

Golder Associates Ltd.

2390 Argentia Road
Mississauga, Ontario, Canada L5N 5Z7
Telephone: (905) 567-4444
Fax: (905) 567-6561



**FOUNDATION
INVESTIGATION AND DESIGN REPORT
HIGH FILL EMBANKMENTS
HIGHWAY 6 WIDENING
BETWEEN HIGHWAYS 403 AND 5
G.W.P. 19-95-01**

Submitted to:

URS Canada Inc.
75 Commerce Valley Drive East
Markham, Ontario
L3T 7N9

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TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
PART A - FOUNDATION INVESTIGATION REPORT	
1.0 INTRODUCTION.....	1
2.0 GENERAL SITE DESCRIPTION	2
3.0 INVESTIGATION PROCEDURES	3
4.0 SITE GEOLOGY AND STRATIGRAPHY	4
4.1 Regional Geological Conditions	4
4.2 Site Stratigraphy	4
4.2.1 Fill	5
4.2.2 Topsoil / Organics	6
4.2.3 Surficial Clayey Silt to Silty Clay	6
4.2.4 Surficial Sand to Sand and Silt.....	7
4.2.5 Clayey Silt to Silty Clay Till	8
4.3 Groundwater Conditions	8
5.0 CLOSURE	10
PART B - FOUNDATION DESIGN REPORT	
6.0 ENGINEERING RECOMMENDATIONS	11
6.1 General	11
6.2 High Fill Embankments.....	11
6.3 Subgrade Preparation and Embankment Construction.....	12
6.3.1 Removal of Topsoil/Organics	12
6.3.2 Removal of Soft Surficial Clayey Silt to Silty Clay	12
6.3.3 Embankment Construction	13
6.4 Embankment Stability	13
6.4.1 Static Global Stability of New and Widened Embankments.....	13
6.4.2 Surficial Stability of New and Widened Embankments.....	14
6.4.3 Creek Valley Stability Adjacent to Proposed Dry Pond	15
6.5 Embankment Settlement.....	16
6.5.1 Settlement of Embankment Fill.....	16
6.5.2 Settlement of Foundation Soils	17
6.6 Excavations and Temporary Roadway Protection	18
6.6.1 Temporary Open-Cut Excavations.....	18
6.6.2 Temporary Excavation Support.....	18
6.7 Construction Considerations	18
6.7.1 Obstructions Within Embankment Fill and Native Till Soils	18
6.7.2 Groundwater and Surface Water Control	19
7.0 CLOSURE	20

In Order
Following
Page 20

Lists of Abbreviations and Symbols

Records of Boreholes B1 to B3, C-2003-03, C-2003-04, DP-01, DP-02, E1 to E14, E16, E18, E22, E-2003-01, E-2003-02, RW-1, RW-2A, RW-3, Y6, Y9, Y11, Z1, Z1A, Z2, Z3, and Z8 to Z10

Drawings 1 to 3

Figures 1 to 7

Appendix A

LIST OF DRAWINGS

Drawing 1	High Fill Embankments, Highway 6 Widening, Borehole Locations
Drawing 2	High Fill Embankments, York Road and Plains Road, Borehole Locations
Drawing 3	High Fill Embankments, Zellens Road, 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 – Surficial Clayey Silt to Silty Clay
Figure 4	Plasticity Chart – Surficial Clayey Silt to Silty Clay
Figure 5	Grain Size Distribution Test Results – Surficial Sand and Silt to Sand
Figure 6A/6B	Grain Size Distribution Test Results – Clayey Silt Till
Figure 7A/7B	Plasticity Chart – Clayey Silt Till

LIST OF APPENDICES

Appendix A	Records of Boreholes BH-Y1, BH-Y2, and BH-Y3
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001-1141F-9

PART A

**FOUNDATION INVESTIGATION REPORT
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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) 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 fill embankments, as follows:

- Widening of the existing Highway 6 embankment between approximately Stations 11+800 and 12+320.
- The new York Road embankment between approximately Stations 10+220 and 10+400.
- The new Plains Road embankment between approximately Stations 10+650 and 10+740, immediately south of York Road.
- The new Zellens Road embankment between approximately Stations 10+100 and 10+380.

The terms of reference for the scope of work are outlined in Golder's 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 GENERAL 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 that is up to about 15 m in height. The existing embankment side slopes are typically oriented at about 1.5 to 2 horizontal to 1 vertical (1.5H:1V to 2H:1V), and are well-vegetated with brush and trees. Grindstone Creek flows along the east side of the existing embankment and at some locations has locally over-steepened the slope toe by erosion and undercutting, such that the overall embankment side slope at these locations has a gradient of about 1H:1V.

3.0 INVESTIGATION PROCEDURES

A total of thirty-nine boreholes have been drilled as part of the subsurface investigation program for the proposed new or widened high fill embankments along Highway 6, York Road, Plains Road, and Zellens Road. The locations of the boreholes along Highway 6 are shown on Drawing 1; the locations of the boreholes at the York Road and Plains Road sites are shown on Drawing 2; and the locations of the boreholes at the Zellens Road site are shown on Drawing 3.

