December 2011

FOUNDATION INVESTIGATION REPORT

Static Scale
Putnam South Commercial Vehicle Inspection Facility
GWP 4100-04-00

Submitted to:
Mr. George McCluskey, P.Eng., Associate
Dillon Consulting Limited
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London, Ontario
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REPORT

Report Number: 11-1132-0082-2000-R05

Geocres No. 40I15-36

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Table of Contents

PART A

FOUNDATION INVESTIGATION REPORT

STATIC SCALE

PUTNAM SOUTH CVIF

GWP 4100-04-00

1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by Dillon Consulting Limited (Dillon) on behalf of Coco Paving Inc. to carry out foundation investigations as part of the design-build work for GWP 4100-04-00. The project consists of the detail design and construction of the new Commercial Vehicle Inspection Facilities (CVIF) at the Putnam north and south sites. This report addresses the static scale to be constructed at the Putnam south site. The location of the site is shown on the Key Plan, Figure 1.

The purpose of the foundation investigation was to determine the subsurface conditions at the location of the proposed static scale 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 Golder Associates' letter dated June 14, 2011.

Dillon provided Golder Associates with preliminary drawings for this project in digital format.

Foundation design parameters, as well as the foundation design, are to be developed by the scale supplier.

2.0 SITE DESCRIPTION

The Putnam South CVIF is located immediately south of Highway 401 about 1.5 kilometres west of the Highway 401/Putnam Road interchange as shown on the Key Plan, Figure 1. Currently, a primary scale lane is oriented parallel to Highway 401 with the scale and existing inspection building located in the eastern portion of the site. South of the scale lane, a "race track" configured, asphalt surfaced parking/inspection area is present. A raised sewage disposal system is located immediately east of the inspection area.

The existing truck inspection station is located at the crest of a moraine in the generally rolling regional topography. The lands in the existing truck inspection station have been constructed on variable thicknesses of fill materials to create a relatively level area. The station entrance ramp rises to the east and the exit ramp declines to the east similar to the adjacent Highway 401.

The topography in the area of the site ranges from about elevation 282 metres near the bullnose of the entrance ramp to about elevation 291 metres in the inspection area.

The adjacent land use is rural agricultural.

2.1 Site Geology

The site is located within the physiographic region of Southwestern Ontario[1] known as the Stratford Till Plain which is a product of the Huron ice lobe. Throughout the area, the till is a fairly uniform, brown calcareous silty clay.

[1] Chapman and Putnam, 1985, The Physiography of Southern Ontario, 3rd Edition, Ontario Geological Series

3.0 INVESTIGATION PROCEDURES

The field work for this component of the investigation was carried out on September 12 and 13, 2011 during which time two boreholes (boreholes 2 and 3) were drilled at the approximate locations shown on Drawing 1. The table below provides the borehole locations, ground surface elevations at the borehole locations and the depths of the boreholes.

Borehole	Location (m)		Ground Surface Elevation	Borehole Depth
	Northing	Easting	(m)	(m)
2	4,760,317	429,747	290.23	8.08
3	4,760,314	429,733	290.24	8.08

It should be noted that ten boreholes (numbered 1 to 10, inclusive) were drilled for the various CVIF components and the results are provided in the associated Foundation Investigation and Design Reports. Boreholes 2 and 3 are relevant to the new static scale.

The investigation was carried out using an all terrain vehicle mounted CME 750 power auger supplied and operated by a specialist drilling contractor. In each borehole, samples of the overburden were obtained at 0.75 metre intervals of depth using 50 millimetre outside diameter split spoon sampling equipment in accordance with the standard penetration test (SPT) procedures. The boreholes were terminated about 8.1 metres below the existing pavement or ground surface.

Groundwater conditions in the boreholes were observed throughout the drilling operations and a piezometer was installed in borehole 3 to measure water levels. Following completion of drilling and sampling, the boreholes were backfilled in accordance with current MTO procedures and Ontario Regulation 903 (as amended by Ontario Regulation 372).

The field work was monitored on a full-time basis by an experienced member of our engineering staff who located the boreholes in the field, monitored the drilling, sampling and in situ testing operations, logged the boreholes and surveyed their locations. The samples were identified in the field, placed in labelled containers and transported to our 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 testing are shown on the Record of Borehole sheets and in Appendix A.

4.0 SUBSURFACE CONDITIONS

4.1 General

The detailed subsurface soil and groundwater conditions encountered in the boreholes, together with the results of the in situ testing and the 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 and the profile on Drawing 1 are inferred from non-continuous samples and observations of drilling resistance and, therefore, may represent transitions between soil types rather than exact planes of geological change. Further, the subsurface conditions will vary between and beyond the borehole locations.

In general, the boreholes encountered the existing pavement structure and underlain by clayey silt fill and clayey silt till which was, in turn, underlain by silts and sands.

4.2 Soil Conditions

4.2.1 Pavements and Fill

Asphalt was encountered at the pavement surface in boreholes 2 and 3. The asphalt layers were about 0.1 metres thick. Granular base and subbase materials were encountered beneath the asphalt in boreholes 2 and 3. These granular layers were a total of 1.3 and 0.5 metres thick in boreholes 2 and 3, respectively.

Beneath the pavement structure, clayey silt fill materials were encountered in both of the boreholes. The firm to very stiff clayey silt fill was about 1.2 to 1.5 metres thick. The clayey silt fill had N values, as determined in the standard penetration testing, of 5 to 15 blows per 0.3 metres with in situ water contents of about 17 to 20 per cent. The clayey silt fill had corresponding plastic and liquid limits of 18 and 30 per cent, respectively, based on a single Atterberg limits determination. The Atterberg limits data are provided on Figure A-5.

A grain size distribution curve for a sample of the clayey silt fill recovered from the standard penetration testing is provided on Figure A-1.

4.2.2 Clayey Silt Till

Beneath the fill, both boreholes encountered very stiff to hard clayey silt till at about elevation 287.7 to 288.1 metres. The clayey silt till was about 4.2 metres thick in borehole 2 and 3.7 metres thick in borehole 3. The clayey silt till had N values of 18 to 62 blows per 0.3 metres with water contents of about 14 to 18 per cent. The clayey silt till had average plastic and liquid limits of about 16 and 28 per cent, respectively, based on two Atterberg limits determinations. The Atterberg limits data are provided on Figure A-5.

