

Golder Associates Ltd.

309 Exeter Road, Unit 1
London, Ontario, Canada N6L 1C1
Telephone 519-652-0099
Fax 519-652-6299



**FOUNDATION INVESTIGATION AND DESIGN REPORT
CULVERTS
HIGHWAY 401
FROM 1.5 KILOMETRES WEST OF MANNING ROAD EASTERLY
TO 1.6 KILOMETRES EAST OF PUCE ROAD
GWP 62-00-00, PURCHASE ORDER NO. 3005-A-000393
MINISTRY OF TRANSPORTATION
SOUTHWESTERN REGION**

Submitted to:

Dillon Consulting Limited
P.O. Box 426, Terminal B
495 Richmond Street
London, Ontario
N6A 4W7

DISTRIBUTION:

- 9 Copies - Dillon Consulting Limited
- 2 Copies - Golder Associates Ltd.

January 12, 2005

041-130054-0-1
Geocres No. 40J2-63



TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
 PART A – FOUNDATION INVESTIGATION REPORT	
1.0 INTRODUCTION	1
2.0 SITE DESCRIPTION	2
2.1 Site Geology	2
3.0 INVESTIGATION PROCEDURES	3
4.0 SUBSURFACE CONDITIONS	6
4.1 Site Stratigraphy	6
4.2 North 12th Concession Drain Culvert (Station 19+336 SS)	6
4.2.1 Topsoil	6
4.2.2 Fill	7
4.2.3 Silty Clay Till	7
4.3 Croft Drain 21 Culvert (Station 19+717 SS)	7
4.3.1 Topsoil	7
4.3.2 Fill	7
4.3.3 Silty Clay Till	8
4.4 10th Concession Drain 14 Culvert (Station 10+224 M)	8
4.4.1 Topsoil	8
4.4.2 Fill	8
4.4.3 Silty Clay Till	9
4.5 9th Concession Drain Culvert (Station 11+529 M)	9
4.5.1 Topsoil	9
4.5.2 Fill	9
4.5.3 Silty Clay Till	10
4.6 8th Concession Centre Drain Culvert (Station 12+098 M)	10
4.6.1 Topsoil	10
4.6.2 Fill	10
4.6.3 Silty Clay Till	11
4.7 8th Concession Drain Culvert (Station 12+935 M)	11
4.7.1 Topsoil	11
4.7.2 Fill	11
4.7.3 Sandy Silt	12
4.7.4 Silty Clay Till	12
4.7.5 Sandy Silt Till	12
4.8 7th Concession Drain Culvert (Station 14+308 M)	12
4.8.1 Topsoil	12
4.8.2 Fill	13
4.8.3 Sandy Silt	13

TABLE OF CONTENTS CONTINUED

4.8.4	Silty Clay Till	13
4.9	Mahon Drain Culvert (Station 15+024 M).....	13
4.9.1	Topsoil	13
4.9.2	Fill	14
4.9.3	Silty Clay Till	14
4.10	Little Creek Drain Culvert (Station 15+685 M).....	14
4.10.1	Topsoil	14
4.10.2	Fill	14
4.10.3	Silty Clay Till	15
4.10.4	Sand	15
4.11	Anger Drain Culvert (Station 17+097 M)	15
4.11.1	Topsoil	15
4.11.2	Fill	15
4.11.3	Silty Clay Till	16
4.11.4	Silt.....	16
4.12	4th Concession Drain Culvert (Station 18+428 M)	16
4.12.1	Topsoil	16
4.12.2	Fill	17
4.12.3	Silty Clay Till	17
4.13	Groundwater Conditions	17
5.0	MISCELLANEOUS.....	18

PART B – FOUNDATION DESIGN REPORT

6.0	ENGINEERING RECOMMENDATIONS	19
6.1	General.....	19
6.2	Foundations.....	19
6.2.1	North 12th Concession Drain Culvert (19+336 SS)	20
6.2.2	Croft Drain 21 Culvert (19+717 SS).....	20
6.2.3	10th Concession Drain 14 Culvert (10+224 M).....	21
6.2.4	9th Concession Drain Culvert (11+529 M).....	21
6.2.5	8th Concession Centre Drain Culvert (12+098 M)	21
6.2.6	8th Concession Drain Culvert (12+935 M).....	22
6.2.7	7th Concession Drain Culvert (14+308 M).....	22
6.2.8	Mahon Drain Culvert (15+024 M)	22
6.2.9	Little Creek Drain Culvert (15+685 M)	23
6.2.10	Anger Drain Culvert (17+097 M)	23
6.2.11	4th Concession Drain Culvert (18+428 M).....	24

TABLE OF CONTENTS CONTINUED

6.3	Excavations	24
6.4	Backfill	24
6.5	Surface And Groundwater Control	25
6.6	Additional Comments	26

TABLE I - Summary of Groundwater Levels

LIST OF ABBREVIATIONS

LIST OF SYMBOLS

RECORD OF BOREHOLE SHEETS

FIGURE 1 - Location Plan

DRAWINGS 1 to 11 – Borehole Locations and Stratigraphic Profiles

APPENDIX A - Laboratory Test Data

PART A – FOUNDATION INVESTIGATION REPORT

CULVERTS HIGHWAY 401

**FROM 1.5 KILOMETRES WEST OF MANNING ROAD
EASTERLY TO 1.6 KILOMETRES EAST OF PUCE ROAD
GWP 62-00-00, PURCHASE ORDER NO. 3005-A-000393
MINISTRY OF TRANSPORTATION – SOUTHWESTERN REGION**

January 2005

041-130054-0-1

Golder Associates

1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by Dillon Consulting Limited (Dillon) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out foundation investigations as part of the detail design work for the widening of Highway 401 near Windsor under GWP 62-00-00. The project involves the detail design of the improvements at the Highway 401/Manning Road interchange and the Highway 401/Puce Road interchange and the rehabilitation of the Maidstone Township Concession Roads 6 and 9 underpasses near Windsor, Ontario. The foundation component of the project includes:

- i) The grade raise and widening of the approach embankment/ramps at Manning Road;
- ii) Culvert extensions/replacements;
- iii) Overhead and breakaway signs;
- iv) Widening of the existing Puce River structure; and
- v) Widening of the existing Pike Creek structure.

This report addresses the planned extension or replacement of eleven existing culverts within the Highway 401 project area.

The purpose of the foundation investigation was to determine the subsurface conditions at the location of the proposed culvert extensions/replacements by drilling boreholes and carrying out in situ testing and laboratory tests on selected samples. The terms of reference for the scope of work are outlined in the MTO's Request for Proposal and in Golder Associates' proposal P31-3115 dated February 2, 2004. The work was carried out in accordance with our Quality Control Plan for Foundations Engineering dated March 29, 2004.

The centreline and stations of the alignment were surveyed by others prior to commencing the foundation investigation program. Dillon provided design elevations for the culvert inverts and elevations for the top of the existing culverts.

It should be noted that the chainage for Highway 401 changes from Sandwich South Township to Maidstone Township at Manning Road where Station 20+191.026 Sandwich South is equivalent to Station 10+000 Maidstone. Chainages west and east of Manning Road are suffixed SS and M, respectively. The chainages at the project limits along Highway 401 are Station 18+675 SS at the west limit and 18+650 M at the east limit.

2.0 SITE DESCRIPTION

GWP 62-00-00 comprises the design for the widening of Highway 401 from Manning Road to Puce Road and associated work near Windsor, Ontario. The location of the project is shown on the Site Location Plan, Figure 1.

This section of Highway 401 is currently a four lane divided freeway with a depressed grass median. Manning Road within the project limits is a two lane roadway. The topography in the area of the site is generally flat with the areas outside of the paved surfaces well vegetated with grasses. The primary land use in the area is agricultural.

The eleven culverts selected for extension or replacement are open concrete box culverts ranging from 1.22 x 1.22 metres to 4.88 x 1.83 metres in size. Embankment heights vary from 1.1 to 4.9 metres.

2.1 Site Geology

The project lies within the Essex Clay Plain, a subregion of the physiographic region of southern Ontario known as the St. Clair Clay Plains, identified in "The Physiography of Southern Ontario" by Chapman and Putnam (1984). The clay plain is described as a till plain that has been smoothed by shallow deposits of lacustrine clay which settled in the depressions of the till. The prevailing soil type is reportedly the Brookston clay.

Based on the Ontario Department of Mines and Northern Affairs Preliminary Maps P.749 and P.750 entitled "Quaternary Geology of the Windsor-Essex Area" Western and Eastern Parts, respectively, the project area is reportedly located in predominantly clayey silt till. At the Manning Road interchange, a thin and discontinuous glaciolacustrine medium sand layer reportedly overlies the clayey silt till in the southeast, southwest and part of the northwest quadrants.

The underlying bedrock is reported to be limestone of the Dundee Formation of Middle Devonian age.

3.0 INVESTIGATION PROCEDURES

It is understood that it is proposed to extend or replace eleven culverts at the following locations:

<u>DRAIN</u>	<u>LOCATION</u>	<u>REPLACEMENT/ EXTENSION</u>	<u>RELEVANT BOREHOLES</u>
North 12th Concession Drain	19+336 SS	Extension - Lt & Rt	C-21, C-22, C-23, C-24
Croft Drain 21	19+717 SS	Replacement	C-19, C-20, C-25, C-26
10th Concession Drain 14	10+224 M	Extension - Lt & Rt	C-17, C-18, C-27, C-28
9th Concession Drain	11+529 M	Replacement	C-15, C-16, C-29, C-30
8th Concession Centre Drain	12+098 M	Extension - Lt	C-13, C-14
8th Concession Drain	12+935 M	Replacement	C-11, C-12, C-31, C-32
7th Concession Drain	14+308 M	Replacement	C-9, C-10, C-33, C-34
Mahon Drain	15+024 M	Extension - Lt & Rt	C-7, C-8, C-35, C-36
Little Creek Drain	15+685 M	Replacement	C-5, C-6, C-37, C-38
Anger Drain	17+097 M	Replacement	C-3, C-4, C-39, C-40
4th Concession Drain	18+428 M	Extension - Lt & Rt	C-1, C-2, C-41, C-42

The field work for this portion of the investigation was carried out between July 28 and August 23, 2004, at which time forty-two boreholes were drilled in the areas of the proposed culvert extensions and replacements. The locations of the boreholes are shown on the Borehole Location Plans, Drawings 1 to 11.

The boreholes were located as follows:

<u>DRAIN</u>	<u>LOCATION</u>	<u>BOREHOLE</u>	<u>NORTHING</u>	<u>EASTING</u>	<u>ELEVATION</u> (m)
Township of Sandwich South					
North 12th Concession Drain	19+336 SS	C-21	4678030.9	273135.3	186.27
		C-22	4678035.7	273135.8	185.56
		C-23	4677990.7	273123.2	185.72
		C-24	4677981.6	273122.9	184.96
Croft Drain	19+717 SS	C-19	4678016.8	273502.8	186.02
		C-20	4678023.7	273509.1	184.34
		C-25	4677965.0	273501.8	184.36
		C-26	4677968.7	273501.8	184.72

<u>DRAIN</u>	<u>LOCATION</u>	<u>BOREHOLE</u>	<u>NORTHING</u>	<u>EASTING</u>	<u>ELEVATION</u> (m)
Township of Maidstone					
10th	10+224 M	C-17	4677996.9	274196.5	185.17
Concession		C-18	4677983.6	274196.5	186.85
Drain 14		C-27	4677946.3	274195.7	187.25
		C-28	4677938.3	274194.6	185.48
9th	10+529 M	C-15	4677937.7	275503.6	186.77
Concession		C-16	4677928.2	275502.2	187.42
Drain		C-29	4677881.9	275487.8	185.97
		C-30	4677892.4	275488.8	187.88
8th Conc.	12+098 M	C-13	4677902.5	276058.9	187.63
Centre Dr.		C-14	4677915.7	276071.8	185.69
8th	12+935 M	C-11	4677877.1	276907.5	187.03
Concession		C-12	4677866.5	276907.0	187.75
Drain		C-31	4677815.6	276903.8	187.03
		C-32	4677829.1	276901.5	187.63
9th	14+308 M	C-9	4677818.8	278275.4	186.38
Concession		C-10	4677806.8	278276.9	186.93
Drain		C-33	4677770.1	278273.7	186.97
		C-34	4677760.3	278274.5	186.48
Mahon	15+024 M	C-7	4677778.4	278992.6	185.70
Drain		C-8	4677790.3	278981.3	184.63
		C-35	4677729.3	278988.9	184.85
		C-36	4677737.1	278989.1	185.74
Little Creek	15+685 M	C-5	4677745.5	279647.1	185.62
Drain		C-6	4677752.3	279645.8	185.19
		C-37	4677710.5	279649.1	185.64
		C-38	4677702.2	279650.0	185.36
Anger	17+097 M	C-3	4677698.9	281057.0	185.51
Drain		C-4	4677720.2	281057.0	183.44
		C-39	4677654.7	281048.5	184.73
		C-40	4677661.3	281051.7	185.36
4th	18+428 M	C-1	4677661.3	282395.0	185.19
Concession		C-2	4677668.4	282388.0	184.64
Drain		C-41	4677626.0	282377.3	185.21
		C-42	4677620.7	282384.2	183.65

The investigation was carried out using an all-terrain vehicle mounted CME 750 power auger supplied and operated by a specialist drilling contractor. In the boreholes, samples of the overburden were obtained at suitable intervals of depth using 50 millimetre outside diameter split spoon sampling equipment in accordance with the standard penetration test (SPT) procedures. In addition, in situ vane shear strength testing was carried out in the softer cohesive strata, where feasible. The boreholes were terminated between 6.7 and 9.8 metres below the existing ground surface. Groundwater conditions in the boreholes were observed throughout the drilling operations and these observations are shown on the corresponding Record of Borehole sheets. The boreholes were backfilled in accordance with current Ministry standards and Ontario Ministry of Environment Regulation 903 (amended to Ontario Regulation 128). A bentonite seal was provided just below ground surface in all of the boreholes.

The field work was supervised on a full-time basis by experienced members of our engineering staff who located the boreholes in the field, directed the drilling, sampling and in situ testing operations and logged the boreholes. 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.

The as-drilled borehole locations and ground surface elevations at the boreholes were determined by Golder Associates using information provided by Dillon. The locations of the boreholes are noted above and shown on the Record of Borehole sheets and on Drawings 1 to 11, attached.

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 testing 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 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.

Culverts which require extension will generally be lengthened at both ends. The exception is the 8th Concession Centre Drain culvert at Station 12+098 M which will be extended on the north only. Two boreholes were advanced near the ends of each culvert to be extended or replaced. The boreholes typically encountered surficial topsoil and fill underlain by firm to hard silty clay till. A crust of generally very stiff to hard silty clay till is present to depths of about 3 to 5 metres below the ground surface. The consistency of the softer till material underlying the crust varies from firm to very stiff.

The locations and elevations of the boreholes, together with the interpreted stratigraphic profiles, are shown on the attached Drawings 1 to 11. A detailed description of the subsurface conditions encountered in the boreholes is provided on the Record of Borehole sheets and is summarized at each culvert location in the following sections. A summary of the groundwater and surface water level measurements is given in Table I.

4.2 North 12th Concession Drain Culvert (Station 19+336 SS)

Boreholes C-21, C-22, C-23 and C-24 were drilled within the proposed North 12th Concession Drain culvert extension areas.

4.2.1 Topsoil

Topsoil layers between 0.1 and 0.2 metres thick were encountered at the ground surface in boreholes C-22 through C-24 inclusive.

4.2.2 Fill

Fill materials extended from the ground surface at borehole C-21 and from the base of the topsoil layers near elevation 185.5 metres at borehole C-22 and C-23. Fill thicknesses ranged between 0.5 to 2.1 metres. Crusher run sand and gravel fill and silty sand fill were encountered at boreholes C-21 and C-23 respectively. Silty clay fill was intercepted at boreholes C-21 and C-23. The silty clay fill had an average water content of 21 per cent with standard penetration test N values ranging from 3 to 8 blows per 0.3 metres of penetration.

4.2.3 Silty Clay Till

The fill layers in boreholes C-21 to C-23 inclusive and the topsoil layer in borehole C-24 were underlain by a stratum of silty clay till. The surface of the silty clay till was encountered between elevations 184.1 and 185.0 metres and extended to the termination depths of the boreholes some 6.7 to 8.8 metres below the existing ground surface.

The silty clay till was composed primarily of silt and clay sized materials with some sand and trace amounts of gravel. The gradation curves are shown on Figures A-3 and A-4 in Appendix A. Standard penetration test N values varied between 8 and 32 blows per 0.3 metres with an average of 16 blows per 0.3 metres. A very stiff to hard silty clay till crust was present to depths of 2.9 to 4.4 metres below the ground surface. The till below this depth was generally found to be stiff to very stiff. Water contents ranged from 14 to 21 per cent with an average water content of 17 per cent. The till is of low plasticity based on average plastic and liquid limits of 13 and 32 per cent, respectively. The Atterberg limits information is shown on the Plasticity Charts on Figures A-6 and A-7 in Appendix A.

4.3 Croft Drain 21 Culvert (Station 19+717 SS)

Boreholes C-19, C-20, C-25 and C-26 were drilled within the proposed Croft Drain 21 culvert replacement.

4.3.1 Topsoil

Topsoil layers between 0.2 and 0.4 metres thick were encountered at the ground surface at all four borehole locations.

4.3.2 Fill

A layer of silty clay fill between 0.2 to 1.2 metres thick extended from the base of the topsoil layers at boreholes C-19, C-25 and C-26. The fill was intercepted between elevations 184.1 and

185.8 metres. Standard penetration test N values of 8 and 24 blows per 0.3 metres of penetration were obtained from tests conducted in the fill at boreholes C-19 and C-25. A water content of 18 per cent was measured in the fill at borehole C-19.

4.3.3 Silty Clay Till

The topsoil at borehole C-20 and the fill layers at the remaining three boreholes were underlain by silty clay till which extended some 7.6 to 8.4 metres, or between elevation 183.8 and 184.7 metres, to the termination depths of the boreholes.

The silty clay till was composed primarily of silt and clay sized material with some sand and trace amounts of gravel. The gradation curves are shown on Figures A-3 and A-4 in Appendix A. Standard penetration test N values varied between 5 and 30 blows per 0.3 metres with an average of 14 blows per 0.3 metres. A generally very stiff to hard silty clay till crust was present to depths of 2.9 to 4.4 metres below the ground surface. The till below these depths was generally firm to very stiff. Shear strengths of 83 to greater than 144 kilopascals and corresponding sensitivities of 1.2 and 1.5 were indicated from the results of in-situ vane shear tests conducted in the softer till layers at depth.

Water contents ranged from 13 to 22 per cent with an average water content of 18 per cent. The silty clay till is of low plasticity based on average plastic and liquid limits of 15 and 33 per cent, respectively. The Atterberg limits information is shown on the Plasticity Charts on Figures A-6 and A-7 in Appendix A.

4.4 10th Concession Drain 14 Culvert (Station 10+224 M)

Boreholes C-17, C-18, C-27 and C-28 were drilled within the proposed 10th Concession Drain 14 culvert extension areas.

4.4.1 Topsoil

Topsoil layers, approximately 0.1 metres thick, were encountered at the ground surface at all boreholes.

4.4.2 Fill

Fill materials were encountered from the ground surface at borehole C-27 and from the base of the topsoil layer at elevation 186.8 metres in borehole C-18. A fill thickness of approximately 2 metres was observed. The upper 0.1 to 0.5 metres consisted of granular fill material (sand and gravel) which was underlain by silty clay fill. The silty clay fill had standard penetration test N

values of 3 to 9 blows per 0.3 metres of penetration. The water contents ranged from 22 to 25 per cent.

4.4.3 Silty Clay Till

The topsoil at boreholes C-17 and C-28 and the fill layers at the two remaining boreholes were underlain by silty clay till which extended some 6.7 to 7.2 metres or, between elevations 184.7 and 185.4 metres to the termination depths of the boreholes.

The silty clay till is composed primarily of silt and clay sized materials with some sand and trace amounts of gravel. The gradation curves are shown on Figures A-3 and A-4 in Appendix A. Standard penetration test N values varied between 8 and 35 blows per 0.3 metres with an average of 17 blows per 0.3 metres. A crust of generally very stiff to hard till was present to depths of 2.9 to 4.1 metres below the ground surface. The till below this depth was typically stiff to very stiff. Water contents ranged from 15 to 21 per cent, with an average of about 17 per cent. The silty clay till is of low plasticity based on average plastic and liquid limits of 15 and 32 per cent, respectively. The Atterberg limits information is shown on the Plasticity Charts on Figures A-6 and A-7 in Appendix A.

4.5 9th Concession Drain Culvert (Station 11+529 M)

Boreholes C-15, C-16, C-29 and C-30 were drilled within the area of proposed 9th Concession Drain culverts replacement.

4.5.1 Topsoil

Topsoil layers between 0.1 and 0.3 metres thick were encountered from the ground surface at boreholes C-15, C-16 and C-29.

4.5.2 Fill

Fill materials were noted from the ground surface at borehole C-30 and the base of the topsoil layers, between elevations 186.5 and 187.3 metres, in boreholes C-15 and C-16. Granular (sand and gravel) fill was present at ground surface at boreholes C-30 and C-16. The fill at borehole C-30 also contained layers of loose sand interlayered with silty clay fill at depth. Silty clay fill was also noted at borehole C-15.

Standard penetration test N values of 5 to 9 blows per 0.3 metres of penetration were obtained from tests conducted in the fill at boreholes C-15 and C-30. Water contents of 14 and 15 per cent were measured in the sand fills and water contents of 17 to 30 per cent were measured in the silty

clay fills. The silty clay fill contained mainly silt and clay size materials with some sand and a trace amount of gravel. A gradation curve of the fill materials obtained from borehole C-15 is presented on Figure A-1 in Appendix A.

4.5.3 Silty Clay Till

The topsoil at borehole C-29 and the fill layers at the remaining three boreholes were underlain by silty clay till. All boreholes were terminated in the silty clay till after exploring them for some 6.7 to 8.7 metres. The surface of the till was encountered at elevations between 185.4 and 187.1 metres.

The silty clay till is composed primarily of silt and clay sized materials with some sand and trace amounts of gravel. The gradation curves are shown on Figures A-3 and A-4 in Appendix A. Standard penetration test N values vary between 6 and 34 blows per 0.3 metres with an average of 16 blows per 0.3 metres. A crust of generally very stiff to hard till was present to depths of 2.1 and 5.6 metres below the ground surface. The till below these depths was typically firm to very stiff. Shear strengths of over 144 kilopascals and a sensitivity in the order of 1.2 were estimated from the results of in-situ vane shear tests conducted at depth in borehole C-29.

Water contents ranged from 16 to 22 per cent and average 19 per cent. The silty clay till is of low plasticity based on average plastic and liquid limits of 17 and 32 per cent, respectively. The Atterberg limits information is shown on the Plasticity Charts on Figures A-6 and A-7 in Appendix A.

4.6 8th Concession Centre Drain Culvert (Station 12+098 M)

Boreholes C-13 and C-14 were drilled within the proposed 8th Concession Centre Drain culvert extension areas.

4.6.1 Topsoil

A topsoil layer approximately 0.2 metres thick was encountered at the ground surface in both boreholes.

4.6.2 Fill

The topsoil layer at borehole C-13 was underlain by fill materials to a depth of 2.4 metres or elevation 185.2 metres. The fill consisted of 0.2 metres of topsoil mixed with sand overlying 1.0 metres of silty clay which in turn overlies 1.2 metres of sand. Standard penetration test N values

in the silty clay fill and sand fill were 8 and 6 blows per 0.3 metres, respectively. Water contents of 19 and 16 per cent were measured in the silty clay fill and the sand fill layers, respectively.

4.6.3 Silty Clay Till

The fill layer at borehole C-13 and the topsoil layer at borehole C-14 were underlain by extensive deposits of silty clay till. The till surface was intercepted at elevation 185.4 metres and the till extended some 7.4 to 7.9 metres to the termination depths of the boreholes.

The silty clay till is composed primarily of silt and clay sized materials with some sand and trace amounts of gravel. The gradation curve is shown on Figure A-3 in Appendix A. Standard penetration test N values varied between 6 and 32 blows per 0.3 metres. A crust of generally very stiff to hard till was present to depths of 4.0 and 4.4 metres below the ground surface. The till below these depths was typically firm to stiff. Water contents ranged from 17 to 21 per cent with an average water content of 15 per cent. Atterberg limits testing carried out on a single sample of the silty clay till indicated low to intermediate plasticity with plastic and liquid limits of 16 and 35 per cent, respectively. The Atterberg limits information is shown on the Plasticity Charts on Figure A-7 in Appendix A.

4.7 8th Concession Drain Culvert (Station 12+935 M)

Boreholes C-11, C-12, C-31 and C-32 were drilled within the area of proposed 8th Concession Drain culvert replacement.

4.7.1 Topsoil

Layers of topsoil, approximately 0.2 metres thick, were encountered at the ground surface at each borehole location.

4.7.2 Fill

The topsoil layers at boreholes C-11, C-12 and C-32 are underlain by fill approximately 0.1 to 2.0 metres thick. Fills at boreholes C-11 and C-32 were composed entirely of silty clay materials. The silty clay fill layer at borehole C-12 was between layers of sand and gravel. The silty clay fill layer in borehole C-32 had standard penetration N values of 5 and 6 blows per 0.3 metres and water contents of 22 and 24 per cent.

4.7.3 Sandy Silt

Sandy silt was encountered at elevation 187.1 metres beneath the fill layers in borehole C-12. The sandy silt had a standard penetration N value of 13 blows per 0.3 metres of penetration.

4.7.4 Silty Clay Till

All four boreholes were terminated in silty clay till layers which were intercepted between 0.2 and 2.1 metres below the ground surface or between elevations 185.2 and 186.8 metres. At borehole C-11, an upper layer of silty clay till, approximately 1.1 metres thick, was intercepted at elevation 186.7 metres.

The silty clay till is composed primarily of silt and clay size materials with some sand and trace amounts of gravel. The gradation curves are shown in Figures A-2 and A-4 in Appendix A. Standard penetration test N values vary between 7 and 41 blows per 0.3 metres of penetration. A crust of generally very stiff to hard till was present to depths of 4.4 metres below the ground surface. The till below this depth was typically firm to very stiff. Water contents ranged from 14 to 22 per cent with an average water content of 18 per cent. The silty clay till is of low to intermediate plasticity based on average plastic and liquid limits of 16 and 35 per cent, respectively. The Atterberg limits information is shown on the Plasticity Charts on Figures A-6 and A-8 in Appendix A.

4.7.5 Sandy Silt Till

Layers of sandy silt till were encountered within the silty clay till strata at elevation 185.7 metres at borehole C-11 and under a sandy silt layer at elevation 186.4 metres at borehole C-12. Standard penetration test N values of 18 and 32 blows per 0.3 metres and a water content of 11 per cent were measured in this deposit.

4.8 7th Concession Drain Culvert (Station 14+308 M)

Boreholes C-9, C-10, C-33 and C-34 were drilled within the area of proposed 7th Concession Drain culvert replacement.

4.8.1 Topsoil

Layers of topsoil, between 0.1 and 0.2 metres thick were encountered from the ground surface at the borehole locations. A buried topsoil layer, approximately 0.2 metres thick, was intercepted at elevation 186.2 metres in borehole C-10.

4.8.2 Fill

The topsoil layers at boreholes C-9, C-10 and C-33 were underlain by fill soils approximately 0.4 to 1.3 metres thick. Sand and gravel fill was encountered at elevation 186.9 metres in boreholes C-10 and C-13. Silty clay fill was intercepted in the boreholes at elevations between 186.2 and 186.6 metres. Standard penetration test N values of 11 and 4 blows per 0.3 metres of penetration were recorded in the silty clay fill.

4.8.3 Sandy Silt

Sandy silt was encountered at elevation 185.8 metres in borehole C-9. The sandy silt had a standard penetration N value of 12 blows per 0.3 metres of penetration and a water content of 17 per cent.

4.8.4 Silty Clay Till

Extensive deposits of silty clay till were intercepted at elevations 185.0 to 186.4 metres at the borehole locations. The boreholes were terminated in this layer after exploring for some 6.8 to 8.0 metres.

The silty clay till is composed primarily of silt and clay size materials with some sand. The gradation curves are shown in Figure A-2 and A-5 in Appendix A. Standard penetration test N values vary between 6 and 32 blows per 0.3 metres of penetration. A crust of generally very stiff to hard till was present to a depth of 4.4 metres below the ground surface. The till below this depth was firm to very stiff. Water contents ranged from 15 to 22 per cent with an average water content of 19 per cent. The silty clay till is of low plasticity based on average plastic and liquid limits of 13 and 33 per cent, respectively. The Atterberg limits information is shown on Figures A-6 and A-7 in Appendix A.

