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FOUNDATION INVESTIGATION REPORT

**Embankment Widening and RSS Wall Construction
Highway 400 Widening from North of King Road to North of
South Canal Bridges, Regional Municipality of York
GWP 2025-13-00**

Submitted to:

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REPORT





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1.0 INTRODUCTION

Golder Associated Ltd. (Golder) has been retained by URS Canada Inc. (URS) 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 Canal Bank Road in the Region Municipality of York, Ontario.

This report addresses the foundation investigation carried out for the detail design of the widening of high fill embankment areas between Highway 9 and north of South Canal bridges, as well as the construction of a retained soil system (RSS) wall, that form part of Contract 1. Embankments having a height greater than 3.5 m (at and south of about Station 25+120) are addressed in this report, as follows:

- Embankment south of South Canal bridges:
 - NBL: from approximately Station 24+650 to 24+840, and
 - SBL: from approximately Station 24+650 to 24+800.
- Embankment north of South Canal bridges:
 - NBL: from approximately Station 24+900 to 25+120, and
 - SBL: from approximately Station 24+880 to 25+120.
- Construction of the berm between the realigned South Canal and South Canal Bank Road, which is located on the north side of the existing canal.

The purpose of this investigation is to establish the subsurface conditions within the proposed widened embankments by borehole drilling and laboratory testing on selected samples. To supplement the subsurface information obtained for this geotechnical investigation, Boreholes SC-1 to SC-5, SC-7 to SC-11, SC-13, SC-14 and BO-9, advanced as part of the geotechnical investigation for the South Canal bridges, have been used in this report. In addition, the current investigation was also supplemented with information from a previous investigation at this structure site, as follows:

- **MTO GEOCRES No. 31D-029:** Report titled “Foundation Investigation Report for Proposed Extensions to the Overpass Structures at the Crossing of Hwy. #400 and the South Drainage Canal and Road, Township of King – County of York, District No. 6 (Toronto), W.O. 7C-11089 – W.P. 105-70-04”, by the Department of Highways Ontario (DHO), Foundations Section, Materials and Testing Office, dated December 8, 1970.

The previous boreholes as used in this report have been renumbered to show the MTO GEOCRES reference number followed by the original borehole designation. For this site, the boreholes from MTO GEOCRES 31D-029 have been renumbered to “29-X”, where “X” is the original borehole number (i.e., 29-2 to 29-6 and 29-8).

The terms of reference and scope of work for the foundation investigation are outlined in MTO's Request for Proposal (RFP) dated May 2008, and MTO's revised Terms of Reference an Addendum dated October 14, 2011. The scope of work for the foundation engineering services is presented in Section 6.8 of URS's *Technical Proposal* for this assignment and Golder's scope change letter, dated November 11, 2011. The work has been



carried out in accordance with Golder's Supplemental Specialty Quality Control Plan for this project, dated October 2010.

2.0 SITE DESCRIPTION

The Contract 1 widening of Highway 400 will result in the extension of the embankments on the east and west sides of Highway 400 from about 130 m south of the South Canal bridges to 200 m north of the South Canal bridges in King Township, in the Regional Municipality of York. Within the study area, the South Canal bridges (northbound and southbound) are located approximately 0.5 km north of Highway 9 and span over an approximately 18 m wide excavated canal and South Canal Bank Road. Both bridges consist of six-span structures constructed in 1948, with the original structure supported on driven timber piles. The bridges were widened toward the outside in 1971, with the widened portion supported on driven steel H-piles. Highway 400 in the vicinity of South Canal bridges has been constructed on embankment fill that is approximately 5 m to 7 m high. North of the South Canal bridges, the embankments on the east and west side of the highway gradually reduce in height, such that they are about 1 m to 2 m high at a point about 200 m north of the South Canal bridges. South Canal Bank Road, located on the north side of the canal, is about 1.5 m above the water level of the canal. On the east and west sides of Highway 400, Davis Drive and Wist Road, respectively, extend north from South Canal Bank Road to the project limits.

North of Highway 9, the ground surface slopes downward from the Oak Ridges Moraine to the Holland Marsh; the grade of Highway 400 gradually decreases from about Elevation 240 m at Highway 9 to about Elevation 227 m at the South Canal bridges to about Elevation 222 m at the north limit of the high fill embankment widening area.

In general, the study area is forested south of the South Canal bridges and generally flat lying north of the South Canal bridges. The land use along Davis Drive, Wist Road and South Canal Bank Road is generally mixed residential and agricultural.

The embankment slopes along Highway 400 are generally inclined at about 2 horizontal to 1 vertical (2H:1V), with the slope faces typically well vegetated. No evidence of embankment or pavement settlement or slope instability was observed within the existing embankment areas at the time of the borehole investigation.

3.0 INVESTIGATION PROCEDURES

The field work for this subsurface investigation was carried out between January and April 1, 2011 and in May and June, 2012 during which time a total of twenty boreholes (Boreholes F8-1 to F8-6, and Boreholes 12-1 to 12-14) were advanced at the locations shown on Drawings 1, 3 and 5. In general, the boreholes were configured to be spaced at approximately 50 m intervals along the high embankment fill section, with some of the boreholes advanced through the existing Highway 400 shoulder, some at the toes of the embankment and some on either side of the canal, east and west of Highway 400. Boreholes 12-1 and 12-2 were advanced within the canal using a D-25 drill rig mounted on a barge, while the remaining boreholes were advanced using a D-25 or D-50 drill rig, supplied and operated by Walker Drilling Ltd. of Utopia, Ontario. The boreholes were advanced



through the overburden using either 108 mm inside diameter hollow stem augers or wash boring techniques using 76 mm outer diameter NW casing.

Soil samples were obtained at 0.75 m and 1.5 m intervals of depth, using 50 mm outside diameter split-spoon samplers driven by an automatic hammer, in accordance with the Standard Penetration Test (SPT) procedure (ASTM D). (ASTM D1586-08a – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of the Soil). In situ field vane testing, using MTO standard “N”-size vanes, was carried out in boreholes where soft to stiff cohesive soils were encountered to measure the undrained shear strength of the cohesive deposits. Thin-walled Shelby tube samples (ASTM) were also obtained within the cohesive materials at selected intervals.

The groundwater conditions in the open boreholes were observed during and immediately following the drilling operations and a piezometer was installed in Borehole 12-6 to permit monitoring of the water level at this location. The piezometer consists of 50 mm diameter PVC pipe, with a slotted screen sealed at a select depth within the borehole. Above the sand filter pack and piezometer screen, the annulus surrounding the piezometer pipe was backfilled to the ground surface with bentonite pellets/grout.

Piezometer installation details and water level readings obtained during and following the borehole drilling are described on the Record of Borehole sheets following the text of this report. Boreholes where artesian groundwater conditions were noted were backfilled with cement grout and all other remaining boreholes were backfilled with bentonite, upon completion, in accordance with Ontario Regulation 903 (as amended).

The field work was observed by members of Golder's engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, logged the boreholes, and examined and cared for the soil samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to our Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing of selected samples. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Index and classification testing (water content, Atterberg limits and grain size distributions) were carried out on selected soil samples. In addition, four one-dimensional consolidation (oedometer) tests were carried out on selected samples of the cohesive deposits.

The borehole locations were established in the field by Golder personnel relative to site features. The ground surface elevation at each borehole was estimated from the digital terrain model for the site as provided by URS.

In addition to the boreholes drilled specifically for this investigation, twelve boreholes advanced for the South Canal Bank Road overpass investigation (Boreholes SC-1 to SC-5, SC-7 to SC-11, SC-14 and BO-9) and six boreholes from the previous MTO investigation (GEOCREC No. 31D-029: Boreholes 29-2 to 29-6 and 29-8) have also been used in the assessment of the subsurface stratigraphy for the embankment widening in Contract 1.

The borehole locations (referenced to the MTM NAD83 co-ordinate system), ground surface elevations (referenced to geodetic datum) and drilled depths are summarized below and are shown on Drawings 1 to 5.

Borehole Number	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
12-1	4,877,101.4	297,123.6	219.0*	13.6
12-2	4,877,138.4	297,168.4	219.0*	13.7



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Borehole Number	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
12-3	4,877,222.9	297,142.4	225.0	18.9
12-4	4,877,275.6	297,148.2	219.5	19.9
12-5	4,877,314.1	297,119.9	223.5	21.9
12-6	4,877,363.4	297,126.5	219.7	23.5
12-7	4,877,186.9	297,096.2	220.4	20.3
12-8	4,877,236.1	297,100.5	224.1	21.9
12-9	4,877,276.8	297,071.9	219.5	23.5
12-10	4,877,324.8	297,075.2	222.0	20.4
12-11	4,877,137.4	297,197.1	219.5	10.7
12-12	4,877,173.1	297,222.1	219.0	12.8
12-13	4,877,053.3	297,098.6	219.3	14.3
12-14	4,877,039.6	297,057.1	219.2	14.3
F8-1	4,877,001.3	297,209.6	227.3	6.4
F8-2	4,877,031.6	297,183.6	229.2	15.8
F8-3	4,877,098.8	297,187.5	221.0	6.7
F8-4	4,876,920.8	297,144.9	227.0	6.6
F8-5	4,876,957.9	297,131.3	223.8	9.4
F8-6	4,877,028.4	297,140.7	229.1	17.2
SC-1	4,877,070.0	297,189.1	223.0	12.8
SC-2	4,877,082.3	297,188.1	222.0	17.4
SC-3	4,877,124.8	297,177.2	220.1	17.2
SC-4	4,877,151.8	297,171.4	220.8	27.9
SC-5	4,877,176.1	297,165.0	221.1	15.9
SC-7	4,877,117.8	297,113.1	220.7	40.1
SC-8	4,877,130.1	297,103.5	220.5	12.8
SC-9	4,877,070.2	297,116.5	221.0	20.4
SC-10	4,877,033.5	297,122.5	222.1	15.9
SC-11	4,877,019.1	297,122.9	221.8	14.3
SC-14	4,877,041.9	297,120.6	222.0	18.1
BO-9	4,877,161.8	297,169.1	221.0	26.5
29-2	4,877,083.0	297,134.0	223.9	18.3
29-3	4,877,114.0	297,164.0	220.6	13.9
29-4	4,877,119.0	297,129.0	221.1	16.9
29-5	4,877,149.0	297,157.0	221.1	20.0
29-6	4,877,146.0	297,122.0	225.8	20.3
29-8	4,877,128.0	297,143.0	221.1	20.3

* denotes elevation of water in the canal



4.0 SUBSURFACE CONDITIONS

4.1 Regional Geology

The 13 km long section of Highway 400 included in the overall project site traverses, in a south–north direction, the physiographic regions known as South Slope, Oak Ridges Moraine and Simcoe Lowland, according to *The Physiography of Southern Ontario (Chapman and Putman, 1984)*¹. Along Highway 400, the South Slope is present south of King Road, the Oak Ridge Moraines extends from north of King Road to south of Highway 9 and the Simcoe Lowlands occupy a 4 km wide strip extending from south of Highway 9 to the Holland Marsh. The highway embankment area north and south of the South Canal bridges is located within the Simcoe Lowlands physiographic region.

The surficial soils of the South Slope region are generally cohesive tills. 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 in this area, cuts exposed up to about 10 m of till overlying sand and gravel deposits.

The Holland River valley, which crosses Highway 400 in the vicinity of Highway 9 and South Canal Bank Road, is located within the Simcoe Lowlands region. This valley extends south west from Cook Bay, at the south end of Lake Simcoe, and was once a shallow extension of the lake. The floor of the valley consists of peat, soft clays and loose sands. It is understood that during initial construction of Highway 400, a layer of peat about 2 m to 3 m thick was removed in order to construct the road upon the underlying sand and clay.

A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2 Subsurface Conditions

As part of the subsurface investigation, twenty boreholes were advanced within the proposed high fill embankment widening areas, supplemented by twelve boreholes drilled for different aspects of the Highway 400 assignment and six boreholes from a previous MTO investigation. The borehole locations, ground surface elevations and interpreted stratigraphic conditions are shown on Drawings 1 to 5.

The detailed subsurface soil and groundwater conditions encountered in the boreholes as part of the current investigations, together with results of the in situ and laboratory tests carried out on selected soil samples are provided on the borehole records following the text of this report; the results of the geotechnical laboratory testing are also presented in Appendices A, B and C. The borehole information and laboratory test results from the previous MTO investigation are presented in Appendix D. The results of the in situ field tests (i.e., SPT “N” values and undrained shear strengths from field vane testing) as presented on the borehole records and in the following sections of this report are uncorrected.

The stratigraphic boundaries shown on the borehole records and on the interpreted stratigraphic profiles on Drawings 2, 4 and 5 are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather

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.



than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

The subsurface conditions encountered in the embankment widening south of the existing South Canal are different than the subsurface conditions encountered north of the South Canal and therefore they are presented separately in Sections 4.3 and 4.4, respectively.

4.3 Embankment Widening – SBL (Station 24+650 to 24+800) and NBL (Station 24+650 to 24+840)

This section of proposed embankment widening is located immediately south side of the South Canal bridges, on the east and west sides of the existing Highway 400 embankment. The existing bridges and the Highway 400 embankment in this area are located where the highway slopes downward from the “tableland” south of Highway 9, into the Holland Marsh. The South Canal crosses under the existing South Canal bridges adjacent to the north limit of this embankment section. The ground surface at the crest of the existing embankment is at about Elevation 229 m, and about Elevation 222 m at the embankment toes. Boreholes F8-1 to F8-6 were advanced within the limits of this embankment. Boreholes SC-1, SC-2, SC-10, SC-11, and SC-14 were drilled as part of an investigation completed by Golder for the replacement of the South Canal bridges and also lie within the limits of the embankment. The locations of the boreholes and the interpreted stratigraphic profiles along the SBL and NBL widening are shown on Drawings 1 and 2. The detailed subsurface soil and groundwater conditions encountered in the boreholes advanced for this investigation and the results of in situ and laboratory tests carried out on selected soil samples are provided in Appendix A.

In summary, the subsoils encountered in the boreholes in the area immediately south of the South Canal bridges consist of a layer of topsoil or asphalt underlain by fill and thin deposits of clayey silt and sand and silt. These deposits are underlain by cohesive and non-cohesive glacial till deposits. The non-cohesive till deposits generally extend over the western limit of the proposed embankment area.

A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.3.1 Topsoil and Asphalt

An approximately 100 mm to 200 mm thick layer of topsoil was encountered immediately below the existing ground surface in Boreholes F8-1, F8-3, F8-4, SC-1, SC-2, SC-10, SC-11 and SC-14 which were advanced at or near the toe of the existing high fill embankment.

An approximately 100 mm to 300 mm thick layer of asphalt was encountered beneath the road surface in Boreholes F8-2 and F8-6 which were advanced at the crest of the high fill embankment on the Highway 400 shoulders.

4.3.2 Fill

Fill was encountered below the asphalt and topsoil layers or at ground surface in all boreholes except Boreholes SC-2, SC-10 and SC-14. The elevations of the surface and base of the fill deposit and the deposit thicknesses as encountered in the boreholes are summarized below.



Borehole No.	Depth to Fill Surface (m)	Fill Surface Elevation (m)	Fill Thickness (m)	Fill Base Elevation (m)
F8-1	0.2	227.1	2.0	225.1
F8-2	0.3	228.9	5.3	223.6
F8-3	0.2	220.8	3.1	217.7
F8-4	0.2	226.8	1.4	225.4
F8-5	0.0	223.8	1.5	222.3
F8-6	0.1	229.0	8.6	220.4
SC-1	0.2	222.8	1.3	221.5
SC-11	0.1	221.7	2.2	219.6

Boreholes F8-2 and F8-6 were advanced from the road surface and penetrated fully through the existing Highway 400 high fill embankment, whereas the remaining boreholes were advanced through fill that had been placed at or near the toes of the existing embankment.

The embankment fill consists mainly of cohesive soil but also consists of sand and gravel below the asphalt pavement and silty sand to sand and gravel within the embankment. Rootlets and/or organics were noted within the fill deposit in Boreholes F8-1, F8-3 to F8-5, SC-1 and SC-11.

The measured SPT 'N' values within the fill deposit range from 4 blows to 48 blows per 0.3 m of penetration; however, they typically range from 8 blows to 25 blows per 0.3 m of penetration, indicating a generally loose to compact relative density within the non-cohesive portions of the fill and a stiff to very stiff consistency within the cohesive fill.

The results of six grain size distribution tests performed on samples of the fill are shown on Figure A1 in Appendix A.

Atterberg limits testing carried out on five samples from the cohesive portions of the fill measured liquid limits ranging from 18 per cent to 27 per cent, plastic limits ranging from 13 per cent to 14 per cent and plasticity indices ranging from 5 per cent to 13 per cent. The test results, which are plotted on a plasticity chart on Figure A2 in Appendix A, indicate that this portion of the fill material is a clayey silt of low plasticity. The natural water content measured on samples of the cohesive fill ranges from about 10 per cent to 20 per cent.

4.3.3 Sandy Silt to Sand and Gravel

Deposits of silty sand to sand and gravel were encountered in Boreholes F8-5, SC-1, SC-2, SC-10, S-11 and SC-14. The sandy silt to sand and gravel deposits were contacted at depths between 0.2 m and 2.7 m below ground surface (Elevation 217.3 m to Elevation 222.2 m) and the thickness of these deposits ranges from 0.4 m to 2.3 m at the borehole locations.

The deposits vary from sandy silt to sand and gravel containing varying amounts of clay. Organic material and wood fragments were noted within these deposits in Boreholes SC-1, SC-2, and SC-11.



The measured SPT 'N' values within the deposit range from 2 blows to 44 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The results of four grain size distribution tests performed on samples of the sandy silt to sand and gravel are shown on Figure A3 in Appendix A. The measured natural water content of four samples of the sandy silt to sand and gravel deposit from the current investigation range from 11 per cent to 24 per cent.

4.3.4 Clayey Silt (Upper Deposit)

An upper deposit of clayey silt was encountered underlying the fill in Boreholes F8-2, F8-3, F8-4 and SC-1, below the topsoil in Boreholes SC-2 and SC-10 and below the sandy silt in Borehole SC-14.

The upper clayey silt deposit was contacted at depths between 0.1 m and 5.6 m below ground surface (Elevation 217.3 m to Elevation 225.4 m) and the thickness of these deposits ranges from 0.4 m to 4.0 m at the borehole locations.

The clayey silt deposit contains varying amounts of sand and gravel, and organic materials were noted within the layers in Boreholes F8-2, F8-3, SC-1, SC-10 and SC-14.

The measured SPT 'N' values within the deposit range from 3 blows to 44 blows per 0.3 m of penetration, suggesting a soft to hard consistency for the overall deposit, but are typically between 8 blows and 25 blows per 0.3 m of penetration, suggesting a stiff to very stiff consistency.

The results of three grain size distribution tests performed on samples of the upper clayey silt are shown on Figure A4 in Appendix A.

Atterberg limits tests were carried out on three samples of the clayey silt deposit from the current investigation and the measured liquid limits ranged between 19 per cent and 28 per cent, plastic limits ranging between 11 per cent and 16 per cent and plasticity indices ranging between 8 per cent and 12 per cent. These test results which are plotted on a plasticity chart on Figure A5, indicate that this material is a clayey silt of low plasticity.

An organic content test carried out on a sample of the clayey silt measured 1.8 per cent organics. The measured natural water content measured on twelve samples of the clayey silt deposit from the current investigation ranges between 12 per cent and 26 per cent.

4.3.5 Organic Sandy Silt / Peat

A layer of organic sandy silt / peat was encountered below the fill in Borehole F8-6 and below the upper clayey silt in Boreholes SC-1, SC-2, SC-10 and SC-14. The sandy silt to sand and gravel deposits were contacted at depths between 0.2 m and 2.7 m below ground surface and the thickness of these deposits ranges from 0.4 m to 2.3 m at the borehole locations.

The result of one grain size distribution test performed on a sample of the organic sandy silt is shown on Figure A6 in Appendix A. An organic content test carried out on a sample of the organic sandy silt / peat measured 7 per cent organics.



4.3.6 Silt to Clayey Silt (Lower Deposit)

A lower deposit of silt to clayey silt was encountered below the sandy silt to silty sand till in Borehole F8-1 and below the sandy silt to sand and gravel in Boreholes SC-10, SC-11 and SC-14. The surface of this deposit was encountered at depths ranging from 2.6 m to 4.9 m below ground surface (Elevation 222.4 m to 218.4 m) and the deposit is about 1.1 m to 3.5 m thick. Borehole F8-1 was terminated within the lower silt to silty clay deposit at a depth of 6.4 m below ground surface (Elevation 220.9 m) after penetrating 1.5 m into the layer.

The measured SPT 'N' values measured within the lower silt to silty clay deposit range from 8 blows to 138 blows per 0.3 m of penetration, suggesting a stiff to hard consistency.

The results of one grain size distribution test performed on a sample of the lower clayey silt to silty clay are shown on Figure A7 in Appendix A.

Atterberg limits tests were carried out on four samples of the lower silt to silty clay deposit measured liquid limits ranging from 14 per cent to 31 per cent, plastic limits ranging from 10 per cent to 18 per cent and plasticity indices ranging from 4 per cent to 15 per cent. These test results, which are plotted on a plasticity chart on Figure A8 in Appendix A, indicate that this material is silt of slight plasticity to clayey silt of low plasticity. The measured natural water contents of four samples of the lower silt to clayey silt from the current investigation ranges from 14 per cent to 26 per cent.

4.3.7 Clayey Silt Till

A deposit of clayey silt till was encountered below the fill in Borehole F8-1, below the upper clayey silt in Boreholes F8-2 and F8-3, below the lower clayey silt in Boreholes SC-10 and SC-14 and below the sandy silt to sand and gravel in Boreholes SC-1, SC-2 and SC-11. The clayey silt till was contacted at depths between 2.2 m and 7.2 m below ground surface (Elevation 214.9 m to Elevation 225.1 m) and the thickness of this deposit ranges from 1.5 m to greater than 12.8 m at the borehole locations.

Boreholes F8-2, F8-3, SC-1, SC-10, SC-11 and SC-14 were terminated within the clayey silt till. The till deposit consists of clayey silt containing varying amounts of sand and gravel. Cobbles and boulders are present within this layer, inferred by the bouncing of a split-spoon sampler in Borehole SC-1.

The measured SPT 'N' values within the clayey silt till range from 6 blows per 0.3 m of penetration to 133 blows per 0.23 m of penetration and generally increase with depth. These 'N' values suggest that the till deposit has a firm to hard consistency.

The results of nine grain size distribution tests performed on samples of the clayey silt till are shown on Figures A9A and A9B in Appendix A.

Atterberg limits tests were carried out on sixteen samples of the clayey silt till deposit and measured liquid limits ranging from 16 per cent to 21 per cent, plastic limits ranging from 10 per cent to 13 per cent and plasticity indices ranging from 3 per cent to 11 per cent. These test results, which are plotted on the plasticity charts on Figures A10A and A10B in Appendix A, indicate that this material is a clayey silt of low plasticity. The measured natural water content of thirty-four samples of the clayey silt till from the current investigation ranges from 7 per cent to 25 per cent, typically near the plastic limit of the material.



4.3.8 Sandy Silt to Silty Sand Till

A deposit of sandy silt to silty sand till was encountered below the upper clayey silt in Borehole F8-4, below the organic sandy silt / peat layer in Borehole F8-6, below sand and silt in Borehole F8-5 and below clayey silt till in Boreholes F8-1 and SC-2. The sandy silt to silty sand till was contacted at depths between 3.7 m and 13.9 m below ground surface (Elevation 208.1 m to Elevation 223.6m) and the thickness of this deposit ranged from greater than 1.0 m to greater than 7.7 m at the borehole locations.

All boreholes noted above were terminated within the sandy silt to silty sand till deposit except Borehole F8-1. The till deposit typically contains trace clay and trace to some gravel. Cobbles and boulders were also noted within the deposit, inferred by the grinding of augers as they advanced through the deposit, as noted on the borehole records.

The SPT 'N' values measured within the non-cohesive till deposit range from 40 blows per 0.3 m of penetration to 100 blows per 0.1 m of penetration, indicating a dense to very dense relative density.

The results of five grain size distribution tests performed on samples of the sandy silt to silty sand till deposit are shown on Figure A11 in Appendix A. The natural water content of nine samples of the sandy silt to silty sand till deposit ranges from 3 per cent to 15 per cent.

4.3.9 Groundwater Conditions

The observed/recorded water levels in the open boreholes following completion of drilling and in the standpipe piezometer installed in Borehole SC-1 are shown on the borehole records and are summarized as follows:

Borehole / Piezometer	Ground Surface Elevation (m)	Depth to Groundwater Level (m)	Groundwater Level Elevation (m)	Date	Notes
F8-1	227.3	4.4	222.9	Jan. 18, 2011	Open Borehole
F8-2	229.2	15.2	214.0	Apr.1, 2012	Open Borehole
F8-3	221.0	3.2	217.8	Jan. 18, 2012	Open Borehole
F8-4	227.0	2.7	224.3	Apr.4, 2012	Open Borehole
F8-5	223.8	1.6	222.2	Apr. 7, 2012	Open Borehole
F8-6	229.1	14.9	214.2	Mar. 31, 2012	Open Borehole
SC-1	223.0	2.8	220.2	Jun. 11, 2012	Open Borehole Piezometer
		0.3	222.7	Jun. 12, 2012	
SC-2	222.0	2.0 ags*	224.0	Jun. 8, 2012	Inside Casing
SC-10	222.1	2.1	220.0	May 14, 2012	Open Borehole
SC-11	221.8	Dry	-	May 11, 2012	Open Borehole
SC-14	222.0	3.7	218.3	May 22, 2012	Open Borehole

*ags = above ground surface

Artesian groundwater conditions were encountered within the lower non-cohesive till deposit primarily on the east side of the fill embankment. The groundwater in the casing rose to 2.0 m above ground surface during drilling operations in Borehole SC-2.



The water levels observed in the open boreholes on completion of drilling and in the piezometer may not represent long-term stabilized groundwater levels. The water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring and periods of precipitation.

4.4 Embankment Widening – SBL (Station 24+880 to 25+120) and NBL (Station 24+900 to 25+120)

Boreholes 12-3 to 12-10 were advanced within the limits of this embankment area during the current investigation. In addition to the boreholes drilled specifically for the high fill embankment investigation, Boreholes SC-5, SC-7, SC-8, BO-9, 29-5 and 29-6 from previous investigations with the site limits have also been used in the assessment of the subsurface stratigraphy for this section of the embankment widening. The detailed subsurface soil and groundwater conditions encountered in the boreholes from the current investigation and the results of in situ and laboratory tests carried out on selected soil samples are provided in Appendix B; the results of boreholes from the previous investigation by others are included in Appendix D. The borehole locations and the interpreted stratigraphic profiles along the SBL and NBL widening are shown on Drawings 3 and 4, respectively.

In general, the subsurface conditions at the site consist of surficial layers of topsoil, asphalt and roadway base granular fill and cohesive fill in the vicinity of Highway 400, underlain by a clayey silt to silty clay deposit with silty sand to sandy silt interlayers. The clayey silt to silty clay deposit is underlain by a sand and silt till to clayey silt till deposit. A silty sand to sand and gravel deposit with clayey silt interlayers underlies the till deposit.

A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.4.1 Topsoil and Asphalt

Approximately 100 mm to 500 mm of topsoil was encountered immediately below the existing ground surface in Boreholes 12-7, SC-8, and BO-9. These boreholes were drilled at the embankment toes of Highway 400.

An approximately 100 mm to 300 mm thick layer of asphalt was encountered beneath the road surface in Boreholes 12-3, 12-5, 12-8, 12-10 and SC-5 which were advanced at the crest of the high fill embankment on the Highway 400 shoulders. A 100 mm layer of asphalt was encountered in Borehole 12-6 and SC-5 which were advanced at the base of the South Canal bridges embankment on the side of Wist Road.

4.4.2 Fill

Fill consisting of sand and gravel, clayey silt and sand and silt to silty sand was encountered in all of the boreholes advanced for the widening of the embankment north of the north approach to the South Canal bridges and is described in more detail below.

4.4.2.1 Sand and Gravel Fill

A 0.6 to 1.5 m thick layer of sand and gravel fill was encountered below the asphalt in Boreholes 12-3, 12-5, 12-6, 12-8 and 12-10 and at ground surface in Borehole 12-4. The fill layer typically contains some silt and trace clay. Organics were noted to be present within this layer in Borehole 12-4.



4.4.2.2 Clayey Silt Fill

Clayey silt fill was encountered below the asphalt and topsoil layers or at ground surface in Boreholes 12-4, 12-6, 12-7, 12-9, SC-7, 29-5 and 29-6, below sand and gravel fill in Boreholes 12-3, 12-5, 12-8, 12-10 and below sand and silt to silty sand fill in Borehole SC-5.

The elevation of the surface and base of the clayey silt fill deposit and the deposit thickness as encountered in the boreholes are summarized below.

Borehole No.	Depth to Clayey Silt Fill Surface (m)	Clayey Silt Fill Surface Elevation (m)	Clayey Silt Fill Thickness (m)	Clayey Silt Fill Base Elevation (m)
12-3	1.2	223.8	1.4	222.4
	4.6	220.4	1.8	218.6
12-5	1.5	222.0	1.5	220.5
12-7	0.5	219.9	0.2	219.7
12-8	1.5	222.6	2.2	220.4
	4.5	219.6	2.9	216.7
12-9	0.0	219.5	0.6	218.9
12-10	1.6	220.4	3.6	216.8
SC-5	0.4	220.7	0.3	220.4
SC-7	0.8	220.7	0.8	219.9
29-5	0.0	221.1	0.9	219.2
29-6	0.0	225.8	3.3	222.5

The clayey silt fill layer contains varying amounts of sand and gravel and layers of silty sand were noted in Boreholes 12-3 and 12-5. Organics were also noted to be present within the fill layer in Boreholes 12-3, 12-7, 12-9, SC-7, 29-4, and 29-5.

The measured SPT 'N' values within the fill deposit range from 2 blows to 27 blows per 0.3 m of penetration, however, typically range from 4 blows to 15 blows per 0.3 m of penetration, suggesting a firm to stiff consistency.

The result of one grain size distribution test performed on a sample from the previous investigation is shown on the borehole record in Appendix D. The results of Atterberg limits testing carried out on a sample of the clayey silt fill from the previous investigation are also shown on the borehole record. The measured natural water content measured on samples of the clayey silt fill from the current investigation ranges from approximately 10 per cent to 20 per cent.

4.4.2.3 Sand and Silt to Silty Sand Fill

Sand and silt to silty sand fill was encountered below asphalt in Borehole SC-5 and below the clayey silt fill in Boreholes 12-3, 12-5 and 12-8. The elevation of the surface and base of the clayey silt fill deposit and the deposit thickness as encountered in the boreholes are summarized below.



Borehole No.	Depth to Non-Cohesive Fill Surface (m)	Non-Cohesive Fill Surface Elevation (m)	Non-Cohesive Fill Thickness (m)	Non-Cohesive Fill Base Elevation (m)
12-3	2.6	222.4	2.0	220.4
12-5	3.0	220.5	4.2	216.3
12-8	3.7	220.4	0.8	219.6
SC-5	0.1	221.0	0.3	220.7

The sand and silt to silty sand fill typically contains trace clay and trace gravel. The measured SPT 'N' values within the fill layer range from 3 blows to 40 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The results of two grain size distribution tests performed on samples of the sand and silt to silty sand fill are shown on Figure B1 in Appendix B.

Atterberg limits testing carried out on one sample of the sand and silt fill from the current investigation measured a liquid limit of 17 per cent, a plastic limit of 13 per cent and a plasticity index of 4 per cent. The test result, which is plotted on a plasticity chart on Figure B2 in Appendix B, indicates that the fill material is a silt of low plasticity.

4.4.3 Organic Clay / Peat

A layer of organic clay / peat was encountered below the sand and gravel fill in Boreholes 12-4 and 12-6, below the clayey silt fill in Boreholes 12-7, 12-9, SC-5, SC-7 and 29-5 and below clayey silt in Boreholes SC-8 and BO-9. The organic clay / peat was encountered at depths ranging from 0.6 m to 1.8 m below ground surface (Elevation 220.4 m to 218.7 m) and is 0.5 m to 2.2 m thick. The organic clay / peat was typically encountered in the boreholes advanced at the base of the Highway 400 embankment and was not encountered in the boreholes advanced through the existing Highway 400 embankment.

The organic clay / peat is typically silty and contains rootlets and wood fragments.

The measured SPT 'N' values within the organic clay / peat range from 1 blow to 9 blows per 0.3 m of penetration, but typically range between 1 blow and 5 blows per 0.3 m of penetration, suggesting a very soft to firm consistency for the cohesive portions of the layer and a very loose to loose relative density for the non-cohesive portions.

Organic content tests performed on four selected samples of the organic clay / peat showed 18 per cent to 35 per cent organics.

4.4.4 Silty Sand (Upper Deposit)

A 0.1 m to 0.9 m thick upper layer of silty sand was encountered below the fill in Boreholes 12-8 and 29-6. The upper silty sand deposit was encountered at depths of 7.4 m and 3.4 m below ground surface (Elevation 216.7 m and 222.5 m). The upper silty sand layer typically contains trace clay and trace gravel.

The measured SPT 'N' values measured within the upper silty sand were 9 blows and 66 blows per 0.3 m of penetration, indicating a loose to very dense relative density.



4.4.5 Clayey Silt to Silty Clay

Clayey silt to silty clay was encountered in all boreholes advanced within the embankment area. The clayey silt was encountered at depths ranging from 0.1 m to 7.5 m below ground surface (Elevation 216.3 m to 220.9 m). Boreholes 12-3, 12-5, 12-8, 12-10 and SC-8 were terminated in the clayey silt.

The clayey silt to silty clay deposits typically contains trace to some sand. Seams or interlayers of sandy silt to silty sand were noted to be present in Boreholes 12-3 to 12-10, SC-5, SC-7, SC-8, BO-9 and 29-6. Trace quantities of organic material are present within the upper portions of the clayey silt to silty clay in Boreholes 12-3, 12-6, SC-8 and BO-9.

The measured SPT 'N' values within the clayey silt to silty clay deposits range from 0 blows (weight of the SPT hammer advancing the sampler) to 52 blows per 0.3 m of penetration, but typically range from 1 blow to 15 blows per 0.3 m of penetration, suggesting a generally very soft to stiff consistency. Vane shear tests performed within the clayey silt to silty clay deposit yielded results ranging from 8 kPa to greater than 163 kPa (vane torque refusal) but typically ranging from approximately 20 kPa to 50 kPa, indicating a soft to firm consistency.

The results of nineteen grain size distribution tests performed on samples of the upper deposit of clayey silt to silty clay from the current investigation are shown on Figures B3A, B3B and B3C in Appendix B. The result of a grain size distribution test performed on a sample of the clayey silt to silty clay from the previous investigation is shown on the borehole record in Appendix D.

Atterberg limits testing carried out on forty-seven samples of the clayey silt to silty clay from the current investigation measured liquid limits ranging from 15 per cent to 37 per cent, plastic limits ranging from 9 per cent to 18 per cent and plasticity indices ranging from 3 per cent to 20 per cent. The test results, which are plotted on plasticity charts on Figures B4A to B4H in Appendix B, indicate that the material is clayey silt of low plasticity to silty clay of intermediate plasticity. Atterberg limits testing carried out on samples of clayey silt from the previous investigation are shown on the borehole records in Appendix D. The measured natural water content on samples from the current investigation typically ranges from about 15 per cent to 35 per cent.

An organic content test performed on a sample of the upper portion of the clayey silt to silty clay deposit measured 1 per cent organic material.

Laboratory consolidation tests were carried out on five thin-walled Shelby tube samples of the clayey silt to silty clay deposit. The consolidation test results are presented on Figures B5 to B9 in Appendix B and are summarized below.

Borehole/ Sample No.	Sample Depth/Elev. (m)	Unit Weight (kN/m ³)	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	OCR	e_o	C_c	C_r	C_v^* cm ² /s
12-4 / S6	215.5	21.9	31	116	85	3.7	0.44	0.10	0.025	1.3×10^{-3}
12-6 / S15	203.4	18.3	145	196	51	1.4	1.05	0.39	0.025	3.5×10^{-3}
12-7 / S10	203.3	19.4	83	189	106	2.3	0.81	0.24	0.025	1.9×10^{-3}
SC-5 / T1	12.4 / 208.7	20.1	109	135	26	1.2	0.64	0.16	0.022	2.1×10^{-3}
SC-7 / 11	11.0 / 209.7	20.6	96	150	54	1.6	0.63	0.16	0.026	1.1×10^{-3}



Notes: * for approximate stress range $20 \leq \sigma \leq 150$ kPa

where	σ_p'	Estimated preconsolidation stress	σ_{vo}'	Computed existing vertical effective stress
	C_c	Compression index	C_r	Recompression index
	e_o	Initial void ratio	OCR	Overconsolidation ratio
			C_v	Coefficient of consolidation (cm^2/s) in the normally consolidated range

4.4.6 Silt to Silty Sand Interlayers

Discontinuous silt to silty sand interlayers, approximately 0.1 m to 2.6 m thick, were encountered within the clayey silt to silty clay deposit in all boreholes except Borehole 29-5. The interlayers consist of silt to silty sand and typically contain trace clay. Organics were noted to be present within some of the upper interlayers in Boreholes 12-3, 12-5 and 12-6.

The measured SPT 'N' values within the sandy silt to silty sand interlayers range from 0 blows to 23 blows per 0.3 m of penetration, but are generally between 5 blows and 15 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The results of grain size distribution testing completed on five samples of the silt to silty sand interlayers are shown on Figure B10 in Appendix B. Atterberg limits testing carried out on one sample of the silt interlayers measured a liquid limit of 15 per cent, a plastic limit of 12 per cent and plasticity index of 3 per cent. The results, which are plotted on Figure B11 in Appendix B, indicate that the material is a silt of slight plasticity.

4.4.7 Clayey Silt Till

A deposit of clayey silt till was encountered underlying the clayey silt to silty clay deposit in Boreholes SC-5 and SC-7. Borehole SC-5 was terminated at a depth of 15.9 m (Elevation 205.3 m) after penetrating 1.1 m into the deposit. The surface of till was encountered at a depth of 13.7 m (Elevation 207.0 m) and is 1.5 m in Borehole SC-7. The till deposit consists of clayey silt containing trace to some sand and trace gravel.

The measured SPT 'N' values within the clayey silt till deposit were 32 blows and 66 blows per 0.3 m of penetration, suggesting that the clayey silt till is of a hard consistency.

4.4.8 Silt to Sand to Sand and Gravel

Granular deposits comprised of silt to sand to sand and gravel were encountered underlying the till deposit or interlayered within the till deposit in Boreholes 12-6, SC-7 and BO-9. The thickness of the granular deposit ranges from 0.1 m to 17.1 m. Boreholes SC-7 and BO-9 were terminated within this deposit at depths of 40.1 m and 26.5 m (Elevation 180.6 m and 194.5 m).

The measured SPT 'N' values within the granular deposit range from 21 blows to 286 blows per 0.3 m of penetration, but are generally greater than 60 blows per 0.3 m of penetration. These SPT 'N' values indicate that the deposit has a compact to very dense, but generally very dense relative density.

The results of five grain size distribution tests performed on samples of the sandy silt to sand to sand and gravel are shown on Figure B12A and B12B in Appendix B. Atterberg limits testing carried out one sample of silt measured a liquid limit of 20 per cent, a plastic limit of 16 per cent and a plasticity index of 4 per cent. The result



of the Atterberg limits test, which is plotted on Figure B13 in Appendix B, indicates that the material is a silt of slight plasticity.

4.4.9 Sand and Silt Till

A deposit of sand and silt till was encountered below the clayey silt to silty clay in Boreholes 12-4, 12-7, 12-9, and 29-1 to 29-8 and below sandy silt to silty sand in Borehole 12-6. The surface to the sand and silt till deposit was encountered at depths ranging between 14.9 m and 21.4 m below ground surface (Elevation 206.9 m and 198.3 m). Boreholes 12-4, 12-6, 12-7, 12-9, 29-5 and 29-6 were terminated within the sand and silt till at depths of 19.9 m to 23.5 m below ground surface (Elevation 205.6 m to 196.0 m) after penetrating 1.2 m to 5.1 m into the deposit.

The sand and silt till deposit typically contains trace to some clay and trace gravel. Cobbles and boulders were noted to be present within the till deposit inferred by the grinding of augers as they advanced through the layer.

The measured SPT 'N' values within the sand and silt till deposit range from 37 blows to 162 blows per 0.3 m of penetration, indicating a dense to very dense relative density.

The results of four grain size distribution tests performed on samples of the sand and silt till from the current investigation are shown on Figure B14 in Appendix B. The results of two grain size distribution tests performed on samples of from the previous investigation are shown on the borehole records in Appendix D. Atterberg limits testing carried out on three samples of the sand and silt till from the current investigation measured liquid limits between 13 per cent and 15 per cent, plastic limits between 11 per cent and 12 per cent, and plasticity indices between 3 per cent and 4 per cent. The results of the Atterberg limits testing, which are plotted on Figure B15 in Appendix B, indicate that the material is a silt of slight plasticity.

4.4.10 Clayey Silt Interlayers

Approximately 0.9 m to 6.1 m thick clayey silt interlayers were encountered within the sandy silt to sand and gravel deposit in Boreholes SC-7 and BO-9. Silt seams were encountered in Borehole SC-7. The base of these interlayers was encountered between Elevation 196.2 m and Elevation 182.3 m.

The measured SPT 'N' values within the clayey silt interlayers range from 52 blows to 100 blows per 0.3 m of penetration, suggesting a hard consistency.

The results of two grain size distribution tests performed on samples of the clayey silt interlayers are shown on Figure B16 in Appendix B. Atterberg limits testing carried out on two samples of the clayey silt interlayers measured liquid limits of 18 per cent and 29 per cent, plastic limits of 10 per cent and 15 per cent, and plasticity indices of 8 per cent and 14 per cent. The results of the Atterberg limits testing are plotted on Figure B17 in Appendix B, and suggest that the material is a clayey silt of low plasticity. The natural water content measured on these same samples is approximately 12 per cent and 21 per cent.

4.4.11 Groundwater Conditions

The observed/recorded water levels in the open boreholes and/or casing during drilling operations, following completion of drilling and in the standpipe piezometer installed in Borehole 12-6 are shown on the Record of Borehole sheets are summarized as follows:



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Borehole / Piezometer	Ground Surface Elevation (m)	Approximate Depth/Elev. at which Artesian Groundwater Conditions Encountered (m)	Depth to Groundwater Level (m)	Groundwater Level Elevation (m)	Date	Notes
12-3	225.0	-	2.3	222.7	May 28, 2012	Open Borehole
12-4	219.5	-	2.0	217.5	May 11, 2012	Open Borehole
12-5	223.5	-	2.9	220.2	May 29, 2012	Open Borehole
12-6	219.7	-	2.0 2.0	218.0 218.0	May 14, 2012 May 15, 2012	Open Borehole Piezometer
12-7	220.4	-	1.8	218.6	May 9, 2012	Open Borehole
12-8	224.1	-	4.4	219.7	May 30, 2012	Open Borehole
12-9	219.5	-	1.0	218.5	May 10, 2012	Open Borehole
12-10	222.0	-	0.1	221.9	May 30, 2012	Open Borehole
SC-5	221.1	15.2/205.9	4.2	216.9	November 15, 2012 (Completion of drilling)	Open Borehole
SC-7	220.7	15.8/205.0	1.5 ags*	222.2	November 7, 2012 (During casing removal)	Inside Casing
SC-8	220.5	-	5.5	215.0	November 7, 2012 (Completion of drilling)	Open Borehole
BO-9	221.0	25.9/195.1	1.0 ags*	222.0	November 18, 2011	Inside Casing

Notes: *ags = above ground surface

The water levels observed in the open boreholes on completion of drilling may not represent long-term stabilized groundwater levels. The water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring and periods of precipitation.



4.5 South Canal Berm – South Canal Bank Road Station 9+860 to Station 10+100

Boreholes 12-1, 12-2, 12-11 to 12-14, SC-3, SC-4 and SC-9 were advanced within or near the limits of the proposed berm to be located between the South Canal and South Canal Bank Road, at the locations shown on Drawing 5. The interpreted stratigraphic profile along the proposed berm is also shown on Drawing 5. The detailed soil and groundwater conditions encountered in the boreholes advanced for this investigation and the results of in situ and laboratory tests carried out on selected soil samples are provided in Appendix C. Boreholes 29-2 to 29-4 and 29-8 from the previous investigation, which were advanced by others, are also within or near the proposed berm limits and the Record of Borehole sheets and laboratory testing for these boreholes are included in Appendix D.

In general, the subsurface conditions at the site consist of surficial layers of topsoil, granular and cohesive fill and peat underlain by a clayey silt deposit. The clayey silt deposit is generally underlain by glacial till deposits with non-cohesive interlayers consisting of sandy silt to silty sand to sand and gravel.

A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.5.1 Topsoil and Asphalt

Approximately 200 mm of topsoil was encountered immediately below the existing ground surface in Boreholes 12-11, 12-13, SC-3 and SC-9. Boreholes 12-11 and SC-3 were advanced at the base of the east side of the existing embankment and Boreholes 12-13 and SC-9 were advanced on the west side.

4.5.2 Fill

Fill consisting of clayey silt and silty sand to sandy silt was encountered in some of the boreholes advanced for the realignment of South Canal Bank Road and is described in more detail below.

4.5.2.1 Clayey Silt Fill

A layer of clayey silt fill was encountered below the topsoil layers or at ground surface in Boreholes 12-11, 12-12, 12-14, SC-3 and 29-2 and below sand and silt to silty sand fill in Borehole SC-4. The elevation of the surface and base of the clayey silt fill deposit and the deposit thickness as encountered in the boreholes are summarized below.

Borehole No.	Depth to Surface (m)	Layer Surface Elevation (m)	Layer Thickness (m)	Layer Base Elevation (m)
12-11	0.2	219.3	3.5	215.8
12-12	0.0	219.0	3.7	215.3
12-14	0.0	219.2	0.8	218.4
SC-3	0.2	219.9	1.1	218.8
SC-4	1.5	219.3	0.6	218.7
29-2	0.0	223.9	5.6	218.3



The clayey silt fill layer contains varying amounts of sand and gravel and layers of silty sand were noted in Borehole 12-12. Trace quantities of organic material were also noted to be present within the fill layer in Boreholes 12-11, 12-12, 12-14, SC-3 and SC-4.

The measured SPT 'N' values within the clayey silt fill deposit range from 3 blows to 27 blows per 0.3 m of penetration, suggesting a soft to very stiff consistency.

The results of three grain size distribution tests performed on samples of the clayey silt fill from the current investigation are shown on Figure C1 in Appendix C.

Atterberg limits testing carried out on three samples of the clayey silt fill from the current investigation measured liquid limits ranging from 16 per cent to 26 per cent, plastic limits ranging from 10 per cent to 16 per cent and plasticity indices ranging from 6 per cent to 11 per cent. The test results, which are plotted on a plasticity chart on Figure C2 in Appendix C, indicate that the fill material is a clayey silt of low plasticity. Atterberg limits testing carried out on a sample of the clayey silt fill from the previous investigation is shown on the borehole record in Appendix D. The natural water content measured on samples from the current investigation ranges from about 10 per cent to 20 per cent.

4.5.2.2 Sandy Silt to Silty Sand Fill

Layers of sandy silt to silty sand fill were encountered at ground surface in Borehole SC-4 and below the clayey silt fill in Borehole SC-3 at a depth of 1.3 m below ground surface. The thickness of the sandy silt to silty sand fill ranges from 1.4 m to 1.5 m. The fill contains trace clay, trace to some gravel, organics and wood fragments.

The measured SPT 'N' values within the fill range from 6 blows to 27 blows per 0.3 m of penetration, indicating a loose to compact relative density.

4.5.3 Peat

Peat was encountered below the clayey silt fill in Borehole 12-14 and SC-4 and within the clayey silt in Borehole 12-13. The surface of the peat layer was encountered at depths ranging between 0.5 m and 2.1 m below ground surface (between Elevation 218.8 m and 218.4 m) and the peat is 0.1 m to 1.4 m thick. The peat is typically silty.

The measured SPT 'N' values within the peat range from 3 blows to 9 blows per 0.3 m of penetration, indicating a very loose to loose relative density.

An organic content test performed on a sample of the peat showed 28 per cent organics.

4.5.4 Silt to Silty Sand (Upper Deposit)

An upper layer of silt to silty sand was encountered below the fill in Borehole 29-2, below the peat in Boreholes 12-14 and SC-4, below the topsoil in Borehole SC-9 and at ground surface in Boreholes 29-4 and 29-8. The surface of the upper silt to silty sand was encountered at depths ranging between 0 m (ground surface) and 5.6 m below ground surface (Elevation 221.1 m to Elevation 217.0 m). The thickness of the upper silt to silty sand ranges from 0.4 m to 2.7 m.

The upper silt to silty sand layer typically contains trace to some clay and organics were noted to be present in Boreholes SC-4, 29-4 and 29-8.



The measured SPT 'N' values within the upper silt to silty sand range between 6 blows and 23 blows per 0.3 m of penetration, indicating a loose to compact relative density.

The results of grain size distribution testing completed on three samples of the upper silt to silty sand from the current investigation are shown on Figure C3 in Appendix C. The results of grain size distribution tests performed on samples from the previous investigation are shown on the borehole records in Appendix D.

4.5.5 Clayey Silt (Upper Deposit)

Clayey silt was encountered in all boreholes advanced within the berm area. The clayey silt was encountered at depths between 0 m (ground surface) and 7.3 m below ground surface (between Elevation 215.3 m and 220.6 m) and the thickness of the clayey silt ranged from 4.3 m to 12.2 m.

The clayey silt deposits typically contain trace to some sand and seams/interlayers of silt to silty sand were noted to be present in Boreholes 12-13, SC-4 and SC-9. Trace quantities of organic material are present within the upper portions of the clayey silt deposits in Boreholes 12-1, 12-2, 12-12, 12-13, SC-9 and 29-4.

The measured SPT 'N' values within the clayey silt deposits range from 0 blows (weight of the SPT hammer advanced the sampler) to 31 blows per 0.3 m of penetration, but typically range from 1 blow to 15 blows per 0.3 m of penetration, suggesting a very soft to stiff consistency. Vane shear tests performed within the clayey silt deposits range from 22 kPa to greater than 115 kPa (vane torque refusal), but typically range from approximately 20 kPa to 50 kPa, indicating a soft to firm consistency.

The results of six grain size distribution tests performed on samples of the clayey silt deposit from the current investigation are shown on Figure C4 in Appendix C. The results of three grain size distribution tests performed on samples from the previous investigation are shown on the borehole records in Appendix D.

Atterberg limits testing carried out on seventeen samples of the clayey silt from the current investigation measured liquid limits ranging from 16 to 34 per cent, plastic limits ranging from 10 to 17 per cent and plasticity indices ranging from 2 to 18 per cent. The test results, which are plotted on a plasticity chart on Figure C5A to C5C in Appendix C, indicate that the material is generally a clayey silt of low plasticity, with some samples classified as silt of slight plasticity. Atterberg limits testing carried out on samples from the previous investigation are shown on the borehole records in Appendix D.

The natural water content measured on samples from the current investigation ranges from about 13 per cent to 30 per cent. An organic content test performed on a sample of the upper portion of the clayey silt showed 4 per cent organics.

Laboratory consolidation tests were carried out on two thin-walled Shelby tube samples of the clayey silt deposit. The consolidation test results are presented on Figures C6 to C7 in Appendix C and are summarized in the following table.



FOUNDATION REPORT - HIGHWAY 400 EMBANKMENT WIDENING AND RSS WALL CONSTRUCTION, GWP 2025-13-00

Borehole/ Sample No.	Sample Depth/Elev. (m)	Unit Weight (kN/m ³)	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	OCR	e_o	C_c	C_r	C_v^* cm ² /s
12-14 / S7	6.3 / 212.9	20.6	56	296	240	5.3	0.65	0.16	0.020	1.5×10^{-3}
SC-3 / S1	5.6 / 214.5	20.7	50	280	230	5.6	0.64	0.13	0.025	3.5×10^{-3}

Notes: * for approximate stress range $20 \leq \sigma \leq 150$ kPa

where	σ_p'	Estimated preconsolidation stress	σ_{vo}'	Computed existing vertical effective stress
	C_c	Compression index	C_r	Recompression index
	e_o	Initial void ratio	OCR	Overconsolidation ratio
			C_v	Coefficient of consolidation (cm ² /s) in the normally consolidated range

4.5.6 Silt Interlayers

Silt interlayers, approximately 1.4 m and 1.6 m thick, were encountered within the clayey silt deposits in Boreholes 12-13 and SC-9. The interlayers typically contain some sand and trace to some clay. The measured SPT 'N' values within the silt interlayers range from 13 blows to 25 blows per 0.3 m of penetration, indicating a compact relative density.

Atterberg limits testing carried out on one (1) sample of the silt measured a liquid limits of 19 per cent, a plastic limit of 17 per cent and a plasticity index of 2 per cent. The results, which are plotted on Figure C8, indicate that the material is a silt of slight plasticity.

4.5.7 Clayey Silt Till

A 1.0 m to 9.2 m thick deposit of clayey silt till was encountered underlying the clayey silt in Boreholes 12-1, 12-2, 12-13, 12-14 and SC-9 and below silty sand in Borehole SC-3 at depths ranging from 8.7 m to 12.2 m below ground surface (Elevation 210.8 m to 207.0 m). Boreholes 12-1, 12-13 and 12-14 were terminated within this deposit after penetrating 1.7 m to 5.6 m into the deposit at depths ranging from 13.6 m to 14.3 m below ground surface (Elevation 205.4 m to 204.9 m).

The till deposit consists of clayey silt with sand to trace sand, containing trace gravel.

The measured SPT 'N' values within the clayey silt till deposit range from 7 blows per 0.3 m of penetration to 80 blows per 0.1 m of penetration, but typically range from 60 blows to 90 blows per 0.3 m of penetration. The SPT results suggest that the clayey silt till ranges from firm to hard in consistency, but is typically hard.

The results of six grain size distribution tests performed on samples of the clayey silt till are shown on Figure C9 in Appendix C.

Atterberg limits testing carried out on six samples of the clayey silt till from the current investigation measured liquid limits ranging from 15 per cent to 21 per cent, plastic limits ranging from 9 per cent to 12 per cent and plasticity indices ranging from 6 per cent to 9 per cent. The results of the Atterberg limits testing, which are plotted on Figure C10 in Appendix C, indicate that the material is a clayey silt of low plasticity. The natural water content measured on samples of the clayey silt till from the current investigation ranges from about 8 per cent to 15 per cent.



4.5.8 Silt to Sand and Gravel

Granular deposits comprised of silt to sand and gravel were encountered underlying the clayey silt and till deposits or interlayered within the till deposits in Boreholes 12-2, 12-11, 12-12, SC-3, SC-4 and SC-9. The thickness of the granular deposit / interlayers ranges from 0.2 m to 5.3 m. Boreholes 12-2, 12-11, 12-12, SC-3, SC-4 and SC-9 were terminated within the silt to sand and gravel at depths ranging from 10.7 m to 27.9 m below ground surface (Elevation 208.8 m to 192.9) after penetrating 0.9 m to 5.5 m into the granular layers.

The measured SPT 'N' values within the granular deposit range from 5 blows per 0.3 m of penetration to 100 blows per 0.08 m of penetration, indicating a loose to very dense relative density.

The results of seven (7) grain size distribution tests performed on samples of silt to sand are shown on Figure C11.

Atterberg limits testing carried out one sample of sandy silt to silt from the current investigation measured a liquid limit of 20 per cent, a plastic limit of 16 per cent and a plasticity index of 4 per cent. The result of the Atterberg limits testing, which is plotted on Figure C12, indicates that the material is a silt of slight plasticity.

4.5.9 Sand and Silt Till

A deposit of sand and silt till was encountered below the sandy silt in Borehole SC-4 and below the clayey silt in Boreholes 29-2 to 29-4 and 29-8 at depths ranging between 9.8 m and 14.9 m (Elevation 210.9 m and 206.0 m). Boreholes 29-2 to 29-4 and 29-8 were terminated within the sand and silt till deposit at depths ranging from 13.9 m to 20.3 m below ground surface (Elevation 206.7 m to 175.2 m) after penetrating 4.0 m to 5.4 m into the deposit. When fully penetrated in Borehole SC-4, the till deposit was 5.4 m thick. The sand and silt till deposit typically contains trace to some clay and trace gravel.

The measured SPT 'N' values within the sand and silt till deposit range from 70 blows per 0.3 m of penetration to 108 blows per 0.15 m of penetration, indicating a very dense relative density.

The results of one grain size distribution test performed on a sample from the current investigation are shown on Figure C13 in Appendix C. The results of two grain size distribution tests performed on samples from the previous investigation are shown on the borehole records in Appendix D.

Atterberg limits testing carried out on two samples of the sand and silt till from the current investigation measured liquid limits of 15 per cent and 16 per cent, plastic limits of 11 per cent and plasticity indices of 4 per cent and 5 per cent. The results of the Atterberg limits testing, which are plotted on Figure C14 in Appendix C, indicate that the material is a silt of slight plasticity.

4.5.10 Clayey Silt Interlayers

A 1.5 m thick interlayer of clayey silt was encountered in Borehole SC-4 at a depth of 25.5 m below ground surface (Elevation 195.3 m). The clayey silt interlayer contains trace sand and seams of silty sand.

A measured SPT 'N' value within the clayey silt interlayer was 84 blows per 0.3 m of penetration, suggesting a hard consistency.



4.5.11 Groundwater Conditions

The observed/recorded water levels in the open boreholes and/or casing during drilling operations and following completion of drilling are shown on the Record of Borehole sheets are summarized as follows:

Borehole / Piezometer	Ground Surface Elevation (m)	Approximate Depth/Elevation at which Artesian Groundwater Conditions Encountered (m)	Depth to Groundwater Level (m)	Groundwater Level Elevation (m)	Date	Notes
12-1	219.0	-	Coincident with canal surface	219.0	Jun 25, 2012	Drilled in canal
12-2	219.0	-	Coincident with canal surface	219.0	Jun 26, 2012	Drilled in canal
12-11	219.5	8.0/211.5	Not Recorded	Not Recorded		
12-12	219.0	-	0.4	218.6	May 15, 2012	Open borehole
12-13	219.3	-	6.6	212.7	May 10, 2012	Open borehole
12-14	219.2	-	Not Recorded	Not Recorded		
SC-3	220.1	11.7/208.4	3.6 ags*	223.7	May 25, 2012 (Completion of drilling)	Inside casing
SC-4	220.8	22.9/197.9	Not Recorded	Not Recorded	-	
SC-9	221.0	18.3/202.7	4.1 ags*	225.1	May 16, 2012 (Completion of drilling)	Inside casing

Notes: * ags = above ground surface

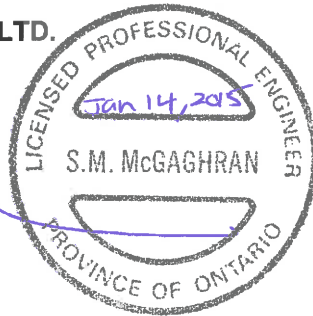
The water levels observed in the open boreholes on completion of drilling may not represent long-term stabilized groundwater levels. The water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring and periods of precipitation.



5.0 CLOSURE

This Foundation Investigation Report was prepared by Mr. Ted Beadle and reviewed by Ms. Sandra McGaghran, P.Eng., a geotechnical engineer and Associate with Golder. Mr. Jorge Costa, P.Eng., a Designated MTO Contact for Foundations and a Principal of Golder, provided quality control review of this report for conformance with the project Terms of Reference.

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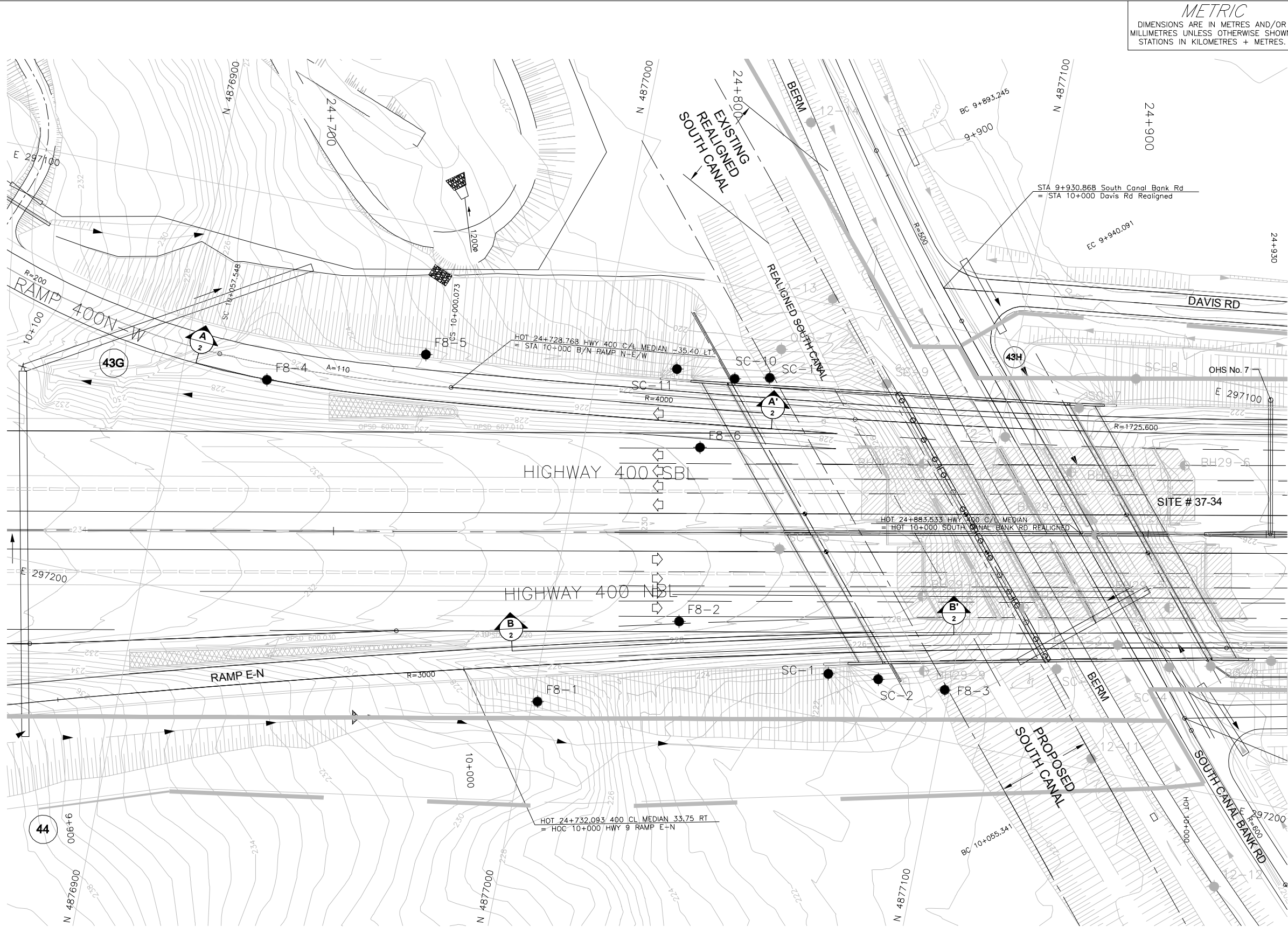
Sandra McGaghran, M.Eng., P.Eng.
Geotechnical Engineer, Associate



Jorge M.A. Costa, P.Eng.
Designated MTO Foundations Contact, Principal

TWB/SMM/TJG/JMAC/sm/jl

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CONT No. 2015-2004
GWP No. 2025-13-00

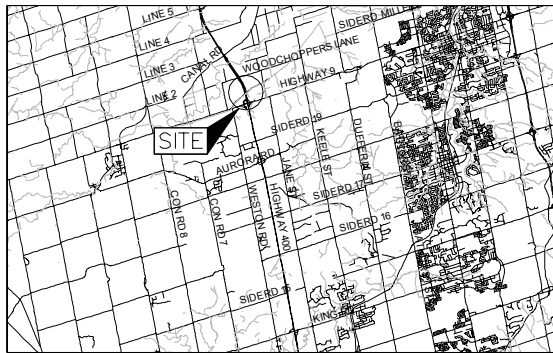
HIGHWAY 400 WIDENING
STA 24+650 TO STA 24+840
BOREHOLE LOCATIONS



SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



LEGEND

- Borehole - Current Investigation by Golder
- Borehole - Previous Investigation (Geocres No. 31D-029)

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
F8-1	227.3	4877001.3	297209.6
F8-2	229.2	4877031.6	297183.6
F8-3	221.0	4877098.8	297187.5
F8-4	227.0	4876920.8	297144.9
F8-5	223.8	4876957.9	297131.3
F8-6	229.1	4877028.4	297140.7
SC-1	223.0	4877070.0	297189.1
SC-2	222.0	4877082.3	297188.1
SC-10	222.1	4877033.5	297122.5
SC-11	221.8	4877019.1	297122.9
SC-14	222.0	4877041.9	297120.6

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.

