Preliminary Foundation Investigation Report

Highway 9
Holland Drainage Canal Bridge
Replacement

Township of King
Site No. 37-030

G.W.P. 2188-08-00

Geocres No. 31D-553

Project No. 165000801

December 2012

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PRELIMINARY FOUNDATION INVESTIGATION REPORT
For
G.W.P 2188-08-00

Highway 9 – Holland Drainage Canal Bridge Replacement

Site No. 37-030
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1.0 Introduction

Stantec Consulting Ltd. (Stantec) was retained by the Ministry of Transportation, Ontario (MTO) to undertake the preliminary design for the replacement of the Holland Drainage Canal Bridge. The project site is located approximately 4.6 km west of the Highway 400/Highway 9 Interchange, in the Township of King, Ontario. The Site Location Plan is indicated on Drawing No.1 in Appendix A.

The proposed bridge replacement is anticipated to include a slight realignment of Highway 9 to the north. It is understood that the bridge replacement option being considered will take into consideration the future expansion requirements of Highway 9. It is also understood that the proposed bridge replacement will include roadway protection requirements for excavations in the vicinity of the existing approach fills and abutments.

This Preliminary Foundation Investigation Report has been prepared specifically and solely for the proposed bridge replacement and anticipated roadway protection.

Project Number: G.W.P.: 2188-08-00

Project Location: Highway 9, Approximately 4.6 km west of Highway 400, Township of King

The work was carried out under Agreement Number 2010-E-066 with Stantec Consulting Ltd., the Preliminary Design Consultant for this project.

2.0 Site Description and Geology

Site Location

The site location is shown on the Key Plan inset to Drawing No. 1, provided in Appendix A. The existing Holland Drainage Canal Bridge carries Highway 9 traffic across the Canal at Structure Site No. 37-030.

General Site Description

At the project site, Highway 9 is oriented in the northeast-southwest direction. For the purpose of this report, Highway 9 is assumed to be oriented in the east-west direction with the chainage

increasing west to east. Highway 9 has a single lane of traffic in each direction with approximately 3 m wide shoulders (see Photographs 1 through 4 in Appendix A).

Flow in the canal is from north to south beneath the bridge to approximately 40 m south of the bridge centerline. The canal (and the flow) runs approximately easterly thereafter.

In the vicinity of the existing bridge the surrounding area is generally flat.

Existing Bridge

The existing Holland Drainage Canal Bridge has two spans, each approximately 7 m long and a width of approximately 12.7 m. The bridge structure is supported on approximately 13.7 m long timber piles. Review of available Geocres reports indicates that the original bridge had been widened to the north along with the construction of new retaining walls (wingwalls) on the north side of the bridge. The wingwalls included deadman anchors to resist lateral loads.

Physiographic Description

The site is located within a physiographic region known as the Schomberg Clay Plains at the northern foothills of the Oak Ridges Moraine (Chapman and Putnam, 1984). This region contains deep deposits of stratified clay and silt. The schomberg sediments are typically varved clays with annual layers of silt (summer) and clay (winter) having variable thicknesses. This physiographic region is also known to contain high organic content soils commonly described as muck.

It is noted that the site is also very close to the southwestern boundary of the physiographic region known as Simcoe Lowlands.

Drainage is generally toward the east and northeast toward Cook's Bay (Lake Simcoe). In the vicinity of the site, flow is towards the Holland Drainage Canal.

3.0 Method of Investigation

3.1 DRILLING INVESTIGATION

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

A geotechnical field investigation consisting of 14 boreholes, two cone penetration test (CPT) holes and one hand auger hole was carried out for this assignment. The boreholes were designated BH12-1 through BH12-3 and BH12-5 through BH12-15. The CPT locations were designated CPT12-4 and CPT12-17 and the hand auger hole AH12-16. The investigation locations are shown on the Borehole Location Plan, Drawing No.1 in Appendix A.

A Dynamic Cone Penetration Test (DCPT) was carried out in BH12-2 from 25.0 m to 31.9 m below ground surface.

The field drilling program was carried out from March 27 to April 25, 2012. All boreholes were advanced with a track mounted Dietrich D-50 drill with a combination of hollow-stem augers and steel casings.

The subsurface stratigraphy encountered in each borehole was recorded in the field by an experienced Stantec Field Technologist. Split spoon samples were collected at regularly spaced intervals (typically every 760 mm) during the course of Standard Penetration Testing (ASTM D1586). In-situ shear vane measurements were also carried at selected locations in the cohesive deposit using MTO field vane and a pocket penetrometer. All samples recovered were returned to Stantec's Ottawa laboratory for detailed classification and testing.

The cone penetration tests (CPT) were carried out in accordance with ASTM D5778 (ASTM, 2007). Dissipation test was performed in one of the two CPT holes.

Artesian flow within borehole BH12-5 was controlled by pushing a nylon wrapped ball of bentonite chips to the bottom of the H-size casing followed by backfilling with bentonite chips and bentonite quick-gel grout. Artesian flow within borehole BH12-1 was controlled by pushing a P-size casing, concentric to the H-size casing, into the cohesive soils to capture all annular flow, followed by extending the P-size casing to 3.1 m above ground and pumping of a heavy grout mix of cement, barite, and bentonite.

A standpipe piezometer was installed within BH12-3. The section of the borehole deeper than 6 m was backfilled with a mix of bentonite chips and bentonite quick-gel grout, from 3 to 6 m a well screen with sand backfill was installed, and from 0 to 3 m a solid well pipe with bentonite backfill was installed.

Boreholes were backfilled with auger cuttings mixed with bentonite and road holes were topped with cold patch asphalt whenever applicable.

3.2 LOCATION AND ELEVATION SURVEY

The borehole location (northing and easting) and elevation (Geodetic) survey was carried out by Stantec using a Global Positioning System (GPS) apparatus Trimble Geo XH. The GPS apparatus had horizontal and vertical accuracies of 0.01 and 0.1 m, respectively.

Table 3.1 summarizes the borehole information.

Table 3.1: Borehole Summary

Borehole	MTM Zone 10 Coordinates		Ground Surface Elevation (m)	Total Depth Drilled (m)	End of Borehole Elevation (m)	Depth[1] Augered (m)	Number of Soil Samples
	Northing	Easting					
BH12-1	4875305	292810	219.7	26.2	193.5	26.2	28
BH12-2	4875312	292843	219.9	31.9	188.0	24.8	27
BH12-3	4875315	292852	220.1	25.5	194.6	25.5	27
CPT12-4	4875310	292807	220.3	10.9	209.4	-	-
BH12-5	4875323	292845	221.8	30.9	190.9	30.9	29
BH12-6	4875299	292800	219.8	9.8	210.0	9.8	13
BH12-7	4875321	292873	220.4	9.8	210.6	9.8	13
BH12-8	4875327	292863	221.2	9.8	211.4	9.8	13
BH12-9	4875305	292789	219.9	9.8	210.1	9.8	13
BH12-10	4875327	292891	220.4	8.2	212.2	8.2	11
BH12-11	4875348	292964	221.4	8.2	213.2	8.2	11
BH12-12	4875374	293033	221.6	8.2	213.4	8.2	10
BH12-13	4875400	293101	221.6	8.2	213.4	8.2	10
BH12-14	4875425	293173	221.7	8.2	213.5	8.2	10
BH12-15	4875446	293245	221.4	8.2	213.2	8.2	10
AH12-16[2]	4875308	292840	219.0	1.5	217.5	1.5	5
CPT12-17	4875316	292852	220.2	18.0	202.2	-	-

Notes: (1) No bedrock coring was carried out in any of the boreholes advanced at this site.
(2) AH refers to hand-auger hole beneath 150 mm of standing water.

3.3 LABORATORY TESTING

All the SPT samples were taken to Stantec's Ottawa laboratory where they were subjected to a detailed visual examination by a Geotechnical Engineer.

The geotechnical laboratory testing program is summarized in the following table.

Table 3.2: Geotechnical Laboratory Testing Program

Test Description	Number of Samples	Remarks
Moisture Content	224	2 by Golder
Atterberg Limits	39	2 by Golder
Grain Size Distribution	61	2 by Golder
Consolidation (oedometer)	2	By Golder
Unconfined Compression (Soil)	2	By Golder
Specific Gravity	2	By Golder

It is noted that where a value is provided for the percent of clay sized particles, the value represents the percent finer than a nominal size of 0.002 mm.

Nine samples were submitted to Parcel Laboratories of Ottawa for analysis of pH, soluble sulphate content, chloride content and resistivity.

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

4.0 Subsurface Conditions

4.1 SUBSURFACE PROFILE

The subsurface conditions observed in the boreholes are presented in detail on the Borehole Records provided in Appendix B. An explanation of the symbols and terms used to describe the Borehole Records is also provided.

Results of two Cone Penetration Tests (CPTu) are also included in Appendix B.

The site is at the western limit of the Holland Marsh and the ground rises to the west resulting in differing subsurface conditions at the east and west sides of the Holland Canal bridge. The following is a generalized description of the subsurface conditions.

- On the east side of the canal the natural soil conditions include an organic silt that is up to 6 m deep underlain by silt and sand layers of limited thickness, underlain by a deep clayey silt deposit extending to about 25 to 30 m below ground surface, followed by a permeable silty sand with artesian groundwater conditions.
- On the west side of the canal the near surface soils consist of sands and silty sands which extend down to the same deep clayey silt deposit and underlying silty sand with artesian groundwater conditions.
- Boreholes drilled through the roadway platform show that the organic silt east of the canal was excavated beneath the existing roadway embankment and replaced with silty sand to sandy silt soils.

Borehole location plans and stratigraphic sections of the soils encountered within the boreholes in the vicinity of the bridge location are provided on Drawing No. 1 through 3 in Appendix A.

4.1.1 Topsoil

Topsoil was encountered in BH12-1, BH12-2, BH12-3, BH12-5, BH12-6, BH12-7, BH12-8 and BH12-9. The thickness of the topsoil ranged between 50 and 300 mm.

4.1.2 Fill

Away from the road embankment, fill was encountered in BH12-2, BH12-3, BH12-5, BH12-7 and BH12-10. The fill was 0.8 to 1.9 m thick with base elevations of 218.6 m to 220.4 m.

Within the road embankment, fill was encountered in BH12-11 to BH12-15. The fill was 3.0 to 3.7 m thick with base elevations of 217.7 m to 218.7 m.

The Standard Penetration Test (SPT) blow counts (N-values) of the fill layer ranged from 4 to 60 blows per 0.3 m.

Fill was also encountered in the hand auger hole advanced beneath standing water in the canal near the exiting northeast wingwall (AH12-16). This fill was mainly silty sand with gravel to sandy silt and had a moisture content ranging between 29 and 35%.

Index tests carried out on representative soil samples retrieved from this layer revealed the following results:

Gravel:	4 to 7%
Sand:	29 to 46%
Silt/Clay:	43 to 66%
Clay:	13 to 14%
Organic Matter:	2%
Moisture Content:	7 to 29%

The fill consists of variable mixtures of sand and silt and is described as a silty sand (SM) to sandy silt (ML).

Representative grain size distribution plots for the fill layer are provided on Figure 1 in Appendix C. Representative plasticity chart is provided on Figure 8 in Appendix C.

4.1.3 Organic Silt (Muck) – East of Canal

This deposit was encountered in BH12-2, BH12-3, BH12-5, BH12-7, BH12-8 and BH12-10 immediately beneath the topsoil and the fill layer. The deposit was encountered in boreholes advanced east of the Holland Drainage Canal and consisted predominantly of silt, clay and some organics. This deposit was 2.4 to 5.0 m thick with base elevations of 215.1 m to 216.6 m.

A buried organic silt was also encountered in BH12-13. This layer was 2.1 m thick with a base elevation of 215.8 m.

The SPT N-values for the organic silt layer were less than 4 blows per 0.3 m suggesting a soft state.

An in-situ field vane test carried out near the base of the organic silt layer indicated an undrained shear strength of 39 kPa. An unconfined compression test carried out on a thin-wall tube sample indicated an undrained shear strength of 14 kPa.

Index tests carried out on representative soil samples retrieved from this layer revealed the following results:

Gravel:	0 to 4%
Sand:	3 to 46%
Silt:	40 to 76%
Clay:	10 to 27%
Moisture content:	32 to 113%
Organic matter:	4 to 23%

This deposit is classified mainly as organic silt (OL) according to the Unified Soil Classification System. Typical grain size distribution and plasticity chart for representative samples from the organic silt deposit are provided on Figures 2 and 9, in Appendix C.

The results of a consolidation test carried out on an organic silt sample from BH12-5 obtained at a depth of 4.7 m is provided in Appendix C. The consolidation and index property test results for this sample suggest the following:

- Natural moisture content 35%
- Specific gravity 2.75
- % sand 5%
- % silt size fines 74%
- % clay size fines 21%
- Estimated preconsolidation pressure, P'_c 70 kPa
- Estimated effective overburden pressure, P'_o 70 kPa
- Compression Index, C_c 0.31
- Recompression Index, C_r 0.08

4.1.4 Sand – West of Canal

A sand layer was encountered immediately beneath the topsoil in BH12-1, BH12-6 and BH12-9. Its thickness ranged between 2.2 m and 2.9 m with base elevations of 216.9 to 217.5 m.

The SPT N-values for this sand layer ranged from 1 to 9 blows per 0.3 m suggesting a very loose to loose state.

The moisture content of the sand layer ranged between 20 and 22%.

4.1.5 Silt

A silt layer was encountered beneath the organic silt or the road embankment in boreholes 12-3, 12-7, 12-8, 12-11, 12-12, 12-14 and 12-15. This layer was 0.8 to 2.4 m thick with base elevations of 216.5 to 214.7 m.

The SPT N-values for this layer were between 2 and 10 blows per 0.3 m suggesting a very loose to compact state.

Index tests carried out on representative soil samples retrieved from the silt layer revealed the following results:

Gravel:	0 to 3%
Sand:	1 to 36%
Silt:	46 to 88%
Clay:	11 to 17%
Moisture content:	18 to 38%
Liquid Limit	20 to 24
Plasticity Index:	6 (for all tests)

According to the Unified Soil Classification System, the silt layer can be classified as CL-ML but has been carried forward as ML in the report (silt, silt with sand or sandy silt). Representative grain size distribution plots and plasticity charts for this layer are provided on Figure 3 and on Figure 10 in Appendix C.

4.1.6 Sand with Silt

A discontinuous sand with silt layer was observed beneath the organic silt layer in BH12-2 and beneath the silt layer in BH12-3. The layer was 1.6 and 2.4 m thick with base elevations of 213.4 m at both locations.

The SPT N-values for this layer were between 7 and 32 blows per 0.3 m suggesting a loose to dense state.

Index tests carried out on representative soil samples retrieved from this layer provided the following results:

Gravel:	1 to 10%
Sand:	83 to 88%
Fines (silt and clay)	7 to 11%
Moisture Content:	12 to 19%

According to the Unified Soil Classification System, this layer can be classified as SP-SM (poorly graded sand with silt). Representative grain size distribution plots for this layer are provided on Figure 4 in Appendix C.

4.1.7 Silty Sand

This layer was encountered in all boreholes except in BH12-5. West of the canal the silty sand deposit was observed directly beneath the loose sand layer. East of the canal it was generally observed beneath discontinuous layers of silt, sand, or clay which underly the organic silt deposit. This layer was not penetrated in boreholes BH12-12 through BH12-15 since drilling was terminated within this layer. Where penetrated, this layer was approximately 0.3 to 2.6 m thick with base elevations of 210.6 to 214.9 m.

The SPT N-values for this layer were between 4 and 37 blows per 0.3 m suggesting a loose to dense state.

Index tests carried out on representative soil samples retrieved from this layer revealed the following results:

Gravel:	2 to 29%
Sand:	47 to 85%
Fines (silt & clay):	6 to 39%
Moisture content:	9 to 20%

The USCS designation for this layer is SM (silty sand to silty sand with gravel). Representative grain size distribution plots for this layer are provided on Figure 5a and 5b in Appendix C.

4.1.8 Clayey Silt

This deposit was encountered in all boreholes except BH12-12 through BH12-15 which were terminated in the overlying silty sand. Where fully penetrated, the clayey silt layer was 17 to 20.8 m thick with base elevations of 195.3 to 192.7 m.

The in-situ undrained shear strength of the clayey silt layer ranged from 38 kPa to greater than 235 kPa suggesting a firm to hard consistency. The undrained shear strength is generally higher below elevation 204.0 m.

The SPT N-values for the clayey silt layer ranged from 1 to 49 blows per 0.3 m.

The results of static cone penetration tests CPT12-4 and CPT12-17 are provided in Appendix B. This result suggests the following:

- The undrained shear strength of the clayey silt is weakest between elevation 204.0 and 207.5 with undrained shear strength of approximately 50 kPa.
- That there are frequent permeable zones above elevation 207.5 m and below elevation 204.0 m.
- Dissipation test was carried out within CPT 12-17 at elevation 204.3 m. The results indicate a $C_h = 1.6x10^{-3}$ cm^2/min.

Index tests carried out on representative soil samples retrieved from the clayey silt deposit yielded the following results:

Gravel:	0 to 1%
Sand:	0 to 25%
Silt:	31 to 73%
Clay:	21 to 68%
Moisture content:	17 to 48%

The Unified Soil Classification System group designation for the clayey silt layer is predominantly CL with limited samples yielding CI or CL-ML. Representative grain size distribution plots for the silty clay deposit are provided on Figures 6A through 6c; plasticity charts are provided on Figures 11a through 11d in Appendix C.

The results of a consolidation test carried out on a clayey silt sample from BH12-3 obtained at a depth of 16.1 m is provided in Appendix D. The consolidation and index property test results for this sample suggest the following:

- Natural moisture content 30%
- Specific gravity 2.77
- % sand 4%
- % silt size fines 69%
- % clay size fines 27%
- Estimated preconsolidated pressure, P'_c 325 kPa
- Estimated effective overburden pressure, P'_o 210 kPa
- Compression Index, C_c 0.29
- Recompression Index, C_r 0.02

4.1.9 Deep Silty Sand

A silty sand deposit was encountered immediately beneath the clayey silt layer in all the deep boreholes that penetrated the dry layer, namely, BH12-1, BH12-2 and BH12-5.

The SPT N-values for this layer ranged from 4 to 25 suggesting a loose to compact state.

Dynamic Cone Penetration Test (DCPT) carried out in BH12-2 indicated a blow count range of 21 to 561 per 0.3 m, generally increasing with depth. The blow count per 0.3 m of penetration increased significantly below elevation 189 m.

Index tests carried out on representative soil samples retrieved from this layer revealed the following results:

Gravel:	0%
Sand:	87%
Fines (silt & clay):	13%
Moisture content:	19%

The Unified Soil Classification System group symbol designation for this layer is SM (silty sand). Representative grain size distribution plot is provided in Figure 7 in Appendix C.

4.2 BEDROCK

Bedrock was not encountered within the depth of exploration of this investigation.

4.3 GROUNDWATER

A groundwater monitoring well was installed in BH12-3 after completion of drilling. The groundwater in this well was measured two weeks later on April 18, 2012. The depth to groundwater was also inferred in all other boreholes at the time of drilling, between March 27 and Aril 25, 2012. The measured and inferred (i.e., at the time of drilling) groundwater levels are summarized in Table 4.1 below.

Table 4.1: Measured Inferred Groundwater Levels (time of drilling)

Borehole No	Ground Surface Elevation (m)	Groundwater	
		Depth (m)	Elevation (m)
Measured			
BH12-3	220.1	0.9	219.2
Inferred			
BH12-1	219.7	0.9	218.8
BH12-2	219.9	2.7	217.2
BH12-5	221.8	4.6	217.2
BH12-6	219.7	0.9	218.8
BH12-7	220.4	5.3	215.1
BH12-8	221.2	6.7	214.5
BH12-9	219.9	0.9	219.0
BH12-10	220.4	4.9	215.5
BH12-11	221.4	4.0	217.4
BH12-12	221.6	4.1	217.5
BH12-13	221.6	5.6	216.0
BH12-14	221.7	3.4	218.3
BH12-15	221.4	4.6	216.8

Fluctuations in the groundwater and culvert water level due to seasonal variations or in response to a particular precipitation event should be anticipated.

The Holland Canal water level was surveyed by others to be at elevation 218.7 m in November 2011 and by Stantec to be at elevation 219.2 in April 2012.

Artesian Condition

Artesian conditions were observed during the course of the investigation. The following summarizes the information and observations regarding the artesian conditions.

- Artesian groundwater pressure was observed beneath the clayey silt in BH12-1, BH12-2 and BH12-5.
- Within BH12-5 a sealed casing was extended 3.1 m above ground surface and significant flow was still observed. The flow was significantly reduced by pumping a mix of cement, barite, and bentonite slurry into the cased borehole.
- Within BH12-2 and BH12-5 artesian water flows were also observed as the H-size casing was advanced through the clayey silt deposit. These observations were observed at depths of greater than 10 m below ground surface.
- In 1965 the artesian water level was recorded at 5.5 m above ground (elevation 224.7 m) at this site.

4.4 CHEMICAL TESTS

Nine samples of the native soil at the site from the different boreholes were tested for pH, water soluble sulphate and chloride concentrations, and resistivity. The analysis results are provided in Table 4.2.

Table 4.2: Results of Chemical Analysis

Borehole No	Sample No.	Depth (m)	pH	Chloride (µg/g)	Sulphate (µg/g)	Resistivity (Ohm-m)
12-1	SS-3	1.22 to 1.83	7.9	480	30	9.51
12-2	SS-6B	3.66 to 4.27	7.4	311	297	11.6
12-3	SS-2	0.61 to 1.22	8.3	289	17	20.2
12-5	SS-6	3.66 to 4.27	7.5	78	105	31.9
12-7	SS-6	3.81 to 4.42	8.1	1190	30	5.62
12-8	SS-7	4.57 to 5.18	6.9	799	221	5.12
12-11	SS-6	3.81 to 4.42	7.9	948	10	8.54
12-13	SS-4	3.05 to 3.66	8.4	961	56	5.51
12-15	SS-3	2.29 to 2.90	8.2	683	42	4.93

5.0 Miscellaneous

The field work was carried out under the supervision of Mr. Jeff Forrester, Geotechnical Engineering Technologist, under the direction of Mr. Chris McGrath, P.Eng.

MultiVIEW Locates Inc. of Mississauga, Ontario, carried out the private and public utility locates for the boreholes.

The D-50 drilling equipment was supplied and operated by Walker Drilling of Utopia, Ontario.

Location and elevation survey of the boreholes was carried out by Stantec.

Geotechnical laboratory testing was carried out at Stantec's Ottawa laboratory and Golder Associate's Mississauga laboratory. Chemical testing for pH, soluble sulphate, and chloride content, and resistivity was carried out by Paracel Laboratories of Ottawa.

This report was prepared by Simon Gudina and reviewed by Chris McGrath and Raymond Haché.

6.0 Closure

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

Respectfully Submitted;

STANTEC CONSULTING LTD.