The majority of the boreholes were advanced 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, Groundworks Drilling Ltd. of Toronto, Ontario, and Walker Drilling Ltd. of Utopia, Ontario. However, portable drilling equipment was used for eleven of the boreholes that were advanced at the toe of the existing Highway 6 and York Road embankments (i.e. Boreholes B1, B3, C-2003-04, E3, E5, E10, E14, E22, E-2003-01, E-2003-02, and RW-3), due to access limitations at these locations. The portable drilling equipment was supplied and operated by Sonic Soil Sampling Ltd. of Concord, Ontario, and Kodiak Drilling Ltd. of Oakville, Ontario.

Samples of the overburden were obtained continuously (in those boreholes advanced using portable drilling equipment) or 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 Boreholes RW-1 and Z-3 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.

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. 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 Limits testing and grain size distribution analyses were carried out on selected soil samples.

The borehole locations were determined by Golder personnel relative to points staked in the field by Callon Dietz and other surface features. The ground surface elevations at the borehole locations were determined from the DTM model developed by Callon Dietz and URS for this project. The borehole locations, including MTM NAD83 northing and easting coordinates, and ground surface elevations referenced to geodetic datum are shown on Drawings 1 to 3.

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 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 area north of Hamilton, and it typically rests directly on the bedrock. Commonly, there is a transition zone of disturbed bedrock at the contact between the Halton Till and the shale.

4.2 Site Stratigraphy

The borehole locations and ground surface elevations for the boreholes advanced along the high fill embankment areas are shown on Drawings 1 to 3. The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of in-situ and laboratory testing are given on the Record of Borehole sheets and Figures 1 to 7. 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 boreholes drilled through the existing Highway 6 and York Road embankment encountered up to about 15 m of variable embankment fill, ranging in composition and consistency from compact silty sand to gravel, to firm to hard clayey silt to silty clay. The existing fill is generally underlain by very stiff to hard clayey silt till. Outside of the existing highway embankment footprint, relatively thin layers of soft to stiff clayey silt to silty clay and loose to compact silty sand to sand and silt are present overlying the generally very stiff to hard clayey silt till.

A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Fill

Embankment Fill

Fill, associated with the existing Highway 6 and York Road embankments, was encountered in Boreholes B2, B3, C-2003-03, E1, E2, E4, E6, E7, E8, E9, E11, E12, E13, E16, E18, Y6, and Y9. The fill ranges from about 0.5 m to 15.2 m in thickness as encountered in these boreholes. The thickest areas of fill are located within the existing Highway 6 “high fill embankment” north of York Road. The fill composition is variable, but typically consists of either sand and gravel, or clayey silt to silty clay containing trace to some sand and trace to some gravel, shale and limestone fragments. In the existing Highway 6 embankment north of York Road, some portions of the clayey silt to silty clay fill appear to consist of re-compacted, weathered shale. Cobbles and boulders were inferred within the fill during drilling, particularly within the existing Highway 6 embankment 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 auger 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 results of grain size distribution tests conducted on seven selected samples of the fill are presented on Figure 1; with respect to this figure, it is noted that the size of the split-spoon sampler limits the size of the recovered particles to less than about 45 mm diameter.

Atterberg limit testing carried out on eight samples of the cohesive embankment fill measured plastic limits of 16 to 20 per cent (but typically 16 to 17 per cent), liquid limits of 28 to 37 per cent (but typically 28 to 32 per cent), and plasticity indices of 11 to 20 per cent (but typically 11 to 14 per cent). The results of this limit testing, shown on a plasticity chart on Figure 2, indicate that the cohesive fill is inorganic and varies from a clayey silt of low plasticity to a silty clay of intermediate plasticity. The measured natural water contents in samples of the clayey silt fill ranged from 6 to 17 per cent, but were typically between about 10 and 15 per cent.

The measured Standard Penetration Test (SPT) “N” values in the fill range from 7 to more than 30 blows per 0.3 m of penetration within the sand and gravel portions of the fill, and from 5 to more than 30 blows per 0.3 m of penetration in the cohesive portions of the fill. An SPT “N” value of 1 blow per 0.3 m of penetration was also measured within the cohesive fill in Borehole E4 at 9.3 m depth, and this is associated with the presence of a 0.3 m high void at this location. 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. The SPT results indicate that the relative density or consistency

is variable, although the sand and gravel fill is typically compact and the clayey silt to silty clay fill is typically stiff to hard.

Other Fill

About 0.2 m to 4.8 m of fill was also encountered in Boreholes DP-01 and DP-02 and BH-Y1 to BH-Y3, which are located on a developed property south of York Road, above the crest of the Grindstone Creek valley, as shown on Drawing 2. Boreholes BH-Y1 to BH-Y3 were advanced as part of an environmental investigation on this property, and the records for these boreholes are contained in Appendix A.

The fill encountered in these boreholes varies in composition from sand and gravel (as encountered immediately below ground surface in two of the boreholes), to sand containing trace to some silt and trace gravel, to clayey silt containing trace to some sand and trace gravel. The measured SPT “N” values in the cohesionless portions of this fill range from 8 to 25 blows per 0.3 m of penetration, indicative of a loose to compact relative density, and the SPT “N” values in the cohesive portions of this fill range from 6 to 9 blows per 0.3 m of penetration, indicative of a firm to stiff consistency.

