

Golder Associates Ltd.

2390 Argentia Road
Mississauga, Ontario, Canada L5N 5Z7
Telephone: (905) 567-4444
Fax: (905) 567-6561



**FOUNDATION INVESTIGATION REPORT
RETAINING WALLS AND RSS SLOPES
QEW WIDENING FROM HIGHWAY 406
TO GARDEN CITY SKYWAY
ST. CATHARINES, ONTARIO
G.W.P. 607-00-00**

Submitted to:

Morrison Hershfield
235 Yorkland Boulevard, Suite 600
Toronto, Ontario
M2J 1T1

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services associated with the widening of the Queen Elizabeth Way (QEW) between Highway 406 and the Garden City Skyway in the City of St. Catharines, in the Region of Niagara. Foundation engineering services are required for the widening or replacement of five structures (Third Street overpass, Martindale Road underpass, Lake Street underpass, Geneva Street overpass, and Welland Avenue overpass), new retaining walls and noise barrier walls, culvert extensions, and high mast light poles.

This report addresses the foundation investigation carried out for the design of retaining walls west and east of the Geneva Street overpass structure, retaining walls east of Martindale Road along the south side of the QEW, and retained soil system (RSS) slopes to the west and east of the Welland Avenue overpass structure.

The terms of reference and scope of work for the foundation investigation are outlined in MTO's Request for Proposal for Agreement No. 2005-A-000564, issued in July 2002, and in Section 6.8 of MH's *Technical Proposal* for G.W.P. 607-00-00.

2.0 SITE DESCRIPTION

The proposed retaining walls or reinforced soil slopes extend along the north and south side of the QEW in the vicinity of the Geneva Street and Welland Avenue overpasses, and along the south side of the QEW east of Martindale Road, in the City of St. Catharines, in the Region of Niagara.

Throughout the study area, the QEW runs roughly parallel to and north of (below) the Niagara escarpment, and sub-parallel to and south of Lake Ontario; the highway is located closer to the lake near the western portion of the study area, and trends away from the lake toward the eastern portion of the study area. The overall surface topography in the City of St. Catharines is relatively flat-lying, with a gentle slope downward to the north towards Lake Ontario. The surrounding area is occupied by commercial and residential property developments.

East of Martindale Road, the QEW has been constructed in a cut with the QEW pavement grade at about Elevation 90 m to 90.5 m, approximately 2 m to 3 m below the natural ground surface which is at about Elevation 92 m to 93 m. The existing cut slope separating the QEW from the natural ground surface to the south is oriented at approximately 2 horizontal to 1 vertical.

The natural ground surface in the vicinity of the Geneva Street overpass is at about Elevation 99 m to 100 m, Geneva Street and other local roads are at about Elevation 100 m, and the existing QEW grade has a maximum elevation of approximately 106 m at the existing overpass. The natural ground surface around the Welland Avenue structure site is at about Elevation 100 m to 101 m, and the existing QEW grade has a maximum elevation of approximately 108 m as it crosses Welland Avenue, which is at an elevation of about 101.5 m. In the vicinity of both the Geneva Street and Welland Avenue overpass sites, the QEW embankment is up to about 6 m in height and is sloped at approximately 2 horizontal to 1 vertical along the north and south sides of the QEW. Existing concrete retaining walls, approximately 2 m to 4 m in height, are present along both sides of the QEW, separating the QEW embankment from the adjacent local roads.

3.0 INVESTIGATION PROCEDURES

Subsurface investigations were carried out in June and July 2005 and November 2006, during which time thirty-one boreholes (Boreholes 06-1, 06-2, W-33 to W-45, W-51 to W-55, W-63 to W-66, W-69 to W-73, W-76 and W-77) were advanced as part of the foundation investigation for the proposed retaining walls. Use has also been made of selected boreholes advanced as part of Golder's investigations for the Martindale Road underpass structure site (Borehole 207) in November 2004, the Geneva Street overpass structure site (Boreholes 401 to 406) in June and July 2005, and for the Welland Avenue overpass structure site (Boreholes 501 to 507) in December 2004. In addition, use has been made of boreholes advanced along the QEW near Geneva Street as part of a 1955 investigation by the Department of Highways, Ontario (MTO GEOCREs No. 30M3-29, titled "Foundation Investigation Report for the Geneva Street Overpass, MTO Project F-55-16", dated 1955). The borehole locations are shown on the Borehole Location and Soil Strata drawings contained in the Contract Documents.

The field investigation was carried out using truck-mounted and track-mounted drill rigs supplied and operated by Walker Drilling Ltd. of Utopia, Ontario. The boreholes were advanced using solid stem or hollow stem augers, to depths ranging from 5.2 m to 15.9 m for boreholes advanced along the retaining wall alignments, and to depths ranging from 6.7 m to 36.7 m below the ground surface for boreholes advanced at the overpass/underpass structure sites.

Soil samples were obtained at 0.75 m to 3 m intervals of depth, using 50 mm outside diameter split-spoon samplers driven by an automatic hammer, in accordance with the Standard Penetration Test (SPT) procedure. In-situ vane testing (using an MTO "N"-sized vane) was carried out at selected depths where firm to stiff cohesive soils were encountered, and relatively undisturbed, thin-walled Shelby tube samples of these materials were obtained.

The groundwater conditions in the open boreholes were observed throughout the drilling operations, and piezometers were installed in seven selected boreholes to permit monitoring of the groundwater level at these locations. The piezometers consist of 50 mm outside diameter rigid PVC tubing with a 1.5 m long screen that is sealed at a selected depth within the boreholes (typically within the clayey silt to silty clay till deposit); the piezometer tip and filter sand pack were backfilled to ground surface using bentonite pellets. All other boreholes were backfilled to ground surface using bentonite pellets on completion of drilling.

The field work was supervised on a full-time basis by a member of Golder's technical staff who located the boreholes in the field, arranged for the clearance of underground service locations, directed the drilling, sampling, and in situ testing operations, and logged the boreholes. The soil samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Mississauga for further examination and testing. Index and classification tests consisting of water content determinations, Atterberg limits testing, and grain size distribution analyses were carried out on selected soil samples, and oedometer (consolidation) testing was conducted on one sample from the Welland Avenue site.

The borehole locations and ground surface elevations were measured by Golder personnel relative to site features and survey stakes placed by MH. The borehole locations (MTM NAD83 northing and easting coordinates) and the ground surface elevations (referenced to geodetic datum) at the borehole locations are presented on the Record of Borehole sheets that follow the text of this report, and on the Borehole Location and Soil Strata drawings contained in the Contract Documents.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

This area of the QEW lies within the Iroquois Plain physiographic region, as delineated in *The Physiography of Southern Ontario*¹ and *Urban Geology of Canadian Cities*².

The Iroquois Plain extends around the western shores of Lake Ontario; on the south side of the lake, in the St. Catharines area, the Plain is located between the present Lake Ontario shorebluffs and the foot of the Niagara Escarpment. The Plain is comprised of the flat to undulating lake bed and beaches of the former glacial Lake Iroquois, which occupied this area during the last glacial recession.

The surficial soils in the Iroquois Plain are typically comprised of glaciolacustrine clays and silts. However, in the St. Catharines area, surficial deposits of beach sand and gravel are present. The surficial sands, silts and clays are underlain by an extensive till deposit; portions of the till are considered to be “water-lain” (that is, formed by sediment rain-out either from a floating ice margin or from iceberg dumping), resulting in a predominantly massive, matrix-supported structure, as well as relatively thin sand to silt stringers or interlayers. This extensive till deposit may be underlain by or interlayered with a lower glaciolacustrine clay deposit, although this glaciolacustrine layer is absent in some portions of the Iroquois Plain in the St. Catharines area. Finally, the till and/or glaciolacustrine layer may be underlain by a lower till unit, that typically has increasing gravel content with proximity to the underlying bedrock (Menzies and Taylor, 1998).

The overburden soils are underlain by red shale bedrock of the Queenston Formation. This shale formation contains siltstone interlayers as well as “occasional patches of gypsum” (Menzies and Taylor, 1998).

4.2 Subsoil Conditions

Thirty-one boreholes were advanced along the proposed retaining wall alignments, and these have been supplemented by fourteen boreholes advanced as part of the foundation investigations at the Martindale Road underpass, Geneva Street overpass and Welland Avenue overpass sites. The locations of these boreholes, in addition to boreholes advanced as part of a 1955 investigation near Geneva Street, are shown on the Borehole Location and Soil Strata drawings contained in the Contract Documents.

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

² J. Menzies and E.M. Taylor. “Urban Geology of St. Catharines-Niagara Falls, Region Niagara”. In *Urban Geology of Canadian Cities*, Geological Association of Canada Special Paper 42, Ed. P.F. Karrow and O.L. White, 1998.

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected soil samples, are given on the attached Record of Borehole sheets following the text of this report and on Figures 1A to 11. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests (SPTs). These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Subsurface conditions will vary between and beyond the borehole locations.

In general, the subsoil conditions consist of fill materials associated with embankments for the QEW and local roads, overlying a thick deposit of clayey silt to silty clay till of firm to hard consistency. Relatively thin surficial deposits of silty sand to sandy silt and clayey silt to silty clay were encountered in some of the boreholes overlying the till deposit. In the deeper boreholes, the clayey silt to silty clay till was underlain by dense to very dense gravelly sand to silt and residual soil deposits.

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

4.2.1 Topsoil

About 100 mm of topsoil was encountered at the ground surface in Boreholes 405, 501, 502 and 503, which were advanced in landscaped areas near the Geneva Street and Welland Avenue sites.

4.2.2 Asphalt and Fill Materials

Asphalt, approximately 100 mm to 200 mm in thickness, was encountered at the ground surface in all of the boreholes advanced through the QEW or local road pavements.

Fill materials were encountered below the topsoil or asphalt, and were encountered immediately below the ground surface in all of the remaining boreholes, which were advanced through unpaved road shoulders.

The fill material encountered in boreholes near Martindale Road varies from about 0.8 m in thickness along the QEW shoulder, up to about 2.6 m in thickness at the Martindale Road embankment. The fill material encountered in boreholes near Geneva Street varies from about 4.1 m to 9.1 m in thickness for boreholes advanced through the QEW embankment, and from about 0.8 m to 1.8 m in thickness in boreholes advanced at the toe of the QEW embankment/retaining walls, adjacent to the local roads. The fill material encountered in boreholes near Welland Avenue varies from about 4.6 m to 7.6 m in thickness for boreholes advanced through the QEW embankment, and from about 0.6 m to 1.5 m in thickness for boreholes advanced at the toe of the QEW embankment, adjacent to the local roads.

The existing fill materials vary in composition from sand to sand and gravel or crushed limestone, clayey silt to silty clay, and foundry sand. A 150 mm to 200 mm thick layer of concrete was encountered in Boreholes W-37, W-42 and W-54, within or at the base of the fill material. The results of grain size distribution testing carried out on thirteen selected samples of the fill are shown on Figures 1A and 1B.

Atterberg limits testing was carried out on five selected samples of the cohesive fill, and measured plastic limits of 14 to 18 per cent, liquid limits of 25 to 35 per cent, and plasticity indices of 11 to 18 per cent. These results, which are plotted on a plasticity chart on figure 2, indicate that the tested fill materials are comprised of clayey silt of low plasticity.

The SPT “N” values measured within the cohesionless fill ranged from 4 to 70 blows per 0.3 m of penetration, indicating that the fill has a variable, loose to very dense relative density. The layers of foundry sand that were encountered within the QEW embankment fill in some boreholes yielded SPT “N” values ranging from 10 to 107 blows per 0.3 m of penetration, indicating that this portion of the fill has a compact to very dense, and generally very dense, relative density. The measured SPT “N” values within the cohesive fill ranged from 6 to 32 blows per 0.3 m of penetration, indicating that the clayey silt fill has a variable, firm to hard consistency.

4.2.3 Surficial Silty Sand to Sandy Silt

Surficial deposits of cohesionless soil were encountered in some of the boreholes (Borehole 207 near Martindale Road, and Boreholes 403, 406, W-36, W-39, W-41, W-44, W-45, W-53 and W-54 near Geneva Street), generally below the topsoil or fill and on top of the clayey silt to silty clay till deposit. Where encountered, the surficial cohesionless deposits varied from approximately 0.2 m to 2 m in thickness.

The surficial cohesionless soils vary in composition from silty sand to sandy silt containing trace to some gravel; silty clay seams were observed within the deposit at some locations. The results of grain size distribution tests conducted on four selected samples of the surficial silty sand to sandy silt are shown on Figure 3; on this figure, the result for Borehole 207, Sample 4 demonstrates the presence of silty clay seams within the deposit. In addition, organic matter, rootlets and wood fragments were observed in recovered samples of the surficial silty sand to sandy silt.

The measured SPT “N” values ranged from 7 to 21 blows per 0.3 m of penetration, indicating that the surficial silty sand to sandy silt has a loose to compact relative density.

4.2.4 Surficial Clayey Silt to Silty Clay

Surficial layers of cohesive soil were encountered in some of the boreholes (Boreholes 405, W-35, W-38 and W-41 near Geneva Street, and Borehole W-72 near Welland Avenue) below the topsoil or fill, and on top of the clayey silt to silty clay till deposit. Where encountered as part of this investigation, the surficial cohesive soils varied from about 0.7 m to 1.5 m in thickness.

The surficial cohesive soils vary in composition from clayey silt to silty clay containing trace to some sand, trace gravel, and trace quantities of organic material. The result of a grain size distribution test conducted on one sample of the surficial clayey silt to silty clay is shown on Figure 4. Atterberg limits testing was carried out on one sample of the surficial soil, and measured a plastic limit of 18 per cent, a liquid limit of 29 per cent, and a plasticity index of 11 per cent; this result, which is plotted on a plasticity chart on Figure 5, indicates that the tested material is a clayey silt of low plasticity.

The SPT “N” values measured within the surficial clayey silt to silty clay deposit range from 4 to 25 blows (but typically 4 to 6 blows) per 0.3 m of penetration, indicating that the deposit has a firm to very stiff, but typically firm, consistency.

4.2.5 Clayey Silt to Silty Clay Till

An extensive till deposit was encountered beneath the topsoil, fill and surficial soil deposits, where present, in all of the boreholes. The surface of this deposit was encountered at a depth of 0.6 m to 2.3 m below the ground surface in boreholes advanced near the local road grade, and at a depth of 6.1 m to 9.4 m below the ground surface in boreholes advanced through the QEW embankments near Geneva Street and Welland Avenue. All of the W-series boreholes were terminated within the till deposit; where fully penetrated in the 200-, 400- and 500-series boreholes, the till deposit is greater than 20 m in thickness.

The till consists of brown to grey clayey silt to silty clay, containing trace to some sand and gravel/shale fragments. Seams of silt and sandy silt have been noted within some of the recovered till samples. Interlayers of moist to wet silty sand to sand and silt were encountered within the clayey silt to silty clay till in Boreholes 207, W-42 and W-45; these interlayers vary from 0.2 m to 3 m in thickness. The results of grain size distribution testing completed on twenty-four selected samples of the clayey silt to silty clay till are shown on Figure 6A to 6C. Although boulders and cobbles were not encountered within the deposit in the boreholes advanced as part of this investigation, the deposit is glacially-derived and may contain cobbles and boulders.

Atterberg limit testing was carried out on eighty-four samples of the till deposit; the results, which are plotted on plasticity charts on Figures 7A to 7F, confirm that the till material grades from a low plasticity clayey silt to an intermediate plasticity silty clay. In general, the till in the

vicinity of Martindale Road consists of lower plasticity clayey silt, grading toward the east to an intermediate plasticity silty clay in the vicinity of Welland Avenue.

The till deposit has a generally stiff to hard consistency, with measured SPT “N” values in the upper portion of the till ranging from 10 to 40 blows per 0.3 m of penetration, and measured SPT “N” values in the lower portion of the till ranging from 15 to greater than 100 blows per 0.3 m of penetration; these SPT “N” values are indicative of a stiff to hard consistency. A thin layer, about 1 m in thickness, of firm till is present immediately below the fill or surficial deposits in some of the boreholes, and a zone of firm to stiff soil is present within the till deposit near Geneva Street and Welland Avenue, as follows:

- In the vicinity of the Geneva Street overpass, the zone of firm to stiff till ranges in thickness between 1.5 m and 8.5 m where fully penetrated. The surface of the firm to stiff till was encountered below approximately Elevation 88.2 m and 82.2 m in the majority of the boreholes in this area, but is as high as Elevation 99.5 m in Borehole W-45 east of Geneva Street.
- In the vicinity of the Welland Avenue overpass, the surface of the firm to stiff till zone was encountered between about Elevation 96.0 m and 88.0 m, and the base (where fully penetrated) was encountered between about Elevation 84.0 m and 82.0 m. The zone of firm to stiff till varies in thickness between about 4.0 m and 14.0 m where this zone was fully penetrated.

The measured SPT “N” values within the firm to stiff zones of the till deposit range from 6 to 12 blows per 0.3 m of penetration, and field vane tests in this zone measured undrained shear strengths of approximately 45 kPa to 100 kPa, with the higher vane shear strengths typically associated with the top or bottom of the “softened” zone, close to the interfaces with the overlying or underlying stiffer soils. These results confirm that the “softened” zone within the till has a firm to stiff consistency.

An oedometer test was conducted on a sample of the firm to stiff till from Borehole 503 near Welland Avenue, and measured a preconsolidation pressure of approximately 250 kPa. The oedometer test results are present on Figures 8A to 8D, and are summarized in the following table:

Borehole/ Sample No.	Sample Depth/Elev.	Unit Wt. (kN/m ³)	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	C_c	C_r	e_o	OCR
503 / 10	9.4 m / 92.0 m	19.8	185	255	70	0.32	0.04	0.75	1.4

NOTES:

σ_p'	Apparent preconsolidation pressure	σ_{vo}'	Computed existing vertical effective stress
C_c	Compression index	C_r	Recompression index
e_o	Initial void ratio	OCR	Overconsolidation ratio

4.2.6 Lower Gravelly Sand to Silt

In the vicinity of Welland Avenue, a cohesionless soil deposit is present below the clayey silt till deposit. The surface of the cohesionless soil was encountered in Boreholes 502, 503 and 505 between Elevations 75.3 m and 77.0 m (at depths of between 24.4 m and 25.9 m below the Welland Avenue grade). All of the boreholes were terminated within this deposit; the deposit has a minimum thickness of 4.7 m to 4.8 m at these locations.

The deposit varies in composition from silty sand containing trace gravel/shale fragments, gravelly sand containing some silt, to silt containing trace to some sand, trace gravel and clay; clayey silt seams were noted within a sandy silt portion of this deposit, as encountered in Borehole 503. The results of grain size distribution tests completed on two selected samples of this lower gravelly sand to silt deposit are shown on Figure 9.

The SPT “N” values measured within the lower gravelly sand to silt deposit range from 33 to greater than 100 blows per 0.3 m of penetration, indicative of a dense to very dense relative density. Typically, the lower SPT “N” values (33 to 82 blows per 0.3 m of penetration) were encountered in the upper 1 m to 1.5 m of the deposit; the surface of the “100-blow” material was encountered in the boreholes between approximately Elevations 75.5 m and 74 m.

4.2.7 Lower Till/Residual Soil

In the vicinity of Geneva Street and Martindale Road, a till/residual soil deposit was encountered below the clayey silt to silty clay till. The surface of the till/residual soil was encountered between Elevations 72.3 m and 77.7 m (about 28.3 m to 33.5 m below the QEW grade) in Boreholes 401 to 404 near Geneva Street, and at about Elevation 70.6 m (a depth of approximately 24.5 m) in Borehole 207 near Martindale Road.

The till/residual soil deposit varies in composition from clayey silt with sand, to silty sand or sand and silt, containing trace gravel, shale and limestone fragments. The results of grain size distribution testing conducted on two samples of this deposit are shown on Figure 10. Atterberg limits testing was carried out on five samples of the cohesive lower till/residual soil, and measured plastic limits between 12 and 16 per cent, liquid limits between 18 and 22 per cent, and plasticity indices between 6 and 8 per cent. These results, which are plotted on a plasticity chart on Figure 11, confirm that the cohesive portion of the lower till/residual soil is a clayey silt of low plasticity.

