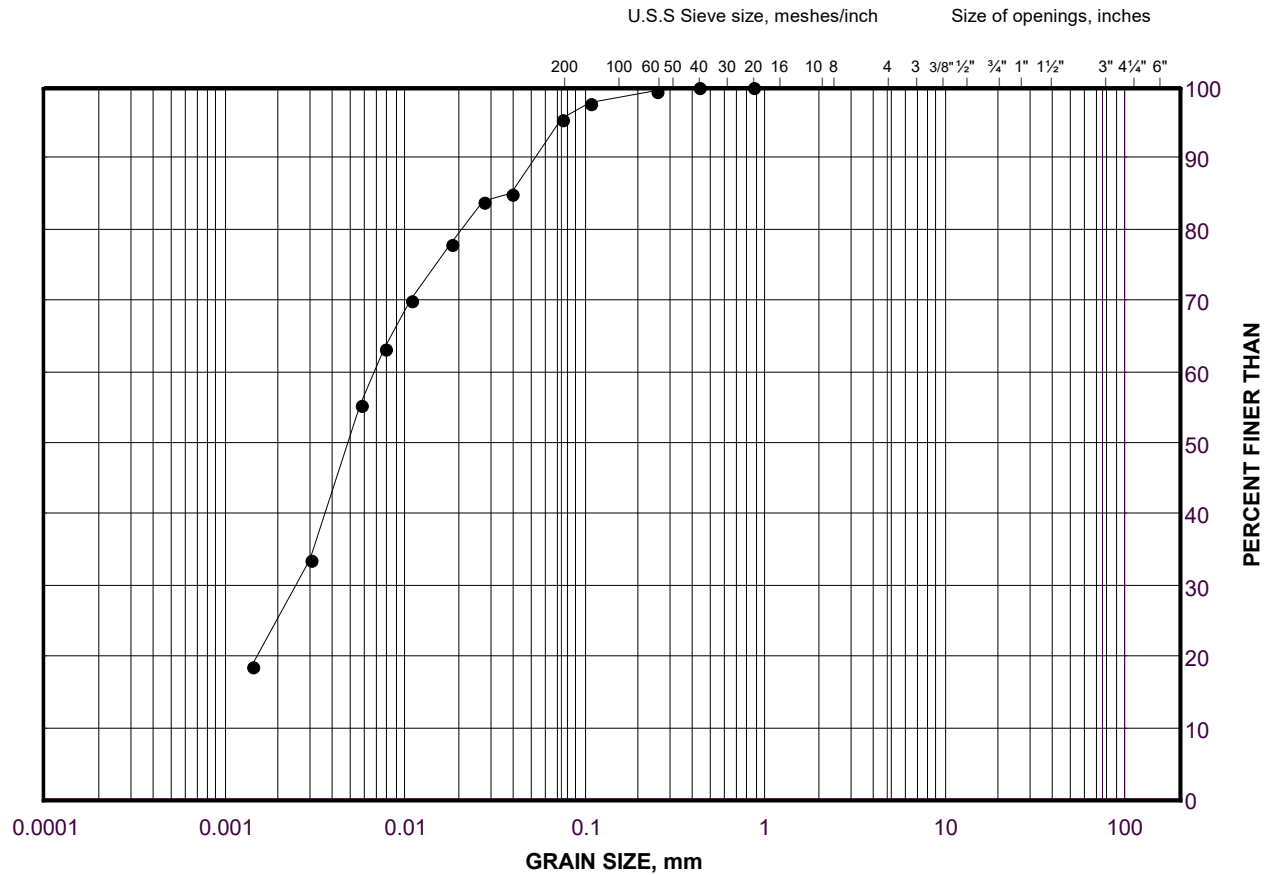
Project No. 1786658 WO15-LS

Checked By: AMP

GRAIN SIZE DISTRIBUTION

CLAYEY SILT (CL)

FIGURE C-3



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

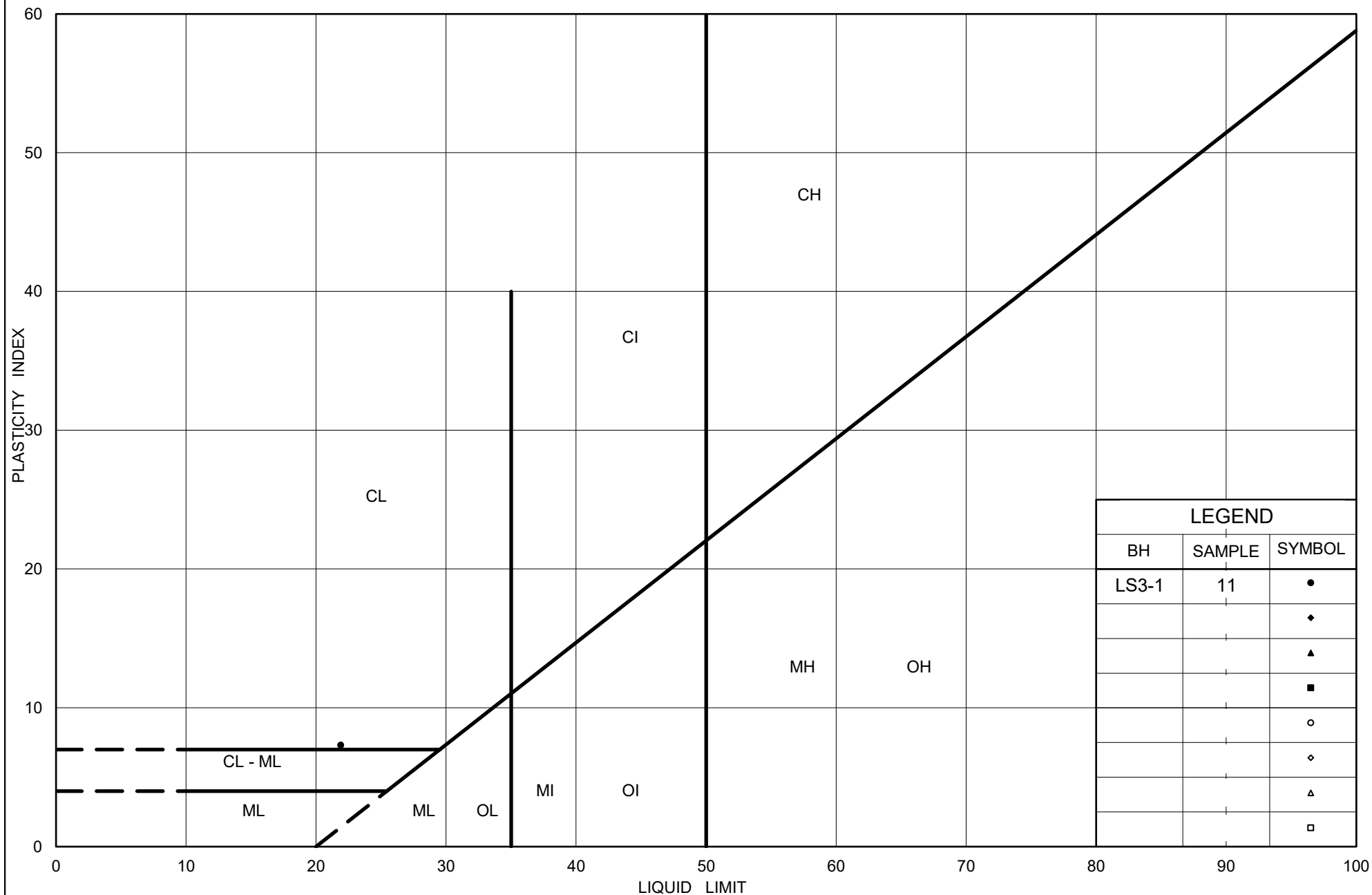
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	LS3-1	11	298.7

Project Number: 1786658 WO15-LS

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Golder Associates

Date: 15-Feb-22



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PLASTICITY CHART CLAYEY SILT (CL)

Figure No. C-4

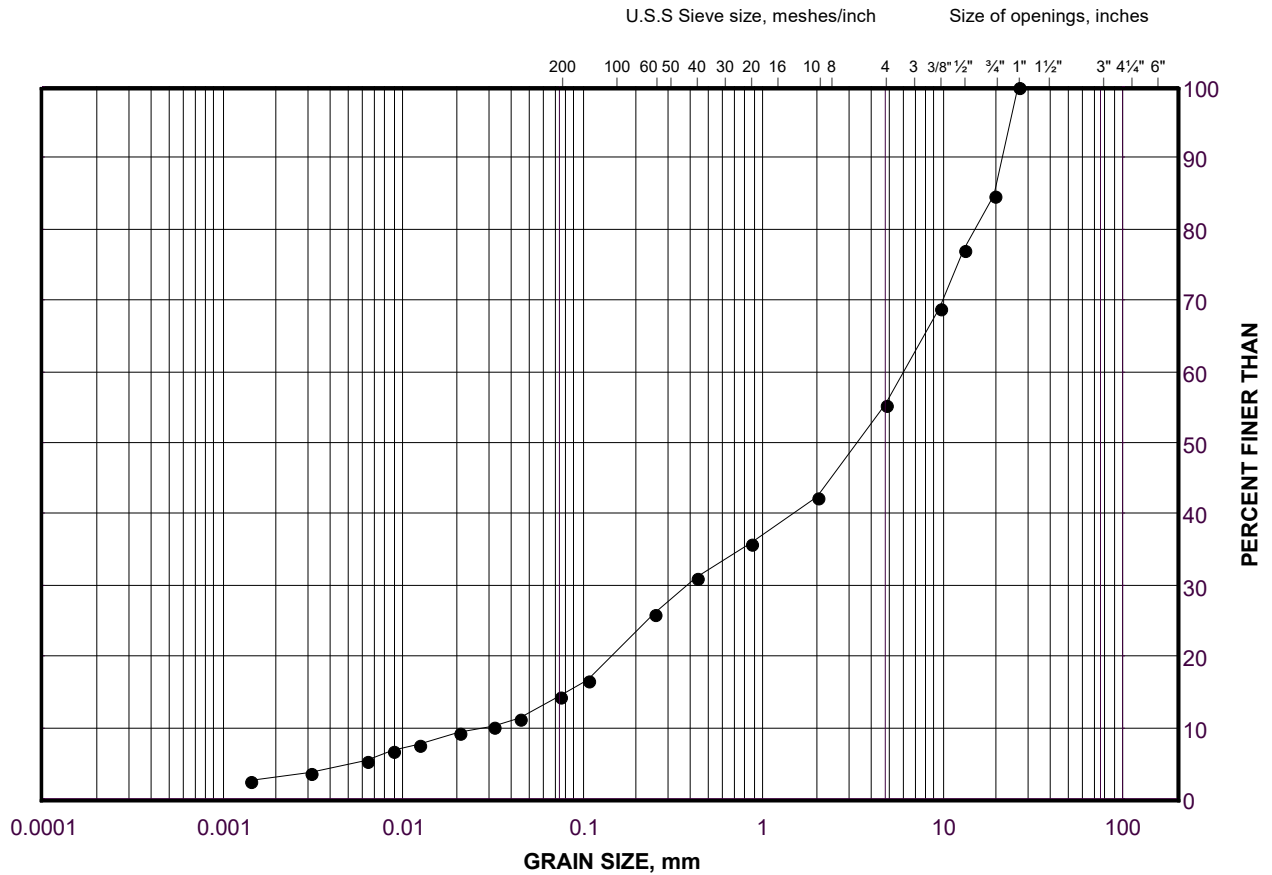
Project No. 1786658 WO15-LS

Checked By: AMP

GRAIN SIZE DISTRIBUTION

SILTY GRAVEL (GM/SM) and sand

FIGURE C-5



SILT AND CLAY SIZES			FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED			SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	LS3-2	13	299.8

Project Number: 1786658 WO15-LS

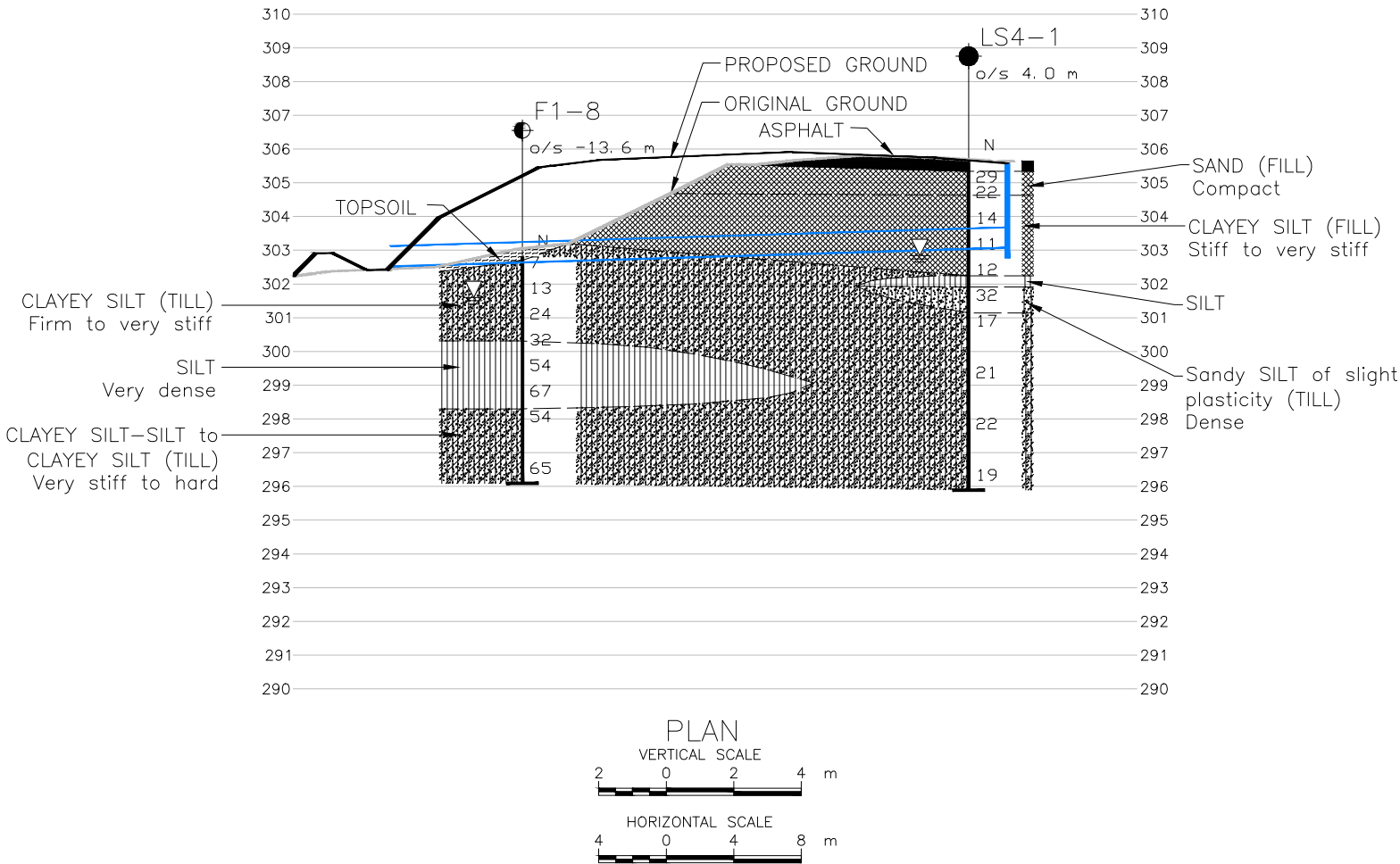
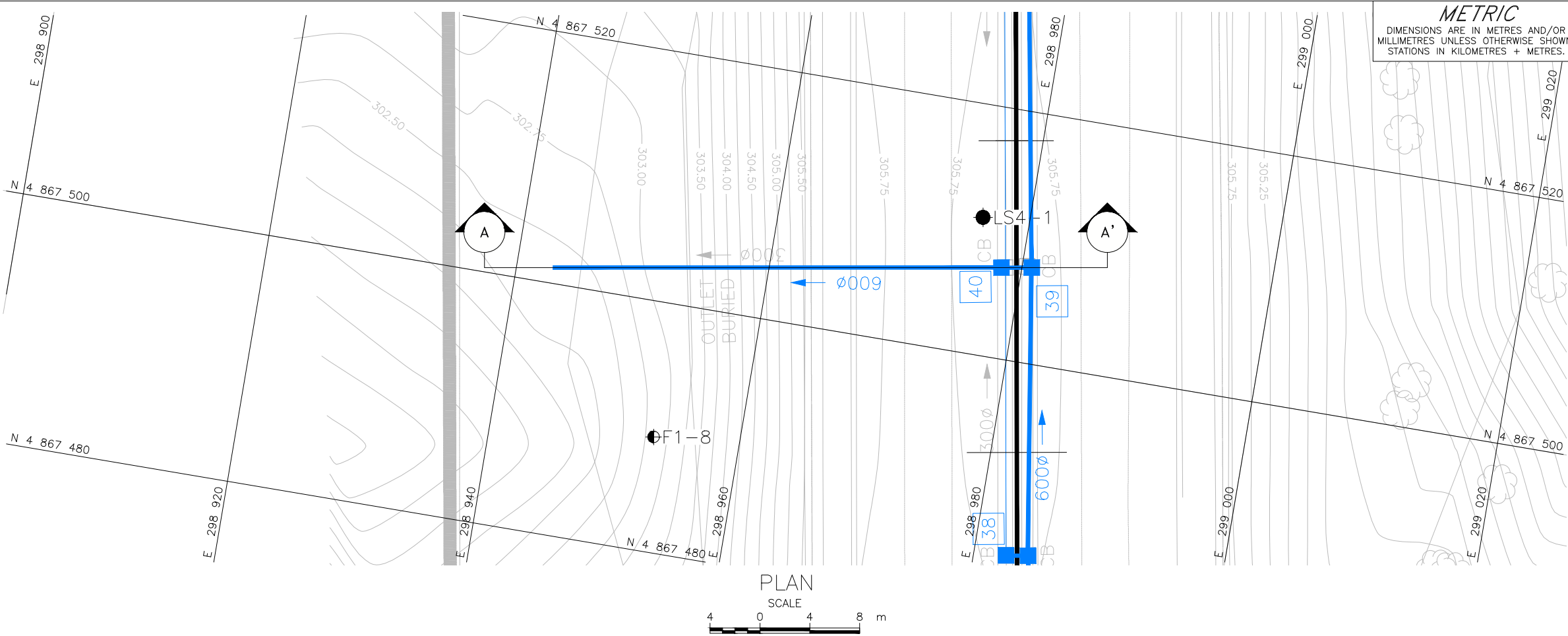
Checked By: AMP

Golder Associates

Date: 15-Feb-22

APPENDIX D

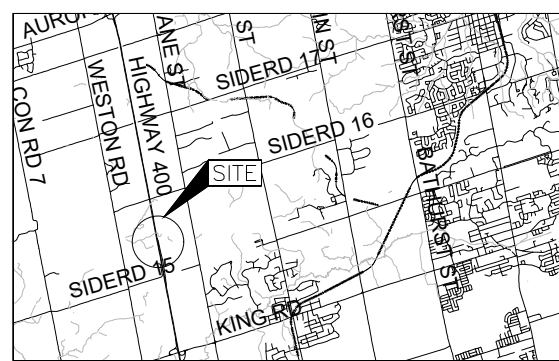
Lateral Sewer 4 at Station 15+090



CONT No.
WP No.

HIGHWAY 400 WIDENING
LATERAL SEWER 4 (STA. 15+090)
BOREHOLE LOCATION AND SOIL STRATA

SHEET



- LEGEND
- Borehole Current Investigation
 - Borehole - Previous Investigation
 - N Standard Penetration Test Value
 - 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
 - ≡ WL upon completion of drilling

BOREHOLE CO-ORDINATES (MTM NAD83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
F1-8	302.8	4867489.2	298953.1
LS4-1	305.6	4867511.0	298976.3



NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

Base plan provided in digital format by MH, drawing file no. X117116615Base (1).dwg, received June 15, 2021.
Topography plan provided in digital format by MH, drawing file no. X117116615Contours.dwg, received June 2, 2021.
Proposed Sewer provided in digital format by MH, drawing file no. x117116615design.dwg, received February 9, 2022 and x117116615Profiles.dwg, received February 14, 2022.

NO.	DATE	BY	REVISION
Geocres No. 30M13-243			
HWY. 400	PROJECT NO. 1786658	DIST.	
SUBM'D. AMP	CHKD. AMP	DATE: 03/17/2022	SITE:
DRAWN: DD/SA	CHKD. WC	APPD. WC	DWG. D-1

PROJECT 09-1111-0018			RECORD OF BOREHOLE No F1-8			SHEET 1 OF 1			METRIC						
W.P. 2835-02-00			LOCATION N 4867489.2 ; E 298953.1			ORIGINATED BY TT									
DIST Central HWY 400			BOREHOLE TYPE D-25 Track Mount, 108 mm Outside Diameter Solid Stem Auger			COMPILED BY MAS									
DATUM Geodetic			DATE December 16, 2010			CHECKED BY SMM									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							PLASTIC LIMIT W _p
302.8	GROUND SURFACE														
0.0	TOPSOIL		1A	SS	7										
	CLAYEY SILT, some sand, trace gravel, trace rootlets to a depth of 0.6 m (TILL) Firm to very stiff Brown and grey Moist		1B												
			2	SS	13										
			3	SS	24										
300.3															
2.5	SILT, trace to some sand, trace to some clay, trace gravel (TILL) Dense to very dense Brown Wet		4	SS	32										
			5	SS	54										
	Becoming grey below a depth of 4.0 m Sand layer at a depth of 4.1 m		6	SS	67										
298.3															
4.5	CLAYEY SILT, trace sand, trace gravel (TILL) Hard Grey Moist		7	SS	54										
			8	SS	65										
296.1															
6.7	END OF BOREHOLE														
NOTES:															
1. Water level at 1.2 m depth below ground surface (Elev. 301.6 m) in open borehole upon completion of drilling.															
2. Borehole caved at a depth of 1.4 m below ground surface (Elev. 301.4 m) upon completion of drilling.															