4.2.2 Topsoil / Organics

Topsoil and organic soils were encountered in some of the boreholes, as follows:

- At/beyond the toe of the existing Highway 6 embankment: About 0.5 m to 1.4 m of topsoil/organic silt was encountered immediately below ground surface in Boreholes B1, E5, E14 and E22, while organics were noted within portions of the surficial clayey silt to silty clay deposit in Boreholes E-2003-01 and E-2003-02.
- Along the Plains Road alignment immediately south of York Road, and along the York Road alignment: Approximately 100 mm to 200 mm of topsoil was encountered immediately below the ground surface in Boreholes RW-1, RW-2A and Y11.
- Along the Zellens Road alignment: Approximately 100 mm to 200 mm of topsoil was encountered immediately below the ground surface in all of the boreholes (Boreholes Z1 to Z3 and Z8 to Z10) drilled along this alignment.

4.2.3 Surficial Clayey Silt to Silty Clay

A relatively thin surficial layer of clayey silt to silty clay was encountered at the site, immediately below the ground surface, topsoil or existing fill, and above the clayey silt till, as follows:

- At/beyond the toe of the existing Highway 6 embankment: Approximately 0.3 m to 2.5 m of clayey silt to silty clay was encountered immediately below the ground

surface or topsoil in Boreholes B1, E3, E5, E10, E14, E22, E-2003-01 and E-2003-02. This clayey silt to silty clay varies in consistency from soft to very stiff based on measured SPT “N” values of 2 to 20 blows per 0.3 m of penetration; however, it is typically soft to stiff.

- Below the existing Highway 6 and York Road embankment fill: Approximately 0.3 m to 1.0 m of surficial clayey silt to silty clay was encountered below the existing embankment fill in Boreholes C-2003-03, E1, E8, E18 and Y9. This clayey silt to silty clay has a firm to stiff consistency, based on measured SPT “N” values of 5 and 15 blows per 0.3 m of penetration and visual observations.
- South of York Road: In Borehole C-2003-04 advanced adjacent to the Grindstone Creek floodplain, about 1.4 m of surficial silty clay was encountered immediately below the ground surface.
- Along the proposed Zellens Road alignment: About 1.3 m and 0.5 m of clayey silt to silty clay was encountered below the topsoil in Boreholes Z1 and Z2, respectively. This material has a firm consistency, based on measured SPT “N” values of 4 to 8 blows per 0.3 m of penetration.

The clayey silt to silty clay contains trace to some sand and trace gravel; the result of a grain size distribution test on one sample of this material is presented on Figure 3. Organics were noted within the surficial silty clay encountered in Boreholes E-2003-01 and E-2003-02.

Atterberg limit testing was carried out on seven samples of this deposit, and measured plastic limits of 18 to 23 per cent, liquid limits of 34 to 55 per cent (but typically 34 to 40 per cent), and corresponding plasticity indices of 13 to 33 per cent (but typically 13 to 23 per cent). These results, which are plotted on a plasticity chart on Figure 4, confirm that the surficial cohesive deposit varies from an inorganic clayey silt of low plasticity to a silty clay of intermediate plasticity; one tested sample from Borehole Z1 represents a high-plasticity clay.

4.2.4 Surficial Sand to Sand and Silt

Approximately 0.3 m of moist to wet silty sand to sand and silt was encountered below the topsoil and surficial clayey silt to silty clay in Boreholes B1 and E3, and about 2.0 m of silty sand to sand was encountered below the existing fill (associated with a residential driveway east of Highway 6) in Borehole B3. This surficial sand to sand and silt immediately overlies the clayey silt till deposit at these locations. These thin soil deposits are considered to represent alluvium associated with the Grindstone Creek valley on the east side of Highway 6 and a surface drainage feature on the west side of Highway 6.

Grain size distribution tests were carried out on two selected samples of this material, and the results are shown on Figure 5.

The measured SPT “N” values within the sand to sand and silt range from 7 to 22 blows per 0.3 m of penetration, which indicates that this surficial deposit has a loose to compact relative density.

4.2.5 Clayey Silt to Silty Clay Till

The embankment fill or topsoil and, where present, the surficial clayey silt to silty clay or sand to sand and silt deposits are underlain by a deposit of brown to red-brown or grey-brown till, which grades to a till/residual soil with depth. All of the boreholes were terminated within the till or till/residual soil. The till is typically comprised of clayey silt (although this grades to silty clay at some locations) containing trace to some sand, and trace to some gravel, shale and limestone fragments. The results of grain size distribution tests conducted on twenty samples of the till deposit are shown on Figures 6A and 6B.

Atterberg limit testing carried out on thirty-one samples of the till measured plastic limits of 13 to 19 per cent, liquid limits of 19 to 42 per cent (but typically 24 to 30 per cent), and plasticity indices of 6 to 23 per cent (but typically 10 to 16 per cent). The results of the limits testing, which are plotted on a plasticity chart on Figures 7A and 7B, confirm that the till is typically comprised of inorganic clayey silt of low plasticity, though portions of the till consist of silty clay of intermediate plasticity.