The measured SPT “N” values within the residual soil range from 81 to greater than 100 blows, but are generally greater than 100 blows per 0.3 m of penetration, indicating that this deposit has a hard consistency.

4.2.8 Bedrock

Bedrock was encountered near Geneva Street in Borehole 403, where it was observed in a split- spoon sample. The surface of the bedrock was encountered in this borehole at about Elevation 70.8 m (at a depth of approximately 35.1 m below the QEW grade).

The bedrock observed in the sample consists of red shale of the Queenston Formation. Although not noted in the split-spoon sample collected, interlayers of strong limestone and siltstone are anticipated to be present within the Queenston Formation shale bedrock.

4.3 Groundwater Conditions

The water levels were noted during and after the drilling operations in the open boreholes. Typically, the open boreholes were dry upon completion of drilling. However, the surficial silty sand to sandy silt soils (where present) may be water-bearing, with water “perched” on top of the underlying, less permeable clayey silt to silty clay till deposit. Water may also be present at the base of cohesionless fill materials, again “perched” on top of the underlying clayey silt to silty clay till deposit.

Piezometers were installed in seven boreholes, sealed within the clayey silt till or the lower gravelly sand to silt deposit (where present near Welland Avenue). Details of the piezometer installations are shown in the Record of Borehole Sheets and in Appendix A following the text of this report. The water levels measured in the piezometers are summarized in the following table; it is noted that the groundwater levels will be subject to seasonal variations, and will rise during wet periods of the year.

<i>Borehole No.</i>	<i>Ground Surface Elevation</i>	<i>Water Level Depth</i>	<i>Water Level Elevation</i>	<i>Date</i>
207	95.1 m	13.9 m	81.3 m	November 26, 2004
		13.2 m	81.9 m	May 13, 2005
		13.4 m	81.7 m	December 6, 2005
405	100.0 m	2.8 m	97.2 m	August 8, 2005
		0.6 m	99.4 m	December 6, 2005
503	101.4 m	13.7 m	87.7 m	December 20, 2004
		11.6 m	90.2 m	May 13, 2005
		11.6 m	90.2 m	December 6, 2005
507	101.5 m	6.0 m	95.5 m	December 20, 2004
		1.6 m	99.9 m	May 13, 2005
		1.9 m	99.6 m	December 6, 2005
W-39	99.5 m	1.5 m	98.0 m	August 8, 2005
		0.9 m	98.6 m	December 6, 2005
W-65	101.2 m	4.2 m	97.0 m	August 8, 2005
		1.2 m	100.0 m	December 6, 2005
W-77	101.4 m	3.2 m	98.2 m	August 8, 2005
		1.1 m	100.3 m	December 6, 2005

In the vicinity of Geneva Street and Welland Avenue, the measured water level in piezometers sealed within the till deposit is typically between 0.6 m and 1.6 m below the ground surface; the water level typically varies from about Elevation 98.6 m and 100.3 m across this area. The water level measurement in the piezometer sealed within the lower gravelly sand to silt deposit in Borehole 503 near Welland Avenue is lower, at about 11.6 m depth or Elevation 90.2 m, indicative of a downward hydraulic gradient through the till in this area.

The water level in the vicinity of Martindale Road (immediately to the west of Martindale Pond), is also lower, at about Elevation 81.5 m to 82 m (about 13 m to 13.5 m deep relative to the natural ground surface), as measured in piezometers sealed within the lower till/residual soil deposit.

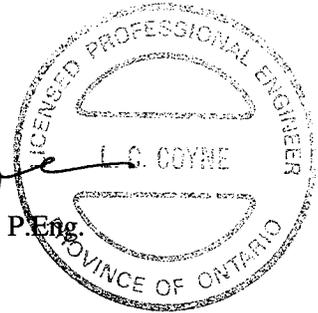
5.0 CLOSURE

This Foundation Investigation Report was prepared by Ms. Houda Jadi, P.Eng., and reviewed by Ms. Lisa Coyne, P.Eng., an Associate and Geotechnical Engineer with Golder. Mr. Fin Heffernan, P.Eng., a Designated MTO Contact for Golder, carried out an independent review of the report.

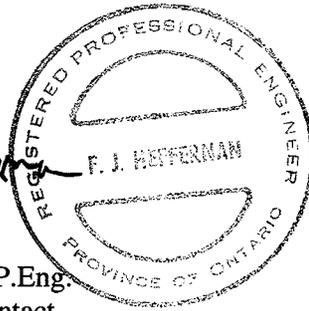
GOLDER ASSOCIATES LTD.



Houda Jadi, P.Eng.
Geotechnical Engineer


Lisa C. Coyne, P.Eng.
Associate

Fintan J. Heffernan, P.Eng.
Designated MTO Contact



HJ/LCC/FJH/hj/lcc

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LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

III. SOIL DESCRIPTION

(a) Cohesionless Soils

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

(b) Cohesive Soils

Consistency

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

Dynamic Cone Penetration Resistance; N_d :

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

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

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

IV. SOIL TESTS

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

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

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LIST OF SYMBOLS

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

I. General

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
ν	poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (continued)

w	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p)/I_p$
I_C	consistency index = $(w_l - w)/I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

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

- Notes:**
- 1 $\tau = c' + \sigma' \tan \phi'$
 - 2 shear strength = (compressive strength)/2
 - * density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

PROJECT 04-1111-002 **RECORD OF BOREHOLE No 06-01** **1 OF 1 METRIC**
W.P. 607-00-00 **LOCATION** N 4782000.0 ; E 323054.2 **ORIGINATED BY** PKS
DIST Central **HWY** QEW **BOREHOLE TYPE** 108 mm Diameter Solid Stem Augers **COMPILED BY** MSM
DATUM Geodetic **DATE** November 26, 2006 **CHECKED BY** LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
90.2	GROUND SURFACE																						
0.0	ASPHALT																						
0.2	Sand and gravel (FILL) Compact		1	AS																			
89.4	Brown Moist																						
0.8	CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to hard Grey Moist		2	SS	7																		
			3	SS	14																		
			4	SS	14																		
			5	SS	13																		
			6	SS	15																		
			7	SS	18																		
			8	SS	24																		
			9	SS	54																		
			10	SS	38																		
			11	SS	20																		
			12	SS	25																		
77.4	END OF BOREHOLE																						
12.8	Note: 1. Borehole dry upon completion of drilling operations.																						

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No 06-02 1 OF 1 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4782017.2; E 323101.7 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY MSM

DATUM Geodetic DATE November 26, 2006 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						WATER CONTENT (%)			
						20	40	60	80	100	10	20	30	GR	SA	SI	CL
90.4	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand and gravel (FILL) Compact		1	SS	9												
89.6	Brown Moist																
0.8	CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to hard Grey Moist		2	SS	19												
			3	SS	12									0	13	57	30
			4	SS	12												
			5	SS	13												
			6	SS	13												
			7	SS	11									1	13	56	30
			8	SS	25												
			9	SS	30									1	7	67	25
			10	SS	24												
			11	SS	27												
			12	SS	24												
77.6	END OF BOREHOLE																
12.8	Note: 1. Borehole dry upon completion of drilling operations.																

MIS-MTO 001 04111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No 207 2 OF 3 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781962.5 ; E 323012.9 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY BLT

DATUM Geodetic DATE November 11, 12, 2004 CHECKED BY ASP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
--- CONTINUED FROM PREVIOUS PAGE ---																
	CLAYEY SILT, some sand, trace to some gravel, containing sand/silt seams (TILL) Stiff to hard Greyish brown to grey Moist to wet	[Hatched pattern]	14	SS	29											
		[Hatched pattern]	15	SS	30											
		[Hatched pattern]	16	SS	12											
		[Hatched pattern]	17	SS	10											
73.8		[Hatched pattern]														
21.2	Sandy SILT Compact Grey Wet	[Dotted pattern]	18	SS	18											
72.2		[Dotted pattern]														
22.9	Silty SAND, some gravel Compact to dense Grey/red Wet	[Dotted pattern]	19	SS	30											
70.8		[Dotted pattern]														
24.5	CLAYEY SILT, some sand, trace gravel Hard Grey	[Hatched pattern]	20	SS	100/18											
	Silty SAND, trace gravel (TILL/RESIDUAL SOIL) Very dense Red Wet	[Dotted pattern]														
69.2		[Dotted pattern]														
25.9	CLAYEY SILT, some sand, trace gravel and shale pieces (TILL/RESIDUAL SOIL) Hard Red Moist	[Hatched pattern]	21	SS	100/13											
67.7		[Hatched pattern]														
27.6	Silty SAND, trace gravel, containing shale pieces (TILL/RESIDUAL SOIL) Very dense Red Wet END OF BOREHOLE	[Dotted pattern]	22	SS	100/15											

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Continued Next Page

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 207	3 OF 3 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781962.5 ; E 323012.9</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>BLT</u>
DATUM <u>Geodetic</u>	DATE <u>November 11, 12, 2004</u>	CHECKED BY <u>ASP</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	--- CONTINUED FROM PREVIOUS PAGE ---															
	Notes: 1. Water level at 25.9 m depth (Elev. 69.2 m) on completion of drilling. 2. Water level measured at 13.85 m depth (Elevation 81.3 m) on Nov. 26, 2004, at 13.2 m depth (Elev. 81.9 m) on May 13, 2005, and at 13.4 m depth (Elev. 87.1 m) on December 6, 2005.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 401 2 OF 3 **METRIC**

PROJECT 04-1111-002

W.P. 607-00-00 LOCATION N 4781742.3 ; E 325860.8 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY HJ

DATUM Geodetic DATE June 29, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40						60
	--- CONTINUED FROM PREVIOUS PAGE ---													
	CLAYEY SILT, some sand, trace gravel and shale pieces (TILL) Stiff to very stiff Grey Moist	13	SS	14										
		14	SS	14										
		15	SS	17										
		16	SS	20										
		17	SS	17										
		18	SS	25										
		19	SS	81										
77.4														
28.3	CLAYEY SILT, some sand, trace gravel and shale pieces (TILL/RESIDUAL SOIL) Hard Red Moist													

Continued Next Page

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

MIS-MTO 001_041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 401	3 OF 3 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781742.3 ; E 325860.8</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>HJ</u>
DATUM <u>Geodetic</u>	DATE <u>June 29, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---					20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED							
72.0	CLAYEY SILT, some sand, trace gravel and shale pieces (TILL/RESIDUAL SOIL) Hard Red Moist		20	SS	153												
74																	
73			21	SS	100/0.13						○					11 21 55 13	
33.7	END OF BOREHOLE Note: 1.) Borehole dry upon completion of drilling operations.		22	SS	100/7.15												

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No 402 1 OF 3 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781732.1 ; E 325899.5 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY HJ

DATUM Geodetic DATE June 27, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
106.0	GROUND SURFACE																						
0.0	ASPHALT																						
0.2	Sand and gravel (FILL) Compact to very dense Red Moist		1	SS	53																		
			2	SS	24																		
			3	SS	13																		
103.0																							
3.1	Silty sand to sand, some silt, trace to some gravel (FILL) Loose to compact Red Moist		4	SS	7																		
			5	SS	12																		
			6	SS	4																		
99.6																							
6.4	Sand and gravel (FILL) Compact to very dense Grey/brown Moist		7	SS	30																		
	Wet below 7.6 m depth		8	SS	50																		
96.9																							
9.1	CLAYEY SILT, some sand, trace gravel and shale pieces (TILL) Stiff to very stiff Grey Moist/wet		9	SS	16																		
			10	SS	15																		
			11	SS	15																		
			12	SS	13																		

MIS-MTO 001_041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No 402 2 OF 3 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781732.1 ; E 325899.5 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY HJ

DATUM Geodetic DATE June 27, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40					
--- CONTINUED FROM PREVIOUS PAGE ---													
	CLAYEY SILT, some sand, trace gravel and shale pieces (TILL) Stiff to very stiff Grey Moist/wet	13	SS	11		90							
		14	SS	10			89						
88.2	SILTY CLAY, some sand, trace gravel and shale fragments (TILL) Firm to Stiff Grey Wet					88							
17.8		15	SS	8									
		16	SS	8			86					50	0 4 37 59
		17	SS	9			85						
	Containing sand seams below 24.4 m depth	18	SS	10									
		19	SS	11			81						
		20	SS	43			78						
79.8	CLAYEY SILT, some sand, trace gravel, shale and limestone pieces (TILL) Hard Grey to red Wet					79							
26.2		21	SS	93			77						
77.7	CLAYEY SILT, some sand, trace gravel, shale and limestone pieces (TILL/RESIDUAL SOIL) Hard Red Wet												
28.3													

MIS-MTO 001_041111002AAMTO.GPJ GAL-MISS_GDT_23/1/07

Continued Next Page

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 402	3 OF 3 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781732.1 ; E 325899.5</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>HJ</u>
DATUM <u>Geodetic</u>	DATE <u>June 27, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)	
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100							
72.2	CLAYEY SILT, some sand, trace gravel, shale and limestone pieces (TILL/RESIDUAL SOIL) Hard Red Wet	[Hatched Box]	22	SS	103								○					
75																		
74			23	SS	110/30													
73																		
72.2	END OF BOREHOLE		24	SS	116													
33.8	Note: 1. Water level measured in open borehole at 32.6 m depth (Elev. 73.4 m) upon completion of drilling operations.																	

MIS-MTO 001 04111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT 04-1111-002 **RECORD OF BOREHOLE No 403** 1 OF 3 **METRIC**
 W.P. 607-00-00 LOCATION N 4781714.1 ; E 325863.9 ORIGINATED BY PKS
 DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY HJ
 DATUM Geodetic DATE June 19, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
105.8	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sand and gravel (FILL) Loose to dense Reddish brown to red Moist		1	SS	38											
			2	SS	25											
			3	SS	8											
			4	SS	8											
102.0	Foundry sand (FILL) Compact to very dense Black Moist		5	SS	10											
			6	SS	25											
			7	SS	82											
99.3	Sandy SILT Very dense Brown Moist															
98.2	CLAYEY SILT to SILTY CLAY, trace sand, trace gravel (TILL) Stiff to very stiff Grey-brown Moist		8	SS	24											
			9	SS	28											
	Becoming grey below 10.7 m depth		10	SS	14											
			11	SS	12											
			12	SS	14											
90.8																

MIS-MTO 001 04111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

Continued Next Page

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

PROJECT 04-1111-002 **RECORD OF BOREHOLE No 403** 3 OF 3 **METRIC**
 W.P. 607-00-00 LOCATION N 4781714.1 ; E 325863.9 ORIGINATED BY PKS
 DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY HJ
 DATUM Geodetic DATE June 19, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
	--- CONTINUED FROM PREVIOUS PAGE ---															
72.3	CLAYEY SILT, trace sand, trace gravel (TILL) Hard Grey Moist Containing shale pieces and red in color below 30.5 m depth		21	SS	57											
33.5	CLAYEY SILT, some sand, containing shale pieces (TILL/RESIDUAL SOIL) Hard Red Moist		22	SS	100/20											
70.8	Red SHALE (BEDROCK)															
35.1																
69.2																
36.7	END OF BOREHOLE Note: 1.) Borehole dry upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 404	3 OF 3 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781705.4 ; E 325898.0</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>HJ</u>
DATUM <u>Geodetic</u>	DATE <u>June 22, 2005</u>	CHECKED BY <u>LCC</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
75.6 30.5	SAND and SILT, trace to some clay (TILL/RESIDUAL SOIL) Very dense Grey to red Moist to wet	[Strat Plot Pattern]	22	SS	1007.10		76											
72.5 33.6	CLAYEY SILT, some sand trace gravel and shale pieces (TILL/RESIDUAL SOIL) Hard Red Wet	[Strat Plot Pattern]					75											
70.9 35.2	END OF BOREHOLE Note: 1.) Open borehole wet below 10.7m depth upon completion of drilling operations.	[Strat Plot Pattern]	23	SS	1007.13		74											5 36 53 6
							73											
							72											
							71											

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 405	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781733.9; E 325941.6</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>HJ</u>
DATUM <u>Geodetic</u>	DATE <u>July 28, 2005</u>	CHECKED BY <u>LCC</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			20	40					
100.0	GROUND SURFACE													
8.0	TOPSOIL													
99.2	CLAYEY SILT, some sand, trace to some gravel, trace organics Firm Dark brown Moist		1	SS	6									
0.8	CLAYEY SILT to SILTY CLAY, some sand, trace gravel (TILL) Stiff to hard Brown Moist		2	SS	32									
			3	SS	32									
	Wet below 2.1 m depth		4	SS	15									
			5	SS	27									
			6	SS	16									
	Becoming grey below 4.5 m depth		7	SS	9									0 9 49 42
			8	SS	17									
			9	SS	15									
			10	SS	16									
90.1	END OF BOREHOLE													
9.9	Note: 1. Water level measured in open borehole at 8.2 m depth upon completion of drilling operations. 2. Water level measured in piezometer at 2.8 m depth (Elevation 97.2 m) on August 8, 2005. 3. Water level measured in piezometer at 0.6 m depth (Elevation 99.4 m) on December 6, 2005.													

MIS-MTO 001_041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 406	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781719.6 ; E 325844.8</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>HJ</u>
DATUM <u>Geodetic</u>	DATE <u>June 17, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
105.6	GROUND SURFACE												
0.0	ASPHALT												
0.2	Sand and gravel (FILL) Very dense Red Moist												
104.5			1	SS	107								
1.1	Foundry sand (FILL) Very dense Black Moist		2	SS	77								
			3	SS	60								
			4	SS	53								
			5	SS	78								
			6	SS	74								
99.2			7	SS	55								
6.4	Sand and gravel (FILL) Very dense Grey Moist												
98.0			8	SS	16								0 19 72 9
7.6	Sandy SILT Compact Brown Wet												
96.2			9	SS	26								
95.9	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff Grey Wet												
9.8	END OF BOREHOLE												
	Note: 1. Bottom of borehole wet upon completion of drilling operations.												

MIS-MTO 001 04111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 406	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781719.6 ; E 325844.8</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>HJ</u>
DATUM <u>Geodetic</u>	DATE <u>June 17, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
105.6	GROUND SURFACE												
0.0	ASPHALT												
0.2	Sand and gravel (FILL) Very dense Red Moist												
104.5			1	SS	107								
1.1	Foundry sand (FILL) Very dense Black Moist		2	SS	77								
			3	SS	60								
			4	SS	53								
			5	SS	78								
			6	SS	74								
99.2			7	SS	55								
6.4	Sand and gravel (FILL) Very dense Grey Moist												
98.0			8	SS	16							0 19 72 9	
7.6	Sandy SILT Compact Brown Wet												
96.2			9	SS	26								
95.9	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff Grey Wet												
9.8	END OF BOREHOLE												
	Note: 1. Bottom of borehole wet upon completion of drilling operations.												

MIS-MTO 001 04111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 501	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781339.1 ; E 327298.4</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SLP</u>
DATUM <u>Geodetic</u>	DATE <u>December 13, 2004</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
101.2	GROUND SURFACE																							
8.0	TOPSOIL																							
	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to very stiff Brown Moist		1	SS	9																			
			2	SS	17																			
			3	SS	22																			
			4	SS	21																			
			5	SS	23																			
			6	SS	13																			
96.8																								
4.4	SILTY CLAY, trace to some sand, trace gravel (TILL) Firm to stiff Grey Moist to wet		7	SS	7																			
			8	SS	8																			
94.5																								
6.7	END OF BOREHOLE																							
	Note: 1. Borehole dry upon completion of drilling operations.																							