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APPENDIX A

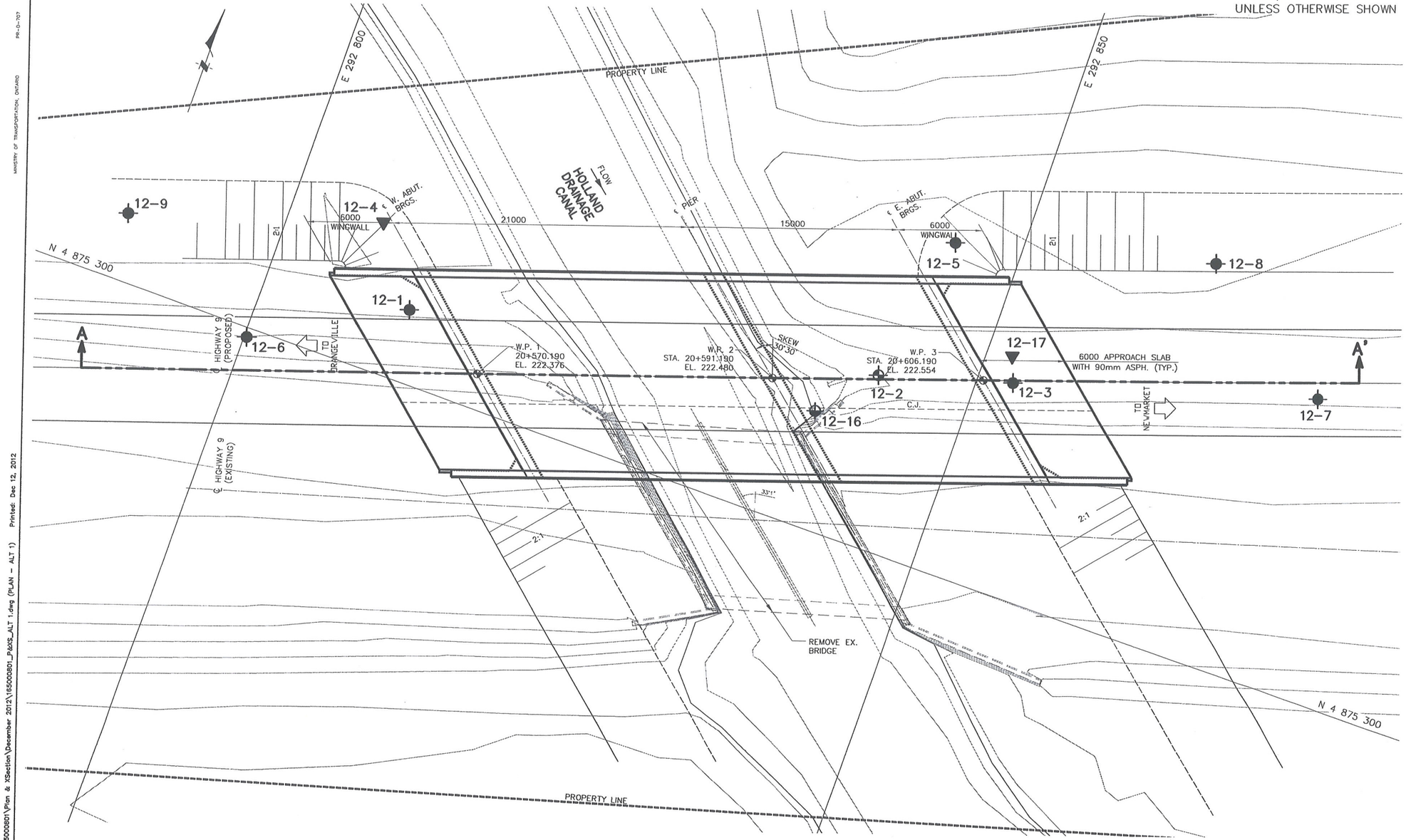
Drawing No. 1 through 3 – Borehole Location Plan and Soil Strata Plot

Site Photos

DRAWING NAME: 165000801_P&XS_ALT 1.dwg
CREATED BY: GBB MODIFIED:
T:\Autocad\Drawings\Project Drawings\2012\165000801\Plan & XSection\December 2012\165000801_P&XS_ALT 1.dwg (PLAN - ALT 1) Printed: Dec 12, 2012

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



PLAN – ALTERNATIVE BRIDGE

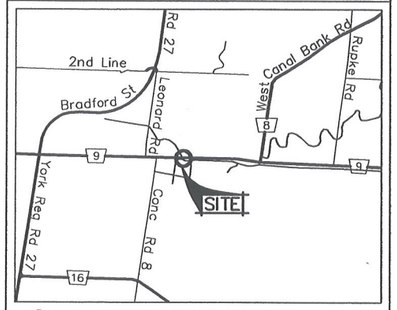
SCALE
3 m 0 3 6 m

PLATE No
CONT
WP 2188-08-00

HOLLAND DRAINAGE CANAL BRIDGE BOREHOLE LOCATIONS

SHEET

Stantec



KEY PLAN
1 km 0 1 2 km

LEGEND

- Borehole
- Borehole and Cone
- Auger Hole
- Cone Penetration Test
- N — Blows/0.3m (Std Pen Test, 475 J/blow)
- Inferred WL at time of investigation April 2012
- WL at Time of Investigation, April 18, 2012

(m NORTH) Offset from Cross Section Line (m)

No	ELEVATION	MTM ZONE 10 COORDINATES NORTH	EAST
12-1	219.7	4 875 305.0	292 810.3
12-2	219.9	4 875 312.0	292 843.3
12-3	220.1	4 875 314.6	292 852.5
12-4	220.3	4 875 310.2	292 806.5
12-5	221.8	4 875 322.5	292 845.4
12-6	219.8	4 875 299.4	292 800.2
12-7	220.4	4 875 320.8	292 873.3
12-8	221.2	4 875 327.3	292 863.2
12-9	219.9	4 875 304.7	292 789.3
12-16	219.0	4 875 308.1	292 839.9
12-17	220.2	4 875 316.4	292 851.8

NOTES

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

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

LICENSED PROFESSIONAL ENGINEER
S. K. GUDINA
Dec. 14, 2012
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
J.G.A.R. HACHÉ
2013/01/14
PROVINCE OF ONTARIO

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

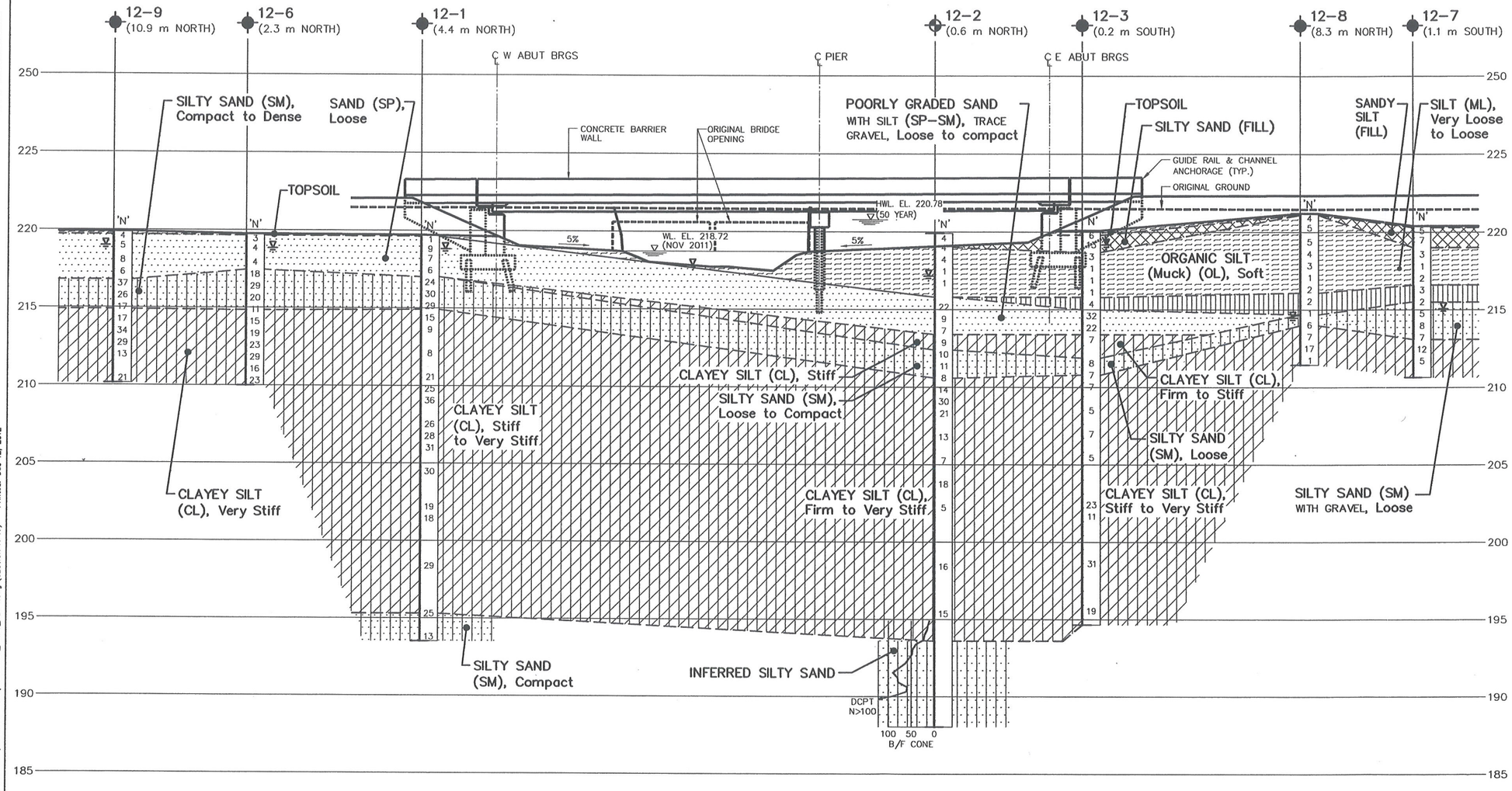
REVISIONS	DATE	BY	DESCRIPTION

GEOCRES No 31D-553

HWY No 9			DIST
SUBM'D SKG	CHECKED	DATE 2012-12-12	SITE 37-30
DRAWN GBB	CHECKED	APPROVED SG	DWG 1

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



CROSS SECTION A–A'

SCALE

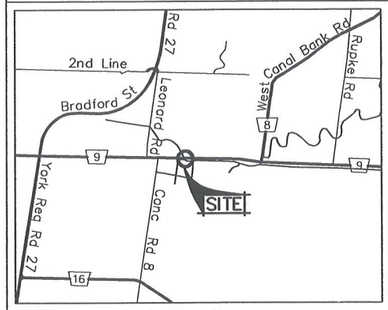
3 m 0 3 6 m

PLATE No
CONT
WP 2188–08–00

HOLLAND DRAINAGE CANAL BRIDGE CROSS SECTION

SHEET

Stantec



KEY PLAN

1 km 0 1 2 km

LEGEND

- Borehole
- Borehole and Cone
- Auger Hole
- Cone Penetration Test
- N — Blows/0.3m (Std Pen Test, 475 J/blow)
- Inferred WL at time of investigation April 2012
- WL at Time of Investigation, April 18, 2012

(m NORTH) Offset from Cross Section Line (m)

No	ELEVATION	MTM ZONE 10 COORDINATES NORTH	EAST
12–1	219.7	4 875 305.0	292 810.3
12–2	219.9	4 875 312.0	292 843.3
12–3	220.1	4 875 314.6	292 852.5
12–4	220.3	4 875 310.2	292 806.5
12–6	219.8	4 875 299.4	292 800.2
12–7	220.4	4 875 320.8	292 873.3
12–8	221.2	4 875 327.3	292 863.2
12–9	219.9	4 875 304.7	292 789.3
12–16	219.0	4 875 308.1	292 839.9
12–17	220.2	4 875 316.4	292 851.8

NOTES

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

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

LICENSED PROFESSIONAL ENGINEER
S. K. GUDINA
Dec. 14, 2012
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
J.G.A.R. HACHÉ
2013/01/14
PROVINCE OF ONTARIO

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

REVISIONS	DATE	BY	DESCRIPTION

GEOCRES No 31D–553

HWY No 9			DIST
SUBM'D SKG	CHECKED	DATE 2012–12–12	SITE 37–30
DRAWN GBB	CHECKED	APPROVED	DWG 2

DRAWING NAME: 165000801_PAKS_ALT 1.dwg
CREATED BY: GBB
MODIFIED:
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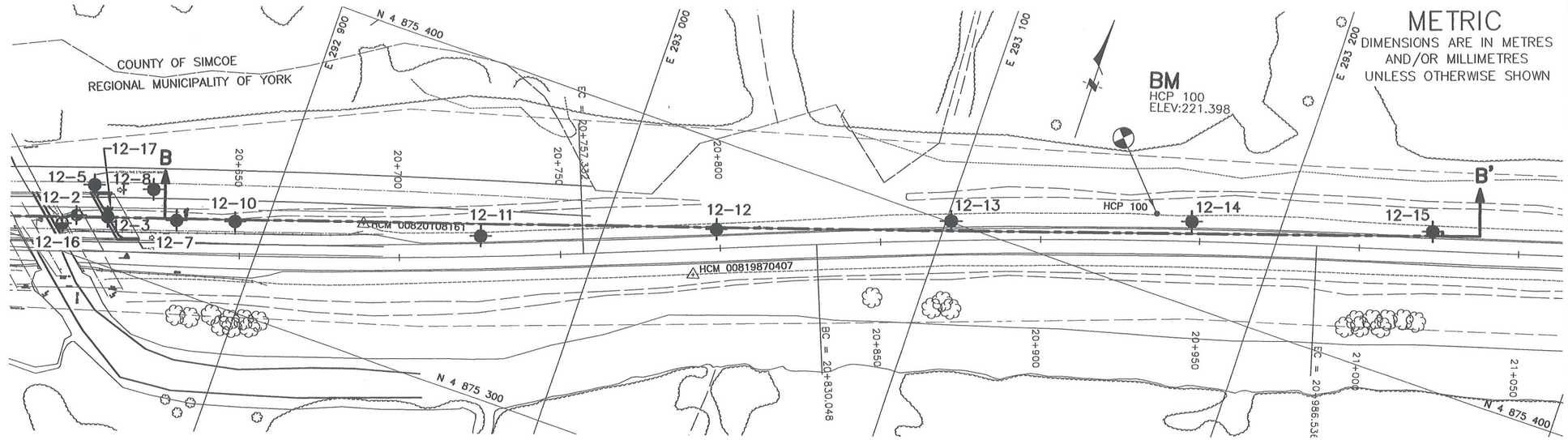
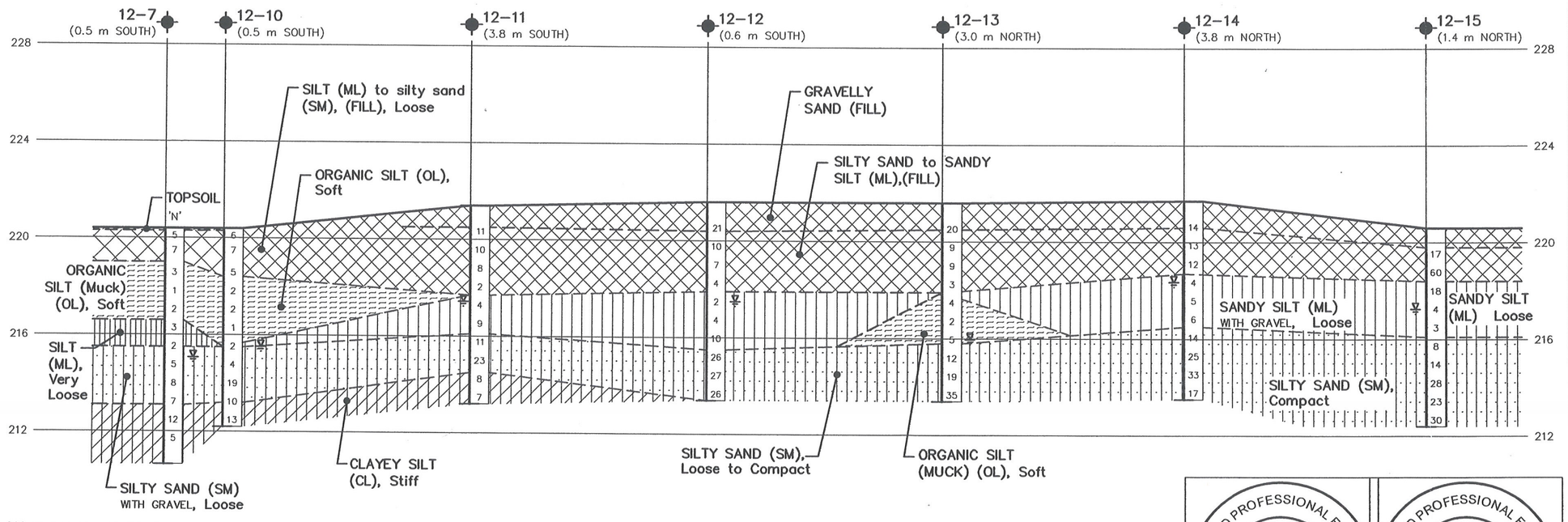
MINISTRY OF TRANSPORTATION, ONTARIO PR–D–707 88–05



PLAN

SCALE

15 m 0 15 30 m



CROSS SECTION B–B'

SCALE

15m 0 15 30m HORIZONTAL

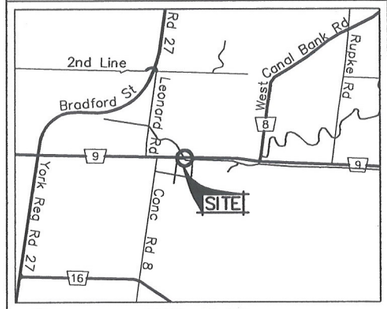
2m 0 2 4m VERTICAL

PLATE No
CONT
WP 2188-08-00

HOLLAND DRAINAGE CANAL BRIDGE
BOREHOLE LOCATIONS & SOIL STRATA

SHEET

Stantec



KEY PLAN

1 km 0 1 2 km

LEGEND

- Borehole
- Borehole and Cone
- Auger Hole
- Cone Penetration Test
- N — Blows/0.3m (Std Pen Test, 475 J/blow)
- Inferred WL at time of investigation April 2012
- (m NORTH) Offset from Cross Section Line (m)

No	ELEVATION	MTM ZONE 10 COORDINATES NORTH	EAST
12-2	219.9	4 875 312.0	292 843.3
12-3	220.1	4 875 314.6	292 852.5
12-7	220.4	4 875 320.8	292 873.3
12-8	221.2	4 875 327.3	292 863.2
12-10	220.4	4 875 326.6	292 890.7
12-11	221.4	4 875 347.6	292 964.2
12-12	221.6	4 875 373.9	293 033.2
12-13	221.6	4 875 400.4	293 101.5
12-14	221.7	4 875 424.9	293 172.9
12-15	221.4	4 875 446.4	293 245.3

NOTES

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

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

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

LICENSED PROFESSIONAL ENGINEER
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Dec. 14, 2012
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
J.G.A.R. HACHÉ
2012/11/14
PROVINCE OF ONTARIO

REVISIONS			
	DATE	BY	DESCRIPTION

GEOCRES No 31D-553

HWY No 9				DIST
SUBM'D SKG	CHECKED	DATE 2012-12-12	SITE	37-30
DRAWN GBB	CHECKED	APPROVED SG	DWG	3

DRAWING NAME: 165000801_PAXS_ALT 1.dwg
CREATED BY: GBB
MODIFIED:
T:\Autocad\Drawings\Project Drawings\2012\165000801\Plan & XSection\December 2012\165000801_PAXS_ALT 1.dwg (PLAN & SECTION B-B') Printed: Dec 12, 2012

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

Photo No. 1: Looking east on Hwy 9 at Holland Drainage Canal Bridge – near the northwest quadrant of the bridge

Photo No. 2: Looking east on Hwy 9 at Holland Drainage Canal Bridge – near existing wingwall at the northwest quadrant of the bridge

Photo No. 3: Looking west on Hwy 9 at Holland Drainage Canal Bridge – near the northeast quadrant of the bridge

Photo No. 4: Looking west along Hwy 9 at Holland Drainage Canal Bridge with the northeast quadrant of bridge near the top left corner

APPENDIX B

Symbols and Terms Used on Borehole Records

Borehole Records

Terminology Used on SCPTu and CPTu Records

CPTu Results

MTO 1965 Borehole Records

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Topsoil	-	mixture of soil and humus capable of supporting vegetative growth
Peat	-	mixture of visible and invisible fragments of decayed organic matter
Till	-	unstratified glacial deposit which may range from clay to boulders
Fill	-	material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	-	having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure
Varved	-	composed of regular alternating layers of silt and clay
Stratified	-	composed of alternating successions of different soil types, e.g. silt and sand
Layer	-	> 75 mm in thickness
Seam	-	2 mm to 75 mm in thickness
Parting	-	< 2 mm in thickness

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488). The classification excludes particles larger than 76 mm (3 inches). The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

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

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

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

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests.

Consistency	Undrained Shear Strength	
	kips/sq.ft.	kPa
Very Soft	<0.25	<12.5
Soft	0.25 - 0.5	12.5 - 25
Firm	0.5 - 1.0	25 - 50
Stiff	1.0 - 2.0	50 – 100
Very Stiff	2.0 - 4.0	100 - 200
Hard	>4.0	>200

ROCK DESCRIPTION

Terminology describing rock quality:

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

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

Terminology describing rock mass:

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

Terminology describing rock strength:

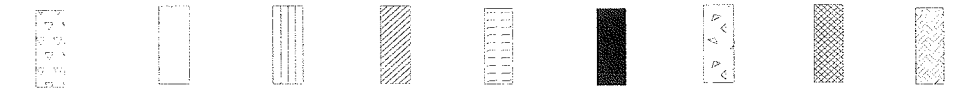
Strength Classification	Unconfined Compressive Strength (MPa)
Extremely Weak	< 1
Very Weak	1 – 5
Weak	5 – 25
Medium Strong	25 – 50
Strong	50 – 100
Very Strong	100 – 250
Extremely Strong	> 250

Terminology describing rock weathering:

Term	Description
Fresh	No visible signs of rock weathering. Slight discolouration along major discontinuities
Slightly Weathered	Discolouration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured.
Moderately Weathered	Less than half the rock is decomposed and/or disintegrated into soil.
Highly Weathered	More than half the rock is decomposed and/or disintegrated into soil.
Completely Weathered	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders Cobbles Gravel | Sand | Silt | Clay | Organics | Asphalt | Concrete | Fill | Bedrock

SAMPLE TYPE

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

WATER LEVEL MEASUREMENT

measured in standpipe, piezometer, or well

inferred

RECOVERY

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

N-VALUE

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and N-values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N value corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to A size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (305 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

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

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

Stantec

RECORD OF BOREHOLE No BH 12-1 1 OF 3 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 305 E: 292 810 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 12 - 2012 04 13 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
219.7	Tall Grass										
219.6	TOPSOIL										
0.1	SAND (SP)		1	SS	1		219				
	Loose										
	Grey to brown, wet		2	SS	9	▽					
			3	SS	7		218				
			4	SS	6						
217.0							217				
2.7	SILTY SAND (SM) with gravel										
	Compact		5	SS	24						
	Grey, moist										
	- with gravel below 3.7 m		6	SS	30		216				
			7	SS	29						29 55 (16)
214.9							215				
4.8	CLAYEY SILT (CL)										
	Stiff to very stiff		8	SS	15						
	Grey, moist						214				
			9	SS	9						
			10	SS	-		213	✖ 3.3	43		0 1 31 68
			11	SS	8		212				
			12	SS	-			>>✖			- S_u > 235 kPa
			13	SS	21		211				
			14	SS	-		210				0 1 71 28

Continued Next Page

✖ 3, × 3 Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-1 2 OF 3 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 305 E: 292 810 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 12 - 2012 04 13 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT (CL) Stiff to very stiff Grey, moist *(continued)*										
			15	SS	36		209				
			16	SS	-						- S_u > 235 kPa
			17	SS	26		208				
			18	SS	28		207				0 1 74 25
			19	SS	31		206				
			20	SS	-						- S_u > 235 kPa
			21	SS	30		205				
			22	SS	-		204				
			23	SS	-		203	1.4			0 1 68 31 - S_u = 141 kPa
			24	SS	19		202				
			25	SS	18		201				
							200				

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✖ 3, × 3 Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-1 3 OF 3 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 305 E: 292 810 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 12 - 2012 04 13 CHECKED BY CM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE, 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	CLAYEY SILT (CL) Stiff to very stiff Grey, moist *(continued)*						199 198 197 196				- S_u > 235 kPa
195.3			26	SS	29				o		
24.4	SILTY SAND (SM) Compact Grey, wet		27	SS	25		195 194				
193.5			28	SS	13				o		0 87 (13)
26.2	End of Borehole - artesian condition encountered below clayey silt										

✖ 3, × 3 Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-2 1 OF 4 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 312 E: 292 843 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 02 - 2012 04 03 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
219.9	Tall Grass						
219.8	TOPSOIL						
0.1	FILL: Silty SAND (SM) Loose Brown, moist		1	SS	4		
219.0			2	SS	4		219
0.9	ORGANIC SILT (muck) (OL) Soft Black, moist to wet - frequent coiled shells throughout		3	SS	4		
			4	SS	1	▽	218
			5	SS	1		217
215.8			6	SS	-		216
4.1	Poorly graded SAND WITH SILT (SP-SM) Loose to compact Grey, trace gravel, wet		7	SS	22		215
			8	SS	9		
			9	SS	7		214
213.4							
6.5	CLAYEY SILT (CL) Stiff Grey, wet		10	SS	9		213
212.4							
7.5	SILTY SAND (SM) Loose to compact Grey, wet		11	SS	10		212
			12	SS	11		211
210.6							
9.3	CLAYEY SILT (CL) Firm to very stiff Grey, moist		13	SS	8		210

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa 20 40 60 80 100
- O UNCONFINED
- ● QUICK TRIAXIAL
- ✖ FIELD VANE
- × LAB VANE

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L

WATER CONTENT (%) 10 20 30

7.2

113
61
44
51
60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
Org M = 23%				
	0	3	70	27
	10	83		(7)
	0	0	62	38
	6	81		(13)

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

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✖ 3, × 3 Numbers refer to Sensitivity

O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-2 2 OF 4 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 312 E: 292 843 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 02 - 2012 04 03 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (UNCONFINED, QUICK TRIAXIAL, FIELD VANE, LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT (CL) Firm to very stiff Grey, moist *(continued)*		14	SS	14						
			15	SS	-		209				- S_u > 108 kPa
			16	SS	21						0 2 72 26
			17	SS	-		208	>>4.0			- S_u = 132 kPa
			18	SS	13		207				
			19	SS	-		206	2.5			
			20	SS	7						
			21	SS	-		205	4.0			0 0 68 32
			22	SS	18		204				
			23	SS	-		203	>>3.7			- S_u = 122 kPa
			24	SS	5		202				
			25	SS	-			2.0			
							201				
							200				

Continued Next Page

$\times^{3}$, $\times^{3}$ Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-2 3 OF 4 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 312 E: 292 843 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 02 - 2012 04 03 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT (CL) Firm to very stiff Grey, moist *(continued)*						199				
			26	SS	16		198				
							197				
							196				
			27	SS	15		195				0 1 50 49
193.6 26.3	Start of Dynamic Cone Penetration Test Inferred silty sand						194	>>✖ 3.2			- S_u = 178 kPa
							193				
							192				
							191				
							190				

Continued Next Page

✖ 3, × 3 Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-2 4 OF 4 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 312 E: 292 843 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 02 - 2012 04 03 CHECKED BY CM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa O UNCONFINED ✖ FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Inferred silty sand *(continued)*										DCPT blows/0.3m 141
											174
							189				196
	- inferred to be dense below 31 m										326
											468
188.0											561
31.9	End of Borehole						188				
	- artesian condition encountered below clayey silt										