4.9 Mahon Drain Culvert (Station 15+024 M)

Boreholes C-7, C-8, C-35 and C-36 were drilled within the proposed Mahon Drain culvert extension areas.

4.9.1 Topsoil

Layers of topsoil, between 0.1 and 0.2 metres thick, were encountered at the ground surface at boreholes C-7, C-8 and C-36.

4.9.2 Fill

Underlying the topsoil at borehole C-36 was a layer of silty clay fill which extended 0.8 metres from elevation 185.6 metres. A standard penetration N value of 20 blows per 0.3 metres and a water content of 20 per cent were measured in the fill.

4.9.3 Silty Clay Till

Extensive deposits of silty clay till were encountered beneath the topsoil layers at boreholes C-7 and C-8, from the ground surface at borehole C-35 and below the fill layer at borehole C-36. The till was intercepted between elevations 184.5 and 185.5 metres and extended some 7.2 to 8.1 metres to the termination depths of the boreholes.

The silty clay till is composed primarily of silt and clay size materials with some sand and trace amounts of gravel. The gradation curves are shown on Figure A-2 and A-5 in Appendix A. Standard penetration test N values varied between 8 and 45 blows per 0.3 metres of penetration and averaged 21 blows per 0.3 metres. A crust of generally very stiff to hard till was present to a depth of about 4.4 metres below the ground surface. Water contents ranged from 14 to 22 per cent with an average water content of 18 per cent. The silty clay till is of intermediate plasticity based on average plastic and liquid limits of 13 and 36 per cent, respectively. The Atterberg limits information is shown on the Plasticity Chart on Figure A-8 in Appendix A.

4.10 Little Creek Drain Culvert (Station 15+685 M)

Boreholes C-5, C-6, C-37 and C-38 were drilled within the area of the proposed Little Creek Drain culvert replacement.

4.10.1 Topsoil

Layers of topsoil, between 0.1 and 0.2 metres thick were encountered at the ground surface at all boreholes.

4.10.2 Fill

The topsoil layers at boreholes C-5, C-6 and C-37 were underlain by fill layers 0.1 to 1.1 metres thick. The fill was variable and, depending on location, was composed of gravel with topsoil, clayey silt, silty clay or sand and gravel. An average standard penetration test N value of 10 blows per 0.3 metres was measured in the cohesive fill. A single sample of clayey silt fill had a water content of 20 per cent.

4.10.3 Silty Clay Till

Silty clay till was encountered in all four boreholes. Continuous layers of till were intercepted between elevations 184.0 and 185.3 metres and extended some 7.0 to 8.1 metres to the termination depth of boreholes C-5, C-6 and C-38. A 5.4 metre thick till layer was encountered at elevation 185.4 metres beneath the fill layer and above a sand layer at borehole C-37. A lower silty clay till layer was intercepted at elevation 178.9 metres and extended to the termination depth of the borehole at elevation 176.8 metres.

The silty clay till is composed primarily of silt and clay size materials with some sand and trace amounts of gravel. The gradation curves are shown in Figures A-2 and A-5 in Appendix A. Standard penetration test N values varied between 8 and 37 blows per 0.3 metres of penetration. A crust of generally very stiff to hard till was present to a depth of 4.4 metres below the ground surface. The till below this depth was typically very stiff. Water contents ranged from 16 to 22 per cent with an average water content of 18 per cent. The silty clay till has low to intermediate plasticity based on average plastic and liquid limits of 15 and 34 per cent, respectively. The Atterberg limits information is shown on the Plasticity Charts on Figures A-6 and A-8 in Appendix A.

4.10.4 Sand

A layer of sand was encountered at elevation 180.0 metres beneath the upper silty clay layer in borehole C-37. A single N value of 8 blows per 0.3 metres was obtained from the standard penetration testing in this layer.

4.11 Anger Drain Culvert (Station 17+097 M)

Boreholes C-3, C-4, C-39 and C-40 were drilled within the proposed Anger Drain culvert replacement area.

4.11.1 Topsoil

Layers of topsoil, between 0.3 and 0.4 metres thick, were encountered at the ground surface at boreholes C-4 and C-39.

4.11.2 Fill

Fill materials were encountered beneath the topsoil layers at boreholes C-4 and C-39 and from the ground surface at boreholes C-3 and C-40. The fill layers were between 0.2 and 2.3 metres thick and consisted predominantly of clayey silt or silty clay with sand and gravel or sand found at the

surface of boreholes C-3 and C-40. A single N value of 27 blows per 0.3 metres of penetration was obtained from the standard penetration testing in the sand fill. N values in the cohesive fills ranged from 5 to 8 blows per 0.3 metres.

4.11.3 Silty Clay Till

The fill layers were underlain by extensive deposits of silty clay till. The till was intercepted between elevations 182.8 and 184.0 metres. Boreholes C-3, C-4 and C-39 were terminated in this layer after exploring it for some 6.2 to 7.4 metres. A 6.1 metre thick layer of silty clay till was fully penetrated in borehole C-40.

The silty clay till is composed primarily of silt and clay size materials with some sand and trace amounts of gravel. The gradation curves are shown on Figure A-2 and A-5 in Appendix A. Standard penetration test N values varied between 5 and 35 blows per 0.3 metres of penetration. A crust of generally very stiff to hard till was present between depths of 2.9 and 5.1 metres below the ground surface. The till below these depths was typically firm to very stiff. Water contents ranged from 16 to 23 per cent with an average water content of 20 per cent. The silty clay till is of low plasticity based on average plastic and liquid limits of 16 and 34 per cent, respectively. The Atterberg limits information is shown on the Plasticity Charts on Figures A-6 and A-7 in Appendix A.

4.11.4 Silt

Silt was encountered at elevation 177.1 metres beneath the silty clay till layer in borehole C-40. The borehole was terminated in the silt layer after exploring it for some 0.6 metres. The silt had a standard penetration test N value of 20 blows per 0.3 metres.

4.12 4th Concession Drain Culvert (Station 18+428 M)

Boreholes C-1, C-2, C-41 and C-42 were drilled within the proposed 4th Concession Drain culvert extension areas.

4.12.1 Topsoil

Topsoil was encountered at ground surface at all borehole locations. The topsoil layers were between 0.1 and 0.2 metres thick.

4.12.2 Fill

Underlying the topsoil layers at borehole C-1 and C-41 near elevation 185.1 metres were silty clay fill layers approximately 1.0 to 1.3 metres thick. The fill had standard penetration test N values of 15 and 8 blows per 0.3 metres and water contents of 17 per cent.

4.12.3 Silty Clay Till

Silty clay till was encountered at the base of the fill layers at boreholes C-1 and C-41 and below the topsoil layers at boreholes C-2 and C-42. The till was intercepted between elevations 183.4 and 184.5 and extended some 7.4 to 7.9 metres to the termination depths of the boreholes.

The silty clay till is composed primarily of silt and clay sized materials with some sand and trace amounts of gravel. The gradation curves are shown on Figure A-2 and A-5 in Appendix A. Standard penetration test N values ranged from 6 to 38 blows per 0.3 metres. A crust of generally very stiff to hard till was present to depths of 4.4 metres below the ground surface. The till below this depth was typically firm to very stiff. In situ shear strength testing attempted in the softer till layers at depth in boreholes C-1 and C-2 indicated shear strengths of 144 kilopascals or greater. Water contents within the silty clay till varied between 15 and 22 per cent with an average water content of 18 per cent. The corresponding average plastic and liquid limits are 15 and 35 per cent, respectively, indicating a clay of low to intermediate plasticity. Individual Atterberg limits information are shown on the Plasticity Charts on Figures A-6 and A-8 in Appendix A.

4.13 Groundwater Conditions

Groundwater levels were observed during and upon completion of drilling and sampling of the boreholes. Perched groundwater was encountered in the fill in borehole C-13 at the 8th Concession Centre Drain culvert at a depth of 1.4 metres below the existing ground surface or at elevation 186.3 metres. Groundwater was also encountered in a sand layer in borehole C-37 drilled at the Little Creek Drain culvert at a depth of 5.6 metres or at elevation 180.0 metres. All of the other boreholes remained dry during drilling. Details of the groundwater conditions encountered in the boreholes are provided in Table I, on the Record of Borehole sheets and on Drawings 1 to 11.

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



5.0 MISCELLANEOUS

The investigation was carried out using equipment supplied and operated by Lantech Drilling Services Inc., an Ontario Ministry of Environment licensed well contractor. Field operations were supervised by Mr. Mike Arthur under the direction of Mr. David J. Mitchell. All laboratory testing was conducted at Golder Associates' London laboratory. This laboratory is an accredited participant in the MTO's Soil and Aggregate Proficiency program and is certified for testing Types C and D Aggregates by the Canadian Council of Independent Laboratories. This report was written by Ms. Dirka U. Prout, P.Eng. under the direction of the Project Manager, Mr. Philip R. Bedell, P.Eng. The report was reviewed by Mr. Fintan J. Heffernan, P.Eng. the Designated MTO Contact and Quality Control Auditor.

GOLDER ASSOCIATES LTD.

 
D. U. PROUT

Dirka U. Prout, P. Eng.

 
PHILIP R. BEDELL
Philip R. Bedell, P. Eng.
Principal

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

DUP/AMH/FJH/er
n:\active\2004\130000\041-130054 dillon - foundations - 401\reports\foundation reports\041-130054-0-1 culvert\0112- (final) parts a and b culverts.doc

PART B – FOUNDATION DESIGN REPORT

**CULVERTS
HIGHWAY 401
FROM 1.5 KILOMETRES WEST OF MANNING ROAD EASTERLY
TO 1.6 KILOMETRES EAST OF PUCE ROAD
GWP 62-00-00, PURCHASE ORDER NO. 3005-A-000393
MINISTRY OF TRANSPORTATION – SOUTHWESTERN REGION**

6.0 ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides our recommendations on the foundation aspects of the design of culvert extensions and proposed replacement culverts under Highway 401 between 1.5 kilometres west of Manning Road and 1.6 kilometres east of Puce Road. Six culverts are to be replaced and five culverts are being extended.

It should be noted that the interpretation and recommendations are intended for use only by the design engineer. Where comments are made on construction they are provided only in order to highlight those aspects which could affect the design of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

6.2 Foundations

Based on the information provided, it is understood that Highway 401 is to be expanded from four to six lanes within the project limits. Eleven existing culverts have been selected for extension or replacement for a program of rehabilitation of existing structures and drainage improvements for this projects. The existing concrete culverts for Croft Drain 21, 9th Concession, 8th Concession, 7th Concession, Little Creek and Anger Drains are to be replaced with new concrete culverts. The culverts at the North 12th Concession Drain, 10th Concession Drain 14, Mahon Drain and 4th Concession Drain are to be extended to the left and right of the Highway 401 alignment. The 8th Concession Centre drain will be extended to the left of the alignment only.

Based on the subsurface conditions encountered in the boreholes, surficial layers of topsoil and fill are present at the sites of the proposed culvert extensions and replacements. The fill and topsoil layers are underlain by extensive deposits of firm to hard, but generally very stiff, silty clay till. A very stiff to hard silty clay crust is typically present to depths of 3 to 5 metres. The till layers below this depth vary from very stiff to firm with depth. Deposits of sandy silt, silt, sandy silt till and sand were also interlayered with the till in some areas.

Based on the anticipated founding elevations, the culverts and extensions will be founded on native soils. It is understood that these will consist of cast-in-place elements, therefore, bedding materials are not required.

All culverts should be designed to withstand the appropriate weight of fill and traffic loading. Site specific recommendations are provided in the following sections. The founding elevations

for the culverts have been inferred from the proposed culvert extension or replacement invert levels provided.

Backfill transition (frost taper) will be required above the frost line. Backfill transition recommendations should be provided in the Pavement Design Report for the project. Camber is not considered necessary nor are inlet and outlet seals.

6.2.1 North 12th Concession Drain Culvert (19+336 SS)

The existing North 12th Concession Drain culvert is 1.22 x 1.22 metres in size. It is proposed to extend the culvert 4.2 metres on the left and 1.0 metre on the right. The design invert elevation is approximately 184.3 metres at the left end and 184.2 metres at the right end. Based on boreholes C-21 through C-24 inclusive, very stiff silty clay till is present at the founding elevations. Minimal groundwater inflow is expected at this depth. Assuming a 1 metre wide footing, the culvert extensions may be designed using the following values:

<u>LOCATION</u>	<u>FOUNDING ELEVATION</u> (m)	<u>SOIL TYPE</u>	<u>GROUNDWATER ELEVATION</u> (m)	<u>GEOTECHNICAL RESISTANCE (kPa)</u>		<u>COEFFICIENT OF SLIDING</u> (unfactored)
				<u>Factored ULS</u>	<u>SLS</u>	
Lt	183.1	Silty Clay Till	Dry	275	175	0.6
Rt	183.0	Silty Clay Till	Dry	300	200	0.6

6.2.2 Croft Drain 21 Culvert (19+717 SS)

The existing Croft Drain 21 culvert at Pike Creek is 4.88 x 1.83 metres in size. It is proposed to replace this culvert with one 5.00 x 2.00 x 69.4 metres in size. The design invert elevations are about 182.3 and 182.7 metres at the left and right ends, respectively. Based on information from boreholes C-19, C-20, C-25 and C-26, stiff silty clay till is present at the founding elevations. Minimal groundwater seepage is expected at this depth. Assuming a 1 metre wide footing, the culvert extensions may be designed using the following values:

<u>LOCATION</u>	<u>FOUNDING ELEVATION</u> (m)	<u>SOIL TYPE</u>	<u>GROUNDWATER ELEVATION</u> (m)	<u>GEOTECHNICAL RESISTANCE (kPa)</u>		<u>COEFFICIENT OF SLIDING</u> (unfactored)
				<u>Factored ULS</u>	<u>SLS</u>	
Lt	181.2	Silty Clay Till	Dry	250	175	0.6
Rt	181.5	Silty Clay Till	Dry	250	175	0.6

Based on the hydraulic gradient at the culvert, temporary diversion of the creek water flows may be required during culvert installation. Adequate erosion protection, such as suitable non-woven geotextile and rip-rap, as determined by hydraulic assessment, may also be required at the inlet and outlet.

6.2.3 10th Concession Drain 14 Culvert (10+224 M)

The existing 10th Concession Drain 14 culvert is 3.05 x 1.52 metres in size. It is proposed to extend the culvert 4.9 metres on the left end. The proposed length of the extension on the right will be 18.0 metres. The approximate design invert elevation is 184.3 metres at the left and right ends. Based on information from boreholes C-17, C-18, C-27 and C-27, very stiff silty clay till is present at the founding elevations. Minimal groundwater seepage is expected at this depth. Assuming a 1 metre wide footing, the culvert extension may be designed using the following values:

<u>LOCATION</u>	<u>FOUNDING ELEVATION</u> (m)	<u>SOIL TYPE</u>	<u>GROUNDWATER ELEVATION</u> (m)	<u>GEOTECHNICAL RESISTANCE (kPa)</u>		<u>COEFFICIENT OF SLIDING</u> (unfactored)
				<u>Factored ULS</u>	<u>SLS</u>	
Lt	183.1	Silty Clay Till	Dry	275	175	0.6
Rt	183.1	Silty Clay Till	Dry	300	200	0.6

6.2.4 9th Concession Drain Culvert (11+529 M)

It is understood that the existing 2.44 x 1.52 metre 9th Concession Drain culvert will be replaced by one 3.0 x 1.50 x 57.8 metres in size. The design invert elevation is 185.2 metres at both the left and right ends. Based on boreholes C-15, C-16, C-29 and C-30, very stiff hard silty clay till is present at the founding elevation. Minimal groundwater seepage is expected at this depth. Assuming a 1 metre wide footing, the replacement culvert may be designed using the following values:

<u>LOCATION</u>	<u>FOUNDING ELEVATION</u> (m)	<u>SOIL TYPE</u>	<u>GROUNDWATER ELEVATION</u> (m)	<u>GEOTECHNICAL RESISTANCE (kPa)</u>		<u>COEFFICIENT OF SLIDING</u> (unfactored)
				<u>Factored ULS</u>	<u>SLS</u>	
Lt	184.0	Silty Clay Till	Dry	300	200	0.6
Rt	184.0	Silty Clay Till	Dry	275	175	0.6

6.2.5 8th Concession Centre Drain Culvert (12+098 M)

The existing 8th Concession Centre Drain culvert is 3.66 x 1.83 metres in size. It is proposed to extend the culvert 7.3 metres on the left end only. The design invert elevation is 184.9 metres. Based on information from boreholes C-13 and C-14, very stiff silty clay till is present at the founding elevations. Minimal groundwater seepage is expected at this depth. Assuming a 1 metre wide footing, the culvert extension may be designed using the following values:

<u>LOCATION</u>	<u>FOUNDING ELEVATION</u> (m)	<u>SOIL TYPE</u>	<u>GROUNDWATER ELEVATION</u> (m)	<u>GEOTECHNICAL RESISTANCE (kPa)</u>		<u>COEFFICIENT OF SLIDING</u> (unfactored)
				<u>Factored ULS</u>	<u>SLS</u>	
Lt	183.7	Silty Clay Till	186.3	300	200	0.6

6.2.6 8th Concession Drain Culvert (12+935 M)

It is understood that the existing 3.05 x 1.52 metre 8th Concession Drain culvert will be replaced by a 57.6 metre long culvert of similar size. The approximate design invert elevation is 185.4 metres at both the left and right ends. Based on information from boreholes C-11, C-12, C-31 and C-32, very stiff to hard silty clay till is present at the founding elevation. Minimal groundwater seepage is expected at this depth. Therefore, assuming a 1 metre wide footing, the replacement culvert can be designed using the following values:

<u>LOCATION</u>	<u>FOUNDING ELEVATION</u> (m)	<u>SOIL TYPE</u>	<u>GROUNDWATER ELEVATION</u> (m)	<u>GEOTECHNICAL RESISTANCE (kPa)</u>		<u>COEFFICIENT OF SLIDING</u> (unfactored)
				<u>Factored ULS</u>	<u>SLS</u>	
Lt	184.2	Silty Clay Till	Dry	350	225	0.6
Rt	184.2	Silty Clay Till	Dry	300	200	0.6

6.2.7 7th Concession Drain Culvert (14+308 M)

It is understood that the existing 1.83 x 1.52 metre 7th Concession Drain culvert will be replaced by one 2.50 x 1.25 x 54.3 metres in size. The design invert elevation is 184.6 at both the left and right ends. Based on boreholes C-9, C-10, C-33 and C-34, very stiff silty clay till is present at the founding elevation. Minimal groundwater seepage is expected at this depth. Assuming a 1 metre wide footing, the replacement culvert may be designed using the following values:

<u>LOCATION</u>	<u>FOUNDING ELEVATION</u> (m)	<u>SOIL TYPE</u>	<u>GROUNDWATER ELEVATION</u> (m)	<u>GEOTECHNICAL RESISTANCE (kPa)</u>		<u>COEFFICIENT OF SLIDING</u> (unfactored)
				<u>Factored ULS</u>	<u>SLS</u>	
Lt	183.4	Silty Clay Till	Dry	300	200	0.6
Rt	183.4	Silty Clay Till	Dry	300	200	0.6

6.2.8 Mahon Drain Culvert (15+024 M)

It is understood that the existing 2.44 x 1.52 metre Mahon Drain culvert will be extended 1 metre at each end. The design invert elevation is 183.8 metres. Based on information from boreholes C-7, C-8, C-35 and C-36, very stiff to hard silty clay till is present at the founding elevation within the proposed extension areas. Minimal groundwater seepage is expected at this depth.

Assuming a 1 metre wide footing, the culvert extensions may be designed using the following values:

<u>LOCATION</u>	<u>FOUNDING ELEVATION</u> (m)	<u>SOIL TYPE</u>	<u>GROUNDWATER ELEVATION</u> (m)	<u>GEOTECHNICAL RESISTANCE (kPa)</u>		<u>COEFFICIENT OF SLIDING</u> (unfactored)
				<u>Factored ULS</u>	<u>SLS</u>	
Lt	182.6	Silty Clay Till	Dry	350	250	0.6
Rt	182.6	Silty Clay Till	Dry	350	250	0.6

6.2.9 Little Creek Drain Culvert (15+685 M)

It is understood that the existing 1.83 x 1.52 metre Little Creek Drain culvert will be replaced by one 2.50 x 1.25 x 55.2 metres in size. The design invert elevation is about 183.1 at both the left and right ends. Based on information from boreholes C-5, C-6, C-37 and C-38, very stiff to hard silty clay till is present at the founding elevation. Minimal groundwater seepage is expected at this depth. Assuming a 1 metre wide footing, the replacement culvert may be designed using the following values:

<u>LOCATION</u>	<u>FOUNDING ELEVATION</u> (m)	<u>SOIL TYPE</u>	<u>GROUNDWATER ELEVATION</u> (m)	<u>GEOTECHNICAL RESISTANCE (kPa)</u>		<u>COEFFICIENT OF SLIDING</u> (unfactored)
				<u>Factored ULS</u>	<u>SLS</u>	
Lt	181.9	Silty Clay Till	Dry	275	175	0.6
Rt	181.9	Silty Clay Till	180.0	275	175	0.6

6.2.10 Anger Drain Culvert (17+097 M)

It is understood that the existing 1.52 x 1.52 metre Anger Drain culvert will be replaced by one 2.50 x 1.25 x 61.6 metres in size. The design invert elevation is 182.9 at both the left and right ends. Based on information from boreholes C-3, C-4, C-39 and C-40, very stiff silty clay till is present at the founding elevation. Minimal groundwater seepage is expected at this depth. Assuming a 1 metre wide footing, the replacement culvert may be designed using the following values:

<u>LOCATION</u>	<u>FOUNDING ELEVATION</u> (m)	<u>SOIL TYPE</u>	<u>GROUNDWATER ELEVATION</u> (m)	<u>GEOTECHNICAL RESISTANCE (kPa)</u>		<u>COEFFICIENT OF SLIDING</u> (unfactored)
				<u>Factored ULS</u>	<u>SLS</u>	
Lt	181.7	Silty Clay Till	Dry	200	150	0.6
Rt	181.7	Silty Clay Till	Dry	300	200	0.6

6.2.11 4th Concession Drain Culvert (18+428 M)

The existing 4th Concession Drain culvert is 3.66 x 1.83 metres in size. It is proposed to extend the culvert 5.0 metres at the left end and 7.0 metres at the right end. The design invert elevation at each end is approximately 182.9 metres. Based on information from boreholes C-1, C-2, C-41 and C-42, very stiff silty clay till is present at the founding elevation. Minimal groundwater seepage is expected at this depth. Assuming a 1 metre wide footing, the culvert extensions may be designed using the following values:

LOCATION	FOUNDING ELEVATION (m)	SOIL TYPE	GROUNDWATER ELEVATION (m)	GEOTECHNICAL RESISTANCE (kPa)		COEFFICIENT OF SLIDING (unfactored)
				Factored	ULS	
Lt	181.7	Silty Clay Till	Dry	300	200	0.6
Rt	181.7	Silty Clay Till	Dry	300	200	0.6

6.3 Excavations

Following diversion of the existing drain flows, all topsoil, fill, organic material and other deleterious materials must be stripped from the proposed founding area prior to construction of the culvert extensions or replacement culverts. It is anticipated that groundwater flows into foundation excavations will be minimal and can be handled by properly located, sized and filtered sumps placed in the base of the excavation. The excavation side slopes should be maintained at an inclination of 1 horizontal to 1 vertical or flatter in accordance with the current Occupational Health and Safety Act (OSHA). Based on the current OSHA, all fill materials, the compact sandy silt and sands and silts below the water level may be classified as Type 3 soils. The sandy silt till and silty clay till may be classified as Type 2 soils.

The exposed subgrades should be inspected by the geotechnical engineer prior to placement of culvert extensions or new culverts. If the culvert installation cannot be completed on the same day as the excavation, it may be necessary to provide a 75 millimetre working slab following inspection to preserve the integrity of the founding soils. Any disturbed or deleterious materials encountered should be removed and low areas brought to grade using compacted Granular A. In areas where groundwater flow may preclude the use of Granular A, 19 millimetre crushed stone placed on a separation geotextile may be used.

6.4 Backfill

Backfill around the culvert should be carried out in accordance with Ontario Provincial Standard Drawing (OPSD) 802.2. Culvert backfill should consist of free-draining, non-frost susceptible granular materials such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B, Type II.

The granular fill should be placed with a width equal to at least 1.2 metres behind the culvert walls. Where backfill soils are placed and compacted behind the walls, a compaction surcharge equal to 12 kilopascals (kPa) should be included in the lateral earth pressures for structural design in accordance with the Canadian Highway Bridge Design Code (CHBDC). Compaction equipment should be used in accordance with OPSS 501.06. For walls backfilled as noted above, the following parameters (unfactored) may be assumed:

Full unit weight: 22 kN/m^3

Coefficients of lateral earth pressures:

‘active’, K_a 0.31

‘at-rest’, K_o 0.47

If the wall support allows lateral yield (unrestrained structure), active earth pressures may be used in the geotechnical design of the structure. If the culvert wall support does not allow lateral yielding (restrained structure), at-rest pressures should be assumed for geotechnical design.

Resistance to sliding may be based on an unfactored shearing resistance of 28 degrees. The unfactored coefficient of passive pressure for the portion of the culvert wall and footing below invert may be taken as 3.1.

6.5 Surface And Groundwater Control

Appropriate grading should be carried out prior to construction to direct surface water flows away from the open excavations.

Depending on the time of year of construction and the prevailing weather conditions, aggressive control of creek flows may be required. Construction should be scheduled to preclude excavation during spring conditions. Control of creek flows, depending on their magnitude, may be handled by pumping from sumps in conjunction with temporary earthen cofferdams constructed on the native silty clay. If excessive creek flows are present, temporary diversion of the channel may be required.

Based on the results of the investigation, it is considered that groundwater control can be accomplished using properly constructed and filtered sumps in the base of the excavations.

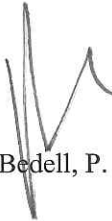
6.6 Additional Comments

Based on our understanding that open footing cast-in-place culverts and extensions will be constructed, it is considered that inlet and outlet seals are not required and that camber for the culverts/extensions is not necessary.

GOLDER ASSOCIATES LTD.



Dirka U. Prout, P. Eng.



Philip R. Bedell, P. Eng.
Principal



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

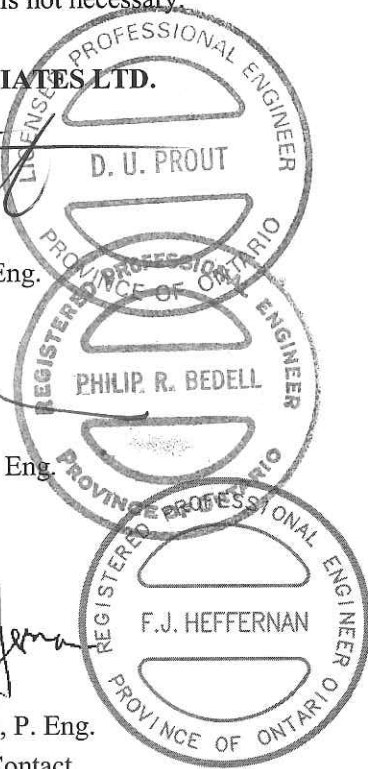


TABLE I
SUMMARY OF GROUNDWATER LEVELS

Highway 401
From 1.5 KM West of Manning Road
Easterly to 1.6 KM East of Puce Road
GWP 62-00-00

BOREHOLE	GROUND SURFACE ELEVATION (m)	ENCOUNTERED GROUNDWATER LEVEL		DRAIN WATER LEVEL (m)	
		Depth	Elevation	North	South
		(m)	(m)		
North 12th Concession Drain					
C-21	186.27	dry	dry	184.27	184.28
C-22	185.75	dry	dry		
C-23	185.72	dry	dry		
C-24	185.96	dry	dry		
Croft Drain 21					
C-19	186.02	dry	dry	182.56	182.47
C-20	184.34	dry	dry		
C-25	184.36	dry	dry		
C-26	184.72	dry	dry		
10th Concession Drain 14					
C-17	185.17	dry	dry	184.55	184.62
C-18	186.85	dry	dry		
C-27	187.25	dry	dry		
C-28	185.48	dry	dry		
9th Concession Drain					
C-15	186.77	dry	dry	184.99	185.19
C-16	187.42	dry	dry		
C-29	185.97	dry	dry		
C-30	187.88	dry	dry		
8th Concession Centre Drain					
C-13	187.63	1.37	186.26	184.67	184.67
C-14	185.69	dry	dry		
8th Concession Drain					
C-11	187.03	dry	dry	185.91	185.73
C-12	187.75	dry	dry		
C-31	187.03	dry	dry		
C-32	187.63	dry	dry		

SUMMARY OF GROUNDWATER LEVELS

BOREHOLE	GROUND SURFACE ELEVATION (m)	ENCOUNTERED		DRAIN WATER LEVEL (m)	
		Depth	Elevation	North	South
		(m)	(m)		
7th Concession Drain					
C-9	186.38	dry	dry	185.58	185.87
C-10	186.93	dry	dry		
C-33	186.97	dry	dry		
C-34	186.48	dry	dry		
Mahon Drain					
C-7	185.70	dry	dry	183.95	183.94
C-8	184.63	dry	dry		
C-35	184.85	dry	dry		
C-36	185.74	dry	dry		
Little Creek Drain					
C-5	185.62	dry	dry	183.48	183.42
C-6	185.19	dry	dry		
C-37	185.64	5.64	180.00		
C-38	185.36	dry	dry		
Anger Drain					
C-3	185.51	dry	dry	183.13	183.03
C-4	183.44	dry	dry		
C-39	184.73	dry	dry		
C-40	185.36	dry	dry		
4th Concession Drain					
C-1	185.19	dry	dry	183.09	183.09
C-2	184.64	dry	dry		
C-41	185.21	dry	dry		
C-42	183.65	dry	dry		

NOTE: Table to be read in conjunction with accompanying report.

