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**FOUNDATION  
INVESTIGATION AND DESIGN REPORT  
HIGH MAST LIGHT POLES  
HIGHWAY 6 WIDENING  
BETWEEN HIGHWAYS 403 AND 5**

**G.W.P. 19-95-01**

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Submitted to:

URS Canada Inc.  
75 Commerce Valley Drive East  
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## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
<b>PART A - FOUNDATION INVESTIGATION REPORT</b>	
1.0 INTRODUCTION .....	1
2.0 SITE DESCRIPTION .....	2
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 Surficial Clayey Silt .....	6
4.2.3 Clayey Silt to Silty Clay Till and Till / Residual Soil .....	7
4.2.4 Bedrock .....	7
4.3 Groundwater Conditions .....	9
5.0 CLOSURE .....	10
<b>PART B - FOUNDATION DESIGN REPORT</b>	
6.0 ENGINEERING RECOMMENDATIONS .....	11
6.1 General .....	11
6.2 Caisson Foundations in Soil .....	11
6.3 Caisson Foundations Embedded in Bedrock, North of Old Guelph Road .....	12
6.4 Foundations Anchored to Rock .....	13
6.5 Construction Considerations .....	14
7.0 CLOSURE .....	15

In Order  
Following  
Page 15

### Table 1

Lists of Abbreviations and Symbols

Records of Boreholes C-2004-1, E4, E8, E11, E13, HML-1, HML-2, NW-4, NW-5, OHS-2003-2,  
OHS-2003-3, OHS-2003-4, P1, and RW-1

Records of Test Pits 04-2 and 04-3

Drawings 1 to 3

Figures 1 to 4

Appendix A

**LIST OF DRAWINGS**

Drawings 1 to 3      High Mast Light Poles, Borehole Locations

**LIST OF FIGURES**

Figure 1              Grain Size Distribution Test Results – Embankment Fill

Figure 2              Plasticity Chart – Embankment Fill

Figure 3              Grain Size Distribution Test Results – Clayey Silt Till and Till / Residual Soil

Figure 4              Plasticity Chart – Clayey Silt to Silty Clay Till and Till / Residual Soil

**LIST OF APPENDICES**

Appendix A          Non-Standard Special Provisions

July 2006

001-1141F-7

## **PART A**

**FOUNDATION INVESTIGATION REPORT  
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## **1.0 INTRODUCTION**

Golder Associates Ltd. has been retained by URS Canada Inc. (URS) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for new bridge structures, a pedestrian tunnel, culverts, retaining walls, high fill embankments, high mast light poles, and overhead signs, associated with the widening of Highway 6 between Highways 403 and 5 near Dundas, Ontario.

This report addresses the high mast light pole foundations. A foundation investigation has been carried out to determine the subsurface conditions across the site.

The terms of reference for the scope of work are outlined in Golder Associates' Proposal No. P01-1166, dated June 2000. The work has been carried out in accordance with Golder Associates' Quality Control Plan for Foundation Engineering Services, dated July 2000.

## 2.0 SITE DESCRIPTION

This 2.5 km length of Highway 6, between Highway 403 and Highway 5 (Dundas Street), is located within the City of Burlington in the Regional Municipality of Halton, and the Towns of Dundas and Flamborough in the New City of Hamilton.

Highway 6 crosses the Niagara escarpment south of Highway 5, in the vicinity of Old Guelph Road. The escarpment crest is at about Elevation 215 m; above the crest, the ground surface rises northward to about Elevation 220 m near the north limit of the project at Highway 5. Below the crest, the ground surface declines from Elevation 215 m to about Elevation 147 m in the vicinity of York Road, and about Elevation 133 m near the south limit of the project.

Above Old Guelph Road, near-vertical rock cuts up to a maximum height of about 20 m have been constructed on either side of Highway 6. The upper portions of the cut are comprised mainly of dolostones and limestones, and are sub-vertical. From just north of Old Guelph Road at about Station 12+375 to approximately Station 12+525, the lower portion of the cuts is oriented at approximately 1.5 horizontal to 1 vertical. These lower slopes increase in height from north to south as the existing highway cuts through the escarpment, varying from less than 2 m to 3 m high at Station 12+525, to about 10 m high immediately north of Old Guelph Road.

Immediately south of Old Guelph Road, Highway 6 has been constructed on embankment fill which is up to about 15 m in height.

### 3.0 INVESTIGATION PROCEDURES

Subsurface borehole investigations were carried out along Highway 6 in November 2000, January 2001, September 2003, February 2004, March 2004 and November 2004, during which time fourteen boreholes (Boreholes C-2004-1, E4, E8, E11, E13, HML-1, HML-2, NW-4, NW-5, OHS-2003-2, OHS-2003-3, OHS-2003-4, P1, and RW-1) and two test pits (Test Pits 04-2 and 04-3) were advanced in the vicinity of the proposed high mast light poles. The locations of the boreholes and test pits are shown on Drawings 1 to 3.

The boreholes were advanced to depths ranging from 5.2 m to 17.3 m with solid stem augers, using truck-mounted and track-mounted drill rigs supplied and operated by Master Soil Investigations Ltd. of Toronto, Ontario, Geo-Environmental Drilling Inc. of Milton, Ontario and Walker Drilling Ltd. of Utopia, Ontario. Samples of the overburden were obtained at 0.75 m and 1.5 m intervals of depth using 50 mm outside diameter split-spoon samplers in accordance with the Standard Penetration Test (SPT) procedure. The water level in the open boreholes was observed throughout the drilling operations, and a 20 mm diameter standpipe piezometer was installed in each of Boreholes HML-2, OHS-2003-3 and RW-1 to monitor the groundwater level across the site. Details of the piezometer installation are shown on the relevant borehole records. Where no piezometer was installed, the boreholes were backfilled using bentonite pellets, mixed in places with soil cuttings; a surface seal of bentonite was placed in all of the boreholes.

Test Pits 04-2 and 04-3 were advanced through the "lower slope" in front of the near-vertical rock cuts along the west side of Highway 6, north of Old Guelph Road. These test pits were advanced using a track-mounted hydraulic excavator supplied and operated by Petrie & Sons Excavation Ltd. Due to the steepness of the "lower slope", the excavator operated from the shoulder of Highway 6, and reached upward using an extendable hoe to dig a test "strip" down the lower slope.

The borehole and test pit investigations were supervised on a full-time basis by a member of Golder's staff who located the boreholes in the field, directed the drilling, sampling, and in situ testing operations, and logged the boreholes. The soil samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Mississauga for further examination. Index and classification tests consisting of water content determinations, Atterberg limit testing and grain size distribution analyses were carried out on selected soil samples.

The borehole and test pit locations and ground surface elevations were determined relative to known surface features or to point staked in the field by Callon Dietz, Ontario Land Surveyors. The MTM NAD83 northing and easting coordinates for the boreholes, and the ground surface elevations referenced to geodetic datum, are shown on the borehole records and on Drawings 1 to 3.

<i>Borehole / Test Pit No.</i>	<i>Ground Surface Elevation (m)</i>	<i>MTM NAD83 Northing (m)</i>	<i>MTM NAD83 Easting (m)</i>
C-2004-1	144.8	4,795,738.0	271,894.0
E4	183.5	4,796,199.8	271,473.0
E8	177.5	4,796,128.2	271,544.2
E11	170.4	4,796,059.4	271,636.2
E13	163.5	4,795,989.1	271,706.9
HML-1	126.1	4,795,107.1	272,629.1
HML-2	131.0	4,795,178.7	272,559.4
NW-4	137.0	4,795,282.4	272,415.8
NW-5	140.7	4,795,336.1	272,362.0
OHS-2003-2	144.6	4,795,408.7	272,307.8
OHS-2003-3	146.4	4,795,685.8	272,039.7
OHS-2003-4	155.9	4,795,889.7	271,792.4
P1	145.1	4,795,502.9	272,225.0
RW-1	145.7	4,795,657.1	272,113.9
TP 04-2	Varies	4,796,344.5	271,320.5
TP 04-3	Varies	4,796,298.7	271,366.7

## **4.0 SITE GEOLOGY AND STRATIGRAPHY**

### **4.1 Regional Geological Conditions**

This 2.5 km section of Highway 6 traverses the Niagara Escarpment, which separates the lower Iroquois Plain to the south from the Flamborough Plain to the north, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, Third Edition, 1984). In the vicinity of the Escarpment itself, covering much of the study area for this project, the Halton Till of the Peel Plain physiographic region is present, according to the *Urban Geology of Canadian Cities* (Karrow and White, 1998).

The escarpment crest is located just north of Old Guelph Road, and well-jointed and bedded sedimentary bedrock consisting of dolostone, limestone, sandstone and shale is exposed in the existing Highway 6 cut. Typically, natural talus intermixed with rubbly glacial debris covers the lower slopes of the escarpment. Below the escarpment, the bedrock consists of shale.

The Halton Till of the Peel Plain physiographic region typically ranges in composition from a dense, reddish clayey silt to silt till to a grey, plastic clayey silt to silty clay till. This Halton Till is the lowest and oldest soil deposit encountered in excavations in the area north of Hamilton, and it typically rests directly on the bedrock. Commonly, there is a transition zone of residual soil and/or disturbed bedrock at the contact between the Halton Till and the shale.

### **4.2 Site Stratigraphy**

The detailed subsurface soil and groundwater conditions encountered in the boreholes or test pits advanced during this investigation, together with the results of the laboratory tests carried out on selected soil samples, are given on the Record of Boreholes and Test Pits and on Figures 1 to 4 following the text of this report. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests (SPTs). These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. The subsurface conditions will vary between and beyond the borehole locations.

Below the existing Highway 6 embankment fill (where present), the predominant native soil deposit at the site is a clayey silt till that grades with depth to a residual soil. A thin layer of surficial clayey silt was encountered atop the till at some borehole locations. Shale bedrock was encountered below the till near the south limit of the project, and dolostone, limestone and shale bedrock is exposed in the escarpment cut near the north limit of the project (north of Old Guelph Road). The following subsections provide further information on the subsoils and groundwater conditions encountered in the boreholes and test pits.

#### **4.2.1 Fill**

Fill, mainly associated with the existing Highway 6 embankment, was encountered in Boreholes C-2004-1, E4, E8, E11, E13, NW-4, NW-5, OHS-2003-2, OHS-2003-3 and OHS-2003-4. The fill ranges from about 0.5 m to 14.6 m in thickness, as encountered in the boreholes that are included in this report. The thickest areas of fill are located within the existing "high fill embankment" north of York Road, and at the approaches to the existing CP Rail overhead structures.

The fill composition is variable, but typically consists of either sand and gravel, or clayey silt containing trace to some sand and trace to some gravel, shale and limestone fragments. In the existing "high fill embankment" north of York Road, some portions of the clayey silt fill appear to consist of recompacted, weathered shale (as encountered in Boreholes E4, E8, E11, E13 and OHS-2003-4). The results of grain size distribution tests conducted on three selected samples of the existing embankment fill are presented on Figure 1. Cobbles and boulders were inferred within the embankment fill during drilling, particularly within the "high fill embankment" section north of York Road, based on grinding of the augers and/or resistance to penetration of the sampler. Instances of heavy grinding and slow or difficult advance are noted on the borehole records. In addition, an approximately 0.3 m deep void was encountered within the fill during sampling in one borehole (Borehole E4).

