

**Golder Associates Ltd.**

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**FOUNDATION INVESTIGATION REPORT  
STRUCTURAL CULVERT  
SITE 6-407-C  
HIGHWAY 3 WIDENING  
GWP 315-98-00  
MINISTRY OF TRANSPORTATION - SOUTHWESTERN REGION**

Submitted to:

Delcan Corporation  
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March 12, 2007

06-1130-177-0-2  
Geocres No. 40J2-89



**TABLE OF CONTENTS**

<u>SECTION</u>	<u>PAGE</u>
<b>PART A – FOUNDATION INVESTIGATION REPORT</b>	
1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	2
2.1 Site Geology.....	2
3.0 INVESTIGATION PROCEDURES.....	3
4.0 SUBSURFACE CONDITIONS.....	5
4.1 Site Stratigraphy.....	5
4.1.1 Topsoil and Fill.....	5
4.1.2 Clayey Silt Till.....	5
4.2 Groundwater Conditions.....	6
5.0 MISCELLANEOUS.....	7

LIST OF ABBREVIATIONS

LIST OF SYMBOLS

RECORD OF BOREHOLE SHEETS

FIGURE 1 - Key Plan

DRAWING 1 - Borehole Locations and Soil Strata

APPENDIX A - Laboratory Test Data

APPENDIX B - Photograph

## 1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by Delcan Corporation (Delcan) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out foundation investigations as part of the detail design work for GWP 315-98-00. The project involves the first phase of the reconstruction and widening of Highway 3 (Talbot Trail) between Windsor and Leamington. The project limits extend along Highway 3 from just west of Essex Road 34 (Talbot Street North) easterly to just east of Essex Road 8 (Maidstone Avenue West) in Essex County, Ontario.

In conjunction with the widening, the scope of work for this project includes:

- Rehabilitation or replacement of selected culverts within the project limits;
- Slotted left turn lanes at all intersections;
- Revision or upgrading of illumination at four intersections;
- Revision or upgrading of traffic signals at two intersections;
- Replacement or relocation of existing traffic counting stations;
- Drainage improvements; and
- Upgrading of existing signage.

It has been proposed to widen five structural culverts and four short span culverts and to replace two short span culverts.

This report addresses the foundation investigation for the extension of the south end of the structural culvert located on Highway 3 at Station 19+320, South Sandwich (Site 6-407-C). It has been proposed to extend this culvert by up to 21 metres.

The purpose of the foundation investigation is to determine the subsurface conditions at the location of the proposed works by drilling boreholes and carrying out in situ testing and laboratory testing on selected samples. The terms of reference for the scope of work are outlined in the MTO's Request for Proposal, in Golder Associates' proposal P61-3113-1 dated August 17, 2006 and our letter dated November 14, 2006. The work was carried out in accordance with our Quality Control Plan for Foundations Engineering dated September 18, 2006.

Delcan provided Golder Associates with a base plan and profile for this project in digital format which included the top elevations of the culverts.

## 2.0 SITE DESCRIPTION

GWP 315-98-00 extends along Highway 3 from 0.5 kilometres west of Essex Road 34 (Talbot Street North) within the Town of Tecumseh easterly to 0.6 kilometres east of Essex Road 8 (Maidstone Avenue West) in the Town of Essex. West of Manning Road, Highway 3 is within South Sandwich Township. East of Manning Road, it is within Maidstone Township. The chainage equation at Manning Road is 20+981.675 South Sandwich (SS) = 10+000.000 Maidstone (M). The west project limit is located at Station 17+700 SS and the east project limit is situated at Station 13+600 M.

Culvert Site 6-407-C is located at Station 19+320 SS on Highway 3 approximately 40 metres east of Malden Road. This culvert conveys flows of the Malden Road East Drain from the right/south side of Highway 3 to the left/north side. The location of the project is shown on the Key Plan, Figure 1, and in the photograph in Appendix B.

The land use in the vicinity of the site is predominantly agricultural. The adjacent topography is generally flat to slightly rolling with ground surface elevations between 191 and 195 metres.

### 2.1 Site Geology

The site is situated on the Essex Clay Plain, a subregion of the physiographic region of southern Ontario known as the St. Clair Clay Plain.<sup>1</sup> This subregion is described as a beveled till plain with little relief that has been locally smoothed by shallow deposits of lacustrine clay deposited in depressions in the till. The prevailing soil type is reported to be the Brookston clay loam.

The available surficial geology mapping for the project area indicates that the predominant surficial soils are clayey silt till.<sup>2</sup> The till is reportedly underlain by limestone, dolomite and shale of the Middle Devonian era and by dolomite of the Upper Silurian era. The overburden thickness within the project area ranges from 27 to 41 metres.<sup>3</sup>

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<sup>1</sup> L.J. Chapman and D.F. Putnam, 1984. *The Physiography of Southern Ontario*. Third Edition. Ontario Geological Survey, Special Volume 2.