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 502	1 OF 3 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781342.0 ; E 327287.0</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SLP</u>
DATUM <u>Geodetic</u>	DATE <u>December 13, 2004</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
101.2	GROUND SURFACE												
0.0	TOPSOIL												
100.4	Sand and gravel, trace rootlets (FILL)		1	SS	7								
0.8	Loose Red Moist		2	SS	9								
	SILTY CLAY, trace to some sand, trace gravel (TILL)		3	SS	22								
	Stiff to very stiff		4	SS	23								
	Brown		5	SS	17								
	Moist to wet		6	SS	14								
			7	SS	13								
			8	SS	11								
			9	SS	9								
			10	SS	8								
			11	SS	8								
			12	SS	5								
			13	SS	7								

MIS-MTO 001_041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No 502 2 OF 3 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781342.0 ; E 327287.0 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SLP

DATUM Geodetic DATE December 13, 2004 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	80	100	10	20
82.0	SILTY CLAY, trace to some sand, trace gravel (TILL) Firm to stiff Grey to reddish grey Wet	14	SS	10																			
		15	SS	8															8	8	48	36	
		16	SS	7																			
19.2		CLAYEY SILT, some sand, trace gravel (TILL) Stiff to very stiff Grey/red Moist to wet	17	SS	12																		
	18		SS	15																			
	19		SS	24																			
76.8	SILTY SAND, trace gravel, trace shale fragments Dense to very dense Grey/red Wet		20	SS	38																		
24.4			21	SS	109																		
		22	SS	107																			
72.1		23	SS	100/13																			
29.1																							

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 +³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 502	3 OF 3 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781342.0 ; E 327287.0</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SLP</u>
DATUM <u>Geodetic</u>	DATE <u>December 13, 2004</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	-- CONTINUED FROM PREVIOUS PAGE --															
	END OF BOREHOLE Note: 1. Water level at 24.4 m depth upon (Elev. 76.8 m) completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 503	2 OF 3 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781350.0 ; E 327255.0</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SLP</u>
DATUM <u>Geodetic</u>	DATE <u>December 16, 2004</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40						60
--- CONTINUED FROM PREVIOUS PAGE ---														
83.5	SILTY CLAY, trace to some sand, trace gravel (TILL) Firm to stiff Grey Wet	14	SS	7										
17.9	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff Grey Wet Contains shale fragments below 22.0 m depth	15	TO	PH										
77.0	GRAVELLY SAND to SAND, some gravel, some silt, trace clay, containing shale fragments Dense to very dense Grey Wet	16	SS	15										
24.4														
74.0	SANDY SILT, containing clayey silt seams Very dense Grey Wet	17	SS	15										
27.4														
72.2		18	SS	22										
29.2														
		19	SS	29										
		20	SS	33										
		21	SS	110									24 54 17 5	
		22	SS	100/23										

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 503	3 OF 3 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781350.0 ; E 327255.0</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SLP</u>
DATUM <u>Geodetic</u>	DATE <u>December 16, 2004</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
	END OF BOREHOLE															
	Note: 1. Water level at 24.4 m depth upon completion of drilling operations. 2. Water level in piezometer at 13.7 m depth (Elevation 87.7 m) on December 20, 2004. 3. Water level in piezometer at 11.6 m depth (Elevation 89.8 m) on May 13, 2005 and on December 6, 2005.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 24/1/07

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 04-1111-002 **RECORD OF BOREHOLE No 504** 1 OF 3 **METRIC**
 W.P. 607-00-00 LOCATION N 4781321.0; E 327215.0 ORIGINATED BY PKS
 DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SLP
 DATUM Geodetic DATE December 20, 2004 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)									
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20	40	60	80	100
101.5	GROUND SURFACE																					
0.0	Asphalt																					
0.2	Sand and gravel (FILL) Compact Brown/red Moist		1	SS	28																	
100.3			2	SS	13																	
1.2	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to very stiff Brown Moist		3	SS	17																	
			4	SS	19																	
			5	SS	16																	
			6	SS	14							42										
			7	SS	13																	
96.0																						
5.5	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff Grey Wet		8	SS	8																	
			9	SS	7																	
			10	SS	9																	
			11	SS	8																	
89.5																						
12.0	SILTY CLAY, trace to some sand, trace gravel (TILL) Firm to stiff Grey Wet		12	SS	7																	
			13	SS	6							43										

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 504	3 OF 3 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781321.0; E 327215.0</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SLP</u>
DATUM <u>Geodetic</u>	DATE <u>December 20, 2004</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	WATER CONTENT (%)					
						20 40 60 80 100					10 20 30					
71.0						71										
30.5	SILT, trace to some sand, trace clay, trace gravel Very dense Grey Wet END OF BOREHOLE Note: 1. Water level in open borehole at 25.9 m depth (Elev. 75.6 m) upon completion of drilling operations.		23	SS	106										3 7 82 8	
70.6																
30.9																

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 505	3 OF 3 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781313.0;E 327227.0</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SLP</u>
DATUM <u>Geodetic</u>	DATE <u>December 15, 2004</u>	CHECKED BY <u>LCC</u>

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
70.7	END OF BOREHOLE		23	SS	100/23		71										
30.7	Note: 1. Water level in open borehole at 24.4 m depth (Elev. 77.0 m) upon completion of drilling operations.																

MIS-MTO.001_041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 506	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781316.5; E 327181.5</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SLP</u>
DATUM <u>Geodetic</u>	DATE <u>December 21, 2004</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
101.4	GROUND SURFACE															
0.0	Asphalt															
0.2	Sand and gravel (FILL) Compact Brown/red Moist		1	SS	24											
			2	SS	13											
99.9																
1.5	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to very stiff Brown to brown/grey Moist		3	SS	18											
			4	SS	21											
			5	SS	14											
			6	SS	14											
			7	SS	14											
			8	SS	16											
94.7																
6.7	END OF BOREHOLE															
	Note: 1. Borehole dry upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No 507	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781306.1 ; E 327232.2</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SLP</u>
DATUM <u>Geodetic</u>	DATE <u>December 14, 2004</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL		
101.5	GROUND SURFACE																							
0.0	Sandy silt, trace gravel (FILL) Compact Red Moist		1	SS	15																			
100.4	SILTY CLAY, trace to some sand, trace gravel and shale fragments (TILL) Stiff to hard Brown/grey Moist		2	SS	11																			
1.1			3	SS	28																			
				4	SS	31																		
				5	SS	36																		
				6	SS	18																		
				7	SS	16																		
				8	SS	10																		
96.0	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff Grey Wet																							
5.5																								
94.7	END OF BOREHOLE																							
6.7	Notes: 1. Borehole dry upon completion of drilling operations. 2. Water level in piezometer at 6.0 m depth (Elevation 95.5 m) on December 20, 2004. 3. Water level in piezometer at 1.6 m depth (Elevation 99.9 m) on May 13, 2005. 4. Water level in piezometer at 1.9 m depth (Elevation 99.6 m) on December 6, 2005.																							

MIS-MTO 001 04111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-33	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781805.7 ; E 325469.4</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>Power Auger, 108 mm Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>June 13, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
97.0	GROUND SURFACE															
0.0	Sand and gravel (FILL) Compact Grey Moist		1	SS	35											
96.2																
0.8	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to very stiff Brown Moist		2	SS	18											
			3	SS	20											
			4	SS	12											
			5	SS	10											
			6	SS	12											
			7	SS	15											
91.8	END OF BOREHOLE															
5.2	Note: 1. Borehole dry upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-34	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781781.9; E 325561.5</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>Power Auger, 108 mm Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>June 13, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
97.7	GROUND SURFACE															
0.0	Sand and gravel (FILL) Compact Grey Moist		1	SS	30											
96.9																
0.8	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to very stiff Brown/grey Moist		2	SS	11											
			3	SS	13											
			4	SS	28											
			5	SS	27											
			6	SS	24											
			7	SS	24											
92.5	END OF BOREHOLE															
5.2	Note: 1. Borehole dry upon completion of drilling operations.															

1 16 52 31

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

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-35	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781762.7 ; E 325633.9</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>Power Auger, 108 mm Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>June 13, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
98.5	GROUND SURFACE															
98.0	Sand and gravel (FILL)															
98.2	Compact															
0.3	Brown															
97.7	Moist		1	SS	23											
0.8	Clayey silt, some sand, trace gravel (FILL)															
97.0	Very stiff															
97.7	Brown		2	SS	25											
1.5	Moist															
	CLAYEY SILT, some sand, containing organics															
	Very stiff															
	Brown/black															
	Moist		3	SS	12											
	CLAYEY SILT, some sand, trace gravel (TILL)															
	Stiff to very stiff															
	Brown															
	Moist		4	SS	21											
			5	SS	23											
			6	SS	24											
			7	SS	22											
93.3	END OF BOREHOLE															
5.2	Note: 1. Borehole dry upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-36	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781744.4 ; E 325706.6</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>Power Auger, 108 mm Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>June 13, 2005</u>	CHECKED BY <u>LCC</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100	20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L			
									○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					
99.1	GROUND SURFACE													
98.8	Sand and gravel (FILL) Compact Brown Moist		1	SS	10		99							
98.3	Clayey silt, some sand, trace gravel (FILL) Stiff Brown Moist		2	SS	17		98							
97.6	SILTY SAND, containing organics Compact Brown/black Moist		3	SS	17		97			○	—			
1.5	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff to hard Brown Moist		4	SS	31		96							
			5	SS	26		95			○				
			6	SS	28		94							
			7	SS	23		93.9			○	—		1 11 51 37	
5.2	END OF BOREHOLE Note: 1. Borehole dry upon completion of drilling operations.													

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No W-37 1 OF 1 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781736.7 ; E 325782.0 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SG

DATUM Geodetic DATE June 16, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
104.7	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sand and gravel (FILL)															
104.1	Compact Brown Moist															
0.6	Foundry sand (FILL) Very dense Black Moist		1	SS	90											
			2	SS	46											
			3	SS	78											
			4	SS	70											
			5	SS	53											
			6	SS	66											
98.8	Concrete															
6.1	Silty sand (FILL) Loose Black Moist		7	SS	9											
97.1	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to hard Brown Moist		8	SS	32											
	Grey below 9.1 m depth															
95.0			9	SS	11											
9.8	END OF BOREHOLE															
	Note: 1. Borehole dry upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-38	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781821.5 ; E 325597.1</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>Power Auger, 108 mm Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>June 15, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
98.7	GROUND SURFACE																						
0.0	Sand and gravel (FILL) Compact Grey Moist		1	SS	22																		
0.8	Sandy silt, some gravel, some clay (FILL) Stiff		2	SS	12																		24 30 31 15
97.9	Brown/grey Moist																						
97.2	CLAYEY SILT, some sand, trace gravel, organics Firm		3	SS	7																		
1.5	Grey/black Moist																						
96.4	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff to hard		4	SS	13																		
2.3	Brown/grey Moist																						
			5	SS	25																		
			6	SS	30																		
			7	SS	21																		
93.5	END OF BOREHOLE																						
5.2	Note: 1. Borehole dry upon completion of drilling operations.																						

MIS-MTO 001 04111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-39	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781801.9 ; E 325669.4</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>Power Auger, 108 mm Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>June 15, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
99.5	GROUND SURFACE															
0.0	Sand and gravel (FILL) Dense Grey Moist		1	SS	30											
98.7																
0.8	Foundry sand (FILL) Loose to very dense Black Moist		2	SS	64											
97.7																
1.8	Organic Silty SAND Loose Grey/black Moist		3	SS	7											
97.2																
2.3	CLAYEY SILT, trace to some sand, trace gravel (TILL) Very stiff to hard Brown Moist		4	SS	17											0 9 58 33
94.3																
5.2	END OF BOREHOLE															
	Notes: 1. Borehole dry upon completion of drilling operations. 2. Water level measured at 1.5 m depth (Elev. 98.0 m) on August 8, 2005, and at 0.9 m depth (Elev. 98.6 m) on December 6, 2005.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-40	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781782.7 ; E 325741.8</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>Power Auger, 108 mm Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>June 7, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
						20	40	60	80	100							
99.6	GROUND SURFACE																
0.0	Sand and gravel (FILL) Compact Brown Moist		1	SS	23												
			2	SS	18												
98.2																	
1.5	Foundry sand (FILL) Compact Black Moist		3	SS	11												
	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to very stiff Brown Moist		4	SS	19												
			5	SS	25												
			6	SS	21												
	Grey below 4.6 m depth		7	SS	14												
94.4	END OF BOREHOLE																
5.2	Note: 1. Borehole dry upon completion of drilling operations.																

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT 04-1111-002 **RECORD OF BOREHOLE No W-41** **1 OF 1 METRIC**
W.P. 607-00-00 **LOCATION** N 4781754.1 ; E 325812.2 **ORIGINATED BY** PKS
DIST Central **HWY** QEW **BOREHOLE TYPE** Power Auger, 108 mm Solid Stem Augers **COMPILED BY** SG
DATUM Geodetic **DATE** July 8, 2005 **CHECKED BY** LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
105.0	GROUND SURFACE																							
0.0	ASPHALT																							
0.2	Sand and gravel (FILL) Compact Brown Moist																							
104.2	Foundry sand (FILL) Very dense Black Moist		1	SS	80																			
0.8			2	SS	69																			
			3	SS	78																			
			4	SS	76																			
			5	SS	75																			
			6	SS	90																			
98.9																								
6.1	Silty SAND, some gravel, trace clay Compact Brown Moist		7	SS	21																			
97.4																								
7.6	SILTY CLAY, some sand, trace gravel (TILL) Very stiff to hard Brown Moist		8	SS	32																			
95.3																								
9.8	END OF BOREHOLE		9	SS	23																			
	Note: 1. Borehole dry upon completion of drilling operations.																							

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-42	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781686.7 ; E 325975.7</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>June 17, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
106.1	GROUND SURFACE															
0.0	ASPHALT															
0.2	Silty sand, trace gravel, trace slag pieces (FILL) Compact to dense Red Moist															
			1	SS	46											
			2	SS	17											
			3	SS	18											
			4	SS	14											
			5	SS	27											
			6	SS	18											
100.2	Concrete															
6.1	CLAYEY SILT, some sand, containing organics Firm Grey/black Moist/wet		7	SS	6											
98.5	CLAYEY SILT, some sand, trace gravel (TILL) Hard Brown Moist		8	SS	35											
97.0	Silty SAND Dense Grey Wet		9	SS	46											
96.4																
9.8	END OF BOREHOLE															
	Note: 1. Borehole dry upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-43	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781657.9 ; E 326045.0</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>July 12, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
100.4	GROUND SURFACE																							
0.0	ASPHALT																							
	Sand and gravel (FILL) Compact Brown Moist																							
99.3			1	SS	17																			
1.1	CLAYEY SILT to SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to very stiff Brown Moist		2	SS	19																			
			3	SS	14																			
			4	SS	12																			
			5	SS	13																			
			6	SS	9																			
			7	SS	12																			
93.7	END OF BOREHOLE																							
6.7	Note: 1. Borehole dry upon completion of drilling operations.																							

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No W-45 1 OF 2 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781618.7 ; E 326189.8 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SG

DATUM Geodetic DATE July 13, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						WATER CONTENT (%)	
101.2	GROUND SURFACE														
0.0	ASPHALT														
0.1	Sand and gravel (FILL) Compact Brown Moist		1	SS	17										
99.7															
1.7	Silty SAND, trace gravel Compact Brown Moist		2	SS	11										
	CLAYEY SILT, some sand, trace gravel (TILL) Stiff Grey Moist		3	SS	7										
			4	SS	6										
			5	SS	7										
			6	SS	7										
94.3															
6.9	SILTY CLAY to CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to very stiff Grey Moist		7	SS	11							1	7	46	46
			8	SS	15										
			9	SS	11										
			10	SS	12										
87.0															
14.3	Silty SAND, some gravel, trace clay Compact Red		11	SS	16										

MIS-MTO.001_041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

Continued Next Page

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-45	2 OF 2 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781618.7 ; E 326189.8</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>July 13, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
	--- CONTINUED FROM PREVIOUS PAGE ---															
85.4 15.9	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff Grey Moist	[Hatched Box]	12	SS	18									[Moisture Content Plot]		
	END OF BOREHOLE Note: 1. Borehole dry upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No W-51 1 OF 1 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781716.5 ; E 325957.4 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SG

DATUM Geodetic DATE July 8, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)				GR SA SI CL	
106.1	GROUND SURFACE															
0.0	Sand and gravel (FILL) Compact Grey Moist															
105.2	Silty sand, trace gravel, trace clay (FILL) Compact to dense Reddish brown Moist		1	SS	47											
0.9			2	SS	47											
			3	SS	26											
			4	SS	17											
			5	SS	21											
			6	SS	18											
99.7			7	SS	66											
99.4	Sand and gravel, containing foundry sand, brick and asphalt fragments (FILL) Very dense Grey/black Moist															
6.7	CLAYEY SILT, some sand, trace gravel (TILL) Hard Brown Moist to wet		8	SS	47											
96.4			9	SS	30											
9.8	END OF BOREHOLE															
	Note: 1. Water level in open borehole measured at 9.5 m (Elev. 96.6 m) upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-52	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781709.9; E 326033.1</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>July 12, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
						20	40	60	80	100							
100.0	GROUND SURFACE																
0.0	ASPHALT																
0.1	Sand and gravel (FILL) Compact Brown Moist																
99.1			1	SS	15	99											
0.9	SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff Brown Moist		2	SS	18	98											
			3	SS	20	97											
			4	SS	15	96											
96.2			5	SS	10	95											
3.8	CLAYEY SILT, some sand, trace gravel (TILL) Stiff Grey Moist	6	SS	9	94												
		7	SS	11	93												
93.3					92												
6.7	END OF BOREHOLE				91												
	Note: 1. Borehole dry upon completion of drilling operations.				90												

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

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

RECORD OF BOREHOLE No W-53 1 OF 1 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781691.2 ; E 326105.8 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SG

DATUM Geodetic DATE July 11, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
100.5	GROUND SURFACE																							
0.0	ASPHALT																							
0.2	Sand and gravel (FILL) Compact																							
99.7	Brown Moist																							
0.8	Silty SAND, trace gravel, containing roots		1	SS	11																			
99.0	Compact Brown Moist																							
1.5	SILTY CLAY, some sand, trace to some gravel (TILL) Stiff to very stiff Brown Moist		2	SS	19																			
			3	SS	13																			
97.5																								
3.0	SILTY CLAY to CLAYEY SILT, trace sand, trace gravel (TILL) Stiff Grey Moist		4	SS	10																			
			5	SS	11																			
			6	SS	8																			
			7	SS	7																			
			8	SS	7																			
			9	SS	14																			
90.8	END OF BOREHOLE																							
9.8	Note: 1. Borehole dry upon completion of drilling operations.																							

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No W-54 1 OF 1 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781660.5 ; E 326175.3 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SG

DATUM Geodetic DATE July 7, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)							
						20	40	60	80	100	20	40	60	80	100	10	20	30		GR	SA	SI	CL	
103.0	GROUND SURFACE																							
0.0	ASPHALT																							
0.2	Silty sand, trace to some gravel, trace clay (FILL) Compact to very dense Reddish brown Moist		1	SS	66																			
			2	SS	28																			
			3	SS	19																			
			4	SS	45																			
99.0	CONCRETE		5	SS	100/15																			
4.1	SAND and SILT, trace gravel, trace clay Compact Brown Wet		6	SS	14																			
96.9	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to very stiff Grey Moist		7	SS	18																			
			8	SS	14																			
			9	SS	14																			
93.3	END OF BOREHOLE																							
9.8	Note: 1. Borehole dry upon completion of drilling operations.																							

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-55	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781653.3 ; E 326250.8</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>July 11, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
						20	40	60	80	100							
101.2	GROUND SURFACE																
0.0	ASPHALT																
0.2	Silty sand, trace gravel (FILL) Compact Brown Moist		1	SS	10												
99.7																	
1.5	SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff Brown Moist		2	SS	14												
97.4																	
3.8	CLAYEY SILT, trace sand, trace gravel (TILL) Stiff Grey Moist		5	SS	8												
96.0																	
5.2	END OF BOREHOLE																
	Note: 1. Borehole dry upon completion of drilling operations.																