The measured Standard Penetration Test (SPT) "N" values within the existing embankment fill range from 9 to more than 30 blows per 0.3 m of penetration within the sand and gravel portions of the fill, and from 3 to more than 30 blows per 0.3 m of penetration in the cohesive portions of the fill. These results indicate that the relative density or consistency is variable, although the sand and gravel fill is typically compact and the clayey silt fill is typically stiff to hard. It is noted that higher SPT "N" values of about 40 to 80 blows per 0.3 m of penetration were also measured in the fill, but it is considered that these results were affected by the presence of gravel and / or cobbles within the sample zone.

Atterberg limit testing was carried out on three samples of the clayey silt embankment fill, and measured plastic limits of 16 to 18 per cent, liquid limits of 33 to 34 per cent, and corresponding plasticity indices of 15 to 18 per cent. These results, which are plotted on a plasticity chart on Figure 2, confirm that the cohesive portions of the fill consist of clayey silt of low plasticity.

#### **4.2.2 Surficial Clayey Silt**

Approximately 1 m of clayey silt was encountered immediately below the embankment fill in Borehole E8, and about 1.4 m of clayey silt was encountered immediately below ground surface in Borehole P1. This surficial clayey silt contains trace sand and gravel, and has a very stiff consistency based on measured SPT "N" values of 15 and 21 blows per 0.3 m of penetration.

#### **4.2.3 Clayey Silt to Silty Clay Till and Till / Residual Soil**

A deposit of brown to red-brown or grey-brown till was encountered in all of the boreholes below the topsoil, existing embankment fill or surficial clayey silt (where present). The till is typically comprised of clayey silt containing trace to some sand, and trace to some gravel, shale and limestone fragments. Below about 7.2 m to 13.1 m depth in Boreholes NW-4, OHS-2003-4, P1 and RW-1, the till grades to a residual soil deposit. The results of grain size distribution tests conducted on nine samples of the clayey silt till and till / residual soil are shown on Figure 3. It is noted that the till is glacially derived and should, therefore, be expected to contain cobbles and boulders, although no such obstructions were encountered within the till in the boreholes advanced as part of this investigation.

Atterberg limit testing was carried out on seventeen samples of the till or till / residual soil, and the results are plotted on a plasticity chart on Figure 4. This testing measured plastic limits of 13 to 17 per cent, and liquid limits of 19 to 40 per cent (but typically 26 to 34 per cent); the corresponding plasticity indices range from 6 to 23 per cent, but are typically between 10 and 18 per cent. These plasticity results indicate that the till is predominantly a clayey silt of low plasticity; however, some portions of the till grade to a silty clay of intermediate plasticity, as encountered in Boreholes NW-5 and OHS-2003-2.

The clayey silt to silty clay till generally has a very stiff to hard consistency, based on measured SPT "N" values of 21 to greater than 100 blows per 0.3 m of penetration. Lower measured SPT "N" values of 9 to 13 blows per 0.3 m of penetration were measured immediately below ground surface or existing fill in Boreholes HML-1, HML-2 and OHS-2003-2, indicating that the upper layer of the till in these boreholes has a stiff consistency.

#### **4.2.4 Bedrock**

##### ***Bedrock at South Limit of Project***

Near the south limit of the project, reddish-brown shale of the Queenston Formation was encountered below the till, at 6.1 m depth (Elevation 120.0 m) and 7.3 m depth (Elevation 123.7 m) in Boreholes HML-1 and HML-2, respectively. These two boreholes were advanced into the shale by augering and split-spoon sampling. All of the SPT "N" values measured within the shale were greater than 100 blows per 0.3 m of penetration.

It should be noted that, although limestone and dolostone interbeds were not specifically observed within the shale samples obtained from Boreholes HML-1 and HML-2, such stronger interbeds are known to be present within the Queenston Formation bedrock.

***Bedrock North of Old Guelph Road***

North of Old Guelph Road, dolostone, limestone and shale bedrock is exposed in the highway cut through the Niagara escarpment. Detailed mapping of these near-vertical bedrock cuts was carried out in November 2000. The results of that mapping, including annotated photo-mosaics of the exposed cut faces, are presented in Golder's *Rockfall Hazard Assessment Report* (dated February 2001) for this project. A brief summary of the bedrock formations exposed within the escarpment cut, in order of decreasing elevation, is provided below:

- **Lockport Formation:** This approximately 5.5 m thick formation consists of buff to grey, thinly to thickly bedded dolostone.
- **Rochester Formation:** This 2 m thick formation consists of medium grey shaley dolostone and soft fissile shale.
- **Irondequoit Formation:** This formation is about 1.5 m thick and consists of a light to medium grey, medium to thickly bedded dolomitic limestone.
- **Reynales Formation:** This approximately 2 m thick formation is generally observed near the base of the existing near-vertical cut, just above the top of the "lower slope". The Reynales Formation is comprised of greenish-grey, thinly- to medium-bedded argillaceous dolostone, containing thin interbeds of shale.
- **Thorold Formation:** This formation consists of an approximately 3 m thick, interbedded sequence of medium to dark green, fissile shale and light grey, thinly to medium-bedded sandstone and siltstone.
- **Grimsby Formation:** This formation is approximately 3 m thick in this area, and is comprised of a dark red-brown, thinly-bedded to laminated mudstone and fissile shale, containing siltstone interbeds.
- **Cabot Head:** This formation consists of a medium grey, fissile shale containing thin interbeds of siltstone and dolostone.

In order to determine the location of the rock line within the existing "lower slopes" in front of the near-vertical rock cuts, test pits were excavated down the face of these lower slopes. Below about 150 mm to 200 mm of topsoil, Test Pits 04-2 and 04-3 encountered about 300 mm to 350 mm of highly weathered, grey-brown to red-brown shale. Fresh to slightly weathered shale was encountered below about 0.5 m depth in both of these test strips; based on the bedrock mapping, this bedrock within the "lower slopes" is considered to be of the Thorold and Grimsby Formations.

### 4.3 Groundwater Conditions

The majority of the boreholes were dry on completion of drilling operations, although about 2 m to 2.5 m of standing water was encountered at the base of Boreholes E4 and E11 on completion of drilling.

Piezometers were installed in Boreholes HML-2, OHS-2003-3 and RW-1 to monitor the groundwater level across the site. The water levels measured in the piezometers approximately six weeks after installation are summarized in the following table:

<i>Borehole No.</i>	<i>Depth to Groundwater</i>	<i>Groundwater Elevation</i>	<i>Date of Measurement</i>
HML-2	1.8 m	129.3 m	November 1, 2003
OHS-2003-3	1.2 m	145.2 m	November 1, 2003
RW-1	9.7 m	136.0 m	November 1, 2003


Based on the measurements summarized above as well as groundwater monitoring information from other piezometers installed as part of the Highway 6 widening study, the stabilized groundwater level at the site is typically between 1.5 m and 3 m below the natural ground surface. The groundwater table is deeper in the vicinity of the Grindstone Creek channel and in the vicinity of the rail cut.

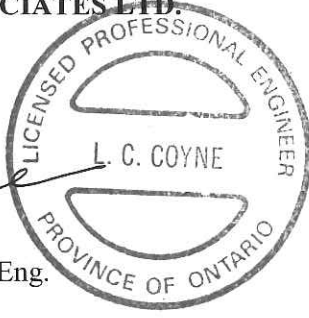
It should be noted that groundwater levels are expected to fluctuate seasonally and are expected to rise during wet periods of the year.

## 5.0 CLOSURE

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

### GOLDER ASSOCIATES LTD.

  
Lisa C. Coyne, P.Eng.  
Associate

A circular professional seal for Lisa C. Coyne, a Licensed Professional Engineer in the Province of Ontario. The seal features a stylized 'E' in the center, with the text 'LICENSED PROFESSIONAL ENGINEER' around the top and 'PROVINCE OF ONTARIO' around the bottom. The name 'L. C. COYNE' is printed across the center of the seal.

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

A circular professional seal for Fintan J. Heffernan, a Registered Professional Engineer in the Province of Ontario. The seal features a stylized 'E' in the center, with the text 'REGISTERED PROFESSIONAL ENGINEER' around the top and 'PROVINCE OF ONTARIO' around the bottom. The name 'F. J. HEFFERNAN' is printed across the center of the seal.

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## **PART B**

**FOUNDATION DESIGN REPORT  
HIGH MAST LIGHT POLES  
HIGHWAY 6 WIDENING BETWEEN HIGHWAYS 403 AND 5  
G.W.P. 19-95-01**

## 6.0 ENGINEERING RECOMMENDATIONS

### 6.1 General

This section of the report provides foundation design recommendations for the proposed high mast light poles. The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the subsurface investigation at this site. The interpretation and recommendations provided are intended only to provide the designers with sufficient information to design the structure foundations. As such, where comments are made on construction they are provided only in order to highlight those aspects which could affect the planning of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods, scheduling and the like.

The HML pole foundations should be designed in accordance with MTO's *Procedures for the Design of High Mast Pole Foundations*, dated June 1994. The parameters to be used in the design of the foundations are provided Table 1 following the text of this report, and are discussed further in the following subsections. It is noted that the existing high fill embankment will be widened in the vicinity of Station 11+850, and between Stations 12+000 and 12+300; for HML poles P20 and P22 to P24 in these areas, it should be recognized that at least some portion of the caisson foundations will be constructed through the new embankment fill. The parameters presented in Table 1 for the existing fill may be considered to apply equally to the new fill.

### 6.2 Caisson Foundations in Soil

The unfactored passive lateral earth pressure,  $P_p$  (kPa), distributed along the depth of the caisson foundation may be calculated using the following equations:

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

where  $K_p$  is the passive earth pressure coefficient, as given in Table 1;  
 $\gamma$  is the bulk unit weight ( $\text{kN/m}^3$ ), as given in Table 1;  
 $\gamma'$  is the effective unit weight below the groundwater level ( $\text{kN/m}^3$ ), as given in Table 1;  
 $d$  is the depth below the ground surface (m); and  
 $d_w$  is the depth to the groundwater level (m), based on the information provided in Table 1.

The lateral earth pressure may be assumed to act over an equivalent width equal to three times the caisson diameter. A resistance factor of 0.5 should be applied to this calculated lateral resistance in order to obtain the factored lateral geotechnical resistance. In addition, the passive resistance

in front of the caisson within the upper 1.2 m below ground surface should be neglected to account for frost action.

For foundation design, full passive resistance will be mobilized only where the width of soil in front or behind the caissons is equal to or greater than eight caisson diameters. This condition may not be met where the HML poles are situated in close proximity to the crest of the Highway 6 embankment. If there is a lesser width of soil for development of passive resistance, the magnitude of the passive resistance may be determined by interpolating between zero passive resistance at ground surface and full passive resistance at the depth where the highway embankment slope face is greater than eight caisson diameters away from the face of the caisson.