<sup>2</sup> Vagners, U. J., 1972. *Quaternary Geology of the Windsor-Essex Area, (Western and Eastern Parts) Southern Ontario*. Ontario Department of Mines and Northern Affairs, Preliminary Maps P. 749 and P.750, Geological Series.

<sup>3</sup> Vagners, U.J., Sado, E.V., and Yundt, S.E. 1973. *Drift Thickness of the Windsor-Essex Area (Western and Eastern Parts) Southern Ontario*, Ontario Division of Mines, Preliminary Maps P.814 and P.815, Drift Thickness Series.

### **3.0 INVESTIGATION PROCEDURES**

The field work for this portion of the investigation was carried out on November 30 and December 1, 2006, at which time two boreholes were drilled in the area of the proposed culvert extension. Borehole 11 was advanced to a depth of 7.5 metres and borehole 12 to a depth of 8.2 metres.

The investigation was carried out using a Deidrich 50 track-mounted power auger supplied and operated by a specialist drilling contractor. Samples of the overburden were obtained at intervals of 0.75 metres up to a depth of 4.6 metres and at 1.5 metre intervals below this depth using 50 millimetre outside diameter split spoon sampling equipment in accordance with the standard penetration test (SPT) procedures.

Groundwater conditions in the boreholes were observed throughout the drilling operations and these observations are provided on the corresponding Record of Borehole sheets. A standpipe piezometer was installed in borehole 11 to monitor the groundwater levels at this location. The boreholes were backfilled in accordance with current regulations, MTO recommended procedures and Ontario Regulation 128/03.

The field work was supervised on a full-time basis by an experienced member of our engineering staff who arranged for utility locates, directed the drilling, sampling and in-situ testing operations, logged the boreholes and cared for the samples obtained. The soil samples were identified in the field, placed in labeled containers and transported to Golder Associates' London laboratory for further examination and testing. Index and classification tests consisting of water content determinations, grain size distribution analyses and Atterberg limits determinations were carried out on selected samples. The results of the field and laboratory testing are given on the Record of Borehole sheets and in Appendix A.

Temporary traffic control was carried out in accordance with the Ontario Traffic Manual, Temporary Conditions, Book 7, dated March 2001.

The as-drilled borehole locations and ground surface elevations are shown on the Record of Borehole sheets and on Drawing 1.

The table below summarizes the culvert dimensions and the coordinates, ground surface elevations and depths of the boreholes.

<u>BOREHOLE</u>	<u>LOCATION (m)</u>		<u>GROUND SURFACE ELEVATION</u>	<u>BOREHOLE DEPTH</u>
	<u>Northing</u>	<u>Easting</u>	(m)	(m)
11	4 674 083.5	272 385.2	190.20	7.47
12	4 674 105.4	272 395.8	190.85	8.23

The existing culvert has the following characteristics:

<u>DIMENSIONS (m)</u>	<u>TOP ELEVATION (m)</u>		<u>CONSTRUCTION</u>
	(Lt)	(Rt)	
3.68 x 1.78 x 28.65	190.68	190.74	Concrete, non-rigid frame open footing

## **4.0 SUBSURFACE CONDITIONS**

### **4.1 Site Stratigraphy**

The detailed subsurface soil and groundwater conditions encountered in the boreholes together with the results of the in situ and laboratory testing carried out on selected samples are given on the attached Record of Borehole sheets following the text of this report and in Appendix A. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling and observations of drilling resistance and represent transitions between soil types rather than exact planes of geological change. Subsurface conditions will vary between and beyond the borehole locations.

In general, the boreholes drilled in the area of the proposed culvert extension typically encountered topsoil and fill materials underlain by an extensive deposit of clayey silt till.

The locations of the boreholes are shown on the attached Drawing 1. A detailed description of the subsurface conditions encountered in the boreholes is provided on the Record of Borehole sheets and is summarized in the following sections.

#### **4.1.1 Topsoil and Fill**

Topsoil was present at the ground surface at both borehole locations. The topsoil layer was 400 millimetres thick at borehole 11 and 80 millimetres thick at borehole 12.

The topsoil layer at borehole 12 was underlain by 1.3 metres of fill materials from elevation 190.8 metres. The fill materials consisted of a 0.6 metre thick layer of fine to medium sand over a 0.7 metre thick layer of clayey silt. The clayey silt fill was stiff with an N value of 11 blows per 0.3 metres.

