

**FOUNDATION INVESTIGATION
AND DESIGN REPORT
OVERHEAD SIGN SUPPORT STRUCTURES
HIGHWAY 401 WIDENING FROM WEST OF
SYDENHAM ROAD TO WEST OF MONTREAL STREET
KINGSTON, ONTARIO
W.P. 77-99-01**

Submitted to:

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GEOCREs No. 31C-186

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TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
PART A - FOUNDATION INVESTIGATION REPORT	
1.0 INTRODUCTION	1
2.0 SITE DESCRIPTION	2
3.0 INVESTIGATION PROCEDURES	3
4.0 SITE GEOLOGY AND STRATIGRAPHY	5
4.1 Regional Geological Conditions	5
4.2 Site Stratigraphy	5
4.2.1 Fill	6
4.2.2 Rock Fill	7
4.2.3 Clayey Silt to Clay	7
4.2.4 Clayey Silt Till to Silty Sand Till	8
4.2.5 Limestone Bedrock	8
4.3 Groundwater Conditions	10
5.0 CLOSURE	11
PART B - FOUNDATION DESIGN REPORT	
6.0 ENGINEERING RECOMMENDATIONS	12
6.1 General	12
6.2 Overhead Sign Foundations	12
6.2.1 Caisson Foundations in Soil	13
6.2.2 Caisson Foundations Socketted into Rock	14
6.2.3 Foundations Dowelled to Rock	15
6.3 Construction Considerations	16
7.0 CLOSURE	18

In Order
Following
Page 18

Tables 1 to 3

Lists of Abbreviations and Symbols

Lithological and Geotechnical Rock Description Terminology

Records of Boreholes 2, 07-02, 07-03, 07-05 to 07-21, 07-23 to 07-28, 07-WIF-01 and 07-WIF-02

Drawings 1 to 7

Figures 1 to 9

Appendix A

LIST OF TABLES

Table 1	Summary of Point Load Index Test Results on Rock Core Samples
Table 2	Summary of Feasible Foundation Options, Overhead Sign Support Structures, Highway 401 Widening from West of Sydenham Road to West of Montreal Street, Kingston, Ontario, W.P. 77-99-01
Table 3	Geotechnical Design Parameters for Trichord Overhead Sign Foundation, Highway 401 Widening from West of Sydenham Road to West of Montreal Street, Kingston, Ontario, W.P. 77-99-01

LIST OF DRAWINGS

Drawing 1	Highway 401, Station 18+015 – Cantilever Sign at County Road 38, Borehole Location
Drawing 2	Highway 401, Station 20+200 to 20+850 – Overhead Sign OH-1, Borehole Locations
Drawing 3	Highway 401, Station 20+900 to 21+600 – Overhead Signs OH-2 and OH-3, Borehole Locations
Drawing 4	Highway 401, Station 22+000 to 22+650 – Overhead Signs OH-4, OH-5 and OH-13, Borehole Locations
Drawing 5	Highway 401, Station 22+900 to 23+550 – Overhead Signs OH-6, OH-7 and OH-8, Borehole Locations
Drawing 6	Highway 401, Station 23+650 to 24+300 – Overhead Sign OH-9, Borehole Locations
Drawing 7	Highway 401, Station 24+900 to 25+650 – Overhead Signs OH-10, OH-11 and OH-12, Borehole Locations

LIST OF FIGURES

Figure 1	Grain Size Distribution Test Results – Sand to Sand and Gravel Fill
Figure 2	Grain Size Distribution Test Results – Silty Sand Fill Containing Clayey Silt Zones
Figure 3	Grain Size Distribution Test Results – Clayey Silt to Silty Clay Fill
Figure 4	Plasticity Chart – Clayey Silt to Silty Clay Fill
Figure 5	Grain Size Distribution Test Results – Rock Fill
Figure 6	Grain Size Distribution Test Results – Silty Clay to Clay
Figure 7	Plasticity Chart – Silty Clay to Clay
Figure 8	Grain Size Distribution Test Results – Silty Sand Till to Clayey Silt Till
Figure 9	Plasticity Chart – Clayey Silt Till

LIST OF APPENDICES

Appendix A	Special Provisions and Non-Standard Special Provisions
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August 2008

05-1111-031-4

PART A

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the detailed design of the Highway 401 widening from four to six lanes, from west of Sydenham Road to west of Montreal Street in the City of Kingston, Ontario. Foundation engineering services are required for the following components under W.P. 77-99-01:

- northward widening of the existing Division Street overpass structure;
- investigation of instability and settlement along a section of the Division Street W-N/S Ramp;
- widening of high fill embankments in the vicinity of Little Cataraqui Creek, between Sydenham Road and Sir John A. MacDonald Boulevard;
- overhead signs; and
- trenchless sewer installation.

This report addresses fourteen new trichord overhead or cantilever signs along Highway 401 and one new overhead sign associated with the Wolfe Island ferry crossing, located adjacent to the Kingston Harbour in the City of Kingston.

The terms of reference for the original scope of work are outlined in the MTO's Request for Proposal (RFP) dated January 2005, and in Section 6.8 of MRC's *Technical Proposal* for this project.

2.0 SITE DESCRIPTION

The proposed overhead signs are located as follows:

<i>Overhead Sign No.</i>	<i>Overhead Sign Location</i>
County Road 38	Highway 401 WBL, Station 18+015
OH-1	Highway 401 WBL, Station 20+677
OH-2	Highway 401 WBL, Station 21+100
OH-3	Highway 401 EBL, Station 21+499
OH-4	Highway 401 EBL, Station 22+059
OH-5	Highway 401 WBL, Station 22+504
OH-6	Highway 401 WBL, Station 22+944
OH-7	Highway 401 EBL, Station 23+150
OH-8	Highway 401 EBL, Station 23+536
OH-9	Highway 401 WBL, Station 23+945
OH-10	Highway 401 WBL, Station 24+975
OH-11	Highway 401 EBL, Station 25+125
OH-12	Highway 401 EBL, Station 25+568
OH-13	Sir John A. MacDonald Boulevard, Station 0+281
Wolfe Island Ferry	Wolfe Island Ferry Area, East of Ontario Street

At the proposed sign locations, Highway 401 has typically been constructed on an embankment that is typically 2 m to 4 m in height relative to the surrounding natural or rock cut grade, except at the following locations:

- OH-3, between Sydenham Road and Sir John A. MacDonald Boulevard, is located within the high fill embankment area near Little Cataraqui Creek; the embankment at this location is approximately 5 m to 6 m in height.
- OH-9, immediately west of Division Street, is located within the 6 m to 7.5 m high approach embankment for this overpass structure.
- OH-13, south of Highway 401 on Sir John A. MacDonald Boulevard, is in an area with approximately 1.2 m to 1.4 m of fill.

3.0 INVESTIGATION PROCEDURES

The field work for this subsurface investigation was carried out in January, February and March 2007. A total of twenty-eight boreholes (Boreholes 2, 07-2, 07-3, 07-5 to 07-21, 07-23 to 07-28, 07-WIF-1 and 07-WIF-2) were advanced using a CME-75 track-mounted drill rig, supplied and operated by Marathon Drilling Company Ltd. of Ottawa, Ontario. The boreholes were advanced at the locations shown on Drawings 1 to 7.

The field work was supervised on a full-time basis by members of Golder's staff, who located the boreholes in the field, directed the drilling, sampling, and in situ testing operations, and logged the boreholes. Soil samples were obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm outside diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedure. In situ vane testing, using an MTO "N"-size vane, was carried out to measure the undrained shear strength where firm to stiff silty clay to clay was encountered. Where bedrock was encountered in Boreholes 2, 07-5, 07-6, 07-15 to 07-20, 07-23 to 07-28, 07-WIF-1 and 07-WIF-2, bedrock coring was completed using NQ-size coring equipment. Following completion of drilling, the boreholes were backfilled with bentonite, in accordance with the requirements of Ontario Regulation 903.

The soil and bedrock samples were identified in the field, placed in labelled containers and transported to Golder's laboratories in Mississauga and Ottawa for further examination and laboratory testing. Index and classification tests consisting of water content determinations, Atterberg limits testing and grain size distribution analyses were carried out on selected soil samples, and point load index testing was carried out on selected samples of bedrock core.

The borehole locations and ground surface elevations were determined by Golder personnel relative to survey staking provided by J.D. Barnes Surveying Ltd.; the ground surface elevations were also checked using the digital terrain model for the project. The borehole locations, including MTM NAD83 northing and easting coordinates and ground surface elevations referenced to geodetic datum, are summarized in the following table and are shown on the borehole records and on Drawings 1 to 7.

<i>Borehole Number</i>	<i>MTM NAD83 Northing (m)</i>	<i>MTM NAD83 Easting (m)</i>	<i>Ground Surface Elevation (m)</i>
2	4,905,053.9	299,229.7	110.6
07-2	4,904,092.3	301,679.7	100.9
07-3	4,904,076.9	301,678.2	101.2
07-5	4,904,013.2	302,097.6	95.6
07-6	4,904,003.4	302,095.1	95.4
07-7	4,903,856.8	302,463.6	85.5
07-8	4,903,864.5	302,465.0	85.7
07-9	4,903,644.7	302,984.8	86.3
07-10	4,903,666.6	302,993.3	87.0
07-11	4,903,329.6	303,242.1	80.8

<i>Borehole Number</i>	<i>MTM NAD83 Northing (m)</i>	<i>MTM NAD83 Easting (m)</i>	<i>Ground Surface Elevation (m)</i>
07-12	4,903,322.0	303,270.6	80.6
07-13	4,903,526.0	303,416.1	88.7
07-14	4,903,513.0	303,410.4	88.8
07-15	4,903,381.4	303,828.6	90.2
07-16	4,903,368.4	303,825.7	91.2
07-17	4,903,308.3	304,024.7	92.0
07-18	4,903,318.5	304,025.6	91.8
07-19	4,903,268.0	304,401.8	90.8
07-20	4,903,282.6	304,410.2	90.9
07-21	4,903,260.3	304,822.3	87.9
07-23	4,903,478.5	305,775.2	110.5
07-24	4,903,471.6	305,780.3	110.6
07-25	4,903,545.5	305,911.3	110.0
07-26	4,903,552.2	305,906.6	111.3
07-27	4,903,802.8	306,270.6	112.5
07-28	4,903,812.5	306,263.8	113.1
07-WIF-1	4,899,164.0	306,514.4	N/A
07-WIF-2	4,899,161.4	306,510.5	N/A

4.0 SITE GEOLOGY AND STRATIGRAPHY

4.1 Regional Geological Conditions

The site is located in the southern portion of the physiographic region of Southern Ontario known as the Napanee Plain, as delineated in *The Physiography of Southern Ontario*¹. The Napanee Plain is flat to undulating, and is characterized by relatively shallow soil deposits overlying bedrock. Geologic mapping² indicates that the bedrock within the Napanee Plain consists of grey limestone/dolostone of the Gull River Formation (of the Trenton-Black River Group), which contains some shale partings and seams.

The overburden soils within the Napanee Plain generally consist of glacial till, although alluvium is present in river and stream valleys and, in the southern portion of the Plain, low-lying areas are typically covered with deposits of stratified clay. Well records indicate that the average depth to bedrock within the Napanee Plain is approximately 2 m. However, in many areas, bedrock outcrops exist at ground surface, while deeper soil deposits (on the order of 10 m) are present in the northern and southern portion of the Plain, and within and adjacent to river valleys throughout the Plain.

4.2 Site Stratigraphy

Twenty-eight boreholes were advanced as part of the geotechnical investigation for the overhead sign locations. The borehole locations are shown on Drawings 1 to 7.

The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of in situ and laboratory testing are given on the borehole records and Figures 1 to 9 following the text of this report. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

In summary, the subsoils at the site consist of variable fill materials (including rock fill) overlying deposits of clayey silt to clay and glacial till, in turn underlain by limestone bedrock. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

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

² Map 2544, Ministry of Northern Development and Mines, 1991.

4.2.1 Fill

Fill was encountered in all of the boreholes, immediately below the existing ground surface or a layer of asphalt. The variation in thickness and the surface and base elevations of the fill are summarized in the following table:

<i>Overhead Sign No.</i>	<i>Borehole No.</i>	<i>Elevation of Surface of Fill (m)</i>	<i>Elevation of Base of Fill (m)</i>	<i>Thickness of Fill (m)</i>
County Road 38	2	110.6	109.4	1.2
OH-1	07-2	100.9	98.3	2.6
	07-3	101.2	97.7	3.5
OH-2	07-5	95.6	94.1	1.5
	07-6	95.4	92.8	2.6
OH-3	07-7	85.5	79.6	5.9
	07-8	85.7	80.7	5.0
OH-4	07-9	86.3	82.6	3.7
	07-10	87.0	85.2	1.8
OH-5	07-13	88.7	86.6	2.1
	07-14	88.8	85.9	2.9
OH-6	07-15	90.2	88.1	2.1
	07-16	91.2	87.5	3.7
OH-7	07-17	92.0	87.7	4.3
	07-18	91.8	90.1	1.7
OH-8	07-19	90.8	86.7	4.1
	07-20	90.9	88.2	2.7
OH-9	07-21	87.9	80.4	7.5
OH-10	07-23	110.5	108.8	1.7
	07-24	110.6	108.7	2.0
OH-11	07-25	110.0	107.8	2.2
	07-26	111.3	109.3	2.0
OH-12	07-27	112.5	111.2	1.3
	07-28	113.1	111.5	1.6
OH-13	07-11	80.8	79.6	1.2
	07-12	80.6	79.2	1.4
Wolfe Island Ferry	07-WIF-1	N/A	N/A	3.0
	07-WIF-2	N/A	N/A	2.1

Typically, the upper portion of the fill is comprised of sandy gravel, to sand and gravel, to gravelly sand, to sand containing some gravel; cobbles were observed within this fill in some of the boreholes, as noted on the borehole records. The results of grain size distribution tests conducted on seven samples of sand and gravel to sand fill are shown on Figure 1. The measured SPT "N" values within the sandy gravel to sand fill ranged from 2 to 112 blows per 0.3 m of penetration, indicative of a variable, very loose to very dense relative density.

Layers of finer cohesionless fills (silty sand, sand and silt or sandy silt), approximately 0.8 m to 2.2 m in thickness, were encountered below the sandy gravel to sand fill in Boreholes 07-13, 07-14, 07-16, 07-17 and 07-25. The results of grain size distribution tests conducted on two samples of silty sand fill that contained zones of clayey silt are shown on Figure 2. The measured

SPT "N" values within the silty sand to sandy silt fill ranged from 4 to 28 blows per 0.3 m of penetration, indicative of a very loose to compact relative density.

Clayey silt to silty clay fill was encountered below the sandy gravel to sand fill in Boreholes 07-2, 07-3, 07-5, 07-7, 07-9, 07-11, 07-14, 07-15, 07-17, 07-19, 07-21, 07-23 and 07-26. The clayey silt to silty clay fill typically contains trace to some sand and trace gravel; the results of grain size distribution tests on three selected samples of the cohesive fill are shown on Figure 3. Atterberg limits testing was conducted on four samples of the cohesive fill, and measured plastic limits of 17 to 24 per cent, liquid limits of 35 to 48 per cent, and plasticity indices of 17 to 26 per cent; these results, which are plotted on a plasticity chart on Figure 4, indicate that the tested cohesive fill consists of silty clay of intermediate plasticity. The measured SPT "N" values within the cohesive fill ranged from 3 to 19 blows per 0.3 m of penetration (but typically 5 to 10 blows per 0.3 m of penetration), indicative of a soft to very stiff (but typically firm to stiff) consistency.

4.2.2 Rock Fill

Rock fill was encountered below the asphalt and sand and gravel fill in Boreholes 07-6, 07-8, 07-20, 07-21 and 07-28. The rock fill encountered in the boreholes consists of 0.7 m to 4.0 m of sandy gravel to gravel, some sand, containing cobbles and boulders. The results of grain size distribution tests on the recovered rock fill samples (excluding cobble- and boulder-sized materials) from two of the boreholes are shown on Figure 5.

The measured SPT "N" value within the rock fill ranged from 5 to 113 blows per 0.3 m of penetration, indicative of a loose to very dense relative density.

4.2.3 Clayey Silt to Clay

A deposit of silty clay to clay was encountered below the fill in Boreholes 07-2, 07-3, 07-7 to 07-14 and 07-21. Some of these boreholes were terminated within the silty clay to clay; however, where fully penetrated, the deposit varies from 0.7 m to 4.3 m in thickness.

The silty clay to clay deposit contains trace sand and gravel; silt seams and interlayers were noted within the deposit in samples recovered from Boreholes 07-10 and 07-13. The results of grain size distribution tests completed on four selected samples of the silty clay to clay are shown on Figure 6. Atterberg limits testing was completed on eleven samples of this cohesive deposit and measured plastic limits of 20 to 31 per cent, liquid limits of 43 to 76 per cent, and plasticity indices of 23 to 51 per cent; these results, which are plotted on a plasticity chart on Figure 7, confirm that the deposit varies from silty clay of intermediate plasticity to high plasticity clay.

The measured SPT "N" values within this deposit ranged from 3 to 25 blows per 0.3 m of penetration. In situ vane testing in the "softer" portions of the deposit (SPT "N" values of 3 and 4 blows per 0.3 m of penetration) measured undrained shear strengths of approximately 48 kPa to 85 kPa. These test results indicate that the silty clay to clay deposit has a firm to very stiff (but typically stiff to very stiff) consistency. The deposit is sensitive, based on measured sensitivities of 4.6 to 10.0.

4.2.4 Clayey Silt Till to Silty Sand Till

A glacial till deposit was encountered below the fill and/or silty clay to clay in Boreholes 07-2, 07-3, 07-11, 07-12, 07-15, 07-16 and 07-WIF-2. The surface of the till deposit was encountered at a depth of between 4.4 m and 5.5 m at the locations of Overhead Signs OH-1 and OH-13 (Boreholes 07-2, 07-3, 07-11 and 07-12); the boreholes at these locations were terminated within the till deposit. The surface of the till deposit was encountered at a depth of 2.1 m and 3.7 m in Boreholes 07-15 and 07-16 at the location of Overhead Sign OH-6, and at a depth of 2.1 m in Borehole 07-WIF-2 at the Wolfe Island ferry crossing site; the till is between 0.5 m and 1.5 m in thickness in these boreholes, and is underlain by bedrock.

The till deposit varies in composition from clayey silt with sand to trace sand and trace to some gravel, to silty sand or sandy silt containing trace to some gravel and trace clay. The results of grain size distribution tests completed on two selected samples of the till are shown on Figure 8. Atterberg limits testing was conducted on one selected sample of the cohesive till, and measured a plasticity index of 11 per cent, a liquid limit of 16 per cent, and a plasticity index of 5 per cent; this result, which is plotted on a plasticity chart on Figure 9, confirms that the cohesive portion of the till consists of low plasticity clayey silt.

The measured SPT "N" values within the clayey silt till ranged from 2 to greater than 30 blows per 0.3 m of penetration, indicative of a soft to hard consistency. The measured SPT "N" values within the silty sand to sandy silt till ranged from 1 to 15 blows per 0.3 m of penetration, indicative of a very loose to compact relative density.

4.2.5 Limestone Bedrock

Limestone bedrock underlies the fill and native soils at the sites for the cantilever sign at County Road 38, Overhead Signs OH-1, OH-2, OH-6 to OH-8, OH-10 to OH-12, and the Wolfe Island ferry crossing. The following table summarizes the depth to the bedrock surface and its elevation, as encountered in the boreholes; the bedrock was confirmed by coring for a length of 2.3 m to 3.3 m in all of these boreholes, except Boreholes 07-2 and 07-3 where the bedrock surface was inferred at the base of the borehole from refusal to auger and/or split-spoon sampler advance.