✖ 3 , × 3 Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-3 1 OF 3 METRIC

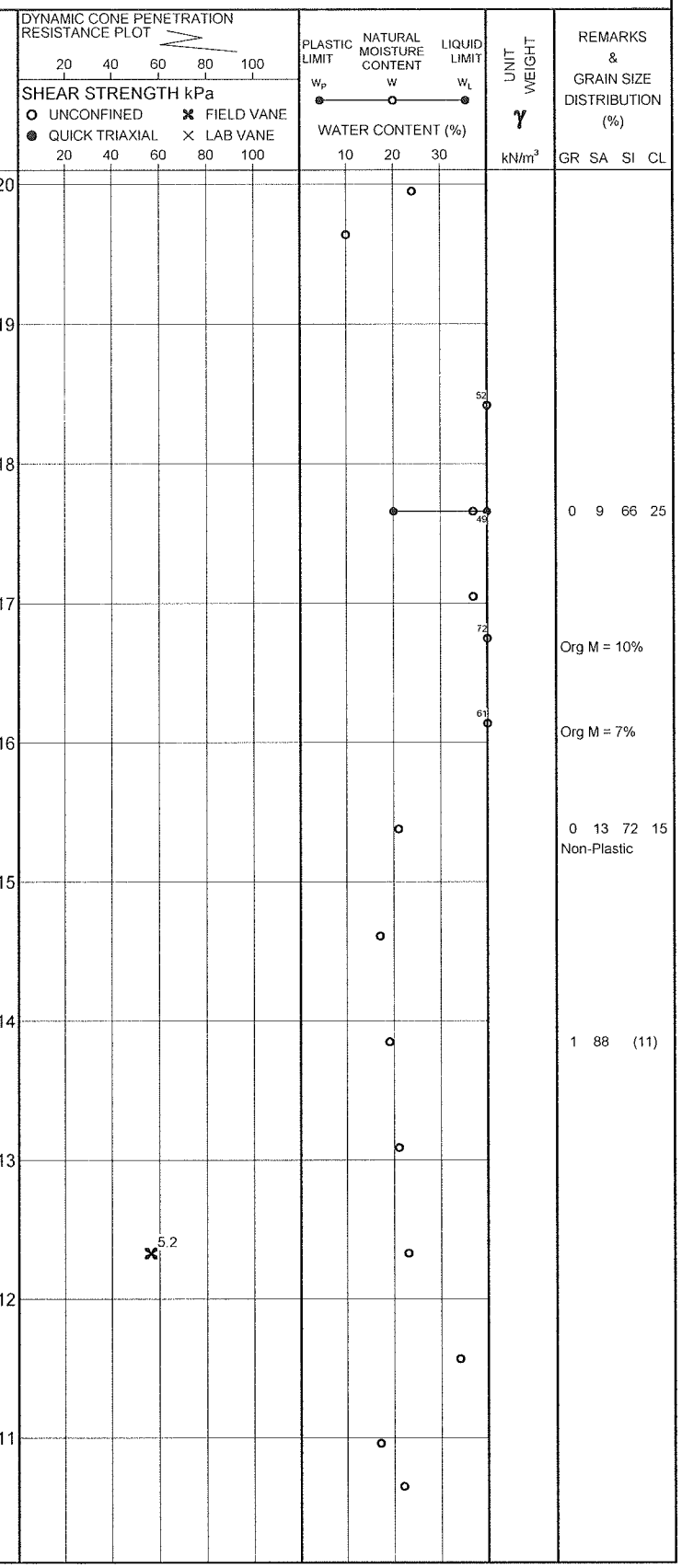
W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 315 E: 292 852 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 04 - 2012 04 05 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES
220.1	Tall Grass			
0.0 / 219.8	TOPSOIL	1	SS	6
0.3	FILL: Silty sand (SM) Compact Brown, moist	2	SS	13
218.7				
1.4	ORGANIC SILT (muck) (OL) Soft Black	3	SS	3
	- frequent coiled shells throughout	4	SS	1
		5	SS	1
		6	SS	1
215.8				
4.3	SILT (ML) Loose Grey, moist	7	SS	4
215.0				
5.1	Poorly graded SAND with silt (SP-SM) Compact to dense Grey, wet	8	SS	32
		9	SS	22
213.4				
6.7	CLAYEY SILT (CL) Firm to stiff Grey, moist	10	SS	7
		11	SS	-
211.9				
8.2	SILTY SAND (SM) Loose Grey, wet	12	SS	8
210.8				
9.3	CLAYEY SILT (CL) Stiff to very stiff Grey, moist	13	SS	7

Continued Next Page



UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	0 9 66 25
	Org M = 10%
	Org M = 7%
	0 13 72 15 Non-Plastic
	1 88 (11)

$\times^{3}$, $\times^{3}$ Numbers refer to Sensitivity

$O^{3\%}$ STRAIN AT FAILURE

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

Stantec

RECORD OF BOREHOLE No BH 12-3 2 OF 3 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 315 E: 292 852 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 04 - 2012 04 05 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (UNCONFINED, QUICK TRIAXIAL, FIELD VANE, LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT (CL) Stiff to very stiff Grey, moist *(continued)*		14	SS	7		210				
			15	SS	-			2.7			
							209				
			16	SS	5						0 2 63 35
							208	3.7			
			17	SS	-						
			18	SS	7		207				
			19	SS	-			3.1			
							206				
			20	SS	5						0 0 56 44
							205				
			21	SS	-			2.7			
							204	11.3%			19.3 0 4 69 27
			22	ST							
			23	SS	-			>>			- S_u > 108 kPa
							203				
			24	SS	23						0 3 65 32
							202	2.3			
			25	SS	11						
							201				

Continued Next Page

$\times^{3}$, $\times^{3}$ Numbers refer to Sensitivity $O^{3\%}$ STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-3 3 OF 3 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 315 E: 292 852 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 04 - 2012 04 05 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT (CL) Stiff to very stiff Grey, moist *(continued)*						200				
							199				
			26	SS	31						
							198				
							197				
							196				
			27	SS	19						0 1 48 51
194.6							195	>> ✖ 1.1			- S_u = 132 kPa
25.5	End of Borehole Monitor Well Installed to 6.10 m										

✖ 3, × 3 Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

Stantec

RECORD OF BOREHOLE No BH 12-5 1 OF 4 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 323 E: 292 845 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 03 28 - 2012 03 29 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
221.8	Tall Grass										
221.8	TOPSOIL										
0.1	Silty sand (SM), FILL Loose Brown, moist		1	SS	5						
			2	SS	4		221				
220.4											
1.4	ORGANIC SILT (muck) (OL) Soft Black, moist		3	SS	2		220		45		Org M = 6%
	- frequent coiled shells throughout		4	SS	1				66		
			5	ST			219				
			6	SS	1		218		46		0 7 66 27
			7	ST		▽	217	14.3%		18.4	0 5 73 22
			8	SS	3				48		
215.9							216				
5.9	CLAYEY SILT (CI) Firm to very stiff Grey, moist		9	SS	9				41		0 2 31 67
			10	SS	16		215				PP = 200 kPa
			11	SS	10		214				PP = 92 kPa
			12	SS	7						PP = 67 kPa 1 2 50 47
			13	SS	5		213				
							212				

Continued Next Page

✖ 3, × 3. Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-5 2 OF 4 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 323 E: 292 845 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 03 28 - 2012 03 29 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT (CI) Firm to very stiff Grey, moist *(continued)*		14	SS	-			3.3 ✖			- S_u > 108 kPa
			15	SS	16		211	>> ✖			
			16	SS	-			>> ✖			0 0 66 34 - S_u > 108 kPa
			17	SS	17		210				PP = 187 kPa
			18	SS	19		209				
			19	SS	28		208				
			20	SS	16		207				0 0 67 33
			21	SS	21		206				
			22	SS	18		205				
			23	SS	21		204				0 0 73 27 PP = 208 kPa
			24	SS	22		203				PP = 183 kPa
			25	SS	20		202				

Continued Next Page

✖ 3, × 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-5 3 OF 4 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 323 E: 292 845 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 03 28 - 2012 03 29 CHECKED BY CM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	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			SHEAR STRENGTH kPa: O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE	WATER CONTENT (%)	γ kN/m³	GR SA SI CL
	CLAYEY SILT (Cl) Firm to very stiff Grey, moist *(continued)*						201 200 199 198 197 196 195 194 193 192	20 40 60 80 100	10 20 30		
			26	SS	21						PP = 192 kPa
			27	SS	49						PP = 175 kPa
			28	SS	29						0 3 66 31 PP = 175 kPa
192.7 29.1	SILTY SAND (SM) Loose Grey, trace gravel, wet										

Continued Next Page

✖ 3, × 3 Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-5 4 OF 4 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 323 E: 292 845 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE H Casing, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 03 28 - 2012 03 29 CHECKED BY CM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE, 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	SILTY SAND (SM)										
	Loose										
	Grey, trace gravel, wet *(continued)*		29	SS	4		191		o		
190.9											
30.9	End of Borehole										
	- artesian condition encountered below clayey silt										

✖ 3, × 3 Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-6 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 299 E: 292 800 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 11 - 2012 04 11 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH kPa: UNCONFINED, QUICK TRIAXIAL, FIELD VANE, LAB VANE; 20 40 60 80 100	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
219.8	Tall Grass											
219.8	TOPSOIL											
0.1	SAND (SP) Loose Grey to brown, moist to wet		1	SS	3		219					
			2	SS	4	▽						
			3	SS	4		218					
217.5												
2.3	SILTY SAND (SM) Compact Grey, moist		4	SS	18		217					
			5	SS	29							
			6	SS	20		216					11 77 (12)
214.9			7	SS	11		215					
4.9	CLAYEY SILT (CL) Very stiff Grey, moist		8	SS	15		214					
			9	SS	19		213					
			10	SS	23							0 4 64 32
			11	SS	29		212					
			12	SS	-		211		>> 2.5			- S_u = 226 kPa
			13	SS	23							0 1 67 32
210.0							210					
9.8	End of Borehole											

✖ 3, × 3. Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

Stantec

RECORD OF BOREHOLE No BH 12-7 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 321 E: 292 873 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 03 27 - 2012 03 27 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.4	Tal Grass										
220.3 / 0.1	TOPSOIL										
	FILL: Sandy silt (ML)		1	SS	5		220				
	Loose										
	Brown to grey, trace gravel, moist		2	SS	7						5 39 (56)
219.0							219				
1.4	ORGANIC SILT (muck) (OL)										
	Soft		3	SS	3				64		Org M = 14%
	Black										
	- frequent coiled shells throughout		4	SS	1		218		53		Org M = 6%
			5	SS	2		217		100		Org M = 18%
216.6											
3.8	SANDY SILT (ML)		6	SS	3		216				
	Very loose										
	Grey, moist		7	SS	2						3 36 46 15
215.5						▽	215				
4.9	SILTY SAND with gravel (SM)										
	Loose		8	SS	5						21 63 (16)
	Grey, wet		9	SS	8		214				
213.3											
7.1	CLAYEY SILT (CL)		10	SS	7		213				9 25 (66)
	Stiff										
	Grey, wet		11	SS	12						
			12	SS	5		212				PP = 58 kPa
			13	SS	-		211	6.0			1 6 57 36
210.6											
9.8	End of Borehole										

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

✖ 3 , × 3 Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-8 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 327 E: 292 863 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 03 27 - 2012 03 27 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
221.2	Tall Grass										
220.9	TOPSOIL										
0.1	ORGANIC SILT (muck) (OL) Soft Black - frequent coiled shells throughout		1	SS	4		221				Org M = 9%
			2	SS	5				41		
							220				
			3	SS	5				48		Org M = 11%
							219				
			4	SS	4				50		Org M = 11%
							218				
			5	SS	3				55		
			6	SS	1		217		51 / 41		0 27 55 18
			7	SS	2				50		Org M = 6%
216.1							216				
5.1	SILT with SAND (ML) Very loose Grey, wet - trace organics at 6.2 m		8	SS	2						0 20 63 17
			9	SS	1		215		42		
214.7											
6.6	SILTY SAND (SM) Loose Grey, very wet					▽	214				
214.3											
6.9	CLAYEY SILT (CL) Very stiff Grey, wet		10	SS	6						2 19 (79)
			11	SS	7		213				PP = 116 kPa
			12	SS	17						PP = 156 kPa
			13	SS	1		212	✖			0 1 68 31 PP = 133 kPa - S_u > 108 kPa
211.4											
9.8	End of borehole										

✖ 3, × 3: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

Stantec

RECORD OF BOREHOLE No BH 12-9 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 305 E: 292 789 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 11 - 2012 04 11 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE, 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
219.9	Tall Grass										
219.8	TOPSOIL										
219.7											
0.2	SAND (SP)		1	SS	4						
	Loose										
	Grey to brown, moist to wet		2	SS	5	▽	219				
			3	SS	8		218				
			4	SS	6						
216.9							217				
3.1	SILTY SAND (SM)										
	Compact to dense		5	SS	37						
	Grey, moist to wet						216				
			6	SS	26						
214.9			7	SS	17		215				9 85 (6)
5.0	CLAYEY SILT (CL)										
	Very stiff										
	Grey, moist		8	SS	17						
							214				
			9	SS	34						0 2 63 35
							213				
			10	SS	29						
			11	SS	13		212				
			12	SS	-			>>✖ 2.9			
							211				
210.1			13	SS	21						0 0 63 37
9.8	End of Borehole										

✖³, ×³: Numbers refer to Sensitivity O³% STRAIN AT FAILURE

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

Stantec

RECORD OF BOREHOLE No BH 12-10 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 327 E: 292 891 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 10 - 2012 04 10 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE, 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.4	Tall Grass									
0.0	FILL: Silt (ML) to silty sand (SM) Loose Brown, moist to wet		1	SS	6		220			
			2	SS	7					
218.6			3	SS	5		219			Org M = 20%
1.9	ORGANIC SILT (OL) Soft Black, moist, with organics and shells - frequent coiled shells throughout		4	SS	2		218			0 8 76 16
			5	SS	2		217			Org M = 11%
			6	SS	1					
215.1			7	SS	2	▽	216			Org M = 10%
5.3	SILTY SAND (SM) with gravel Loose to compact Grey, wet		8	SS	4		215			20 52 (28)
			9	SS	19		214			
213.2			10	SS	10					
7.2	CLAYEY SILT (CL) Stiff Grey, moist						213			
212.2			11	SS	13					3 5 42 50
8.2	End of Borehole									

$\times^{3}$, $\times^{3}$: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

Stantec

RECORD OF BOREHOLE No BH 12-11 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 348 E: 292 964 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 24 - 2012 04 24 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE, 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
221.4	Roadbase Granulars										
0.0	FILL: gravelly sand, brown		1	BS			221				
220.5											
0.9	FILL: Silty sand (SM) to sandy silt (ML) Brown to grey, moist to wet		2	SS	11						
			3	SS	10		220				Org M = 2%
			4	SS	8		219				7 36 (57)
			5	SS	2						
217.7							218				
3.7	SILT with SAND (ML) Very loose to loose Grey, moist, trace organics		6	SS	4	▽					
			7	SS	9		217				0 18 68 14
216.1											
5.3	SILTY SAND (SM) Compact Grey, moist		8	SS	11		216				
			9	SS	23		215				3 79 (18)
214.5											
6.9	CLAYEY SILT (CL) Stiff Grey, moist		10	SS	8		214				
			11	SS	7						
213.2											
8.2	End of Borehole										

✖³, ×³ Numbers refer to Sensitivity O³% STRAIN AT FAILURE

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

Stantec

RECORD OF BOREHOLE No BH 12-12 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 374 E: 293 033 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 25 - 2012 04 25 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
221.6	Roadbase Granulars										
0.0	FILL: Gravelly sand, brown						221				
220.4			1	SS	21						
1.2	FILL: Silty sand (SM) to sandy silt (ML) Grey to brown		2	SS	10		220				
			3	SS	7		219				4 33 50 13
217.9			4	SS	4		218				
3.7	Sandy SILT (ML) Very loose to compact Grey, trace gravel and organics		5	SS	2	▽					
			6	SS	4		217				Org M = 3%
			7	SS	10		216				0 34 37 29
215.5											
6.1	SILTY SAND (SM) Compact Grey, wet		8	SS	26		215				
			9	SS	27						
			10	SS	26		214				2 59 (39)
213.4											
8.2	End of Borehole										

✖³, ×³ Numbers refer to Sensitivity O³% STRAIN AT FAILURE

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

Stantec

RECORD OF BOREHOLE No BH 12-13 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 400 E: 293 101 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 25 - 2012 04 25 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
221.6	Roadbase Granulars										
0.0	FILL: Gravelly sand, brown						221				
220.5			1	SS	20						
1.1	FILL: Silty sand (SM) to sandy silt (ML) Brown to grey, moist to wet						220				
			2	SS	9						
			3	SS	9		219				5 29 52 14
			4	SS	3						
217.9							218				
3.7	ORGANIC SILT (OL) Soft Black - frequent coiled shells throughout		5	SS	4						
			6	SS	2		217				Org M = 3%
215.8			7	SS	5	▽	216			46	4 46 (50)
5.8	SILTY SAND (SM) Compact to dense Grey, wet										Org M = 6%
			8	SS	12		215				
			9	SS	19						
213.4			10	SS	35		214				5 71 (24)
8.2	End of Borehole										

✖³, ×³. Numbers refer to Sensitivity O³% STRAIN AT FAILURE

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

Stantec

RECORD OF BOREHOLE No BH 12-14 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 425 E: 293 173 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 25 - 2012 04 25 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE, 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
221.7	Roadbase Granulars										
0.0	FILL: Gravelly sand, brown										
220.6			1	SS	14						
1.1	FILL: Silty sand (SM) to sandy silt (ML) Brown, moist		2	SS	13						
218.7			3	SS	12						8 49 (43)
3.0	SILT (ML) Loose Brown to grey, wet - trace organics		4	SS	4	▽					
216.5			5	SS	5						
5.2	SILTY SAND (SM) Compact to dense Grey, moist to wet		6	SS	6						
			7	SS	14						
			8	SS	25						
	- with gravel below 6.7 m		9	SS	33						15 76 (9)
213.5			10	SS	17						
8.2	End of Borehole										

✖³, ×³ Numbers refer to Sensitivity O³% STRAIN AT FAILURE

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

Stantec

RECORD OF BOREHOLE No BH 12-15 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 446 E: 293 245 ORIGINATED BY JF

DIST HWY 9 BOREHOLE TYPE Hollow Stem Augers, Splitspoon Sampler COMPILED BY JF

DATUM Geodetic DATE 2012 04 25 - 2012 04 25 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, ● QUICK TRIAXIAL, ✖ FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
221.4	Roadbase Granulars										
0.0	FILL: Gravelly sand, brown						221				
220.6											
0.8	FILL: Silty sand (SM) to sandy silt (ML) Brown, moist		1	SS	17		220				
	- cobbles at 1.8 m		2	SS	60						
			3	SS	18		219				4 47 (49)
218.4											
3.0	SILT (ML) Loose Brown to grey, moist to wet		4	SS	4	▽	218				
			5	SS	3						0 1 87 12
			6	SS	8		217				
216.1											
5.3	SILTY SAND (SM) Compact Grey, moist to wet		7	SS	14		216				
	- with gravel below 6.1 m		8	SS	28		215				
			9	SS	23		214				14 79 (7)
			10	SS	30						
213.2											
8.2	End of Borehole										

✖³, ×³ Numbers refer to Sensitivity O³% STRAIN AT FAILURE

ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

Stantec

RECORD OF BOREHOLE No AH 12-16 1 OF 1 METRIC

W.P. 2188-08-00 LOCATION Hwy 9 Holland Canal N: 4 875 308 E: 292 840 ORIGINATED BY JF

DIST _____ HWY 9 BOREHOLE TYPE Hand Augers COMPILED BY JF

DATUM Geodetic DATE 2012 04 24 - 2012 04 24 CHECKED BY CM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa O UNCONFINED ● QUICK TRIAXIAL ✖ FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
219.0	Creek bed										
0.0 / 218.8	FILL: Dark grey silty sand with gravel		1	BS							
0.2	FILL: Grey to dark grey sandy silt		2	BS							
218.2											
0.8	ORGANIC SILT (muck) (OL)		3	BS							
	Soft		4	BS			218				Org M = 4%
	Black, wet		5	BS							
217.5											
1.5	End of Augerhole										

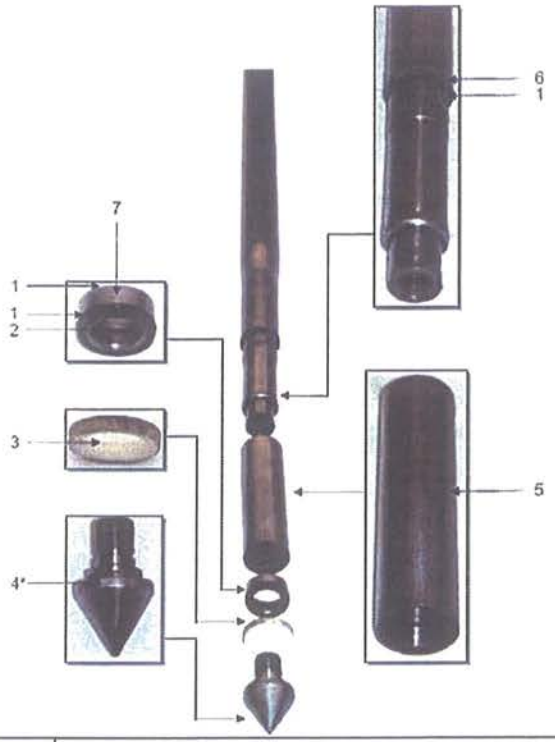
ONTARIO MTO STANTEC 165000801 - HIGHWAY 9 HOLLAND CANAL.GPJ ONTARIO MOT.GDT 12/10/3

✖3, ×3 Numbers refer to Sensitivity O3% STRAIN AT FAILURE

CPT Equipment and Details

Stantec Limited's standard method for cone penetration testing (CPT) uses a Vertek 4579 Digital Piezocone (serial number 2659.109) with a cone area of 10 cm^2 (1.5 in^2) and a mass of 14500 kg (32,000 lb). It is capable of recording the following parameters:

- Tip Resistance, q_c
- Sleeve Friction, f_s (Side Friction)
- Pore Water Pressure, u_2
- Shear Wave Arrival Time
- Compression Wave Arrival Time
- Inclination
- Temperature



Item	Description
1	O-Ring
2	O-Ring
3	Piezo filter, saturated in de-aired silicone oil
4	Piezo tip
*	Standard tip (For use without piezo filter)
5	Friction Sleeve
6	X-Ring
7	Retainer Ring

The CPTu unit can be used to interpret subsurface stratigraphy. The piezocone is pushed at a rate of 2 cm/s, with a drill rig providing the thrust and reaction force. The piezocone measures force in two locations – at the tip of the penetrometer, as well as along the sleeve. The tip load cell, which measures tip resistance (q_c) has a range of 100 kN (22,000 lb) and an accuracy of 0.2%. Other penetrometer specifications include:

- Cone Area: 10 cm^2
- Net Area Ratio: 0.83
- Zero Drift: 0.006 %FS/degF
- Linearity: 0.10%FS (max)
- Overload Cap (%): 150

A load cell along the sleeve measures sleeve friction (f_s) with a range of 20 kN (4,400 lb) and an accuracy of 0.2%. Further specifications include:

- Sleeve Area: 150 cm^2
- Net Area Ratio: 1.00
- Zero Drift: 0.003 %FS/degF
- Linearity: 0.25 %FS (max)
- Overload Cap (%) 150

A piezofilter, saturated in de-aired silicone oil, acts as a pore pressure transducer. This instrument, which is situated behind the cone of the penetrometer (commonly referred to as position u_2), has a standard range of 3.5 MPA (500 psi) and an accuracy of 0.5%. Further specifications are as follows:

- Burst Pressure: 150 %
- Rise Time (10-90%) <1 ms
- Zero Drift: 0.03 %FS/degF
- Static Error Band: 0.03 %FS (max)

The built-in inclinometer has a range of ± 15°, and an accuracy of 1°.

Terminology Used on SCPTu and CPTu Records

Key Terminology and Principles

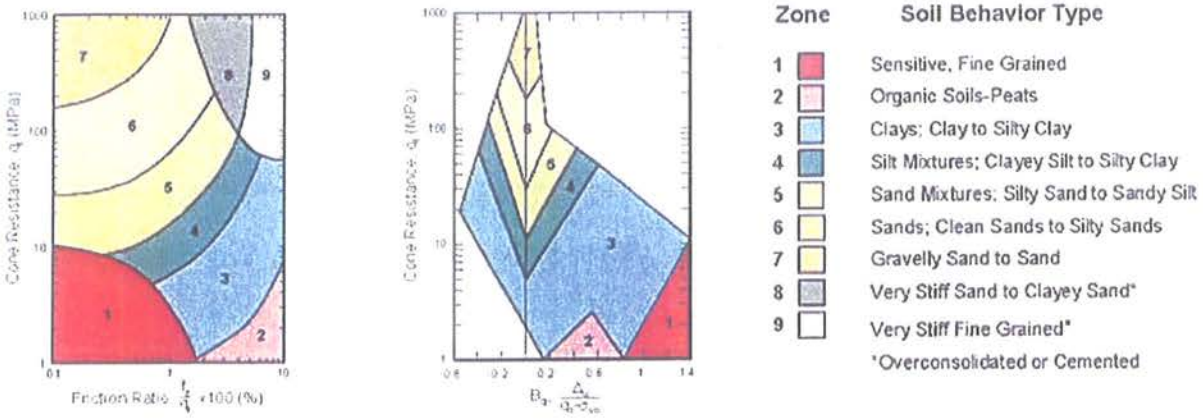
SCPTu:
- Seismic Piezocone (SCPTu);
- A piezocone (CPTu) is an enhanced cone penetration test (CPT) probe that is able to measure porewater pressure (u);
- A seismic piezocone (SCPTu) is further enhanced to measure surface generated compression and shear waves at depth; used to define the shear wave velocity of soils.

Equipment Type and Governing Standard:
- 10 cm^2 seismic piezocone;
- 150 cm^2 friction sleeve;
- manufactured by Applied Research Associates, Inc.;
- ASTM Specification D3441.

SCPTu Investigation Objectives:
- evaluate soil type and soil stratigraphy;
- estimate the relative density of granular soils and in situ undrained shear strength of cohesive soils.

Soil Behavior Type (SBT):
- The SBT is selected based on a soil's response to cone penetration, which is different from an explicit soil type defined by specified laboratory testing procedures, but is normally what the geotechnical engineer requires for design purposes.
- The SBT can be classified on the basis of the soil friction ratio, F_r; ratio between the side shear on the friction sleeve and cone tip resistance.
- The SBT can also be classified on the basis of the normalized pore pressure, B_q; a function of the pore water response to penetration and the cone tip resistance.
- The "CPTu Soil Behavior Type Legend" used for this project is presented below.

CPTu Soil Behavior Type Legend (Robertson et al. 1990)



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Terminology and Key Engineering Relationships

Parameter	Description	Symbol/Equation
Depth/Elevation	Measured at the centroid of the sensor	
Sleeve Stress	Measured friction stress on the friction sleeve located above the cone tip	f_s
Tip Stress, Uncorrected	Measured compression stress on the cone tip surface	q_c
Corrected Tip Stress	Tip stress, corrected for probe geometry	$q_t = q_c + u_2 \cdot (1 - a)$ *where a is a geometry based ratio relating the diameters of the inner load cell and the cone*
Ratio (%)	Friction ratio	$R_f = \frac{f_s}{q_t} \cdot 100\,\%$
In situ Pore Pressure	In situ equilibrium or static value	u_0
Measured Pore Pressure	Penetration pore pressure value	u_2
Overburden Stress		σ_{vo}
Effective Overburden Stress		$\sigma'_{vo} = \sigma_{vo} - u_o$
Normalized Tip Stress		$Q_t = \frac{q_t - \sigma_{vo}}{\sigma'_{vo}}$
Normalized Friction Ratio		$F_r = \frac{f_s}{q_t - \sigma_{vo}}$
Normalized Pore Pressure		$B_q = \frac{\Delta u}{q_t - \sigma_{vo}}$ *where* $\Delta u = u_2 - u_0$

Key References:

T. Lunne, P.K. Robertson, and J.J.M. Powell (1997). "Cone Penetration Testing in Geotechnical Practice"; Spon Press.

P.W. Mayne (1986). "CPT indexing of in situ OCR in Clays"; Proceedings of the ASCE Specialty Conference In Situ '86: Use of In Situ Tests in Geotechnical Engineering, Blacksburg, 780-93, ASCE.