N:\Active\2004\130000\041-130054 DILLON - FOUNDATIONS - 401\Reports\Foundation Reports\041-130054-0-1 Culvert\0112 - Table I sum of gwtr levels.xls\Table I

LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole", on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

<i>AS</i>	auger sample
<i>CS</i>	chunk sample
<i>DO</i>	drive open
<i>DS</i>	Denison type sample
<i>FS</i>	foil sample
<i>RC</i>	rock core
<i>ST</i>	slotted tube
<i>TO</i>	thin-walled, open
<i>TP</i>	thin-walled, piston
<i>WS</i>	wash sample
<i>SS</i>	split spoon

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance:

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 0.3 m (12 in.).

Standard Penetration Resistance, 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 0.3 m (12 in.).

<i>WH</i>	sampler advanced by static weight-weight, hammer
<i>PH</i>	sampler advanced by hydraulic force
<i>PM</i>	sampler advanced by manual force

III. SOIL DESCRIPTION

(a) Cohesionless Soils

	"N" Blows/0.3 m or Blow/ft.
Relative Density	
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

	"Cu" = "Su"
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 1000
Stiff	50 to 100 1000 to 2000
Very stiff	100 to 200 2000 to 4000
Hard	over 200 over 4000

IV. SOIL TESTS

<i>C</i>	consolidation test
<i>H</i>	hydrometer analysis
<i>M</i>	sieve analysis
<i>MH</i>	combined analysis, sieve and hydrometer ¹
<i>Q</i>	undrained triaxial ²
<i>R</i>	consolidated undrained triaxial ²
<i>S</i>	drained triaxial
<i>U</i>	unconfined compression
<i>V</i>	field vane test
<i>Chem</i>	chemical analysis

NOTES:

1. Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.
2. Undrained triaxial tests in which pore pressures are measured are shown as Q or R.

LIST OF SYMBOLS

I. GENERAL

π	$\pi = 3.1416$
e	e = base of natural logarithms 2.7183
\log_e	$\log_e a$ or $\ln a$, natural logarithm of a
\log_{10}	$\log_{10} a$ or $\log a$, logarithm of a to base 10
t	time
g	acceleration due to gravity
V	volume
W	weight
m	mass
M	moment
F	factor of safety

II. STRESS AND STRAIN

u	pore pressure
σ	normal stress
σ'	normal effective stress (σ is also used)
τ	shear stress
ϵ	linear strain
ϵ_{sy}	shear strain
ν	Poisson's ration (μ is also used)
E	modulus of linear deformation (Young's modulus)
G	modulus of shear deformation
K	modulus of compressibility
η	coefficient of viscosity

III. SOIL PROPERTIES

(a) Unit weight

γ	unit weight of soil (bulk density)
γ_s	unit weight of solid particles
γ_w	unit weight of water
γ_d	unit dry weight of soil (dry density)
γ'	unit weight of submerged soil
G_s	specific gravity of solid particles $G_s = \gamma_s/\gamma_w$
e	void ratio
n	porosity
w	water content
S_r	degree of saturation

(b) Consistency

w_L	liquid limit
w_p	plastic limit
I_p	plasticity index
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
D_r	relative density $= (e_{max} - e)/(e_{max} - e_{min})$

(c) Permeability

h	hydraulic head or potential
q	rate of discharge
v	velocity of flow
i	hydraulic gradient
κ	coefficient of permeability
j	seepage force per unit volume

(d) Consolidation (one-dimensional)

m_v	coefficient of volume change $= -\Delta e/(1+e)\Delta\sigma'$
C_c	compression index $= -\Delta e/\Delta\log_{10}\sigma'$
c_v	coefficient of consolidation
T_F	time factor $= c_v t/d^2$ (d , drainage path)
U	degree of consolidation

(e) Shear strength

τ_f	shear strength	in terms of effective stress $\tau_f = c' + \sigma' \tan \phi$
c'	effective cohesion intercept	
ϕ'	effective angle of shearing resistance, or friction	
S_u	apparent cohesion*	
ϕ_u	apparent angle of shearing resistance, or friction	in terms of total stress $\tau_f = cu + \sigma \tan \phi_u$
μ	coefficient of friction	
S_t	sensitivity	

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = S_u$ is taken as half the undrained compressive strength.

PROJECT <u>041-130054-0-1</u>		RECORD OF BOREHOLE No C-1		1 OF 1	METRIC
G.W.P. <u>62-00-00</u>	LOCATION <u>N 4677661.3 ; E 282395.0</u>	ORIGINATED BY <u>MA</u>			
DIST <u>1</u> HWY <u>401</u>	BOREHOLE TYPE <u>POWER AUGER (HOLLOW STEM)</u>	COMPILED BY <u>BG</u>			
DATUM <u>GEODETIC</u>	DATE <u>July 28, 2004</u>	CHECKED BY _____			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
185.19	GROUND SURFACE														
0.00	TOPSOIL, clayey														
0.15	Brown (FILL), silty clay, trace sand, trace gravel, Stiff, Mottled brown and grey		1	SS	15										
184.03															
1.16	SILTY CLAY, some sand, trace gravel (TILL), Very stiff, Mottled brown and grey becoming brown at elev. 182.5m and grey at 181.0m		2	SS	21										
			3	SS	24										
			4	SS	23										
			5	SS	20										
			6	SS	11										
			7	SS	8										
			8	SS	13										
			9	SS	20										
176.35															
8.84	END OF BOREHOLE														
	Borehole dry during drilling July 28, 2004														

N_MTO_04-1130.054.GPJ ON_MOT.GDT 1/12/05

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

RECORD OF BOREHOLE No C-2

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

LOCATION N 4677668.4 ; E 282388.0

ORIGINATED BY MA

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (HOLLOW STEM)

COMPILED BY BG

DATUM GEODETIC

DATE July 29, 2004

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
184.64	GROUND SURFACE														
0.00	TOPSOIL, clayey														
0.12	Brown SILTY CLAY, some sand, trace gravel (TILL) Very stiff to stiff, Mottled brown and grey becoming brown at elev. 182.5m and grey at 180.9m		1	SS	18										
			2	SS	29										
			3	SS	29										
			4	SS	22										
			5	SS	13										
			6	SS	11										
			7	SS	9										
			8	SS	9										
177.32															
7.32	SILTY CLAY, trace sand, trace gravel (TILL), with occasional silt seams, Stiff, Grey		9	SS	11										
176.41															
8.23	SILTY CLAY, trace sand, trace gravel (TILL) Firm, Grey		10	SS	6										
175.80															
8.84	END OF BOREHOLE														
	Borehole dry during drilling July 29, 2004														

RECORD OF BOREHOLE No C-3

1 OF 1

METRIC

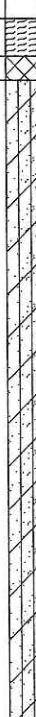
PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4677698.9 ; E 281057.0 ORIGINATED BY MA
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (HOLLOW STEM) COMPILED BY BG
DATUM GEODETIC DATE July 29, 2004 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE						
185.51	GROUND SURFACE						20	40	60	80	100						
0.00	(FILL), sand and gravel, crushed, trace silt, Brown																
185.21																	
0.30	(FILL), fine to coarse sand, some gravel, trace silt Compact, Brown		1	SS	27												
184.14																	
1.37	(FILL), clayey silt, trace sand, trace gravel, trace topsoil, Firm, Mottled brown and grey		2	SS	6												
182.92			3	SS	5												
2.59	SILTY CLAY, some sand, trace gravel (TILL) Firm to very stiff, Mottled brown and grey becoming brown at 3.05m depth and grey at 5.18m depth		4	SS	9												
			5	SS	27												
			6	SS	17												
			7	SS	12												
			8	SS	9												
			9	SS	11												
177.28			10	SS	10												
8.23	SILTY CLAY, trace sand, trace gravel (TILL), with fine to medium sand layers, Stiff, Grey																
176.67	END OF BOREHOLE																
8.84	Borehole dry during drilling July 29, 2004																

N. MTO 04-1130 054.GPJ ON MOT.GDT 1/12/05

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

PROJECT 041-130054-0-1		RECORD OF BOREHOLE No C-4		1 OF 1	METRIC
G.W.P. 62-00-00		LOCATION N 4677720.2 ; E 281057.0		ORIGINATED BY MA	
DIST 1 HWY 401		BOREHOLE TYPE POWER AUGER (HOLLOW STEM)		COMPILED BY BG	
DATUM GEODETIC		DATE July 29, 2004		CHECKED BY	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE	W _p	W	W _L		
183.44	GROUND SURFACE					20	40	60	80	100	10	20	30	
0.00	TOPSOIL, silty													
183.07	Brown													
0.37	(FILL), clayey silt, trace sand, trace topsoil													
0.61	Brown		1	SS	10									
	SILTY CLAY, some sand, trace gravel (TILL)		2	SS	26									
	Firm to very stiff, Mottled brown and grey becoming brown at 1.5m depth and grey at 2.5m depth		3	SS	15									
			4	SS	8									
			5	SS	9									
			6	SS	7									

PROJECT 041-130054-0-1		RECORD OF BOREHOLE No C-5		1 OF 1	METRIC
G.W.P. 62-00-00		LOCATION N 4677745.5 ; E 279647.1		ORIGINATED BY MA	
DIST 1 HWY 401		BOREHOLE TYPE POWER AUGER (HOLLOW STEM)		COMPILED BY BG	
DATUM GEODETIC		DATE July 30, 2004		CHECKED BY	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20 40 60 80 100		20 40 60 80 100		10 20 30					

185.62	GROUND SURFACE															
0.09	TOPSOIL, sandy, trace gravel, Brown															
0.30	(FILL), gravel, with topsoil, some sand, Brown															
184.40	(FILL), clayey silt, trace sand, some topsoil, Stiff,		1	SS	10											
1.22	Mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff, Mottled brown and grey becoming brown at elev. 183.5m and grey at elev. 181.2m		2	SS	10											
			3	SS	16											
			4	SS	30											
			5	SS	24											
			6	SS	11											
			7	SS	13											
			8	SS	14											
			9	SS	10											
			10	SS	8											
176.78	END OF BOREHOLE															
8.84	Borehole dry during drilling July 30, 2004															

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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

RECORD OF BOREHOLE No C-6

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

LOCATION N 4677752.3 ; E 279645.8

ORIGINATED BY MA

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (HOLLOW STEM)

COMPILED BY BG

DATUM GEODETTIC

DATE July 30, 2004

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED	+ FIELD VANE	×					
								● QUICK TRIAXIAL	×	LAB VANE					
185.19	GROUND SURFACE						20	40	60	80	100				
0.00	TOPSOIL, clayey Brown					185									
0.18	(FILL), silty clay, trace sand, trace gravel, trace topsoil Stiff, Brown		1	SS	10										
184.00						184									
1.19	SILTY CLAY, some sand, trace gravel (TILL) Stiff, to very stiff, Brown becoming grey at elev. 181.5m		2	SS	14										
						183									
			3	SS	24										
						182									
			4	SS	19										
					181										
		5	SS	11											
					180										
					179										
		6	SS	15											
					178										
					177										
176.96			8	SS	8										
8.23	END OF BOREHOLE Borehole dry during drilling July 30, 2004														

N_MTO 04-1130 054.GPJ ON_MOT.GDT 1/12/05

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

RECORD OF BOREHOLE No C-7

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

LOCATION N 4677778.4 ;E 278992.6

ORIGINATED BY MA

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (UNCASED)

COMPILED BY BG

DATUM GEODETIC

DATE August 4, 2004


CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100		
185.70	GROUND SURFACE												
0.00	TOPSOIL, clayey												
0.15	Brown												
	SILTY CLAY, some sand, trace gravel (TILL)												
	Stiff to hard,												
	Brown becoming grey at elev. 182.6m												
			1	SS	10	185							
			2	SS	18	184							
			3	SS	21	183							
			4	SS	28	182							
			5	SS	34	181							
			6	SS	19	180							
			7	SS	17	179							
			8	SS	10	178							
177.47	END OF BOREHOLE												
8.23	Borehole dry during drilling Aug. 4, 2004												

+ 3, X 3: Numbers refer to Sensitivity

O 3% STRAIN AT FAILURE

PROJECT 041-130054-0-1		RECORD OF BOREHOLE No C-8		1 OF 1	METRIC
G.W.P. 62-00-00		LOCATION N 4677790.3 : E 278981.3		ORIGINATED BY MA	
DIST 1 HWY 401		BOREHOLE TYPE POWER AUGER (UNCASED)		COMPILED BY BG	
DATUM GEODETIC		DATE August 4, 2004		CHECKED BY	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
184.63	GROUND SURFACE						20	40	60	80	100	10	20	30		
0.09	TOPSOIL, clayey Brown SILTY CLAY, some sand, trace gravel (TILL) Hard to stiff, Brown becoming grey at elev. 181.7m		1	SS	30											
			2	SS	30											
			3	SS	31											
			4	SS	26											
			5	SS	19											
			6	SS	16											
			7	SS	14											
			8	SS	15											
177.31	END OF BOREHOLE															
7.32	Borehole dry during drilling Aug. 4, 2004															

PROJECT <u>041-130054-0-1</u>		RECORD OF BOREHOLE No C-10		1 OF 1	METRIC
G.W.P. <u>62-00-00</u>		LOCATION <u>N 4677806.8 :E 278276.9</u>		ORIGINATED BY <u>MA</u>	
DIST <u>1</u> HWY <u>401</u>		BOREHOLE TYPE <u>POWER AUGER (UNCASED)</u>		COMPILED BY <u>BG</u>	
DATUM <u>GEODETIC</u>		DATE <u>August 4, 2004</u>		CHECKED BY _____	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL				x LAB VANE	
186.93	GROUND SURFACE						20	40	60	80	100	10	20	30			
0.09	TOPSOIL, sandy, Brown																
0.27	(FILL), sand and gravel, some silt, trace topsoil																
186.17	Brown																
0.76	(FILL), silty clay, trace sand, trace gravel, trace topsoil, Brown		1	SS	11												
0.91	TOPSOIL, clayey, trace sand, Stiff, Brown		2	SS	12												
	SILTY CLAY, some sand, trace gravel (TILL), Stiff to hard, Mottled brown and grey becoming brown at Elev. 184.8m and grey at 182.9m		3	SS	31												
			4	SS	32												
			5	SS	21												
			6	SS	18												
			7	SS	15												
			8	SS	9												
			9	SS	16												
178.09	END OF BOREHOLE																
8.84	Borehole dry during drilling Aug. 4, 2004																

IN_MTO 04-1130 054.GPJ ON MOT.GDT 1/12/05

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

PROJECT 041-130054-0-1			RECORD OF BOREHOLE No C-11			1 OF 1			METRIC								
G.W.P. 62-00-00			LOCATION N 4677877.1 :E 276907.5			ORIGINATED BY MA											
DIST 1 HWY 401			BOREHOLE TYPE POWER AUGER (UNCASED)			COMPILED BY BG											
DATUM GEODETIC			DATE August 5, 2004			CHECKED BY											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
187.03	GROUND SURFACE																
0.00	TOPSOIL, clayey, Brown																
0.15	(FILL), silty clay, trace sand, trace gravel, Brown																
0.30	SILTY CLAY, trace sand, trace gravel, (TILL), with sandy silt layers, Very stiff, Mottled brown and grey		1	SS	20												
185.66	SANDY SILT, some clay, trace gravel, (TILL), Dense, Brown		2	SS	32												
1.37	SILTY CLAY, some sand, trace gravel (TILL) Stiff to hard, Brown becoming grey at elev. 183.4m		3	SS	41												
185.17			4	SS	32												
1.86			5	SS	15												
			6	SS	11												
			7	SS	11												
			8	SS	11												
178.80	END OF BOREHOLE																
8.23	Borehole dry during drilling Aug 5, 2004																

RECORD OF BOREHOLE No C-12

1 OF 1

METRIC

PROJECT 041-130054-0-1 LOCATION N 4677866.5 :E 276907.0 ORIGINATED BY MA
G.W.P. 62-00-00 BOREHOLE TYPE POWER AUGER (UNCASED) COMPILED BY BG
DIST 1 HWY 401 DATE August 5, 2004 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT			LIQUID LIMIT UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								20 40 60 80 100		W _P	W	W _L		
								20 40 60 80 100						
187.75	GROUND SURFACE													
0.00	TOPSOIL, sandy, Brown													
0.21	(FILL), sand and gravel, some silt, Brown													
0.43	(FILL), silty clay, trace sand, some topsoil, Brown		1	SS	13		187							
0.61	(FILL), silty sand and gravel, Brown													
186.38	SANDY SILT, trace to some clay, Compact, Grey becoming brown at elev. 186.8m		2	SS	18		186							
1.37	SANDY SILT, trace gravel, trace to some clay, (TILL), Compact, Mottled brown and grey		3	SS	38		185							
185.62	SILTY CLAY, some sand, trace gravel (TILL) Stiff to hard, Brown becoming grey at elev. 183.3m		4	SS	35		184							
2.13			5	SS	25		183							
			6	SS	15		182							
							181							
			7	SS	10		180							
			8	SS	14		179							
			9	SS	17									
178.91	END OF BOREHOLE													
8.84	Borehole dry during drilling Aug. 5, 2004													

IN_MTO 04-1130 054.GPJ ON MOT.GDT 1/12/05

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

RECORD OF BOREHOLE No C-13

1 OF 1

METRIC

PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4677902.5 :E 276058.9
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (HOLLOW STEM)
DATE GEODETIC DATE August 5, 2004
ORIGINATED BY MA
COMPILED BY BG
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
187.63	GROUND SURFACE													
0.00	(TOPSOIL), some sand, some gravel, Brown													
0.21	(FILL), silty clay, trace sand, trace gravel, Firm, Mottled brown and grey		1	SS	8		187				○			
186.44	(FILL), fine to coarse sand, some gravel, trace silt, Loose, Brown		2	SS	6		186				○			
1.19														
185.19			3	SS	8		185				○			
2.44	SILTY CLAY, some sand, trace gravel (TILL) Firm to hard, Brown becoming grey at 184.0m		4	SS	32		184				○			
			5	SS	27									
			6	SS	16		183				○			3 21 42 36
							182							
			7	SS	9		181				○			
			8	SS	11		180				○			
							179							
			9	SS	6		178				○			
177.88	END OF BOREHOLE													
9.75	Groundwater encountered in borehole at elev. 186.26m during drilling Aug 5, 2004													

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

RECORD OF BOREHOLE No C-14

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

DIST 1 HWY 401

DATUM GEODETIC

LOCATION N 4677915.7 E 276071.8

BOREHOLE TYPE POWER AUGER (HOLLOW STEM)

DATE August 5, 2004

ORIGINATED BY MA

COMPILED BY BG

CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
185.69	GROUND SURFACE												
0.00	TOPSOIL, clayey												
0.23	Brown SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff, Brown becoming grey at elev. 183.6m		1	SS	19								
			2	SS	29								
			3	SS	20								
			4	SS	12								
			5	SS	14								
			6	SS	10								
			7	SS	8								
			8	SS	9								
177.61	END OF BOREHOLE												
8.08	Borehole dry during drilling Aug. 5, 2004												

RECORD OF BOREHOLE No C-15

1 OF 1

METRIC

PROJECT 041-130054-0-1

ORIGINATED BY MA

G.W.P. 62-00-00

LOCATION N 4677937.7 :E 275503.6

COMPILED BY BG

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (UNCASED)

CHECKED BY

DATUM GEODETIC

DATE August 6, 2004

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _p W W _L	WATER CONTENT (%) 10 20 30			
186.77	GROUND SURFACE												
0.00 186.50 0.27	TOPSOIL, clayey, Brown (FILL), silty clay, some sand, trace topsoil, Stiff, Mottled brown and grey		1	SS	9		186						1 18 47 34
185.40 1.37	SILTY CLAY, some sand, trace gravel (TILL) Stiff to hard, Mottled brown and grey becoming brown at elev. 185.1m and grey at 183.1m		2	SS	9		185						18 50 32
			3	SS	34		184						
			4	SS	28		183						
			5	SS	14		182						
			6	SS	10		181						
			7	SS	10		180						
			8	SS	9		179						
178.69 8.08	END OF BOREHOLE Borehole dry during drilling Aug. 6, 2004												

+ 3, X 3: Numbers refer to Sensitivity

O 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No C-16

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

DIST 1 HWY 401

DATUM GEODETIC

LOCATION N 4677928.2 E 275502.2

BOREHOLE TYPE POWER AUGER (UNCASED)

DATE August 6, 2004

ORIGINATED BY MA

COMPILED BY BG

CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
187.42	GROUND SURFACE												
0.00	TOPSOIL, sandy												
0.25	Brown (FILL), sand and gravel, some topsoil												
	Brown SILTY CLAY, some sand, trace gravel (TILL)		1	SS	11								
	Stiff to hard, Mottled brown and grey becoming brown at elev. 185.1m and grey at 183.0m		2	SS	11								
			3	SS	32								
			4	SS	32								
			5	SS	26								
			6	SS	18								
			7	SS	12								
			8	SS	8								
			9	SS	16								
178.58	END OF BOREHOLE												
8.84	Borehole dry during drilling Aug. 6, 2004												

RECORD OF BOREHOLE No C-17

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

DIST 1 HWY 401

DATUM GEODETIC

LOCATION N 4677996.9 :E 274196.5

BOREHOLE TYPE POWER AUGER (UNCASED)

DATE August 6, 2004

ORIGINATED BY MA

COMPILED BY BG

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL						x LAB VANE		
185.17	GROUND SURFACE						20	40	60	80	100	10	20	30						
0.09	TOPSOIL, clayey Brown SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff, Brown becoming grey at elev. 182.6m		1	SS	24								○			1 20 46 33				
			2	SS	28								○							
			3	SS	20								○							
			4	SS	11								○							
			5	SS	10								○							
			6	SS	10								○							
178.46	END OF BOREHOLE		7	SS	8								○							
6.71	Borehole dry during drilling Aug. 6, 2004																			

IN_MTO_04-1130_054.GPJ ON MOT.GDT 1/12/05

RECORD OF BOREHOLE No C-18

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

DIST 1 HWY 401

DATUM GEODETIC

LOCATION N 4677983.6 E 274196.5

BOREHOLE TYPE POWER AUGER (UNCASED)

DATE August 9, 2004

ORIGINATED BY MA

COMPILED BY BG

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE	W _p	W	W _L		
							20 40 60 80 100							
186.85	GROUND SURFACE													
0.18	TOPSOIL, clayey Brown (FILL), sand and gravel, some silt, with topsoil Brown (FILL), silty clay, trace sand, trace topsoil, with fine to medium sand seams, Soft to firm, Mottled brown & grey becoming grey at elev. 185.5m		1	SS	7									
			2	SS	3									
184.72			3	SS	13									
2.13	SILTY CLAY, trace sand, trace gravel (TILL) Stiff to hard, Mottled brown and grey becoming brown at elev. 184m and grey at 182.9m		4	SS	35									
			5	SS	28									
			6	SS	15									
			7	SS	10									
			8	SS	9									
			9	SS	16									
178.01	END OF BOREHOLE													
8.84	Borehole dry during drilling Aug. 9, 2004													

ON_MTO 04-1130 054.GPJ ON_MOT.GDT 1/12/05

RECORD OF BOREHOLE No C-19

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

DIST 1 HWY 401

DATUM GEODETIC

LOCATION N 4678016.8 ; E 273502.8

BOREHOLE TYPE POWER AUGER (HOLLOW STEM)

DATE August 9, 2004

ORIGINATED BY MA

COMPILED BY BG

CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
							20 40 60 80 100						
							○ UNCONFINED + FIELD VANE						
							● QUICK TRIAXIAL × LAB VANE						
							20 40 60 80 100		10 20 30				
186.02	GROUND SURFACE												
0.00	TOPSOIL, clayey, some gravel, trace sand, Brown												
0.18	(FILL), silty clay, trace sand, trace gravel, Stiff, Mottled brown and grey		1	SS	8								
184.65													
1.37	SILTY CLAY, some sand, trace gravel (TILL), Firm to very stiff, Mottled brown and grey becoming brown at 183.1m and grey at 180.5m		2	SS	13								
			3	SS	24								
			4	SS	21								
			5	SS	23								
			6	SS	14								
			7	SS	8								
			8	SS	7								
			9	SS	7								
176.27	END OF BOREHOLE												
9.75	Borehole dry during drilling Aug. 9, 2004												

+ 3, X 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No C-20

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

LOCATION N 4678023.7 ; E 273509.1

ORIGINATED BY MA

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (UNCASED)

COMPILED BY BG

DATUM GEODETIC

DATE August 9, 2004

CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100					
184.34	GROUND SURFACE												
0.00	TOPSOIL, clayey												
0.15	Brown												
	SILTY CLAY, some sand, trace gravel (TILL)												
	Stiff to hard, Brown becoming grey at elev. 181.4m												
			1	SS	30								
			2	SS	29								
			3	SS	23								
			4	SS	13								
			5	SS	10								
			6	SS	8								
			7	SS	9								
			8	SS	8								
176.11	END OF BOREHOLE												
8.23	Borehole dry during drilling Aug. 9, 2004												

+³, ×³: Numbers refer to Sensitivity

○³% STRAIN AT FAILURE

RECORD OF BOREHOLE No C-21

1 OF 1

METRIC

PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4678030.9 :E 273135.3
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (UNCASED)
DATUM GEODETIC DATE August 10, 2004
ORIGINATED BY MA
COMPILED BY BG
CHECKED BY

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
186.27	GROUND SURFACE						20	40	60	80	100									
0.00	(FILL), sand and gravel, crushed, some silt, Brown																			
185.60																				
0.67	(FILL), silty clay, trace sand, trace gravel, trace topsoil, Soft to firm, Mottled brown & grey		1	SS	6															
			2	SS	3															
184.14																				
2.13	SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff, Brown becoming grey at elev. 183.3m		3	SS	26															
			4	SS	29															
			5	SS	19															
			6	SS	13															
			7	SS	12															
			8	SS	13															
			9	SS	18															
177.43	END OF BOREHOLE																			
8.84	Borehole dry during drilling Aug. 10, 2004																			

IN_MTO 04-1130 054.GPJ ON MOT.GDT 1/12/05

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

RECORD OF BOREHOLE No C-22

1 OF 1

METRIC

PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4678035.7 :E 273135.8
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (UNCASED)
DATUM GEODETIC DATE August 10, 2004
ORIGINATED BY MA
COMPILED BY BG
CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20					
185.56	GROUND SURFACE												
0.00 0.12	TOPSOIL, clayey, Brown (FILL), silty clay, trace sand, trace gravel, trace topsoil, Stiff, Mottled brown		1	SS	8								
184.40 1.16	SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff, Brown becoming grey at elev. 183.3m		2	SS	24								
			3	SS	30								
			4	SS	20								
			5	SS	11								
			6	SS	10								
			7	SS	10								
			8	SS	8								
177.48 8.08	END OF BOREHOLE Borehole dry during drilling Aug. 10, 2004												

RECORD OF BOREHOLE No C-23

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

LOCATION N 4677990.7 ; E 273123.2

ORIGINATED BY MA

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (UNCASED)

COMPILED BY BG

DATUM GEODETIC

DATE August 10, 2004

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED		+ FIELD VANE							● QUICK TRIAXIAL	
185.72	GROUND SURFACE						20	40	60	80	100	10	20	30				
0.00	TOPSOIL, sandy																	
0.15	Brown																	
185.02	(FILL), silty sand, some clay, with topsoil, Brown																	
0.70	SILTY CLAY, some sand, trace gravel (TILL) Stiff to hard Mottled brown & grey becoming brown at elev. 184.4m and grey at 182.4m		1	SS	12								○					
			2	SS	22								○					
			3	SS	32								○					
			4	SS	28								○					
			5	SS	10								○					
			6	SS	11								○					
			7	SS	8								○					
			8	SS	8								○					
177.49	END OF BOREHOLE																	
8.23	Borehole dry during drilling Aug. 10, 2004																	