<i>Overhead Sign No.</i>	<i>Borehole No.</i>	<i>Ground Surface Elevation (m)</i>	<i>Depth to Bedrock (m)</i>	<i>Bedrock Surface Elevation (m)</i>
County Road 38	2	110.6	1.2	109.4
OH-1	07-2	100.9	5.6	95.3
	07-3	101.2	6.6	94.7
OH-2	07-5	95.6	1.5	94.1
	07-6	95.4	2.6	92.8
OH-6	07-15	90.2	2.6	87.6
	07-16	91.2	4.4	86.8
OH-7	07-17	92.0	4.3	87.7
	07-18	91.8	1.7	90.1
OH-8	07-19	90.8	4.1	86.7
	07-20	90.9	2.7	88.2
OH-10	07-23	110.5	1.7	108.8
	07-24	110.6	2.0	108.7
OH-11	07-25	110.0	2.2	107.8
	07-26	111.3	2.0	109.3
OH-12	07-27	112.5	1.3	111.2
	07-28	113.1	1.6	111.5
Wolfe Island Ferry	07-WIF-1	N/A	3.0	N/A
	07-WIF-2	N/A	3.6	N/A

A description of some of the terms used in the description of the bedrock samples from this site is provided on the *Lithological and Geotechnical Rock Description Terminology* sheet which precedes the Record of Borehole sheets included with this report.

The limestone bedrock at the site is a member of the Gull River Formation; it is slightly weathered to fresh, thinly-bedded, grey, and medium strong to very strong. The Rock Quality Designation (RQD) values measured on selected core samples generally ranged from about 25 to 85 per cent, indicating that the bedrock is generally of poor to good quality; however, some fracturing/broken core was observed within the upper 1.2 m of the bedrock core recovered from Borehole 2 (at the County Road 38 cantilever sign location) and in the upper 0.4 m of the bedrock from Borehole 07-19 (at OH-8), with measured RQDs of 0 per cent over these intervals. The discontinuities observed in the rock core are typically horizontal, associated with bedding planes in this thinly-bedded rock.

Point load strength tests were performed on selected samples of the bedrock core. The point load test results and the approximate unconfined compressive strength as obtained from correlation with the diametral and axial point load strength tests are summarized in Table 1 following the text of this report. The point load index test results and correlated unconfined compressive strengths confirm that the limestone is classified as a medium strong to very strong rock.

4.3 Groundwater Conditions

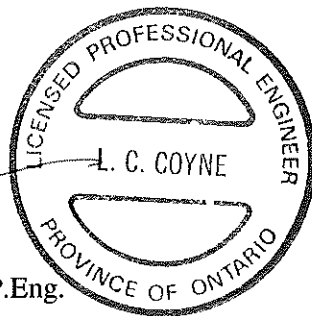
The majority of the boreholes were observed to be dry during and immediately following completion of overburden drilling and prior to rock coring. In addition, the granular fill, which ranges from in thickness from 1.5 m to 5.9 m, was dry to moist at the time of the borehole investigation. However, wet cohesionless (silty sand till) soil layers were observed at depth (3.7 m and 5.2 m) in some of the boreholes, as noted on the borehole records.

The water levels measured in piezometers installed by Golder for other elements of this project indicate that the stabilized groundwater level within the project limits is typically between 0 m and 2 m below the natural ground surface and the roadway fill. The groundwater level is expected to fluctuate seasonally, and is expected to rise during wet periods of the year. Cohesionless interlayers within the silty clay to clay deposit, as well as silty sand till layers, should be expected to be water-bearing; in addition, "perched" groundwater should be expected near the base of cohesionless fills, on top of the underlying, less permeable silty clay to clay deposit.

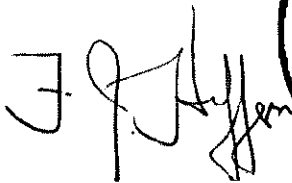
5.0 CLOSURE

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

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PART B

**FOUNDATION DESIGN REPORT
OVERHEAD SIGN SUPPORT STRUCTURES
HIGHWAY 401 WIDENING FROM WEST OF
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W.P. 77-99-01**

6.0 ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides geotechnical parameters and recommendations for the design and construction of foundations for the proposed overhead and cantilever signs. The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the subsurface investigation for these overhead signs. The interpretation and recommendations provided are intended to provide the designers with sufficient information to design the proposed sign foundations. Where comments are made on construction they are provided in order to highlight those aspects which could affect the planning of the project, and for which special provisions or operational constraints may be required during construction. 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, scheduling and the like.

6.2 Overhead Sign Foundations

Table 2, following the text of this report, summarizes the feasible foundation options for each sign support location, based on the soil conditions and the depth to bedrock as encountered in the borehole drilled at each proposed sign support location.

Based on the subsurface information as presented on the borehole records and summarized in Table 3 following the text of this report, the "standard" caisson design (i.e. caisson length equal to frost depth plus 5 m) is expected to apply for the foundation supports for Overhead Signs OH-1 (South Support only), OH-3, OH-4, OH-5, OH-9 and OH-13. Discussion regarding the "standard" caisson design is provided in Section 6.2.1. The standard design can be checked and optimized by a structural designer, if desired, using the recommendations provided in Section 6.2.1 and the geotechnical parameters provided in Table 3 following the text of this report. It is noted that the borehole depth at some of these sign support locations was only 6 m, in accordance with the RFP terms of reference, and there is potential for bedrock to be encountered at these locations below 6 m but above 6.5 m (i.e., within the standard caisson length). As discussed further in Section 6.2.1, a site-specific design check could be carried out for these sign support locations during design or construction (i.e., if bedrock is encountered), to determine if an overall caisson length of 6 m is sufficient or if socketting of the caisson into rock will be required.

At all other locations, the depth to the bedrock surface is less than 5 m below the design frost depth, and either caissons socketted into bedrock or foundations (caissons or footings) dowelled to bedrock will be required. Recommendations for caissons socketted into bedrock are provided in Section 6.2.2, and recommendations for foundations dowelled to bedrock are provided in Section 6.2.3.

6.2.1 Caisson Foundations in Soil

Caisson foundations for overhead sign supports should be designed in accordance with the requirements in MTO's *Sign Support Manual*. The *Sign Support Manual* includes a standard caisson foundation design (Section 4 and Standard Drawings SS118-3, SS118-4 and SS118-5), in which a 1.2 m diameter caisson is extended 5 m below the design frost depth (i.e. a total length of 6.5 m below grade for this project), except where bedrock is encountered within this depth. The standard design is based on the following minimum soil conditions:

- **Case 1 (Cohesionless Soils):** Sand with a friction angle of 28 degrees surrounding the upper two-thirds of the portion of the caisson foundation below the frost depth, and sand with a friction angle of 30 degrees surrounding the lower third of the portion of the caisson below the design frost depth.
- **Case 2 (Cohesive Soils):** Soft clay with an undrained shear strength of 25 kPa surrounding the upper two-thirds of the portion of the caisson foundation below the frost depth, and "soft" clay with an undrained shear strength of 50 kPa surrounding the lower third of the portion of the caisson below the design frost depth.

The standard foundation design provided in MTO's *Sign Support Manual* does not apply to sites where extensive poor fill materials or materials softer than those of Case 2 are present; for such subsurface conditions, a site-specific design is required.

As noted above, the subsurface soils at the locations for Overhead Signs OH-1, OH-3, OH-4, OH-5, OH-9 and OH-13 have friction angles and/or undrained shear strengths that exceed the input parameters used in the modeling of the standard caisson foundations. Therefore, the standard caisson foundation design (i.e., a 6.5 m long caisson) is suitable for the supports at these sign locations. However, as discussed above, there is potential for bedrock to be encountered near the base of the foundations (below a depth of about 6 m but above 6.5 m) for three of the sign supports near Sir John A. MacDonald Boulevard, as follows:

<i>Sign Support Location</i>	<i>Borehole No.</i>
OH-4, South Support	07-9
OH-4, North Support	07-10
OH-5, North Support	07-13
OH-5, South Support	07-14
OH-13, West Support	07-11
OH-13, East Support	07-12

NOTE: Although Borehole 07-8 at OH-3, North Support is only 5.9 m deep, it is not included here based on subsurface information from the surrounding high fill investigation, which shows that the bedrock is much deeper in this area.

A site-specific design check can be carried out for the above-noted sign support locations during design or construction (i.e., should bedrock be encountered during construction), to determine if an overall caisson length of 6 m is sufficient or if socketting into the bedrock (if present above a

depth of 6.5 m) will be required. The standard design can be checked and optimized by the structural designer using the recommendations provided below and the geotechnical parameters provided in Table 3 following the text of this report.

A site-specific caisson design may be determined using the following equations to calculate the unfactored passive lateral earth pressure, P_p (kPa), distributed along the depth of the caisson foundation; this earth pressure distribution is triangular with depth:

$$\begin{aligned} P_p &= K_p \gamma d_w && \text{above the groundwater table, and} \\ P_p &= K_p \gamma d_w + K_p \gamma' (d - d_w) && \text{below the groundwater table,} \end{aligned}$$

where K_p is the passive earth pressure coefficient, as given in Table 3;
 γ is the bulk unit weight (kN/m³), as given in Table 3;
 γ' is the effective unit weight below the groundwater level (kN/m³);
 d is the depth below the ground surface (m); and
 d_w is the depth to the groundwater level (m), as given in Table 3.

The unfactored lateral resistance should be calculated assuming an equivalent pile width equal to three times the caisson diameter. A resistance factor of 0.5 should be applied to the unfactored lateral resistance to obtain the factored lateral geotechnical resistance at Ultimate Limit States (ULS).

The undrained capacity of the caisson should also be checked to establish whether the drained or the undrained case will govern. For the undrained case, the lateral resistance for the length of the caisson within the cohesive soil should be calculated assuming an unfactored passive lateral pressure distribution varying from $2 s_u$ (undrained shear strength) at ground surface to $9 s_u$ at and below a depth equivalent to three pile diameters, acting over the actual width of the caisson. A resistance factor of 0.5 should be applied to this calculated lateral resistance in order to obtain the factored lateral geotechnical resistance at ULS.

For both the drained and undrained cases, the passive resistance in front of the caisson within the upper 1.5 m below ground surface should be neglected in the design of the foundations to account for frost action.

6.2.2 Caisson Foundations Socketted into Rock

In accordance with Standard Drawing SS118-3 of MTO's *Sign Support Manual*, where bedrock is encountered at a depth, z (in metres), of less than 5 m below the bottom of the frost layer, the required depth (in metres) of the caisson foundation below the frost layer may be taken as:

$$z + [(5 - z) / 2]$$

Based on the above, the caissons at the overhead sign support locations will be socketted between 0.5 m and 2.5 m into the limestone bedrock, as summarized in the table below. It is noted that these estimated caisson lengths and bedrock socket lengths assume that the ground surface elevation at the borehole location is identical to that at the proposed sign support location. Variations in the ground surface or bedrock surface could result in shorter socket lengths; in this case, the socket length should be that calculated using the formula above or 0.3 m, whichever is greater.

<i>Sign</i>	<i>Support</i>	<i>Borehole No.</i>	<i>Depth to Bedrock</i>	<i>Total Caisson Length</i>	<i>Bedrock Socket Length</i>
County Road 38	Single	2	1.2 m	3.7 m	2.5 m
OH-1	North	07-2	5.6 m	6.1 m	0.5 m
OH-2	North	07-5	1.5 m	4.0 m	2.5 m
	South	07-6	2.6 m	4.5 m	2.0 m
OH-6	North	07-15	2.6 m	4.5 m	2.0 m
	South	07-16	3.7 m	5.1 m	1.4 m
OH-7	North	07-18	1.7 m	4.1 m	2.4 m
	South	07-17	4.3 m	5.4 m	1.1 m
OH-8	North	07-20	2.7 m	4.6 m	1.9 m
OH-8	South	07-19	4.1 m	5.3 m	1.2 m
OH-10	North	07-23	1.7 m	4.1 m	2.4 m
	South	07-24	2.0 m	4.3 m	2.3 m
OH-11	North	07-26	2.0 m	4.3 m	2.3 m
	South	07-25	2.2 m	4.4 m	2.2 m
OH-12	North	07-28	1.6 m	4.1 m	2.5 m
	South	07-27	1.3 m	3.8 m	2.5 m
Wolfe Island Ferry	North (Left)	07-WIF-1	3.0 m	4.8 m	1.8 m
	South (Right)	07-WIF-2	3.6 m	5.1 m	1.5 m

The limestone bedrock at the site is medium strong to very strong, and coring or churn drilling will be necessary to advance the socket into the bedrock. A socket length of up to 2.5 m would be required in the rock for these sign support locations; therefore, consideration could also be given to the use of foundations dowelled/anchored to the rock, to minimize coring in the medium strong to very strong bedrock. Recommendations for the design of rock dowels are provided in the following section.

6.2.3 Foundations Dowelled to Rock

Dowelling of concrete foundations (either spread footings or caissons) to the bedrock could be considered where the depth to bedrock is less than 2 m to 3 m, to minimize the amount of bedrock coring and/or churn drilling required for larger diameter caisson sockets. Dowelled caissons may also be considered for all other locations where bedrock will be encountered within the standard foundation depth.

Where dowelled/anchored foundations are adopted, subexcavation of any loose, fractured bedrock will be required prior to construction of the foundation on the bedrock surface. MTO's

Special Provision SP902S01 should be included in the Contract Documents requiring inspection and approval of the foundation area by the Quality Verification Engineer prior to footing construction, to ensure that all loose and/or fractured rock has been removed from the foundation areas prior to construction of the footings or caissons.

The horizontal resistance of the dowels is dependent on the strength of the bedrock, grout and steel. The dowels may be designed based on a factored lateral resistance for the rock mass at ULS of 5 MPa. The rock dowels should have a minimum embedded length within the bedrock of 1 m, except for the cantilever sign at County Road 38 where rock dowels should have a minimum embedded length within the bedrock of 2 m, to extend below the zone of fractured bedrock encountered in the borehole at this location. The structural strength of the dowel and the compressive strength of the grout should not be exceeded.

For uplift of the dowels, a factored value of 700 kPa may be assumed for the grout-to-rock bond stress for ULS design. The actual bond stress along the rock-grout interface may vary from the design value given and it should, therefore, be verified in the field by pull-out testing. It is recommended that, if this foundation type is selected, MTO's Special Provision for supply, installation and testing of dowels be included in the Contract Documents.

6.3 Construction Considerations

It is recommended that a Non-Standard Special Provision (NSSP) be included in the Contract Documents to warn the Contractor of the following items which are expected to affect the installation of the caisson foundations for the sign supports:


- **Control of overburden soils and groundwater:** Excavations for the sign foundations will be advanced through fill materials, cohesive and cohesionless soil deposits. Cohesionless soils should be expected to be unstable below the groundwater level. Appropriate equipment and construction procedures (such as the use of a temporary liner) will be required to construct the caissons where water-bearing cohesionless soils are present.
- **Rock fill:** Rock fill was encountered at some of the sign support locations, as noted on the borehole records and discussed in Section 4.2.2. Appropriate equipment and procedures will be required to penetrate the rock fill as part of caisson installation for the overhead sign supports.
- **Bedrock strength:** Some of the sign foundations will require sockets to be formed within the bedrock, which is medium strong to very strong. Appropriate equipment and construction procedures (such as rock coring or churn drilling techniques) will be required to advance the caisson holes into the bedrock.

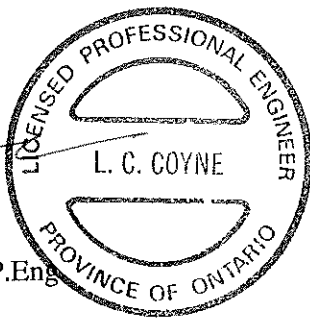
Sample NSSPs to address the control of overburden soils and groundwater, foundation construction through rock fill and bedrock strength are provided in Appendix A.

7.0 CLOSURE

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

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TABLE 1
SUMMARY OF POINT LOAD INDEX TEST RESULTS ON ROCK CORE SAMPLES

<i>Borehole Number</i>	<i>Depth (m)</i>	<i>Test Type</i>	<i>Is Axial (MPa)</i>	<i>Is Diametral (MPa)</i>	<i>Is₅₀ (MPa)</i>	<i>UCS* (MPa)</i>
07-5	3.9	Diametral		12.3	10.8	249
07-5	4.2	Diametral		7.9	7.0	161
07-6	3.8	Diametral		6.3	5.7	120
07-6	5.6	Axial	6.6		6.4	148
07-15	3.8	Diametral		7.7	6.9	158
07-15	4.9	Diametral		4.1	3.7	84
07-15	5.3	Diametral		4.0	3.6	83
07-16	4.9	Diametral		7.2	6.4	147
07-16	5.5	Diametral		8.1	7.1	164
07-16	6.5	Diametral		6.5	5.9	135
07-17	4.6	Diametral		4.7	4.4	100
07-17	4.9	Diametral		4.9	4.6	105
07-17	7.3	Diametral		3.3	3.1	71
07-18	2.3	Diametral		4.8	4.4	93
07-18	3.0	Axial	5.4		5.1	108
07-18	4.0	Diametral		6.9	6.3	132
07-19	5.1	Diametral		5.2	4.8	110
07-19	7.0	Diametral		4.6	4.3	99
07-19	7.2	Diametral		4.5	4.1	95
07-20	3.3	Diametral		4.7	4.3	90
07-20	4.8	Axial	4.7		4.6	107
07-23	2.2	Diametral		4.1	3.7	86
07-23	2.4	Diametral		4.2	3.9	89
07-23	3.6	Diametral		4.7	4.3	99
07-24	4.4	Diametral		4.9	4.5	104
07-24	4.6	Diametral		3.4	3.1	71
07-25	2.9	Diametral		5.1	4.7	107
07-25	3.1	Diametral		5.7	5.4	124
07-25	3.5	Diametral		4.3	3.9	90
07-26	3.0	Diametral		5.6	5.1	106
07-26	3.9	Axial	2.9		2.7	60
07-27	3.5	Diametral		0.5	0.4	10
07-28	2.4	Axial	3.6		3.6	83
07-28	3.6	Diametral		5.7	5.2	109
07-28	4.5	Diametral		0.6	0.5	11
07-WIF-1	3.5	Diametral		8.3	7.2	152
07-WIF-1	5.2	Axial	4.5		4.3	99
07-WIF-2	3.9	Diametral		6.9	6.3	132
07-WIF-2	4.9	Axial	9.0		8.2	181

Checked: K. GallantReviewed: L.C. Coyne

* The UCS values have been approximated using $Is_{50} \times 23$, from ISRM ("Suggested Methods for Determining Point Load Strength", International Society for Rock Mechanics Commission on Testing Methods, Int. Journal Rock Mech. Min. Sci. and Geomechanical Abstr., Vol. 22, No. 2, 1985, pp. 51-60.

