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**FOUNDATION INVESTIGATION REPORT  
PROTECTION SYSTEMS  
QEW WIDENING FROM HIGHWAY 406  
TO GARDEN CITY SKYWAY  
ST. CATHARINES, ONTARIO  
G.W.P. 607-00-00**

Submitted to:

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## 1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield Limited (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.

This report addresses the foundation investigation carried out for temporary protection systems at the following locations:

- QEW Niagara-bound lanes from approximately Station 10+700 (just west of Ontario Street) to 12+900 (just west of Geneva Street), for the installation of a median storm sewer.
- QEW Niagara-bound lanes from approximately Station 13+330 to 13+545 (between Geneva Street and Niagara Street) for the installation of a median storm sewer.
- QEW Niagara-bound lanes from approximately Station 12+500 to 12+885 (just west of Geneva Street) and from approximately Station 13+075 to 13+350 (just east of Geneva Street), for temporary widening of the existing shoulder as part of the construction staging operations.

The terms of reference and scope of work for the foundation engineering services are outlined in MTO's Request for Proposal for Agreement No. 2005-A-000564, issued in July 2002, in Section 6.8 of MH's *Technical Proposal* for G.W.P. 607-00-00, and in Golder's letter dated December 22, 2006.

## **2.0 SITE DESCRIPTION**

The proposed temporary protection systems are located along the Niagara-bound lanes of the QEW between approximately Station 10+700 (just east of Martindale Pond and west of Ontario Street) and Station 13+545 (between Geneva Street and Niagara Street).

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 terrain along the QEW is generally flat-lying to gently sloping, with a regional slope downward to the north toward Lake Ontario. East of Martindale Pond, the natural ground surface around the QEW climbs gradually toward the east, from about Elevation 92 m to 93 m near Ontario Street to about Elevation 99 m to 101 m near Geneva Street. The QEW grade is slightly higher than the surrounding natural grade from Ontario Street to west of Geneva Street; around Geneva Street, the QEW has been constructed on embankment fill that is up to about 7 m in height, with the QEW grade at approximately Elevation 106 m near Geneva Street.

### **3.0 INVESTIGATION PROCEDURES**

#### **3.1 Current Borehole Investigation**

Twenty-seven boreholes (Boreholes 07-01 to 07-27) were advanced along the proposed alignment for the temporary protection system for the median sewers, between January 23 and February 1, 2007. Ten additional boreholes, which were drilled for the Lake Street underpass median pier (Borehole 306) and for retaining walls and noise barrier walls near Geneva Street (Boreholes W-33 to W-37 and W-42 to W-45), were advanced as part of previous investigations by Golder in December 2004 and June and July 2005. The borehole locations are shown on Drawings 1 and 2.

The field investigation was carried out using truck-mounted drill rigs supplied and operated by Walker Drilling Ltd. of Utopia, Ontario. Boreholes 07-01 to 07-27 were advanced to depths of 8.1 m to 8.2 m below the QEW grade, using 108 mm diameter solid stem augers; Borehole 306 was advanced to a depth of 24.5 m below the QEW grade using solid stem augers; and Boreholes W-33 to W-37 and W-42 to W-45 were advanced to depths of 5.2 m to 15.9 m below the ground surface at the borehole locations, using solid stem augers. Soil samples were obtained at intervals of 0.75 m to 1.5 m in depth, using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer, in accordance with Standard Penetration Test (SPT) procedure.

The groundwater conditions in the open boreholes were observed throughout the drilling operations. All of the boreholes were backfilled to ground surface upon completion of the drilling operations using bentonite pellets.

The field work was supervised on a full-time basis by members of Golder's staff who located the boreholes in the field, arranged for the clearance of underground service locations, directed the drilling, sampling, 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 geotechnical laboratory testing. Index and classification tests consisting of water content determinations, Atterberg limits and grain size distribution analyses were carried out on selected soil samples.

The as-drilled borehole locations were measured in the field by Golder relative to site features (for Borehole 07-01 to 07-27) or to survey stakes placed by MH (for Boreholes 306, W-33 to W-37 and W-42 to W-45). The ground surface elevations at the borehole locations were determined from the digital terrain model (DTM) for this project. The borehole locations (NAD83 northing and easting coordinates) and ground surface elevations (referenced to geodetic datum) are presented on the Record of Borehole sheets and on Drawings 1 to 2.

### 3.2 Previous Borehole Investigation

In addition to the foundation investigation carried out by Golder as part of the current assignment, use has been made of two boreholes (Boreholes 954-2 and 954-4) which were advanced in 1961; this borehole information was obtained from the following report:

- MTO GEOCREs No. 30M3-28: *Foundation Investigation Report for Proposed Revisions to Crossing of Niagara – St. Catharines – Toronto Electric Railway Over the Queen Elizabeth Way*; dated November 1961.

The locations of Boreholes 954-2 and 954-4 are shown on Drawing 2, and the records for these boreholes are contained in Appendix A. The locations of these boreholes, as presented in the 1961 report, were defined by stations and offsets. These boreholes have been measured onto the current alignment plans, and the MTM NAD83 northing and easting coordinates have been approximated.

## **4.0 GENERAL SITE GEOLOGY AND STRATIGRAPHY**

### **4.1 Regional Geological Conditions**

The area of the QEW from Highway 406 to the Garden City Skyway lies within the Iroquois Plain physiographic region, as delineated in *The Physiography of Southern Ontario*<sup>1</sup> and *Urban Geology of Canadian Cities*<sup>2</sup>.

The Iroquois Plain extends around the western shore 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 also 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 Site Stratigraphy**

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 and Figures 1 to 7C

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<sup>1</sup> 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.

<sup>2</sup> 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.

following the text of this report. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Subsoil conditions will vary between and beyond the borehole locations.

In general, the surficial soils at the site consist of fill materials associated with embankments for the QEW, overlying a thick deposit of clayey silt to silty clay till of firm to hard consistency. Relatively thin surficial deposits of sand to sandy silt and clayey silt were encountered in some of the boreholes, overlying the till deposit. All of the boreholes were typically terminated within the clayey silt to silty clay till at depths ranging from 5.2 m to 25.4 m below the ground surface.

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

#### **4.2.1 Fill Materials**

A layer of asphalt, between approximately 100 mm and 300 mm in thickness, was encountered immediately below the ground surface in all of the boreholes except Borehole 07-04 (which was drilled immediately south of the QEW shoulder), Borehole 306 (which was drilled in the median), and Boreholes W-33 to W-36 (which were drilled south of the QEW embankment, adjacent to Dunlop Drive).

Fill material is present below the asphalt pavement in all of the boreholes, and was encountered immediately below the ground surface in Boreholes 306 and W-33 to W-36. The fill varies in thickness from about 0.6 m to 2.9 m west of Geneva Street, and from about 2.8 m to 7.3 m in the vicinity of Geneva Street (where the QEW has been constructed on an embankment that is up to about 7 m in height).

The fill materials vary in composition, but typically consist of sand and gravel or crushed limestone immediately below the asphalt pavement, underlain where the fill is thicker by sand to silty sand or clayey silt fill. Foundry sand was encountered within the embankment fill in some of the boreholes near Geneva Street (Boreholes 07-21 to 07-23 and W-37). A 150 mm to 200 mm thick layer of concrete was encountered within or at the base of the fill in Boreholes W-37 and W-42. The results of grain size distribution tests conducted on eleven selected samples of the fill are shown on Figure 1.

Atterberg limit testing was conducted on three selected samples of the cohesive fill, and measured plastic limits of about 15 to 17 per cent, liquid limits of 22 to 27 per cent, and plasticity indices of



6 to 11 per cent. These results, which are plotted on a plasticity chart on Figure 2, confirm that the tested cohesive fill is a clayey silt of low plasticity.

The measured SPT “N” values within the cohesionless portions of the fill ranged from 5 to 55 blows per 0.3 m of penetration, but are typically between about 5 and 30 blows per 0.3 m of penetration, indicating that the cohesionless fill has a variable, very loose to very dense (but typically loose to compact) relative density. Where foundry sand was encountered within the embankment fill in Boreholes 07-21 to 07-23 and W-37 near Geneva Street, the measured SPT “N” values of 46 to greater than 100 blows per 0.3 m of penetration indicate that this material has a dense to very dense relative density. The measured SPT “N” values within the clayey silt portions of the fill ranged from 3 to 19 blows per 0.3 m of penetration, indicating that this portion of the fill has a soft to very stiff consistency.

#### **4.2.2 Surficial Sand to Sandy Silt**

A surficial deposit of cohesionless soil was encountered in eighteen of the boreholes (Boreholes 07-02, 07-06 to 07-08, 07-12 to 07-20, 07-27, 306, W-36, W-44 and W- 45), below the fill and on top of the clayey silt to silty clay till deposit. Where encountered, the surficial cohesionless soil deposit varied from about 0.1 m to 2.4 m in thickness.

The surficial cohesionless soils vary in composition from sand containing some silt and trace gravel, to sandy silt; clayey silt seams were observed in the deposit at some locations. The results of grain size distribution tests conducted on nine selected samples of the surficial sand to sandy silt deposit are shown on Figure 3; on this figure, the results for Boreholes 07-07, 07-08, 07-14 and 07-19 demonstrate the presence of clayey silt seams within the deposit.

The measured SPT “N” values ranged from 5 to 33 blows per 0.3 m of penetration, but are typically between about 10 and 20 blows per 0.3 m of penetration; these results indicate that the surficial sand to sandy silt has a loose to dense, but typically compact, relative density.

#### **4.2.3 Surficial Clayey Silt**

A surficial clayey silt deposit was encountered in some of the boreholes (Boreholes 07-04, W-35 and W-42) below the topsoil or fill, and on top of the clayey silt to silty clay till deposit. Where encountered, the surficial clayey silt varied from about 0.7 m to 3.0 m in thickness.

The deposit consists of clayey silt containing trace to some sand, trace gravel and organics. The result of a grain size distribution test conducted on one selected sample of the surficial clayey silt deposit is shown on Figure 4. Atterberg limits testing was conducted on one selected sample of the surficial clayey silt deposit, and measured a plastic limit of 16 per cent, a liquid limit of 29 per

cent, and a plasticity index of 13 per cent; this result, which is plotted on a plasticity chart on Figure 5, confirms that this material is a clayey silt of low plasticity.

The SPT “N” values measured within the surficial clayey silt to silty clay ranged from 6 to 25 blows per 0.3 m of penetration, indicating that this material has a firm to very stiff consistency.

#### **4.2.4 Clayey Silt to Silty Clay Till**

An extensive till deposit was encountered beneath the fill and surficial soil deposits, where present, in all of the boreholes. The surface of this deposit was encountered at a depth of between 0.8 m and 7.6 m below the ground surface at the borehole locations, ranging between approximately Elevations 91.6 m and 100.5 m (generally rising toward the east). All of the boreholes were terminated within the till deposit at depths ranging from 5.2 m to 9.8 m below the ground surface; Borehole 306, which was advanced to 24.5 m depth, was also terminated within the till, indicating that the deposit has a thickness of greater than 22.3 m at that location.

The till consists of brown to grey clayey silt to silty clay, containing trace to some sand and trace gravel. Seams of silt and sandy silt were 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 deposit in Boreholes W-42 and W-45; these interlayers vary from 0.2 m to greater than 0.9 m in thickness. The results of grain size distribution testing completed on fifteen selected samples of the clayey silt to silty clay till are shown on Figures 6A and 6B. 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 completed on 44 samples of the till deposit, and measured plastic limits of 12 to 20 per cent, liquid limits of 22 to 40 per cent, and plasticity indices of 9 to 21 per cent. These results, which are plotted on plasticity charts on Figures 7A to 7C, confirm that the till typically consists of a clayey silt of low plasticity, varying locally to a silty clay of intermediate plasticity.

The SPT “N” values measured within the clayey silt to silty clay till deposit ranged from 4 to 56 blows per 0.3 m of penetration. Typically, the lower SPT “N” values of 4 to 8 blows per 0.3 m of penetration were measured within the upper 1 m of the till, or in Boreholes 07-25 to 07-27, W-44 and W-45 east of Geneva Street; in situ vane testing in the boreholes east of Geneva Street measured undrained shear strengths of approximately 75 kPa to 90 kPa, as shown on the borehole records. Elsewhere, the measured SPT “N” values typically vary from about 10 to 30 blows per 0.3 m of penetration. The results of the SPT “N” values and in situ vane testing confirm that the till deposit typically has a stiff to very stiff consistency, though portions of the deposit (as noted above) grade to firm or hard.

### **4.3 Groundwater Conditions**

The water levels in the open boreholes were noted during and immediately following the drilling operations. “Perched” groundwater was observed within the surficial sand to sandy silt deposit and at the base of cohesionless fill materials (perched on top of the underlying, less permeable clayey silt to silty clay till deposit) in Boreholes 07-07, 07-08, 07-11 to 07-20, 07-25, 07-26 and 306, all of which were drilled in the winter. Typically, the surficial sand to sandy silt soils were observed to be wet below a depth of 0.8 m to 1.5 m; the observed conditions are noted on the borehole records.


Piezometers were not installed in the boreholes included in this Foundation Investigation Report. However, piezometers have been installed within the clayey silt to silty clay till deposit as part of other subsurface investigation work by Golder for this project. Typically, the water level measured in the piezometers installed for other elements of this project varies from about 1.5 m to 4 m below the natural ground surface at the site. Where encountered as part of the subsurface investigation, lenses or interlayers of cohesionless soil within the clayey silt to silty clay till deposit were observed to be water-bearing.

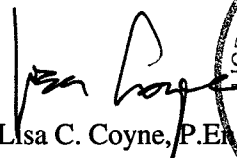
The groundwater levels will be subject to seasonal fluctuations, and will be higher during wetter periods of the year.

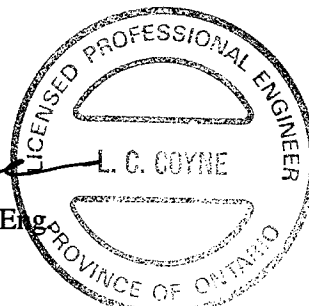
## 5.0 CLOSURE

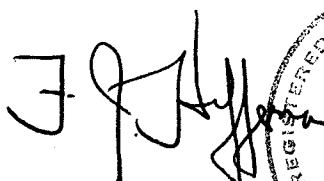
This Foundation Investigation Report was prepared by Ms. Karyn Gallant and reviewed by Ms. Lisa Coyne, P.Eng., an Associate and geotechnical engineer with Golder. Mr. Fin Heffernan, P.Eng., a Designated MTO Contact for Golder, carried out an independent review of the report.


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KG/LCC/FJH/kg/lcc

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## LIST OF SYMBOLS

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

### I. General

$\pi$	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

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma$
$\epsilon$	linear strain
$\epsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	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
$\gamma'$	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
$\sigma'_p$	pre-consolidation pressure
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

#### (d) Shear Strength

$\tau_p, \tau_r$	peak and residual shear strength
$\phi'$	effective angle of internal friction
$\delta$	angle of interface friction
$\mu$	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  $\rho$ . Unit weight symbol is  $\gamma$  where  $\gamma = \rho g$  (i.e. mass density x acceleration due to gravity)

## 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
DO	Drive open
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.)