RECORD OF BOREHOLE No C-24

1 OF 1

METRIC

PROJECT 041-130054-0-1 LOCATION N 4677981.6 :E 273122.9 ORIGINATED BY MA
G.W.P. 62-00-00 BOREHOLE TYPE POWER AUGER (UNCASED) COMPILED BY BG
DIST 1 HWY 401 DATE August 10, 2004 CHECKED BY _____
DATUM GEODETIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)			
							20 40 60 80 100						
							20 40 60 80 100						
184.96	GROUND SURFACE												
0.00	TOPSOIL, clayey, Brown												
0.18	SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff, Mottled brown and grey becoming brown at elev. 183.6m and grey at elev. 182.1m		1	SS	8	184							
			2	SS	27	183							
			3	SS	28	182							
			4	SS	13	181							
			5	SS	10	180							
			6	SS	9	179							
			7	SS	9	178							
			8	SS	14								
177.64	END OF BOREHOLE												
7.32	Borehole dry during drilling Aug. 10, 2004												

N_MTO 04-1130 054.GPJ ON_MOT.GDT 1/12/05

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

RECORD OF BOREHOLE No C-25

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

DIST 1 HWY 401

DATUM GEODETIC

LOCATION N 4677965.0 E 273501.8

BOREHOLE TYPE POWER AUGER (UNCASED)

DATE August 10, 2004

ORIGINATED BY MA

COMPILED BY BG

CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100					
184.36	GROUND SURFACE												
0.00	TOPSOIL, clayey, Brown												
0.23	(FILL), silty clay, trace sand, trace gravel, Brown												
183.75													
0.61	SILTY CLAY, some sand, trace gravel (TILL) Firm to hard, Mottled brown and grey becoming brown at elev. 183.0m and grey at 182.0m		1	SS	24								
			2	SS	30								
			3	SS	15								
			4	SS	9								
			5	SS	8								
			6	SS	8								
			7	SS	8								
			8	SS	5								
176.28	END OF BOREHOLE												
8.08	Borehole dry during drilling Aug. 10, 2004												

RECORD OF BOREHOLE No C-26

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

LOCATION N 4677968.7 ; E 273501.8

ORIGINATED BY MA

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (UNCASED)

COMPILED BY BG

DATUM GEODETIC

DATE August 11, 2004

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
184.72	GROUND SURFACE							20 40 60 80 100	10 20 30						
0.00	TOPSOIL, clayey, Brown														
184.35	(FILL), silty clay, trace sand, trace topsoil, Brown														
0.37															
0.61	SILTY CLAY, some sand, trace gravel (TILL) Firm to very stiff, Mottled brown & grey becoming brown at elev. 182.6m and grey at 181.0m		1	SS	9		184								
			2	SS	22		183								
			3	SS	24		182								
			4	SS	11		181								
			5	SS	10		180								
			6	SS	6		179								
			7	SS	6		178								
			8	SS	7		177								
176.49	END OF BOREHOLE														
8.23	Borehole dry during drilling Aug. 11, 2004														

N_MTO_04-1130_054.GPJ ON_MOT.GDT 1/12/05

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

PROJECT 041-130054-0-1		RECORD OF BOREHOLE No C-27		1 OF 1	METRIC
G.W.P. 62-00-00		LOCATION N 4677946.3 E 274195.7		ORIGINATED BY MA	
DIST 1 HWY 401		BOREHOLE TYPE POWER AUGER (UNCASED)		COMPILED BY BG	
DATUM GEODETIC		DATE August 11, 2004		CHECKED BY	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)			
								<div><div></div><div>20406080100</div></div>								<div><div></div><div>102030</div></div>			
187.25	GROUND SURFACE																		
0.00	(FILL), sand and gravel, crushed, trace to some silt, Brown						187												
186.76							186												
0.49	(FILL), silty clay, trace sand, trace gravel, trace topsoil, Firm to stiff, Grey		1	SS	9														
			2	SS	5														
185.12							185												
2.13	SILTY CLAY, some sand, trace gravel (TILL) Stiff to hard, Mottled brown and grey becoming brown at elev. 184.1m and grey at elev. 182.9m		3	SS	10														
			4	SS	26		184												
			5	SS	32														
			6	SS	17		183												
							182												
			7	SS	15		181												
							180												
			8	SS	12														
			9	SS	16		179												
178.41																			
8.84	END OF BOREHOLE Borehole dry during drilling Aug. 11, 2004																		

PROJECT 041-130054-0-1		RECORD OF BOREHOLE No C-28		1 OF 1	METRIC
G.W.P. 62-00-00		LOCATION N 4677938.3 ; E 274194.6		ORIGINATED BY MA	
DIST 1 HWY 401		BOREHOLE TYPE POWER AUGER (UNCASED)		COMPILED BY BG	
DATUM GEODETIC		DATE August 11, 2004		CHECKED BY	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT LIMIT CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
185.48	GROUND SURFACE													
0.00	TOPSOIL, clayey, Brown													
0.12	SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff, Mottled brown and grey becoming brown at elev. 184.1m and grey at 182.6m		1	SS	8									
			2	SS	24									
			3	SS	29									
			4	SS	18									
			5	SS	9									
			6	SS	10									
			7	SS	9									
			8	SS	15									
178.16	END OF BOREHOLE													
7.32	Borehole dry during drilling Aug. 11, 2004													

PROJECT 041-130054-0-1		RECORD OF BOREHOLE No C-29		1 OF 1	METRIC
G.W.P. 62-00-00		LOCATION N 4677881.9 :E 275487.8		ORIGINATED BY MA	
DIST 1 HWY 401		BOREHOLE TYPE POWER AUGER (UNCASED)		COMPILED BY BG	
DATUM GEODETIC		DATE August 12, 2004		CHECKED BY	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p	W	W _L		
185.97	GROUND SURFACE						20	40	60	80	100	10	20	30			
0.08	TOPSOIL, clayey, Brown SILTY CLAY, some sand, trace gravel (TILL) Firm to hard, Brown becoming grey at elev. 2.3m depth		1	SS	16												
			2	SS	31												
			3	SS	15												
			4	SS	8												
			5	SS	7												
			6	SS	7												
			7	SS	6												
			8	SS	13												
178.65	END OF BOREHOLE																
7.32	Borehole dry during drilling Aug. 12, 2004																

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

RECORD OF BOREHOLE No C-30

1 OF 1 METRIC

PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4677892.4 :E 275488.8
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (UNCASED)
DATUM GEODETIC DATE August 12, 2004
ORIGINATED BY MA
COMPILED BY BG
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
187.88	GROUND SURFACE						20	40	60	80	100	10	20	30		
0.00	(FILL), sand and gravel, crushed, some silt, Brown															
187.36																
0.52	(FILL), fine to coarse sand, trace gravel, trace silt, Loose, Brown		1	SS	7											
186.97																
0.91	(FILL), silty clay, trace sand, trace gravel, Firm, Mottled brown and grey		2	SS	5											
186.20																
1.68	(FILL), fine to medium sand, some gravel, trace silt, Loose, Brown		3	SS	9											
1.83																
185.75	(FILL), silty clay, trace sand, trace gravel, Firm, Mottled brown and grey		4	SS	13											
2.13	SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff, Mottled brown and grey becoming brown at 3.7m depth and grey at 4.9m depth		5	SS	29											
			6	SS	22											
			7	SS	10											
			8	SS	8											
			9	SS	15											
179.04	END OF BOREHOLE															
8.84	Borehole dry during drilling Aug. 12, 2004															

IN_MTO 04-1130 054.GPJ ON MOT.GDT 1/12/05

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

RECORD OF BOREHOLE No C-31

1 OF 1

METRIC

PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4677815.6 :E 276903.8
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (UNCASED)
DATUM GEODETIC DATE August 12, 2004

ORIGINATED BY MA
COMPILED BY BG
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
187.03	GROUND SURFACE																
0.00	TOPSOIL, clayey, Brown																
0.15	SILTY CLAY, some sand, trace gravel (TILL) Firm to very stiff, Mottled brown & grey becoming brown at 2.3m and grey at 3.7m depth		1	SS	11		186										
			2	SS	18		185										
			3	SS	30		184										
			4	SS	22		183										
			5	SS	14		182										
			6	SS	10		181										
			7	SS	10		180										
			8	SS	7		179										
178.80	END OF BOREHOLE																
8.23	Borehole dry during drilling Aug. 12, 2004																

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

RECORD OF BOREHOLE No C-32

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

LOCATION N 4677829.1 :E 276901.5

ORIGINATED BY MA

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (UNCASED)

COMPILED BY BG

DATUM GEODETIC

DATE August 13, 2004

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE								● QUICK TRIAXIAL		× LAB VANE
187.63	GROUND SURFACE						20	40	60	80	100									
0.00	TOPSOIL, clayey																			
0.15	Brown (FILL), silty clay, trace sand, trace gravel, trace topsoil, Firm, Mottled brown and grey		1	SS	6															
			2	SS	5															
185.50																				
2.13	SILTY CLAY, some sand, trace gravel (TILL) Stiff to very stiff, Brown becoming grey at 4.2m depth		3	SS	24															
			4	SS	27															
			5	SS	19															
			6	SS	9															
			7	SS	9															
			8	SS	9															
			9	SS	17															
178.79																				
8.84	END OF BOREHOLE																			
	Borehole dry during drilling Aug. 13, 2004																			

N. MTO 04-1130 054.GPJ ON_MOT.GDT 1/12/05

+³, ×³

Numbers refer to Sensitivity

○³%

STRAIN AT FAILURE

RECORD OF BOREHOLE No C-33

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

LOCATION N 4677770.1 ; E 278273.7

ORIGINATED BY MA

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (UNCASED)

COMPILED BY BG

DATUM GEODETIC

DATE August 13, 2004

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
							WATER CONTENT (%)										
186.97	GROUND SURFACE						20	40	60	80	100	10	20	30			
0.08 186.80	TOPSOIL, sandy Brown																
0.37	(FILL), sand and gravel, with topsoil, Brown																
	(FILL), silty clay, trace sand, trace gravel, trace topsoil, Firm,		1	SS	4												
185.60	Mottled brown and grey																
1.37	SILTY CLAY, some sand, trace gravel (TILL), with fine to medium sand seam at elev. 179.2m depth Firm to very stiff, Mottled brown and grey becoming brown at elev. 184.7m and grey at 182.6m		2	SS	7												
			3	SS	16												
			4	SS	28												
			5	SS	28												
			6	SS	11												
			7	SS	9												
			8	SS	7												
			9	SS	16												
178.13 8.84	END OF BOREHOLE Borehole dry during drilling Aug. 13, 2004																

17

44

39

IN_MTO 04-1130 054 GPJ ON MOT/GDT 1/12/05

+³, ×³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No C-34

1 OF 1

METRIC

PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4677760.3 :E 278274.5
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (UNCASED)
DATUM GEODETIC DATE August 13, 2004
ORIGINATED BY MA
COMPILED BY BG
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE							
186.48	GROUND SURFACE						20	40	60	80	100	10	20	30				
0.00	TOPSOIL, clayey																	
0.15	Brown SILTY CLAY, some sand, trace gravel (TILL) Firm to hard, Mottled brown & grey becoming brown at elev. 184.4m and grey at 183.2m		1	SS	11													
			2	SS	8													
			3	SS	31													
			4	SS	24													
			5	SS	14													
			6	SS	10													
			7	SS	8													
			8	SS	6													
178.25	END OF BOREHOLE																	
8.23	Borehole dry during drilling Aug. 13, 2004																	

N MTO 04-1130 054.GPJ ON_MOT.GDT 1/12/05

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

RECORD OF BOREHOLE No C-35

1 OF 1

METRIC

PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4677729.3 ; E 278988.9
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (UNCASED)
DATUM GEODETIC DATE August 13, 2004 - August 16, 2004
ORIGINATED BY MA
COMPILED BY BG
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT LIMIT CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				w _p w w _L				
184.85 0.00	GROUND SURFACE SILTY CLAY, some sand, trace gravel (TILL) Stiff to hard, Brown becoming grey at elev. 181.8m						20	40	60	80	100	10	20	30		
			1	SS	22		184									
			2	SS	23		183									
			3	SS	31		182									
			4	SS	14		181									
			5	SS	13		180									
			6	SS	8		179									
			7	SS	16		178									
			8	SS	12											
177.53 7.32	END OF BOREHOLE Borehole dry during drilling Aug. 13 & 16, 2004															

N MTO 04-1130 054.GPJ ON_MOT.GDT 1/12/05

+³, X³: Numbers refer to Sensitivity O³% STRAIN AT FAILURE

PROJECT 041-130054-0-1		RECORD OF BOREHOLE No C-36		1 OF 1	METRIC
G.W.P. 62-00-00	LOCATION N 4677737.1 ; E 278989.1	ORIGINATED BY MA			
DIST 1 HWY 401	BOREHOLE TYPE POWER AUGER (UNCASED)	COMPILED BY BG			
DATUM GEODETIC	DATE August 16, 2004	CHECKED BY			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED								+ FIELD VANE		● QUICK TRIAXIAL

185.74	GROUND SURFACE													
0.09	TOPSOIL, clayey Brown (FILL), silty clay, trace sand, trace gravel, trace topsoil, Very stiff,													
184.83	Mottled brown and grey		1	SS	20									
0.91	SILTY CLAY, some sand, trace gravel (TILL), Very stiff to hard, Mottled brown & grey becoming brown at elev. 185.3m		2	SS	35									
183.76														
1.98	SILTY CLAY, some sand, trace gravel (TILL), Stiff to hard, Brown becoming grey at elev. 182.0m		3	SS	45									
			4	SS	35									
			5	SS	17									
			6	SS	19									
			7	SS	10									
			8	SS	10									
177.51	END OF BOREHOLE													
8.23	Borehole dry during drilling Aug. 16, 2004													

0.09

184.83

0.91

183.76

1.98

177.51

8.23

185

184

183

182

181

180

179

178

20

40

60

80

100

20

40

60

80

100

10

20

30

1

17

46

36

04-1130 054.GPJ ON MOT.GDT 1/12/05

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

RECORD OF BOREHOLE No C-37

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

LOCATION N 4677710.5; E 279649.1

ORIGINATED BY MA

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (UNCASED)

COMPILED BY BG

DATUM GEODETIC

DATE August 16, 2004

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE							
185.64	GROUND SURFACE						20	40	60	80	100							
0.18	TOPSOIL, sandy Brown (FILL), sand and gravel, with topsoil, Brown SILTY CLAY, trace sand, trace gravel, (TILL) Very stiff, Mottled brown and grey		1	SS	17													
184.27	SILTY CLAY, some sand, trace gravel (TILL), Stiff to hard, Mottled brown and grey becoming brown at elev. 183.5m and grey at 181.2m		2	SS	16													
1.37			3	SS	37													
			4	SS	30													
			5	SS	23													
			6	SS	11													
180.00																		
5.64	SAND, fine to medium, some silt, trace gravel, Loose, Grey		7	SS														
178.93	SILTY CLAY, trace sand, trace gravel (TILL), Stiff to very stiff, Grey		8	SS	8													
6.71			9	SS	8													
			10	SS	24													
176.80																		
8.84	END OF BOREHOLE																	
	Groundwater encountered in borehole at elev. 180.0m during drilling Aug. 16, 2004																	

N MTO 04-1130 054.GPJ ON MOT.GDT 1/12/05

+ 3, X 3; Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No C-38

1 OF 1

METRIC

PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4677702.2 ; E 279650.0
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (UNCASED)
DATUM GEODETIC DATE August 16, 2004
ORIGINATED BY MA
COMPILED BY BG
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
185.36	GROUND SURFACE													
0.09	TOPSOIL, clayey Brown SILTY CLAY, some sand, trace gravel (TILL) Stiff to hard, Mottled brown & grey becoming brown at elev. 183.9m and grey at 181.7m		1	SS	12		185							
			2	SS	15		184							
			3	SS	33		183							
			4	SS	29		182							
			5	SS	16		181							
			6	SS	11		180							
			7	SS	10		179							
			8	SS	8		178							
177.13	END OF BOREHOLE													
8.23	Borehole dry during drilling Aug. 16, 2004													

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

RECORD OF BOREHOLE No C-39

1 OF 1

METRIC

PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4677654.7 ; E 281048.5
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (UNCASED)
DATUM GEODETIC DATE August 17, 2004
ORIGINATED BY MA
COMPILED BY BG
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
							20 40 60 80 100					10 20 30					
184.73	GROUND SURFACE																
0.00	TOPSOIL, clayey																
184.39	Brown																
0.34	(FILL), silty clay, trace sand, trace																
183.97	gravel, trace topsoil,																
0.76	Brown																
	SILTY CLAY, trace sand, trace		1	SS	9		184										
	gravel (TILL)																
	Stiff to hard,		2	SS	10		183										
	Mottled brown & grey becoming																
	brown at elev. 182.6m and grey at		3	SS	26		182										
	181.0m																
			4	SS	35		181										
			5	SS	13		180										
			6	SS	14		179										
			7	SS	8		178										
177.72																	
7.01	SILTY CLAY, trace sand, trace																
	gravel (TILL), with fine to medium																
	sand layers,																
	Very stiff,																
	Grey																
176.50			8	SS	18		177										
8.23	END OF BOREHOLE																
	Borehole dry during drilling Aug. 17,																
	2004																

N MTO 04-1130 054.GPJ ON MOT GDT 1/12/05

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

RECORD OF BOREHOLE No C-40

1 OF 1

METRIC

PROJECT 041-130054-0-1
G.W.P. 62-00-00 LOCATION N 4677661.3;E 281051.7 ORIGINATED BY MA
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER (UNCASED) COMPILED BY BG
DATUM GEODETIC DATE August 23, 2004 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)	
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL							× LAB VANE
185.36	GROUND SURFACE					20	40	60	80	100	10	20	30				
0.00	(FILL), sand and gravel, crushed, some silt, Brown																
184.87																	
0.49	(FILL), silty clay, trace sand, trace gravel, trace topsoil, Firm, Mottled brown and grey		1	SS	6												
			2	SS	8												
183.23																	
2.13	SILTY CLAY, some sand, trace gravel (TILL), Firm to very stiff, Mottled brown & grey becoming brown at elev. 182.5m and grey at 181.0m		3	SS	7												
			4	SS	23												
			5	SS	26												
			6	SS	10												
			7	SS	8												
177.74																	
7.62	SILTY CLAY, trace sand, trace gravel (TILL), with sand and silt seams, Firm, Grey		8	SS	7												
177.13																	
8.23	SILT, trace sand, trace to some clay, with sandy silt and silty clay layers Compact, Grey		9	SS	20												
176.52																	
8.84	END OF BOREHOLE																
	Borehole dry during drilling Aug. 23, 2004																

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

RECORD OF BOREHOLE No C-41

1 OF 1

METRIC

PROJECT 041-130054-0-1

G.W.P. 62-00-00

LOCATION N 4677626.0;E 282377.3

ORIGINATED BY MA

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER (UNCASED)

COMPILED BY BG

DATUM GEODETIC

DATE August 23, 2004

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE	×							
								● QUICK TRIAXIAL	×	LAB VANE							
							20	40	60	80	100	WATER CONTENT (%)			10	20	30
185.21	GROUND SURFACE																
0.18	TOPSOIL, sandy Brown (FILL), sand with gravel, crushed, some silt, Brown (FILL), silty clay, trace sand, trace gravel, Firm, Brown		1	SS	8		185										
183.84			2	SS	16		184										
1.37	SILTY CLAY, some sand, trace gravel (TILL), Stiff to hard, Mottled brown & grey becoming brown at elev. 183.1m and grey at 181.9m		3	SS	25		183										
			4	SS	19		182										
			5	SS	19		181										
			6	SS	11		180										
			7	SS	9		179										
			8	SS	12		178										
			9	SS	38		177										
176.37	END OF BOREHOLE																
8.84	Borehole dry during drilling Aug. 23, 2004																

IN_MTO 04-1130 054.GPJ ON MOT.GDT 1/12/05

+ 3, x 3: Numbers refer to Sensitivity

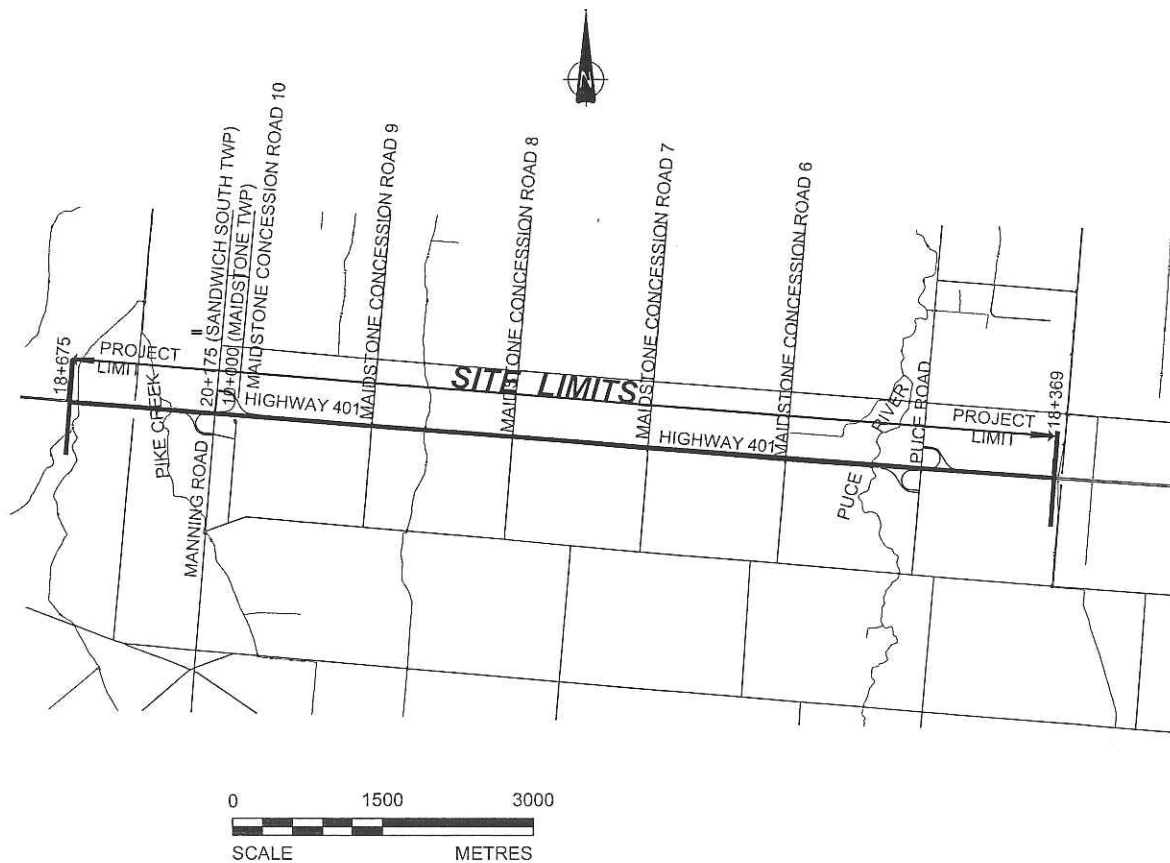
○ 3% STRAIN AT FAILURE


PROJECT <u>041-130054-0-1</u>		RECORD OF BOREHOLE No C-42		1 OF 1	METRIC
G.W.P. <u>62-00-00</u>	LOCATION <u>N 4677620.7 :E 282384.2</u>	ORIGINATED BY <u>MA</u>			
DIST <u>1</u> HWY <u>401</u>	BOREHOLE TYPE <u>POWER AUGER (UNCASED)</u>	COMPILED BY <u>BG</u>			
DATUM <u>GEODETIC</u>	DATE <u>August 23, 2004</u>	CHECKED BY _____			

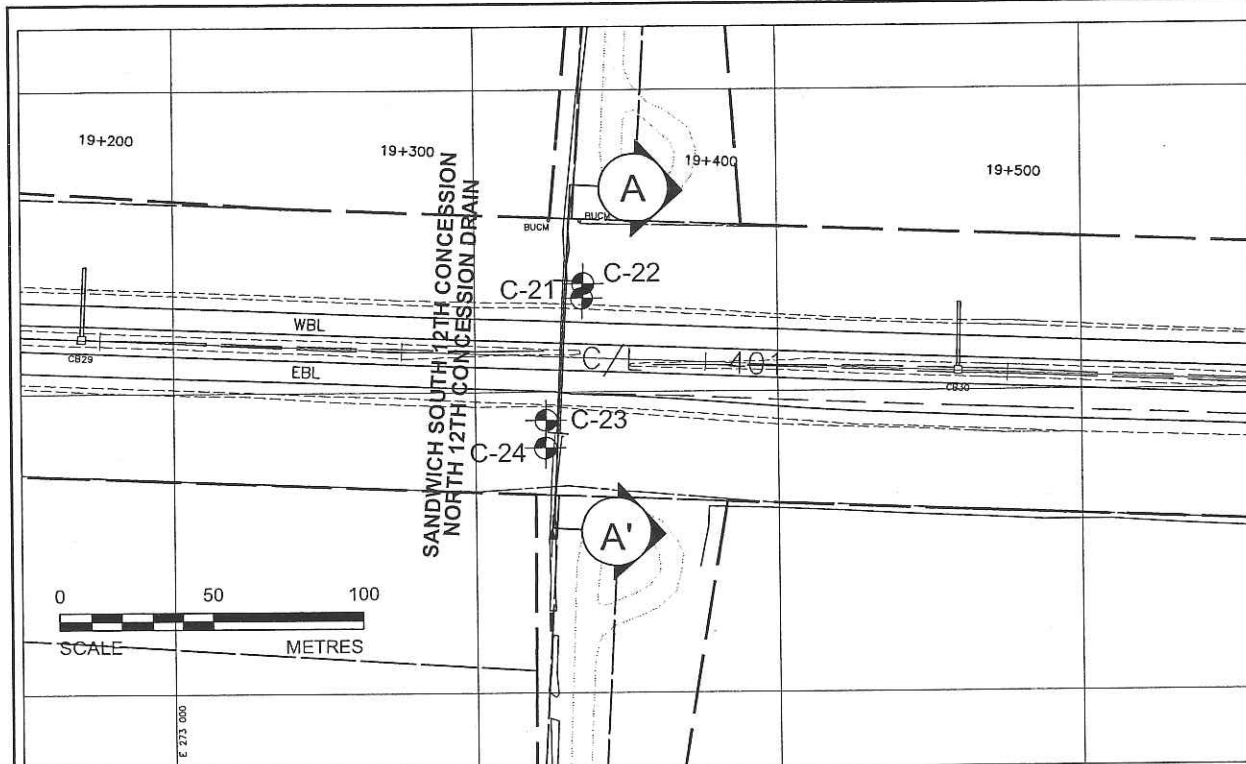
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								<div><div><div></div><div></div><div></div><div></div><div></div></div><div>20406080100</div></div>					<div><div><div></div><div></div><div></div></div><div>w_pww_L</div></div>				
183.65	GROUND SURFACE																
0.00	TOPSOIL, clayey Brown																
0.21	SILTY CLAY, trace sand, trace gravel (TILL) Stiff to very stiff, Mottled brown & grey becoming brown at elev. 182.3m and grey at 181.5m		1	SS	21									○			
			2	SS	16									○			
			3	SS	15									○			
			4	SS	10									○			
			5	SS	10									○			
			6	SS	10									○			
			7	SS	17									○			
176.49	SILTY CLAY, some sand, trace gravel (TILL), with silt, sandy silt and sand layers, Very stiff, Grey		8	SS	18									○			
175.57	END OF BOREHOLE																
8.08	Borehole dry during drilling Aug. 23, 2004																

IN_MTO 04-1130 054.GPJ ON MOT.GDT 1/12/05

+³, x³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



PROJECT		GWP 62-00-00 HIGHWAY 401			
TITLE		KEY PLAN			
 Golder Associates LONDON, ONTARIO		PROJECT No. 041-130054-0-1		FILE No. 041-130054-0-1D001	
		CADD	BG	DEC. 04	SCALE AS SHOWN
		CHECK	MEB	DEC. 04	REV. 0
		FIGURE 1			



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST HWY. 401
CONT. No.
WP No. 62-00-00



HWY. 401 STA. 19+336 SANDWICH S
NORTH 12TH CONCESSION DRAIN CULVERT

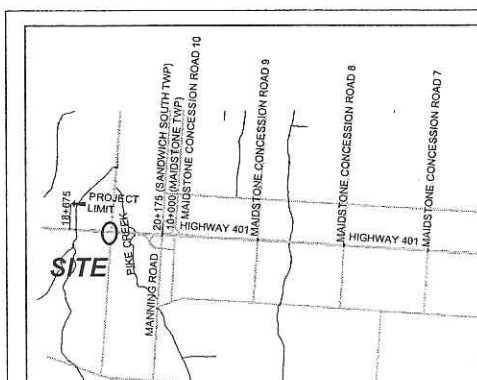
SHEET

BOREHOLE LOCATIONS & STRATA PROFILE



Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



KEY PLAN

LEGEND

- Borehole
- Seal
- Piezometer
- Blows/0.3m (Std. Pen. Test, 475 j/blow)
- WL in piezometer
- WL during drilling
- DRY during drilling