TABLE 2
SUMMARY OF FEASIBLE FOUNDATION OPTIONS
OVERHEAD SIGN SUPPORT STRUCTURES
HIGHWAY 401 WIDENING FROM WEST OF SYDENHAM ROAD
TO WEST OF MONTREAL STREET, KINGSTON, ONTARIO
W.P. 77-99-01

<i>Sign</i>	<i>Support</i>	<i>Borehole No.</i>	<i>Depth to Bedrock (m)</i>	<i>Standard Caisson in Soil</i>	<i>Site-Specific Caisson in Soil</i>	<i>Caisson Socketted into Rock</i>	<i>Foundation Anchored to Rock</i>
County Rd 38	Single	2	1.2			X	X
OH-1	North	07-2	5.6			X	
	South	07-3	6.6	X			
OH-2	North	07-5	1.5			X	X
	South	07-6	2.6			X	X
OH-3	North	07-8	-	X			
	South	07-7	-	X			
OH-4	North	07-10	-	X			
	South	07-9	-	X			
OH-5	North	07-13	-	X			
	South	07-14	-	X			
OH-6	North	07-15	2.6			X	X
	South	07-16	3.7			X	X
OH-7	North	07-18	1.7			X	X
	South	07-17	4.3			X	X
OH-8	North	07-20	2.7			X	X
	South	07-19	4.1			X	X
OH-9	Single	07-21	-	X			
OH-10	North	07-23	1.7			X	X
	South	07-24	2.0			X	X
OH-11	North	07-26	2.0			X	X
	South	07-25	2.2			X	X
OH-12	North	07-28	1.6			X	X
	South	07-27	1.3			X	X
OH-13	West	07-11	-	X			
	East	07-12	-	X			
Wolfe Island Ferry	North (Left)	07-WIF-1	3.0			X	X
	South (Right)	07-WIF-2	3.6			X	X

TABLE 3
GEOTECHNICAL DESIGN PARAMETERS FOR TRICHORD OVERHEAD SIGN FOUNDATIONS
HIGHWAY 401 WIDENING FROM WEST OF SYDENHAM ROAD TO WEST OF MONTREAL STREET
KINGSTON, ONTARIO – W.P. 77-99-01

Sign Support	Borehole No.	Stratum	Depth ¹ (m)	Elevation (m)	Groundwater Elevation (m)	s _u	φ'	γ	γ'	K _p
County Road 38 Single Support	2	Compact gravel fill Limestone bedrock	Above 1.2 Below 1.2	Above 109.4 Below 109.4	N/A	- -	30 -	20 -	10 -	3.0 -
OH-1 North Support	07-2	Compact sand and gravel fill Firm to stiff clayey silt fill Very stiff silty clay Very stiff to hard clayey silt till Probable limestone bedrock	Above 1.4 1.4 – 3.7 3.7 – 4.4 4.4 – 5.6 Below 5.6	Above 99.5 99.5 - 97.2 97.2 – 96.5 96.5 – 95.3 Below 95.3	96.5	- 50 100 - -	30 28 30 32 -	20 19 19 21 -	10 9 9 11 -	3.0 2.8 3.0 3.3 -
OH-1 South Support	07-3	Compact to very dense sand and gravel fill Firm to stiff silty clay fill/silty clay/ clayey silt till Soft to firm silty clay/clayey silt till Stiff clayey silt till	Above 1.7 1.7 – 5.9 Below 5.9	Above 99.5 99.5 – 95.3 Below 95.3	96.5	- 50 100	30 28 30	20 19 21	10 9 11	3.0 2.8 3.0
OH-2 North Support	07-5	Loose to compact sand and gravel fill / Stiff clayey silt fill Limestone bedrock	Above 1.5 Below 1.5	Above 94.1 Below 94.1	92.0	- -	30 -	20 -	10 -	3.0 -
OH-2 South Support	07-6	Very dense sand and gravel fill/rock fill Limestone bedrock	Above 2.6 Below 2.6	Above 92.8 Below 92.8	92.0	- -	30 -	19 -	9 -	3.0 -
OH-3 North Support	07-8	Loose to compact sandy gravel fill Stiff silty clay to clay	Above 5.0 Below 5.0	Above 80.7 Below 80.7	80.0	- 75	30 28	20 19	10 9	3.0 2.8
OH-3 South Support	07-7	Loose to dense sandy gravel fill Stiff clayey silt fill/clay	Above 5.2 Below 5.2	Above 80.3 Below 80.3	80.0	- 75	30 28	20 19	10 9	3.0 2.8
OH-4 North Support	07-10	Compact to dense sand and gravel fill Firm to very stiff silty clay to clay	Above 1.8 Below 1.8	Above 85.2 Below 85.2	81.0	- 75	30 28	20 19	10 9	3.0 2.8

- NOTES:**
1. Depths are given for the borehole location; the ground surface elevation at the borehole location should be compared to the ground surface elevation at the actual sign support location, and the depths of the soil strata and depth to bedrock adjusted accordingly.
 2. Design parameters: c_u = undrained shear strength (kPa) ϕ' = effective friction angle (degrees)
 γ = bulk unit weight (kN/m³) γ' = effective unit weight below the groundwater level (kN/m³)
 K_p = passive earth pressure coefficient
 3. Although the passive resistance in the upper 1.5 m is neglected to account for frost action, c_u , ϕ' and K_p parameters are given in the event that the ground surface elevation varies significantly between the borehole and sign support locations.

TABLE 3 (Continued)
GEOTECHNICAL DESIGN PARAMETERS FOR TRICHORD OVERHEAD SIGN FOUNDATIONS
HIGHWAY 401 WIDENING FROM WEST OF SYDENHAM ROAD TO WEST OF MONTREAL STREET
KINGSTON, ONTARIO – W.P. 77-99-01

<i>Sign Support</i>	<i>Borehole No.</i>	<i>Stratum</i>	<i>Depth¹ (m)</i>	<i>Elevation (m)</i>	<i>Groundwater Elevation (m)</i>	<i>s_x</i>	<i>φ'</i>	<i>γ</i>	<i>γ'</i>	<i>K_p</i>
OH-4 South Support	07-9	Compact sand and gravel fill	Above 1.1	Above 85.2	81.0	-	30	20	10	3.0
		Stiff to very stiff silty clay fill/silty clay	Below 1.1	Below 85.2		100	28	19	9	2.8
OH-5 North Support	07-13	Compact sand and gravel fill/Loose silty sand fill	Above 2.1	Above 86.6	83.0	-	28	20	10	2.8
		Stiff to very stiff silty clay to clay	2.1 – 5.8	86.6 – 82.9		-	30	19	9	3.0
		Firm silty clay	Below 5.8	Below 82.9		50	28	19	9	2.8
OH-5 South Support	07-14	Compact sand to silty sand fill	Above 2.1	Above 86.7	83.0	-	30	20	10	3.0
		Soft to firm clayey silt fill	2.1 – 2.9	86.7 – 85.9		25	28	19	9	2.8
		Compact sandy silt	2.9 – 3.7	85.9 – 85.1		-	30	19	9	3.0
		Very stiff silty clay to clay	3.7 – 6.0	85.1 – 82.8		100	30	19	9	3.0
		Stiff silty clay to clay	Below 6.0	Below 82.8		50	28	19	9	2.8
OH-6 North Support	07-15	Compact sand and gravel fill	Above 1.4	Above 88.8	86.0	-	30	20	10	3.0
		Very stiff clayey silt fill	1.4 – 2.1	88.8 – 88.1		-	28	19	9	2.8
		Compact silty sand till	2.1 – 2.6	88.1 – 87.6		-	30	21	11	3.0
		Limestone bedrock	Below 2.6	Below 87.6		-	-	-	-	-
OH-6 South Support	07-16	Loose to compact sand and gravel to sandy silt fill	Above 3.7	Above 87.5	86.0	-	28	20	10	2.8
		Compact silty sand till	3.7 – 4.4	87.5 – 86.8		-	30	21	11	3.0
		Limestone bedrock	Below 4.4	Below 86.8		-	-	-	-	-
OH-7 North Support	07-18	Compact sand and gravel fill	Above 1.7	Above 90.1	87.0	-	30	20	10	3.0
		Limestone bedrock	Below 1.7	Below 90.1		-	-	-	-	-

- NOTES:**
1. Depths are given for the borehole location; the ground surface elevation at the borehole location should be compared to the ground surface elevation at the actual sign support location, and the depths of the soil strata and depth to bedrock adjusted accordingly.
 2. Design parameters: c_u = undrained shear strength (kPa) ϕ' = effective friction angle (degrees)
 γ = bulk unit weight (kN/m³) γ' = effective unit weight below the groundwater level (kN/m³)
 K_p = passive earth pressure coefficient
 3. Although the passive resistance in the upper 1.5 m is neglected to account for frost action, c_u , ϕ' and K_p parameters are given in the event that the ground surface elevation varies significantly between the borehole and sign support locations.

TABLE 3 (Continued)
GEOTECHNICAL DESIGN PARAMETERS FOR TRICHORD OVERHEAD SIGN FOUNDATIONS
HIGHWAY 401 WIDENING FROM WEST OF SYDENHAM ROAD TO WEST OF MONTREAL STREET
KINGSTON, ONTARIO – W.P. 77-99-01

<i>Sign Support</i>	<i>Borehole No.</i>	<i>Stratum</i>	<i>Depth¹ (m)</i>	<i>Elevation (m)</i>	<i>Groundwater Elevation (m)</i>	<i>s_u</i>	<i>φ'</i>	<i>γ</i>	<i>γ'</i>	<i>K_p</i>
OH-7 South Support	07-17	Compact sand and gravel fill	Above 1.4	Above 90.6	87.0	-	30	20	10	3.0
		Stiff clayey silt fill/Compact sandy silt fill	1.4 – 4.3	90.6 – 87.7		-	28	19	9	2.8
		Limestone bedrock	Below 4.3	Below 87.7		-	-	-	-	-
OH-8 North Support	07-20	Compact to dense sand fill/rock fill	Above 2.7	Above 88.2	86.0	-	30	20	10	3.0
		Limestone bedrock	Below 2.7	Below 88.2		-	-	-	-	-
OH-8 South Support	07-19	Compact sand and gravel fill	Above 2.1	Above 88.7	86.0	-	30	20	10	3.0
		Stiff clayey silt fill	2.1 – 4.1	88.7 – 86.7		50	28	19	9	2.8
		Limestone bedrock	Below 4.1	Below 86.7		-	-	-	-	-
OH-9	07-21	Compact sand and gravel fill	Above 2.1	Above 85.8	80.0	-	30	20	10	3.0
		Loose to dense rock fill	2.1 – 6.0	85.8 – 81.9		-	32	19	9	3.3
		Stiff to very stiff clayey silt fill/Stiff silty clay	Below 6.0	Below 81.9		-	28	19	9	2.8
OH-10 North Support	07-23	Sand and gravel fill/Stiff clayey silt fill	Above 1.7	Above 108.8	108.0	-	28	20	10	2.8
		Limestone bedrock	Below 1.7	Below 108.8		-	-	-	-	-
OH-10 South Support	07-24	Very loose to dense gravelly sand to sand and gravel fill	Above 2.0	Above 108.7	108.0	-	30	20	10	3.0
		Limestone bedrock	Below 2.0	Below 108.7		-	-	-	-	-
OH-11 North Support	07-26	Dense to very dense sand and gravel fill	Above 1.4	Above 109.9	108.0	-	30	20	10	3.0
		Stiff clayey silt fill	1.4 – 2.0	109.9 – 109.3		-	28	19	9	2.8
		Limestone bedrock	Below 2.0	Below 109.3		-	-	-	-	-
OH-11 South Support	07-25	Loose to very dense sand to sandy silt fill	Above 2.2	Above 107.8	108.0	-	28	20	10	2.8
		Limestone bedrock	Below 2.2	Below 107.8		-	-	-	-	-

- NOTES:**
1. Depths are given for the borehole location; the ground surface elevation at the borehole location should be compared to the ground surface elevation at the actual sign support location, and the depths of the soil strata and depth to bedrock adjusted accordingly.
 2. Design parameters: c_u = undrained shear strength (kPa) ϕ' = effective friction angle (degrees)
 γ = bulk unit weight (kN/m³) γ' = effective unit weight below the groundwater level (kN/m³)
 K_p = passive earth pressure coefficient
 3. Although the passive resistance in the upper 1.5 m is neglected to account for frost action, c_u , ϕ' and K_p parameters are given in the event that the ground surface elevation varies significantly between the borehole and sign support locations.

TABLE 3 (Continued)
GEOTECHNICAL DESIGN PARAMETERS FOR TRICHORD OVERHEAD SIGN FOUNDATIONS
HIGHWAY 401 WIDENING FROM WEST OF SYDENHAM ROAD TO WEST OF MONTREAL STREET
KINGSTON, ONTARIO – W.P. 77-99-01

<i>Sign Support</i>	<i>Borehole No.</i>	<i>Stratum</i>	<i>Depth¹ (m)</i>	<i>Elevation (m)</i>	<i>Groundwater Elevation (m)</i>	<i>s_u</i>	<i>φ'</i>	<i>γ</i>	<i>γ'</i>	<i>K_p</i>
OH-12 North Support	07-28	Dense to very dense sand and gravel/ rock fill	Above 1.6	Above 111.5	110.0	-	30	20	10	3.0
		Limestone bedrock	Below 1.6	Below 111.5		-	-	-	-	-
OH-12 South Support	07-27	Compact sand and gravel fill	Above 1.3	Above 111.2	110.0	-	30	20	10	3.0
		Limestone bedrock	Below 1.3	Below 111.2		-	-	-	-	-
OH-13 West Support	07-11	Stiff silty clay fill/silty clay to clay	Above 3.8	Above 77.0	77.0	75	28	19	9	2.8
		Firm to stiff silty clay to clay	3.8 – 5.5	77.0 – 75.3		50	28	19	9	2.8
		Very loose silty sand till	Below 5.5	Below 75.3		-	28	21	11	2.8
OH-13 East Support	07-12	Loose sand and gravel fill	Above 1.4	Above 79.2	77.0	-	28	20	10	2.8
		Very stiff silty clay to clay	1.4 – 4.1	79.2 – 76.5		-	30	19	9	3.0
		Stiff silty clay to clay	4.1 – 5.3	76.5 – 75.3		65	28	19	9	2.8
		Loose sandy silt	Below 5.3	Below 75.3		-	28	21	11	2.8
Wolfe Island Ferry North (Left) Support	07-WIF-1	Compact to very loose sand and gravel fill	Above 3.0	To be confirmed	To be confirmed	-	28	20	10	2.8
		Limestone bedrock	Below 3.0			-	-	-	-	-
Wolfe Island Ferry South (Right) Support	07-WIF-2	Compact to dense sand and gravel fill	Above 2.1	To be confirmed	To be confirmed	-	30	20	10	3.0
		Loose to compact silty sand till	2.1 – 3.6			-	30	21	11	3.0
		Limestone bedrock	Below 3.6			-	-	-	-	-

- NOTES:**
1. Depths are given for the borehole location; the ground surface elevation at the borehole location should be compared to the ground surface elevation at the actual sign support location, and the depths of the soil strata and depth to bedrock adjusted accordingly.
 2. Design parameters: c_u = undrained shear strength (kPa); ϕ' = effective friction angle (degrees);
 γ = bulk unit weight (kN/m³); γ' = effective unit weight below the groundwater level (kN/m³); and
 K_p = passive earth pressure coefficient.
 3. Although the passive resistance in the upper 1.5 m is neglected to account for frost action, c_u , ϕ' and K_p parameters are given in the event that the ground surface elevation varies significantly between the borehole and sign support locations.

LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

III. SOIL DESCRIPTION

(a) Cohesionless Soils

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Consistency

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

(b) Cohesive Soils

Dynamic Cone Penetration Resistance; N_d :

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

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

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

IV. SOIL TESTS

w water content
 w_p plastic limit
 w_l liquid limit
C consolidation (oedometer) test
CHEM chemical analysis (refer to text)
CID consolidated isotropically drained triaxial test¹
CIU consolidated isotropically undrained triaxial test with porewater pressure measurement¹
 D_R relative density (specific gravity, G_s)
DS direct shear test
M sieve analysis for particle size
MH combined sieve and hydrometer (H) analysis
MPC Modified Proctor compaction test
SPC Standard Proctor compaction test
OC organic content test
 SO_4 concentration of water-soluble sulphates
UC unconfined compression test
UU unconsolidated undrained triaxial test
V field vane (LV-laboratory vane test)
 γ unit weight

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

LIST OF SYMBOLS

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

I. General

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation
*	Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

- Notes: 1 $\tau = c' + \sigma' \tan \phi'$
2 Shear strength = (Compressive strength)/2

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE

Fresh: no visible sign of weathering.

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock texture and structure are preserved.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	> 2 m
Thickly bedded	0.6 m to 2m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	< 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	> 3 m
Wide	1 - 3 m
Moderately close	0.3 - 1 m
Close	50 - 300 mm
Very close	< 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	> 60 mm
Coarse Grained	2 - 60 mm
Medium Grained	60 microns - 2 mm
Fine Grained	2 - 60 microns
Very Fine Grained	< 2 microns

Note: * Grains > 60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid sticks.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to (W.R.T.) Core Axis




The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90° angle is horizontal.

Description and Notes

An abbreviated description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

B - Bedding	P - Polished
FO - Foliation/Schistosity	S - Slickensided
CL - Cleavage	SM - Smooth
SH - Shear Plane/Zone	R - Ridged/Rough
VN - Vein	ST - Stepped
F - Fault	PL - Planar
CO - Contact	FL - Flexured
J - Joint	UE - Uneven
FR - Fracture	W - Wavy
MF - Mechanical Fracture	C - Curved
- Parallel To	
⊥ - Perpendicular To	

PROJECT 021-1142			RECORD OF BOREHOLE No 2				1 OF 1 METRIC									
W.P. 76-99-01		LOCATION N 4905053.9 ; E 289229.7		ORIGINATED BY PKS												
DIST 41 HWY 401		BOREHOLE TYPE 108mm ID Hollow Stem Auger		COMPILED BY JFC												
DATUM Geodetic		DATE September 27, 2002		CHECKED BY LCC												
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							WATER CONTENT (%)	
110.6	GROUND SURFACE						20	40	60	80	100					
0.9	Silty Sand, trace clay to clayey silt with sand, some gravel, some styrofoam pieces (FILL) Compact/Stiff		1	SS	13											
109.4	Crushed limestone gravel (FILL) Compact		2	SS	24											
1.2	Limestone/Dolostone (BEDROCK)															
	For bedrock coring details, refer to Record of Drillhole 2.															
106.3	NOTE: Borehole dry on completion of overburden drilling.															
4.3																

MIS-MTO 001 021-1142.GPJ GAL-MISS.GDT 5/26/08

PROJECT: 021-1142

RECORD OF DRILLHOLE: 2

SHEET 1 OF 1

LOCATION: N 4905053.9 ; E 299229.7



DRILLING DATE: September 27, 2002

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-55 Bombardier

DRILLING CONTRACTOR: Marathon

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN NO.	PENETRATION RATE (mm/min)	FLUSH % RETURN	FR/FX-FRACTURE F-FAULT												SM-SMOOTH				FL-FLEXURED				BC-BROKEN CORE				DIAMETER POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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								SH-SHEAR				P-POLISHED				ST-STEPPED				W-WAVY				B-BEDDING																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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		RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
TOTAL CORE %	SOLID CORE %	DIP W/LL CORE AXIS	TYPE AND SURFACE DESCRIPTION			K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec	K _{core} cm/sec																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
2	CME-55 BOMBARDIER 108mm ID HOLLOW STEM AUGER	Refer to Previous Page		1.24	1	0.1	50													4	Broken Core																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															</

DEPTH SCALE

1:50



LOGGED: PKS

CHECKED: LCC

MIS-ROCK 001 1142-ROCK.GPJ GAL-MISS.GDT 5/28/08 JFC

PROJECT 05-1111-031			RECORD OF BOREHOLE No 07-2			1 OF 1 METRIC									
W.P. 77-99-01			LOCATION N 4904092.3 ; E 301679.7			ORIGINATED BY DM									
DIST Eastern HWY 401			BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers			COMPILED BY KG									
DATUM Geodetic			DATE January 23, 2007			CHECKED BY LCC									
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
100.9	GROUND SURFACE														
0.0	Sand and gravel (FILL) Compact Grey Moist		1	SS	18										
99.5															
1.4	Clayey silt, trace sand and gravel (FILL) Firm to stiff Brown Moist		2	SS	4										
98.3			3	SS	9										
2.7	TOPSOIL Clayey silt, containing sand seams (Possible FILL) Firm Brown Moist		4	SS	7										
97.2															
3.7	SILTY CLAY, trace sand Very stiff Brown Moist		5	SS	15										
96.5															
4.4	CLAYEY SILT with sand, some gravel (TILL) Very stiff to hard Brown Wet		6	SS	20										
95.3															
5.6	End of Borehole Auger Refusal		7	SS	30/0.13										
Notes: 1. Water encountered at 5.2 m depth during drilling.															