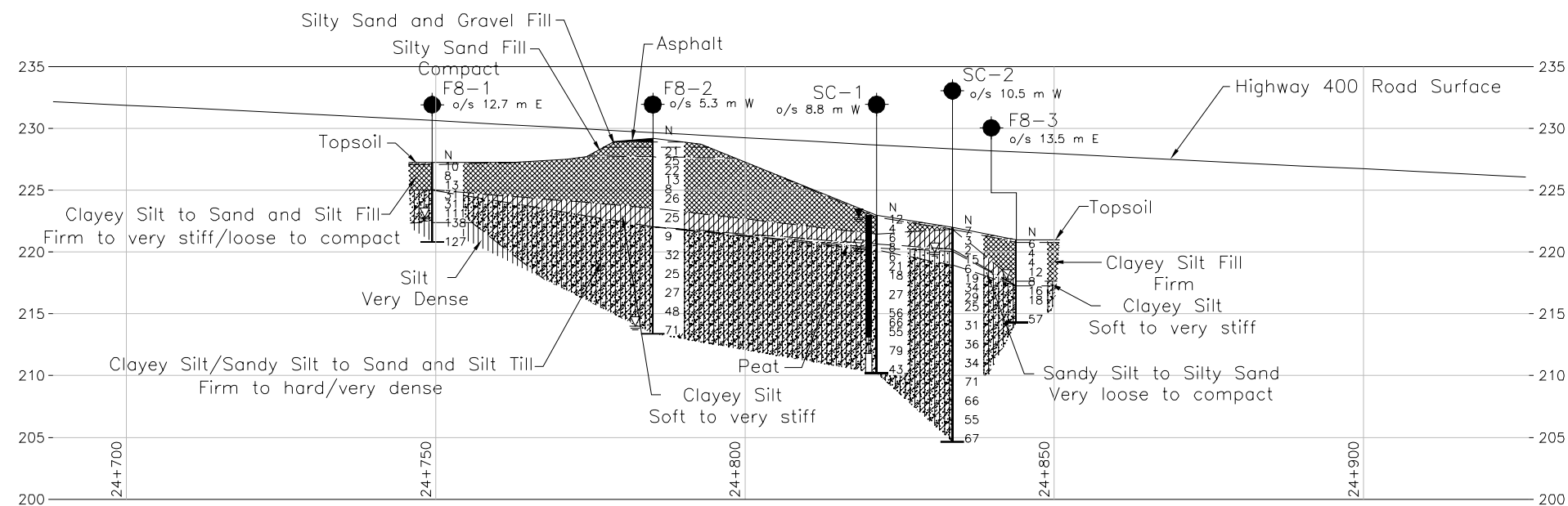
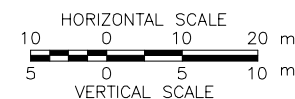
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans and General Arrangement provided in digital format by URS Canada Inc., (Drawing Files "Hwy400_plan.dwg" and "01_GA_July 10 2012.dwg") received November 13, 2013 and September 26, 2012.

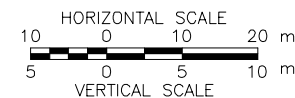


NO.	DATE	BY	REVISION
1			
Geocres No. 31D-576			
HWY. 400	PROJECT NO. 09-1111-0018		DIST.CENTRAL
SUBM'D. TWB	CHKD. SMM	DATE: Nov. 2013	SITE:
DRAWN: JFC	CHKD. LCC	APPD. JMAC	DWG.1



B-B'
1

HIGH FILL EMBANKMENT AREA 8-NBL PROFILE
(STATION 24+740 TO STATION 24+840)



METRIC
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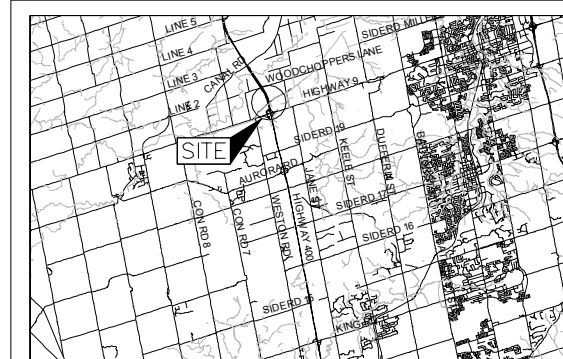
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GWP No. 2025-13-00

HIGHWAY 400 WIDENING
STA 24+650 TO STA 24+840
SOIL STRATA

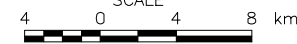
SHEET








Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN



LEGEND

- | | |
|---|--|
|  | Borehole – Current Investigation |
|  | Seal |
|  | Piezometer |
| N | Standard Penetration Test Value |
| 16 | Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow) |
|  | WL in piezometer, measured on June 12, 2012 |
|  | WL upon completion of drilling |

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
F8-1	227.3	4877001.3	297209.6
F8-2	229.2	4877031.6	297183.6
F8-3	221.0	4877098.8	297187.5
F8-4	227.0	4876920.8	297144.9
F8-5	223.8	4876957.9	297131.3
F8-6	229.1	4877028.4	297140.7
SC-1	223.0	4877070.0	297189.1
SC-2	222.0	4877082.3	297188.1
SC-10	222.1	4877033.5	297122.5
SC-11	221.8	4877019.1	297122.9
SC-14	222.0	4877041.9	297120.6

NOTES

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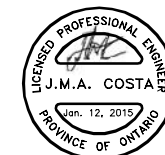
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

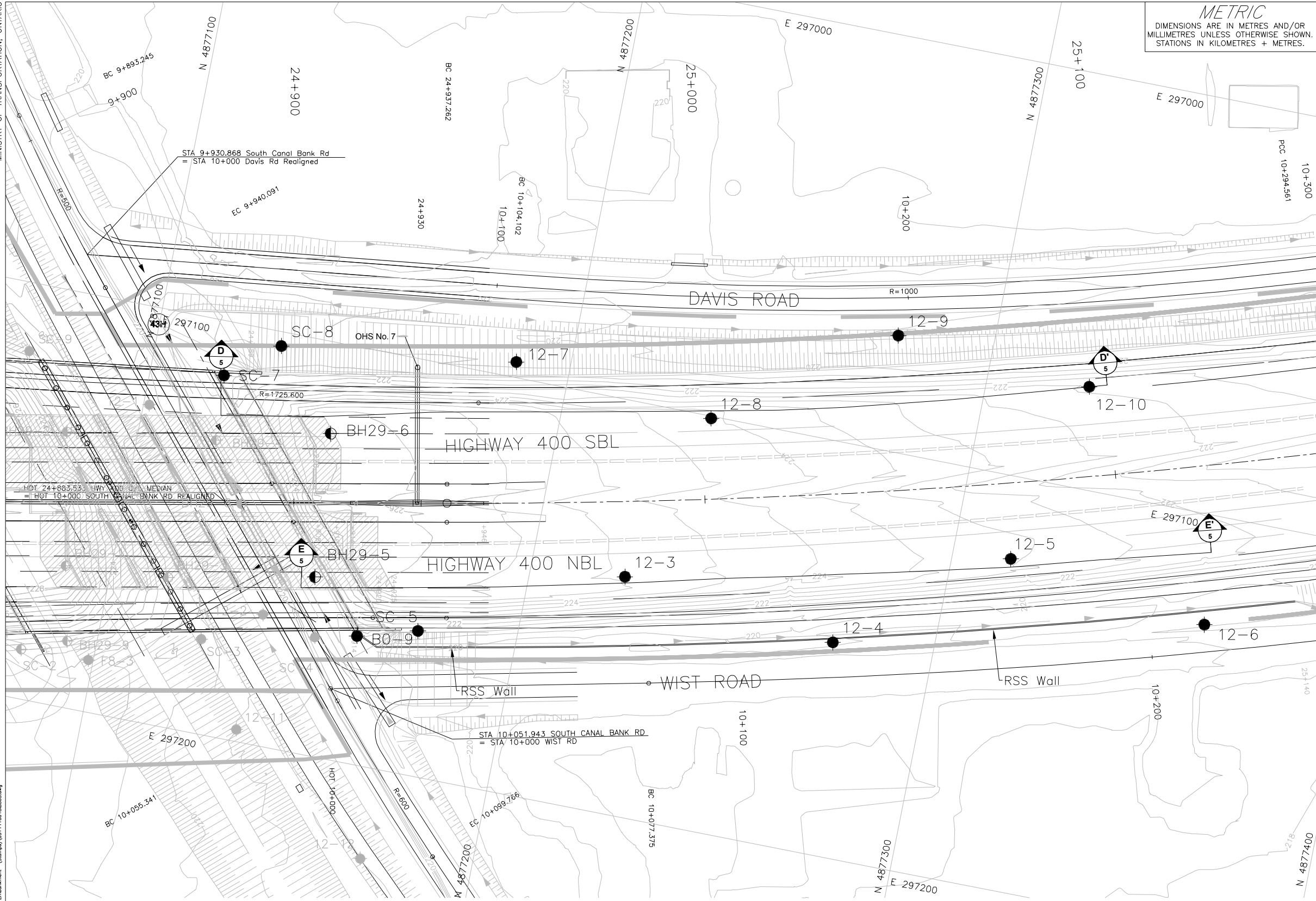
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Ground Surface Line cut from a digital file by URS, drawing file no. Hwy400_contours.dwg, received July 12, 2011.

NO.	DATE	BY	REVISION
Geocres No. 31D-576			
HWY. 400		PROJECT NO. 09-1111-0018	DIST.CENTRAL
SUBM'D. TWB	CHKD. SMM	DATE: Nov. 2013	SITE:
DRAWN: JFC	CHKD. LCC	APPD. JMAG	DWG. 2



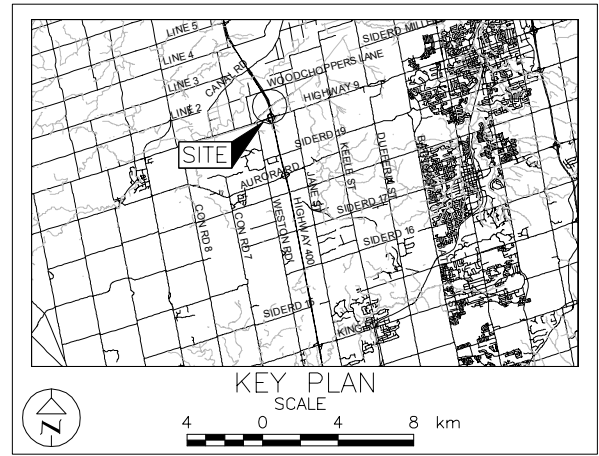


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MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. 2015-2004
GWP No. 2025-13-00

HIGHWAY 400 WIDENING
STATION 24+880 to STATION 25+120
BOREHOLE LOCATIONS

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



LEGEND

- Borehole - Current Investigation by Golder
- ⊕ Borehole - Previous Investigation (Geocres No. 31D-029)

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
12-3	225.0	4877222.9	297142.4
12-4	219.5	4877275.6	297148.2
12-5	223.5	4877314.1	297119.9
12-6	219.7	4877363.4	297126.5
12-7	220.4	4877186.9	297096.2
12-8	224.1	4877236.1	297100.5
12-9	219.5	4877276.8	297071.9
12-10	222.0	4877324.8	297075.2
B0-9	221.0	4877161.8	297169.1
BH29-5	221.1	4877149.0	297157.0
BH29-6	225.8	4877146.0	297122.0
SC-5	221.1	4877176.1	297165.0
SC-7	220.7	4877117.8	297113.1
SC-8	220.5	4877130.1	297103.5

NOTES

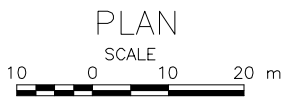
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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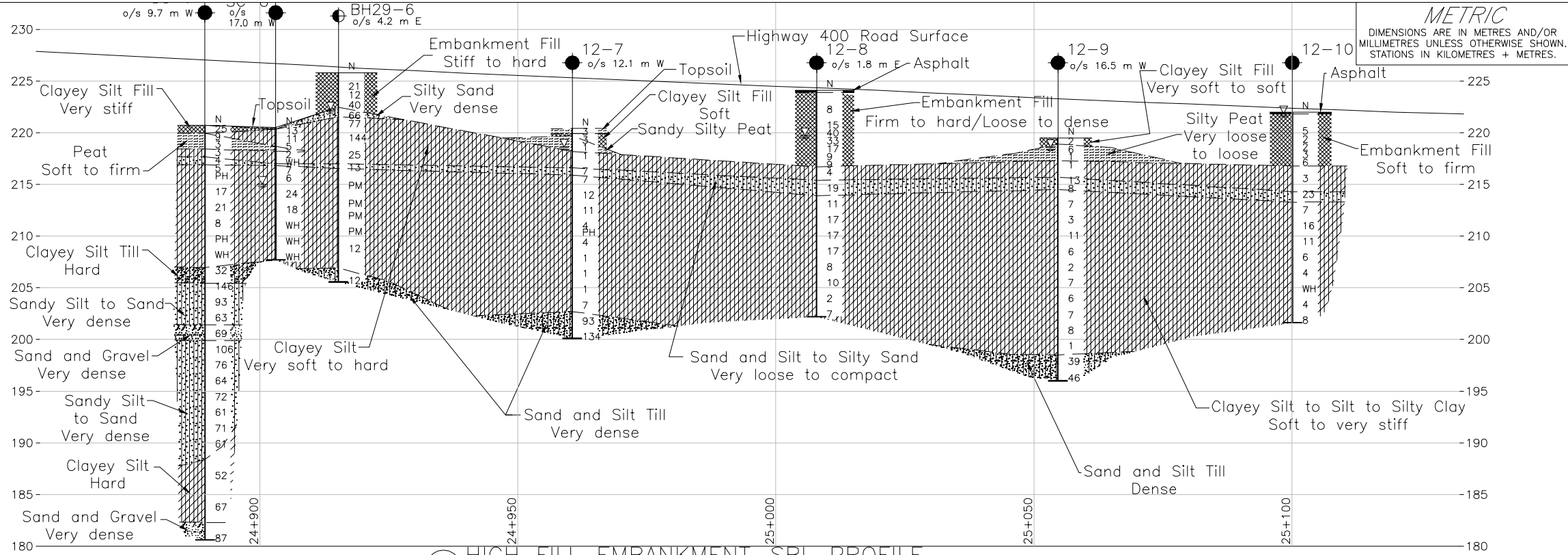
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

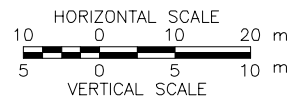
Base plans and General Arrangement provided in digital format by URS Canada Inc., (Drawing Files "Hwy400_plan.dwg" and "01_GA_July 10 2012.dwg") received November 13, 2013 and September 26, 2012.



NO.	DATE	BY	REVISION
Geocres No.31D-576			
HWY. 400	PROJECT NO. 09-1111-0018		DIST.CENTRAL
SUBM'D.TWB	CHKD. SMM	DATE: Nov. 2013	SITE:
DRAWN: JFC	CHKD. LCC	APPD. JMAC	DWG.3



D-D'
4
HIGH FILL EMBANKMENT-SBL PROFILE
(STATION 24+880 to STATION 25+120)



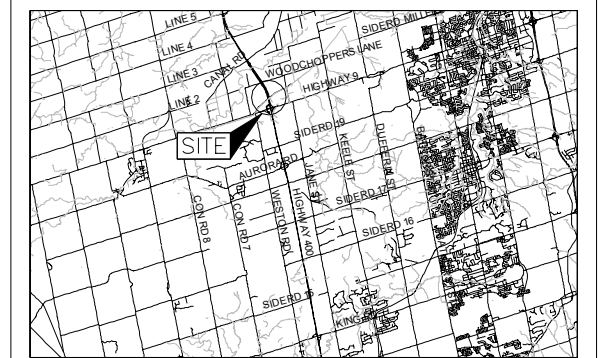
CONT No. 2015-2004
GWP No. 2025-13-00

HIGHWAY 400 WIDENING
STATION 24+880 to STATION 25+120
SOIL STRATA

SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation (Geocres No. 31D-029)
- ⊥ Seal
- ⊥ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- ≡ WL in piezometer, measured on June 12, 2013
- ≡ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
12-3	225.0	4877222.9	297142.4
12-4	219.5	4877275.6	297148.2
12-5	223.5	4877314.1	297119.9
12-6	219.7	4877363.4	297126.5
12-7	220.4	4877186.9	297096.2
12-8	224.1	4877236.1	297100.5
12-9	219.5	4877276.8	297071.9
12-10	222.0	4877324.8	297075.2
BO-9	221.0	4877161.8	297169.1
BH29-5	221.1	4877149.0	297157.0
BH29-6	225.8	4877146.0	297122.0
SC-5	221.1	4877176.1	297165.0
SC-7	220.7	4877117.8	297113.1
SC-8	220.5	4877130.1	297103.5

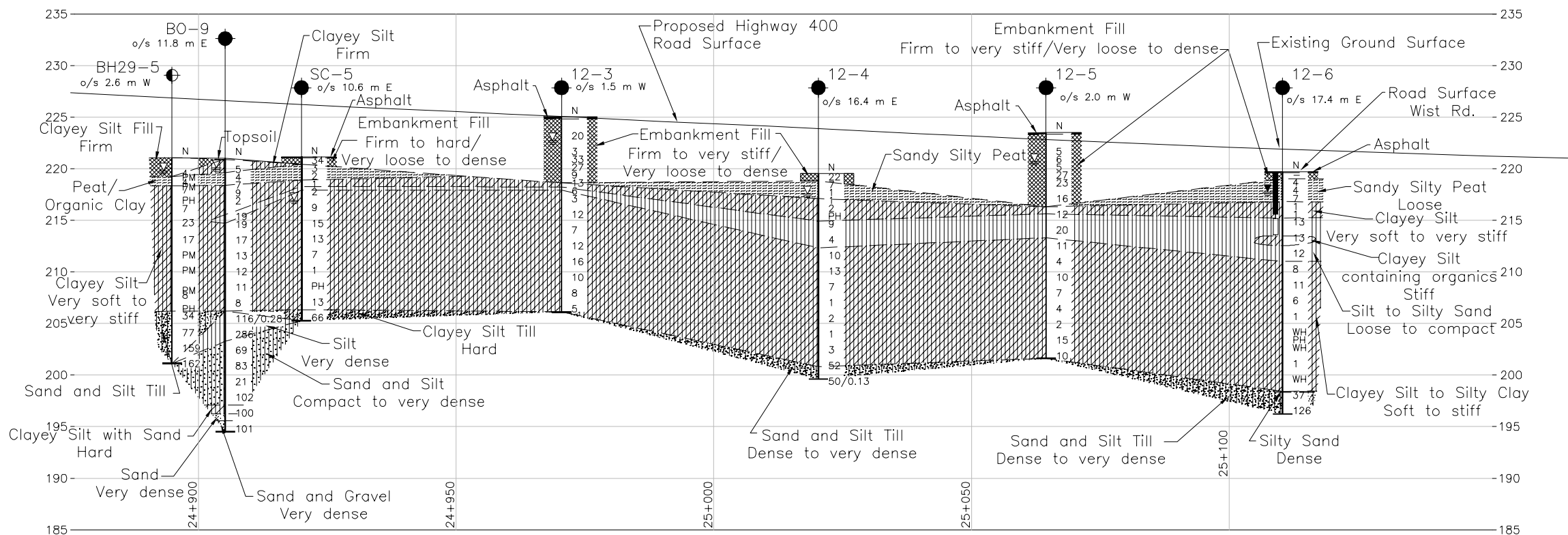
NOTES

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.

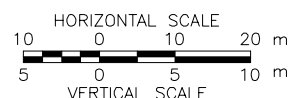
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

NO.	DATE	BY	REVISION
Geocres No. 31D-576			
HWY. 400			PROJECT NO. 09-1111-0018 DIST. CENTRAL
SUBM'D. TWB	CHKD. SMM	DATE: July 2013	SITE:
DRAWN: JFC	CHKD. LCC	APPD. JMAC	DWG. 4



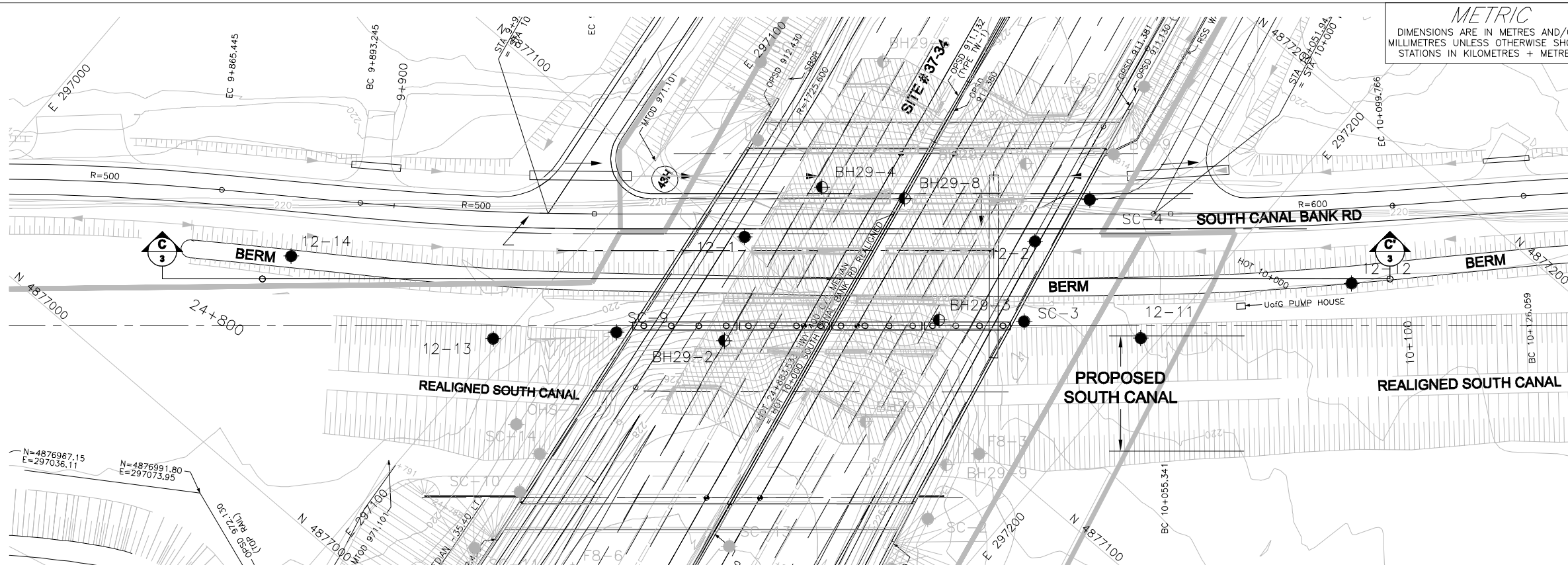
E-E'
4
HIGH FILL EMBANKMENT-NBL PROFILE
(STATION 24+900 to STATION 25+120)



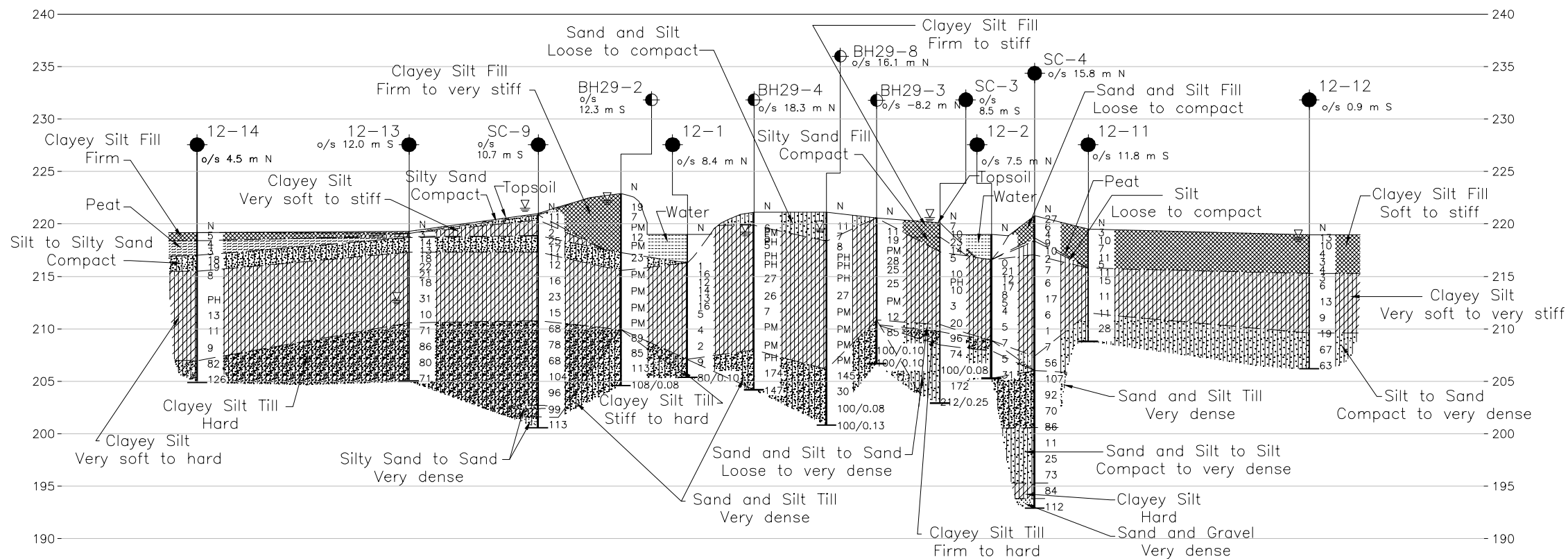
REFERENCE

Ground Surface Line cut from a digital file by URS, drawing files no. Hwy400_contours.dwg, received July 12, 2011 and Hwy400_profile_July 2013.dwg, received July 25, 2013.





PLAN

SCALE
10 0 10 20 mC-C
3SOUTH CANAL BERM-CENTERLINE PROFILE
STATION 9+860 TO STATION 10+100HORIZONTAL SCALE
10 0 10 20 m
VERTICAL SCALE
5 0 5 10 m

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.

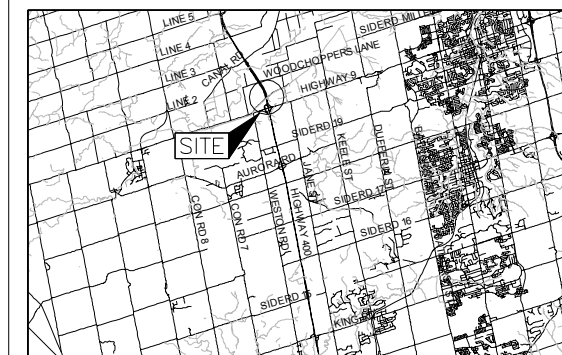
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

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

CONT No.2015-2004
GWP No. 2025-13-00HIGHWAY 400 WIDENING
SOUTH CANAL BANK ROAD
STATION 9+860 to STATION 10+100
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADAKEY PLAN
SCALE

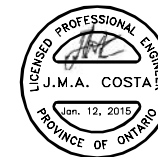
4 0 4 8 km

LEGEND

- Borehole - Current Investigation by Golder
- ⊕ Borehole - Previous Investigation (Geocres No. 31D-029)
- 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

No.	ELEVATION	NORTHING	EASTING
12-1	219.0	4877101.4	297123.6
12-2	219.0	4877138.4	297168.4
12-11	219.5	4877137.4	297197.1
12-12	219.0	4877173.1	297222.1
12-13	219.3	4877053.3	297098.6
12-14	219.2	4877039.6	297057.1
BH29-2	223.9	4877083.0	297134.0
BH29-3	220.6	4877114.0	297164.0
BH29-4	221.1	4877119.0	297129.0
BH29-8	221.1	4877128.0	297143.0
SC-3	220.1	4877124.8	297177.2
SC-4	220.8	4877151.8	297171.4
SC-9	221.0	4877070.2	297116.5



REFERENCE

Base plans and General Arrangement provided in digital format by URS Canada Inc., (Drawing Files "Hwy400_plan.dwg" and "01_GA_July 10 2012.dwg") received November 13, 2013 and September 26, 2012.

NO.	DATE	BY	REVISION
1			
Geocres No.31D-576			
HWY. 400		PROJECT NO. 09-1111-0018	DIST.CENTRAL
SUBM'D. TWB	CHKD. SMM	DATE: July 2013	SITE:
DRAWN: JFC	CHKD. LCC	APPD. JMAC	DWG.5



LIST OF SYMBOLS

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

(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 = $(w_l - w_p)$
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_α	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
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c'	effective cohesion
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	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

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

Notes: 1
2

$$\tau = c' + \sigma' \tan \phi'$$

$$\text{shear strength} = (\text{compressive strength})/2$$



LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. 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.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; 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

Piezo-Cone Penetration Test (CPT)

A 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 (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

Density Index	N
Relative Density	Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils Consistency

	C_u, S_u	
	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
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
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	field vane (LV-laboratory vane test)
γ	unit weight

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

V. MINOR SOIL CONSTITUENTS

Per cent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (non-cohesive (cohesionless)) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand



APPENDIX A

**Borehole Records and Laboratory Test Results – Highway 400
Embankment - SBL (Station 24+650 to 24+800) and NBL (Station
24+650 to 24+840)**

PROJECT 09-1111-0018			RECORD OF BOREHOLE No F8-1			SHEET 1 OF 1			METRIC																					
G.W.P. 2835-02-00			LOCATION N 4877001.3 ; E 297209.6			ORIGINATED BY AM																								
DIST Central HWY 400			BOREHOLE TYPE D-25 Track Mount, 108 mm Inside Diameter Hollow Stem Augers			COMPILED BY TT																								
DATUM Geodetic			DATE January 18, 2011			CHECKED BY SMM																								
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																									
227.3	GROUND SURFACE																													
0.0	TOPSOIL																													
0.2	Clayey silt, trace to some sand, trace gravel, containing rootlets to a depth of 1.4 m (FILL) Firm to stiff Brown Moist		1	SS	10																									
			2	SS	8																									
	Containing sand zones below a depth of 1.5 m		3	SS	13																									
225.1																														
2.2	CLAYEY SILT, trace sand, trace gravel, containing sandy silt interlayers (TILL) Hard Brown Wet		4	SS	31																									
			5	SS	31																									
223.6																														
3.7	Sandy SILT, trace to some clay, trace gravel (TILL) Very dense Brown Moist		6	SS	111																									
			7	SS	138																									
222.4																														
4.9	SILT, trace clay, trace sand, trace gravel, containing zones of silty sand Very Dense Brown to grey Moist Becoming grey at a depth of 5.6 m																													
220.9			8	SS	127																									
6.4	END OF BOREHOLE																													
	NOTE: 1. Water level in open borehole at a depth of 4.4 m below ground surface (Elev. 222.9 m) upon completion of drilling.																													

GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 01/13/15 SIB

PROJECT 09-1111-0018				RECORD OF BOREHOLE No F8-2				SHEET 2 OF 2				METRIC					
G.W.P. 2835-02-00				LOCATION N 4877031.6 ; E 297183.6				ORIGINATED BY AM									
DIST Central HWY 400				BOREHOLE TYPE D-90 Track Mount, 108 mm Inside Diameter Hollow Stem Augers				COMPILED BY CS									
DATUM Geodetic				DATE April 1, 2011				CHECKED BY SMM									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL 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					W _p	W	W _L		
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100					
213.4	Becoming wet at a depth of 14.8 m Augers grinding at a depth of 15.2 m		13	SS	71	▽	214										
15.8	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 15.2 m below ground surface (Elev. 214.0 m) upon completion of drilling.																

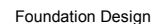
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PROJECT 09-1111-0018			RECORD OF BOREHOLE No F8-3			SHEET 1 OF 1			METRIC								
G.W.P. 2835-02-00			LOCATION N 4877098.8 ; E 297187.5			ORIGINATED BY AM											
DIST Central HWY 400			BOREHOLE TYPE D-25 Track Mount, 108 mm Inside Diameter Hollow Stem Augers			COMPILED BY TT											
DATUM Geodetic			DATE January 18, 2011			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									
221.0	GROUND SURFACE																
0.0	TOPSOIL																
0.2	Clayey silt, trace to some sand, trace gravel, slightly organic, rootlets and wood fragments (FILL) Firm Brown Moist		1	SS	6												
			2	SS	4												
			3	SS	4												
218.8																	
2.2	Clayey silt, trace sand (FILL) Stiff Brown Wet Grey clayey silt seams between depths of 2.7 m and 2.8 m		4	SS	12												0 3 69 28
217.7			5	SS	8												
217.3	CLAYEY SILT, trace sand, containing rootlets Stiff Grey Moist		6	SS	16												
3.7	CLAYEY SILT with sand (TILL) Very stiff to hard Grey Moist		7	SS	18												0 26 53 21
			8	SS	57												
214.3	END OF BOREHOLE																
6.7	NOTE: 1. Water level in open borehole at a depth of 3.2 m below ground surface (Elev. 217.8 m) upon completion of drilling.																

GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 01/13/15 SIB

PROJECT 09-1111-0018		RECORD OF BOREHOLE No F8-4		SHEET 1 OF 1		METRIC											
G.W.P. 2835-02-00		LOCATION N 4876920.8 ; E 297144.9		ORIGINATED BY TT													
DIST Central HWY 400		BOREHOLE TYPE Geoprobe, 108 mm Outside Diameter Solid Stem Auger		COMPILED BY CS													
DATUM Geodetic		DATE April 4, 2011		CHECKED BY SMM													
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m ³	GR SA SI CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p — W — W _L				
227.0	GROUND SURFACE							20 40 60 80 100									
0.0	TOPSOIL																
0.2	Sand, trace clay, trace gravel (FILL)		1	SS	20												
226.4	Compact Brown Moist		2	SS	11												
0.6	Clayey silt, some sand, trace gravel, containing rootlets, slightly organic (FILL)		3A														
225.6	Stiff Brown and grey Moist		3B	SS	5												
1.6	Organic clayey silt (FILL) Black Moist		4A														
	CLAYEY SILT, some sand, trace gravel, containing grey silty sand seams		4B	SS	11												
	Firm to very stiff Brown Moist		5	SS	18												
	Becoming grey at a depth of 4.0 m		6	SS	26												
			7	SS	39												
221.4	SAND and SILT, trace gravel, trace clay (TILL)																
5.6	Very dense Grey Wet		8	SS	106												
220.4	END OF BOREHOLE																
6.6	NOTE: 1. Water level in open borehole at a depth of 2.7 m below ground surface (Elev. 224.3 m) upon completion of drilling.																

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




METRIC

CHECKED BY SMM

+ 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 01/13/15 SIB

PROJECT		RECORD OF BOREHOLE		No F8-6		SHEET 2 OF 2		METRIC									
G.W.P. 2835-02-00		LOCATION		N 4877028.4 ; E 297140.7		ORIGINATED BY		AM									
DIST Central HWY 400		BOREHOLE TYPE		D-90 Truck Mount, 108 mm Inside Diameter Hollow Stem Auger		COMPILED BY		CS									
DATUM Geodetic		DATE		March 31, 2011		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					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)				
								20	40	60	80	100	10	20	30		
211.9	Sandy SILT to Silty SAND, trace to some clay, trace gravel (TILL) Compact to very dense Grey Moist		13	SS	104		214										
							213										
			14	SS	103		212										
17.2	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 14.9 m below ground surface (Elev. 214.2 m) upon completion of drilling.																

GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 01/13/15 SIB

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

PROJECT <u>09-1111-0018</u>		RECORD OF BOREHOLE No SC-1				SHEET 2 OF 2		METRIC												
G.W.P. <u>2835-02-00</u>		LOCATION <u>N 4877070.0 ; E 297189.1</u>				ORIGINATED BY <u>OS</u>														
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing</u>				COMPILED BY <u>NK</u>														
DATUM <u>Geodetic</u>		DATE <u>June 8 and 11, 2012</u>				CHECKED BY <u>LCC</u>														
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 ---						<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE </div> <div style="display: flex; justify-content: space-between;"> ● QUICK TRIAXIAL × REMOULDED </div>													
	END OF BOREHOLE NOTES: 1. Water level in open borehole measured at a depth of 2.8 m (Elev. 220.2 m) on completion of drilling. 2. Water level in piezometer measured at a depth of 0.3 m (Elev. 222.7 m) on June 12, 2012.																			

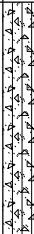
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PROJECT		RECORD OF BOREHOLE		No SC-2		SHEET 1 OF 2		METRIC						
G.W.P. 2835-02-00		LOCATION		N 4877082.3 ; E 297188.1		ORIGINATED BY		OS						
DIST Central HWY 400		BOREHOLE TYPE		D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing		COMPILED BY		NK						
DATUM Geodetic		DATE		June 6-8, 2012		CHECKED BY		LCC						
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						
222.0	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	TOPSOIL							○ UNCONFINED + FIELD VANE	○ UNCONFINED + FIELD VANE					
0.1	CLAYEY SILT with sand, trace to some gravel, containing wet silty sand lenses Soft to firm Brown to grey below 0.7 m Moist		1	SS	7			● QUICK TRIAXIAL × REMOULDED	● QUICK TRIAXIAL × REMOULDED					
			2	SS	3		221							
220.3	PEAT, containing silt Loose Dark brown to black Moist		3	SS	2		220							
1.9	Sandy SILT, some clay, containing wood fragments and organic matter Very loose to compact Grey Moist to wet		4	SS	15		219						0 25 60 15	
218.9	CLAYEY SILT with sand, trace to some gravel (TILL) Firm to hard Grey Moist		5	SS	6		218						9 25 46 20	
3.1			6	SS	19		217							
			7	SS	34		216							
			8	SS	29		215							
			9	SS	25		214							
			10	SS	31		213							
			11	SS	36		212							
			12	SS	34		211							
			13	SS	71		210							
			14	SS	66		209							
208.1	SAND and SILT, trace clay, trace gravel (TILL) Very dense Grey Wet						208							

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

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PROJECT		RECORD OF BOREHOLE		No SC-2		SHEET 2 OF 2		METRIC									
G.W.P. 09-1111-0018		LOCATION		N 4877082.3 ; E 297188.1		ORIGINATED BY		OS									
DIST Central HWY 400		BOREHOLE TYPE		D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing		COMPILED BY		NK									
DATUM Geodetic		DATE		June 6-8, 2012		CHECKED BY		LCC									
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 ---																
	SAND and SILT, trace clay, trace gravel (TILL) Very dense Grey Wet		15	SS	55		206										2 61 30 7
204.6 17.4	END OF BOREHOLE		16	SS	67		205										
NOTES: 1. Artesian conditions observed at a depth of 13.7 m (Elev. 208.3 m) during drilling operations. 2. Water level measured inside casing at 2.0 m above ground surface (Elev. 224.0 m) on completion of drilling. 3. Borehole abandoned using cement grout.																	

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PROJECT <u>09-1111-0018</u>		RECORD OF BOREHOLE No SC-10		SHEET 1 OF 2		METRIC	
G.W.P. <u>2835-02-00</u>		LOCATION <u>N 4877033.5 ; E 297122.5</u>		ORIGINATED BY <u>OS</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing</u>		COMPILED BY <u>NK</u>			
DATUM <u>Geodetic</u>		DATE <u>May 14, 2012</u>		CHECKED BY <u>LCC</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
222.1	GROUND SURFACE													
0.0	TOPSOIL													
0.1	CLAYEY SILT with to some sand, some gravel, containing rootlets and organic matter/wood fragments Firm to very stiff Brown to grey Moist		1	SS	7									
			2	SS	14									
			3	SS	27									
219.9	PEAT (Fibrous) Stiff Black Moist		4	SS	11									
219.4	Gravelly SAND and SILT, trace clay, containing clayey silt seams Compact to dense Grey Moist		5	SS	35									25 40 30 5
218.4	CLAYEY SILT, trace to some gravel, trace to some sand Stiff to very stiff Grey Moist		6	SS	26									
3.7			7	SS	19									0 2 64 34
			8	SS	14									
214.9	CLAYEY SILT with to some sand, trace gravel (TILL) Hard Grey Moist		9	SS	40									
7.2			10	SS	52									
			11	SS	74									1 25 47 27
			12	SS	110									
			13	SS	105									

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PROJECT		RECORD OF BOREHOLE				No SC-10		SHEET 2 OF 2		METRIC							
G.W.P. 2835-02-00		LOCATION				N 4877033.5 ; E 297122.5		ORIGINATED BY OS									
DIST Central HWY 400		BOREHOLE TYPE				D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing		COMPILED BY NK									
DATUM Geodetic		DATE				May 14, 2012		CHECKED BY LCC									
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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					10 20 30 WATER CONTENT (%)					
206.2	CLAYEY SILT with to some sand, trace gravel (TILL) Hard Grey Moist		14	SS	121		207										
15.9	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 2.1 m (Elev. 220.0 m) on completion of drilling.																

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PROJECT		RECORD OF BOREHOLE		No SC-11		SHEET 1 OF 2		METRIC								
G.W.P. 2835-02-00		LOCATION		N 4877019.1 ; E 297122.9		ORIGINATED BY		OS								
DIST Central HWY 400		BOREHOLE TYPE		D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing		COMPILED BY		NK								
DATUM Geodetic		DATE		May 11, 2012		CHECKED BY		LCC								
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 (%)
221.8	GROUND SURFACE							20	40	60	80	100				
0.0	TOPSOIL															
0.1	Sand and gravel, trace clay, some silt, containing rootlets and organic matter (FILL) Loose to compact Dark brown to brown Moist, becoming wet at a depth of 0.3 m		1	SS	9										49 33 13 5	
220.4			2	SS	15											
1.4	Clayey silt with sand (FILL) Firm Brown Moist		3	SS	7											
219.7	PEAT															
219.2	SAND and GRAVEL, containing wood fragments Dense Grey Moist		4	SS	44											
2.6																
	CLAYEY SILT, trace sand, trace gravel Very stiff Grey Moist		5	SS	20											
218.1			6	SS	46											
3.7	CLAYEY SILT some to with sand, trace to some gravel (TILL) Very stiff to hard Grey Moist		7	SS	33											
			8	SS	29										19 21 43 17	
			9	SS	29											
			10	SS	29											
			11	SS	43											
			12	SS	80											
			13	SS	106										0 28 47 25	
207.5																
14.3																

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PROJECT <u>09-1111-0018</u>		RECORD OF BOREHOLE No SC-11				SHEET 2 OF 2		METRIC																
G.W.P. <u>2835-02-00</u>		LOCATION <u>N 4877019.1 ; E 297122.9</u>				ORIGINATED BY <u>OS</u>																		
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing</u>				COMPILED BY <u>NK</u>																		
DATUM <u>Geodetic</u>		DATE <u>May 11, 2012</u>				CHECKED BY <u>LCC</u>																		
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 ---						<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE </div> <div style="display: flex; justify-content: space-between;"> ● QUICK TRIAXIAL × REMOULDED </div>																	
	END OF BOREHOLE NOTE: 1. Borehole dry on completion of drilling.																							

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PROJECT 09-1111-0018		RECORD OF BOREHOLE No SC-14		SHEET 1 OF 2		METRIC	
G.W.P. 2835-02-00		LOCATION N 4877041.9;E 297120.6				ORIGINATED BY OS	
DIST Central HWY 400		BOREHOLE TYPE D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing				COMPILED BY NK	
DATUM Geodetic		DATE May 22, 2012				CHECKED BY LCC	

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

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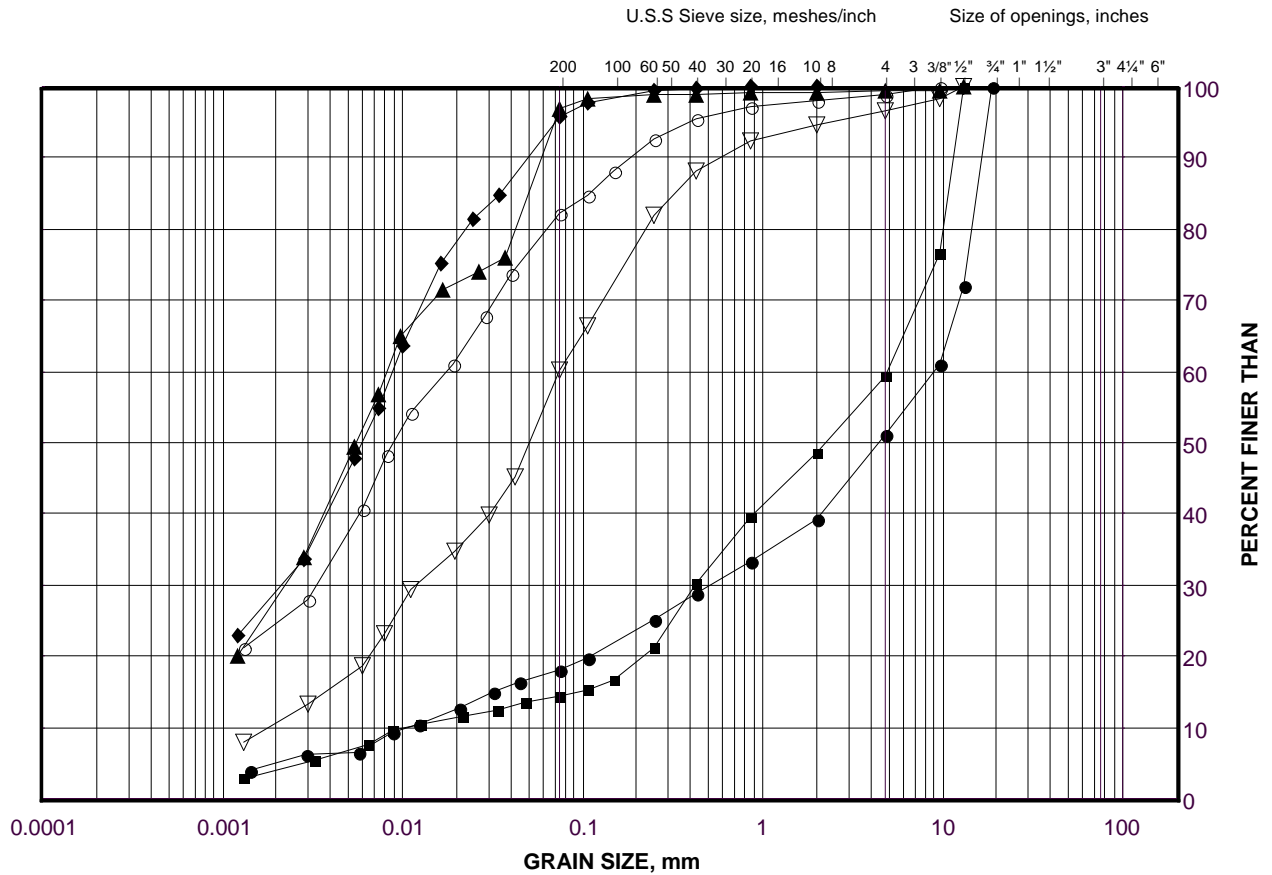
PROJECT 09-1111-0018				RECORD OF BOREHOLE No SC-14				SHEET 2 OF 2				METRIC					
G.W.P. 2835-02-00				LOCATION N 4877041.9; E 297120.6				ORIGINATED BY OS									
DIST Central HWY 400				BOREHOLE TYPE D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing				COMPILED BY NK									
DATUM Geodetic				DATE May 22, 2012				CHECKED BY LCC									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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 (%)				
	--- CONTINUED FROM PREVIOUS PAGE ---																
	CLAYEY SILT with to some sand, trace gravel (TILL) Hard Firm Moist		14	SS	65												
			15	SS	72												
			16	SS	71												
203.9 18.1	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 3.7 m (Elev. 218.3 m) on completion of drilling.																

GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 01/13/15 SIB

GRAIN SIZE DISTRIBUTION

Sand and Gravel/Sand and Silt/Clayey Silt (Fill)

FIGURE A1



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

LEGEND

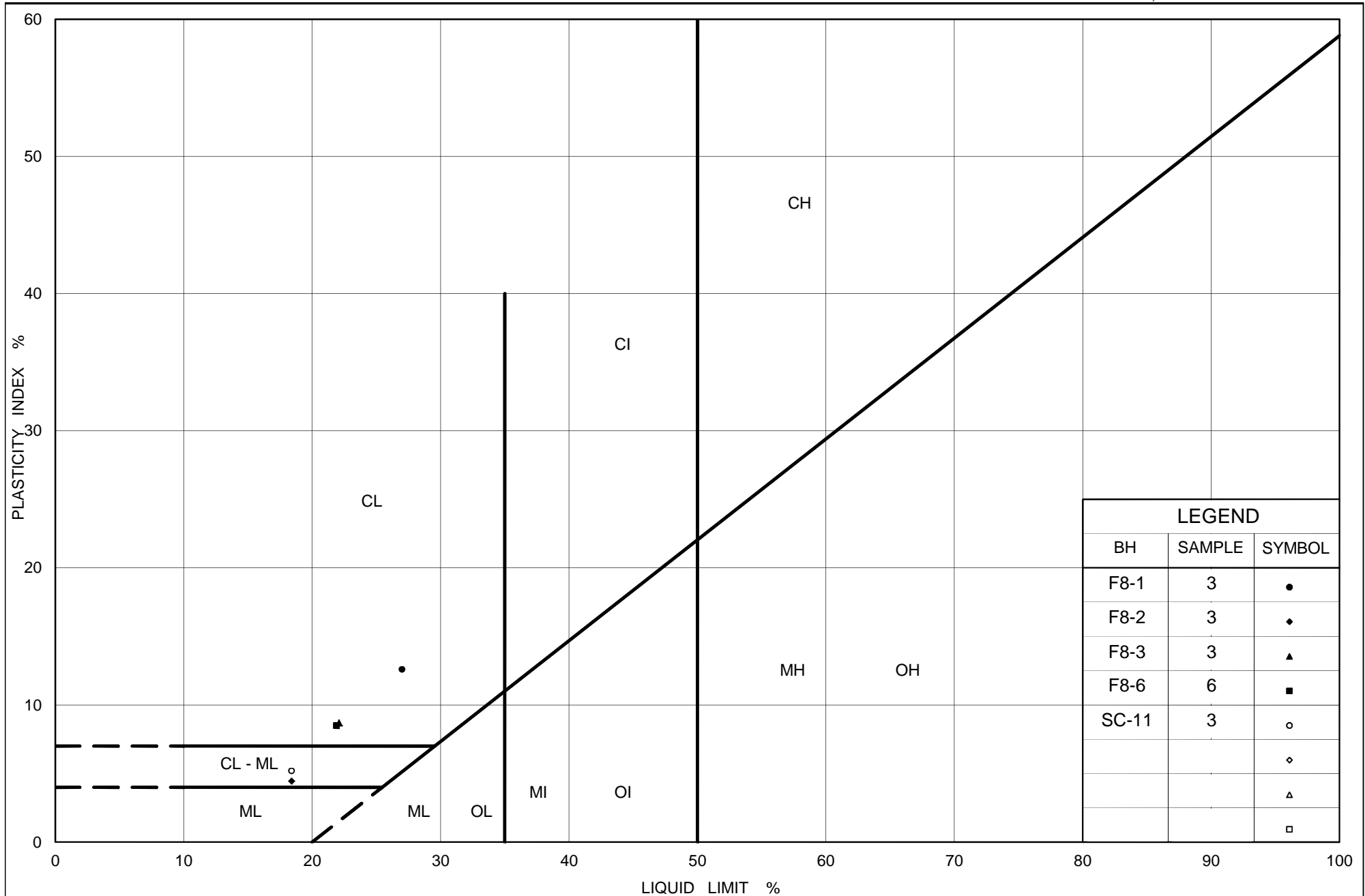
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SC-11	2	220.7
■	F8-6	3	226.6
◆	F8-1	3	225.5
▲	F8-3	4	218.4
▽	F8-2	5	225.1
○	F8-6	6	224.2

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 10-Jul-13



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PLASTICITY CHART

Clayey Silt (Fill)

Figure No. A2

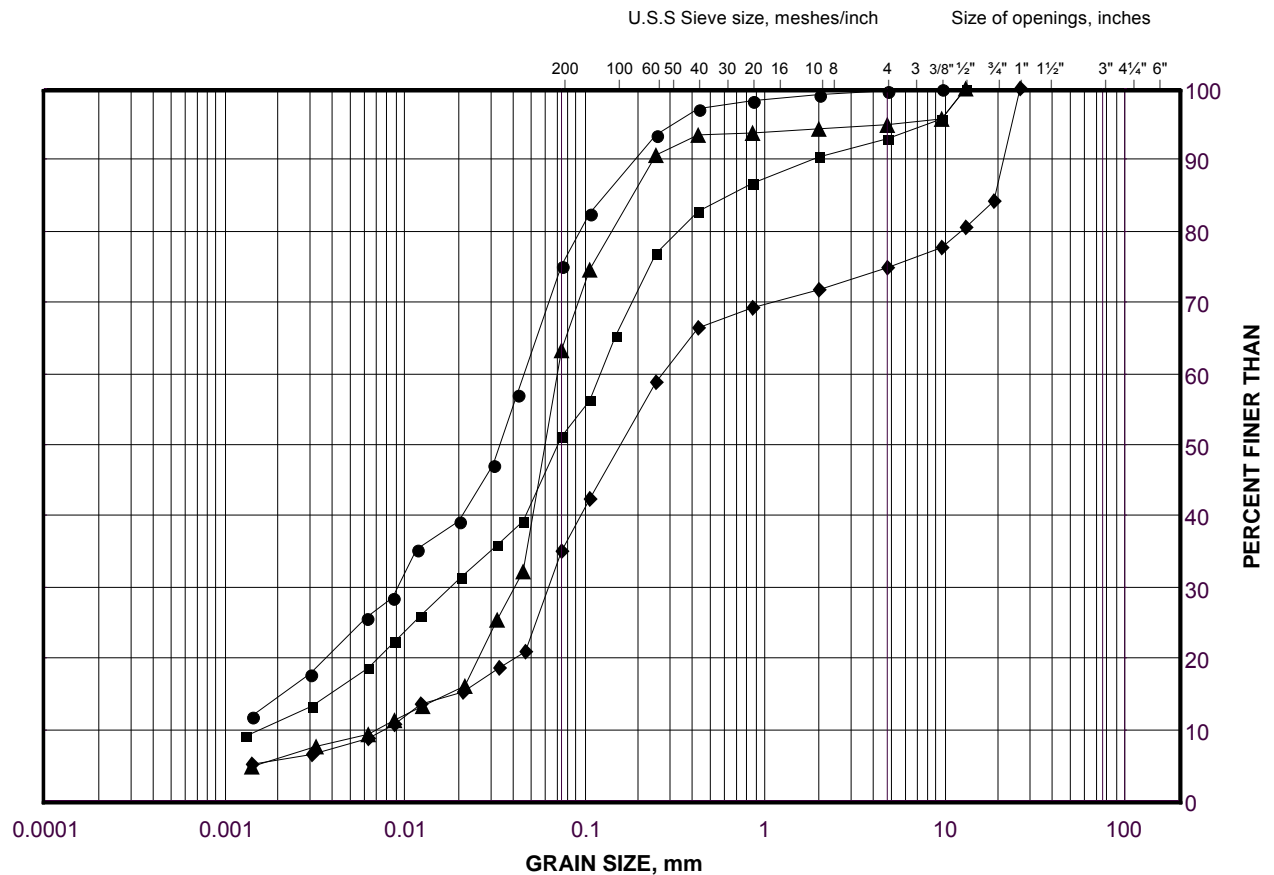
Project No. 09-1111-0018

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GRAIN SIZE DISTRIBUTION

Sandy Silt to Sand and Silt

FIGURE A3



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SC-2	4	219.4
■	F8-5	4	221.2
◆	SC-10	5	218.8
▲	SC-14	5A	218.6

Project Number: 09-1111-0018

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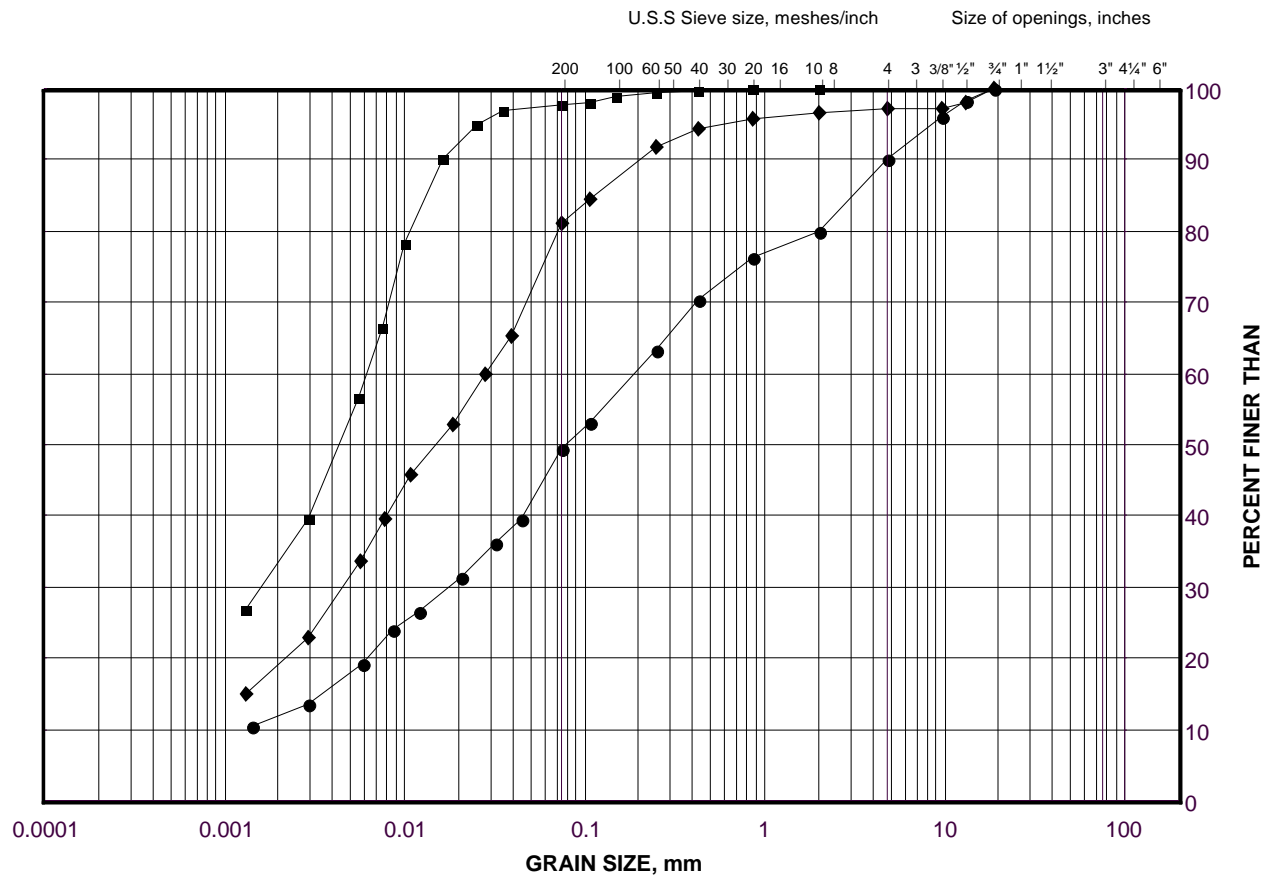
Golder Associates

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GRAIN SIZE DISTRIBUTION

Clayey Silt (Upper Deposit)