Grain size distribution curves for samples of the clayey silt till recovered from the standard penetration testing are provided on Figure A-2. Although not specifically encountered in the boreholes, cobbles and boulders should be expected in the clayey silt till.

4.2.3 Clayey Silt

Layers of stiff to hard clayey silt totalling about 2.1 metres in thickness were encountered beneath the clayey silt till in borehole 3 at elevation 284.5 metres. The clayey silt had N values of 15 to 38 blows per 0.3 metres with water contents of about 20 to 25 per cent. The clayey silt had corresponding plastic and liquid limits of 17 and 24 per cent, respectively, based on a single Atterberg limits determination. The Atterberg limits data are provided on Figure A-5.

A grain size distribution curve for a sample of the clayey silt recovered from the standard penetration testing is provided on Figure A-3.

4.2.4 Silty Clay

A layer of silty clay about 0.5 metres thick was encountered between the silt layers in borehole 2 at about elevation 283.2 metres. The hard silty clay had an N value of 41 blows per 0.3 metres with a water content of about 23 per cent.

4.2.5 Silt

Layers of silt were encountered beneath the clayey silt till and silty clay in borehole 2 at elevations 283.5 and 282.8 metres. The upper layer of silt was about 0.3 metres thick. Borehole 2 was terminated in the lower silt after exploring it for about 0.6 metres. The compact to dense silt had N values of 27 to 41 blows per 0.3 metres. The higher N value corresponds to a test only partially completed in the layer. The silt had water contents of 19 to 21 per cent.

A grain size distribution curve for a sample of the silt recovered from the standard penetration testing is provided on Figure A-4.

4.2.6 Sand

Beneath the clayey silt, borehole 3 encountered and was terminated in a layer of dense sand. The sand was encountered at elevation 282.3 metres and was explored for about 0.2 metres prior to terminating the borehole. The sand had an N value of 38 blows per 0.3 metres for a test partially completed in the layer with a water content of about 3 per cent.

4.3 Groundwater Conditions

Groundwater was encountered in borehole 2 about 6.7 metres below the pavement surface or at about elevation 283.5 metres on September 12, 2011. Borehole 3 was dry on completion of drilling on September 13, 2011.

A piezometer was installed in borehole 3 to monitor the groundwater level. The piezometer was dry to elevation 282.8 metres on September 30, 2011.

The inferred long term groundwater level is at about elevation 285 metres. Groundwater levels should be expected to fluctuate seasonally and in response to significant precipitation events.

5.0 MISCELLANEOUS

This investigation was carried out using equipment supplied and operated by Lantech Drilling Services Inc., an Ontario Ministry of Environment licensed well contractor. The field operations were supervised by Mr. Dan Babcock, P.Eng. under the direction of Mr. Michael E. Beadle, P.Eng. 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 Types C and D aggregates. This report was prepared by Mr. Michael E. Beadle, P.Eng. under the direction of the Team Leader, 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.

ORIGINAL SIGNED

ORIGINAL SIGNED

Michael E. Beadle, P.Eng.

Philip R. Bedell, P.Eng.
Senior Consultant

ORIGINAL SIGNED

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

MEB/PRB/FJH/ly

n:\active\2011\1132-geo\1132-0000\11-1132-0082 dillon - gwp 3100-04-00 - putnam cvif\ph 2000 - foundations\rpts\r05\1111320082-2000-r05 dec 13 11 (final)-part a fdn-static scale.docx

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

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.)

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, 60º 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^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) 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

(b) Cohesive Soils

Consistency

	c_u, s_u 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

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

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

LIST OF SYMBOLS

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

I. General

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

Notes:
1. $\tau = c' + \sigma' \tan\phi'$
2. shear strength = (compressive strength)/2

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

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 2

METRIC

PROJECT 11-1132-0082
W.P. 4100-04-00
LOCATION N 4760317.0 ;E 429746.8
ORIGINATED BY DB
DIST
HWY 401
BOREHOLE TYPE POWER AUGER, HOLLOW STEM
COMPILED BY WDF/LMK
DATUM GEODETIC
DATE September 12, 2011
CHECKED BY

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
290.23	GROUND SURFACE						
0.10	ASPHALT					290	
0.31	FILL, crushed granular base, Brown						
	FILL, sand and gravel, with cobbles, Compact, Brown	1	SS	17			
288.86 / 1.37	FILL, clayey silt, trace sand, trace gravel, some topsoil, Firm to very stiff, Brown and black	2	SS	5		289	3 13 49 35
287.70 / 2.53	CLAYEY SILT TILL, trace sand, trace gravel, Very stiff to hard, Brown becoming grey at about elev. 284.3m	3	SS	17		288	
		4	SS	28		287	0 16 51 33
		5	SS	34		286	
		6	SS	28		285	
		7	SS	48			
		8	SS	18	▽	284	
283.52 / 6.71	SILT, some sand, Dense, Grey	9	SS	41		283	
282.76 / 7.47	SILTY CLAY, trace sand, Hard, Grey						
282.15 / 8.08	SILT, trace sand, trace clay, Compact, Brown	10	SS	27			0 1 82 17
	END OF BOREHOLE						

Groundwater encountered at about elev. 283.5m during drilling on September 12, 2011.