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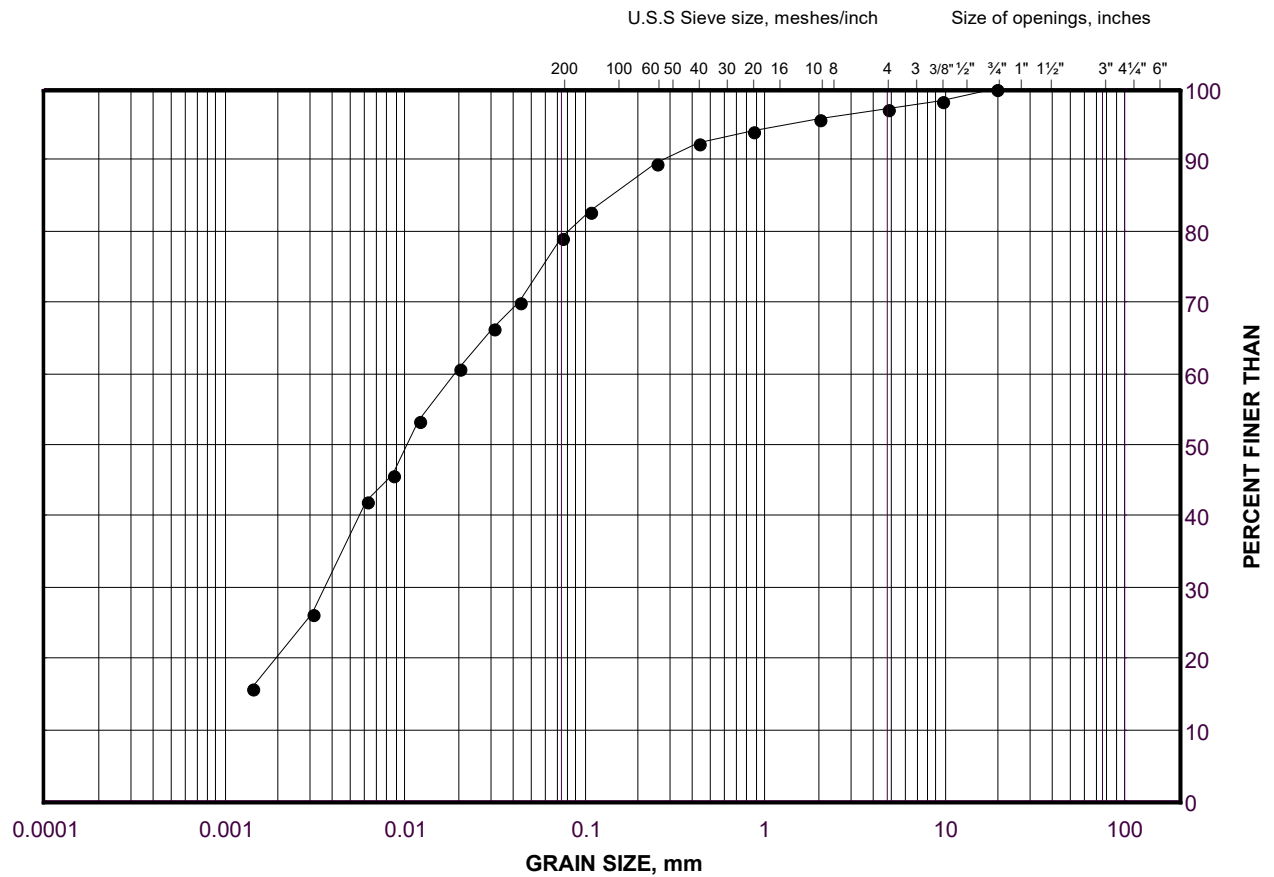
PROJECT		1786658 (W015)				RECORD OF BOREHOLE No LS4-1				SHEET 1 OF 1				METRIC							
G.W.P.		2385-02-00				LOCATION				N 4867511.0; E 298976.3 MTM NAD 83 ZONE 10 (LAT. 43.947565; LONG. -79.572556)				ORIGINATED BY SC							
DIST		Central HWY 400				BOREHOLE TYPE				Power Auger; 200 mm O.D. Solid Stem Augers				COMPILED BY KJC							
DATUM		CGVD28 / HT2_0 (Geodetic)				DATE				October 13, 2021				CHECKED BY AMP							
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											
										○ UNCONFINED + FIELD VANE											
										● QUICK TRIAXIAL × REMOULDED											
										20 40 60 80 100											
305.6	GROUND SURFACE																				
0.0	ASPHALT (300 mm)																				
305.3																					
0.3	SAND (SP), trace to some gravel (FILL)					1A	SS	29													
304.6	Compact Brown Moist					2A	SS	22													
1.0	CLAYEY SILT (CL), some sand to sandy, trace gravel, trace organics (FILL)					2B	SS														
	Stiff to very stiff Brown Moist to wet					3	SS	14													
						4	SS	11													
302.2						5A	SS	12													
301.9	SILT (ML), some sand Grey Wet					5B	SS														
3.7	Sandy SILT (ML) of slight plasticity, some gravel (TILL)					6	SS	32													
301.1	Dense Brown Moist					7	SS	17													
4.5	- Rock fragments at 4.0 m depth																				
	CLAYEY SILT (CL), some sand (TILL)																				
	Very stiff Brown to grey Moist					8	SS	21													
	- Grey below 6.1 m depth																				
						9	SS	22													
295.9						10	SS	19													
9.8	END OF BOREHOLE																				
NOTES:																					
1. Water encountered at a depth of 2.8 m below ground surface (Elev. 302.8 m) during drilling.																					
2. Borehole dry inside augers upon completion of drilling.																					

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GRAIN SIZE DISTRIBUTION

CLAYEY SILT (CL) (FILL)

FIGURE D-1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

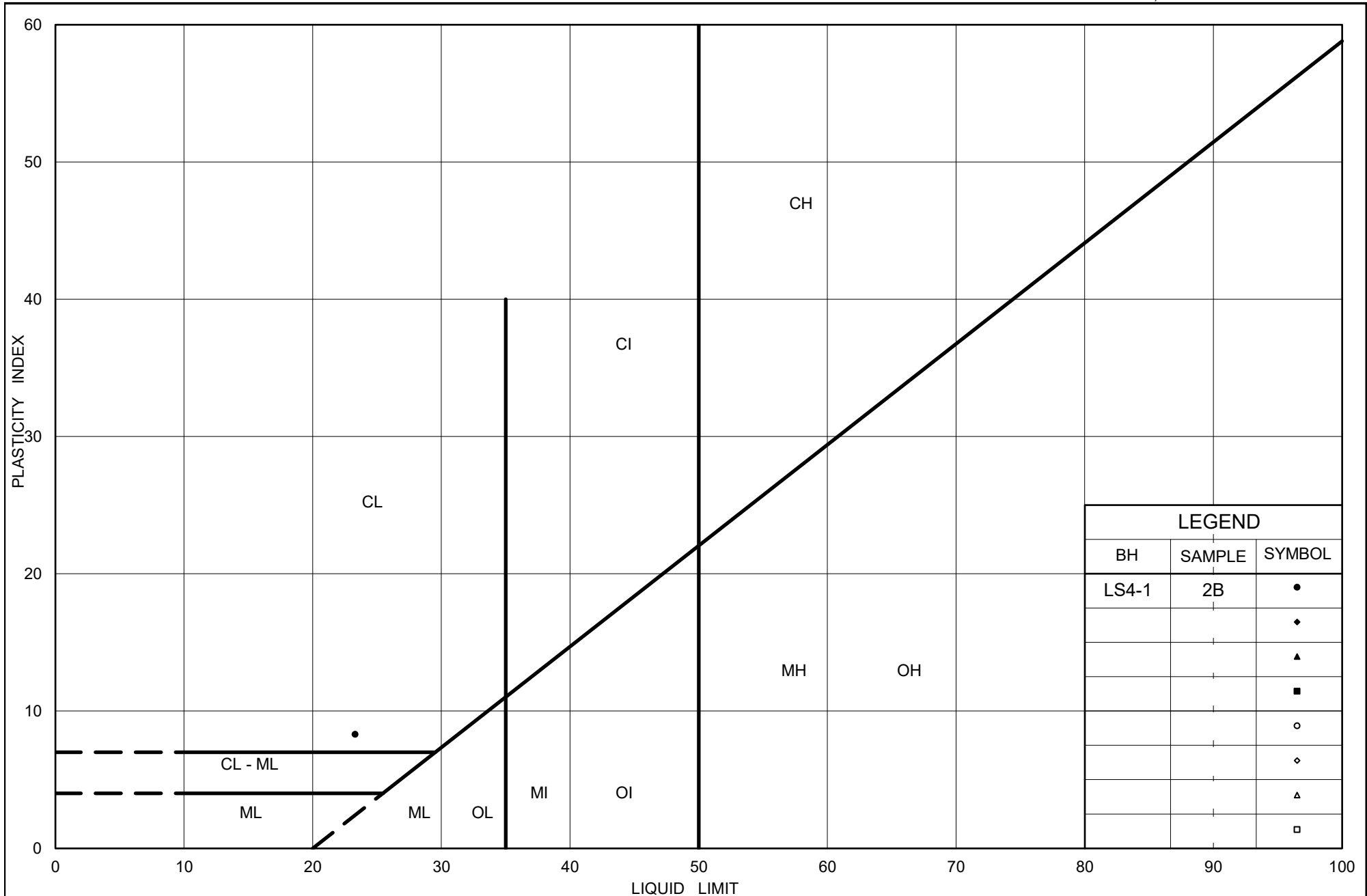
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	LS4-1	2B	304.5

Project Number: 1786658 WO15-LS

Checked By: AMP

Golder Associates

Date: 15-Feb-22



Ministry of Transportation

Ontario

PLASTICITY CHART CLAYEY SILT (CL) (FILL)

Figure No. D-2

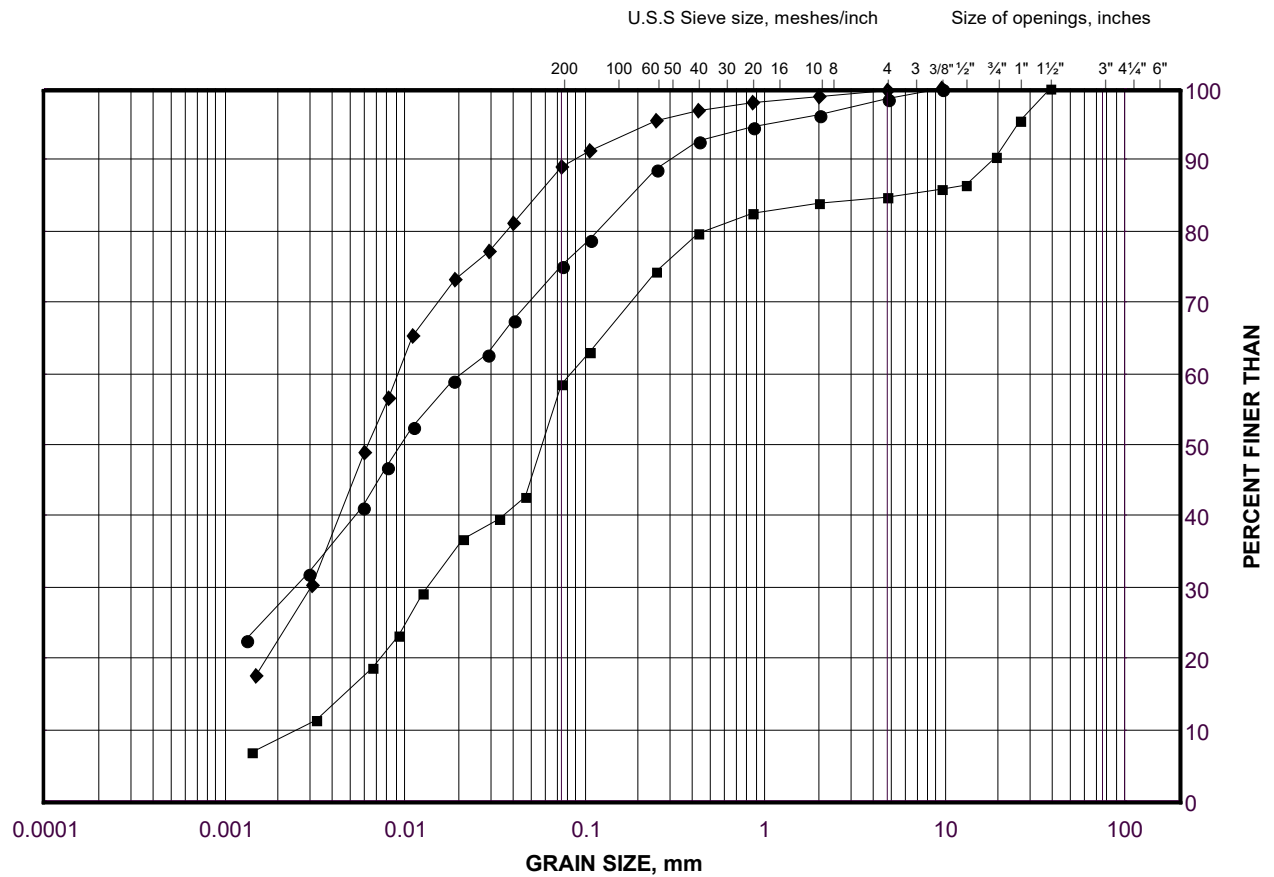
Project No. 1786658 WO15-LS

Checked By: AMP

GRAIN SIZE DISTRIBUTION

SILT (ML) to sandy CLAYEY SILT (CL) (TILL)

FIGURE D-3



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

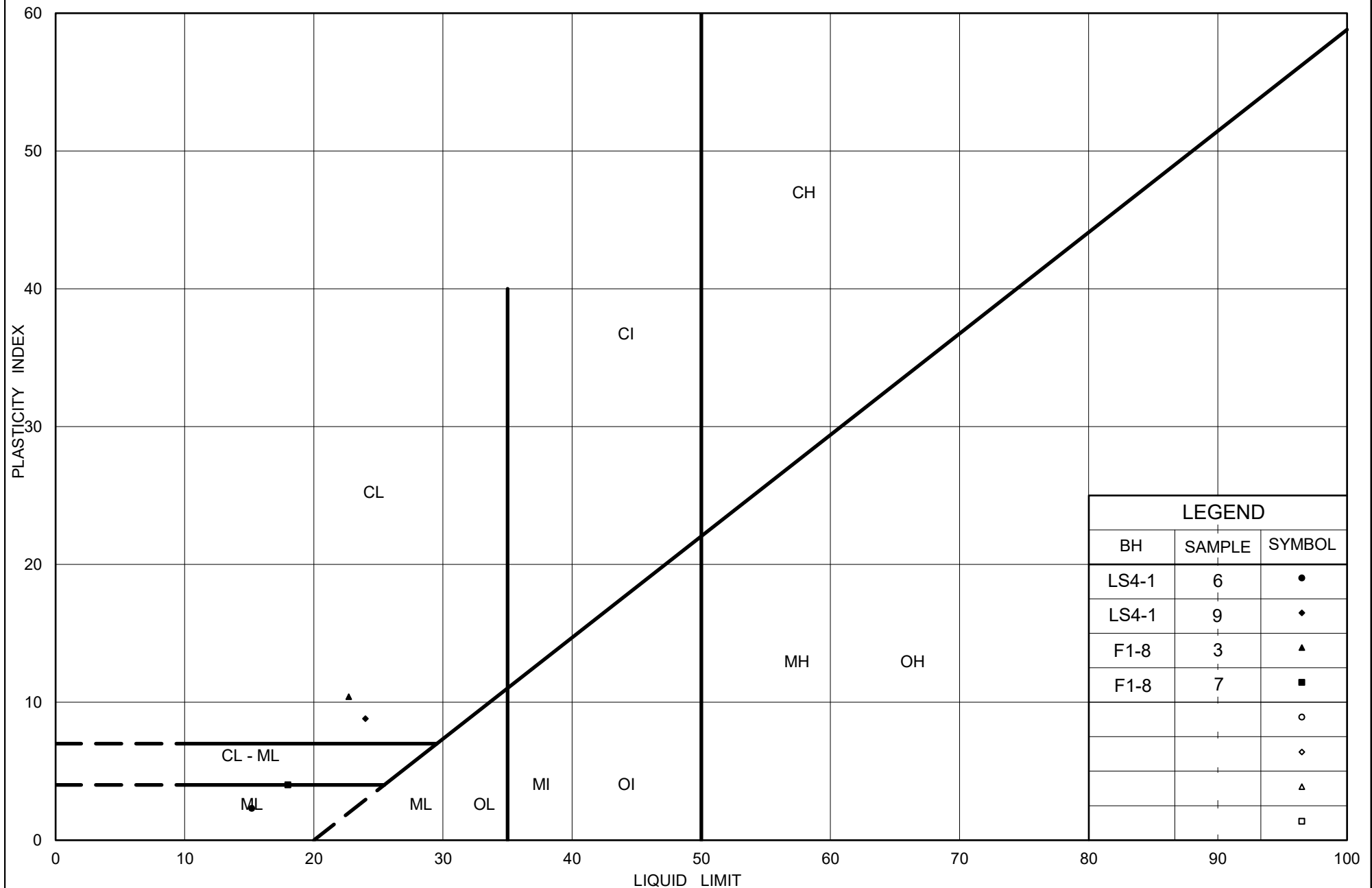
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	F1-8	3	301
■	LS4-1	6	301.6
◆	LS4-1	9	297.8

Project Number: 1786658

Checked By: AMP

Golder Associates

Date: 17-Feb-22



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PLASTICITY CHART

SILT (ML) to Sandy CLAYEY SILT-SILT (CL-ML) (TILL)

Figure No. D-4

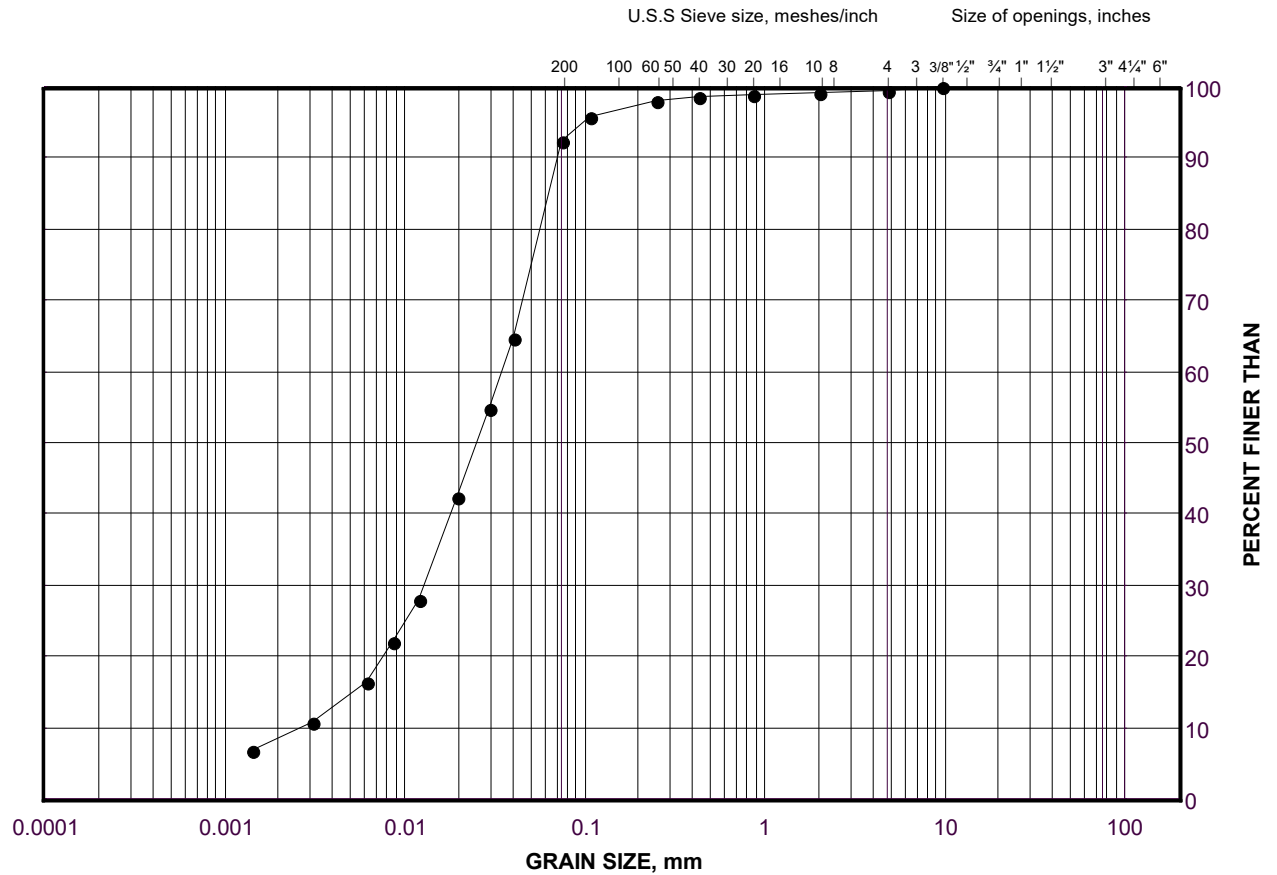
Project No. 1786658-WO15-LS

Checked By: AMP

GRAIN SIZE DISTRIBUTION

SILT (ML)