#### Consistency

	<u>kPa</u>	<u>psf</u>
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

#### (b) Cohesive Soils

$c_u, s_u$

#### 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 cm<sup>2</sup> 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 <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
$D_R$	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)
$\gamma$	unit weight

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

S:\FINALDAT\ABBREV\2000\LOFA-D00.DOC

PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-01		1 OF 1 METRIC										
W.P.		607-00-00		LOCATION		N 4782216.2 ; E 323649.2										
DIST		Central HWY QEW		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers										
DATUM		Geodetic		DATE		January 23, 2007										
				ORIGINATED BY		GD										
				COMPILED BY		KG										
				CHECKED BY		LCC										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa				WATER CONTENT (%)				
92.5	GROUND SURFACE						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
8.0	ASPHALT															
91.7	Sand and gravel (FILL) Brown Moist															
0.8	CLAYEY SILT, trace sand and gravel (TILL) Very stiff to hard Brown to grey-brown Moist		1	SS	29											
			2	SS	46											
			3	SS	35											
			4	SS	22											
			5	SS	20											
			6	SS	30											
84.4	END OF BOREHOLE															
8.1	Note: 1. Borehole dry upon completion of drilling.															

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

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PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-02			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4782229.5 ; E 323785.5			ORIGINATED BY PKS		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE January 23, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100 PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30
93.1	GROUND SURFACE							
0.0	ASPHALT							
0.2	Sand and gravel (FILL)							
92.3	Brown Moist							
0.8	Silty SAND Brown		1	SS	21			
	CLAYEY SILT, trace sand and gravel (TILL)							
	Very stiff to hard		2	SS	25			
	Brown to grey-brown Moist							
			3	SS	32			
			4	SS	15			
			5	SS	18			
			6	SS	26			
84.9								
8.2	END OF BOREHOLE							
	Note: 1. Borehole dry upon completion of drilling.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 2/26/07



PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-03			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4782228.7 ; E 323845.2			ORIGINATED BY GD		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE January 24, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100
93.3	GROUND SURFACE							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> W W <sub>L</sub> WATER CONTENT (%)
8.0	ASPHALT						93	
92.5	Sand and gravel, some silt (FILL) Brown Moist							
0.8	CLAYEY SILT, trace to some sand, trace gravel (TILL) Very stiff to hard Brown to grey-brown Dry to moist		1	SS	22		92	○
			2	SS	39		91	
			3	SS	56		90	
			4	SS	31		89	○
			5	SS	35		88	
	Becoming grey below 6.1 m depth		6	SS	25		87	
85.2	END OF BOREHOLE						86	
8.1	Note: 1. Borehole dry upon completion of drilling.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-04			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4782190.7 ; E 323915.8			ORIGINATED BY GD		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE January 29, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100
93.0	GROUND SURFACE							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> W W <sub>L</sub> WATER CONTENT (%)
89.9	TOPSOIL CLAYEY SILT, some sand, trace gravel Stiff Brown and grey Moist to wet		1	SS	13		92	2 14 56 28
			2	SS	8		91	
							90	
3.1	CLAYEY SILT, trace to some sand, trace gravel (TILL) Firm to very stiff Brown to grey-brown Moist to wet  Becoming grey below 4.5 m depth		3	SS	4		89	
			4	SS	26		88	
							87	
			5	SS	23		86	
							85	
84.8	END OF BOREHOLE		6	SS	25			
8.2	Note: 1. Water level in open borehole at 2.4 m depth upon completion of drilling operations.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-05		1 OF 1 METRIC												
W.P.		607-00-00		LOCATION		N 4782217.8 ; E 323945.2												
DIST		Central HWY QE		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers												
DATUM		Geodetic		DATE		January 23, 2007												
ORIGINATED BY		PKS		COMPILED BY		KG												
CHECKED BY		LCC																
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR SA SI CL
								20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30	kN/m <sup>3</sup>				
93.7		GROUND SURFACE																
93.2		ASPHALT																
0.3		Sand and gravel, some silt (FILL) Compact Light brown to brown Moist		1	SS	13		93										28 56 13 3
				2	SS	11		92										
91.6		CLAYEY SILT, trace to some sand, trace gravel (TILL) Very stiff to hard Brown to grey-brown Moist		3	SS	37		91										
								90										
		Becoming grey below 4.5 m depth		4	SS	23		89										
								88										
				5	SS	30		87										
								86										
85.5		END OF BOREHOLE		6	SS	17												
8.2		Note: 1. Borehole dry upon completion of drilling.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-06			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4782196.5 ; E 324042.5			ORIGINATED BY PKS		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE January 23, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100 PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)
94.1	GROUND SURFACE						94	
0.0	ASPHALT							
0.2	Sand and gravel (FILL) Loose Light brown Moist		1	SS	5		93	
92.9	Silty SAND Brown Moist		2	SS	26		92	○
1.3	CLAYEY SILT, trace to some sand, trace gravel (TILL) Very stiff to stiff Brown to grey-brown Moist		3	SS	28		91	
	Becoming grey below 4.5 m depth		4	SS	22		90	
			5	SS	13		88	○
			6	SS	11		86	
85.9	END OF BOREHOLE							
8.2	Note: 1. Borehole dry upon completion of drilling.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-07			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4782171.1 ; E 324139.4			ORIGINATED BY GD		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE January 24, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100
						PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)		
						UNIT WEIGHT γ		
						REMARKS & GRAIN SIZE DISTRIBUTION (%)		
94.6	GROUND SURFACE							
0.0	ASPHALT							
	Sand and gravel (FILL)							
93.8								
0.8	SAND and SILT, trace gravel, containing clayey silt seams Dark brown Loose Wet		1	SS	7	▽	94	
93.1								
1.5	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff to hard Brown to grey-brown Moist to dry		2	SS	21		93	
							92	
			3	SS	45		91	
							90	
	Becoming grey below 4.5 m depth		4	SS	19			
							89	
			5	SS	29		88	
							87	
86.5			6	SS	26			
8.1	END OF BOREHOLE							
	Notes: 1. Wet soils encountered at about 1.0 m depth during drilling. 2. Borehole dry upon completion of drilling.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-08			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4782146.1 ; E 324236.3			ORIGINATED BY PKS		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE January 23, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100
94.9	GROUND SURFACE							PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)
94.8	ASPHALT							
0.3	Sand and gravel (FILL) Brown Moist							
94.1								
0.8	Sandy SILT, containing clayey silt seams Loose Black and brown Moist to wet		1	SS	7	▽	94	
93.2								
1.7	CLAYEY SILT, trace to some sand, trace gravel (TILL) Very stiff to stiff Brown to grey-brown Moist		2	SS	19		93	
			3	SS	26		92	
			4	SS	14		91	
			5	SS	12		90	
							89	
							88	
86.7			6	SS	22		87	
8.2	END OF BOREHOLE							
	Notes: 1. Wet soils encountered at about 1.0 m depth during drilling. 2. Borehole dry upon completion of drilling.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-09			1 OF 1 METRIC					
W.P. 607-00-00			LOCATION N 4782121.6 ; E 324333.2			ORIGINATED BY GD					
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG					
DATUM Geodetic			DATE January 24, 2007			CHECKED BY LCC					
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
95.1	GROUND SURFACE										
0.0	ASPHALT						95				
0.2	Sand and gravel (FILL) Brown Moist										
94.3											
0.8	Clayey silt, some sand, trace gravel (FILL) Stiff to firm Grey Moist to wet		1	SS	8		94				0 17 53 30
			2	SS	6						
93.0							93				
2.1	CLAYEY SILT, trace to some sand, trace gravel (TILL) Hard to very stiff Brown Moist										
			3	SS	35		92				
							91				
			4	SS	23		90				
							89				
			5	SS	19						
							88				
							87				
86.9			6	SS	15						
8.2	END OF BOREHOLE										
	Note: 1. Water level in open borehole at 6.1 m depth upon completion of drilling operations.										

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 04-1111-002		<b>RECORD OF BOREHOLE No 07-10</b>				1 OF 1 <b>METRIC</b>											
W.P. 607-00-00		LOCATION N 4782096.0 ; E 324429.9				ORIGINATED BY PKS											
DIST Central HWY QEW		BOREHOLE TYPE 108 mm Diameter Solid Stem Augers				COMPILED BY KG											
DATUM Geodetic		DATE January 23, 2007				CHECKED BY LCC											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
95.3	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand and gravel (FILL)																
94.5	Brown Moist																
	Clayey silt (FILL)																
1.1	Stiff Brown Moist		1	SS	11												
	TOPSOIL																
	CLAYEY SILT, trace to some sand, trace gravel (TILL)		2	SS	14												
	Stiff to very stiff Brown to grey-brown Moist																
	Becoming grey below 4.5 m depth		3	SS	21												
			4	SS	9												
			5	SS	10												
			6	SS	13												
87.1	END OF BOREHOLE																
8.2	Note: 1. Borehole dry upon completion of drilling.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

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PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-11		1 OF 1 METRIC										
W.P.		607-00-00		LOCATION		N 4782071.1 ; E 324526.7										
DIST		Central HWY QEW		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers										
DATUM		Geodetic		DATE		January 29, 2007										
				ORIGINATED BY		GD										
				COMPILED BY		KG										
				CHECKED BY		LCC										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
95.4	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sand and gravel (FILL) Brown Moist															
94.6																
0.8	Sand, trace silt (FILL) Compact to very loose Brown Wet		1	SS	10											
93.9																
1.5	Clayey silt, some sand, trace gravel (FILL) Soft Brown Moist		2	SS	3											
92.3																
3.1	CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to very stiff Brown to grey-brown Moist		3	SS	13											
	Becoming grey below 4.5 m depth															
			4	SS	13											
			5	SS	10											
			6	SS	15											
87.2																
8.2	END OF BOREHOLE															
	Notes: 1. Wet soils encountered at about 1.0 m depth during drilling. 2. Borehole dry upon completion of drilling.															

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

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PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-12			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4782045.3 ; E 324622.4			ORIGINATED BY PKS		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE January 29, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100
95.7	GROUND SURFACE							PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)
0.0	ASPHALT							
0.2	Sand and gravel (FILL)							
94.9	Brown Moist							
0.8	Sandy SILT, trace clay, trace gravel Loose to compact Black to brown Moist to wet		1	SS	5		95	
			2	SS	14		94	
							93	
92.5	CLAYEY SILT, trace to some sand, trace gravel (TILL) Very stiff to stiff Brown to grey-brown Moist		3	SS	16		92	
3.2	Becoming grey below 4.5 m depth		4	SS	17		91	
							90	
			5	SS	15		89	
							88	
87.5			6	SS	13			
8.2	END OF BOREHOLE							
	Notes: 1. Wet soils encountered at about 1.5 m depth during drilling. 2. Borehole dry upon completion of drilling.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-13		1 OF 1 METRIC												
W.P.		607-00-00		LOCATION		N 4782020.2 ; E 324719.3												
DIST		Central HWY QEW		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers												
DATUM		Geodetic		DATE		January 29, 2007												
				ORIGINATED BY		GD												
				COMPILED BY		KG												
				CHECKED BY		LCC												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR SA SI CL
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30				
95.8		GROUND SURFACE																
0.0		ASPHALT																
0.2		Sand and gravel (FILL)																
95.0		Brown Moist																
0.8		Silty SAND, trace gravel Loose to compact Black to brown Moist to wet		1	SS	7		95										
				2	SS	13		94										
								93										
92.8																		
3.1		CLAYEY SILT, trace to some sand, trace gravel (TILL) Hard to stiff Brown to grey-brown Moist to wet		3	SS	31		92										
								91										
		Becoming grey below 4.5 m depth		4	SS	14		90										
				5	SS	20		89										
				6	SS	17		88										
87.6																		
8.2		END OF BOREHOLE																
		Notes: 1. Wet soils encountered at about 1.5 m depth during drilling. 2. Water level in open borehole at 6.9 m depth upon completion of drilling operations.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-16		1 OF 1 METRIC														
W.P.		607-00-00		LOCATION		N 4781919.1 ; E 325106.5														
DIST		Central HWY QEW		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers														
DATUM		Geodetic		DATE		January 29, 2007														
				ORIGINATED BY		PKS														
				COMPILED BY		KG														
				CHECKED BY		LCC														
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa			WATER CONTENT (%)			γ			GR SA SI CL		
96.9		GROUND SURFACE							20 40 60 80 100			10 20 30			kN/m <sup>3</sup>					
0.0		ASPHALT							20 40 60 80 100			10 20 30								
0.2		Sand and gravel (FILL)							20 40 60 80 100			10 20 30								
96.1		Brown Moist							20 40 60 80 100			10 20 30								
0.8		Silty SAND Loose to compact Brown Moist to wet		1	SS	10		96										0 66 28 6		
95.0				2	SS	11		95												
1.9		CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to very stiff Brown to grey-brown Moist						94												
		Becoming grey below 3.0 m depth		3	SS	16		93												
				4	SS	14		92												
				5	SS	13		91												
				6	SS	15		90												
88.7								89												
8.2		END OF BOREHOLE																		
		Notes: 1. Wet soils encountered at about 1.0 m depth during drilling. 2. Borehole dry upon completion of drilling.																		

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 2/26/07

PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-17		1 OF 1 METRIC												
W.P.		607-00-00		LOCATION		N 4781894.2 ; E 325203.1												
DIST		Central HWY QEW		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers												
DATUM		Geodetic		DATE		January 31, 2007												
				ORIGINATED BY		GD												
				COMPILED BY		KG												
				CHECKED BY		LCC												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR SA SI CL
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30	kN/m <sup>3</sup>			
97.2		GROUND SURFACE																
0.0		ASPHALT																
0.2		Sand and gravel (FILL)																
96.4		Brown Moist																
0.8		Silty SAND, some gravel		1	SS	7												
95.7		Loose Brown Moist																
1.5		SAND, some silt, trace gravel		2	SS	24												
94.1		Compact Brown Wet																
3.1		CLAYEY SILT, trace to some sand, trace gravel (TILL)		3	SS	23												
		Very stiff Brown to grey-brown Moist to wet																
		Becoming grey below 4.5 m depth		4	SS	21												
				5	SS	22												
				6	SS	19												
89.0		END OF BOREHOLE																
8.2		Notes:																
		1. Wet soils encountered at about 1.5 m depth during drilling.																
		2. Water level in open borehole at 6.6 m depth upon completion of drilling operations.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 2/26/07

PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-18		1 OF 1 METRIC														
W.P.		607-00-00		LOCATION		N 4781869.6 ; E 325300.1														
DIST		Central HWY QEW		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers														
DATUM		Geodetic		DATE		January 30, 2007														
				ORIGINATED BY		PKS														
				COMPILED BY		KG														
				CHECKED BY		LCC														
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa			WATER CONTENT (%)			γ					
97.1		GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30									
0.0		ASPHALT						97												
0.2		Sand and gravel (FILL)						96												
96.3		Brown Moist																		
0.8		Silty SAND, trace gravel		1	SS	9	▽													
95.6		Loose Brown Wet																		
1.5		CLAYEY SILT, trace sand and gravel (TILL)		2	SS	22														
		Very stiff to stiff																		
		Brown to grey-brown																		
		Moist																		
		Becoming grey below 3.0 m depth		3	SS	15														
				4	SS	13														
				5	SS	12														
				6	SS	11														
88.9								89												
8.2		END OF BOREHOLE																		
		Notes:																		
		1. Wet soils encountered at about 1.0 m depth during drilling.																		
		2. Borehole dry upon completion of drilling.																		