FIGURE A4



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

LEGEND

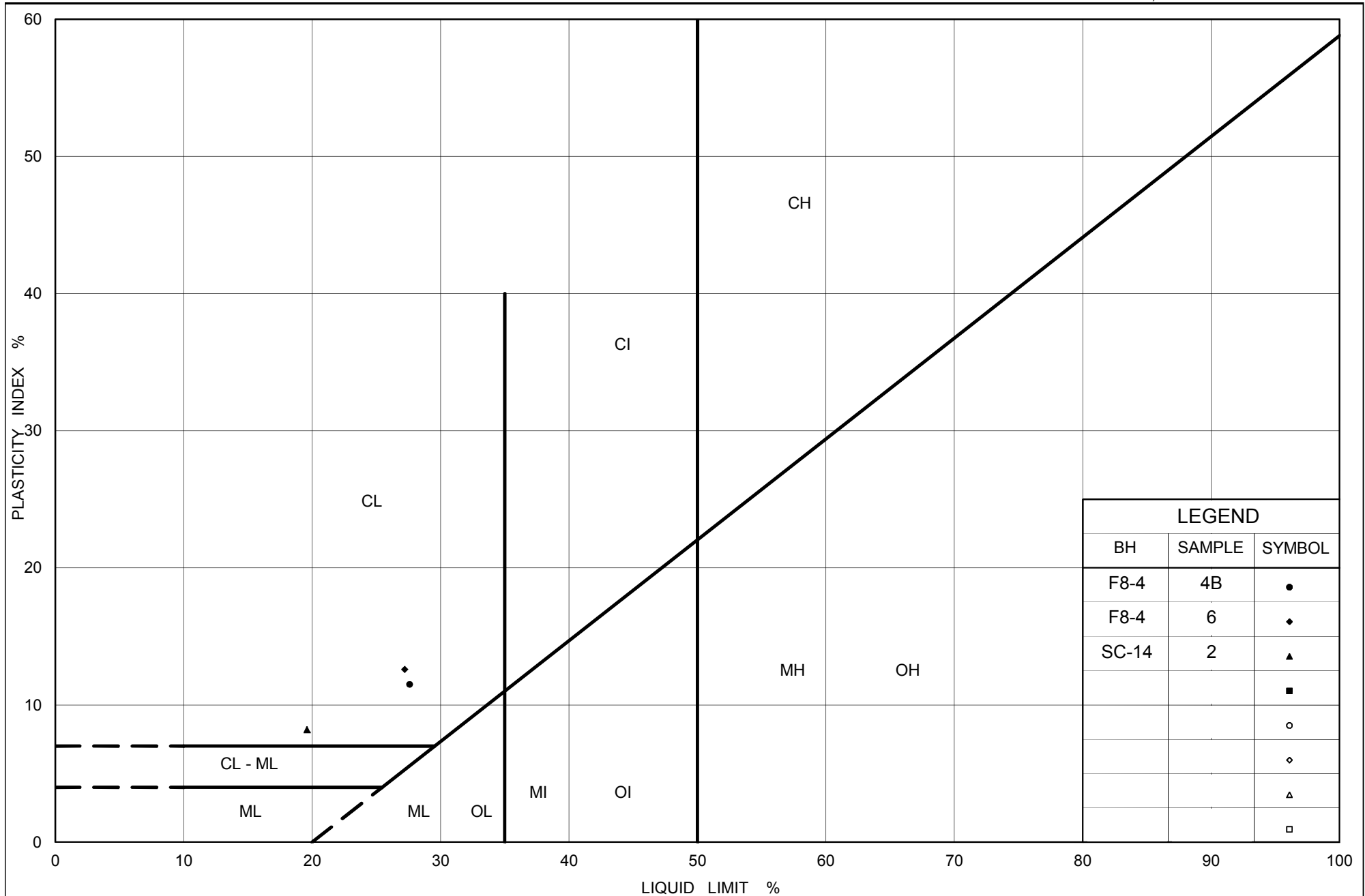
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SC-14	2	220.9
■	F8-4	6	222.9
◆	F8-2	7	222.8

Project Number: 09-1111-0018

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PLASTICITY CHART

Clayey Silt (Upper Deposit)

Figure No. A5

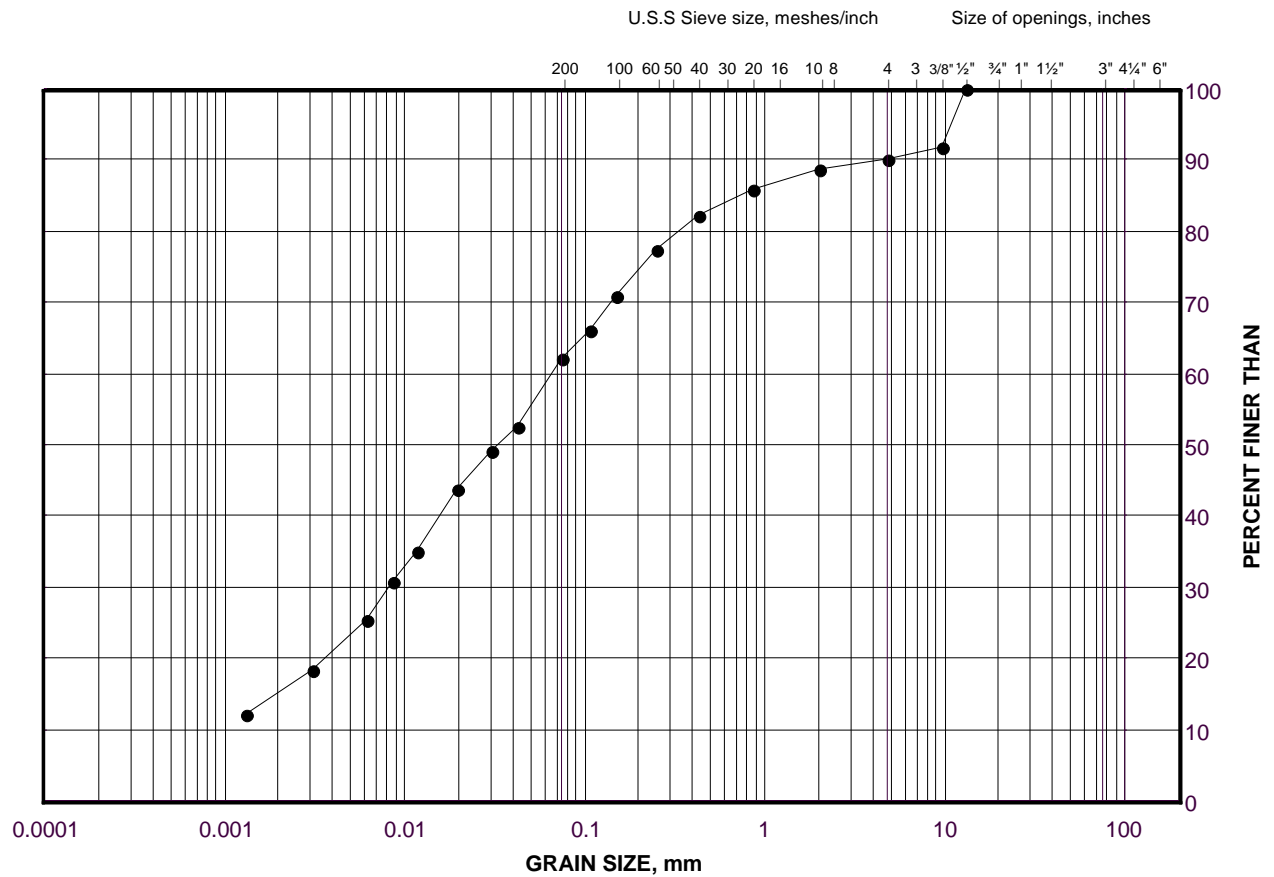
Project No. 09-1111-0018

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GRAIN SIZE DISTRIBUTION

Organic Sandy Silt

FIGURE A6



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	F8-6	9A	219.8

Project Number: 09-1111-0018

Checked By: LCC

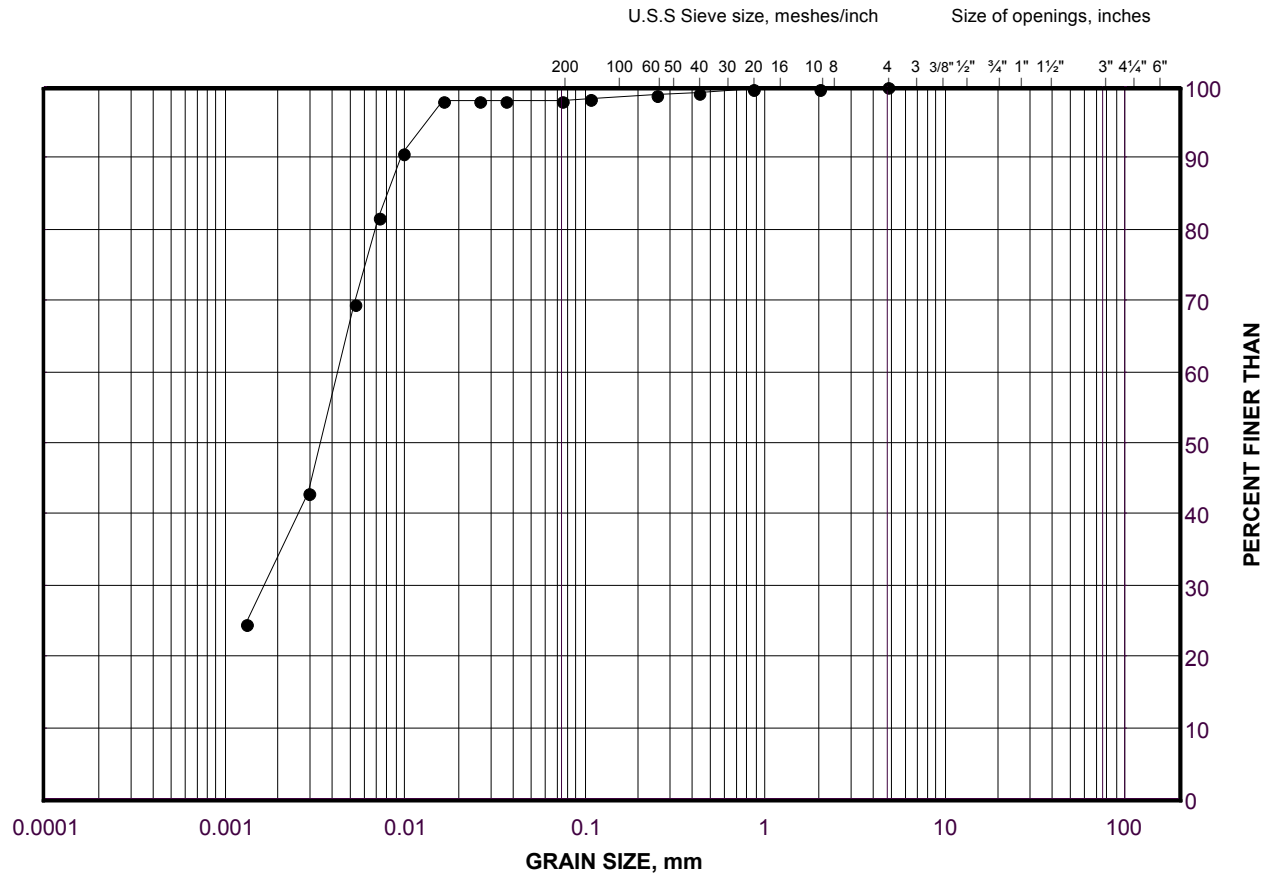
Golder Associates

Date: 10-Jan-13

GRAIN SIZE DISTRIBUTION

Clayey Silt (Lower Deposit)

FIGURE A7



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

LEGEND

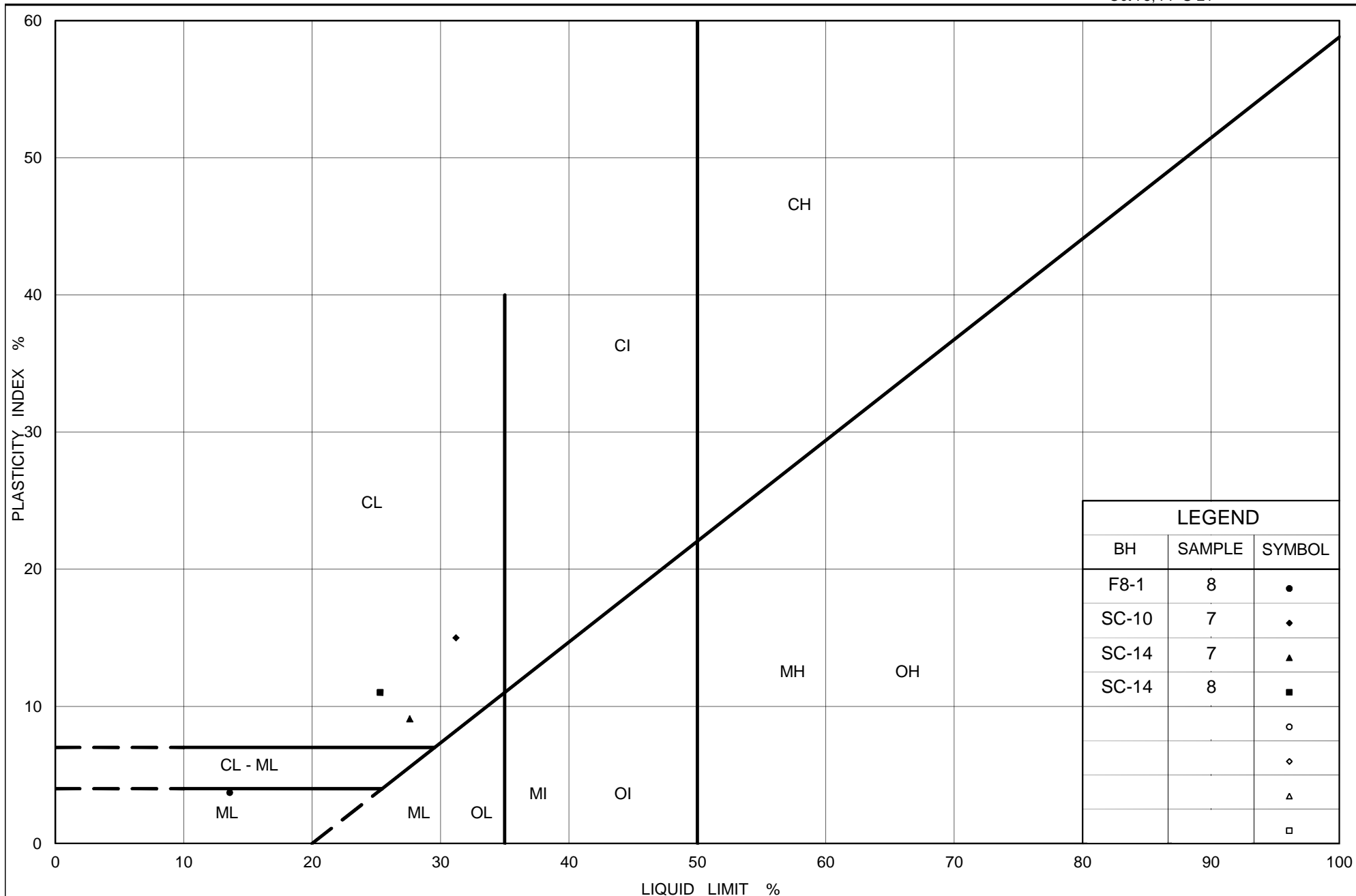
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	SC-10	7	217.2

Project Number: 09-1111-0018

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Date: 10-Jan-13



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PLASTICITY CHART

Clayey Silt (Lower Deposit)

Figure No. A8

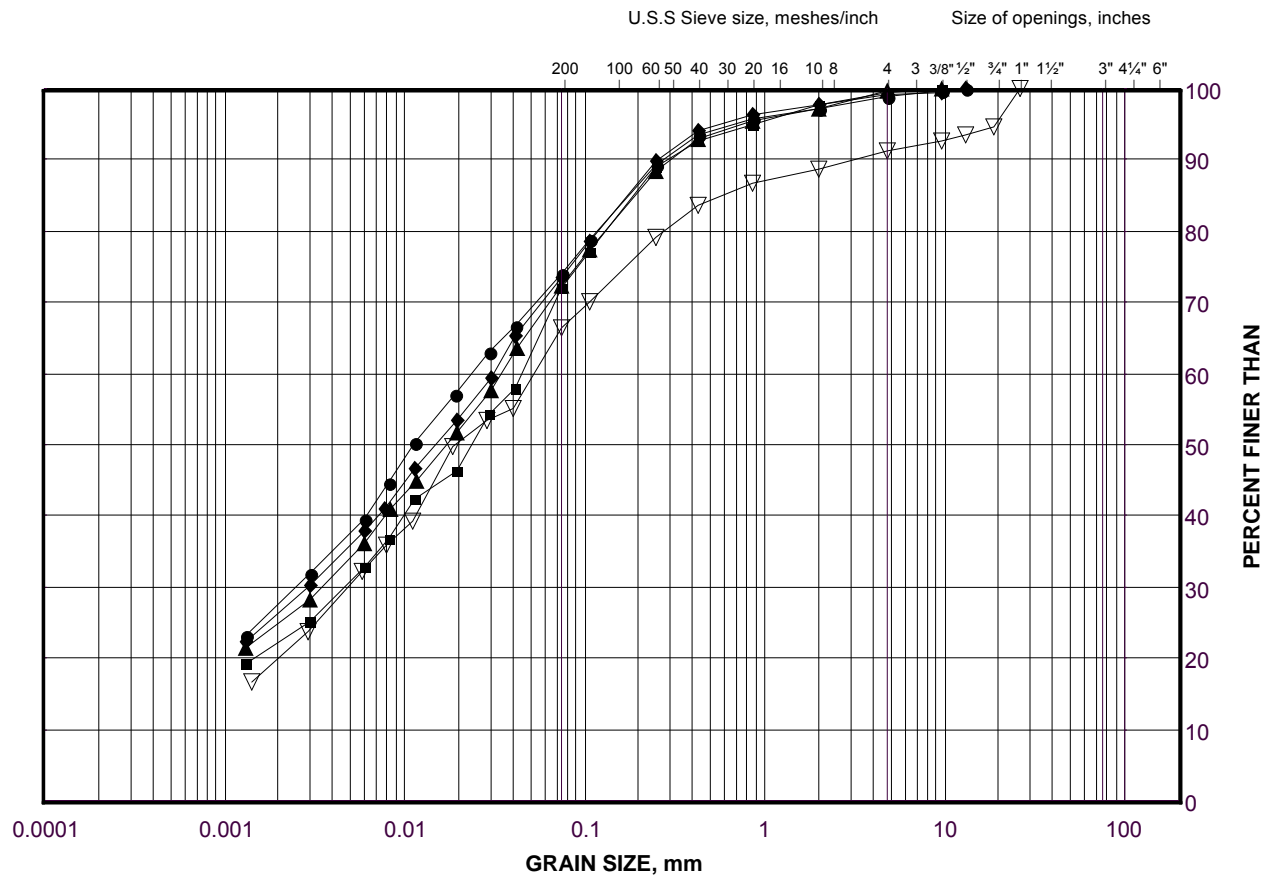
Project No. 09-1111-0018

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GRAIN SIZE DISTRIBUTION

Clayey Silt (Till)

FIGURE A9A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SC-10	11	211.1
■	SC-1	13	210.5
◆	SC-14	13	208.0
▲	SC-11	13	207.8
▽	SC-2	6	217.9

Project Number: 09-1111-0018

Checked By: LCC

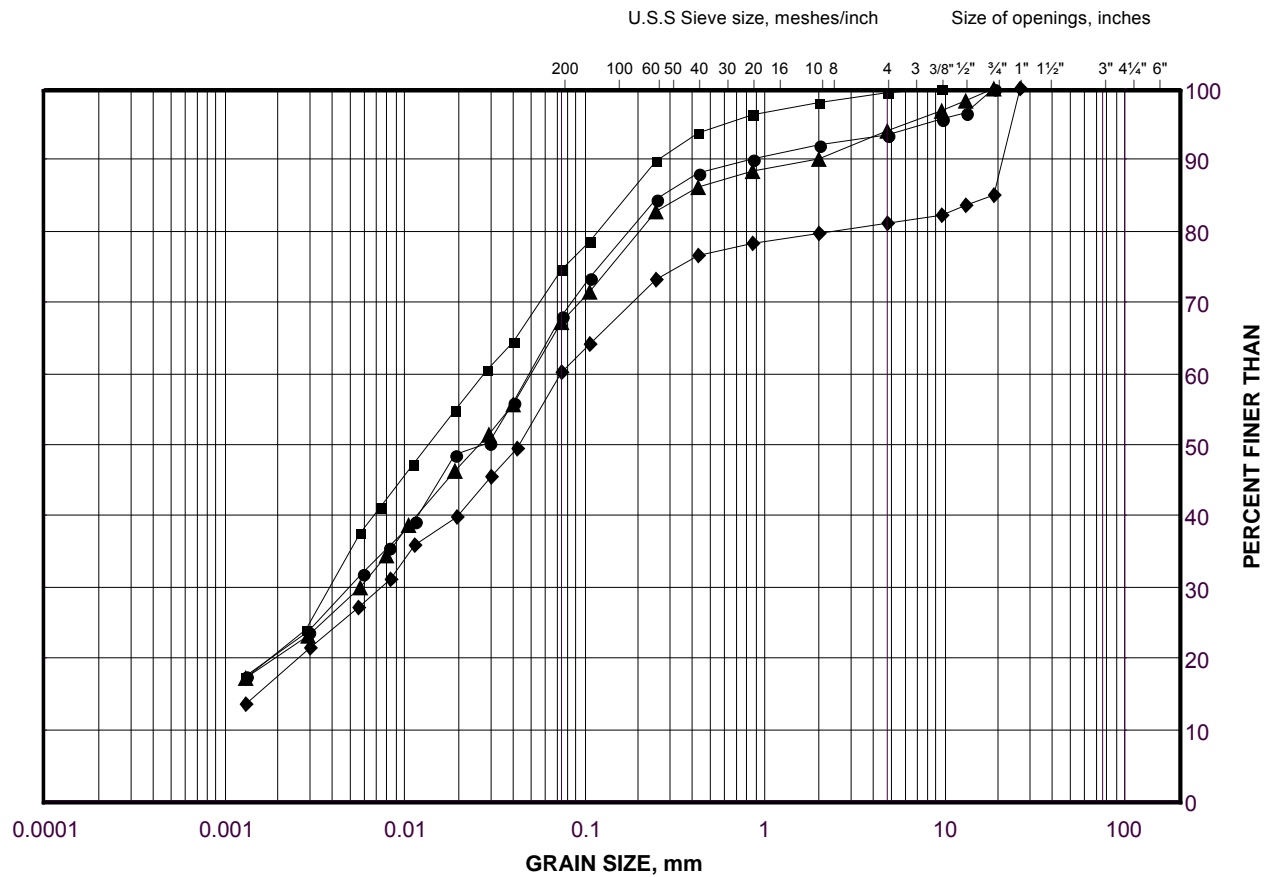
Golder Associates

Date: 10-Jul-13

GRAIN SIZE DISTRIBUTION

Clayey Silt (Till)

FIGURE A9B



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

LEGEND

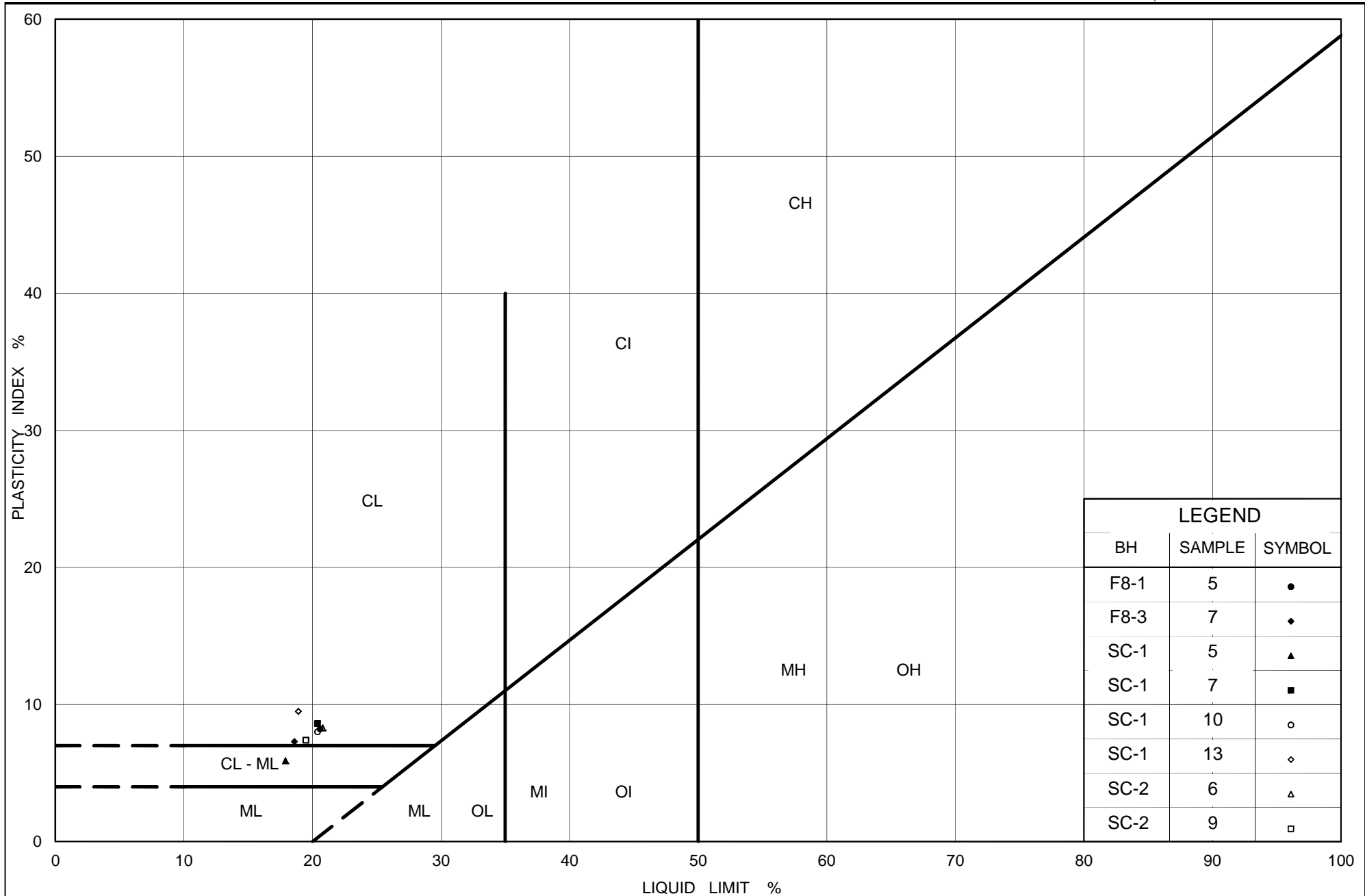
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SC-1	7	218.1
■	F8-3	7	216.1
◆	SC-11	8	215.4
▲	F8-2	9	219.8

Project Number: 09-1111-0018

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Date: 10-Jan-13



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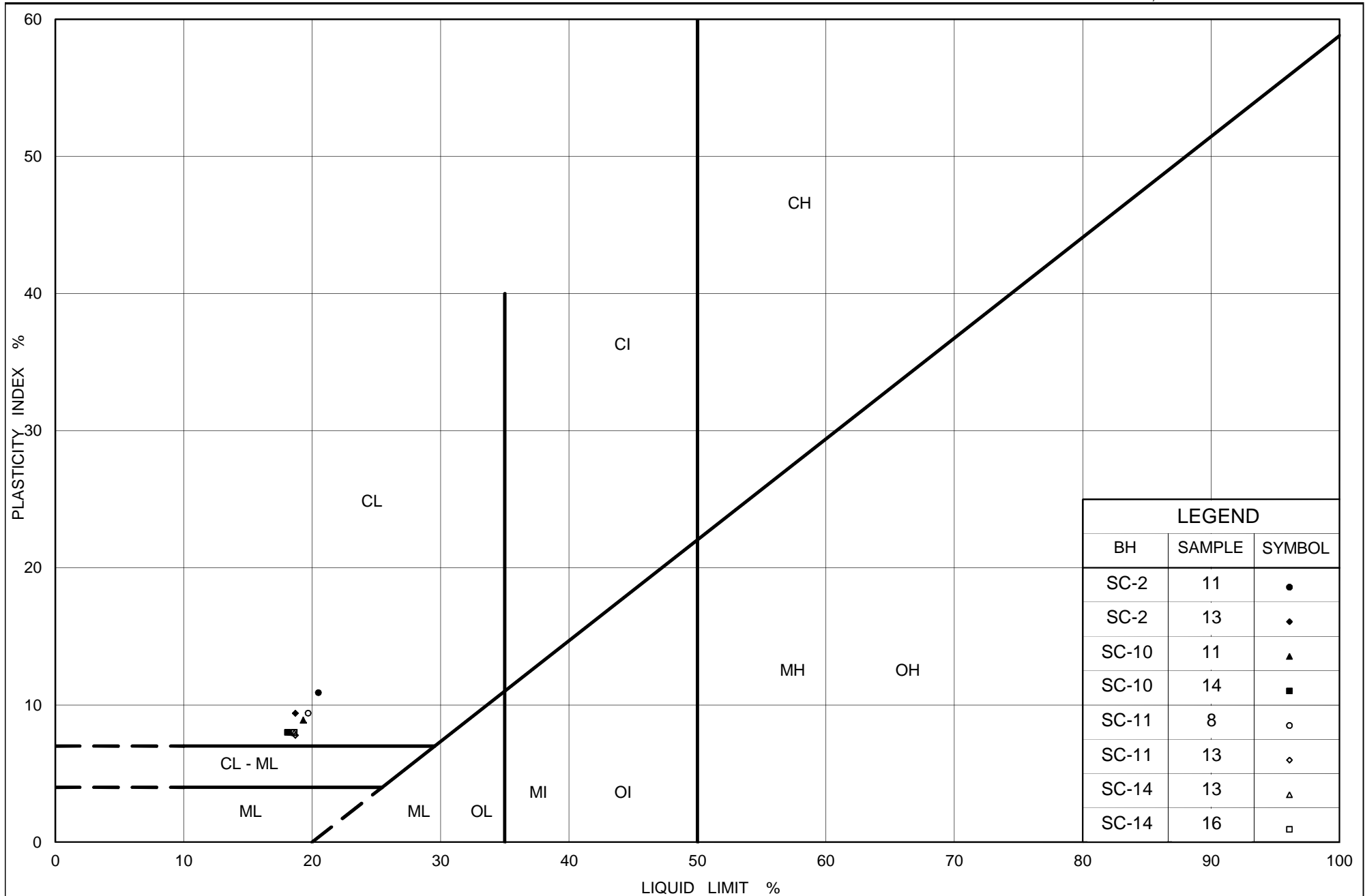
PLASTICITY CHART

Clayey Silt (Till)

Figure No. A10A

Project No. 09-1111-0018

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PLASTICITY CHART Clayey Silt (Till)

Figure No. A10B

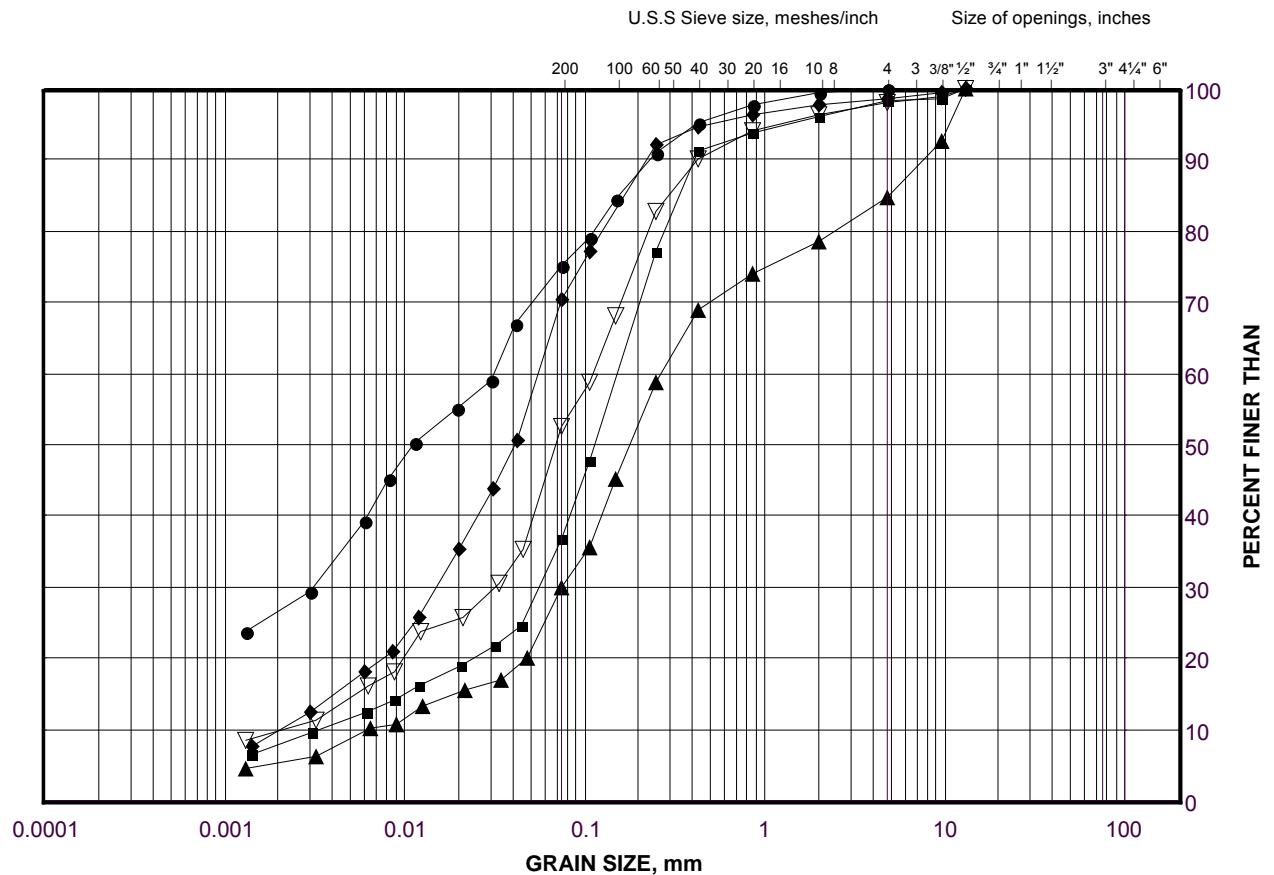
Project No. 09-1111-0018

Checked By: LCC

GRAIN SIZE DISTRIBUTION

Sandy Silt to Silty Sand Till

FIGURE A11



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	F8-6	11	216.8
■	SC-2	15	206.5
◆	F8-1	6	223.2
▲	F8-5	7	218.9
▽	F8-4	8	220.6

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 10-Jan-13



APPENDIX B

**Borehole Records and Laboratory Test Results - Highway 400
Embankment - SBL (Station 24+880 to 25+120) and NBL (Station
24+900 to 25+120)**

PROJECT 09-1111-0018			RECORD OF BOREHOLE No 12-3			SHEET 1 OF 2			METRIC								
G.W.P. 2835-02-00			LOCATION N 4877222.9 ; E 297142.4			ORIGINATED BY TWB											
DIST Central HWY 400			BOREHOLE TYPE D-90 Truck Mount, 89 mm O.D. Tricone Wash Bore, N Casing			COMPILED BY CC											
DATUM Geodetic			DATE May 28, 2012			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 (%)
225.0	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT																
0.2	Sand and gravel, some silt, trace clay (FILL) Brown Moist																
223.8							224										
1.2	Clayey silt with sand, trace to some gravel, containing silty sand layers (FILL) Very stiff Grey Moist		1	SS	20		223										
222.4																	
2.6	Sand and silt, some clay, trace gravel, containing clayey silt seams (FILL) Very loose to dense Brown Wet		2	SS	3		222										
			3	SS	33		221										
220.4																	
4.6	Clayey silt with sand, trace gravel, containing organics (FILL) Stiff to very stiff Brown and grey Moist		4	SS	27		220										
			5	SS	9												
218.6			6A	SS	13		219										
218.2	CLAYEY SILT, trace to some sand, trace gravel Stiff Grey Moist		6B														
217.9			7A	SS	6		218										
7.1	SILTY SAND, trace clay, containing organics Loose Grey Wet		7B														
			8	SS	3		217										
	CLAYEY SILT, trace sand, containing organics to a depth of 7.5 m Firm to very stiff Grey Moist																
			9	SS	12		216										
							215										
			10	SS	7		214										
							213										
			11	SS	12		212										
			12	SS	16		211										

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

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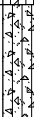
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT		RECORD OF BOREHOLE No 12-4		SHEET 1 OF 2		METRIC												
G.W.P. 2835-02-00		LOCATION N 4877275.6; E 297148.2		ORIGINATED BY TWB														
DIST Central HWY 400		BOREHOLE TYPE D-50 Track Mount, 108 mm I.D. Hollow Stem Augers		COMPILED BY CC														
DATUM Geodetic		DATE May 11, 2012		CHECKED BY SMM														
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa		W _p W W _L		WATER CONTENT (%)		γ		GR SA SI CL		
219.5	GROUND SURFACE							20 40 60 80 100	○ UNCONFINED + FIELD VANE									
0.0	Sand and gravel, some silt, trace clay, containing organics below a depth of 0.5 m (FILL)		1	SS	22		219		● QUICK TRIAXIAL × REMOULDED									
218.8	Compact Brown Moist		2	SS	7		218											
0.7	Sandy SILTY PEAT, trace clay, rootlets and wood fragments Very loose to loose Dark brown to black Moist		3	SS	1													
217.1			4A				217											
2.4	CLAYEY SILT, trace sand, containing silty sand seams to a depth of 3.8 m, containing organics Very soft to soft Grey Moist		4B	SS	1													
			5	SS	2		216											
			6	TO	PH													
214.9							215											
4.6	SILT, some sand, some clay Loose Grey Wet		7	SS	9		214											
			8	SS	4		213											
212.3							212											
7.2	CLAYEY SILT, trace sand Soft to stiff Grey Moist		9	SS	10		211											
			10	SS	13		210											
			11	SS	7		209											
			12	SS	1		208											
			13	SS	2		207											
							206											
							205											

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

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PROJECT		RECORD OF BOREHOLE No 12-4		SHEET 2 OF 2		METRIC													
G.W.P. 2835-02-00		LOCATION N 4877275.6 ; E 297148.2		ORIGINATED BY TWB															
DIST Central HWY 400		BOREHOLE TYPE D-50 Track Mount, 108 mm I.D. Hollow Stem Augers		COMPILED BY CC															
DATUM Geodetic		DATE May 11, 2012		CHECKED BY SMM															
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa			WATER CONTENT (%)			γ			GR SA SI CL		
	--- CONTINUED FROM PREVIOUS PAGE ---							20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	10 20 30	kN/m ³					
200.8	CLAYEY SILT, trace sand Soft to stiff Grey Moist		14	SS	1		204	+									0 1 71 28		
							203	+											
			15	SS	3		202												
							201												
18.7	SAND and SILT, trace to some clay, trace gravel (TILL) Very dense Grey Moist		16	SS	52		201												
199.6							200												
19.9	END OF BOREHOLE		17	SS	50/0.13												3 47 40 10		
	NOTE: 1. Water level in open borehole at a depth of 2.0 m below ground surface (Elev. 217.5 m) upon completion of drilling.																		

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PROJECT 09-1111-0018		RECORD OF BOREHOLE No 12-5		SHEET 1 OF 2		METRIC	
G.W.P. 2835-02-00		LOCATION N 4877314.1 ; E 297119.9		ORIGINATED BY TWB			
DIST Central HWY 400		BOREHOLE TYPE D-90 Truck Mount, 89 mm O.D. Tricone Wash Bore, N Casing		COMPILED BY CC			
DATUM Geodetic		DATE May 29, 2012		CHECKED BY SMM			

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 (%)		
								<div><div></div><div>20 40 60 80 100</div></div> <div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED</div>							<div><div></div><div>W_p W W_L</div><div>10 20 30</div></div>		
223.5	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand and gravel, some silt, trace clay (FILL) Brown Moist						223										
222.0							222										
1.5	Clayey silt with sand, trace gravel, containing layers of silty sand (FILL) Firm Greyish brown Moist		1	SS	5		221										
220.5			2	SS	6												
3.0	Silty sand, trace clay, trace gravel (FILL) Loose Brown Wet		3	SS	5		220										
219.5			4A														
4.0	Sand and silt, trace to some clay, trace to some gravel (FILL) Compact Greyish brown Moist		4B	SS	27		219										
			5	SS	23												
							218										
			6	SS	16		217										
216.3							216										
7.2	CLAYEY SILT, trace sand Stiff Grey Moist		7A														
215.6			7B	SS	12		215										
7.9	SAND and SILT, trace clay, containing organics to a depth of 8.7 m, becoming grey below a depth of 8.7 m Compact Greyish brown Wet						214										
			8	SS	20												
213.3							213										
10.2	CLAYEY SILT, trace to some sand, silty sand seam from 10.8 m - 10.9 m depth Firm to stiff Grey Moist		9	SS	11		212										
							211										
			10	SS	4												
							210										
			11	SS	10												
							209										

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

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PROJECT <u>09-1111-0018</u>			RECORD OF BOREHOLE No 12-5			SHEET 2 OF 2			METRIC								
G.W.P. <u>2835-02-00</u>			LOCATION <u>N 4877314.1 ; E 297119.9</u>			ORIGINATED BY <u>TWB</u>											
DIST <u>Central</u> HWY <u>400</u>			BOREHOLE TYPE <u>D-90 Truck Mount, 89 mm O.D. Tricone Wash Bore, N Casing</u>			COMPILED BY <u>CC</u>											
DATUM <u>Geodetic</u>			DATE <u>May 29, 2012</u>			CHECKED BY <u>SMM</u>											
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					
	CLAYEY SILT, trace to some sand, silty sand seam from 10.8 m - 10.9 m depth Firm to stiff Grey Moist		12	SS	7		208										
							207										
			13	SS	4		206										
							205										
			14	SS	2		204										
							203										
			15	SS	15		202										
201.6	END OF BOREHOLE		16	SS	10												
21.9	NOTE: 1. Water level in open borehole at a depth of 2.9 m below ground surface (Elev. 220.2 m) upon completion of drilling.																

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PROJECT 09-1111-0018			RECORD OF BOREHOLE No 12-6			SHEET 1 OF 2			METRIC																				
G.W.P. 2835-02-00			LOCATION N 4877363.4 ; E 297126.5			ORIGINATED BY TWB																							
DIST Central HWY 400			BOREHOLE TYPE D-50 Track Mount, 108 mm I.D. Hollow Stem Augers			COMPILED BY CC																							
DATUM Geodetic			DATE May 14, 2012			CHECKED BY SMM																							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			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		ELEVATION SCALE		20	40	60	80	100	W _p	W	W _L	20	40	60	80	100	10	20	30	γ	GR	SA	SI	CL
219.7	GROUND SURFACE																												
0.0	ASPHALT																												
219.0	Sand and gravel, trace clay, trace silt (FILL) Brown Moist		1	AS	-		219																						
0.7	Sandy SILTY PEAT, trace clay, rootlets and wood fragments Loose Dark brown		2	SS	4		218																						
			3	SS	4		217																						
			4	SS	7		216																						
216.8	CLAYEY SILT some sand, trace gravel, containing organics, rootlets and wood fragments Very soft to soft Grey Moist		5	SS	1		215																						
2.9			6	SS	1		214																						
215.2	SAND and SILT, trace to some clay, trace gravel Compact Grey Wet		7	SS	13		213																						
4.5			8A	SS	13		212																						
213.5	CLAYEY SILT, trace sand, containing organics Stiff Grey Moist		8B	SS	13		211																						
6.2			9	SS	12		210																						
212.5	SAND and SILT, trace clay, containing wood fragments Compact Grey Wet						209																						
7.2							208																						
211.0	CLAYEY SILT to SILTY CLAY, trace sand Soft to stiff Grey Moist		10	SS	8		207																						
8.7			11	SS	11		206																						
			12	SS	6		205																						
			13	SS	1																								

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PROJECT 09-1111-0018		RECORD OF BOREHOLE No 12-7		SHEET 1 OF 2	METRIC
G.W.P. 2835-02-00		LOCATION N 4877186.9 ; E 297096.2		ORIGINATED BY TWB	
DIST Central HWY 400		BOREHOLE TYPE D-50 Track Mount, 108 mm I.D. Hollow Stem Augers		COMPILED BY CC	
DATUM Geodetic		DATE May 9, 2012		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						
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED					
220.4	GROUND SURFACE													
0.0	TOPSOIL		1A	SS	3									
219.9			1B	SS	3									
0.7	Clayey silt, trace to some sand, containing organics (FILL) Soft Brown Moist		2	SS	3								95.5	OC = 22.9
	Sandy SILTY PEAT, trace clay, containing rootlets and wood fragments Very loose Dark brown to black Moist		3	SS	1									
218.2														
2.2	CLAYEY SILT, trace sand Very soft to firm Grey Moist		4	SS	1									0 1 78 21
216.6	SILTY SAND, trace clay Loose Grey Wet		5	SS	7									
215.9														
4.5	CLAYEY SILT, trace sand, containing silty sand seams to a depth of 7.2 m Soft to stiff Grey Moist		6	SS	7									
			7	SS	12									
			8	SS	11									
			9	SS	4									
			10	TO	PH								19.4	
			11	SS	4									
			12	SS	1									
			13	SS	1									0 4 61 35

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PROJECT 09-1111-0018			RECORD OF BOREHOLE No 12-8			SHEET 1 OF 2			METRIC																								
G.W.P. 2835-02-00			LOCATION N 4877236.1 ; E 297100.5			ORIGINATED BY TWB																											
DIST Central HWY 400			BOREHOLE TYPE D-90 Truck Mount, 89 mm O.D. Tricone Wash Bore, N Casing			COMPILED BY CC																											
DATUM Geodetic			DATE May 30, 2012			CHECKED BY SMM																											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			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		ELEVATION SCALE	20	40	60	80	100	W _p	W	W _L	UNCONFINED	FIELD VANE	QUICK TRIAXIAL	REMOULDED	20	40	60	80	100	10	20	30	γ	GR	SA	SI	CL
224.1	0.0	GROUND SURFACE						224																									
	0.2	ASPHALT						223																									
	0.2	Sand and gravel, some silt, trace clay (FILL) Brown Moist						222.6																									
	1.5	Clayey silt with sand, trace gravel (FILL) Firm to stiff Brown Moist		1	SS	8		222																									
								221																									
				2	SS	15		220																									
	3.7	Sand and silt, trace clay, trace gravel (FILL) Dense Greyish brown Moist		3	SS	40		219.6																									
	4.5	Clayey silt with sand, trace gravel (FILL) Stiff to hard Brown Moist		4	SS	33		219																									
				5	SS	17		218																									
				6	SS	9		217																									
				7A	SS	9		216.7																									
	7.5	Silty SAND, trace clay Loose Grey Wet		8	SS	4		216																									
		CLAYEY SILT, trace sand Firm Grey Moist						215																									
	8.7	Silty SAND, trace clay Compact Grey Wet		9	SS	19		214																									
								213																									
	10.2	CLAYEY SILT, trace sand, trace to some gravel Firm to very stiff Grey Moist		10	SS	11		212																									
								211																									
				11	SS	17		210																									
		some gravel between depths of 13.3 m - 14.8 m		12	SS	17																											

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PROJECT <u>09-1111-0018</u>			RECORD OF BOREHOLE No 12-8			SHEET 2 OF 2			METRIC								
G.W.P. <u>2835-02-00</u>			LOCATION <u>N 4877236.1 ; E 297100.5</u>			ORIGINATED BY <u>TWB</u>											
DIST <u>Central</u> HWY <u>400</u>			BOREHOLE TYPE <u>D-90 Truck Mount, 89 mm O.D. Tricone Wash Bore, N Casing</u>			COMPILED BY <u>CC</u>											
DATUM <u>Geodetic</u>			DATE <u>May 30, 2012</u>			CHECKED BY <u>SMM</u>											
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					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)				
								20	40	60	80	100	10	20	30		
	CLAYEY SILT, trace sand, trace to some gravel Firm to very stiff Grey Moist		13	SS	17		209										
							208										
			14	SS	8		207										
							206										
			15	SS	10		205										
							204										
			16	SS	2		203										
			17	SS	7												
202.2 21.9	END OF BOREHOLE																
	NOTE: 1. Water level in open borehole at a depth of 4.4 m below ground surface (Elev. 219.7 m) upon completion of drilling.																

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PROJECT 09-1111-0018		RECORD OF BOREHOLE No 12-9		SHEET 1 OF 2		METRIC	
G.W.P. 2835-02-00		LOCATION N 4877276.8 ;E 297071.9				ORIGINATED BY TWB	
DIST Central HWY 400		BOREHOLE TYPE D-50 Track Mount, 108 mm I.D. Hollow Stem Augers				COMPILED BY CC	
DATUM Geodetic		DATE May 10, 2012				CHECKED BY SMM	

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PROJECT 09-1111-0018			RECORD OF BOREHOLE No 12-9			SHEET 2 OF 2			METRIC													
G.W.P. 2835-02-00			LOCATION N 4877276.8 ; E 297071.9			ORIGINATED BY TWB																
DIST Central HWY 400			BOREHOLE TYPE D-50 Track Mount, 108 mm I.D. Hollow Stem Augers			COMPILED BY CC																
DATUM Geodetic			DATE May 10, 2012			CHECKED BY SMM																
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	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m ³	GR SA SI CL					
							20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p — W — W _L 10 20 30									
--- CONTINUED FROM PREVIOUS PAGE ---																						
	CLAYEY SILT, trace to some sand and gravel, Firm to stiff Grey Moist		13	SS	6		204															
								203														
				14	SS	7		202														
				15	SS	8		201														
				16	SS	1		200														
198.5 21.0	SAND and SILT, trace clay, trace gravel (TILL) Dense Grey Wet						199															
				17	SS	39		198														
				18	SS	46		197														
196.0 23.5	END OF BOREHOLE						196															
	NOTE: 1. Water level in open borehole at a depth of 1.0 m below ground surface (Elev. 218.5 m) upon completion of drilling.																					

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PROJECT 09-1111-0018		RECORD OF BOREHOLE No 12-10		SHEET 1 OF 2	METRIC
G.W.P. 2835-02-00		LOCATION N 4877324.8 ; E 297075.2		ORIGINATED BY TWB	
DIST Central HWY 400		BOREHOLE TYPE D-90 Truck Mount, 89 mm O.D. Tricone Wash Bore, N Casing		COMPILED BY CC	
DATUM Geodetic		DATE May 30, 2012		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 (%)				
222.0	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand and gravel, some silt, trace clay (FILL) Brown Moist																
220.4			1A	SS	5												
1.6	Clayey silt some to with sand, trace gravel (FILL) Soft to firm Brown to greyish brown Moist		1B														
			2	SS	2												
			3	SS	2												
			4	SS	3												
			5	SS	6												
216.8																	
5.2	CLAYEY SILT, trace sand Soft Grey Moist		6	SS	3												
214.3																	
7.7	SILTY SAND, trace clay Compact Grey Wet		7	SS	23												
213.3																	
8.7	CLAYEY SILT to SILTY CLAY, trace sand Firm to very stiff Grey Moist		8	SS	7												
	sand seams between depths of 10.2 m and 11.7 m		9	SS	16												
			10	SS	11												
			11	SS	6												

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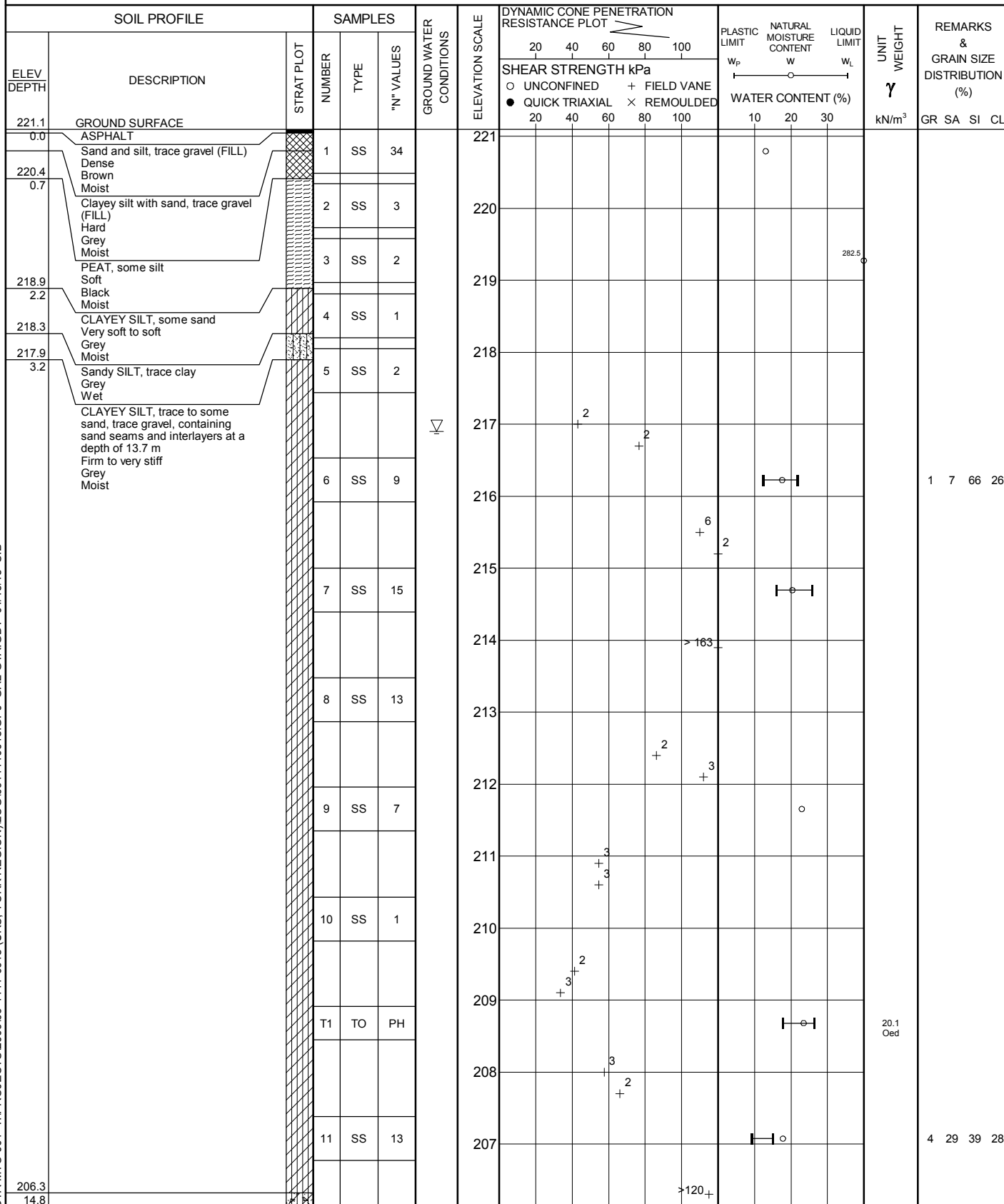
+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 09-1111-0018			RECORD OF BOREHOLE No 12-10			SHEET 2 OF 2			METRIC											
G.W.P. 2835-02-00			LOCATION N 4877324.8 ; E 297075.2			ORIGINATED BY TWB														
DIST Central HWY 400			BOREHOLE TYPE D-90 Truck Mount, 89 mm O.D. Tricone Wash Bore, N Casing			COMPILED BY CC														
DATUM Geodetic			DATE May 30, 2012			CHECKED BY SMM														
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	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m ³	GR SA SI CL			
								20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	10 20 30									
	--- CONTINUED FROM PREVIOUS PAGE ---																			
	CLAYEY SILT to SILTY CLAY, trace sand Firm to very stiff Grey Moist		12	SS	4		206													
			13	SS	WH		205													
							204													
			14	SS	4		203													
201.6			15	SS	8		202													
20.4	END OF BOREHOLE																			
	NOTE: 1. Water level in open borehole at a depth of 0.1 m below ground surface (Elev. 221.9 m) upon completion of drilling.																			

GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 01/13/15 SIB


PROJECT 09-1111-0018		RECORD OF BOREHOLE No SC-5		SHEET 1 OF 2	METRIC
G.W.P. 2835-02-00		LOCATION N 4877176.1 ; E 297165.0		ORIGINATED BY TT	
DIST Central HWY 400		BOREHOLE TYPE 108 mm Inside Diameter Hollow Stem Augers		COMPILED BY NK	
DATUM Geodetic		DATE November 15, 2011		CHECKED BY LCC	



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 01/13/15 SIB

PROJECT		RECORD OF BOREHOLE		No SC-5		SHEET 2 OF 2		METRIC									
G.W.P. 09-1111-0018		LOCATION		N 4877176.1 ; E 297165.0		ORIGINATED BY		TT									
DIST Central HWY 400		BOREHOLE TYPE		108 mm Inside Diameter Hollow Stem Augers		COMPILED BY		NK									
DATUM Geodetic		DATE		November 15, 2011		CHECKED BY		LCC									
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					
205.3 15.9	CLAYEY SILT, some sand, trace gravel (TILL) Hard Grey Moist END OF BOREHOLE NOTES: 1. Blowing sands encountered at a depth of 15.2 m (Elev. 205.9 m) 2. Water level in open borehole at a depth of 4.2 m (Elev. 216.9 m) on completion of drilling.		12	SS	66		206										

GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 01/13/15 SIB



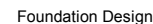
PROJECT <u>09-1111-0018</u>		RECORD OF BOREHOLE No SC-7		SHEET 1 OF 3		METRIC	
G.W.P. <u>2835-02-00</u>		LOCATION <u>N 4877117.8;E 297113.1</u>		ORIGINATED BY <u>SB/TT</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>108 mm Inside Diameter Hollow Stem Augers</u>		COMPILED BY <u>NK</u>			
DATUM <u>Geodetic</u>		DATE <u>November 7, 2011</u>		CHECKED BY <u>LCC</u>			

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Continued Next Page

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

○ 3% STRAIN AT FAILURE



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

PROJECT 09-1111-0018		RECORD OF BOREHOLE No SC-7		SHEET 3 OF 3		METRIC						
G.W.P. 2835-02-00		LOCATION N 4877117.8; E 297113.1		ORIGINATED BY SB/TT								
DIST Central HWY 400		BOREHOLE TYPE 108 mm Inside Diameter Hollow Stem Augers		COMPILED BY NK								
DATUM Geodetic		DATE November 7, 2011		CHECKED BY LCC								
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					
	--- CONTINUED FROM PREVIOUS PAGE ---											
188.4	SAND and SILT to SAND, trace to some silt, trace gravel and clay Very dense Grey Wet		24	SS	61	190						
32.3	CLAYEY SILT, trace sand, trace gravel, containing silt seams Hard Grey Moist		25	SS	52	187						1 1 65 33
182.3			26	SS	67	184						
38.4	SAND and GRAVEL, some silt, trace clay Very dense Grey Wet		27	SS	87	181						47 39 13 1
180.6	END OF BOREHOLE											
40.1	NOTES: 1. Blowing sands and artesian conditions encountered below a depth of 15.7 m (Elev. 205.0m). 2. Tricone and wash boring used below a depth of 15.2 m (Elev. 205.5 m) due to artesian conditions in the sand layer. 3. Artesian pressure up to 1.5 m above ground surface (Elev. 222.2 m) noted during removal of hollow stem augers. 4. Borehole caved at a depth of 36.6 m (Elev. 184.1 m) on completion of drilling. 5. Borehole abandoned using cement grout, with 3 m of bentonite placed above the grout immediately below ground surface.											