FIGURE D-5



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	F1-8	5	299.5

Project Number: 1786658

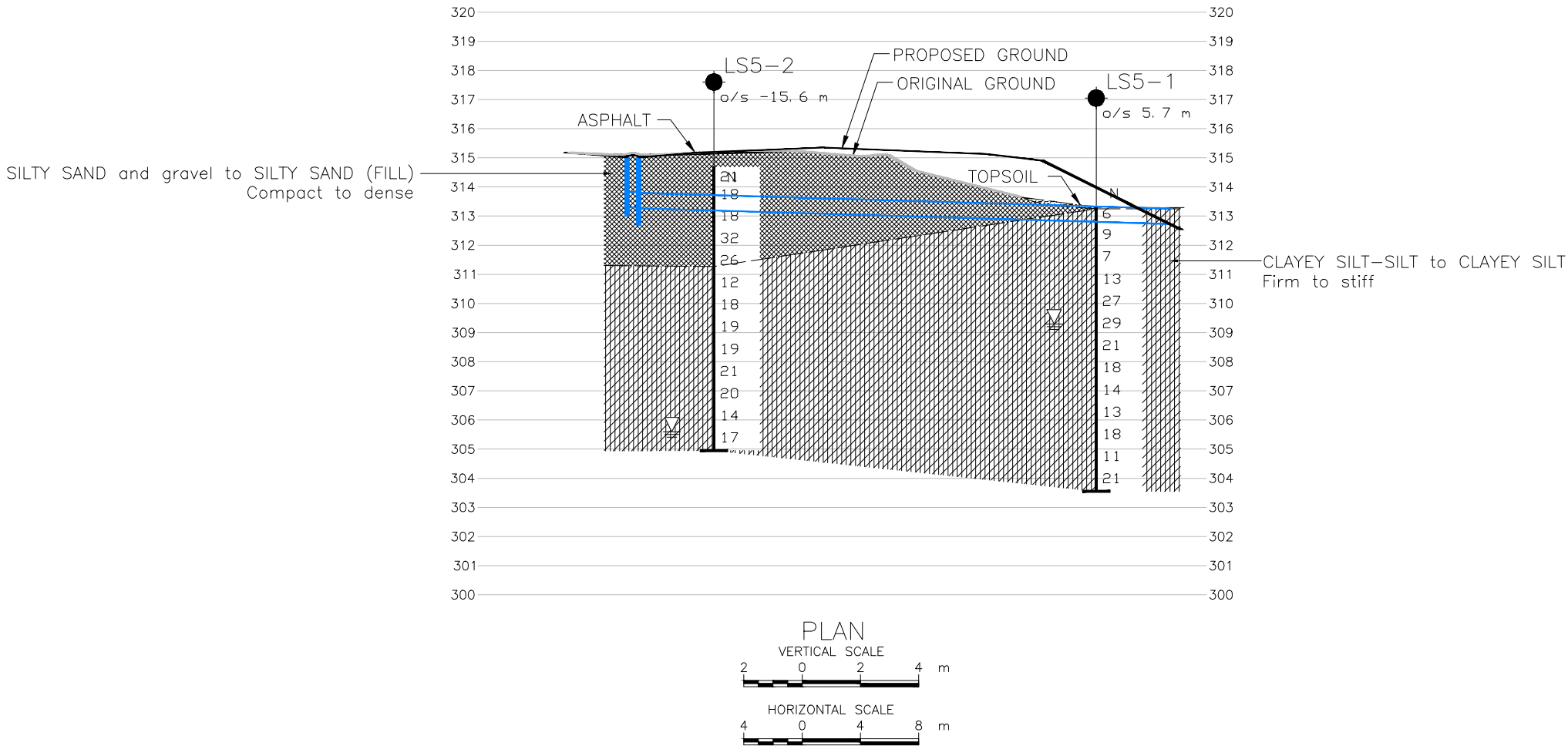
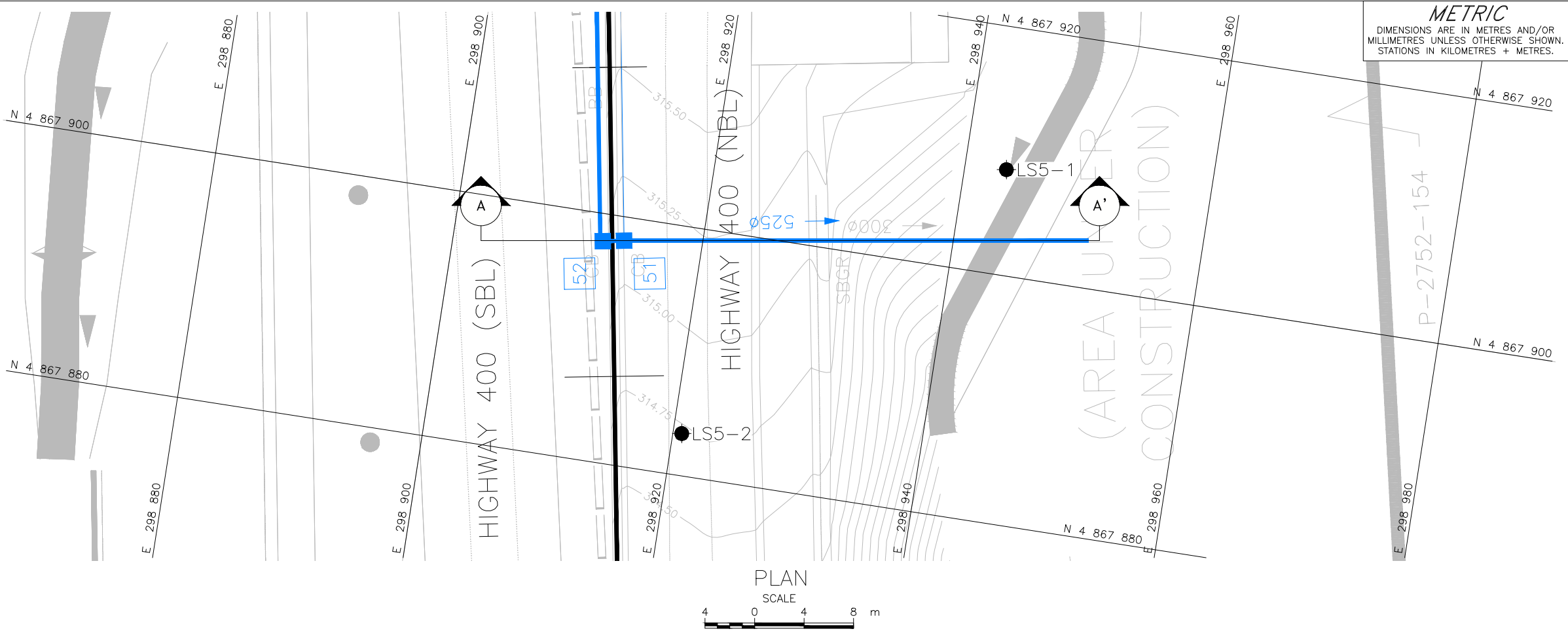
Checked By: AMP

Golder Associates

Date: 17-Feb-22

APPENDIX E

Lateral Sewer 5 at Station 15+486



CONT No.
WP No.

HIGHWAY 400 WIDENING
LATERAL SEWER 5 (STA. 15+486)
BOREHOLE LOCATION AND SOIL STRATA

GOLDER

KEY PLAN
SCALE 2 0 2 4 km

LEGEND

- Borehole Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling/during drilling

BOREHOLE CO-ORDINATES (MTM NAD83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
LS5-1	312.9	4867908.5	298943.4
LS5-2	313.8	4867883.4	298920.7

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

Base plan provided in digital format by MH, drawing file no. X117116615Base (1).dwg, received June 15, 2021.
Topography plan provided in digital format by MH, drawing file no. X117116615Contours.dwg, received June 2, 2021.
Proposed Sewer provided in digital format by MH, drawing file no. x117116615design.dwg, received February 9, 2022 and 52-51-outlet pr.dwg, received February 14, 2022.

NO.	DATE	BY	REVISION
Geocres No. 30M13-243			
HWY. 400	PROJECT NO. 1786658		DIST. .
SUBM'D. AMP	CHKD. AMP	DATE: 03/17/2022	SITE: .
DRAWN: DD/SA	CHKD. WC	APPD. WC	DWG. E-1

PROJECT 1786658 (W015)			RECORD OF BOREHOLE No LS5-1			SHEET 1 OF 1			METRIC									
G.W.P. 2385-02-00			LOCATION N 4867908.5; E 298943.4 MTM NAD 83 ZONE 10 (LAT. 43.951142; LONG. -79.572971)			ORIGINATED BY ML												
DIST Central HWY 400			BOREHOLE TYPE Power Auger; 200 mm O.D. Solid Stem Augers			COMPILED BY KJC												
DATUM CGVD28 / HT2 0 (Geodetic)			DATE December 10, 2021			CHECKED BY AMP												
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
313.3	GROUND SURFACE																	
8.9	TOPSOIL (50 mm)																	
	CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML), trace to some sand, trace gravel, containing rootlets to 0.7 m depth		1	SS	6													
	Firm to stiff		2	SS	9													
	Black to brown to grey		3	SS	7													
	Moist		4	SS	13													
	- Brown below 0.7 m depth		5	SS	27													
			6	SS	29													
			7	SS	21													
			8	SS	18													
			9	SS	14													
			10	SS	13													
			11	SS	18													
			12	SS	11													
			13	SS	21													
303.5	END OF BOREHOLE																	
9.8	NOTES: 1. Water encountered at a depth of 4.0 m (Elevation 309.3 m) below ground surface during drilling. 2. Water measured in open borehole at a depth of 5.6 m (Elevation 307.7 m) below ground surface upon completion of drilling.																	

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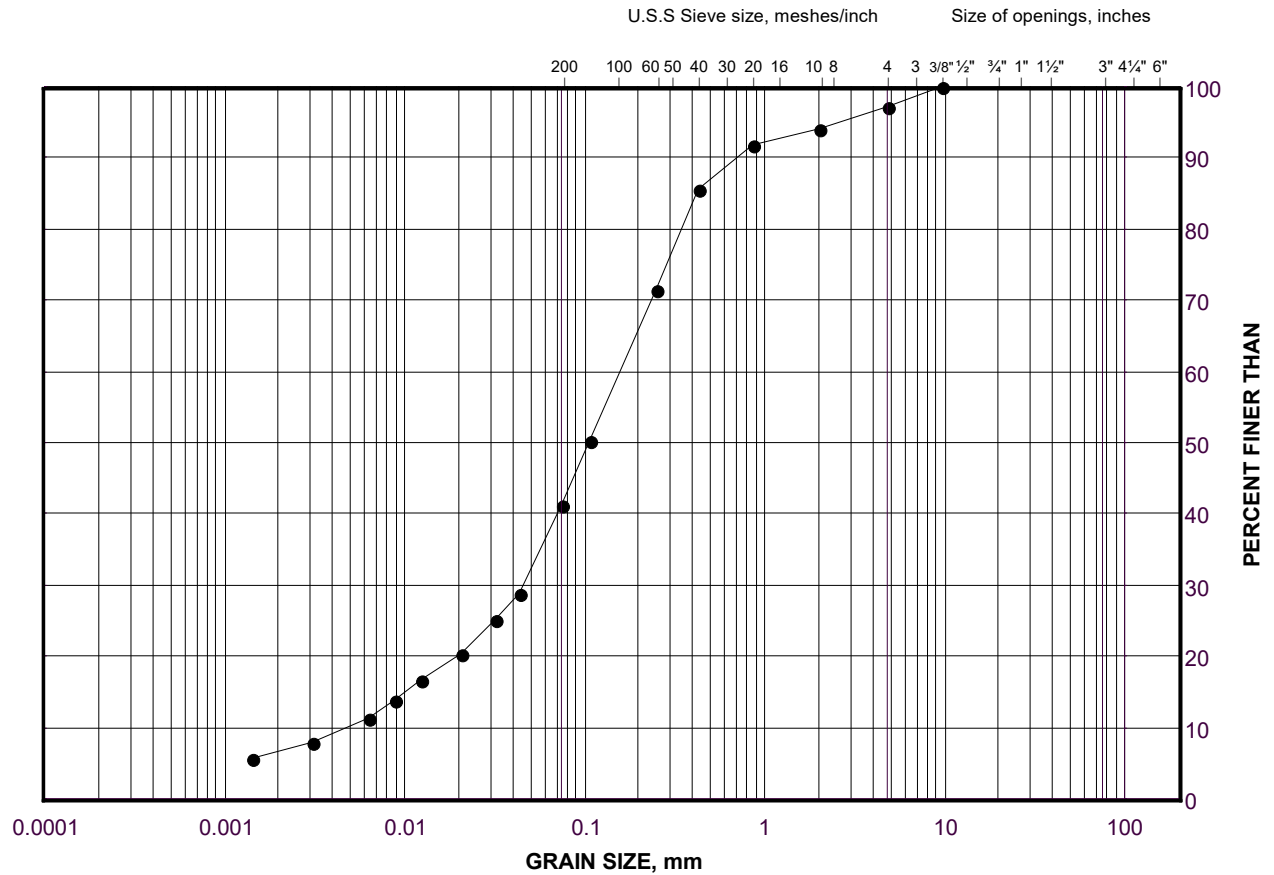
PROJECT		1786658 (W015)		RECORD OF BOREHOLE		No LS5-2		SHEET 1 OF 1		METRIC						
G.W.P.		2385-02-00		LOCATION		N 4867883.4; E 298920.7 MTM NAD 83 ZONE 10 (LAT. 43.950916; LONG. -79.573253)		ORIGINATED BY		PJ						
DIST		Central HWY 400		BOREHOLE TYPE		Power Auger; 200 mm O.D. Solid Stem Augers		COMPILED BY		KJC						
DATUM		CGVD28 / HT2 0 (Geodetic)		DATE		November 30, 2020		CHECKED BY		AMP						
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								
314.7	GROUND SURFACE															
0.0	ASPHALT (180 mm)															
0.2	SILTY SAND (SM/GM) and gravel to SILTY SAND (SM), trace gravel (FILL) Compact to dense Brown to greyish brown Moist -180 mm thick layer of sandy clayey silt fill at 1.2 m depth		1A	SS	21											
			1B													
			2A	SS	18											
			2B													
			3	SS	18											
			4	SS	32											
			5A													
311.3	CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML), trace sand to some sand, containing organics and rootlets to 3.7 m depth Stiff to very stiff Brown to grey		5B	SS	26											
3.4			6	SS	12											
			7	SS	18											
			8	SS	19											
			9	SS	19											
			10	SS	21											
			11	SS	20											
			12	SS	14											
			13	SS	17											
305.0	END OF BOREHOLE															
9.8	NOTES: 1. Water encountered at a depth of 9.1 m (Elev. 305.6 m) below ground surface during drilling. 2. Borehole dry upon completion of drilling. 3. Borehole caved to a depth of 7.7 m (Elev. 307.0 m) upon completion of drilling.															

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GRAIN SIZE DISTRIBUTION

SILTY SAND (SM)

FIGURE E-1



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	LS5-2	4	311.2

Project Number: 1786658 WO15-LS

Checked By: AMP

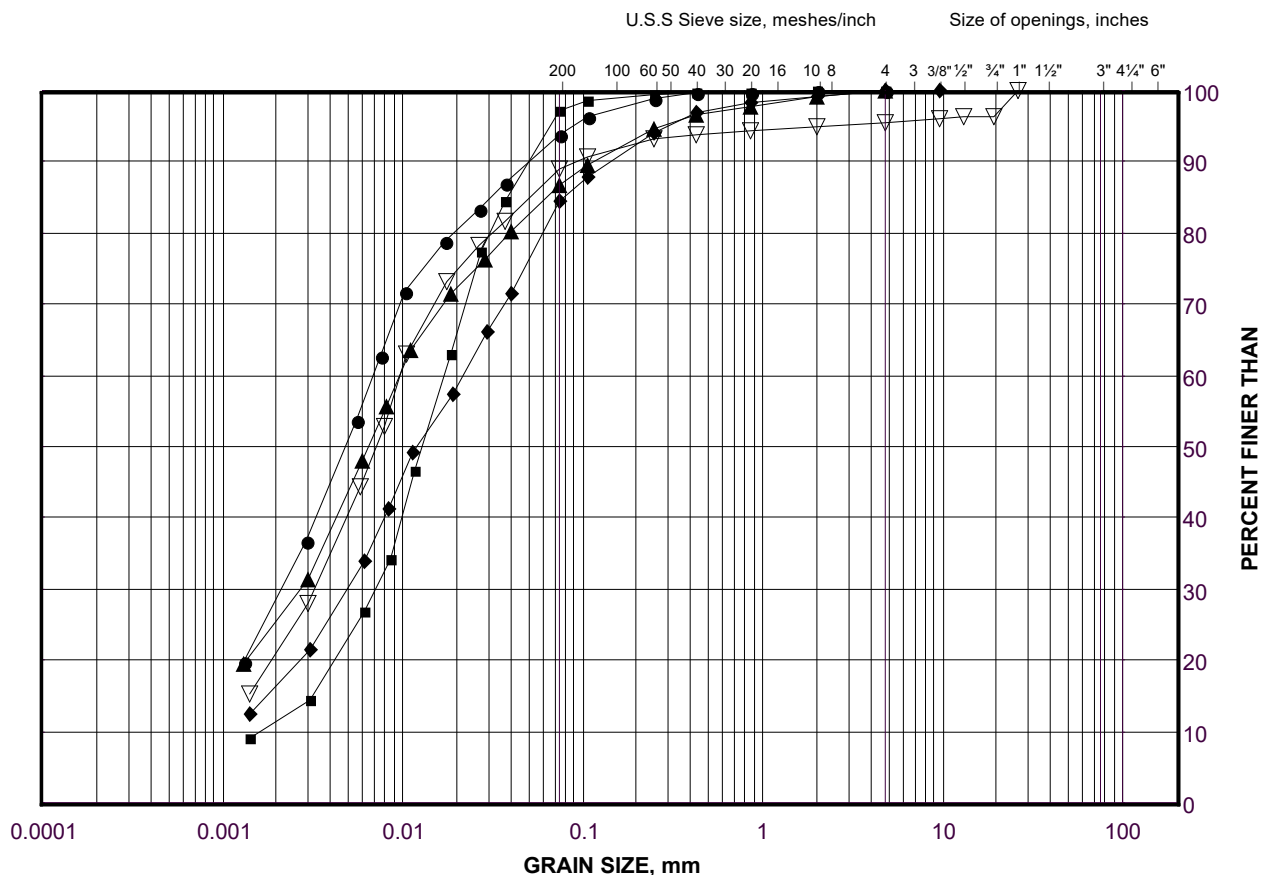
Golder Associates

Date: 15-Feb-22

GRAIN SIZE DISTRIBUTION

CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML)

FIGURE E-2



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

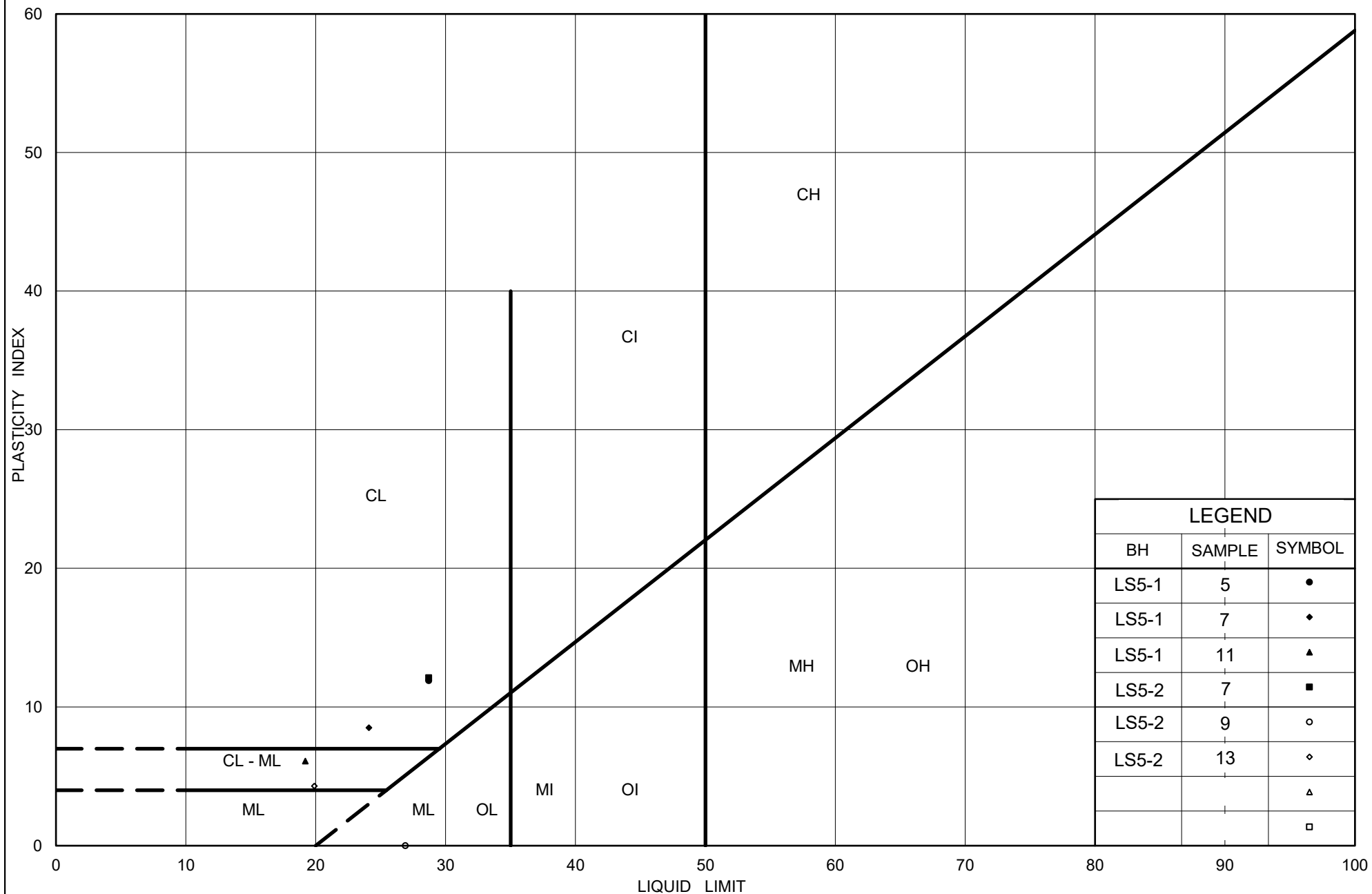
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	LS5-1	12	304.2
■	LS5-2	13	304.5
◆	LS5-1	3	311.1
▲	LS5-2	7	309.0
▽	LS5-1	8	308.0

Project Number: 1786658 WO15-LS

Checked By: AMP

Golder Associates

Date: 15-Feb-22



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PLASTICITY CHART CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML)