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

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PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-19		1 OF 1 METRIC												
W.P.		607-00-00		LOCATION		N 4781845.2 ; E 325396.9												
DIST		Central HWY QEW		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers												
DATUM		Geodetic		DATE		January 31, 2007												
				ORIGINATED BY		GD												
				COMPILED BY		KG												
				CHECKED BY		LCC												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR SA SI CL
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30	kN/m <sup>3</sup>			
96.9		GROUND SURFACE																
0.0		ASPHALT																
0.2		Sand and gravel (FILL)																
96.1		Brown Moist																
0.8		Sandy SILT, trace gravel, containing clayey silt seams		1	SS	33		96									3 37 46 13	
95.4		Dense Brown Wet																
1.5		CLAYEY SILT, some sand, trace gravel (TILL)		2	SS	20		95										
		Very stiff Brown to grey-brown Moist to wet																
		Becoming grey below 4.5 m depth		3	SS	18		94										
								93										
				4	SS	24		92										
								91										
				5	SS	16		90										
								89										
88.7				6	SS	15												
8.2		END OF BOREHOLE																
		Notes:																
		1. Wet soils encountered at about 1.0 m depth during drilling.																
		2. Borehole dry upon completion of drilling.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-20		1 OF 1 METRIC												
W.P.		607-00-00		LOCATION		N 4781819.3 ; E 325493.7												
DIST		Central HWY QEW		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers												
DATUM		Geodetic		DATE		January 31, 2007												
				ORIGINATED BY		PKS												
				COMPILED BY		KG												
				CHECKED BY		LCC												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR SA SI CL
								20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30	kN/m <sup>3</sup>				
97.5		GROUND SURFACE																
0.0		ASPHALT																
0.3		Sand and gravel (FILL)																
96.7		Brown Moist																
1.0		Silty SAND		1	SS	9												
		Loose Brown Wet																
		CLAYEY SILT, trace to some sand, trace gravel (TILL)		2	SS	33												
		Stiff to hard Brown to grey-brown Moist																
		Becoming grey below 3.0 m depth		3	SS	15												
				4	SS	13												
				5	SS	14												
				6	SS	14												
89.3		END OF BOREHOLE																
8.2		Notes:																
		1. Wet soils encountered at about 0.8 m depth during drilling.																
		2. Borehole dry upon completion of drilling.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

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PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-21			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4781794.2 ; E 325590.5			ORIGINATED BY GD		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE January 31, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100 PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)
99.2	GROUND SURFACE							
0.0	ASPHALT							
0.2	Sand and gravel (FILL)							
98.4	Brown Moist							
0.8	Silty sand, some gravel, containing brick fragments and foundry sand (FILL)		1	SS	116			
97.4	Very dense Dark brown to black Moist							
1.8	Clayey silt, some sand, trace gravel (FILL)		2	SS	16			
96.1	Very stiff Brown and grey Moist							
3.1	CLAYEY SILT, trace to some sand, trace gravel (TILL)		3	SS	45			
	Hard to very stiff Brown to grey-brown Moist to wet							
			4	SS	34			
			5	SS	18			
	Becoming grey below 7.5 m depth							
91.0			6	SS	17			
8.2	END OF BOREHOLE							
	Note: 1. Borehole dry upon completion of drilling.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-22		1 OF 1 METRIC							
W.P.		607-00-00		LOCATION		N 4781770.9 ; E 325687.7							
DIST		Central HWY QEW		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers							
DATUM		Geodetic		DATE		January 31, 2007							
				ORIGINATED BY		PKS							
				COMPILED BY		KG							
				CHECKED BY		LCC							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
102.2	GROUND SURFACE												
101.9	ASPHALT												
0.3	Sand and gravel (FILL) Brown Moist												
101.4	Foundry Sand, some silt, trace gravel (FILL) Very dense Black Moist		1	SS	86								
0.8			2	SS	110								
			3	SS	102								
98.2	CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to hard Brown to grey-brown Moist		4	SS	13								
4.0													
			5	SS	38								
	Becoming grey below 7.5 m depth		6	SS	39								
94.0	END OF BOREHOLE												
8.2	Note: 1. Borehole dry upon completion of drilling.												

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

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PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-23			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4781746.8 ; E 325784.6			ORIGINATED BY GD		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE February 1, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100
104.7	GROUND SURFACE							PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)
104.0	ASPHALT							
0.3	Sand and gravel (FILL) Brown Moist						104	
0.8	Sand and gravel, some silt (FILL) Very dense Brown Moist		1	SS	123			○
103.2							103	
1.5	Foundry sand, some silt, trace gravel (FILL) Very dense Black Moist		2	SS	113			
							102	
			3	SS	67/0.15		101	
							100	
			4	SS	61/0.15		99	
98.6							98	
6.1	Clayey silt with sand, trace gravel (FILL) Very stiff Dark brown to brown Moist		5	SS	19			●
97.1							97	
7.6	CLAYEY SILT, some sand, trace gravel (TILL) Hard Brown Moist		6	SS	33			
96.5								
8.2	END OF BOREHOLE							
Note: 1. Borehole dry upon completion of drilling.								

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3</sup>% STRAIN AT FAILURE

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PROJECT		04-1111-002		RECORD OF BOREHOLE No 07-25		1 OF 1 METRIC												
W.P.		607-00-00		LOCATION		N 4781620.0 ; E 326268.4												
DIST		Central HWY QEW		BOREHOLE TYPE		108 mm Diameter Solid Stem Augers												
DATUM		Geodetic		DATE		February 1, 2007												
				ORIGINATED BY		GD												
				COMPILED BY		KG												
				CHECKED BY		LCC												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR SA SI CL
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30	kN/m <sup>3</sup>			
101.9	0.0	GROUND SURFACE																
	0.2	ASPHALT																
	0.2	Sand and gravel (FILL)																
	101.1	Brown Moist																
	0.8	Silty sand, trace gravel (FILL)		1	SS	6	▽	101									4 51 31 4	
	100.4	Loose Brown and grey Wet																
	1.5	Sand, some silt (FILL)		2	SS	8		100										
		Loose Red-brown Wet																
	98.9							99										
	3.1	CLAYEY SILT, trace to some sand, trace gravel (TILL)		3	SS	8		98										
		Stiff Brown to grey-brown Moist																
				4	SS	10		97										
				5	SS	9		96										
		Becoming grey below 7.5 m depth						95										
	93.7			6	SS	13		94										
	8.2	END OF BOREHOLE																
		Notes:																
		1. Wet soils encountered at about 1.0 m depth during drilling.																
		2. Borehole dry upon completion of drilling.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-26			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4781594.6 ; E 326365.1			ORIGINATED BY PKS		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE January 31, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100 PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)
102.2	GROUND SURFACE							
0.0	ASPHALT							
0.2	Sand and gravel (FILL)							
101.4	Brown Moist							
0.8	Silty sand, trace gravel (FILL)		1	SS	9			
	Loose							
	Black to brown		2	SS	4			
	Moist to wet							
99.1	CLAYEY SILT to SILTY CLAY, trace sand and gravel (TILL)		3	SS	9			
	Stiff to firm							
	Brown to grey-brown		4	SS	9			
	Moist							
	Becoming grey below 6.0 m depth		5	SS	7			
			6	SS	8			
94.0	END OF BOREHOLE							
8.2	Notes: 1. Wet soils encountered at about 1.5 m depth during drilling. 2. Borehole dry upon completion of drilling.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 04-1111-002			RECORD OF BOREHOLE No 07-27			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4781584.4 ; E 326405.4			ORIGINATED BY PKS		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY KG		
DATUM Geodetic			DATE January 31, 2007			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100
102.0	GROUND SURFACE							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> W W <sub>L</sub> WATER CONTENT (%)
0.0	ASPHALT							
0.2	Sand and gravel (FILL)							
101.2	Brown Moist							
0.8	SAND and SILT Compact		1	SS	14		101	
100.5	Brown Moist							
1.5	CLAYEY SILT, trace to some sand, trace gravel (TILL)		2	SS	13		100	
	Stiff Brown to grey-brown Moist							
			3	SS	10		99	
							98	
	Becoming grey below 4.5 m depth		4	SS	9		97	
							96	
			5	SS	9		95	
							94	
93.8			6	SS	8			
8.2	END OF BOREHOLE							
	Note: 1. Borehole dry upon completion of drilling.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3</sup>% STRAIN AT FAILURE



PROJECT 04-1111-002			RECORD OF BOREHOLE No 306			2 OF 2 METRIC		
W.P. 607-00-00			LOCATION N 4781946.9; E 325034.1			ORIGINATED BY PKS		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Solid Stem Augers			COMPILED BY SLP		
DATUM Geodetic			DATE December 5, 2004			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100 PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30
81.5	CLAYEY SILT, some sand, trace gravel, shale fragments (TILL) Stiff Grey Wet		14	SS	11		81	
80.5	SAND and SILT, some gravel, trace to some clay (TILL) Compact Grey Wet		15	SS	14		80	
79.0	CLAYEY SILT, trace sand and gravel, containing silty sand interlayers (TILL) Very stiff to hard Red Wet		16	SS	16		78	
17.8			17	SS	17		77	
72.3			18	SS	100/20		75	
24.5	END OF BOREHOLE		19	SS	100/20		73	
Note: 1. Water level in open borehole at 3.1 m depth upon completion of drilling operations								

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT <u>04-1111-002</u>		<b>RECORD OF BOREHOLE No W-33</b>		1 OF 1 <b>METRIC</b>													
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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
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	96											
			3	SS	20	95											
			4	SS	12	94											
			5	SS	10												
			6	SS	12	93											
			7	SS	15	92											
91.8																	
5.2	END OF BOREHOLE																
	Note: 1. Borehole dry upon completion of drilling operations.																

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>04-1111-002</u>		<b>RECORD OF BOREHOLE No W-34</b>				1 OF 1 <b>METRIC</b>											
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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × REMOULDED									
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																	
5.2	END OF BOREHOLE																
	Note:  1. Borehole dry upon completion of drilling operations.																

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 2/26/07

PROJECT		04-1111-002		<b>RECORD OF BOREHOLE No W-35</b>		1 OF 1 <b>METRIC</b>										
W.P.		607-00-00		LOCATION		N 4781762.7 ; E 325633.9										
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 108 mm Solid Stem Augers										
DATUM		Geodetic		DATE		June 13, 2005										
						ORIGINATED BY <u>PKS</u>										
						COMPILED BY <u>SG</u>										
						CHECKED BY <u>LCC</u>										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
98.5	GROUND SURFACE															
98.0	Sand and gravel (FILL)		1	SS	23											
98.2	Compact															
0.3	Brown															
97.7	Moist															
0.8	Clayey silt, some sand, trace gravel (FILL)		2	SS	25											
97.0	Very stiff															
1.5	Brown															
	Moist															
	CLAYEY SILT, some sand, containing organics		3	SS	12											
	Very stiff															
	Brown/black															
	Moist															
	CLAYEY SILT, some sand, trace gravel (TILL)		4	SS	21											
	Stiff to very stiff															
	Brown															
	Moist															
			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.															

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT 04-1111-002			RECORD OF BOREHOLE No W-36			1 OF 1 METRIC			
W.P. 607-00-00			LOCATION N 4781744.4 ; E 325706.6			ORIGINATED BY PKS			
DIST Central HWY QEW			BOREHOLE TYPE Power Auger, 108 mm Solid Stem Augers			COMPILED BY SG			
DATUM Geodetic			DATE June 13, 2005			CHECKED BY LCC			
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100 PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30 UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
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				
			7	SS	23				
93.9	END OF BOREHOLE						94		1 11 51 37
5.2	Note: 1. Borehole dry upon completion of drilling operations.								

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 04-1111-002			RECORD OF BOREHOLE No W-37			1 OF 1 METRIC		
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			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100 PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)
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		104	
			2	SS	46		103	
			3	SS	78		102	
			4	SS	70		101	
			5	SS	53		100	
			6	SS	66		99	
98.8	Concrete							
6.1	Silty sand (FILL) Loose Black Moist		7	SS	9		98	
97.1	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to hard Brown Moist		8	SS	32		97	
7.6							96	
	Grey below 9.1 m depth		9	SS	11		95	
95.0	END OF BOREHOLE							
9.8	Note: 1. Borehole dry upon completion of drilling operations.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 2/26/07



PROJECT 04-1111-002			RECORD OF BOREHOLE No W-42			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4781686.7 ; E 325975.7			ORIGINATED BY PKS		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY SG		
DATUM Geodetic			DATE June 17, 2005			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100
106.1	GROUND SURFACE							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> W W <sub>L</sub> WATER CONTENT (%)
0.0	ASPHALT						106	
0.2	Silty sand, trace gravel, trace slag pieces (FILL) Compact to dense Red Moist		1	SS	46		105	
			2	SS	17		104	
			3	SS	18		103	○
			4	SS	14		102	
			5	SS	27		101	○
			6	SS	18		100	
100.2	Concrete						99	
6.1	CLAYEY SILT, some sand, containing organics Firm Grey/black Moist/wet		7	SS	6		98	
98.5	CLAYEY SILT, some sand, trace gravel (TILL) Hard Brown Moist		8	SS	35		97	
9.1	Silty SAND Dense Grey Wet		9	SS	46			
96.4	END OF BOREHOLE							
9.8	Note: 1. Borehole dry upon completion of drilling operations.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 2/26/07

PROJECT 04-1111-002			RECORD OF BOREHOLE No W-43			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4781657.9 ; E 326045.0			ORIGINATED BY PKS		
DIST Central HWY QEW			BOREHOLE TYPE 108 mm Diameter Solid Stem Augers			COMPILED BY SG		
DATUM Geodetic			DATE July 12, 2005			CHECKED BY LCC		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100 PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)
100.4	GROUND SURFACE							
0.0	ASPHALT						100	
	Sand and gravel (FILL)							
	Compact							
	Brown							
	Moist							
99.3	CLAYEY SILT to SILTY CLAY, trace to some sand, trace gravel (TILL)		1	SS	17		99	
1.1	Stiff to very stiff		2	SS	19		98	
	Brown		3	SS	14		97	
	Moist		4	SS	12		96	
			5	SS	13		95	
			6	SS	9		94	
			7	SS	12			
93.7	END OF BOREHOLE							
6.7	Note: 1. Borehole dry upon completion of drilling operations.							