### 6.3 Caisson Foundations Embedded in Bedrock, North of Old Guelph Road

HML poles P25 to P28 will be constructed within the escarpment cut north of Old Guelph Road. The surface of the bedrock at these HML pole locations, following the proposed grading of the ditches and cut slopes, is expected to be less than or similar to the frost depth of 1.2 m. Caisson foundations for HML poles P25 and P26 would extend into shale bedrock, which contains interlayers of stronger limestone and dolostone. Caisson foundations for HML poles P27 and P28 would extend into the stronger dolostone or shaley dolostone bedrock that is present at these locations.

For HML poles P25 to P28, the depth to the surface of the rock following the highway and cut slope re-grading may be used for  $V$  (the depth to resisting soil or rock), using the solutions given in Section 6.1 of MTO's *Procedures for the Design of High Mast Pole Foundations*. The factored lateral geotechnical resistance at Ultimate Limit States (ULS) of the rock mass may be taken as given in the following table. Notwithstanding the design length determined using this factored lateral resistance at ULS, a minimum caisson embedment length in the rock of 2.5 m should be used for these pole foundations, in accordance with Section 6.1 of the *Procedures for the Design of High Mast Pole Foundations*.

<i>HML Pole No.</i>	<i>Bedrock Type</i>	<i>Factored Lateral Resistance at ULS</i>
P25, P26	Shale	1.5 MPa
P27, P28	Dolostone / Shaley dolostone	5 MPa

Alternatively, since formation of the caisson socket within the stronger dolostone / shaley dolostone layers will require appropriate coring equipment and could be more difficult and/or time-consuming, consideration could be given to anchoring the foundations for these HML poles to the bedrock as discussed in the following section.

#### **6.4 Foundations Anchored to Rock**

If anchoring is adopted for HML poles P25 to P28, north of Old Guelph Road, it is recommended that the concrete foundation be embedded a minimum of 0.3 m into the bedrock. In accordance with the *Procedures for the Design of High Mast Light Poles*, a minimum concrete foundation length of 1.75 m is required to allow sufficient length for the anchorage assembly, so it may be necessary to embed the foundations deeper into the rock, depending on the bedrock depth following the cut slope re-grading and highway widening works. It is noted that the upper portion of the bedrock may be fractured due to past and proposed cut works, and subexcavation of any loose, fractured bedrock will be required prior to construction of the footing; this requirement is not related to bearing capacity for the footing, but rather to ensuring that the upper portion of the rock, into which the dowels will be extended, is competent. In this regard, 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 to ensure that all loose and/or fractured rock has been removed from the foundation areas prior to construction of the spread footings.

For uplift of the dowels, the following factored values may be assumed for the grout-to-rock bond stress for ULS design.

P25 and P26 (shale bedrock):	200 kPa
P27 and P28 (dolostone / shaley dolostone):	500 kPa

The rock dowels should have a minimum embedded length within the bedrock of 1 m, and the structural strength of the dowel and the compressive strength of the grout should not be exceeded. It is noted that 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; in this case, a Special Provision will have to be included in the Contract Documents to cover this testing, if anchored footings are used for support of the HML poles.

## 6.5 Construction Considerations

It is recommended that a Non-Standard Special Provision (NSP) be included in the Contract Documents to warn the Contractor of the following items which are expected to affect the installation of the high mast light pole foundations:


- **Caisson installation through Highway 6 embankment fill:** The existing Highway 6 embankment fill is variable, and includes zones of cohesionless soil, cobbles, boulders, and voids. It should be anticipated that the caisson holes will have to be advanced using a temporary liner in order to avoid loss of ground. In addition, appropriate equipment and procedures will be required to penetrate obstructions (cobbles and boulders) that may be present within the fill.
- **Formation of caisson sockets in bedrock:** North of Old Guelph Road, at the locations of HML poles P25 to P28, sockets for caisson foundations will be formed within the bedrock. Caisson foundations for HML poles P1 and P2, near the south limit of the project, may also extend into the bedrock. At HML poles P1 and P2, and for HML poles P25 and P26, the bedrock is predominantly shale; however, this shale formation is known to contain stronger limestone and dolostone interlayers. North of about Station 12+600 (i.e. for HML poles P27 and P28), a stronger dolostone/shaley dolostone "cap" is present at the highway grade, above the shale. Consideration of the presence of the stronger limestone and dolostone must be made in the selection of caisson installation equipment at these locations.


Sample NSSPs to address the above items are provided in Appendix A.

## 7.0 CLOSURE

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

### GOLDER ASSOCIATES LTD.

  
Lisa C. Coyne, P.Eng.  
Associate



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



LCC/FJH/lcc

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**TABLE 1: DESIGN PARAMETERS FOR HIGH MAST LIGHT POLE FOUNDATIONS  
HIGHWAY 6 WIDENING  
W.P. 19-95-01**

<i>HML Pole No.</i>	<i>Borehole/Test Pit No.</i>	<i>Borehole/Test Pit Location</i>	<i>Stratum</i>	<i>Depth<sup>1</sup> (m)</i>	<i>Elevation (m)</i>	<i>Groundwater Elevation (m)</i>	$\phi'$	$\gamma$	$\gamma'$	$K_p$
P1	HML-1	N - 4,795,107.1 E - 272,629.1	Fill / Clayey silt till Clayey silt till Shale bedrock	0 - 2.5 2.5 - 6.1 Below 6.1	126.1 - 123.6 123.6 - 120.0 Below 120.0	124	28 34 38	20 21 23	10 11 13	2.8 3.5 4.2
P2	HML-2	N - 4,795,178.7 E - 272,559.4	Clayey silt till Shale bedrock	0.0 - 7.3 Below 7.3	131.0 - 123.7 Below 123.7	129.5	34 38	21 23	11 13	3.5 4.2
P3	NW-4	N - 4,795,282.4 E - 272,415.8	Fill Clayey silt till Clayey silt till / residual soil	0.0 - 4.5 4.5 - 7.2 Below 7.2	137.0 - 132.5 132.5 - 129.8 Below 129.8	130	28 32 34	20 21 21	10 11 11	2.8 3.3 3.5
P4	NW-5	N - 4,795,336.1 E - 272,362.0	Fill / Clayey silt till Clayey silt till	0.0 - 7.2 Below 7.2	140.7 - 133.5 Below 133.5	134	28 32	20 21	10 11	2.8 3.3
P5	OHS-2003-02	N - 4,795,386.9 E - 272,280.5	Fill / Clayey silt till Clayey silt till	0.0 - 5.6 Below 5.6	144.6 - 139.0 Below 139.0	138	28 32	20 21	10 11	2.8 3.3
P6	P1	N - 4,795,502.9 E - 272,225.0	Clayey silt Clayey silt till	0.0 - 1.4 Below 1.4	145.1 - 143.7 Below 143.7	138	28 34	20 21	10 11	2.8 3.5
P7	RW-1	N - 4,795,657.3 E - 272,113.8	Clayey silt till Clayey silt till / residual soil	0.0 - 10.2 Below 10.2	145.7 - 135.5 Below 135.5	138	32 34	21 21	11 11	3.3 3.5
P8	OHS-2003-03	N - 4,795,685.6 E - 272,040.4	Clayey silt till	0.0 - 11.1	146.4 - 135.3	145	32	21	11	3.3
P15	C-2004-1	N - 4,795,738.0 E - 271,894.0	Fill Clayey silt till	0.0 - 1.5 Below 1.5	144.8 - 143.3 Below 143.3	142	28 32	20 21	10 11	2.8 3.3
P16, P20	OHS-2003-4	N - 4,795,889.7 E - 271,792.4	Fill Clayey silt till	0.0 - 4.1 Below 4.1	155.9 - 151.8 Below 151.8	150	28 32	20 11	10 11	2.8 3.3
P21	E13	N - 4,795,989.1 E - 271,706.9	Fill Clayey silt till	0.0 - 2.3 Below 2.3	163.5 - 161.2 Below 161.2	160	28 34	20 21	10 11	2.8 3.5
P22	E11	N - 4,796,059.4 E - 271,636.2	Fill Clayey silt till	0.0 - 14.6 Below 14.6	170.4 - 155.8 Below 155.8	160	28 34	20 21	10 11	2.8 3.5
P23	E8	N - 4,796,128.2 E - 271,544.2	Fill / Clayey silt Clayey silt till	0.0 - 13.6 Below 13.6	177.5 - 163.9 Below 163.9	164	28 32	20 21	11 10	2.8 3.3
P24	E4	N - 4,796,199.8 E - 271,473.0	Fill Clayey silt till	0.0 - 11.4 Below 11.4	183.5 - 172.1 Below 172.1	172	28 34	20 21	10 11	2.8 3.5

**TABLE 1: DESIGN PARAMETERS FOR HIGH MAST LIGHT POLE FOUNDATIONS (Continued)**  
**HIGHWAY 6 WIDENING**  
**W.P. 19-95-01**

HML Pole No.	Borehole/Test Pit No.	Borehole/Test Pit Location	Stratum	Depth <sup>1</sup> (m)	Elevation (m)	Groundwater Elevation (m)	$\phi'$	$\gamma$	$\gamma'$	$K_p$
P25	TP 04-3	N - 4,796,298.7 E - 271,366.2	Shale bedrock	See Note 3						
P26	TP 04-2	N - 4,796,344.5 E - 271,320.5	Shale bedrock	See Note 3						
P27	Rock cut mapping	N/A	Dolostone/shaley dolostone bedrock	See Note 3						
P28	Rock cut mapping	N/A	Dolostone/shaley dolostone bedrock	See Note 3						

**NOTES:**

- Although the passive resistance in the upper 1.2 m is neglected to account for frost action,  $\phi'$  and  $K_p$  parameters are given in the event that the ground surface elevation varies significantly between the borehole and high mast light pole locations.
- Design parameters:  $\phi'$  = effective friction angle (degrees);  
 $\gamma$  = bulk unit weight ( $\text{kN/m}^3$ );  
 $\gamma'$  = effective unit weight below the groundwater level ( $\text{kN/m}^3$ ); and  
 $K_p$  = passive earth pressure coefficient.
- North of Old Guelph Road, the HML pole foundations will be installed within shale bedrock (P25 and P26) or dolostone / shaley dolostone bedrock (P27 and P28). Recommendations for design of these poles are presented in Section 6.3 (Caisson Foundations Embedded in Bedrock, North of Old Guelph Road) and Section 6.4 (Foundations Anchored to Bedrock).