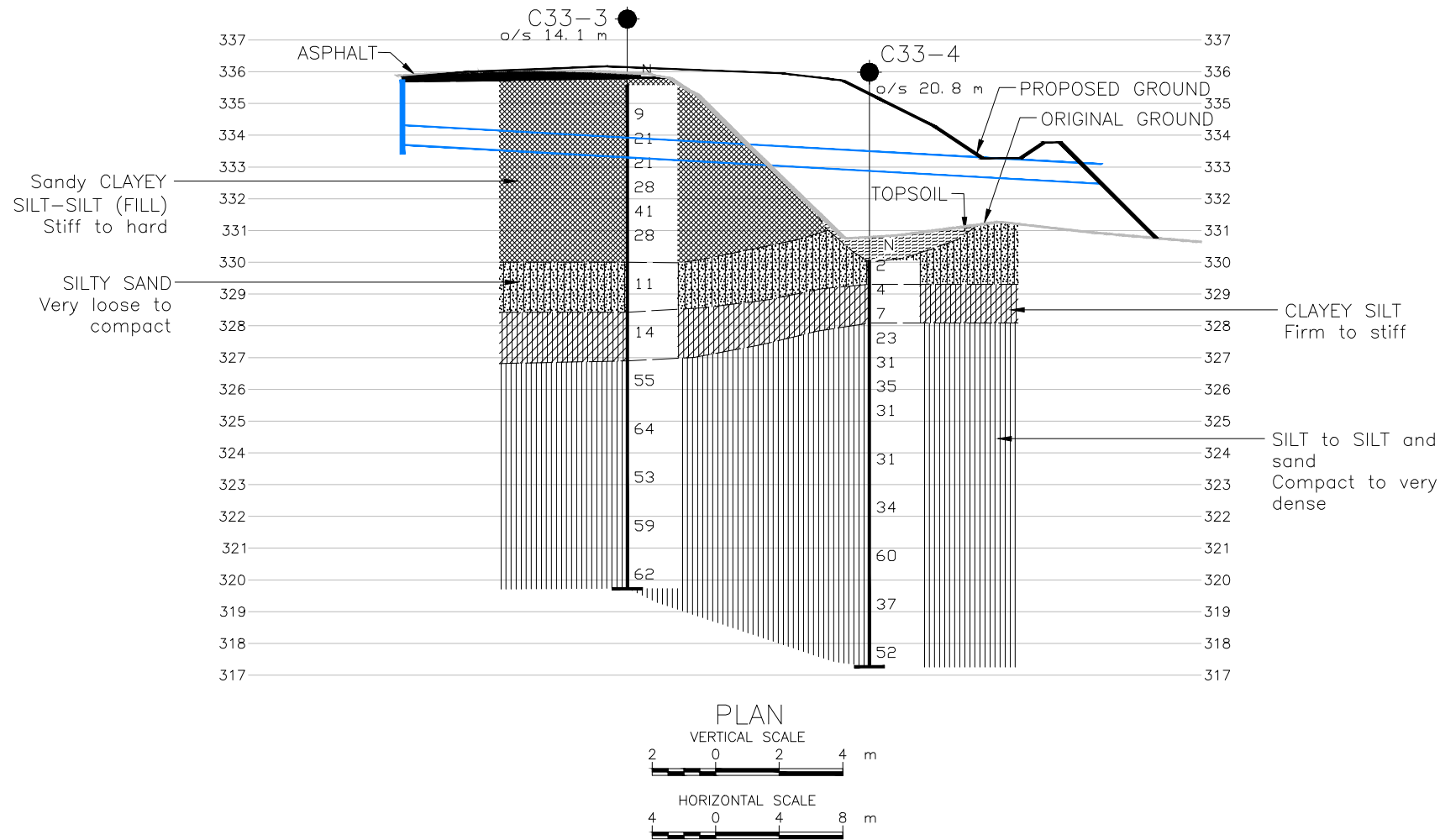
Figure No. E-3

Project No. 1786658 WO15-LS

Checked By: AMP

APPENDIX F

Lateral Sewer 6 at Station 17+509

[illegible]


PROJECT 09-1111-0018		RECORD OF BOREHOLE No C33-3		SHEET 1 OF 2		METRIC	
G.W.P. 2835-02-00		LOCATION N 4869908.4 ; E 298583.5		ORIGINATED BY SB/AM			
DIST Central HWY 400		BOREHOLE TYPE D-90 Truck Mount, 101 mm Diameter Solid Stem Augers		COMPILED BY TT/HS			
DATUM Geodetic		DATE January 5, 2011		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
								<div><div></div><div>20406080100</div></div> <div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED</div>					<div><div></div><div>102030</div></div> <div>W_P W W_L</div>							
335.6	GROUND SURFACE																			
0.0	ASPHALT																			
0.2	Clayey silt with sand, trace gravel (FILL) Stiff to hard Brown Moist						335													
			1	SS	9		334						○							
			2	SS	21															
			3	SS	21		333													
			4	SS	28		332						○				4 31 50 15			
	Trace organics at a depth of 3.8 m		5	SS	41		331													
	Containing lenses of sand at a depth of 4.6 m		6	SS	28		330													
330.0																				
5.6	Silty SAND, trace clay, trace gravel, lenses of clayey silt Compact Brown Moist		7	SS	11		329						○				1 67 28 4			
328.4																				
7.2	CLAYEY SILT, trace sand, trace gravel Stiff Brown Moist		8	SS	14		328						○							
326.9							327													
8.7	SILT and SAND, trace clay, trace gravel, lenses of clayey silt Very dense Brown Moist		9	SS	55		326													
							325						○				0 41 55 4			
			10	SS	64		324													
							323													
			11	SS	53		322													
			12	SS	59		321													

Continued Next Page

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

GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA-GDT 11/30/15 SIB

PROJECT 09-1111-0018				RECORD OF BOREHOLE No C33-3				SHEET 2 OF 2				METRIC					
G.W.P. 2835-02-00				LOCATION N 4869908.4 ; E 298583.5				ORIGINATED BY SB/AM									
DIST Central HWY 400				BOREHOLE TYPE D-90 Truck Mount, 101 mm Diameter Solid Stem Augers				COMPILED BY TT/HS									
DATUM Geodetic				DATE January 5, 2011				CHECKED BY SMM									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100	W _p	W	W _L		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
								20	40	60	80	100	10	20	30		
319.7	SILT and SAND, trace clay, trace gravel, lenses of clayey silt Very dense Brown Moist		13	SS	62		320										
15.9	END OF BOREHOLE																
NOTES: 1. Borehole caved at a depth of 15.2 m (Elev. 320.4 m) upon completion of drilling. 2. Open borehole dry upon completion of drilling.																	

GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 11/30/15 SIB

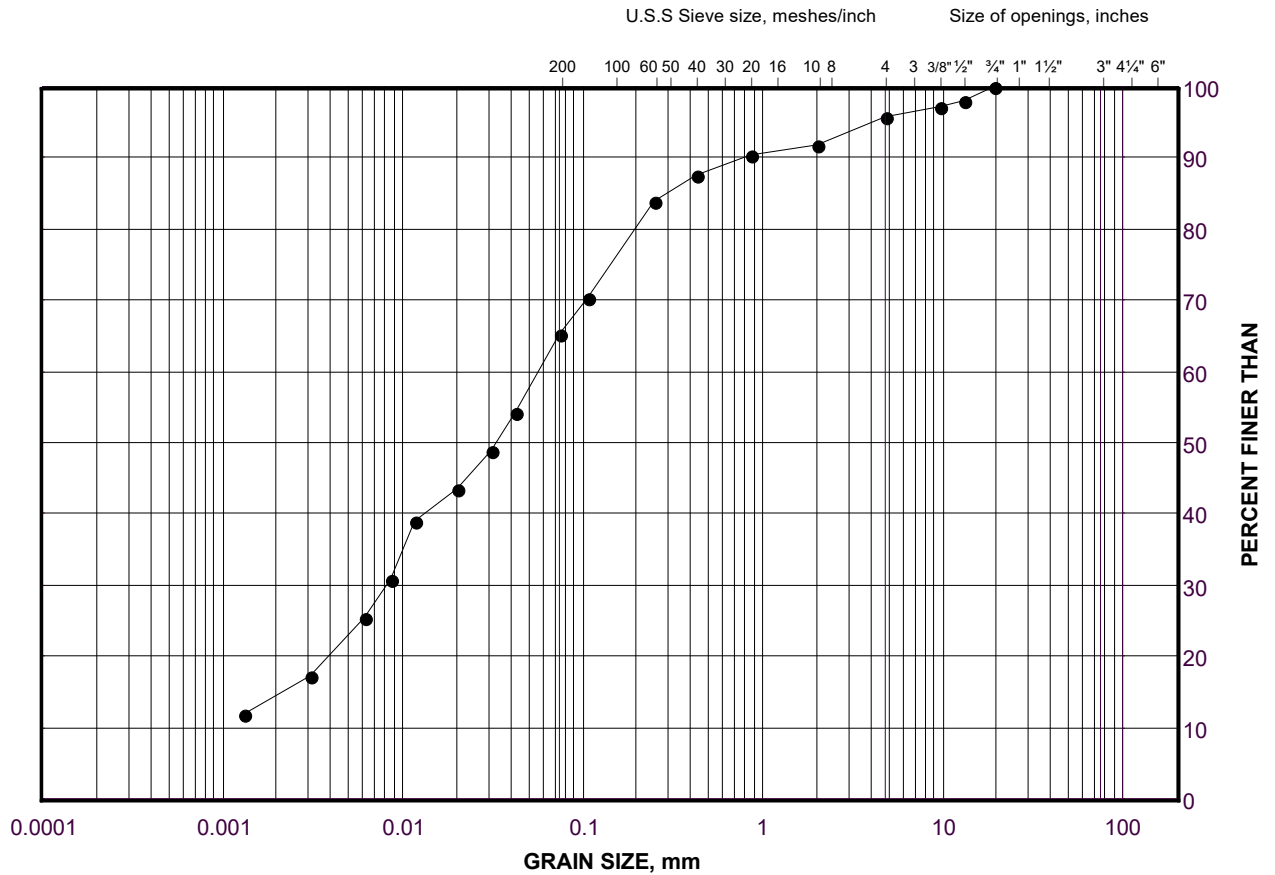
PROJECT 09-1111-0018			RECORD OF BOREHOLE No C33-4				SHEET 1 OF 1			METRIC					
G.W.P. 2835-02-00			LOCATION N 4869917.6 ;E 298597.4				ORIGINATED BY SB								
DIST Central HWY 400			BOREHOLE TYPE D-50 Track Mount, 108 mm Diameter Solid Stem Augers				COMPILED BY ARM/HS								
DATUM Geodetic			DATE December 19, 2010				CHECKED BY SMM								
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							
								○ UNCONFINED + FIELD VANE							
								● QUICK TRIAXIAL × REMOULDED							
								20 40 60 80 100							
330.1	GROUND SURFACE														
0.0	TOPSOIL														
0.1	Silty SAND, trace clay, trace gravel, containing rootlets		1	SS	2										
329.3	Very loose Brown Moist														
0.8	CLAYEY SILT, trace sand, trace gravel		2	SS	4		329								
	Firm Brown Moist														
328.1			3A	SS	7										
			3B				328								
2.0	SILT to Sandy SILT, trace to some sand, trace to some clay														
	Compact to dense Brown Moist		4	SS	23										
							327								
			5	SS	31										
			6	SS	35		326								
			7	SS	31		325								
							324								
			8	SS	31										
							323								
			9	SS	34		322								
321.3							321								
8.8	SILT and SAND, trace clay		10	SS	60										
	Dense to very dense Brown Moist						320								
			11	SS	37		319								
							318								
			12	SS	52										
317.3															
12.8	END OF BOREHOLE														
	NOTE:														
	1. Open borehole dry upon completion of drilling.														

GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 11/30/15 SIB

GRAIN SIZE DISTRIBUTION

Sandy CLAYEY SILT (CL) (FILL")

FIGURE F-1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

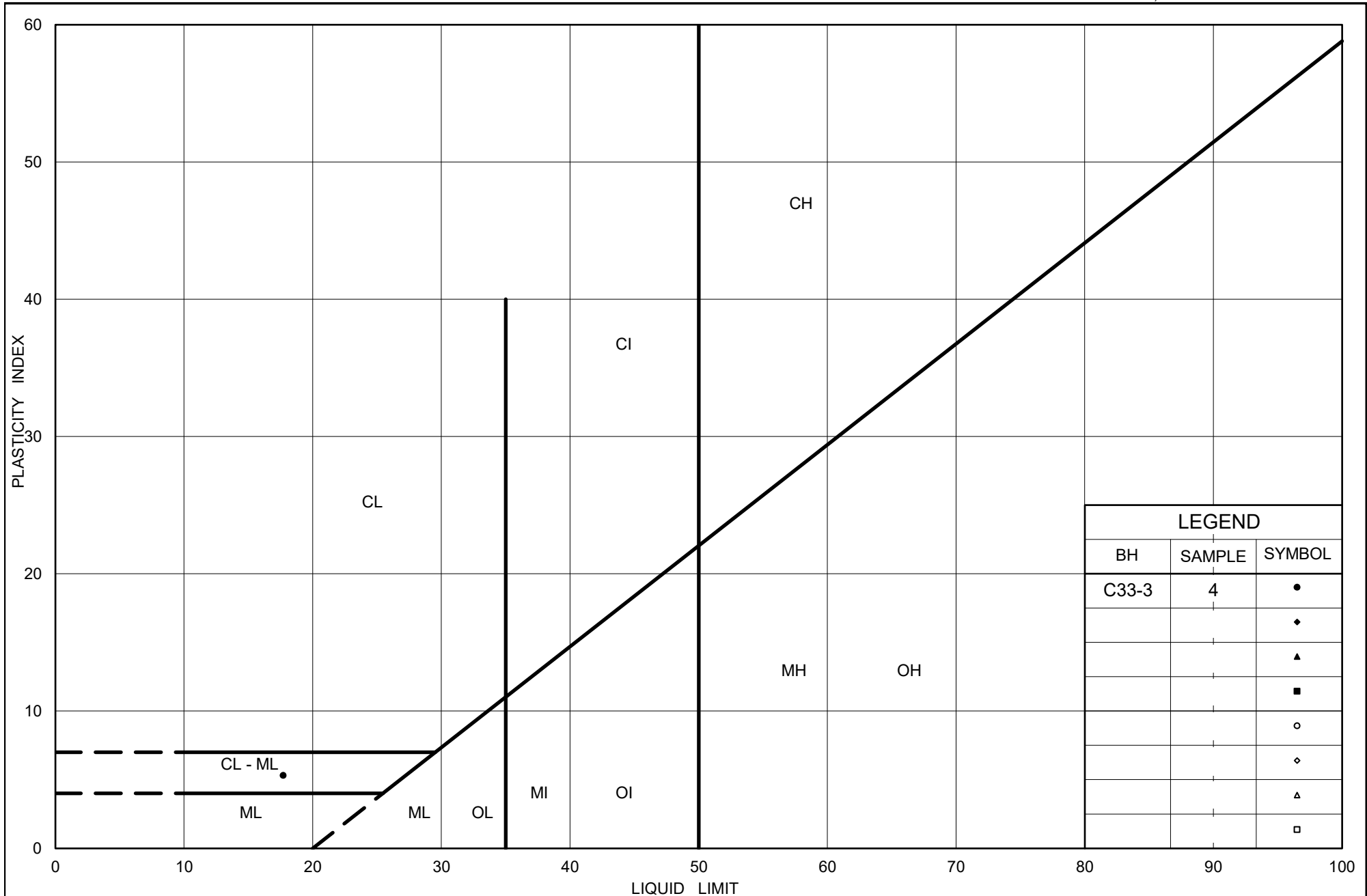
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	C33-3	4	332.2

Project Number: 1786658

Checked By: _____

Golder Associates

Date: 17-Feb-22



Ministry of Transportation

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PLASTICITY CHART Sandy CLAYEY SILT (CL) (FILL)

Figure No. F-2

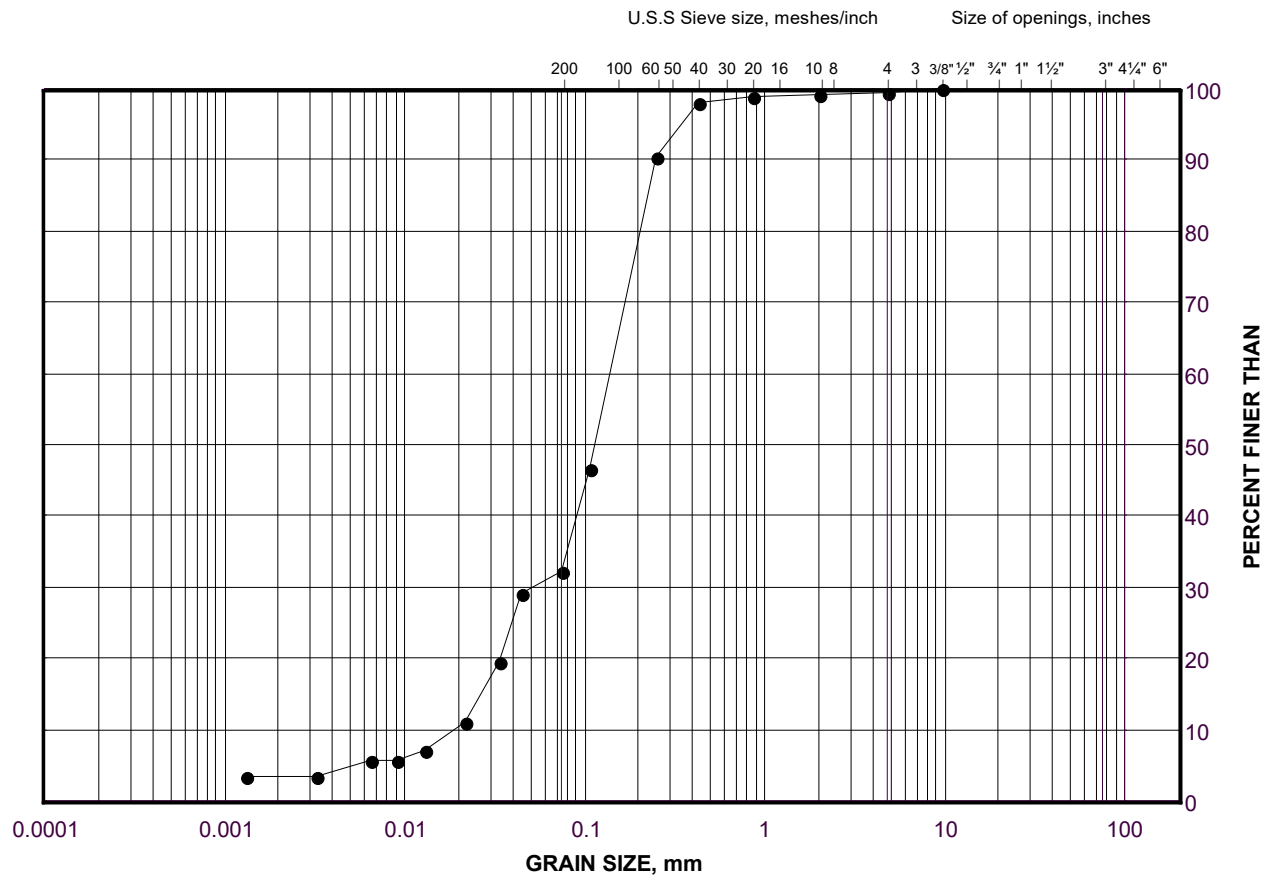
Project No. 1786658-WO15-LS

Checked By: AMP

GRAIN SIZE DISTRIBUTION

SILTY SAND (SM)

FIGURE F-3



SILT AND CLAY SIZES			FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED			SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

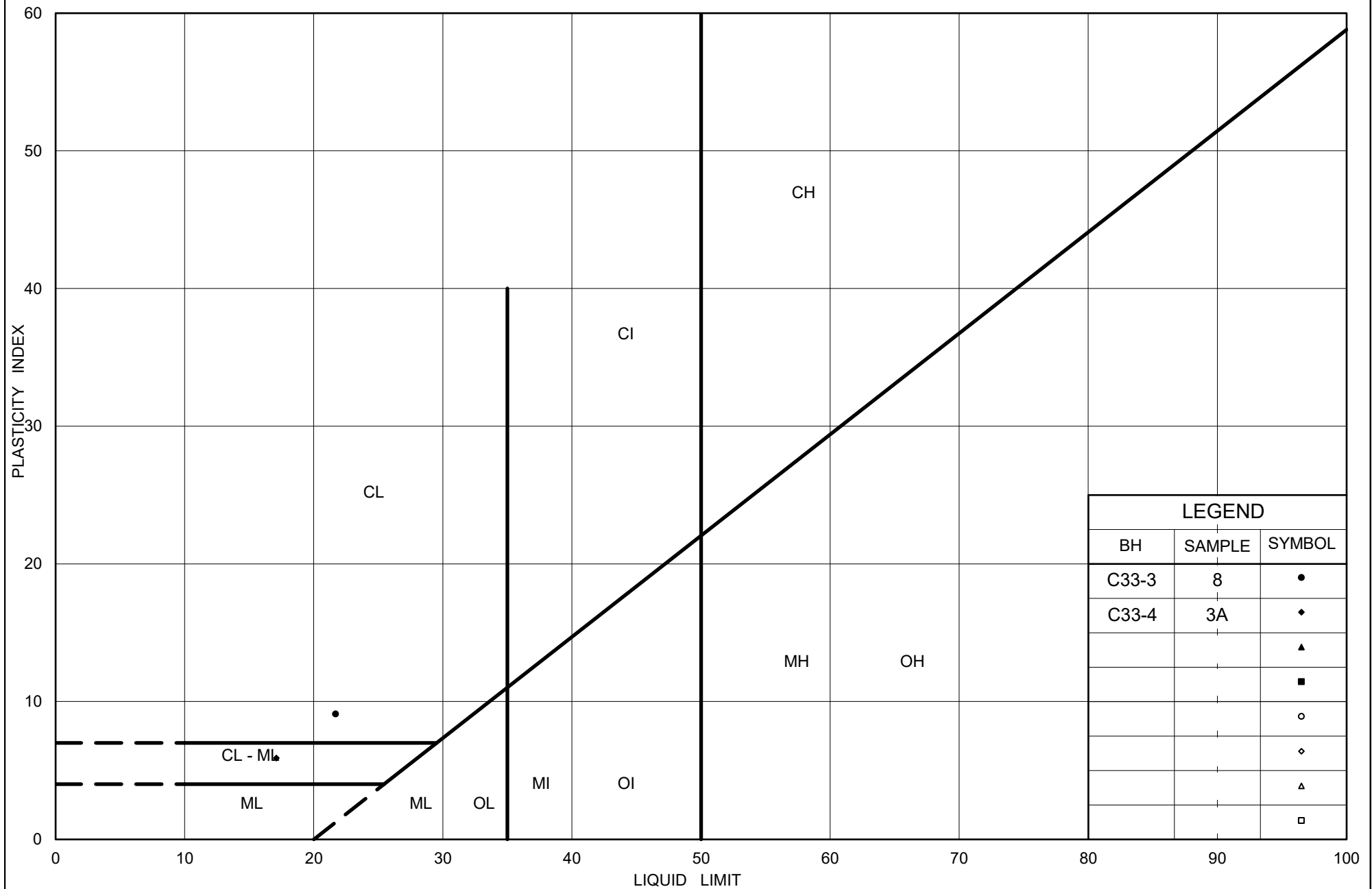
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	C33-3	7	329.2