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 2/26/07

PROJECT 04-1111-002			RECORD OF BOREHOLE No W-44			1 OF 1 METRIC		
W.P. 607-00-00			LOCATION N 4781638.0; E 326117.2			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			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100
100.8	GROUND SURFACE							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> W W <sub>L</sub> WATER CONTENT (%)
0.0	ASPHALT							
0.1	Sand and gravel (FILL)							
100.0	Compact Brown Moist							
0.8	Silty SAND, trace gravel		1	SS	7		100	
99.3	Loose Brown/black Moist							
1.5	SILTY CLAY, trace sand and gravel (TILL)		2	SS	23		99	40
	Stiff to very stiff							
	Brown becoming grey below 2.3 m depth		3	SS	14		98	
	Moist							
			4	SS	8		97	
			5	SS	8		96	
			6	SS	12		95	
94.1	END OF BOREHOLE							
6.7	Note: 1. Borehole dry upon completion of drilling operations.							



+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

MIS-MTO 001 041111002AAMTO.GPJ GAL-MISS.GDT 2/26/07

PROJECT 04-1111-002			RECORD OF BOREHOLE No W-45			1 OF 2 METRIC											
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			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m³	GR SA SI CL
							20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>			
101.2	GROUND SURFACE																
0.0	ASPHALT						101										
0.1	Sand and gravel (FILL) Compact Brown Moist		1	SS	17		100										
99.7																	
1.7	Silty SAND, trace gravel Compact Brown Moist		2	SS	11		99										
	CLAYEY SILT, some sand, trace gravel (TILL) Stiff Grey Moist		3	SS	7		98										
			4	SS	6		97										
			5	SS	7		96										
			6	SS	7		95										
94.3							94										
6.9	SILTY CLAY to CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to very stiff Grey Moist		7	SS	11		93										
			8	SS	15		92										
			9	SS	11		91										
			10	SS	12		90										
			11	SS	16		89										
87.0							88										
14.3	Silty SAND, some gravel, trace clay Compact Red						87										

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>04-1111-002</u>		<b>RECORD OF BOREHOLE No W-45</b>				2 OF 2 <b>METRIC</b>											
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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
	--- CONTINUED FROM PREVIOUS PAGE ---																
85.4 15.9	CLAYEY SILT, some sand, trace gravel (TILL) Very stiff Grey Moist  END OF BOREHOLE  Note:  1. Borehole dry upon completion of drilling operations.		12	SS	18		86										

+ <sup>3</sup>, × <sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



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

CONT No.  
WP No. 607-00-00

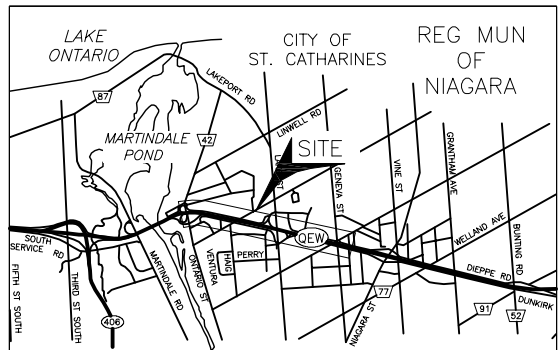


QEW WIDENING  
PROTECTION SYSTEMS  
BOREHOLE LOCATIONS

SHEET



Golder Associates Ltd.  
MISSISSAUGA, ONTARIO, CANADA



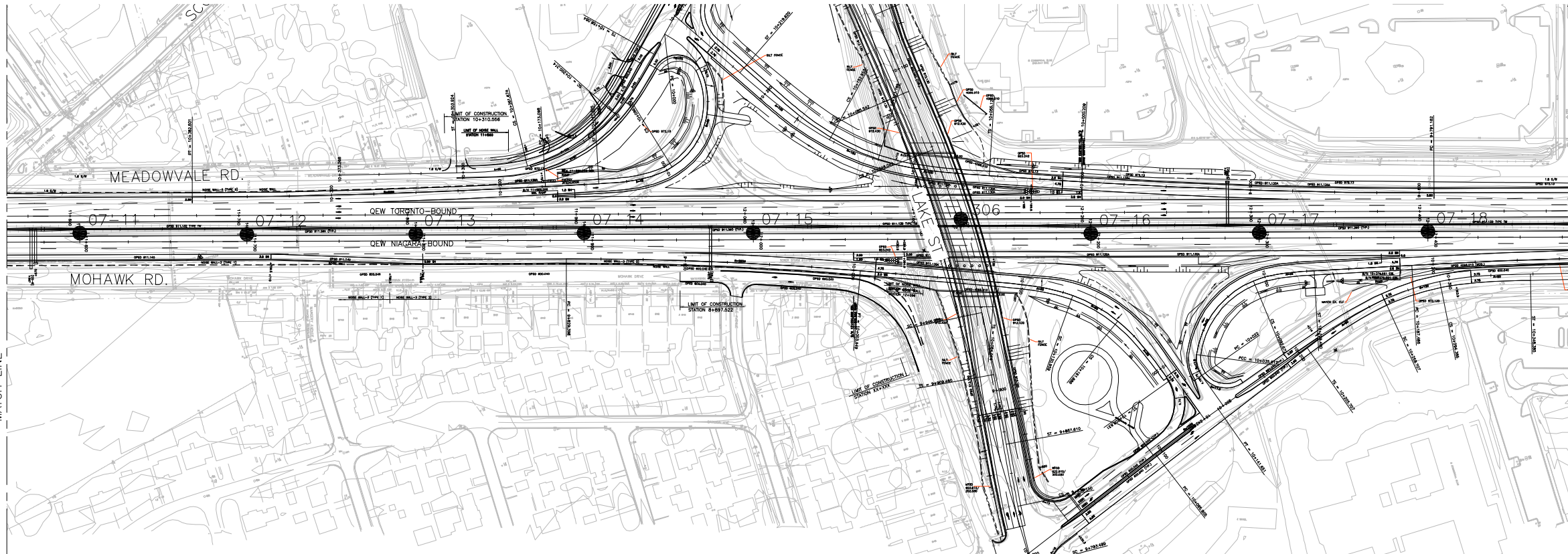
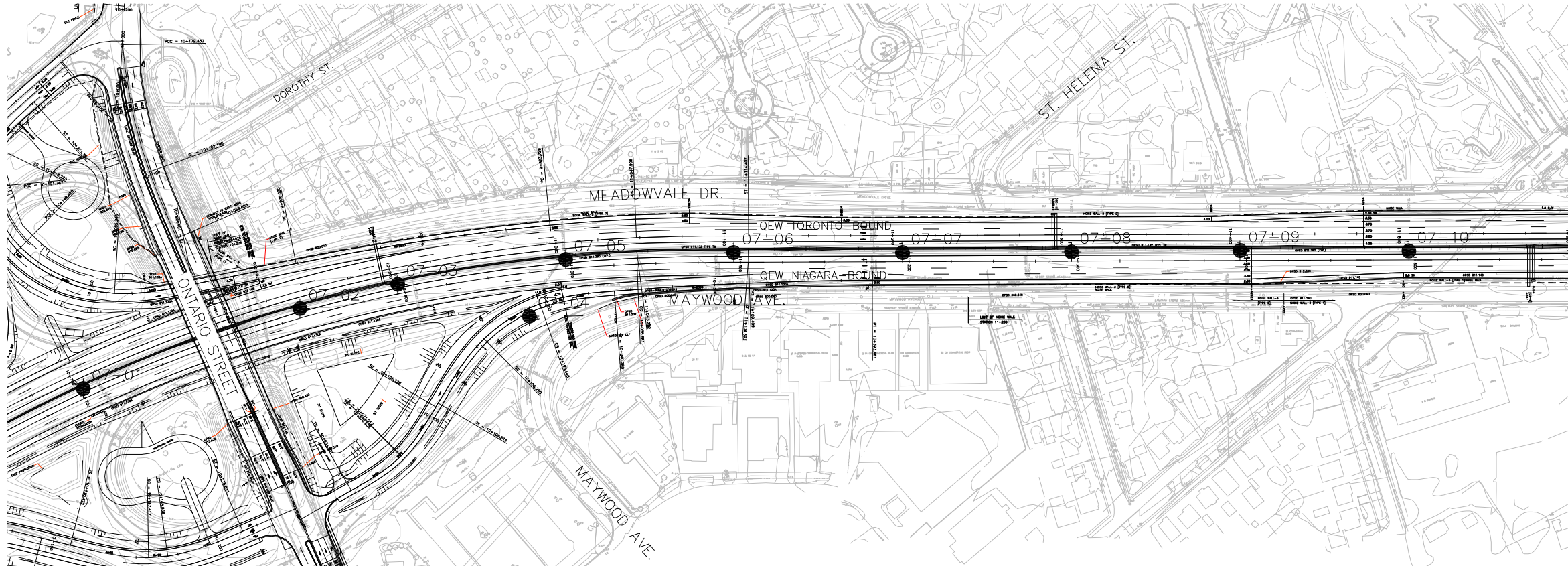
KEY PLAN



LEGEND

Existing Borehole - Golder Investigation

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
07-01	92.5	4782216.2	323649.2
07-02	93.1	4782229.5	323785.5
07-03	93.3	4782228.7	323845.2
07-04	93.0	4782190.7	323915.8
07-05	93.7	4782217.8	323945.2
07-06	94.1	4782196.5	324042.5
07-07	94.6	4782171.1	324139.4
07-08	94.9	4782146.1	324236.3
07-09	95.1	4782121.6	324333.2
07-10	95.3	4782096.0	324429.9
07-11	95.4	4782071.1	324526.7
07-12	95.7	4782045.3	324622.4
07-13	95.8	4782020.2	324719.3
07-14	96.1	4781995.5	324815.9
07-15	96.2	4781970.3	324913.0
07-16	96.9	4781919.1	325106.5
07-17	97.2	4781894.2	325203.1
07-18	97.1	4781869.6	325300.1
306	96.8	4781946.9	325034.1



PLAN



NO.	DATE	BY	REVISION
Geocres No.			
HWY. QEW		PROJECT NO. 04-1111-002	DIST.
SUBM'D. LCC	CHKD. KG	DATE: FEB 2007	SITE:
DRAWN: MSM	CHKD. LCC	APPD. LCC	DWG. 1



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

CONT No.  
WP No. 607-00-00

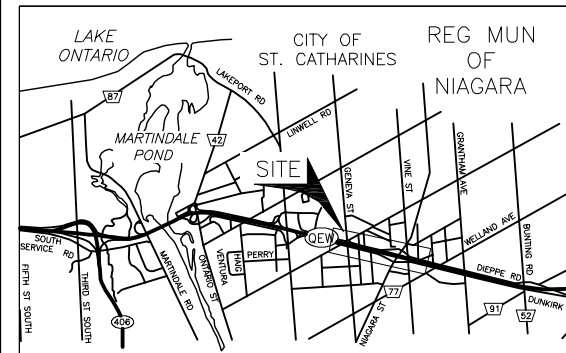


QEW WIDENING  
PROTECTION SYSTEMS  
BOREHOLE LOCATIONS

SHEET



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MISSISSAUGA, ONTARIO, CANADA



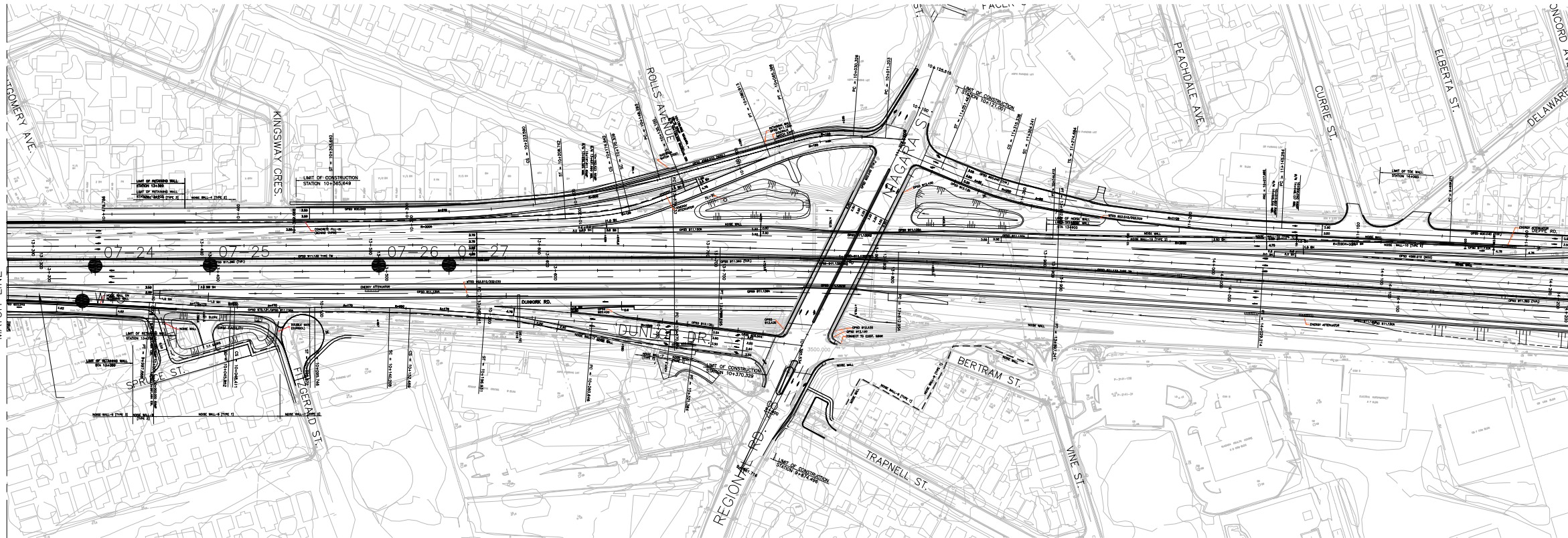
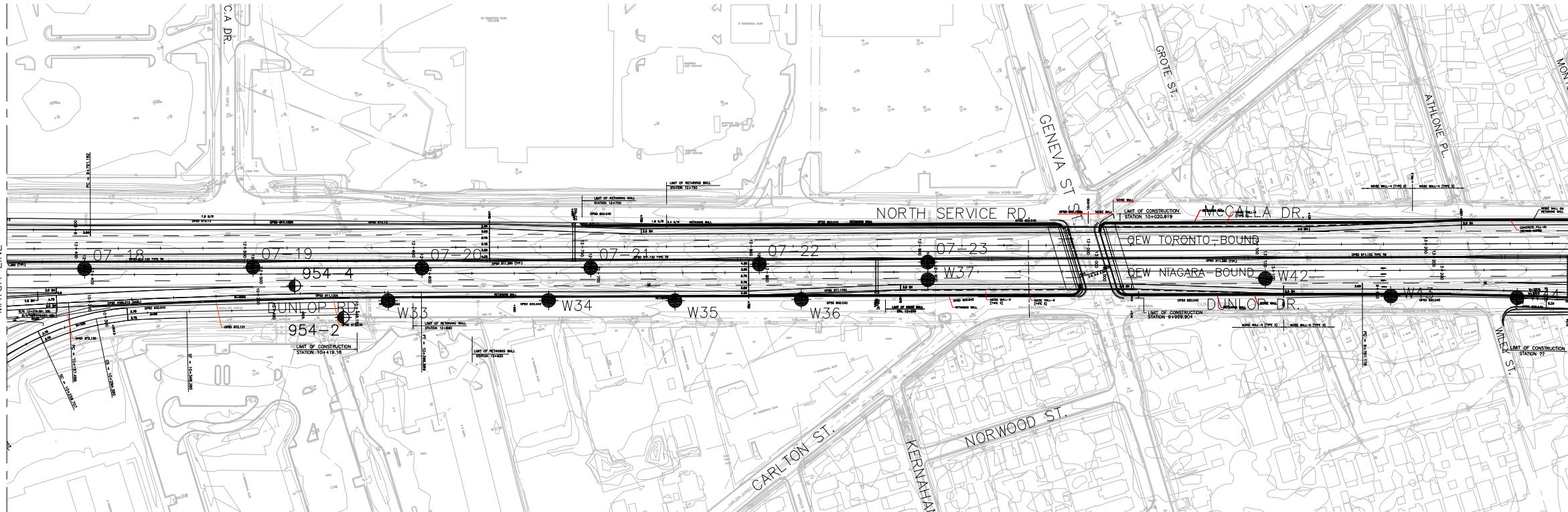
KEY PLAN