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

PROJECT 09-1111-0018		RECORD OF BOREHOLE No B0-9		SHEET 1 OF 2	METRIC
G.W.P. 2835-02-00		LOCATION N 4877161.8; E 297169.1		ORIGINATED BY TZ	
DIST Central HWY 400		BOREHOLE TYPE 108 mm Inside Diameter Hollow Stem Augers		COMPILED BY NK	
DATUM Geodetic		DATE November 14-15, 2011		CHECKED BY LCC	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _P W W _L				
								SHEAR STRENGTH kPa		WATER CONTENT (%)				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED							
221.0	GROUND SURFACE													
0.0	TOPSOIL													
0.1	CLAYEY SILT, trace gravel, trace sand, containing organics													
	Firm		1	SS	5									
	Brown													
	Moist													
219.5														
1.5	PEAT (Amorphous), containing rootlets and decomposed wood fragments, containing clayey silt seams		2	SS	4									
	Firm													
	Black													
218.4	Moist		3	SS	7									
2.6	CLAYEY SILT, trace to some sand													
	Firm to stiff		4	SS	9									
	Grey													
	Moist													
			5	SS	2									

Continued Next Page

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

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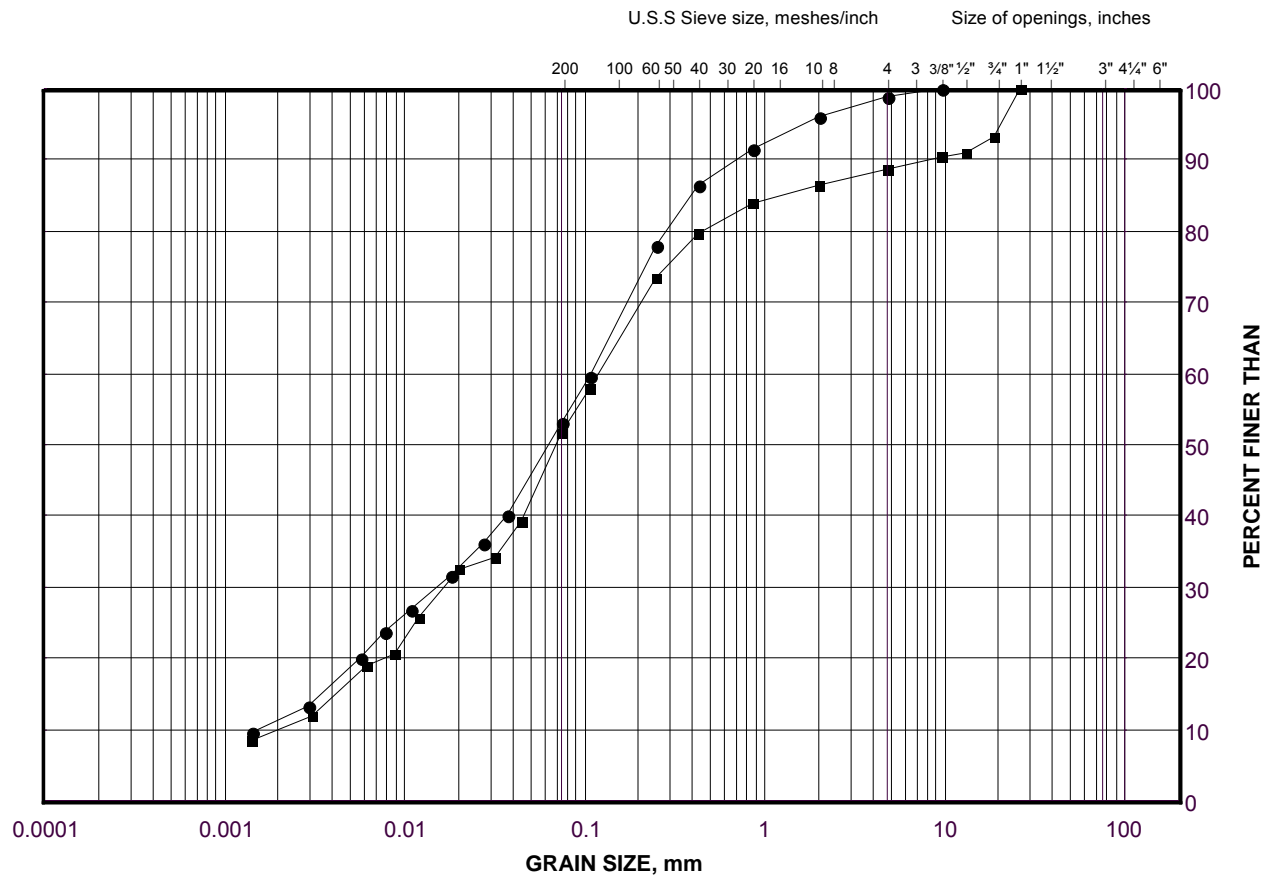


+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

Sand and Silt (Fill)

FIGURE B1



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

LEGEND

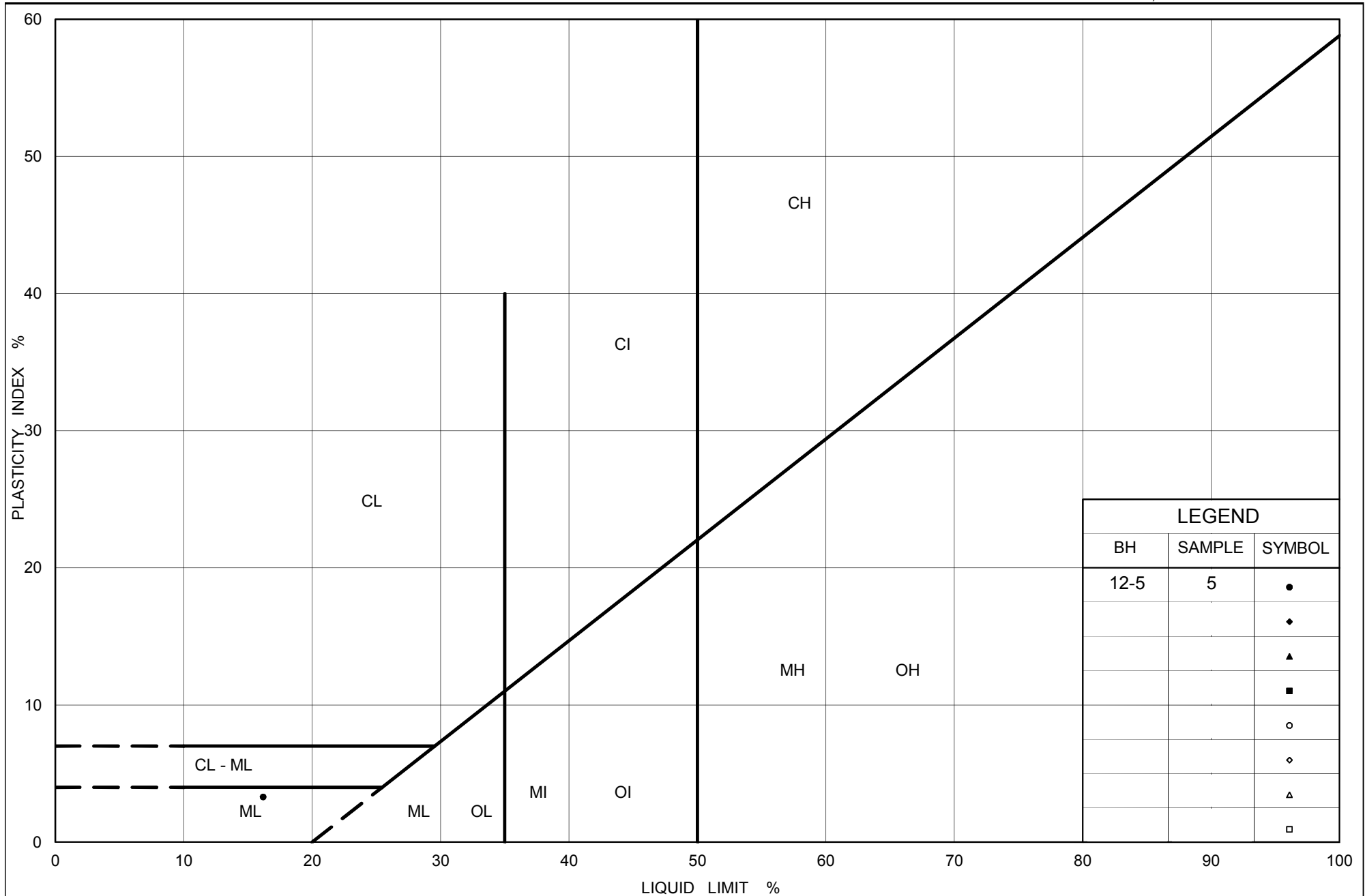
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-3	2	221.7
■	12-5	5	218.6

Project Number: 09-1111-0018

Checked By: _____

Golder Associates

Date: 25-Jan-13



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PLASTICITY CHART

Sand and Silt (Fill)

Figure No. B2

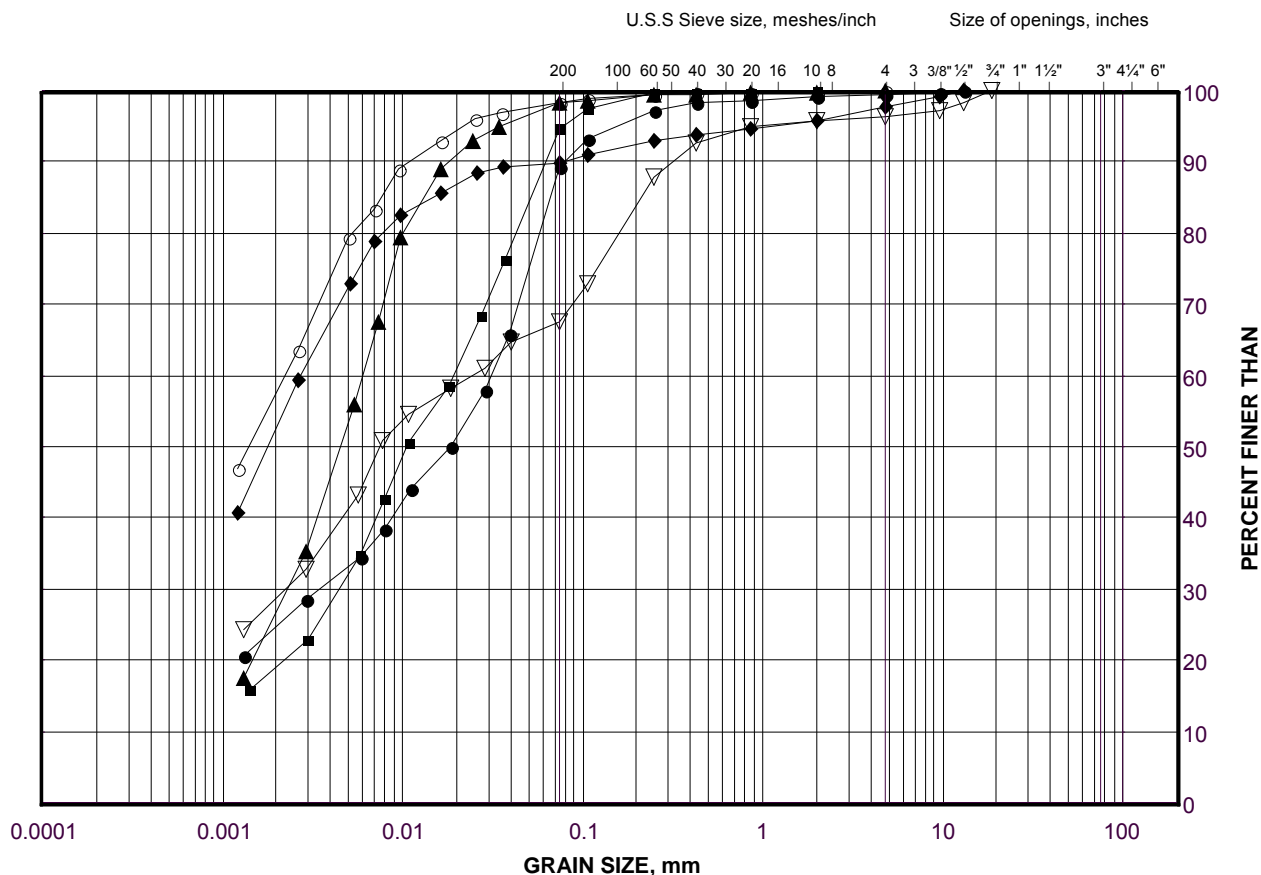
Project No. 09-1111-0018

Checked By: LCC

GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay (Upper Deposit)

FIGURE B3A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-5	10	211.0
■	12-3	10	214.0
◆	12-9	10	208.5
▲	BO-9	10	210.0
▽	SC-5	11	207.1
○	12-6	12	207.2

Project Number: 09-1111-0018

Checked By: LCC

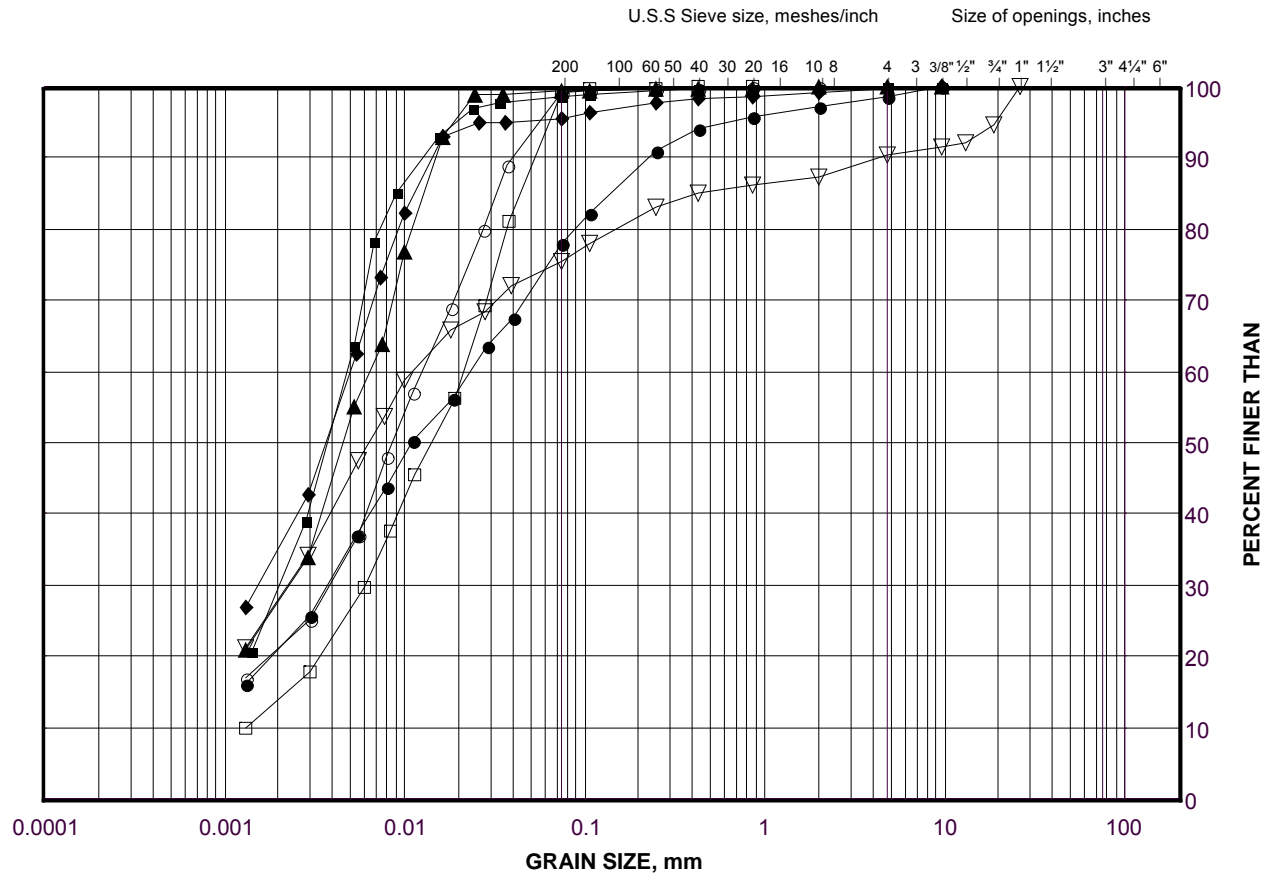
Golder Associates

Date: 08-Feb-13

GRAIN SIZE DISTRIBUTION

Clayey Silt

FIGURE B3B



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SC-7	12	208.2
■	SC-8	12	208.0
◆	12-7	13	206.4
▲	12-4	14	203.9
▽	12-9	16	199.4
○	12-7	4	217.8
□	SC-8	4	217.9

Project Number: 09-1111-0018

Checked By: LCC

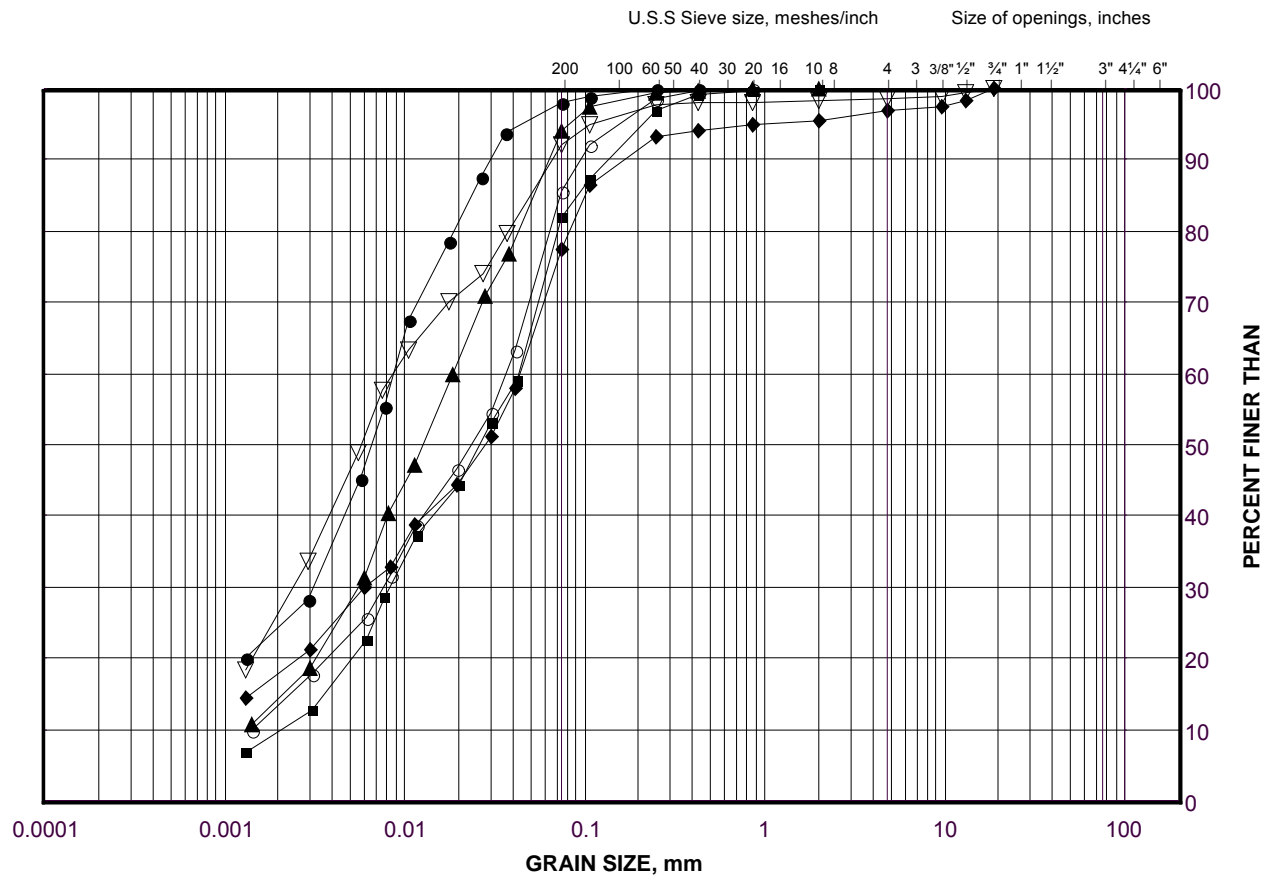
Golder Associates

Date: 25-Jan-13

GRAIN SIZE DISTRIBUTION

Clayey Silt

FIGURE B3C



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

LEGEND

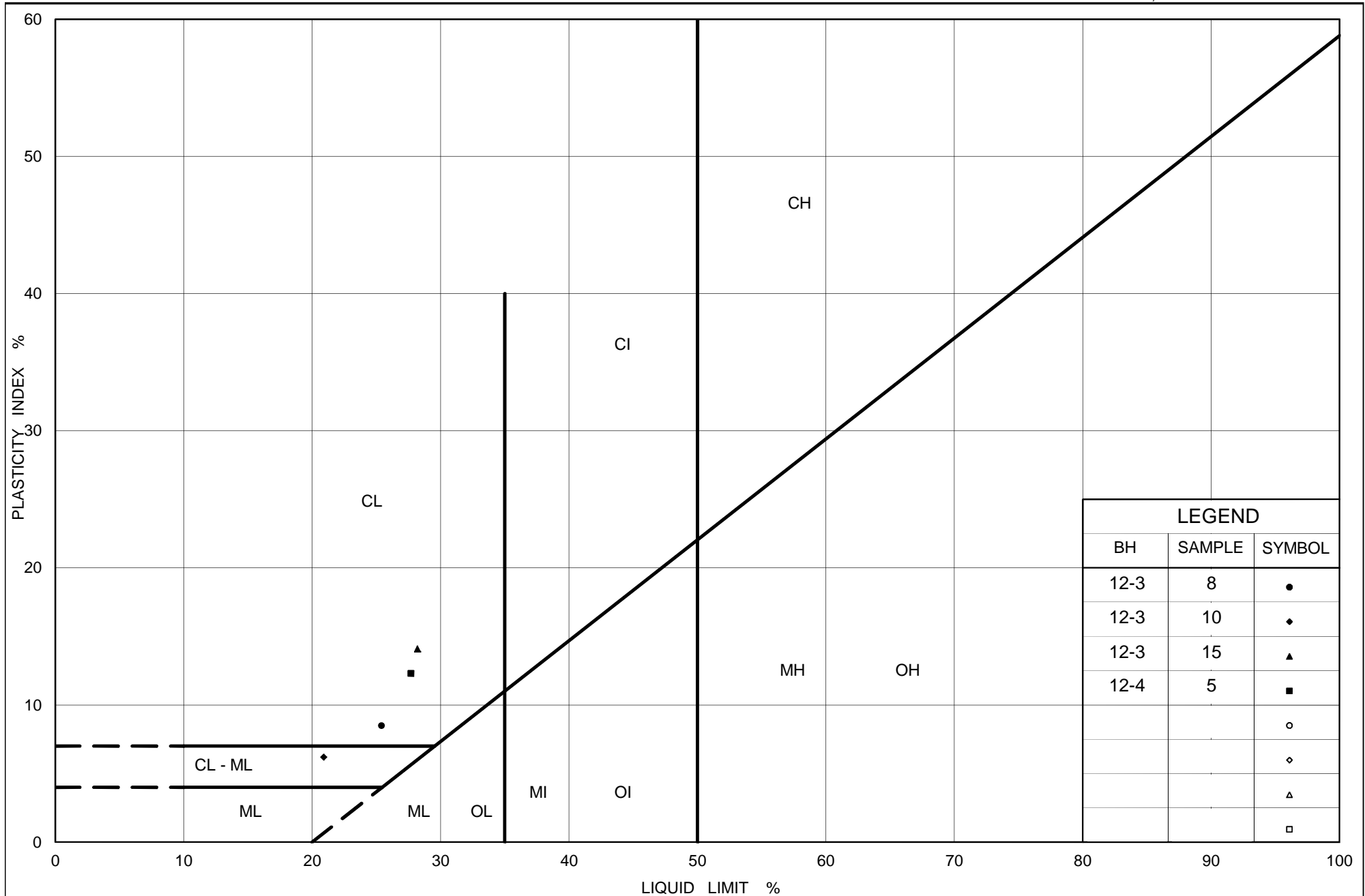
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-4	5	216.2
■	BO-9	5	216.9
◆	12-6	6	215.6
▲	SC-7	6	216.7
▽	SC-5	6	216.2
○	SC-8	8	214.1

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 10-Jul-13



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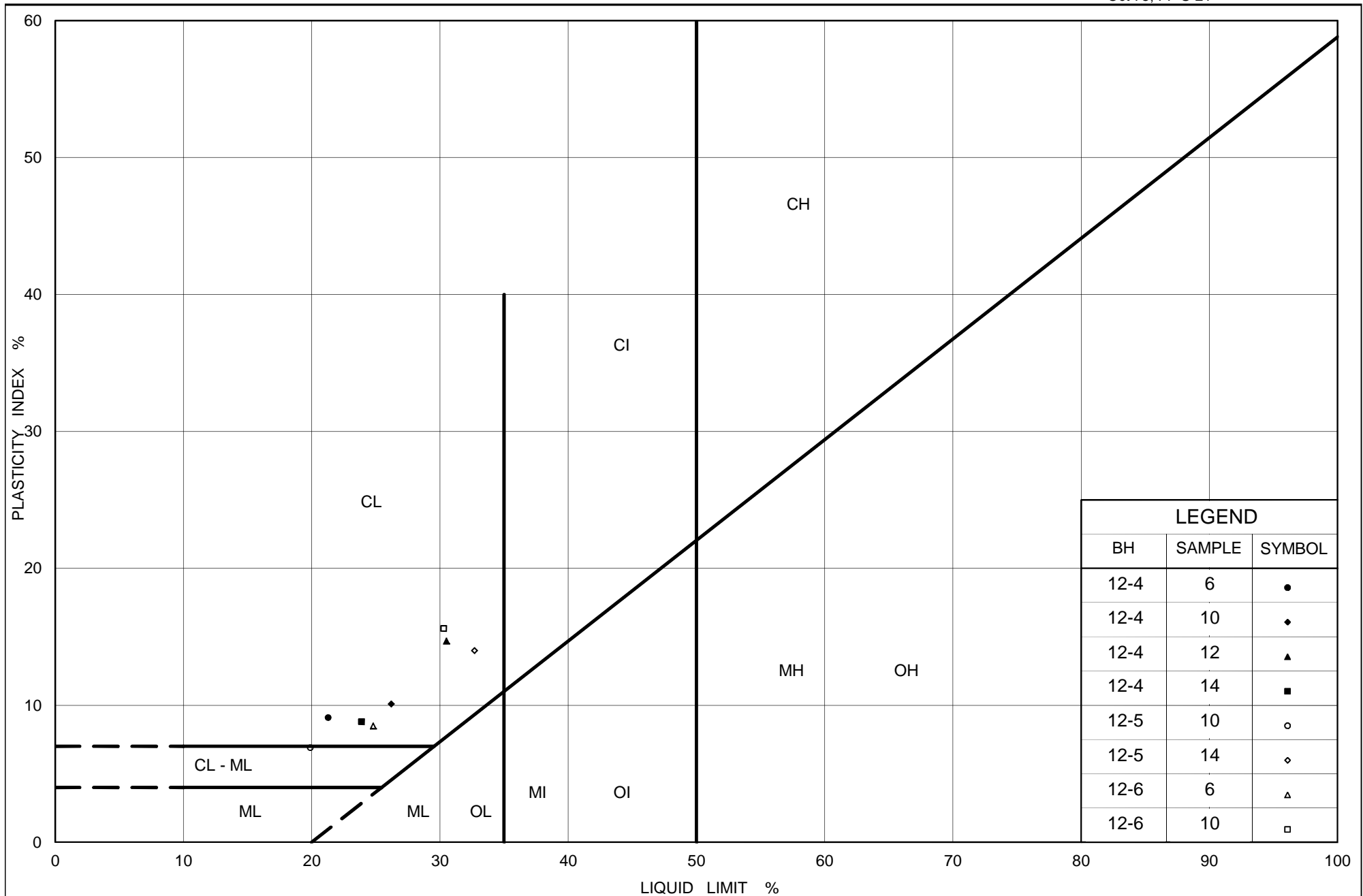
PLASTICITY CHART

Clayey Silt

Figure No. B4A

Project No. 09-1111-0018

Checked By: LCC



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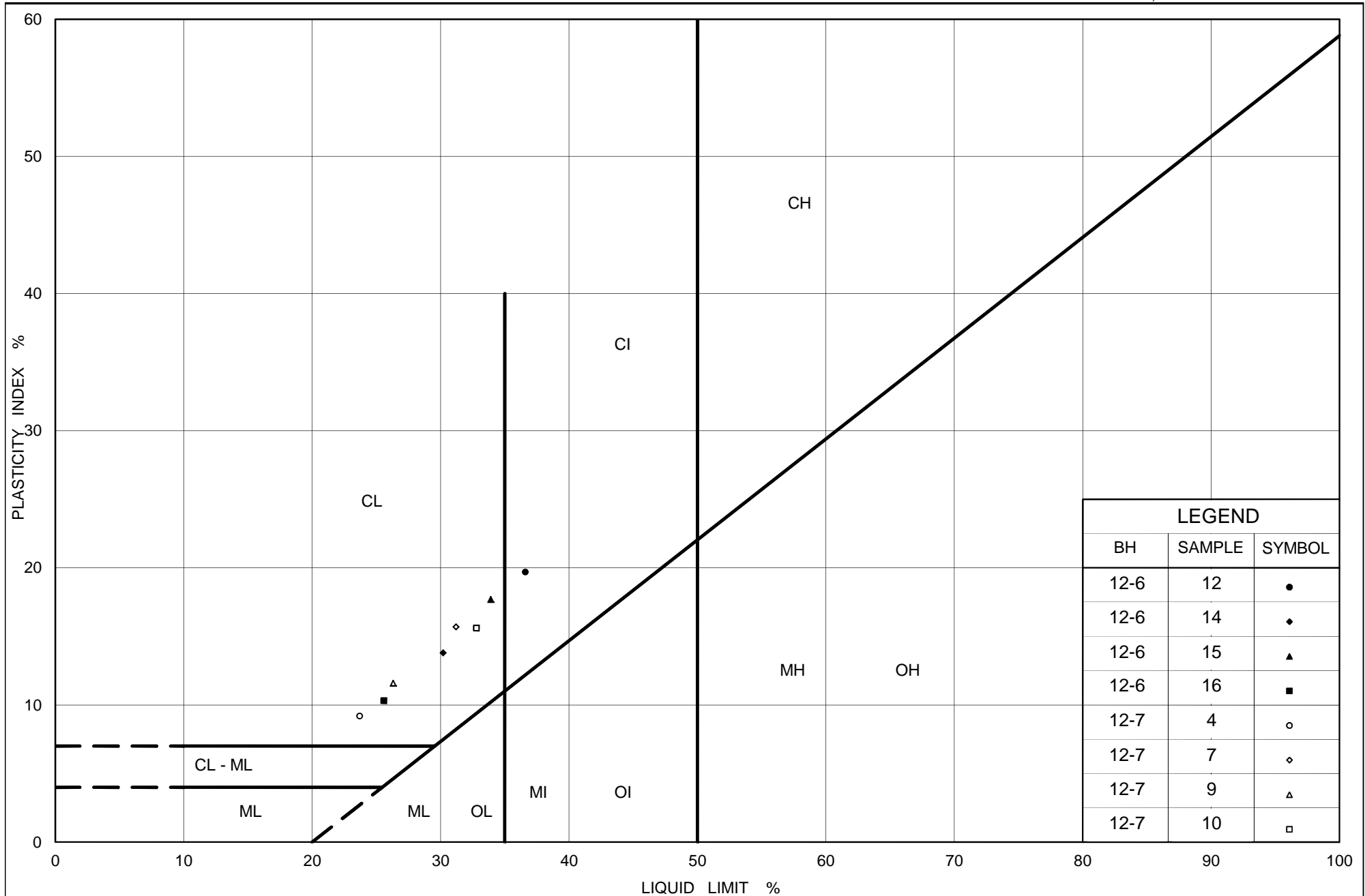
PLASTICITY CHART

Clayey Silt

Figure No. B4B

Project No. 09-1111-0018

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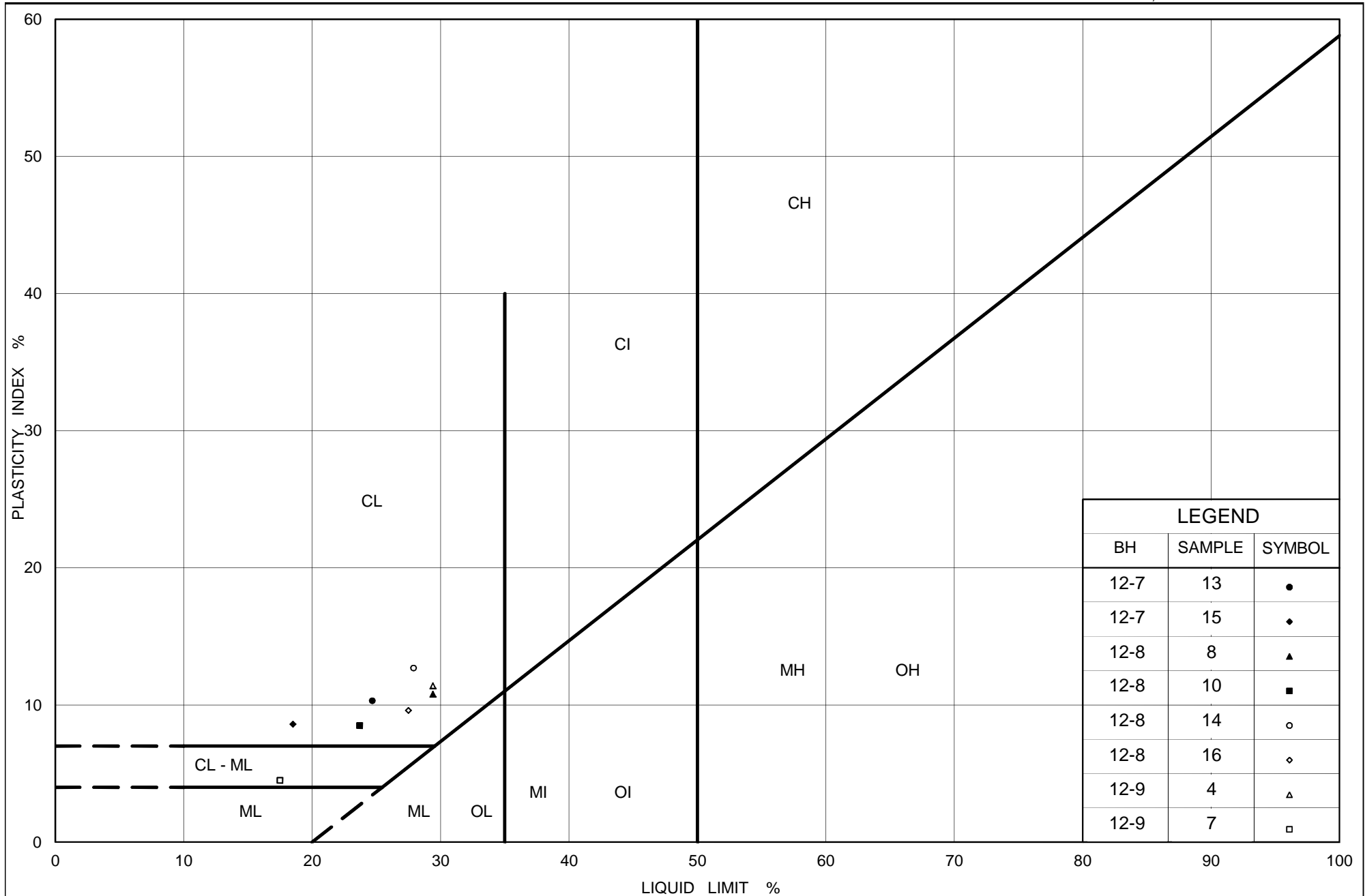
Ontario

PLASTICITY CHART Clayey Silt to Silty Clay

Figure No. B4C

Project No. 09-1111-0018

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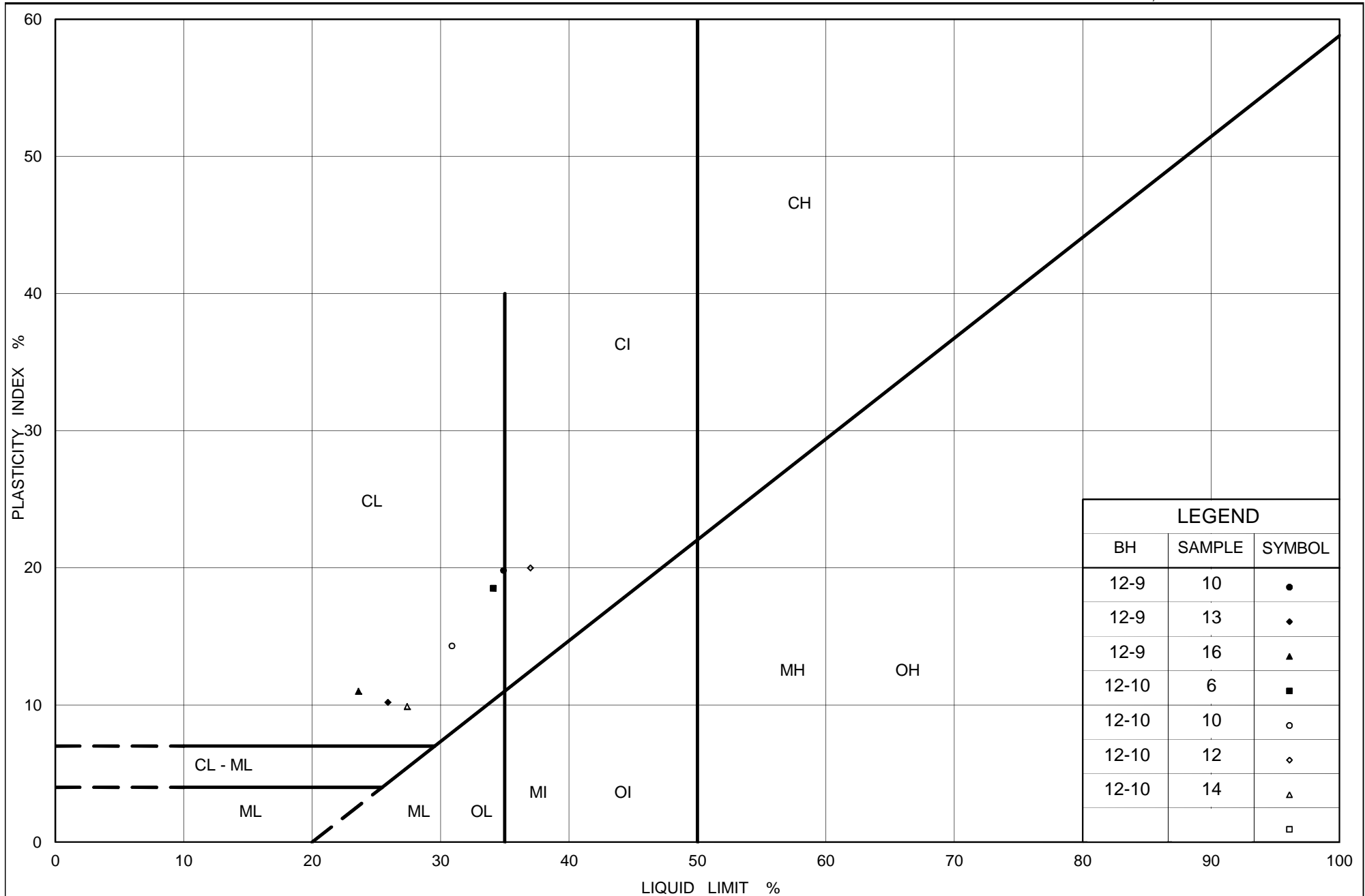
Ontario

PLASTICITY CHART Clayey Silt

Figure No. B4D

Project No. 09-1111-0018

Checked By: LCC



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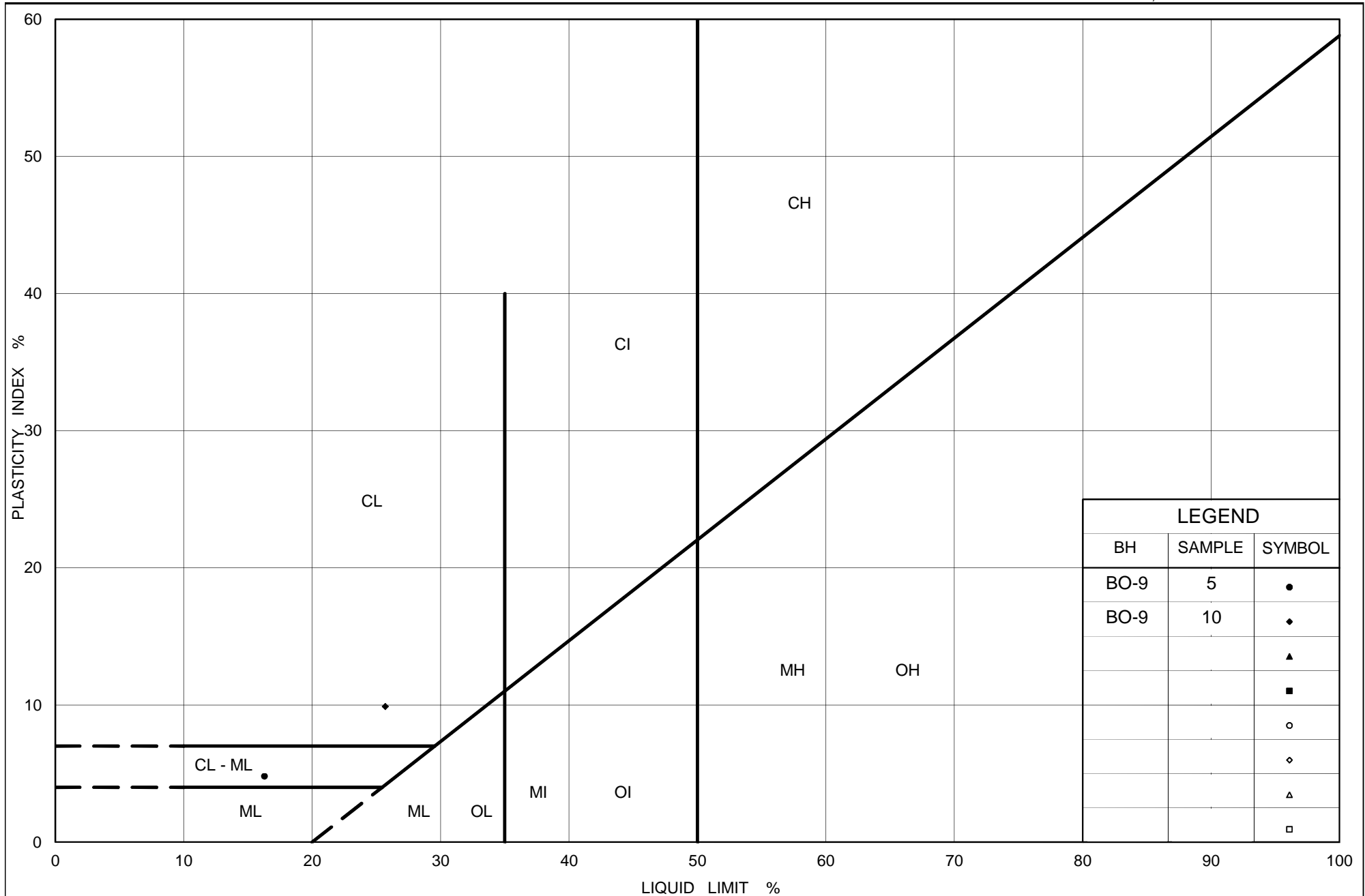
Ontario

PLASTICITY CHART Clayey Silt to Silty Clay

Figure No. B4E

Project No. 09-1111-0018

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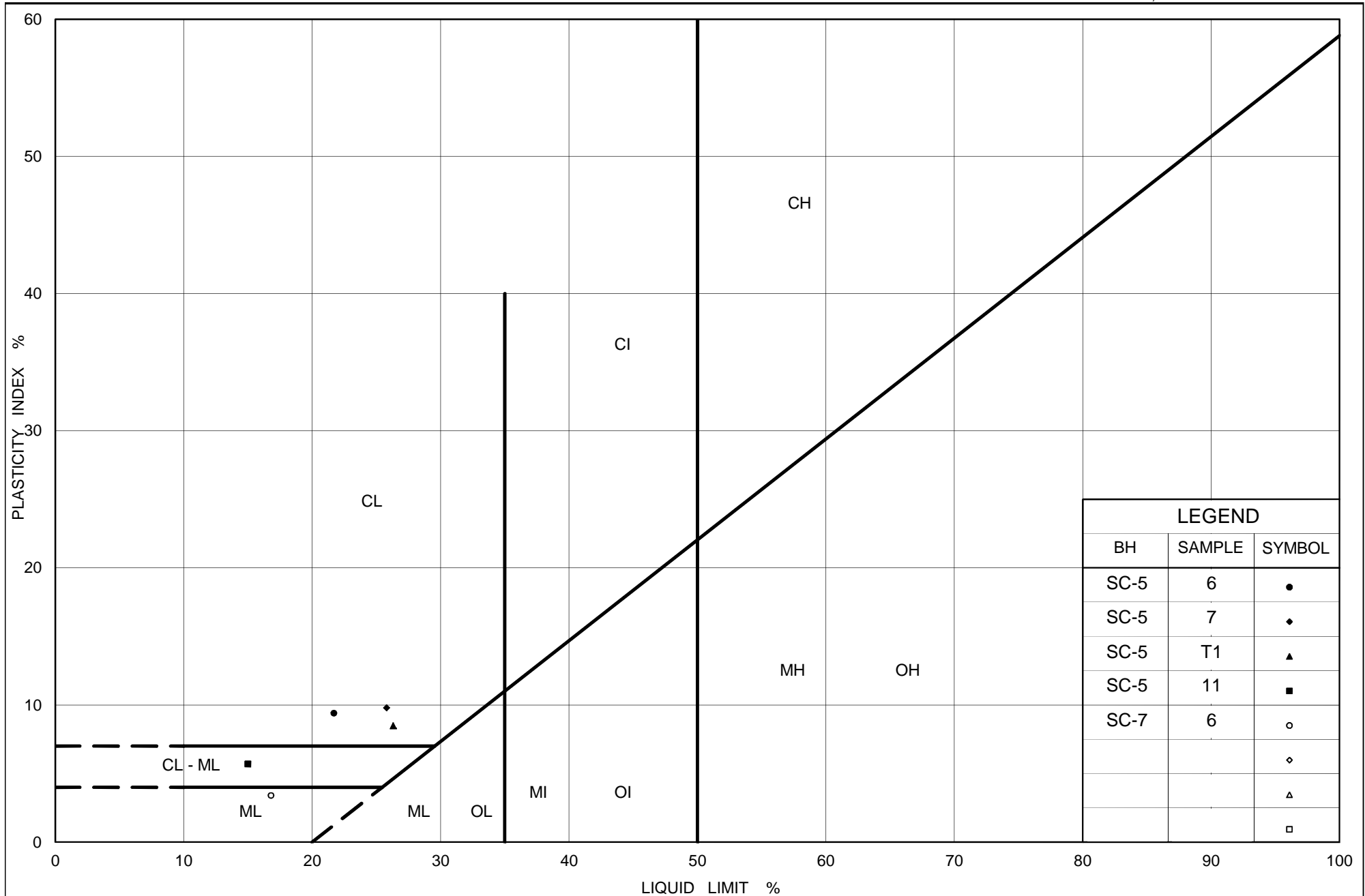
PLASTICITY CHART

Clayey Silt

Figure No. B4F

Project No. 09-1111-0018

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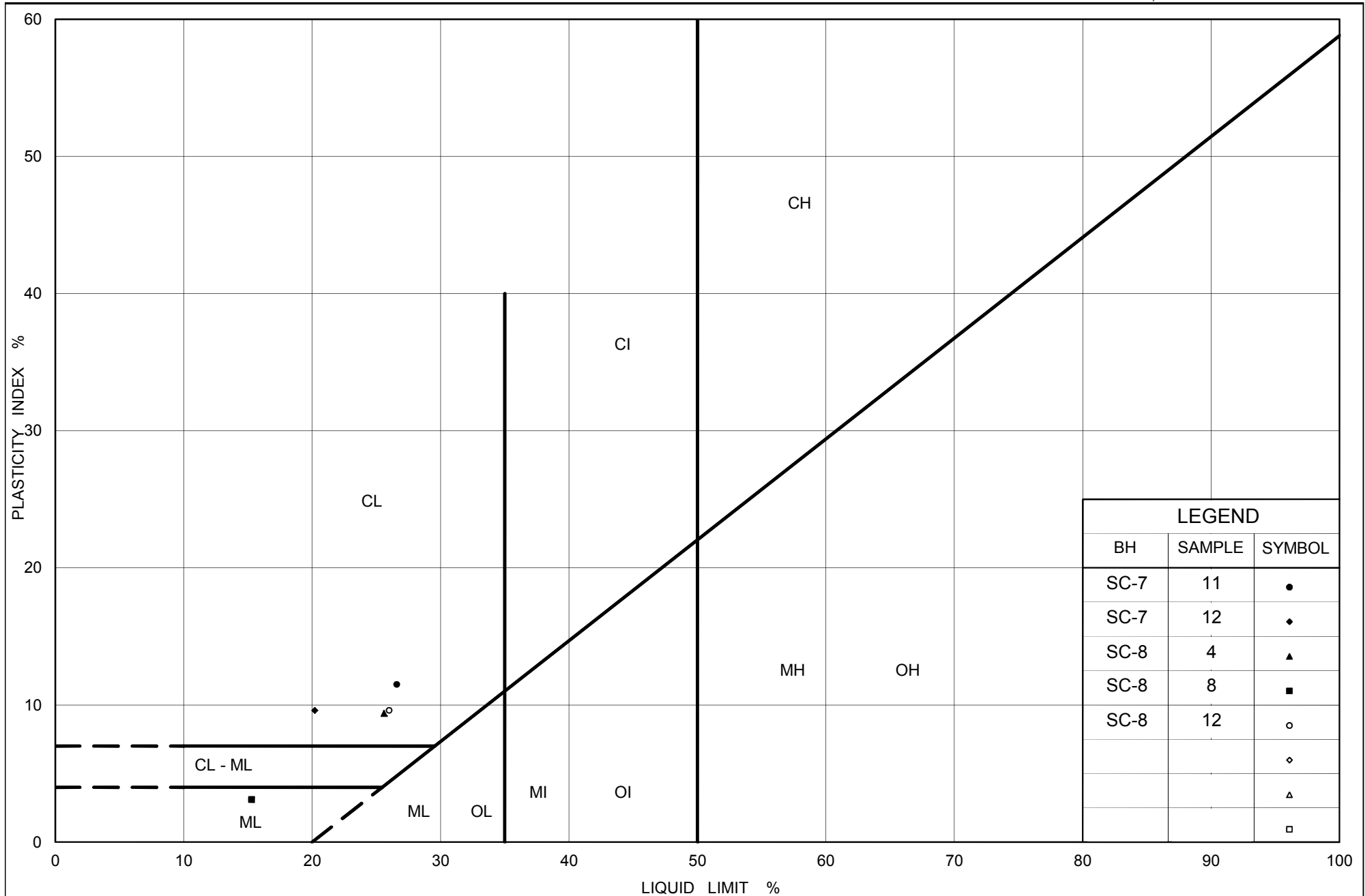
PLASTICITY CHART

Clayey Silt

Figure No. B4G

Project No. 09-1111-0018

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PLASTICITY CHART Clayey Silt

Figure No. B4H

Project No. 09-1111-0018

Checked By: LCC

CONSOLIDATION TEST SUMMARY**FIGURE B5**
Sheet 1 of 4**SAMPLE IDENTIFICATION**

Project Number	09-1111-0018	Sample Number	6
Borehole Number	12-4	Sample Depth, m	3.81-4.27

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	11		
Date Started	06/11/2012		
Date Completed	06/25/2012		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.55	Unit Weight, kN/m ³	21.93
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	18.78
Area, cm ²	31.60	Specific Gravity, measured	2.75
Volume, cm ³	80.42	Solids Height, cm	1.772
Water Content, %	16.81	Volume of Solids, cm ³	55.99
Wet Mass, g	179.86	Volume of Voids, cm ³	24.43
Dry Mass, g	153.98	Degree of Saturation, %	105.9

TEST COMPUTATIONS

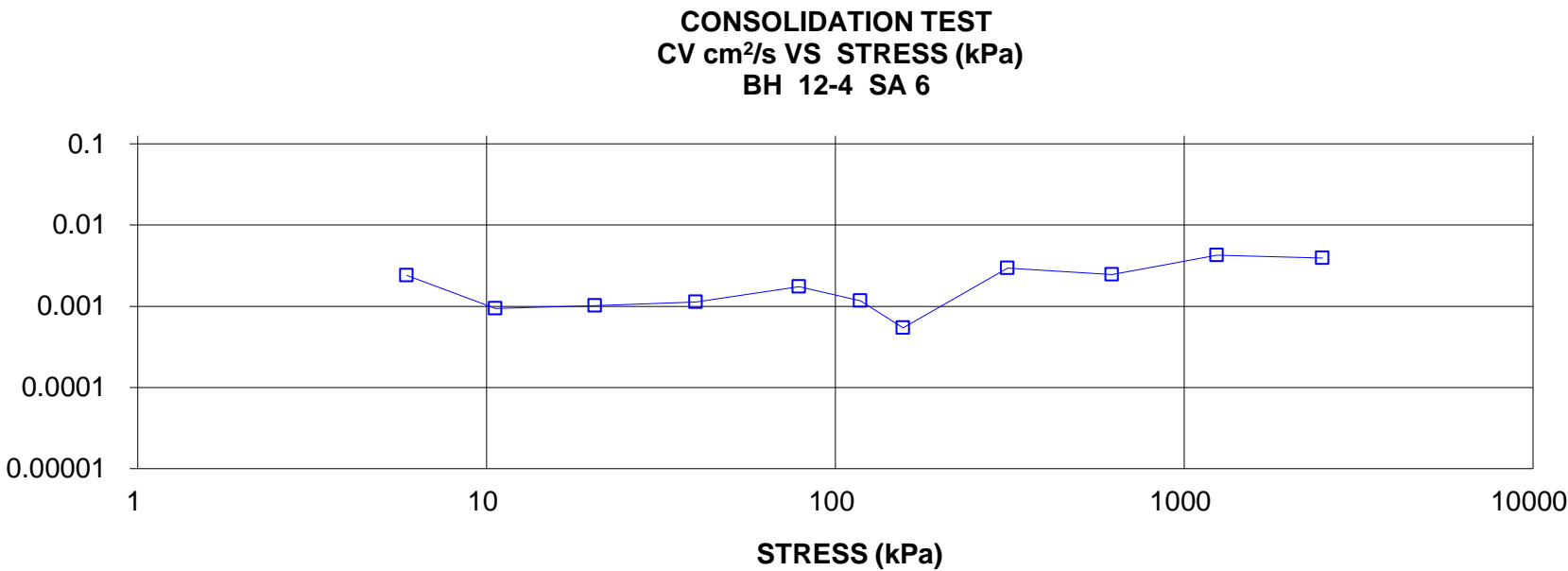
Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	cv. cm ² /s	mv m ² /kN	k cm/s
0.00	2.545	0.436	2.545				
5.90	2.487	0.403	2.516	558	2.40E-03	3.88E-03	9.13E-07
10.61	2.476	0.397	2.481	1382	9.44E-04	9.43E-04	8.72E-08
20.43	2.463	0.390	2.469	1270	1.02E-03	4.92E-04	4.91E-08
39.84	2.443	0.379	2.453	1135	1.12E-03	4.09E-04	4.50E-08
78.69	2.419	0.365	2.431	714	1.75E-03	2.40E-04	4.12E-08
117.76	2.404	0.357	2.412	1058	1.17E-03	1.51E-04	1.72E-08
156.27	2.392	0.350	2.398	2233	5.46E-04	1.22E-04	6.55E-09
311.22	2.360	0.332	2.376	406	2.95E-03	8.29E-05	2.40E-08
620.94	2.323	0.311	2.341	470	2.47E-03	4.63E-05	1.12E-08
1240.62	2.286	0.290	2.304	265	4.25E-03	2.37E-05	9.85E-09
2489.67	2.245	0.267	2.266	277	3.93E-03	1.28E-05	4.92E-09
1240.62	2.246	0.268	2.246				
311.22	2.263	0.277	2.255				
78.69	2.279	0.286	2.271				
20.43	2.305	0.301	2.292				
5.90	2.321	0.310	2.313				

Note:
k calculated using cv based on t₉₀ values.

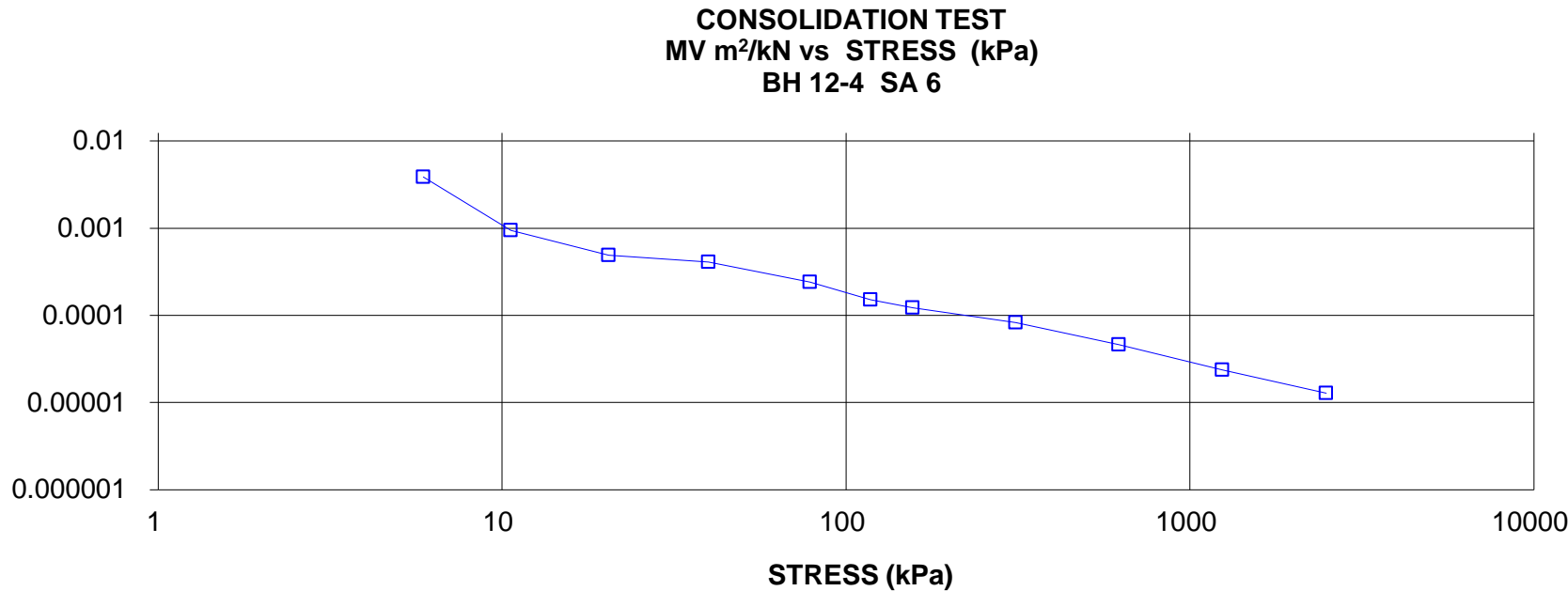
SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.32	Unit Weight, kN/m ³	23.41
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	20.59
Area, cm ²	31.60	Specific Gravity, measured	2.75
Volume, cm ³	73.35	Solids Height, cm	1.772
Water Content, %	13.73	Volume of Solids, cm ³	55.99
Wet Mass, g	175.12	Volume of Voids, cm ³	17.36
Dry Mass, g	153.98		

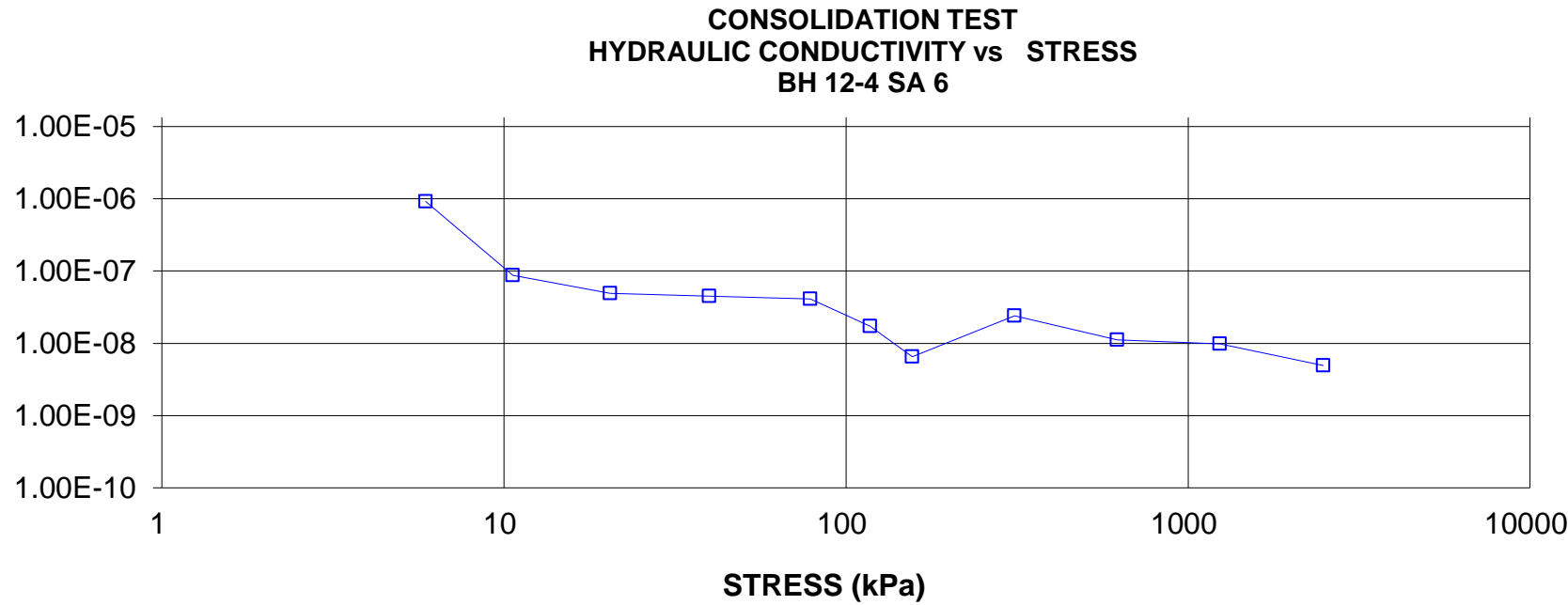
COEFFICIENT OF CONSOLIDATION,
cm²/s

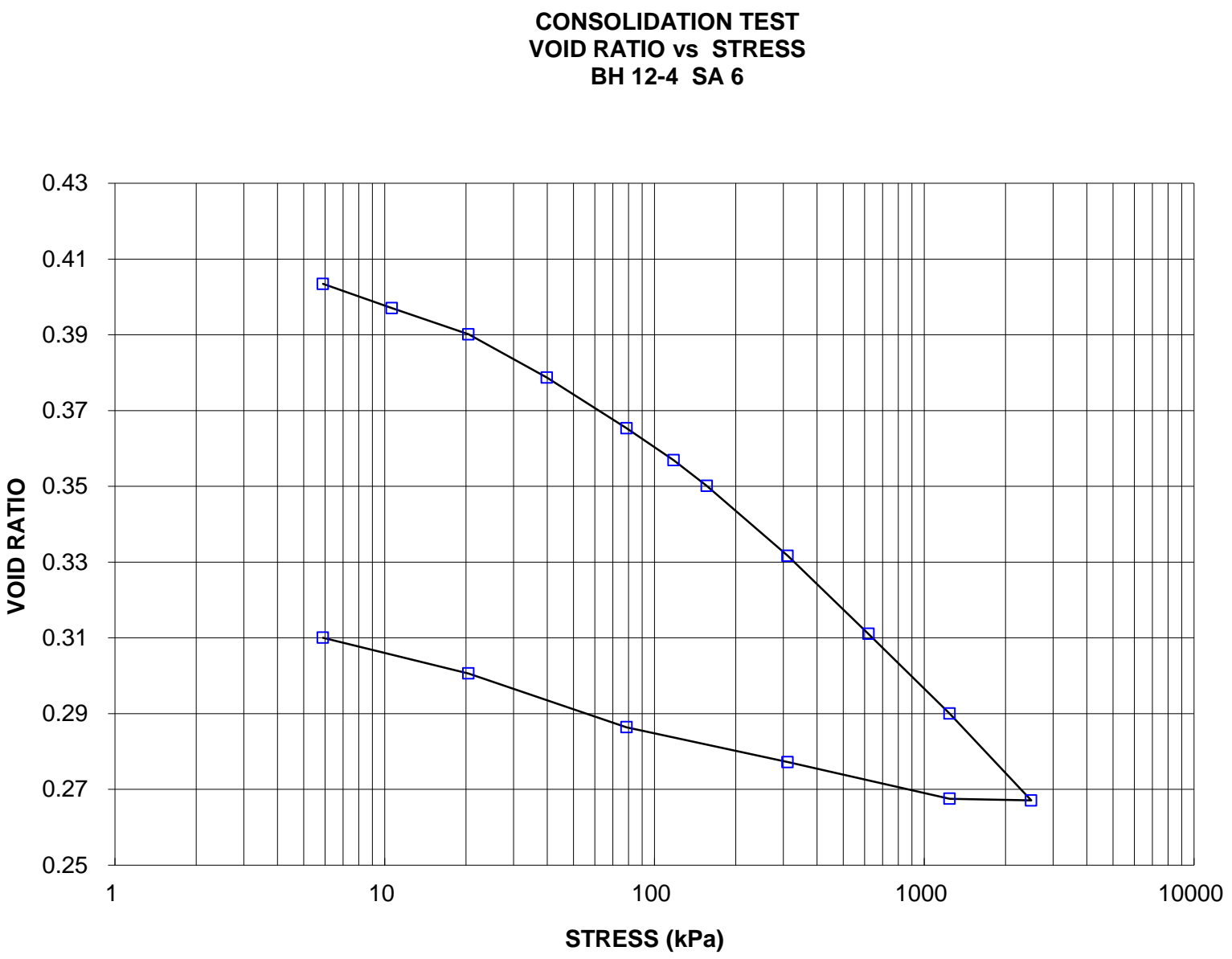


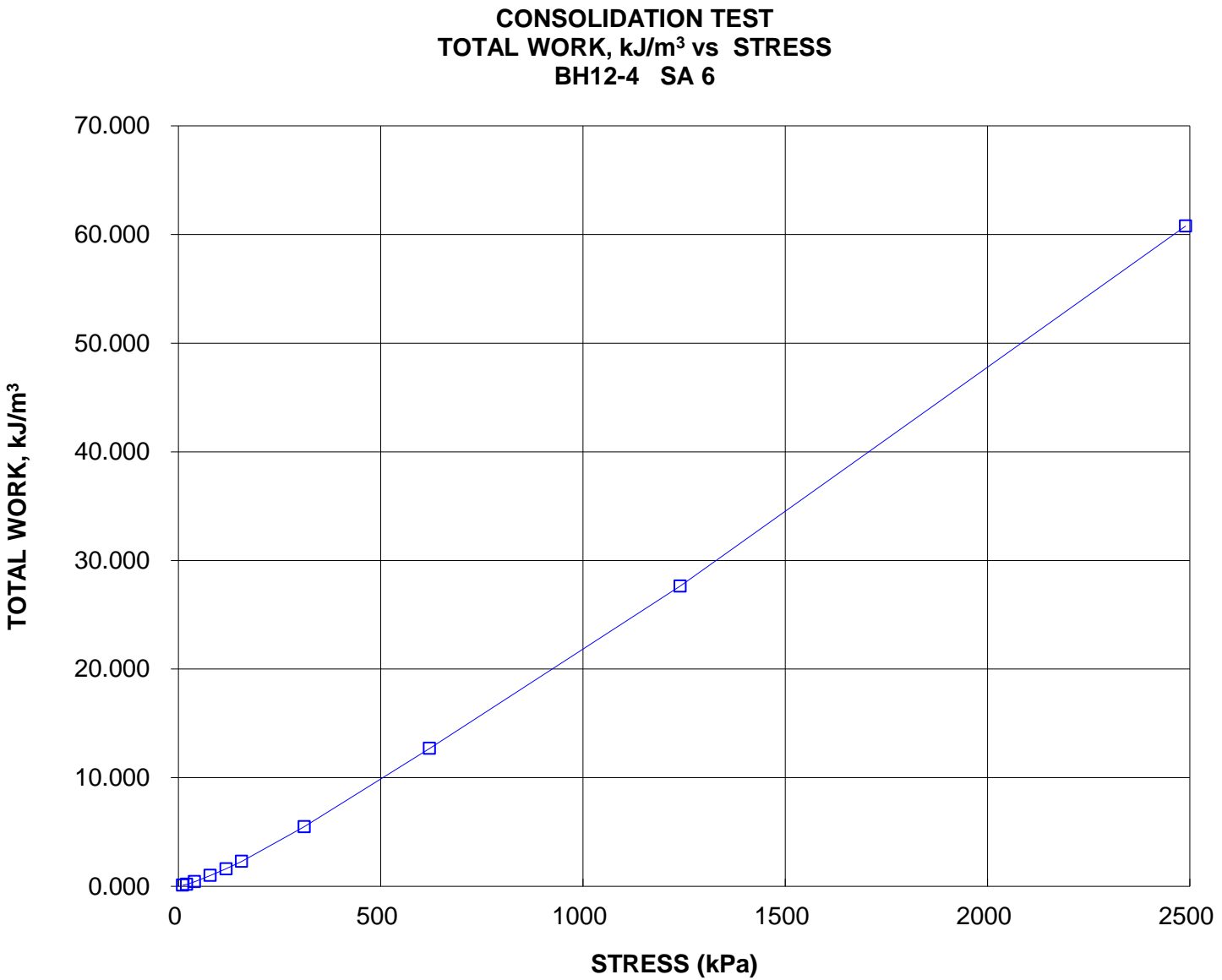
VOLUME COMPRESSIBILITY, m²/kN



HYDRAULIC CONDUCTIVITY,
cm/s







CONSOLIDATION TEST SUMMARY

FIGURE B6
Sheet 1 of 4

SAMPLE IDENTIFICATION

Project Number	09-1111-0018	Sample Number	15
Borehole Number	12-6	Sample Depth, m	16.01-16.62

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	4		
Date Started	06/11/2012		
Date Completed	06/28/2012		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m ³	18.28
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	13.28
Area, cm ²	31.53	Specific Gravity, measured	2.78
Volume, cm ³	80.02	Solids Height, cm	1.237
Water Content, %	37.63	Volume of Solids, cm ³	38.99
Wet Mass, g	149.18	Volume of Voids, cm ³	41.03
Dry Mass, g	108.39	Degree of Saturation, %	99.4

TEST COMPUTATIONS

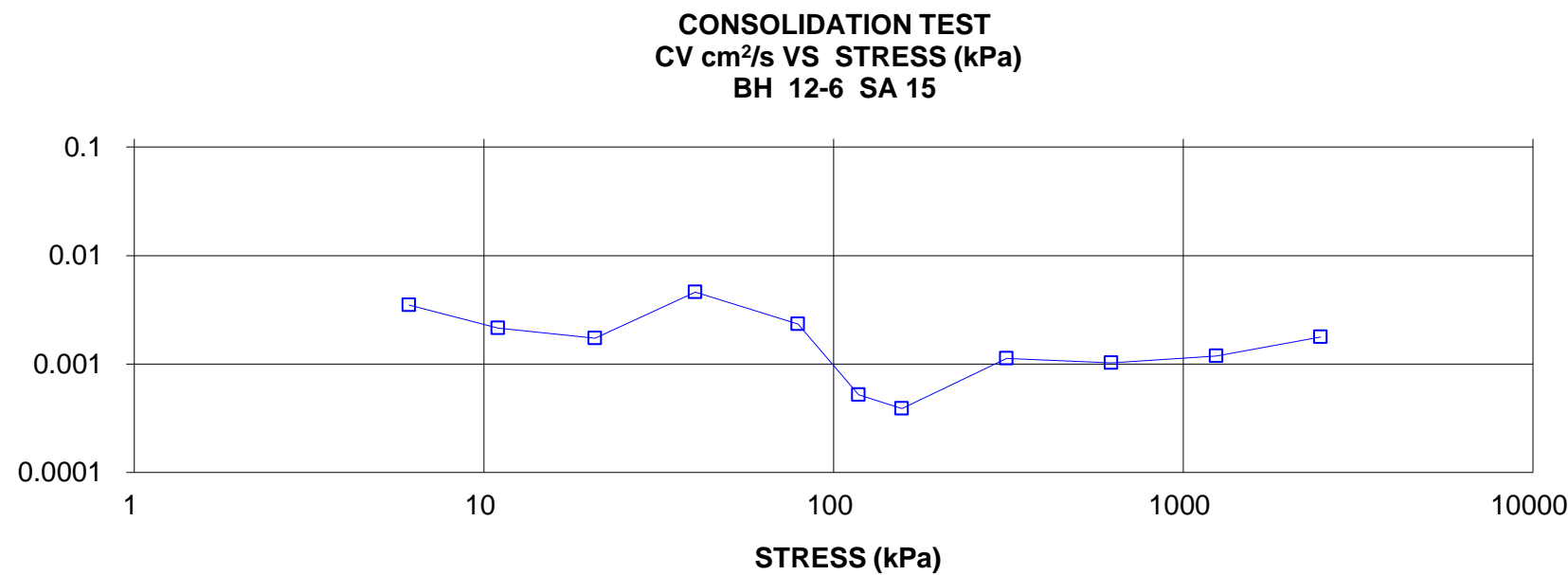
Stress	Corr. Height	Void Ratio	Average Height	t ₉₀ sec	cv. cm ² /s	mv m ² /kN	k cm/s
kPa	cm		cm				
0.00	2.538	1.052	2.538				
6.11	2.533	1.049	2.536	390	3.49E-03	3.10E-04	1.06E-07
10.97	2.528	1.044	2.530	634	2.14E-03	4.62E-04	9.70E-08
20.76	2.517	1.035	2.522	778	1.73E-03	4.31E-04	7.32E-08
40.25	2.497	1.019	2.507	290	4.59E-03	4.00E-04	1.80E-07
79.12	2.468	0.996	2.483	558	2.34E-03	2.93E-04	6.72E-08
117.90	2.444	0.977	2.456	2458	5.20E-04	2.41E-04	1.23E-08
156.77	2.423	0.959	2.434	3241	3.87E-04	2.20E-04	8.35E-09
312.68	2.315	0.872	2.369	1058	1.12E-03	2.73E-04	3.01E-08
623.18	2.150	0.739	2.232	1033	1.02E-03	2.09E-04	2.09E-08
1243.60	2.030	0.641	2.090	778	1.19E-03	7.65E-05	8.92E-09
2475.35	1.929	0.560	1.979	470	1.77E-03	3.20E-05	5.55E-09
1243.60	1.935	0.565	1.932				
312.68	1.973	0.596	1.954				
79.12	2.020	0.633	1.996				
20.76	2.065	0.670	2.042				
6.27	2.105	0.703	2.085				

Note:
k calculated using cv based on t₉₀ values.