Project Number: 1786658

Checked By: _____

Golder Associates

Date: 17-Feb-22



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PLASTICITY CHART CLAYEY SILT- SILT (CL-ML) to CLAYEY SILT (CL)

Figure No. F-4

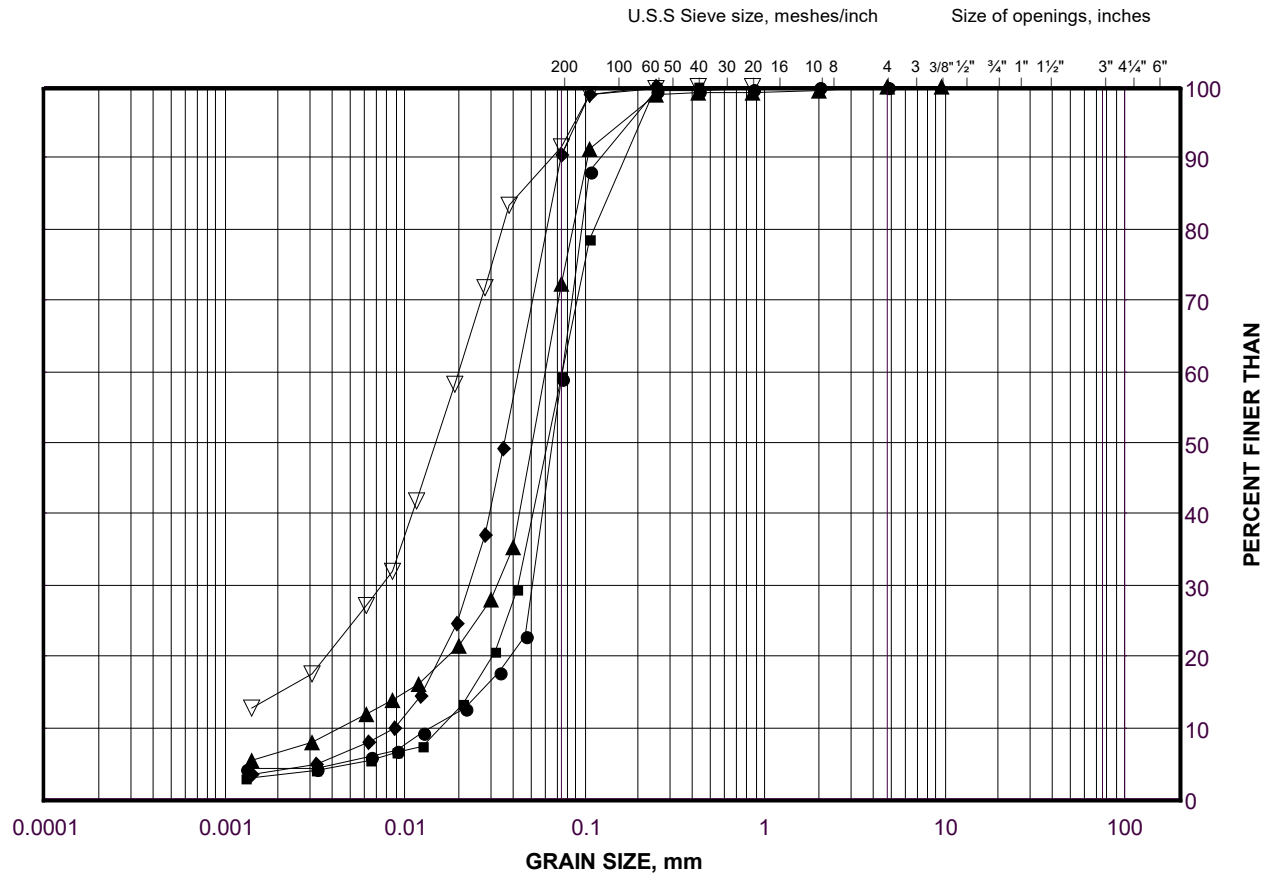
Project No. 1786658-WO15-LS

Checked By: AMP

GRAIN SIZE DISTRIBUTION

SILT (ML) to SILT (ML) and sand

FIGURE F-5



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	C33-3	10	324.7
■	C33-4	11	319.1
◆	C33-4	5	326.8
▲	C33-4	8	323.7
▽	C33-4	9	322.2

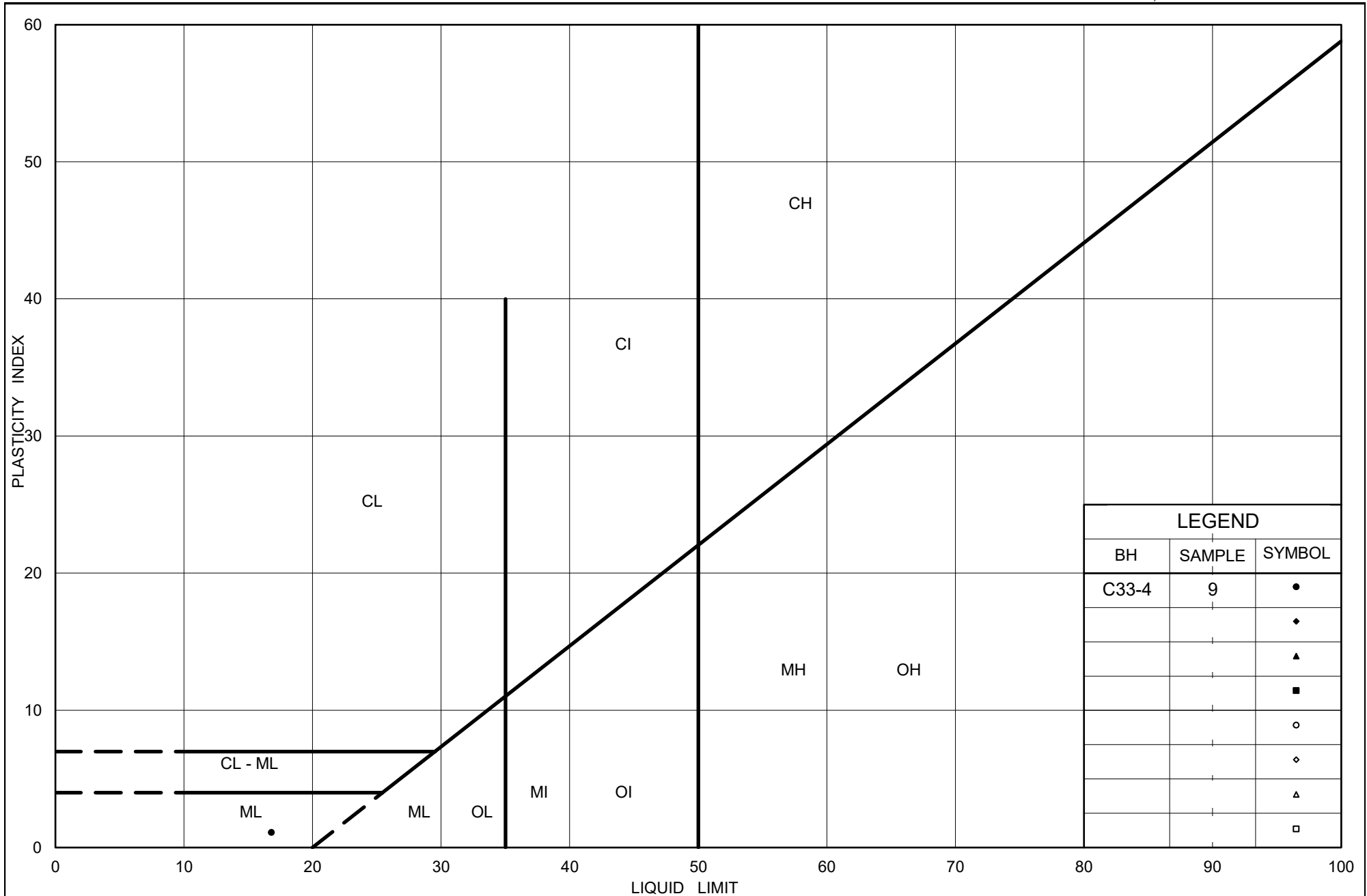
Project Number: 1786658

AMP

Checked By: _____

Golder Associates

Date: 17-Feb-22



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PLASTICITY CHART

SILT (ML) of slight plasticity

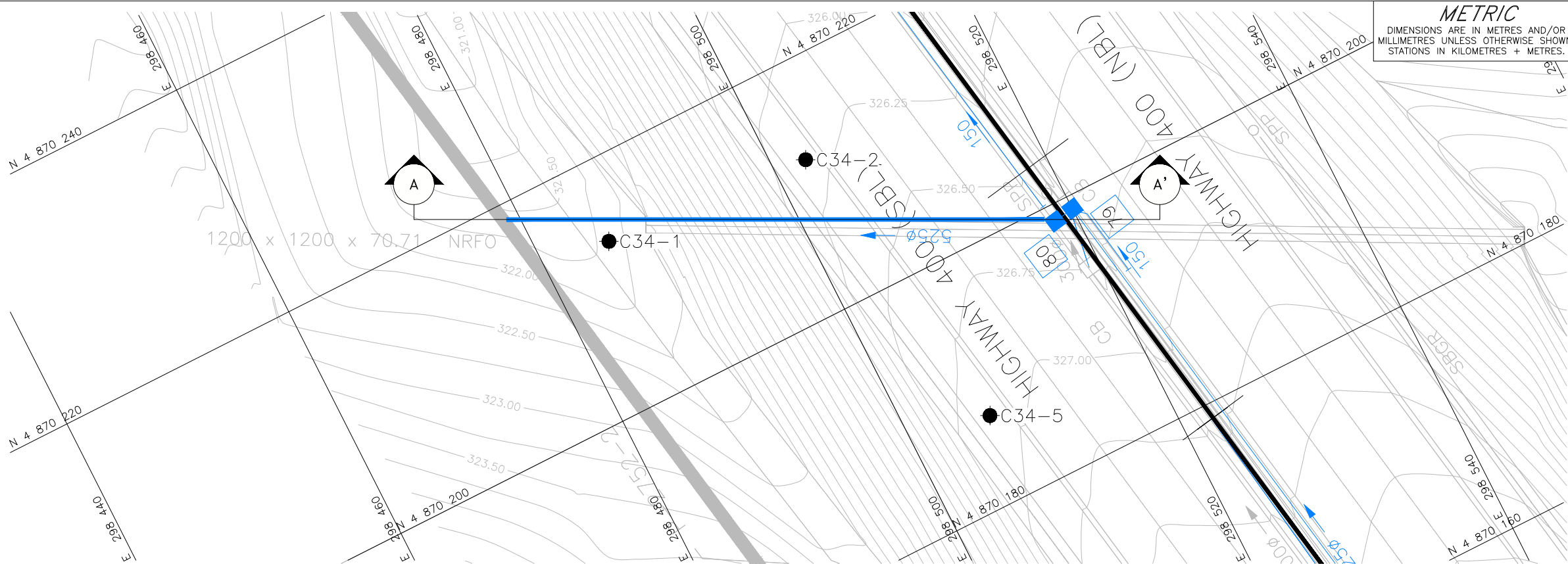
Figure No. F-6

Project No. 1786658-WO15-LS

Checked By: AMP

APPENDIX G

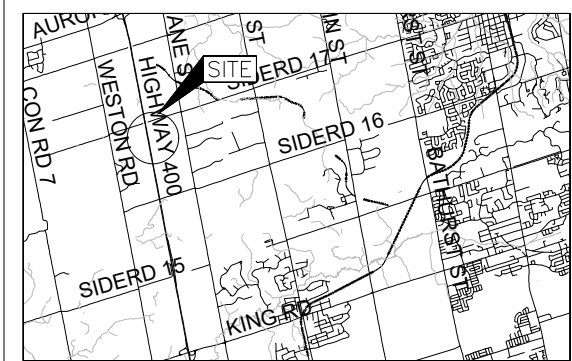
Lateral Sewer 7 at Station 17+821



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

CONT No.
WP No.

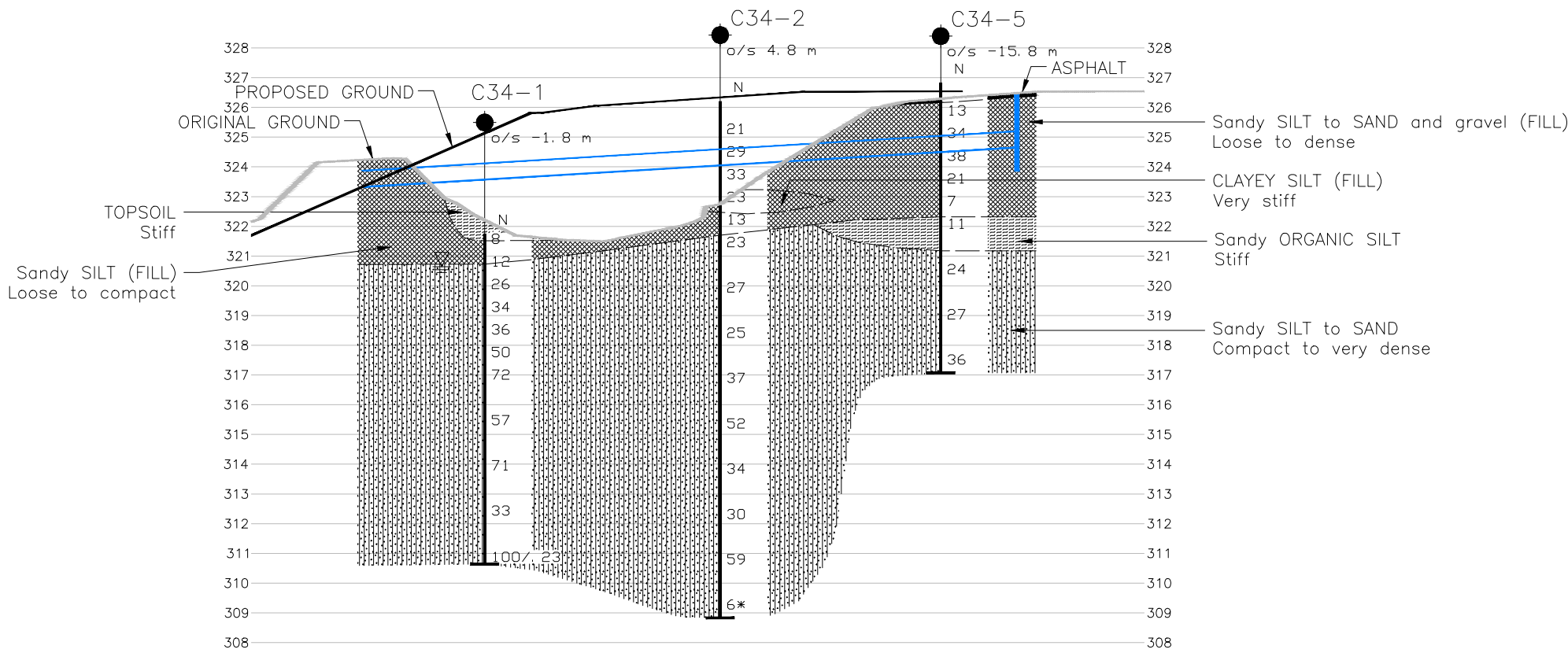
HIGHWAY 400 WIDENING
LATERAL SEWER 7 (STA. 17+821)
BOREHOLE LOCATION AND SOIL
STRATA



LEGEND

- Borehole Previous Investigation (GEOCRE 30M13-214)
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling/during drilling

BOREHOLE CO-ORDINATES (MTM NAD83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
C34-1	321.7	4870213.4	298485.5
C34-2	326.2	4870212.1	298502.6
C34-5	326.8	4870187.1	298506.6



NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

Base plan provided in digital format by MH, drawing file no. X117116615Base (1).dwg, received June 15, 2021.
Topography plan provided in digital format by MH, drawing file no. X117116615Contours.dwg, received June 2, 2021.
Proposed Sewer provided in digital format by MH, drawing file no. x117116615design.dwg, received February 9, 2022 and x117116615Profiles.dwg, received February 17, 2022.

NO.	DATE	BY	REVISION
Geocres No. 30M13-243			
HWY. 400		PROJECT NO. 1786658	
SUBM'D. AMP		DATE: 03/17/2022	
DRAWN: DD		SITE: .	
CHKD. WC		APPD. WC	
		DWG. G-1	

PROJECT 09-1111-0018			RECORD OF BOREHOLE No C34-1			SHEET 1 OF 1			METRIC									
G.W.P. 2835-02-00			LOCATION N 4870213.4 ; E 298485.5			ORIGINATED BY TT												
DIST Central HWY 400			BOREHOLE TYPE D-50 Track Mount, 108 mm Diameter Solid Stem Augers			COMPILED BY ARM/HS												
DATUM Geodetic			DATE November 30 and December 1, 2010			CHECKED BY SMM												
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 (%)
321.7	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL							20	40	60	80	100						
0.2	Sandy silt, trace gravel, trace clay (FILL) Loose to compact Brown Moist		1	SS	8	▽												
320.7			2	SS	12													
1.0	SAND and SILT, trace clay Compact to very dense Grey to brown below 8.7 m Moist		3	SS	26													
			4	SS	34													0 51 46 3
			5	SS	36													
			6	SS	50													
			7	SS	72													
			8	SS	57													0 54 42 4
			9	SS	71													
			10	SS	33												0 30 65 5	
310.6			11	SS	100/23													
11.1	END OF BOREHOLE																	
NOTES:																		
1. Borehole caved at a depth of 8.4 m (Elev. 313.3 m) upon completion of drilling.																		
2. Water level in open borehole at a depth of 1.1 m (Elev. 320.6 m) upon completion of drilling.																		

PROJECT		RECORD OF BOREHOLE		No C34-2		SHEET 2 OF 2		METRIC									
G.W.P. 09-1111-0018		LOCATION		N 4870212.1 ; E 298502.6		ORIGINATED BY		SB									
DIST Central HWY 400		BOREHOLE TYPE		D-90 Truck Mount, 108 mm Inside Diameter Hollow Stem Augers		COMPILED BY		ARM/HS									
DATUM Geodetic		DATE		November 29 and 30, 2010		CHECKED BY		SMM									
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			SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100					
308.8	Sandy SILT to SAND, some silt, trace to some clay Compact to very dense Brown Moist		13	SS	59												0 81 11 8
309			14	SS	6*												
17.4	END OF BOREHOLE																
	NOTE: *Due to blowing sands, the SPT "N"-value recorded during the driving of the split spoon to obtain sample 14 is not considered to represent in-situ soil conditions. 1. Borehole caved to a depth of 15.3 m (Elev. 310.9 m) upon completion of drilling. 2. Open borehole dry upon completion of drilling.																

PROJECT <u>1786658 (W015)</u>		RECORD OF BOREHOLE No C34-5		SHEET 1 OF 1		METRIC	
G.W.P. <u>2835-02-00</u>		LOCATION <u>N 4870187.1; E 298506.6 MTM NAD 83 ZONE 10 (LAT. 43.971648; LONG. -79.578440)</u>		ORIGINATED BY <u>KC</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>Power Auger; 203 mm O.D. Hollow Stem Augers</u>		COMPILED BY <u>CC</u>			
DATUM <u>CGVD28 / HT2 0 (Geodetic)</u>		DATE <u>November 12, 2020</u>		CHECKED BY <u>AMP</u>			

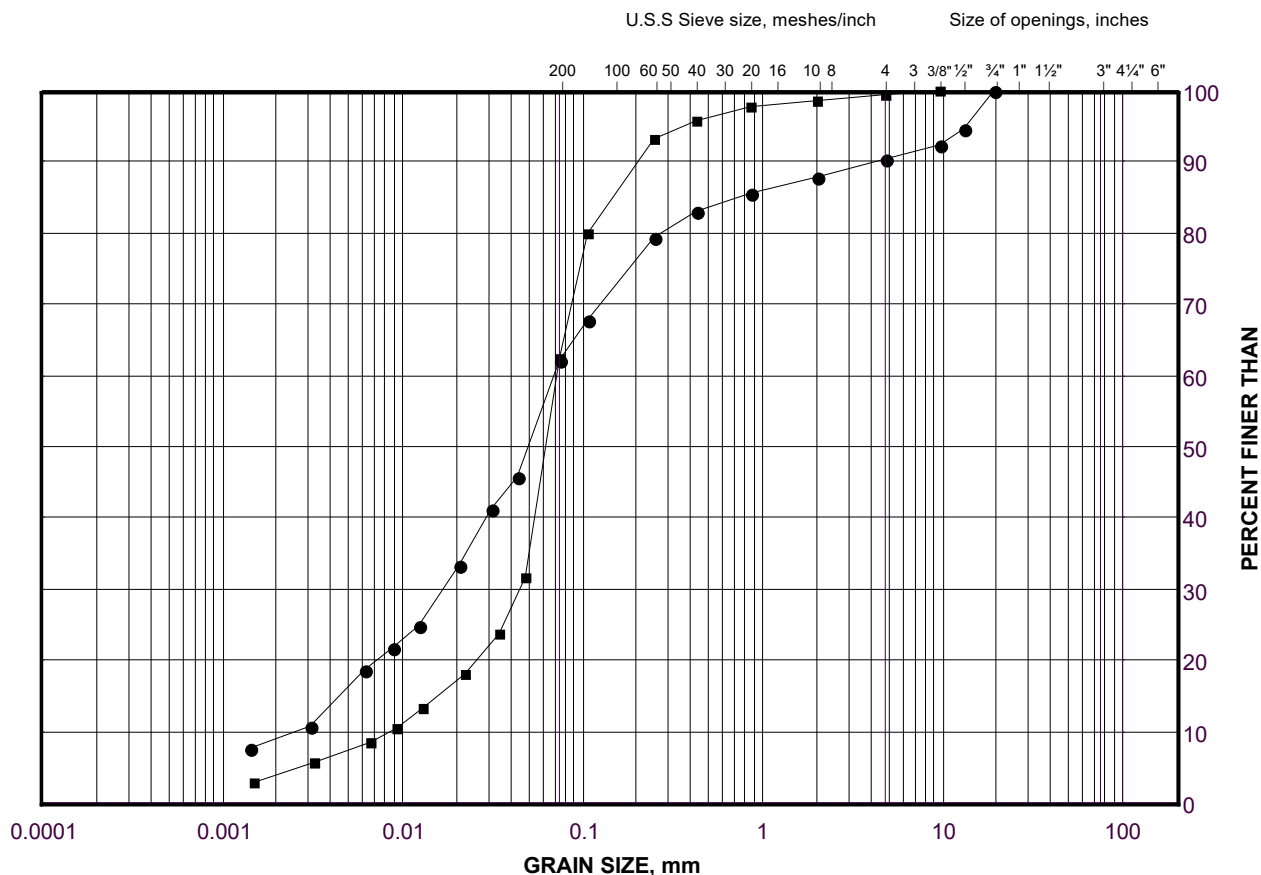
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					w _p w w _L				
326.8	GROUND SURFACE						20	40	60	80	100						
0.0	ASPHALT (200 mm)																
0.2	SILTY SAND (SM), some gravel (FILL) Compact Brown Moist		1	SS	13												
325.4																	
1.5	SILT (ML) and sand, trace clay, trace gravel (FILL) Loose to dense Brown Moist		2	SS	34												
			3	SS	38												
			4	SS	21												
			5	SS	7												
322.3																	
4.5	Sandy ORGNIC SILT (ML/OL) Stiff Dark brown Moist		6	SS	11												
321.2																	
5.6	Sandy SILT (ML) Compact Brown Moist		7A														
320.6																	
6.3	SAND (SP) trace gravel to gravelly, some silt Compact to dense Brown Moist		7B	SS	24												
			8	SS	27												
			9	SS	36												
317.1																	
9.8	END OF BOREHOLE																
	NOTES: 1. Borehole open and dry upon completion of drilling. 2. NP indicates "Non-Plastic"																