#### **4.1.2 Clayey Silt Till**

Clayey silt till was encountered beneath the topsoil layer in borehole 11 from elevation 189.8 metres and beneath the fill layers in borehole 12 from elevation 189.5 metres. The results of grain size analyses conducted on three samples obtained from the standard penetration testing are shown in Figure A-1 in Appendix A.

The clayey silt till is stiff to hard with N values ranging from 10 blows to 57 blows per 0.3 metres. Water contents in the till ranged from 16 to 18 per cent. The clayey silt till is of low plasticity based on average plastic and liquid limits of 15 and 32 per cent, respectively, and an

average plasticity index of 17 per cent. The results of the Atterberg limits testing are shown on the Plasticity Chart, Figure A-2.

Cobbles and boulders were not encountered in either of the boreholes for this investigation. However, the presence of cobbles and boulders should be anticipated in the clayey silt till.

#### **4.2 Groundwater Conditions**

Groundwater conditions were observed during and on completion of drilling and sampling. Both boreholes were dry during and upon completion of drilling.

A standpipe piezometer was installed in borehole 11 to monitor the groundwater conditions. On December 14, 2006, the groundwater level was measured at elevation 187.4 metres or at a depth of 2.8 metres below the ground surface. The most recent measurement was taken on February 26, 2007. On that date, the groundwater level was 1.52 metres below the existing ground surface or at elevation 188.7 metres.

The groundwater levels are expected to fluctuate seasonally and are likely to be higher during periods of sustained precipitation or spring melt.

The water level in the Malden Road East Drain was measured at elevation 189.96 metres on December 1, 2006.

## **5.0 MISCELLANEOUS**

The investigation was carried out using equipment supplied and operated by London Soil Test Limited which is an Ontario Ministry of Environment licensed well contractor. The field operations were supervised by Mr. Mike Arthur under the direction of Mr. David J. Mitchell. The laboratory testing was carried out at Golder Associates' London laboratory under the direction of Mr. Chris M. Sewell. The laboratory is an accredited participant in the MTO Soil and Aggregate Proficiency Program and is certified by the Canadian Council of Independent Laboratories for testing of Types C and D aggregates. This report was prepared by Ms. Dirka U. Prout, P. Eng. under the direction of the Project Manager, Mr. Philip R. Bedell, P. Eng. This report was reviewed by Mr. Fintan J. Heffernan, P. Eng., the Designated MTO Contact and Quality Control Auditor for this assignment.

### **GOLDER ASSOCIATES LTD.**

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Principal

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

DUP/PRB/FJH/cr  
n:\active\2006\1130 - geotechnical\1130-100\06-1130-177 delcan - gwp 315-98-00 fdns - hwy 3\reports\(-2) site 6-407\mar 12 07 - (final) fdn rpt - structural culvert - site 6-407-c hwy 3.doc

## LIST OF ABBREVIATIONS

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

### I. SAMPLE TYPE

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

### III. SOIL DESCRIPTION

#### (a) Cohesionless Soils

Density Index (Relative Density)	N <u>Blows/300 mm or Blows/ft.</u>
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.) split spoon sampler for a distance of 300 mm (12 in.)

#### (b) Cohesive Soils

#### Consistency

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

#### Dynamic Cone Penetration Resistance; $N_d$ :

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

**PH:** Sampler advanced by hydraulic pressure

**PM:** Sampler advanced by manual pressure

**WH:** Sampler advanced by static weight of hammer

**WR:** Sampler advanced by weight of sampler and rod

#### Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 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.

## 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
$\log_{10} x$	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)

**RECORD OF BOREHOLE No 11**

1 OF 1

**METRIC**

PROJECT 06-1130-177

G.W.P. 315-98-00

LOCATION N 4674083.5 ; E 272385.2

ORIGINATED BY MA

DIST \_\_\_\_\_ HWY 3

BOREHOLE TYPE Power Auger, Solid Stem

COMPILED BY LMK

DATUM GEODETIC

DATE November 30, 2006

CHECKED BY \_\_\_\_\_

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 (%)		
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40
190.20	GROUND SURFACE																	
0.00	TOPSOIL, clayey Brown																	
189.80																		
0.40	CLAYEY SILT, trace sand, trace gravel (TILL) Stiff to Hard Brown becoming Grey at about elev. 186.6m																	
		1	SS	10														
		2	SS	15														
		3	SS	39														0 21 45 34
		4	SS	32														
		5	SS	25														
		6	SS	17														0 22 41 37
		7	SS	18														
		8	SS	18														
182.73	END OF BOREHOLE																	
7.47	Borehole dry during drilling November 30, 2006.  Water level measured in standpipe at elev. 187.40m Dec. 14, 2006.  Water level measured in standpipe at elev. 188.68m Feb. 26, 2007.																	