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L
WATER CONTENT (%) 10 20 30
UNIT WEIGHT γ kN/m³

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

LDN_MTO_06 11-1132-0082-2000.GPJ LDN_MTO.GDT 09/12/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 3

METRIC

PROJECT 11-1132-0082
W.P. 4100-04-00
LOCATION N 4760313.8 ;E 429732.8
ORIGINATED BY DB
DIST HWY 401
BOREHOLE TYPE POWER AUGER, HOLLOW STEM
COMPILED BY WDF/LMK
DATUM GEODETIC
DATE September 12, 2011 - September 13, 2011
CHECKED BY

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
290.24	GROUND SURFACE						
0.10	ASPHALT				Granular Bentonite		
0.27	FILL, crushed granular base Brown						
289.64 / 0.60	FILL, sand and gravel, with cobbles Brown						
	FILL, clayey silt, some sand, trace gravel, trace topsoil Stiff Brown	1	SS	10	Cuttings		
		2	SS	15			
288.11 / 2.13	CLAYEY SILT TILL, trace sand, trace gravel Very stiff to hard Brown	3	SS	26	Granular Bentonite	288	
		4	SS	28		287	2 8 52 38
		5	SS	62	Cuttings	286	
		6	SS	26			
		7	SS	23		285	
284.45 / 5.79	CLAYEY SILT, trace sand, with silt layers Stiff to hard Grey	8	SS	32	Granular Bentonite	284	
		9	SS	15	Piezometer	283	
282.77 / 7.47	CLAYEY SILT, trace sand Hard Brown	10	SS	38			0 1 76 23
282.32 / 7.92	SAND, trace silt, trace gravel Dense Brown						
8.08	END OF BOREHOLE						

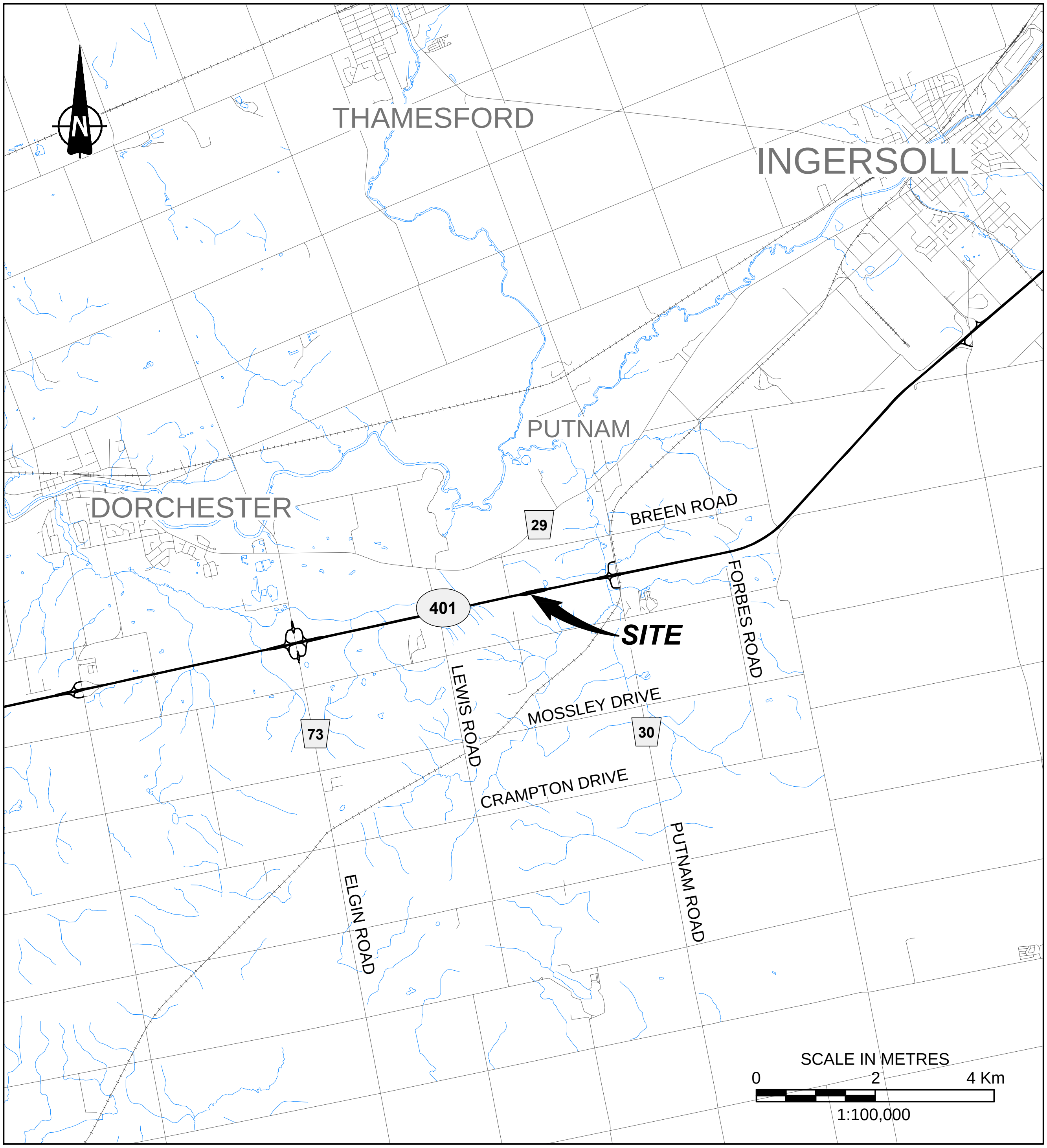
Borehole dry during drilling on September 12 and 13, 2011.

Piezometer dry to elev. 282.8m on September 30, 2011.

Chart headings: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ kN/m³

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

LDN_MTO_06 11-1132-0082-2000.GPJ LDN_MTO.GDT 09/12/11



REFERENCE

DRAWING BASED ON CANMAP STREETFILES V2008.4.