GTA-MTO 001 S:\CLIENTS\MTOWHY_400_KING_TO_LLOYDTOWN.GPJ GAL-GTA.GDT 2/25/22

GRAIN SIZE DISTRIBUTION

Sandy SILT (ML) to SILT (ML) and sand (FILL)

FIGURE G-1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	C34-2	3	323.6
■	C34-5	5	322.8

Project Number: 1786658 WO15-LS

Checked By: AMP

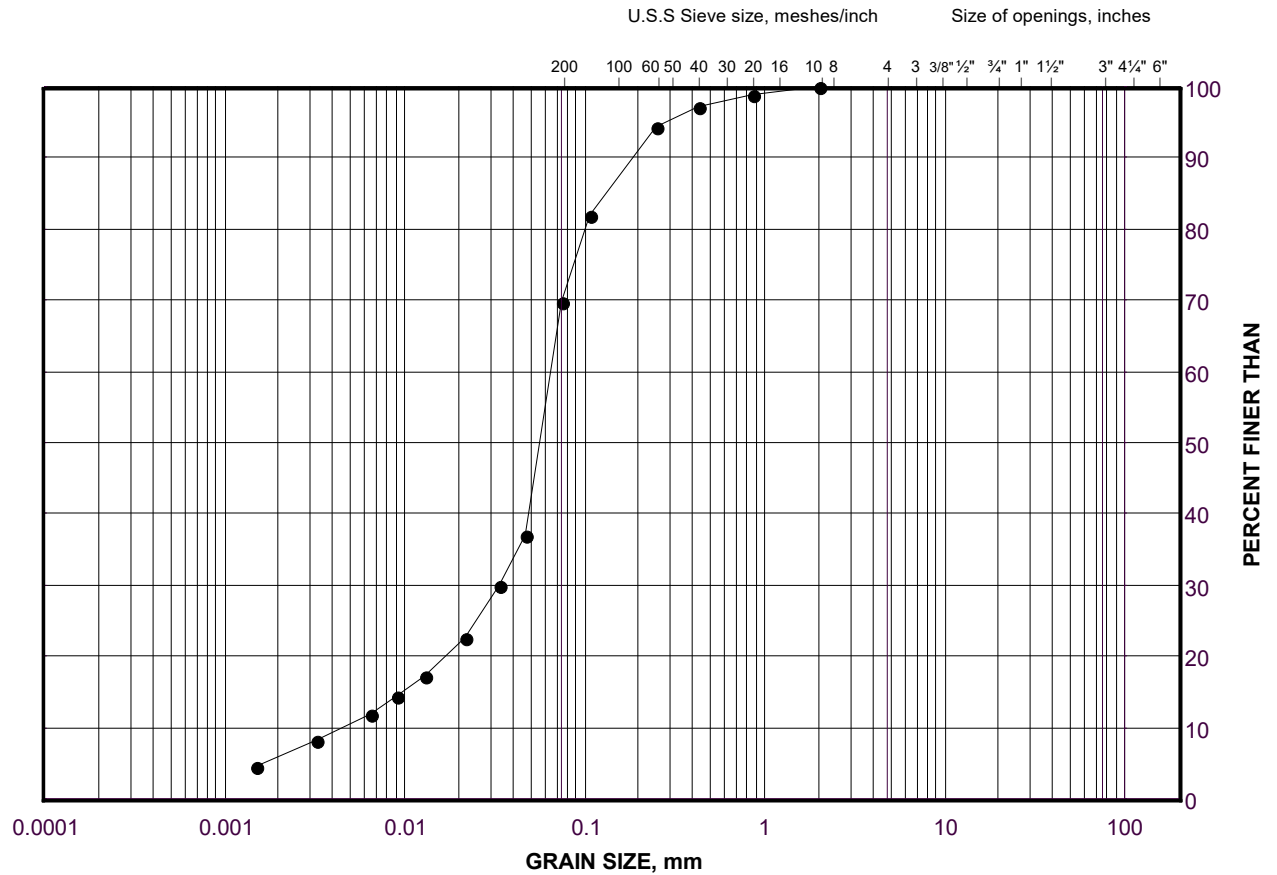
Golder Associates

Date: 15-Feb-22

GRAIN SIZE DISTRIBUTION

Sandy ORGANIC SILT (ML/OL)

FIGURE G-2



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

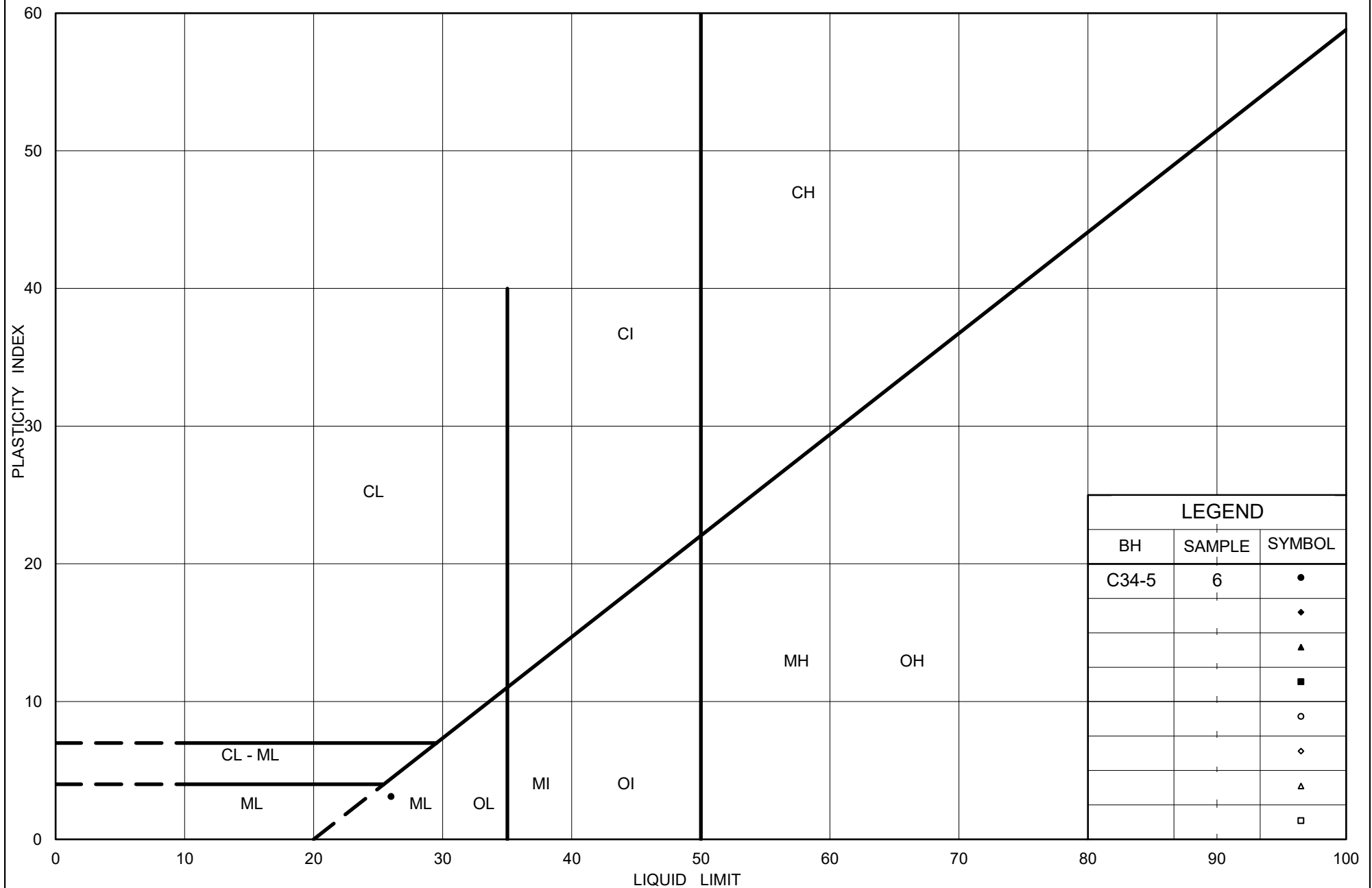
SYMBOL	Borehole	SAMPLE	DEPTH(m)
•	C34-5	6	321.9

Project Number: 1786658 WO15-LS

Checked By: AMP

Golder Associates

Date: 15-Feb-22



Ministry of Transportation

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PLASTICITY CHART Sandy ORGANIC SILT (ML/OL)

Figure No. G-3

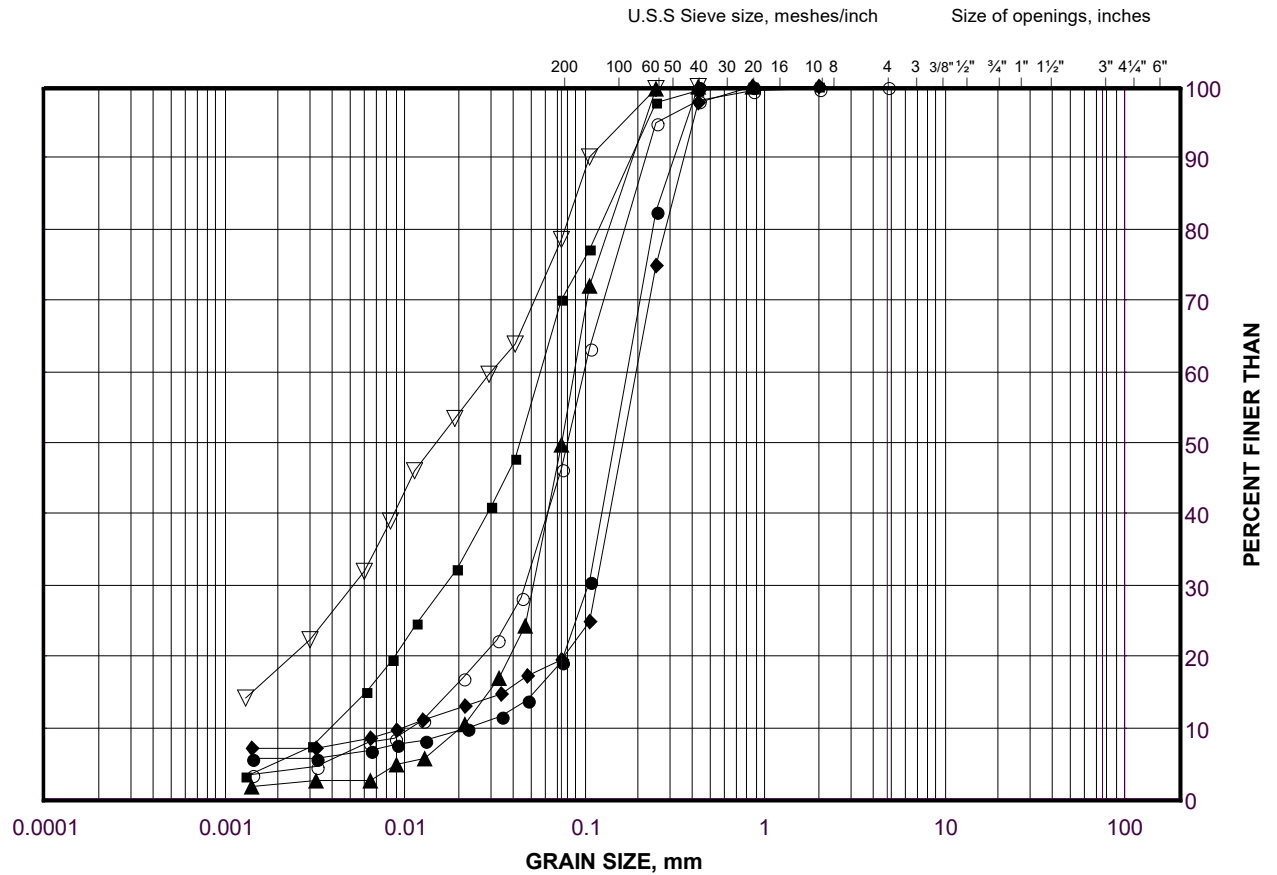
Project No. 1786658 WO15-LS

Checked By: AMP

GRAIN SIZE DISTRIBUTION

Sandy SILT (ML) to SILTY SAND (SM)

FIGURE G-4



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	C34-2	10	315.2
■	C34-1	10	312.3
◆	C34-2	13	310.7
▲	C34-1	4	319.1
▽	C34-2	7	319.8
○	C34-1	8	315.4

Project Number: 1786658 WO15-LS

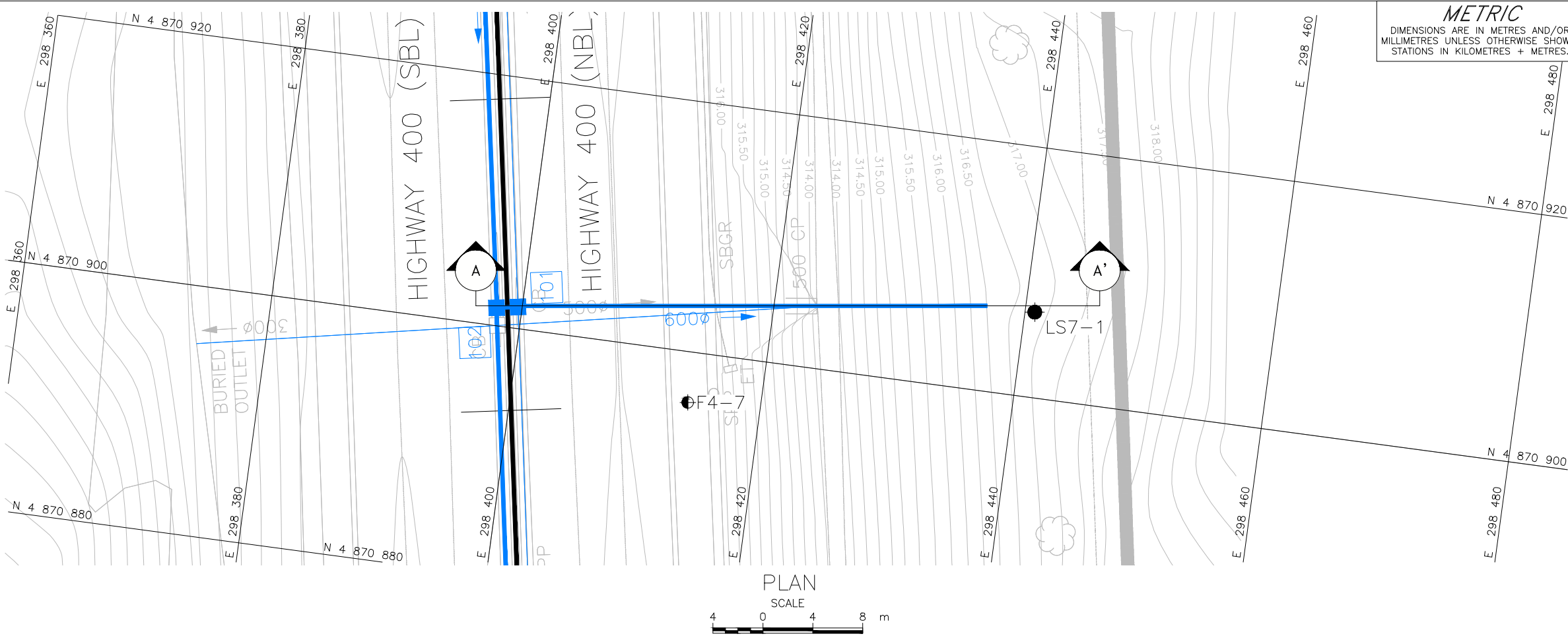
Checked By: AMP

Golder Associates

Date: 15-Feb-22

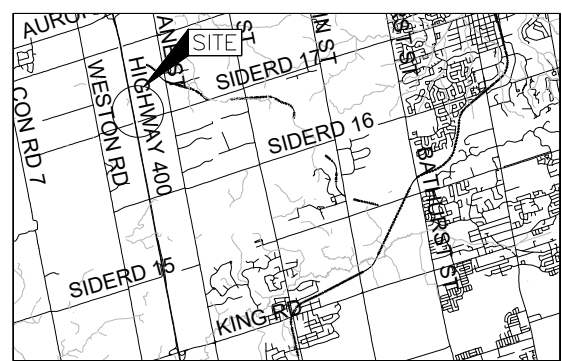
APPENDIX H

Lateral Sewer 8 at Station 18+533

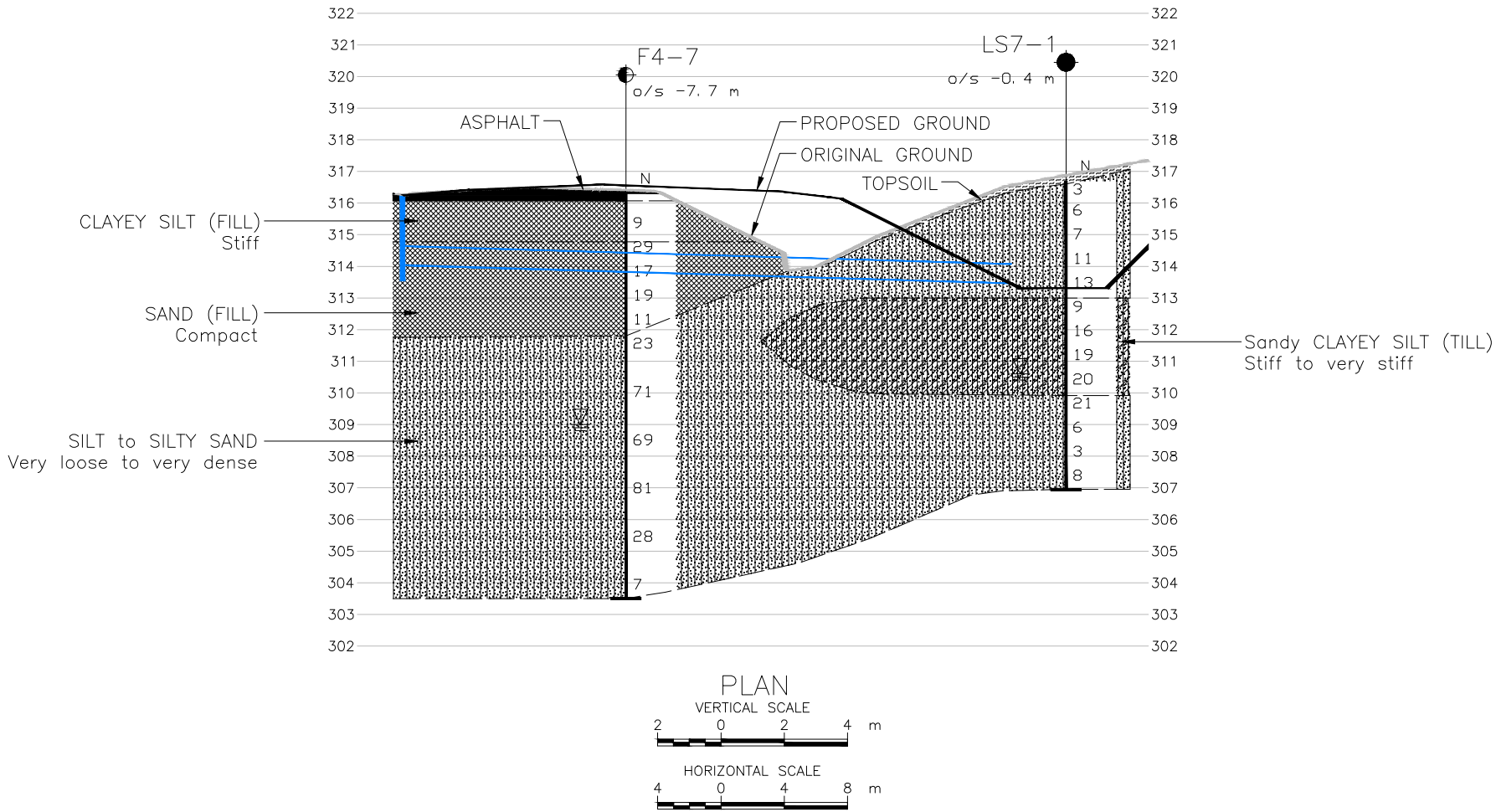


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.		SHEET
WP No.		
HIGHWAY 400 WIDENING LATERAL SEWER 8 (STA. 18+533) BOREHOLE LOCATION AND SOIL STRATA		



BOREHOLE CO-ORDINATES (MTM NAD83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
F4-7	316.3	4870896.0	298414.2
LS7-1	316.3	4870906.8	298440.8





NOTES
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE
Base plan provided in digital format by MH, drawing file no. X117116615Base (1).dwg, received June 15, 2021.
Topography plan provided in digital format by MH, drawing file no. X117116615Contours.dwg, received June 2, 2021.
Proposed Sewer provided in digital format by MH, drawing file no. x117116615design.dwg, received February 9, 2022 and x117116615Profiles.dwg, received February 14, 2022.