The measured SPT “N” values within the till range from 6 to greater than 100 blows per 0.3 m of penetration. The lower SPT “N” values of 6 to 15 blows per 0.3 m of penetration were measured in some boreholes within the upper 1 m to 2 m of the till deposit, indicating that this portion of the deposit has a firm to stiff consistency. In general, however, the till has a very stiff to hard (and typically hard) consistency.

4.3 Groundwater Conditions

The majority of the boreholes were dry on completion of drilling operations. However, water was encountered between 0 m and 1.5 m depth in Boreholes B1, C-2003-04, E5, E14 and E22, which are located at or beyond the toe of the existing Highway 6 and York Road embankments, immediately adjacent to the Grindstone Creek or other surface drainage channel. Standing water was also encountered near or slightly below the base of the existing Highway 6 embankment fill in Boreholes B2, E2, E4, E9 and E11. In general, the water encountered in the open boreholes at the site is associated with the surficial sand to sand and silt deposit, or results from zones of granular fill perched within cohesive embankment fill or atop the native clayey silt till deposit.

Piezometers were installed in Boreholes RW-1 and Z-3 to monitor the groundwater level across the site. The water levels measured in the piezometers approximately one to 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>
RW-1	9.7 m	136.0 m	November 1, 2003
Z-3	3.3 m	129.9 m	November 10, 2004

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 (as shown in Borehole RW-1). It should be noted that the 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 Senior 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

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PART B

**FOUNDATION DESIGN REPORT
HIGH FILL EMBANKMENTS
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 geotechnical recommendations for the proposed high fill embankments associated with the Highway 6 widening project. The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the subsurface investigations at this site. The interpretation and recommendations provided are intended to provide the designers with sufficient information to design the proposed embankment widenings or new high fill embankments. Where comments are made on construction, they are provided in order to highlight those aspects which could affect the design and construction of the project, and for which special provisions or operational constraints may be required in the Contract Documents. 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 High Fill Embankments

New or widened high fill embankments are required in the following areas:

- The existing Highway 6 embankment between Stations 11+800 and 12+320 will be widened by approximately 4 m to 12 m on each side. In this area, the existing embankment is up to about 15 m in height, with existing embankment side slopes typically oriented at 1.5H:1V, although some local oversteepening is present along the east side of the embankment adjacent to the existing Grindstone Creek channel.
- The new York Road embankment between Stations 10+220 and 10+400, where the embankments to the west and east of the new York Road underpass will be up to approximately 9 m in height.
- The new Zellens Road embankment between approximately Stations 10+100 and 10+380, where the embankments to the north and south of the new structure over CP Rail will be up to about 9 m in height.
- The new Plains Road embankment between approximately Stations 10+650 and 10+740, immediately south of York Road, which will be approximately 4.5 m to 8.5 m in height.

The following sections of this report address subgrade preparation requirements, embankment stability under static conditions, embankment settlement, and construction concerns for the proposed high fill embankments. In addition, the creek valley stability adjacent to the proposed dry pond (to be located east of Highway 6 and south of York Road) is addressed within Section 6.4.

6.3 Subgrade Preparation and Embankment Construction

Based on the borehole results, the embankment subgrade soils will consist of topsoil/organics, surficial clayey silt to silty clay and sand to sand and silt, or very stiff to hard clayey silt till. The widening of the existing Highway 6 embankment will also require fill placement within the existing Grindstone Creek valley where the surficial soils are expected to be variable and contain recent alluvium and organic deposits.

6.3.1 Removal of Topsoil/Organics

It is not normal practice to carry out topsoil stripping from below embankments that are greater than 1.2 m in height (OPSS 206 only requires stripping of topsoil below embankments of less than 1.2 m in height). For the widening of the existing embankments on Highway 6 and on York Road, however, it is recommended that all topsoil/organic soils and softened/loosened soils be stripped from within the footprint of the new widened embankments, in order to minimize settlement and stability issues and improve the long-term performance of the new/widened embankments and roadways. In these areas, the exposed subgrade soils should be proof-rolled prior to fill placement in accordance with OPSS 206.

6.3.2 Removal of Soft Surficial Clayey Silt to Silty Clay

On the south side of York Road in the vicinity of the existing Grindstone Creek channel, Borehole C-2003-04 encountered a surficial deposit of very soft to firm silty clay. This deposit extends from the existing ground surface (approximately Elevation 139 m) immediately adjacent to the Grindstone Creek channel, down to about Elevation 136.4 m. As recommended in the Foundation Report for the culverts and retaining walls on this project, this surficial silty clay layer should be subexcavated down to Elevation 136.3 m to minimize embankment settlement and instability in this area; the subexcavation should extend from the south side of the existing York Road embankment to the south limit of the future embankment, where the existing ground surface is below Elevation 139 m adjacent to the Grindstone Creek channel. This subgrade should be inspected following subexcavation to ensure that all soft clayey materials have been removed, then the subexcavated area should be replaced with Granular "A" or Granular "B" backfill that is placed and compacted in accordance with the requirements of MTO's Special Provision SP105S10.

Adjacent to the existing Highway 6 embankment, localized deposits of surficial clayey silt to silty clay deposit are present, varying in consistency from soft to very stiff. It is recommended that provision be included in the Contract Documents for the subexcavation of very soft to soft surficial clayey silt to silty clay soils, where these are encountered within the embankment widening footprint.