## 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.)

#### (b) Cohesive Soils

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

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

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

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

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

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

### IV. SOIL TESTS

w	water content
w <sub>p</sub>	plastic limit
w <sub>l</sub>	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
D <sub>R</sub>	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 <sub>4</sub>	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
$\gamma$	unit weight

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

## LIST OF SYMBOLS

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

### I. General

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

### II. STRESS AND STRAIN

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma$
$\epsilon$	linear strain
$\epsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	Poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	shear stress
$u$	porewater pressure
$E$	modulus of deformation
$G$	shear modulus of deformation
$K$	bulk modulus of compressibility

### III. SOIL PROPERTIES

#### (a) Index Properties

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


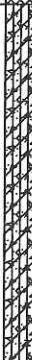
$C_c$	compression index (normally consolidated range)
$C_r$	recompression index (over-consolidated range)
$C_s$	swelling index
$C_a$	coefficient of secondary consolidation
$m_v$	coefficient of volume change
$c_v$	coefficient of consolidation
$T_v$	time factor (vertical direction)
$U$	degree of consolidation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

#### (d) Shear Strength

$\tau_p, \tau_r$	peak and residual shear strength
$\phi'$	effective angle of internal friction
$\delta$	angle of interface friction
$\mu$	coefficient of friction $= \tan \delta$
$c'$	effective cohesion
$c_u, s_u$	undrained shear strength ( $\phi = 0$ analysis)
$p$	mean total stress $(\sigma_1 + \sigma_3)/2$
$p'$	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
$q$	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
$q_u$	compressive strength $(\sigma_1 + \sigma_3)$
$S_i$	sensitivity

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

PROJECT <u>001-1141F</u>		<b>RECORD OF BOREHOLE No C-2004-01</b>		1 OF 1 <b>METRIC</b>	
W.P. <u>19-95-00</u>		LOCATION <u>N 4795738.0 E 271894.0</u>		ORIGINATED BY <u>PKS</u>	
DIST <u>Central HWY 6</u>		BOREHOLE TYPE <u>108mm Diameter Solid Stem Augers</u>		COMPILED BY <u>KG</u>	
DATUM <u>Geodetic</u>		DATE <u>November 9, 2004</u>		CHECKED BY <u>LCC</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
144.8	Ground Surface						20	40	60	80	100	10	20	30			
0.0	Clayey Silt, some sand, trace gravel, organics, topsoil and wood (FILL) Stiff Brown Moist		1	SS	11												
			2	SS	9												
143.3																	
1.5	Clayey Silt, some sand, trace gravel, shale and limestone fragments (TILL) Brown to red-brown Very stiff to hard Moist		3	SS	36												
			4	SS	38												
			5	SS	29												
			6	SS	33												
			7	SS	120												
139.6																	
5.2	End of Borehole  Notes:  1. Open hole dry upon completion of drilling.																

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

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PROJECT 001-1141F			RECORD OF BOREHOLE No E4			1 OF 2 METRIC											
W.P. 19-95-00		LOCATION N 4796199.8 ; E 271473.0		ORIGINATED BY AS													
DIST Central HWY 6		BOREHOLE TYPE 108mm Diameter Solid Stem Augers		COMPILED BY LCC													
DATUM Geodetic		DATE November 20-21, 2000		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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>	γ	GR SA SI CL				
183.5	Ground Surface																
0.0	Sand and gravel, containing cobbles (FILL) Compact Brown Dry		1	SS	14		183										
							182										
181.1							181										
2.4	Clayey silt, some sand, some gravel and shale fragments, containing cobbles (FILL) Stiff to very stiff Brown to red-brown Moist		2	SS	17		180										
							179										
			3	SS	11		178										
							177										
			4	SS	22		176										
							175										
			5	SS	11		174										
							173										
			6	SS	1		172										
							171										
			7	SS	17		170										
172.1							169										
11.4	Clayey Silt, trace to some sand, trace gravel and shale fragments (TILL) Hard Brown to grey-brown Dry to moist		7B	AS													
			8	SS	60												
			9	SS	92/.28												

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

PROJECT <u>001-1141F</u>		<b>RECORD OF BOREHOLE No E8</b>		1 OF 2 <b>METRIC</b>	
W.P. <u>19-95-00</u>		LOCATION <u>N 4796128.2 ; E 271544.2</u>		ORIGINATED BY <u>GM</u>	
DIST <u>Central</u> HWY <u>6</u>		BOREHOLE TYPE <u>108mm Diameter Solid Stem Augers</u>		COMPILED BY <u>LCC</u>	
DATUM <u>Geodetic</u>		DATE <u>November 23, 2000</u>		CHECKED BY <u>LCC</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20 40 60 80 100							w <sub>p</sub> w w <sub>L</sub>		
177.5	Ground Surface						177										
0.0	Sand and gravel, trace silt, containing cobbles (FILL) Compact to dense Brown Dry		1	SS	34		176										
175.4							175										
2.1	Clayey silt, trace sand and gravel, containing weathered shale and limestone cobbles/boulders (FILL) Firm to hard Brown Dry to moist		2	SS	15		174										
	Heavy grinding and slow auger advance at: 2.1m to 2.5m 6.8m to 7.5m 8.4m to 8.8m 10.0m to 10.5m 12.8m to 13.5m		3	SS	11		173										
			4	SS	29		172										
			5	SS	16		171										
			6	SS	6		170										
			7	SS	37		169										
			8	SS	20		168										
							167										
							166										
							165										
163.9							164										
13.6	Clayey Silt, trace sand and gravel, containing rootlets Very stiff Brown Moist		9	SS	15		163										
162.9																	
14.6																	

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

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PROJECT <u>001-1141F</u>		<b>RECORD OF BOREHOLE No E8</b>		2 OF 2 <b>METRIC</b>	
W.P. <u>19-95-00</u>		LOCATION <u>N 4796128.2 ; E 271544.2</u>		ORIGINATED BY <u>GM</u>	
DIST <u>Central</u> HWY <u>6</u>		BOREHOLE TYPE <u>108mm Diameter Solid Stem Augers</u>		COMPILED BY <u>LCC</u>	
DATUM <u>Geodetic</u>		DATE <u>November 23, 2000</u>		CHECKED BY <u>LCC</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	10 20 30			
-- CONTINUED FROM PREVIOUS PAGE --								SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × REMOULDED						

# RECORD OF BOREHOLE No E11

1 OF 2 **METRIC**

PROJECT 001-1141F LOCATION N 4796059.4 E 271636.2 ORIGINATED BY GM  
W.P. 19-95-00 DIST Central HWY 6 BOREHOLE TYPE 108mm Diameter Solid Stem Augers COMPILED BY LCC  
DATUM Geodetic DATE November 14, 2000 CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
170.4 0.0	Ground Surface Sand and gravel, trace to some silt, trace clay, containing cobbles (FILL) Loose to dense Brown to grey Dry to moist		1	SS	9		170								
			2	SS	13		169								
			3	SS	13		168								
			4	SS	21		167								
			5	SS	31		166								
			6	SS	30		165								
			7	SS	26		164								
162.0 8.4	Clayey silt, trace to some sand, trace to some gravel and shale fragments (FILL) Stiff to very stiff Brown Moist		8	SS	14		163								
			9	SS	10		162								
			10	SS	12		161								
			11	SS	20		160								
155.8 14.6							159								
							158								
							157								
							156								

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

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PROJECT <u>001-1141F</u>			<b>RECORD OF BOREHOLE No E11</b>			2 OF 2 <b>METRIC</b>		
W.P. <u>19-95-00</u>			LOCATION <u>N 4796059.4; E 271636.2</u>			ORIGINATED BY <u>GM</u>		
DIST <u>Central</u> HWY <u>6</u>			BOREHOLE TYPE <u>108mm Diameter Solid Stem Augers</u>			COMPILED BY <u>LCC</u>		
DATUM <u>Geodetic</u>			DATE <u>November 14, 2000</u>			CHECKED BY <u>LCC</u>		

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PILOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x REMOULDED					
	--- CONTINUED FROM PREVIOUS PAGE ---												
	Clayey Silt, trace sand and gravel (TILL) Hard Brown Dry to moist		12	SS	80	155							
						154							
153.2			13	SS	82								
17.2	End of Borehole  Note:  Water level in open borehole at about 14.6m depth (Elevation 155.8m) on completion of drilling.												

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PROJECT 001-1141F

**RECORD OF BOREHOLE No E13**

1 OF 1 **METRIC**

W.P. 19-95-00

LOCATION N 4795989.1 ; E 271706.9

ORIGINATED BY AS

DIST Central HWY 6

BOREHOLE TYPE 108mm Diameter Solid Stem Augers

COMPILED BY LCC

DATUM Geodetic

DATE November 14, 2000

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
163.5	Ground Surface		1	SS	29													
0.0	Sand and gravel (FILL) Compact																	
162.9	Clayey silt with gravel to some gravel, some sand, containing cobbles (FILL) Firm to hard Brown to red-brown Dry to moist		2	SS	30													
0.6			3	SS	6													
161.2	Clayey Silt, some sand, trace gravel (TILL) Very stiff to hard Brown to grey-brown Moist   																	

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

MISS\_MTO 0011141FAAMTO.GPJ ON\_MOT.GDT 3/8/05

PROJECT <u>001-1141F</u>		<b>RECORD OF BOREHOLE No HML-1</b>		1 OF 1 <b>METRIC</b>	
W.P. <u>19-95-00</u>		LOCATION <u>N 4795107.1 ; E 272629.1</u>		ORIGINATED BY <u>GPD</u>	
DIST <u>Central</u> HWY <u>6</u>		BOREHOLE TYPE <u>108mm Diameter Solid Stem Augers</u>		COMPILED BY <u>JDR</u>	
DATUM <u>Geodetic</u>		DATE <u>September 17, 2003</u>		CHECKED BY <u>LCC</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
126.1	Ground Surface													
0.0	Topsoil		1	SS	9/15									
0.3	Sand and gravel (FILL)													
	Asphalt													
	Clayey silt, trace sand and gravel (FILL)													
	Stiff													
	Brown													
	Moist		2	SS	12									
124.6														
1.5	Clayey Silt, trace to some sand, trace to some gravel and shale fragments (TILL)		3	SS	9									
	Stiff to hard													
	Grey-brown to red-brown													
	Moist		4	SS	38									
			5	SS	71/15									
			6	SS	50/08									
			7	SS	60/13									
120.0														
6.1	Shale (BEDROCK)		8	SS	50/08									
	Red-brown													
			9	SS	75/08									
			10	SS	80/10									
115.3														
10.8	End of Borehole		11	SS	57/15									
	NOTE: Borehole dry on completion of drilling operations.													

**RECORD OF BOREHOLE No HML-2**

1 OF 1 **METRIC**

PROJECT 001-1141F

W.P. 19-95-00

LOCATION N 4795178.7; E 272559.4

ORIGINATED BY GPD

DIST Central HWY 6

BOREHOLE TYPE 108mm Diameter Solid Stem Augers

COMPILED BY JDR

DATUM Geodetic

DATE September 18, 2003

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
131.0	Ground Surface							20 40 60 80 100	○ UNCONFINED + FIELD VANE					
0.0 0.1	Topsoil							20 40 60 80 100	● QUICK TRIAXIAL × REMOULDED					
	Clayey Silt, trace to some sand, trace gravel and shale fragments (TILL) Hard Brown to red-brown Dry to moist		1	SS	12									
			2	SS	55		130							
			3	SS	47		129							
			4	SS	70/08		128							
			5	SS	80/13		127							
			6	SS	61		126							
			7	SS	70/15		125							
			8	SS	129		124							
123.7 7.3	Shale (BEDROCK) Red-brown		9	SS	110/05		123							
			10	SS	87/10		122							
120.3 10.7	End of Borehole		11	SS	110/05		121							
NOTES:  1. Borehole dry on completion of drilling operations.  2. Water level in piezometer measured at 1.8m depth (Elevation 129.3m) on November 1, 2003.														