NO.	DATE	BY	REVISION
Geocres No. 30M13-243			
HWY. 400	PROJECT NO. 1786658	DIST.	
SUBM'D. AMP	CHKD. AMP	DATE: 03/17/2022	SITE:
DRAWN: DD	CHKD. WC	APPD. WC	DWG. H-1

PROJECT <u>09-1111-0018</u>		RECORD OF BOREHOLE No F4-7		SHEET 1 OF 1		METRIC	
G.W.P. <u>2835-02-00</u>		LOCATION <u>N 4870896.0 ; E 298414.2</u>		ORIGINATED BY <u>SB</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D-90 Truck Mount, 108 mm Outside Diameter Solid Stem Auger</u>		COMPILED BY <u>TT</u>			
DATUM <u>Geodetic</u>		DATE <u>January 13, 2011</u>		CHECKED BY _____			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
								\circ UNCONFINED	$+$ FIELD VANE	\bullet QUICK TRIAXIAL	\times REMOULDED	w_p	w	w_L						
316.3	GROUND SURFACE							20	40	60	80	100								
0.0	ASPHALT																			
0.2	Clayey silt, trace gravel, containing zones of silty sand (FILL) Stiff Brown Moist						316													
			1	SS	9		315													
314.8																				
1.5	Sand, trace silt, trace clay (FILL) Compact Brown Moist		2	SS	29		314													
			3	SS	17															
		4	SS	19		313														
		5	SS	11		312														
311.8																				
4.5	SILT and SAND to SILT, trace clay, trace gravel, containing zones of clayey silt Loose to very dense Brown Moist		6	SS	23		311													
							310													
			7	SS	71															
							309													
			8	SS	69		308													
							307													
			9	SS	81															
							306													
			10	SS	28		305													
							304													
303.5			11	SS	7															
12.8	END OF BOREHOLE NOTES: 1. Borehole open to a depth of 10.0 m below ground surface (Elev. 306.3 m) on removal of augers. 2. Water level in open borehole at a depth of 7.3 m below ground surface (Elev. 309.0 m) upon completion of drilling.																			

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

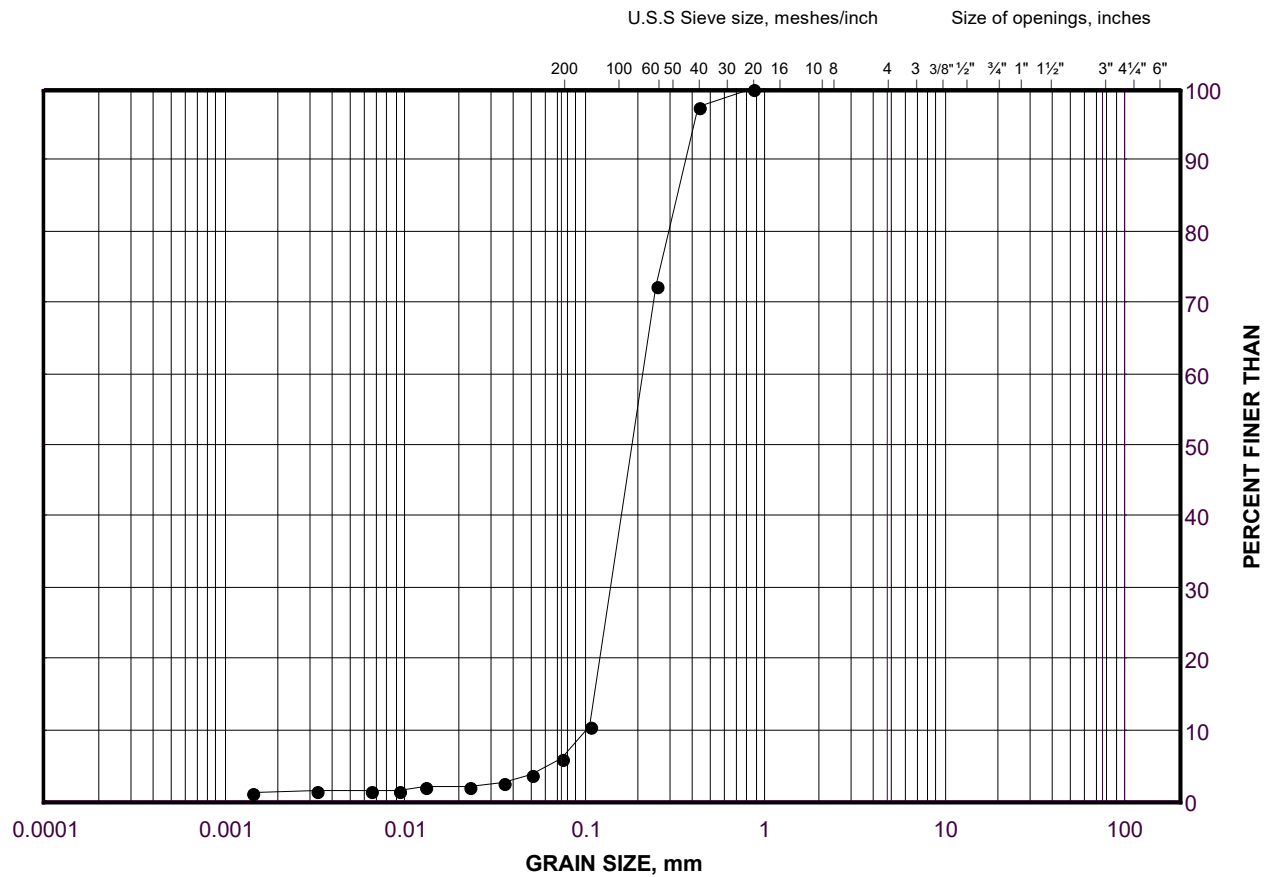
GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 19/11/15 SIB

PROJECT		1786658 (W015)		RECORD OF BOREHOLE No LS7-1		SHEET 1 OF 1		METRIC									
G.W.P.		2385-02-00		LOCATION		N 4870906.8; E 298440.8 MTM NAD 83 ZONE 10 (LAT. 43.978126; LONG. -79.579268)		ORIGINATED BY ML									
DIST		Central HWY 400		BOREHOLE TYPE		Power Auger; 200 mm O.D. Solid Stem Augers		COMPILED BY KJC									
DATUM		CGVD28 / HT2 0 (Geodetic)		DATE		December 9, 2021		CHECKED BY AMP									
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 (%)
316.7	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL (100 mm)																
0.1	SILT (ML/SM) and sand of slight plasticity Loose to compact Brown Moist to wet		1	SS	3												
			2	SS	6												
			3	SS	7												
			4	SS	11												
			5	SS	13												
313.0																	
3.7	Sandy CLAYEY SILT (CL), trace gravel (TILL) Stiff to very stiff Grey Moist		6	SS	9												
			7	SS	16												
			8	SS	19												
			9	SS	20												
309.9																	
6.8	Sandy SILT (ML) Compact Brown Wet		10	SS	21												
309.2																	
7.5	SILTY SAND (SM) Very loose to loose Brown Wet		11	SS	6												
			12	SS	3												
			13	SS	8												
306.9																	
9.8	END OF BOREHOLE																
NOTES: 1. Water encountered at a depth of 6.1 m (Elevation 310.6 m) below ground surface during drilling. 2. Water measured in open borehole at a depth of 6.2 m (Elevation 310.5 m) below ground surface upon completion of drilling. 3. Borehole caved to a depth of 7.9 m (Elevation 308.8 m) below ground surface upon completion of drilling.																	

GRAIN SIZE DISTRIBUTION

SAND (SP) (FILL)

FIGURE H-1



SILT AND CLAY SIZES				FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED				SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	F4-7	3	313.7

Project Number: 1786658 WO15-LS

Checked By: AMP

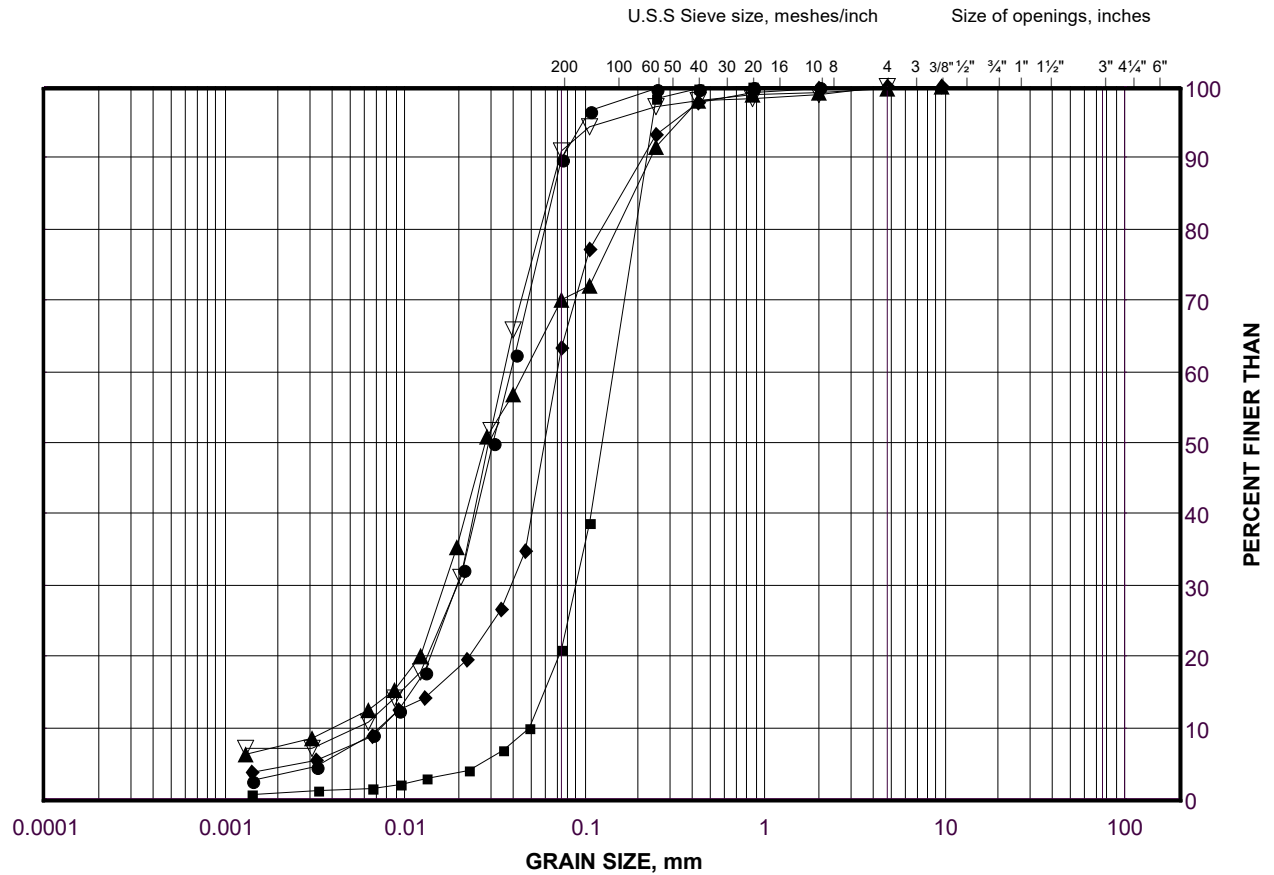
Golder Associates

Date: 15-Feb-22

GRAIN SIZE DISTRIBUTION

SILT (ML) to SILTY SAND (SM)

FIGURE H-2



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	LS7-1	10	306.8
■	LS7-1	11	306.8
◆	LS7-1	3	306.8
▲	F4-7	7	309.9
▽	F4-7	9	306.8

Project Number: 1786658 WO15-LS

Checked By: AMP

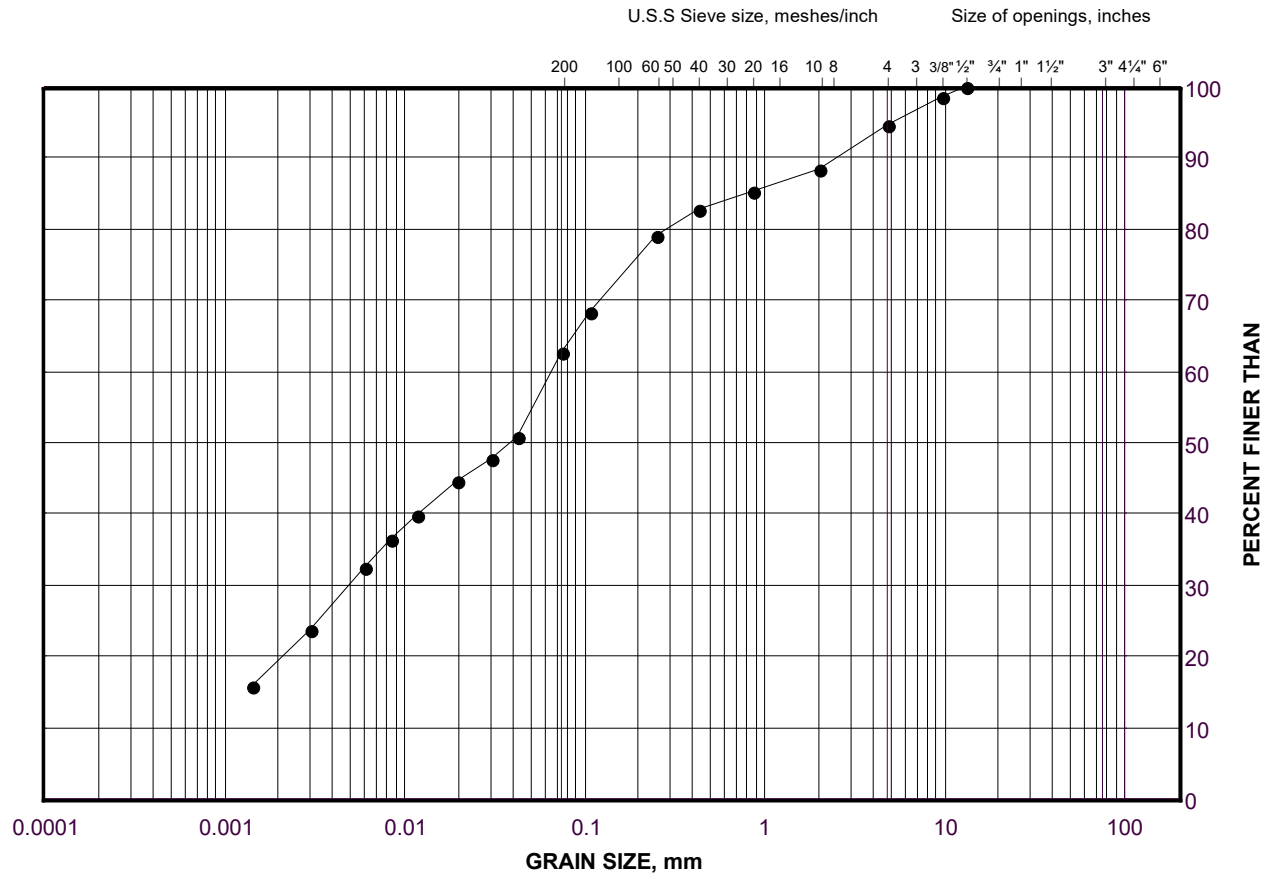
Golder Associates

Date: 15-Feb-22

GRAIN SIZE DISTRIBUTION

Sandy CLAYEY SILT (CL) (TILL)

FIGURE H-4



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

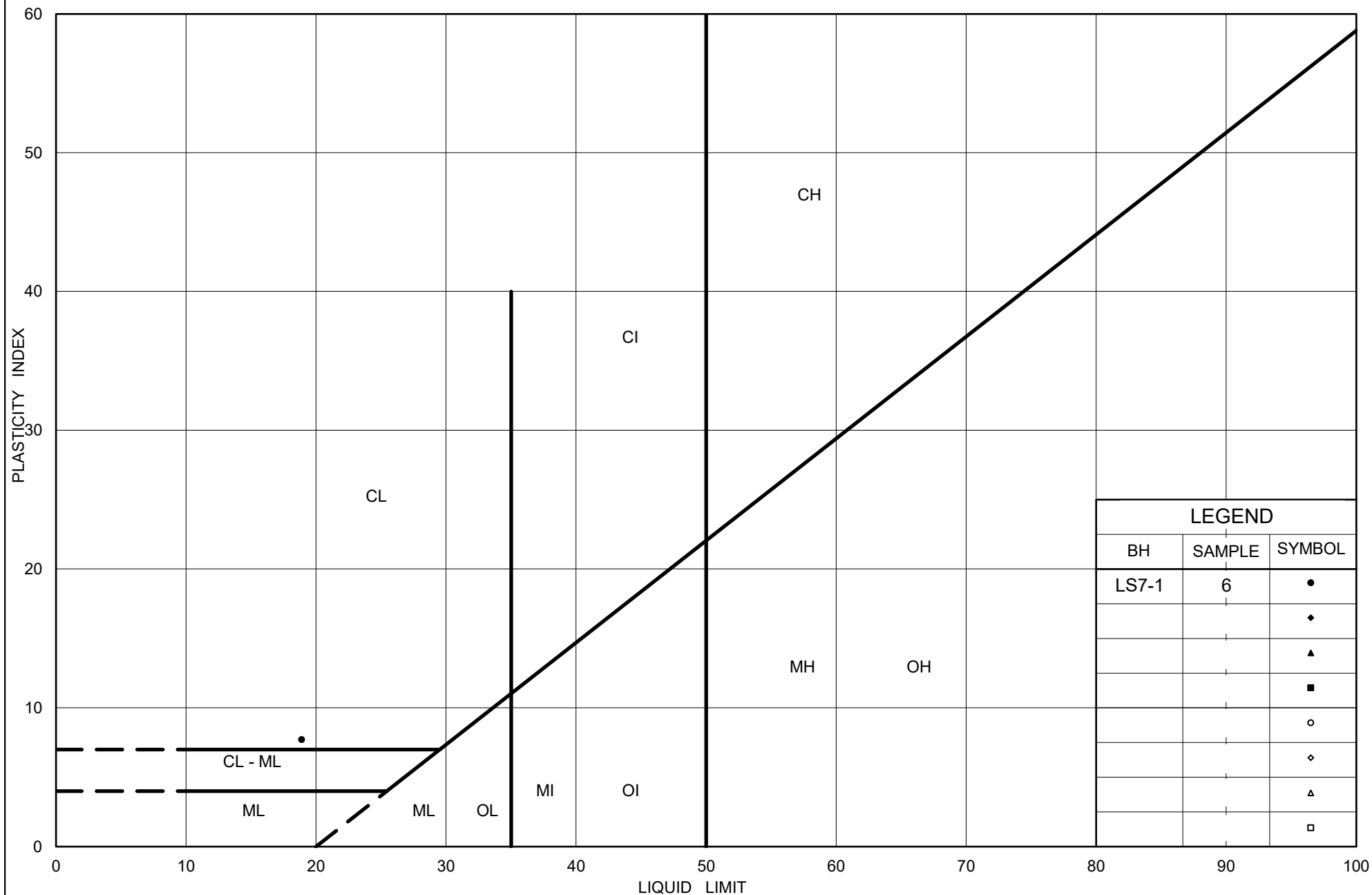
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	LS7-1	6	306.8

Project Number: 1786658 WO15-LS

Checked By: AMP

Golder Associates

Date: 15-Feb-22



Ministry of Transportation

Ontario

PLASTICITY CHART Sandy CLAYEY SILT (CL) (TILL)

Figure No. H-5

Project No. 1786658 WO15-LS

Checked By: AMP

APPENDIX I

Borehole LS6-2

GTA-MTO 001 S:\CLIENTS\IMTO\HWY 400 KING TO LLOYDTOWN\02 DATA\GINTHWY 400 KING TO LLOYDTOWN.GPJ GAL-GTA.GDT 2/17/22

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

APPENDIX J

Analytical Laboratory Result



Your Project #: 1786658 WO 15
Site Location: HWY 400, NEAR KING CITY
Your C.O.C. #: n/a

Attention: Anastasia Poliacik

Golder Associates Ltd
100 Scotia Crt
Whitby, ON
CANADA L1N 8Y6

Report Date: 2021/12/23

Report #: R6938205

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1Z1562

Received: 2021/12/15, 16:53

Sample Matrix: Soil
Samples Received: 5

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	5	2021/12/20	2021/12/21	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	5	2021/12/20	2021/12/20	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	5	N/A	2021/12/20	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	5	N/A	2021/12/19	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	5	2021/12/17	2021/12/17	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	5	2021/12/16	2021/12/20	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	5	2021/12/20	2021/12/22	CAM SOP-00464	EPA 375.4 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Bureau Veritas Calgary (19th), 4000 19th Street NE, Calgary, AB, T2E 6P8

(2) Offsite analysis requires that subcontracted moisture be reported.