SCALE  
0 1 km

LEGEND

- Existing Borehole - Golder Investigation
- Existing Borehole - Previous MTO Investigation

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
07-18	97.1	4781869.6	325300.1
07-19	96.9	4781845.2	325396.9
07-20	97.5	4781819.3	325493.7
07-21	99.2	4781794.2	325590.5
07-22	102.2	4781770.9	325687.7
07-23	104.7	4781746.8	325784.6
07-24	102.5	4781636.9	326202.4
07-25	101.9	4781620.0	326268.4
07-26	102.2	4781594.6	326365.1
07-27	102.0	4781584.4	326405.4
W-33	97.0	4781805.7	325469.4
W-34	97.7	4781781.9	325561.5
W-35	98.5	4781762.7	325633.9
W-36	99.1	4781744.4	325706.6
W-37	104.7	4781736.7	325782.0
W-42	106.1	4781686.7	325975.7
W-43	100.4	4781657.9	326045.0
W-44	100.8	4781638.0	326117.2
W-45	101.2	4781618.7	326189.8
954-2	97.2	4781803.0	325441.3
954-4	97.3	4781828.3	325418.1



PLAN

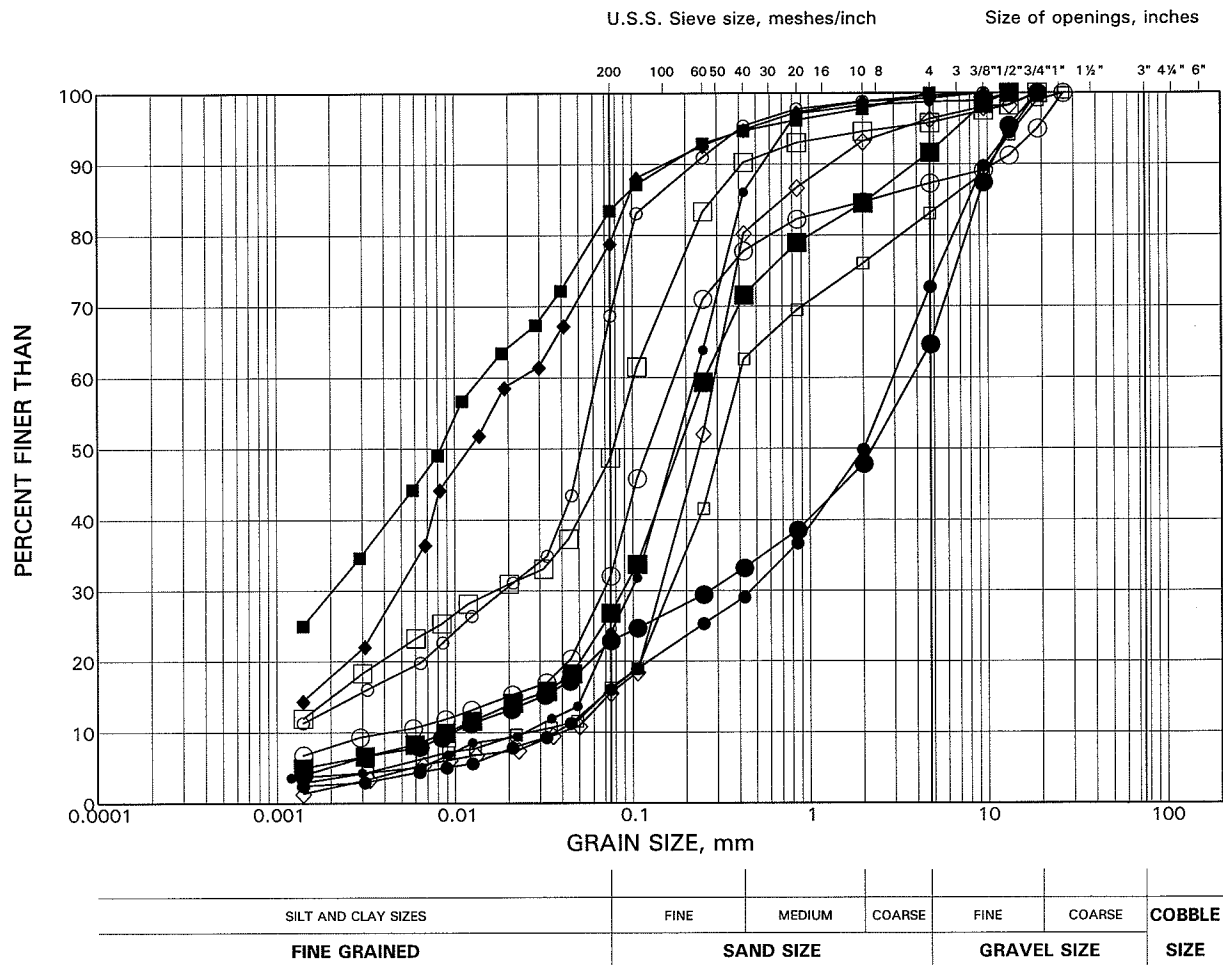
SCALE  
30 0 30 60 m

NO.	DATE	BY	REVISION
Geocres No.			
HWY. QEW	PROJECT NO. 04-1111-002		DIST.
SUBM'D. LCC	CHKD. LCC	DATE: FEB 2007	SITE:
DRAWN: MSM	CHKD. KG	APPD. LCC	DWG. 2

# GRAIN SIZE DISTRIBUTION TEST RESULTS

Fill

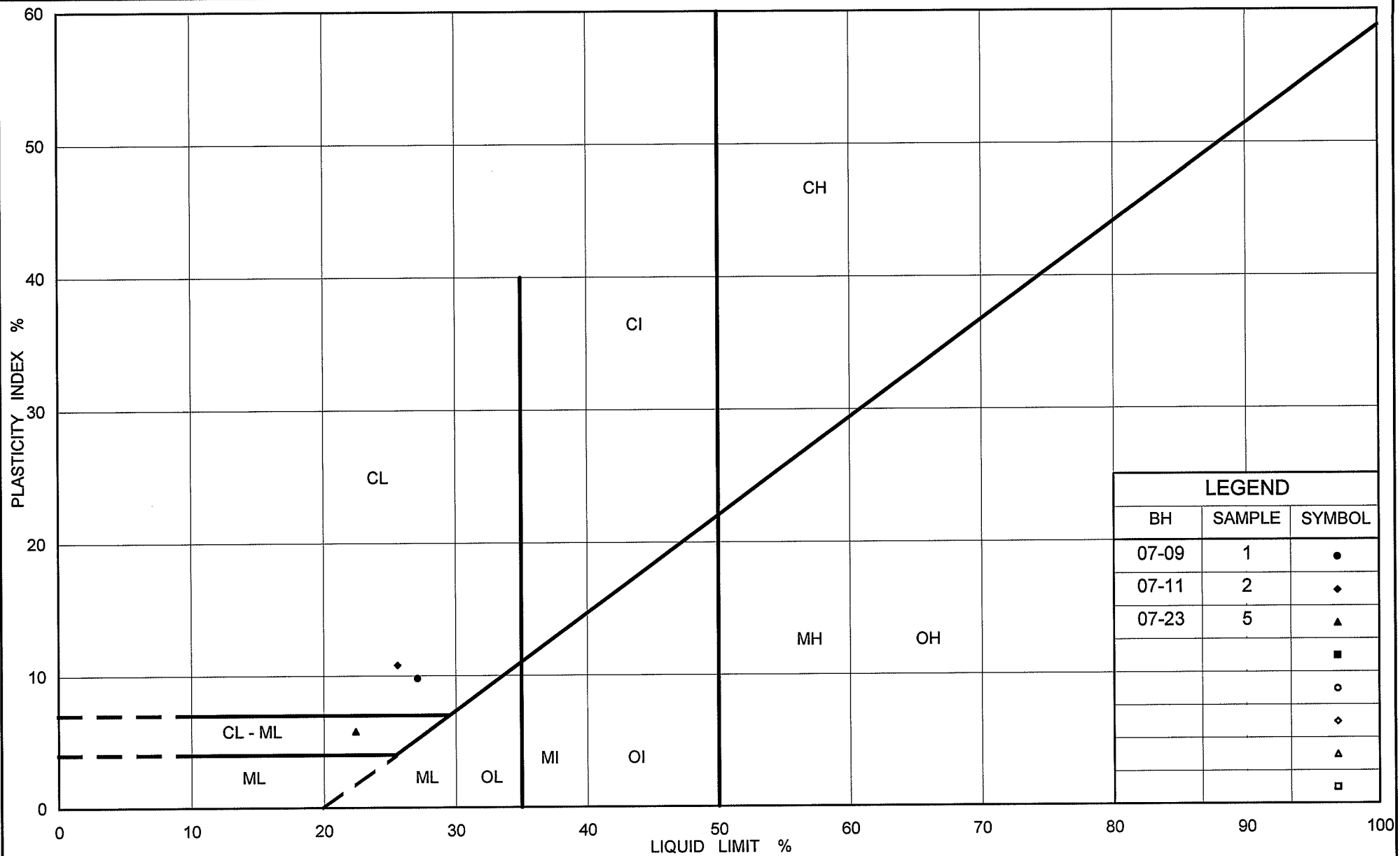
FIGURE 1



## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	07-05	1	92.7
■	07-09	1	94.1
◆	07-11	2	93.6
○	07-15	1	95.1
□	07-21	1	98.1
◇	07-22	2	100.4
●	07-23	1	103.7
■	07-24	1	101.5
○	07-24	2	100.7
□	07-25	1	100.8
•	W-42	3	103.5





Ministry of Transportation

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# PLASTICITY CHART Fill

FIG No. 2

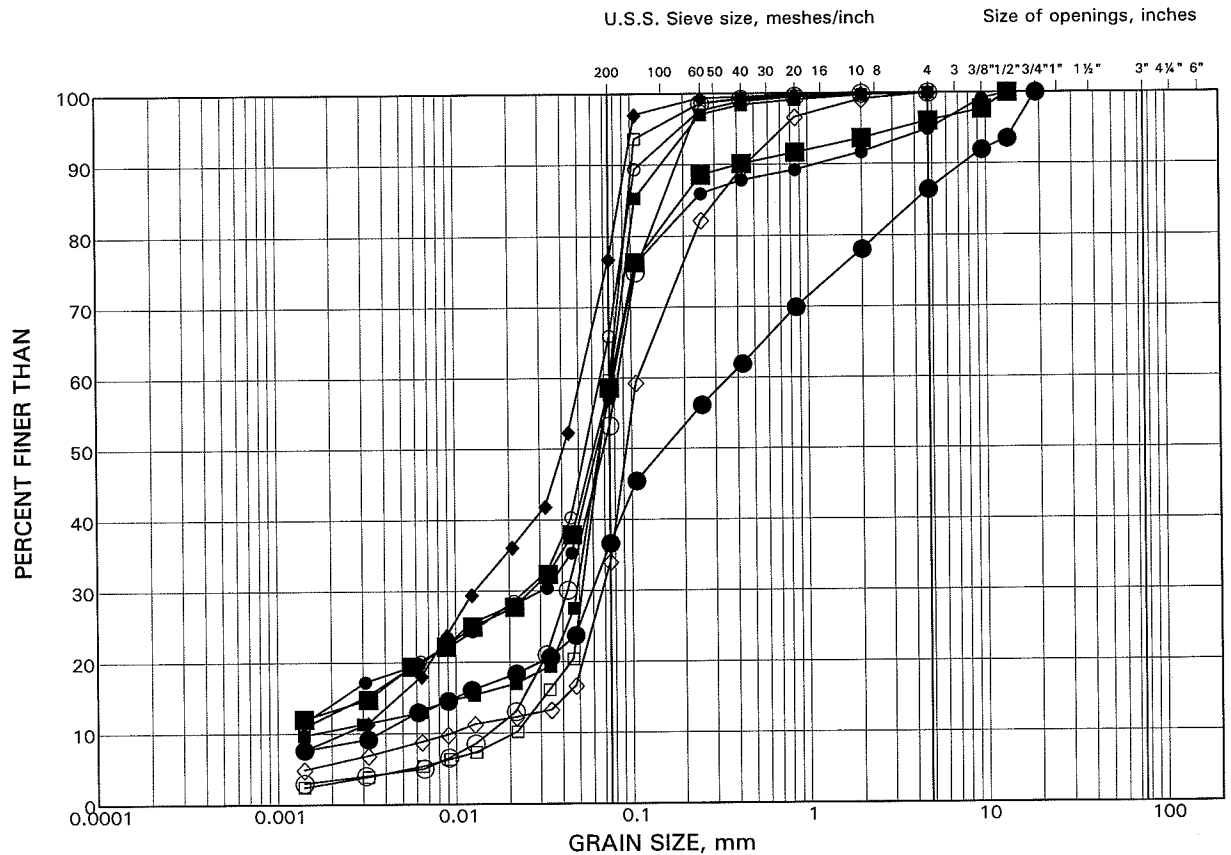
Project No. 04-1111-002

Checked by: *[Signature]*

# GRAIN SIZE DISTRIBUTION TEST RESULTS

Surficial 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)
●	07-07	1	93.6
■	07-08	1	93.8
◆	07-12	2	93.8
○	07-14	1	95.0
□	07-15	2	94.5
◇	07-16	1	95.8
●	07-17	1	96.1
■	07-19	1	95.8
○	07-27	1	100.9