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

MISS\_MTO\_0011141FAAMTO.GPJ ON\_MOT.GDT 38/05

PROJECT <u>001-8059</u>		<b>RECORD OF BOREHOLE No NW-4</b>		1 OF 1 <b>METRIC</b>	
W.P. <u>19-95-00</u>		LOCATION <u>N 4795282.4 ; E 272415.8</u>		ORIGINATED BY <u>GD</u>	
DIST <u>Central</u> HWY <u>6</u>		BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>		COMPILED BY <u>KG</u>	
DATUM <u>Geodetic</u>		DATE <u>Sept. 15, 2003</u>		CHECKED BY <u>LCC</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED						
137.0	GROUND SURFACE														
0.0	Asphalt														
0.2	Sand and gravel, trace silt, containing cobbles (FILL) Compact Brown Moist		1	SS	27										
			2	SS	26										
135.5															
1.5	Clayey silt, some sand and gravel, trace asphalt fragments, containing cobbles (FILL) Very dense Brown Moist		3	SS	55										
			4	SS	50/08										
134.0															
3.1	Clayey silt, some sand, trace gravel, containing rootlets (FILL) Firm to stiff Brown and grey Moist		5	SS	11										
			6	SS	8										
132.5															
4.5	Clayey Silt to Silty Clay, trace sand and gravel (TILL) Hard Brown to grey-brown Moist		7	SS	34										
			8	SS	47										
129.8															
7.2	Clayey Silt, some sand, trace gravel (TILL/RESIDUAL SOIL) Hard Red-brown Dry		9	SS	102/15										
127.9															
9.1	Silty Clay, trace sand, containing silt seams (TILL/RESIDUAL SOIL) Hard Grey Moist		10	SS	87										
126.3															
126.0	Clayey Silt, some sand, trace gravel (TILL/RESIDUAL SOIL) Hard Red-brown Moist		11	SS	62/15										
11.0	End of Borehole														
	Notes  1. Open borehole dry upon completion of drilling operations.														

MISS. MTO 001-8059 HWY6 NOISE BARRIER WALL.GPJ ON MOT.GDT 3/8/05

PROJECT 001-8059

**RECORD OF BOREHOLE No NW-5**

1 OF 1 **METRIC**

W.P. 19-95-00

LOCATION N 4795336.1 ; E 272362.0

ORIGINATED BY GD

DIST Central HWY 6

BOREHOLE TYPE 108 mm Diameter Solid Stem Augers

COMPILED BY KG

DATUM Geodetic

DATE Sept. 15, 2003

CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)					
								○ UNCONFINED    + FIELD VANE	w <sub>p</sub> w                      w <sub>L</sub>						
								● QUICK TRIAXIAL    × REMOULDED							
140.7	GROUND SURFACE						20	40	60	80	100	10	20	30	
0.0	Asphalt														
0.2	Sand and gravel, trace silt (FILL)		1	SS	49										
139.9	Dense Brown Moist														
0.8	Clayey silt, some sand and gravel, containing cobbles (FILL)		2	SS	17										
	Firm to very stiff Brown Moist														
			3	SS	7										
			4	SS	9										
			5	SS	13										
136.6															
4.1	Clayey Silt to Silty Clay, trace sand and gravel (TILL)		6	SS	11										
	Firm to very stiff Brown to grey-brown Moist														
			7	SS	7										
			8	SS	17										
133.5															
7.2	Clayey Silt, trace sand and gravel, containing shale fragments (TILL)														
	Hard Brown Moist		9	SS	48										
132.5															
8.2	End of Borehole														
	Notes:														
	1. Open hole dry upon completion of drilling operations.														

PROJECT 001-1141F			RECORD OF BOREHOLE No OHS-2003-2			1 OF 1 METRIC											
W.P. 19-95-00		LOCATION N 4795408.7 E 272307.8		ORIGINATED BY PKS													
DIST Central HWY 6		BOREHOLE TYPE 108mm Diameter Solid Stem Augers		COMPILED BY JDR													
DATUM Geodetic		DATE June 16, 2003		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	20 40 60 80 100	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)	γ	GR SA SI CL				
144.6	Road Surface																
0.0	Asphalt																
0.2	Sand and gravel (FILL)																
144.0																	
0.6	Clayey silt to silty clay, some sand, trace to some gravel and shale fragments (FILL) Stiff to very stiff Brown to grey-brown Moist		1	SS	25		144										
			2	SS	12		143										
			3	SS	11		142										
141.6																	
3.1	Clayey Silt to Silty Clay, some sand, trace to some gravel and shale fragments (TILL) Stiff to hard Brown Moist		4	SS	13		141										
			5	SS	13		140										
			6	SS	12		139										
			7	SS	76		138										
			8	SS	70		137										
	Becoming red-brown below 7.6 m depth		9	SS	80		136										
			10	SS	45		135										
133.5							134										
11.1	End of Borehole																
NOTES: 1. Borehole dry on completion of drilling operations. 2. Water level in piezometer measured at 1.2m depth (Elevation 145.2m) on November 1, 2003.																	

<b>PROJECT</b> 001-1141F		<b>RECORD OF BOREHOLE No OHS-2003-3</b>		1 OF 1 <b>METRIC</b>	
<b>W.P.</b> 19-95-00		<b>LOCATION</b> N 4795685.8 ; E 272039.7		<b>ORIGINATED BY</b> GPD	
<b>DIST</b> Central HWY 6		<b>BOREHOLE TYPE</b> 108mm Diameter Solid Stem Augers		<b>COMPILED BY</b> JDR	
<b>DATUM</b> Geodetic		<b>DATE</b> September 18, 2003		<b>CHECKED BY</b> LCC	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED							
146.4	Ground Surface																	
0.0	Gravel, trace to some sand (FILL)		1	SS	26													
145.9	Compact																	
0.5	Grey Dry																	
	Clayey Silt, some sand, trace to some gravel (TILL) Very stiff to hard Brown Moist		2	SS	28													
			3	SS	28													
			4	SS	25													
			5	SS	27													
			6	SS	21													
			7	SS	26													
			8	SS	27													
			9	SS	47													
			10	SS	23													
	Containing red shale fragments below approximately 9m depth																	
135.4			11	SS	70/23													
11.1	End of Borehole																	
NOTES:  1. Borehole dry on completion of drilling operations.  2. Water level in piezometer measured at 1.2 m depth (Elevation 145.2 m) on November 1, 2003.																		

PROJECT 001-1141F

**RECORD OF BOREHOLE No OHS-2003-4**

1 OF 1 **METRIC**

W.P. 19-95-00

LOCATION N 4795889.7 :E 271792.4

ORIGINATED BY PKS

DIST Central HWY 6

BOREHOLE TYPE 108mm Diameter Solid Stem Augers

COMPILED BY JDR

DATUM Geodetic

DATE June 16, 2003


CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
155.9	Road Surface													
0.0	Asphalt													
0.2	Sand and gravel (FILL)													
155.3														
0.6	Clayey Silt, trace to some sand and gravel, containing shale and limestone fragments (FILL) Brown to red-brown Soft to hard Moist		1	SS	33		155							
			2	SS	11		154							33 12 39 16
			3	SS	16		153							
			4	SS	3		152							
151.8			5	SS	23		151							
4.1	Clayey Silt, trace to some sand, trace gravel and shale fragments (TILL) Very stiff to hard Brown to red-brown Moist		6	SS	46		150							
			7	SS	50		149							1 11 53 35
			8	SS	34		148							
			9	SS	37		147							
145.2			10	SS	72		146							
10.7	Clayey Silt, trace to some sand, trace gravel, shale and limestone fragments (TILL / RESIDUAL SOIL)						145							
144.8	Hard													
11.1	Red Moist End of Borehole													
NOTE: Borehole dry on completion of drilling operations.														

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

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<b>PROJECT</b> 001-1141F		<b>RECORD OF BOREHOLE No P1</b>		<b>1 OF 2 METRIC</b>	
<b>W.P.</b> 19-95-00		<b>LOCATION</b> N 4795502.9; E 272225.0		<b>ORIGINATED BY</b> GM	
<b>DIST</b> Central HWY 6		<b>BOREHOLE TYPE</b> 108mm Diameter Solid Stem Augers		<b>COMPILED BY</b> LCC	
<b>DATUM</b> Geodetic		<b>DATE</b> January 8, 2001		<b>CHECKED BY</b> ASP	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100						WATER CONTENT (%)
145.1	Ground Surface						145								
0.0	Clayey SILT, trace sand and gravel Very stiff Red-brown		1	SS	21		144								
143.7			2	SS	69		143								
1.4	Clayey SILT, trace to some sand, trace gravel (Till) Hard Brown becoming grey-brown below 3m depth Dry to moist		3	SS	86		142								
			4	SS	100		141								
			5	SS	90		140								
			6	SS	80		139								
			7	SS	75/1.15		138								
			8	SS	50		137								
			9	SS	66		136								
			10	SS	75		135								
			11	SS	70		134								
132.0							133								
13.1	Clayey SILT, trace to some sand, trace gravel and shale fragments (Till/Residual Soil) Hard Red-brown Dry to moist		12	SS	72/1.15		132								
							131								

MISS MTO 0011141FAAMTO.GPJ ON MOT.GDT 3/8/05

Continued Next Page

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

**RECORD OF BOREHOLE No P1**

2 OF 2 **METRIC**

PROJECT 001-1141F  
 W.P. 19-95-00 LOCATION N 4795502.9 ; E 272225.0 ORIGINATED BY GM  
 DIST Central HWY 6 BOREHOLE TYPE 108mm Diameter Solid Stem Augers COMPILED BY LCC  
 DATUM Geodetic DATE January 8, 2001 CHECKED BY ASP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
	— CONTINUED FROM PREVIOUS PAGE —																
	Clayey SILT, trace to some sand, trace gravel and shale fragments (Till/Residual Soil) Hard Red-brown Dry to moist		13	SS	102/15												
128.1			14	SS	110/23												
17.0	End of Borehole  Note: Borehole dry on completion of drilling operations.																