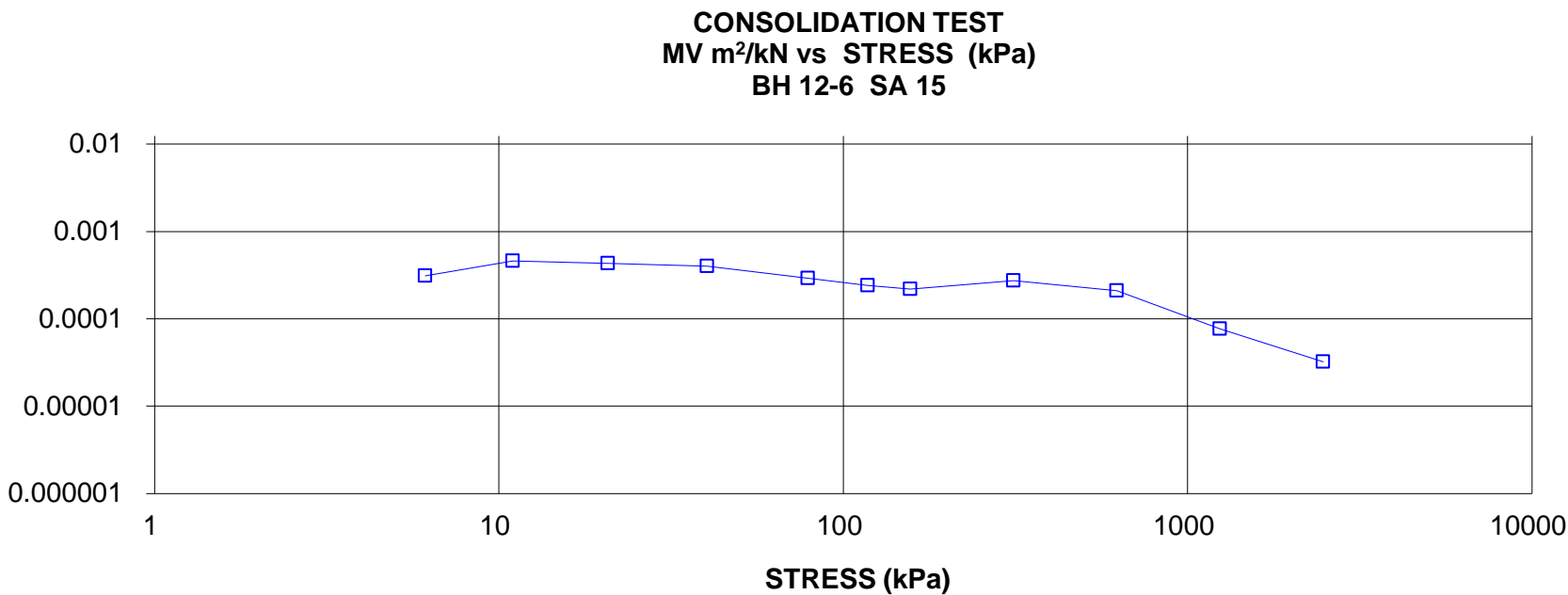
SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.11	Unit Weight, kN/m ³	20.19
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	16.01
Area, cm ²	31.53	Specific Gravity, measured	2.78
Volume, cm ³	66.38	Solids Height, cm	1.237
Water Content, %	26.09	Volume of Solids, cm ³	38.99
Wet Mass, g	136.67	Volume of Voids, cm ³	27.39
Dry Mass, g	108.39		

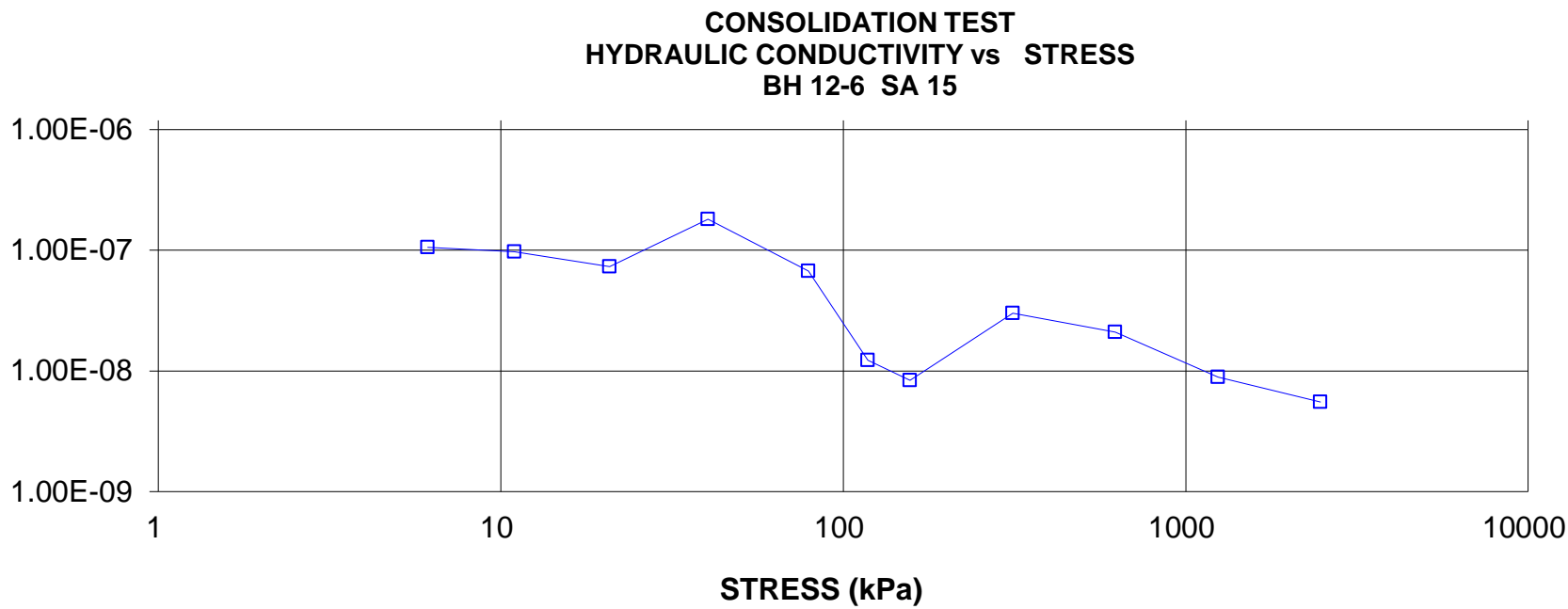
COEFFICIENT OF CONSOLIDATION,
cm²/s

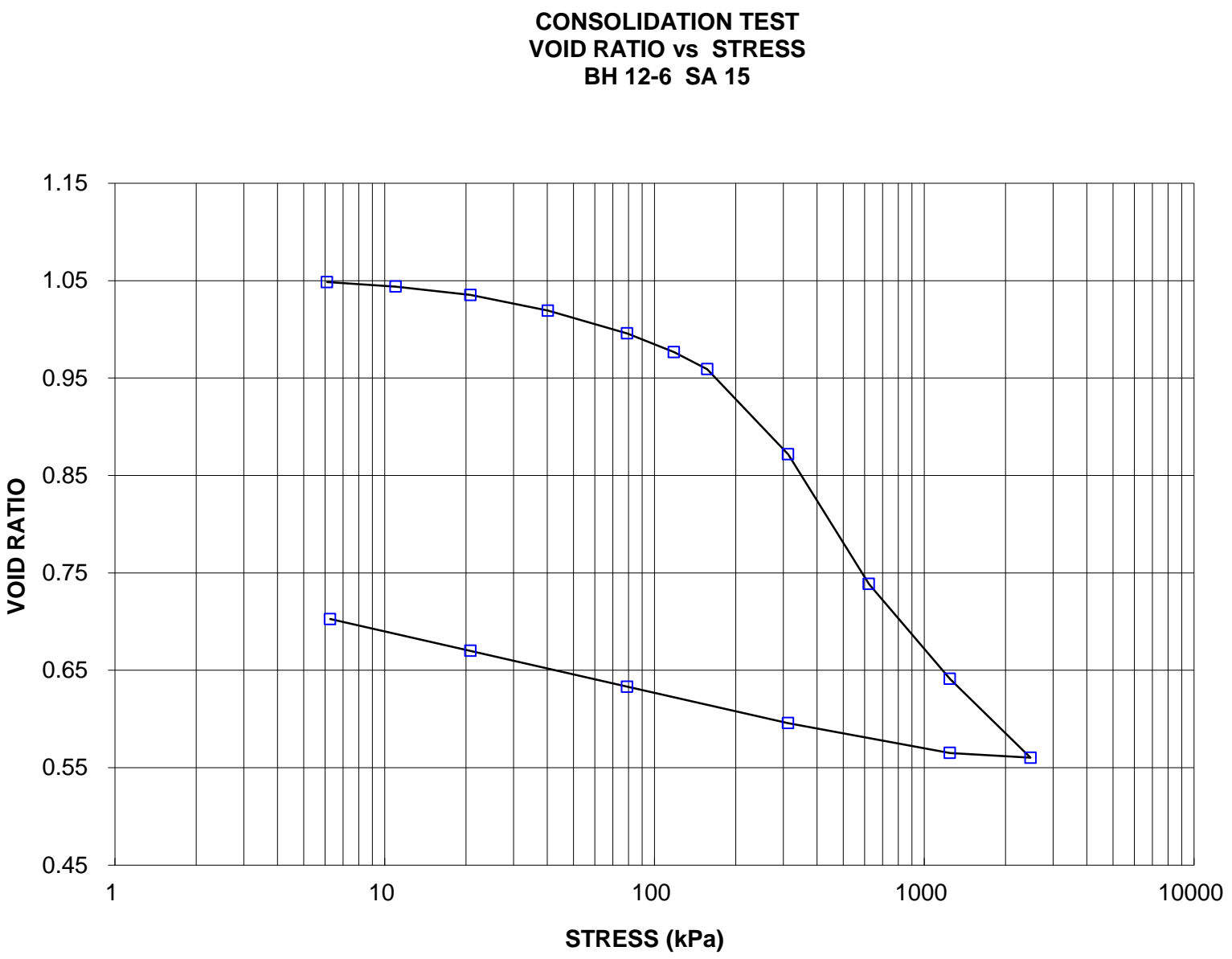


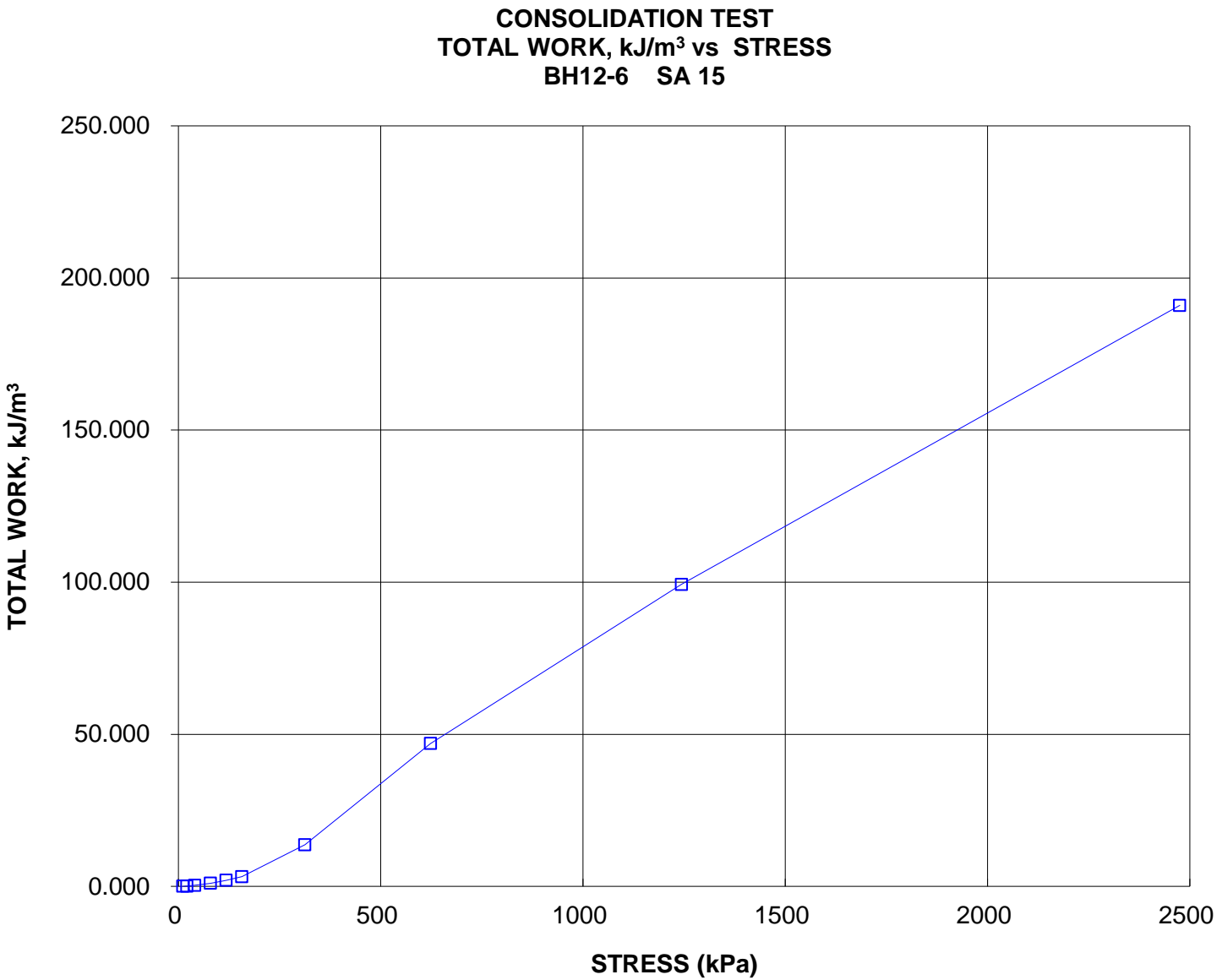
VOLUME COMPRESSIBILITY, m²/kN



HYDRAULIC CONDUCTIVITY,
cm/s







CONSOLIDATION TEST SUMMARY**FIGURE B7**
Sheet 1 of 4**SAMPLE IDENTIFICATION**

Project Number	09-1111-0018	Sample Number	10
Borehole Number	12-7	Sample Depth, m	9.76-10.21

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	2		
Date Started	06/11/2012		
Date Completed	06/25/2012		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m ³	19.37
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	15.03
Area, cm ²	31.58	Specific Gravity, measured	2.77
Volume, cm ³	80.09	Solids Height, cm	1.403
Water Content, %	28.92	Volume of Solids, cm ³	44.30
Wet Mass, g	158.20	Volume of Voids, cm ³	35.79
Dry Mass, g	122.71	Degree of Saturation, %	99.2

TEST COMPUTATIONS

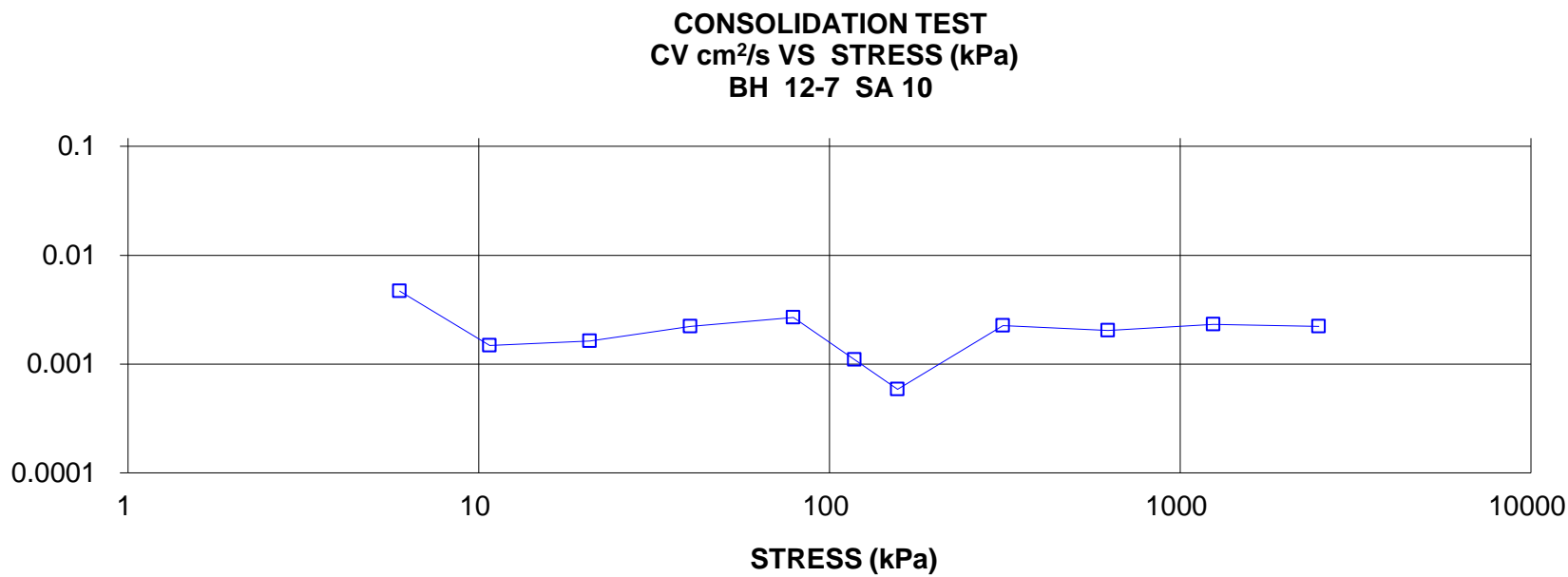
Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	cv. cm ² /s	mv m ² /kN	k cm/s
0.00	2.536	0.808	2.536				
5.95	2.529	0.803	2.533	290	4.69E-03	4.57E-04	2.10E-07
10.75	2.521	0.797	2.525	913	1.48E-03	6.33E-04	9.18E-08
20.72	2.510	0.789	2.516	821	1.63E-03	4.51E-04	7.22E-08
40.16	2.491	0.776	2.500	595	2.23E-03	3.87E-04	8.46E-08
78.90	2.467	0.758	2.479	487	2.67E-03	2.47E-04	6.48E-08
117.96	2.448	0.745	2.457	1162	1.10E-03	1.92E-04	2.07E-08
156.24	2.432	0.733	2.440	2160	5.84E-04	1.64E-04	9.38E-09
312.03	2.368	0.688	2.400	540	2.26E-03	1.61E-04	3.58E-08
621.92	2.269	0.618	2.319	558	2.04E-03	1.26E-04	2.52E-08
1242.60	2.183	0.556	2.226	454	2.31E-03	5.49E-05	1.24E-08
2487.10	2.103	0.499	2.143	437	2.23E-03	2.54E-05	5.54E-09
1242.56	2.104	0.500	2.103				
312.03	2.127	0.516	2.116				
78.90	2.151	0.533	2.139				
20.72	2.185	0.558	2.168				
5.95	2.206	0.573	2.196				

Note:
k calculated using cv based on t₉₀ values.

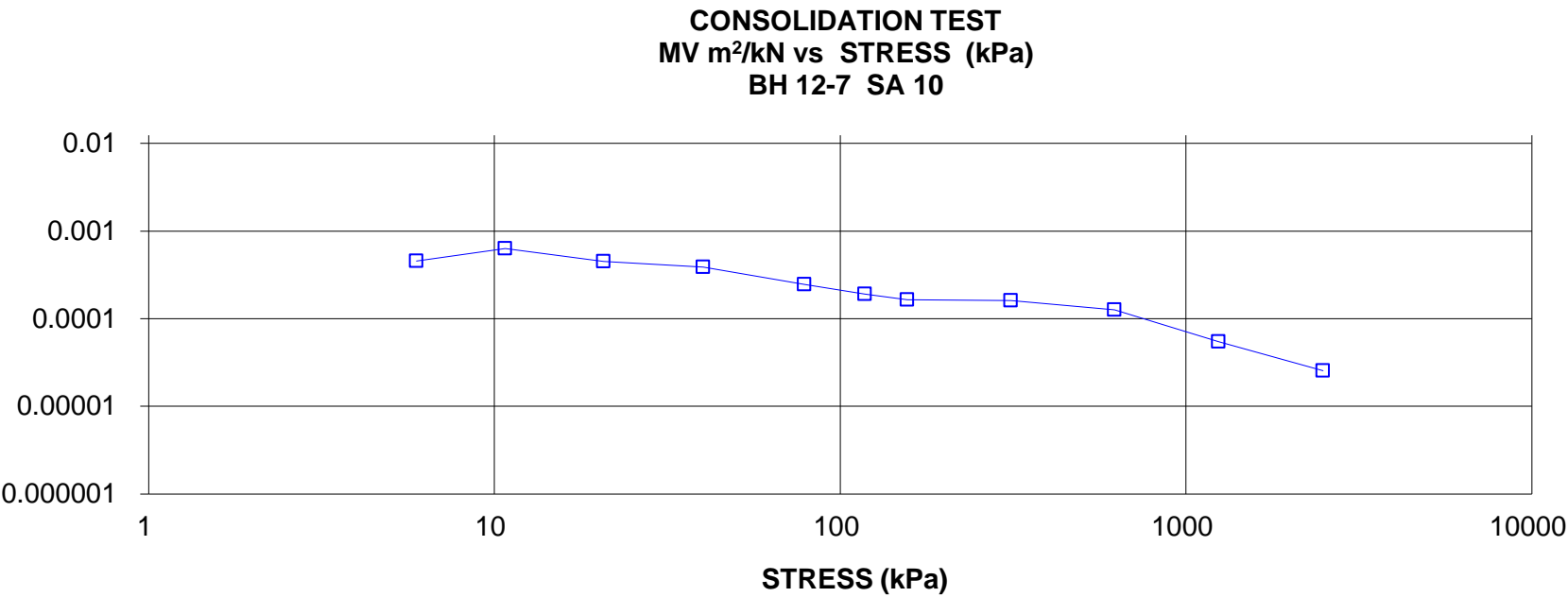
SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.21	Unit Weight, kN/m ³	21.02
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	17.27
Area, cm ²	31.58	Specific Gravity, measured	2.77
Volume, cm ³	69.67	Solids Height, cm	1.403
Water Content, %	21.69	Volume of Solids, cm ³	44.30
Wet Mass, g	149.32	Volume of Voids, cm ³	25.37
Dry Mass, g	122.71		

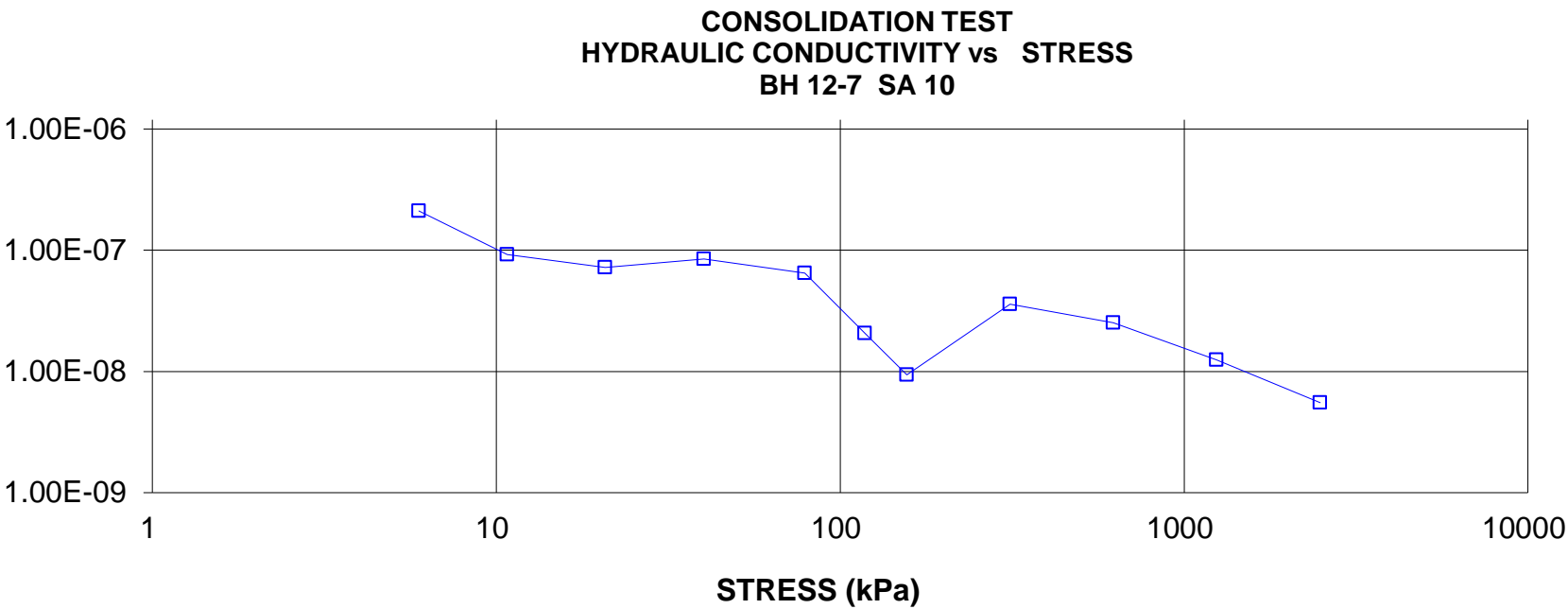
COEFFICIENT OF CONSOLIDATION,
cm²/s

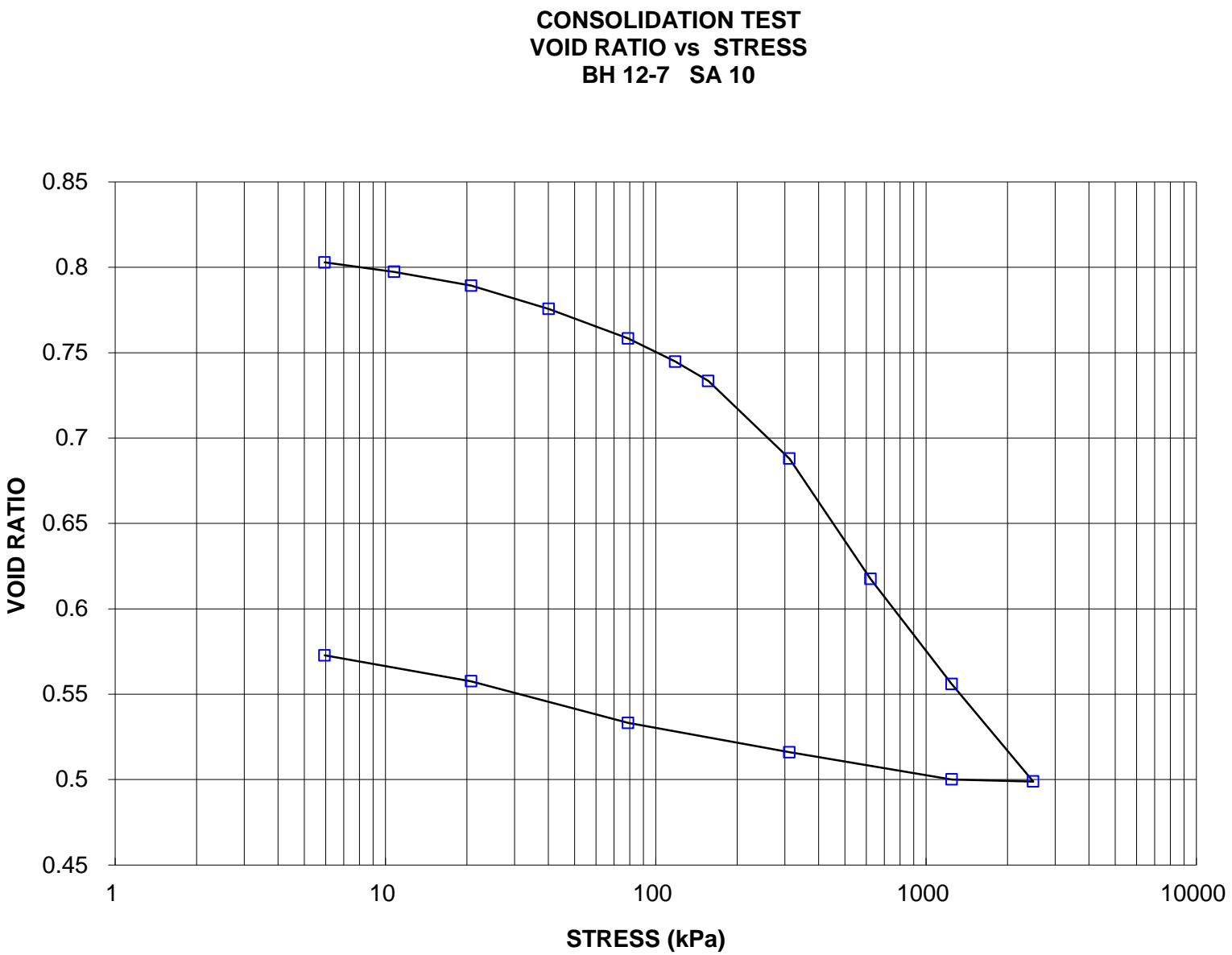


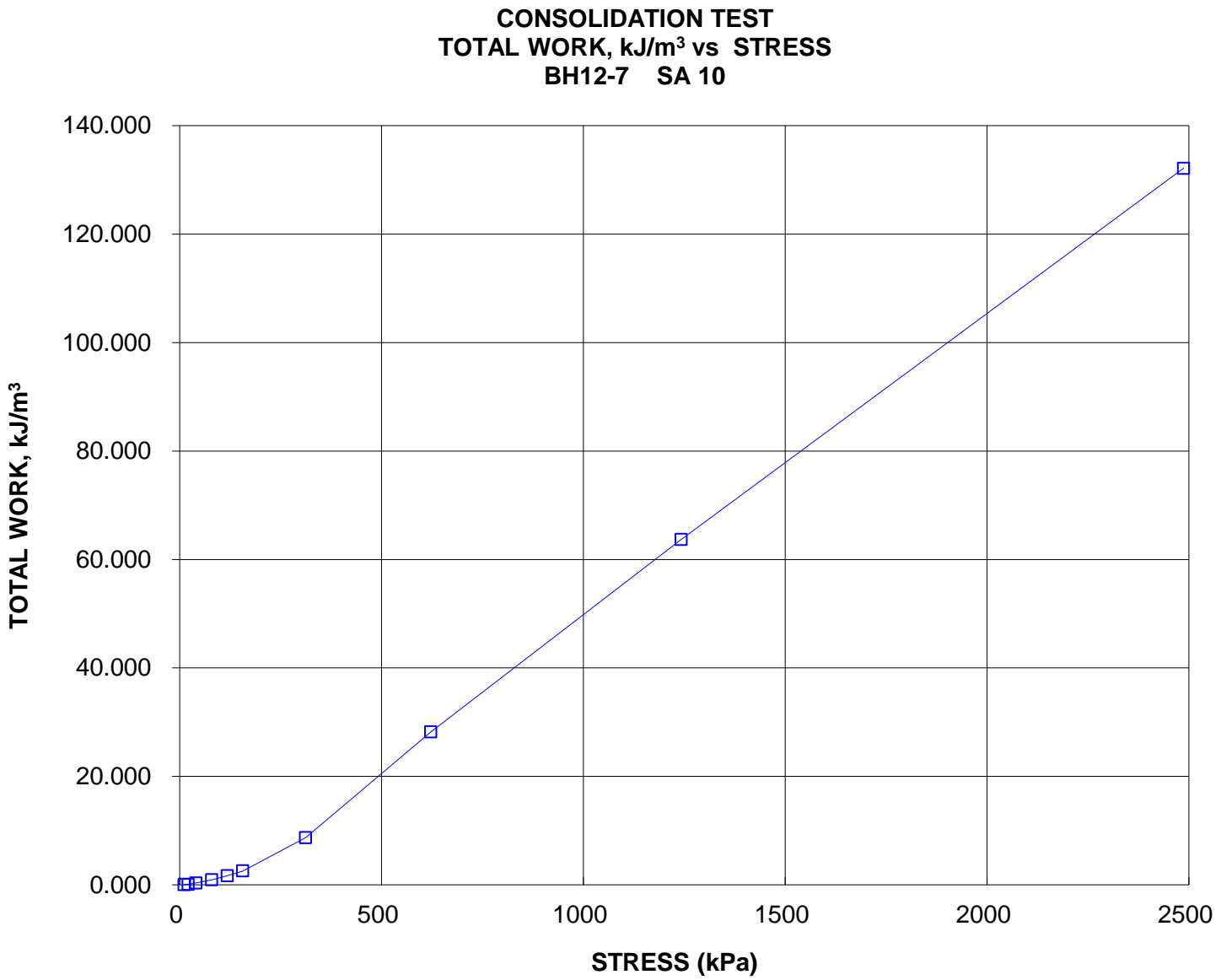
VOLUME COMPRESSIBILITY, m²/kN



HYDRAULIC CONDUCTIVITY,
cm/s

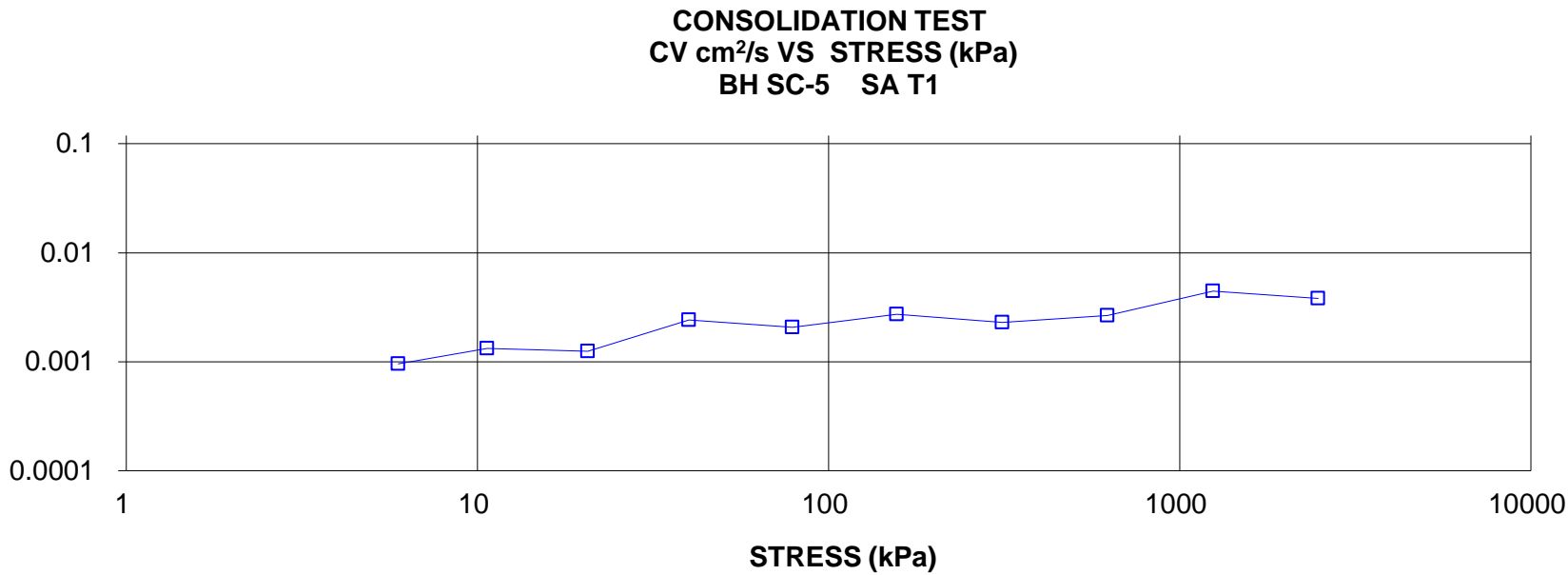




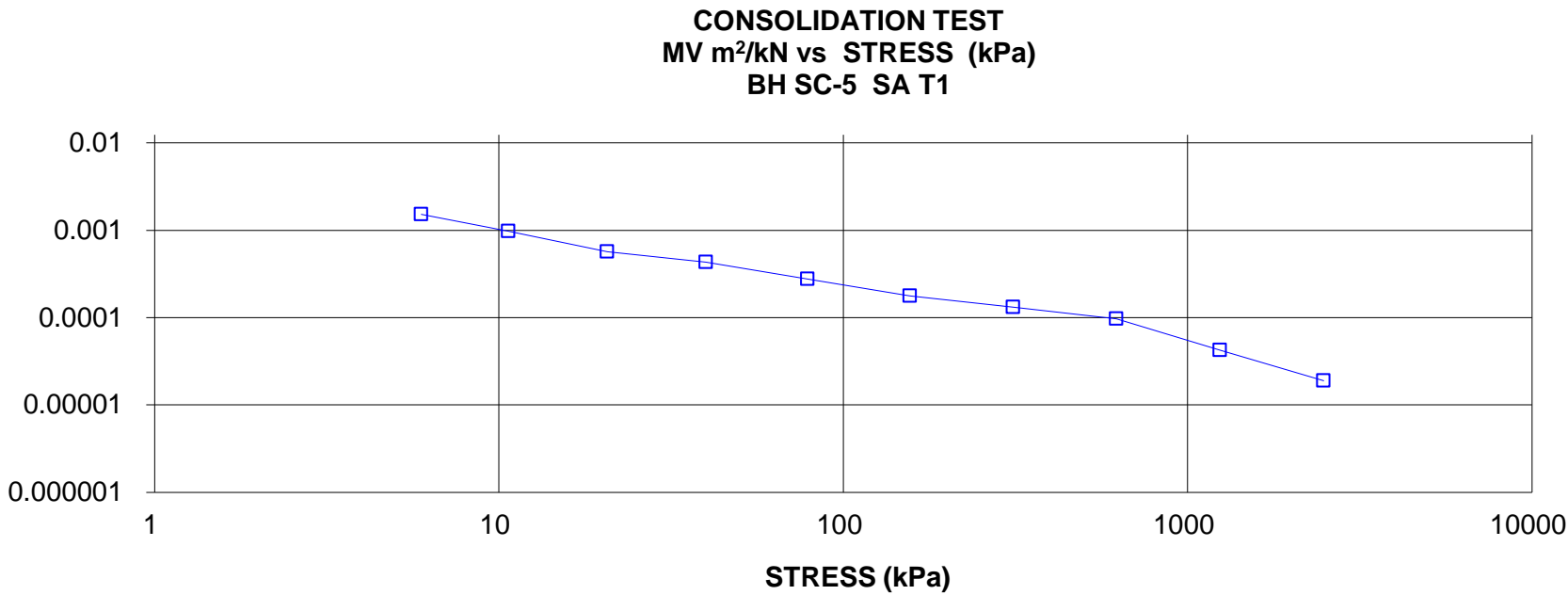


CONSOLIDATION TEST SUMMARY					FIGURE B8 Sheet 1 of 4		
SAMPLE IDENTIFICATION							
Project Number	09-1111-0018			Sample Number	T1		
Borehole Number	SC-5			Sample Depth, m	12.20-12.65		
TEST CONDITIONS							
Test Type	Standard			Load Duration, hr	24		
Oedometer Number	2						
Date Started	06/26/2012						
Date Completed	07/10/2012						
SAMPLE DIMENSIONS AND PROPERTIES - INITIAL							
Sample Height, cm	2.54			Unit Weight, kN/m ³	20.11		
Sample Diameter, cm	6.34			Dry Unit Weight, kN/m ³	16.29		
Area, cm ²	31.58			Specific Gravity, measured	2.72		
Volume, cm ³	80.09			Solids Height, cm	1.548		
Water Content, %	23.49			Volume of Solids, cm ³	48.90		
Wet Mass, g	164.26			Volume of Voids, cm ³	31.18		
Dry Mass, g	133.01			Degree of Saturation, %	100.2		
TEST COMPUTATIONS							
	Corr.		Average				
Stress	Height	Void	Height	t ₉₀	cv.	mv	k
kPa	cm	Ratio	cm	sec	cm ² /s	m ² /kN	cm/s
0.00	2.536	0.638	2.536				
5.95	2.513	0.623	2.525	1417	9.54E-04	1.52E-03	1.42E-07
10.66	2.501	0.615	2.507	1009	1.32E-03	9.80E-04	1.27E-07
20.63	2.487	0.606	2.494	1058	1.25E-03	5.70E-04	6.96E-08
39.97	2.466	0.592	2.476	540	2.41E-03	4.30E-04	1.02E-07
78.79	2.439	0.575	2.452	614	2.08E-03	2.77E-04	5.64E-08
156.24	2.404	0.552	2.421	457	2.72E-03	1.78E-04	4.74E-08
312.03	2.352	0.519	2.378	520	2.31E-03	1.31E-04	2.96E-08
622.07	2.276	0.470	2.314	427	2.66E-03	9.64E-05	2.51E-08
1242.57	2.209	0.427	2.243	240	4.44E-03	4.25E-05	1.85E-08
2482.49	2.150	0.388	2.179	265	3.80E-03	1.90E-05	7.07E-09
1242.57	2.150	0.389	2.150				
312.03	2.170	0.401	2.160				
78.79	2.191	0.415	2.180				
20.63	2.220	0.434	2.205				
5.95	2.235	0.443	2.228				
Note: k calculated using cv based on t ₉₀ values.							
SAMPLE DIMENSIONS AND PROPERTIES - FINAL							
Sample Height, cm	2.24			Unit Weight, kN/m ³	22.06		
Sample Diameter, cm	6.34			Dry Unit Weight, kN/m ³	18.48		
Area, cm ²	31.58			Specific Gravity, measured	2.72		
Volume, cm ³	70.59			Solids Height, cm	1.548		
Water Content, %	19.39			Volume of Solids, cm ³	48.90		
Wet Mass, g	158.80			Volume of Voids, cm ³	21.69		
Dry Mass, g	133.01						
Prepared By: LH		Golder Associates			Checked By: LCC		

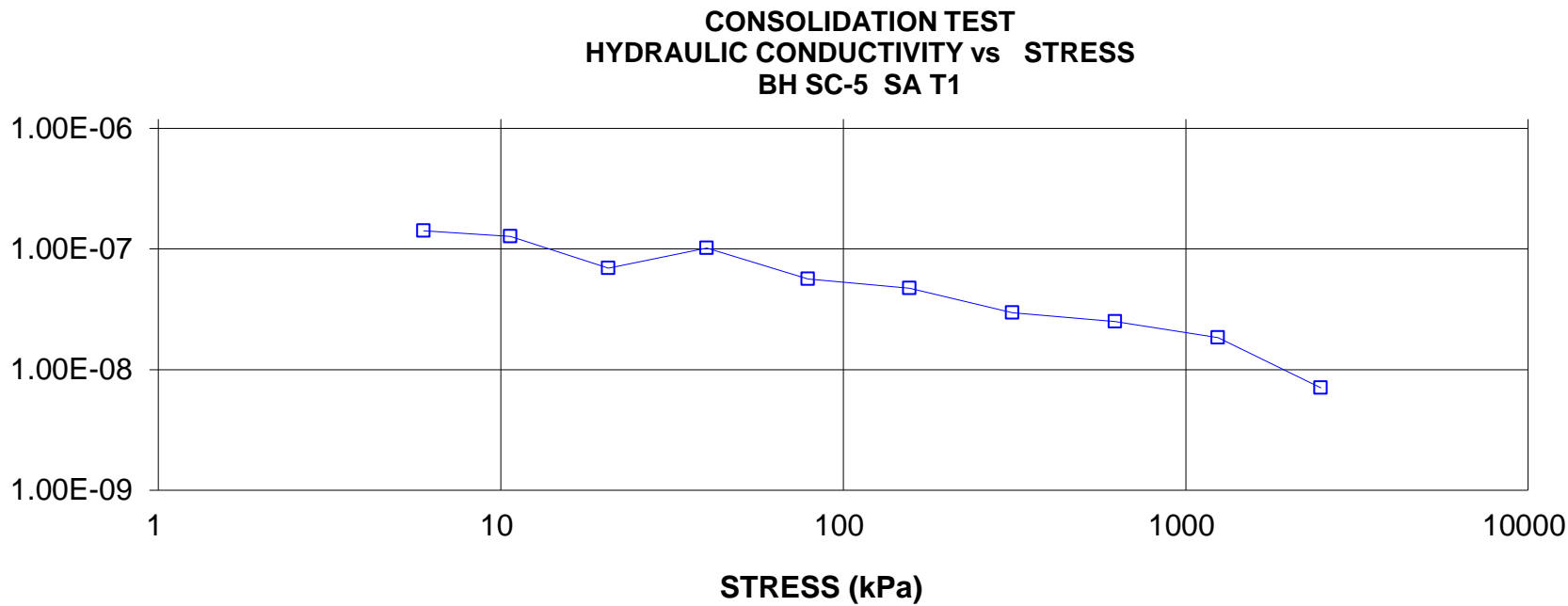
COEFFICIENT OF CONSOLIDATION,
cm²/s

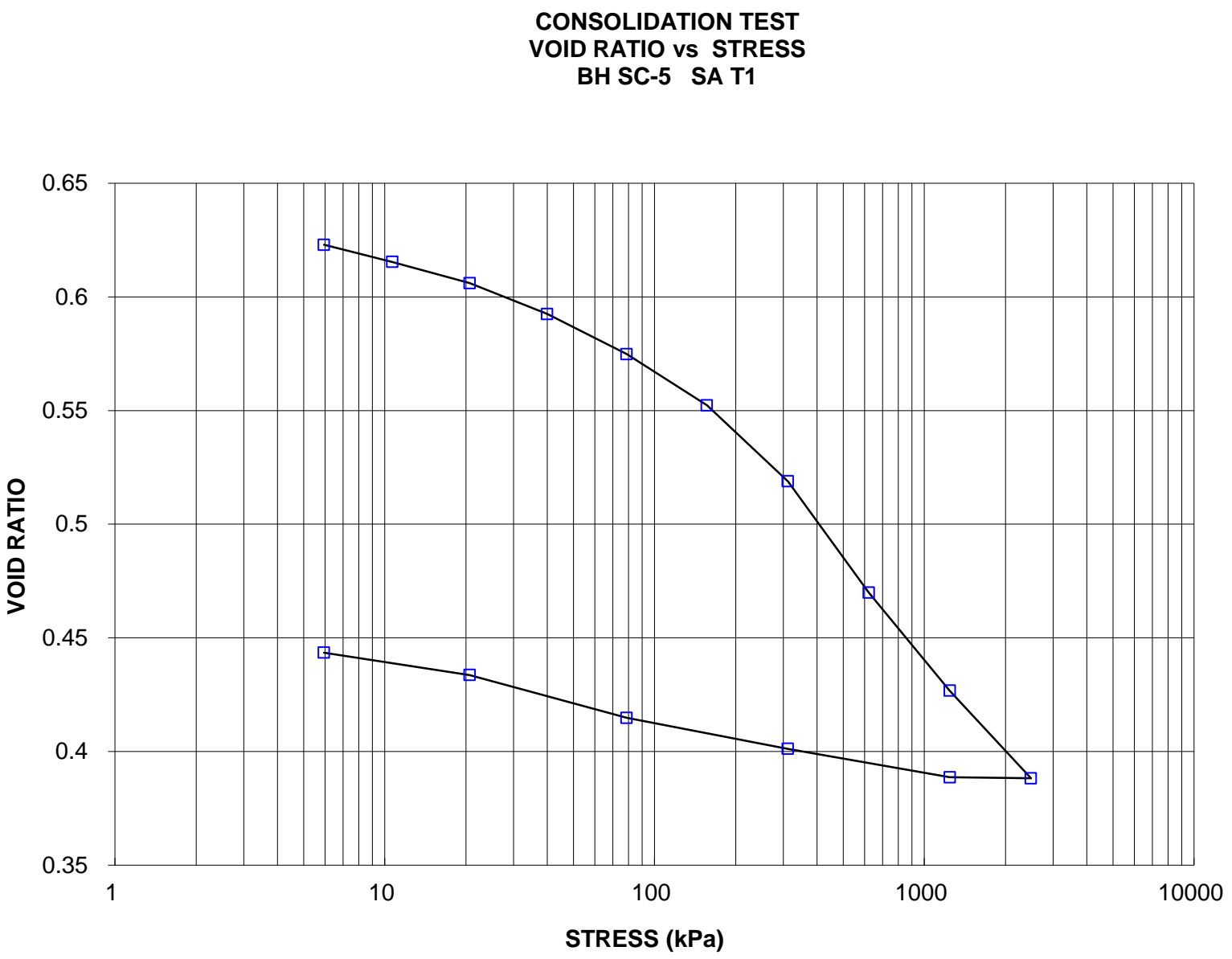


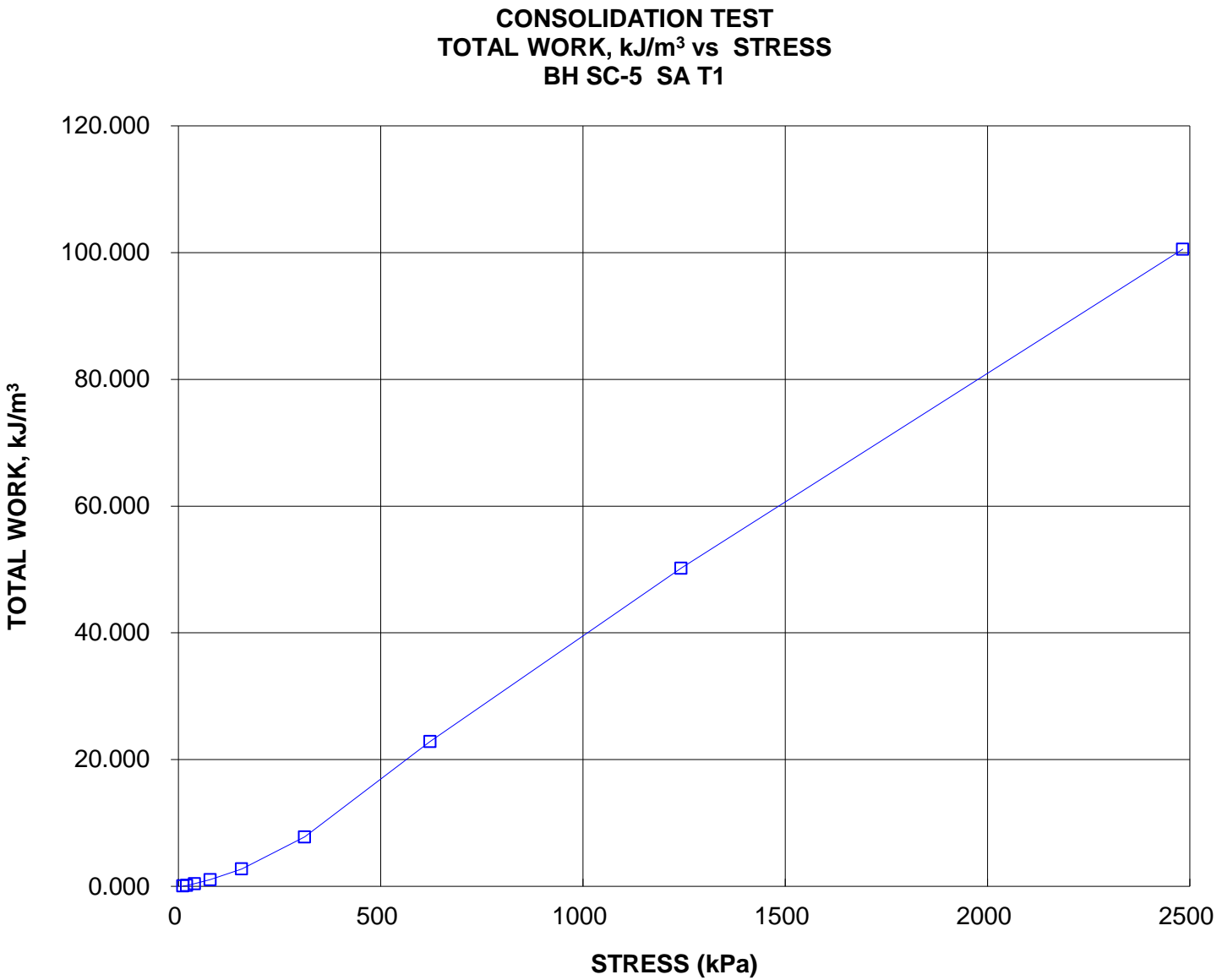
VOLUME COMPRESSIBILITY, m²/kN



HYDRAULIC CONDUCTIVITY,
cm/s







CONSOLIDATION TEST SUMMARY**FIGURE B9**
Sheet 1 of 4**SAMPLE IDENTIFICATION**

Project Number	09-1111-0018	Sample Number	11
Borehole Number	SC-7	Sample Depth, m	10.67-11.28

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	9		
Date Started	06/20/2012		
Date Completed	07/05/2012		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m ³	20.59
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m ³	16.64
Area, cm ²	31.43	Specific Gravity, measured	2.76
Volume, cm ³	59.65	Solids Height, cm	1.167
Water Content, %	23.75	Volume of Solids, cm ³	36.67
Wet Mass, g	125.26	Volume of Voids, cm ³	22.98
Dry Mass, g	101.22	Degree of Saturation, %	104.6

TEST COMPUTATIONS

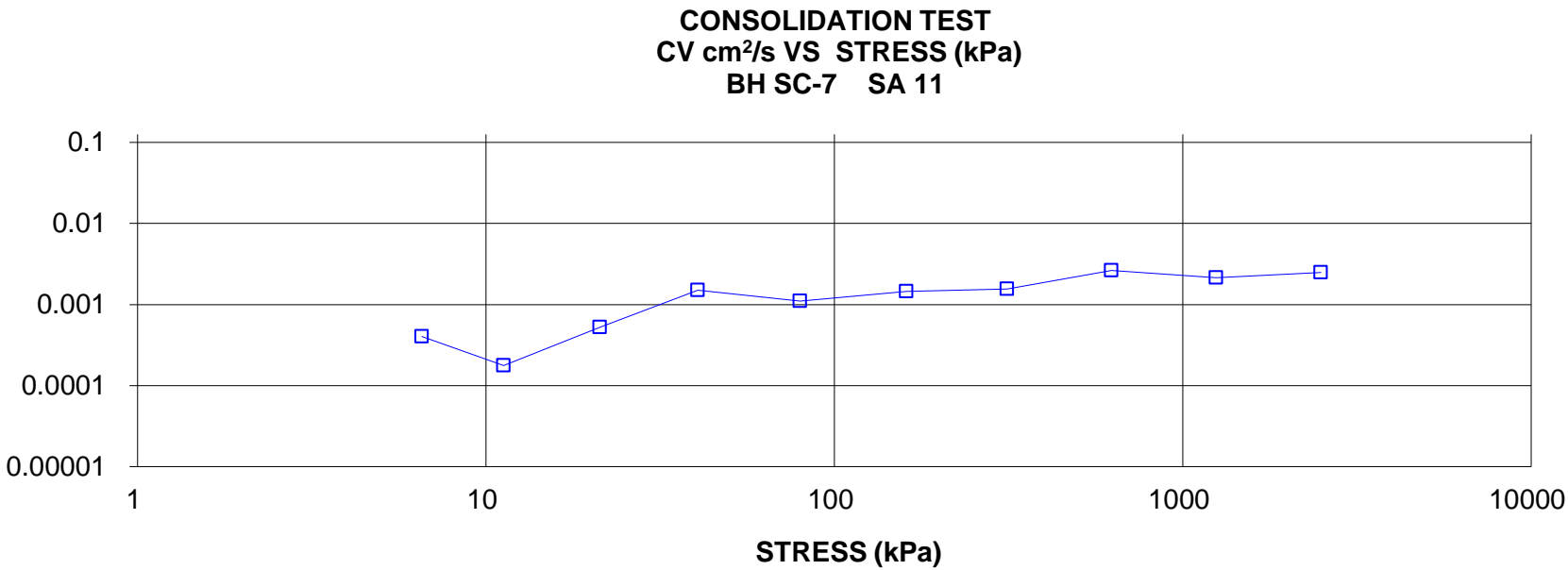
Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	cv. cm ² /s	mv m ² /kN	k cm/s
0.00	1.898	0.627	1.898				
6.55	1.863	0.596	1.880	1848	4.06E-04	2.85E-03	1.13E-07
11.23	1.851	0.586	1.857	4133	1.77E-04	1.33E-03	2.30E-08
21.21	1.835	0.573	1.843	1370	5.26E-04	8.39E-04	4.32E-08
40.58	1.808	0.550	1.822	470	1.50E-03	7.26E-04	1.07E-07
79.64	1.783	0.528	1.796	622	1.10E-03	3.39E-04	3.65E-08
160.90	1.750	0.500	1.766	454	1.46E-03	2.16E-04	3.08E-08
313.19	1.706	0.462	1.728	406	1.56E-03	1.52E-04	2.32E-08
624.68	1.662	0.425	1.684	228	2.64E-03	7.41E-05	1.91E-08
1247.80	1.616	0.385	1.639	265	2.15E-03	3.91E-05	8.25E-09
2494.02	1.570	0.345	1.593	217	2.48E-03	1.95E-05	4.73E-09
1247.80	1.574	0.349	1.572				
313.19	1.592	0.365	1.583				
79.64	1.616	0.385	1.604				
21.21	1.631	0.398	1.624				
6.55	1.646	0.411	1.639				

Note:
k calculated using cv based on t₉₀ values.