ONL\_MTO\_06-1130-177-BB.GPJ\_LDN\_MTO.GDT\_3/13/07

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

**RECORD OF BOREHOLE No 12**

1 OF 1

**METRIC**

PROJECT 06-1130-177

G.W.P. 315-98-00

LOCATION N 4674105.4 ; E 272395.8

ORIGINATED BY MA

DIST \_\_\_\_\_ HWY 3

BOREHOLE TYPE Power Auger, Solid Stem

COMPILED BY LMK

DATUM GEODETIC

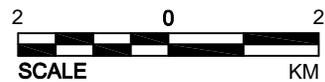
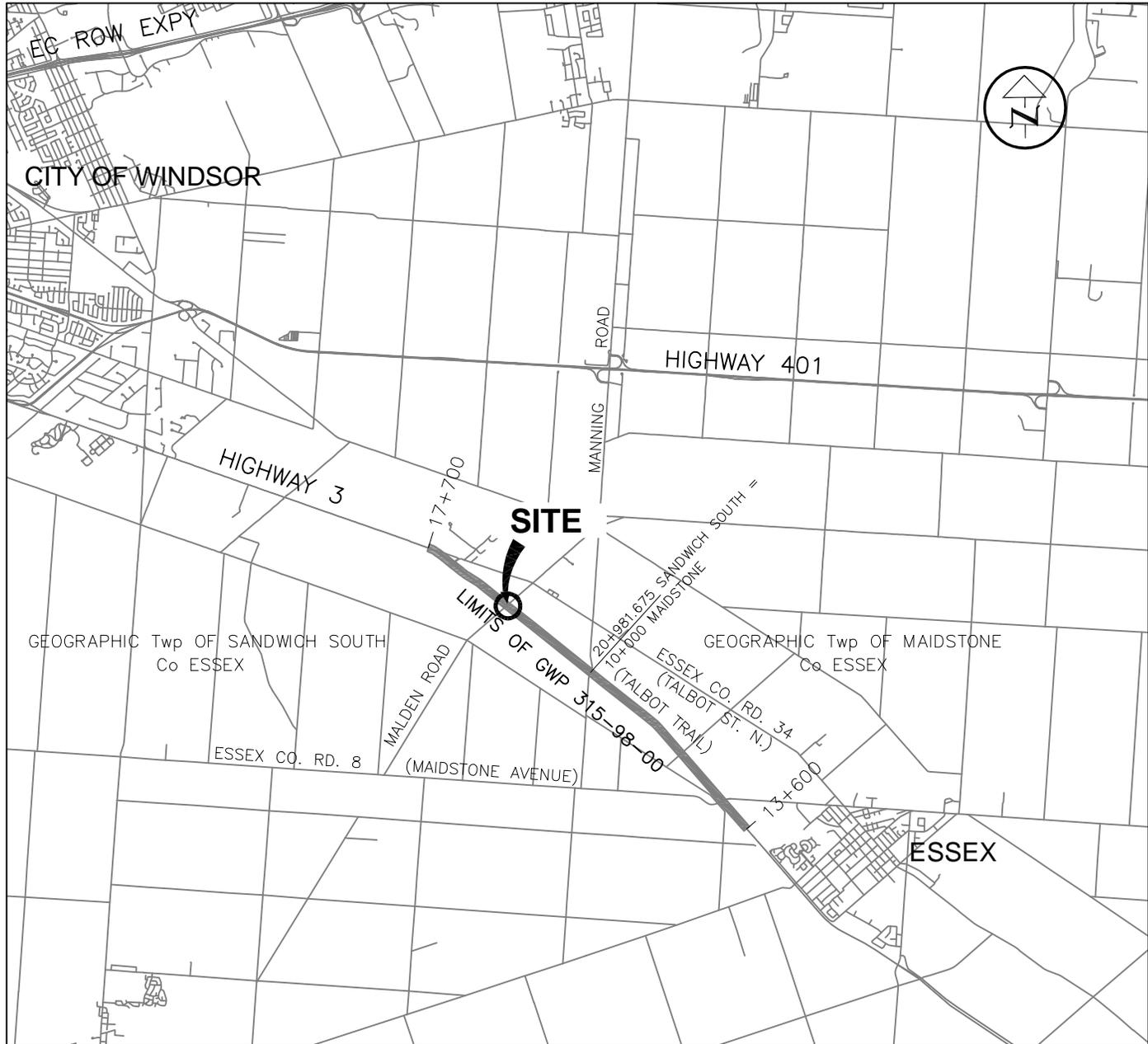
DATE December 1, 2006