Date February, 2007  
Project 04-1111-002

**Golder Associates**

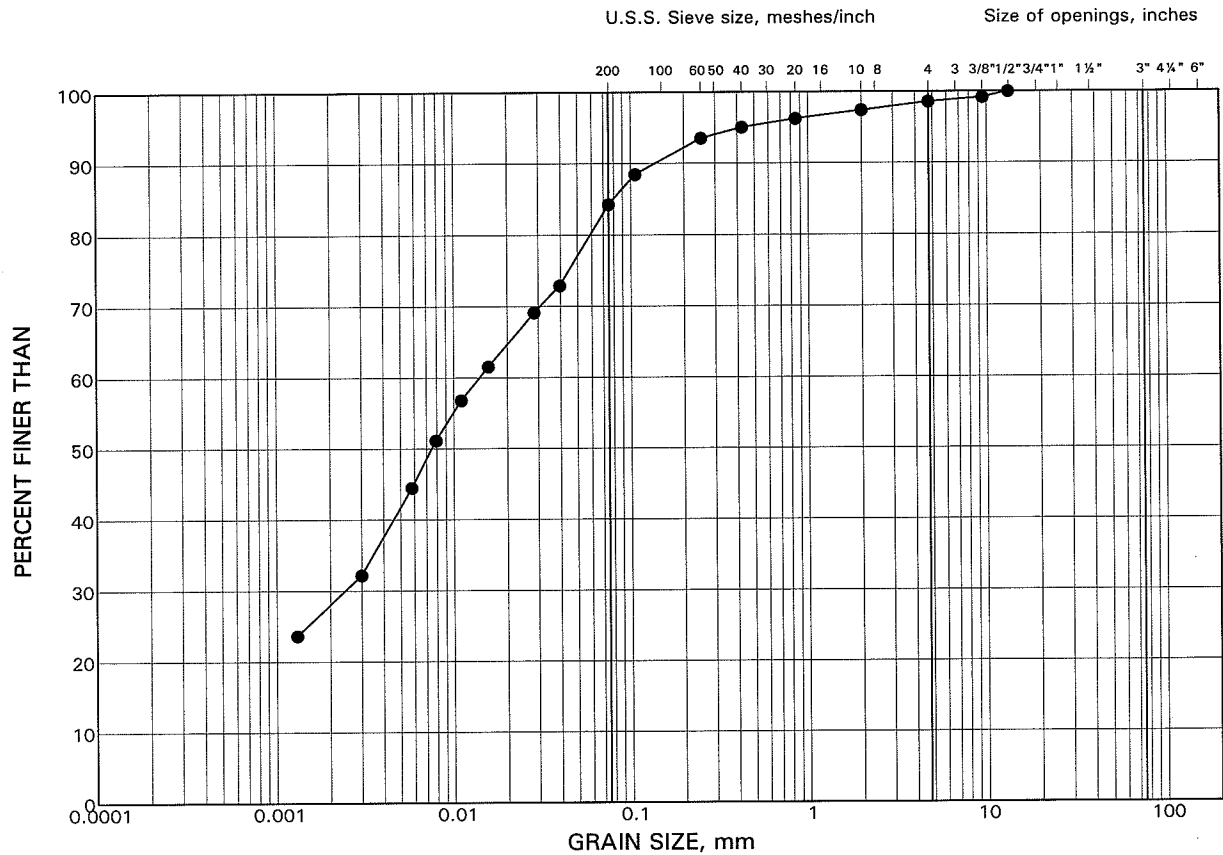
Prepared by LG

Checked by

# 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

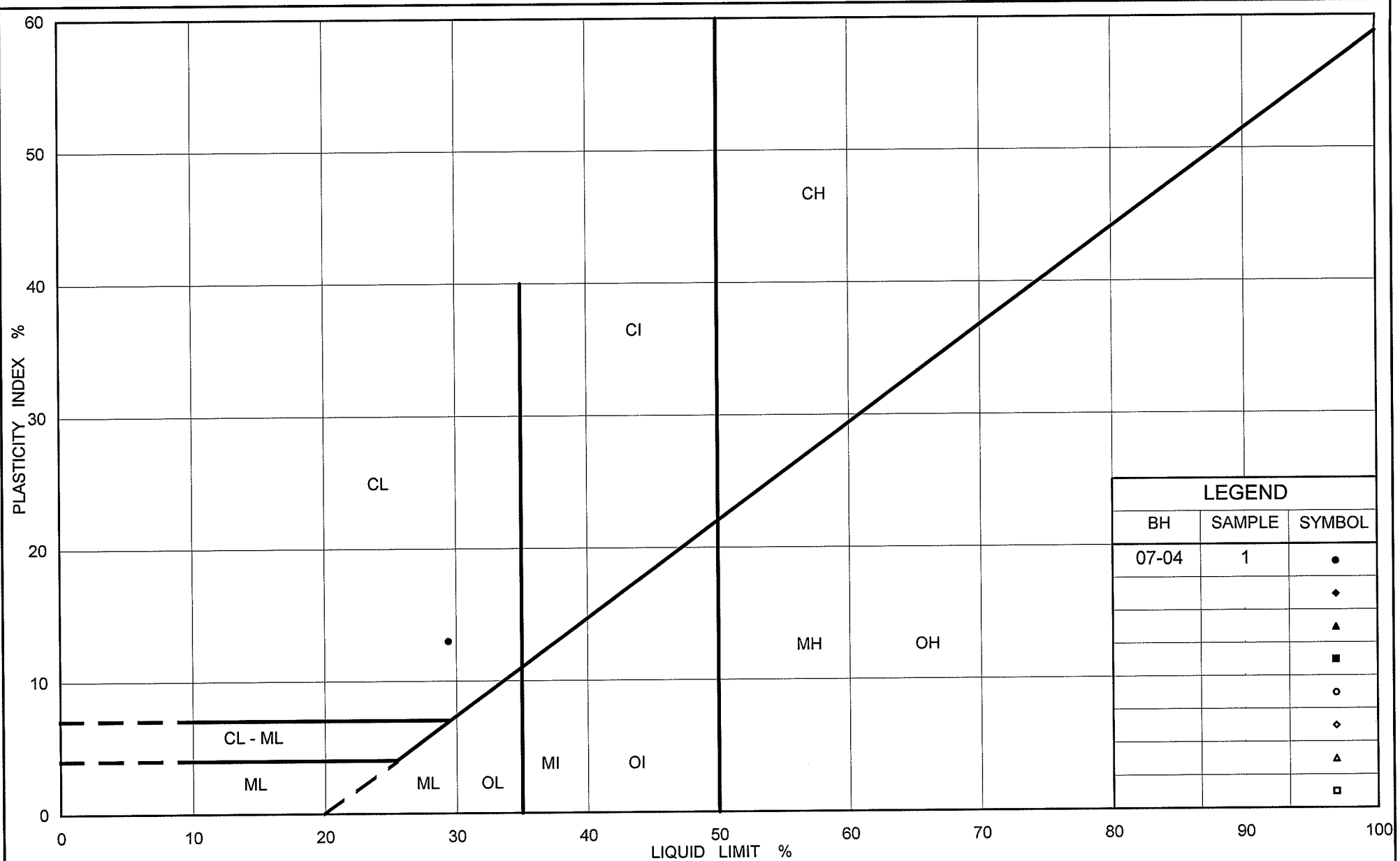
SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
•	07-04	1	91.9

Date February, 2007  
Project 04-1111-002

**Golder Associates**

Prepared by LG

Checked by *ll*



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# PLASTICITY CHART Surfacial Clayey Silt

FIG No. 5

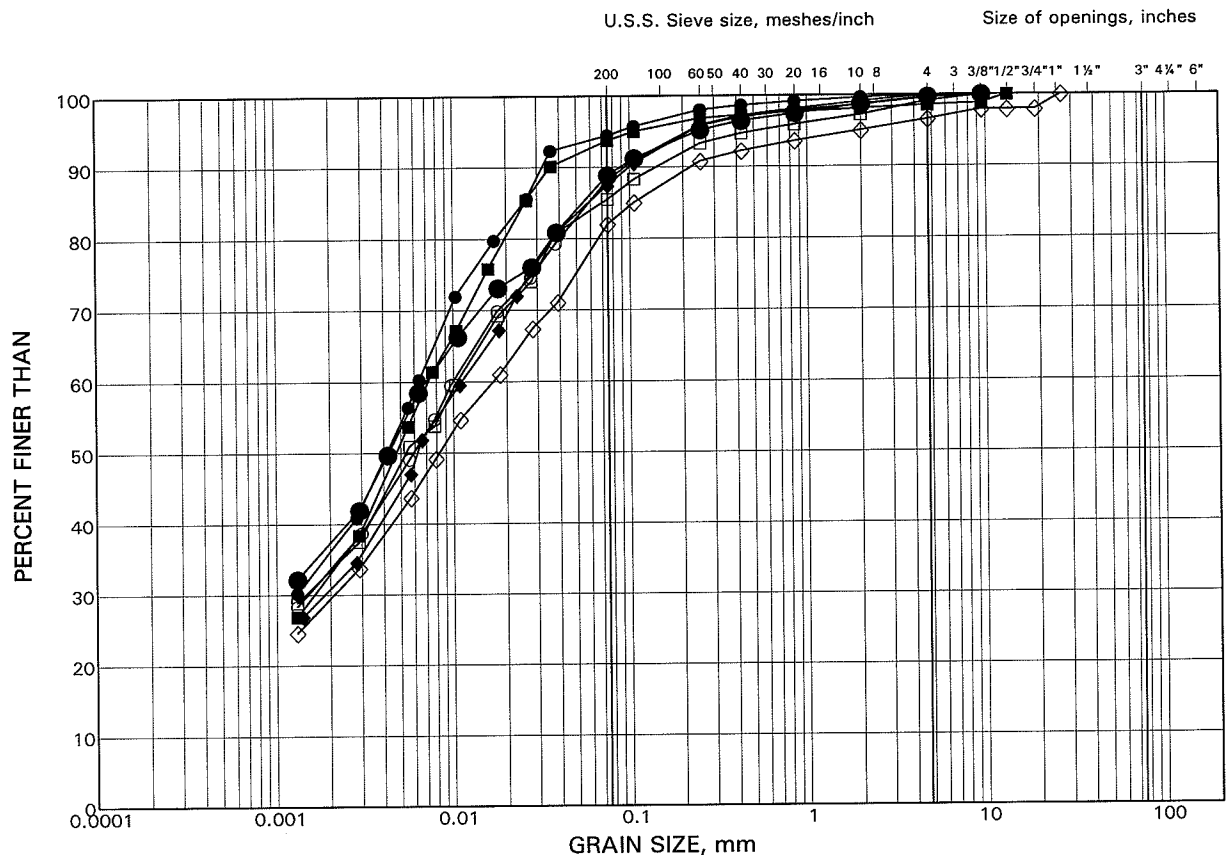
Project No. 04-1111-002

Checked by *ll*

# 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)
●	07-01	2	90.7
■	07-02	6	85.2
◆	07-03	1	92.3
○	07-06	2	92.3
□	07-10	5	88.9
◇	07-13	5	89.4
●	07-18	2	95.3