NOTES

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

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

FOUNDATION INVESTIGATION
STATIC SCALE
PUTNAM SOUTH CVIF, GWP 4100-04-00

TITLE

KEY PLAN

Golder Associates
LONDON, ONTARIO

PROJECT No.		11-1132-0082	FILE No.	1111320082-2000-F05001
			SCALE AS SHOWN	REV.
CADD	DCH/AMG	NOV. 17/11	**FIGURE 1**	
CHECK				

Drawing file: 1111320082-2000-F05001.dwg Dec 09, 2011 - 10:41am

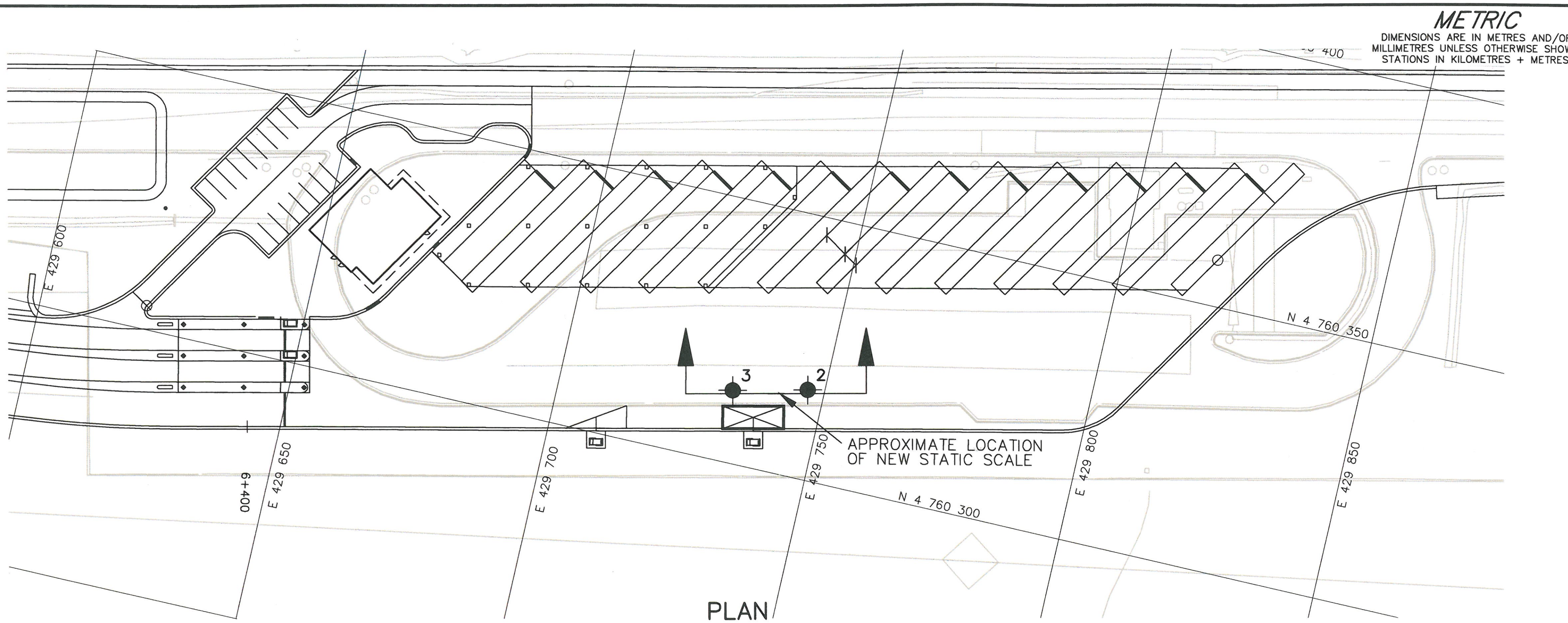
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 4100-04-00