CHECKED BY \_\_\_\_\_

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	20	40	60	80						100	20	40	60	80	100	10	20
190.85	GROUND SURFACE																							
0.08	TOPSOIL, clayey Brown																							
190.18	FILL, fine to medium sand, trace gravel Brown																							
0.67	FILL, clayey silt, trace sand, trace gravel, trace topsoil Stiff Brown		1	SS	11																			
189.48	FILL, clayey silt, trace sand, trace gravel, trace topsoil Stiff Brown and Black																							
1.37	CLAYEY SILT, trace sand, trace gravel (TILL) Stiff to Hard Brown becoming Grey at about elev. 187.8m		2	SS	18																			
			3	SS	53																			
			4	SS	57																			
			5	SS	32																			
			6	SS	30																			
			7	SS	25																			
			8	SS	15																			
182.62	END OF BOREHOLE																							
8.23	Borehole dry during drilling December 1, 2006.																							

ONL\_MTO\_06-1130-177-BB.GPJ LDN\_MTO.GDT\_3/13/07

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

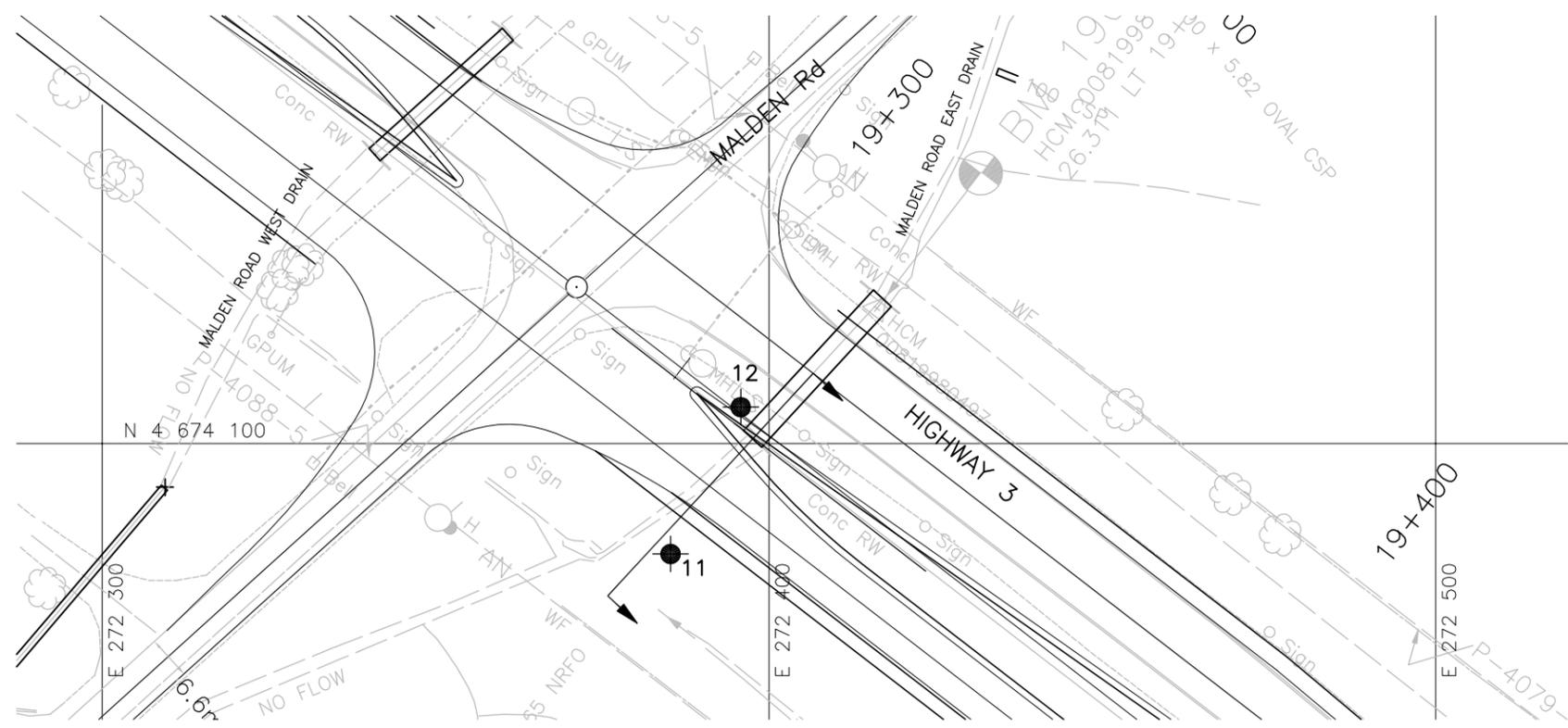


**NOTE**

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

PROJECT		STRUCTURAL CULVERT - SITE 6-407-C HIGHWAY 3 WIDENING GWP 315-98-00	
TITLE		KEY PLAN	
PROJECT No. 06-1130-177-0-2		FILE No. 061130177-BB001	
CADD WDF Dec. 13/06		SCALE AS SHOWN REV. 0	
CHECK		FIGURE 1	