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

PROJECT <u>001-1141F</u>		<b>RECORD OF BOREHOLE No RW-1</b>		1 OF 2 <b>METRIC</b>	
W.P. <u>19-95-00</u>		LOCATION <u>N 4795657.1 ; E 272113.9</u>		ORIGINATED BY <u>GPD</u>	
DIST <u>Central</u> HWY <u>6</u>		BOREHOLE TYPE <u>108mm Diameter Solid Stem Augers</u>		COMPILED BY <u>LCC</u>	
DATUM <u>Geodetic</u>		DATE <u>September 18-22, 2003</u>		CHECKED BY <u>LCC</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	WATER CONTENT (%)					
145.7	Ground Surface													
145.7	Topsoil													
	Clayey Silt, trace to some sand, trace gravel (TILL) Stiff to hard Brown Dry to moist		1	SS	11									
			2	SS	27									
			3	SS	29									
			4	SS	29									
			5	SS	19									
	Becoming grey-brown at 3.8 m depth		6	SS	27									
			7	SS	17									
			8	SS	32									
			9	SS	50									
	Becoming reddish-grey at 9.1 m depth		10	SS	46									
135.5			11	SS	67/15									
10.2	Clayey Silt, some sand, trace to some gravel, shale and limestone fragments (TILL / RESIDUAL SOIL) Hard Grey to red-brown Dry to moist		12	SS	66									
			13	SS	103									

MISS. MTO 0011141FAAMTO.GPJ ON MOT.GDT 3/8/05

Continued Next Page

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

**RECORD OF BOREHOLE No RW-1**

2 OF 2 **METRIC**

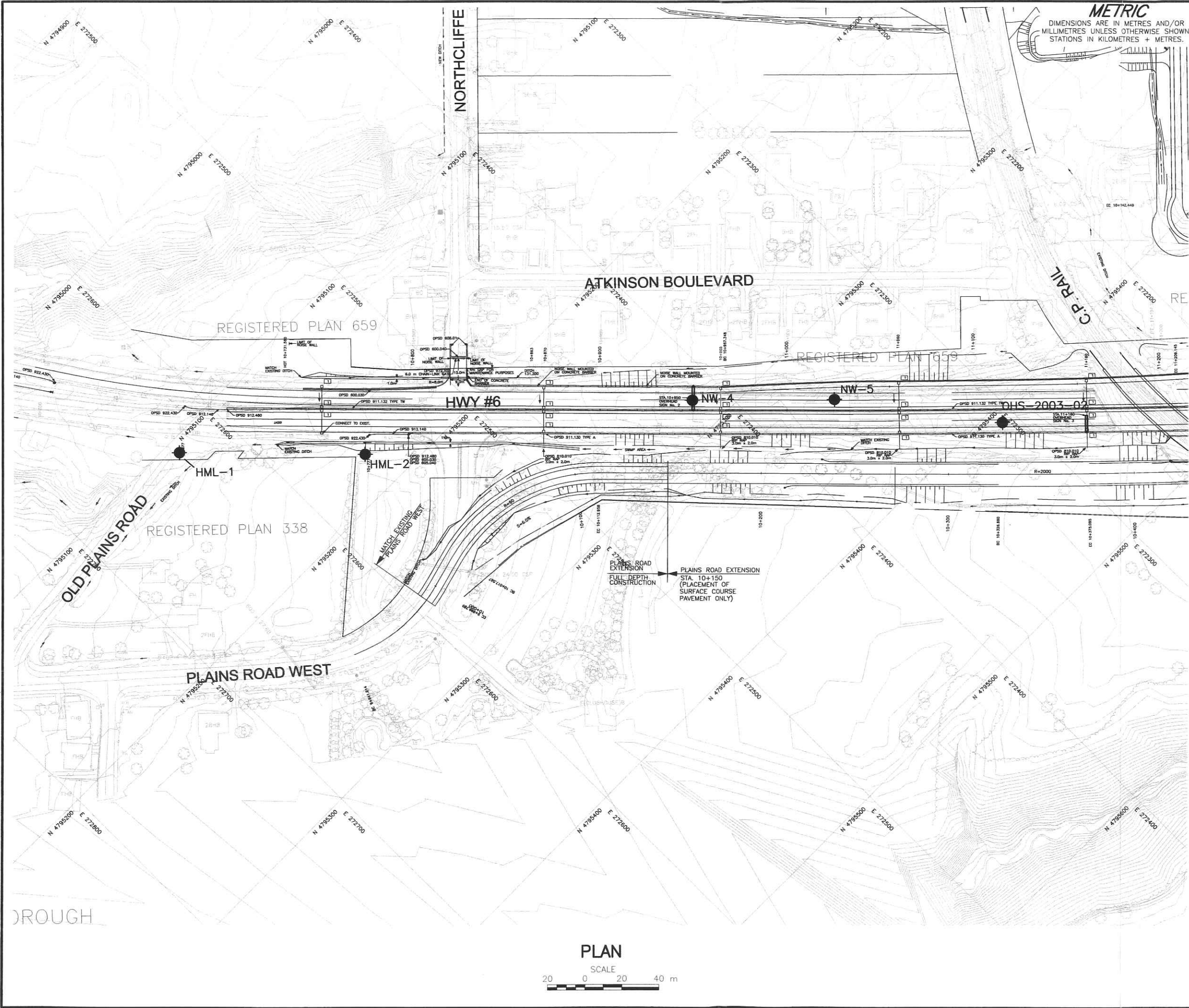
PROJECT 001-1141F LOCATION N 4795657.1 ; E 272113.9 ORIGINATED BY GPD  
 W.P. 19-95-00 DIST Central HWY 6 BOREHOLE TYPE 108mm Diameter Solid Stem Augers COMPILED BY LCC  
 DATUM Geodetic DATE September 18-22, 2003 CHECKED BY LCC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100					
							○ UNCONFINED	+	FIELD VANE							
							● QUICK TRIAXIAL	x	REMOULDED							
							20	40	60	80	100					
							WATER CONTENT (%)									
												10	20	30		
130.3																
15.4	End of Borehole		14	SS	57/15											
	Notes:															
	1. Borehole dry on completion of drilling operations.															
	2. Water level in piezometer measured at 9.7m depth (Elevation 136.0m) on November 1, 2003.															

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

MISS\_MTO 0011141FAAMTO.GPJ ON\_MOT.GDT 3/8/05

PROJECT		RECORD OF BOREHOLE				No TEST PIT 04-3		1 OF 1		METRIC				
W.P. 19-95-00		LOCATION				N 4796298.7 ; E 271366.7				ORIGINATED BY GPD				
DIST Central HWY 6		BOREHOLE TYPE				Hydraulic excavator				COMPILED BY SP				
DATUM Geodetic		DATE				March 22, 2004				CHECKED BY LCC				
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
0.0	GROUND SURFACE													
-0.5	TOPSOIL													
-0.6	Clayey Silt with shale fragments (possibly highly weathered shale) Grey-brown to red-brown Moist													
	Shale (BEDROCK) Red-brown to grey Slightly weathered to fresh End of Borehole													



CONT No.  
WP No. 19-95-01

HIGHWAY 6  
HIGH MAST LIGHT POLES  
BOREHOLE LOCATIONS

**Golder Associates**

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

KEY PLAN

LEGEND

Borehole

Test Pit

NOTES

The proposed works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contract 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 GC 2.01 of OPS General Conditions.

For subsurface information only.

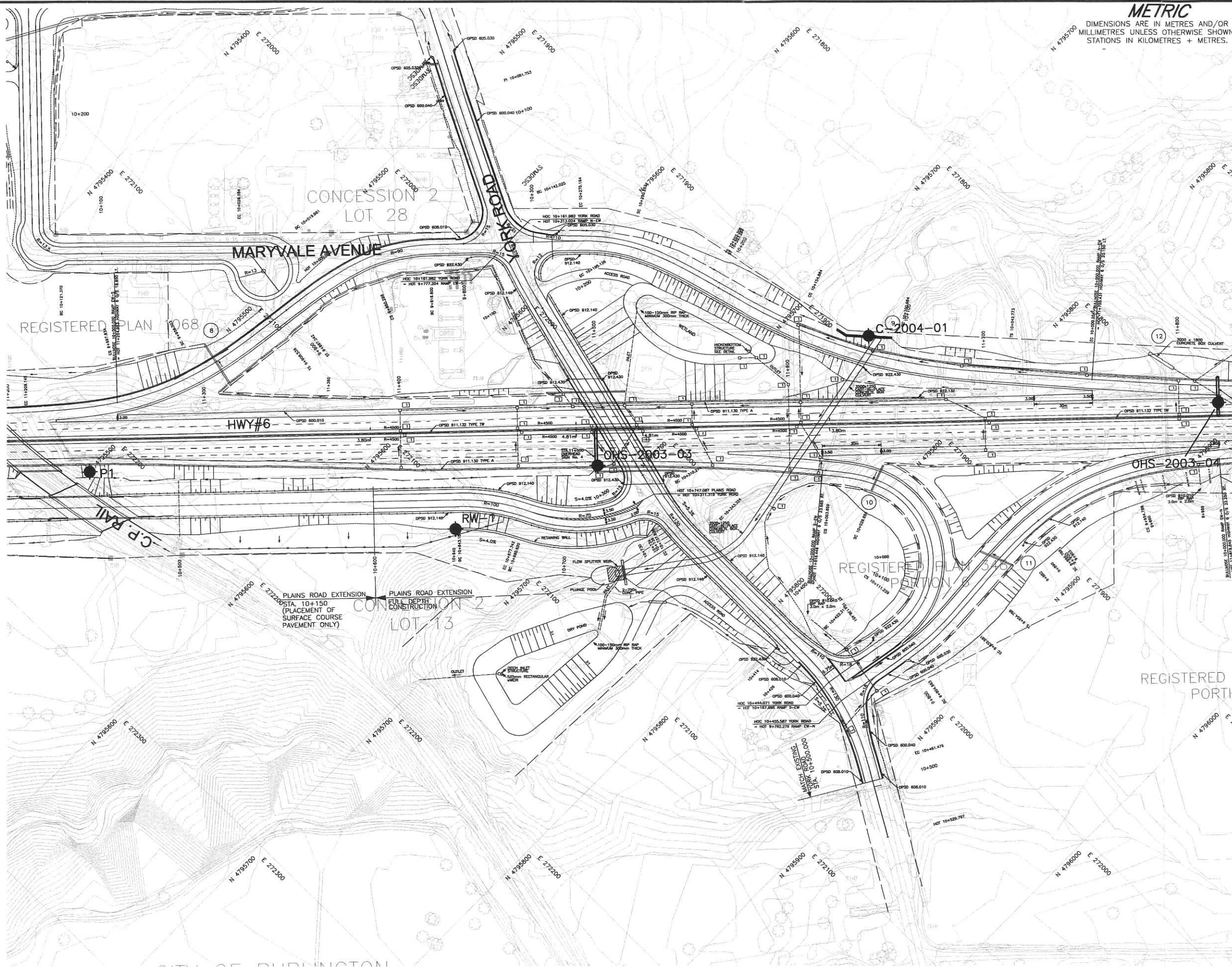
REFERENCE

Base plans provided in digital format by URS Canada Inc.