P.K. Robertson and R.G. Campanella (1988). "Guidelines for geotechnical design using CPT and CPTU"; University of British Columbia, Vancouver, Department of Civil Engineering, Soil Mechanics Series 120.

P.K. Robertson (1990) "Soil classification using the cone penetration test", Canadian Geotechnical Journal, Vol. 27, No. 1, pp. 151-158.

Stantec Consulting Ltd.
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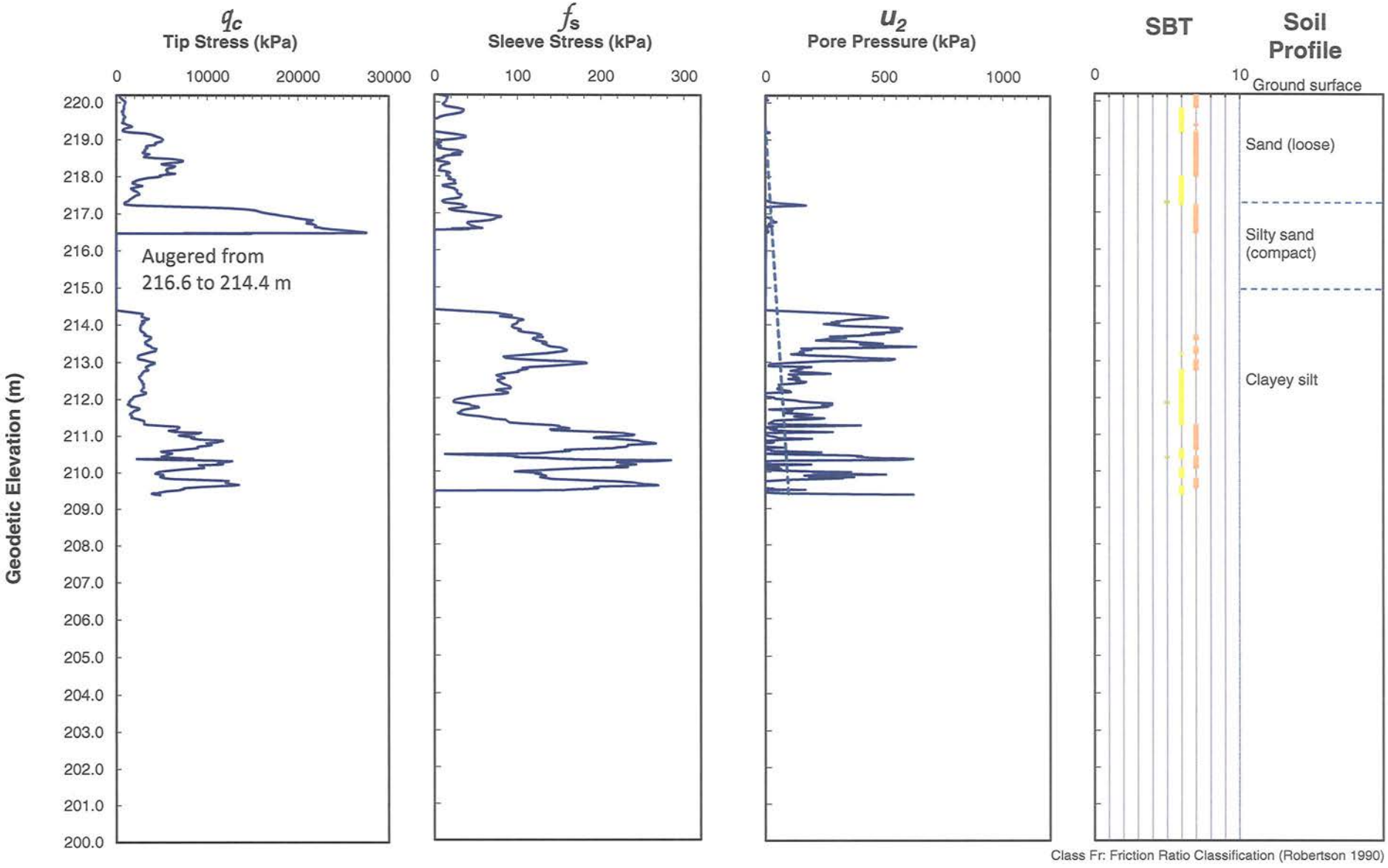
Ottawa ON, K1B 1A7

Elevation: 220.26 m	Test Date: April 17, 2012	CPT12-4
SCPTu Start Elevation: 220.26 m	Project No. 165000801	
Groundwater Elevation: 219.35 m		

Client: MTO

Project: Hwy 9 Holland Canal Drainage Bridge



Class Fr: Friction Ratio Classification (Robertson 1990)

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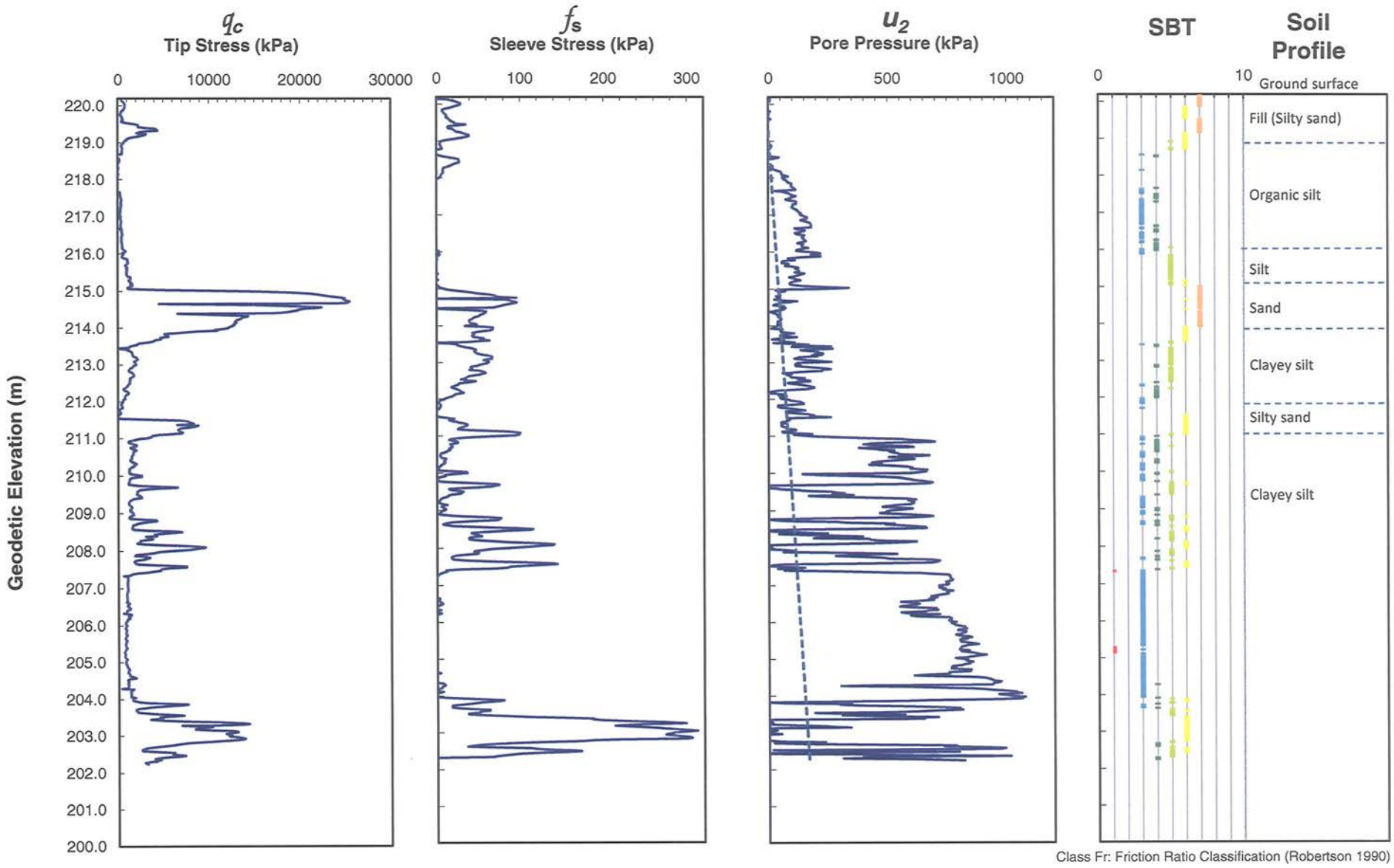
Ottawa ON, K1B 1A7

Elevation:	220.20 m	Test Date: March 28, 2012	CPT12-17
SCPTu Start Elevation:	220.20 m	Project No. 165000801	
Groundwater Elevation:	219.28 m		

Client: MTO

Project: Hwy 9 Holland Canal Drainage Bridge



Class Fr: Friction Ratio Classification (Robertson 1990)

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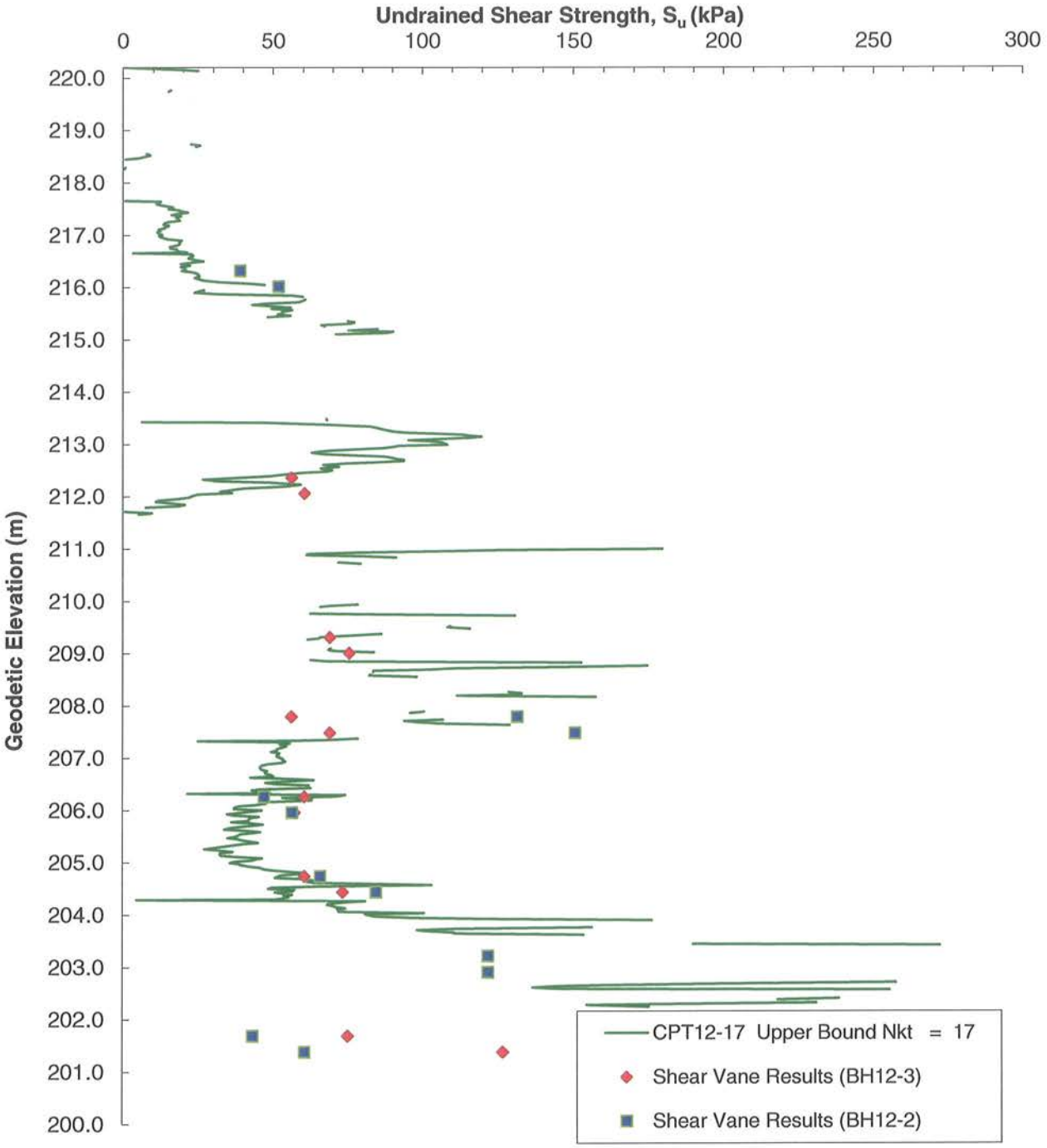
Ottawa ON, K1B 1A7

SCPTu RESULTS
Undrained Shear Strength, S_u



Project No. 165000801
CPT12-17

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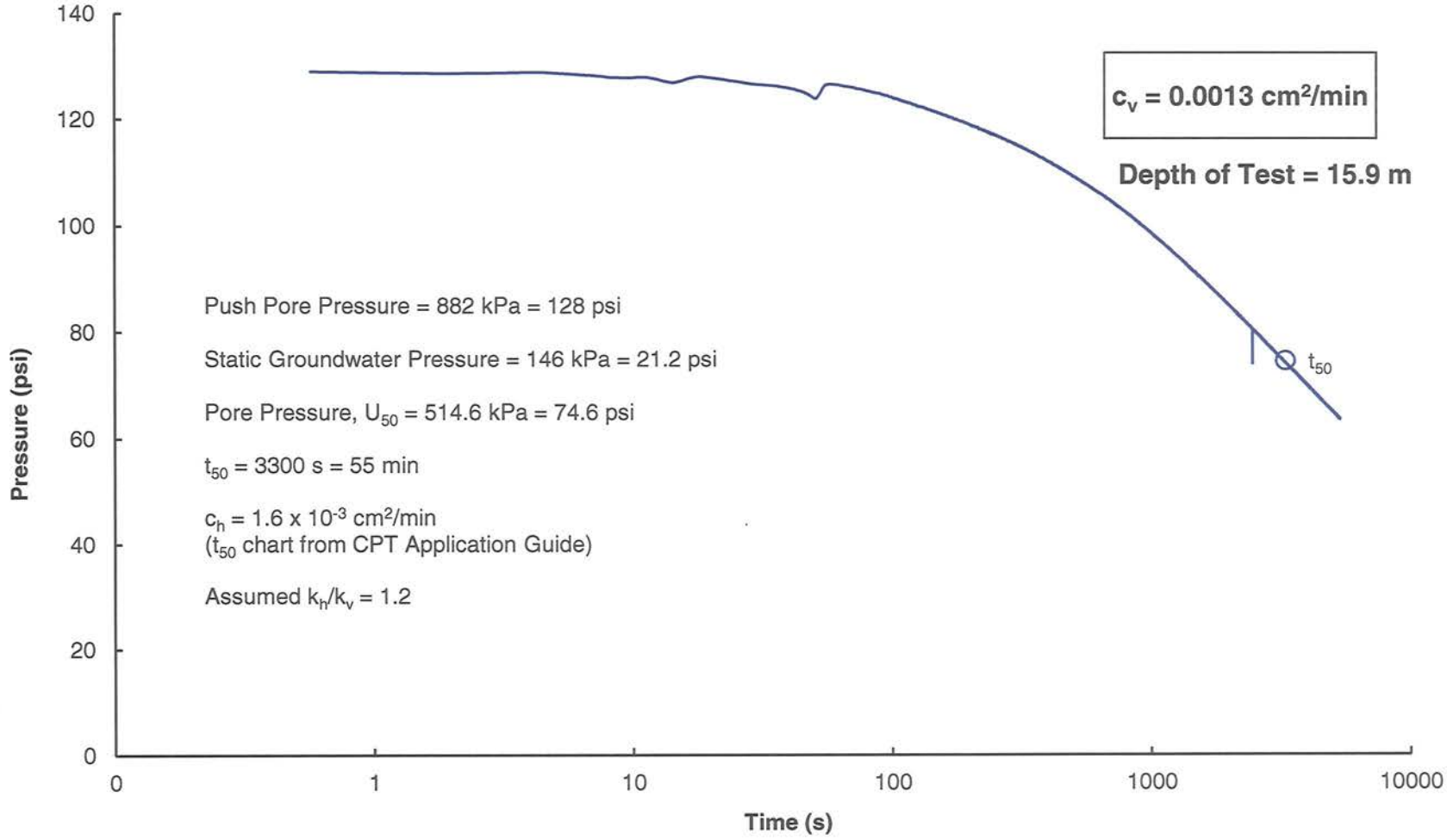
SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



Project No. 165000801
CPT12-17

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS, REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

65-1831

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 65-F-114 LOCATION East Abutment - North Corner. ORIGINATED BY P.P.
W.P. 172-65 BORING DATE Oct. 20, 22, 25, 1965. COMPILED BY P.P.
DATUM Geodetic BOREHOLE TYPE Washbore - NX & BX Casings. CHECKED BY

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
720.9	Groundlevel					
0.0	Organic Material (Sand, silt and clay) Muck Black		1	SS	2	
			2	TW	PM	
			3	TW	PM	710
707.9			4	TW	PM	
13.0	Sand with layers of clayey silt and some gravel. Brown Loose to compact.		5	SS	10	
			6	SS	19	
			7	SS	PM.DR	700
			8	SS	7	
691.4						
29.5	Clayey silt with occasional layers of sand and silt. Grey Firm to v. stiff.		9	SS	22	690
			10	TW	PM.DR	
			11	SS	13	680
			12	TW	PM	670
			13	TW	PM	660
			14	TW	32	650
			15	SS	16	640
633.9						
87.0	Sandy silt Grey					
629.4	V. loose		16	SS	6	630
91.5	End of borehole.					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 25 50 75 100 125
SHEAR STRENGTH P.S.F. ● Unconfined — 500 1000 1500 2000 2500
End of cone test

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
w_P w w_L
WATER CONTENT % — 20 40 60

BULK DENSITY γ P.C.F.	REMARKS
	Gr 22% Sa 72% Si) 6% Cl)
	Gr 1% Sa 88% Si) 11% Cl)
127.5	
123	
132	Gr 0% Sa 2% Si 66% Cl 32%
130	

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

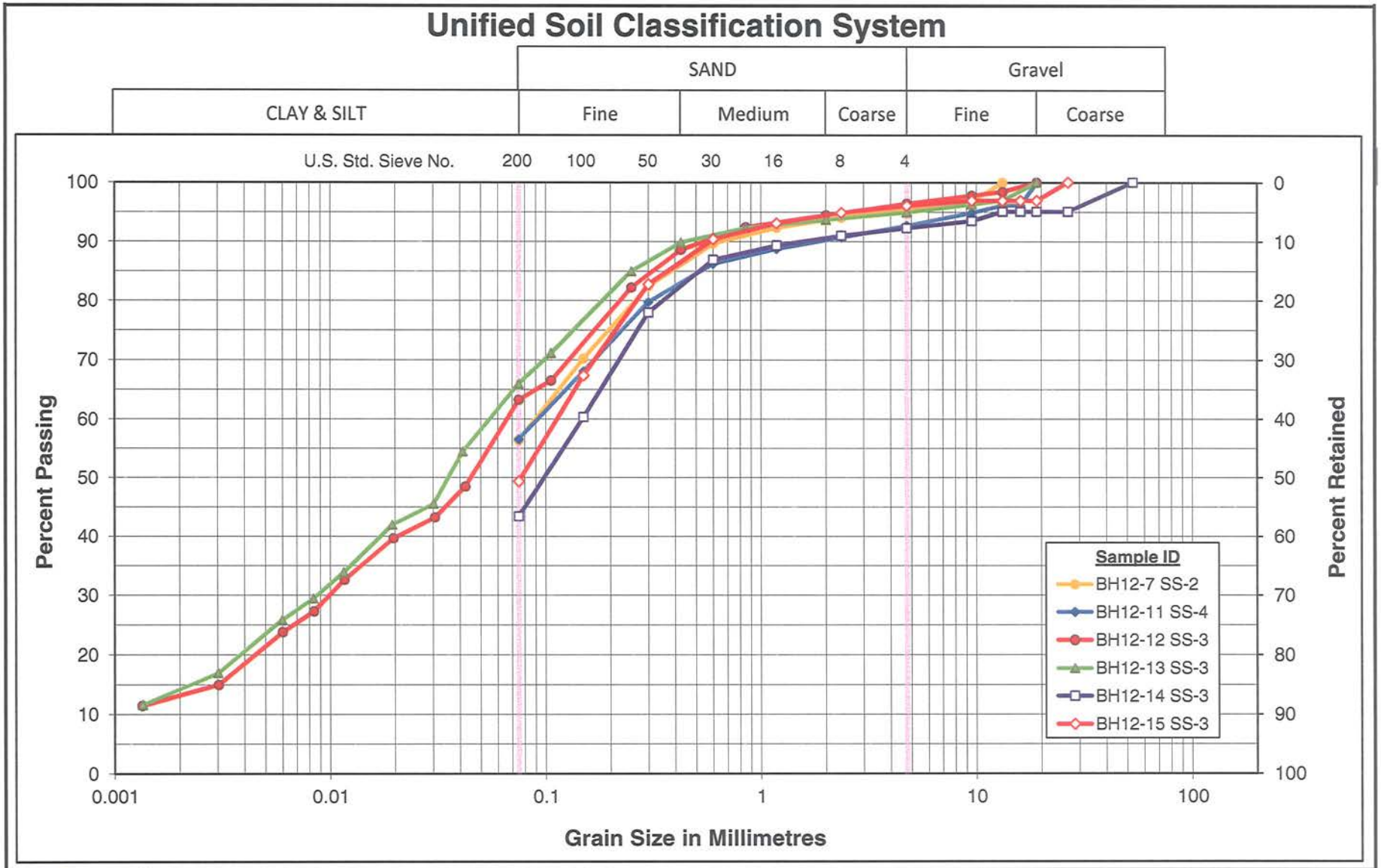
JOB 65-F-114 LOCATION West Abutment - North Corner ORIGINATED BY P.P.
W.P. 172-65 BORING DATE Oct. 25 & 26, 1965. COMPILED BY P.P.
DATUM Geodetic BOREHOLE TYPE Washbore - NX Casing. CHECKED BY AR

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 25 50 75 100 125 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — w_P w w_L — WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS
726.0	Groundlevel									
0.0	Sand Brown V. loose Fill		1	SS	3	720				
717.0										
9.0	Sandy silt to silty sand. Greyish brown Loose to compact.		2	SS	9					Gr 0% Sa 12% Si) Cl) 88%
			3	SS	29	710				
702.8			4	SS	39					Gr 6% Sa 84% Si) Cl) 10%
23.2	Clayey silt with traces of sand. Grey. Firm to hard.		5	SS	37	700	End of cone test			
			6	SS	29					
			7	SS	22	690				
			8	SS	32					
			9	SS	19	680				Gr 0% Sa 1% Si 58% Cl 41%
673.0			10	SS	30					
			11	SS	30					
53.0	End of borehole.					670				

APPENDIX C

Laboratory Test Results

Consolidation Test Results (from Golder)



Stantec

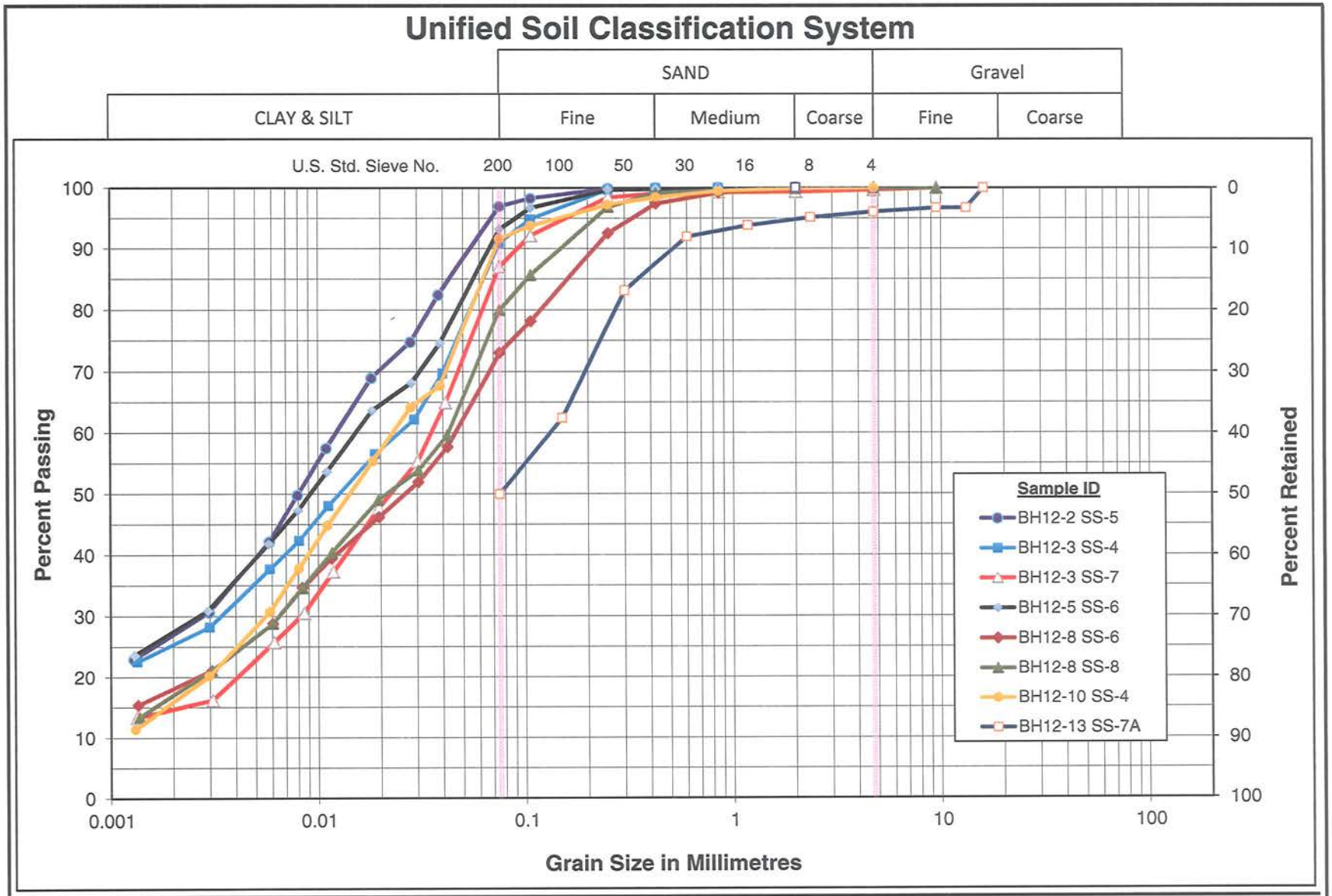
GRAIN SIZE DISTRIBUTION

FILL: Silty sand (SM) to sandy silt (ML)