RECORD OF BOREHOLE No 07-3

1 OF 1 **METRIC**

PROJECT 05-1111-031

W.P. 77-99-01

LOCATION N 4904076.9 ; E 301678.2

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE February 27, 2007

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
101.2	GROUND SURFACE																
0.0	ASPHALT						101										
0.3	Sand and gravel (FILL) Compact to very dense Brown Moist		1	SS	112		100										
99.5			2	SS	13		99										
1.7	Silty clay, some sand and gravel, containing organics (FILL) Firm to stiff Brown to grey Moist		3	SS	5		98										
97.7			4	SS	6		97										
3.5	SILTY CLAY, trace sand, containing organics Stiff Grey-brown Moist		5	SS	10		96										
96.8			6	SS	4		95										
4.4	SILTY CLAY, some sand, trace gravel Firm Brown Moist		7	SS	2												
96.2			8	SS	14												
5.0	CLAYEY SILT with sand, some gravel (TILL) Soft to stiff Brown Wet																
94.7																	
6.6	End of Borehole Auger and Split Spoon Sampler Refusal Notes: 1. Borehole dry upon completion of drilling.																

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

RECORD OF BOREHOLE No 07-5

1 OF 1 **METRIC**

PROJECT 05-1111-031

W.P. 77-99-01

LOCATION N 4904013.2 ; E 302097.6

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE January 29, 2007

CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100					
95.6	GROUND SURFACE															
0.0	Sand and gravel (FILL) Loose to compact Grey Moist															
94.7			1	SS	8											
0.9	Clayey silt, trace sand and gravel (FILL) Stiff Brown Moist		2	SS	5/0.15											
94.1																
1.5	LIMESTONE (BEDROCK) containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		3	RC	REC 35%											RQD = 23%
	Bedrock cored from 1.5 m to 4.2 m depth. For bedrock coring details, refer to Record of Drillhole 07-5		4	RC	REC 98%											RQD = 61%
91.4																
4.2	End of Borehole															
	Notes: 1. Borehole dry prior to start of rock coring operations.															

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-5

SHEET 1 OF 1

LOCATION: N 4904013.2 ; E 302097.6

DRILLING DATE: January 29, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	PENETRATION RATE min/(m)	FLUSH % RETURN	COLOUR	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PG - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock	NOTES WATER LEVELS INSTRUMENTATION
NO Rotary Coring, Uncased													
2		Continued from Record of Borehole 07-5		94.08									
3		LIMESTONE (BEDROCK) containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		1.52									
4													
5		End of Drillhole		91.36									
6				4.24									
7													
8													
9													
10													
11													

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-RCK 004 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT 05-1111-031		RECORD OF BOREHOLE No 07-6		1 OF 1 METRIC	
W.P. 77-99-01		LOCATION N 4904003.4 :E 302095.1		ORIGINATED BY DM	
DIST Eastern HWY 401		BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers		COMPILED BY KG	
DATUM Geodetic		DATE February 27, 2007		CHECKED BY LCC	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
95.4	GROUND SURFACE						20	40	60	80	100	25	50	75			
0.0	ASPHALT																
0.3	Sand and gravel, trace silt and clay, containing cobbles (FILL.) Very dense Grey Moist Gravel and cobbles, some sand (ROCK FILL.) Very dense Grey Dry																
94.5			1	SS	50/0.15												
0.9			2	SS	113											39 52 7 2	
92.8			3	SS	51/0.15												
2.6	LIMESTONE (BEDROCK) containing shale seams Fresh Grey Medium strong to very strong Thinly bedded Bedrock cored from 2.6 m to 5.8 m depth. For bedrock coring details, refer to Record of Drillhole 07-6		4	RC	REC 100%											RQD = 37%	
				5	RC	REC 100%											RQD = 84%

MIS-MTO 001 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-6

SHEET 1 OF 1

LOCATION: N 4904003.4 E 302095.1

DRILLING DATE: February 27, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: --

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN NO.	PENETRATION RATE mm/min	FLUSH % RETURN	RECOVERY TOTAL CORE %	SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.3 m	DISCONTINUITY DATA										HYDRAULIC CONDUCTIVITY K, cm/sec				Diametral Point Load Index (MPa)	RMC Q AVG.	NOTES WATER LEVELS INSTRUMENTATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
												JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock	NOTE: For additional abbreviations refer to list of abbreviations & symbols	TYPE AND SURFACE DESCRIPTION	Jr	Ju	Jn	10°	10°	10°	10°				10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	1

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-RCX 004 051111031.GPJ GAL-MISS.GDT 2/8/08

RECORD OF BOREHOLE No 07-7

1 OF 1 **METRIC**

PROJECT 05-1111-031

W.P. 77-99-01

LOCATION N 4903856.8 ; E 302463.6

ORIGINATED BY DM

DIST Eastern HWY 401




BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE January 11, 2007

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
85.5	GROUND SURFACE						20	40	60	80	100							
0.0	Sand and gravel (FILL)																	
85.0	Grey																	
0.5	Clayey silt (FILL)																	
84.6	Very stiff		1	SS	28													
0.9	Grey-brown																	
	Moist																	
	Sandy gravel, trace silt, containing cobbles (FILL)		2	SS	13													
	Loose to dense																	
	Grey-brown	3	SS	16														
	Moist																	
		4	SS	6														
		5	SS	5														
		6	SS	30														
80.3																		
5.2	Clayey silt, trace sand and gravel (FILL)		7	SS	8													
79.6	Stiff																	
5.9	Brown																	
	Moist																	
	CLAY, trace sand		8	SS	12													
79.0	Stiff																	
	Brown																	
6.6	Moist																	
	End of Borehole																	
	Notes:																	
	1. Borehole dry upon completion of drilling.																	

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

RECORD OF BOREHOLE No 07-8

1 OF 1 **METRIC**

PROJECT 05-1111-031

W.P. 77-99-01

LOCATION N 4903864.5 ; E 302465.0

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG



DATUM Geodetic

DATE February 28, 2007

CHECKED BY LCC

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		
85.7	GROUND SURFACE													
0.0	ASPHALT													
85.3														
0.4	Sand and gravel (FILL)													
84.7	Brown Dry													
1.0	Sandy gravel, trace silt, containing cobbles/boulders (ROCK FILL) Grey-brown Loose to compact Dry		1	SS	9									
			2	SS	17									
			3	SS	5									
			4	SS	8									
			5	SS	8									
80.7			6	SS	11									
5.0	SILTY CLAY to CLAY, trace sand Stiff Brown Moist													
79.8														
5.9	End of Borehole Notes: 1. Borehole dry upon completion of drilling.													

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

PROJECT 05-1111-031		RECORD OF BOREHOLE No 07-9		1 OF 1 METRIC															
W.P. 77-99-01		LOCATION N 4903644.7 E 302984.8		ORIGINATED BY DM															
DIST Eastern HWY 401		BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers		COMPILED BY KG															
DATUM Geodetic		DATE January 29, 2007		CHECKED BY LCC															
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa			WATER CONTENT (%)			γ			GR SA SI CL		
86.3 0.0	GROUND SURFACE Sand and gravel (FILL) Compact Grey Moist						86												
85.2 1.1	Silty clay, trace to some sand, trace gravel, containing organics (FILL) Stiff to very stiff Brown to grey-brown Moist		1	SS	25		85				o								
			2	SS	19		84				o						0 14 44 42		
			3	SS	10		83												
82.6 3.7	SILTY CLAY, trace sand and gravel Stiff to very stiff Brown to grey-brown Moist		4	SS	9		82				o								
			5	SS	13		81												
			6	SS	16														
80.2 6.1	End of Borehole Notes: 1. Borehole dry upon completion of drilling.			7	SS	10						o							

MIS-MTO 001 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT 05-1111-031		RECORD OF BOREHOLE No 07-10		1 OF 1 METRIC	
W.P. 77-99-01		LOCATION N 4903666.6 ; E 302993.3		ORIGINATED BY DM	
DIST Eastern HWY 401		BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers		COMPILED BY KG	
DATUM Geodetic		DATE March 1, 2007		CHECKED BY LCC	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								20 40 60 80 100										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED										
87.0	GROUND SURFACE																	
0.0	ASPHALT																	
86.6																		
0.4	Sand and gravel, containing clayey silt pockets (FILL) Compact to dense Brown Moist		1	SS	38													
85.2			2	SS	9													
1.8	SILTY CLAY to CLAY, trace to some sand, trace gravel, containing silt seams and layers Firm to very stiff Grey-brown Moist		3	SS	5													
			4	SS	12													
			5	SS	17													
			6	SS	9													
			7	SS	8													
81.1	End of Borehole																	
5.9	Notes: 1. Borehole dry upon completion of drilling.																	

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

RECORD OF BOREHOLE No 07-12

1 OF 1 **METRIC**

PROJECT 05-1111-031

W.P. 77-99-01

LOCATION N 4903322.0 ; E 303270.6

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE January 16, 2007

CHECKED BY LCC

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		
80.6	GROUND SURFACE													
0.0	Sand and gravel, some silt, trace clay (FILL) Loose Brown Moist		1	SS	6									
79.2														
1.4	SILTY CLAY to CLAY, trace sand and gravel Stiff to very stiff Brown Moist		2	SS	14									
	Becoming grey-brown at 3.8 m depth		3	SS	13									
			4	SS	8									
			5	SS	4									
75.3	Becoming grey at 5.2 m depth													
5.3	SANDY SILT, trace gravel and clay (TILL)		6	SS	3									
74.8	Loose													
5.8	Grey Wet End of Borehole													
	Notes: 1. Borehole dry upon completion of drilling.													

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

RECORD OF BOREHOLE No 07-13

1 OF 1 **METRIC**

PROJECT 05-1111-031

W.P. 77-99-01

LOCATION N 4903526.0 ; E 303416.1

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE January 18, 2007

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
88.7	GROUND SURFACE														
0.0	Sand and gravel (FILL) Compact Grey Moist		1	SS	19		88								
87.4															
1.3	Silty sand, trace gravel, containing clayey silt zones (FILL) Loose Brown Moist		2	SS	5		87							3 53 22 22	
86.6															
2.1	SILTY CLAY to CLAY, trace to some sand Stiff to very stiff Brown Moist		3	SS	10		86								
			4	SS	13		85								
			5	SS	20		84								
			6	SS	17		83								
82.9			7	SS	6										
82.6	SILTY CLAY, trace sand, containing silt seams Firm Grey Moist														
6.1	End of Borehole														
	Notes: 1. Borehole dry upon completion of drilling.														



RECORD OF BOREHOLE No 07-14

1 OF 1 METRIC

PROJECT 05-1111-031

W.P. 77-99-01

LOCATION N 4903513.0; E 303410.4

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE January 31, 2007

CHECKED BY LCC

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		
88.8	GROUND SURFACE													
0.0	ASPHALT													
0.2	Sand and gravel (FILL) Grey													
88.1														
0.7	Sand to silty sand, trace gravel (FILL) Compact Brown Moist		1	SS	28		88							
			2	SS	16		87							
86.7														
2.1	Clayey silt, some sand, trace gravel, containing rootlets (FILL) Soft to firm Grey-brown Moist		3	SS	3		86							
85.9														
2.9	SANDY SILT, trace gravel Compact Brown Moist		4	SS	17		85							
85.1														
3.7	SILTY CLAY to CLAY, trace sand and gravel, containing sand seams Very stiff to stiff Grey-brown Moist		5	SS	23		84							
			6	SS	25		83							
82.7														
6.1	End of Borehole		7	SS	5									
	Notes: 1. Borehole dry upon completion of drilling.													

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

RECORD OF BOREHOLE No 07-15

1 OF 1 **METRIC**

PROJECT 05-1111-031

W.P. 77-99-01

LOCATION N 4903381.4 ; E 303828.6

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE January 22, 2007

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
90.2	GROUND SURFACE						20	40	60	80	100	25	50	75		
0.0	Sand and gravel (FILL) Grey						90									
89.6																
0.8	Silty clay, trace sand and gravel (FILL)		1	SS	25											
88.8	Sand and gravel, some silt (FILL)						89									
1.4	Compact Grey Moist		2	SS	15											
88.1	Clayey silt, some sand and gravel (FILL)															
2.1	Very stiff Brown Moist		3	SS	15		88									
87.6																
2.6	SILTY SAND, some gravel, trace clay (TILL) Compact Brown Moist		4	RC	REC 89%		87								RQD = 35%	
	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		5	RC	REC 100%		86								RQD = 82%	
	Bedrock cored from 2.6 m to 5.4 m depth. For bedrock coring details, refer to Record of Drillhole 07-15		6	RC	REC 83%		85								RQD = 27%	
84.8																
5.4	End of Borehole															
	Notes: 1. Borehole dry prior to start of rock coring operations.															

+ 3, X 3: Numbers refer to Sensitivity

O 3% STRAIN AT FAILURE

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-15

SHEET 1 OF 1

LOCATION: N 4903381.4 ; E 303828.6

DRILLING DATE: January 22, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE mm/rev	FLUSH % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vain CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES WATER LEVELS INSTRUMENTATION
3		Continued from Record of Borehole 07-15		87.61									
4		LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded - Soil infilling at 3.65 m - Weathered rock and vertical fracture from 4.60 m to 4.90 m		2.59	4								
5					5								
6					6								
7		End of Drillhole		84.84									
8				5.36									
9													
10													
11													
12													

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-RCK 004 051111031.GPJ GAL-MISS.GDT 28/08



RECORD OF BOREHOLE No 07-16

1 OF 1 METRIC

PROJECT 05-1111-031

W.P. 77-99-01

DIST Eastern HWY 401

DATUM Geodetic

LOCATION N 4903368.4 ; E 303825.7

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

DATE January 31, 2007

ORIGINATED BY DM

COMPILED BY KG

CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) 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					
91.2	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sand and gravel, trace silt (FILL) Compact Grey-brown to grey Moist		1	SS	29											
89.0																
2.2	Sand and silt to sandy silt, some gravel, containing organics (FILL) Compact to loose Grey-brown Moist		2	SS	17											
			3	SS	9											
87.5																
3.7	Silty SAND, trace gravel and clay (TILL) Compact Brown Moist		4	SS	11											9 63 (28)
86.8	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		5	RC	REC 100%											RQD = 64%
4.4	Bedrock cored from 4.4 m to 7.4 m depth. For bedrock coring details, refer to Record of Drillhole 07-16		6	RC	REC 95%											RQD = 65%
83.8																
7.4	End of Borehole															
	Notes: 1. Borehole dry prior to start of rock coring operations.															

MIS-MTO 001 051111031.GPJ GAL-MISS.GDT 2/8/08

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

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-16

SHEET 1 OF 1

LOCATION: N 4903368.4 ;E 303825.7

DRILLING DATE: January 31, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: --

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN NO.	PENETRATION RATE mm/(m)	FLUSH	COLOUR	% RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock	NOTE: For additional abbreviations refer to list of abbreviations & symbols.	RECOVERY TOTAL CORE % SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.3 m	B Angle	DIP W1 CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diameter Point Load Index (MPa)	RQD % AVG.	NOTES WATER LEVELS INSTRUMENTATION
		Continued from Record of Borehole 07-16		86.78																							
5	NG Rotary Coring, Uncased	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded - Fractured zone at 4.72 m		4.42	5																						
6					6																						
7																											
8		End of Drillhole		83.76																							
9				7.44																							
10																											
11																											
12																											
13																											
14																											

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-ROK 004 051111031.GPJ GAL-MISS.GOT 2/8/08

RECORD OF BOREHOLE No 07-17

1 OF 1 **METRIC**

PROJECT 05-1111-031

W.P. 77-99-01

LOCATION N 4903308.3 E 304024.7

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE January 24, 2007

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100														
								SHEAR STRENGTH kPa										WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED														
92.0	GROUND SURFACE																					
0.0	Sand and gravel (FILL) Compact Grey Moist		1	SS	22																	
90.6																						
1.4	Clayey silt, some sand, trace gravel (FILL) Stiff Grey-brown Moist		2	SS	8																	
89.9																						
2.1	Sandy silt, trace gravel and clay, containing clayey silt zones and organics (FILL) Compact Brown to grey Moist		3	SS	19											1 21 59 19						
			4	SS	13																	
			5	SS	19																	
87.7																						
4.3	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded Bedrock cored from 4.3 m to 7.5 m depth. For bedrock coring details, refer to Record of Drillhole 07-17		6	RC	REC 100%											RQD = 63%						
			7	RC	REC 78%											RQD = 43%						
			8	RC	REC 100%											RQD = 59%						
84.5																						
7.5	End of Borehole Note: 1. Borehole dry prior to start of rock coring operations.																					

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

LOCATION: N 4903308.3 ;E 304024.7

DRILLING DATE: January 24, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: --

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

[illegible]

MIS-RCK 004 051111031.GPJ GAL-MISS.GDT 2/8/08

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

PROJECT 05-1111-031

RECORD OF BOREHOLE No 07-18

1 OF 1 **METRIC**

W.P. 77-99-01

LOCATION

N 4903318.5 ; E 304025.6

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE

Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE

March 27, 2007

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) 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										
91.8	GROUND SURFACE																	
0.0	ASPHALT																	
0.4	Sand and gravel (FILL)																	
	ASPHALT																	
90.1	Sand and gravel, trace to some silt (FILL)																	
	Compact		1	SS	26													
	Brown		2	SS	14/0.15													
	Moist		3	RC	REC 76%													
			4	RC	REC 86%													
1.7	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded																	
87.2	Bedrock cored between 1.7 and 4.6 m depth. For bedrock coring details, refer to Record of Drillhole 07-18.		5	RC	REC 100%													
4.6	End of Borehole																	
	Note: 1. Borehole dry prior to start of rock coring operations.																	

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

PROJECT: 05-1111-031

LOCATION: N 4903318.5 ; E 304025.6

INCLINATION: -90° AZIMUTH: —

RECORD OF DRILLHOLE: 07-18

DRILLING DATE: March 27, 2007

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Marathon Drilling Ltd.																																																																																																																																																																																																																																																																																		
DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE mm/min	FLUSH % RETURN	COLOUR % RETURN	RECOVERY				FRACT INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY K, cm/sec				Diameter Point Load Index (MPa)				NOTES WATER LEVELS INSTRUMENTATION																																																																																																																																																																																																																																																								
									TOTAL CORE %		SOLID CORE %			R.Q.D. %	B Angle	DIP w/rl CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	T	C	O	N	RMC -C/ AVG.																																																																																																																																																																																																																																																									
									JN - Joint		FLT - Fault																BD - Bedding	PL - Planar	PO - Polished	BR - Broken Rock																																																																																																																																																																																																																																																				
									SHR - Shear		VN - Vein																				FO - Foliation	CU - Curved	K - Slickensided	NOTE: For additional abbreviations refer to list of abbreviations & symbols																																																																																																																																																																																																																																																
CJ - Conjugate		CO - Contact		OR - Orthogonal	UN - Undulating	SM - Smooth	Ro - Rough	MB - Mechanical Break																																																																																																																																																																																																																																																																										
CL - Cleavage		ST - Stepped							IR - Irregular	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - Mechanical Break	MB - 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DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-RCK 004 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT 05-1111-031

RECORD OF BOREHOLE No 07-19

1 OF 1 **METRIC**

W.P. 77-99-01

LOCATION N 4903268.0 E 304401.8

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE January 24, 2007

CHECKED BY LCC

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			SHEAR STRENGTH kPa					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L
90.8	GROUND SURFACE														
0.0	Sand and gravel to gravel, some sand, containing cobbles (FILL) Compact Grey Moist		1	SS	20										
			2	SS	42										
88.7															
2.1	Clayey silt with sand, trace gravel, containing organics (FILL) Stiff Dark brown to grey Moist		3	SS	9										
			4	SS	8										
			5	SS	8										
86.7															
4.1	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded Bedrock cored from 4.1 m to 7.4 m depth. For bedrock coring details, refer to Record of Drillhole 07-19		7	RC	REC 75%										
			8	RC	REC 93%										
			9	RC	REC 100%										
83.4															
7.4	End of Borehole Note: 1. Borehole dry prior to start of rock coring operations.														