NO.	DATE	BY	REVISION

Geocres No. \_\_\_\_\_

HWY. 6		PROJECT NO. 001-1141F	DIST.
SUBM'D. PKS	CHKD. PKS	DATE: APRIL 2005	SITE:
DRAWN: JDR	CHKD. PKS	APPD. LCC	DWG. 1



# PLAN



## METRIC

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

CONT No.  
 WP No. 19-95-01

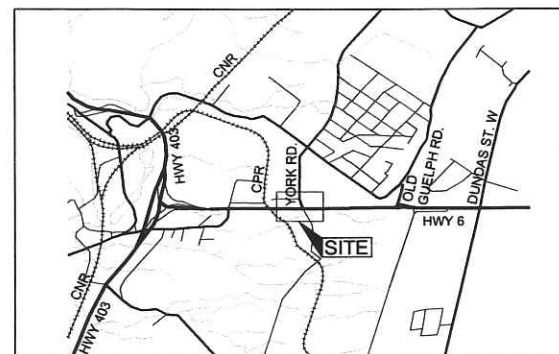


HIGHWAY 6  
 HIGH MAST LIGHT POLES  
 BOREHOLE LOCATIONS

SHEET



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



KEY PLAN

## LEGEND

- Borehole
- Test Pit

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
C-2004-01	144.8	4795738.0	271894.0
OHS-2003-03	146.4	4795685.8	272039.7
OHS-2003-04	146.4	4795889.7	271792.4
RW-1	145.7	4795657.1	272113.9
P1	145.1	4795502.9	272225.0

## NOTES

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NO.	DATE	BY	REVISION
Geocres No.			
HWY. 6		PROJECT NO. 001-1141F	DIST.
SUBM'D. PKS	CHKD. PKS	DATE: APRIL 2005	SITE:
DRAWN: JDR	CHKD. PKS	APPD. LCC	DWG. 2

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

CONT No.  
WP No. 19-95-01

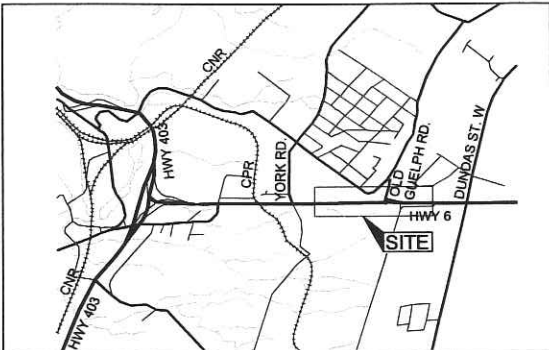


HIGHWAY 6  
HIGH MAST LIGHT POLES  
BOREHOLE LOCATIONS

SHEET



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



KEY PLAN



LEGEND

- Borehole
- Test Pit

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
E4	183.5	4796199.8	271473.0
E8	177.5	4796128.2	271544.2
E11	170.4	4796059.4	271636.2
E13	163.5	4795989.1	271706.9
TP04-2	NA	4796344.5	271320.5
TP04-3	NA	4796298.7	271366.7

NOTES

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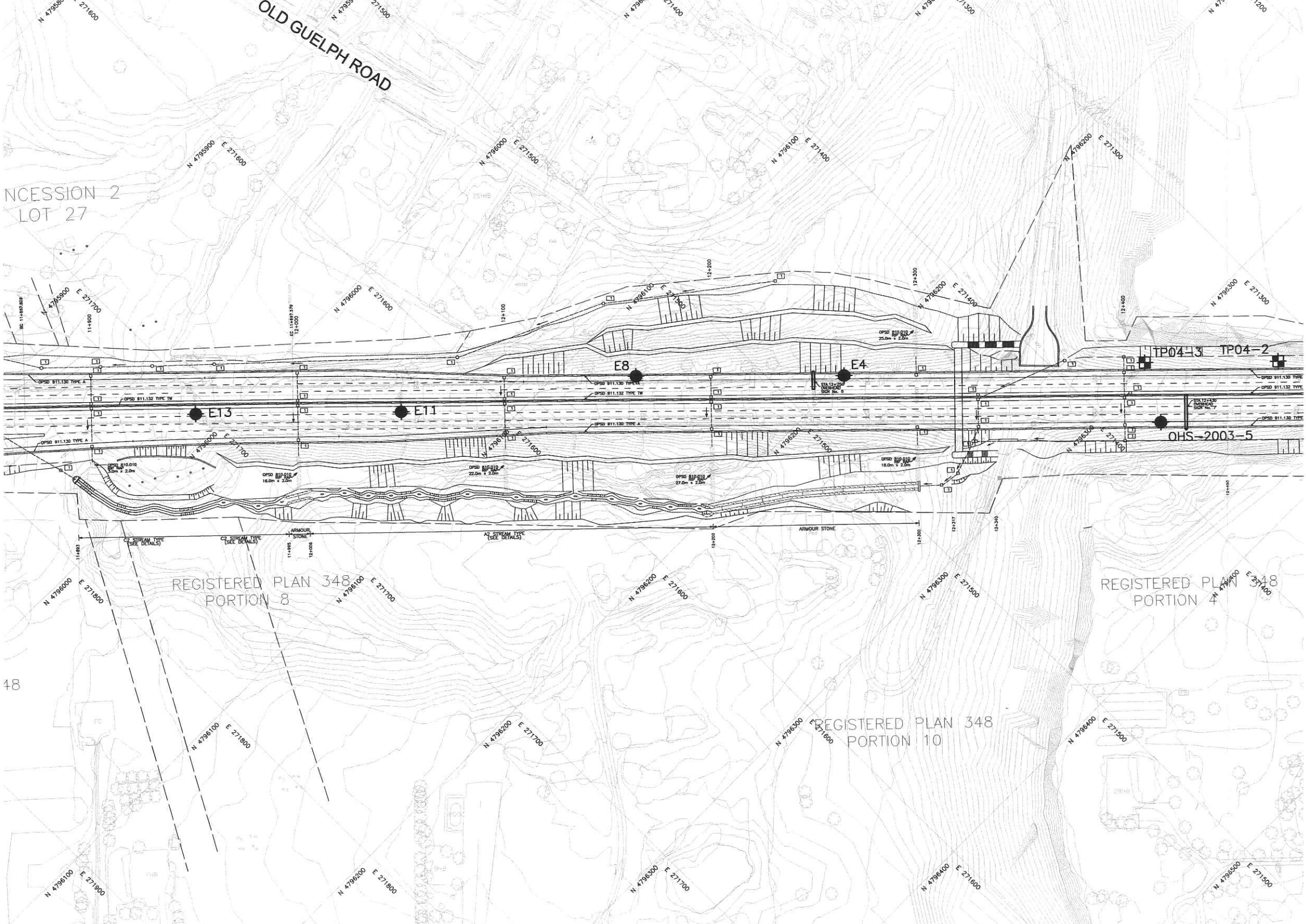
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REFERENCE

Base plans provided in digital format by URS Canada Inc.

NO.	DATE	BY	REVISION
Geocres No.			
HWY. 6		PROJECT NO. 001-1141F	DIST.
SUBM'D. PKS	CHKD. PKS	DATE: APRIL 2005	SITE:
DRAWN: JDR	CHKD. PKS	APPD. LCC	DWG. 3