Figure No. 1

Project No. 165000801

GWP No. 2188-08-00



Stantec

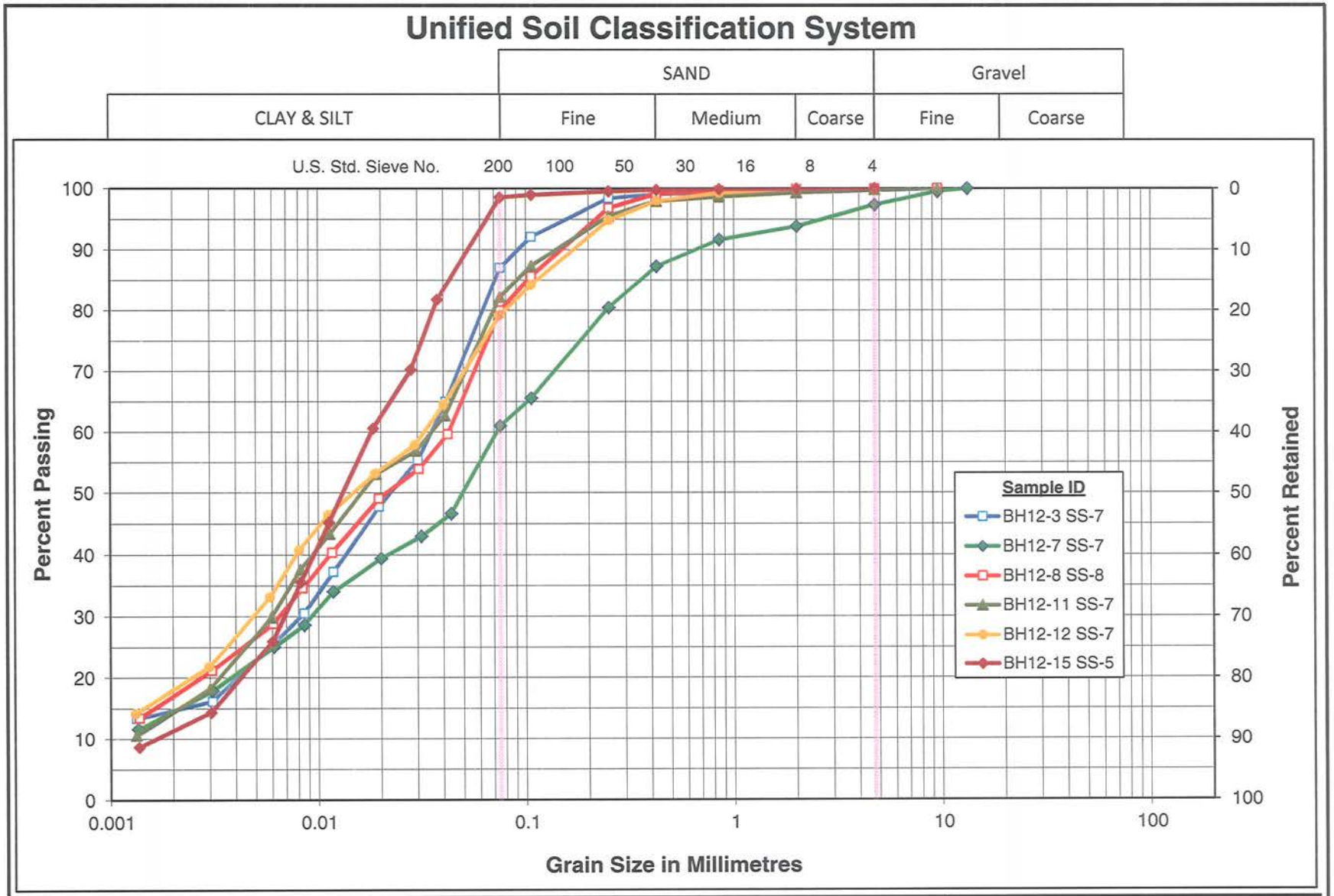
GRAIN SIZE DISTRIBUTION

Organic silt (OL) (Muck)

Figure No. 2

Project No. 165000801

GWP No. 2188-08-00



Stantec

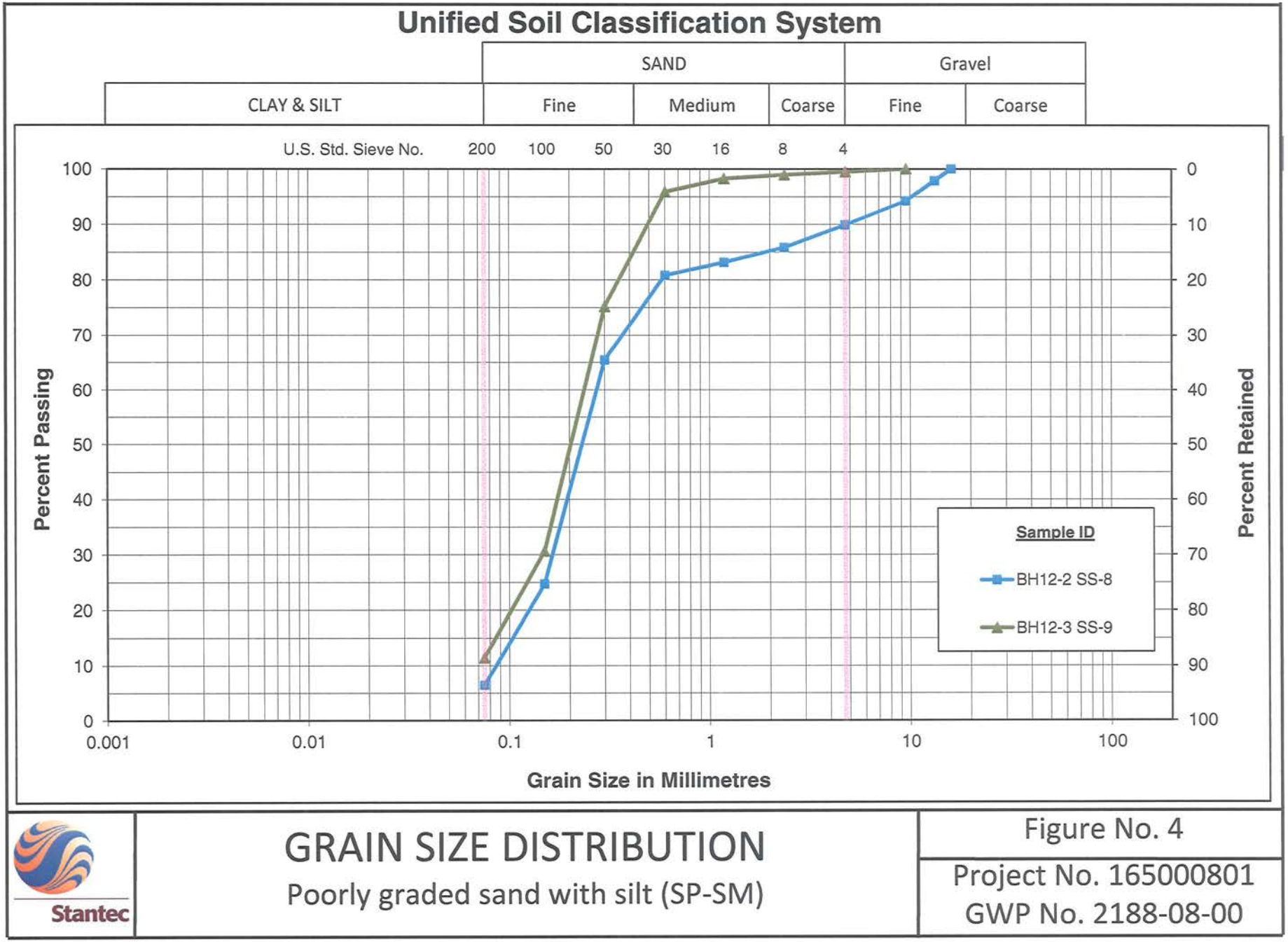
GRAIN SIZE DISTRIBUTION

Silt to sandy silt (ML)

Figure No. 3

Project No. 165000801

GWP No. 2188-08-00



Stantec

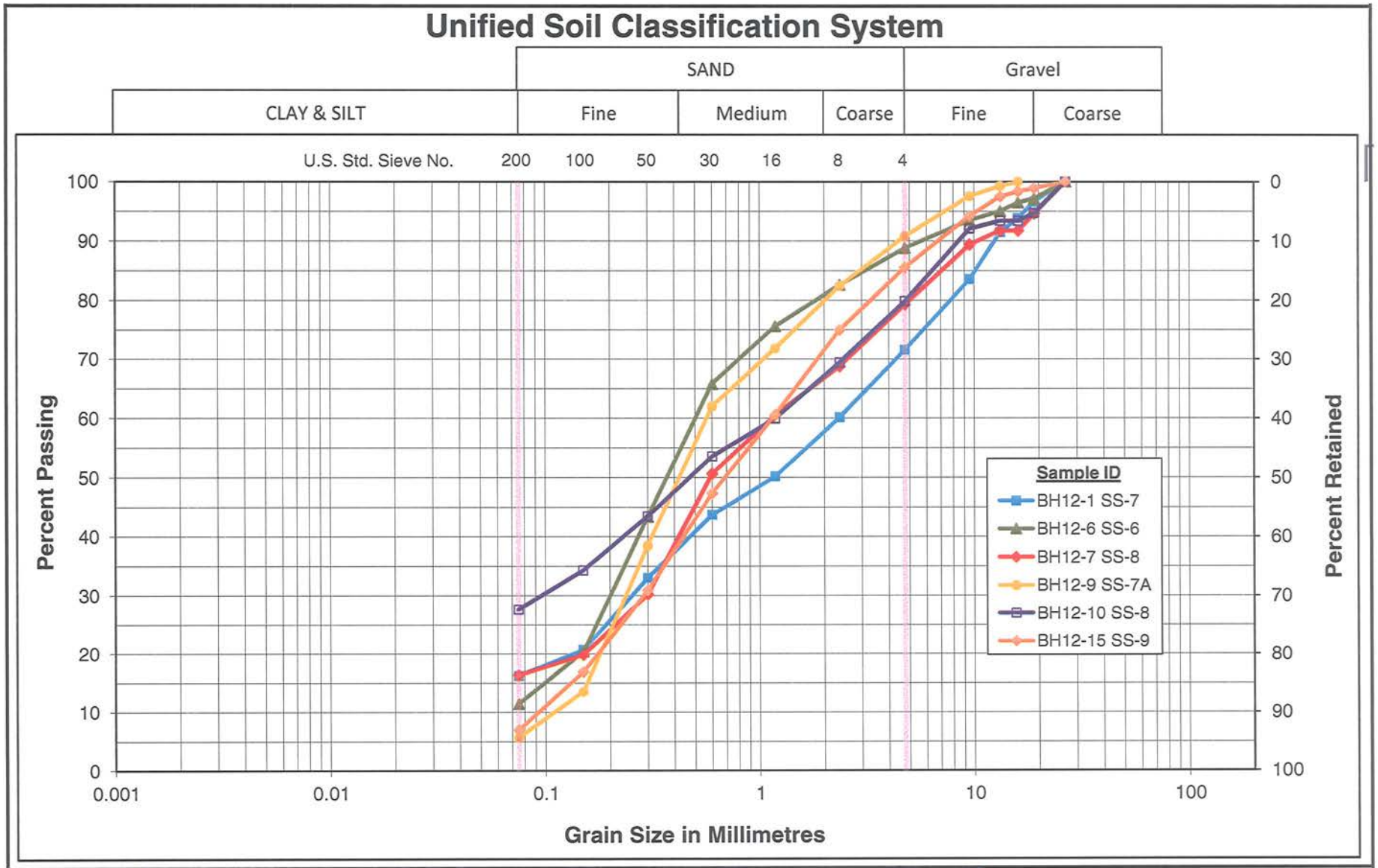
GRAIN SIZE DISTRIBUTION

Poorly graded sand with silt (SP-SM)

Figure No. 4

Project No. 165000801

GWP No. 2188-08-00



Stantec

GRAIN SIZE DISTRIBUTION

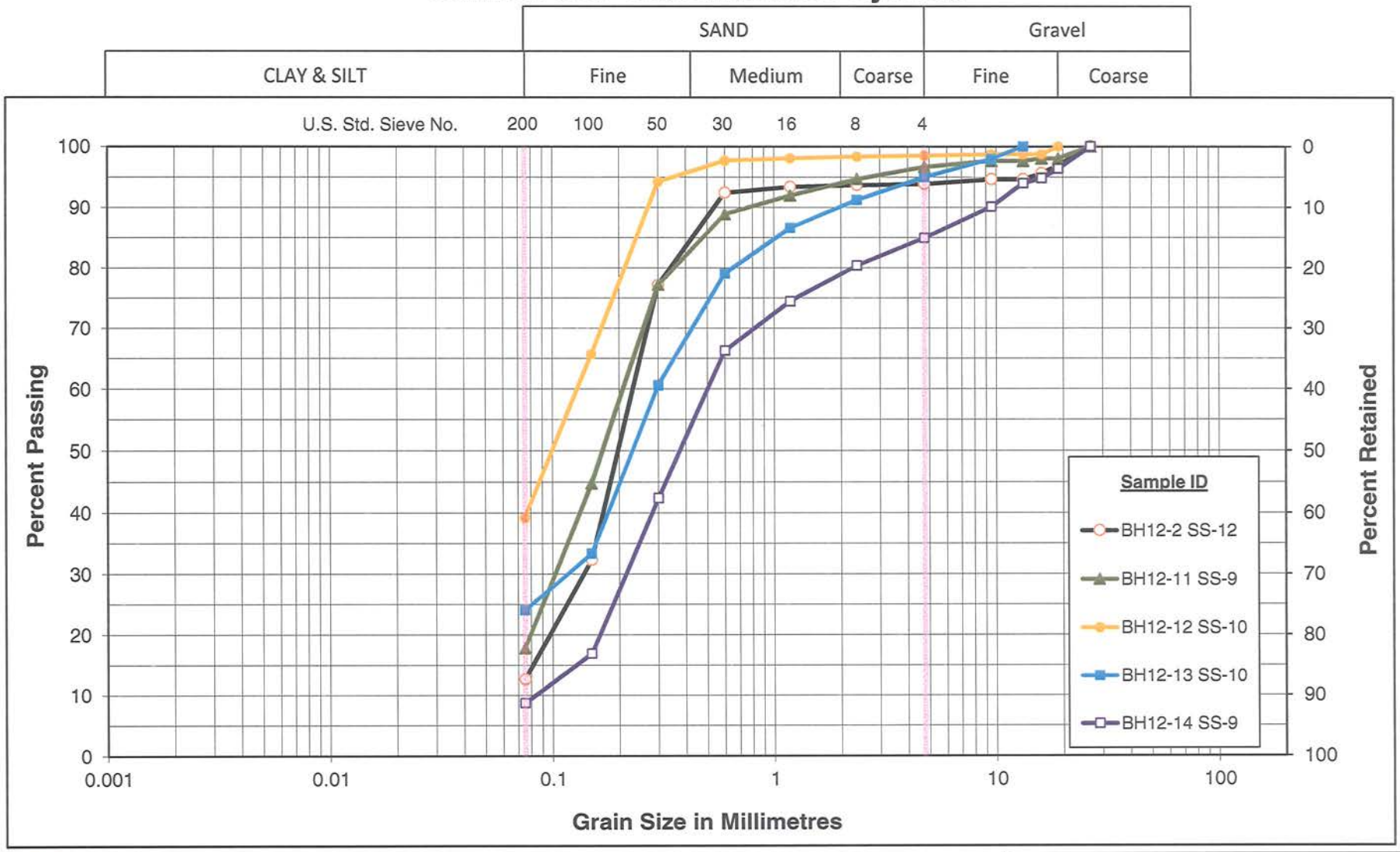
Silty sand (SM) to silty sand with gravel (SM)

Figure No. 5a

Project No. 165000801

GWP No. 2188-08-00

Unified Soil Classification System



Stantec

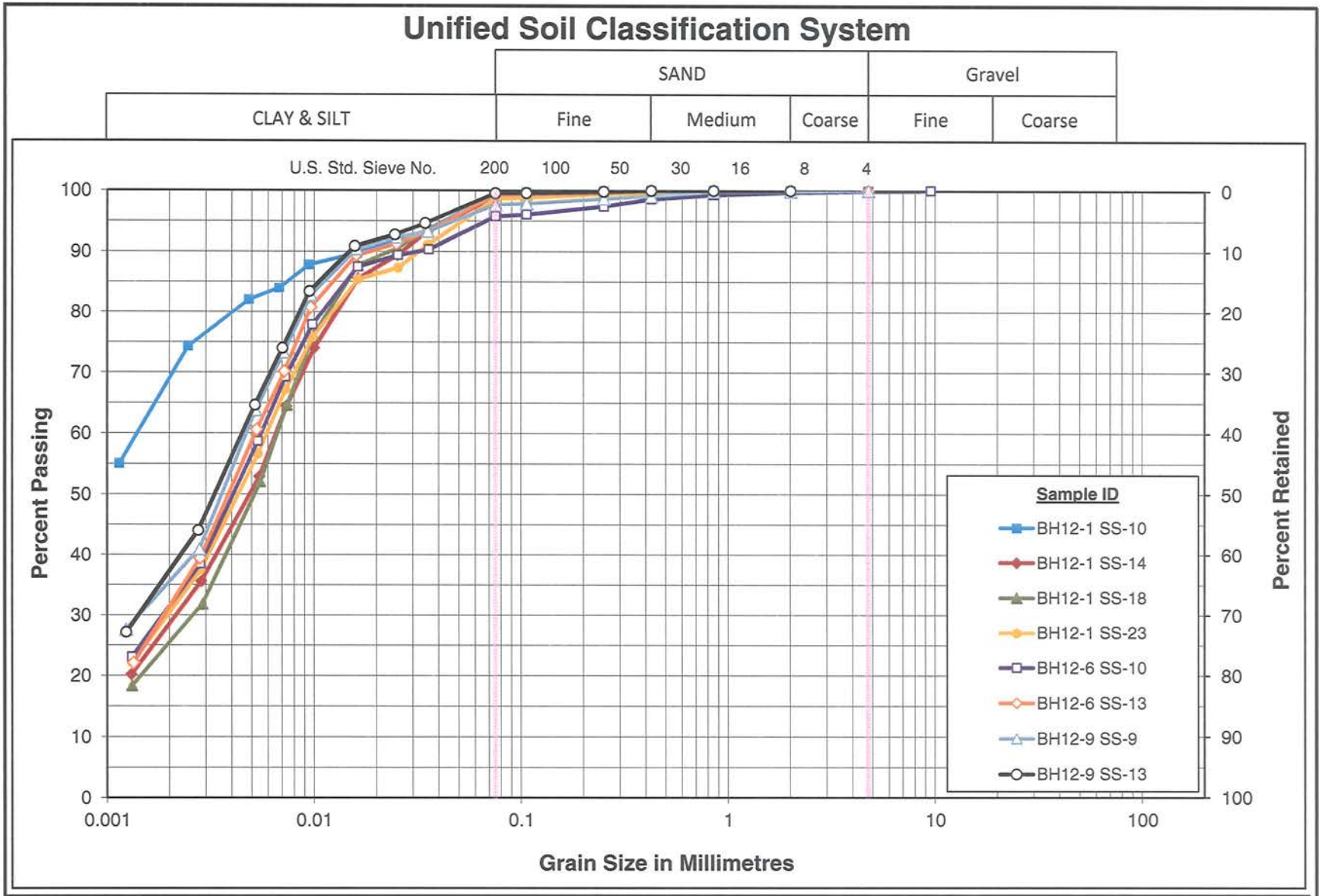
GRAIN SIZE DISTRIBUTION

Silty sand (SM)

Figure No. 5b

Project No. 165000801

GWP No. 2188-08-00



Stantec

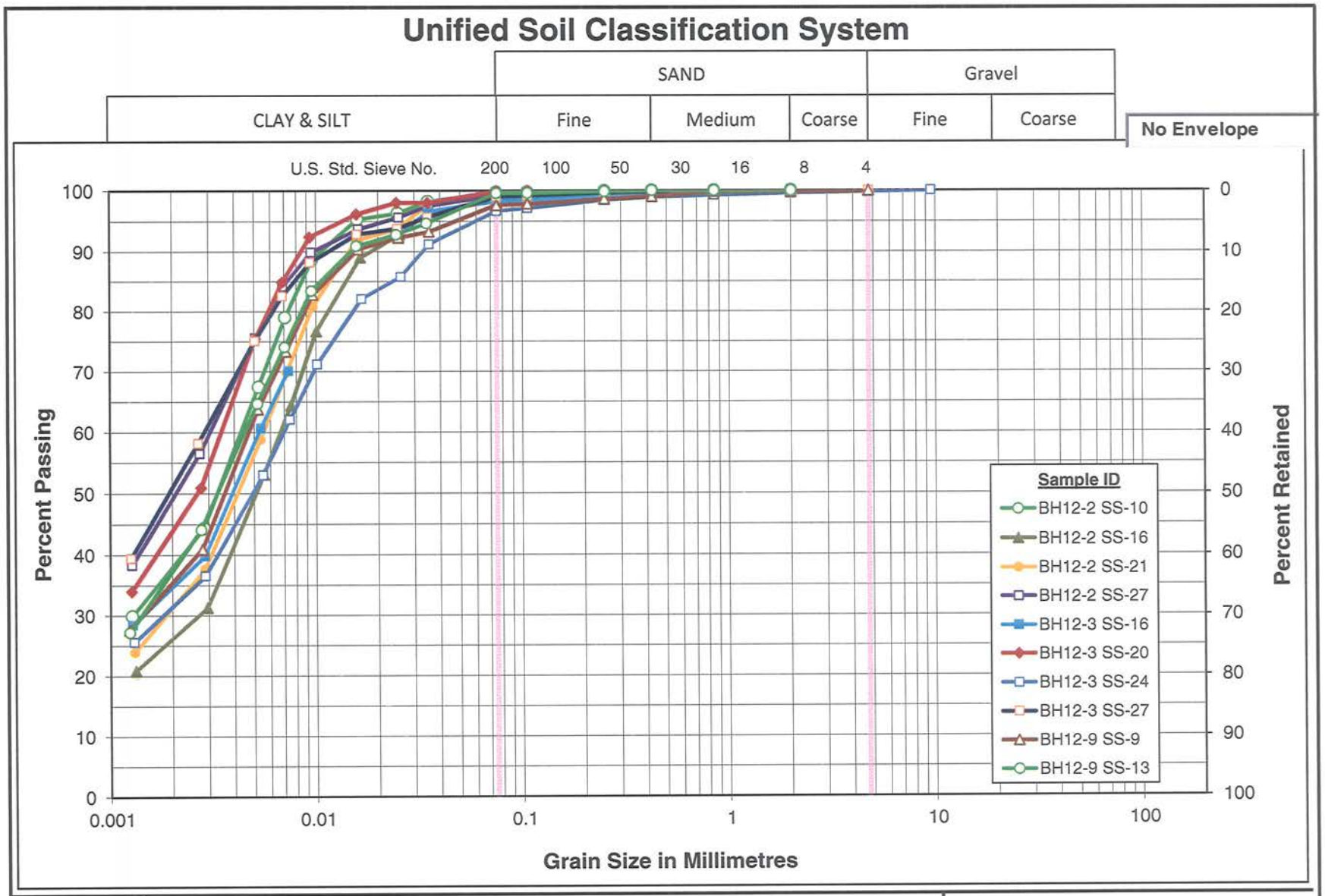
GRAIN SIZE DISTRIBUTION

Clayey silt (CL)

Figure No. 6a

Project No. 165000801

GWP No. 2188-08-00



Stantec

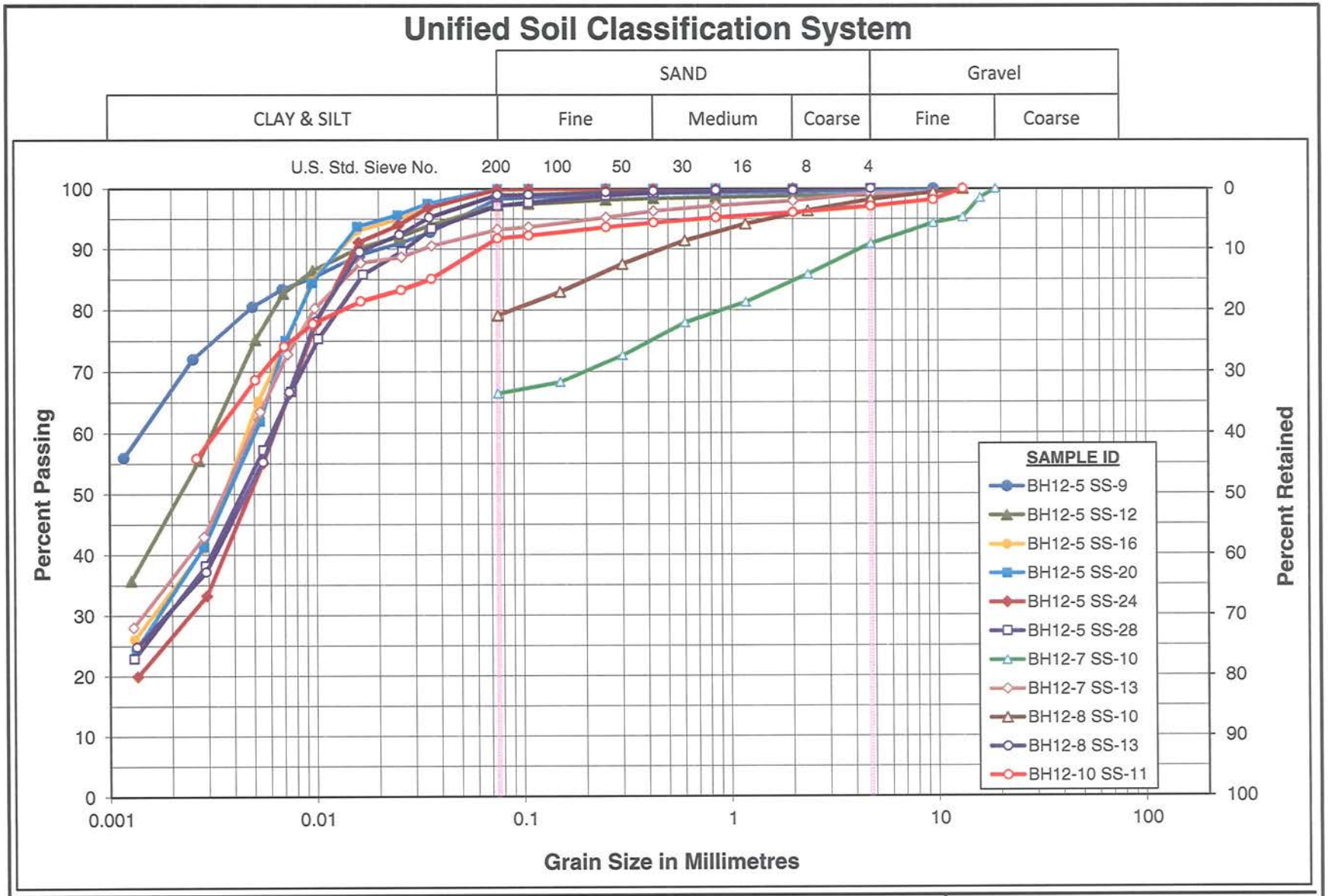
GRAIN SIZE DISTRIBUTION

Clayey silt (CL)