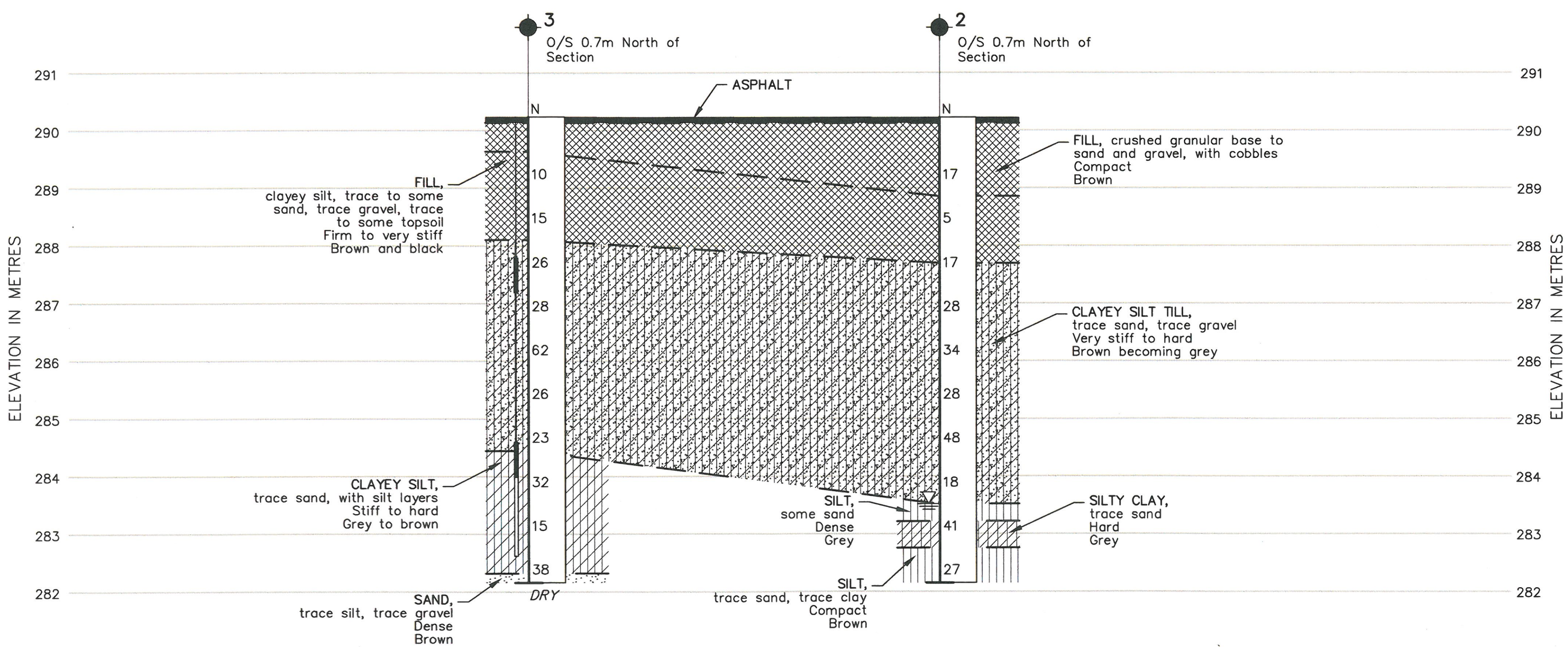
SHEET

STATIC SCALE
HIGHWAY 401/PUTNAM SOUTH CVIF
BOREHOLE LOCATIONS AND SOIL STRATA

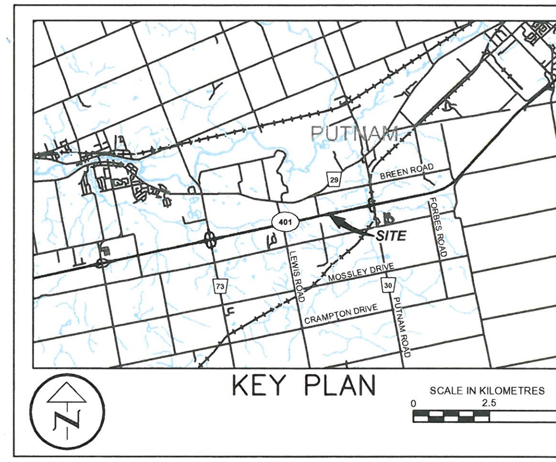
Golder Associates Ltd.
LONDON, ONTARIO, CANADA



PLAN
SCALE
10 0 10 m



SECTION
HORIZONTAL SCALE 2 0 2 m
VERTICAL SCALE 2 0 1 m



KEY PLAN
SCALE IN KILOMETRES 0 2.5 5.0

LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- DRY Borehole dry during drilling
- WL encountered during drilling

No.	ELEVATION	CO-ORDINATES MTM ZONE 10 NORTHING	EASTING
2	290.23	4 760 317.0	429 746.8
3	290.24	4 760 313.8	429 732.8

F.J. HEFFERNAN – REGISTERED PROFESSIONAL ENGINEER – PROVINCE OF ONTARIO
M. E. BEABLE – LICENSED PROFESSIONAL ENGINEER – PROVINCE OF ONTARIO

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 Dillon Consulting.