No.	ELEVATION (metres)	CO-ORDINATES	
		NORTH	EAST
C-21	186.27	4678031.0	273135.3
C-22	185.56	4678036.0	273135.8
C-23	185.72	4677990.7	273123.2
C-24	184.96	4677981.6	273122.9

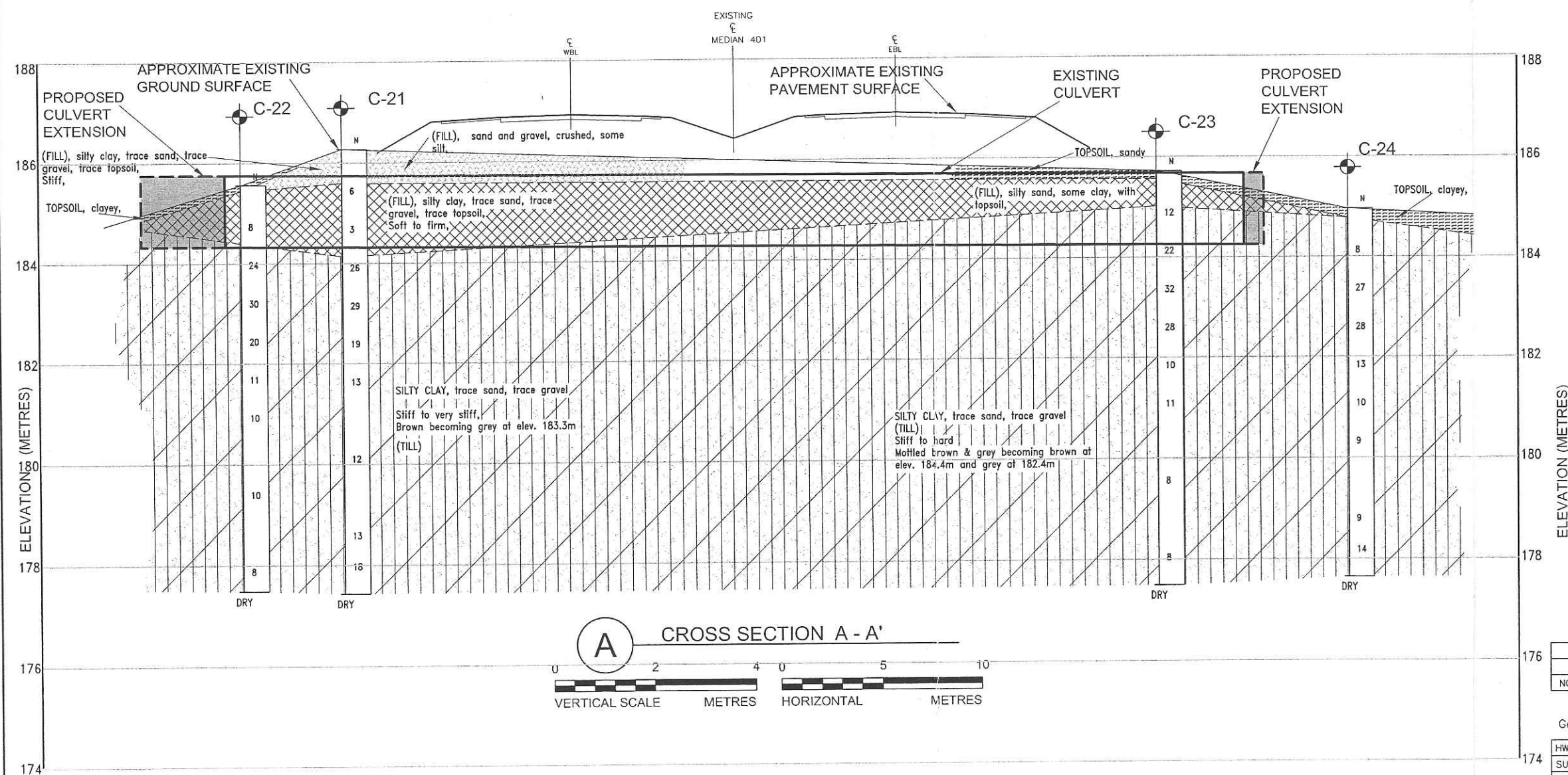
NOTES

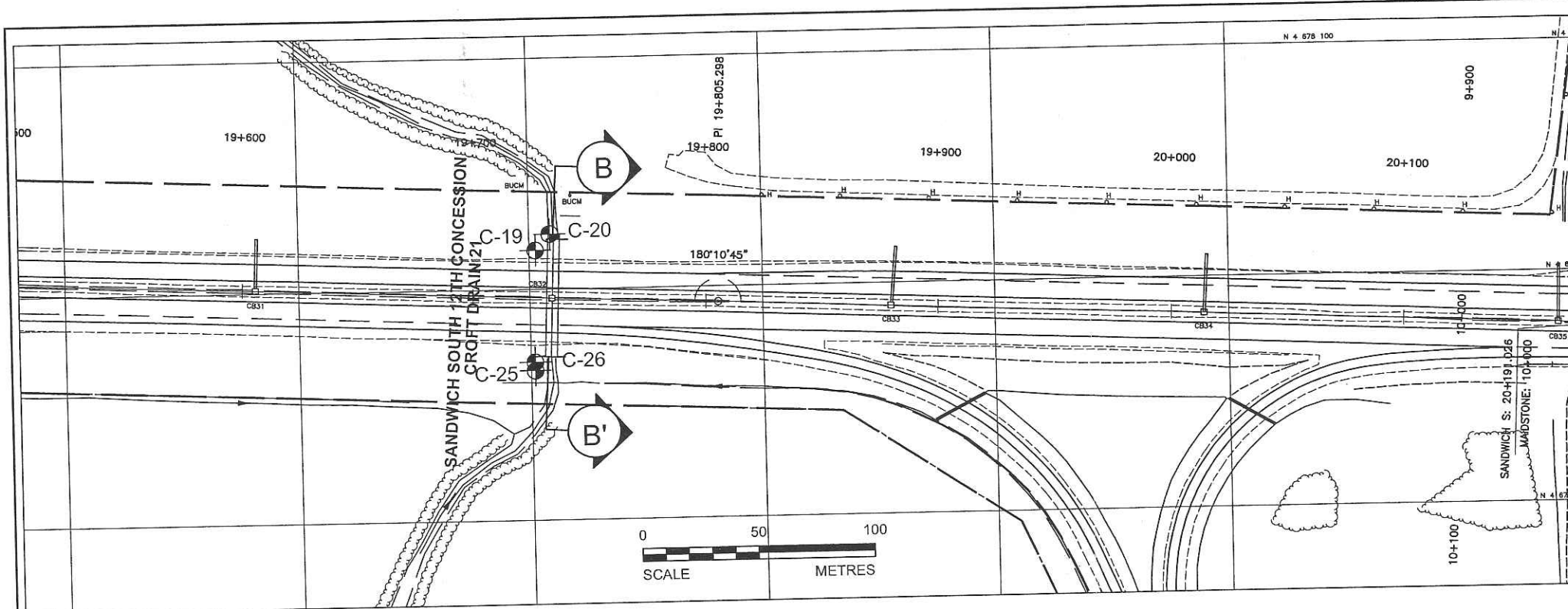
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

NO.	DATE	BY	REVISION

Geocres No. 40J2-63

HWY. No.	401	PROJECT NO.	041-130054-0-1
SUBM'D.	-	CHKD.	-
DRAWN:	BC	CHKD.	DP
DATE:	JAN. 11/05	APPD.	
DWG.	1		





METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST. HWY. 401
CONT. No.
WP No. 62-00-00



HWY. 401 STA. 19+717 SANDWICH S
CROFT DRAIN 21 CULVERT

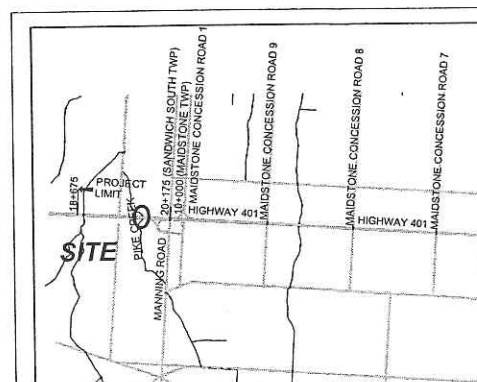
SHEET

BOREHOLE LOCATIONS & STRATA PROFILE

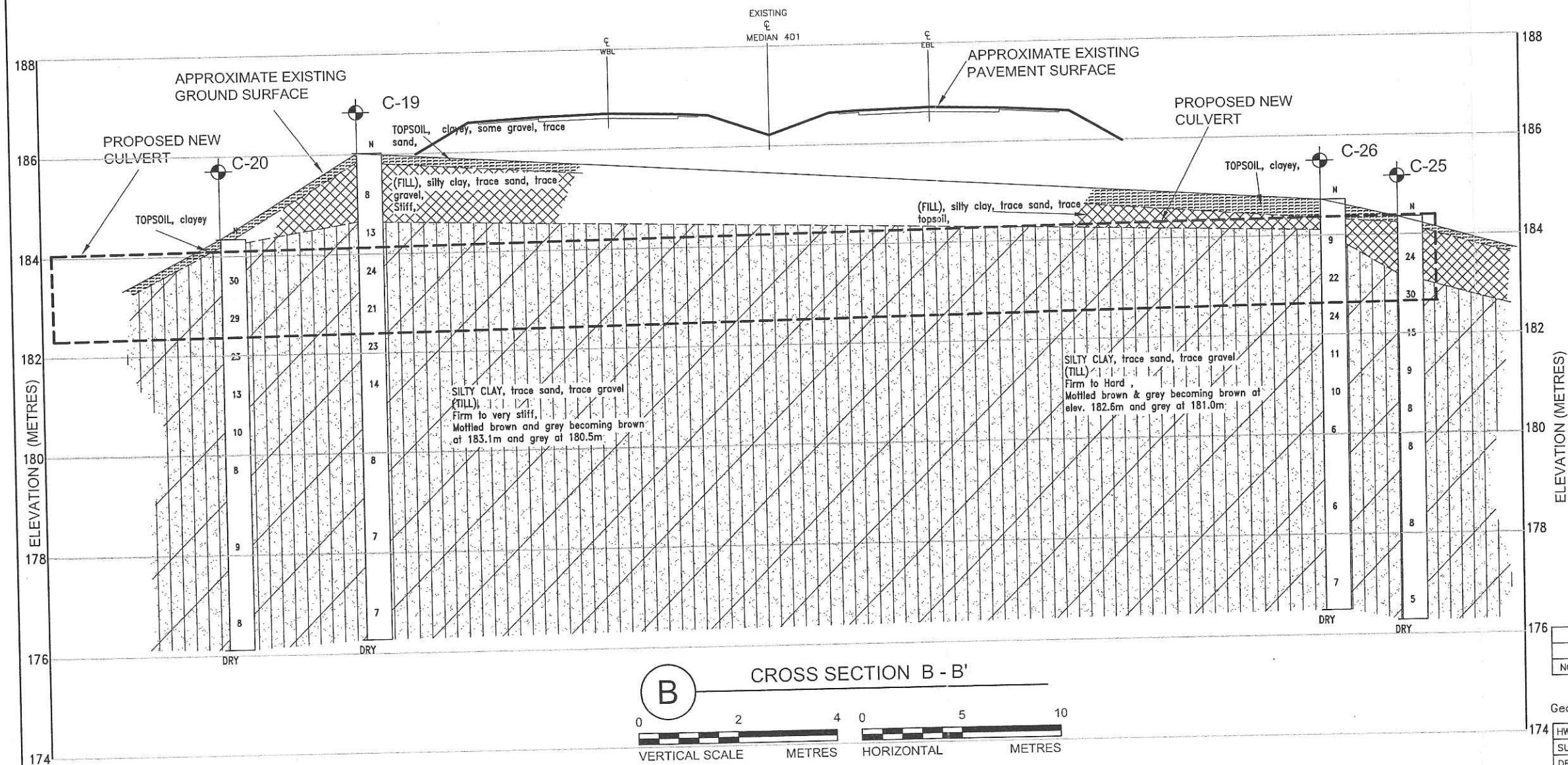


Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



KEY PLAN



LEGEND

- Borehole
- Seal
- Piezometer
- N Blows/0.3m (Std. Pen. Test, 475 j/blow)
- WL in piezometer
- WL during drilling

No.	ELEVATION (metres)	CO-ORDINATES	
		NORTH	EAST
C-19	186.02	4678017.0	273502.8
C-20	184.34	4678023.8	273509.1
C-25	184.36	4677965.0	273501.8
C-26	184.72	4677968.7	273501.8

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

NO.	DATE	BY	REVISION

Geocres No. 40J2-63

HWY. No.	401	PROJECT NO.:	041-130054-0-1
SUBM'D.	-	CHKD.	-
DRAWN:	BG	CHKD.	DP
DATE:	JAN. 11/05	APPD.	-
DWG.	2		

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST HWY. 401
CONT. No.
WP No. 62-00-00



HWY 401 STA. 10+224 MAIDSTONE
10TH CONCESSION DRAIN 14 CULVERT

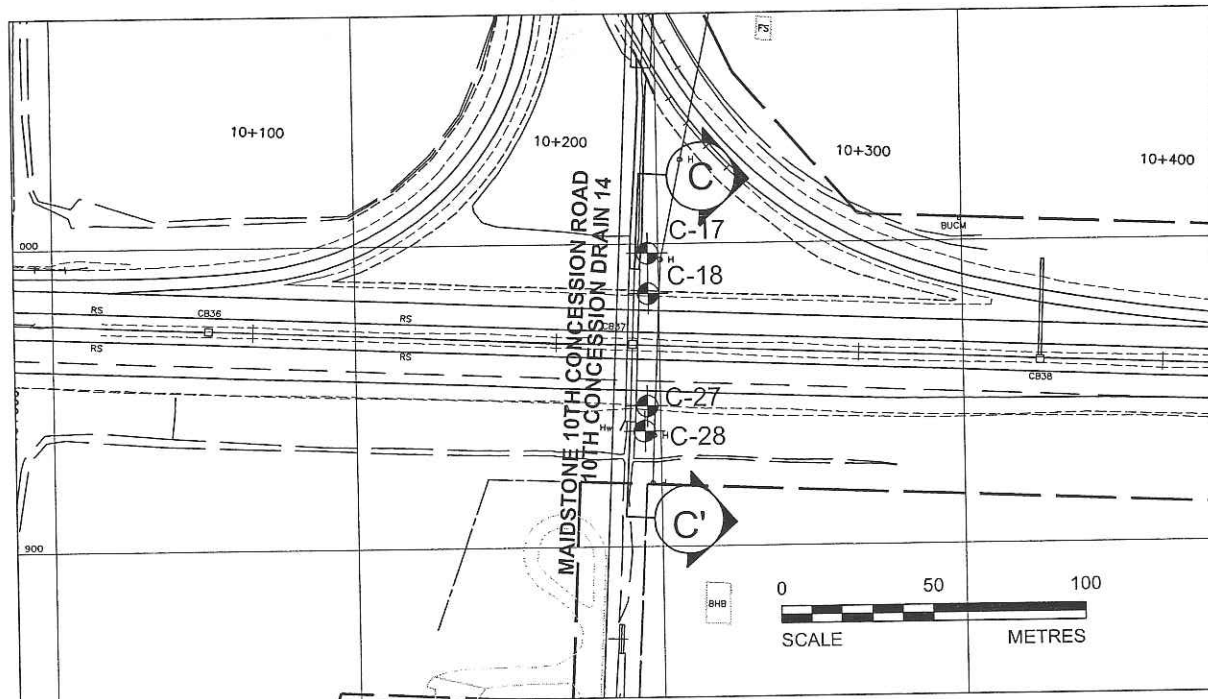
SHEET

BOREHOLE LOCATIONS & STRATA PROFILE

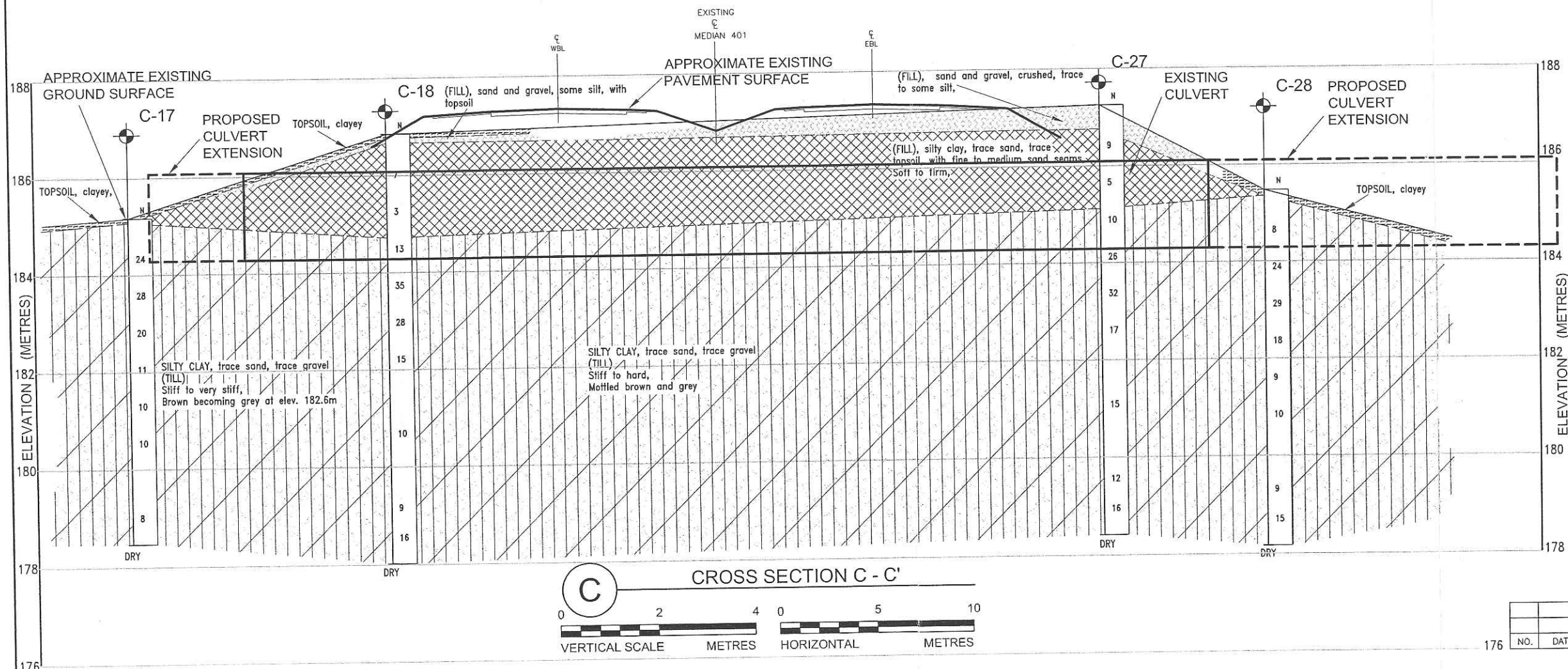


Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



KEY PLAN



LEGEND

- Borehole
- Seal
- Piezometer
- Blows/0.3m (Std. Pen. Test, 475 j/blow)
- WL in piezometer
- WL during drilling
- DRY during drilling

No.	ELEVATION (metres)	CO-ORDINATES	
		NORTH	EAST
C-17	185.17	4677997.0	274196.5
C-18	186.85	4677984.0	274196.5
C-27	187.25	4677947.0	274195.7
C-28	185.48	4677938.0	274194.6

NOTES

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

176

No.	DATE	BY	REVISION

Geocres No. 40J2-63

HWY. No.	401	PROJECT NO.	041-130054-0-1
SUBM'D.	-	CHKD.	-
DRAWN:	BG	CHKD.	DP
DATE:	JAN. 11, 2005	APPD.	-
DWG.	3		

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST HWY. 401
CONT. No.
WP No. 62-00-00



HWY. 401 STA. 11+529 MAIDSTONE
9TH CONCESSION DRAIN CULVERT

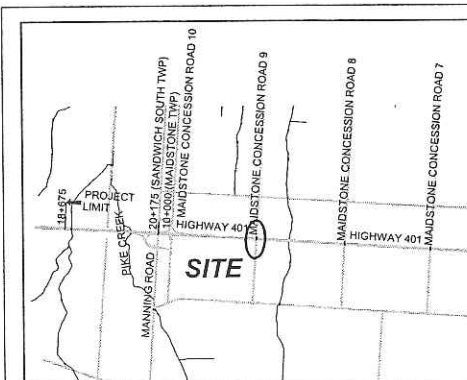
SHEET

BOREHOLE LOCATIONS & STRATA PROFILE



Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



KEY PLAN

LEGEND

- Borehole
- Seal
- Piezometer
- Blows/0.3m (Std. Pen. Test, 475 j/blow)
- WL in piezometer
- WL during drilling
- DRY

No.	ELEVATION (metres)	CO-ORDINATES	
		NORTH	EAST
C-15	186.77	4677938.0	275503.6
C-16	187.42	4677984.0	275502.2
C-29	185.97	4677882.0	275487.8
C-30	187.88	4677892.0	275488.8

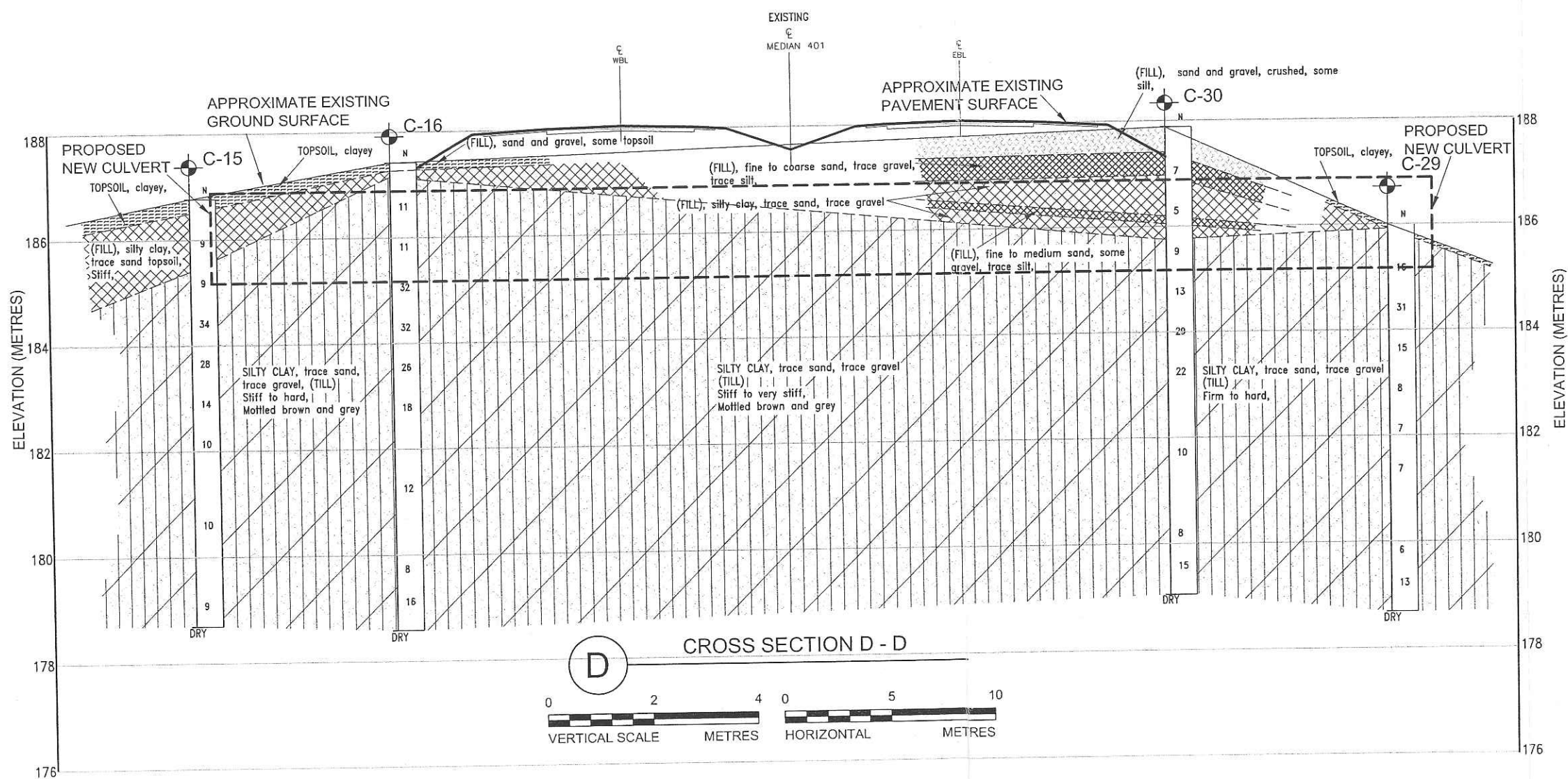
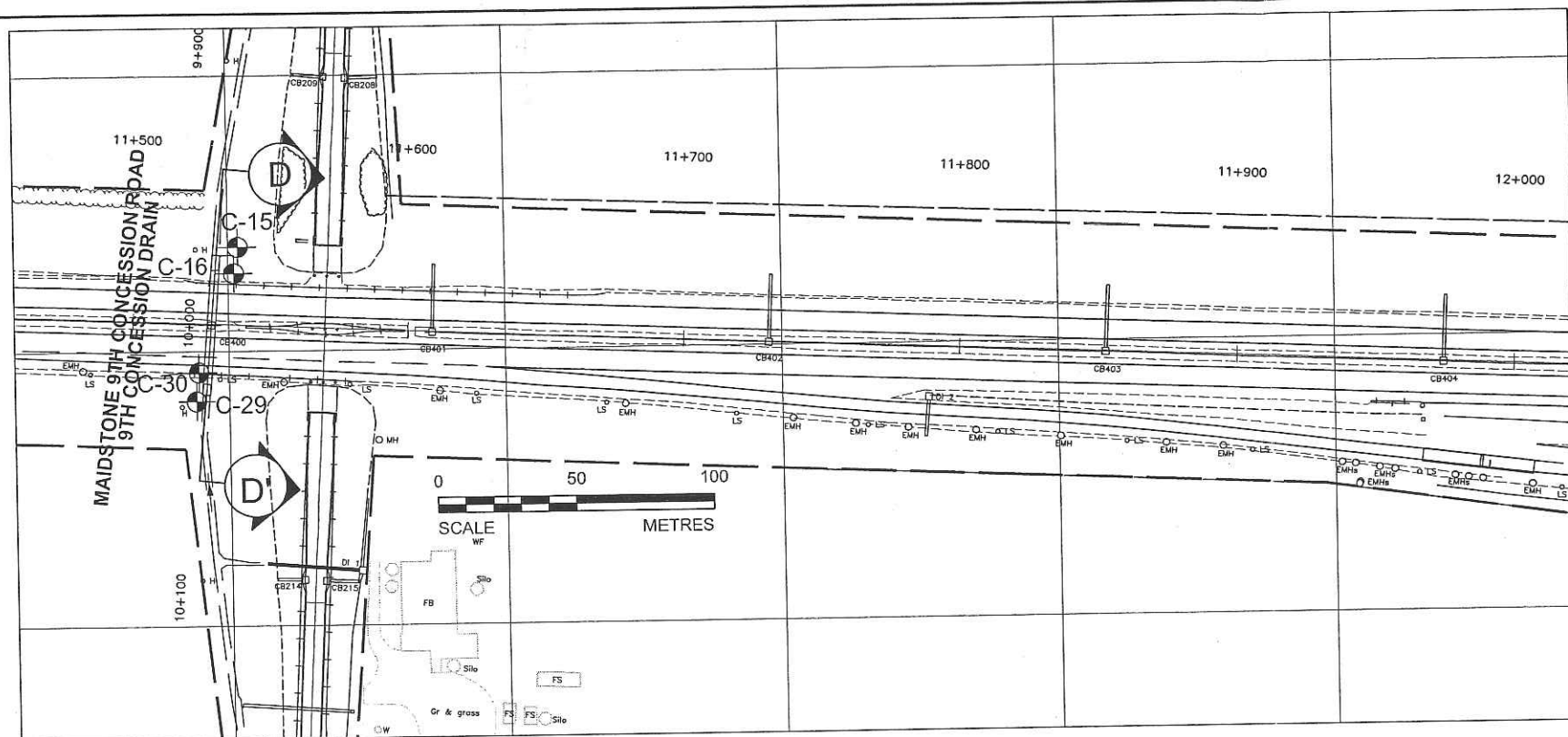
NOTES