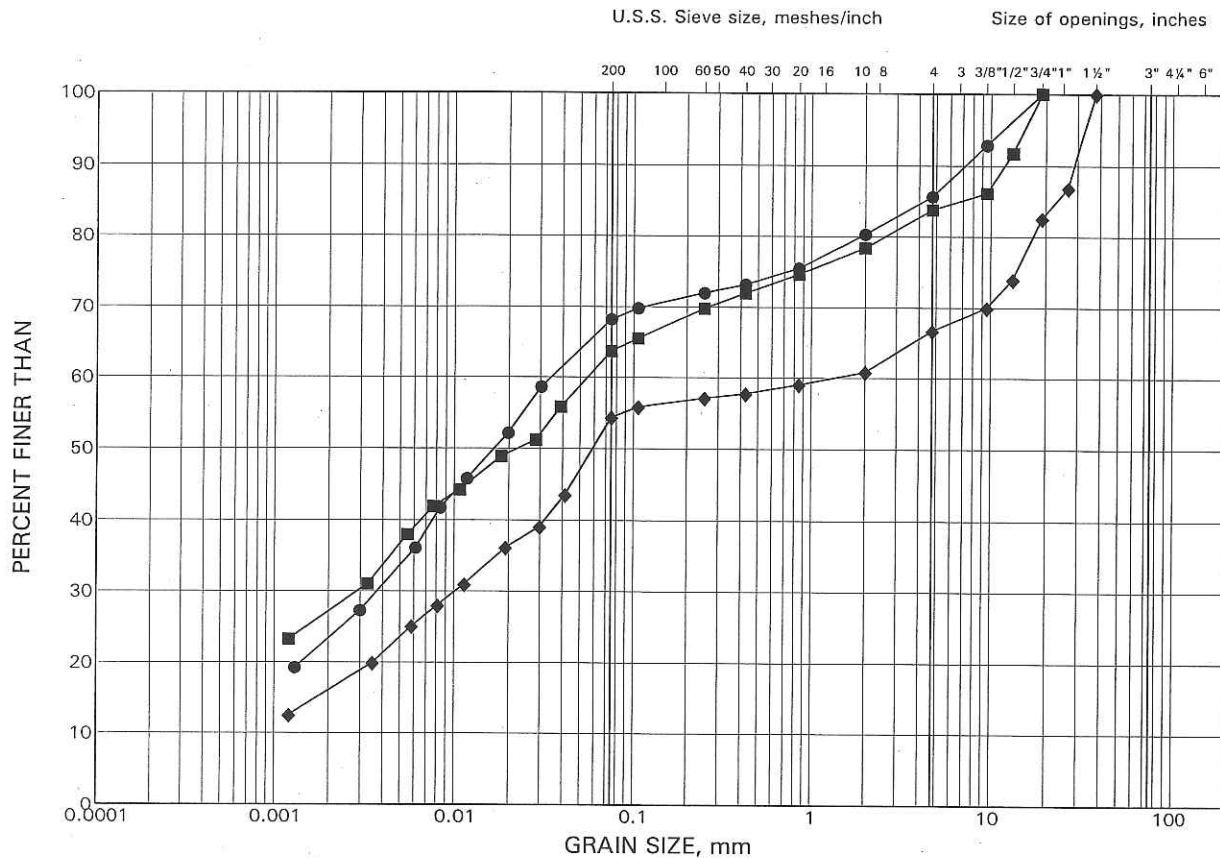
PLAN



# GRAIN SIZE DISTRIBUTION TEST RESULTS

## Embankment Fill

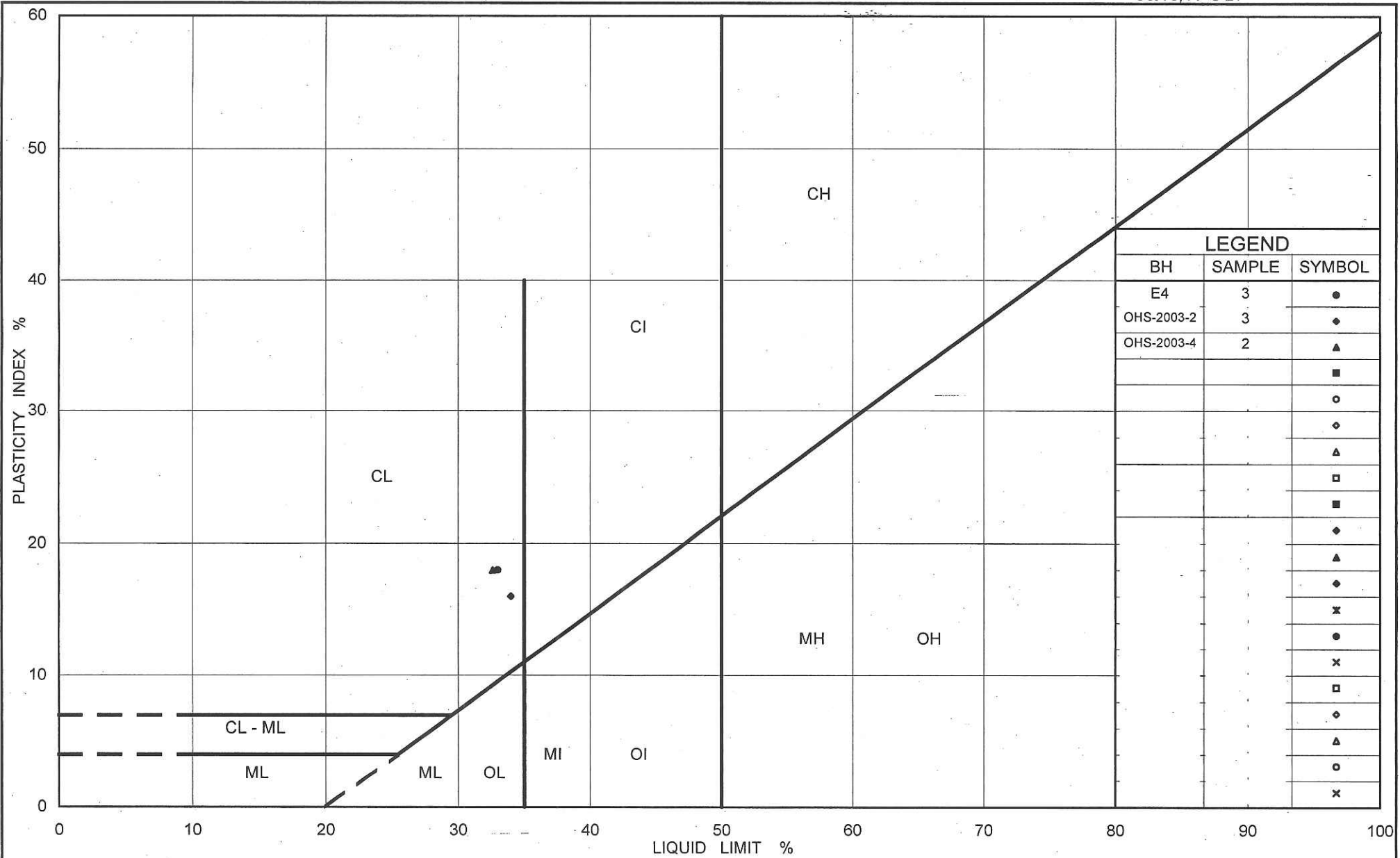
FIGURE 1



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

### LEGEND

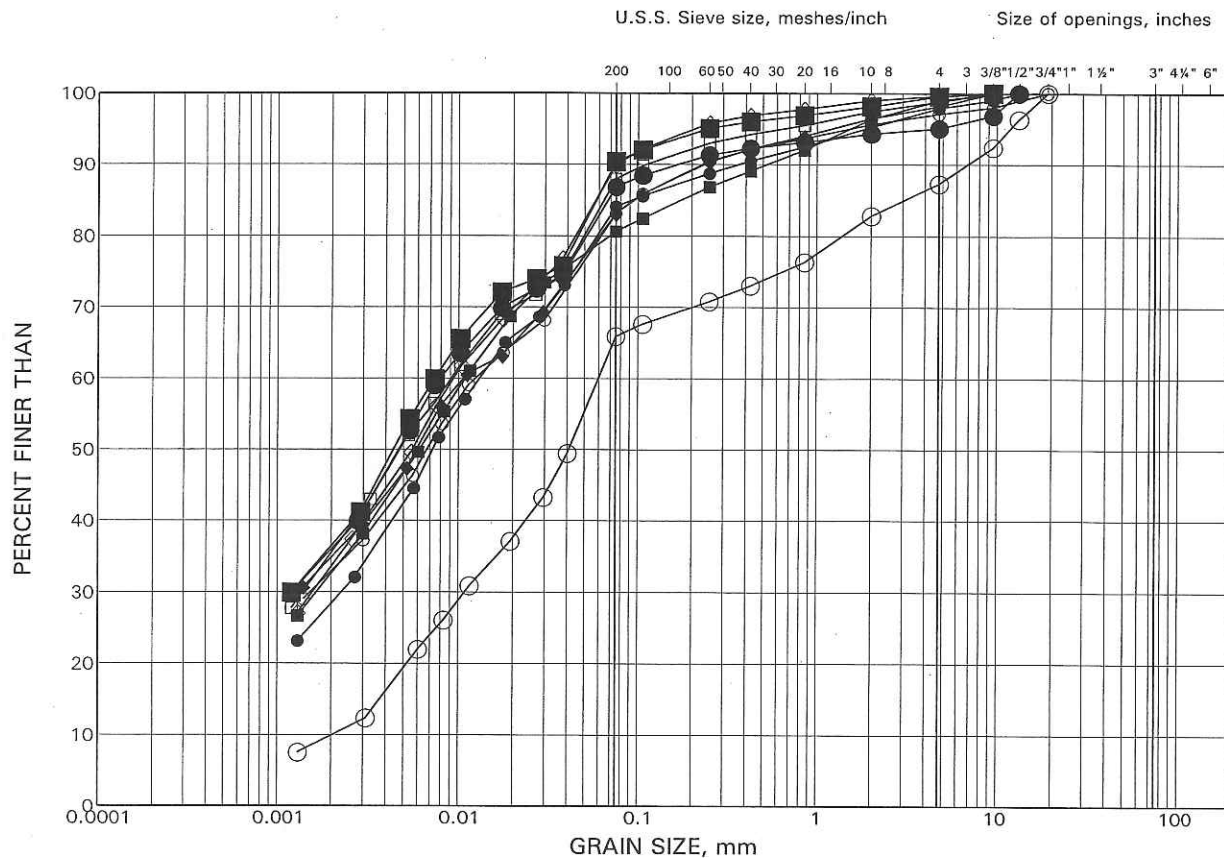
SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	E-4	3	178.6
■	OHS-2003-02	3	142.1
◆	OHS-2003-04	2	154.2



# GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt Till and Till / Residual Soil

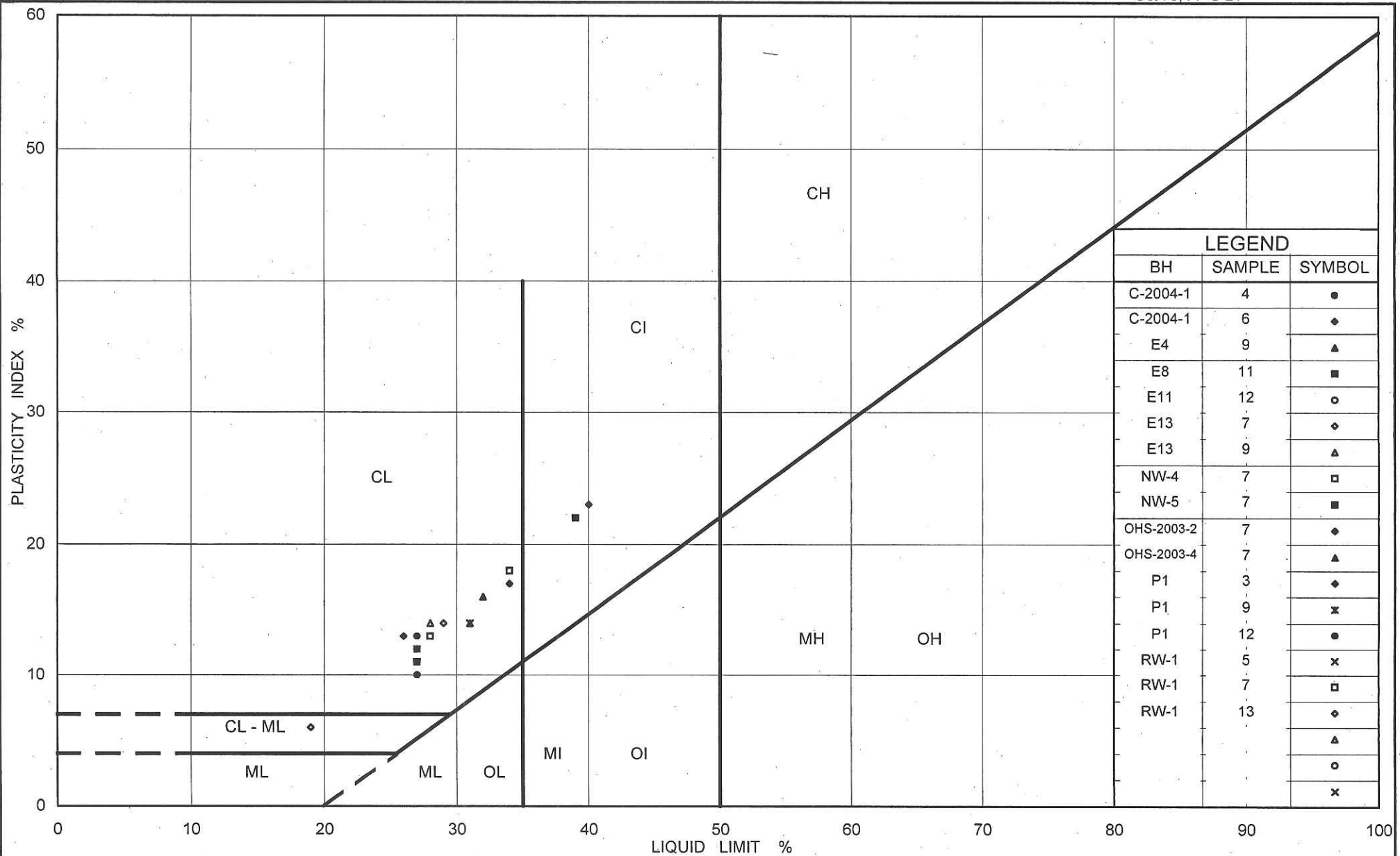
FIGURE 3



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	C-2004-1	4	142.2
■	E4	9	169.6
◆	E13	7	158.7
○	E13	9	155.7
□	OHS-2003-04	7	149.6
◇	NW-4	7	132.2
●	RW-1	5	142.4
■	RW-1	7	140.8
○	RW-1	13	131.7



July 2006

001-1141F-7

## **APPENDIX A**

### **NON-STANDARD SPECIAL PROVISIONS**

## **HML POLES – CAISSON INSTALLATION - ITEM NO.**

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### **Special Provision**

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#### **1.0 Scope**

The caisson foundations for some of the HML poles will be installed through the existing Highway 6 embankment fill. The existing Highway 6 embankment fill is variable, and includes zones of cohesionless soil, cobbles, boulders, and voids. It should be anticipated that the caisson holes will have to be advanced using a temporary liner in order to avoid loss of ground. In addition, appropriate equipment and procedures will be required to penetrate obstructions (cobbles and boulders) that may be present within the fill.

#### **2.0 Basis of Payment**

Payment at the contract price for the above tender item shall include full compensation for all labour and materials to complete the work.

END OF SECTION

## **HML POLES – CAISSON INSTALLATION - ITEM NO.**

---

### **Special Provision**

---

#### **1.0 Scope**

North of Old Guelph Road, at the locations of HML poles P25 to P28, sockets for caisson foundations will be formed within the bedrock. Caisson foundations for HML poles P1 and P2, near the south limit of the project, may also extend into the bedrock. At HML poles P1 and P2, and for HML poles P25 and P26, the bedrock is predominantly shale; however, this shale formation is known to contain stronger limestone and dolostone interlayers. North of about Station 12+600 (i.e. for HML poles P27 and P28), a stronger dolostone/shaley dolostone "cap" is present at the highway grade, above the shale. Consideration of the presence of the stronger limestone and dolostone must be made in the selection of caisson installation equipment at these locations.

#### **2.0 Basis of Payment**

Payment at the contract price for the above tender item shall include full compensation for all labour and materials to complete the work.

END OF SECTION