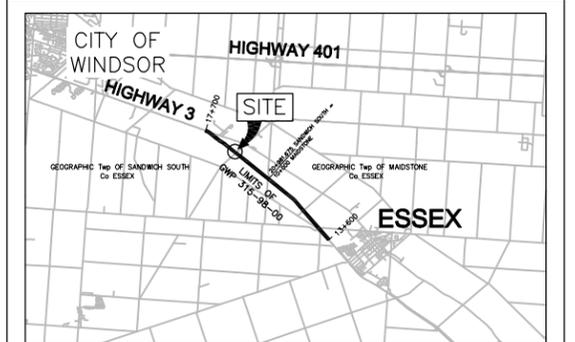
**PLAN**  
 SCALE  
 10 0 10 m

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

CONT No. WP No. 315-98-00  
 STRUCTURAL CULVERT  
 SITE 6-407-C  
 HIGHWAY 3 WIDENING  
 BOREHOLE LOCATION AND SOIL STRATA



**Golder Associates Ltd.**  
 LONDON, ONTARIO, CANADA



**KEY PLAN**  
 SCALE  
 3000 0 3000m

**LEGEND**

- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- Seal
- Standpipe
- WL in standpipe, measured on Feb. 26, 2007.
- DRY Borehole dry during drilling

No.	ELEVATION	CO-ORDINATES (MTM Zone 11)	
		NORTHING	EASTING
11	190.20	4 674 083.5	272 385.2
12	190.85	4 674 105.4	272 395.8