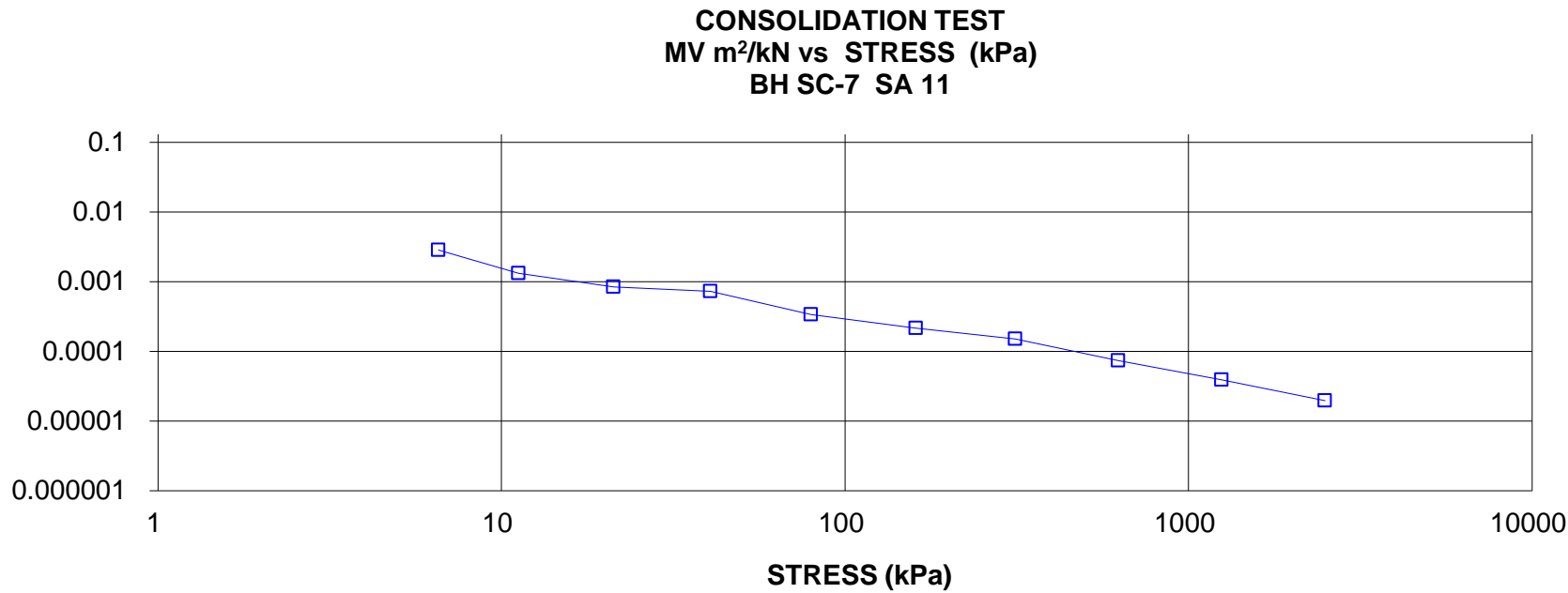
SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.65	Unit Weight, kN/m ³	22.67
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m ³	19.19
Area, cm ²	31.43	Specific Gravity, measured	2.76
Volume, cm ³	51.73	Solids Height, cm	1.167
Water Content, %	18.14	Volume of Solids, cm ³	36.67
Wet Mass, g	119.58	Volume of Voids, cm ³	15.06
Dry Mass, g	101.22		

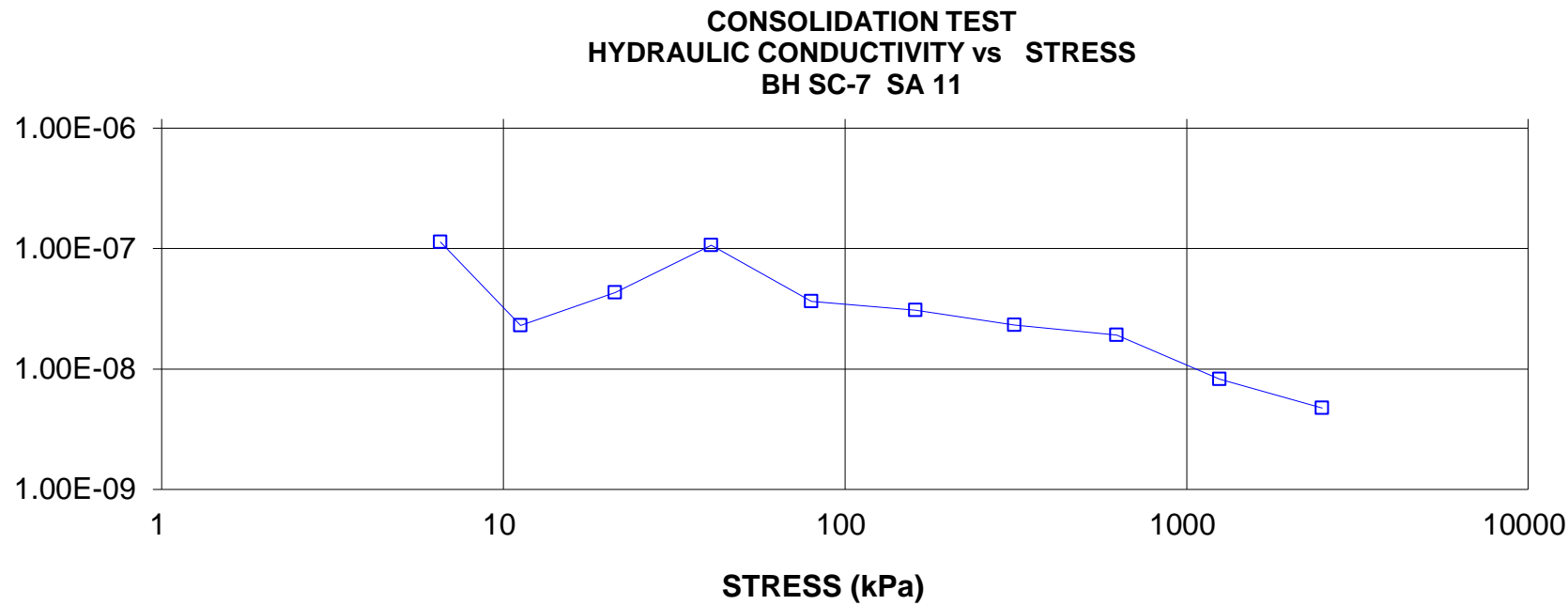
COEFFICIENT OF CONSOLIDATION,
cm²/s

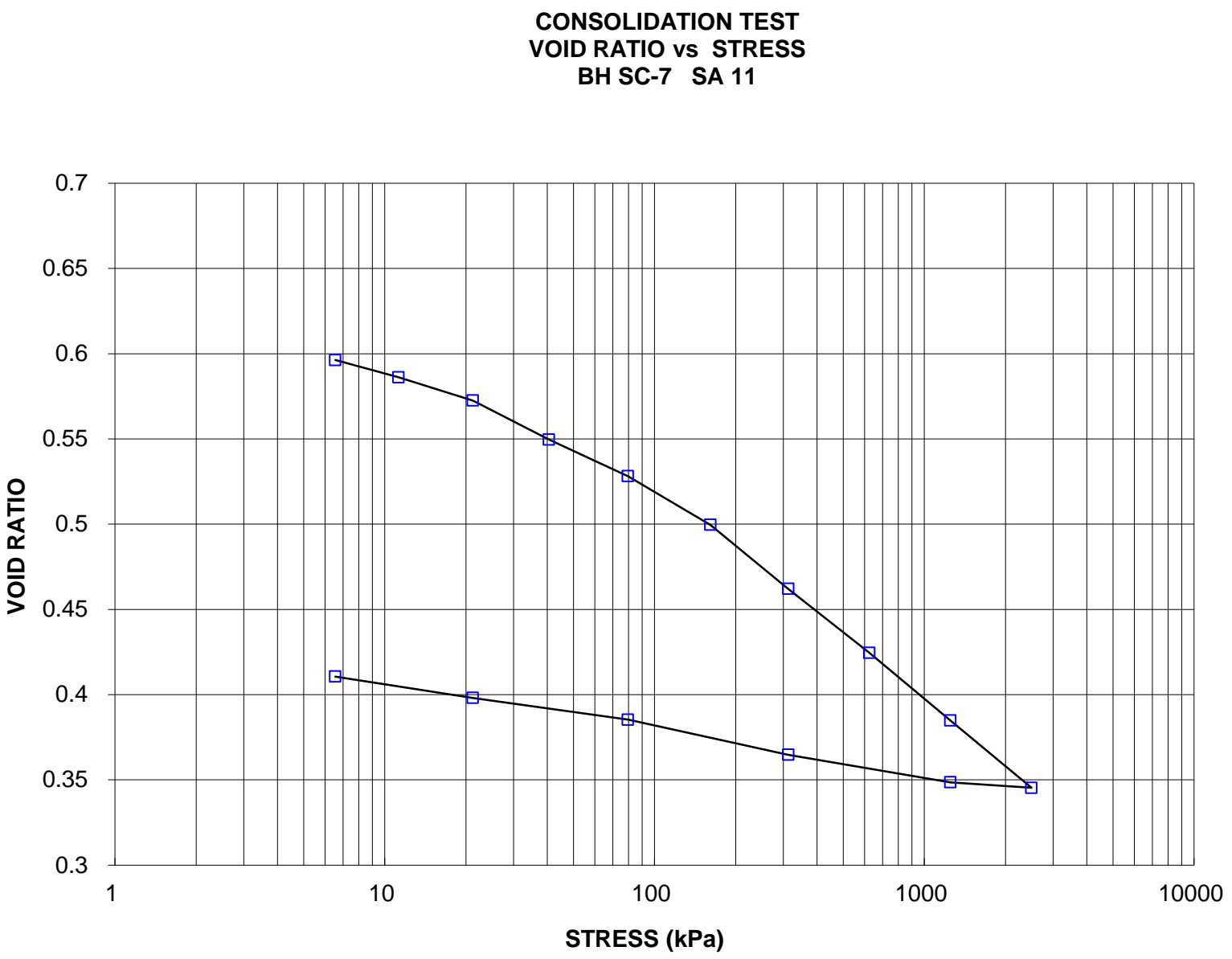


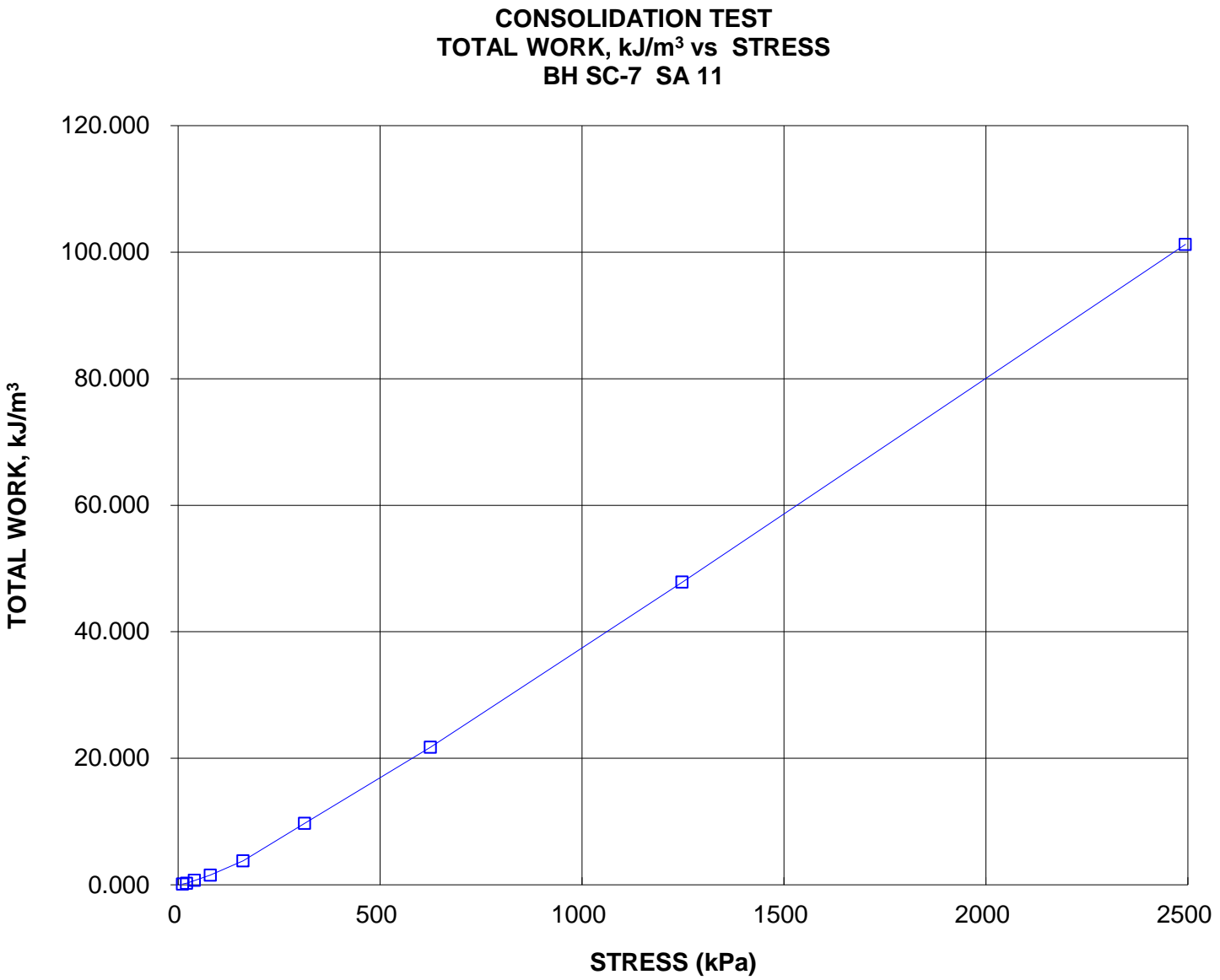
VOLUME COMPRESSIBILITY, m²/kN



HYDRAULIC CONDUCTIVITY,
cm/s



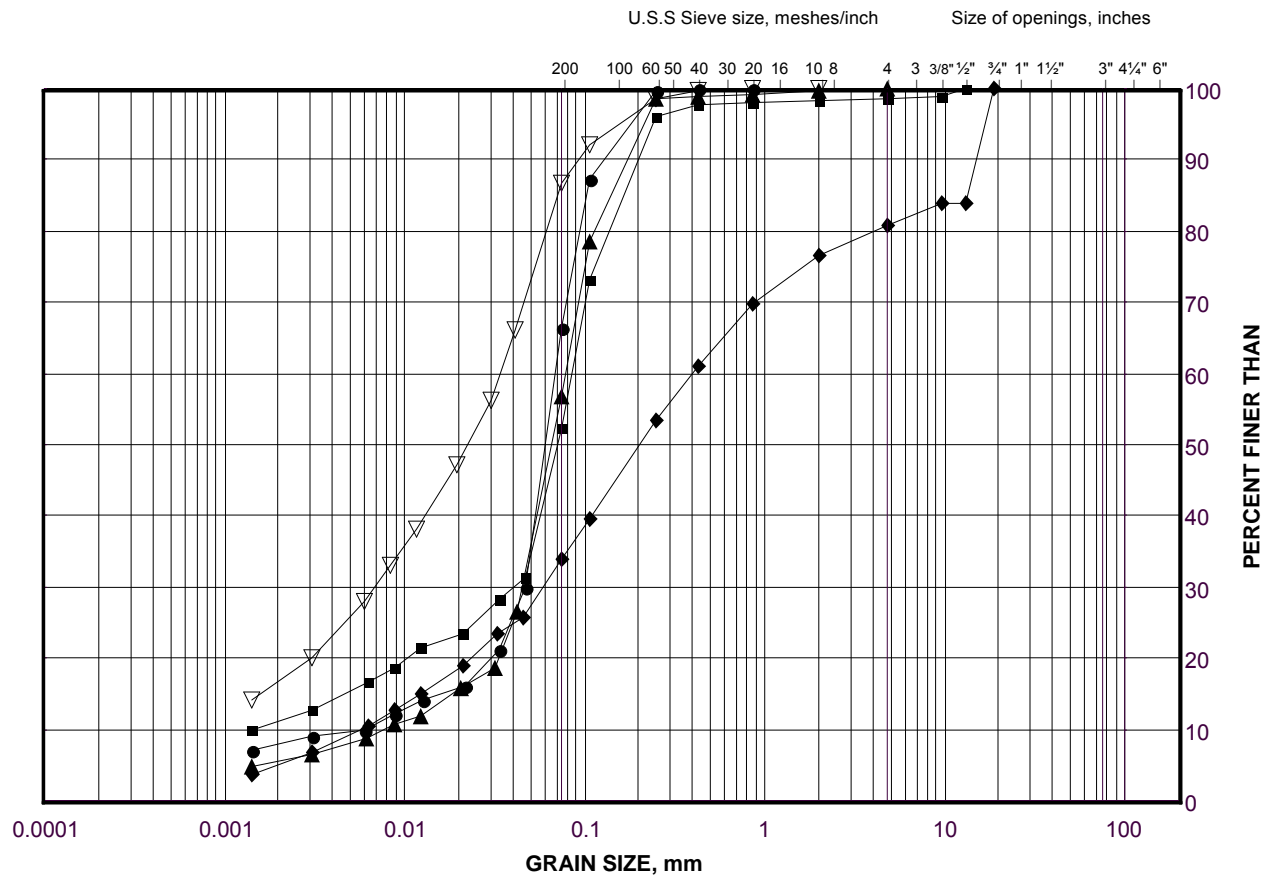




GRAIN SIZE DISTRIBUTION

Silt to Sand and Silt (Interlayer)

FIGURE B10



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

LEGEND

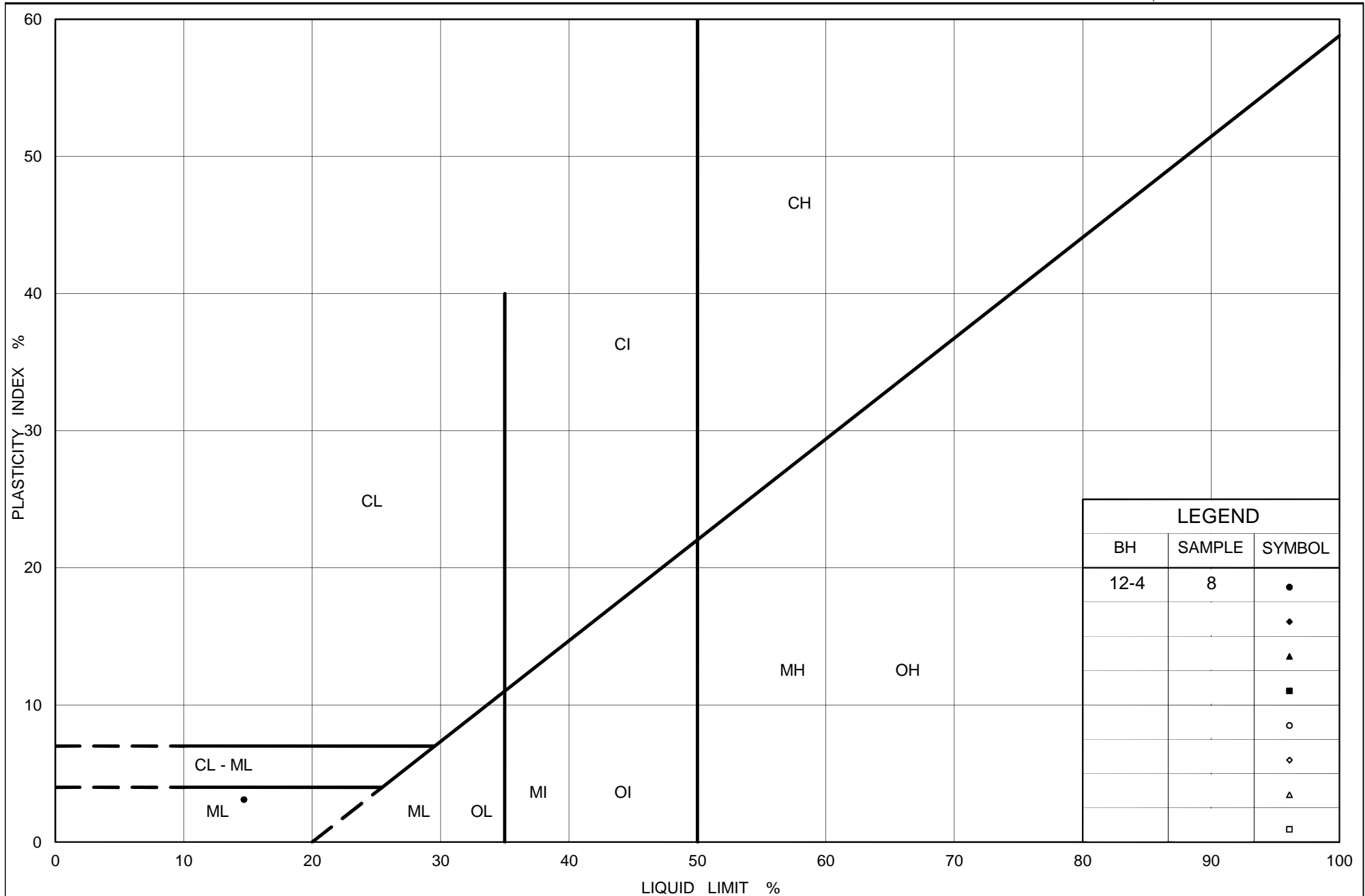
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-9	5	215.4
■	12-6	7	214.9
◆	BO-9	7A	214.8
▲	12-5	8	214.1
▽	12-4	8	213.1

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 11-Jul-13



Ministry of Transportation

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PLASTICITY CHART

Silt Interlayer

Figure No. B11

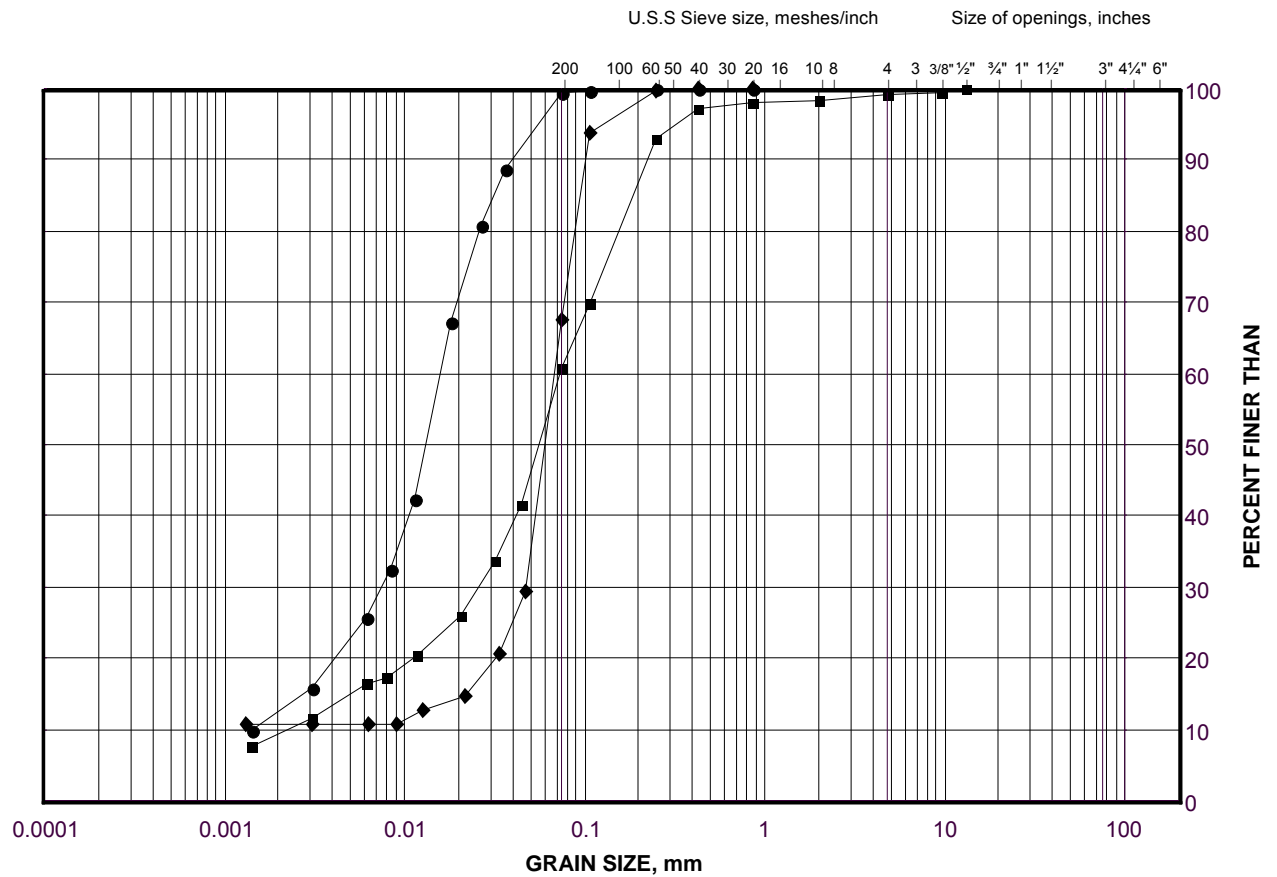
Project No. 09-1111-0018

Checked By: LCC

GRAIN SIZE DISTRIBUTION

Silt to Sand and Silt

FIGURE B12A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	BO-9	13	205.5
■	SC-7	14	205.3
◆	BO-9	15	202.4

Project Number: 09-1111-0018

Checked By: LCC

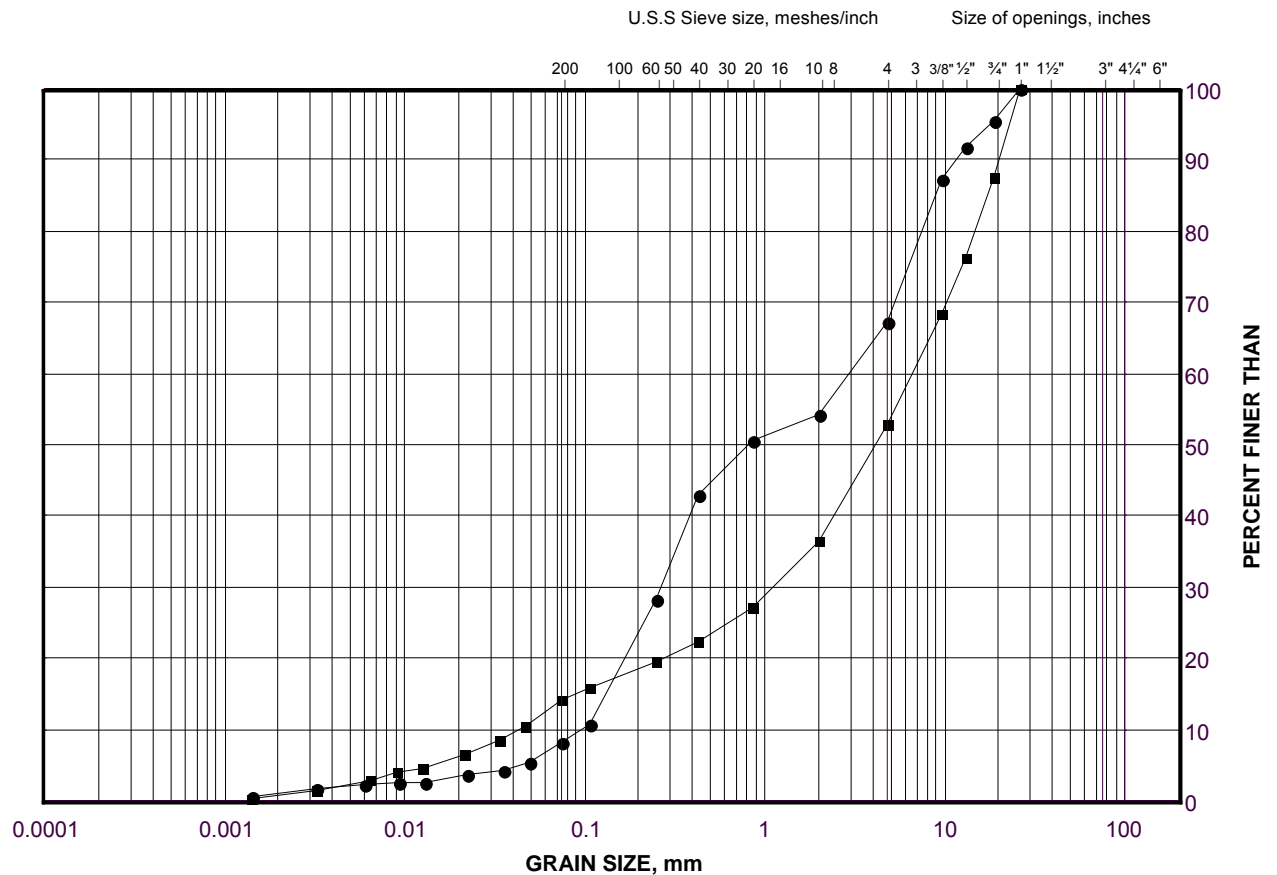
Golder Associates

Date: 08-Feb-13

GRAIN SIZE DISTRIBUTION

Sand and Gravel

FIGURE B12B



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

LEGEND

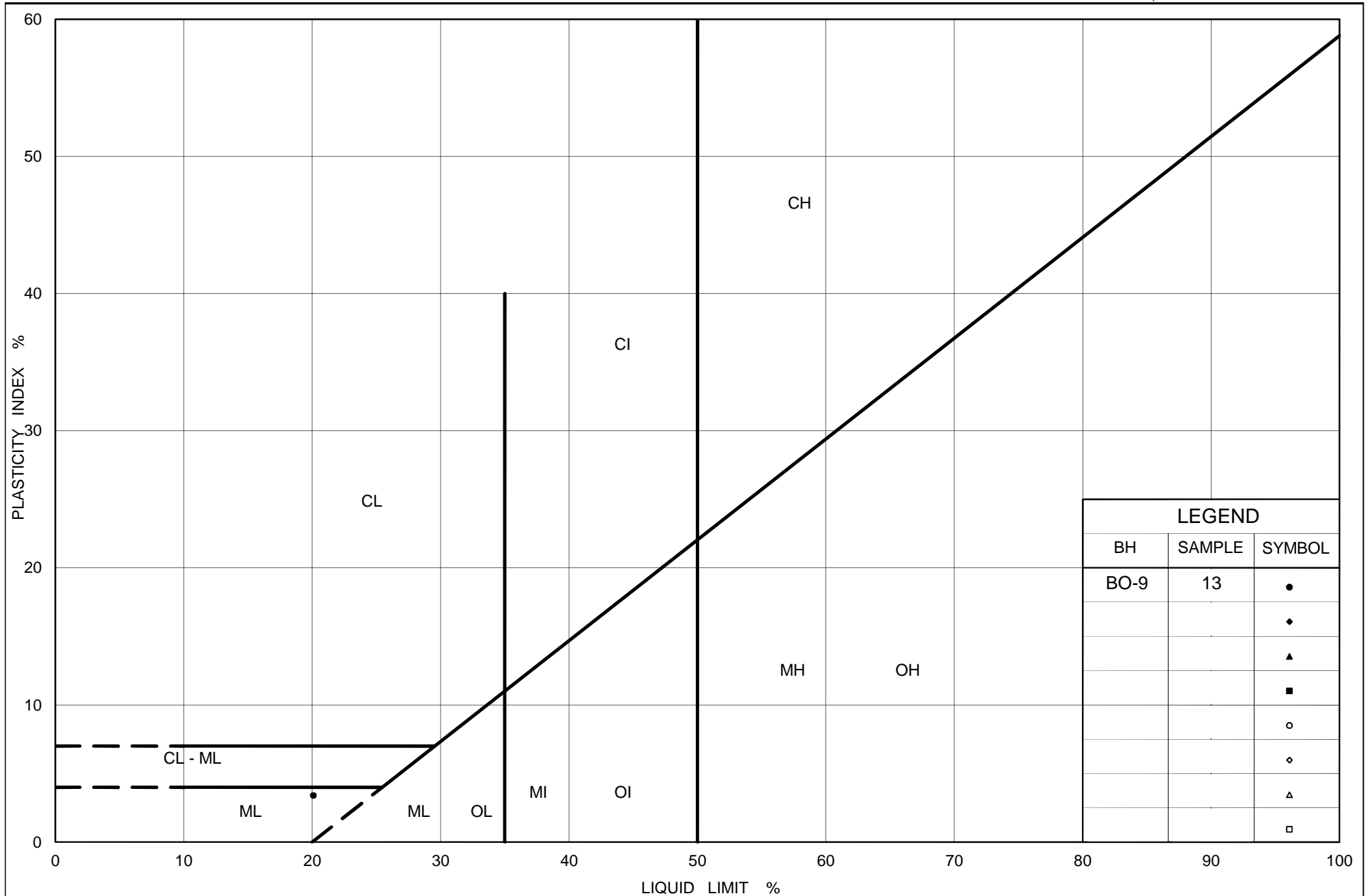
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SC-7	17	200.7
■	SC-7	27	180.8

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 08-Feb-13



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PLASTICITY CHART

Silt

Figure No. B13

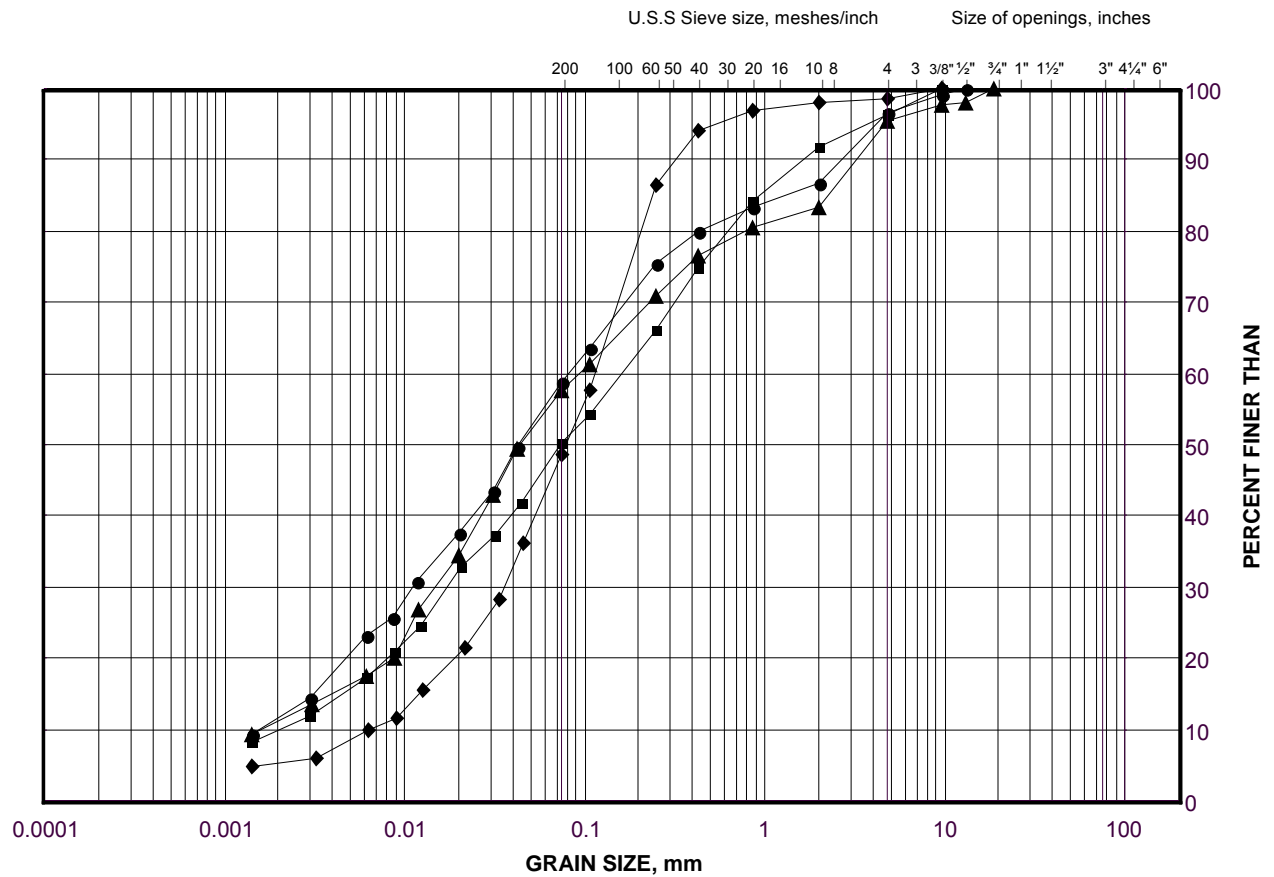
Project No. 09-1111-0018

Checked By: LCC

GRAIN SIZE DISTRIBUTION

Sand and Silt (Till)

FIGURE B14



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

LEGEND

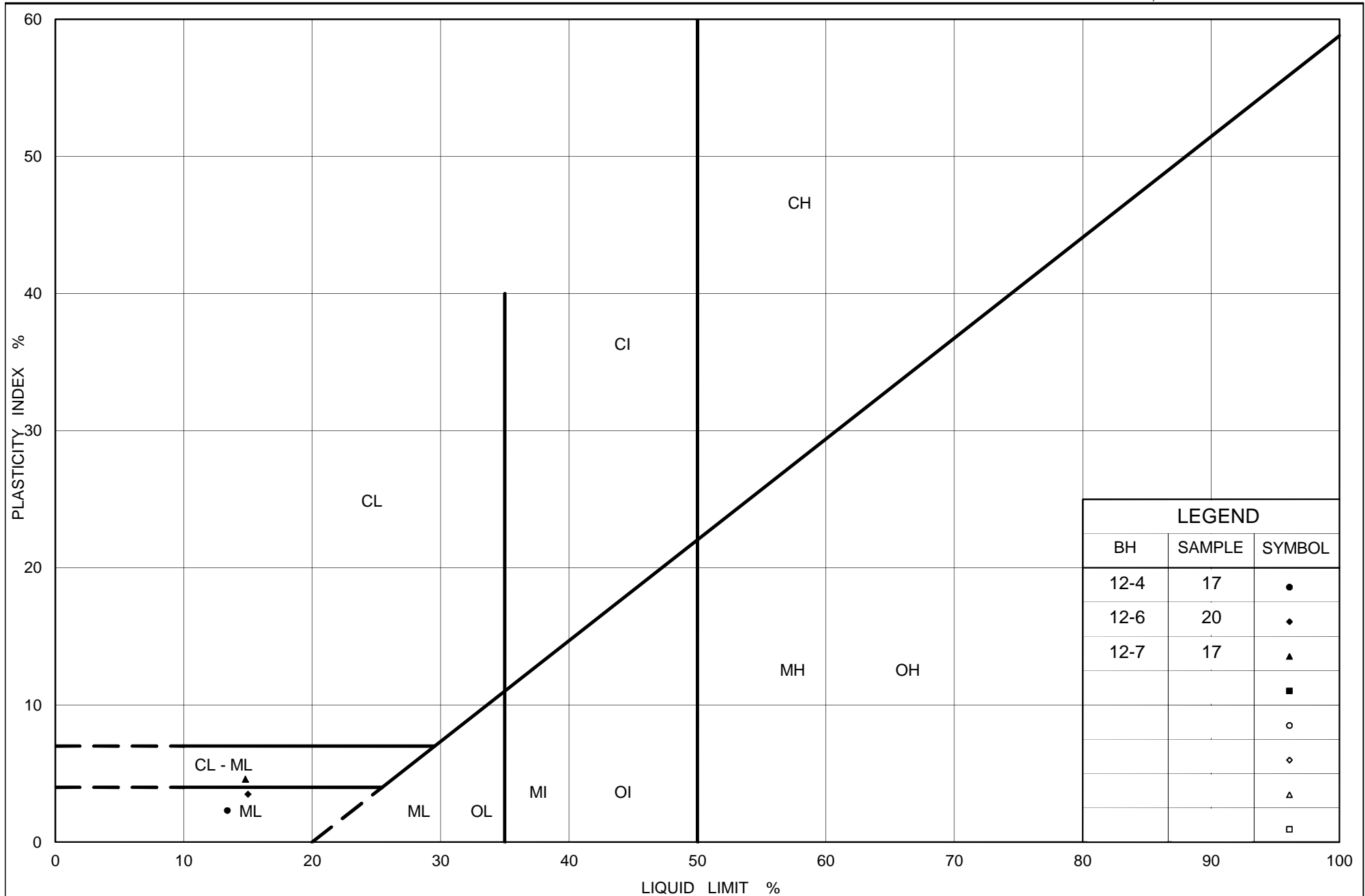
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-7	17	200.4
■	12-4	17	199.7
◆	12-9	18	196.3
▲	12-6	20	196.6

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 08-Feb-13



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PLASTICITY CHART

Sand and Silt (Till)

Figure No. B15

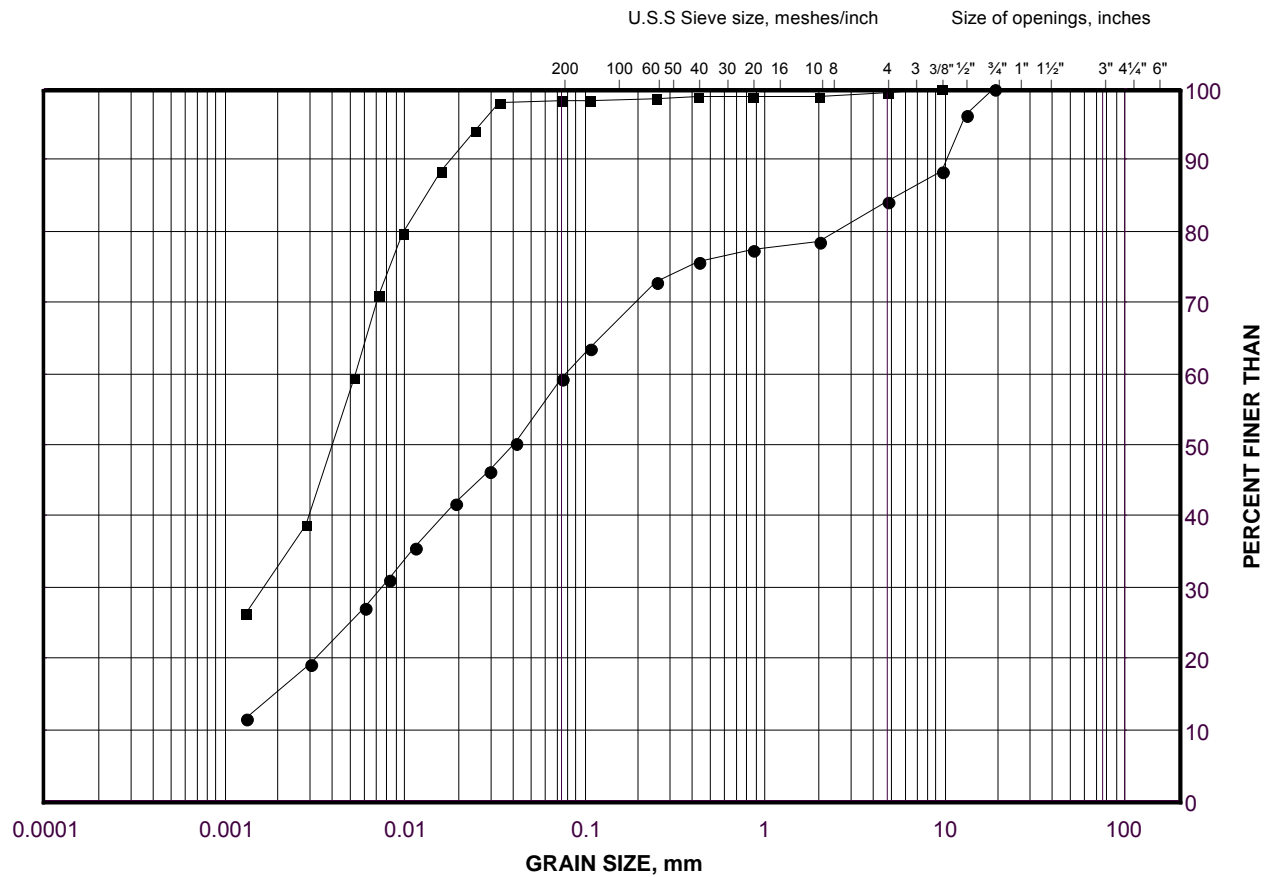
Project No. 09-1111-0018

Checked By: LCC

GRAIN SIZE DISTRIBUTION

Clayey Silt Interlayers

FIGURE B16



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

LEGEND

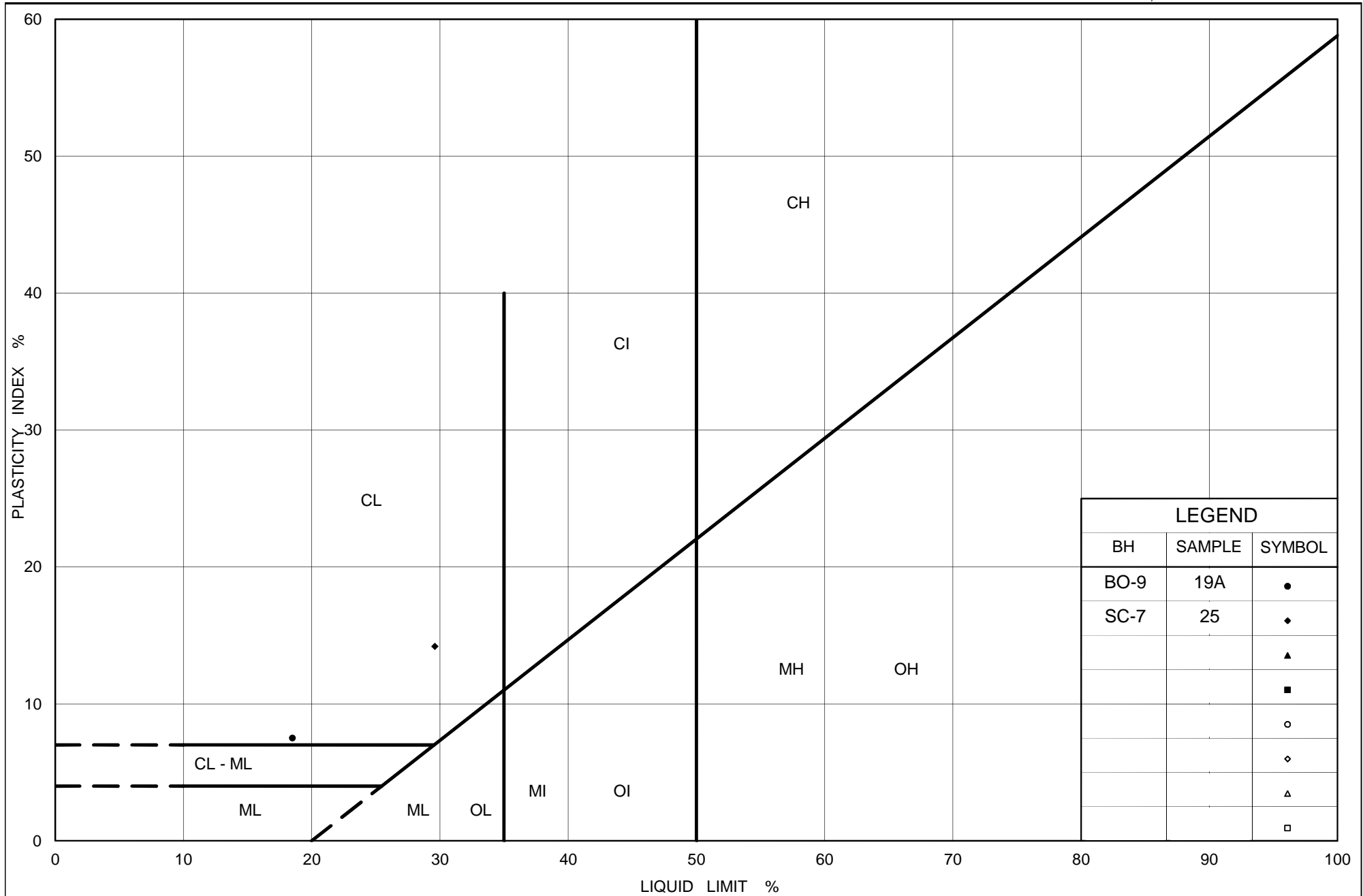
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	BO-9	19A	196.4
■	SC-7	25	186.9

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 25-Jan-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt Interlayer

Figure No. B17

Project No. 09-1111-0018

Checked By: LCC




APPENDIX C

Borehole Records and Laboratory Test Results – South Canal Bank Road - Station 9+860 to Station 10+100

PROJECT 09-1111-0018		RECORD OF BOREHOLE No 12-1		SHEET 1 OF 1		METRIC															
G.W.P. 2835-02-00		LOCATION N 4877101.4 ; E 297123.6		ORIGINATED BY TWB																	
DIST Central HWY 400		BOREHOLE TYPE D-25 Barge Mount, 89 mm O.D. Tricone Wash Bore, N Casing		COMPILED BY CC																	
DATUM Geodetic		DATE June 25, 2012		CHECKED BY SMM																	
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ					
								20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	10 20 30	γ	GR	SA	SI	CL			
219.0 0.0	TOP OF WATER WATER																				
216.3 2.7	CLAYEY SILT, some sand, trace gravel, containing organics and rootlets Very soft to soft Grey		1	SS	1																
215.5 3.5	Moist to wet CLAYEY SILT, trace to some sand Soft to very stiff Grey Moist		2	SS	16																
			3	SS	12																
			4	SS	14																
			5	SS	13																
			6	SS	16																
			7	SS	5																
			8	SS	4																
			9	SS	2																
207.1 11.9	CLAYEY SILT with sand, trace gravel (TILL) Stiff to hard Grey Moist		10	SS	9																
205.4 13.6	END OF BOREHOLE		11	SS	80/0.10																
	Note : The water level in the N casing borehole was not recorded upon completion of drilling																				





GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 01/13/15 SIB

PROJECT 09-1111-0018			RECORD OF BOREHOLE No 12-2			SHEET 1 OF 1			METRIC											
G.W.P. 2835-02-00			LOCATION N 4877138.4 ; E 297168.4			ORIGINATED BY TWB														
DIST Central HWY 400			BOREHOLE TYPE D-25 Barge Mount, 89 mm O.D. Tricone Wash Bore, N Casing			COMPILED BY CC														
DATUM Geodetic			DATE June 26, 2012			CHECKED BY SMM														
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	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR SA SI CL			
							20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED	W _p	W	W _L	20 40 60 80 100	10 20 30	kN/m ³					
219.0 0.0	TOP OF WATER WATER																			
216.6 2.4	CLAYEY SILT, trace to some sand, trace gravel, containing organics Very soft Grey Wet CLAYEY SILT, trace to some sand Firm to very stiff Grey Moist firm below 5.4 m depth		1	SS	0		218													
215.9 3.1			2	SS	21		217													
			3	SS	12		216													
			4	SS	17		215													
			5	SS	8		214													
			6	SS	5		213													
			7	SS	4		212													
			8	SS	5		211													
			9	SS	7		210													
208.9 10.1			CLAYEY SILT with sand, trace to some gravel (TILL) Firm Grey Moist		9	SS	7		209									13 32 38 17		
207.9 11.1	SAND, trace trace to some silt Loose to dense Grey Wet		10	SS	5		208													
							207													
205.3 13.7	END OF BOREHOLE Note : The water level in the N casing was coincident with the surface water of the canal.		11	SS	31		206									1 87 8 4				

GTA-MTO 001 T:\PROJECTS\2009\09-1111-0018 (URS, YORK REGION)\LOG\0911110018.GPJ GAL-GTA.GDT 01/13/15 SIB

PROJECT		09-1111-0018		RECORD OF BOREHOLE No 12-11		SHEET 1 OF 1		METRIC						
G.W.P.		2835-02-00		LOCATION		N 4877137.4 ; E 297197.1		ORIGINATED BY OS						
DIST		Central HWY 400		BOREHOLE TYPE		D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing		COMPILED BY CC						
DATUM		Geodetic		DATE		July 11 and 12, 2012		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						
219.5	GROUND SURFACE													
0.0	TOPSOIL													
0.2	Clayey silt, some sand, trace gravel, containing rootlets and organics (FILL)		1	SS	3		219							
218.7	Soft Dark brown to grey Moist		2	SS	10									
0.8	Clayey silt with sand, trace gravel, containing wood fragments to a depth of 2.3 m (FILL)		3	SS	7		218							
	Firm to stiff Grey Moist to wet		4A 4B	SS	11		217							0 29 58 13
			5	SS	5		216							1 32 53 14
215.8	CLAYEY SILT, trace sand Firm to stiff Grey Moist		6	SS	11		215							
3.7			7	SS	15									
							214							
			8	SS	11		213							
							212							
			9A 9B	SS	11									
211.5	Silty SAND to SAND, trace silt, trace gravel Compact to dense Grey Wet						211							
8.0			10	SS	28		210							
							209							
208.8	END OF BOREHOLE													
10.7	NOTE: 1. Artesian conditions encountered at a depth of 8.0 m (Elev. 211.5 m) during drilling. 2. Water level not measured in borehole upon completion of drilling. 3. Borehole backfilled with a cement having a ratio of 1 water to 2 cement.													

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PROJECT 09-1111-0018		RECORD OF BOREHOLE No 12-12		SHEET 1 OF 1		METRIC														
G.W.P. 2835-02-00		LOCATION N 4877173.1 ; E 297222.1		ORIGINATED BY TWB																
DIST Central HWY 400		BOREHOLE TYPE D-50 Track Mount, 210 mm Inside Diameter Hollow Stem Augers		COMPILED BY CC																
DATUM Geodetic		DATE May 15, 2012		CHECKED BY SMM																
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%) W _p — W — W _L			γ	GR	SA	SI	CL
219.0 0.0	GROUND SURFACE Clayey silt with sand, trace gravel, containing organics, containing layers of silty sand (FILL) Soft to stiff Brown Moist		1	SS	13		218													
			2	SS	10		217													
			3	SS	4		216													
			4	SS	3		215													
			5	SS	4		214													
215.3 3.7	CLAYEY SILT with sand, trace gravel, containing organics, rootlets and wood fragments Soft Grey Moist		6	SS	3			213												
214.4 4.6	CLAYEY SILT, trace sand Firm to stiff Grey Moist		7	SS	6		212													
			8	SS	13		211													
			9	SS	9		210													
			10A 10B	SS	19		209													
209.6 9.4	SILT, trace clay, trace sand Compact to very dense Grey Wet		11	SS	67			208												
			12	SS	63		207													
206.2 12.8	END OF BOREHOLE																			
	NOTE: 1. Water level in open borehole at a depth of 0.4 m below ground surface (Elev. 218.6 m) upon completion of drilling.																			

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PROJECT		09-1111-0018		RECORD OF BOREHOLE No 12-13		SHEET 1 OF 2		METRIC						
G.W.P.		2835-02-00		LOCATION		N 4877053.3 ; E 297098.6		ORIGINATED BY OS						
DIST		Central HWY 400		BOREHOLE TYPE		D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing		COMPILED BY CC						
DATUM		Geodetic		DATE		May 10, 2012		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						
219.3	GROUND SURFACE													
0.0	TOPSOIL													
218.8	CLAYEY SILT, trace to some sand, containing organics, rootlets and oxidation staining		1	SS	3									
0.6	Soft Dark brown Wet		2	SS	14									
	PEAT, Soft Brown Moist		3A	SS	13									
217.3	SILT, some sand, trace clay Compact Brown and grey Moist to wet		3B											
2.0	CLAYEY SILT, containing silt seams to a depth of 2.1 m Stiff to hard Grey Moist		4	SS	18									
			5	SS	22									
			6	SS	21									
			7	SS	18									
			8	SS	31									
			9	SS	10									
210.6	CLAYEY SILT with sand, trace to some gravel (TILL) Hard Grey Moist		10	SS	71									
8.7			11	SS	86									
			12	SS	80									
			13	SS	71									
205.0	END OF BOREHOLE													
14.3														

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

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

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



PROJECT 09-1111-0018		RECORD OF BOREHOLE No SC-3		SHEET 1 OF 2		METRIC	
G.W.P. 2835-02-00		LOCATION N 4877124.8 ; E 297177.2				ORIGINATED BY OS	
DIST Central HWY 400		BOREHOLE TYPE D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing				COMPILED BY NK	
DATUM Geodetic		DATE May 23-25, 2012				CHECKED BY LCC	

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

○ 3% STRAIN AT FAILURE

PROJECT 09-1111-0018				RECORD OF BOREHOLE No SC-3				SHEET 2 OF 2				METRIC					
G.W.P. 2835-02-00				LOCATION N 4877124.8 ; E 297177.2				ORIGINATED BY OS									
DIST Central HWY 400				BOREHOLE TYPE D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing				COMPILED BY NK									
DATUM Geodetic				DATE May 23-25, 2012				CHECKED BY LCC									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL 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					W _p	W	W _L		
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100					
203.8	SAND and SILT, trace clay Very dense Grey Moist		13	SS	172												0 52 39 9
16.3	Silty SAND, containing silt seams Very dense Grey Moist																
202.9			14	SS	212/0.25												
17.2	END OF BOREHOLE NOTES: 1. Artesian groundwater conditions were encountered within the cohesionless soil below a depth of 11.7 m (Elev. 208.4 m). 2. Artesian groundwater level was measured at 3.6 m above ground surface (Elev. 223.7 m) on May 25, 2012, after completion of drilling. 3. Borehole abandoned using cement grout.																

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PROJECT <u>09-1111-0018</u>		RECORD OF BOREHOLE No SC-4		SHEET 1 OF 2		METRIC	
G.W.P. <u>2835-02-00</u>		LOCATION <u>N 4877151.8 ; E 297171.4</u>		ORIGINATED BY <u>TT</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>108 mm Inside Diameter Hollow Stem Augers</u>		COMPILED BY <u>NK</u>			
DATUM <u>Geodetic</u>		DATE <u>November 17, 18 and 21, 2011</u>		CHECKED BY <u>LCC</u>			

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

○ 3% STRAIN AT FAILURE



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


PROJECT 09-1111-0018		RECORD OF BOREHOLE No SC-9		SHEET 1 OF 2		METRIC	
G.W.P. 2835-02-00		LOCATION N 4877070.2; E 297116.5		ORIGINATED BY OS			
DIST Central HWY 400		BOREHOLE TYPE D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing		COMPILED BY NK			
DATUM Geodetic		DATE May 15 and 16, 2012		CHECKED BY LCC			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			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 (%)				
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED	W _P	W	W _L		
221.0	GROUND SURFACE						20 40 60 80 100							
0.0	TOPSOIL													
0.2	Silty SAND, some gravel, trace clay, containing rootlets and organic matter		1	SS	12									
220.4	Compact Brown Moist		2	SS	11									
0.6	CLAYEY SILT, some sand, some gravel, contains rootlets and organic matter, containing peat at a depth of 1.0 m		3	SS	2									
218.9	Soft to stiff													
2.1	Grey Moist		4	SS	25									
	SILT, some sand, trace to some clay													
	Compact Grey Wet		5	SS	17									
217.3	CLAYEY SILT, trace sand, trace gravel		6	SS	11									
3.7	Stiff to very stiff		7	SS	12									
	Grey Moist to wet													
			8	SS	16									
			9	SS	23									
			10	SS	15									
210.8	CLAYEY SILT with to some sand, trace gravel (TILL)		11	SS	68									
10.2	Hard Grey Moist													
			12	SS	78									
			13	SS	68									

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

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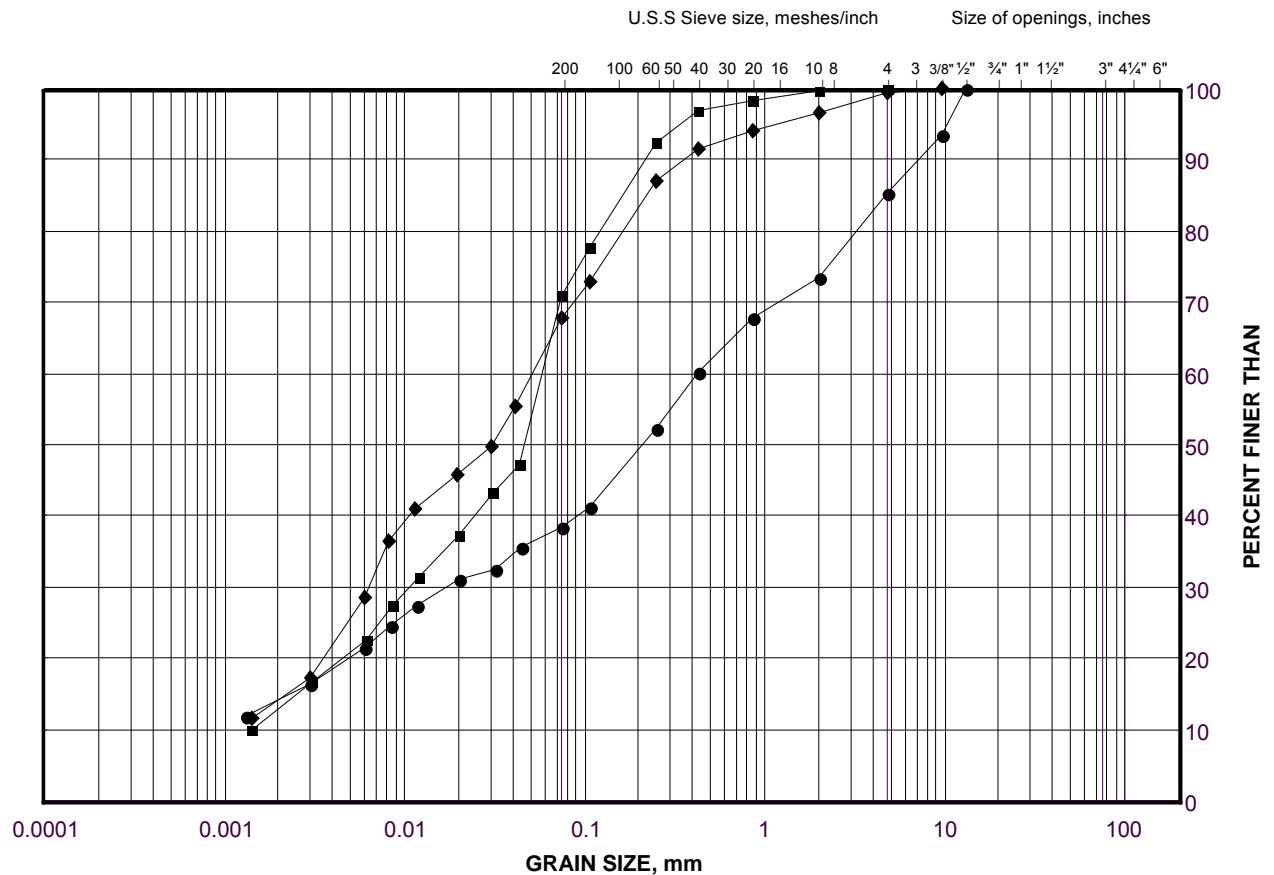
PROJECT 09-1111-0018			RECORD OF BOREHOLE No SC-9			SHEET 2 OF 2			METRIC								
G.W.P. 2835-02-00			LOCATION N 4877070.2; E 297116.5			ORIGINATED BY OS											
DIST Central HWY 400			BOREHOLE TYPE D-25 Track Mount, 76 mm Wash Rotary Boring, NW Casing			COMPILED BY NK											
DATUM Geodetic			DATE May 15 and 16, 2012			CHECKED BY LCC											
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					
202.7	CLAYEY SILT with to some sand, trace gravel (TILL) Hard Grey Moist		14	SS	104												
18.5	Silty SAND Grey Wet		15	SS	96												
201.6	CLAYEY SILT with sand, some gravel (TILL) Hard Grey Wet																
19.4	SAND, some silt, trace gravel, trace clay Very dense Grey Wet		16	SS	99												
200.6																	
20.4	END OF BOREHOLE		17	SS	113												
	NOTES: 1. Artesian groundwater conditions were encountered within the cohesionless soil below a depth of 18.3 m (Elev. 202.7 m) during drilling operations 2. Artesian groundwater level was measured at 4.1 m above ground surface (Elev. 225.1 m) on May 16, 2012. 3. Borehole abandoned using cement grout.																