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-63	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781447.8 ; E 326973.2</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>July 19, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
101.5	GROUND SURFACE															
0.0	Silty sand, trace gravel (FILL) Loose Red Moist		1	SS	9											
100.7																
0.8	SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff Brown Moist		2	SS	15											
			3	SS	15											
			4	SS	17									42		
			5	SS	14											
			6	SS	12											
			7	SS	14										41	
96.3	END OF BOREHOLE															
5.2	Note: 1. Borehole dry upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No W-66 1 OF 1 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781363.3 ; E 327182.7 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SG

DATUM Geodetic DATE July 25, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
107.5	GROUND SURFACE												
0.0	ASPHALT												
0.2	Sand and gravel (FILL) Brown Moist												
106.7													
0.8	Clayey silt, some sand, trace gravel (FILL) Firm to very stiff Brown Moist		1	SS	7								
			2	SS	16								
			3	SS	7								
			4	SS	11								
			5	SS	11								
			6	SS	15								
101.4													
6.1	Gravelly sand, some silt (FILL) Compact Brown Moist to wet		7	SS	28								23 55 18 4
99.9													
7.6	SILTY CLAY, some sand, trace gravel (TILL) Very stiff to hard Brown Moist		8	SS	60								
			9	SS	22								
97.8													
9.8	END OF BOREHOLE												
	Note: 1. Borehole dry upon completion of drilling operations.												

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No W-70 1 OF 1 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781323.1 ; E 327306.1 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SG

DATUM Geodetic DATE July 24, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
107.6	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sand and gravel to gravel, some sand, trace silt (FILL) Loose Brown/grey Moist		1	SS	7											
			2	SS	8											
105.0			3	SS	6											
2.6	Clayey silt to silty clay, some sand, trace to some gravel (FILL) Stiff Brown Moist		4	SS	13											
			5	SS	12											
			6	SS	10											
101.5			7	SS	70											
6.1	Silty sand and gravel (FILL) Very dense Brown/red Moist															
100.0			8	SS	32											
7.6	SILTY CLAY, some sand, trace gravel (TILL) Very stiff to hard Brown Moist															
			9	SS	28											
97.9																
9.8	END OF BOREHOLE															
	Note: 1. Borehole dry upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No W-71 1 OF 1 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781309.5 ; E 327348.7 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SG

DATUM Geodetic DATE July 24, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20
107.2	GROUND SURFACE																	
0.0	ASPHALT																	
0.2	Sand and gravel (FILL) Compact																	
106.4	Brown Moist																	
0.8	Clayey silt, some sand, trace to some gravel (FILL) Firm to very stiff Brown Moist		1	SS	8													
			2	SS	5													
			3	SS	6													
			4	SS	6													
			5	SS	14													
			6	SS	22													
101.7	Sand and gravel (FILL) Grey Moist																	
5.6	SILTY CLAY, some sand, trace gravel (TILL) Very stiff to hard Brown Moist		7	SS	15													
			8	SS	27							47						
			9	SS	31													
97.5	END OF BOREHOLE																	
9.8	Note: 1. Borehole dry upon completion of drilling operations.																	

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-72	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781300.4 ; E 327426.3</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>July 21, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20 40 60 80 100	20 40 60 80 100									
101.3	GROUND SURFACE															
0.0	ASPHALT															
	CONCRETE															
	Sand and gravel (FILL)															
100.5	Compact Brown Moist															
0.8	SILTY CLAY, some sand, trace gravel, containing organics		1	SS	4											
99.8	Firm Grey to grey-black Moist		2	SS	14											
1.5	SILTY CLAY, some sand, trace gravel (TILL)															
	Stiff to very stiff Brown Moist		3	SS	14											
			4	SS	17									48		
			5	SS	15											
			6	SS	13											
96.1	END OF BOREHOLE															
5.2	Note: 1. Borehole dry upon completion of drilling operations.															

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

RECORD OF BOREHOLE No W-76 1 OF 1 **METRIC**

PROJECT 04-1111-002 W.P. 607-00-00 LOCATION N 4781307.0 ; E 327269.3 ORIGINATED BY PKS

DIST Central HWY QEW BOREHOLE TYPE 108 mm Diameter Solid Stem Augers COMPILED BY SG

DATUM Geodetic DATE July 27, 2005 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20
107.8	GROUND SURFACE																	
0.0	ASPHALT																	
0.2	Sand and gravel (FILL)																	
107.2	Brown Moist																	
0.6	Clayey silt, trace to some sand, trace gravel (FILL) Stiff to very stiff Reddish brown to brown Moist		1	SS	13													
			2	SS	11													
			3	SS	14													
			4	SS	13													
			5	SS	20													
			6	SS	18													
101.7	Sand and gravel (FILL) Compact Brown/grey Moist/wet		7	SS	22													
101.1	SILTY CLAY, some sand, trace gravel (TILL) Very stiff to hard Brown/grey Moist		8	SS	41													
98.0	END OF BOREHOLE		9	SS	21													
9.8	Note: 1. Borehole dry upon completion of drilling operations.																	

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

PROJECT <u>04-1111-002</u>	RECORD OF BOREHOLE No W-77	1 OF 1 METRIC
W.P. <u>607-00-00</u>	LOCATION <u>N 4781265.1 ; E 327334.9</u>	ORIGINATED BY <u>PKS</u>
DIST <u>Central</u> HWY <u>QEW</u>	BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>	COMPILED BY <u>SG</u>
DATUM <u>Geodetic</u>	DATE <u>July 21, 2005</u>	CHECKED BY <u>LCC</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
101.4	GROUND SURFACE												
0.0	ASPHALT												
0.2	Sand and gravel (FILL)												
100.8	Compact Brown Moist												
0.6	SILTY CLAY, some sand, trace gravel (TILL) Firm to very stiff Brown Moist		1	SS	6								
			2	SS	15						51		
			3	SS	20								
			4	SS	14								
			5	SS	13								
			6	SS	11								
96.2	END OF BOREHOLE												
5.2	Notes: 1. Borehole dry upon completion of drilling operations. 2. Water level measured in piezometer at 3.2 m depth (Elev. 98.2 m) on August 8, 2005. 3. Water level measured in piezometer at 1.1 m depth (Elev. 100.3 m) on December 6, 2005.												

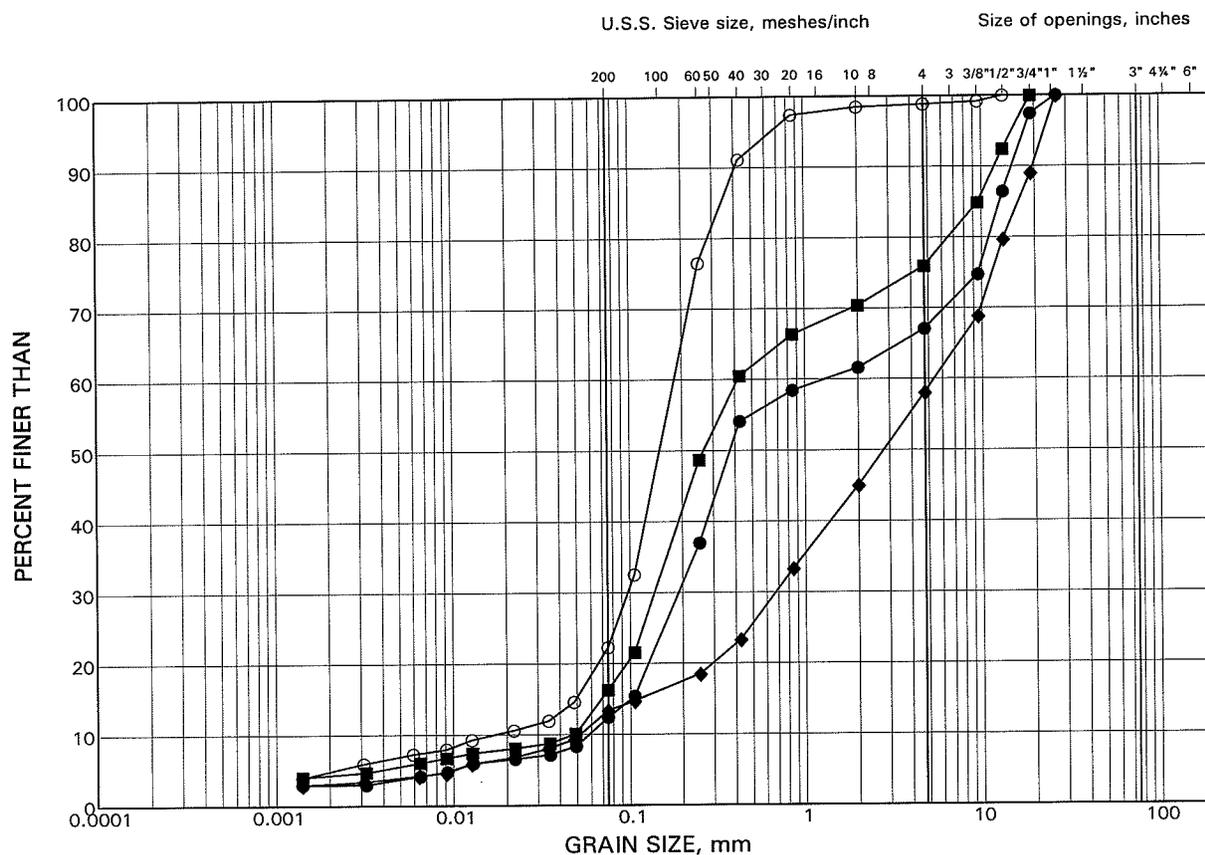
MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 23/1/07

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

GRAIN SIZE DISTRIBUTION TEST RESULTS

Fill

FIGURE 1A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	401	7	99.3
■	402	4	102.7
◆	403	4	102.4
○	404	4	102.8

Date January, 2007
Project 04-1111-002-6

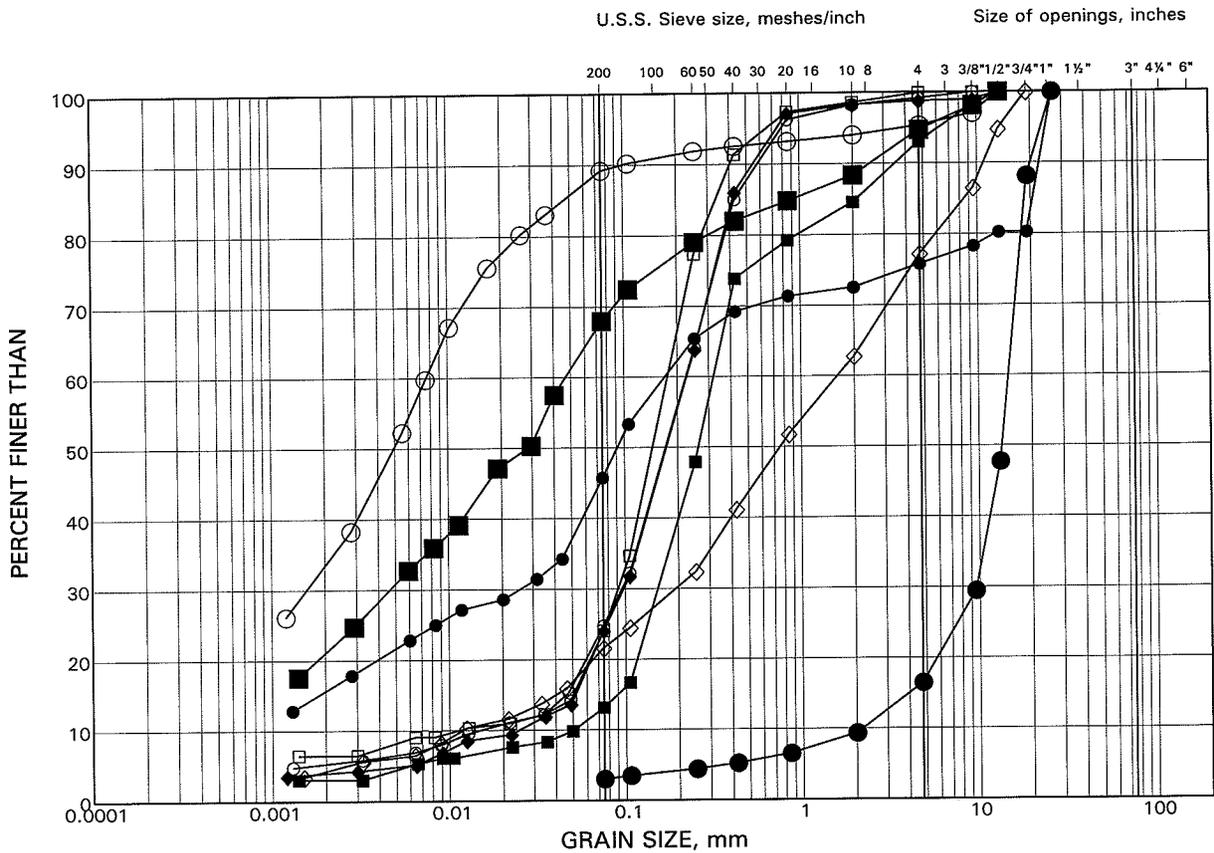
Golder Associates

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Checked by *ll*

GRAIN SIZE DISTRIBUTION TEST RESULTS

Fill

FIGURE 1B



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

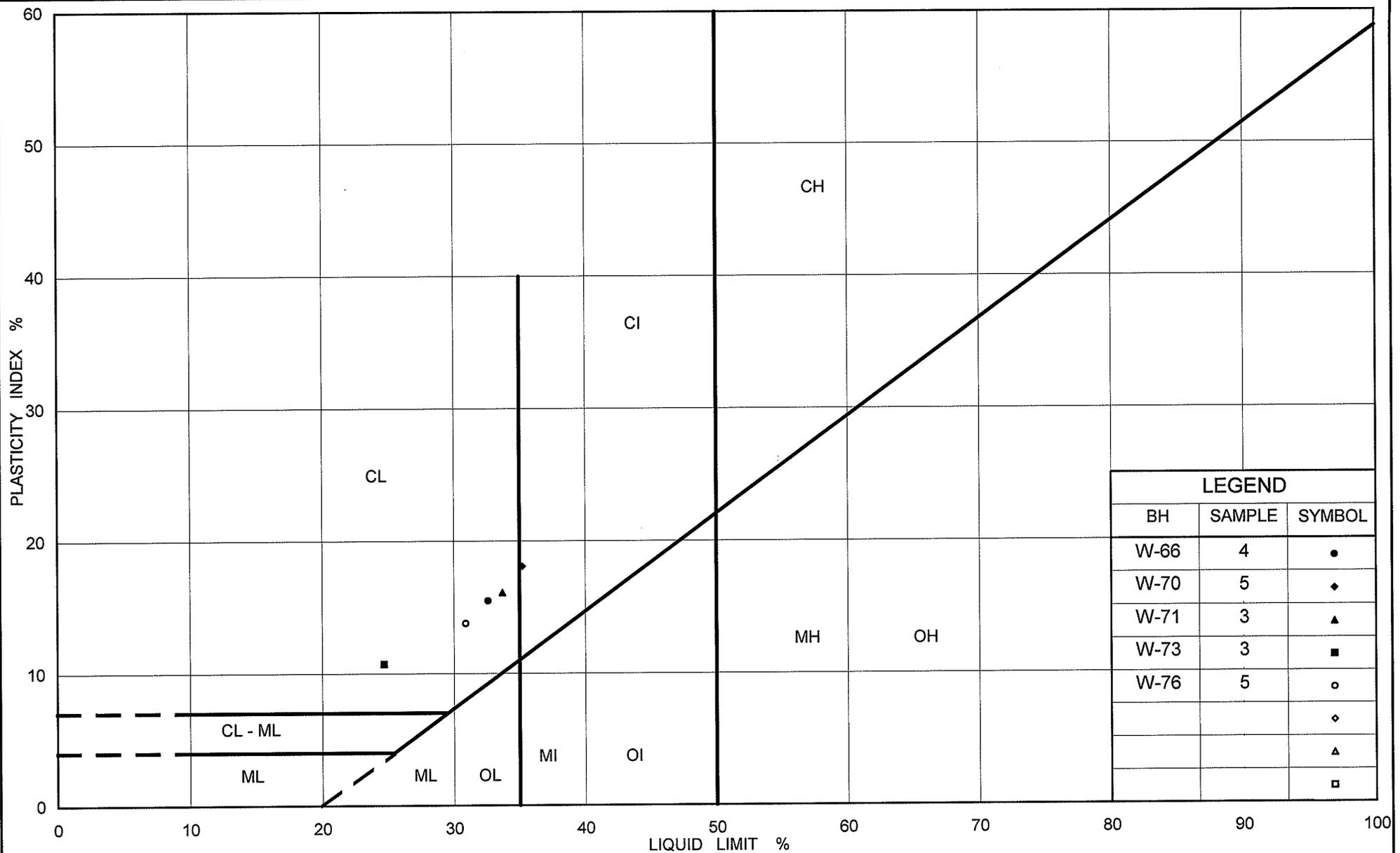
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	W-38	2	97.7
■	W-41	4	101.6
◆	W-42	3	103.5
○	W-51	4	102.7
□	W-54	3	100.4
◇	W-66	7	101.1
●	W-70	2	105.8
■	W-73	3	101.4
○	W-76	5	103.7