6.3.3 Embankment Construction

The fill for the new or widened embankments should be placed and compacted in accordance with MTO's Special Provision 105S10, with inspection and field density testing by qualified personnel during placement operations to ensure appropriate materials are used and that adequate levels of compaction are achieved.

For the widening of the Highway 6 embankment and where new fill will be placed on top of the existing York Road embankment, benching of the existing embankment side slopes should be carried out to "key in" the new fill materials in accordance with OPSD 208.01.

The widened and new embankments should be constructed with side slopes oriented at 2H:1V or flatter, as discussed further in Section 6.4. Mid-height benches, at least 2 m in width, should be provided for all widened or new embankments where the total embankment height is equal to or greater than 8 m, in accordance with MTO guidelines.

6.4 Embankment Stability

6.4.1 Static Global Stability of New and Widened Embankments

Limit equilibrium slope stability analyses have been performed for the proposed new and widened high fill embankments using the commercially available program SLOPE/W, produced by Geo-Slope International Ltd., to check that a minimum factor of safety of 1.3 is achieved for the proposed embankment heights and geometries under static conditions. This minimum factor of safety is considered appropriate for the embankments for this project, considering the design requirements and the available field and laboratory testing data.

After stripping of the topsoil and softened surficial clayey silt to silty clay, the subsoils below the new or widened high fill embankment areas will consist of firm to stiff surficial clayey silt to silty clay and surficial sand to sand and silt (present in localized areas), overlying generally very stiff to hard, overconsolidated clayey silt till. For the cohesionless soil layers and the till deposit, effective stress parameters were used in the stability analyses assuming drained conditions for the soils; the effective stress parameters for these soils were estimated from empirical correlations using the SPT "N" values, using the correlations proposed by Peck et al. (1974), Schmertmann (1975) and US Navy (1971), tempered by engineering judgement. For the soft to stiff surficial

clayey silt to silty clay, both total stress (short-term) and effective stress (long-term) analyses were carried out. The undrained shear strength for the cohesive soils has been estimated based on correlations with the SPT “N” values and Atterberg limit test results.

The following table summarizes the parameters that have been used in the short-term and long-term slope stability analyses. In the analyses, the groundwater level has been assumed at 1.5 m to 3 m depth.

<i>Soil</i>	<i>Unit Weight</i>	<i>Effective Friction Angle</i>	<i>Undrained Shear Strength</i>
Embankment fill (range of parameters assuming earth and granular fill)	20-22 kN/m ³	30° - 35°	–
Surficial clayey silt to silty clay	20 kN/m ³	28°	25 - 50 kPa
Surficial sand to sand and silt	20 kN/m ³	28°	–
Very stiff to hard clayey silt till	21 kN/m ³	32° - 35°	–

The analyses have been carried out for “critical sections” corresponding to the highest embankment section; embankments up to 15 m in height have been analyzed for the Highway 6 embankment widening, and embankments up to about 9 m in height have been analyzed for the York Road, Plains Road and Zellens Road high fill embankment areas. The results of the slope stability analyses indicate that embankments with side slopes oriented at 2H:1V will have the following minimum factor of safety against deep-seated slope instability, assuming appropriate subgrade preparation and proper placement and compaction of the embankment fill materials:

- Factor of safety = 1.3 or greater for widening of the existing Highway 6 and York Road embankments; and
- Factor of safety = 1.5 or greater for the new high fill embankment along Plains Road and Zellens Road.

The analyses assume that all topsoil, organic matter and softened/loosened soils are stripped from below the embankment widening areas along Highway 6 and York Road. In addition, the analyses assume that subexcavation of any very soft to soft surficial clayey silt to silty clay soils is carried out where such soils are encountered within the embankment footprints. It is noted that the surficial clayey silt to silty clay is generally firm to stiff in the majority of the boreholes along the Highway 6 widening as well as along the York Road, Zellens Road and Plains Road high fill embankments (except as identified in Section 6.3.2).

6.4.2 Surficial Stability of New and Widened Embankments

To reduce surface water erosion on the new or widened embankment side slopes, placement of topsoil and seeding or pegged sod is recommended.

Along the east side of the existing Highway 6 embankment, Grindstone Creek will be realigned such that the new channel is located further eastward, beyond the toe of the widened embankment. The channel run and drop pool sections of the realigned creek should be lined with river stone or rip-rap protection, placed on a geotextile separator, that extends across the full width of the channel and up the widened embankment side slope as necessary to protect against the design flooding levels. In the global stability analyses for the Highway 6 east embankment side slope, it has been assumed that the river stone/rip-rap layer has been sized by hydraulic engineers such that this layer will remain in-place and stable under the design flood conditions, and will continue to provide protection against erosion of the channel banks and embankment toe.

6.4.3 Creek Valley Stability Adjacent to Proposed Dry Pond

It is understood that CP Rail has expressed concern regarding the stability of the existing natural slopes adjacent to the proposed dry pond that is to be constructed east of Highway 6 and south of York Road. The existing ground surface on the tableland, where the dry pond is to be constructed, varies from approximately Elevation 141.8 m near York Road to about Elevation 140.4 m at the crest of the Grindstone Creek valley. The existing valley slope has a gradient of approximately 2H:1V to 2.5H:1V, sloping downward from the dry pond area to the creek to the south/west. The creek, which flows along the toe of the valley slope, is about 20 m away from the nearest edge of the dry pond.