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GRAIN SIZE DISTRIBUTION

Clayey Silt Fill

FIGURE C1



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

LEGEND

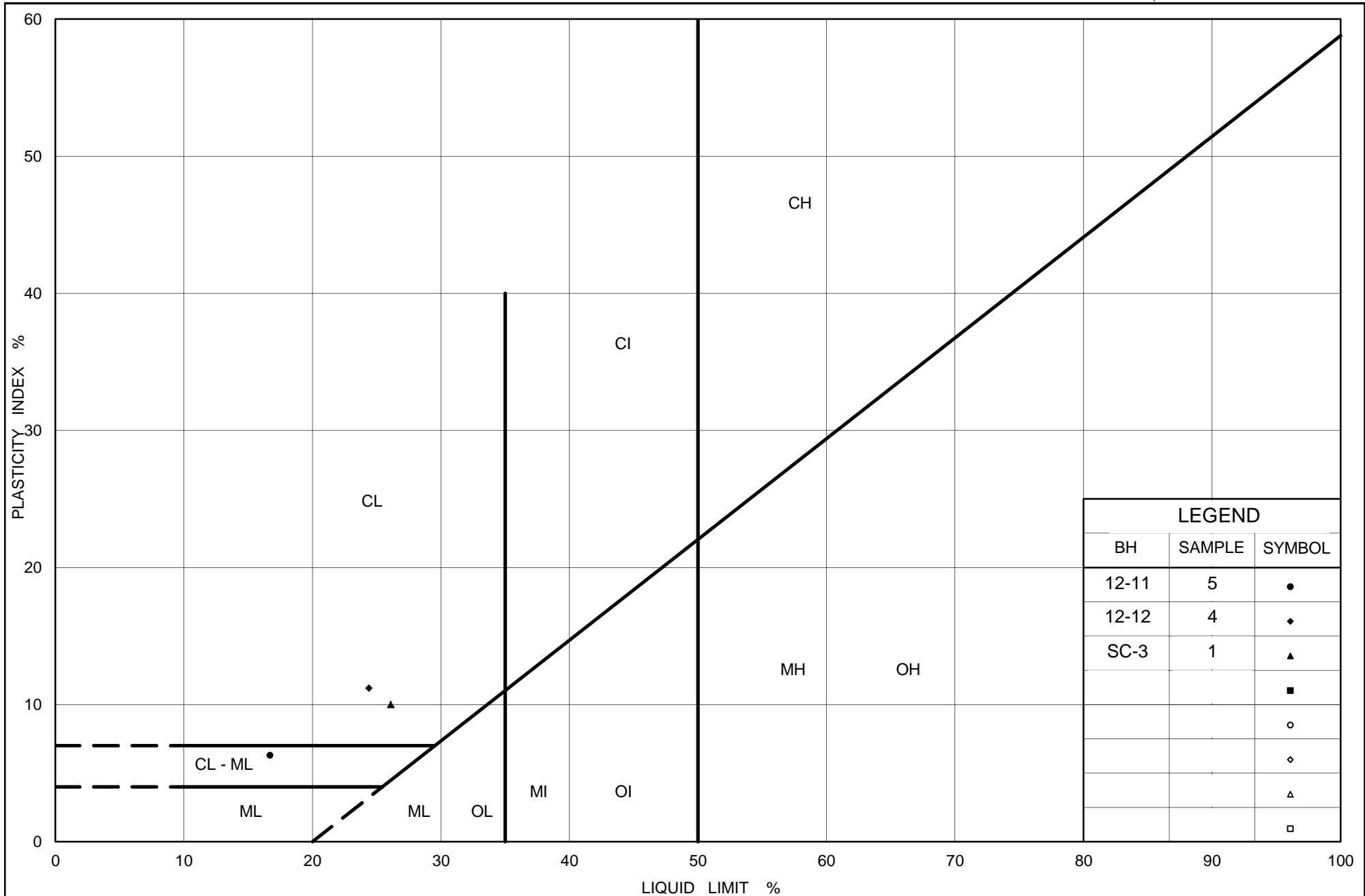
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-12	4	216.4
■	12-11	4A	217.0
◆	12-11	5	216.2

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 25-Jan-13



Ministry of Transportation

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PLASTICITY CHART

Clayey Silt Fill

Figure No. C2

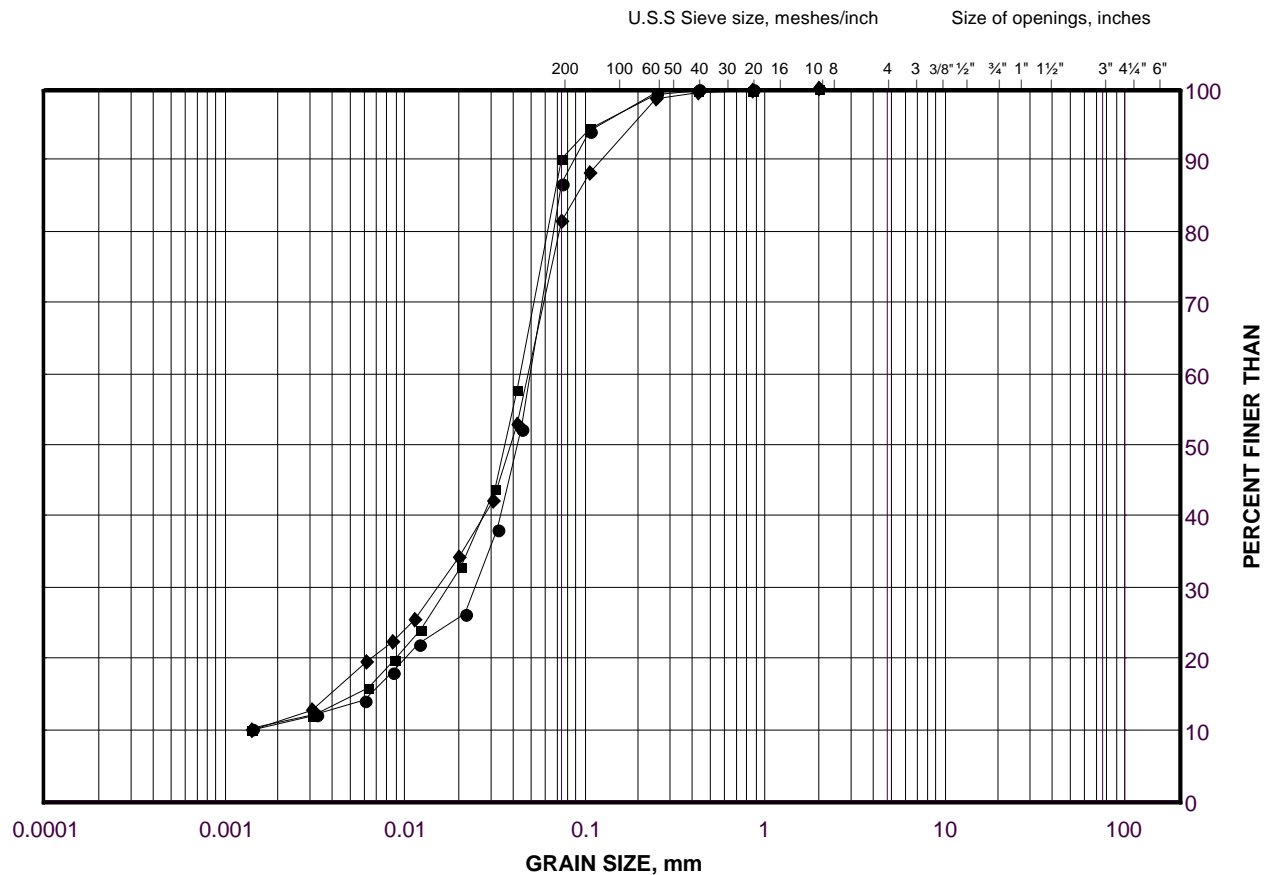
Project No. 09-1111-0018

Checked By: LCC

GRAIN SIZE DISTRIBUTION

Silt (Upper Deposit)

FIGURE C3



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SC-9	4	218.4
■	12-14	4	216.6
◆	SC-4	5	217.5

Project Number: 09-1111-0018

Checked By: LCC

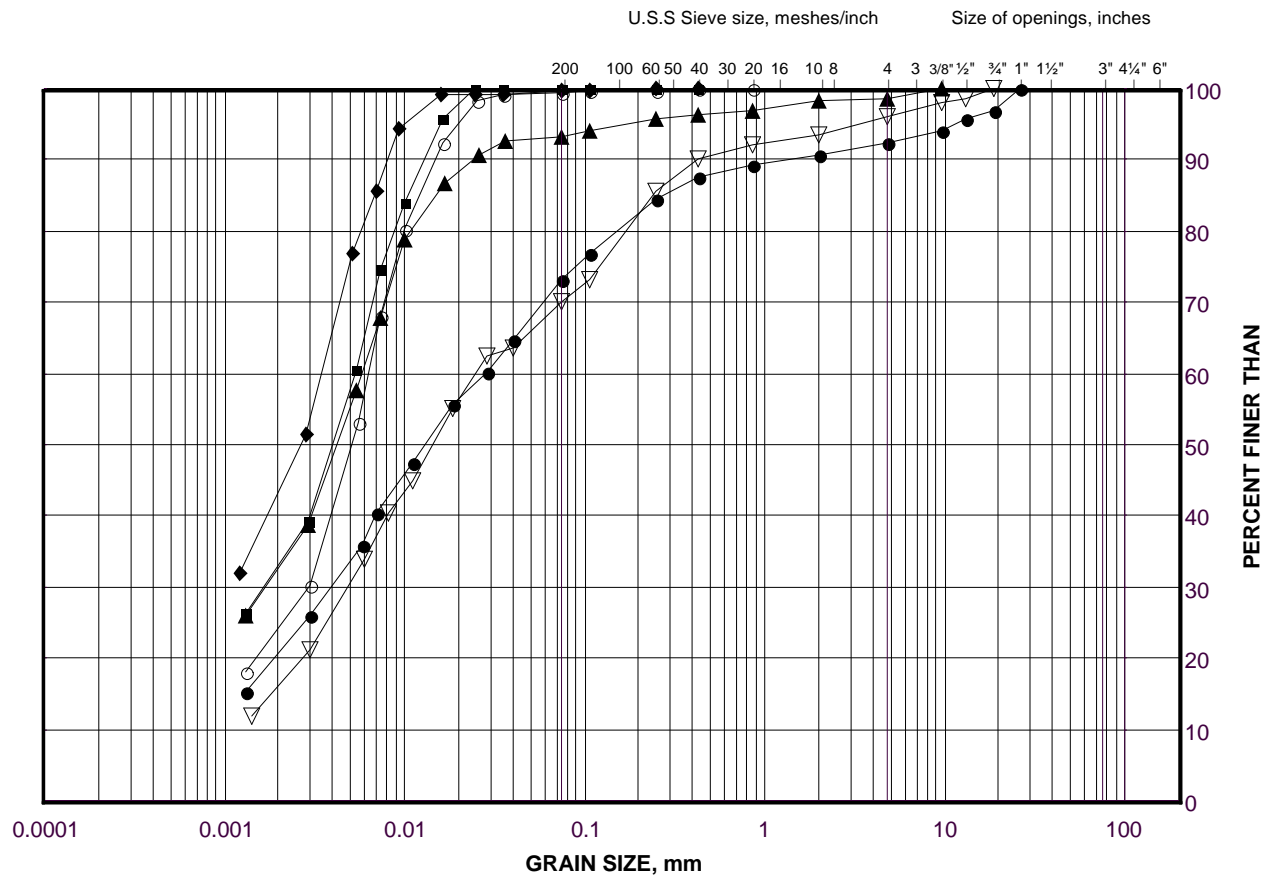
Golder Associates

Date: 10-Jul-13

GRAIN SIZE DISTRIBUTION

Clayey Silt (Upper Deposit)

FIGURE C4



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

LEGEND

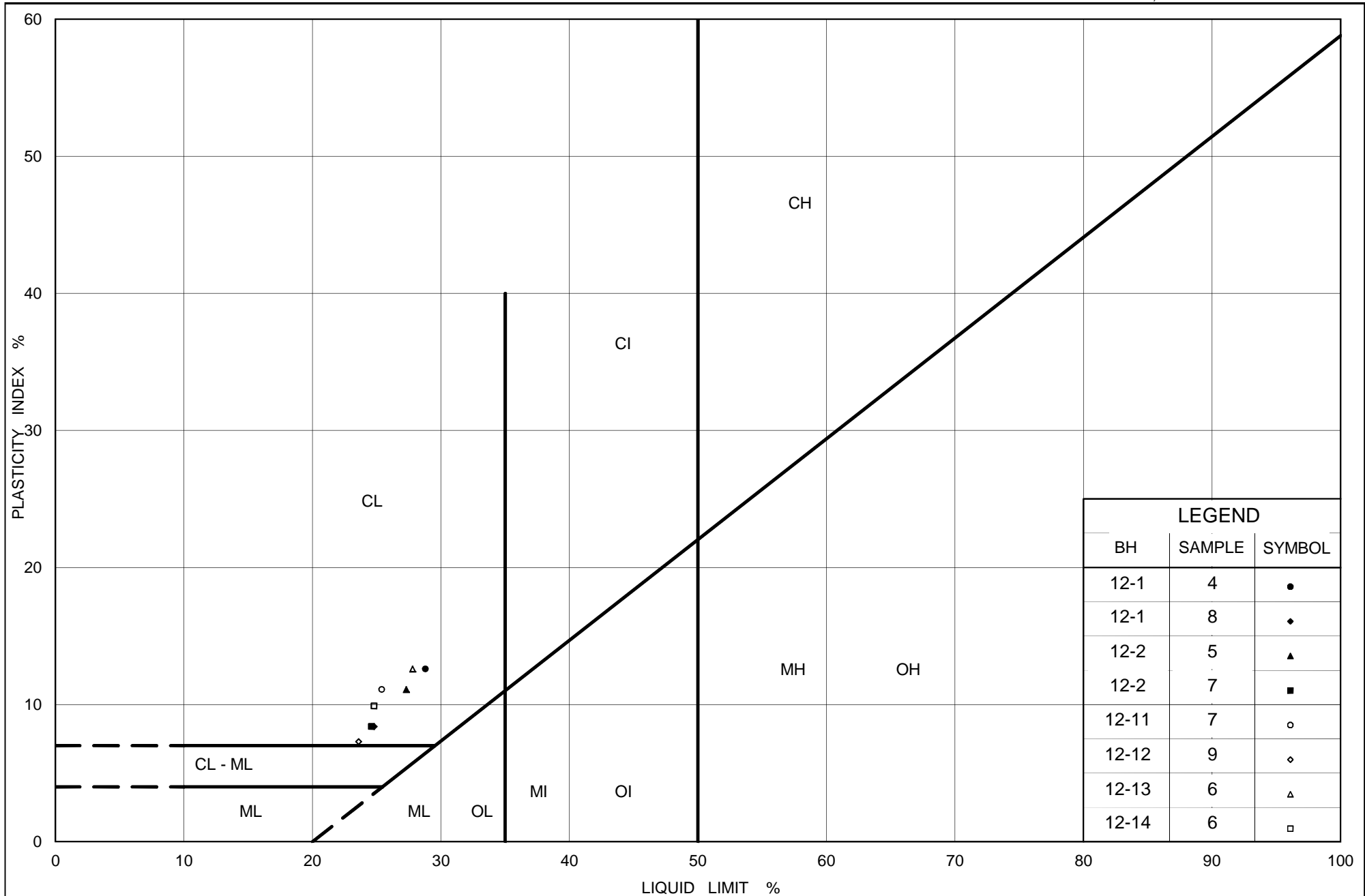
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SC-4	12	208.3
■	12-13	6	215.2
◆	SC-9	8	214.6
▲	12-14	8	211.3
▽	SC-4	8	214.4
○	12-12	9	211.1

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 08-Feb-13



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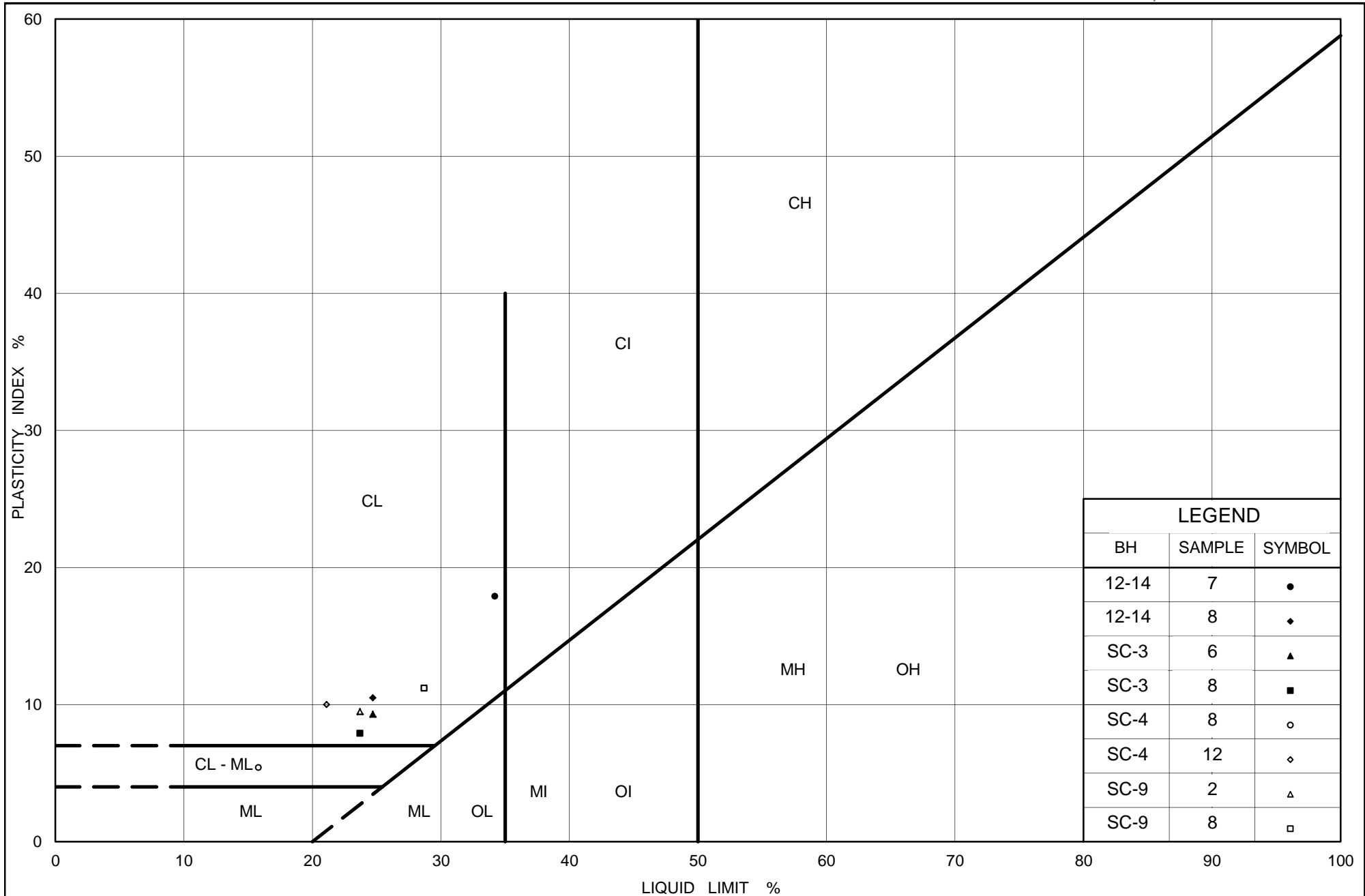
PLASTICITY CHART

Clayey Silt (Upper Deposit)

Figure No. C5A

Project No. 09-1111-0018

Checked By: LCC



Ministry of Transportation

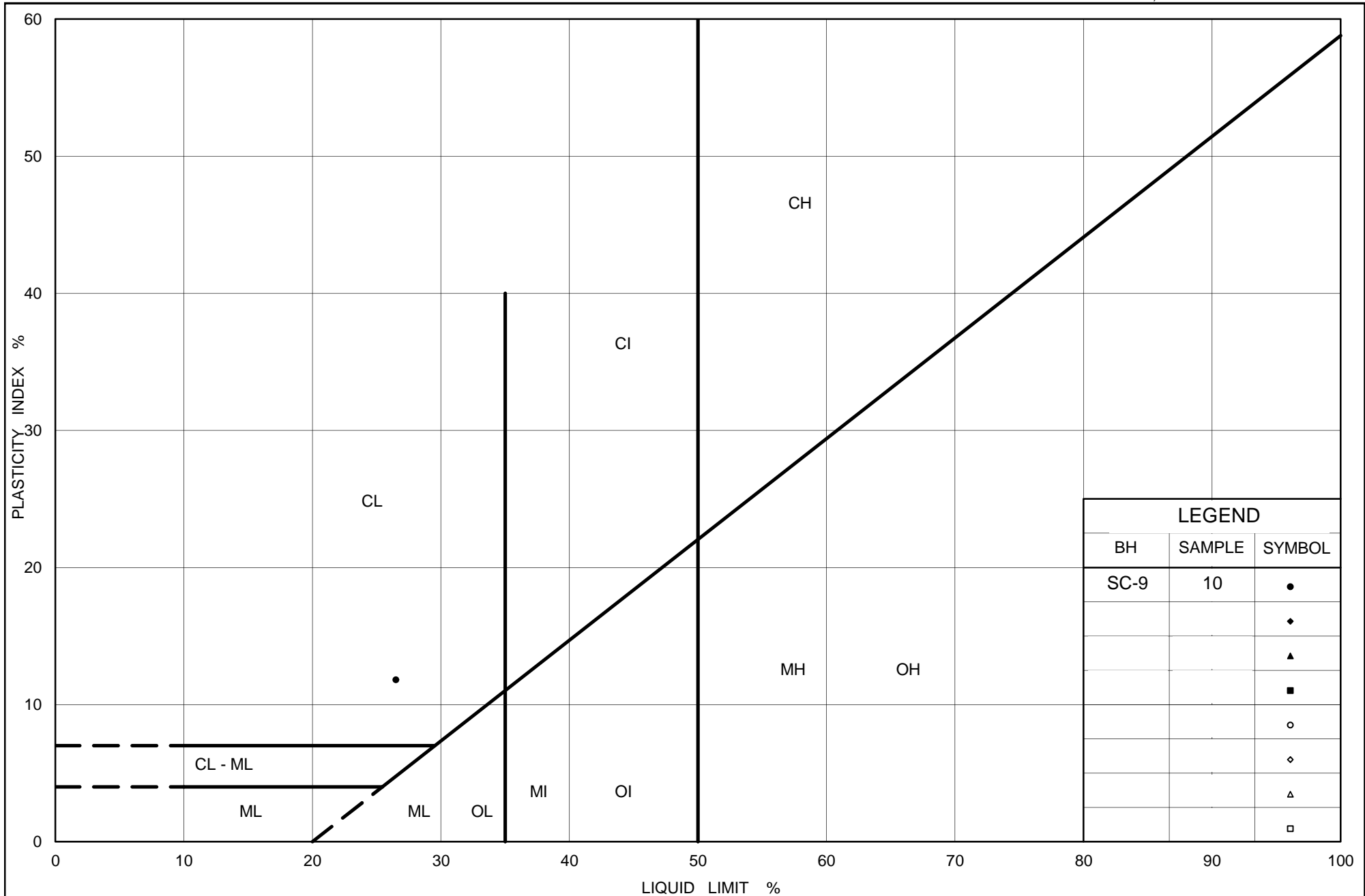
Ontario

PLASTICITY CHART Clayey Silt (Upper Deposit)

Figure No. C5B

Project No. 09-1111-0018

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PLASTICITY CHART Clayey Silt (Upper Deposit)

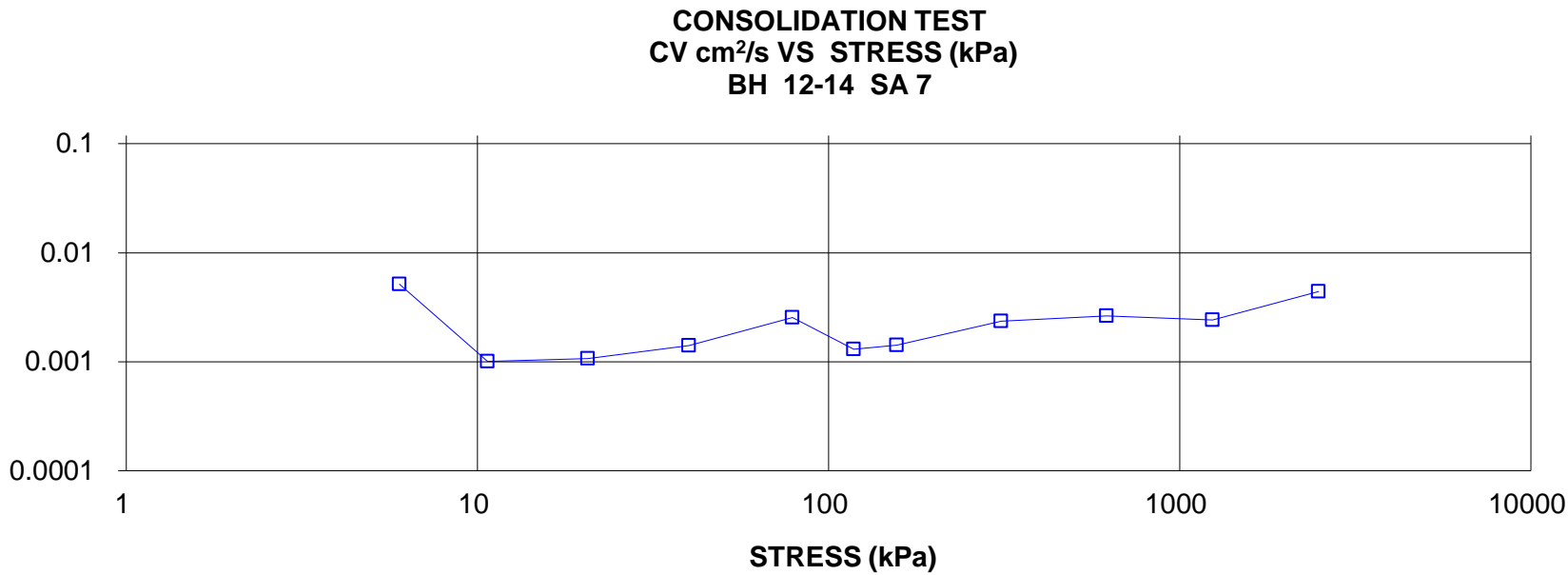
Figure No. C5C

Project No. 09-1111-0018

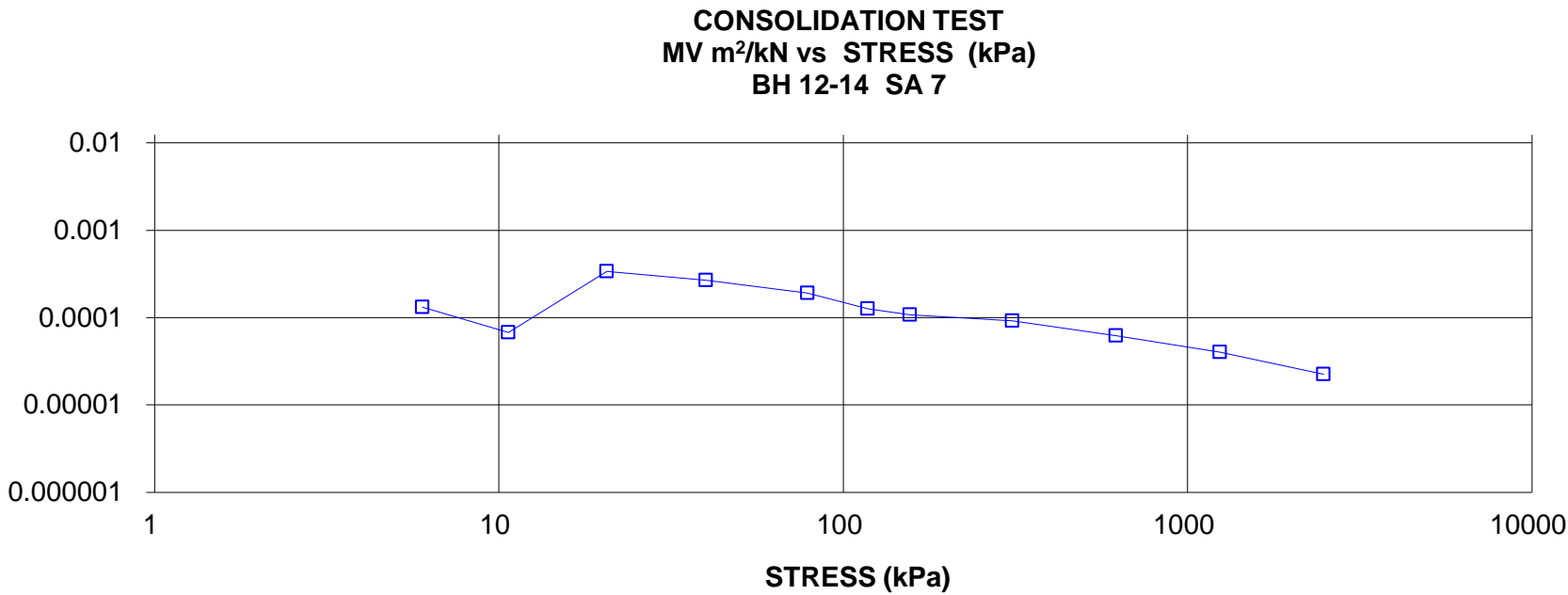
Checked By: LCC

CONSOLIDATION TEST SUMMARY					FIGURE C6 Sheet 1 of 4		
SAMPLE IDENTIFICATION							
Project Number	09-1111-0018			Sample Number	7		
Borehole Number	12-14			Sample Depth, m	6.10-6.55		
TEST CONDITIONS							
Test Type	Standard			Load Duration, hr	24		
Oedometer Number	10						
Date Started	06/11/2012						
Date Completed	06/28/2012						
SAMPLE DIMENSIONS AND PROPERTIES - INITIAL							
Sample Height, cm	2.54			Unit Weight, kN/m ³	20.56		
Sample Diameter, cm	6.34			Dry Unit Weight, kN/m ³	16.57		
Area, cm ²	31.53			Specific Gravity, measured	2.78		
Volume, cm ³	80.02			Solids Height, cm	1.543		
Water Content, %	24.06			Volume of Solids, cm ³	48.64		
Wet Mass, g	167.76			Volume of Voids, cm ³	31.38		
Dry Mass, g	135.23			Degree of Saturation, %	103.7		
TEST COMPUTATIONS							
Stress	Corr.		Average				
kPa	Height	Void	Height	t ₉₀	cv.	mv	k
	cm	Ratio	cm	sec	cm ² /s	m ² /kN	cm/s
0.00	2.538	0.645	2.538				
6.00	2.536	0.644	2.537	265	5.15E-03	1.31E-04	6.63E-08
10.67	2.535	0.643	2.536	1354	1.01E-03	6.75E-05	6.66E-09
20.61	2.527	0.638	2.531	1270	1.07E-03	3.37E-04	3.53E-08
39.98	2.514	0.629	2.520	960	1.40E-03	2.66E-04	3.66E-08
78.89	2.495	0.617	2.504	522	2.55E-03	1.90E-04	4.75E-08
118.01	2.482	0.609	2.489	1009	1.30E-03	1.26E-04	1.61E-08
156.46	2.472	0.602	2.477	913	1.42E-03	1.08E-04	1.50E-08
310.07	2.436	0.579	2.454	540	2.36E-03	9.21E-05	2.13E-08
620.12	2.387	0.547	2.412	470	2.62E-03	6.18E-05	1.59E-08
1241.22	2.324	0.506	2.356	487	2.42E-03	4.02E-05	9.52E-09
2484.03	2.253	0.460	2.289	252	4.41E-03	2.24E-05	9.69E-09
1241.22	2.257	0.463	2.255				
310.07	2.292	0.485	2.274				
78.89	2.329	0.509	2.310				
20.61	2.363	0.532	2.346				
5.90	2.385	0.546	2.374				
Note: k calculated using cv based on t ₉₀ values.							
SAMPLE DIMENSIONS AND PROPERTIES - FINAL							
Sample Height, cm	2.39			Unit Weight, kN/m ³	21.43		
Sample Diameter, cm	6.34			Dry Unit Weight, kN/m ³	17.63		
Area, cm ²	31.53			Specific Gravity, measured	2.78		
Volume, cm ³	75.20			Solids Height, cm	1.543		
Water Content, %	21.53			Volume of Solids, cm ³	48.64		
Wet Mass, g	164.35			Volume of Voids, cm ³	26.56		
Dry Mass, g	135.23						
Prepared By: LH		Golder Associates			Checked By: LCC		

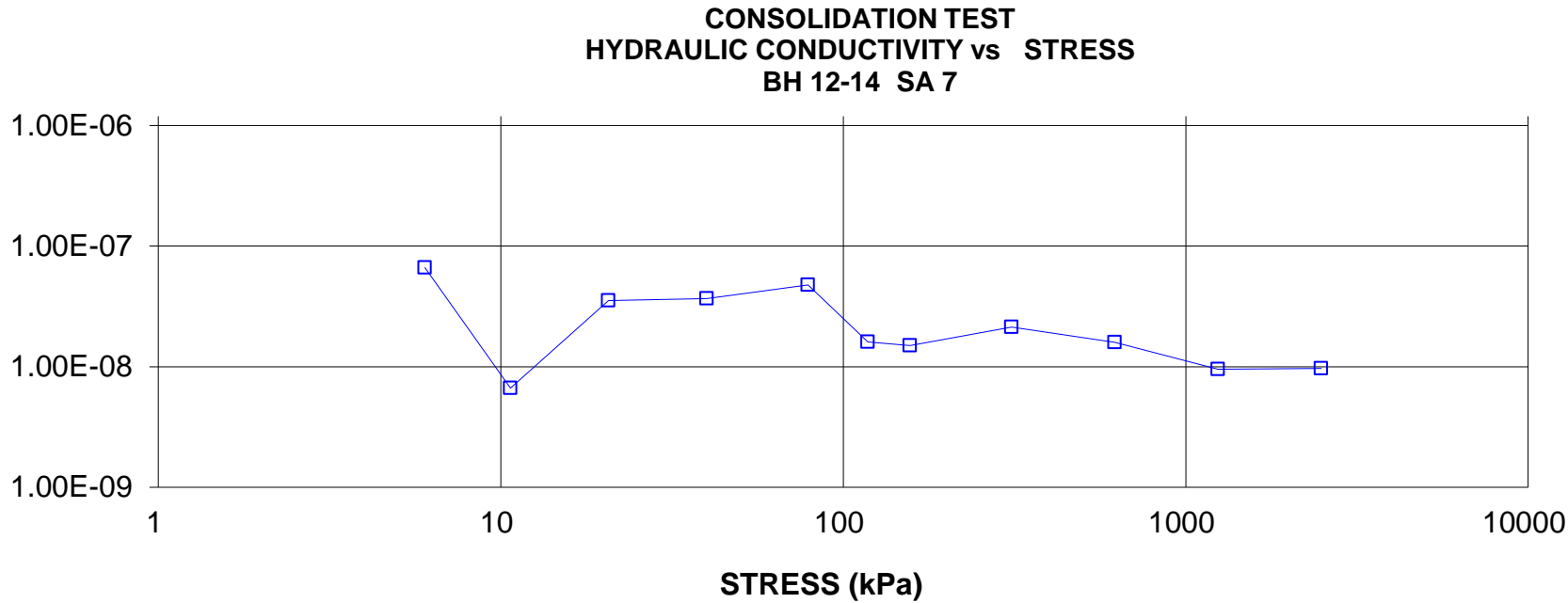
COEFFICIENT OF CONSOLIDATION,
cm²/s

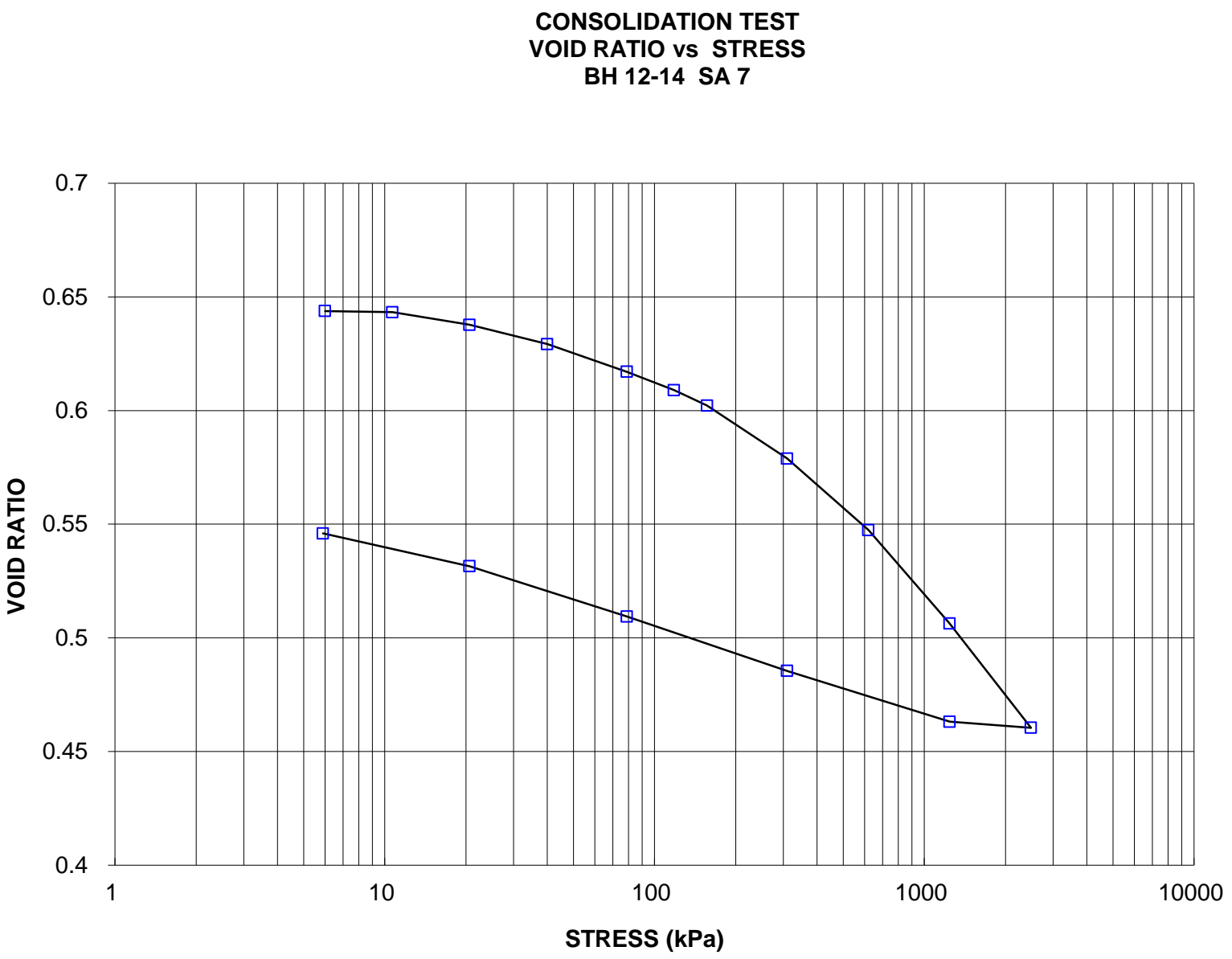


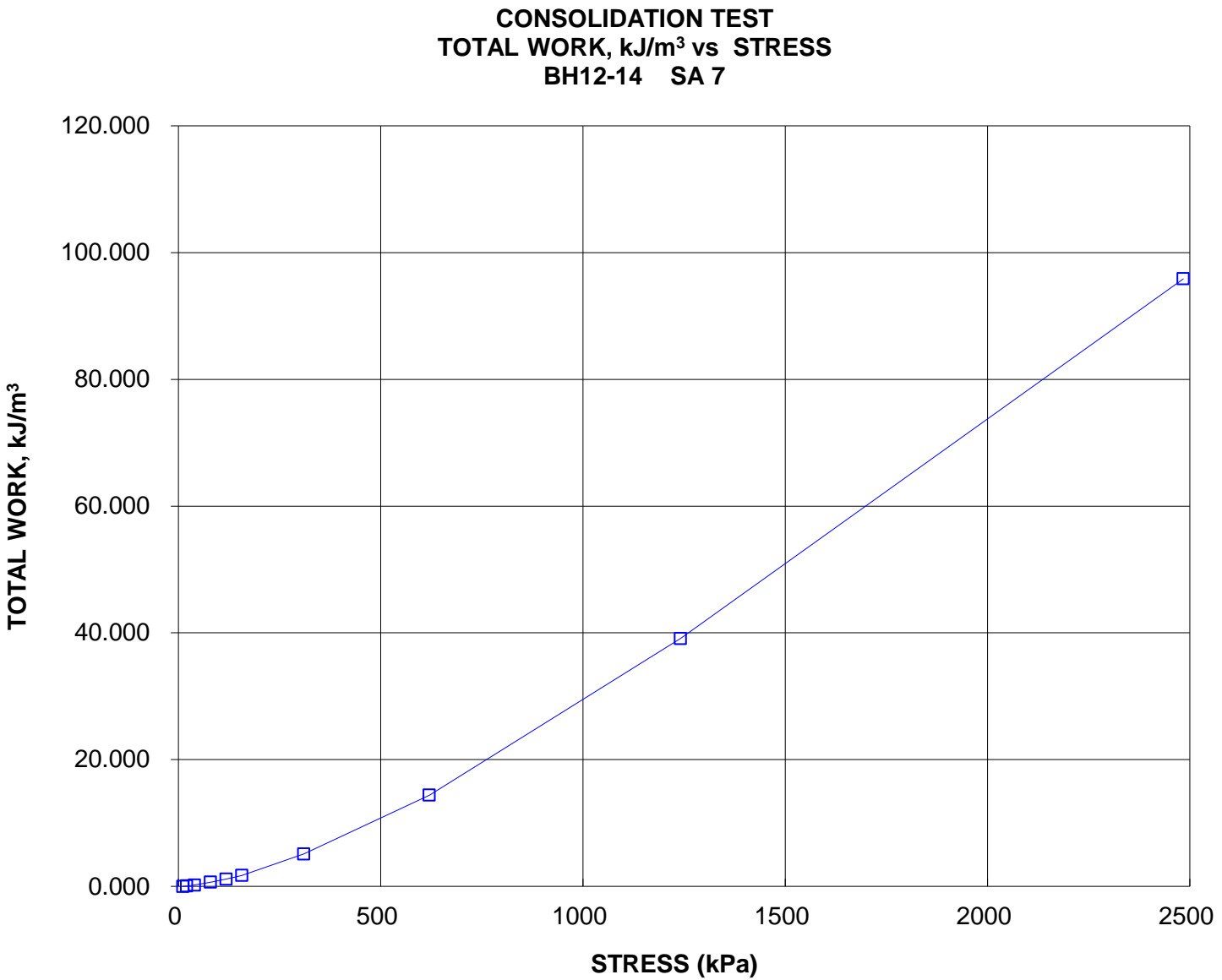
VOLUME COMPRESSIBILITY, m²/kN



HYDRAULIC CONDUCTIVITY,
cm/s

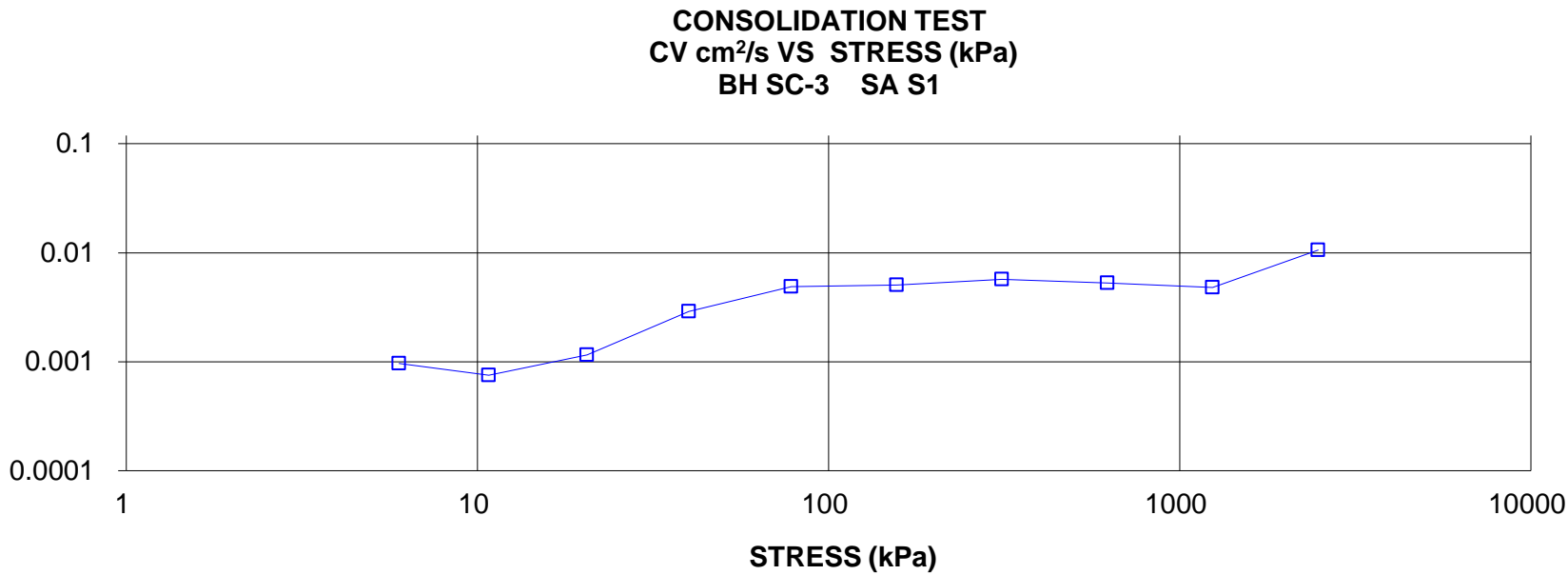




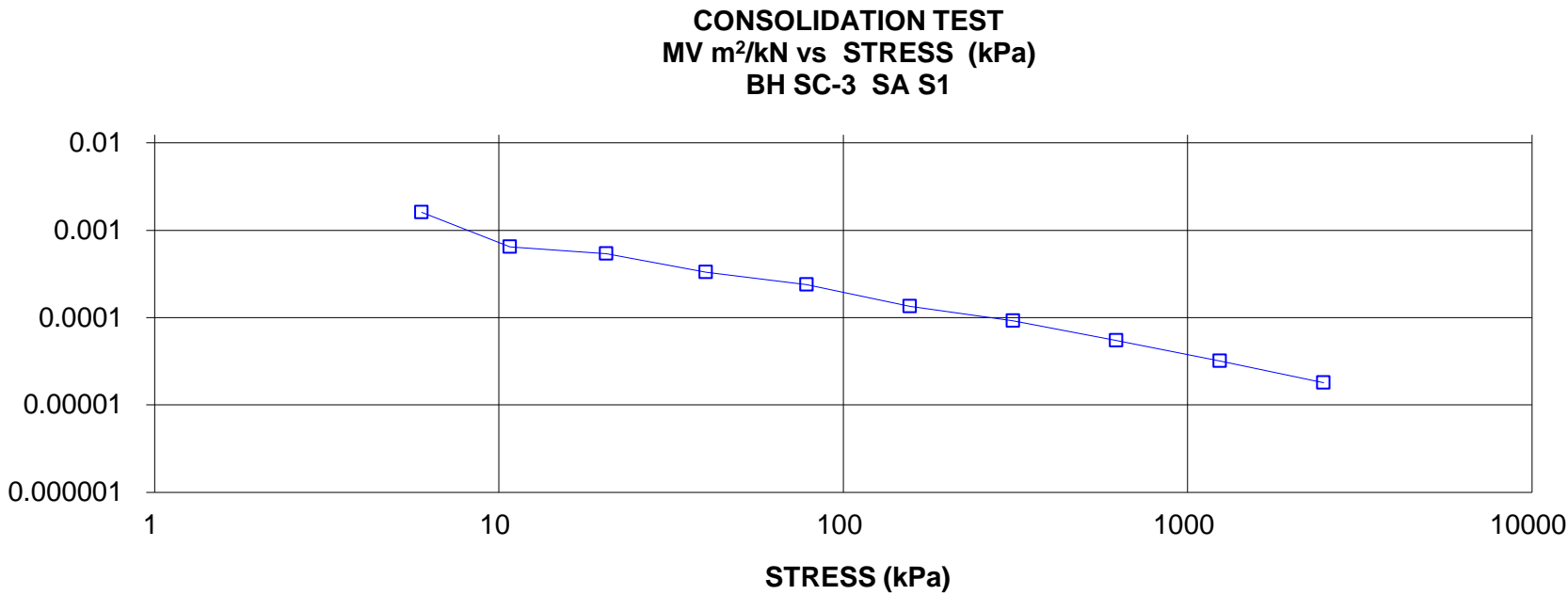


CONSOLIDATION TEST SUMMARY					FIGURE C7 Sheet 1 of 4		
SAMPLE IDENTIFICATION							
Project Number	09-1111-0018			Sample Number	S1		
Borehole Number	SC-3			Sample Depth, m	5.34-5.79		
TEST CONDITIONS							
Test Type	Standard			Load Duration, hr	24		
Oedometer Number	12						
Date Started	06/20/2012						
Date Completed	07/05/2012						
SAMPLE DIMENSIONS AND PROPERTIES - INITIAL							
Sample Height, cm	2.55			Unit Weight, kN/m ³	20.74		
Sample Diameter, cm	6.34			Dry Unit Weight, kN/m ³	16.56		
Area, cm ²	31.58			Specific Gravity, measured	2.77		
Volume, cm ³	80.46			Solids Height, cm	1.553		
Water Content, %	25.28			Volume of Solids, cm ³	49.04		
Wet Mass, g	170.18			Volume of Voids, cm ³	31.42		
Dry Mass, g	135.84			Degree of Saturation, %	109.3		
TEST COMPUTATIONS							
Stress	Corr.		Average				
kPa	Height	Void	Height	t ₉₀	cv.	mv	k
	cm	Ratio	cm	sec	cm ² /s	m ² /kN	cm/s
0.00	2.548	0.641	2.548				
5.97	2.524	0.625	2.536	1411	9.66E-04	1.60E-03	1.52E-07
10.77	2.516	0.620	2.520	1782	7.55E-04	6.46E-04	4.78E-08
20.51	2.502	0.611	2.509	1156	1.15E-03	5.40E-04	6.11E-08
39.99	2.486	0.601	2.494	454	2.90E-03	3.30E-04	9.41E-08
78.32	2.463	0.586	2.474	265	4.90E-03	2.38E-04	1.14E-07
156.28	2.436	0.569	2.449	252	5.05E-03	1.35E-04	6.67E-08
311.94	2.400	0.545	2.418	217	5.71E-03	9.18E-05	5.14E-08
622.06	2.356	0.517	2.378	228	5.26E-03	5.49E-05	2.83E-08
1241.34	2.306	0.485	2.331	240	4.80E-03	3.18E-05	1.50E-08
2481.97	2.249	0.448	2.277	104	1.06E-02	1.81E-05	1.87E-08
1241.34	2.253	0.451	2.251				
311.94	2.275	0.465	2.264				
78.32	2.301	0.482	2.288				
20.51	2.324	0.496	2.313				
6.04	2.343	0.509	2.334				
Note: k calculated using cv based on t ₉₀ values.							
SAMPLE DIMENSIONS AND PROPERTIES - FINAL							
Sample Height, cm	2.34			Unit Weight, kN/m ³	21.73		
Sample Diameter, cm	6.34			Dry Unit Weight, kN/m ³	18.00		
Area, cm ²	31.58			Specific Gravity, measured	2.77		
Volume, cm ³	74.00			Solids Height, cm	1.553		
Water Content, %	20.69			Volume of Solids, cm ³	49.04		
Wet Mass, g	163.94			Volume of Voids, cm ³	24.96		
Dry Mass, g	135.84						
Prepared By: LH		Golder Associates			Checked By: LCC		

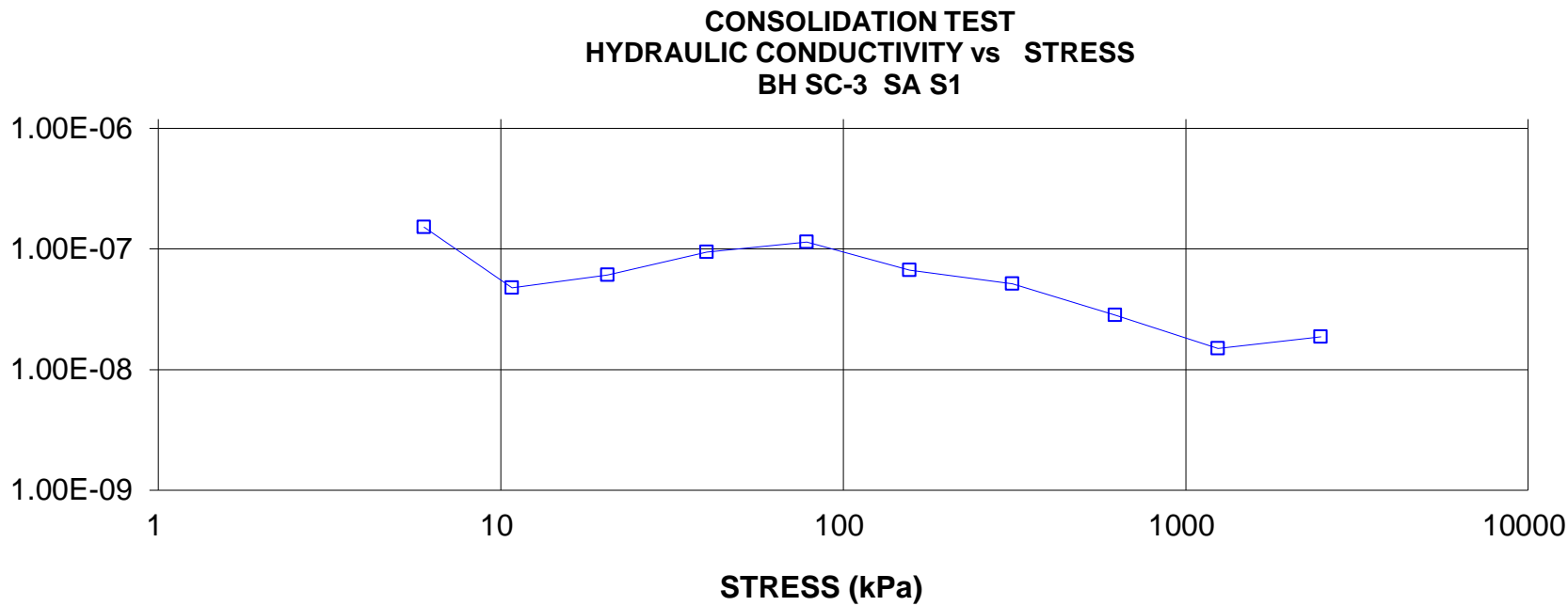
COEFFICIENT OF CONSOLIDATION,
cm²/s

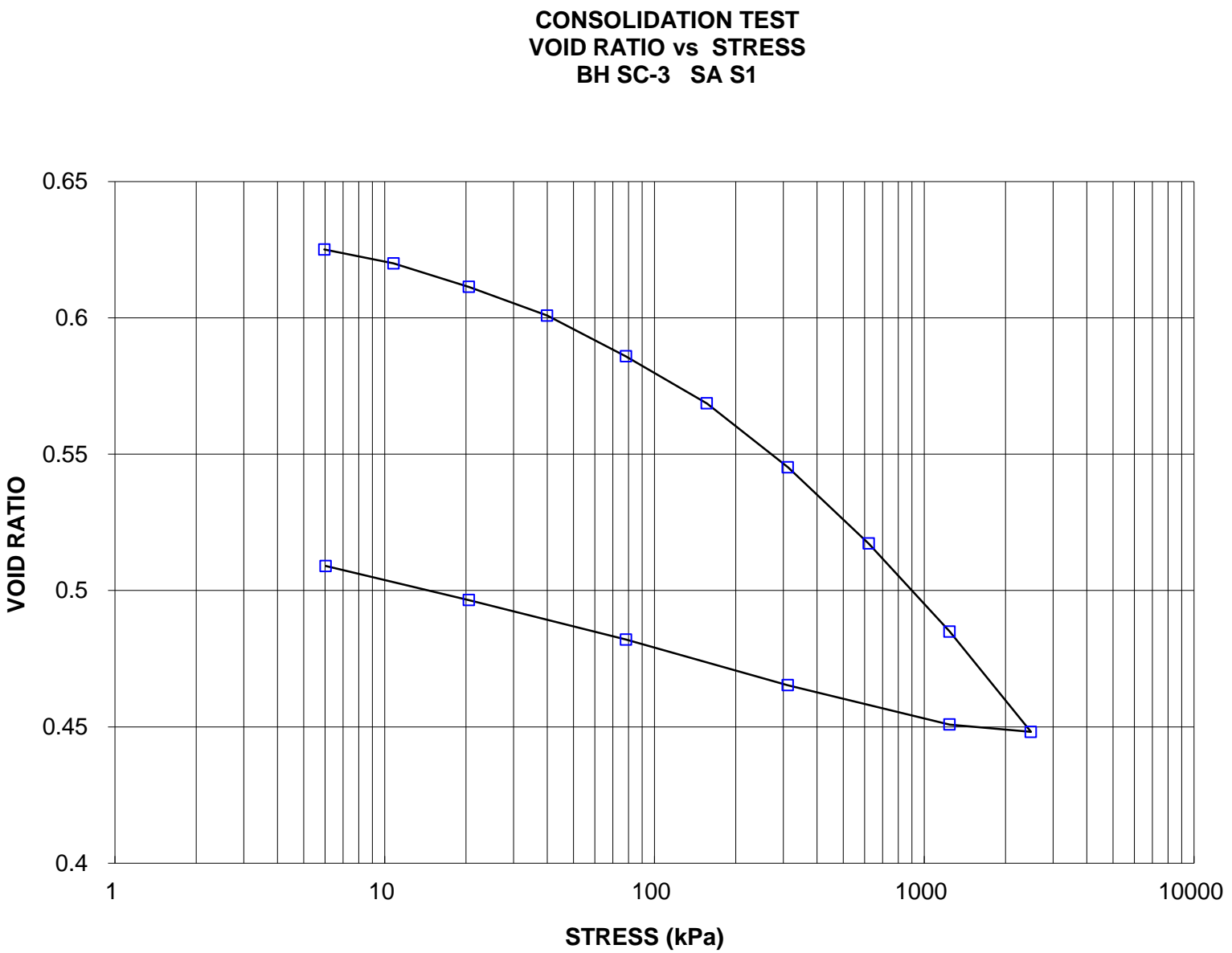


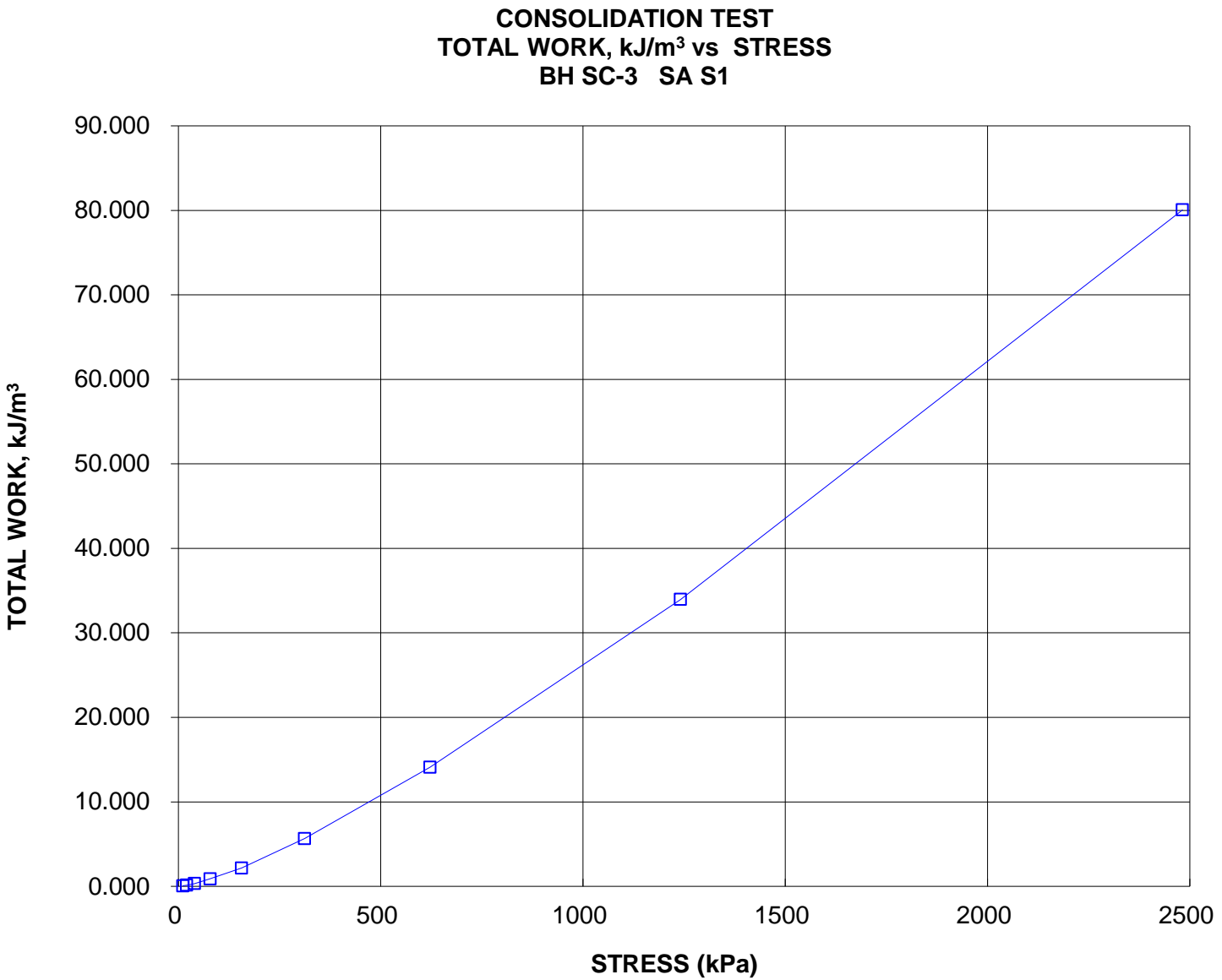
VOLUME COMPRESSIBILITY, m²/kN

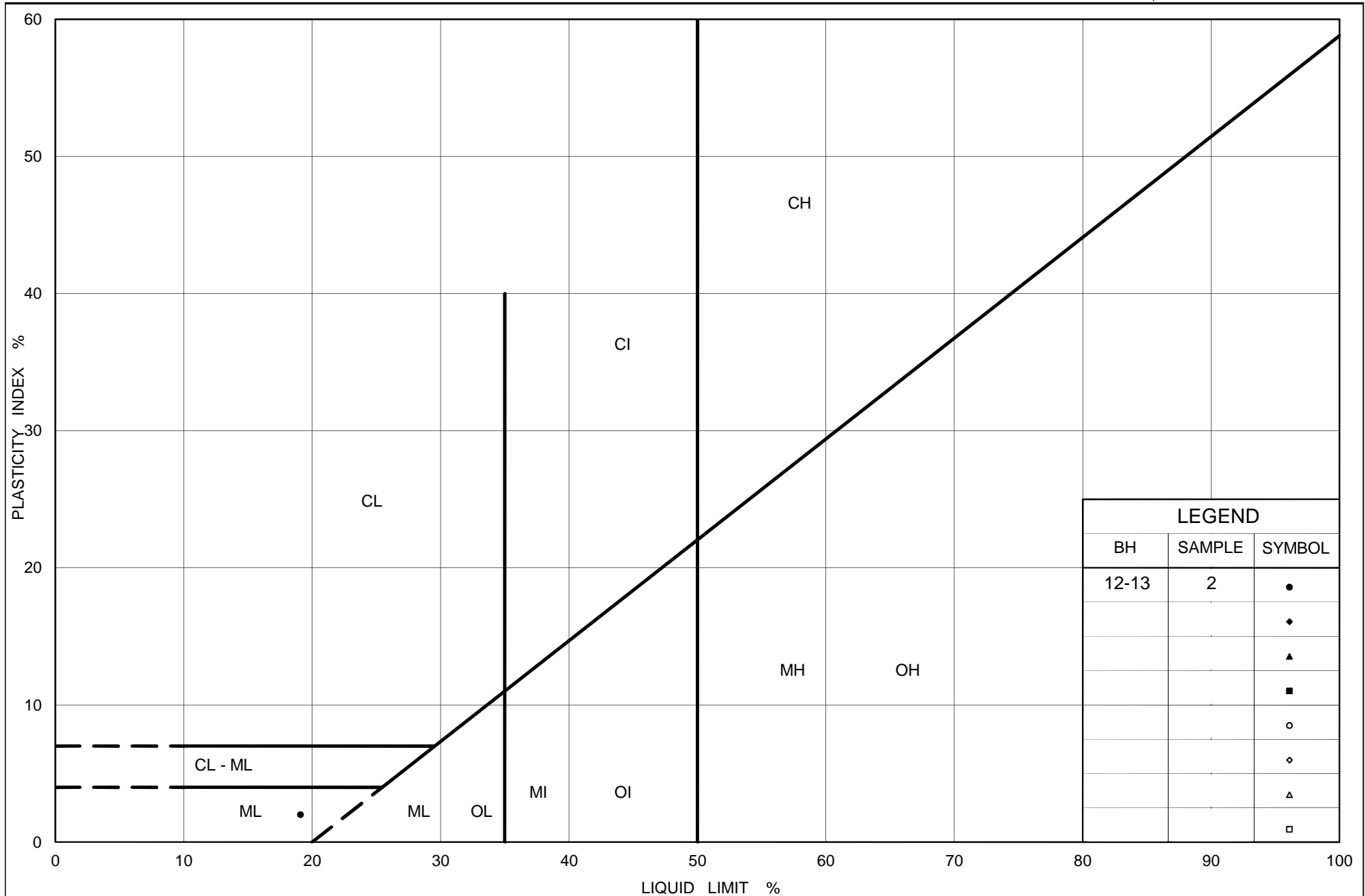


HYDRAULIC CONDUCTIVITY,
cm/s









Ministry of Transportation

Ontario

PLASTICITY CHART Silt (Interlayers)