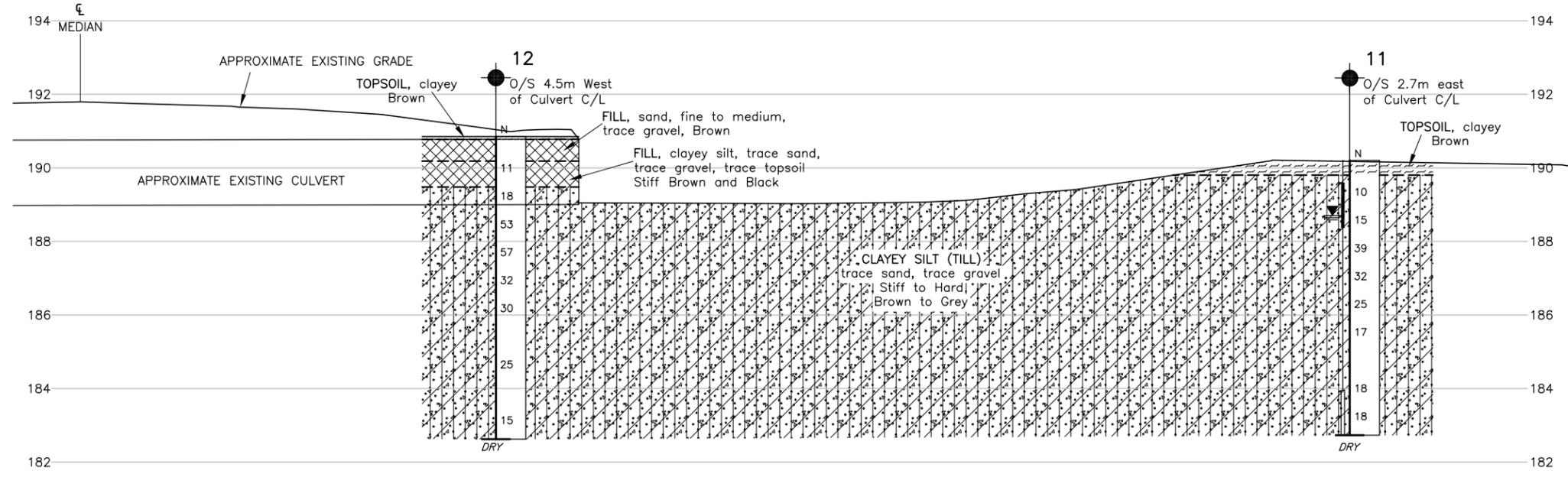
**NOTES**

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

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

**REFERENCE**

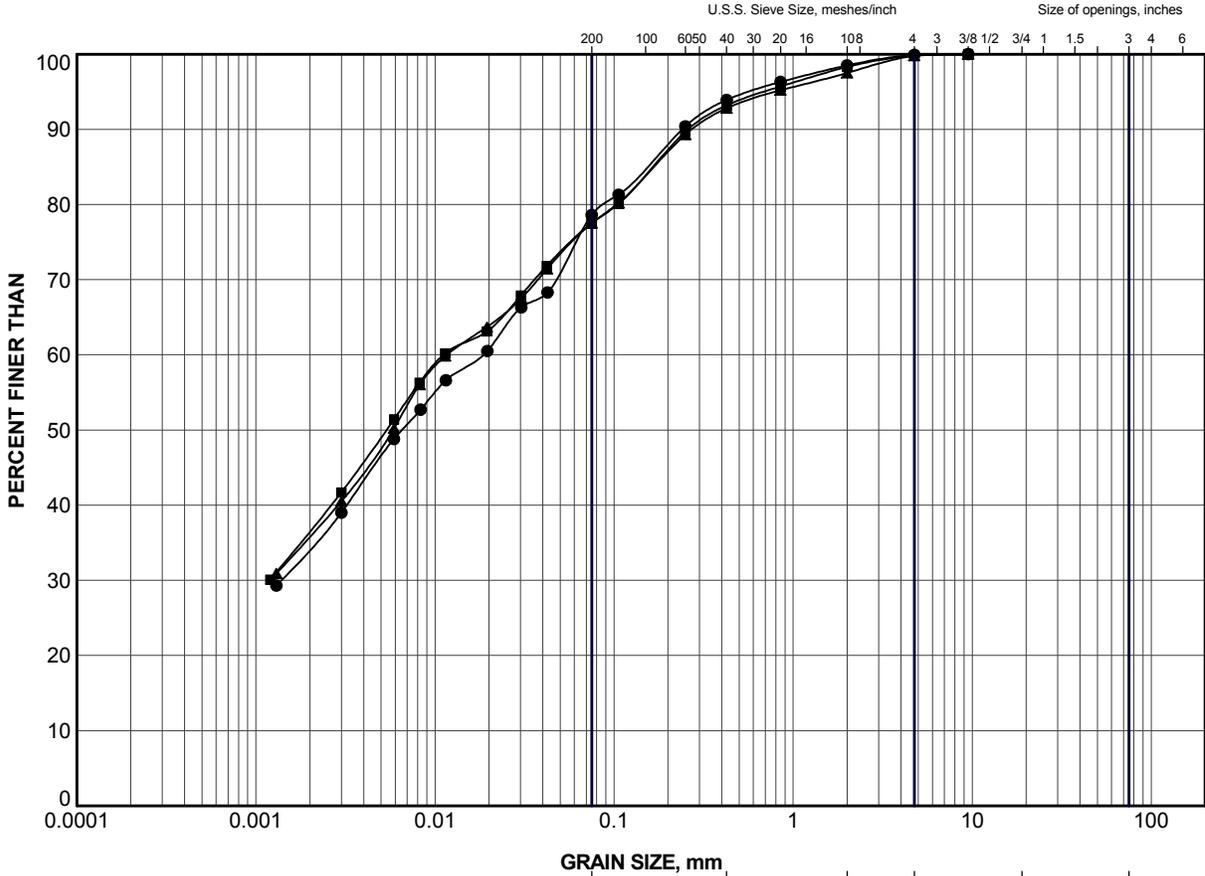
Base plans provided in digital format by DELCAN.



**PROFILE ALONG C/L OF CULVERT**  
 SCALE  
 1.5 0 1.5 m

NO.	DATE	BY	REVISION
Geocres No. 40J2-89			
HWY.	3	PROJECT NO.	06-1130-177-0-2 DIST.
SUBM'D.	DUP	CHKD.	DATE: Dec. 19/06 SITE: 6-407-C
DRAWN:	WDF	CHKD.	APPD. DWG. 1