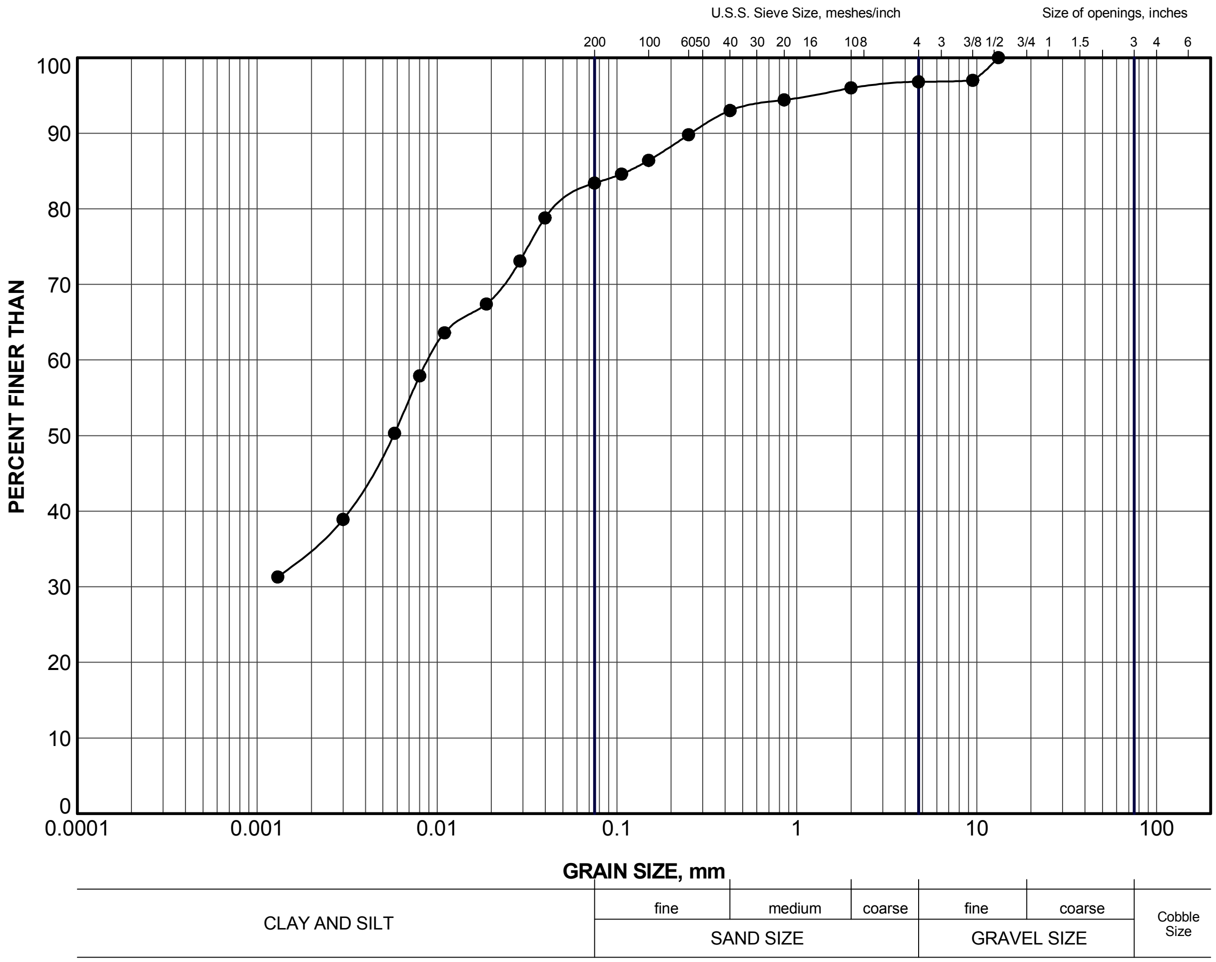
NO.	DATE	BY	REVISION

Geocres No. 40I15-36

HWY. 401		PROJECT NO. 11-1132-0082	DIST.
SUBM'D. MB	CHKD.	DATE: Nov. 4/11	SITE:
DRAWN: DCH/LMK	CHKD.	APPD.	DWG. 1

APPENDIX A

Laboratory Test Data



LEGEND

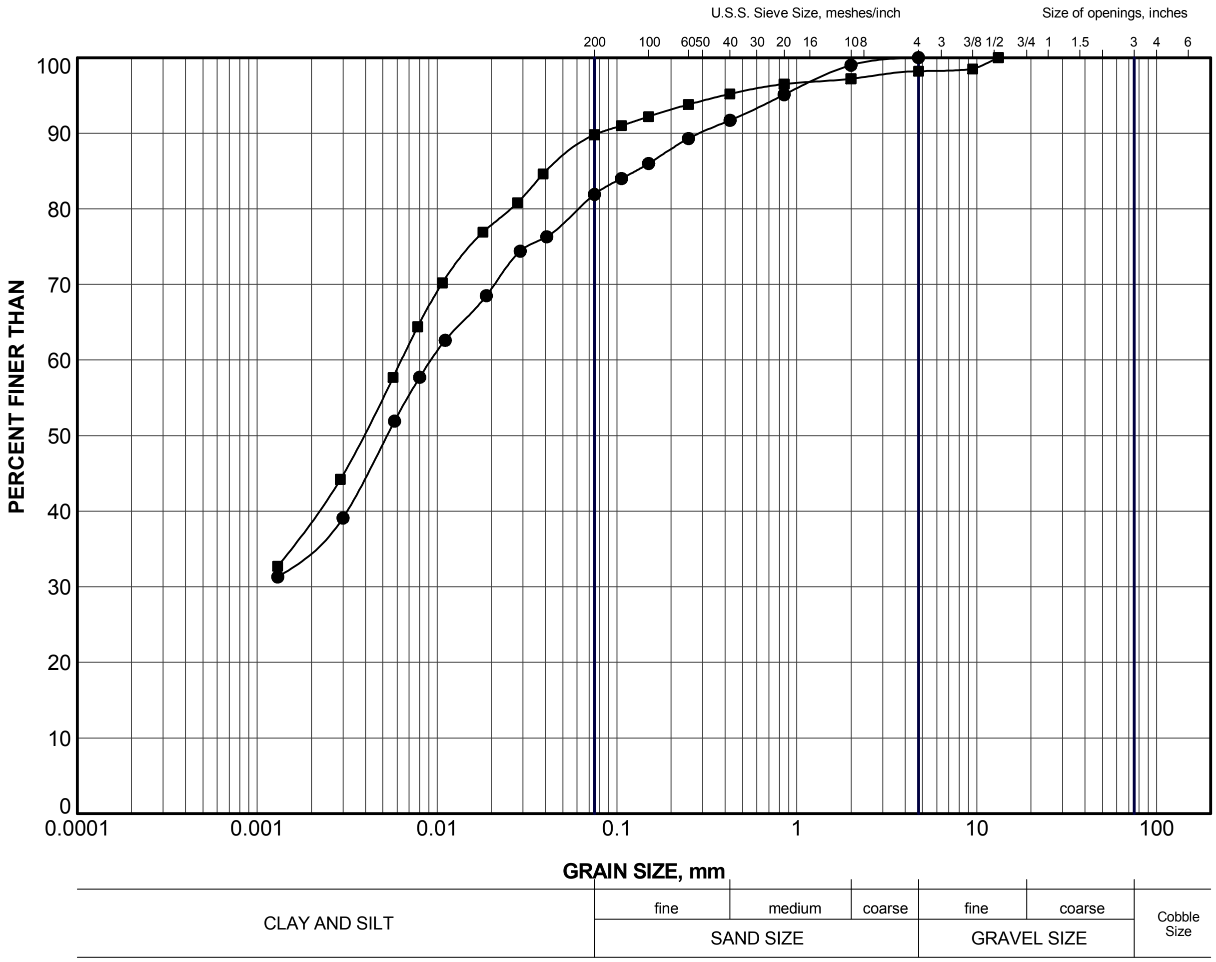
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	2	2	288.5

PROJECT	FOUNDATION INVESTIGATION STATIC SCALE PUTNAM SOUTH CVIF GWP 4100-04-00
TITLE	**GRAIN SIZE DISTRIBUTION** **FILL**

Golder Associates
LONDON, ONTARIO

PROJECT No.		11-1132-0082	FILE No.	1111320082-2000-F050A1
			SCALE N/A	REV.
DRAWN	LMK	Nov 04/11	**FIGURE A-1**	
CHECK				

LDN_MTO_GSD GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	2	4	286.9
■	3	4	286.9