Figure No. 6b

Project No. 165000801

GWP No. 2188-08-00



Stantec

GRAIN SIZE DISTRIBUTION

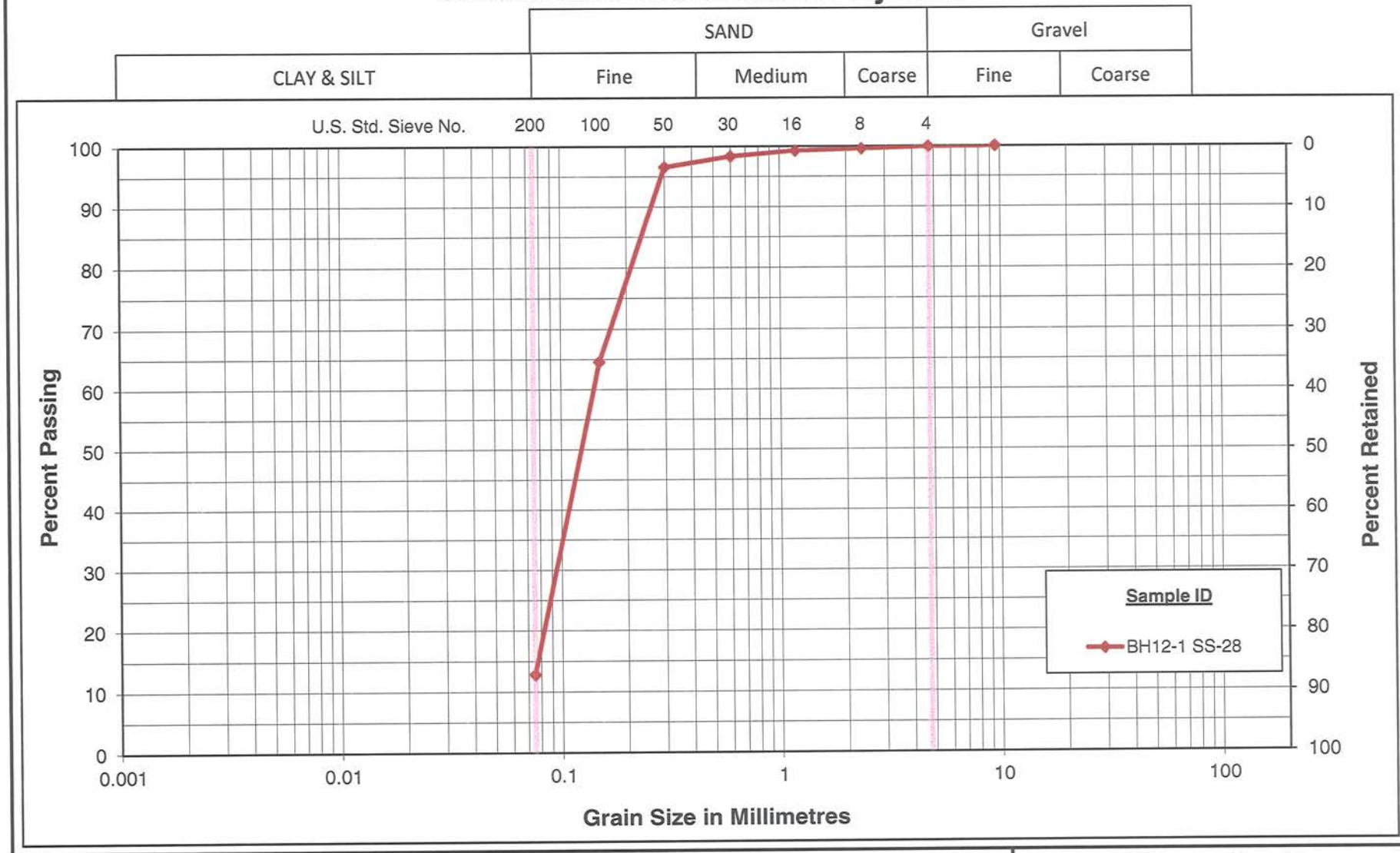
Clayey silt (CL)

Figure No. 6c

Project No. 165000801

GWP No. 2188-08-00

Unified Soil Classification System



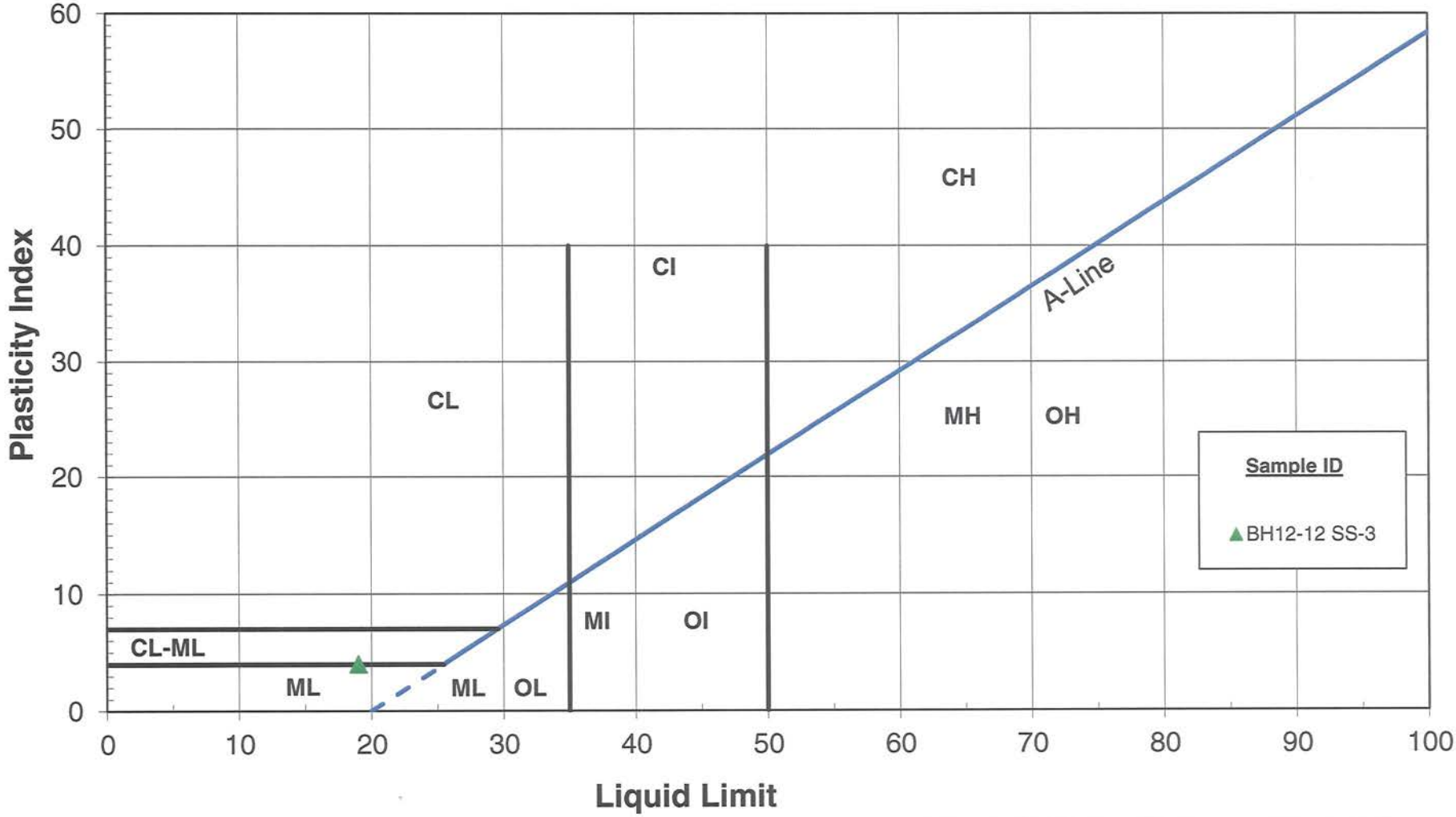
Stantec

GRAIN SIZE DISTRIBUTION

Silty sand (SM)

Figure No. 7

Project No. 165000801
GWP No. 2188-08-00



Stantec

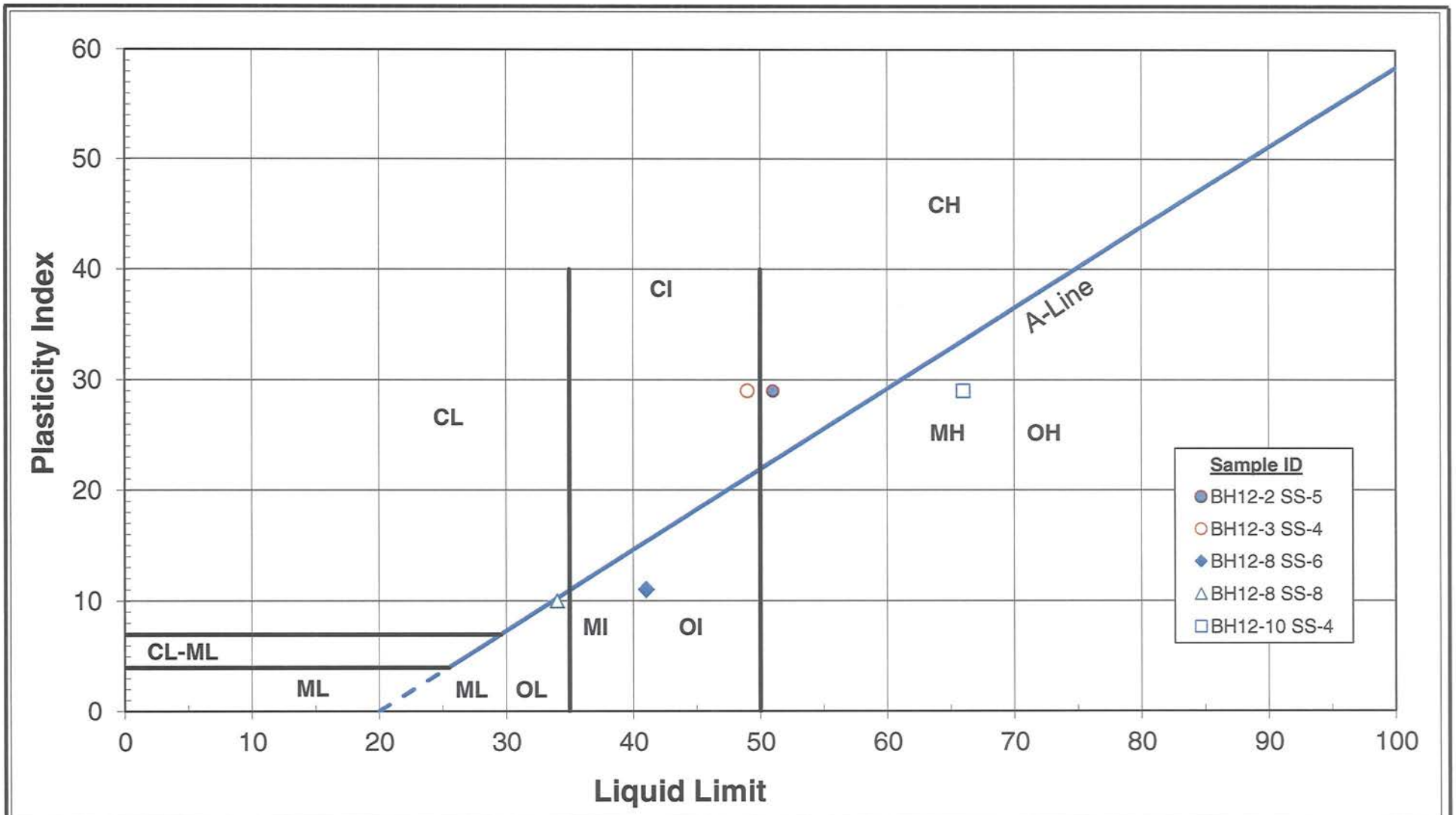
PLASTICITY CHART

Fill: Silt

Figure No. 8

Project No. 165000801

GWP No. 2188-08-00



Stantec

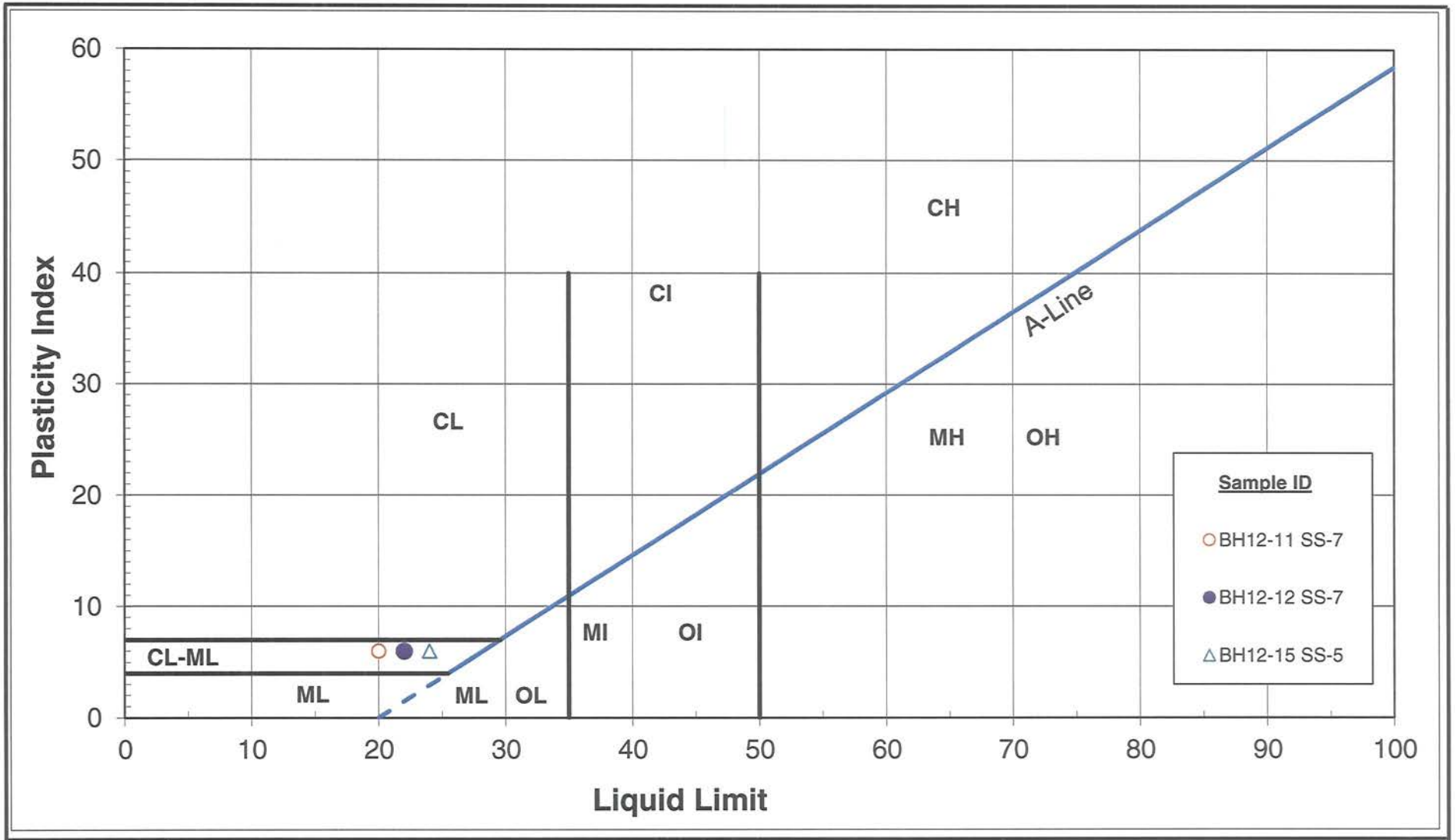
PLASTICITY CHART

Organic silt (Muck)