Date January, 2007
Project 04-1111-002-6

Golder Associates

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PLASTICITY CHART Fill

FIG No. 2

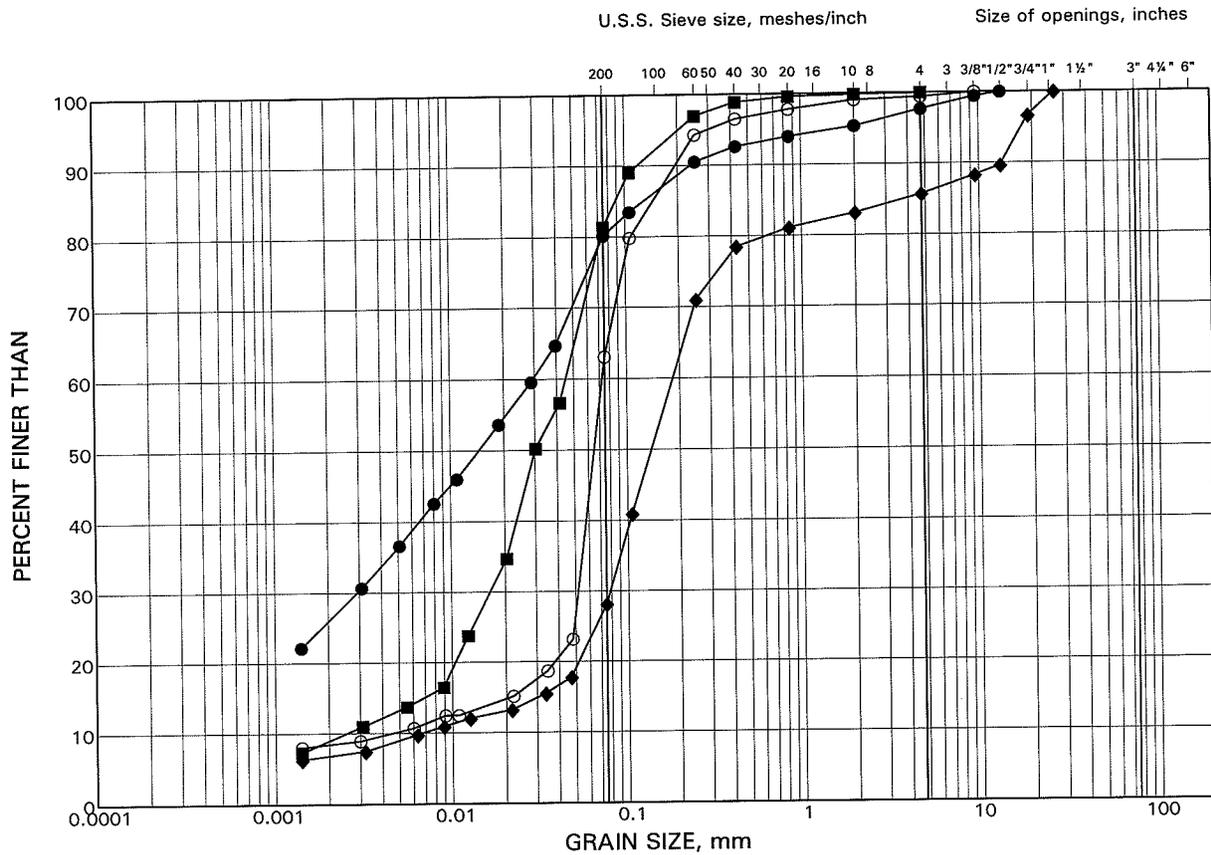
Project No. 04-1111-002-6

Checked by: *lll*

GRAIN SIZE DISTRIBUTION TEST RESULTS

Surficial Silty Sand to Sandy Silt

FIGURE 3



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

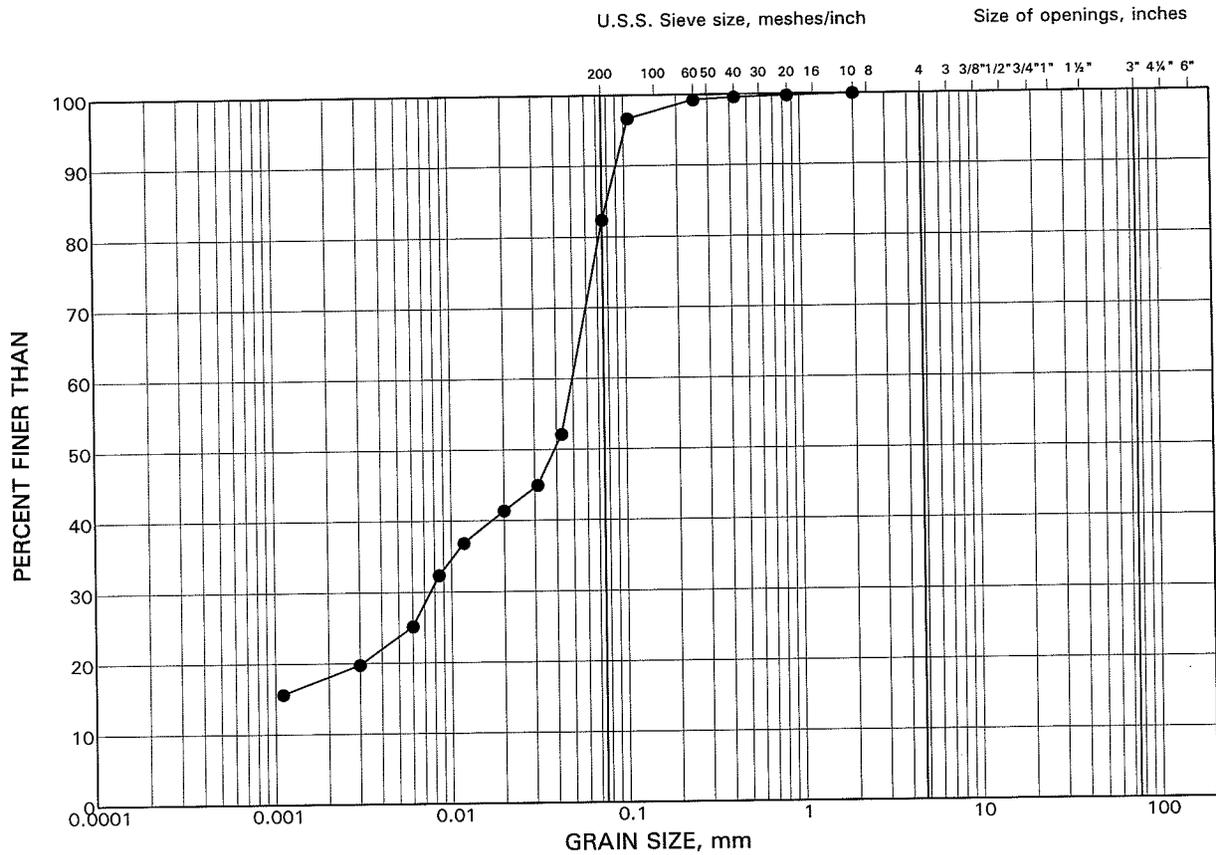
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	207	4	92.5
■	406	8	97.7
◆	W-41	7	98.6
○	W-54	6	98.1

GRAIN SIZE DISTRIBUTION TEST RESULT

Surficial Clayey Silt

FIGURE 4



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

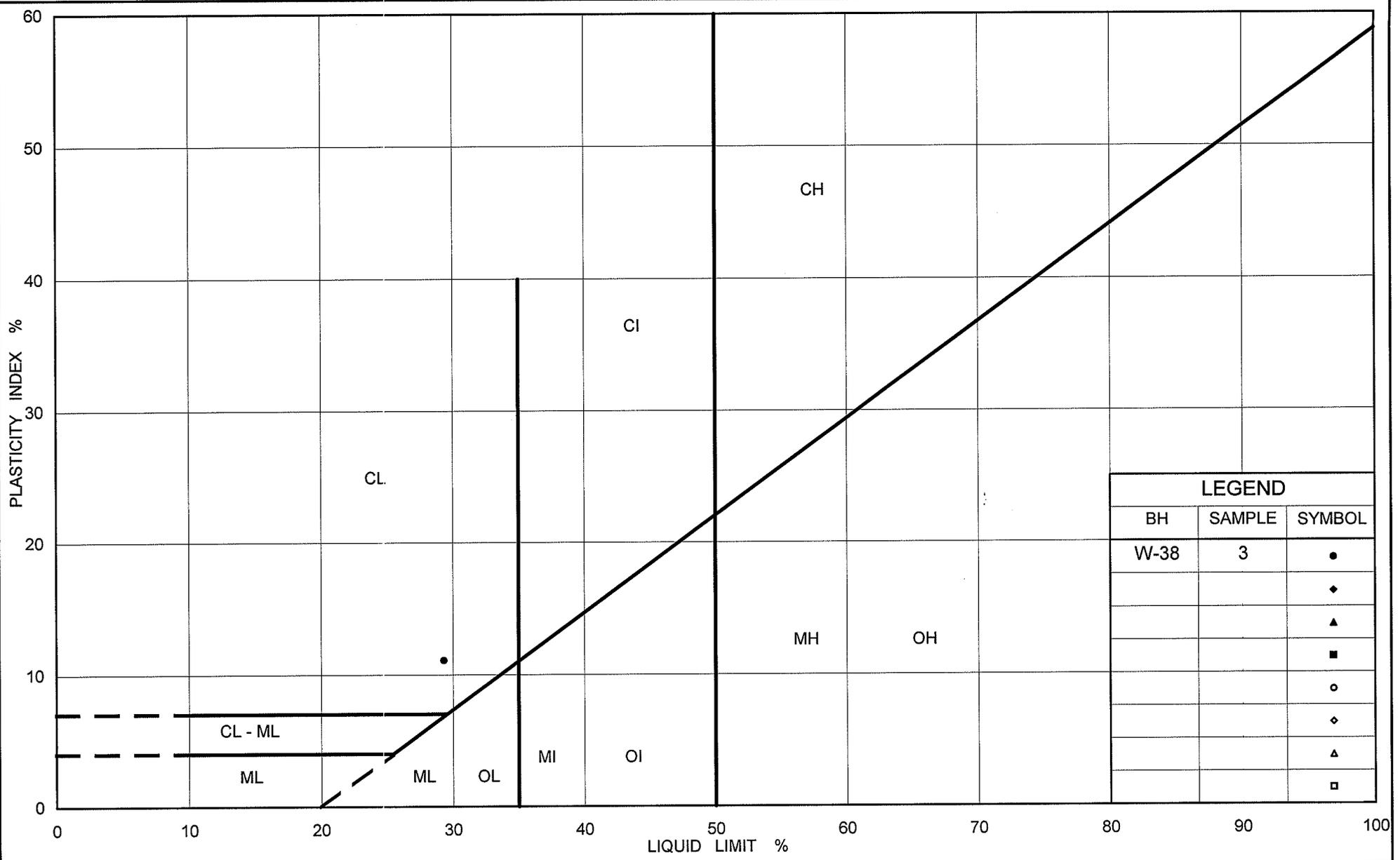
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	W-18	1	94.4

Date January, 2007
Project 04-1111-002-6

Golder Associates

Prepared by LG
Checked by *llc*



LEGEND		
BH	SAMPLE	SYMBOL
W-38	3	●
		◆
		▲
		■
		○
		◇
		△
		□



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PLASTICITY CHART

Surficial Clayey Silt to Silty Clay

FIG No. 5

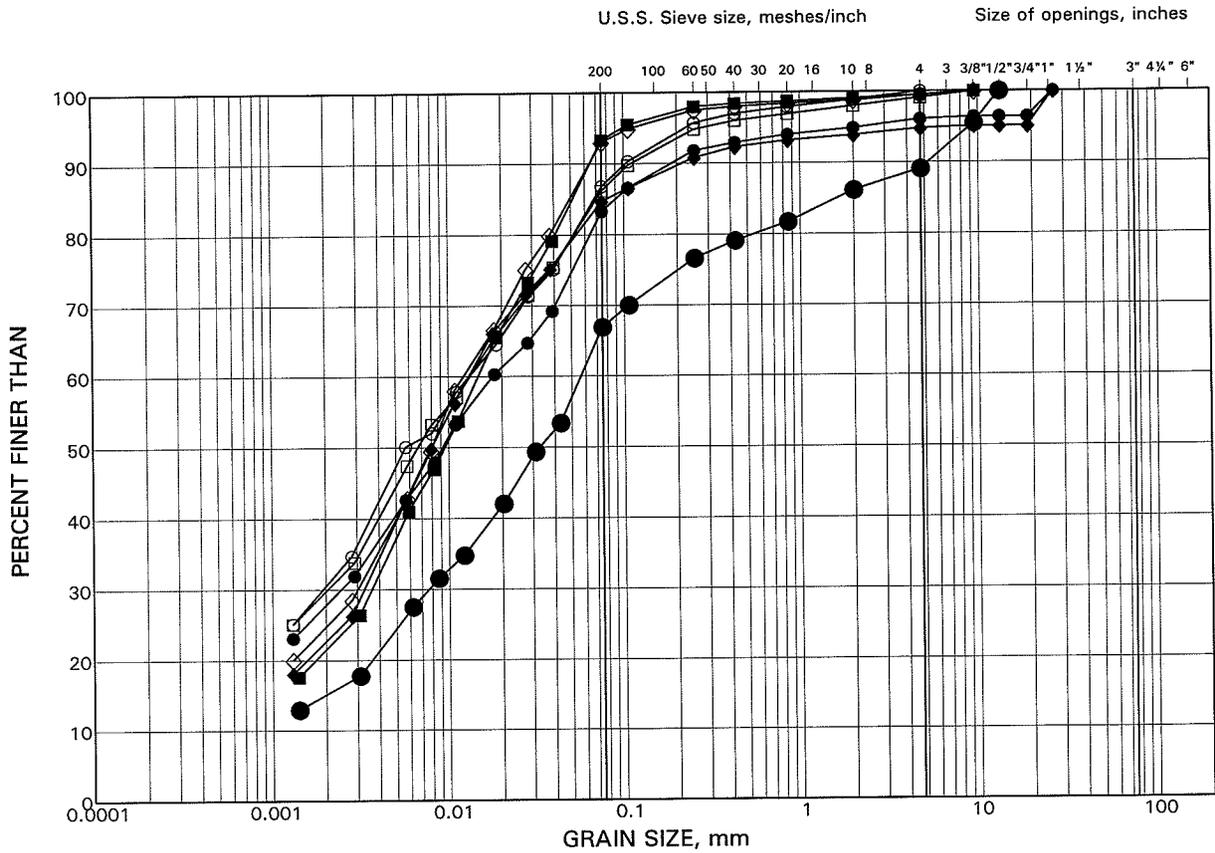
Project No. 04-1111-002-6

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GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt to Silty Clay Till

FIGURE 6A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	06-01	5	86.8
■	06-01	8	83.8
◆	06-01	10	80.7
○	06-02	3	88.6
□	06-02	7	85.5
◇	06-02	9	82.5
●	207	6	91.0

Date January, 2007
Project 04-1111-002-6

Golder Associates

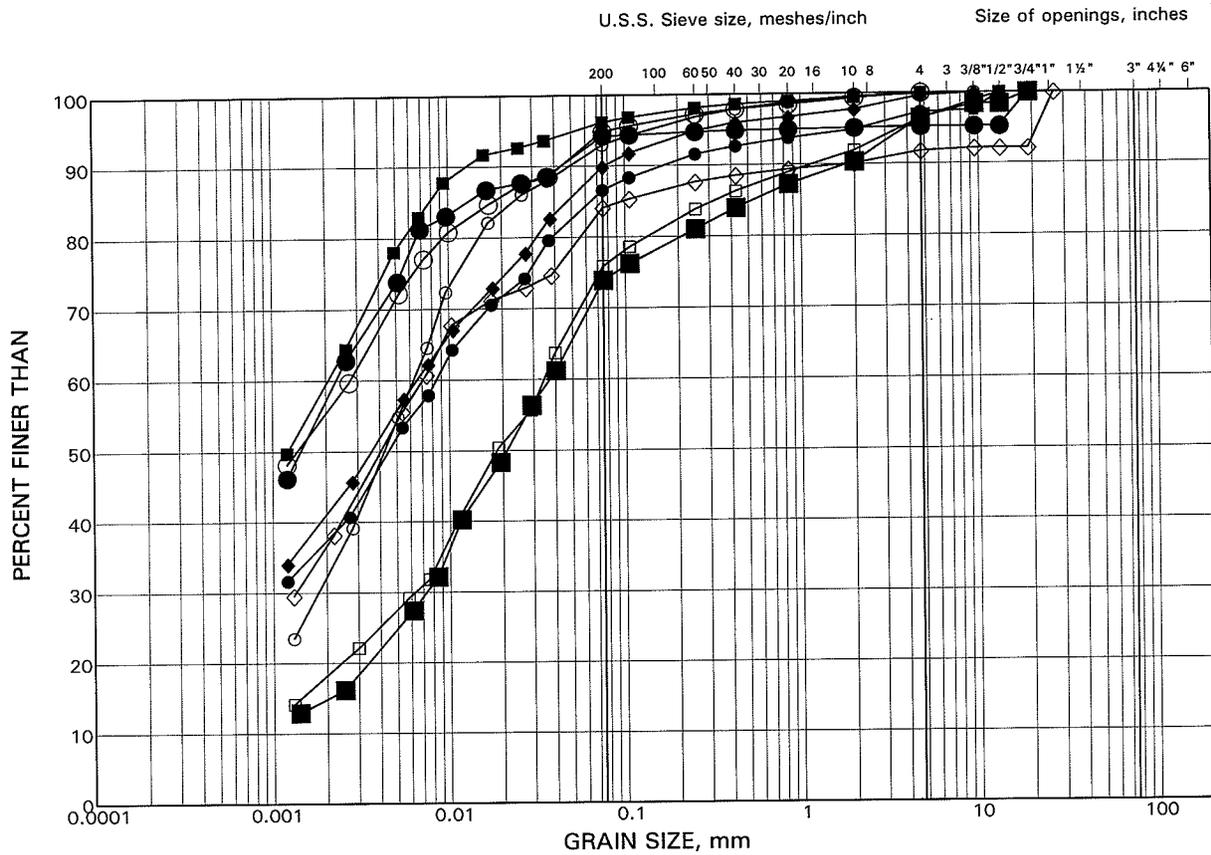
Prepared by LG

Checked by *[Signature]*

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt to Silty Clay Till

FIGURE 6B



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

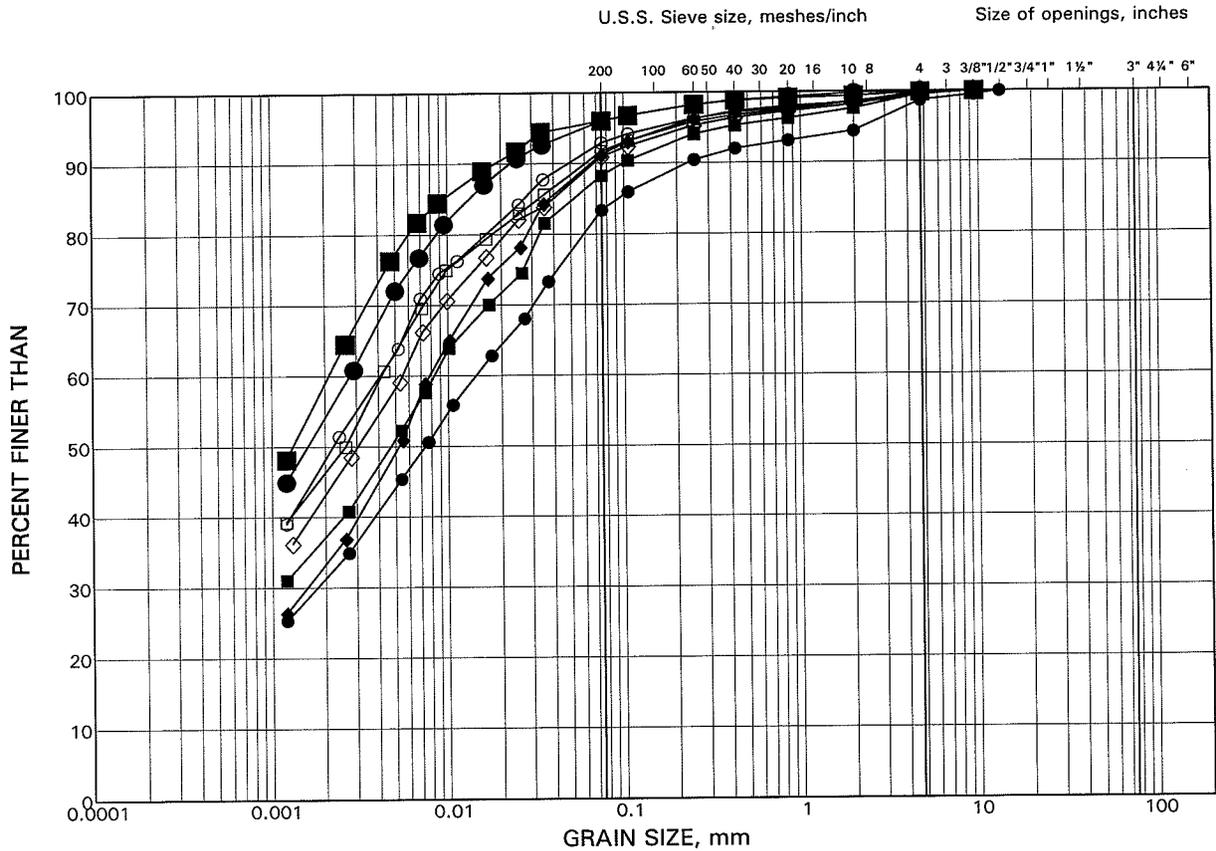
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	401	11	93.2
■	402	16	85.9
◆	403	9	96.3
○	403	19	81.1
□	404	20	79.9
◇	502	15	84.1
●	503	13	87.4
■	505	19	79.2
○	507	6	97.4