The proposed dry pond is to be constructed with side slopes at a gradient of 3H:1V. The design invert level is approximately Elevation 136.9 m and the design flood level is at Elevation 139.7 m. The results of boreholes advanced at the site indicate the presence of variable fill overlying hard clayey silt till. The groundwater level in the tableland immediately above the creek valley is at about Elevation 135.5 m (5 m or more below the natural ground surface of the tableland).

Slope stability analyses were carried out based on the slope profile and subsoil conditions encountered in the area where a septic bed was previously located; this is considered to be the most critical section. At this location, up to 2.7 m of sand fill was encountered between the pond and the crest of the valley slope (although it is noted that at other areas, minimal fill is present and the till was encountered at relatively shallow depths). The stability analyses indicate that the valley slope has a factor of safety against global instability of greater than 1.3 under normal conditions. When the sand fill becomes saturated during flood conditions, a shallow surficial failure of the sandy soils within the slope may result (based on a factor of safety of 1.2 for this condition). If the clayey silt till becomes fully saturated during flooding (i.e. up to Elevation 139.7 m), the factor of safety against global instability of the slope decreases to 1.15; however, based on the nature and consistency of the till in this area, a long period of time would be required for this portion of the till to become fully saturated, and this is unlikely given that the dry pond will have an outlet to the creek.

Based on the stability analysis results presented above, an adequate factor of safety is achieved against global instability of the Grindstone Creek valley slope during flooding of the proposed dry pond in this area.

6.5 Embankment Settlement

Settlement of the new or widened high fill embankments will occur as a result of compression of the new embankment fill itself, as well as short-term compression of the cohesionless soils or very stiff to hard, overconsolidated clayey silt till soils that underlie the embankments, and longer-term consolidation settlement within the soft to firm portions of the surficial clayey silt to silty clay, where present.

6.5.1 Settlement of Embankment Fill

Provided that the embankment material consists of select subgrade material or clean earth fill, the post-construction settlement of the embankment fill itself is expected to be less than 25 mm. The use of granular fill for the new embankment construction would reduce this magnitude of settlement, since the majority of settlement of granular fills will occur during construction, whereas the majority of the settlement of cohesive fill, if used, would occur after construction.

For the widening of the Highway 6 high fill embankment, differential settlement will occur between the new widened portions and the existing embankment fill. As noted in Section 6.3.3, the new embankment fill should be keyed into the existing embankment side slopes in accordance with OPSD 208.01, and this will help to reduce the impact of differential settlement. In addition, the differential settlement between the existing and widened portions of the Highway 6 embankment could be minimized by the use of granular fill for the widenings, as discussed above.

Where rock fill is used, settlement of the rock fill itself will depend on the type of rock, and on the method and sequence of placement and compaction of the fill; for this project it is assumed that the sedimentary bedrock (consisting predominantly of limestone, dolostone and shale) from the escarpment cut widening will be re-used within the high fill embankments. Assuming that the rock fill is not end-dumped into its final position and that it is placed in accordance with the requirements outlined in the Special Provision Amendment to OPSS 206, the settlement of rock fill in embankments up to about 15 m in height is estimated to be about 1 per cent of the embankment height. This settlement occurs as a result of degradation/breakage of “contact” points between rock particles, which is partially attributable to traffic loading. Based on the typical sections provided by URS, the widening of the existing Highway 6 embankments will require placement of up to about 7 m of rock fill or less, generally in the lower portion of the embankment widening, below the embankment side slope and not below the widened lanes themselves. Since the rock fill will not be directly loaded by traffic, it is anticipated that the

magnitude of settlement will be lower than 1 per cent of the rock fill height, potentially on the order of 25 mm to 50 mm. Some of the predicted settlement will occur during or very shortly after placement of the rock fill, and the remainder will occur during the first year following construction; however, this magnitude of settlement will affect the widened embankment side slope and not the driving lanes.

Based on the above considerations, it is expected that the magnitude of post-construction settlement of the new fill itself that will affect the paved lanes and shoulder of the widened Highway 6 embankment will be less than 25 mm; as noted previously, if granular fill is used for the widening under the driving lanes and shoulder, then the settlement will occur during construction.

6.5.2 Settlement of Foundation Soils

Settlement analyses for the foundation soils were carried out using the commercially available computer program Unisettle. The elastic compression of the surficial sand to sand and silt and the clayey silt till was modelled using elastic deformation moduli, based on correlations with the measured SPT “N” values. The consolidation settlement of the surficial clayey silt to silty clay stratum, where present, was modelled based on estimates of consolidation parameters from correlations with the Atterberg limit test results. The following parameters were used in the analyses:

<i>Soil Type</i>	<i>Bulk Unit Weight</i>	<i>Elastic Modulus</i>	<i>P_c'</i>	<i>e_o</i>	<i>C_c</i>	<i>C_r</i>
Embankment fill (range of parameters assumed for earth fill and granular fill)	20-22 kN/m ³	—	—	—	—	—
Firm surficial clayey silt to silty clay	20 kN/m ³	—	100	0.55	0.25	0.025
Stiff surficial clayey silt to silty clay	20 kN/m ³	10 – 15 MPa	—	—	—	—
Surficial sand to sand and silt	20 kN/m ³	10 – 15 MPa	—	—	—	—
Stiff to hard clayey silt till	21 kN/m ³	40 MPa	—	—	—	—