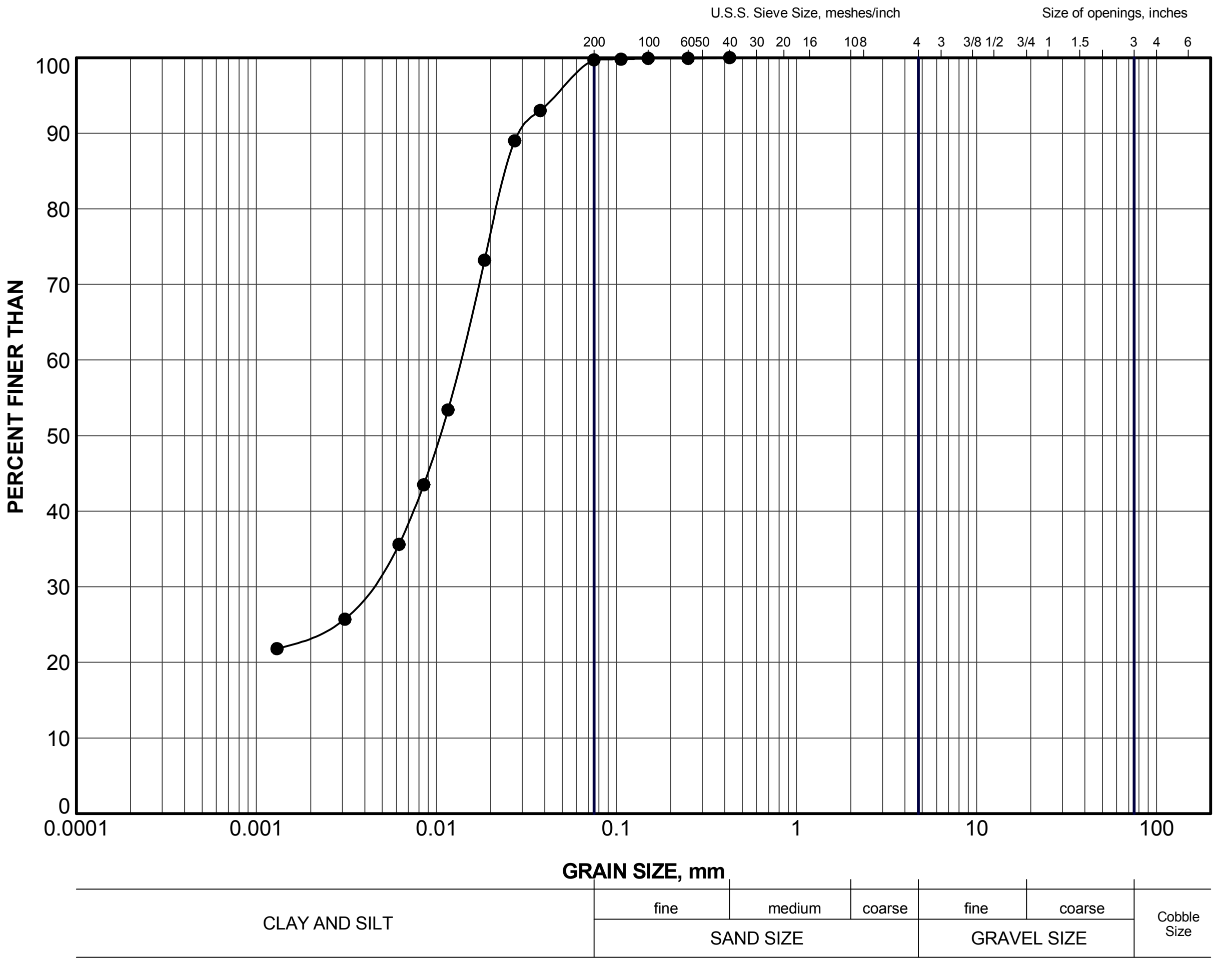
PROJECT
FOUNDATION INVESTIGATION
STATIC SCALE
PUTNAM SOUTH CVIF
GWP 4100-04-00

TITLE
GRAIN SIZE DISTRIBUTION
CLAYEY SILT TILL

Golder Associates
LONDON, ONTARIO

PROJECT No.	11-1132-0082		FILE No.	1111320082-2000-F050A2
			SCALE N/A	REV.
DRAWN	LMK	Nov 04/11	**FIGURE A-2**	
CHECK				

LDN_MTO_GSD GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	3	10A	282.5

PROJECT
FOUNDATION INVESTIGATION
STATIC SCALE
PUTNAM SOUTH CVIF
GWP 4100-04-00

TITLE

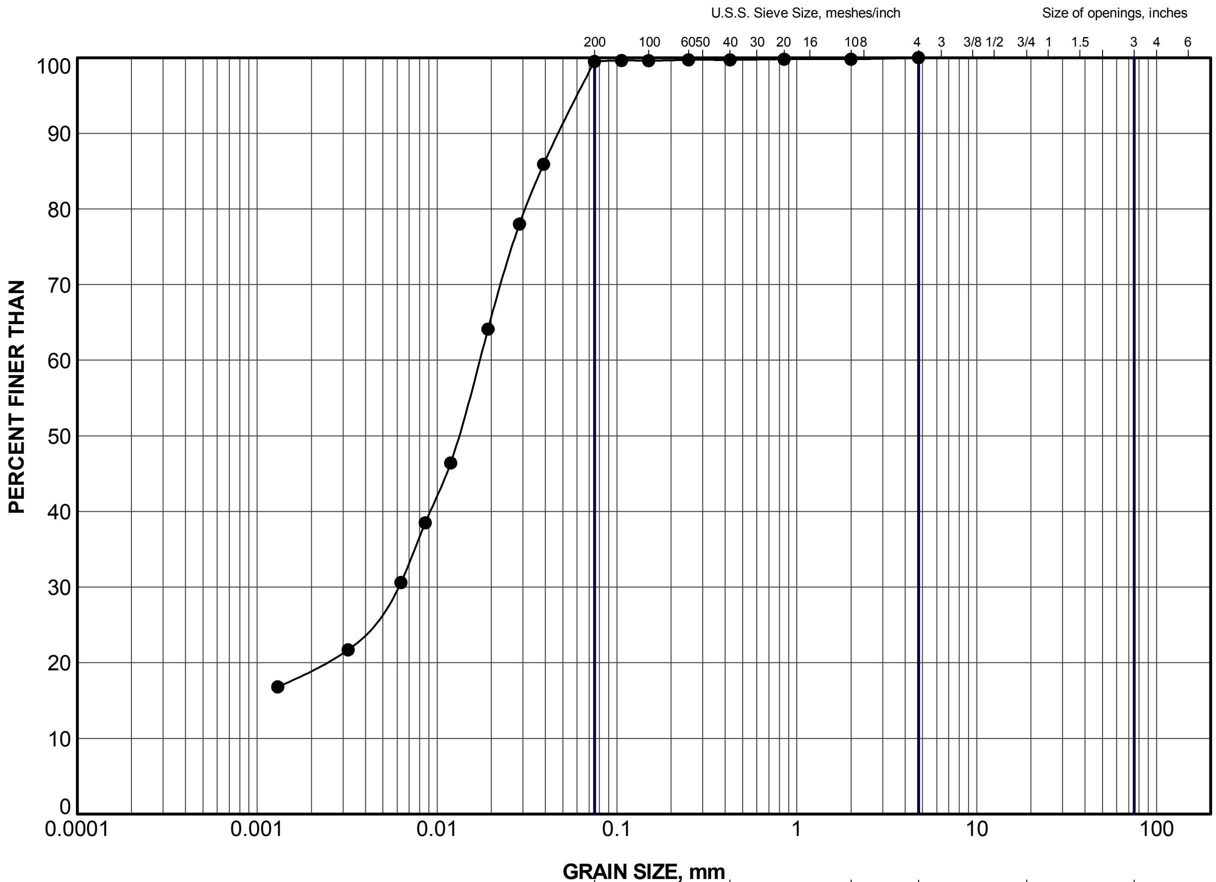
GRAIN SIZE DISTRIBUTION

CLAYEY SILT

Golder Associates
LONDON, ONTARIO

PROJECT No.	11-1132-0082		FILE No.	1111320082-2000-F050A3
			SCALE N/A	REV.
DRAWN	LMK	Nov 04/11	FIGURE A-3	
CHECK				

LDN_MTO_GSD GLDR_LDN.GDT



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	2	10	282.4

PROJECT

FOUNDATION INVESTIGATION
STATIC SCALE
PUTNAM SOUTH CVIF
GWP 4100-04-00

TITLE