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt to Silty Clay Till

FIGURE 6C



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

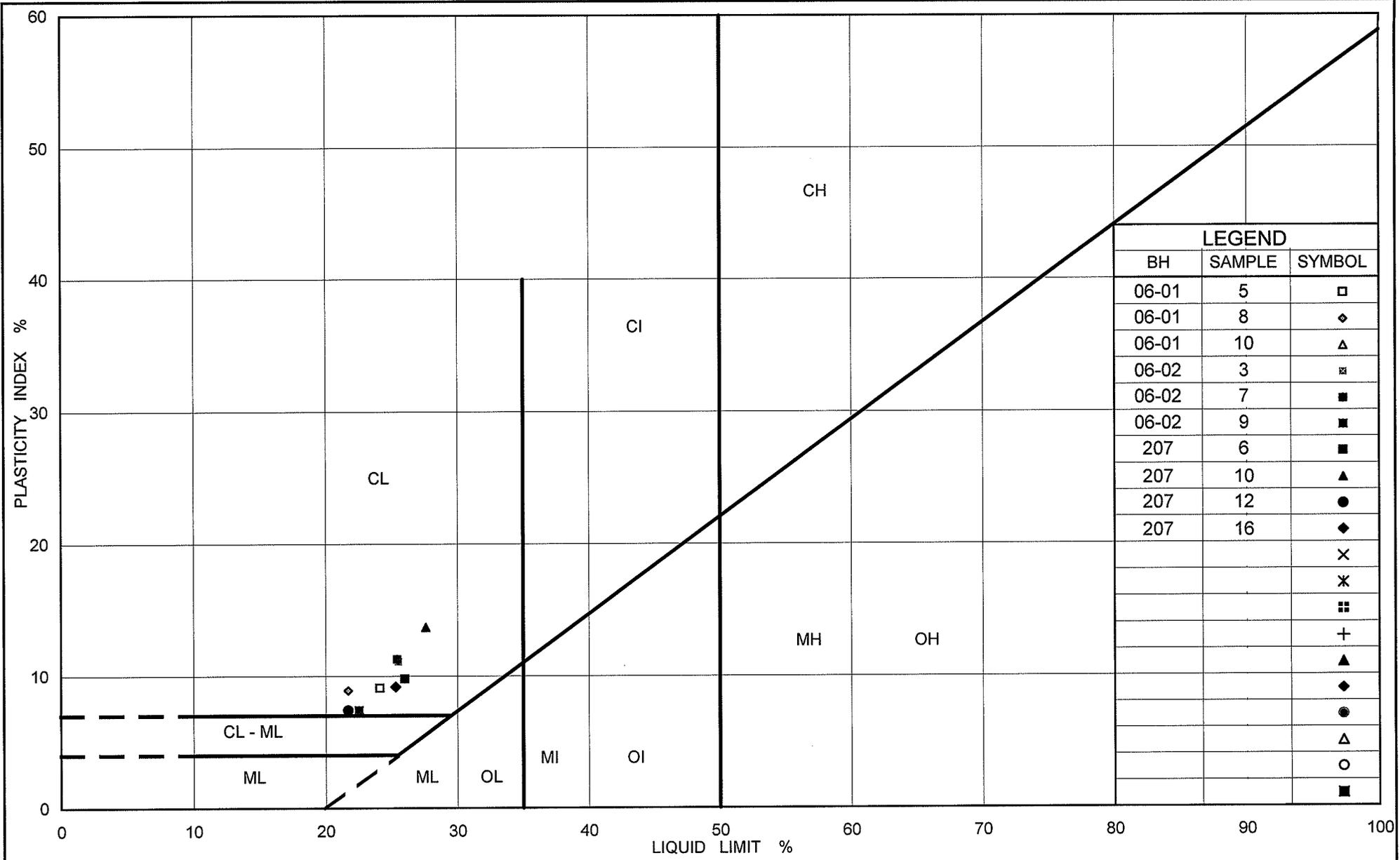
LEGEND

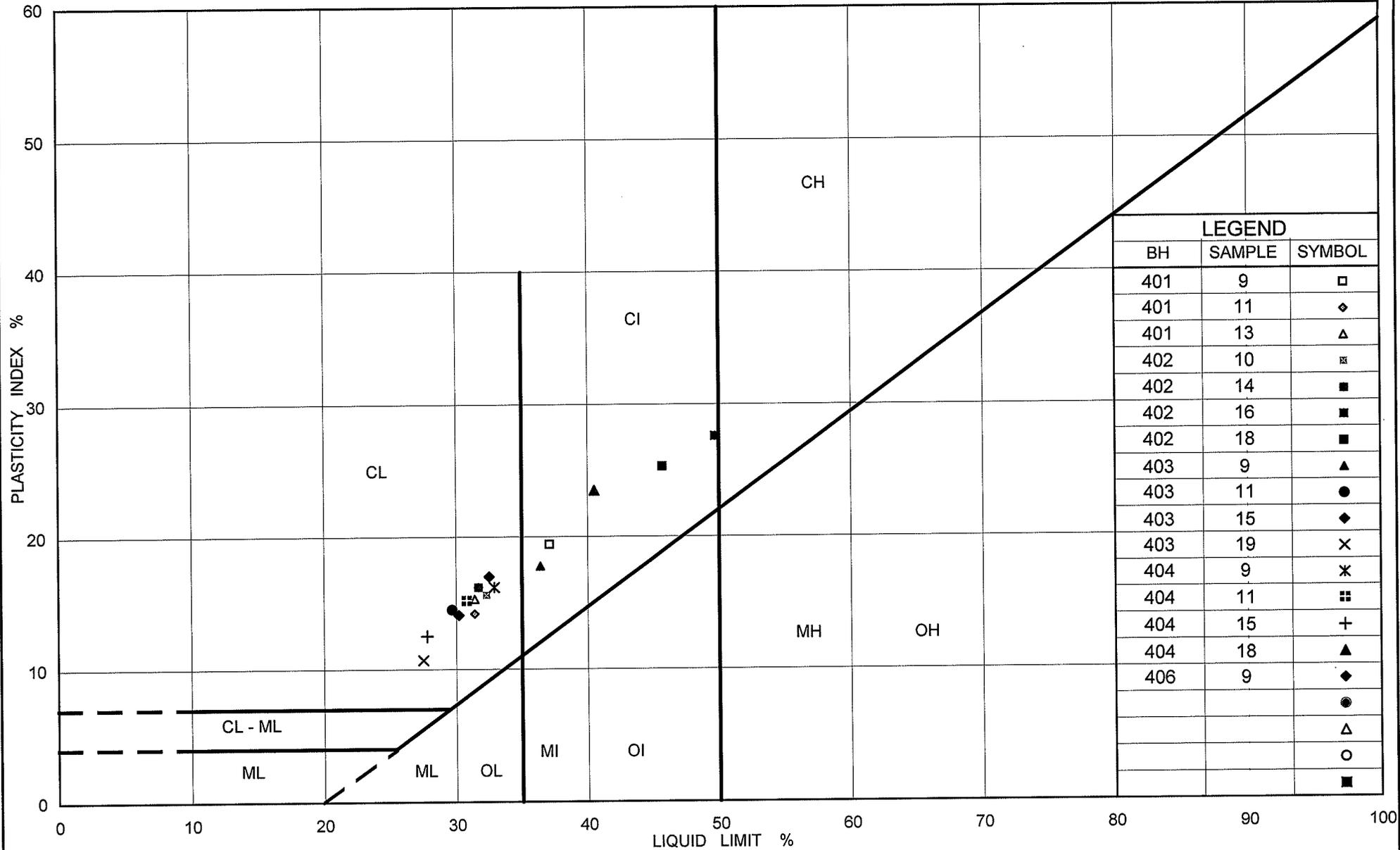
SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	W-34	5	94.3
■	W-36	7	94.2
◆	W-39	4	96.9
○	W-44	2	99.0
□	W-45	7	93.3
◇	W-53	8	92.6
●	W-64	8	95.0
■	W-69	5	97.4

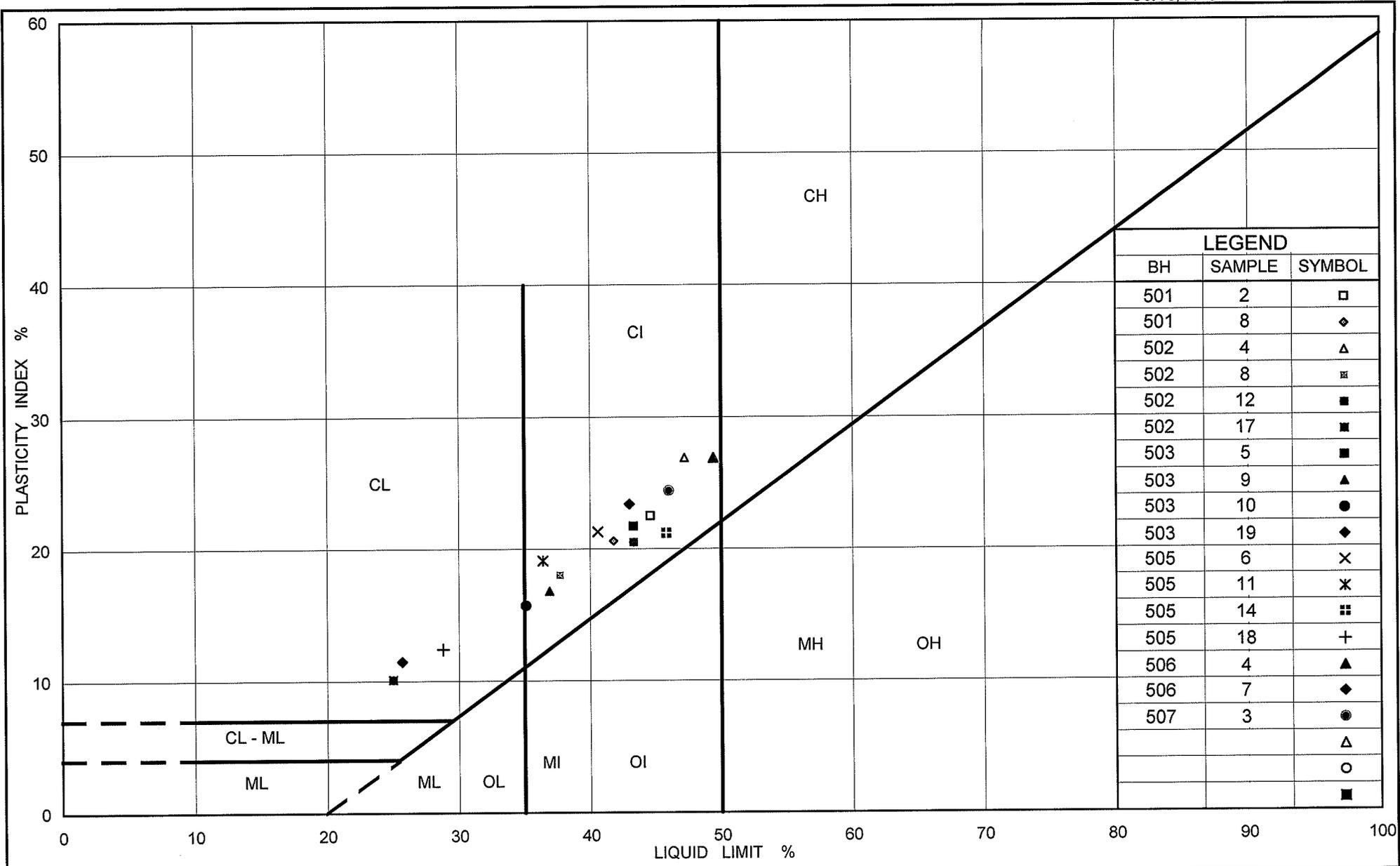
Date January, 2007
Project 04-1111-002-6

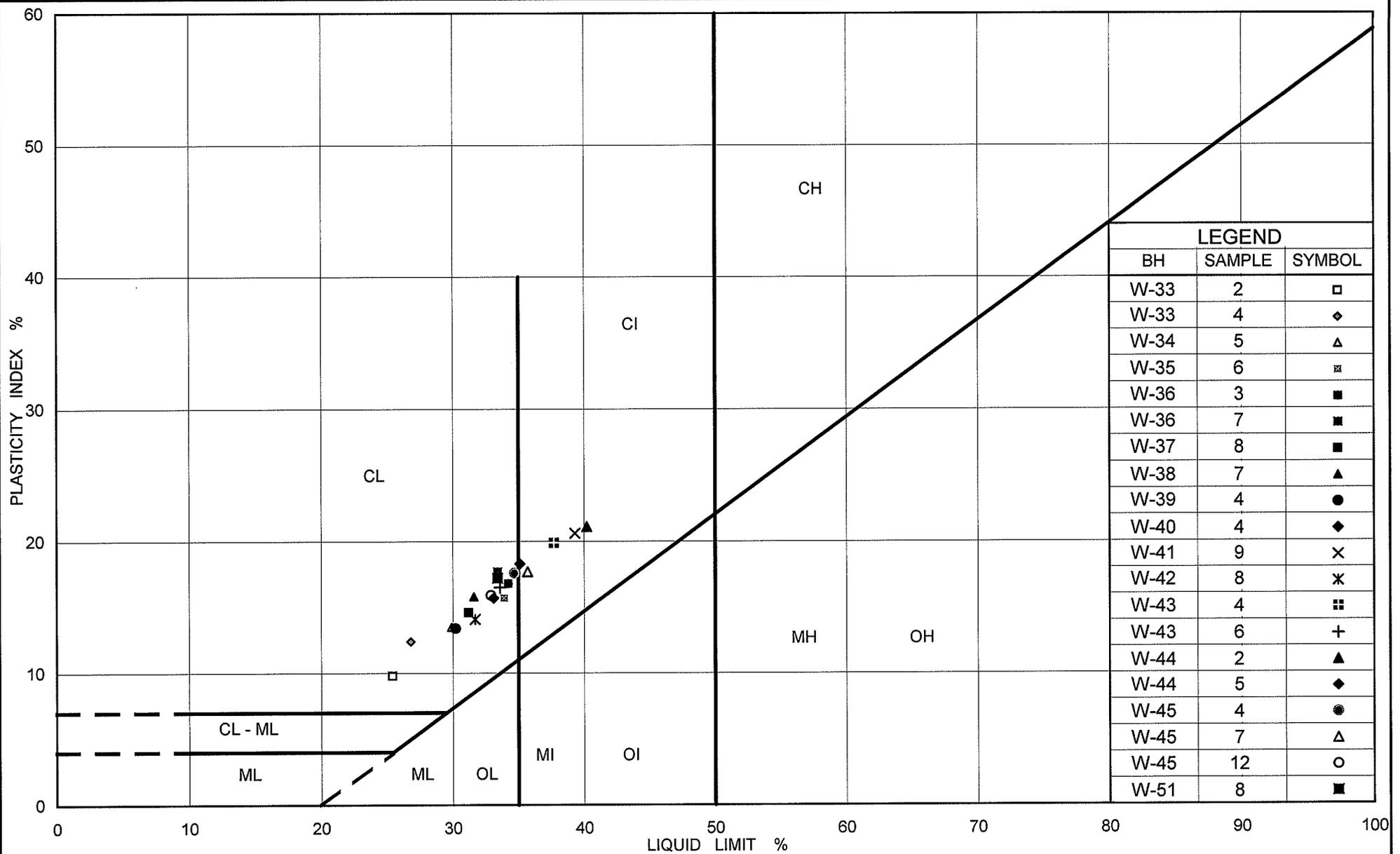
Golder Associates

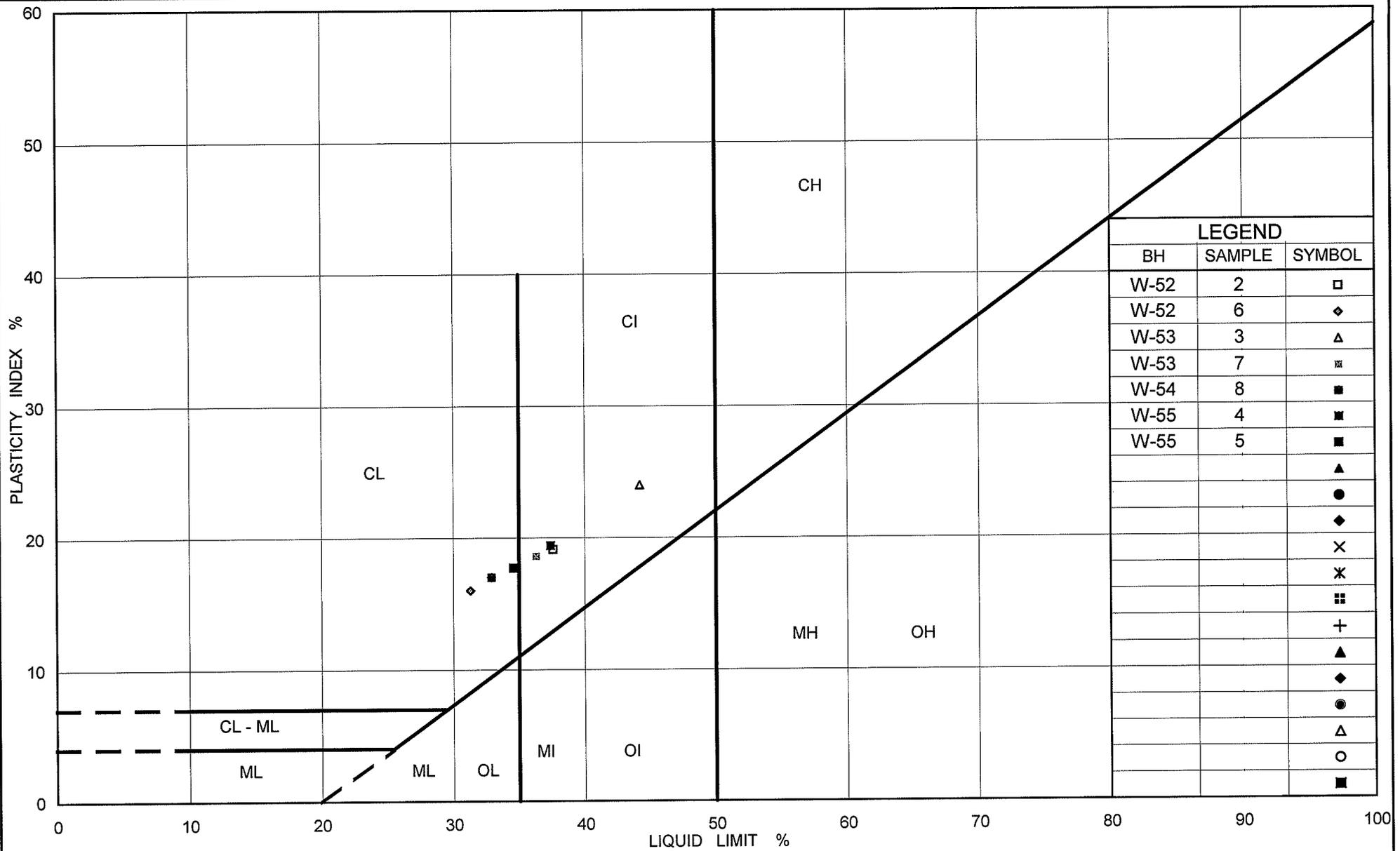
Prepared by LG
Checked by *lll*

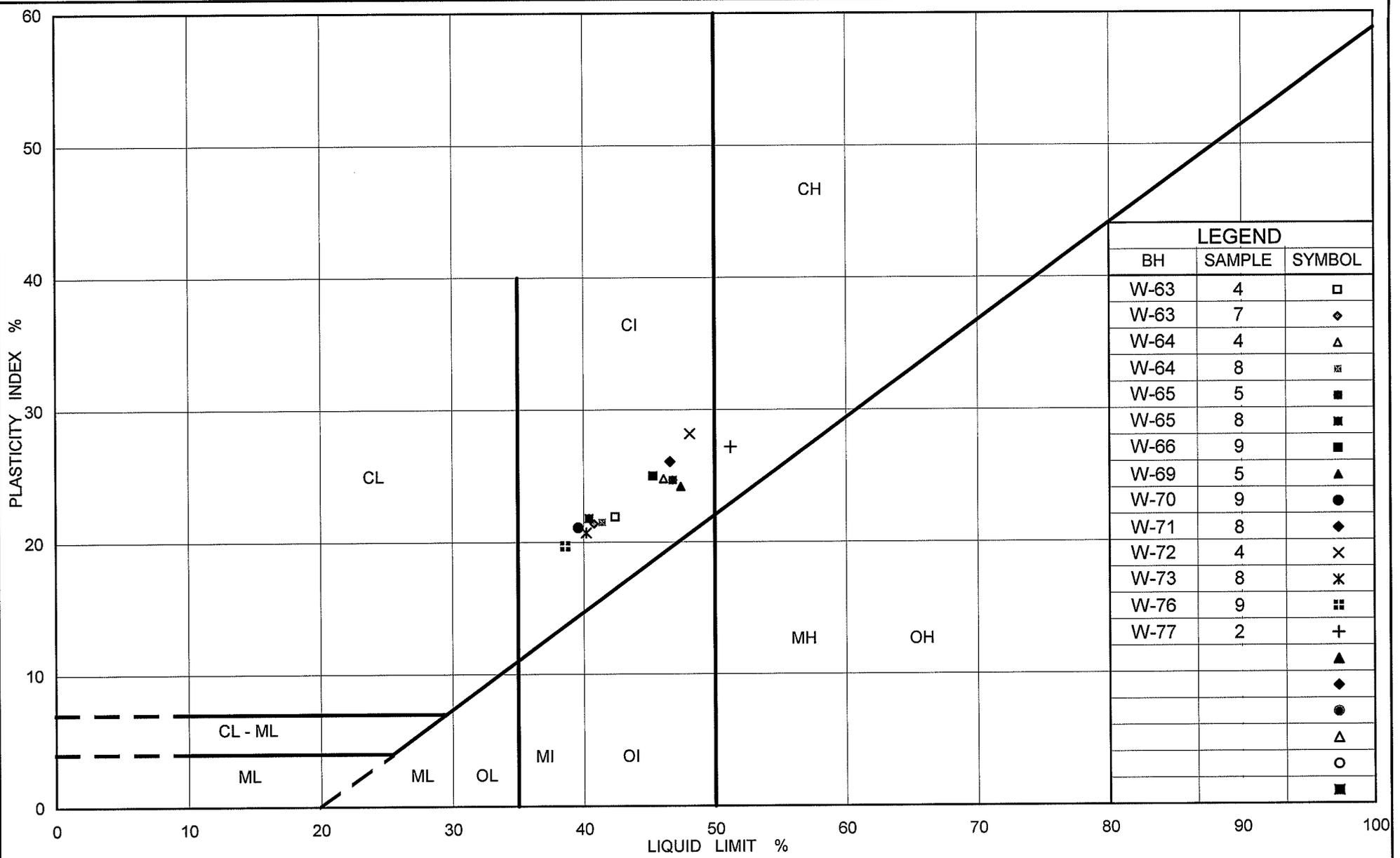












**CONSOLIDATION TEST SUMMARY
SILTY CLAY TILL**

FIGURE 8A

SAMPLE IDENTIFICATION

Project Number	04-1111-002	Sample Number	10
Borehole Number	503	Sample Depth, m	9.1-9.8