Based on the above, and provided that proper subgrade preparation is carried out, the settlement under the new or widened portions of the high fill embankments will generally be less than 25 mm, and will occur relatively quickly during or immediately following construction (i.e. within about three to six months following construction). Longer-term consolidation settlement of the firm surficial clayey silt to silty clay layer, where present, will occur under the embankment loading. The firm clayey soils have generally been encountered in boreholes located beyond the existing Highway 6 embankment toe; elsewhere, the surficial clayey soils tend to be stiff. The placement of up to about 9 m of fill would result in between 25 mm and 50 mm of settlement in this layer, which is typically between 0.5 m and 1 m in thickness. The predicted magnitude of consolidation settlement can be reduced by subexcavation of the firm portions of

the surficial clayey silt to silty clay deposit where encountered in the high fill embankment subgrade. However, it is noted that this magnitude of settlement will generally affect the embankment side slopes, with less consolidation settlement (up to approximately 10 mm to 15 mm) experienced at the embankment shoulder and in the paved lanes.

6.6 Excavations and Temporary Roadway Protection

6.6.1 Temporary Open-Cut Excavations

Where space permits, open-cut excavations can be used for benching the new embankment fill into the existing Highway 6 embankment fill. The excavations are expected to extend through the granular road base materials into the existing variable embankment fill. Some “perched” groundwater should be anticipated within the road base materials, the surficial cohesionless fill where it is present, and any zones or layers of granular fill within the clayey silt fill. Groundwater and surface water control are addressed in Section 6.7.

Excavations should be carried out in accordance with the guidelines outlined in the latest edition of the Occupational Health and Safety Act (OHSA) for Construction Activities. The existing embankment fill is classified as a Type 3 soil according to the OHSA. Temporary excavations (i.e. those which are only open for a relatively short period) through the existing fill should be made with side slopes no steeper than 1H:1V.

6.6.2 Temporary Excavation Support

Where space restrictions and construction staging requirements preclude the use of temporary open-cut excavations for the Highway 6 embankment widening, a temporary excavation support system could be considered. Where required, the temporary excavation support system should be designed and constructed in accordance with MTO’s Special Provision 105S19 (formerly SP 539S01). The lateral movement of the temporary shoring system should meet Performance Level 2 as specified in SP 105S19, provided that any buried utilities that may be present adjacent to the excavation can tolerate this magnitude of deformation.

6.7 Construction Considerations

6.7.1 Obstructions Within Embankment Fill and Native Till Soils

The existing Highway 6 embankment fill contains cobbles and boulders; instances of difficult drilling and of encountered obstructions are noted on the borehole records. In addition, the underlying native till deposit should be expected to contain cobbles and boulders. The presence of these obstructions will affect the installation of driven or augered steel H-piles for temporary excavation support, and will also affect the installation of soil anchors (tie-backs).

If temporary excavation support is required for the high fill embankments due to space restrictions or construction staging requirements, it is recommended that a Non-Standard Special Provision be included in the Contract Documents to warn the Contractor of the presence of cobbles and boulders within the Highway 6 embankment fill and the native till soils, as the presence of such obstructions may affect the installation of soldier piles and/or temporary anchors at the site.

6.7.2 Groundwater and Surface Water Control

Excavations associated with the construction of the new or widened high fill embankments will generally be maintained above the groundwater level. However, seepage into the excavation could occur from perched water within the existing granular road base fill (where present), zones of granular embankment fill, or surficial sand to sand and silt layers. It is considered that the quantity of water seepage can be handled by pumping from properly filtered sumps placed at the base of the excavation.

7.0 CLOSURE

This Foundation Design Report was prepared by Ms. Lisa Coyne, P.Eng., an Associate and Senior 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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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

	c_u, s_u	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

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 test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

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

LIST OF SYMBOLS

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

I. General

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
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

(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_t	sensitivity

- Notes:**
- 1 $\tau = c' + \sigma' \tan \phi'$
 - 2 shear strength $= (\text{compressive strength})/2$
 - * density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

PROJECT 001-1141F		RECORD OF BOREHOLE No B1				1 OF 1		METRIC						
W.P. 19-95-00		LOCATION N 4,796,226.2 E 271,421.8				ORIGINATED BY GM								
DIST Central HWY 6		BOREHOLE TYPE Continuous Split-Spoon Sampling				COMPILED BY LCC								
DATUM Geodetic		DATE Oct.15/02				CHECKED BY ASP								
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						
179.8	GROUND SURFACE													
0.0	Topsoil		1	SS	4									
179.1					2									
0.7	Clayey Silt, trace to some sand, trace gravel, containing silty sand pockets		2	SS	6									
178.3	Soft to stiff				8									
178.0	Mottled brown to red-brown				9									
1.8	Moist to wet				19									
	Sand and Silt, trace gravel		3	SS	19									
	Loose				35									
	Moist to wet				42									
177.0	Clayey Silt, some sand, trace to some gravel, shale and limestone fragments (Till)		4	SS	42									
2.8	Very stiff to hard				15/08									
	Brown to red-brown													
	Moist													
	END OF BOREHOLE													
Notes: 1. Water level in open borehole on completion of drilling at 1.5m depth (Elev.178.3m). 2. Borehole advanced using portable drilling equipment with a half-weight hammer. The SPT "N" values have been adjusted on this log to reflect the values that would be obtained using a standard-weight hammer.														