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

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-19

SHEET 1 OF 1

LOCATION: N 4903268.0 ; E 304401.8

DRILLING DATE: January 24, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN NO.	PENETRATION RATE mm/min	FLUSH % RETURN	COLOUR	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Congeal	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Sickensided SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols	NOTES WATER LEVELS INSTRUMENTATION
		Continued from Record of Borehole 07-19		86.66										
		LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded - Occasional horizontal infilled seams		4.14										
5				7										
6				8										
7				9										
		End of Drillhole		83.41										
				7.39										
8														
9														
10														
11														
12														
13														
14														

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-ROK 004 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT 05-1111-031

RECORD OF BOREHOLE No 07-20

 1 OF 1 **METRIC**

W.P. 77-99-01

LOCATION N 4903282.6 E 304410.2

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE March 27, 2007

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
90.9	GROUND SURFACE													
0.0	ASPHALT													
0.3	Sand, some gravel and silt, trace clay (FILL) Dense Grey Moist		1	SS	38									
89.7	Gravel and cobbles, some sand, trace silt (ROCK FILL) Compact Grey Dry		2	SS	26									
1.2			3	SS	13									
88.2	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		4	RC	REC 100%									
2.7	Bedrock cored between 2.7 and 5.2 m depth. For bedrock coring details, refer to Record of Drillhole 07-20.		5	RC	REC 67%									
85.7			6	RC	REC 96%									
5.2	End of Borehole													
	Note: 1. Borehole dry prior to start of rock coring operations.													

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

MIS-MTO 001 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-20

SHEET 1 OF 1

LOCATION: N 4903282.6 ; E 304410.2

DRILLING DATE: March 27, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: --

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE mm/min	FLUSH	RECOVERY		R.Q.D. %	FRACT INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY K, cm/sec				Domest Point Load Index (MPa)	RQD % AVG.	NOTES WATER LEVELS INSTRUMENTATION													
								TOTAL CORE %	SOLID CORE %			B Angle	DIPWRT CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jk	Jm	Jn	T1	T2				T3												
																								JL	JR	JL	JR	JL	JR	JL	JR	JL	JR	JL	JR
		Continued from Record of Borehole 07-20		88.16																															
3		LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		2.74																															
4																																			
5																																			
6		End of Drillhole		85.72																															
7																																			
8																																			
9																																			
10																																			
11																																			
12																																			

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-ROK-004 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT 05-1111-031		RECORD OF BOREHOLE No 07-21		1 OF 1 METRIC									
W.P. 77-99-01		LOCATION N 4903260.3 ; E 304822.3		ORIGINATED BY DM									
DIST Eastern HWY 401		BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers		COMPILED BY KG									
DATUM Geodetic		DATE January 22, 2007		CHECKED BY LCC									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED					PLASTIC LIMIT w _p
87.9	GROUND SURFACE												
0.0	ASPHALT												
0.3	Sand and gravel to sand, trace gravel (FILL) Compact Brown to grey Moist		1	SS	26								
			2	SS	20								
85.8													
2.3	Clayey silt, trace sand and gravel (FILL) Very stiff to hard Brown Moist		3	SS	47								
	Gravel and cobbles, some sand (ROCK FILL) Loose to dense Grey Moist		4	SS	12								
			5	SS	5								
			6	SS	8								
			7	SS	24								
82.0													
6.0	TOPSOIL Clayey silt with sand to some sand, trace gravel (FILL) Stiff to very stiff Grey-brown Moist		8	SS	10								
			9	SS	16								
80.4													
7.5	SILTY CLAY, trace gravel Stiff Brown Moist		10	SS	14								
79.8													
8.1	End of Borehole												
	Note: 1. Borehole dry upon completion of drilling.												

MIS-MTO 001 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-23

SHEET 1 OF 1

LOCATION: N 4903478.5 ; E 305775.2

DRILLING DATE: January 22, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE mm/min	FLUSH % RETURN	UN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Congregate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols	NOTES WATER LEVELS INSTRUMENTATION
		Continued from Record of Borehole 07-23		108.83									
2		LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		1.67									
3		-Vertical and horizontal seams from 2.21 m to 4.06 m infilled with calcite											
4		End of Drillhole		106.44									
5				4.06									
6													
7													
8													
9													
10													
11													

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-RCK-004 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT 05-1111-031		RECORD OF BOREHOLE No 07-24				1 OF 1 METRIC												
W.P. 77-99-01		LOCATION N 4903471.6 ; E 305780.3				ORIGINATED BY DM												
DIST Eastern HWY 401		BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers				COMPILED BY KG												
DATUM Geodetic		DATE January 29, 2007				CHECKED BY LCC												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			GR SA SI CL		
110.6	GROUND SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					25 50 75 W _p W W _L					
0.0	ASPHALT																	
0.1	Gravelly sand, trace silt (FILL)																	
	Dense																	
	Brown																	
	Moist																	
109.5	Sand and gravel, containing cobbles (FILL)		1	SS	35		110									25 67 (8)		
1.1	Very loose																	
	Grey																	
108.7	Moist		2	SS	2		109											
2.0	LIMESTONE (BEDROCK), containing shale seams																	
	Fresh																	
	Grey																	
	Medium strong to very strong																	
	Thinly bedded																	
	Bedrock cored from 2.0 m to 4.6 m depth. For bedrock coring details, refer to Record of Drillhole 07-24																	
			3	RC	REC 96%		108									RQD = 73%		
			4	RC	REC 98%		107									RQD = 46%		
106.0	End of Borehole						106											
4.6	Note:																	
	1. Borehole dry prior to start of rock coring operations.																	

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-24

SHEET 1 OF 1

LOCATION: N 4903471.6 E 305780.3

DRILLING DATE: January 29, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: --

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN NO.	PENETRATION RATE (mm/min)	FLUSH	COLOR	RETURN	RECOVERY				R.O.D. %	FRACT INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY K, cm/sec				Diameter Point Load Index (RPS)	RMC -Q AVG.	NOTES WATER LEVELS INSTRUMENTATION								
										UN - Joint	FLT - Fault	SHR - Shear	VN - Vein			CJ - Conjugate	BD - Bedding	FO - Foliation	CO - Contact	OR - Orthogonal	CL - Cleavage	PL - Planar	CU - Curved				UN - Undulating	ST - Stepped	IR - Irregular	PO - Polished	K - Slickensided	SM - Smooth	Ro - Rough	MB - Mechanical Break
2		Continued from Record of Borehole 07-24		108.65																														
3		LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		1.95																														
3		- Fractured zones between 1.95 m to 2.06 m and 3.58 m to 3.74 m																																
4		- Horizontal infilled seams, occasional calcite inclusions																																
4		End of Drillhole		105.98																														
5				4.62																														
6																																		
7																																		
8																																		
9																																		
10																																		
11																																		

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-RCK-004 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT 05-1111-031

RECORD OF BOREHOLE No 07-25

1 OF 1 METRIC

W.P. 77-99-01

LOCATION N 4903545.5 ; E 305911.3

ORIGINATED BY DM

DIST Eastern HWY 401

BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE January 24, 2007

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					

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

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-25

SHEET 1 OF 1

LOCATION: N 4903545.5 ; E 305911.3

DRILLING DATE: January 24, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: --

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN NO.	PENETRATION RATE mm/min	FLUSH	RECOVERY TOTAL CORE % SOLID CORE %	R.O.D. % PER 0.3 m	FRACT INDEX PER 0.3 m	B Angle	DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jh	HYDRAULIC CONDUCTIVITY K, cm/sec	C ₁	C ₂	C ₃	C ₄	Diameter Point Load Index (MPa)	RQD % AVG.	NOTES WATER LEVELS INSTRUMENTATION
		Continued from Record of Borehole 07-25		107.80																				
3	NO Rotary Coring, Uncased	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		2.20																				
4																								
5																								
6		End of Drillhole		104.59 5.41																				
7																								
8																								
9																								
10																								
11																								
12																								

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-RCK-004_051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT 05-1111-031		RECORD OF BOREHOLE No 07-26				1 OF 1 METRIC														
W.P. 77-99-01		LOCATION N 4903552.2; E 305806.6				ORIGINATED BY DM														
DIST Eastern HWY 401		BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers				COMPILED BY KG														
DATUM Geodetic		DATE March 8, 2007				CHECKED BY LCC														
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED					WATER CONTENT (%) W _p W W _L			γ	GR SA SI CL			
111.3	GROUND SURFACE																			
0.0	ASPHALT																			
0.2	Sand and gravel to gravel, some sand, trace silt, containing cobbles (FILL) Dense to very dense Brown to grey Moist		1	SS	36/0.28		111													
109.9	Clayey silt, some sand, trace gravel (FILL) Stiff Grey-brown Moist		2	SS	8		110													
109.3	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		3	RC	REC 99%		109												RQD = 31%	
2.0	Bedrock cored from 2.0 m to 4.5 m depth. For bedrock coring details, refer to Record of Drillhole 07-26		4	RC	REC 87%		108												RQD = 65%	
106.8	End of Borehole						107													
4.5	Note: 1. Borehole dry prior to start of rock coring operations.																			

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-26

SHEET 1 OF 1

LOCATION: N 4903552.2 ; E 305906.6

DRILLING DATE: March 8, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE min(m)	FLUSH	RECOVERY		R.Q.D. %	FRACT INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY				Diameter Point Load Index (MPa)	RUC -C7 AVG	NOTES WATER LEVELS INSTRUMENTATION	
				DEPTH (m)				TOTAL CORE %	SOLID CORE %			B Angle	DIP w/FL CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jh	K, cm/sec 10 ⁻³	10 ⁻³				10 ⁻³
2		Continued from Record of Borehole 07-26		109.32																			
		LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		1.98			100																
3																							
4							100																
5		End of Drillhole		106.78																			
6				4.52																			
7																							
8																							
9																							
10																							
11																							

DEPTH SCALE

1:50



LOGGED: DM

CHECKED: LCC

MIS-RCK-004 051111031.GPJ GAL-MISS.GDT 28/08

PROJECT 05-1111-031		RECORD OF BOREHOLE No 07-27				1 OF 1 METRIC							
W.P. 77-99-01		LOCATION N 4903802.8 ; E 306270.6				ORIGINATED BY DM							
DIST Eastern HWY 401		BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers				COMPILED BY KG							
DATUM Geodetic		DATE January 24, 2007				CHECKED BY LCC							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
112.5	GROUND SURFACE						20 40 60 80 100						
0.0	Sand and gravel (FILL) Compact Brown Moist												
111.7	Clayey silt, some sand (FILL) Sand and gravel, containing cobbles (FILL) Compact Brown Moist		1	SS	25/0.15								
111.2	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		2	RC	REC 63%								RQD = 27%
1.3			3	RC	REC 68%								RQD = 28%
109.0	Bedrock cored from 1.3 m to 3.6 m depth. For bedrock coring details, refer to Record of Drillhole 07-27		4	RC	REC 76%								RQD = 21%
3.6	End of Borehole												
Note: 1. Borehole dry prior to start of rock coring operations.													

MIS-MTO 001 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT 05-1111-031		RECORD OF BOREHOLE No 07-28		1 OF 1 METRIC	
W.P. 77-99-01		LOCATION N 4903812.5; E 306263.8		ORIGINATED BY DM	
DIST Eastern HWY 401		BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers		COMPILED BY KG	
DATUM Geodetic		DATE March 12, 2007		CHECKED BY LCC	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 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 x REMOULDED					WATER CONTENT (%) w _p w w _L				
113.1	GROUND SURFACE						20	40	60	80	100						
0.0	ASPHALT																
0.2	Sand and gravel, some silt, trace clay (FILL)																
112.2	Dense to very dense Brown Moist		1	SS	87											41 46 10 3	
0.9	Gravel and cobbles (ROCK FILL)																
111.5	Very dense Grey Dry		2	SS	56/0.10												
1.6	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded Bedrock cored from 1.6 m to 4.7 m depth. For bedrock coring details, refer to Record of Drillhole 07-28		3	RC	REC 92%											RQD = 19%	
			4	RC	REC 100%											RQD = 73%	
108.5	End of Borehole																
4.7	Note: 1. Borehole dry prior to start of rock coring operations.																

MIS-MTO 001 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-28

SHEET 1 OF 1

LOCATION: N 4903812.5 ; E 306263.8

DRILLING DATE: March 12, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE mm/min	FLUSH % RETURN	JOINT JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate	BEDDING BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PLANAR PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	POLISHED PO - Polished K - Sticksided SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock	NOTES: For additional abbreviations refer to list of abbreviations A symbols	RECOVERY TOTAL CORE % SOLID CORE % R.Q.D. % FRACT INDEX PER 0.3 m	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec 10 ⁻¹⁰ 10 ⁻⁹ 10 ⁻⁸ 10 ⁻⁷ 10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³ 10 ⁻² 10 ⁻¹ 10 ⁰ 10 ¹ 10 ² 10 ³ 10 ⁴ 10 ⁵ 10 ⁶ 10 ⁷ 10 ⁸ 10 ⁹ 10 ¹⁰	Diameter Point Load Index (MPa)	RVC Q _u AWG	NOTES WATER LEVELS INSTRUMENTATION
		Continued from Record of Borehole 07-28		111.48															
2		LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		1.62															
3		- Moderately weathered and fractured between 1.58 m and 1.91 m																	
4		- Fractured between 2.59 m and 2.66 m																	
5		- Fractured between 3.09 m and 3.32 m																	
6																			
7																			
8																			
9																			
10																			
11																			
		End of Drillhole		108.45															
				4.65															

DEPTH SCALE

1 : 50



LOGGED: DM

CHECKED: LCC

MIS-RCK-004 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT <u>05-1111-031</u>		RECORD OF BOREHOLE No 07-WIF-1		1 OF 1 METRIC	
W.P. <u>77-99-01</u>		LOCATION <u>N 4899164.0 ; E 306514.4</u>		ORIGINATED BY <u>DM</u>	
DIST <u>Eastern</u> HWY <u>401</u>		BOREHOLE TYPE <u>Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers</u>		COMPILED BY <u>KG</u>	
DATUM <u>Geodetic</u>		DATE <u>March 26, 2007</u>		CHECKED BY <u>LCC</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
							20	40	60	80	100						
	GROUND SURFACE																
0.0	ASPHALT																
0.1	Sand and gravel, some silt, trace clay, containing asphalt and brick fragments (FILL) Compact to very loose Brown to grey Moist		1	SS	28											38 41 15 6	
			2	SS	4												
			3	SS	8												
3.0	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded Bedrock cored between 3.0 and 5.4 m depth. For bedrock coring details, refer to Record of Drillhole 07-WIF-1.		5	RC	REC 100%											RQD = 72%	
			6	RC	REC 95%											RQD = 51%	
			7	RC	REC 100%											RQD = 62%	
5.4	End of Borehole Note: 1. Borehole dry prior to start of rock coring operations.																

MIS-MTO 001 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-WIF-1

SHEET 1 OF 1

LOCATION: N 4899164.0 ; E 306514.4

DRILLING DATE: March 26, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/m	FLUSH % RETURN	COLOUR	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols	NOTES WATER LEVELS INSTRUMENTATION
3		Continued from Record of Borehole 07-WIF-1		2.99										
5		LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		5										
6				6										
7				7										
5.38		End of Drillhole		5.38										
6														
7														
8														
9														
10														
11														
12														

DEPTH SCALE

1:50



LOGGED: DM

CHECKED: LCC

MIS-ROK 004 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT 05-1111-031		RECORD OF BOREHOLE No 07-WIF-2		1 OF 1 METRIC															
W.P. 77-99-01		LOCATION N 4899161.4 ; E 306510.5		ORIGINATED BY DM															
DIST Eastern HWY 401		BOREHOLE TYPE Track-Mounted C.M.E. 75, 200mm O.D. Hollow Stem Augers		COMPILED BY KG															
DATUM Geodetic		DATE March 26, 2007		CHECKED BY LCC															
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED			WATER CONTENT (%) Wp W WL			γ			GR SA SI CL		
0.0	GROUND SURFACE																		
0.1	ASPHALT																		
	Sand and gravel, trace silt and clay, containing cobbles, asphalt and brick fragments (FILL) Dense to compact Brown to grey Moist		1	SS	40													41 45 9 5	
			2	SS	12														
2.1	Silty SAND, some gravel, trace clay (TILL) Loose to compact Brown Moist		3	SS	8														
			4	SS	10														
3.6	LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		5	RC	REC 93%													RQD = 27%	
	Bedrock cored between 3.6 and 6.1 m depth. For bedrock coring details, refer to Record of Drillhole 07-WIF-2.		6	RC	REC 95%													RQD = 70%	
6.1	End of Borehole Note: 1. Borehole dry prior to start of rock coring operations.																		

MIS-MTO 001 051111031.GPJ GAL-MISS.GDT 2/8/08

PROJECT: 05-1111-031

RECORD OF DRILLHOLE: 07-WIF-2

SHEET 1 OF 1

LOCATION: N 4899161.4 ; E 306510.5

DRILLING DATE: March 26, 2007

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-75

DRILLING CONTRACTOR: Marathon Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE mm/min	FLUSH % RETURN	COLOUR	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.	NOTES WATER LEVELS INSTRUMENTATION
4		Continued from Record of Borehole 07-WIF-2		3.55										
5		LIMESTONE (BEDROCK), containing shale seams Fresh Grey Medium strong to very strong Thinly bedded		5										
6				6										
7		End of Drillhole		8.10										
8														
9														
10														
11														
12														
13														

DEPTH SCALE

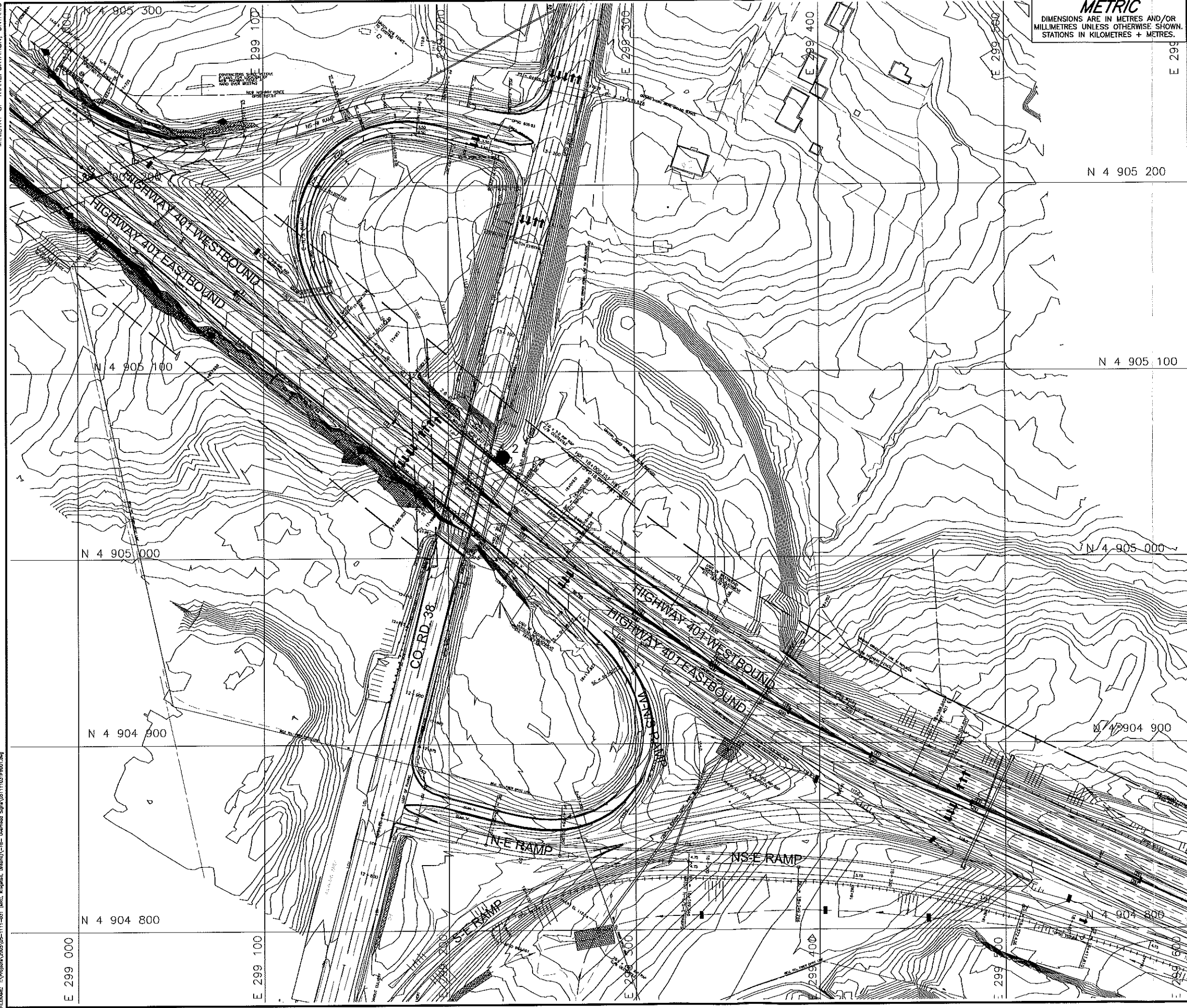
1 : 50



LOGGED: DM

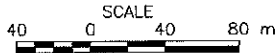
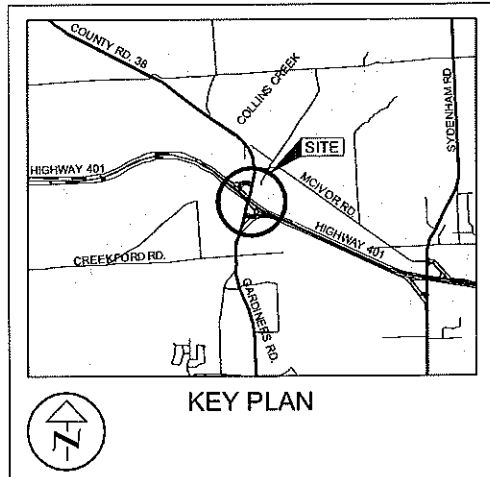
CHECKED: LCC