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	7		
Date Started	01/15/2005		
Date Completed	01/31/2005		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m ³	19.81
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m ³	15.45
Area, cm ²	31.65	Specific Gravity, measured	2.76
Volume, cm ³	60.13	Solids Height, cm	1.084
Water Content, %	28.22	Volume of Solids, cm ³	34.32
Wet Mass, g	121.45	Volume of Voids, cm ³	25.81
Dry Mass, g	94.72	Degree of Saturation, %	103.5

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	cv. cm ² /s	mv m ² /kN	k cm/s
0.00	1.900	0.752	1.900				
4.83	1.900	0.752	1.900	5	1.53E-01	0.00E+00	0.00E+00
9.46	1.897	0.749	1.899	64	1.19E-02	3.41E-04	3.99E-07
19.51	1.889	0.742	1.893	271	2.80E-03	4.19E-04	1.15E-07
38.91	1.874	0.728	1.882	287	2.61E-03	4.07E-04	1.04E-07
77.57	1.855	0.711	1.865	197	3.74E-03	2.59E-04	9.48E-08
154.88	1.827	0.685	1.841	124	5.79E-03	1.91E-04	1.08E-07
38.91	1.844	0.701	1.836			7.72E-05	
9.46	1.868	0.723	1.856			4.29E-04	
4.83	1.876	0.730	1.872			9.09E-04	
9.46	1.874	0.728	1.875	124	6.01E-03	2.27E-04	1.34E-07
19.51	1.868	0.723	1.871	375	1.98E-03	3.14E-04	6.09E-08
38.91	1.856	0.712	1.862	394	1.87E-03	3.26E-04	5.95E-08
77.57	1.841	0.698	1.849	287	2.52E-03	2.04E-04	5.05E-08
154.88	1.820	0.678	1.831	171	4.15E-03	1.43E-04	5.82E-08
309.55	1.769	0.631	1.795	271	2.52E-03	1.74E-04	4.28E-08
618.87	1.685	0.554	1.727	404	1.57E-03	1.43E-04	2.19E-08
1238.51	1.593	0.469	1.639	366	1.56E-03	7.81E-05	1.19E-08
2475.91	1.499	0.382	1.546	197	2.57E-03	4.00E-05	1.01E-08
1238.51	1.513	0.395					
309.55	1.554	0.433					
77.57	1.605	0.480					
19.51	1.664	0.535					
4.83	1.704	0.571					

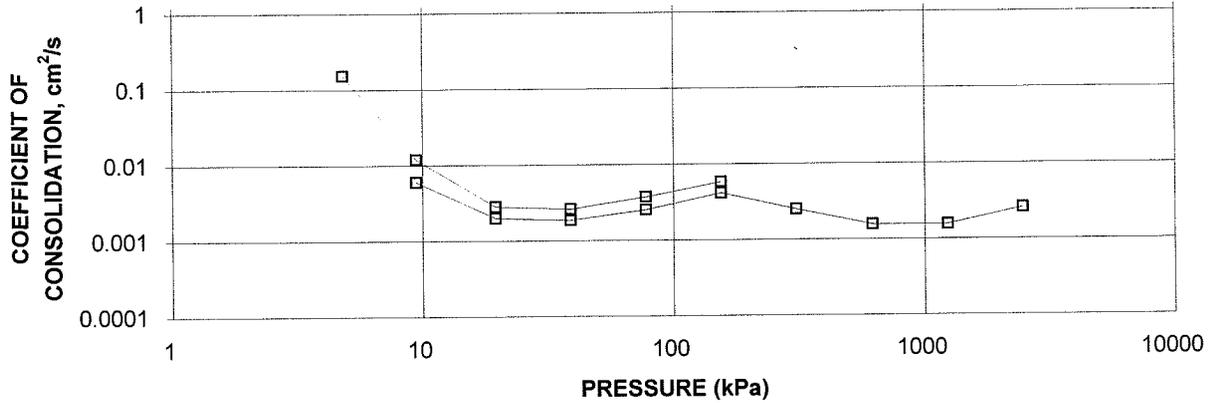
Notes:

k calculated using cv based on t₉₀ values.

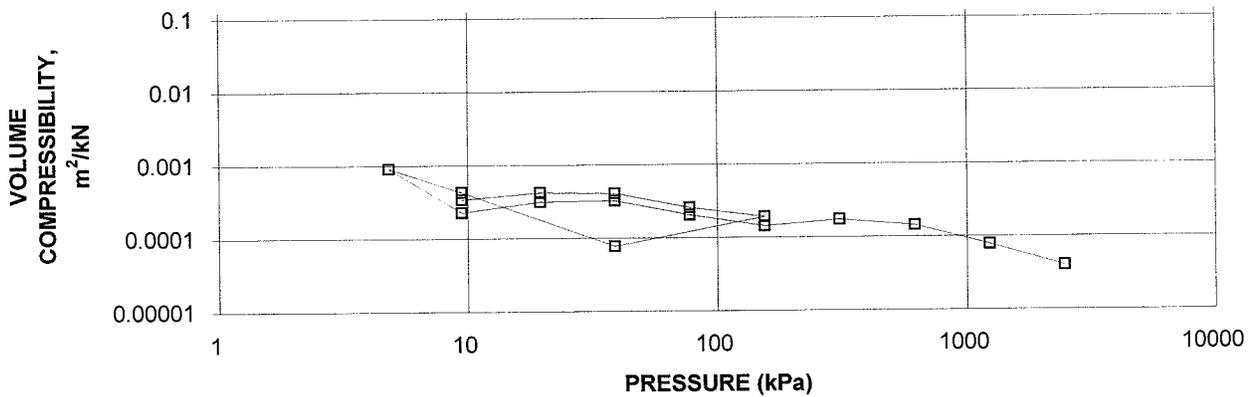
**CONSOLIDATION TEST SUMMARY
SILTY CLAY TILL**

FIGURE 8B

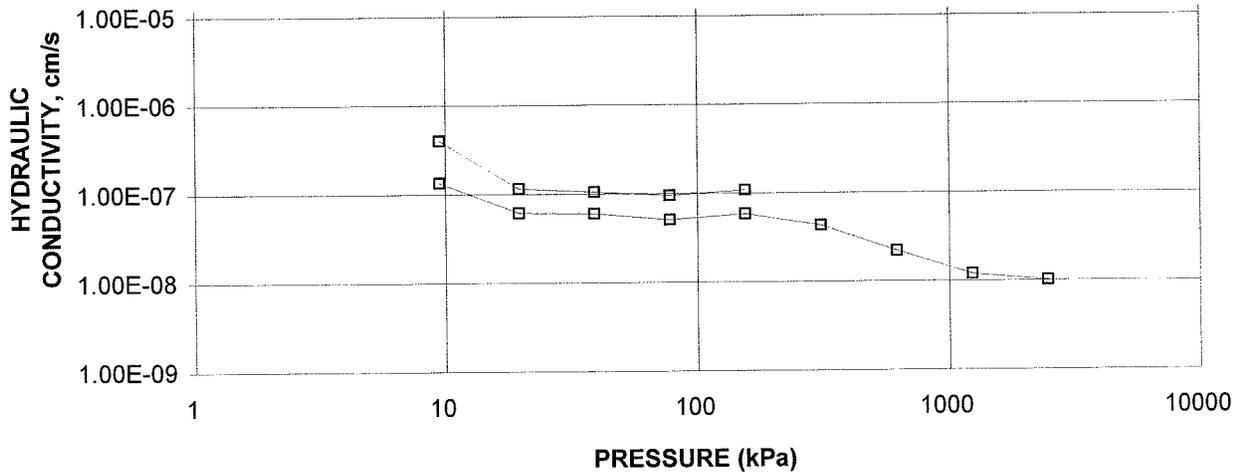
**CONSOLIDATION TEST
CV cm²/s VS PRESSURE (kPa)
BH 503 SA 10**



**CONSOLIDATION TEST
MV m²/kN vs PRESSURE (kPa)
BH 503 SA 10**



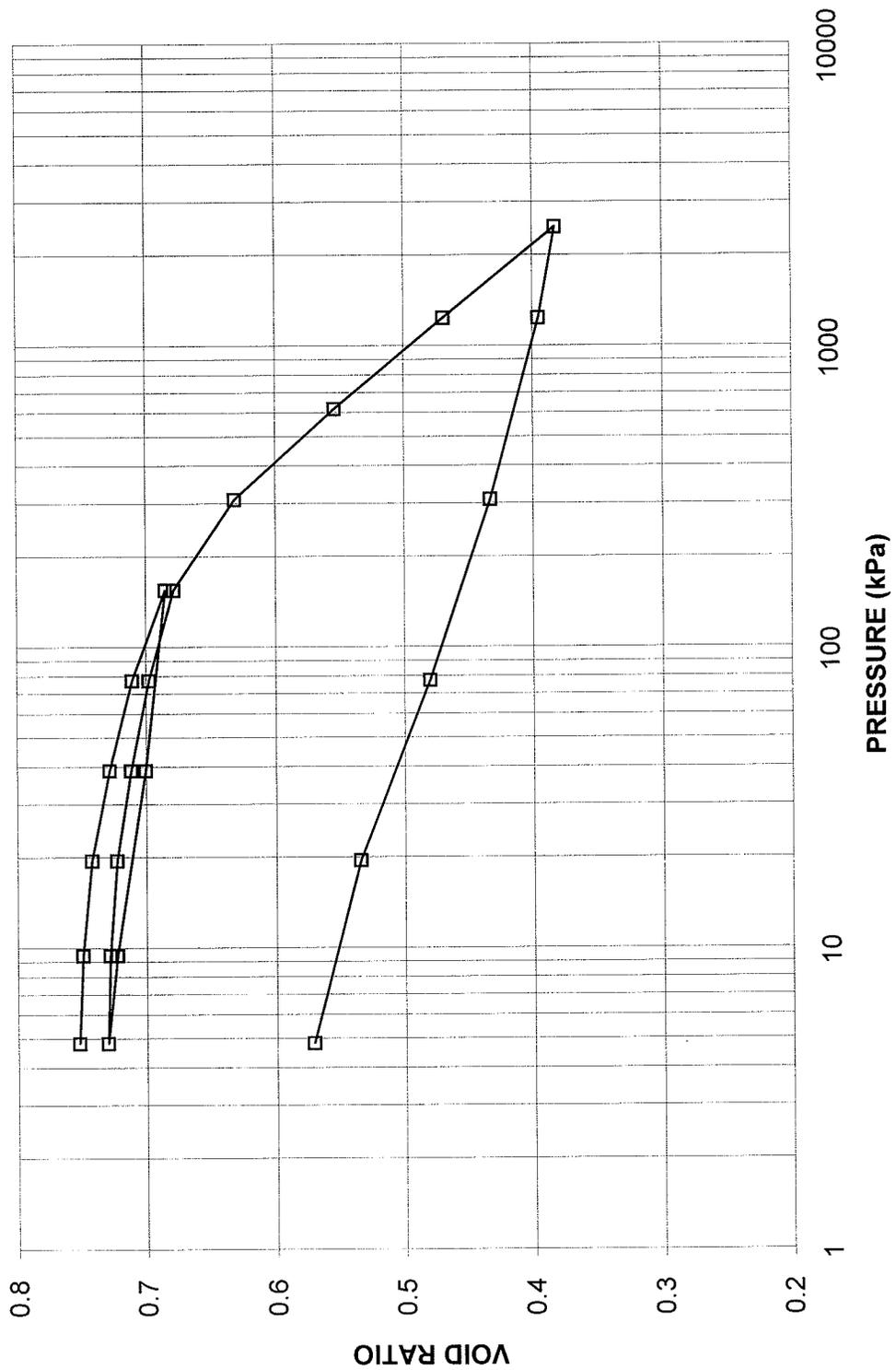
**CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs PRESSURE
BH 503 SA 10**



CONSOLIDATION TEST RESULTS
SILTY CLAY TILL

FIGURE 8C

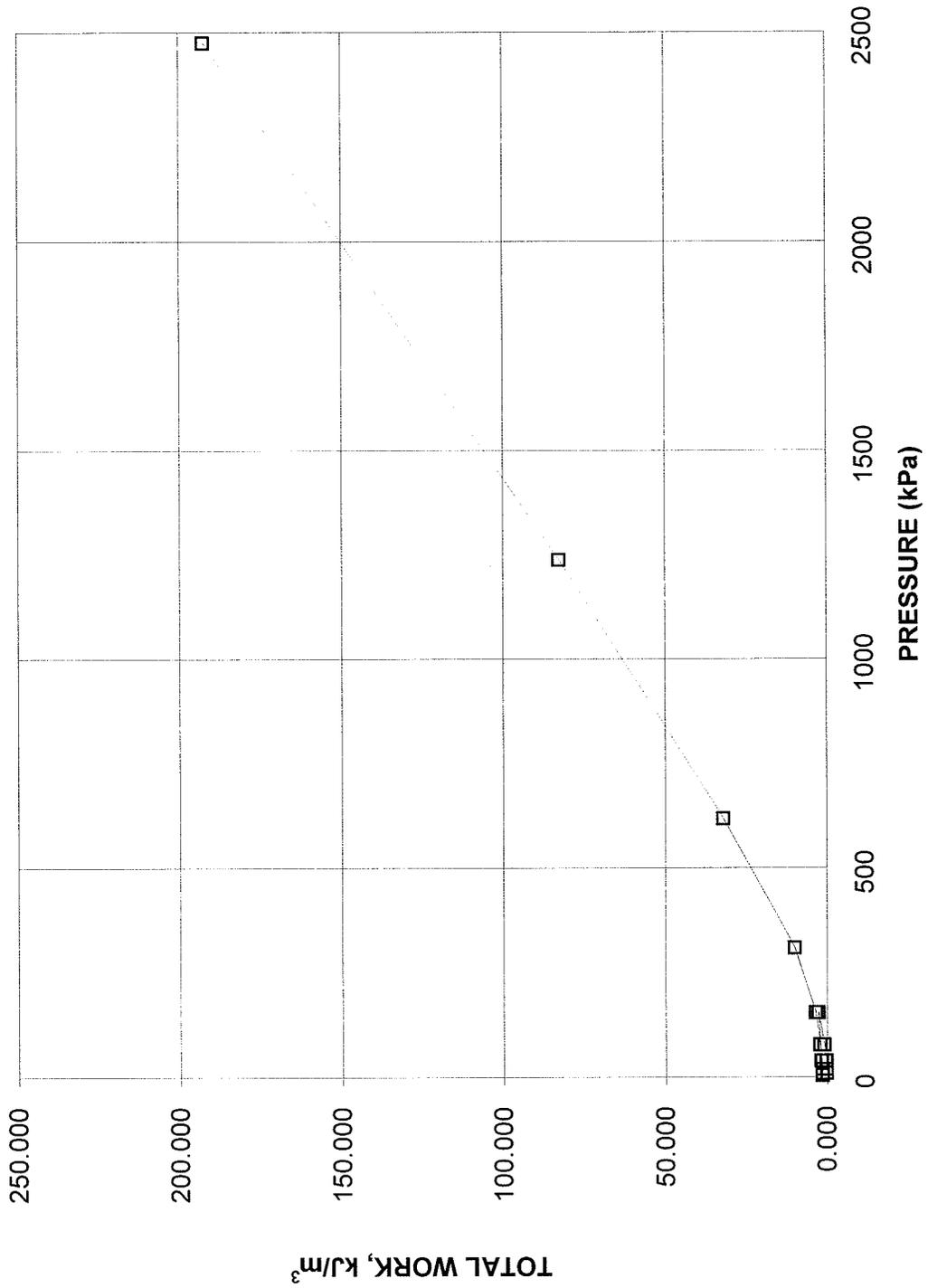
CONSOLIDATION TEST
VOID RATIO vs PRESSURE
BOREHOLE 503, SAMPLE 10



CONSOLIDATION TEST RESULTS
SILTY CLAY TILL

FIGURE 8D

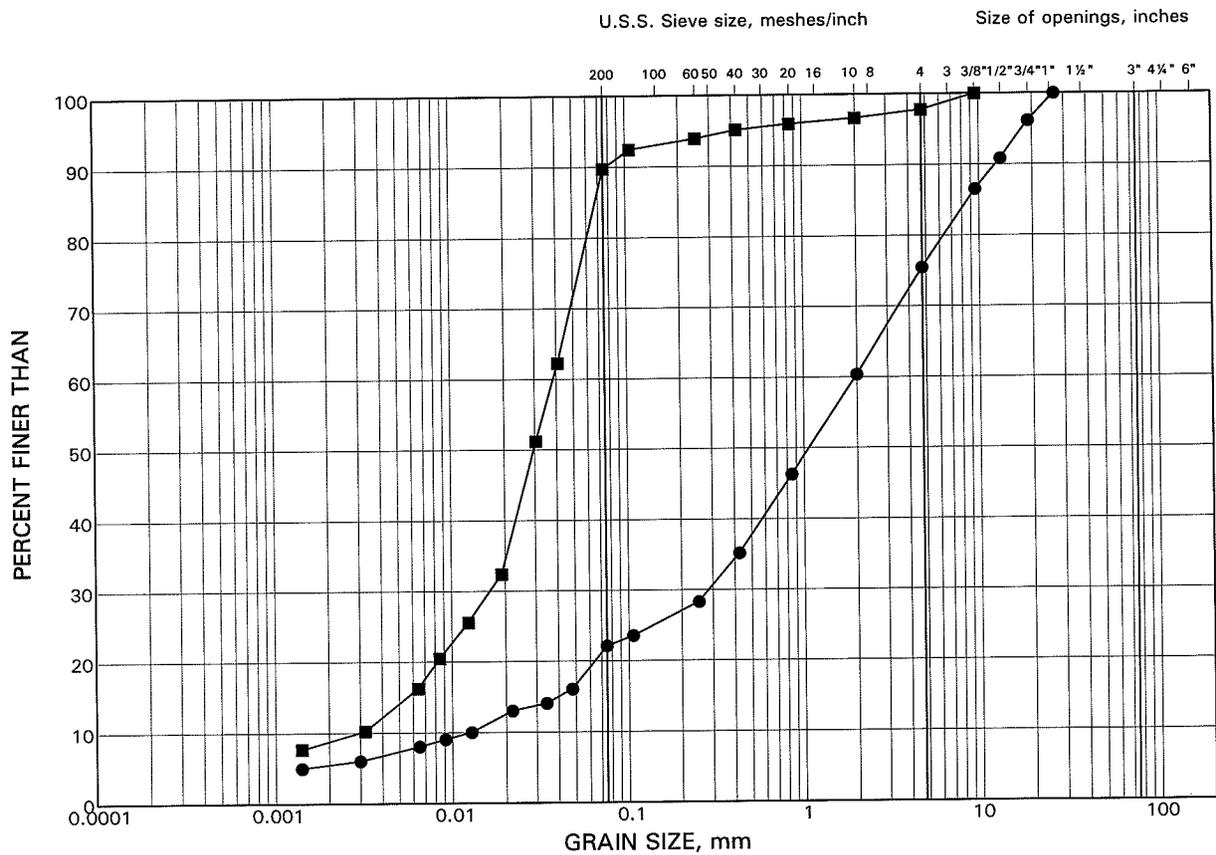
CONSOLIDATION TEST
TOTAL WORK, kJ/m^3 vs PRESSURE
BOREHOLE 503, SAMPLE 10