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

NO.	DATE	BY	REVISION

Geocres No. 40J2-63

HWY. No.	401	PROJECT NO.	041-130054-0-1
SUBM'D.	-	CHKD.	-
DRAWN:	BG	CHKD.	DP
		DATE:	JAN. 11/05
		APPD.	
		DWG.	4



00132250001.DWG

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST HWY. 401
CONT. No.
WP No. 62-00-00



HWY. 401 STA. 12+098 MAIDSTONE
8TH CONCESSION CENTRE DRAIN CULVERT

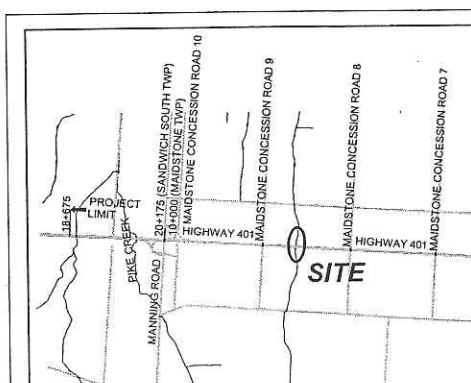
SHEET

BOREHOLE LOCATIONS & STRATA PROFILE



Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



KEY PLAN

LEGEND

- Borehole
- Seal
- Piezometer
- Blows/0.3m (Std. Pen. Test, 475 j/blow)
- WL in piezometer
- WL during drilling
- DRY Dry during drilling

No.	ELEVATION (metres)	CO-ORDINATES	
		NORTH	EAST
C-13	187.63	4677903.0	276058.9
C-14	185.69	4677916.0	276071.8

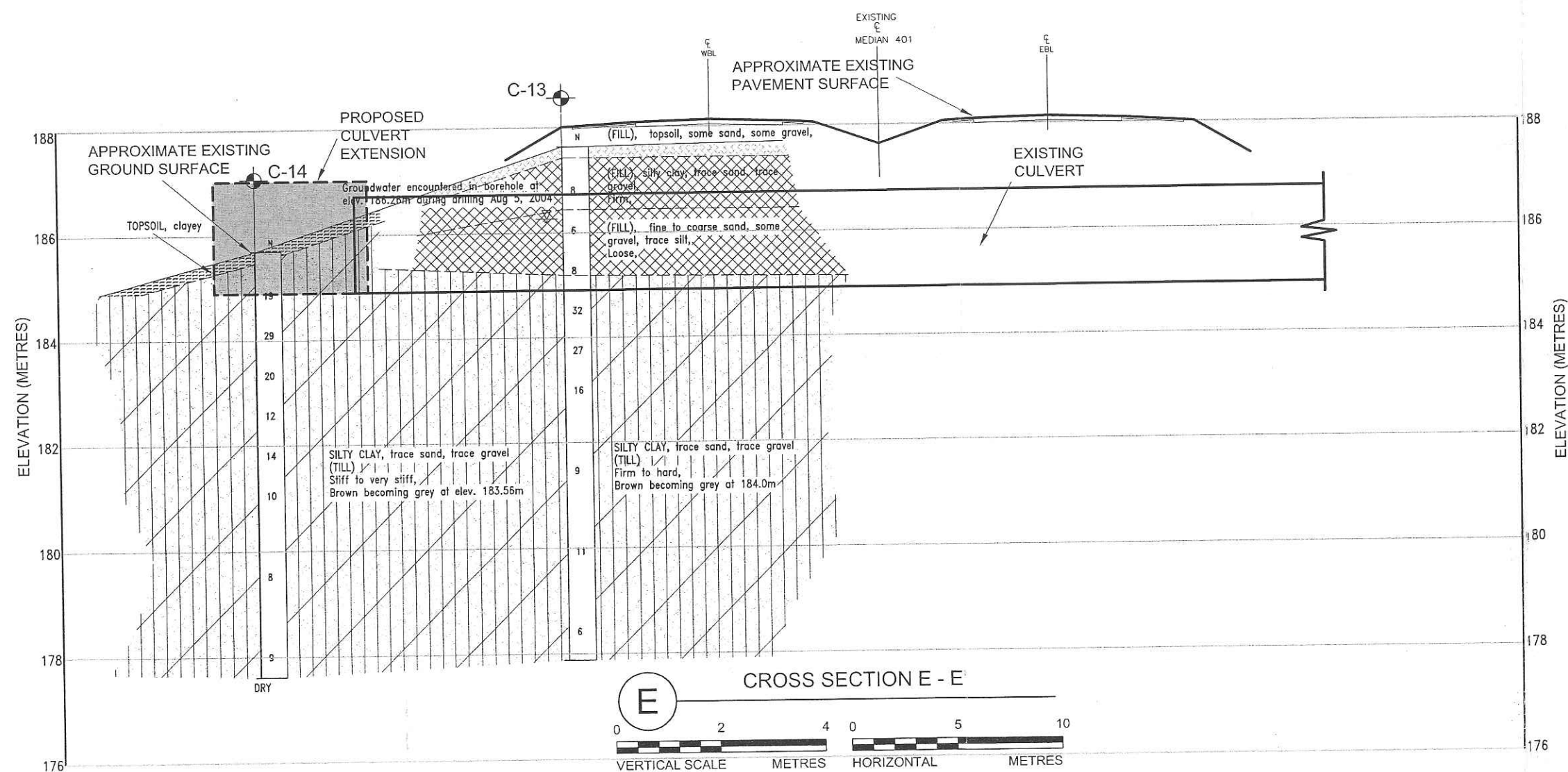
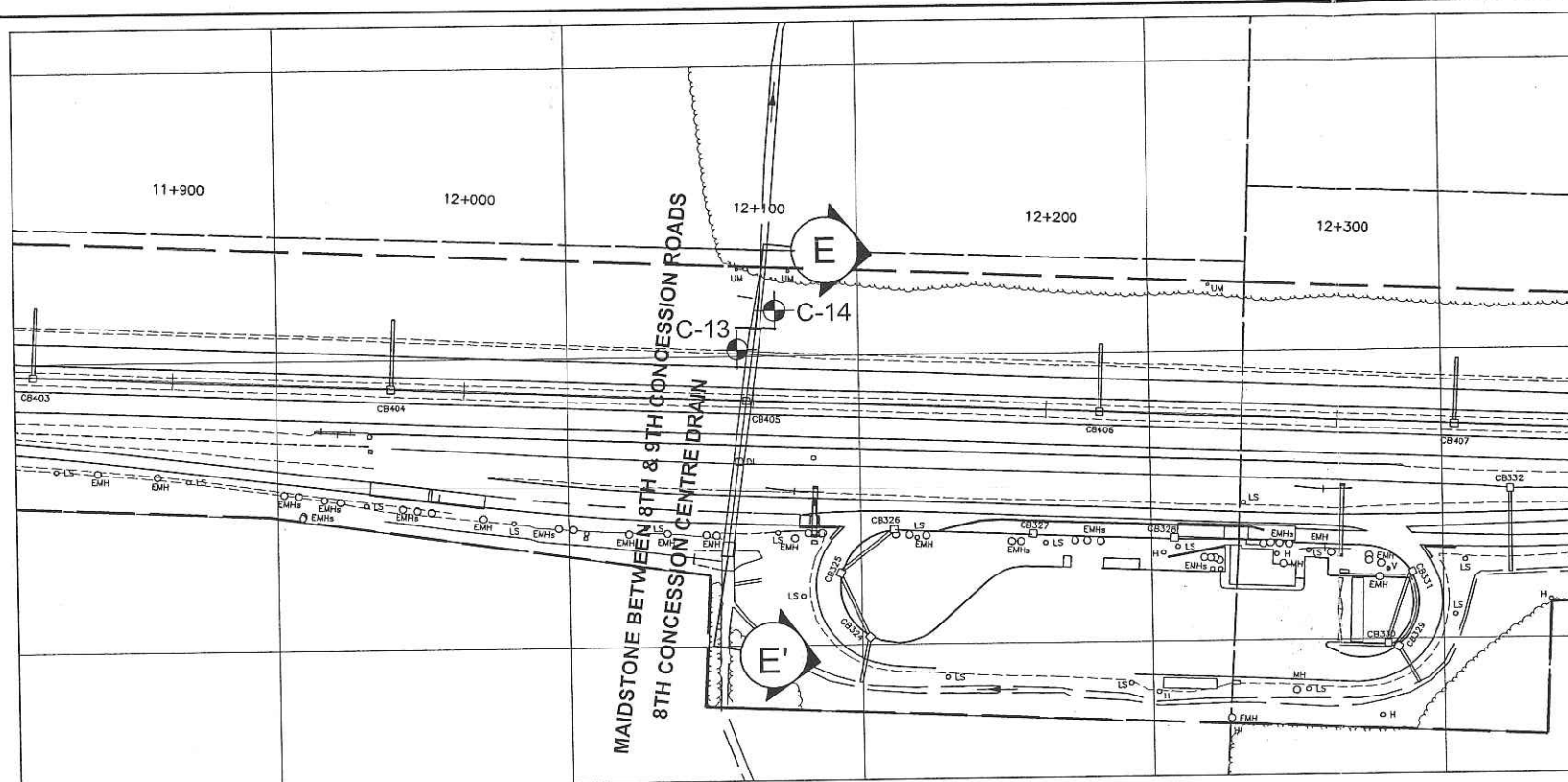
NOTES

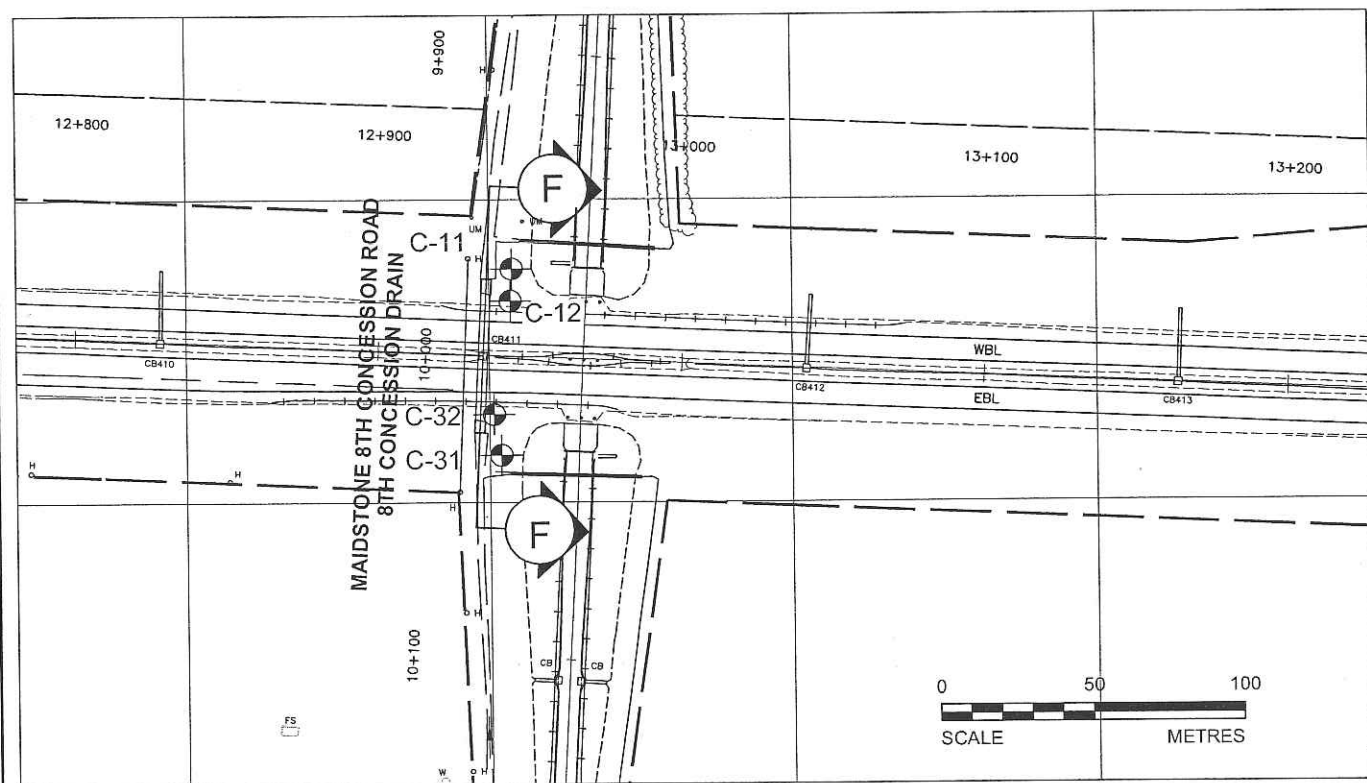
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

NO.	DATE	BY	REVISION

Geocres No. 40J2-63

HWY. No. 401	PROJECT NO.: 041-130054-0-1	DATE: JAN. 11/04	DWG. 5
SUBM'D. -	CHKD. -	APPD. -	
DRAWN: BG	CHKD. DP		





METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST HWY. 401
CONT. No.
WP No. 62-00-00



HWY. 401 STA. 12+935 MAIDSTONE
8TH CONCESSION DRAIN CULVERT

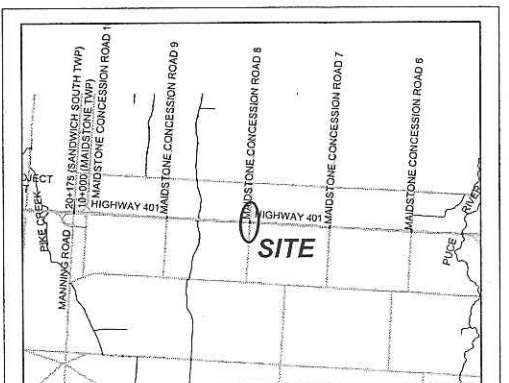
SHEET

BOREHOLE LOCATIONS & STRATA PROFILE

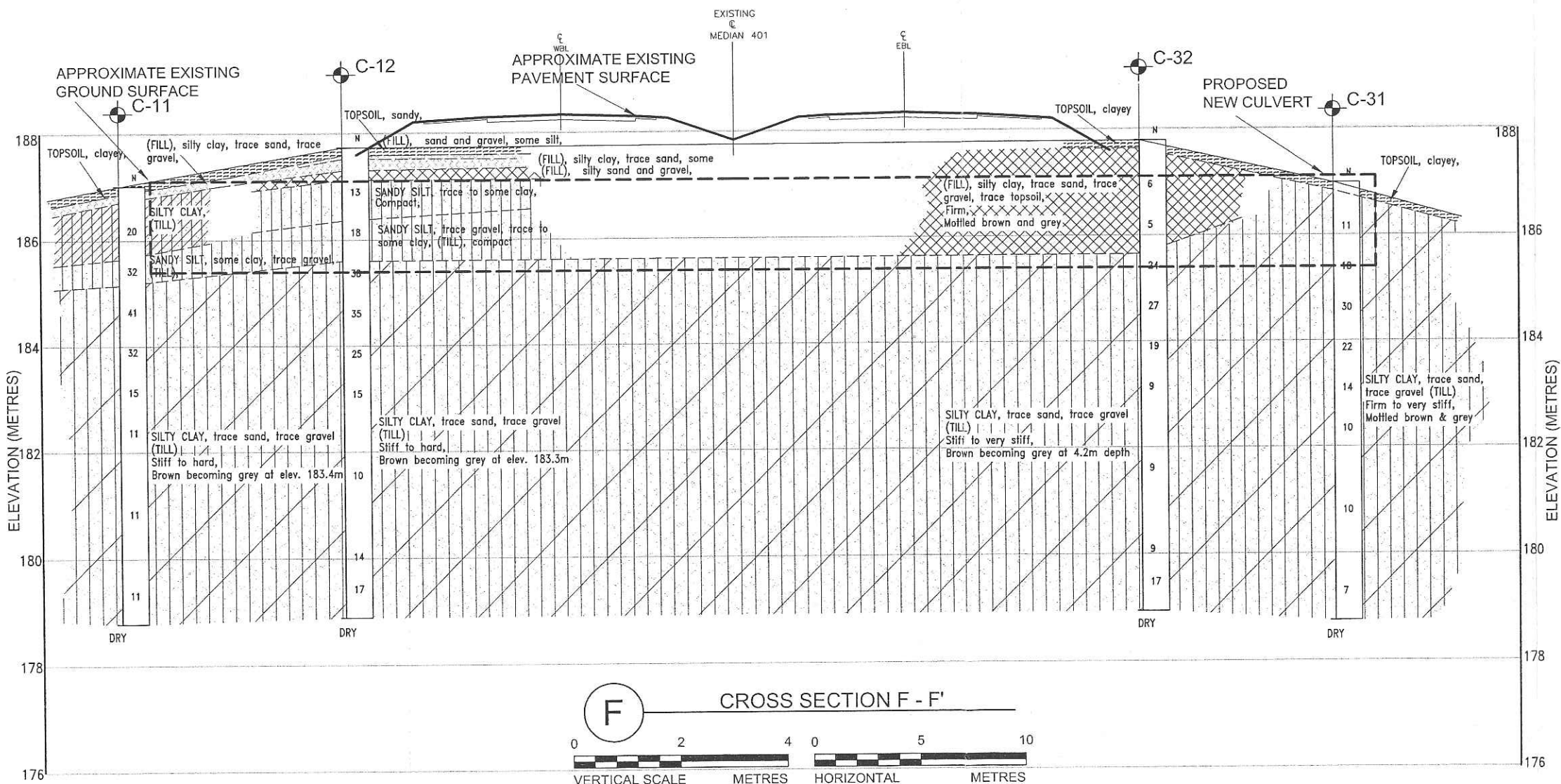


Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



KEY PLAN



LEGEND

- Borehole
- Seal
- Piezometer
- Blows/0.3m (Std. Pen. Test, 475 j/blow)
- WL in piezometer
- WL during drilling
- DRY during drilling

No.	ELEVATION (metres)	CO-ORDINATES	
		NORTH	EAST
C-11	187.03	4677877.0	276907.5
C-12	187.75	4677866.4	276907.0
C-31	187.03	4677815.6	276903.8
C-32	187.63	4677829.1	276901.5

NOTES

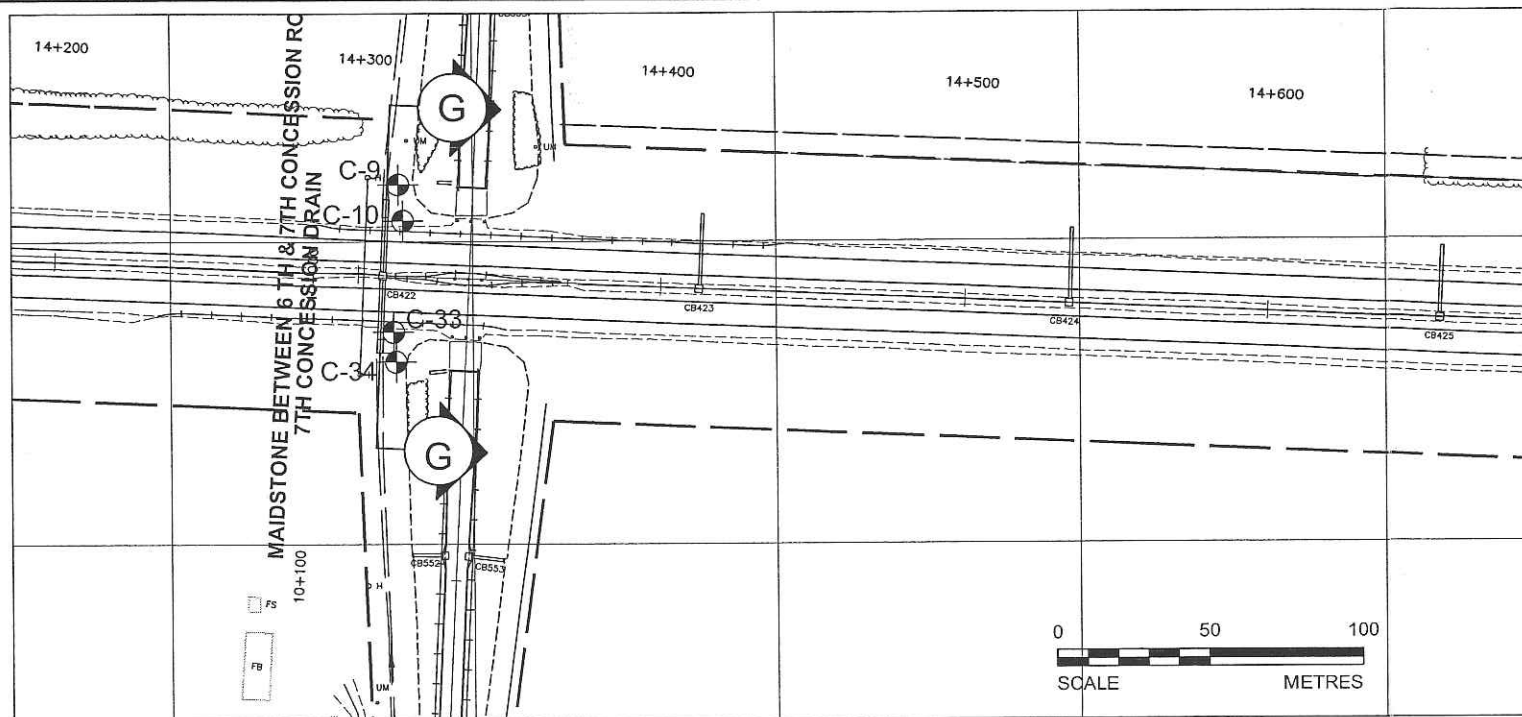
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

NO.	DATE	BY	REVISION

Geocres No. 40J2-63

HWY. No.	401	PROJECT NO.	041-130054-0-1
SUBM'D.	-	CHKD.	-
DRAWN:	BG	CHKD.	DP
		DATE:	JAN. 11/05
		APPD.	
		DWG.	6

0013225D001.DWG



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST HWY. 401
CONT. No.
WP No. 62-00-00



HWY. 401 STA. 14+308 MAIDSTONE
7TH CONCESSION DRAIN CULVERT

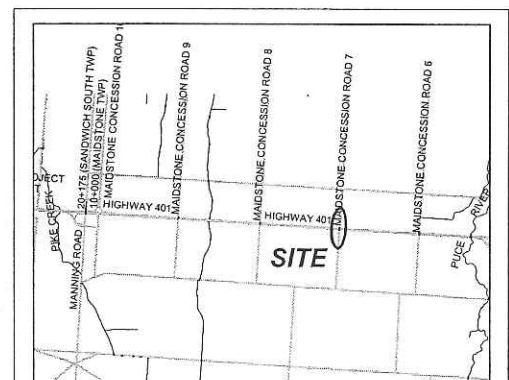
SHEET

BOREHOLE LOCATIONS & STRATA PROFILE

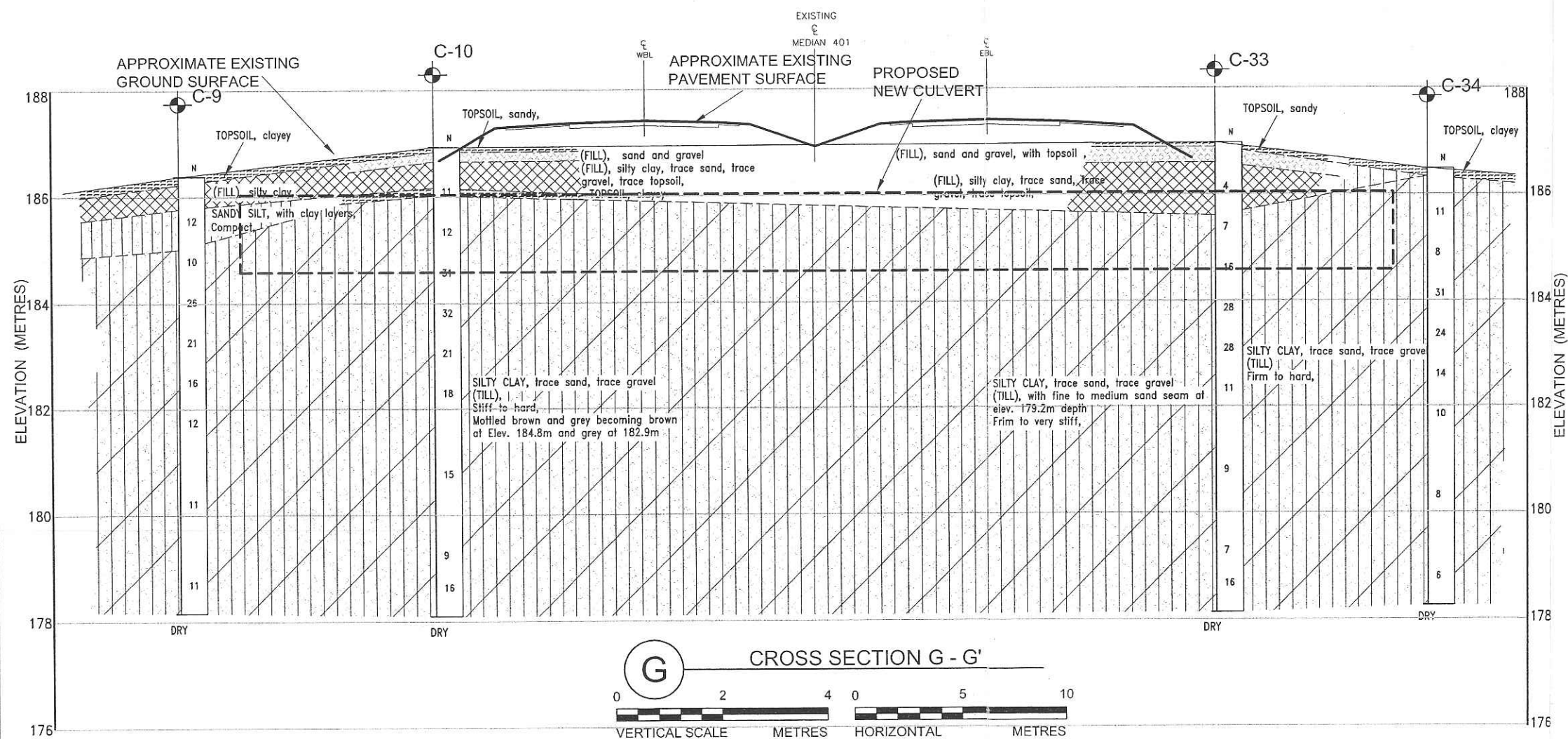


Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



KEY PLAN



LEGEND

- Borehole
- Seal
- Piezometer
- Blows/0.3m (Std. Pen. Test, 475 j/blow)
- WL in piezometer
- WL during drilling
- Dry during drilling

No.	ELEVATION (metres)	CO-ORDINATES	
		NORTH	EAST
C-9	186.38	4677818.8	278275.4
C-10	186.93	4677806.8	278276.9
C-33	186.97	4677770.1	278273.7
C-34	186.48	4677760.3	278274.5

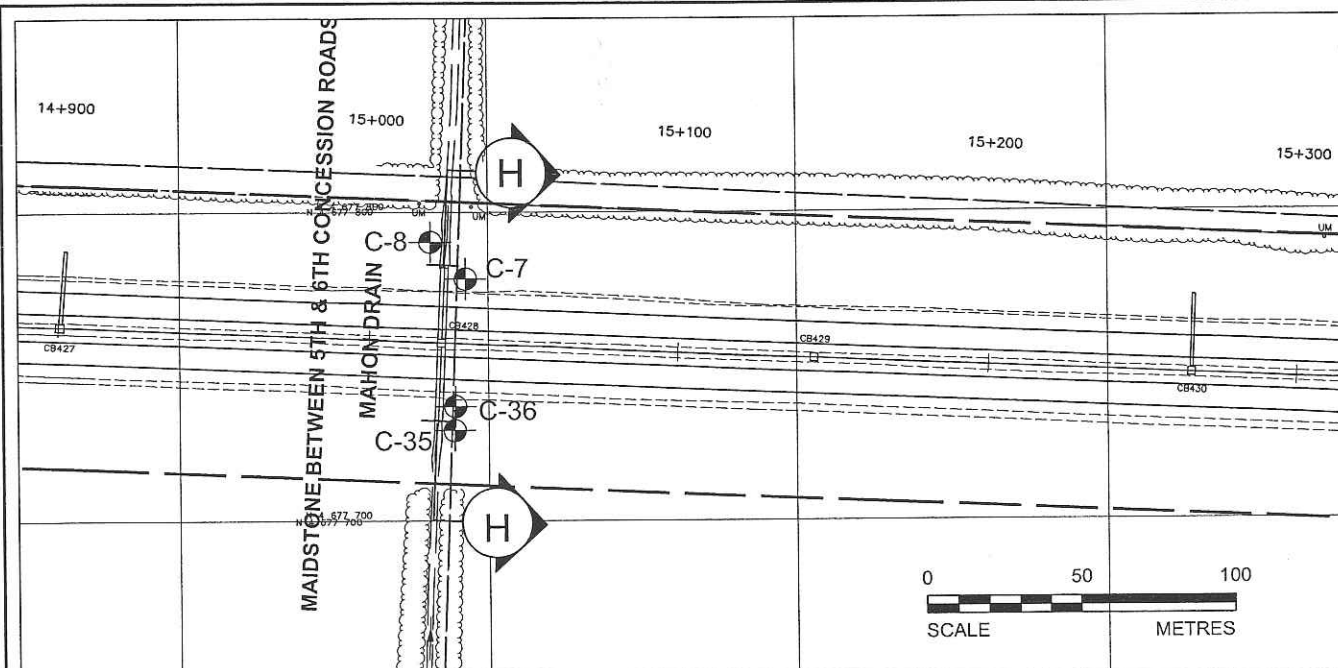
NOTES

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

NO.	DATE	BY	REVISION

Geocres No. 40J2-63

HWY. No. 401	PROJECT NO.: 041-130054-0-1		
SUBM'D. -	CHKD: -	DATE: JAN. 11/05	
DRAWN: BG	CHKD: DP	APPD.	DWG. 7



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST HWY. 401
CONT. No. WP No. 62-00-00