MIS-RCK 004 051111031.GPJ GAL-MISS.GDT 2/8/08



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

CONT No. WP No. 77-99-01		 SHEET
HIGHWAY 401, STATION 18+015 Cantilever Sign at County Road 38 BOREHOLE LOCATION		
 Golder Associates Ltd. MISSISSAUGA, ONTARIO, CANADA		



LEGEND			
Borehole - Current Investigation			
No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
2	110.6	4905053.9	299229.7

NOTES

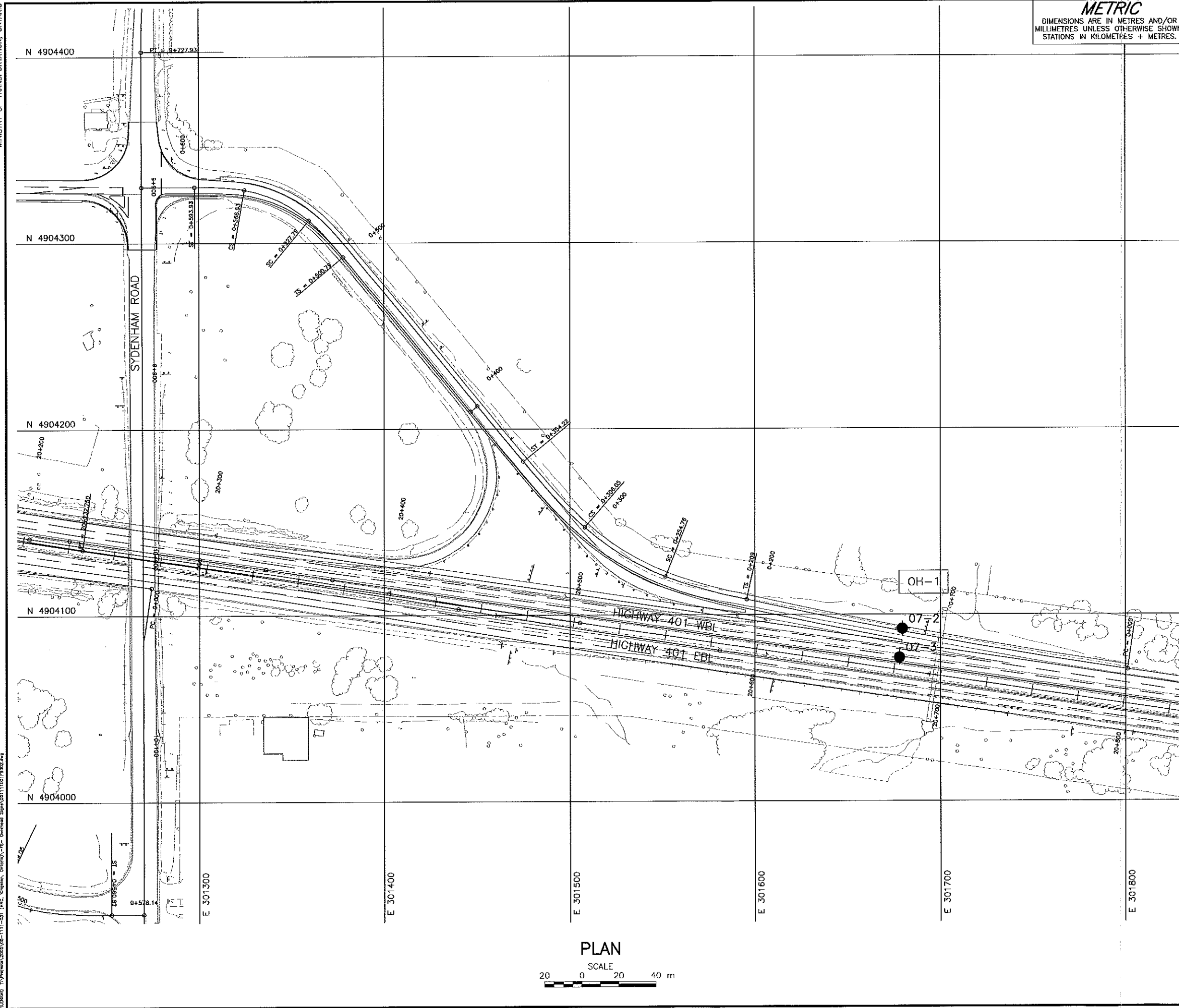
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section CC 2.01 of OPS General Conditions.

REFERENCE

This drawing was prepared using a base plan supplied in digital format by MTO Eastern Region

NO.	DATE	BY	REVISION
Geocres No. HWY. 401 PROJECT NO. 05-1111-031 DIST. SUBM'D. LCC CHKD. LCC DATE: May, 28, 08 SITE: DRAWN: MMZ CHKD. LCC APPD. ASP DWG. 1			



PLAN

SCALE
20 0 20 40 m

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

CONT No.
WP No. 77-99-01

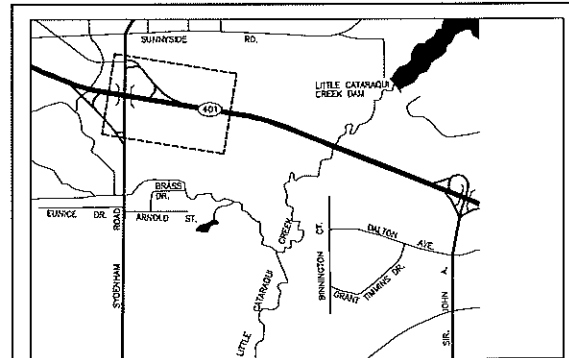
HIGHWAY 401, 20+200 - 20+850
Overhead Sign OH-1
BOREHOLE LOCATIONS



SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN



LEGEND

● Borehole - Current Investigation

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
07-2	100.9	4904092.3	301679.7
07-3	101.2	4904076.9	301678.2

NOTES

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The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MRC, drawing files no. "Align 6230 bp Division W-NS Ramp Settlement 06-04-27.dwg" received February 16, 2007, "Align H6230XM01.dwg", "H6230XB01.dwg" and "H6230XB02.dwg" received January 10, 2006, and "OHS.dwg" received January 09, 2006.

NO.	DATE	BY	REVISION
Geocres No.			
HWY. 401	PROJECT NO. 05-1111-031		DIST.
SUBM'D. KG	CHKD. LCC	DATE: May. 26, 08	SITE:
DRAWN: DD	CHKD. KG	APPD. LCC	DWG. 2

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

CONT No.
WP No. 77-99-01

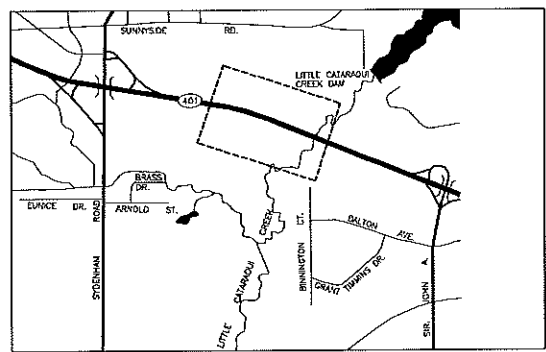
HIGHWAY 401, 20+900 - 21+600
Overhead Signs OH-2 and OH-3
BOREHOLE LOCATIONS



SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN



LEGEND

● Borehole - Current Investigation

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
07-5	95.6	4904013.2	302097.6
07-6	95.4	4904003.4	302095.1
07-7	85.5	4903856.8	302463.6
07-8	85.7	4903864.5	302465.0

NOTES

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The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by MRC, drawing files no "Align 6230 bp Division W-NS Ramp Settlement 06-04-27.dwg" received February 16, 2007, "Align H6230XM01.dwg", "H6230XB01.dwg" and "H6230XB02.dwg" received January 10, 2006, and "OHS.dwg" received January 09, 2006.

NO.	DATE	BY	REVISION
Geocres No.			
HWY. 401		PROJECT NO. 05-1111-031	DIST.
SUBM'D. KG	CHKD. LCC	DATE: May, 26, 08	SITE:
DRAWN: DD	CHKD. KG	APPD. LCC	DWG. 3

N 4904100

N 4904000

N 4903900

N 4903800

E 302000

E 302100

E 302200

E 302300

E 302400

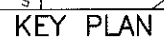
E 302500

PLAN

SCALE
20 0 20 40 m



SHEET

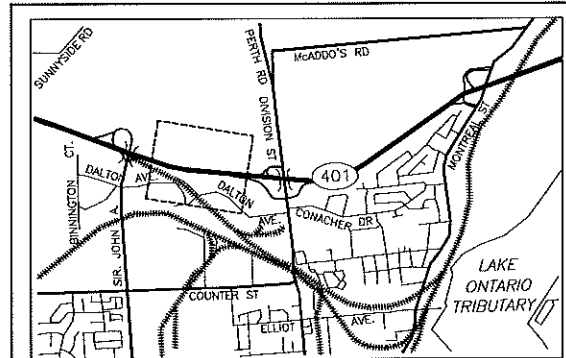


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NO.	DATE	BY	REVISION	
Geocres No.				
HWY. 401		PROJECT NO. 05-1111-031		DIST.
SUBM'D. KG	CHKD. LCC	DATE: May. 26, 08		SITE:
DRAWN: DD	CHKD. KG	APPD. LCC		DWG. 4


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.CONT No.
WP No. 77-99-01HIGHWAY 401, 22+900 - 23+550
Overhead Signs OH-6, OH-7 and OH-8
BOREHOLE LOCATIONS

SHEET

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

KEY PLAN



LEGEND			
 Borehole - Current Investigation			
No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
07-15	90.2	4903381.4	303828.6
07-16	91.2	4903368.4	303825.7
07-17	92.0	4903308.3	304024.7
07-18	91.8	4903318.5	304025.6
07-19	90.8	4903268.0	304401.8
07-20	90.9	4903282.6	304410.2

NOTES

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NO.	DATE	BY	REVISION
Geocres No.			
HWY. 401	PROJECT NO. 05-1111-031		DIST.
SUBM'D. KG	CHKD. LCC	DATE: May. 26, 08	SITE:
DRAWN: DD	CHKD. KG	APPD. LCC	DWG. 5

N 4903500

N 4903400

N 4903300

N 4903200

N 4903100

E 303900

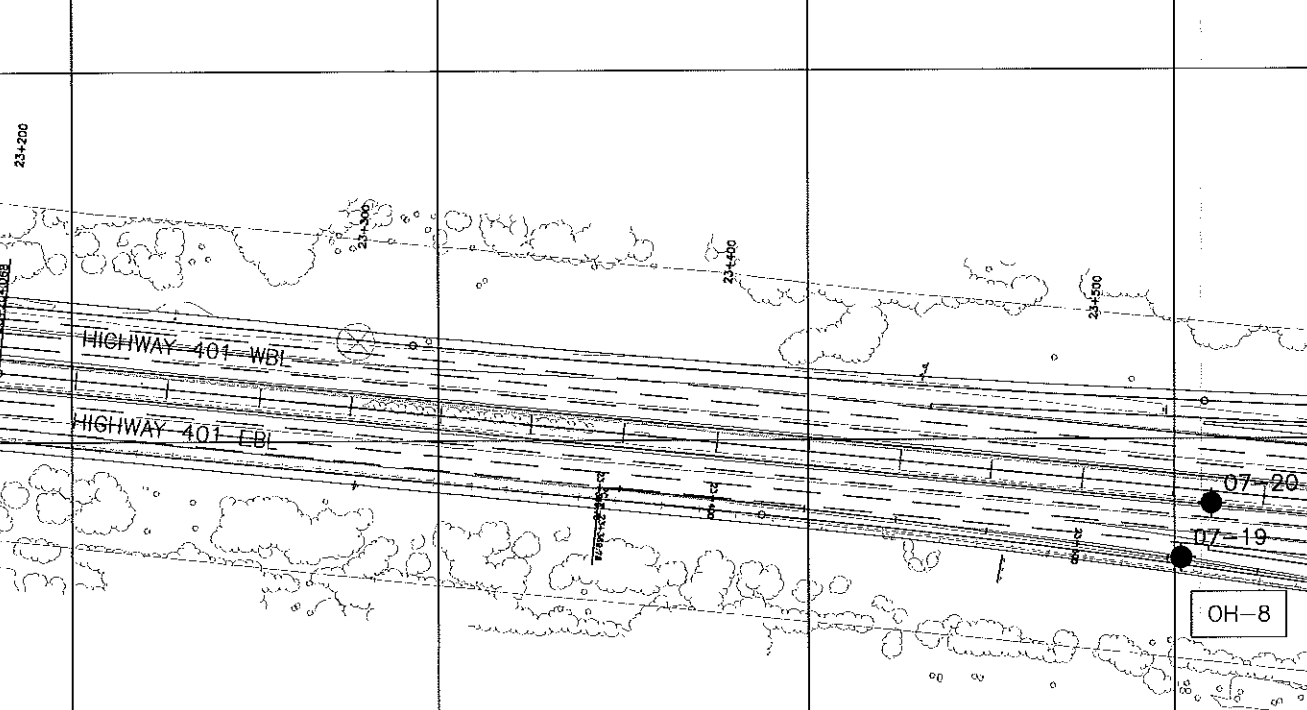
E 304000

E 304100

E 304200

E 304300

E 304400



PLAN

SCALE

20 0 20 40 m

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

CONT No.
 WP No. 77-99-01

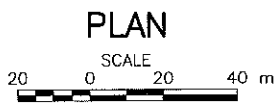
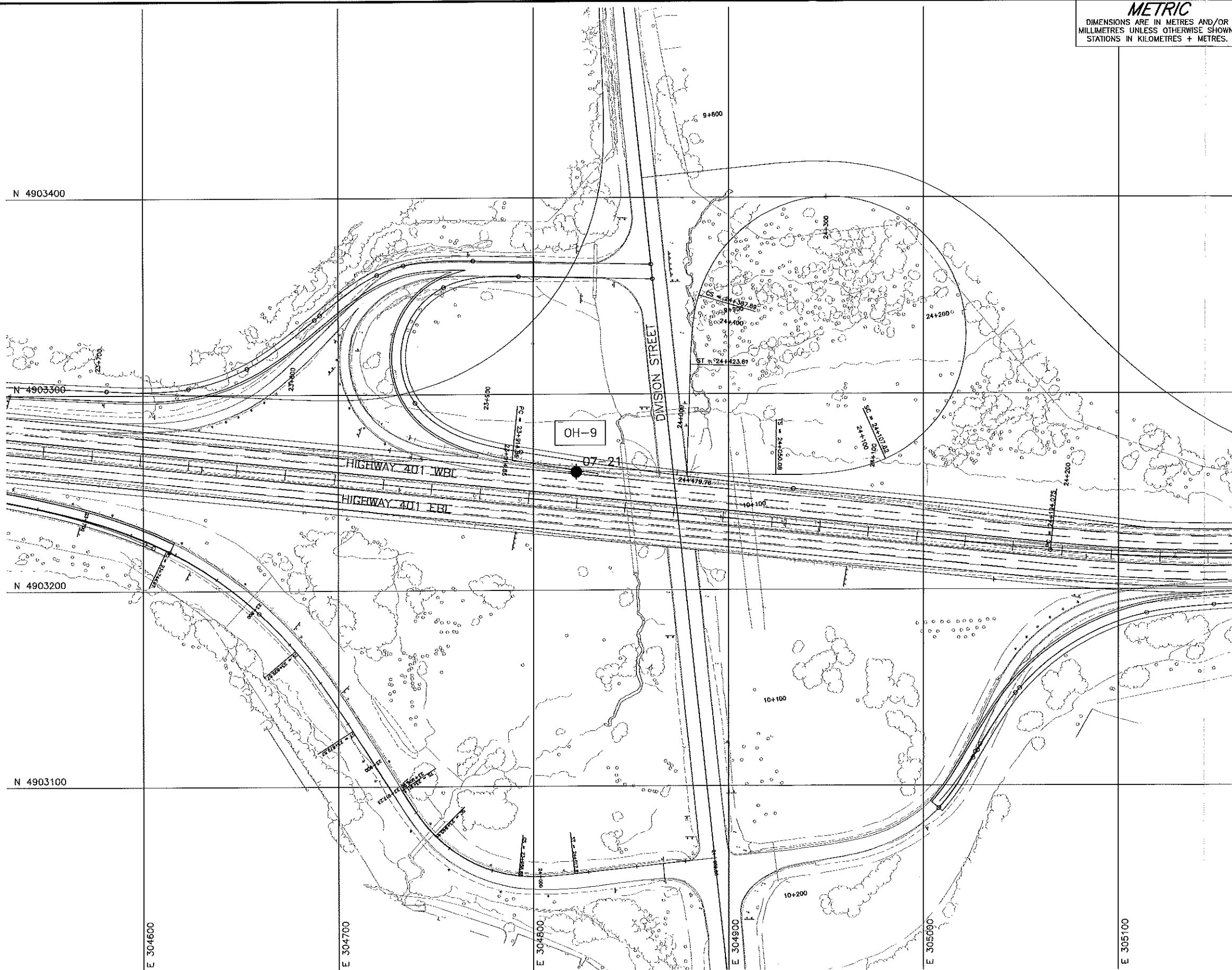
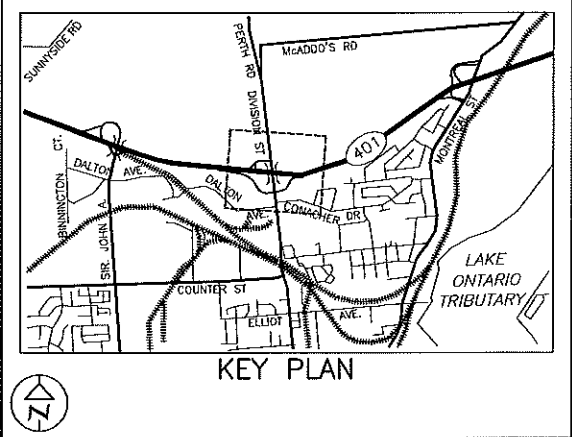
HIGHWAY 401, 23+650 - 24+300
 Overhead Sign OH-9
 BOREHOLE LOCATIONS