Figure No. C8

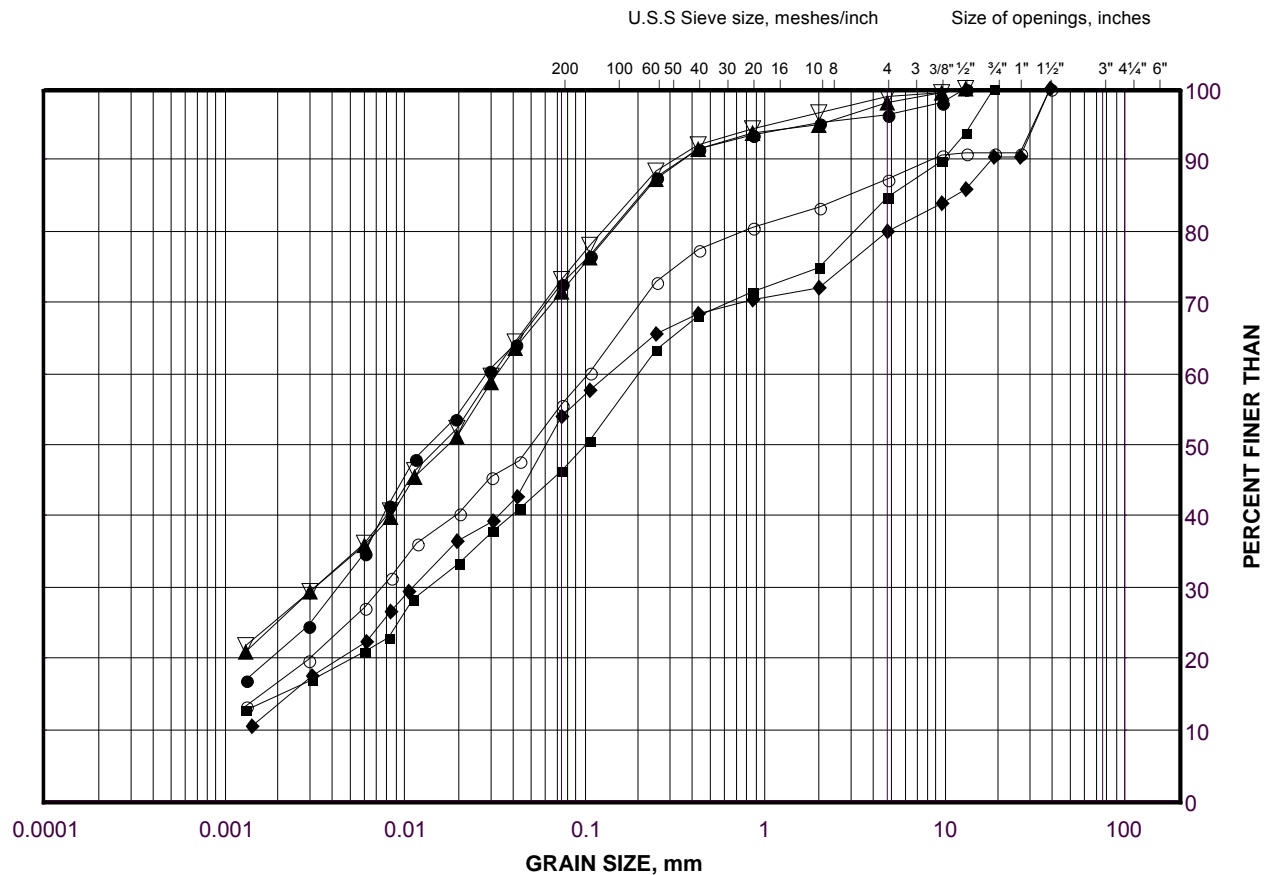
Project No. 09-1111-0018

Checked By: LCC

GRAIN SIZE DISTRIBUTION

Clayey Silt Till

FIGURE C9



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

LEGEND

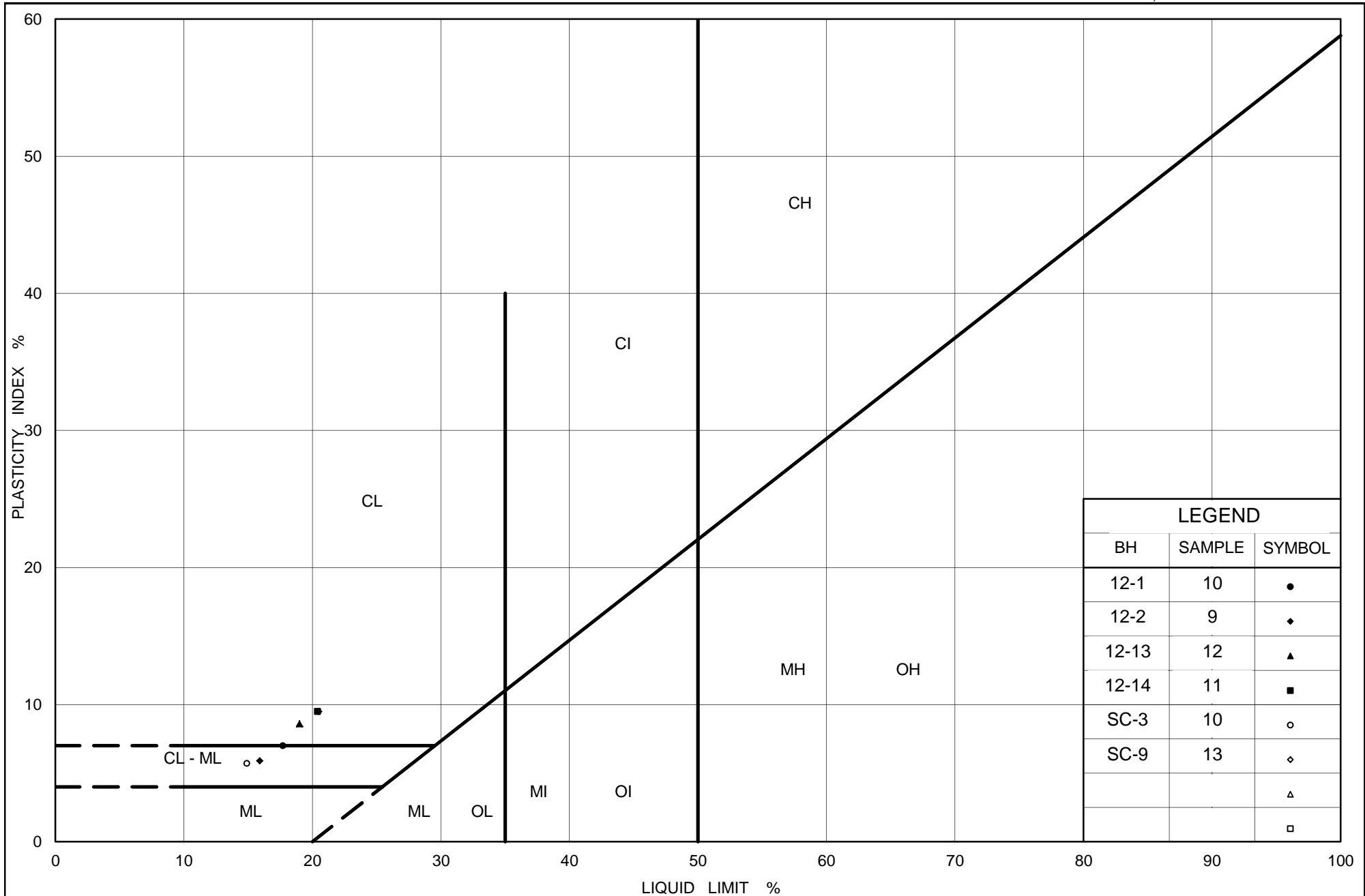
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-1	10	206.8
■	SC-3	10	209.2
◆	12-14	11	206.8
▲	12-13	12	206.8
▽	SC-9	13	207.0
○	12-2	9	208.7

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 25-Jan-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt Till

Figure No. C10

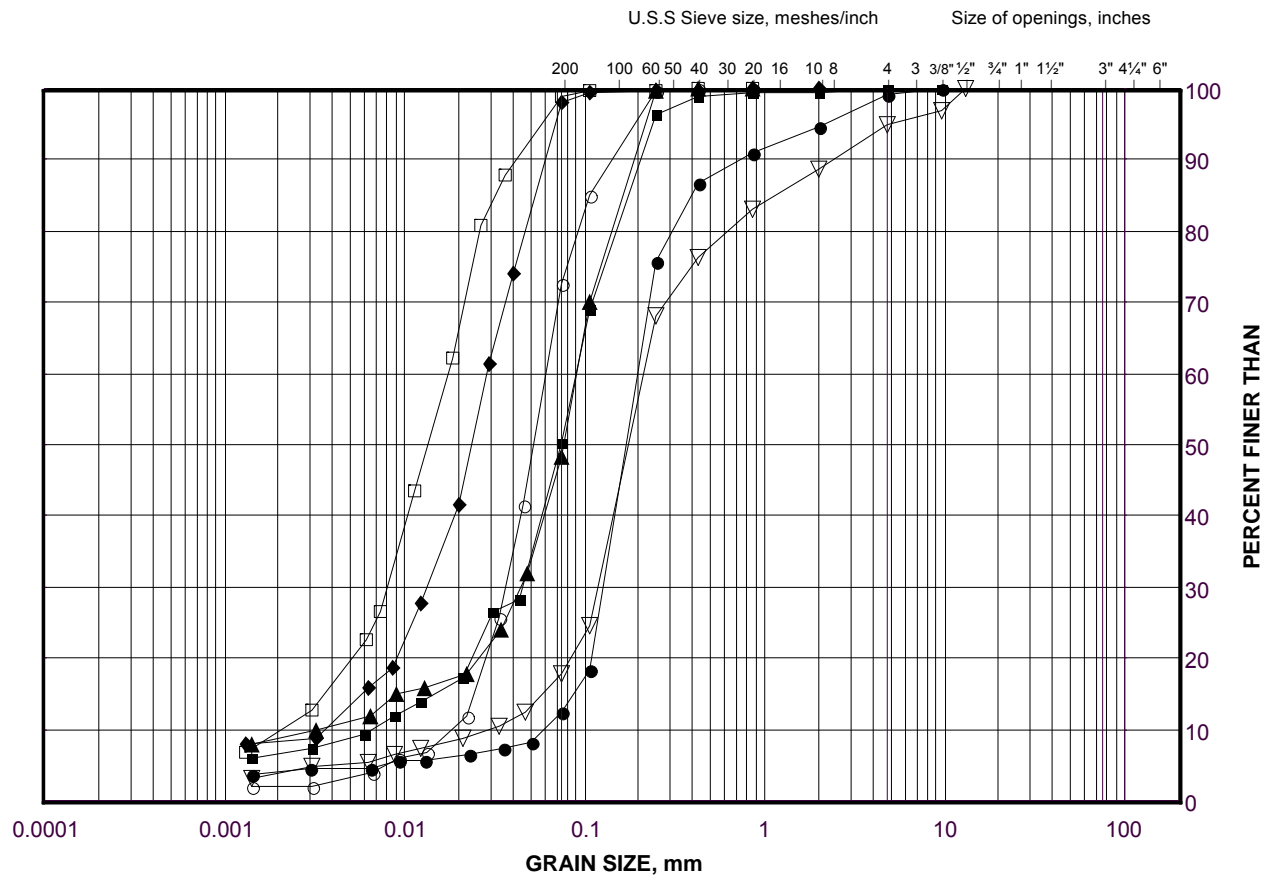
Project No. 09-1111-0018

Checked By: LCC

GRAIN SIZE DISTRIBUTION

Silt to Sand

FIGURE C11



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

LEGEND

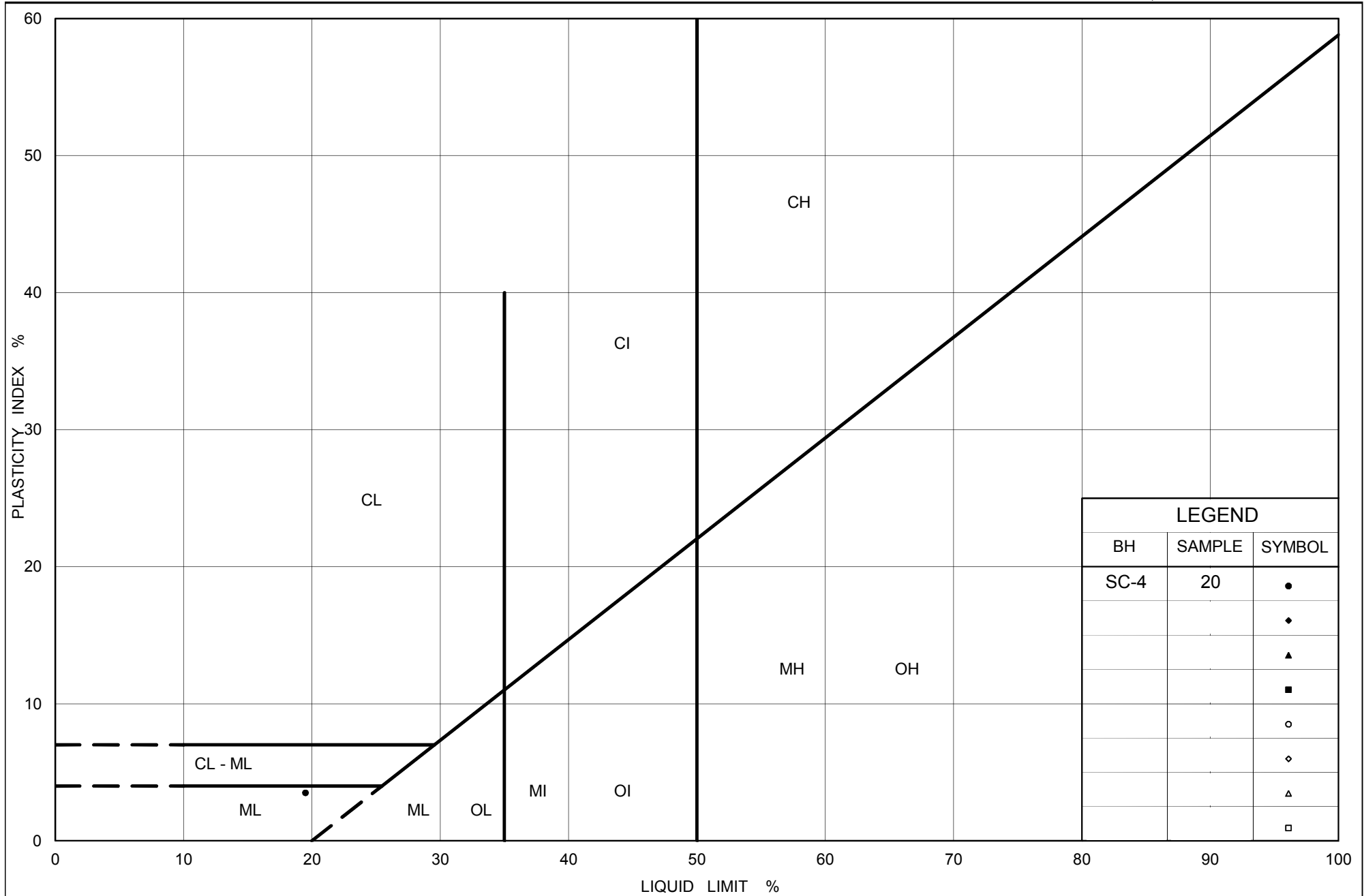
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	12-2	11	205.6
■	SC-3	11	207.7
◆	12-12	11	208.0
▲	SC-3	13	204.6
▽	SC-9	17	200.9
○	SC-4	18	199.1
□	SC-4	20	196.1

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 08-Feb-13



Ministry of Transportation

Ontario

PLASTICITY CHART Sandy Silt to Silt

Figure No. C12

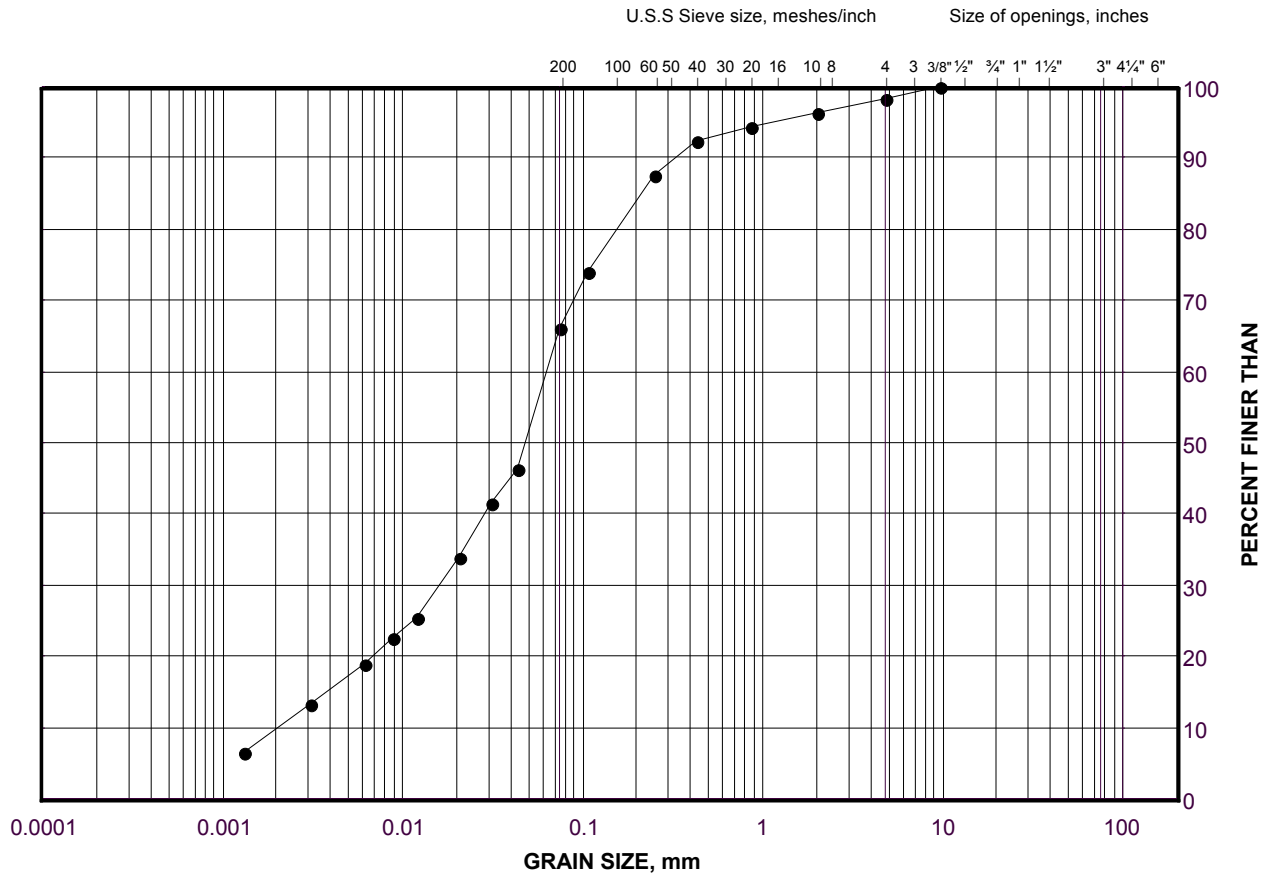
Project No. 09-1111-0018

Checked By: LCC

GRAIN SIZE DISTRIBUTION

Sand and Silt Till

FIGURE C13



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

LEGEND

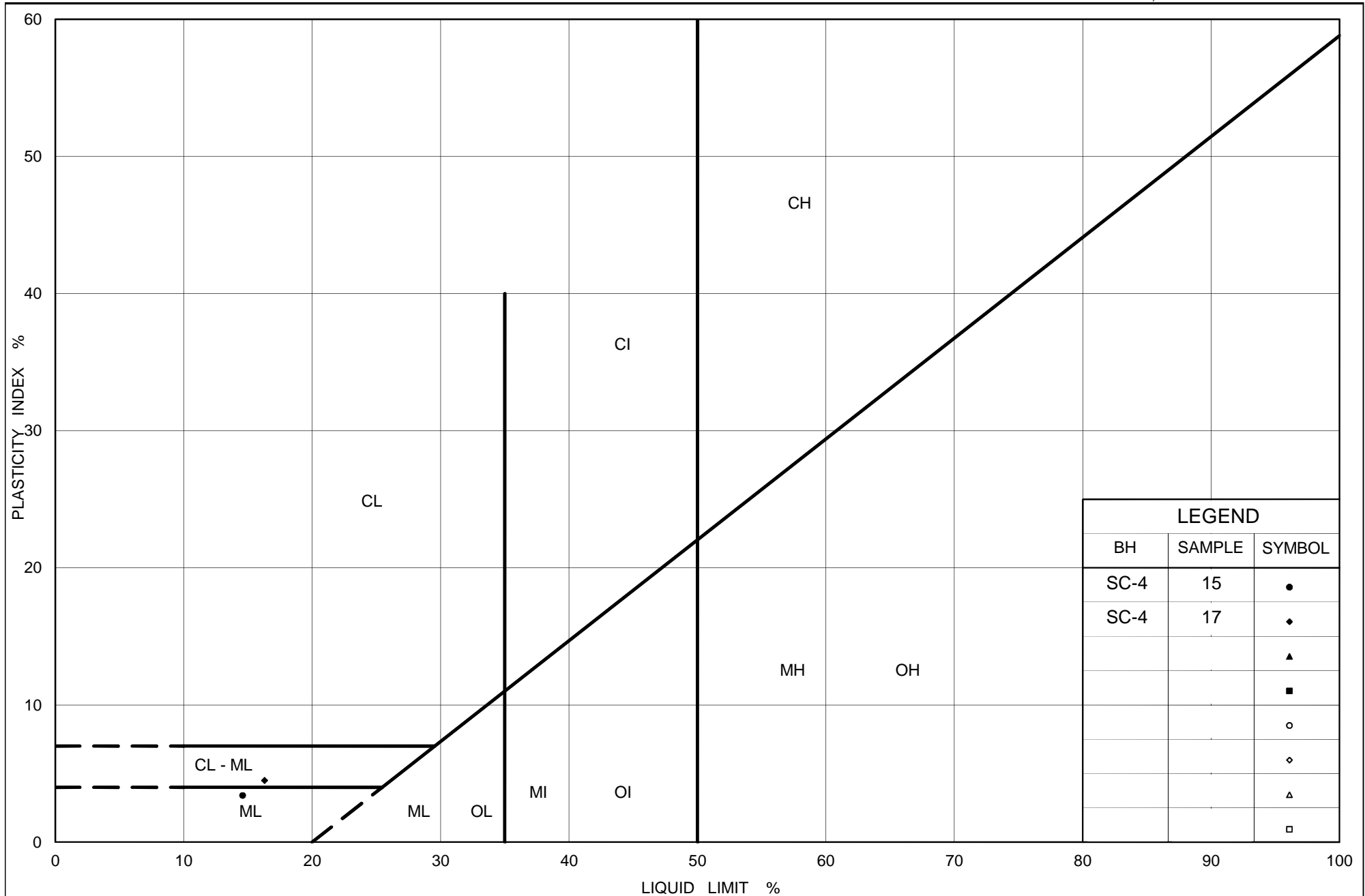
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	SC-4	15	203.8

Project Number: 09-1111-0018

Checked By: LCC

Golder Associates

Date: 10-Jul-13



Ministry of Transportation

Ontario

PLASTICITY CHART Sand and Silt (Till)

Figure No. C14

Project No. 09-1111-0018

Checked By: LCC



APPENDIX D

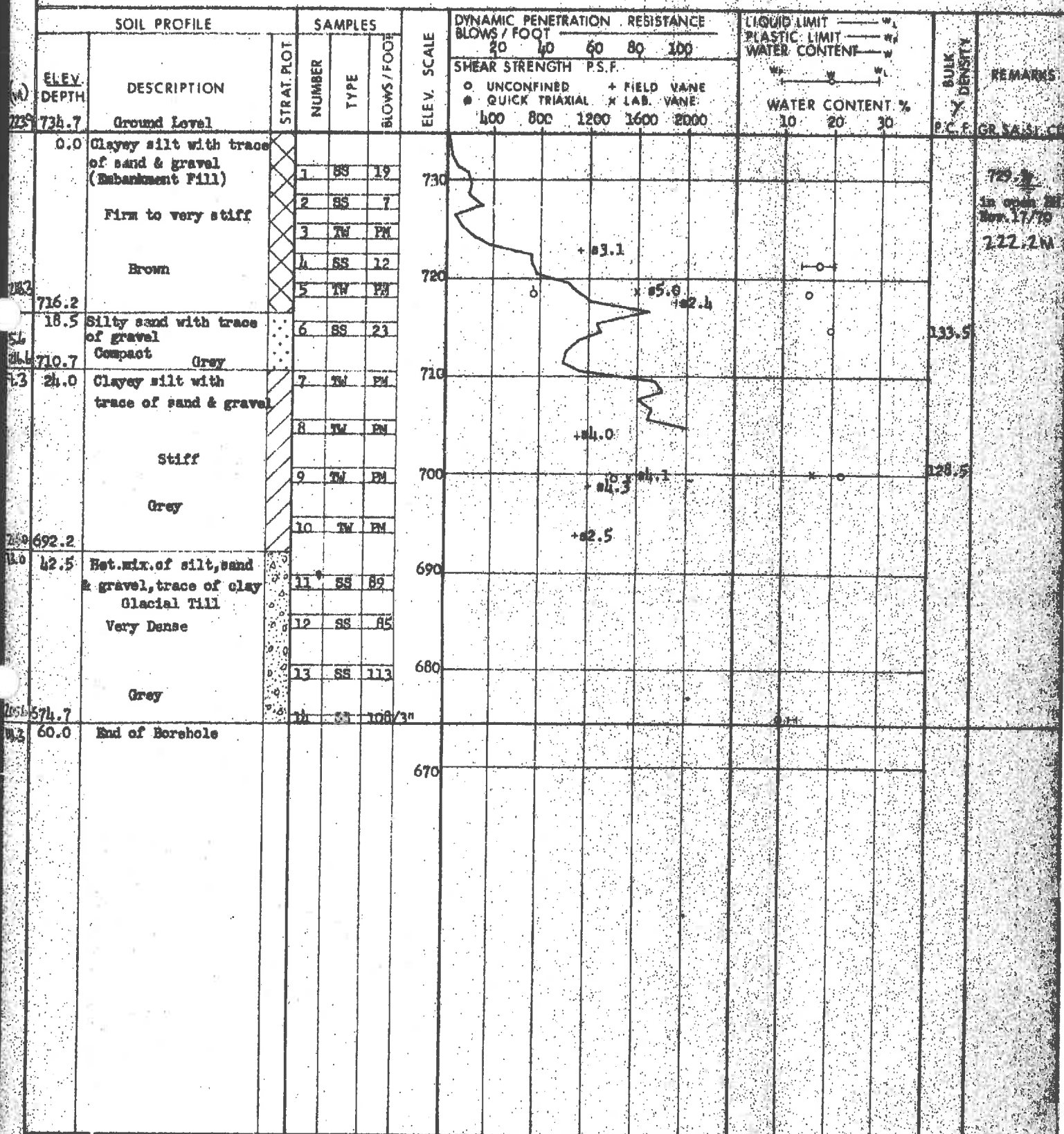
**Records of Boreholes and Laboratory Test Results from
Previous Report (GEOCRES No.
31D-029)**

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 29-2

FOUNDATION SECTION

 JOB 70-11089 LOCATION Sta. 587 + 07 o/s 5th Lt.
 W.P. 105-70-04 BORING DATE Nov. 13, 1970
 DATUM Geodetic BOREHOLE TYPE Washboring-VI Casing

 ORIGINATED BY VK
 COMPILED BY SAA
 CHECKED BY


DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3 BH 29-3

FOUNDATION SECTION

JOB 70-11089 LOCATION Sta. 587 + 87 O/S 59' Rt.
W.P. 105-70-04 BORING DATE Nov. 10, 1970
DATUM Geodetic BOREHOLE TYPE Washboring and NX CasingORIGINATED BY VK
COMPILED BY SAA
CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		BULK DENSITY γ P.C.F.	REMARKS				
(m)	ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE		BLOWS / FOOT		SHEAR STRENGTH P.S.F.				WATER CONTENT %			
							20	40	60	80				100	UNCONFINED ● QUICK TRIAXIAL	FIELD VANE + FIELD VANE x LAB. VANE
							400	800	1200	1600	2000	10	20	30		
210.6	727.6	Ground Level														GRSA 51 CV
	0.0	Clayey silt with trace of sand & gravel. Stiff to Very Stiff		1	SS	11	720									
218.0	715.1	Brown		2	SS	19										0 10 85
2.6	8.5	Gray		3	TV	TH									132	
				4	SS	20	710									
				5	SS	25										
				6	SS	25										
				7	TV	TH	700									129
				8	SS	12										
210.8	691.6															
9.8	32.0	Het. mix. of silt, sand & gravel, trace of clay. Glacial Till		9	SS	85	690									0 37 52 20
		Very Dense		10	SS	100/4"										
104.7	678.1	Gray		11	SS	100/4"	680									
13.9	45.5	End of Borehole														
							670									

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5 BH 29-5 FOUNDATION SECTION

JOB 70-11C89 LOCATION Sta. 589 + 08 o/s 57' Rt. ORIGINATED BY TK
 W.P. 105-70-04 BORING DATE Oct. 20/70 COMPILED BY SAA
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY

(M) ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT PLASTIC LIMIT WATER CONTENT			BUCK DENSITY	REMARKS
			NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	20	40	60	80	100	W _L	W _P		
221.1	725.3															
	0.0															
219.2	719.3		1	SS	1	780									109	0 25 65 19
1.8	6.0		2	SS	1											2.25 Org.
218.3	716.3		2A	TW	PM											87.15 Org.
2.7	9.0		3	SS	7											
			4	TW	PM	710										
			5	SS	7											
			6	SS	23											
			7	SS	17	700										
			8	TW	PM											
			9	TW	PM	690										
			10	TW	PM											
			10A	SS	8											
			11	TW	PM	680										
206.1	676.3															
14.9	49.0		12	SS	31	670										
			13	SS	77											
			14	SS	159											
201.1	659.8		15	SS	162	660										
20.0	65.5															
						650										

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6 BH 29-6

FOUNDATION SECTION

JOB 70-11089 LOCATION Sta. 589 + 15 o/s 54.5' Lt. ORIGINATED BY VK
 W.P. 105-70-04 BORING DATE Nov. 19/70 COMPILED BY SAA
 DATUM Geodetic BOREHOLE TYPE Washboring-MI Casing CHECKED BY *fr*

(W)	SOIL PROFILE			STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ	REMARKS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
	ELEV. DEPTH	DESCRIPTION	NUMBER		TYPE	BLOWS/FOOT	BLOWS / FOOT					SHEAR STRENGTH P.S.F.			WATER CONTENT %																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
							20		40	60	80	100	UNCONFINED			FIELD VANE			QUICK TRIAXIAL			LAB. VANE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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225.8	740.9	Ground Level																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													</

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

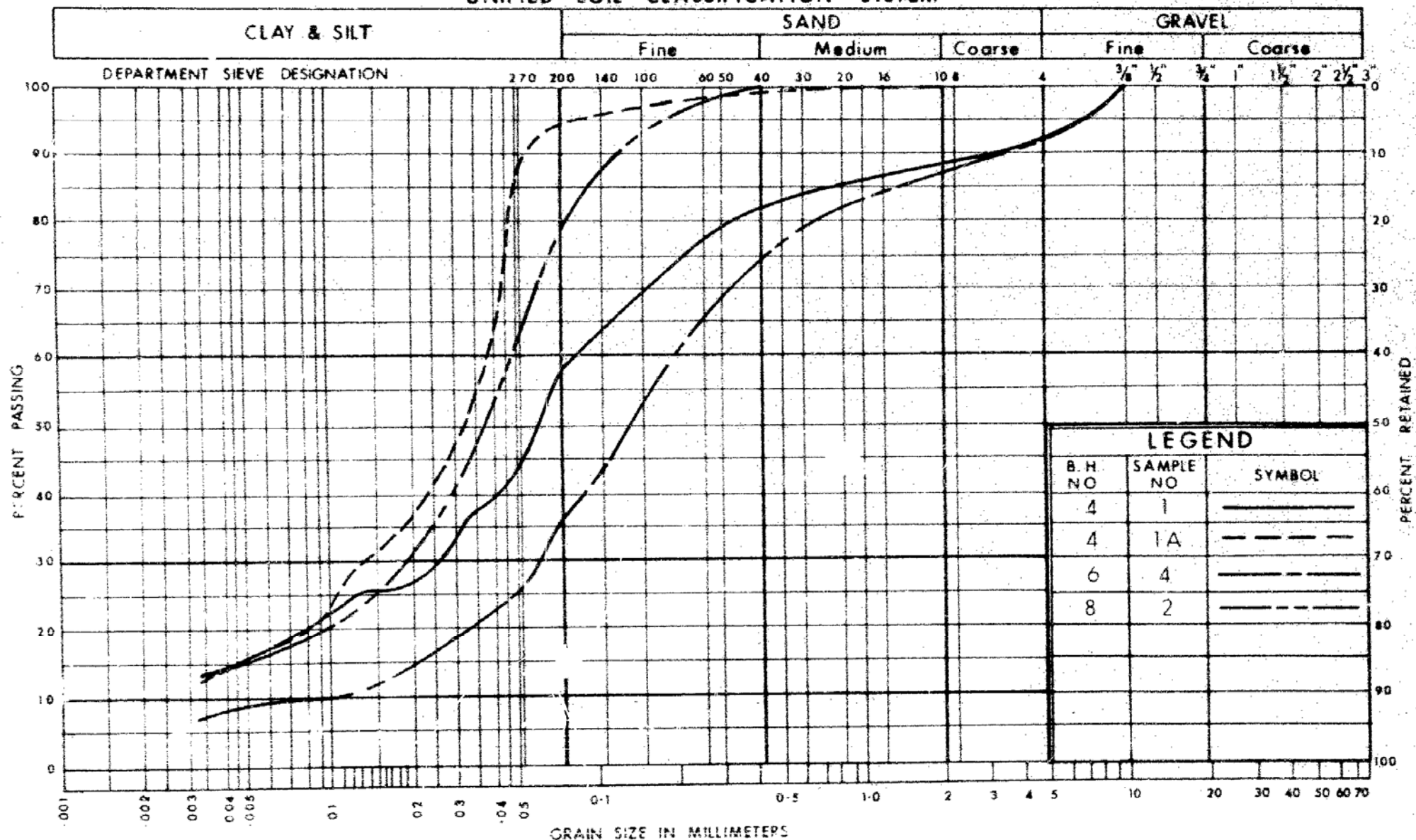
RECORD OF BOREHOLE No. 8 3H29-8

FOUNDATION SECTION

JOB 70-11089 LOCATION Sta. 588 + 48 o/s 2' Lt. ORIGINATED BY VK
 W.P. 105-70-04 BORING DATE Oct. 21/70 COMPILED BY 844
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY 844

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT % 10 20 30				
							SHEAR STRENGTH P.S.F.									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE									
(M)						400	800	1200	1600	2000						
221.1	725.5	Ground Level														
	0.0	Sandy silt, trace of organics														
		Loose to compact	1	SS	11											
		Brown	2	SS	7											
218.4	716.5		3	SS	8											
2.7	9.0	Clayey silt with trace of sand & gravel	4	TW	PH											
		Soft to Stiff	5	TW	PH											
		Grey	6	TW	PH											
			7	SS	27											
			8	TW	PH											
			9	TW	PH											
			10	TW	PH											
			11	TW	PH											
206.2	676.5															
14.9	49.0	Het. mix. of silt, sand & gravel, trace of clay - Glacial Till	12	SS	145											
			13	SS	30											
		Dense to Very Dense	14	SS	100/3"											
		Grey	15	SS	100/5"											
200.9	659.0															
20.3	66.5	End of Borehole														

UNIFIED SOIL CLASSIFICATION SYSTEM



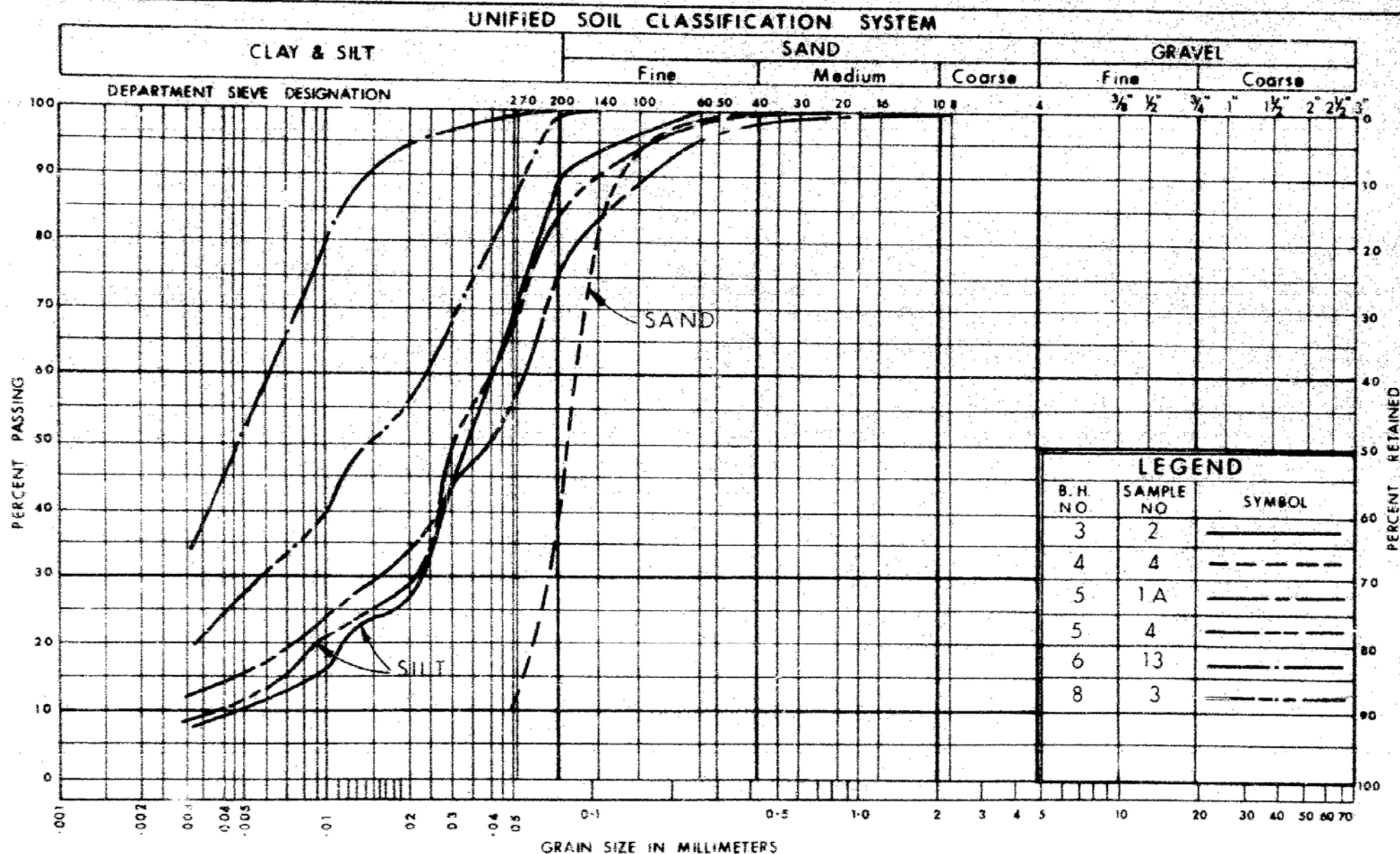
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
SANDY SILT TO SILTY SAND

W.P. No. 105-70-04

JOB No. 70-11089

FIG. 1



DEPARTMENT OF HIGHWAYS
**MATERIALS and
TESTING
DIVISION**

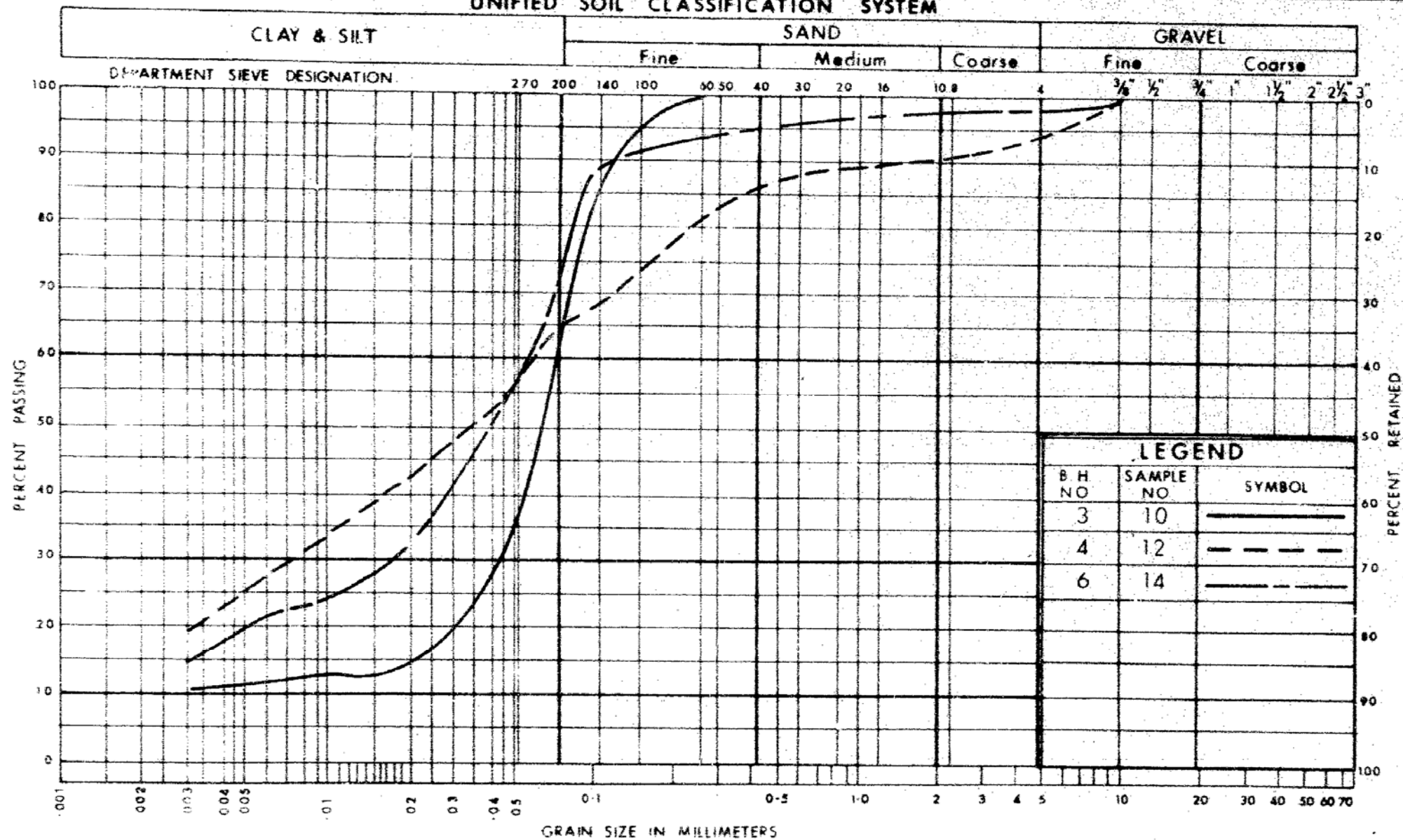
GRAIN SIZE DISTRIBUTION CLAYEY SILT

W.P. No. 105-70-04

JOB No. 70-11089

FIG. 2

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

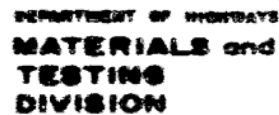
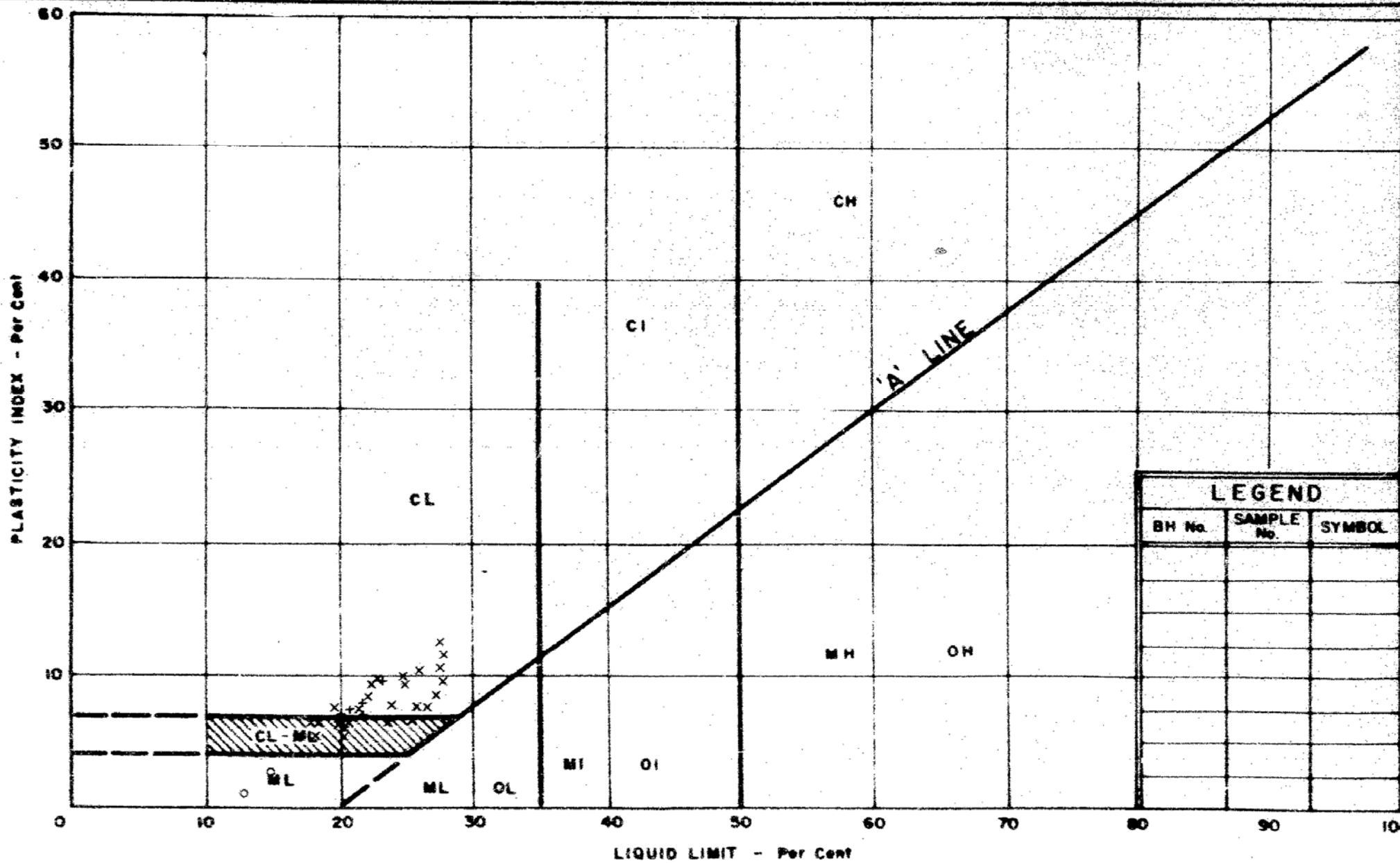
GRAIN SIZE DISTRIBUTION

GLACIAL TILL

W.P. No. 105-70-04

JOB No. 70-11089

FIG. 3



PLASTICITY CHART

FILL (CLAYEY SILT) — + CLAYEY SILT STRATUM — x
GLACIAL TILL — o

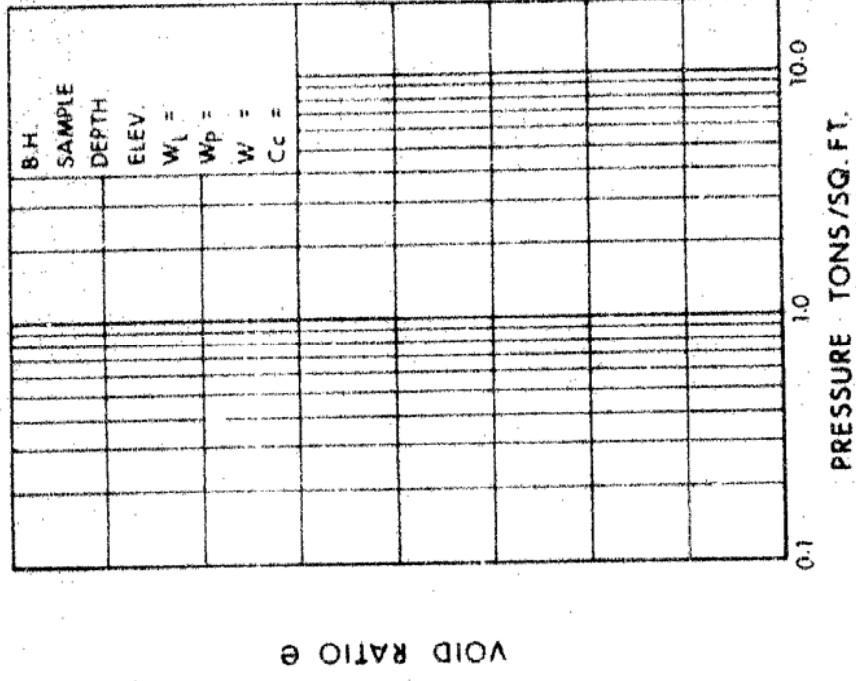
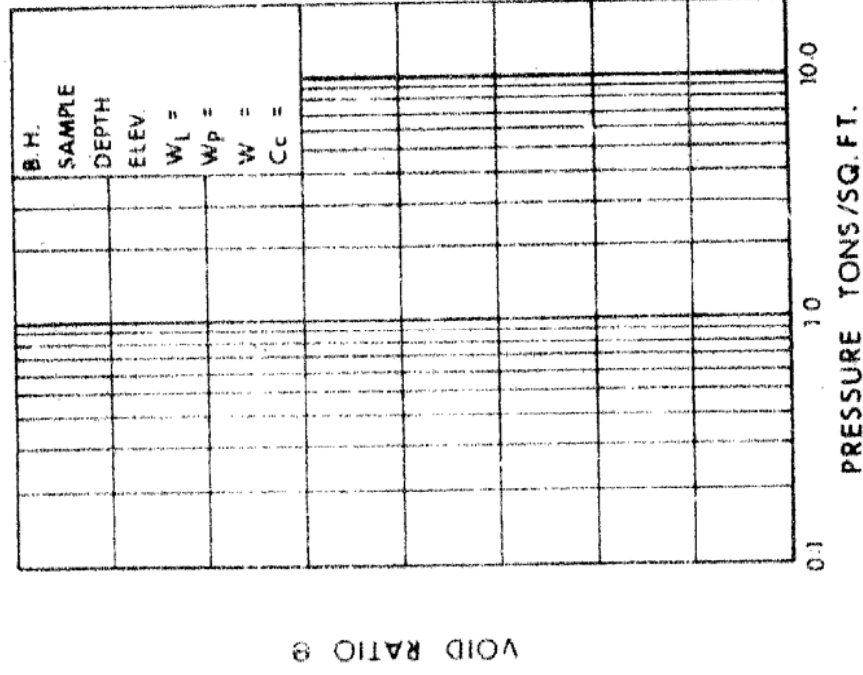
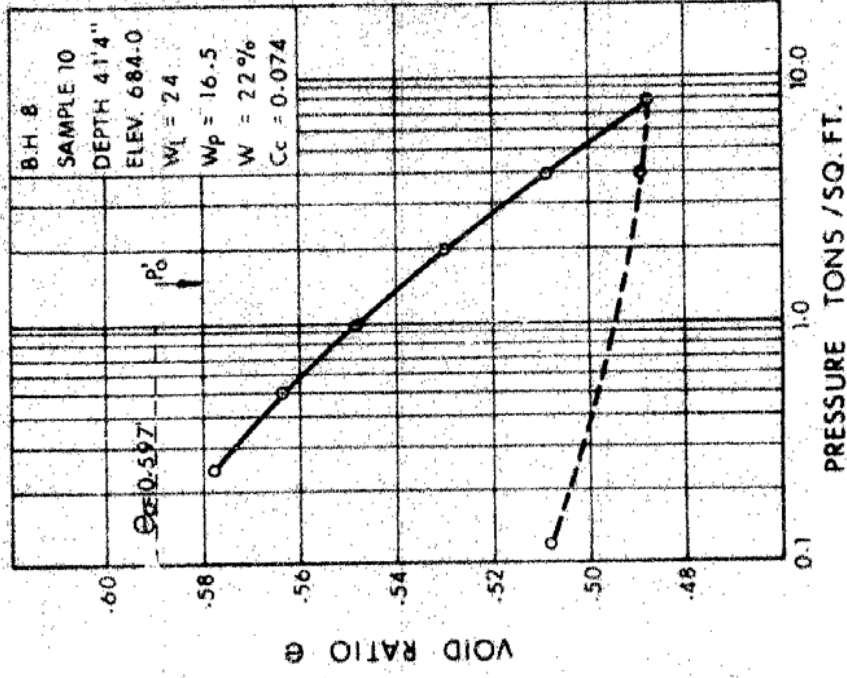
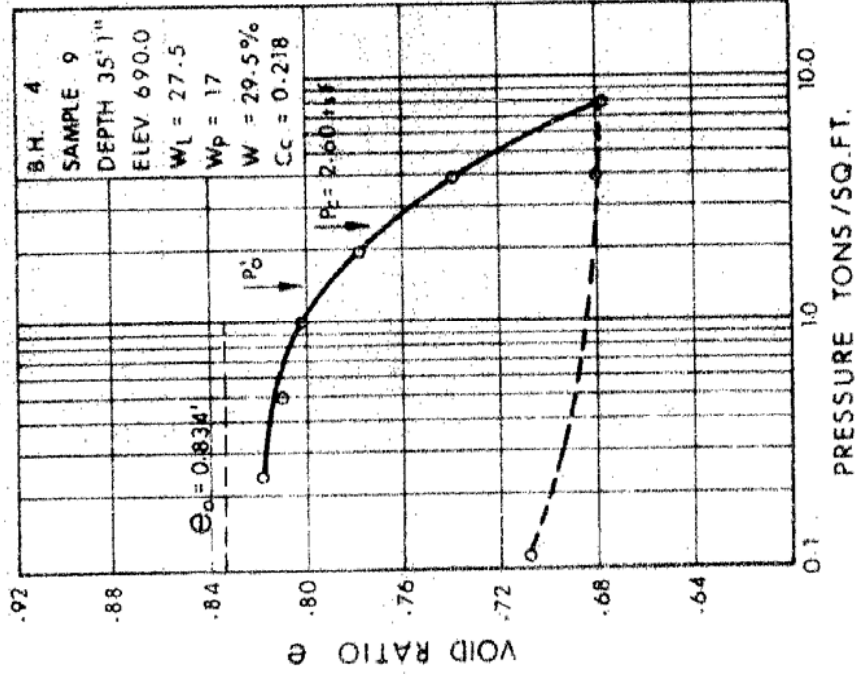
W.P. No. 105-70-04

JOB No. 70-11089

FIG. 4

VOID RATIO -PRESSURE CURVES

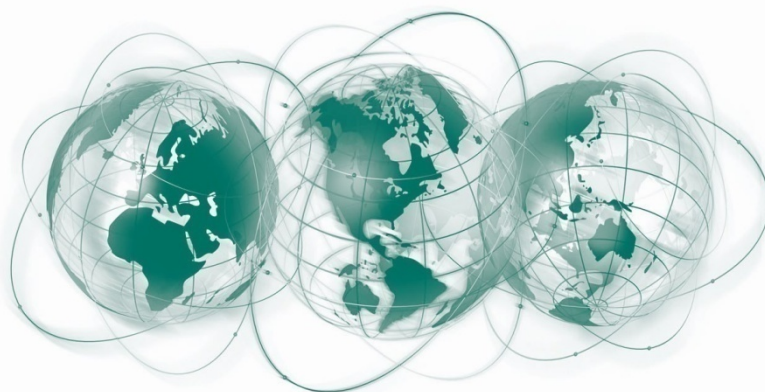
JOB NO. 70-11089



At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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Europe	+ 356 21 42 30 20
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South America	+ 55 21 3095 9500

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