**HWY. 401 STA. 15+024 MAIDSTONE
MAHON DRAIN CULVERT**

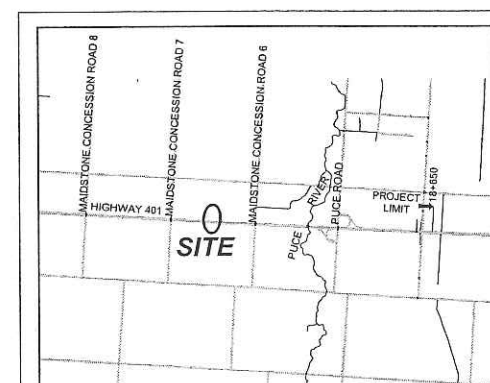
SHEET

BOREHOLE LOCATIONS & STRATA PROFILE

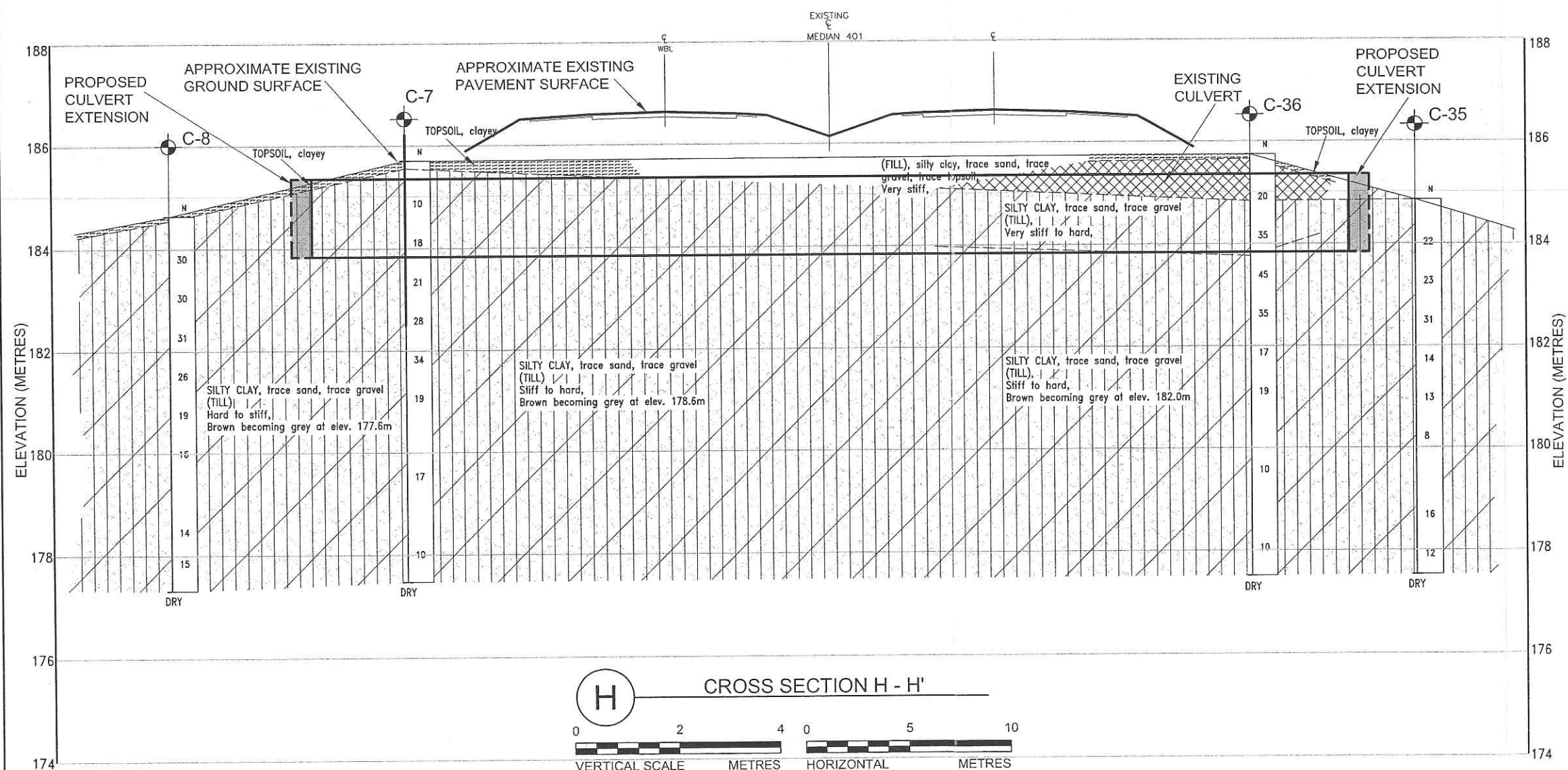


Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



KEY PLAN



LEGEND

- Borehole
- Seal
- Piezometer
- Blows/0.3m (Std. Pen. Test, 475 j/blow)
- WL in piezometer
- WL during drilling
- DRY during drilling

No.	ELEVATION (metres)	CO-ORDINATES	
		NORTH	EAST
C-7	185.70	4677778.4	278992.6
C-8	184.63	4677790.3	278981.3
C-35	184.85	4677729.3	278988.9
C-36	185.74	4677737.1	278989.1

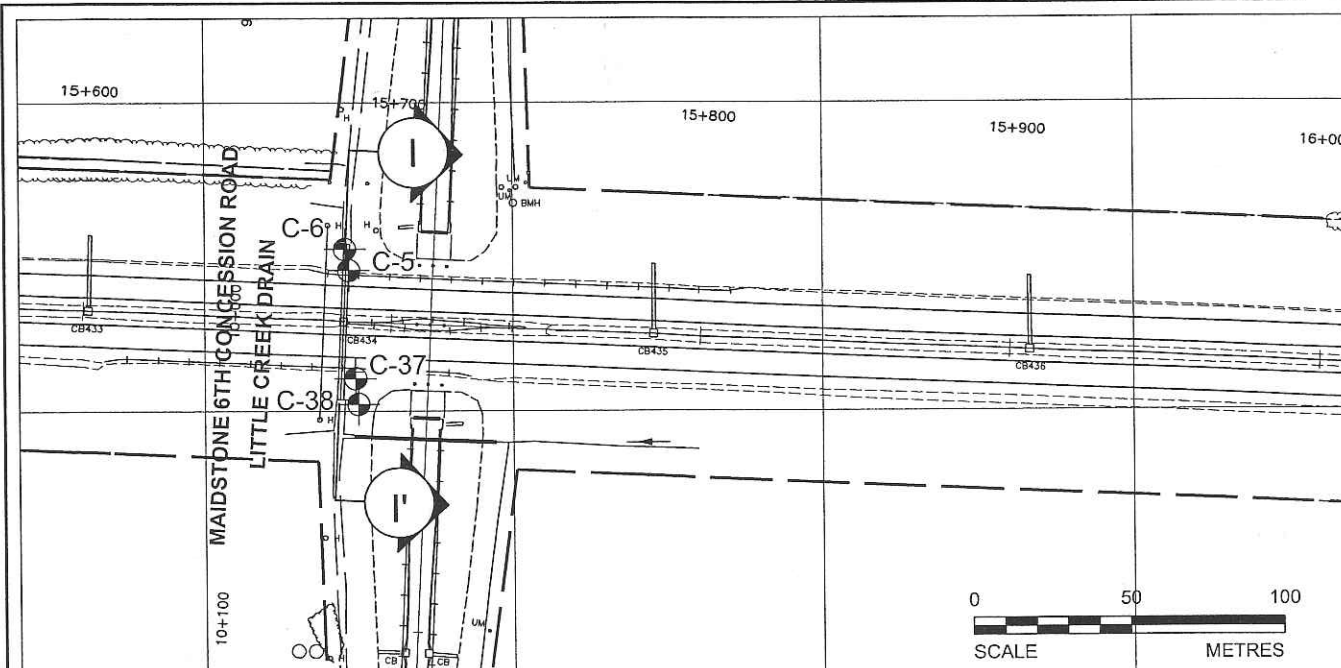
NOTES

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

NO.	DATE	BY	REVISION

Geocres No. 40J2-63

HWY. No. 401	PROJECT NO.:041-130054-0-1
SUBM'D. -	CHKD: - DATE: JAN. 11/05
DRAWN: BG	CHKD: DP APPD. DWG. 8



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST HWY. 401
CONT. No.
WP No. 62-00-00



HWY. 401 STA. 15+685 MAIDSTONE
LITTLE CREEK DRAIN CULVERT

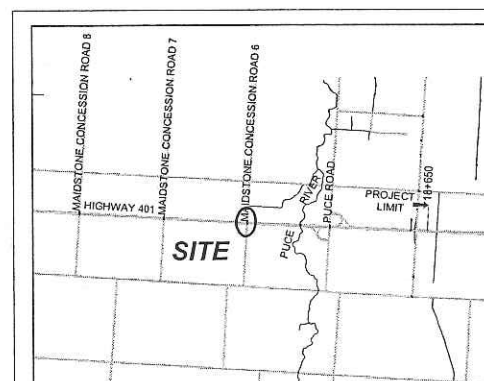
SHEET

BOREHOLE LOCATIONS & STRATA PROFILE

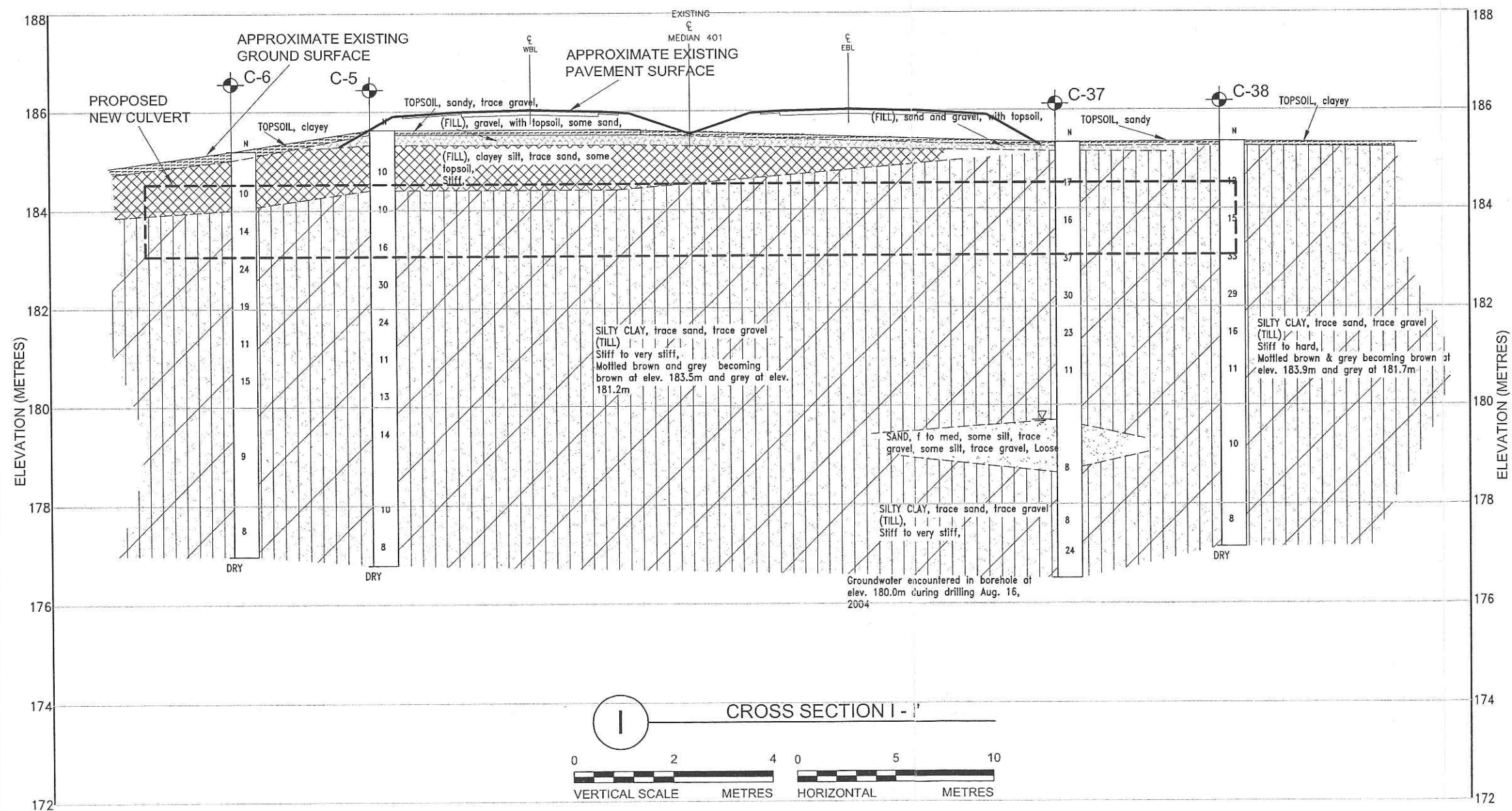


Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



KEY PLAN



LEGEND

- Borehole
- Seal
- Piezometer
- N Blows/0.3m (Std. Pen. Test, 475 j/blow)
- WL in piezometer
- WL during drilling
- DRY Dry during drilling

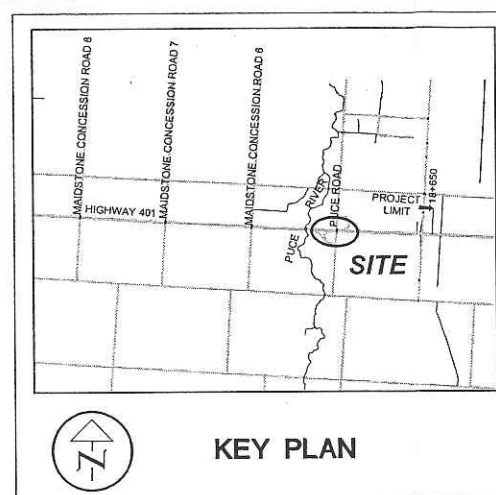
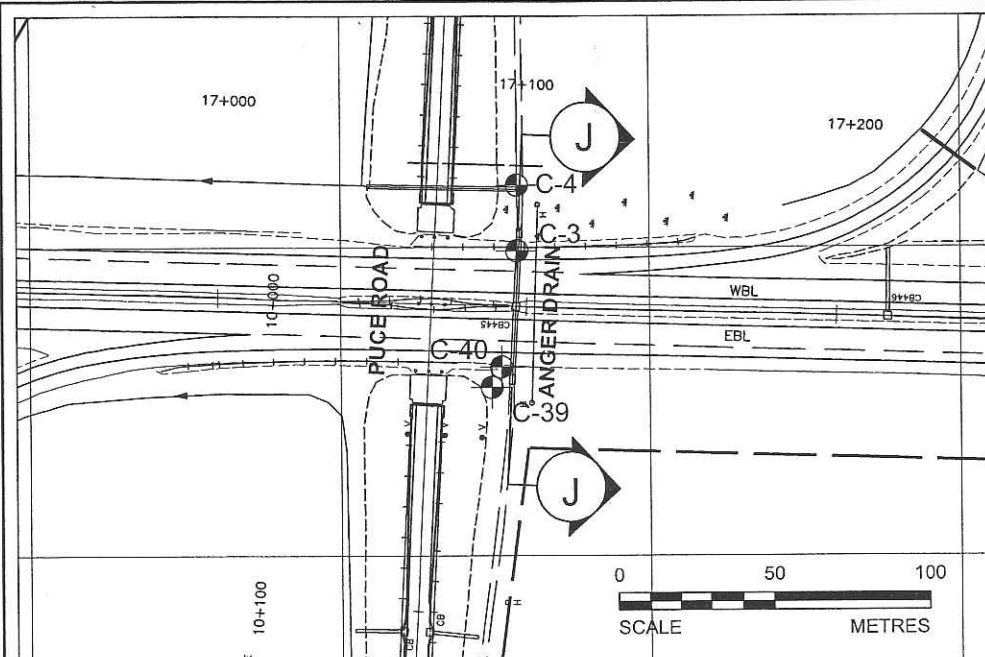
No.	ELEVATION (metres)	CO-ORDINATES	
		NORTH	EAST
C-5	185.62	4677745.5	279647.1
C-6	185.19	4677752.3	279645.8
C-37	185.64	4677710.5	279649.1
C-38	185.36	4677702.2	279650.0

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

Geocres No. 40J2-63

HWY. No.	401	PROJECT NO.:	041-130054-0-1
SUBM'D.	-	CHKD:	-
DRAWN:	BG	CHKD:	DP
		APPD.	DWG. 9

0013225D001.DWG



LEGEND			
	Borehole		
	Seal		
	Piezometer		
	Blows/0.3m (Std. Pen. Test, 475 j/blow)		
	WL in piezometer		
	WL during drilling		
	DRY		
CO-ORDINATES			
No.	ELEVATION (metres)	NORTH	EAST
C-3	185.51	4677698.9	281057.0
C-4	183.44	4677720.2	281057.0
C-39	184.73	4677655.0	281048.5
C-40	185.36	4677661.3	281051.7

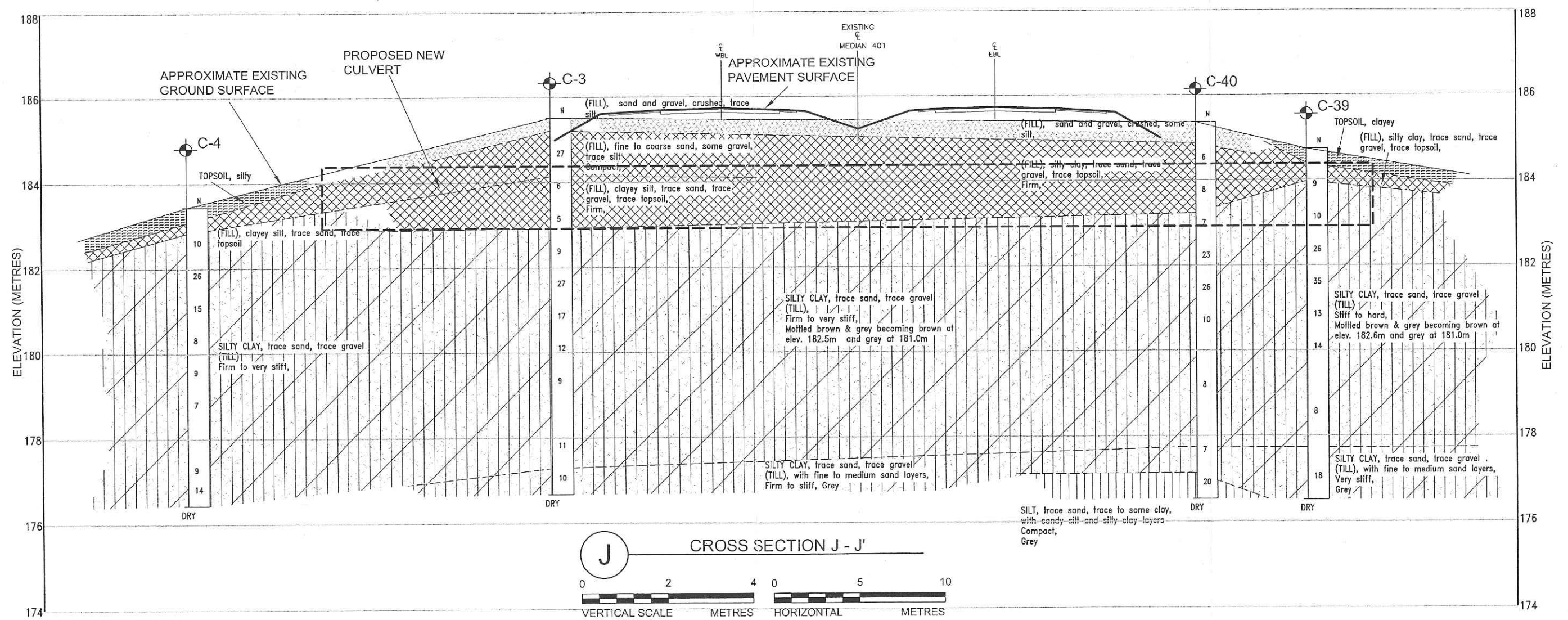
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST
CONT. No.
WP No. 62-00-00

HWY. 401
STA. 17+097 MAIDSTONE
ANGER DRAIN CULVERT

Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



NO.	DATE	BY	REVISION
Geocres No. 40J2-63			
HWY. No.	401	PROJECT NO.	041-130054-0-1
SUBM'D.	—	CHKD.	—
DRAWN:	BG	CHKD.	DP
		APPD.	
		DWG.	10



DIST	HWY. 401
CONT. No.	
WP No. 62-00-00	



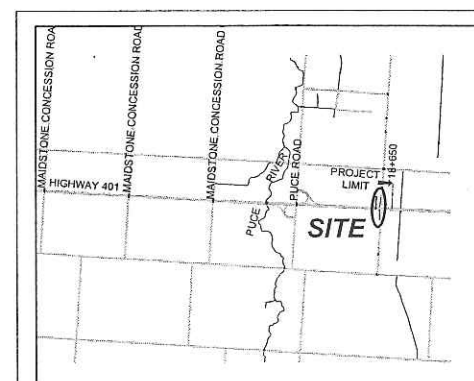
HWY. 401 STA. 18+428 MAIDSTONE
4TH CONCESSION DRAIN CULVERT

BOREHOLE LOCATIONS & STRATA PROFILE








Golder Associates Ltd.
LONDON, ONTARIO, CANADA

REFERENCE
DRAWING SUPPLIED BY ONTARIO MINISTRY OF TRANSPORTATION
ENTITLED: SOUTHWEST REGION
HWY 401 AND MANNING ROAD, GENERAL ARRANGEMENT
GWP - 62-00-00



KEY PLAN

LEGEND

- | | |
|---|---|
|  | Borehole |
|  | Seal |
|  | Piezometer |
| N | Blows/0.3m (Std. Pen. Test, 475 j/blow) |
|  | WL in piezometer |
|  | WL during drilling |
| DRY | Dry during drilling |

NOTES

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

NO.	DATE	BY	REVISION

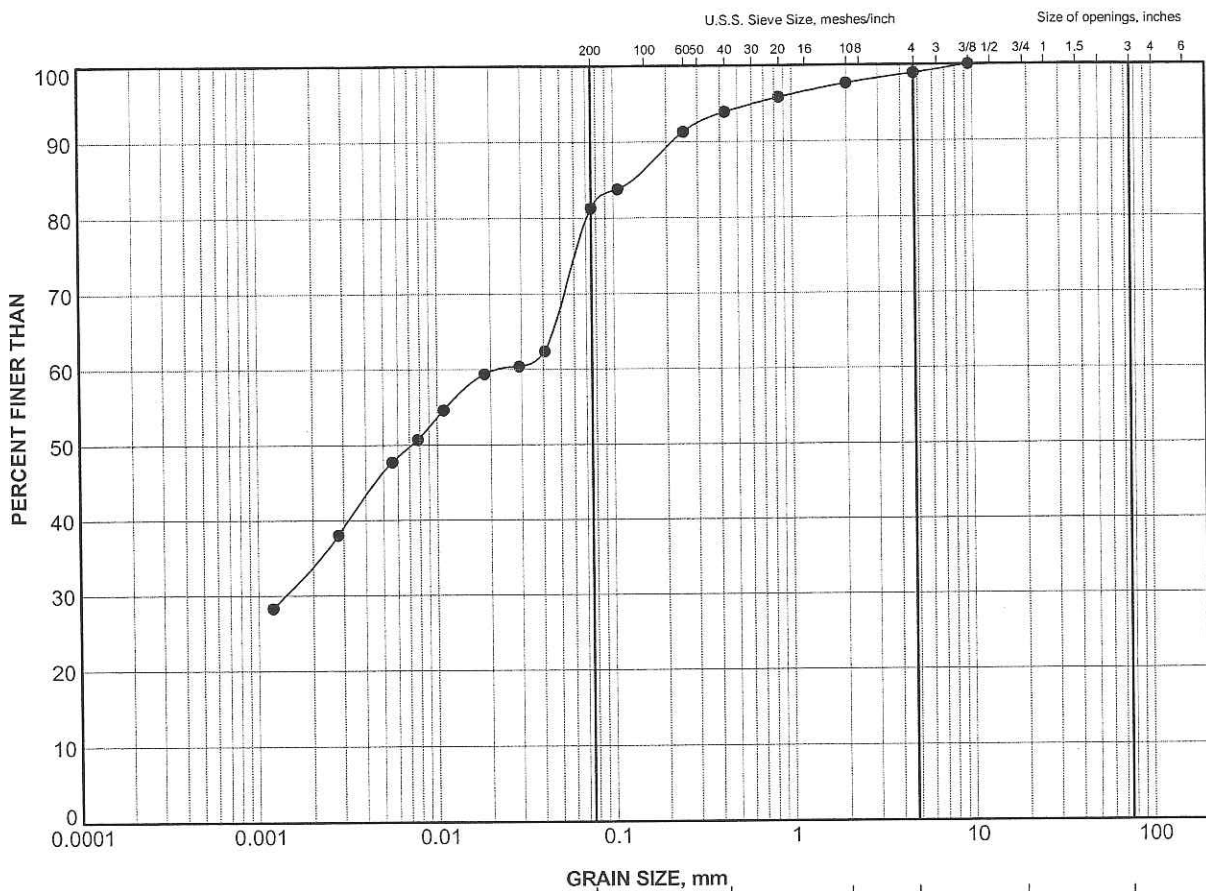
Geocres No. 40J2-63

HWY. No.	401	PROJECT NO.:	041-130054-D-1
SUBM'D.	—	CHKD.	—
DRAWN:	BG	CHKD.	DP
		APPD.	
			DWG 11

Geocres No. 40J2-63

HWY. No. 401		PROJECT NO.:041-130054-0-1	
SUBM'D. -	CHKD: -	DATE: JAN. 11/05	
DRAWN: BG	CHKD: DP	APPD.	DWG. 11


APPENDIX A
LABORATORY TEST DATA

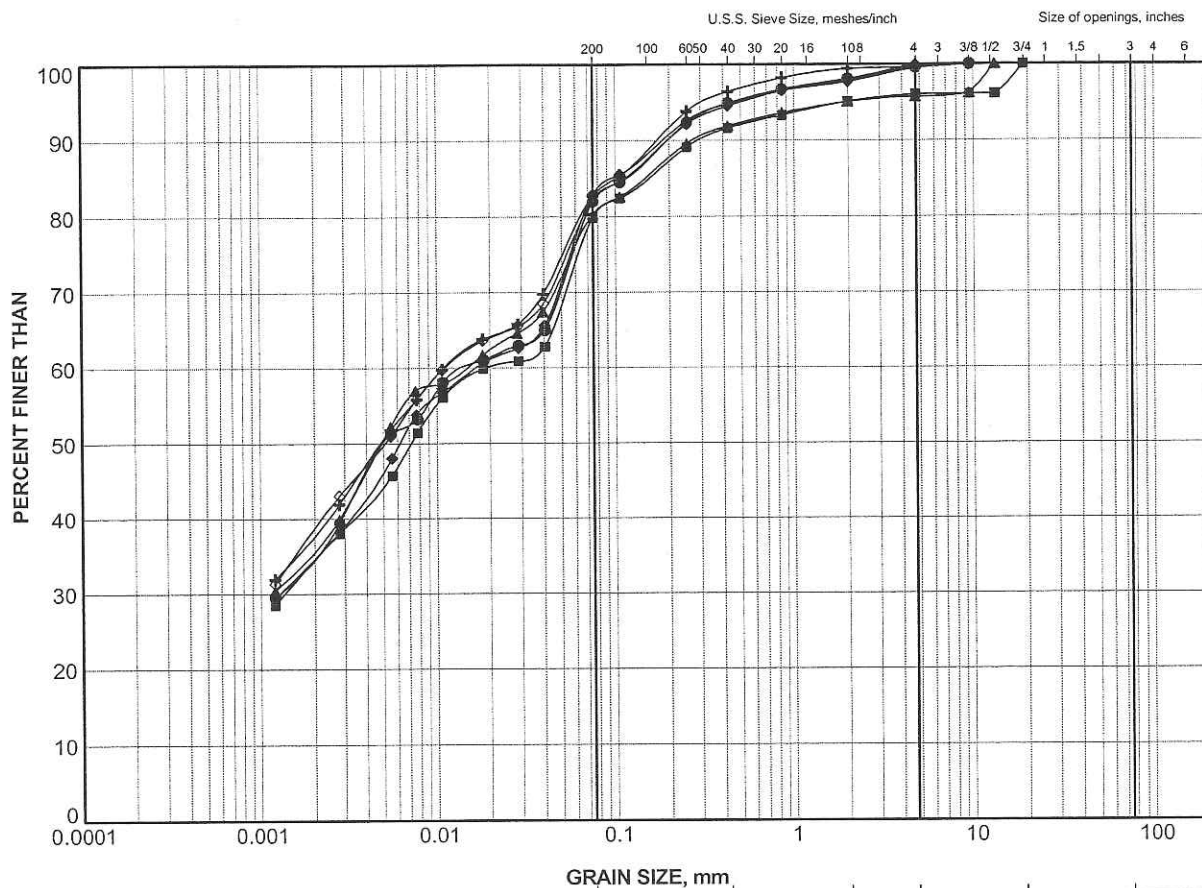


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C-15	1	185.8


PROJECT				HIGHWAY 401 WIDENING GWP 62-00-00			
TITLE				GRAIN SIZE DISTRIBUTION (FILL) Silty clay			
PROJECT No. 041-130 054-0-1		FILE No. 04-1130 054-0-1.GPJ		SCALE N/A		REV.	
DRAWN	BG	Sep 23/04		FIGURE A-1			
CHECK	DP	Jan. 12/05					
 Golder Associates LONDON, ONTARIO							