SHEET



Golder Associates Ltd.
 MISSISSAUGA, ONTARIO, CANADA



LEGEND

● Borehole - Current Investigation			
No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
07-21	90.5	4903260.3	304822.3

NOTES

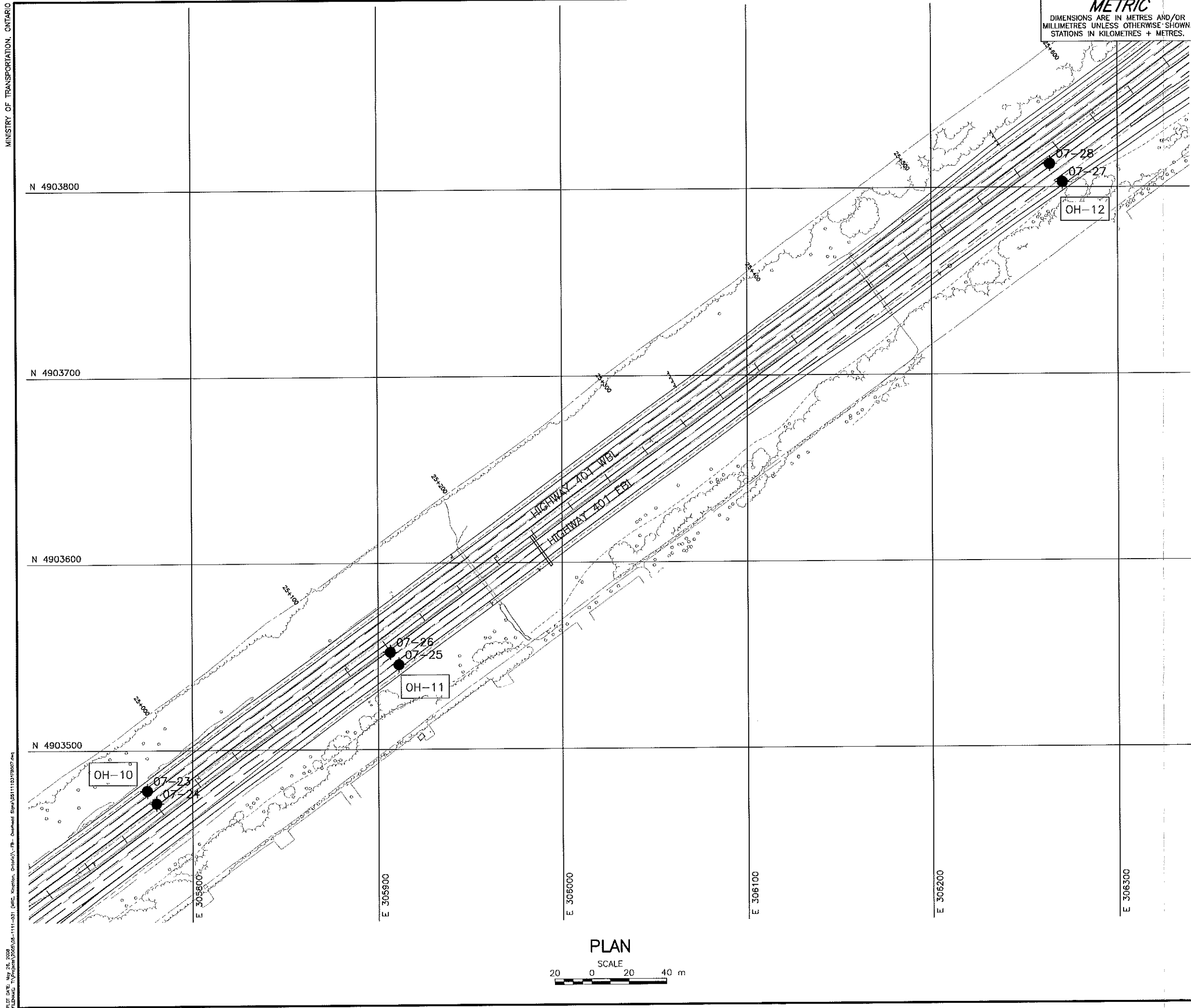
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NO.	DATE	BY	REVISION
Geocres No.			
HWY. 401	PROJECT NO. 05-1111-031		DIST.
SUBM'D. KG	CHKD. LCC	DATE: May. 26, 08	SITE:
DRAWN: DD	CHKD. KG	APPD. LCC	DWG. 6



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

CONT No.
WP No. 77-99-01

SHEET

HIGHWAY 401, 24+900 - 25+650
Overhead Signs OH-10, OH-11 and OH-12

BOREHOLE LOCATIONS

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA

KEY PLAN

LEGEND			
● Borehole - Current Investigation			
No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
07-23	110.5	4903478.5	305775.2
07-24	110.6	4903471.6	305780.3
07-25	110.0	4903545.5	305911.3
07-26	111.3	4903552.2	305906.6
07-27	112.5	4903802.8	306270.6
07-28	113.1	4903812.5	306263.8

NOTES

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REFERENCE

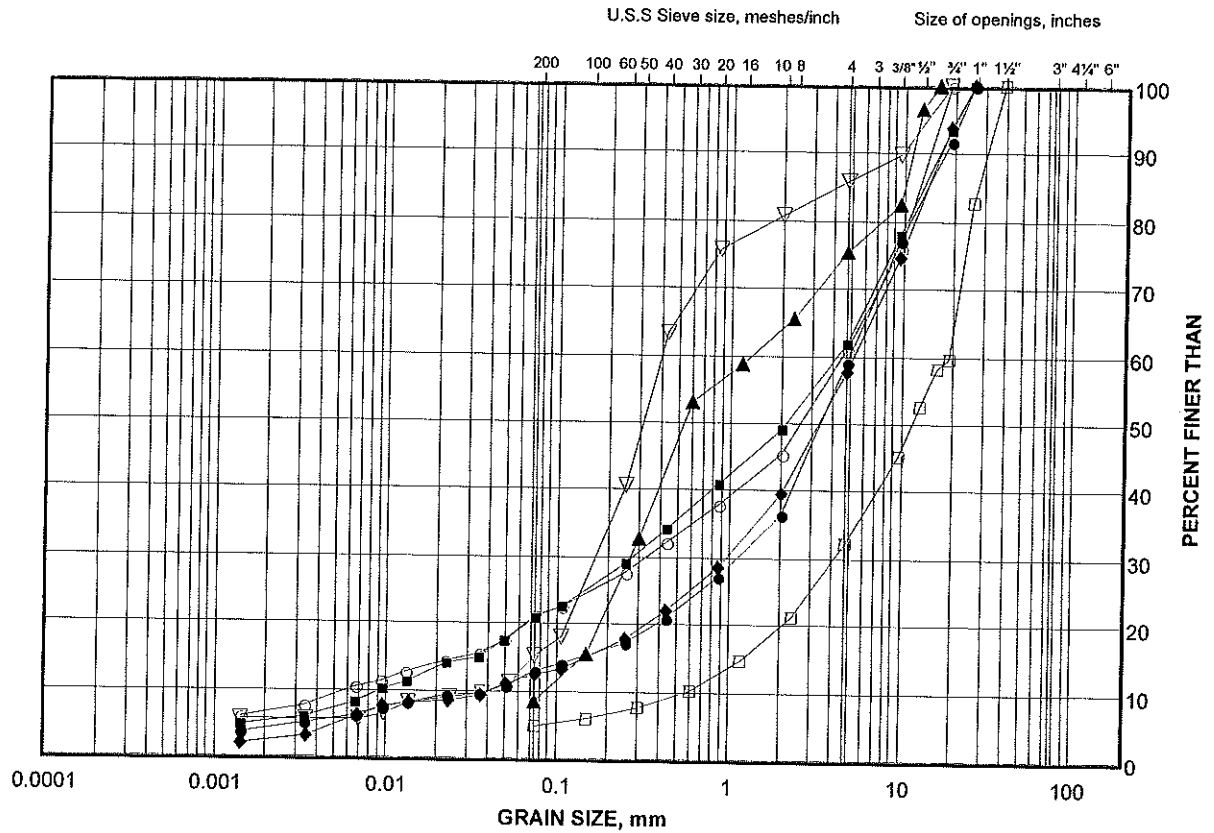
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NO.	DATE	BY	REVISION
Geocres No.			
HWY. 401		PROJECT NO. 05-1111-031	DIST.
SUBM'D. KG	CHKD. LCC	DATE: May. 26, 08	SITE:
DRAWN: DD	CHKD. KG	APPD. LCC	DWG. 7

GRAIN SIZE DISTRIBUTION TEST RESULTS

Sand to Sand and Gravel Fill

FIGURE 1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	07-WIF-02	1	
■	07-WIF-01	1	
◆	07-28	1	112.4
▲	07-24	1	109.7
▽	07-20	1	90.0
○	07-18	2	90.4
□	07-7	3	83.1

Project Number: 05-1111-031

Checked By: *[Signature]*

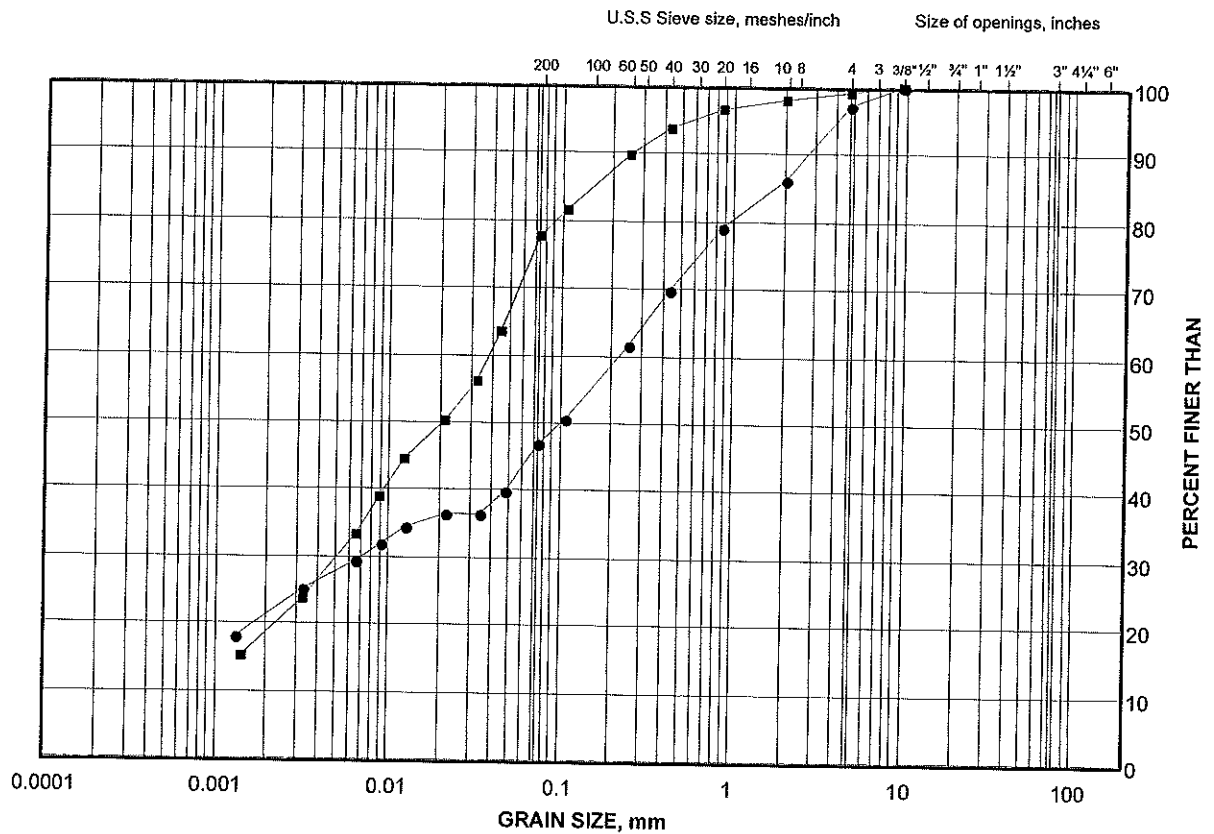
Golder Associates

Date: 04-Feb-08

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silty Sand Fill Containing Clayey Silt Zones

FIGURE 2



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	07-13	2	87.0
■	07-17	3	89.6

Project Number: 05-1111-031

Checked By: *[Signature]*

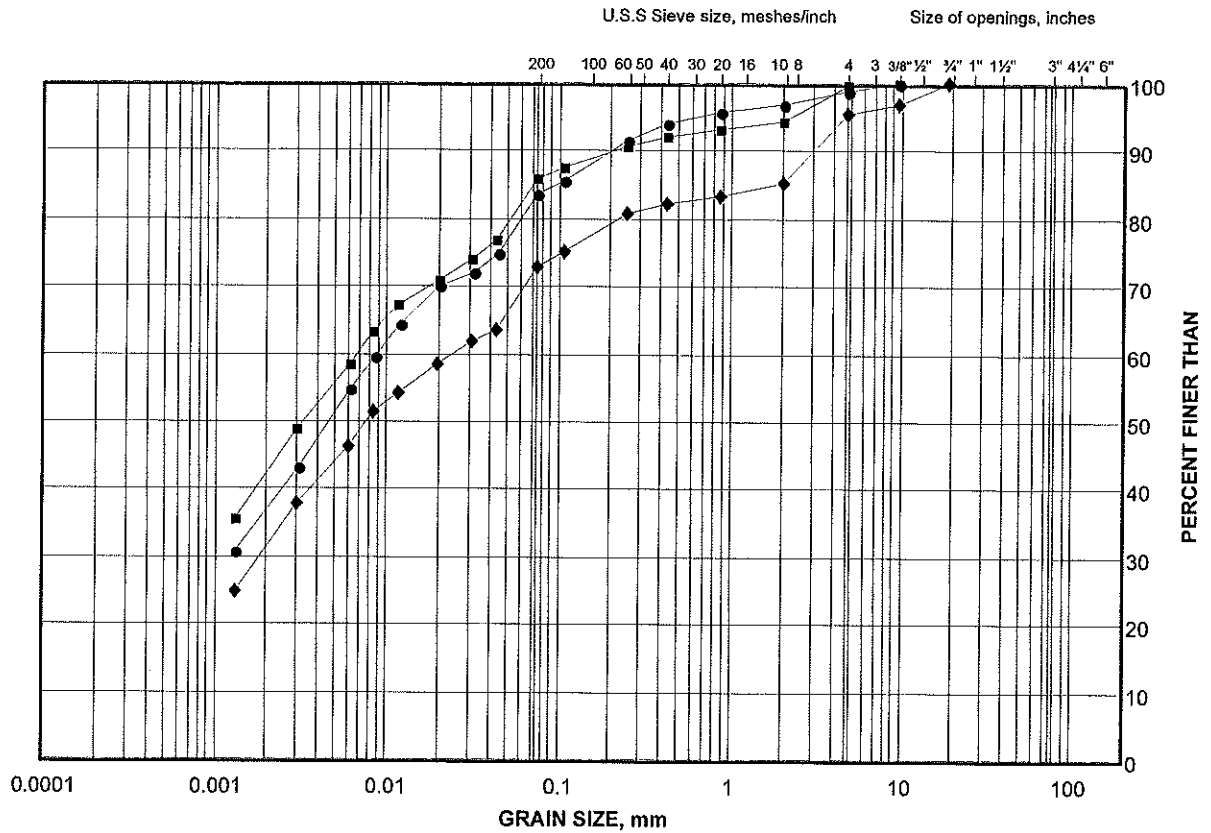
Golder Associates

Date: 04-Feb-08

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt to Silty Clay Fill

FIGURE 3



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

LEGEND

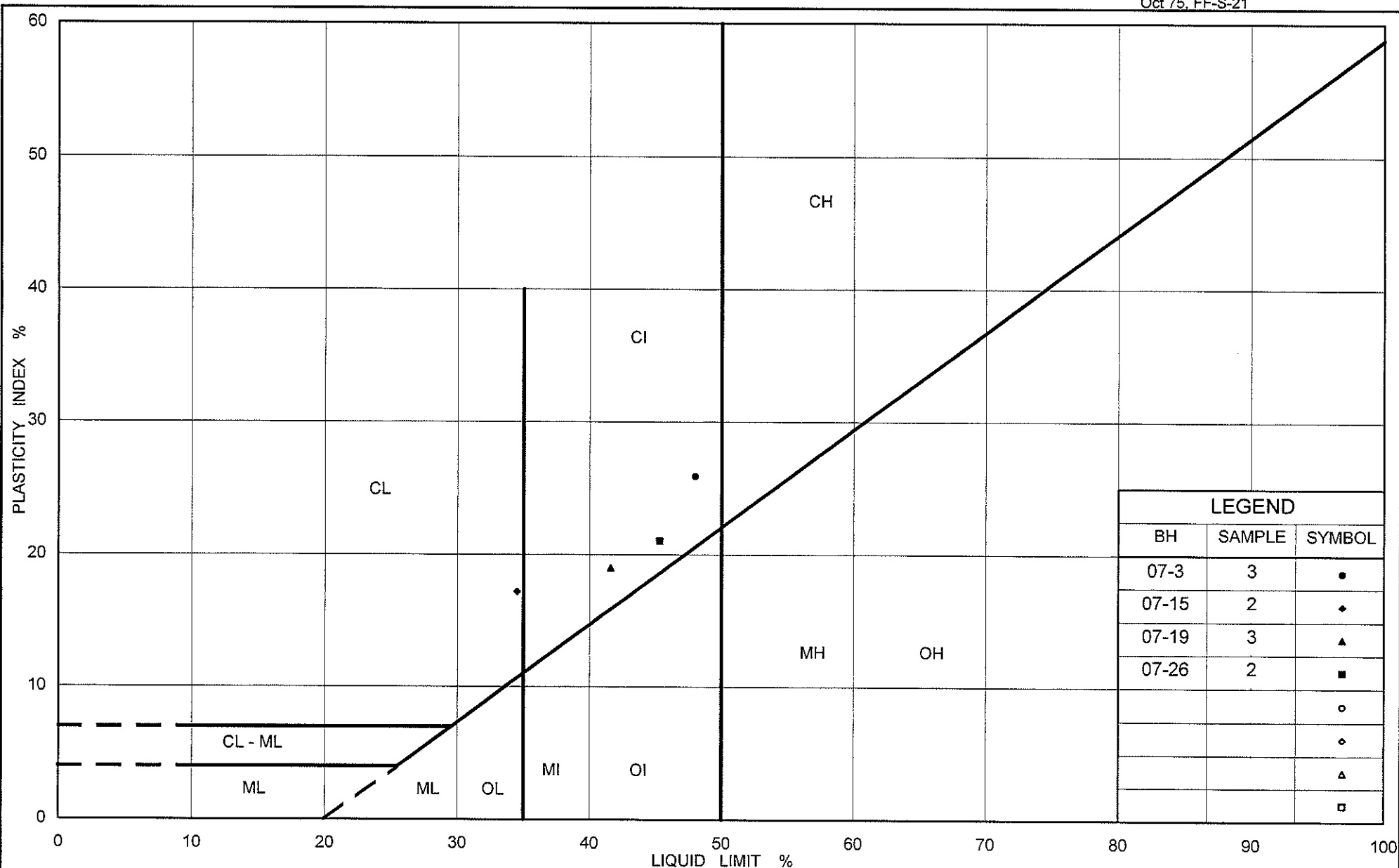
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	07-14	3	86.4
■	07-9	3	83.9
◆	07-21	9	80.9