**APPENDIX A**  
**LABORATORY TEST DATA**



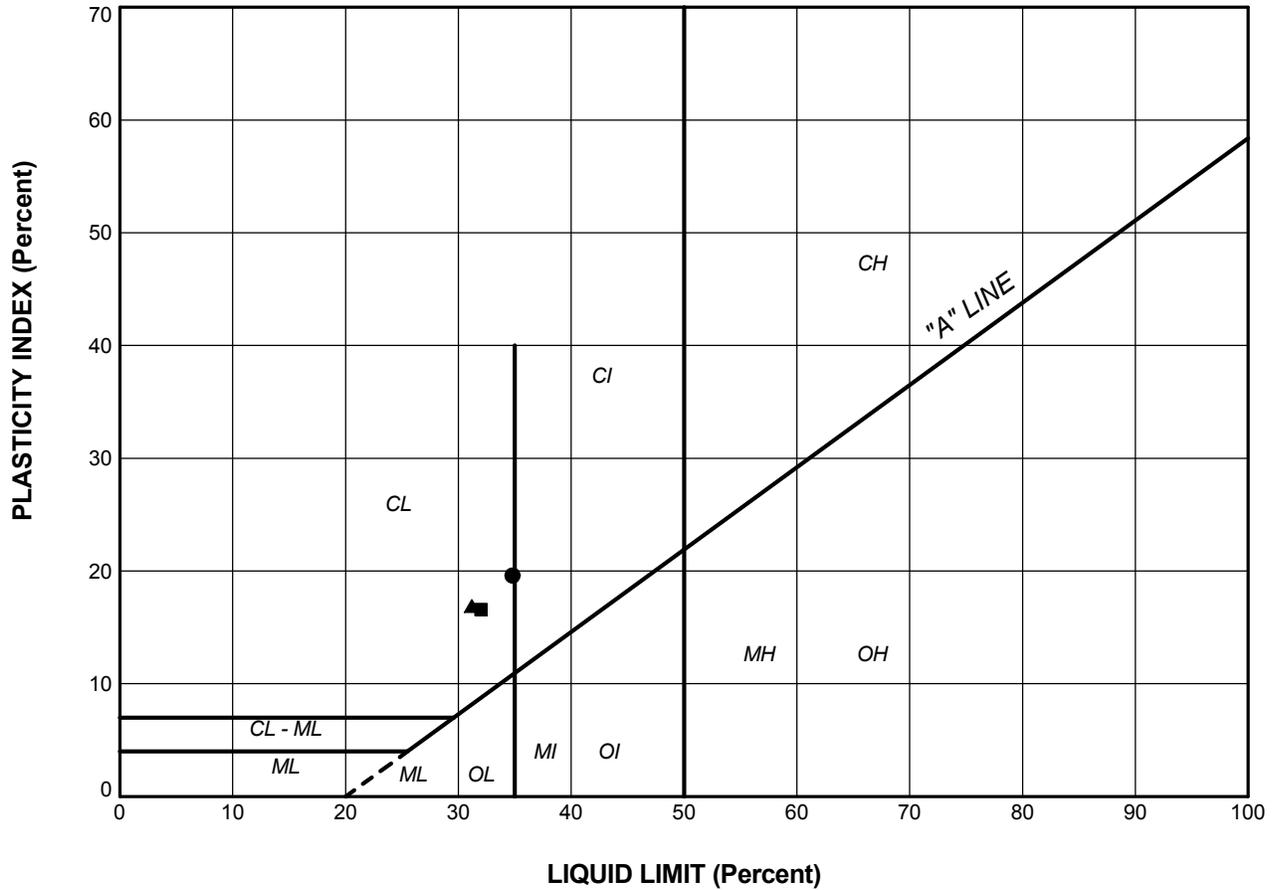
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	11	3	187.7
■	11	6	185.4
▲	12	5	186.8

PROJECT	STRUCTURAL CULVERT - SITE 6-407-C HIGHWAY 3 WIDENING GWP 315-98-00				
TITLE	<b>GRAIN SIZE DISTRIBUTION CLAYEY SILT (TILL)</b>				
 <b>Golder Associates</b> LONDON, ONTARIO	PROJECT No.	06-1130-177	FILE No.	06-1130-177-BB.GPJ	
	DRAWN	WDF	Dec 17/06	SCALE	N/A
	CHECK			REV.	
<b>FIGURE A-1</b>					

LDN\_MTO\_NEW\_GLDR\_LDN.GDT



**SOIL TYPE**  
 C = Clay  
 M = Silt  
 O = Organic

**PLASTICITY**  
 L = Low  
 I = Intermediate  
 H = High

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	11	3	34.8	15.2	19.6
■	11	6	32.0	15.4	16.6
▲	12	5	31.2	14.3	16.9

PROJECT					STRUCTURAL CULVERT - SITE 6-407-C HIGHWAY 3 WIDENING GWP 315-98-00				
TITLE					PLASTICITY CHART				
PROJECT No.		06-1130-177		FILE No.		06-1130-177-BB.GPJ			
DRAWN		WDF		Dec 17/06		SCALE		N/A	
CHECK						REV.			
 <b>Golder Associates</b> LONDON, ONTARIO					<b>FIGURE A-2</b>				

**APPENDIX B**  
**PHOTOGRAPH**

March 2007

06-1130-177-0-2

## SITE PHOTOGRAPH



Photo 1: Culvert Site 6-407-C (Station 19+320 SS Highway 3). View of inlet looking north.