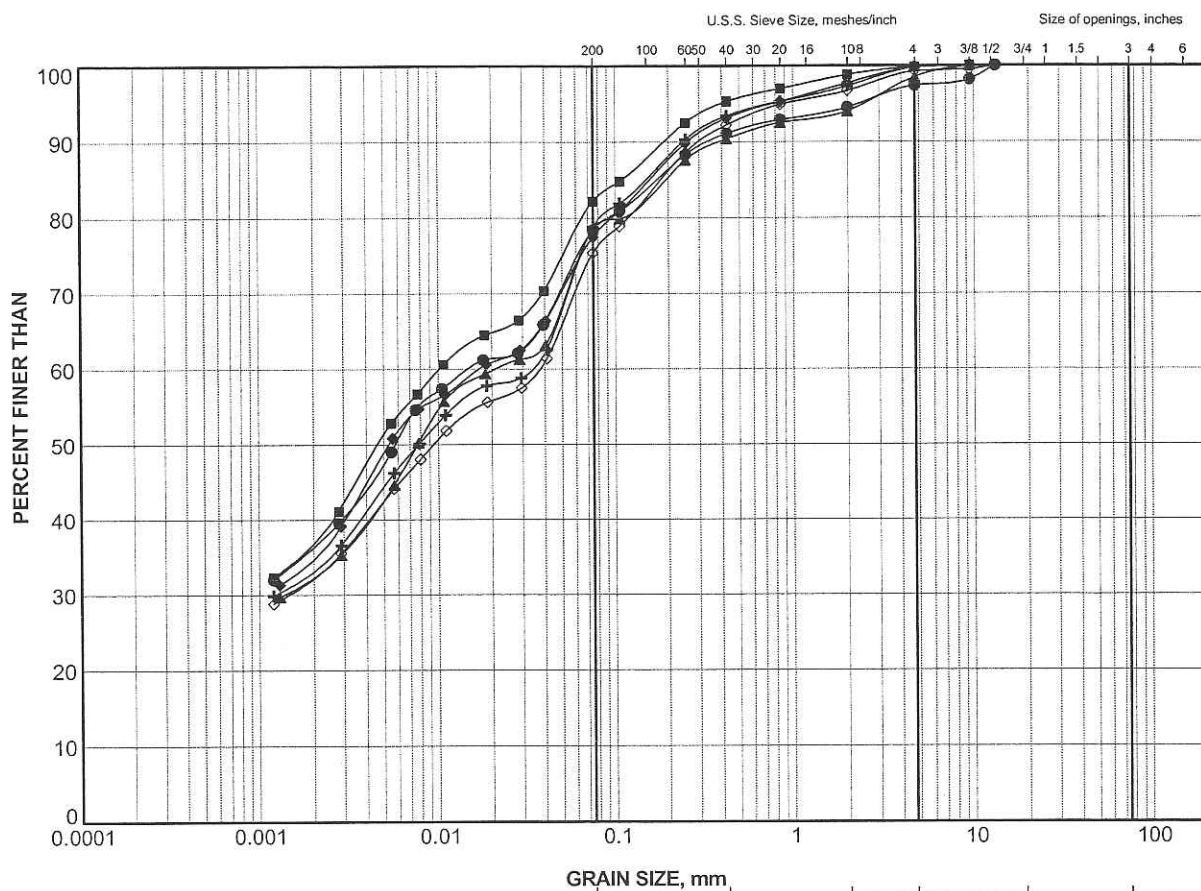


GRAIN SIZE, mm						Cobble Size
CLAY AND SILT	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C-1	4	181.9
■	C-11	5	183.0
▲	C-4	4	180.2
+	C-5	4	182.3
◆	C-8	5	176.5
◇	C-9	3	183.9


PROJECT				HIGHWAY 401 WIDENING GWP 62-00-00			
TITLE				GRAIN SIZE DISTRIBUTION SILTY CLAY TILL			
PROJECT No.		041-130 054-0-1		FILE No.		04-1130 054-0-1.GPJ	
DRAWN		BG		SCALE		N/A	
CHECK		DP		REV.			
		Sep 23/04					
		Jan. 12/05					
 Golder Associates LONDON, ONTARIO				FIGURE A-2			

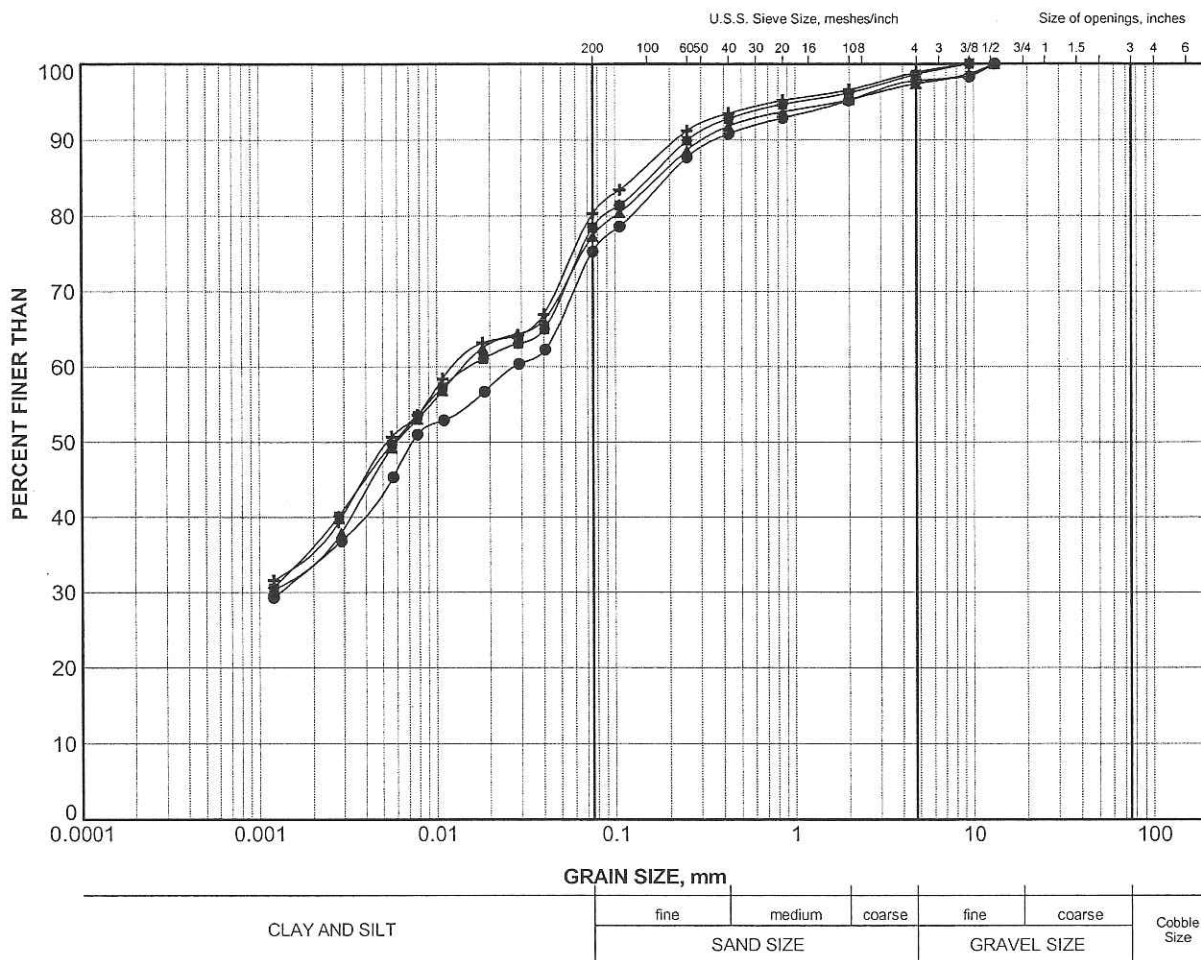


CLAY AND SILT	GRAVEL SIZE, mm						Cobble Size
	fine	medium	coarse	fine	coarse		
	SAND SIZE			GRAVEL SIZE			

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C-13	6	182.8
■	C-15	6	182.0
▲	C-17	4	181.9
+	C-18	5	182.8
◆	C-19	6	181.2
◇	C-21	5	182.2

PROJECT				HIGHWAY 401 WIDENING GWP 62-00-00			
TITLE				GRAIN SIZE DISTRIBUTION SILTY CLAY TILL			
PROJECT No.		041-130054-0-1		FILE No.		04-1130 054-0-1.GPJ	
DRAWN		BG		SCALE		N/A	
CHECK		DP		REV.		Jan. 12/05	
 Golder Associates LONDON, ONTARIO				FIGURE A-3			



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C-23	5	181.7
■	C-26	5	180.7
▲	C-27	6	182.5
+	C-30	6	183.1
◆	C-32	5	183.6

PROJECT

HIGHWAY 401 WIDENING
GWP 62-00-00

TITLE

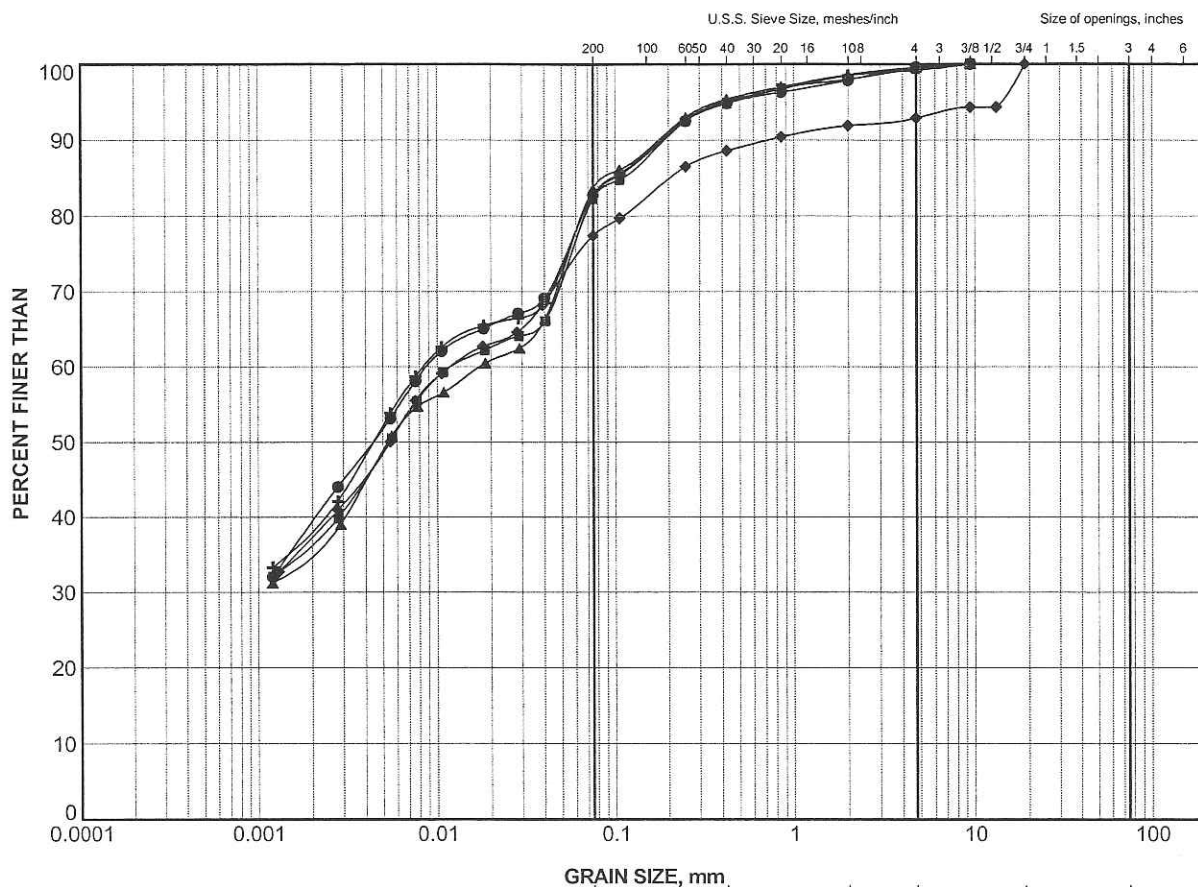
GRAIN SIZE DISTRIBUTION SILTY CLAY TILL



Golder Associates
LONDON, ONTARIO

PROJECT No.	041-130 054-0-1	FILE No.	04-1130 054-0-1.GPJ
DRAWN	BG	SCALE	N/A
CHECK	DP	REV.	


FIGURE A-4

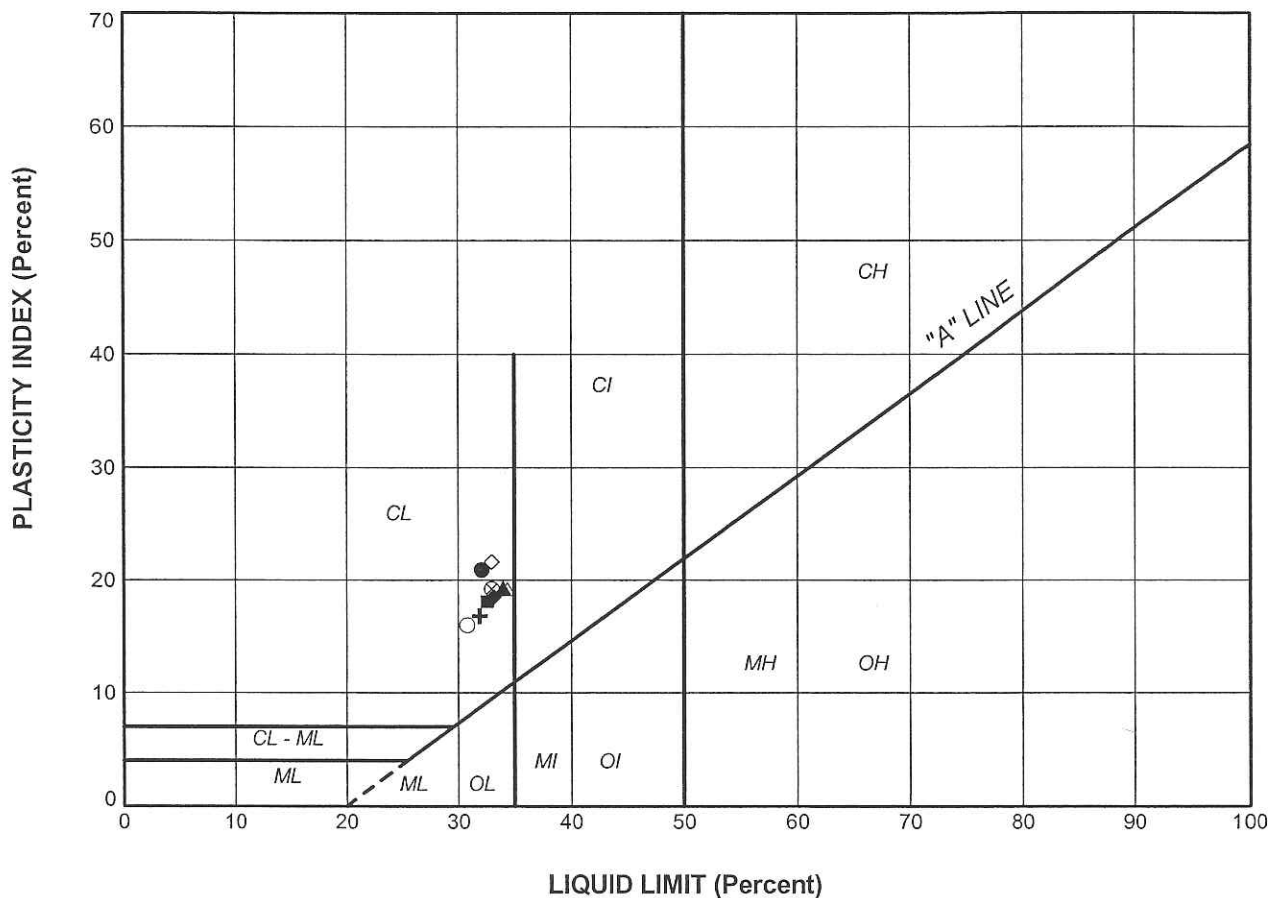


CLAY AND SILT	SAND SIZE, mm			GRAVEL SIZE, mm		Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C-33	6	182.2
■	C-36	5	181.7
▲	C-38	5	181.3
+	C-39	4	181.4
◆	C-42	6	178.9

PROJECT				HIGHWAY 401 WIDENING GWP 62-00-00			
TITLE				GRAIN SIZE DISTRIBUTION SILTY CLAY TILL			
PROJECT No.		041-130 054-0-1		FILE No.		04-1130 054-0-1.GPJ	
DRAWN		BG		Sep 23/04		SCALE N/A	
CHECK		DP		Jan. 12/05		REV.	
 Golder Associates LONDON, ONTARIO				FIGURE A-5			

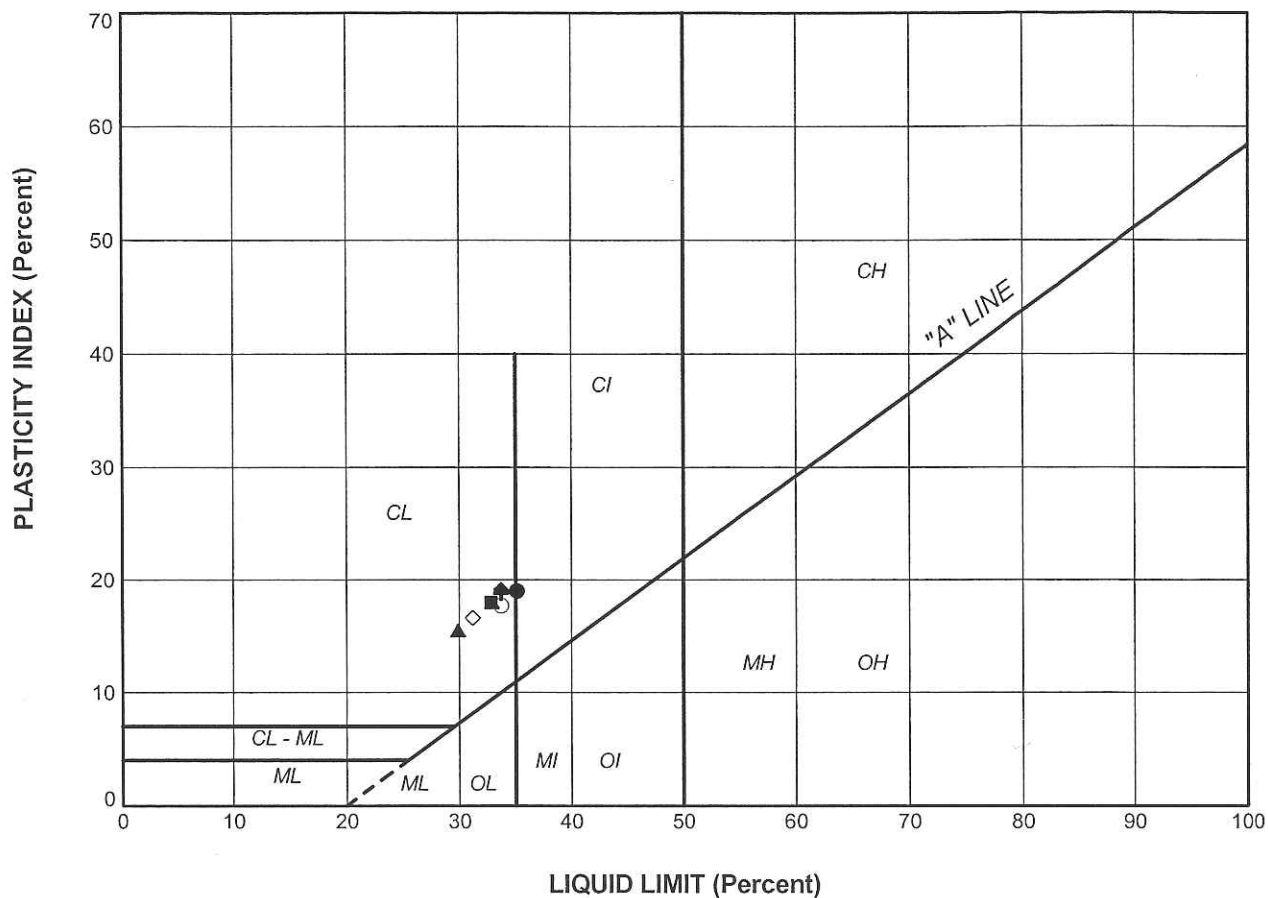


LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)	LL(%)	PL(%)	PI
●	C-23	6	181.2	32.1	11.2	20.9
■	C-26	6	180.2	32.6	14.5	18.1
▲	C-27	5	183.4	34.0	14.7	19.3
+	C-30	7	181.8	31.9	15.1	16.8
◆	C-32	6	183.1	33.2	14.7	18.5
◇	C-33	7	180.9	33.0	11.4	21.6
○	C-38	6	180.8	30.8	14.8	16.0
△	C-39	6	180.2	34.4	15.2	19.2
⊗	C-42	5	179.8	33.0	13.8	19.2

PROJECT			
HIGHWAY 401 WIDENING GWP 62-00-00			
TITLE			
PLASTICITY CHART (SILTY CLAY TILL)			
PROJECT No. 041-130 054-0-1		FILE No. 04-1130 054-0-1.GPJ	
DRAWN BG Sep 23/04		SCALE N/A REV.	
CHECK DP Jan. 12/05		FIGURE A-6	

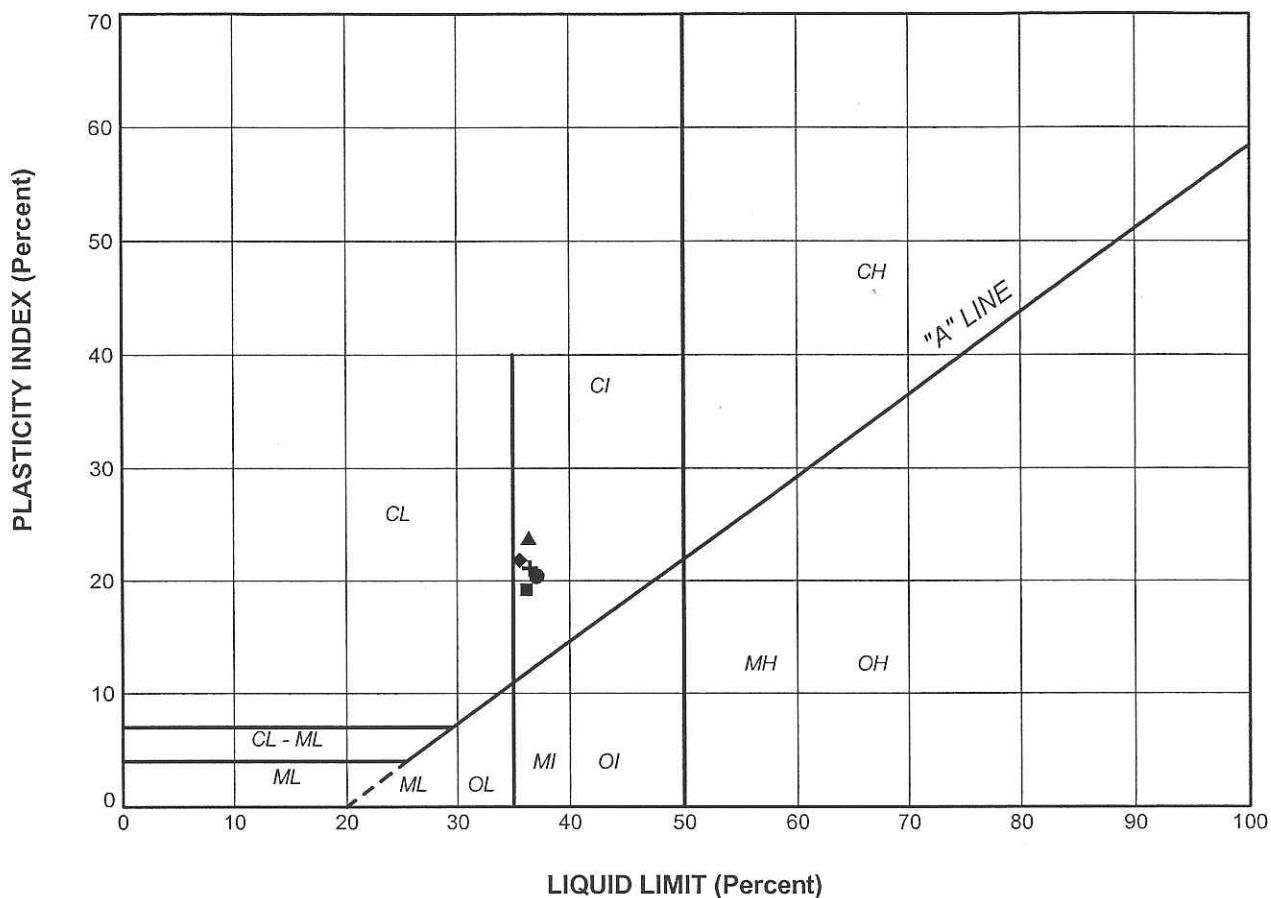




LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)	LL(%)	PL(%)	PI
●	C-13	5	183.8	35.1	16.1	19.0
■	C-15	5	183.0	32.8	14.8	18.0
▲	C-17	5	181.4	29.9	14.4	15.5
+	C-18	4	183.8	33.7	14.9	18.8
◆	C-19	5	182.2	33.7	14.6	19.1
◇	C-21	6	181.7	31.2	14.6	16.6
○	C-4	3	181.2	33.7	16.0	17.7
△	C-9	5	182.6	32.9	14.9	18.0

PROJECT				HIGHWAY 401 WIDENING GWP 62-00-00			
TITLE							
PLASTICITY CHART (SILTY CLAY TILL)							
PROJECT No. 041-130 054-0-1				FILE No. 04-1130 054-0-1.GPJ			
DRAWN BG				Sep 23/04			
CHECK DP				Jan. 12/05			
Golder Associates LONDON, ONTARIO				SCALE N/A REV.			
FIGURE A-7							



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)	LL(%)	PL(%)	PI
●	C-1	5	181.4	37.1	16.7	20.4
■	C-11	4	184.0	36.2	17.0	19.2
▲	C-36	6	181.2	36.4	12.6	23.8
+	C-5	5	181.8	36.5	15.4	21.1
◆	C-8	4	177.5	35.6	13.8	21.8

PROJECT			
HIGHWAY 401 WIDENING GWP 62-00-00			
TITLE			
PLASTICITY CHART (SILTY CLAY TILL)			
PROJECT No. 041-130 054-0-1		FILE No. 04-1130 054-0-1.GPJ	
SCALE		N/A	
DRAWN	BG	Sep 23/04	FIGURE A-8
CHECK	DP	Jan. 12/05	



**Golder
Associates**
LONDON, ONTARIO