Project Number: 05-1111-031

Checked By: *[Signature]*

Golder Associates

Date: 04-Feb-08



Ministry of Transportation

Ontario

PLASTICITY CHART Clayey Silt to Silty Clay Fill

Figure No. 4

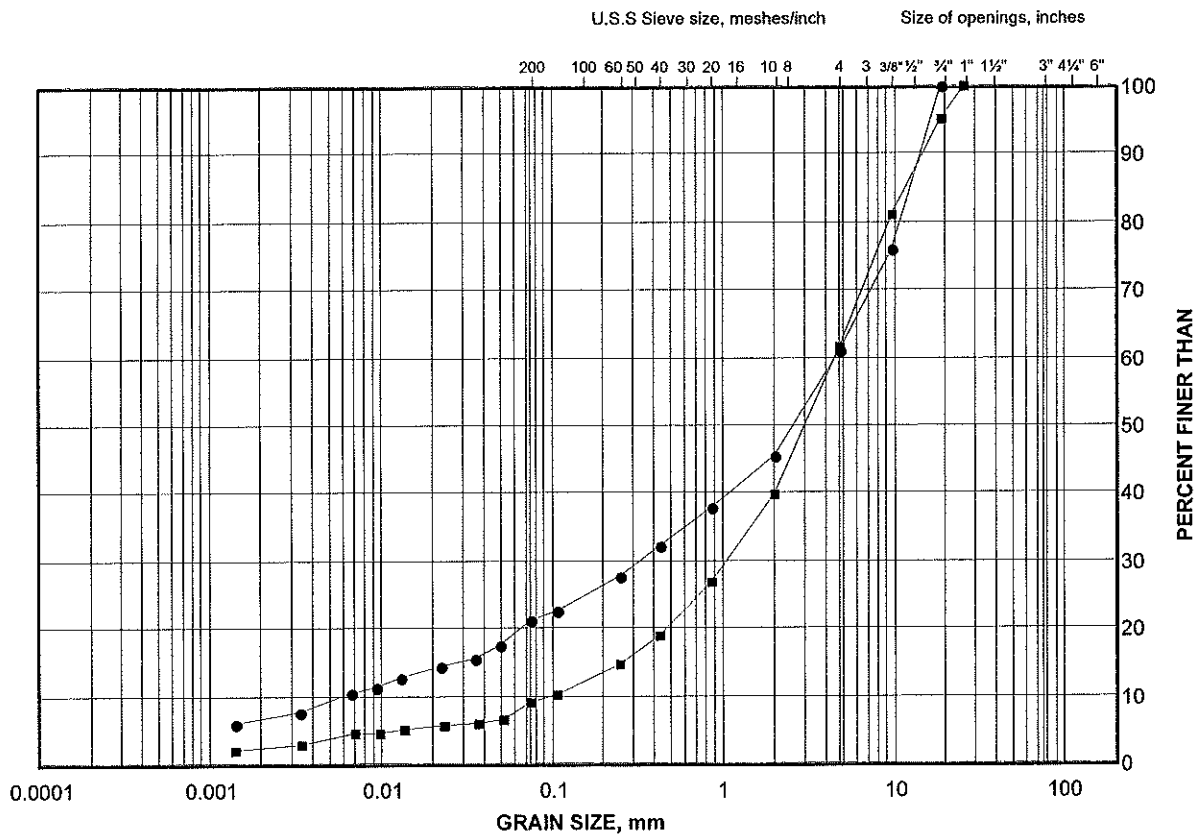
Project No. 05-1111-031

Checked By: *W. J. J.*

GRAIN SIZE DISTRIBUTION TEST RESULTS

Rock Fill

FIGURE 5



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	07-8	2	83.1
■	07-6	2	93.7

Project Number: 05-1111-031

Checked By: *[Signature]*

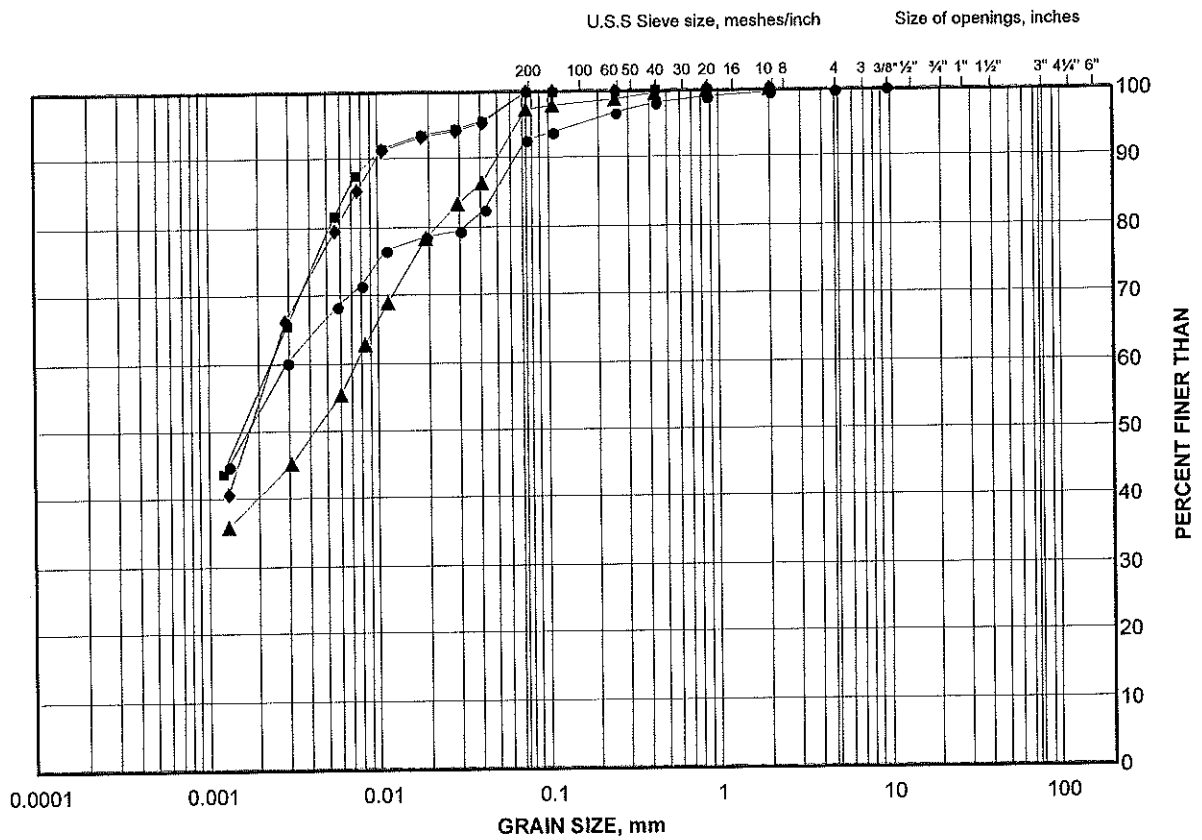
Golder Associates

Date: 04-Feb-08

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silty Clay to Clay

FIGURE 6



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

LEGEND

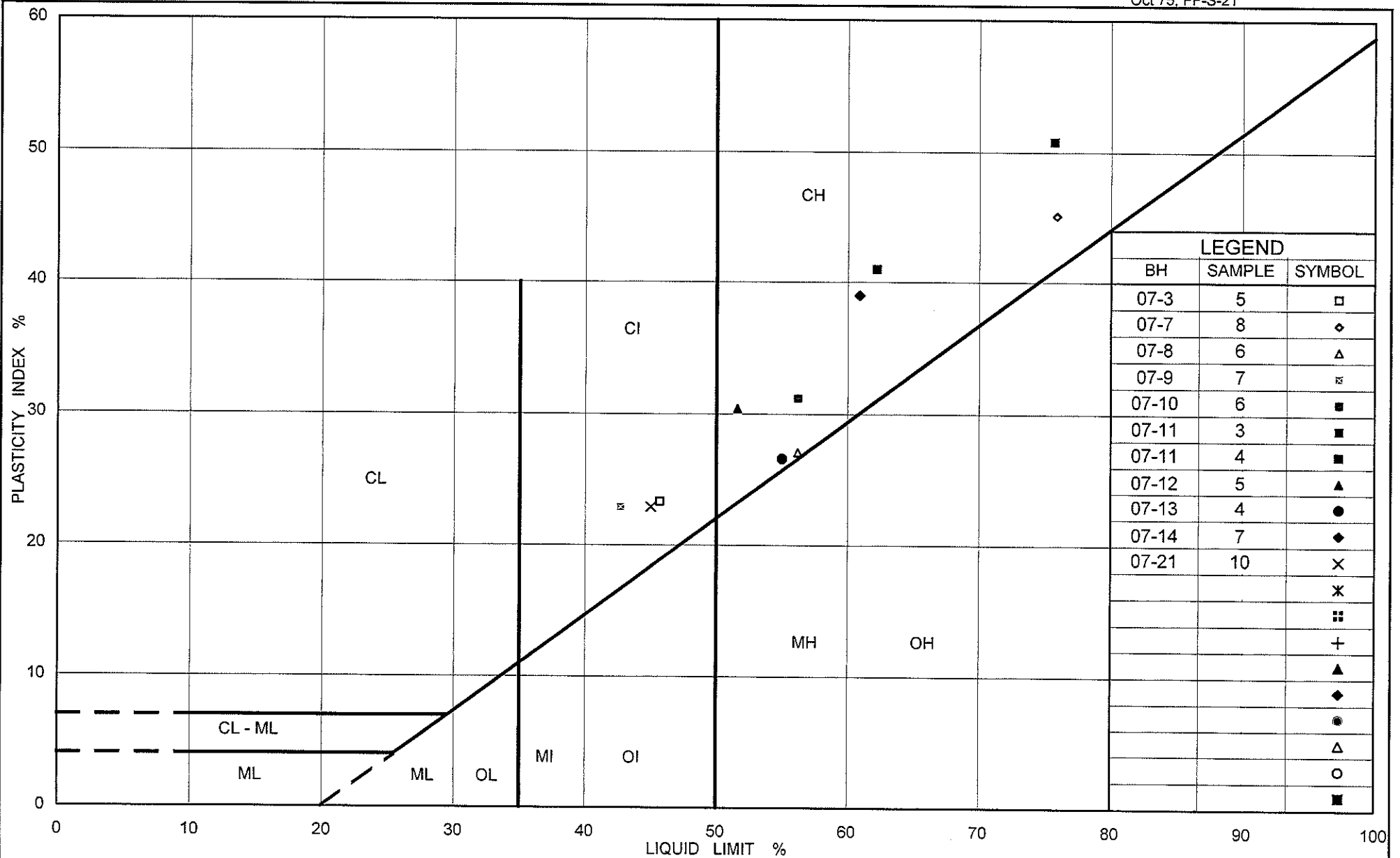
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	07-10	2	85.1
■	07-11	4	76.7
◆	07-12	5	76.5
▲	07-3	5	97.1

Project Number: 05-1111-031

Checked By: *W. Hays*

Golder Associates

Date: 04-Feb-08



Ministry of Transportation

Ontario

PLASTICITY CHART Silty Clay to Clay

FIG No.7

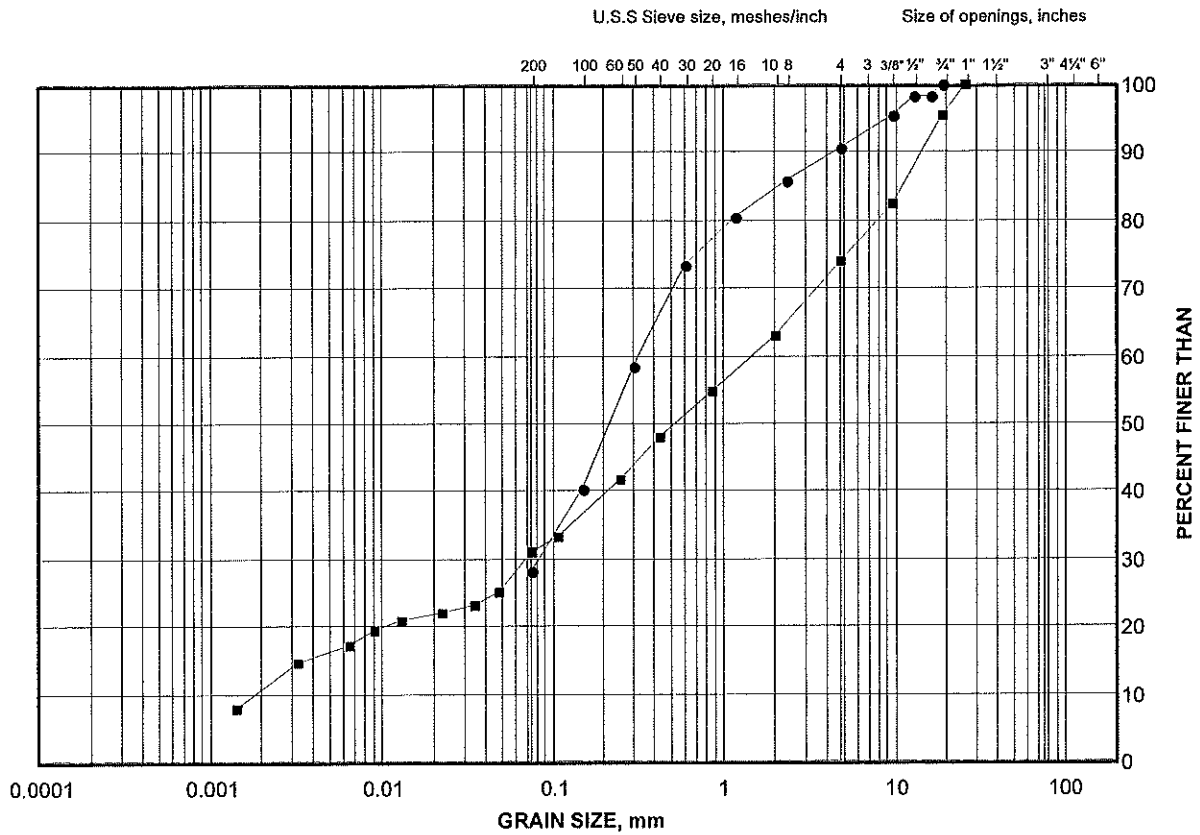
Project No.05-1111-031

Checked By: *W. J. [Signature]*

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silty Sand Till to Clayey Silt Till

FIGURE 8



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

LEGEND

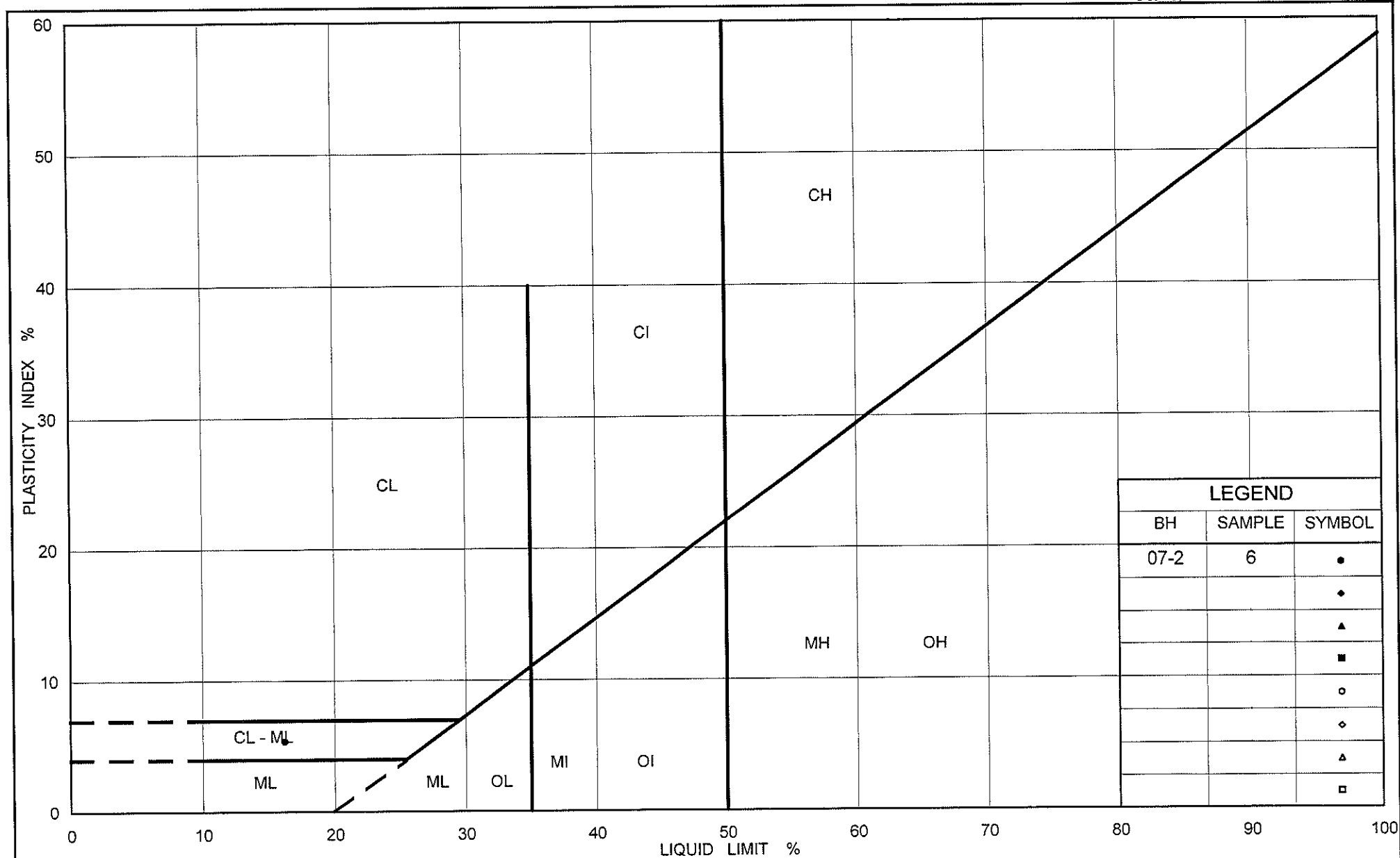
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	07-16	4	87.1
■	07-2	6	96.2

Project Number: 05-1111-031

Checked By: *[Signature]*

Golder Associates

Date: 04-Feb-08



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Ontario

PLASTICITY CHART Clayey Silt Till

Figure No. 9

Project No. 05-1111-031

Checked By: *[Signature]*

August 2008

05-1111-031-4

APPENDIX A

**SPECIAL PROVISIONS AND
NON-STANDARD SPECIAL PROVISIONS**

CAISSON SOCKETS IN BEDROCK - Item No.

Special Provision

The limestone bedrock at this site varies from medium strong to very strong. Appropriate construction equipment and procedures will be required for construction of caisson foundation sockets within the bedrock.

Basis of Payment

Payment at the lump sum contract price for this tender item shall be full compensation for all labour, equipment and materials for completion of the work.

END OF SECTION

**CONTROL OF OVERBURDEN SOILS AND GROUNDWATER DURING CAISSON
INSTALLATION - Item No.**

Special Provision

Caisson excavations will be advanced through cohesionless fill and cohesionless soil interlayers within cohesive soil deposits, which may be water-bearing; these soils should be expected to slough/flow into unsupported caisson holes. Appropriate construction procedures and equipment will be required to control sloughing and flowing during drilling and concrete placement for caisson foundations.

Basis of Payment

Payment at the lump sum contract price for this tender item shall be full compensation for all labour, equipment and materials for completion of the work.

END OF SECTION

BOULDERS/OBSTRUCTIONS IN ROCK FILL DURING CAISSON INSTALLATION
FOR OVERHEAD SIGNS - Item No.

Special Provision

Rock fill was encountered at some of the sign support locations, as noted on the borehole records. Appropriate equipment and procedures will be required to penetrate the rock fill as part of caisson installation for the overhead sign supports.

Basis of Payment

Payment at the lump sum contract price for this tender item shall be full compensation for all labour, equipment and materials for completion of the work.

END OF SECTION