Date February, 2007  
Project 04-1111-002

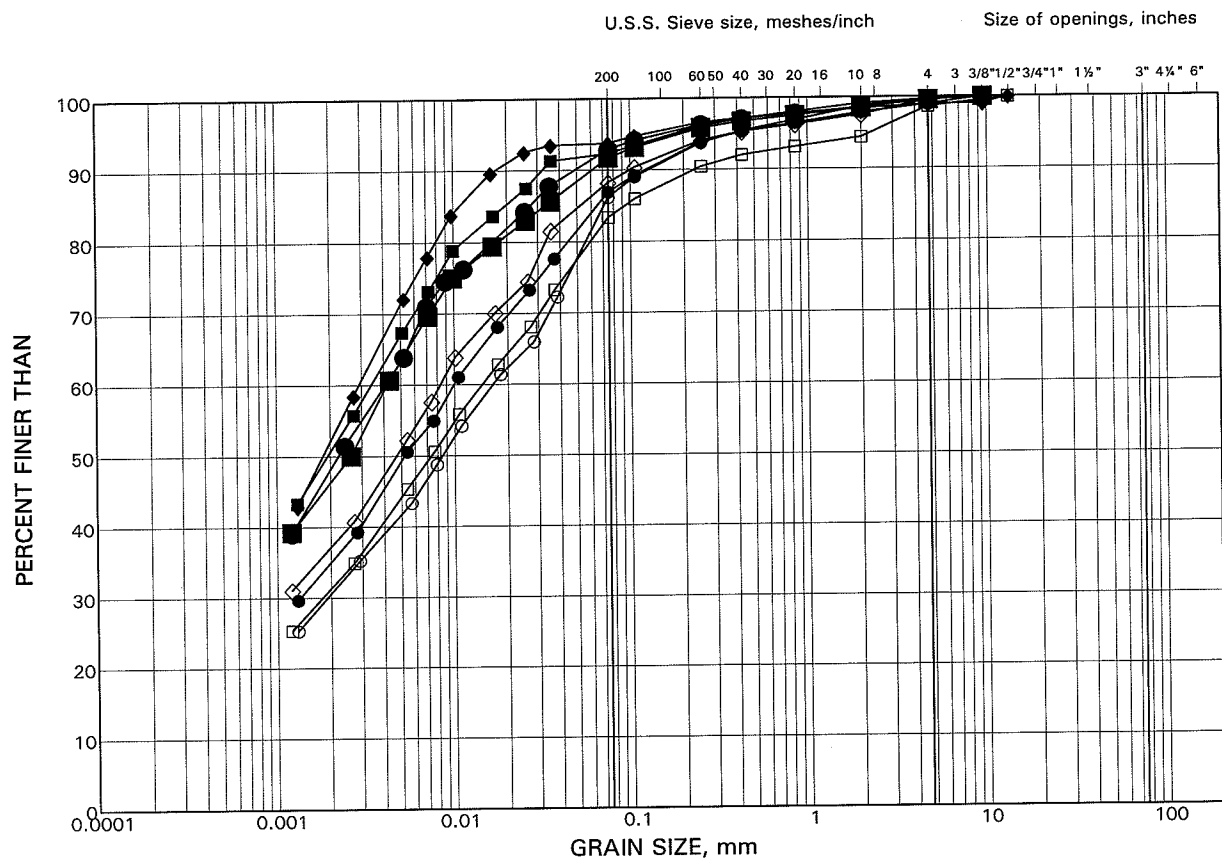
**Golder Associates**

Prepared by LG  
Checked by *lee*

# 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

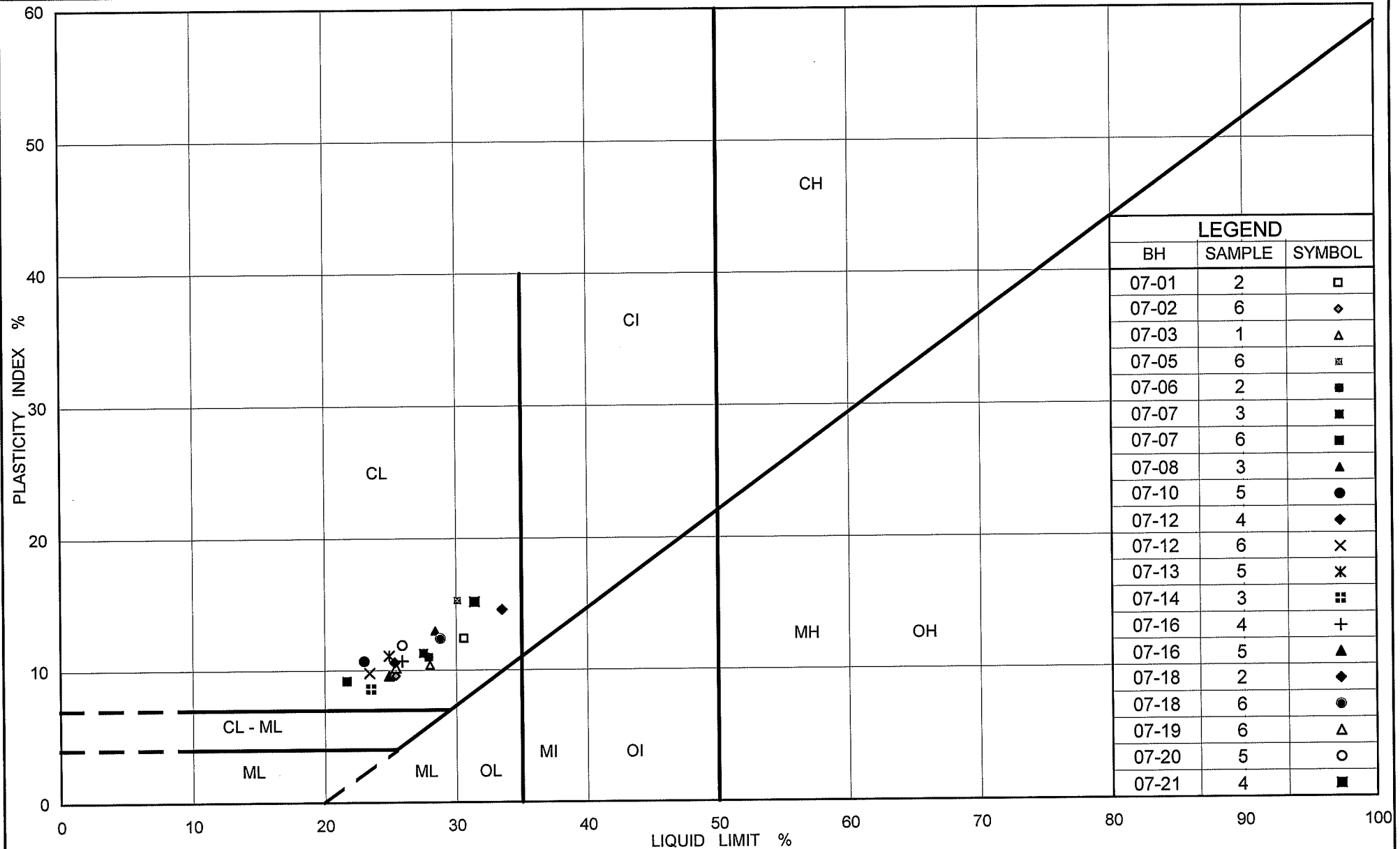
## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	07-20	5	91.1
■	07-24	6	94.6
◆	07-26	4	97.3
○	306	9	88.9
□	W-34	5	94.3
◇	W-36	7	94.2
●	W-44	2	99.0
■	W-45	7	93.3

Date February, 2007  
Project 04-1111-002

**Golder Associates**

Prepared by LG  
Checked by *lll*



Ministry of Transportation

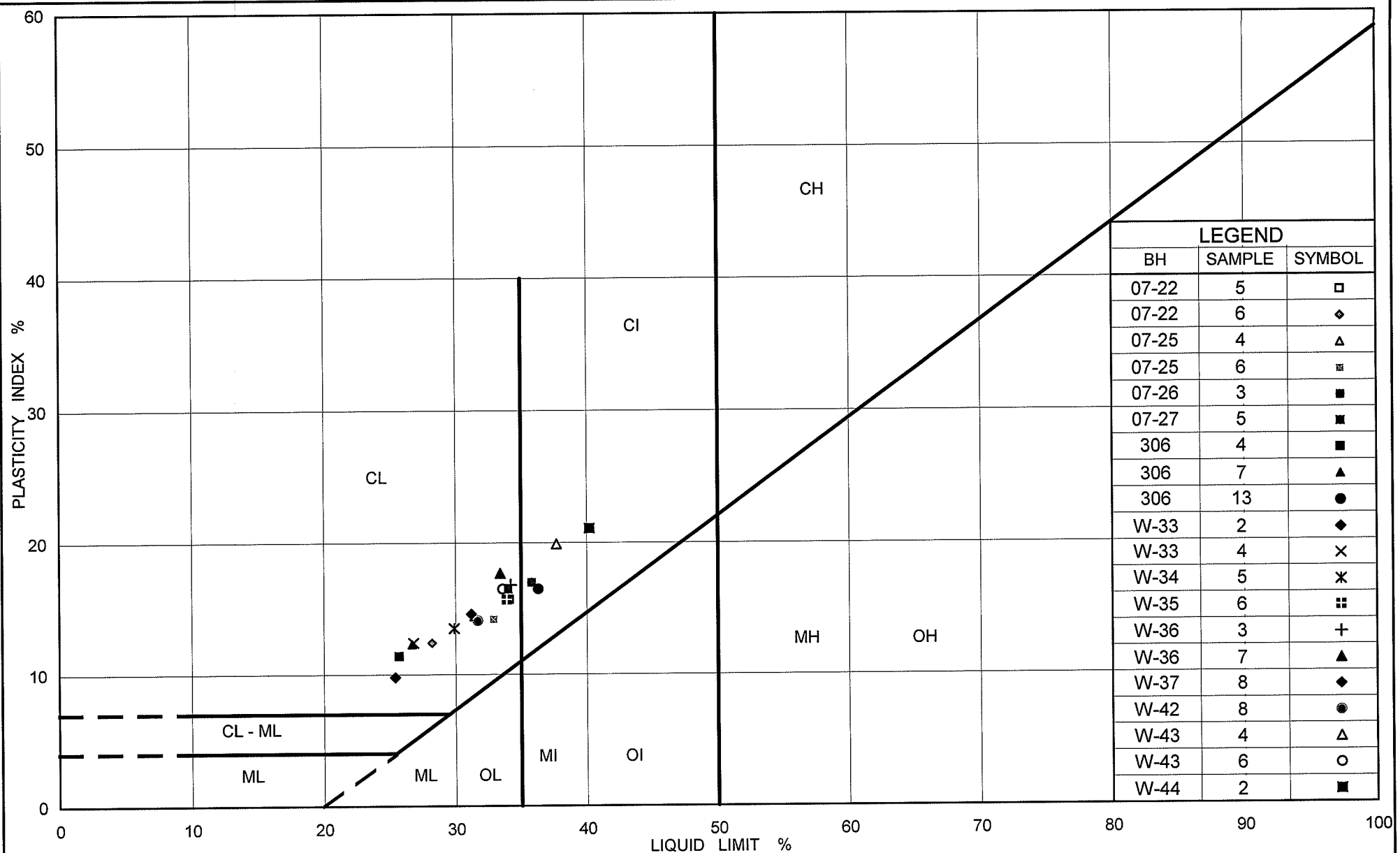
Ontario

# PLASTICITY CHART Clayey Silt to Silty Clay Till

FIG No. 7A

Project No. 04-1111-002

Checked by: *lll*



Ministry of Transportation

Ontario

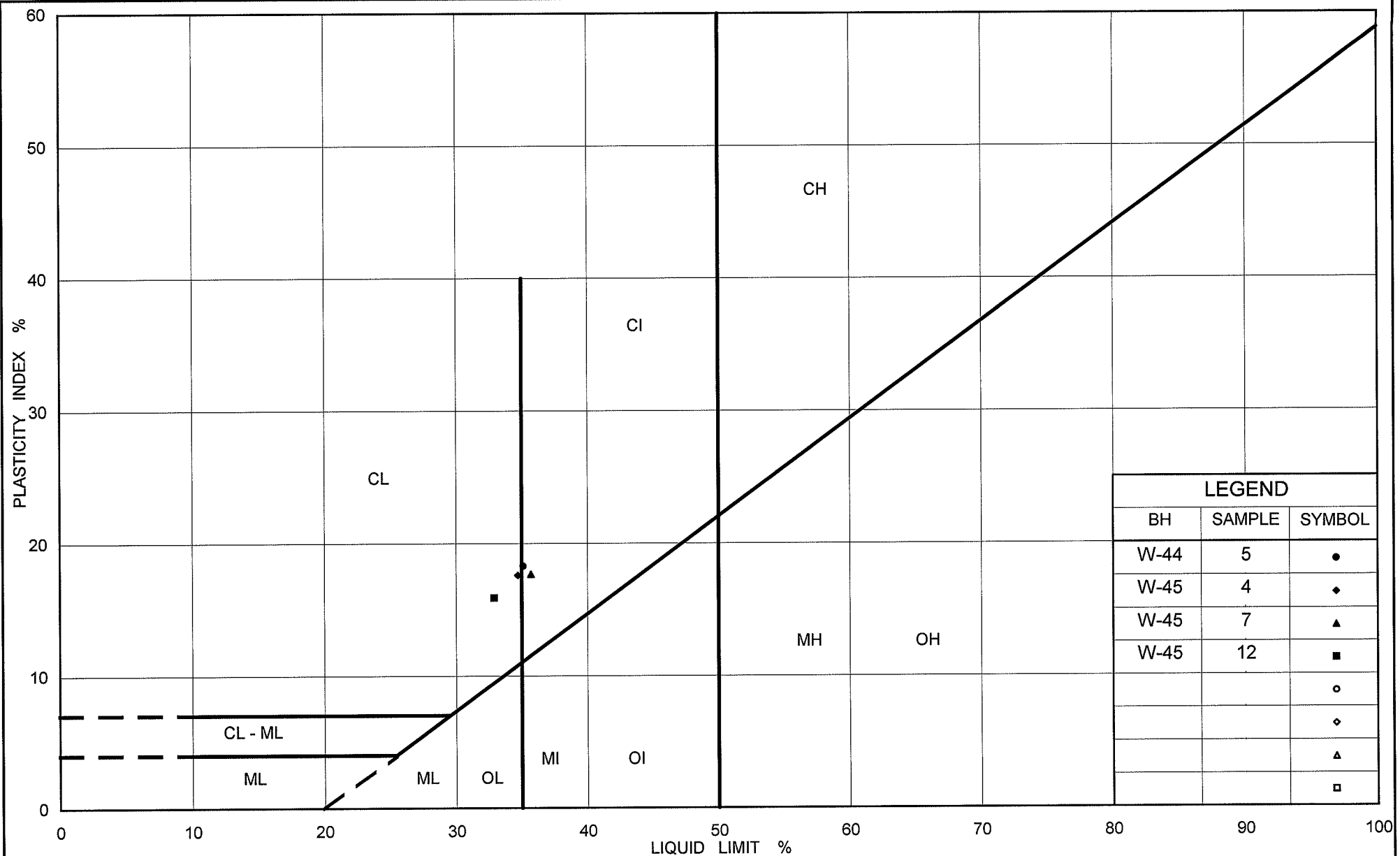
# PLASTICITY CHART Clayey Silt to Silty Clay Till

FIG No. 7B

Project No. 04-1111-002

Checked by: *pl*





Ministry of Transportation

Ontario

# PLASTICITY CHART Clayey Silt to Silty Clay Till

FIG No. 7C

Project No. 04-1111-002

Checked by: *ll*

## **APPENDIX A**

### **RECORDS OF BOREHOLES 954-2 AND 954-4 1961 INVESTIGATION H.G. ACRES & COMPANY LIMITED**

H. G. AGRES & COMPANY LIMITED - CONSULTING ENGINEERS  
 NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS JOB No. 954  
 PROJECT: W.P. 224-61 HOLE No. 954-2  
 SITE: QEW & NS&T Railway Subway SHEET No. 1 of 3  
 CONTRACTOR: F.E. Johnston Drilling Company Limited  
 STARTED 8:00 A.M. October 23 1961  
 FINISHED 11:00 A.M. October 25 1961  
 METHOD OF DRILLING: SOIL Modified wash boring CASING DIAM. NX  
 ROCK CORE DIAM.  
 LOCATION: LATITUDE Sta 87+30 ELEVATIONS: DATUM G.S.C.  
 DEPARTURE 110 ft Right Centreline DRILL PLATFORM -  
 BEARING QEW GROUND SURFACE 315.8  
 INITIAL DIP 90 degrees ROCK SURFACE -  
 OTHER DIPS BOTTOM OF HOLE 257.3  
 WATER TABLE

DEPTH Feet	SOIL TYPE	DESCRIPTION: COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	S A M P L E					PENETRATION TEST # Blows
			NO.	TYPE*	SIZE	DEPTH	RET'D	
0.0	Gravel	Brownish loose fill			In.	Ft.	In.	
	Sand Silt and Clay	material						
2.0	Gravel	Brownish mottled grey						
	Sand Silt and Clay	and yellow highly weathered stiff and dry	1	AQ	2	5.0	15	
						5.5		8
						6.0		23
						6.5		35
			2	BO	2	10.0	10	Pushed
						10.7		1300 lb
						11.0		10
						11.5		17
2.0	Gravel	Grey, stiff and no signs						
	Sand Silt and Clay	of weathering observed			Vane Test	13.0		
			3	BO	2	15.0	12	
						15.5		
6.0	Gravel	Brownish grey, some						
	Sand Silt and Clay	varving or layering visible				16.0		
						16.5		
					Vane Test	17.0		
			4	AQ	2	17.0	12	
						17.5		5
						18.0		8
						18.5		26

SAMPLING METHOD:

\*A - SPLIT TUBE  
 B - THIN WALL TUBE  
 C - PISTON SAMPLER  
 D - CORE BARREL

E - AUGER  
 F - WASH

SHIPPING CONTAINER:

N - INSERT  
 O - TUBE  
 P - WATER CONTENT TIN  
 Q - GLASS JAR

R - CLOTH BAG  
 S - PLIOFILM BAG  
 Z - DISCARDED

INSPECTOR: B.W. Hyder

LOGGED BY: B.W. Hyder

APPROVED

DATE

November 1961

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS  
 NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS  
 PROJECT: W.P. 224-61  
 SITE: QEW & NS&T Railway Subway