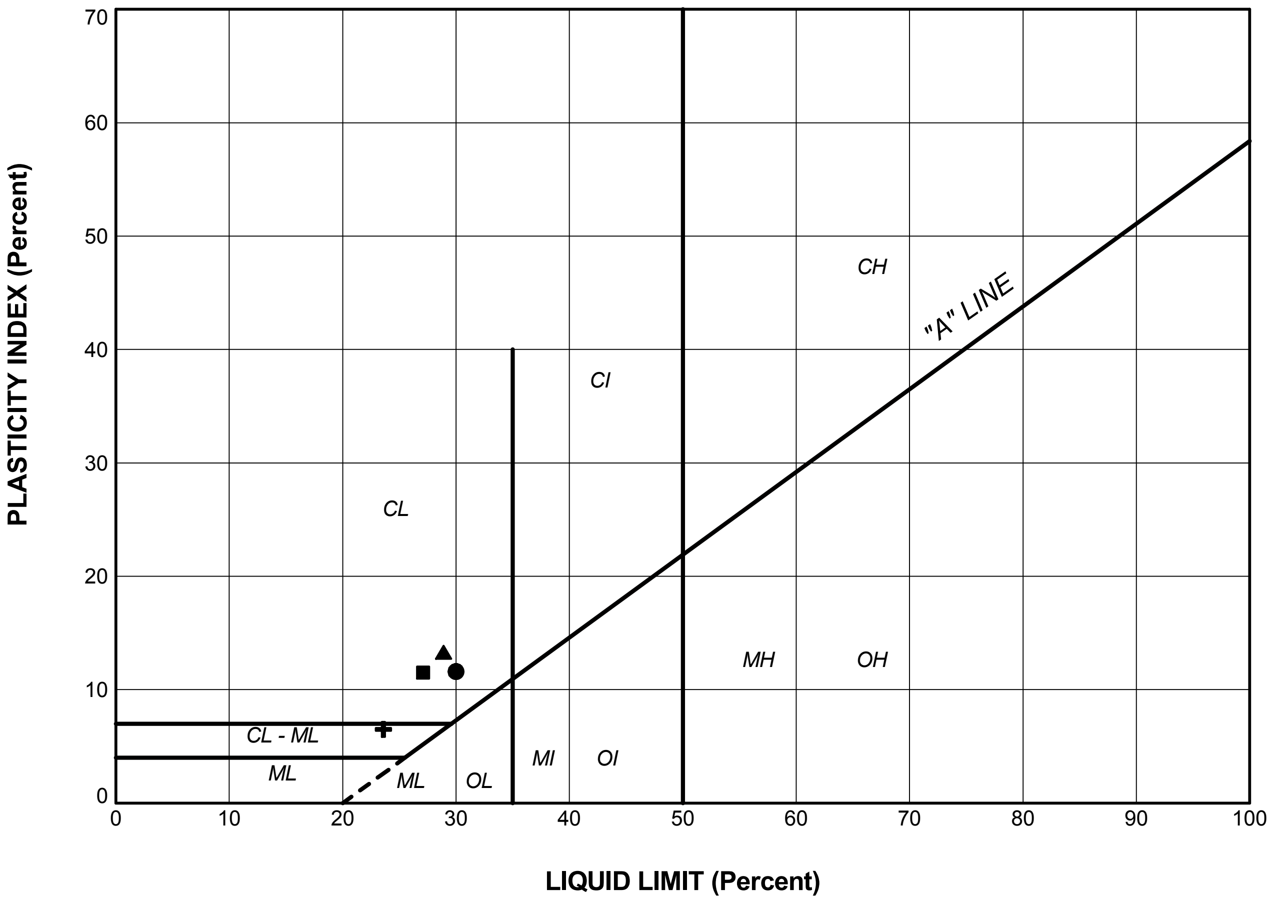
GRAIN SIZE DISTRIBUTION

SILT

Golder Associates
LONDON, ONTARIO

PROJECT No.	11-1132-0082	FILE No.	1111320082-2000-F050A4
		SCALE	N/A REV.
DRAWN	LMK	Nov 04/11	FIGURE A-4
CHECK			

LDN_MTO_GSD GLDR_LDN.GDT



SOIL TYPE	PLASTICITY
C = Clay	L = Low
M = Silt	I = Intermediate
O = Organic	H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
FILL					
●	2	2	30.0	18.4	11.6
CLAYEY SILT TILL					
■	2	4	27.1	15.6	11.5
▲	3	4	28.9	15.6	13.3
CLAYEY SILT					
✚	3	10	23.6	17.1	6.5

PROJECT

FOUNDATION INVESTIGATION
STATIC SCALE
PUTNAM SOUTH CVIF
GWP 4100-04-00

TITLE

PLASTICITY CHART

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PROJECT No.	11-1132-0082	FILE No.	1111320082-2000-F050A5
		SCALE	N/A	REV.
DRAWN	LMK	Nov 04/11	FIGURE A-5
CHECK			

LDN_MTO_PI GLDR_LDN.GDT

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

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