Your Project #: 1786658 WO 15
Site Location: HWY 400, NEAR KING CITY
Your C.O.C. #: n/a

Attention: Anastasia Poliacik

Golder Associates Ltd
100 Scotia Crt
Whitby, ON
CANADA L1N 8Y6

Report Date: 2021/12/23
Report #: R6938205
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1Z1562
Received: 2021/12/15, 16:53

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829

=====

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Bureau Veritas Job #: C1Z1562

Report Date: 2021/12/23

Golder Associates Ltd

Client Project #: 1786658 WO 15

Site Location: HWY 400, NEAR KING CITY

Sampler Initials: AM

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		RJD881			RJD881		
Sampling Date		2021/12/10			2021/12/10		
COC Number		n/a			n/a		
	UNITS	LS3-1 SA02 2'6"-4'6"	RDL	QC Batch	LS3-1 SA02 2'6"-4'6" Lab-Dup	RDL	QC Batch

Calculated Parameters							
Resistivity	ohm-cm	770		7732686			
Inorganics							
Soluble (20:1) Chloride (Cl-)	ug/g	720	20	7741334			
Conductivity	umho/cm	1300	2	7741152			
Available (CaCl2) pH	pH	7.83		7734955			
Soluble (20:1) Sulphate (SO4)	ug/g	63	20	7741338			
Sulphide	mg/kg	5.3 (1)	0.5	7748944	5.3	0.5	7748944
Physical Testing							
Moisture-Subcontracted	%	16	0.30	7748943			
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate (1) Sample contained greater than 10% headspace at time of extraction. Sample extracted past method-specified hold time. Analyzed past method specified hold time							

Bureau Veritas ID		RJD882			RJD882		
Sampling Date		2021/12/10			2021/12/10		
COC Number		n/a			n/a		
	UNITS	LS5-1 SA02 2'6"-4'6"	RDL	QC Batch	LS5-1 SA02 2'6"-4'6" Lab-Dup	RDL	QC Batch

Calculated Parameters							
Resistivity	ohm-cm	1400		7732686			
Inorganics							
Soluble (20:1) Chloride (Cl-)	ug/g	400	20	7741334			
Conductivity	umho/cm	691	2	7741152	690	2	7741152
Available (CaCl2) pH	pH	7.62		7734955			
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	7741338	<20	20	7741338
Sulphide	mg/kg	3.6 (1)	0.5	7748944			
Physical Testing							
Moisture-Subcontracted	%	16	0.30	7748945			
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate (1) Sample contained greater than 10% headspace at time of extraction. Sample extracted past method-specified hold time. Analyzed past method specified hold time							



Bureau Veritas Job #: C1Z1562
Report Date: 2021/12/23

Golder Associates Ltd
Client Project #: 1786658 WO 15
Site Location: HWY 400, NEAR KING CITY
Sampler Initials: AM

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		RJD883		RJD884		
Sampling Date		2021/12/09		2021/11/30		
COC Number		n/a		n/a		
	UNITS	LS7-1 SA05 10'-12'	QC Batch	LS5-2 SA06 12'6" 14'6"	RDL	QC Batch
Calculated Parameters						
Resistivity	ohm-cm	10000	7732686	1300		7732686
Inorganics						
Soluble (20:1) Chloride (Cl-)	ug/g	<20	7741334	440	20	7741334
Conductivity	umho/cm	96	7741152	763	2	7741152
Available (CaCl2) pH	pH	7.75	7734968	7.48		7734955
Soluble (20:1) Sulphate (SO4)	ug/g	<20	7741338	<20	20	7741338
Sulphide	mg/kg	2.7 (1)	7748944	2.3 (1)	0.5	7748944
Physical Testing						
Moisture-Subcontracted	%	14	7748945	15	0.30	7748945
RDL = Reportable Detection Limit QC Batch = Quality Control Batch (1) Sample extracted past method-specified hold time. Analyzed past method specified hold time						

Bureau Veritas ID		RJD884			RJD885		
Sampling Date		2021/11/30			2021/11/30		
COC Number		n/a			n/a		
	UNITS	LS5-2 SA06 12'6" 14'6" Lab-Dup	RDL	QC Batch	LS6-2 SA04 7'6"-9'6"	RDL	QC Batch
Calculated Parameters							
Resistivity	ohm-cm				650		7732686
Inorganics							
Soluble (20:1) Chloride (Cl-)	ug/g	410	20	7741334	700	20	7741334
Conductivity	umho/cm				1530	2	7741152
Available (CaCl2) pH	pH				7.53		7734955
Soluble (20:1) Sulphate (SO4)	ug/g				<20	20	7741338
Sulphide	mg/kg				0.8 (1)	0.5	7748944
Physical Testing							
Moisture-Subcontracted	%				17	0.30	7748945
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate (1) Sample contained greater than 10% headspace at time of extraction. Sample extracted past method-specified hold time. Analyzed past method specified hold time							



Bureau Veritas Job #: C1Z1562
Report Date: 2021/12/23

Golder Associates Ltd
Client Project #: 1786658 WO 15
Site Location: HWY 400, NEAR KING CITY
Sampler Initials: AM

TEST SUMMARY

Bureau Veritas ID: RJD881
Sample ID: LS3-1 SA02 2'6"-4'6"
Matrix: Soil

Collected: 2021/12/10
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7741334	2021/12/20	2021/12/21	Alina Dobreanu
Conductivity	AT	7741152	2021/12/20	2021/12/20	Kien Tran
Moisture (Subcontracted)	BAL	7748943	N/A	2021/12/20	Salini Vidhyadharan
Sulphide in Soil	SPEC	7748944	N/A	2021/12/19	Bailey Morrison
pH CaCl2 EXTRACT	AT	7734955	2021/12/17	2021/12/17	Taslina Aktar
Resistivity of Soil		7732686	2021/12/20	2021/12/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7741338	2021/12/20	2021/12/22	Avneet Kour Sudan

Bureau Veritas ID: RJD881 Dup
Sample ID: LS3-1 SA02 2'6"-4'6"
Matrix: Soil

Collected: 2021/12/10
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide in Soil	SPEC	7748944	N/A	2021/12/19	Bailey Morrison

Bureau Veritas ID: RJD882
Sample ID: LS5-1 SA02 2'6"-4'6"
Matrix: Soil

Collected: 2021/12/10
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7741334	2021/12/20	2021/12/21	Alina Dobreanu
Conductivity	AT	7741152	2021/12/20	2021/12/20	Kien Tran
Moisture (Subcontracted)	BAL	7748945	N/A	2021/12/20	Salini Vidhyadharan
Sulphide in Soil	SPEC	7748944	N/A	2021/12/19	Bailey Morrison
pH CaCl2 EXTRACT	AT	7734955	2021/12/17	2021/12/17	Taslina Aktar
Resistivity of Soil		7732686	2021/12/20	2021/12/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7741338	2021/12/20	2021/12/22	Avneet Kour Sudan

Bureau Veritas ID: RJD882 Dup
Sample ID: LS5-1 SA02 2'6"-4'6"
Matrix: Soil

Collected: 2021/12/10
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7741152	2021/12/20	2021/12/20	Kien Tran
Sulphate (20:1 Extract)	KONE/EC	7741338	2021/12/20	2021/12/22	Avneet Kour Sudan

Bureau Veritas ID: RJD883
Sample ID: LS7-1 SA05 10'-12'
Matrix: Soil

Collected: 2021/12/09
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7741334	2021/12/20	2021/12/21	Alina Dobreanu
Conductivity	AT	7741152	2021/12/20	2021/12/20	Kien Tran
Moisture (Subcontracted)	BAL	7748945	N/A	2021/12/20	Salini Vidhyadharan
Sulphide in Soil	SPEC	7748944	N/A	2021/12/19	Bailey Morrison



Bureau Veritas Job #: C1Z1562

Report Date: 2021/12/23

Golder Associates Ltd

Client Project #: 1786658 WO 15

Site Location: HWY 400, NEAR KING CITY

Sampler Initials: AM

TEST SUMMARY

Bureau Veritas ID: RJD883
Sample ID: LS7-1 SA05 10'-12'
Matrix: Soil

Collected: 2021/12/09
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	7734968	2021/12/17	2021/12/17	Taslina Aktar
Resistivity of Soil		7732686	2021/12/20	2021/12/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7741338	2021/12/20	2021/12/22	Avneet Kour Sudan

Bureau Veritas ID: RJD884
Sample ID: LS5-2 SA06 12'6" 14'6"
Matrix: Soil

Collected: 2021/11/30
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7741334	2021/12/20	2021/12/21	Alina Dobreanu
Conductivity	AT	7741152	2021/12/20	2021/12/20	Kien Tran
Moisture (Subcontracted)	BAL	7748945	N/A	2021/12/20	Salini Vidhyadharan
Sulphide in Soil	SPEC	7748944	N/A	2021/12/19	Bailey Morrison
pH CaCl2 EXTRACT	AT	7734955	2021/12/17	2021/12/17	Taslina Aktar
Resistivity of Soil		7732686	2021/12/20	2021/12/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7741338	2021/12/20	2021/12/22	Avneet Kour Sudan

Bureau Veritas ID: RJD884 Dup
Sample ID: LS5-2 SA06 12'6" 14'6"
Matrix: Soil

Collected: 2021/11/30
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7741334	2021/12/20	2021/12/21	Alina Dobreanu

Bureau Veritas ID: RJD885
Sample ID: LS6-2 SA04 7'6"-9'6"
Matrix: Soil

Collected: 2021/11/30
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7741334	2021/12/20	2021/12/21	Alina Dobreanu
Conductivity	AT	7741152	2021/12/20	2021/12/20	Kien Tran
Moisture (Subcontracted)	BAL	7748945	N/A	2021/12/20	Salini Vidhyadharan
Sulphide in Soil	SPEC	7748944	N/A	2021/12/19	Bailey Morrison
pH CaCl2 EXTRACT	AT	7734955	2021/12/17	2021/12/17	Taslina Aktar
Resistivity of Soil		7732686	2021/12/20	2021/12/20	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7741338	2021/12/20	2021/12/22	Avneet Kour Sudan



Bureau Veritas Job #: C1Z1562
Report Date: 2021/12/23

Golder Associates Ltd
Client Project #: 1786658 WO 15
Site Location: HWY 400, NEAR KING CITY
Sampler Initials: AM

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	12.0°C
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Results relate only to the items tested.



Bureau Veritas Job #: C1Z1562

Report Date: 2021/12/23

Golder Associates Ltd

Client Project #: 1786658 WO 15

Site Location: HWY 400, NEAR KING CITY

Sampler Initials: AM

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7734955	TAK	Spiked Blank	Available (CaCl ₂) pH	2021/12/17		100	%	97 - 103
7734955	TAK	RPD	Available (CaCl ₂) pH	2021/12/17	0.40		%	N/A
7734968	TAK	Spiked Blank	Available (CaCl ₂) pH	2021/12/17		100	%	97 - 103
7734968	TAK	RPD	Available (CaCl ₂) pH	2021/12/17	0.85		%	N/A
7741152	KIT	Spiked Blank	Conductivity	2021/12/20		98	%	90 - 110
7741152	KIT	Method Blank	Conductivity	2021/12/20	<2		umho/cm	
7741152	KIT	RPD [RJD882-01]	Conductivity	2021/12/20	0.14		%	10
7741334	ADB	Matrix Spike [RJD884-01]	Soluble (20:1) Chloride (Cl ⁻)	2021/12/21		NC	%	70 - 130
7741334	ADB	Spiked Blank	Soluble (20:1) Chloride (Cl ⁻)	2021/12/21		103	%	70 - 130
7741334	ADB	Method Blank	Soluble (20:1) Chloride (Cl ⁻)	2021/12/21	<20		ug/g	
7741334	ADB	RPD [RJD884-01]	Soluble (20:1) Chloride (Cl ⁻)	2021/12/21	6.9		%	35
7741338	AKD	Matrix Spike [RJD882-01]	Soluble (20:1) Sulphate (SO ₄)	2021/12/22		122	%	70 - 130
7741338	AKD	Spiked Blank	Soluble (20:1) Sulphate (SO ₄)	2021/12/22		107	%	70 - 130
7741338	AKD	Method Blank	Soluble (20:1) Sulphate (SO ₄)	2021/12/22	<20		ug/g	
7741338	AKD	RPD [RJD882-01]	Soluble (20:1) Sulphate (SO ₄)	2021/12/22	NC		%	35
7748943	SVI	Method Blank	Moisture-Subcontracted	2021/12/20	<0.30		%	
7748944	BYM	Matrix Spike [RJD881-02]	Sulphide	2021/12/19		123	%	75 - 125
7748944	BYM	Spiked Blank	Sulphide	2021/12/19		90	%	75 - 125
7748944	BYM	Method Blank	Sulphide	2021/12/19	<0.5		mg/kg	
7748944	BYM	RPD [RJD881-02]	Sulphide	2021/12/19	0.46		%	30
7748945	SVI	Method Blank	Moisture-Subcontracted	2021/12/20	<0.30		%	

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

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

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).



Bureau Veritas Job #: C1Z1562
Report Date: 2021/12/23

Golder Associates Ltd
Client Project #: 1786658 WO 15
Site Location: HWY 400, NEAR KING CITY
Sampler Initials: AM

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

Michael Sheppard, B.Sc., P. Biol., QP, Senior Scientific Specialist, Organics

Sze Yeung Fock, B.Sc., Scientific Specialist

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Your Project #: 1786658
Your C.O.C. #: n/a

Attention: Anastasia Poliacik

Golder Associates Ltd
100 Scotia Crt
Whitby, ON
CANADA L1N 8Y6

Report Date: 2022/01/25
Report #: R6976890
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C214492

Received: 2022/01/19, 13:32

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	4	2022/01/24	2022/01/25	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	4	2022/01/24	2022/01/24	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	4	N/A	2022/01/22	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	4	N/A	2022/01/25	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	4	2022/01/20	2022/01/20	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	4	2022/01/19	2022/01/24	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	4	2022/01/24	2022/01/24	CAM SOP-00464	EPA 375.4 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

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Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Bureau Veritas Calgary (19th), 4000 19th Street NE, Calgary, AB, T2E 6P8

(2) Offsite analysis requires that subcontracted moisture be reported.



Your Project #: 1786658
Your C.O.C. #: n/a

Attention: Anastasia Poliacik

Golder Associates Ltd
100 Scotia Crt
Whitby, ON
CANADA L1N 8Y6

Report Date: 2022/01/25
Report #: R6976890
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C214492

Received: 2022/01/19, 13:32

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Ema Gitej, Senior Project Manager

Email: emese.gitej@bureauveritas.com

Phone# (905)817-5829

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**SOIL CORROSIVITY PACKAGE (SOIL)**

Bureau Veritas ID		RQO181			RQO181			RQO182		
Sampling Date		2022/01/18			2022/01/18			2022/01/18		
COC Number		n/a			n/a			n/a		
	UNITS	LS1-1 SA#7	RDL	QC Batch	LS1-1 SA#7 Lab-Dup	RDL	QC Batch	LS2-1 SA#3	RDL	QC Batch
Calculated Parameters										
Resistivity	ohm-cm	940		7789695				410		7789695
Inorganics										
Soluble (20:1) Chloride (Cl-)	ug/g	470	20	7796421				1100	40	7796421
Conductivity	umho/cm	1070	2	7796100				2440	2	7796100
Available (CaCl2) pH	pH	8.09		7790899				7.58		7790899
Soluble (20:1) Sulphate (SO4)	ug/g	55	20	7796427				<20	20	7796427
Sulphide	mg/kg	4.7 (1)	0.5	7799701	5.0	0.5	7799701	0.8 (1)	0.5	7799701
Physical Testing										
Moisture-Subcontracted	%	11	0.30	7799700	12	0.30	7799700	17	0.30	7799700
RDL = Reportable Detection Limit										
QC Batch = Quality Control Batch										
Lab-Dup = Laboratory Initiated Duplicate										
(1) Sample contained greater than 10% headspace at time of extraction.										

Bureau Veritas ID		RQO182			RQO183	RQO184		
Sampling Date		2022/01/18			2022/01/18	2022/01/19		
COC Number		n/a			n/a	n/a		
	UNITS	LS2-1 SA#3 Lab-Dup	RDL	QC Batch	LS4-1 SA#5B	LS3-1 SS#3	RDL	QC Batch
Calculated Parameters								
Resistivity	ohm-cm				640	930		7789695
Inorganics								
Soluble (20:1) Chloride (Cl-)	ug/g				720	530	20	7796421
Conductivity	umho/cm				1560	1080	2	7796100
Available (CaCl2) pH	pH				8.03	7.95		7790899
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	7796427	<20	50	20	7796427
Sulphide	mg/kg				3.7 (1)	5.8 (1)	0.5	7799701
Physical Testing								
Moisture-Subcontracted	%				13	15	0.30	7799700
RDL = Reportable Detection Limit								
QC Batch = Quality Control Batch								
Lab-Dup = Laboratory Initiated Duplicate								
(1) Sample contained greater than 10% headspace at time of extraction.								



Bureau Veritas Job #: C214492

Report Date: 2022/01/25

Golder Associates Ltd

Client Project #: 1786658

Sampler Initials: MTI

TEST SUMMARY

Bureau Veritas ID: RQO181
Sample ID: LS1-1 SA#7
Matrix: Soil

Collected: 2022/01/18
Shipped:
Received: 2022/01/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7796421	2022/01/24	2022/01/25	Alina Dobreanu
Conductivity	AT	7796100	2022/01/24	2022/01/24	Neil Dassanayake
Moisture (Subcontracted)	BAL	7799700	N/A	2022/01/22	Margarita Aguilera
Sulphide in Soil	SPEC	7799701	N/A	2022/01/25	Preetleen Kathuria
pH CaCl2 EXTRACT	AT	7790899	2022/01/20	2022/01/20	Taslina Aktar
Resistivity of Soil		7789695	2022/01/24	2022/01/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7796427	2022/01/24	2022/01/24	Avneet Kour Sudan

Bureau Veritas ID: RQO181 Dup
Sample ID: LS1-1 SA#7
Matrix: Soil

Collected: 2022/01/18
Shipped:
Received: 2022/01/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture (Subcontracted)	BAL	7799700	N/A	2022/01/22	Margarita Aguilera
Sulphide in Soil	SPEC	7799701	N/A	2022/01/25	Preetleen Kathuria

Bureau Veritas ID: RQO182
Sample ID: LS2-1 SA#3
Matrix: Soil

Collected: 2022/01/18
Shipped:
Received: 2022/01/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7796421	2022/01/24	2022/01/25	Alina Dobreanu
Conductivity	AT	7796100	2022/01/24	2022/01/24	Neil Dassanayake
Moisture (Subcontracted)	BAL	7799700	N/A	2022/01/22	Margarita Aguilera
Sulphide in Soil	SPEC	7799701	N/A	2022/01/25	Preetleen Kathuria
pH CaCl2 EXTRACT	AT	7790899	2022/01/20	2022/01/20	Taslina Aktar
Resistivity of Soil		7789695	2022/01/24	2022/01/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7796427	2022/01/24	2022/01/24	Avneet Kour Sudan

Bureau Veritas ID: RQO182 Dup
Sample ID: LS2-1 SA#3
Matrix: Soil

Collected: 2022/01/18
Shipped:
Received: 2022/01/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate (20:1 Extract)	KONE/EC	7796427	2022/01/24	2022/01/24	Avneet Kour Sudan

Bureau Veritas ID: RQO183
Sample ID: LS4-1 SA#5B
Matrix: Soil

Collected: 2022/01/18
Shipped:
Received: 2022/01/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7796421	2022/01/24	2022/01/25	Alina Dobreanu
Conductivity	AT	7796100	2022/01/24	2022/01/24	Neil Dassanayake
Moisture (Subcontracted)	BAL	7799700	N/A	2022/01/22	Margarita Aguilera
Sulphide in Soil	SPEC	7799701	N/A	2022/01/25	Preetleen Kathuria
pH CaCl2 EXTRACT	AT	7790899	2022/01/20	2022/01/20	Taslina Aktar



Bureau Veritas Job #: C214492
Report Date: 2022/01/25

Golder Associates Ltd
Client Project #: 1786658
Sampler Initials: MTI

TEST SUMMARY

Bureau Veritas ID: RQO183
Sample ID: LS4-1 SA#5B
Matrix: Soil

Collected: 2022/01/18
Shipped:
Received: 2022/01/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Resistivity of Soil		7789695	2022/01/24	2022/01/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7796427	2022/01/24	2022/01/24	Avneet Kour Sudan

Bureau Veritas ID: RQO184
Sample ID: LS3-1 SS#3
Matrix: Soil

Collected: 2022/01/19
Shipped:
Received: 2022/01/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7796421	2022/01/24	2022/01/25	Alina Dobreanu
Conductivity	AT	7796100	2022/01/24	2022/01/24	Neil Dassanayake
Moisture (Subcontracted)	BAL	7799700	N/A	2022/01/22	Margarita Aguilera
Sulphide in Soil	SPEC	7799701	N/A	2022/01/25	Preetleen Kathuria
pH CaCl ₂ EXTRACT	AT	7790899	2022/01/20	2022/01/20	Taslina Aktar
Resistivity of Soil		7789695	2022/01/24	2022/01/24	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7796427	2022/01/24	2022/01/24	Avneet Kour Sudan



Bureau Veritas Job #: C214492
Report Date: 2022/01/25

Golder Associates Ltd
Client Project #: 1786658
Sampler Initials: MTI

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.0°C
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Results relate only to the items tested.



QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7790899	TAK	Spiked Blank	Available (CaCl ₂) pH	2022/01/20		101	%	97 - 103
7790899	TAK	RPD	Available (CaCl ₂) pH	2022/01/20	0.44		%	N/A
7796100	NYS	Spiked Blank	Conductivity	2022/01/24		100	%	90 - 110
7796100	NYS	Method Blank	Conductivity	2022/01/24	<2		umho/cm	
7796100	NYS	RPD	Conductivity	2022/01/24	1.5		%	10
7796421	ADB	Matrix Spike	Soluble (20:1) Chloride (Cl ⁻)	2022/01/25		NC	%	70 - 130
7796421	ADB	Spiked Blank	Soluble (20:1) Chloride (Cl ⁻)	2022/01/25		106	%	70 - 130
7796421	ADB	Method Blank	Soluble (20:1) Chloride (Cl ⁻)	2022/01/25	<20		ug/g	
7796421	ADB	RPD	Soluble (20:1) Chloride (Cl ⁻)	2022/01/25	0.77		%	35
7796427	AKD	Matrix Spike [RQO182-01]	Soluble (20:1) Sulphate (SO ₄)	2022/01/24		154 (1)	%	70 - 130
7796427	AKD	Spiked Blank	Soluble (20:1) Sulphate (SO ₄)	2022/01/24		105	%	70 - 130
7796427	AKD	Method Blank	Soluble (20:1) Sulphate (SO ₄)	2022/01/24	<20		ug/g	
7796427	AKD	RPD [RQO182-01]	Soluble (20:1) Sulphate (SO ₄)	2022/01/24	NC		%	35
7799700	éHG	Method Blank	Moisture-Subcontracted	2022/01/22	<0.30		%	
7799700	éHG	RPD [RQO181-01]	Moisture-Subcontracted	2022/01/22	5.1		%	20
7799701	PK8	Matrix Spike [RQO181-01]	Sulphide	2022/01/25		105	%	75 - 125
7799701	PK8	Spiked Blank	Sulphide	2022/01/25		116	%	75 - 125
7799701	PK8	Method Blank	Sulphide	2022/01/25	<0.5		mg/kg	
7799701	PK8	RPD [RQO181-01]	Sulphide	2022/01/25	7.6		%	30

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

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

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.



Bureau Veritas Job #: C214492
Report Date: 2022/01/25

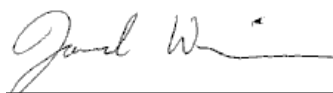
Golder Associates Ltd
Client Project #: 1786658
Sampler Initials: MTI

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:




Eva Pranjić, M.Sc., C.Chem, Scientific Specialist



Jared Wiseman, B.Sc., P.Chem., QP, Senior Analyst, Organics



Sze Yeung Fock, B.Sc., Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



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