JOB No. 954  
 HOLE No. 954-2  
 SHEET No. 2 OF 3

DEPTH Feet	SOIL TYPE	DESCRIPTION: COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	S A M P L E					PENETRATION TEST *
			NO.	TYPE	SIZE In.	DEPTH Ft.	RET'D In.	
20.0	Gravel	Reddish brown, very stiff. Had to wash ahead of casing, 365 blows with 250-lb hammer to advance casing one foot		BZ	2	20.0 20.4		35
			5a	AQ	2	20.4 20.9 21.4 21.9	10	32 37 35
			5b	AQ	2	22.5 23.0 23.5 24.0	12	26 28 27
24.5	Gravel Sand Silt and Clay	Brownish grey, very dense and stiff		Vane Test		23.0		
			6	BO	2	25.0 25.5 26.0 26.5	18	Pushed 1400 lb
				Vane Test		28.0		
			7	BO	2	30.0 30.5 31.0 31.5	18	Pushed 1000 lb
				Vane Test		33.0		
			10	AQ		34.0 36.0	18	
			8	BO	2	35.0 35.5 36.0 36.5	18	Pushed 800 lbs
7.0	Silty Clay	Brownish, medium stiff homogeneous		Vane Test		38.0		
			11	AQ		38.0 40.0	18	
			9	BO	2	40.0 40.5 41.0 41.5	18	Pushed 800 lbs
				Vane Test		43.0		

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS  
 NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT ONTARIO DEPARTMENT OF HIGHWAYS

JOB No. 954

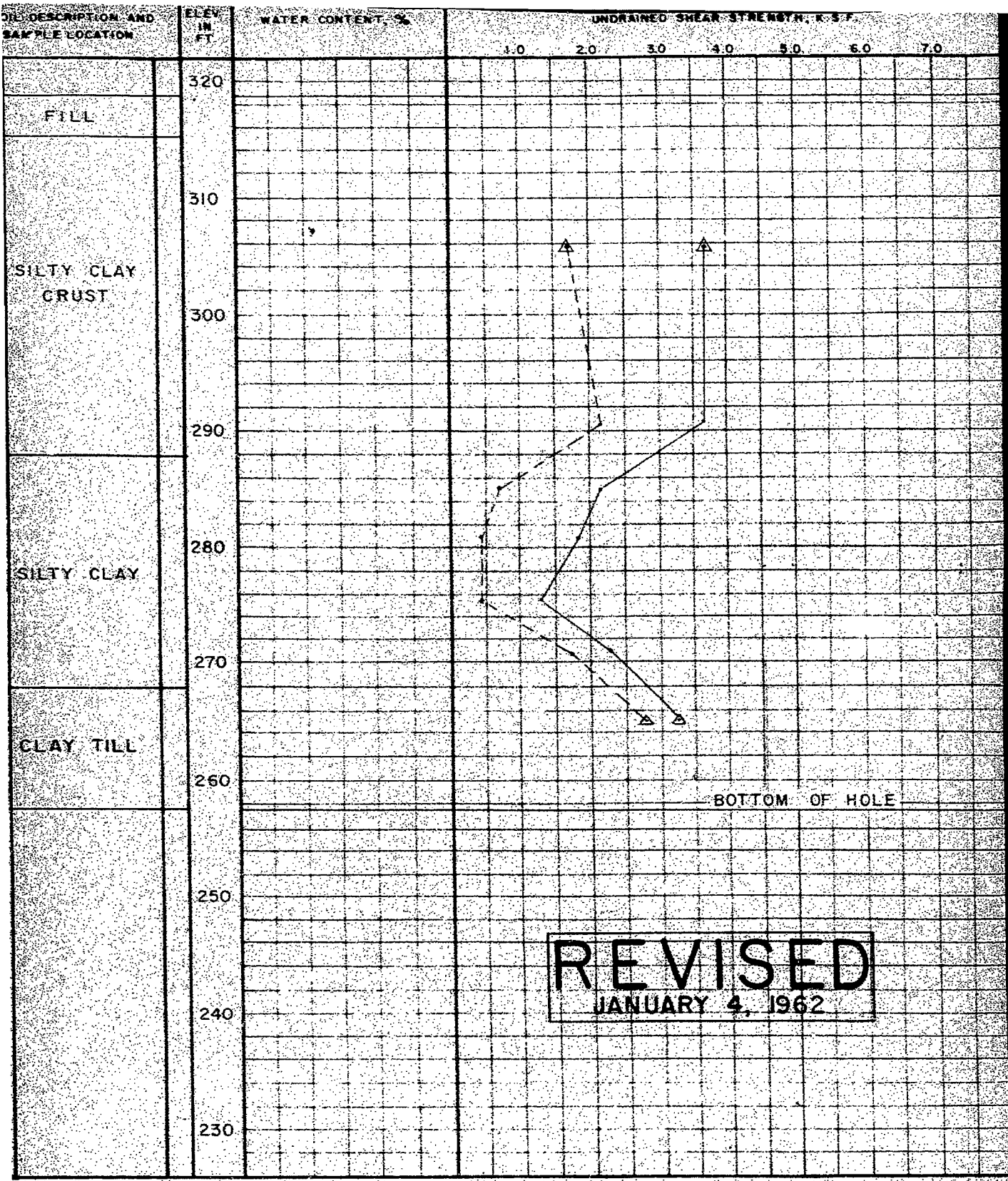
PROJECT W.P. 224-61

HOLE No. 954-2

SITE QEW & NS&T Railway Subway

SHEET No. 3 OF 3

DEPTH Feet	SOIL TYPE	DESCRIPTION: COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	S A M P L E					PENETRATION TEST *
			NO.	TYPE	SIZE In.	DEPTH Ft.	RET'D In.	
			12	AQ		42.0		
5.0	Silty Clay	Greyish medium stiff some 1" diameter stones	13	B0	2	44.0 45.0 46.2	15	Pushed
6.2	Silty Clay	Greyish brown silty clay with patches and laminations of silt, some gravel present		Vane Test		46.2		
			14	AQ	2	46.2 46.7 47.2 47.7	16	
				Vane Test		49.0		
10.0	Gravel Sand Silt and Clay	Reddish brown, very stiff	15	AQ	2	50.0 50.5 51.0 51.5	18	12 9 13
				Vane Test		53.0		
				BZ	2	55.0 55.4	0	40
			17	AQ	2	55.4 55.9 56.4 56.9	18	14 19 23
				Vane Test		57.2		
				AQ	2	60.0 60.5 61.0 61.5	0	23 17 26
1.5		End of Hole						
		* Penetration Test This is the number of blows of a 140-pound weight falling 30 inches required to advance the tube sampler or split-spoon to depth indicated						



<div>3</div> <div>○</div> <div>—</div> <div>—</div>	<div>SOIL SAMPLE</div> <div>NATURAL WATER CONTENT</div> <div>LIQUID LIMIT</div> <div>PLASTIC LIMIT</div>	<div>○</div> <div>△</div> <div>—</div> <div>---</div>	<div>UNDRAINED COMPRESSION TEST</div> <div>FIELD VANE TEST</div> <div>NATURAL STRENGTH</div> <div>REMOULDED STRENGTH</div>	<div>0</div> <div>15</div> <div>5</div> <div>10</div>	<div>FAILURE STRAIN</div>
H. G. ACRES & COMPANY LIMITED CONSULTING ENGINEERS NIAGARA FALLS CANADA			SUMMARY OF DRILLING AND TEST RESULTS		
ONTARIO DEPARTMENT OF HIGHWAYS			HOLE 954-2		
W.P. 224 - 61			APPROVED		DATE NOVEMBER 1961
					JOB No. 954
			H.G. ACRES & COMPANY LTD.		PLATE 7



H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS  
 NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS  
 PROJECT: W.P. 224-61  
 SITE: QEW and NS&T Railway Subway  
 CONTRACTOR: F.E. Johnston Drilling Company Limited  
 METHOD OF DRILLING: SOIL Modified wash boring  
 ROCK  
 LOCATION: LATITUDE Sta 86+35  
 DEPARTURE 49 ft Right Centreline  
 BEARING QEW  
 INITIAL DIP 90 degrees  
 OTHER DIPS  
 STARTED 8:00 A.M. November 7 1961  
 FINISHED 5:00 P.M. November 8 1961  
 JOB No. 954  
 HOLE No. 954-4  
 SHEET No. 1 OF 2  
 CASING DIAM. 4"  
 CORE DIAM.  
 ELEVATIONS: DATUM G.S.C.  
 DRILL PLATFORM -  
 GROUND SURFACE 319.1  
 ROCK SURFACE -  
 BOTTOM OF HOLE 231.1  
 WATER TABLE

DEPTH Feet	SOIL TYPE	DESCRIPTION: COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC	S A M P L E				PENETRATION TEST # Blows
			NO.	TYPE	SIZE In.	DEPTH Ft.	RETD In.
0.0	Silty Sand	Reddish brown backfill					
3.5	Silty Clay	Brownish grey, stiff with some lamination and gravel size particles. Between 25.0 and 30.0 gravel content increases	1	BO	3	5.0 6.5 8.0	18 Pushed 1500 lbs
			2	CO	3	10.0 11.7 12.0	20 Pushed 1200 lbs
			3	CO	3	15.0 16.7 17.0	20 Pushed 1200 lbs
			4	CO	3	20.0 21.7 23.0	20 Pushed 1200 lbs
				CO	3	25.0	0 Unable to push

SAMPLING METHOD

A - SPLIT TUBE  
 B - THIN WALL TUBE  
 C - PISTON SAMPLER  
 D - CORE BARREL

E - AUGER  
 F - WASH

SHIPPING CONTAINER

M - INSERT  
 O - TUBE  
 P - WATER CONTENT TIN  
 Q - GLASS JAR

R - CLOTH BAG  
 S - FLEXIFILM BAG  
 T - DISCARDED

INSPECTOR: H.W. Ryder  
 LOGGED BY: H.W. Ryder

APPROVED

DATE

November 1961

Plate 5A

FORM NO. 614

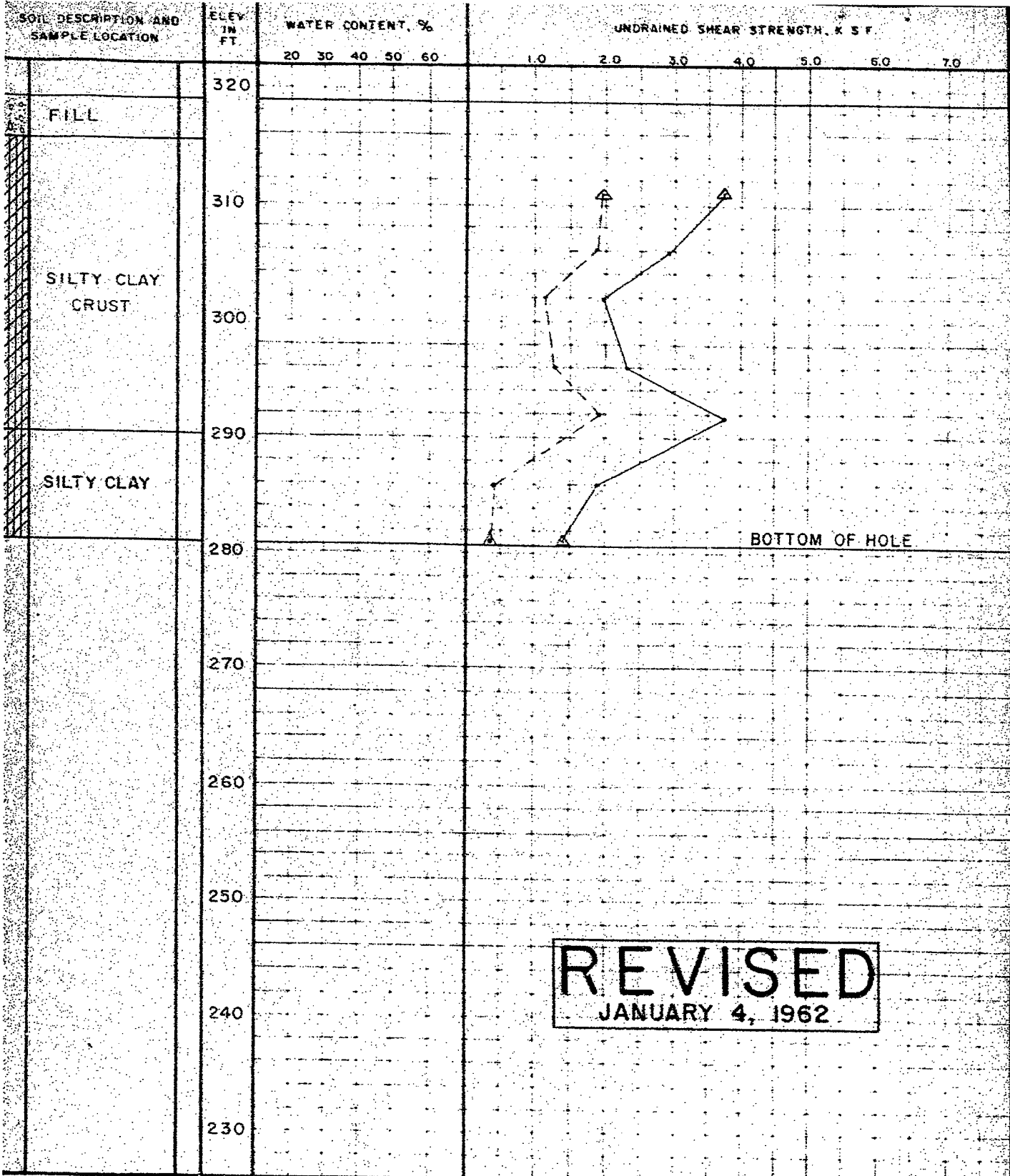
DRILLING REPORT

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS  
 PROJECT: W.P. 224-61  
 SITE: QEW & NS&T Railway Subway

JOB No. 954  
 HOLE No. 954-4  
 SHEET No. 2 OF 2

DEPTH Feet	SOIL TYPE	DESCRIPTION, COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	SAMPLE					PENETRATION TEST
			NO.	TYPE	SIZE In.	DEPTH Ft.	BIT In.	BLOWS
			5	BO	3	25.0	18	
						25.5		8
						26.0		7
						26.5		7
			Vane Test			27.0		
			6	CO	3	30.0	12	Unable
						31.7		to push
			Vane Test			33.0		30 blows
			7	CO	3	35.0	20	Pushed
						36.7		1300 lbs
8.0		End of Hole	Vane Test			38.0		
		<u>* Penetration Test</u>						
		This is the number of blows of a 140-pound weight falling 30 inches required to advance the tube sampler or split-spoon to depth indicated						





**REVISED**  
JANUARY 4, 1962

- 3 SOIL SAMPLE
- NATURAL WATER CONTENT
- LIQUID LIMIT
- PLASTIC LIMIT
- UNDRAINED COMPRESSION TEST
- △ FIELD VANE TEST
- NATURAL STRENGTH
- REMOULDED STRENGTH
- 15 — ○ — 5 FAILURE STRAIN

<b>H. G. ACRES &amp; COMPANY LIMITED</b> CONSULTING ENGINEERS NIAGARA FALLS CANADA		<b>SUMMARY OF DRILLING AND TEST RESULTS</b> HOLE 954-4	
ONTARIO DEPARTMENT OF HIGHWAYS		APPROVED <i>[Signature]</i> H. G. ACRES & COMPANY, LTD.	DATE NOVEMBER 1961 JOB No. 954 <b>PLATE 9</b>
W. P. 224-61			