Figure No. 9

Project No. 165000801

GWP No. 2188-08-00



Stantec

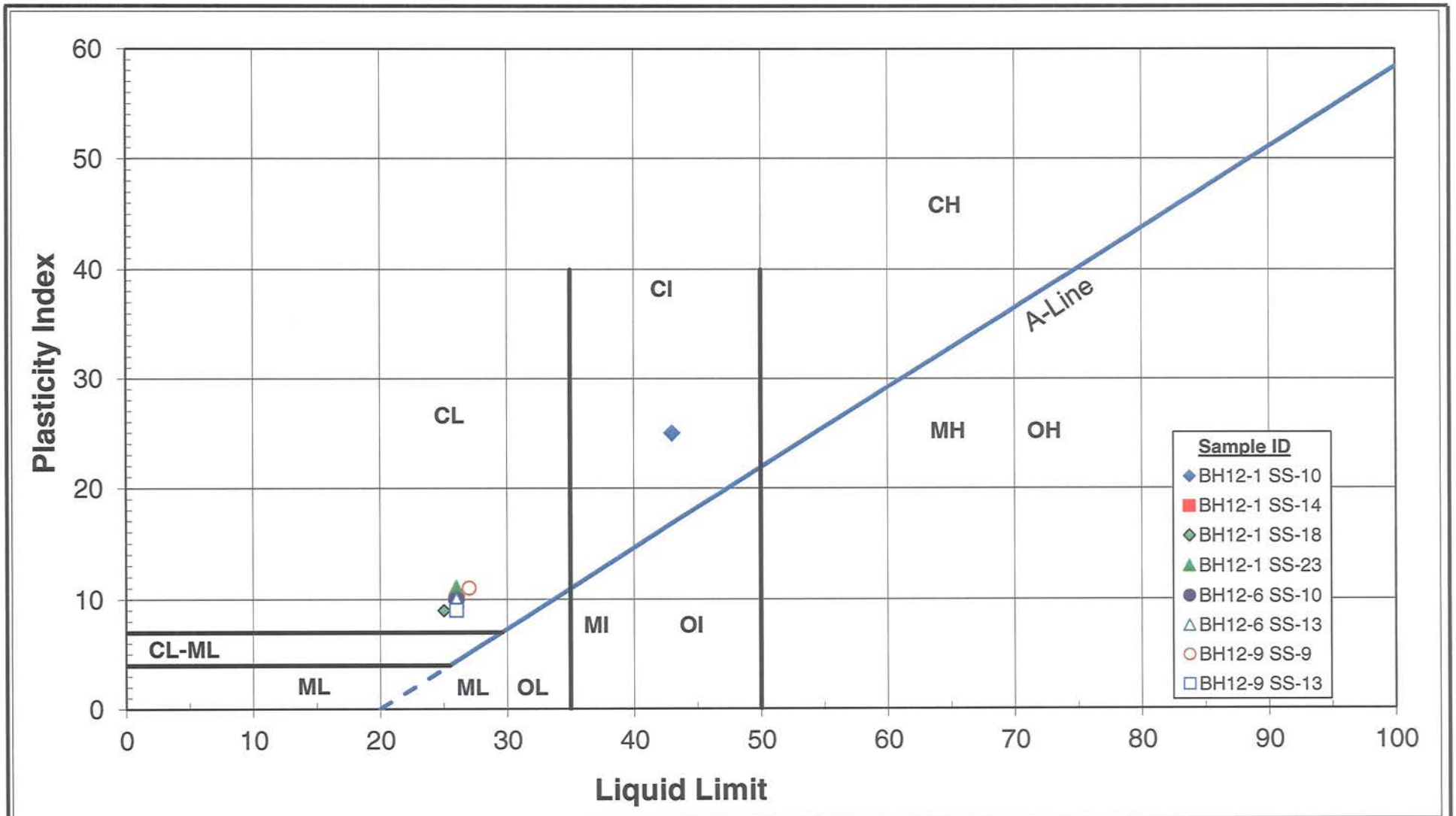
PLASTICITY CHART

Silt

Figure No. 10

Project No. 165000801

GWP No. 2188-08-00



Stantec

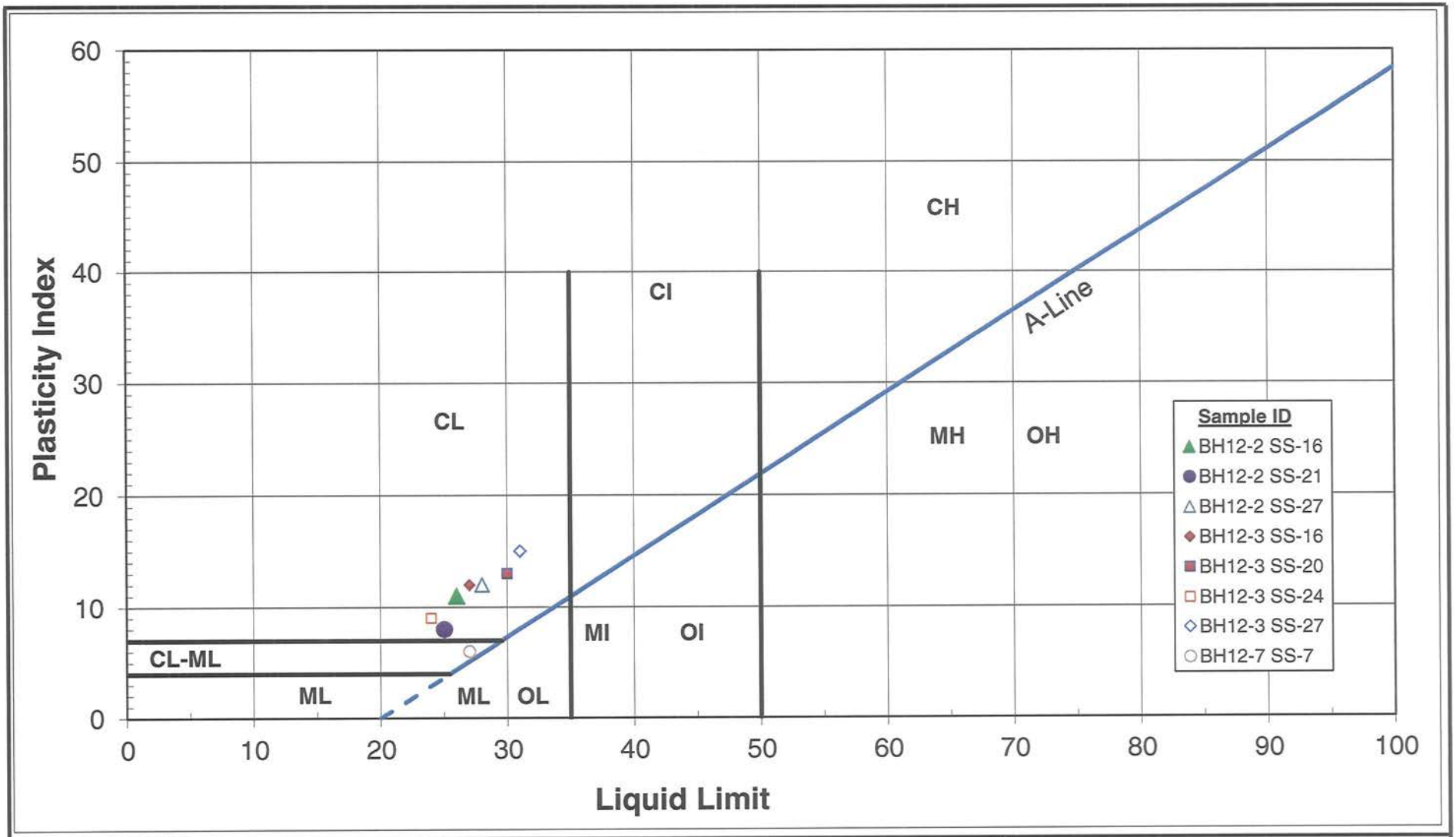
PLASTICITY CHART

Clayey silt

Figure No. 11a

Project No. 165000801

GWP No. 2188-08-00



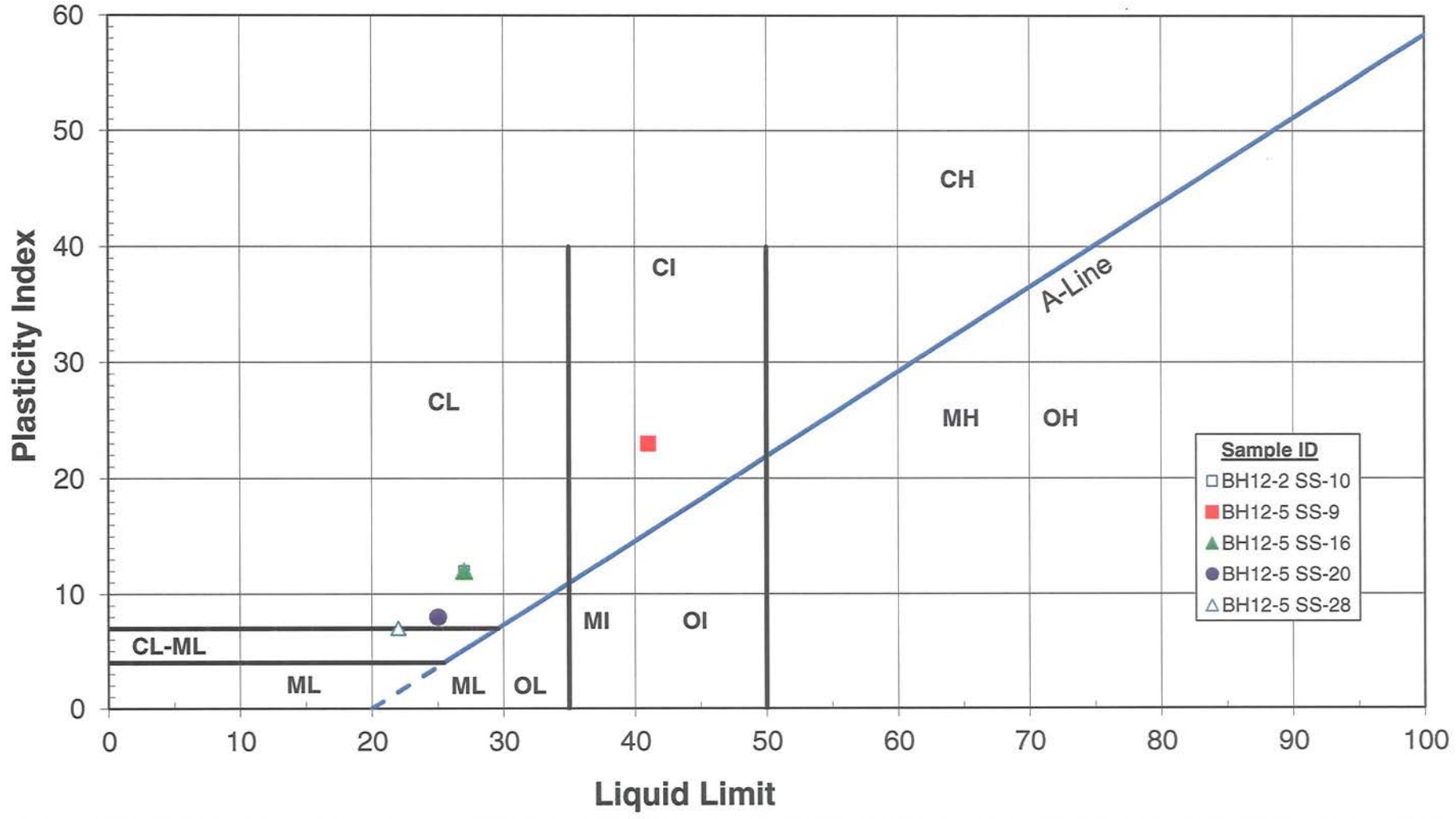
Stantec

PLASTICITY CHART

Clayey silt

Figure No. 11b

Project No. 165000801
GWP No. 2188-08-00



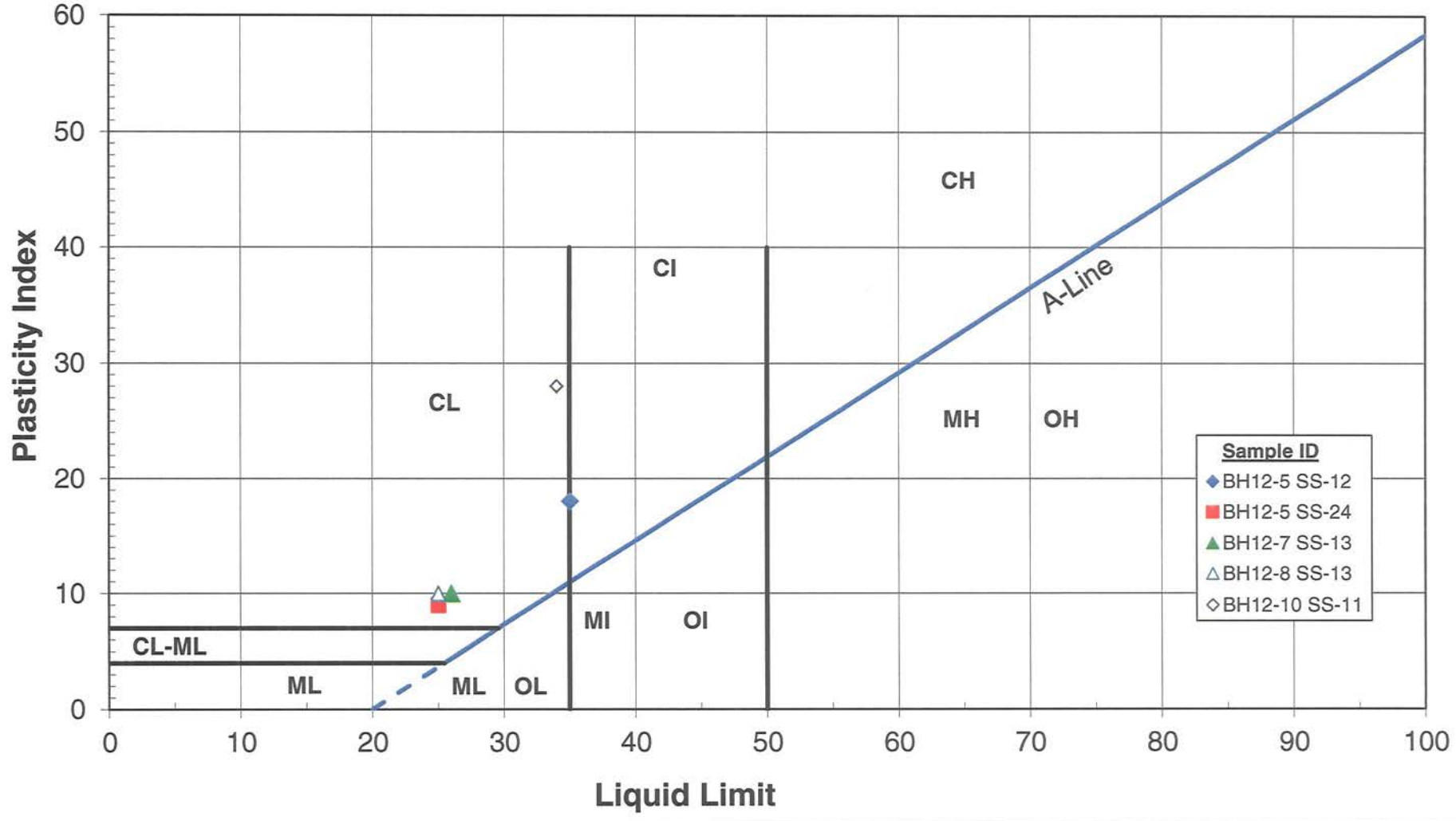
Stantec

PLASTICITY CHART

Clayey silt

Figure No. 11c

Project No. 165000801
GWP No. 2188-08-00



Stantec

PLASTICITY CHART

Clayey silt

Figure No. 11d

Project No. 165000801
GWP No. 2188-08-00

May 31, 2012

Project No. 12-1183-0048

165000801

Simon Gudina
Stantec Consulting Ltd.
200 - 2781 Lancaster Road
Ottawa, Ontario
K1B 1A7

GEOTECHNICAL LABORATORY TESTING

Dear Sir

This letter reports the results of laboratory testing carried out on the samples received at our office in Mississauga. The results of the tests are summarized in the attached tables and figures.

The testing services reported herein have been performed in accordance with the indicated recognized standard, unless noted otherwise. This report is for the sole use of the designated client. This report constitutes a testing service only and does not represent any results interpretation or opinion regarding specification compliance or material suitability.

We trust that the results are sufficient for your current requirements. If you have any questions, please do not hesitate to call us.

GOLDER ASSOCIATES LTD.

Marijana Manojlovic
Laboratory Manager

MM/lg

Golder Associates Ltd.
2390 Argentia Road, Mississauga, Ontario, Canada L5N 5Z7
Tel: +1 (905) 567 4444 Fax: +1 (905) 567 6561 www.golder.com
Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

CONSOLIDATION TEST SUMMARY

FIGURE

SAMPLE IDENTIFICATION

Project Number	12-1183-0048	Sample Number	ST-22
Borehole Number	12-3	Sample Depth, m	15.8-16.5

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	6		
Date Started	4/23/2012		
Date Completed	5/4/2012		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m^3	19.27
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m^3	14.81
Area, cm^2	31.55	Specific Gravity, measured	2.77
Volume, cm^3	59.88	Solids Height, cm	1.035
Water Content, %	30.16	Volume of Solids, cm^3	32.64
Wet Mass, g	117.69	Volume of Voids, cm^3	27.24
Dry Mass, g	90.42	Degree of Saturation, %	100.1

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	c_v cm^2/s	m_v m^2/kN	k cm/s
0.00	1.898	0.834	1.898				
5.86	1.895	0.832	1.897	22	3.47E-02	2.61E-04	8.86E-07
10.66	1.888	0.825	1.892	126	6.02E-03	7.35E-04	4.34E-07
20.44	1.883	0.820	1.886	689	1.09E-03	2.86E-04	3.06E-08
39.92	1.874	0.812	1.879	265	2.82E-03	2.38E-04	6.59E-08
78.77	1.861	0.798	1.867	240	3.08E-03	1.86E-04	5.61E-08
156.26	1.839	0.778	1.850	290	2.50E-03	1.44E-04	3.53E-08
311.42	1.805	0.744	1.822	265	2.66E-03	1.18E-04	3.07E-08
621.60	1.734	0.675	1.769	342	1.94E-03	1.21E-04	2.30E-08
1242.77	1.644	0.589	1.689	392	1.54E-03	7.60E-05	1.15E-08
2483.77	1.567	0.514	1.605	289	1.89E-03	3.27E-05	6.06E-09
1242.77	1.582	0.529	1.574				
311.42	1.607	0.553	1.594				
78.77	1.643	0.588	1.625				
20.44	1.689	0.633	1.666				
5.86	1.725	0.667	1.707				

Note:
k calculated using cv based on t_{90} values.
Specimen taken 20cm from bottom of the tube.
Loading stages assigned by the client.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.72	Unit Weight, kN/m^3	20.45
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m^3	16.30
Area, cm^2	31.55	Specific Gravity, measured	2.77
Volume, cm^3	54.41	Solids Height, cm	1.035
Water Content, %	25.49	Volume of Solids, cm^3	32.64
Wet Mass, g	113.47	Volume of Voids, cm^3	21.77
Dry Mass, g	90.42		

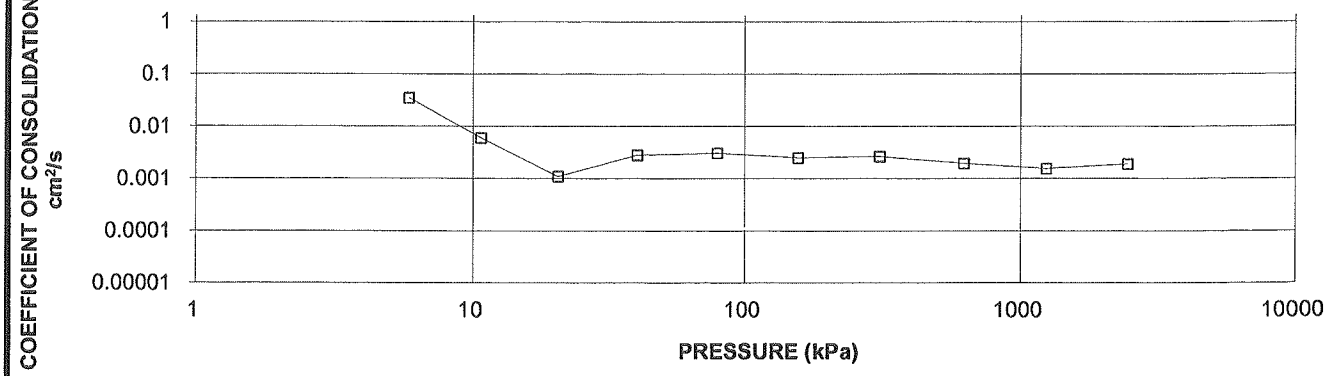
Prepared By: LFG

Golder Associates

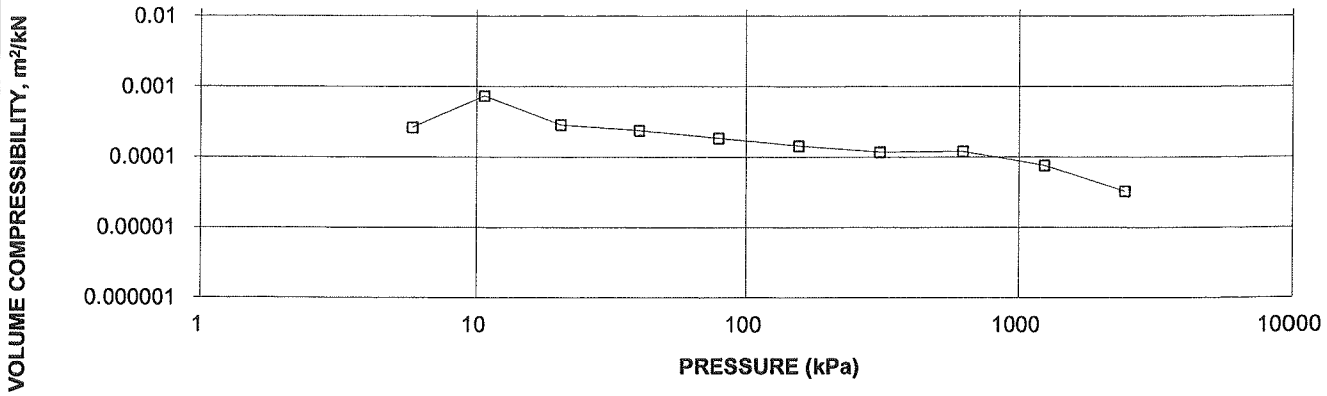
Checked By:

CONSOLIDATION TEST SUMMARY	FIGURE

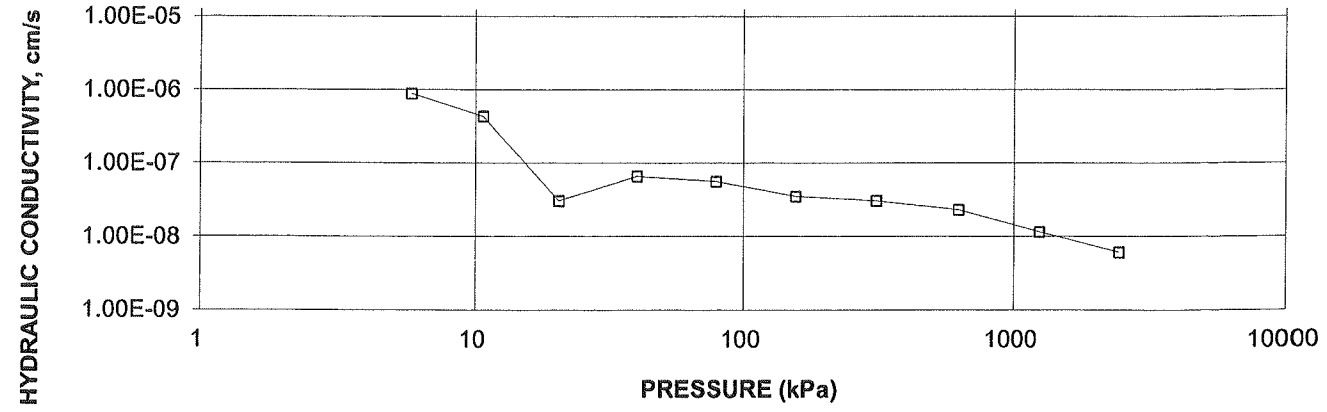
CONSOLIDATION TEST
C_V cm²/s VS PRESSURE (kPa)
BH 12-3 ST-22



CONSOLIDATION TEST
M_V m²/kN vs PRESSURE (kPa)
BH 12-3 ST-22



CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs PRESSURE
BH 12-3 ST-22

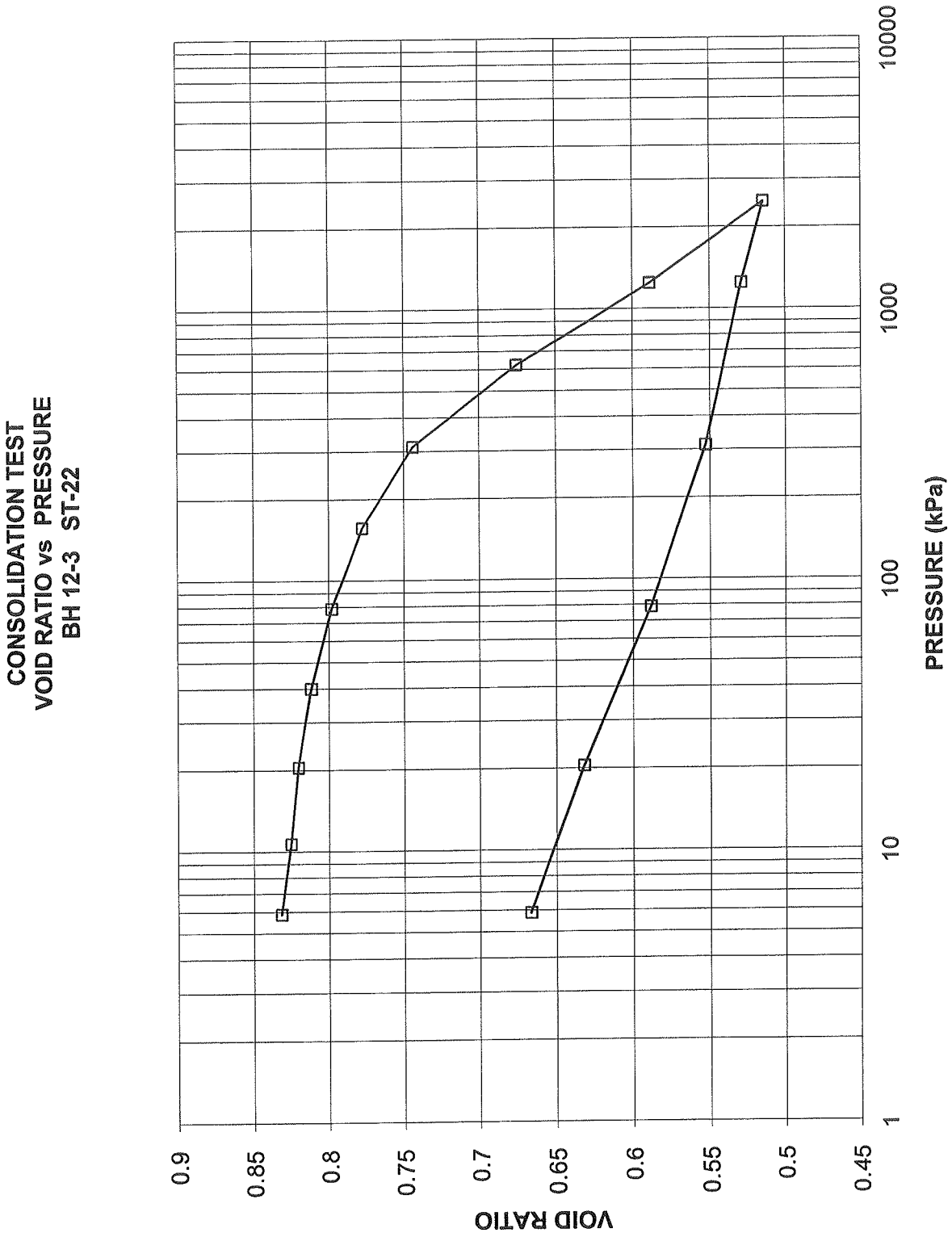


Project No. 12-1183-0048
Prepared By: LFG

Golder Associates

Checked By:

CONSOLIDATION TEST VOID RATIO VS LOG PRESSURE	FIGURE



Project No. 12-1183-0048

Prepared By: LFG

Golder Associates

Checked By:

UNCONFINED COMPRESSION TEST (UC)

ASTM D 2166 - 06

SAMPLE IDENTIFICATION

PROJECT NUMBER	12-1183-0048	SAMPLE NUMBER	ST-22
BOREHOLE NUMBER	12-3	SAMPLE DEPTH, m	15.85-16.46

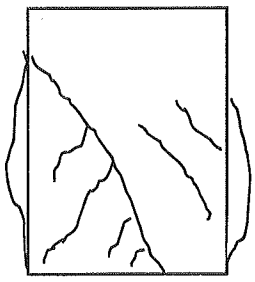
TEST CONDITIONS

MACHINE SPEED, mm/min	1.42	TYPE OF SPECIMEN	Thin wall tube sample
RATE OF AXIAL STRAIN, %/min	1.00	L/D	2.07

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	14.21	WATER CONTENT, (specimen) %	19.75
SAMPLE DIAMETER, cm	6.87	UNIT WEIGHT, kN/m^3	21.17
SAMPLE AREA, cm^2	37.11	DRY UNIT WT., kN/m^3	17.68
SAMPLE VOLUME, cm^3	527.36	SPECIFIC GRAVITY, measured	2.77
WET WEIGHT, g	1138.90	VOID RATIO	0.54
DRY WEIGHT, g	951.06		

FAILURE SKETCH



TEST RESULTS

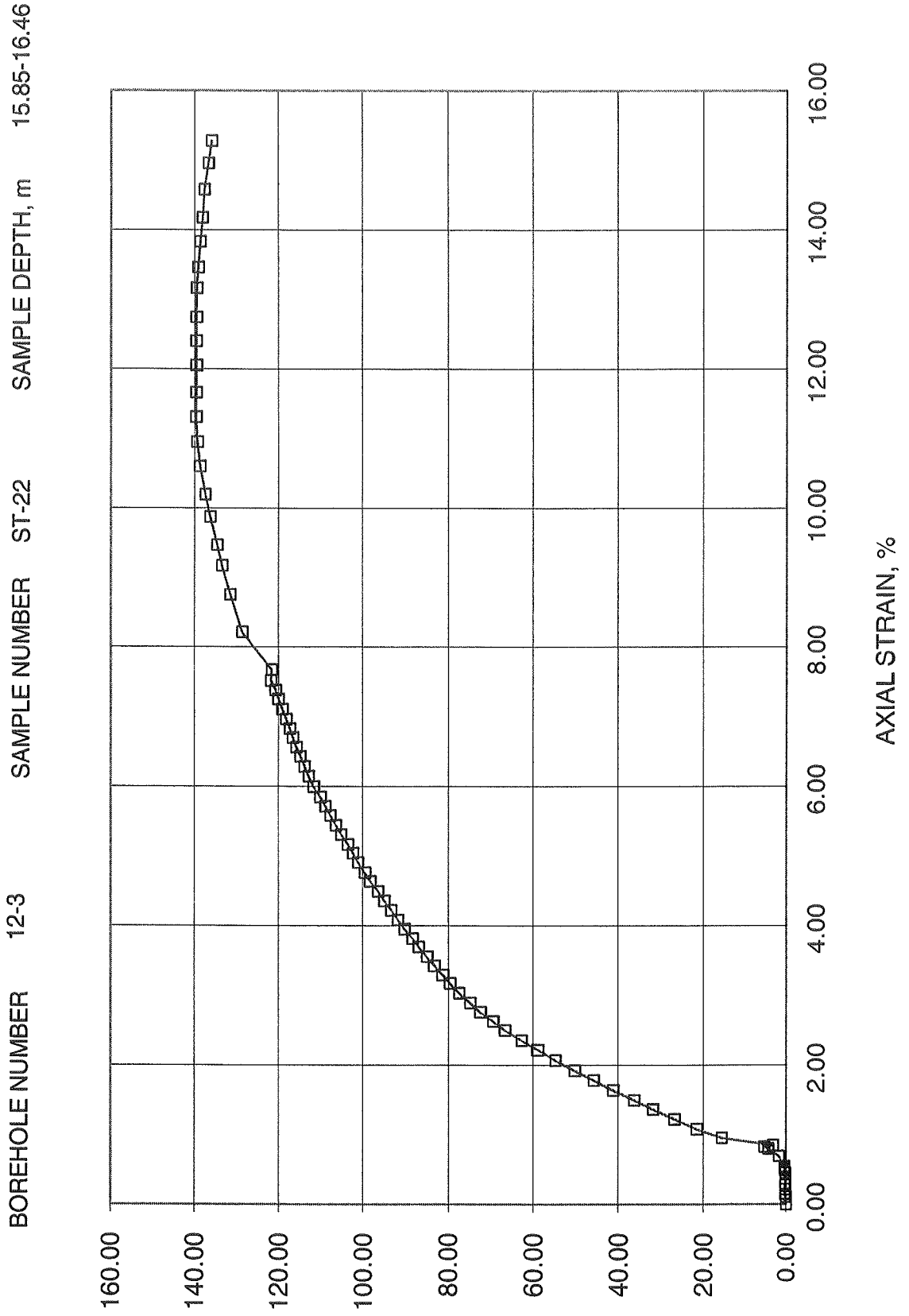
STRAIN AT FAILURE, %	11.3	COMPRESSIVE STRESS, kPa	140

REMARKS: Specimen taken from bottom of the tube. DATE: 04/24/2012

Checked By: MM

Golder Associates

UNCONFINED COMPRESSION TEST (UC)	FIGURE

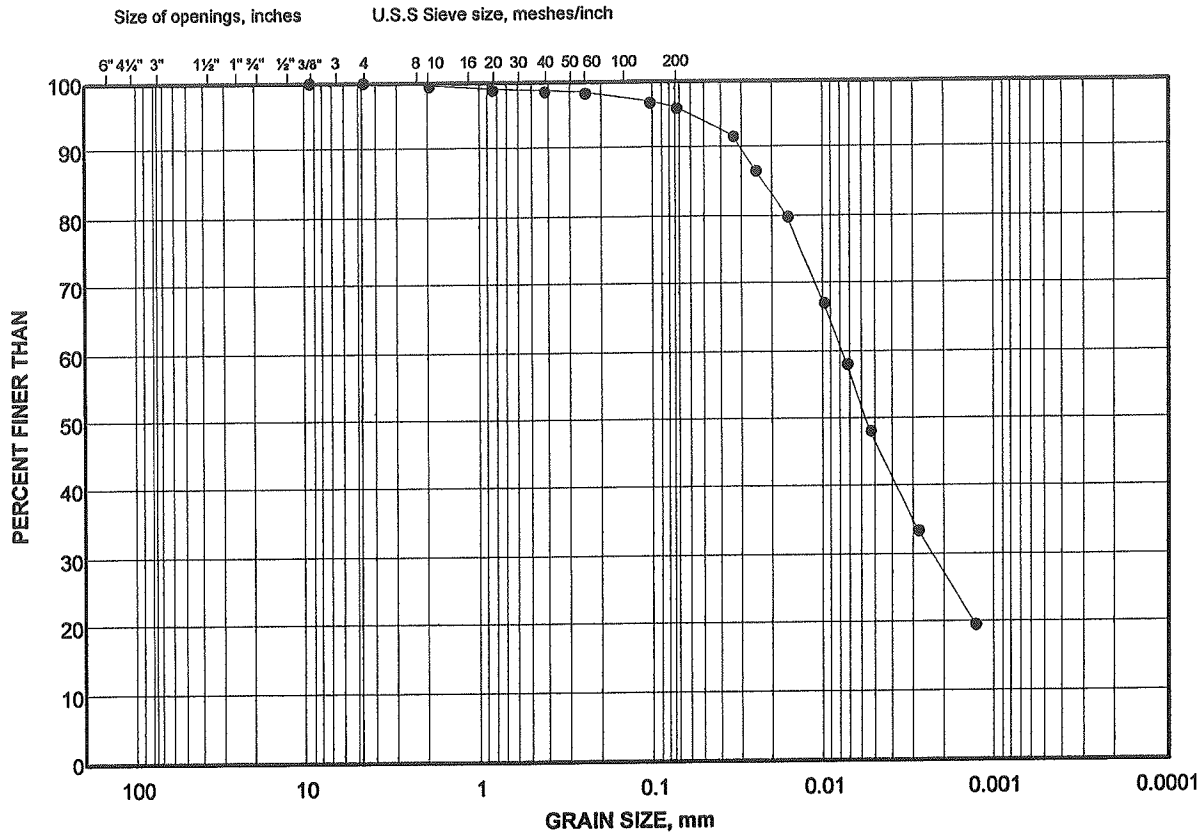


Project No.12-1183-0048

Checked By:

GRAIN SIZE DISTRIBUTION

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	12-3	ST-22	15.80 - 16.50

Project Number: 12-1183-0048

Checked By: _____

Golder Associates

Date: 09-May-12

CONSOLIDATION TEST SUMMARY

FIGURE

SAMPLE IDENTIFICATION

Project Number	12-1183-0048	Sample Number	ST-7
Borehole Number	12-5	Sample Depth, m	4.4-5.0

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	7		
Date Started	4/23/2012		
Date Completed	5/08/2012		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.89	Unit Weight, kN/m^3	18.45
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	13.66
Area, cm^2	31.48	Specific Gravity, measured	2.75
Volume, cm^3	59.59	Solids Height, cm	0.959
Water Content, %	35.04	Volume of Solids, cm^3	30.19
Wet Mass, g	112.10	Volume of Voids, cm^3	29.41
Dry Mass, g	83.01	Degree of Saturation, %	98.9

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	c_v cm^2/s	m_v m^2/kN	k cm/s
0.00	1.893	0.974	1.893				
5.94	1.887	0.968	1.890	375	2.02E-03	5.25E-04	1.04E-07
10.65	1.881	0.962	1.884	227	3.32E-03	6.62E-04	2.15E-07
20.60	1.862	0.942	1.872	360	2.06E-03	1.02E-03	2.06E-07
39.95	1.835	0.914	1.849	359	2.02E-03	7.29E-04	1.44E-07
78.94	1.781	0.857	1.808	577	1.20E-03	7.42E-04	8.74E-08
156.70	1.695	0.767	1.738	634	1.01E-03	5.83E-04	5.77E-08
312.34	1.604	0.672	1.649	581	9.92E-04	3.09E-04	3.00E-08
623.38	1.518	0.583	1.561	894	5.78E-04	1.46E-04	8.28E-09
1246.39	1.438	0.499	1.478	427	1.08E-03	6.77E-05	7.19E-09
2490.46	1.364	0.423	1.401	409	1.02E-03	3.12E-05	3.11E-09
1246.39	1.373	0.432	1.369				
312.34	1.384	0.443	1.379				
78.94	1.406	0.467	1.395				
20.60	1.445	0.507	1.426				
5.94	1.473	0.537	1.459				

Note:
k calculated using cv based on t_{90} values.
Specimen taken 28cm from bottom of the tube.
Loading stages assigned by the client.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.47	Unit Weight, kN/m^3	21.30
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	17.55
Area, cm^2	31.48	Specific Gravity, measured	2.75
Volume, cm^3	46.38	Solids Height, cm	0.959
Water Content, %	21.38	Volume of Solids, cm^3	30.19
Wet Mass, g	100.76	Volume of Voids, cm^3	16.20
Dry Mass, g	83.01		

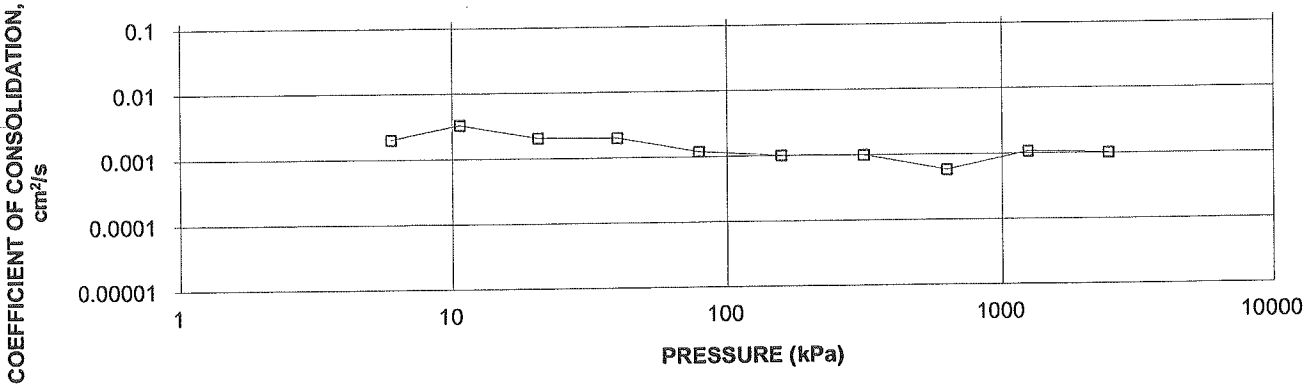
Prepared By: LFG

Golder Associates

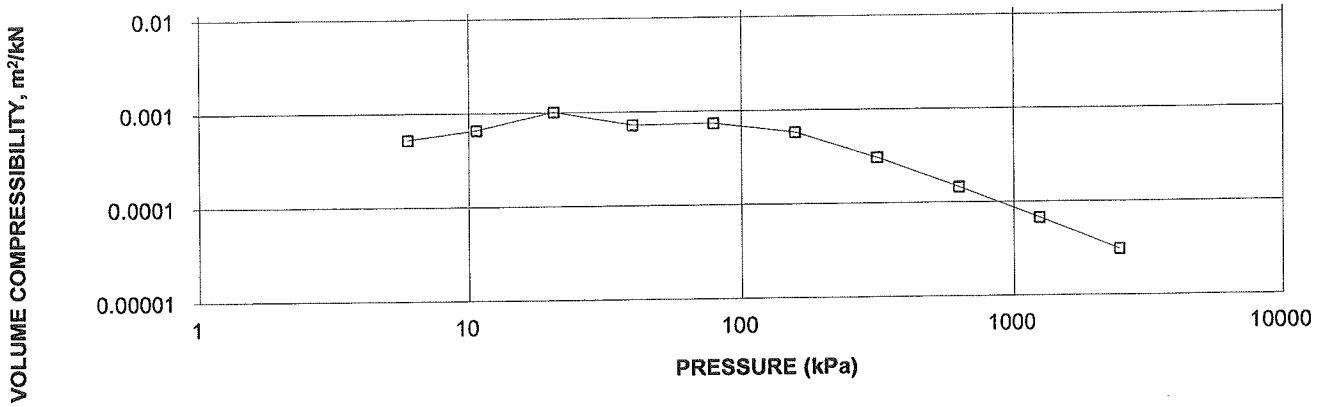
Checked By: MM

CONSOLIDATION TEST SUMMARY	FIGURE

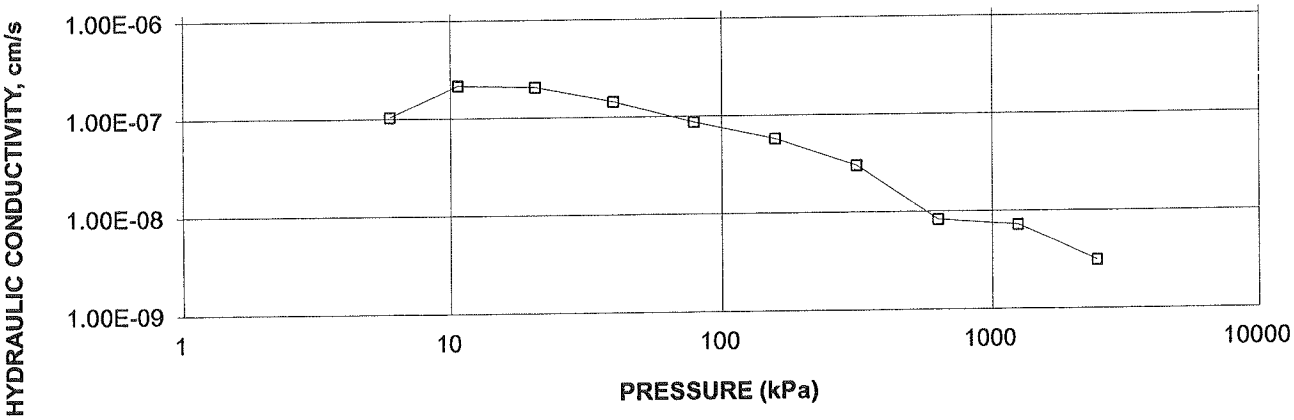
CONSOLIDATION TEST
C_V cm²/s VS PRESSURE (kPa)
BH 12-5 ST-7



CONSOLIDATION TEST
M_V m²/kN vs PRESSURE (kPa)
BH 12-5 ST-7



CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs PRESSURE
BH 12-5 ST-7

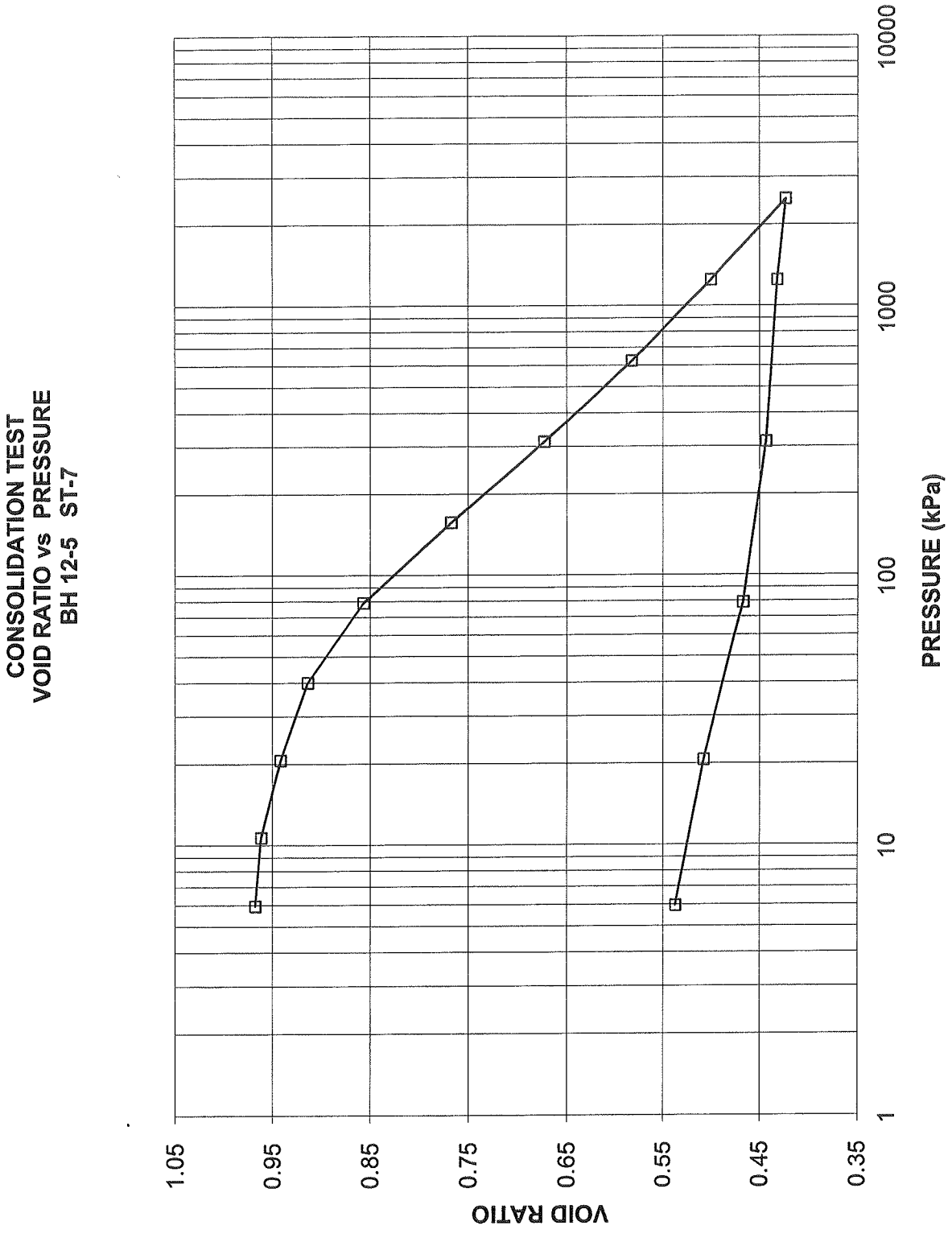


Project No. 12-1183-0048
Prepared By: LFG

Golder Associates

Checked By: MH

CONSOLIDATION TEST VOID RATIO VS LOG PRESSURE	FIGURE



Project No. 12-1183-0048

Prepared By: LFG

Golder Associates

Checked By:

UNCONFINED COMPRESSION TEST (UC)

ASTM D 2166 - 06

SAMPLE IDENTIFICATION

PROJECT NUMBER	12-1183-0048	SAMPLE NUMBER	ST-7
BOREHOLE NUMBER	12-5	SAMPLE DEPTH, m	4.40-5.00

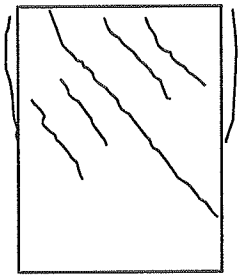
TEST CONDITIONS

MACHINE SPEED, mm/min	1.42	TYPE OF SPECIMEN	Thin wall tube sample
RATE OF AXIAL STRAIN, %/min	1.02	L/D	2.03

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	13.93	WATER CONTENT, (specimen) %	35.67
SAMPLE DIAMETER, cm	6.87	UNIT WEIGHT, kN/m^3	18.77
SAMPLE AREA, cm^2	37.09	DRY UNIT WT., kN/m^3	13.84
SAMPLE VOLUME, cm^3	516.66	SPECIFIC GRAVITY, measured	2.75
WET WEIGHT, g	989.30	VOID RATIO	0.95
DRY WEIGHT, g	729.18		

FAILURE SKETCH



TEST RESULTS

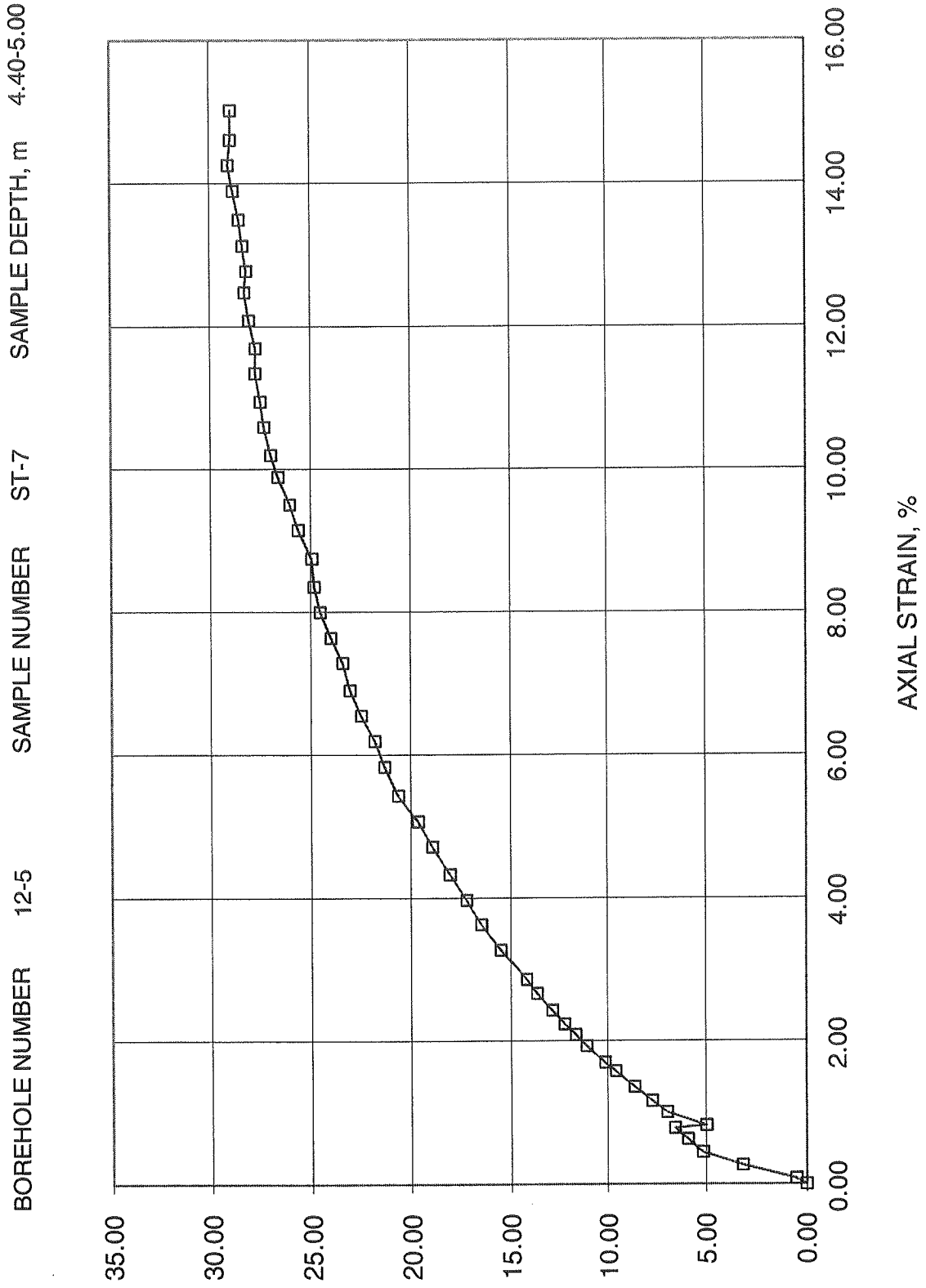
STRAIN AT FAILURE, %	14.3	COMPRESSIVE STRESS, kPa	29

REMARKS: Specimen taken 33cm from bottom of the tube. DATE: 04/24/2012

Checked By: MM

Golder Associates

UNCONFINED COMPRESSION TEST (UC)	FIGURE

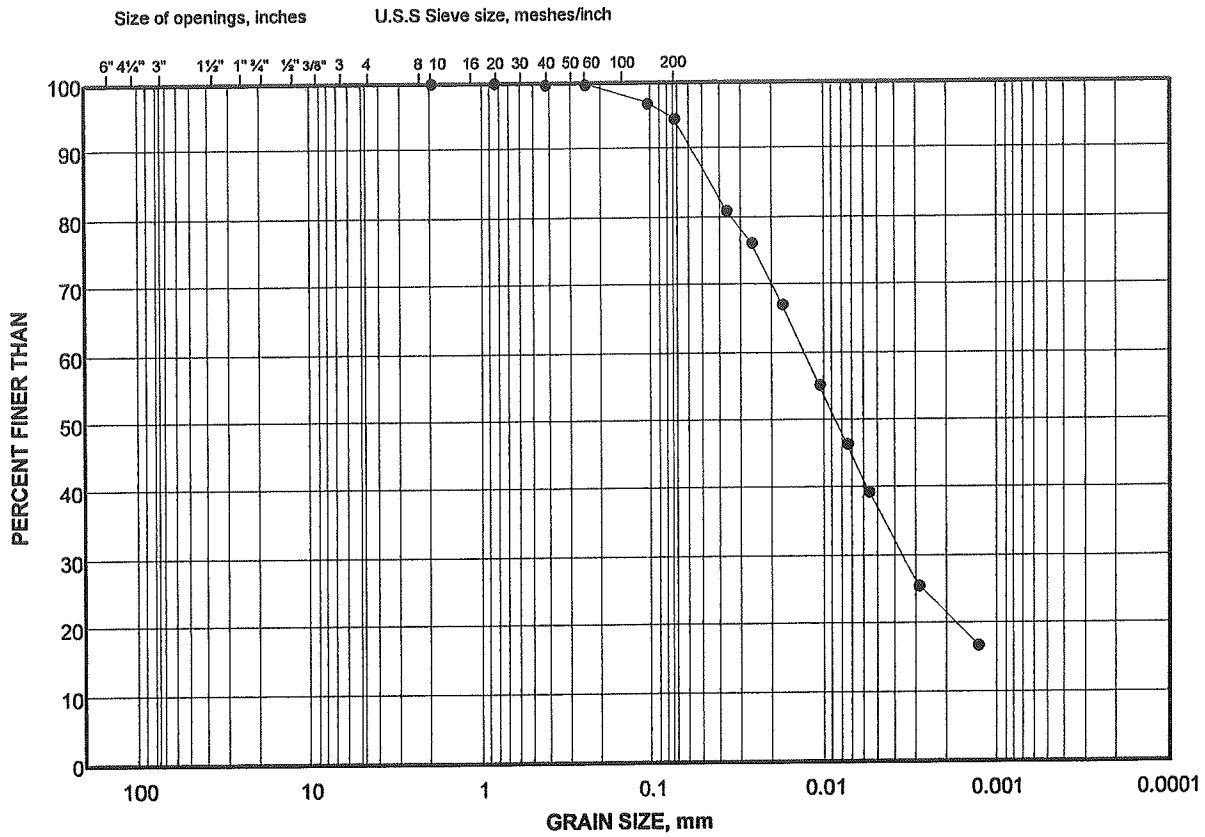


Project No.12-1183-0048

Checked By:

GRAIN SIZE DISTRIBUTION

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	12-5	ST-7	4.40 - 5.00

Project Number: 12-1183-0048

Checked By: _____

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Date: 09-May-12

SPECIFIC GRAVITY TEST RESULTS

ASTM D 854-06 TEST METHOD A

PROJECT NUMBER	12-1183-0048
PROJECT NAME	Stantec / Testing / 165000801
DATE TESTED	May, 2012

Borehole No.	Sample No.	Specific Gravity
12-3	ST-22	2.77
12-5	ST-7	2.75

Note: Test carried out on soil particles <2.00mm using distilled water.

Checked By: MM

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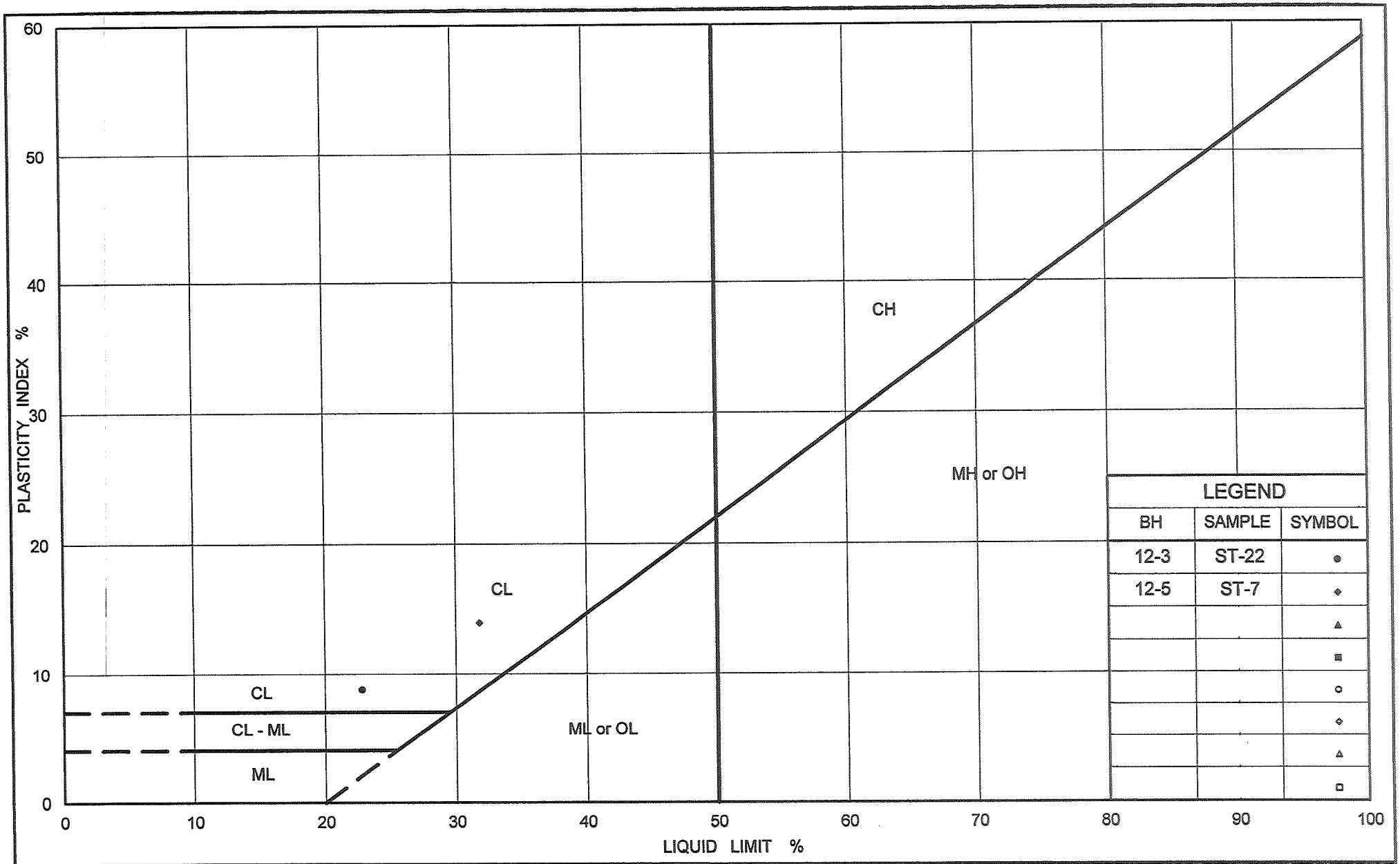

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PLASTICITY CHART

Figure No.

Project No. 12-1183-0048

Checked By: MM