GRAIN SIZE DISTRIBUTION TEST RESULTS

Lower Gravelly Sand to Silt

FIGURE 9



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

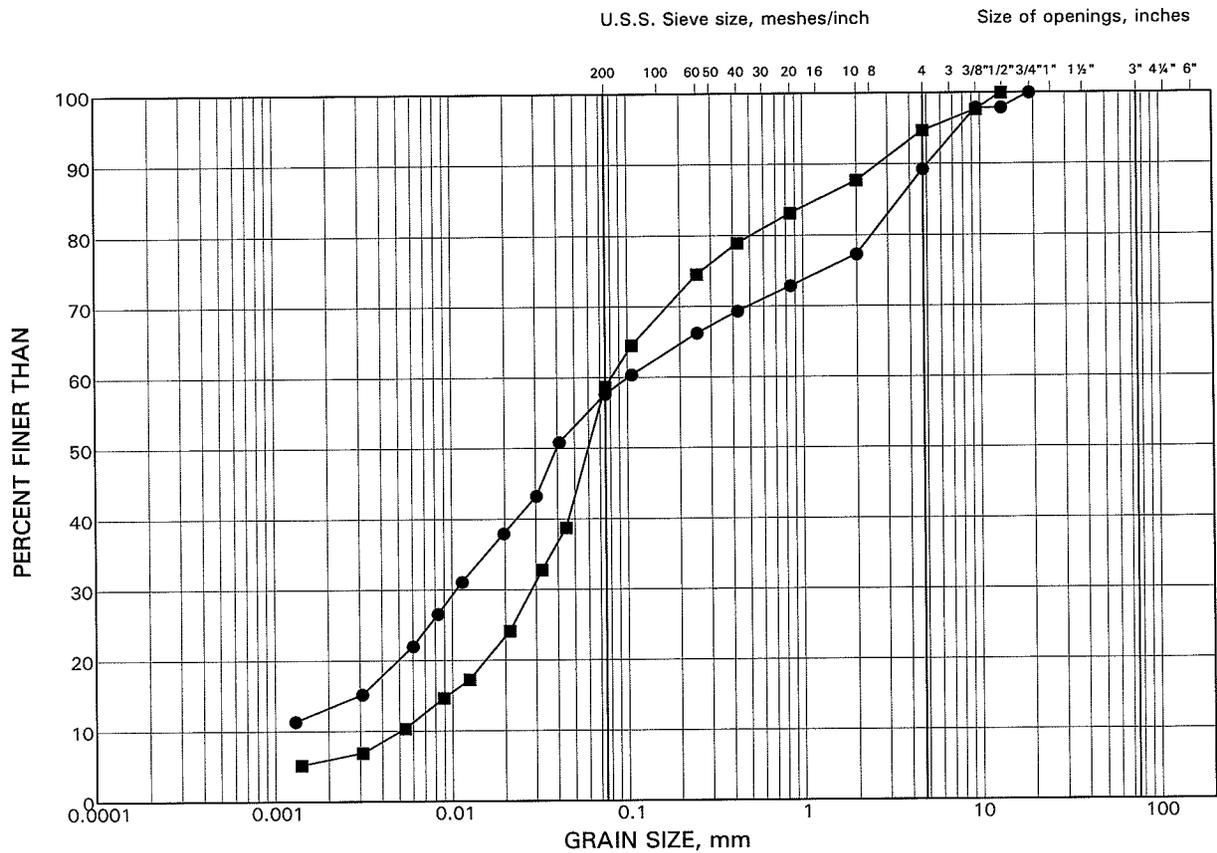
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	503	21	75.2
■	504	23	70.7

GRAIN SIZE DISTRIBUTION TEST RESULTS

Lower Clayey Silt Till / Residual Soil

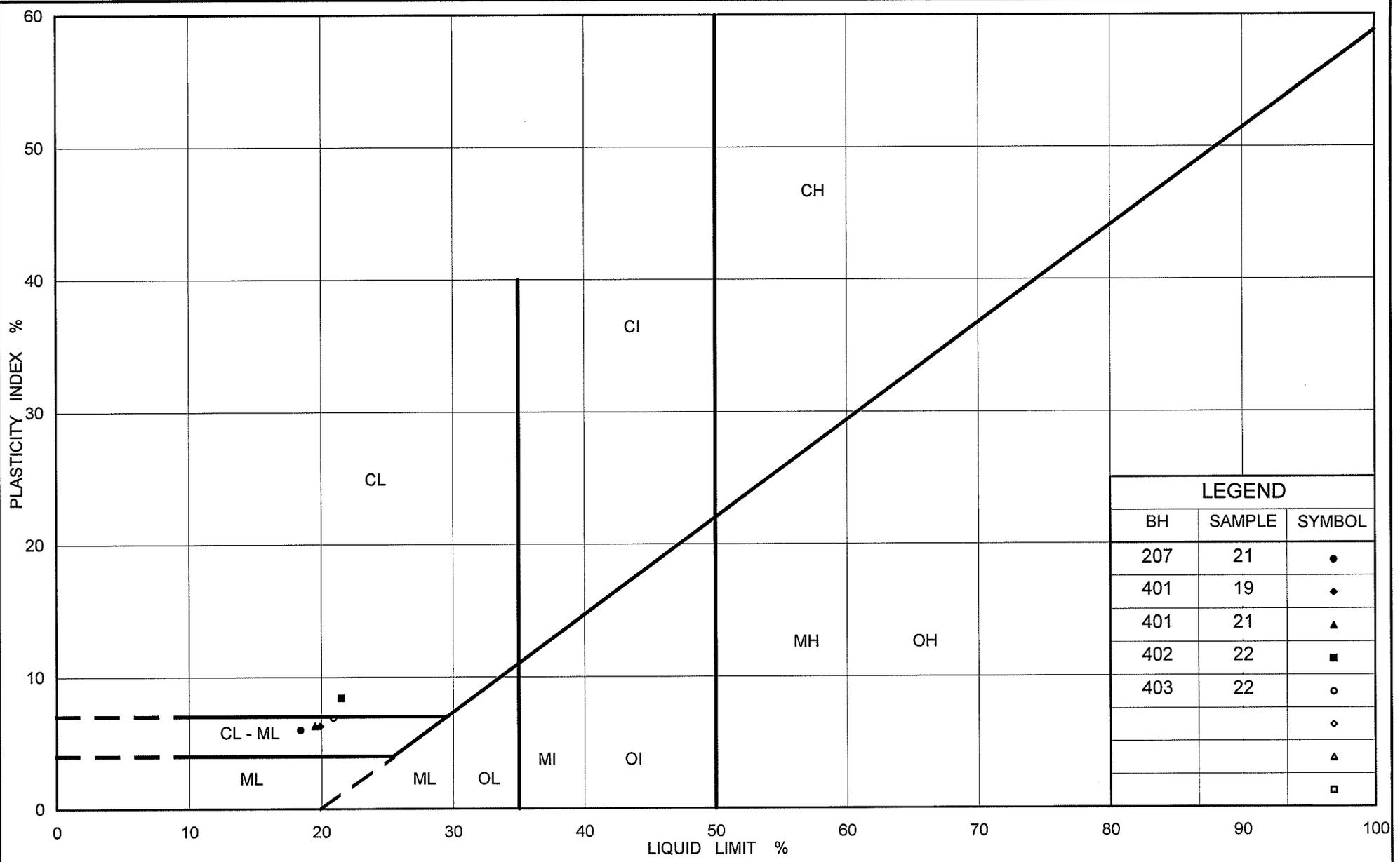
FIGURE 10



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	401	21	73.6
■	404	22	74.1



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt Till / Residual Soil

FIG No. 11

Project No. 04-1111-002-6

Checked by: *ll*

APPENDIX A

BOREHOLE RECORDS FROM 1955 INVESTIGATION BY DEPARTMENT OF HIGHWAYS, ONTARIO

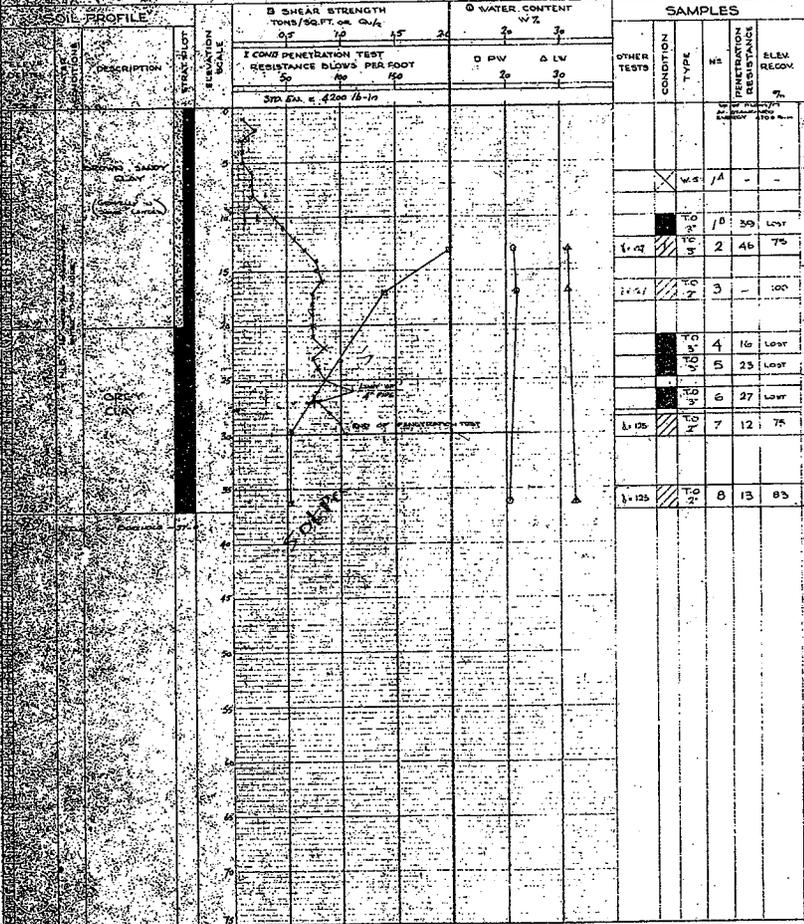
MATERIALS LABORATORY - DEPARTMENT OF HIGHWAYS - DIST. NO. 10
 OFFICE REPORT ON SOIL EXPLORATION

JOB 55-F-16 BORING NO. 3
 DATUM STU 09.14 DATE REPORT SEPT. 16, 1953
 COMPILED BY B.H. CHECKED BY H. W. W. W. BORING DATE SEPT. 14-16, 1953

SAMPLE CONDITION
 AS TESTED
 100%
 100%
 100%

SAMPLE TYPES
 CS - CHUNK
 OC - DRIVE OPEN
 OF - DRIVE FOOT VALVE
 YO - THIN WALLED OPEN
 WS - WASHED SAMPLE
 RC - ROCK CORE

ABBREVIATIONS
 V - INSITU VANE SHEAR TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 Q - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 P - UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 CA - CASING
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL



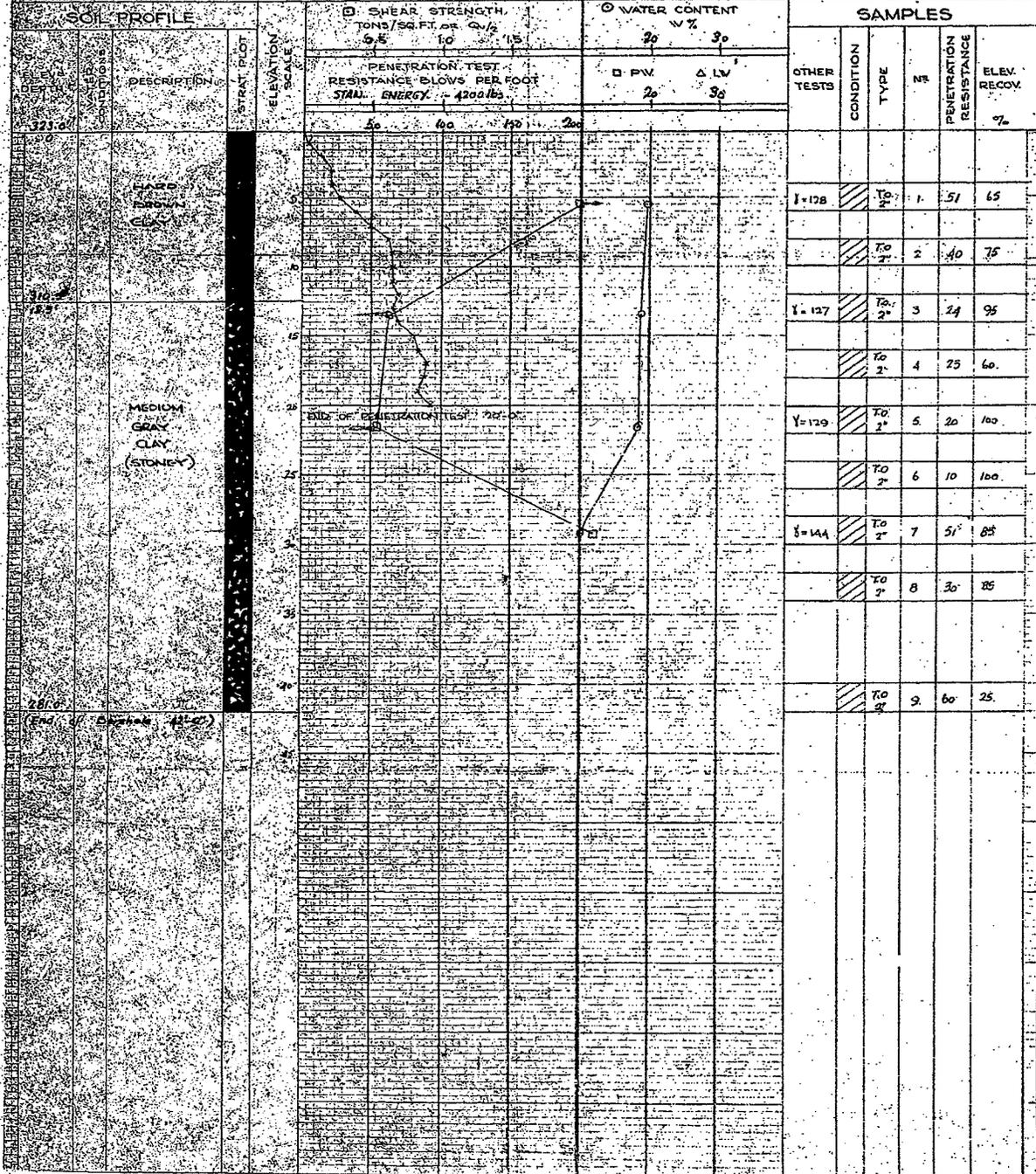
MATERIALS LABORATORY - DEPARTMENT OF HIGHWAYS - ONTARIO
OFFICE REPORT ON SOIL EXPLORATION

DRILL ORIG. POWER DRILL
 CASING 4" C.P. STANDARD SAMPLERS TO FIT UNLESS NOTED
 SAMPLER HAMMER WT. 140 LBS. DIAM. 2 1/2" INCHES
 JOB C-53-16 ST. CATHERINES BORING NO. 10
 DATUM STAL 974.19.5 64.92 DATE REPORT 22-11-55
 COMPILED BY J.B. CHECKED BY J. L. BORGING DATE 20-11-55

SAMPLE CONDITION
 Hatched box: NOT USED
 Solid box: GOOD
 Dotted box: LOST

SAMPLE TYPES
 C.S. - CHUNK
 D.S. - DRIVE OPEN
 D.F. - DRIVE FOOT VALVE
 T.O. - THIN WALLED OPEN
 W.S. - WASHED SAMPLE
 R.C. - ROCK CORE

ABBREVIATIONS
 V - INSITU VANE SHEAR TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 Qc - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 CA - CASING
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL



MATERIALS LABORATORY-DEPARTMENT OF HIGHWAYS - OILT 210
OFFICE REPORT ON SOIL EXPLORATION.

DRILL RIG CORE DRILL # 4 JOB F-55-16 BORING NO. 144
 CASING B.X. (STANDARD SAMPLERS TO FIT UNLESS NOTED) DATUM STM 104 + 76 60-0" B DATE REPORT 6-1-55
 SAMPLER HAMMER WT 750 # 29 DROP 24 INCHES COMPILED BY LB CHECKED BY N. W. W. BORING DATE 4-5-55

SAMPLE CONDITION



DISTURBED
 GOOD
 LOST

SAMPLE TYPES

C.S - CHUNK
 D.C - DRIVE OPEN
 D.F - DRIVE FOOT VALVE
 W.S - WASHED SAMPLE
 T.O - THIN WALLED OPEN
 R.C - ROCK CORE

ABBREVIATIONS

V - INSITU VANE SHEAR TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 Q_c - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW
 γ - UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION
 CA - CASING
 WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL

SOIL PROFILE

SHEAR STRENGTH
 TONS/SQ.FT OR Q_{u/2}

WATER CONTENT
 W%

SAMPLES

ELEV. DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT. PLOT	ELEVATION SCALE	SHEAR STRENGTH TONS/SQ.FT OR Q _{u/2}			WATER CONTENT W%			OTHER TESTS	CONDITION	TYPE	NO.	PENETRATION RESISTANCE	ELEV. RECOV.
					0.5	1.0	1.5	20	30	Δ L.V.						
326.9					X-COMB PENETRATION TEST RESISTANCE BLOWS PER FOOT			□ P.V.								
					50	100	150	20	30							
					STD. EN. = 4200 lb-in.											
326.9																
311.9		HARD BROWN CLAY		5									1	83	100	
				10									2	27	100	
				15									3	30	75	
				20									4	14	40	
		MEDIUM GREY CLAY		25									5	10	100	
				30									6	100	100	
				35									7	17	100	
				40									8	17	Lost	
				45									9	20	35	
				50												

(END OF BOREHOLE 40'-0")
 286.9