RECORD OF BOREHOLE No B2

1 OF 1

METRIC

PROJECT 001-1141F

W.P. 19-95-00

LOCATION N 4,796,254.2 E 271,445.1

ORIGINATED BY PKS

DIST Central HWY 6

BOREHOLE TYPE 108mm Diameter Solid Stem Augers

COMPILED BY LCC

DATUM Geodetic

DATE Oct.18/02

CHECKED BY ASP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
189.4	GROUND SURFACE							20 40 60 80 100		10 20 30				
0.0	Asphalt						189							
188.8	Sand and Gravel (Fill)													
0.6	Compact Moist													
188.2	Clayey Silt, some sand and gravel, trace organics (Fill)		1	SS	15									
1.2	Stiff to very stiff													
	Brown/black Moist						188							
	Clayey Silt to Silty Clay, some sand, some gravel, shale, limestone and siltstone fragments (Fill)		2	SS	19									
	Firm to very stiff													
	Red-brown to reddish-grey		3	SS	8		187							
	Moist to wet													
			4	SS	6		186							
			5	SS	7		185							
	Spoon bouncing on gravel/cobble in sample 6		6	SS	42									
183.9							184							
5.5	Gravel, some sand and silt, trace clay to Silty Sand, some gravel, trace clay, containing clayey silt pockets (Fill)													
	Compact		7	SS	14		183							
	Brown to red-brown													
	Moist						182							
			8	SS	27		181							
180.1														
9.3	Clayey Silt, some sand, trace to some gravel, shale and limestone fragments (Till)		9	SS	39		180							
	Hard													
	Red-brown to reddish-grey						179							
	Moist													
			10	SS	33		178							
176.8			11	SS	38		177							
12.6	END OF BOREHOLE													
	Note:													
	1. Water level in open borehole on completion of drilling at 12.3m depth (Elev.177.1m)													

PROJECT 001-1141F			RECORD OF BOREHOLE No B3			1 OF 1		METRIC						
W.P. 19-95-00			LOCATION N 4,796,266.8 E 271459.9			ORIGINATED BY GM								
DIST Central HWY 6			BOREHOLE TYPE Continuous Split-Spoon Sampling			COMPILED BY LCC								
DATUM Geodetic			DATE Oct.11/02			CHECKED BY ASP								
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						
186.1	GROUND SURFACE													
0.0	Clayey Silt, some sand, trace to some gravel (Fill) Firm to very stiff Mottled red-brown to green Dry		1	SS	5 13 19									
184.6			2	SS	16 8									
1.5	Silty Sand to Sand, some silt, trace gravel Loose to compact Brown to red-brown Dry becoming moist below 2.3m depth		3	SS	7 12 18									
			4	SS	22 19									
182.6			5	SS	20 33 28									
3.5	Clayey Silt with sand to some sand, some gravel (Till) Very stiff to hard Brown to red-brown Moist		6	SS	39									
181.8														
4.3	END OF BOREHOLE													
Notes: 1. Borehole dry on completion of drilling operations. 2. Borehole advanced using portable drilling equipment with a half-weight hammer. The SPT "N" values have been adjusted on this log to reflect the values that would be obtained using a standard-weight hammer.														


ON_MOT 0011141F.GPJ ON_MOT.GDT 23/12/02

PROJECT 001-1141F		RECORD OF BOREHOLE No C-2003-03		1 OF 1	METRIC
W.P. 19-95-00		LOCATION N 4795771.7 ; E 272029.4		ORIGINATED BY PKS	
DIST Central HWY 6		BOREHOLE TYPE 108 mm Diameter Solid Stem Augers		COMPILED BY LCC	
DATUM Geodetic		DATE June 16, 2003		CHECKED BY LCC	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	W _P	W		
145.8	Ground Surface					20	40	60	80	100	10	20	30		
0.0	Asphalt														
0.2	Sand and gravel (FILL)														
145.2															
0.6	Silty clay, trace to some sand and gravel (FILL) Firm to very stiff Brown Moist		1	SS	16										
			2	SS	7										
143.2			3	SS	5										
2.6	Silty Clay, some sand, trace gravel, trace organics														
142.8	Firm Dark brown / black Moist		4	SS	25										
3.1	Clayey Silt, trace sand and gravel, containing shale pieces (TILL) Very stiff to hard Red-brown Moist		5	SS	34										
			6	SS	53										
			7	SS	25										
138.8															
7.0	Clayey Silt, trace sand and gravel, containing shale and limestone pieces (TILL/RESIDUAL SOIL) Hard Red Dry to moist		8	SS	49										
			9	SS	50/05										
134.8			10	SS	90/15										
11.0	End of Borehole														
	Notes: 1. Borehole dry on completion of drilling.														

MISS_MTO_0011141FAAMTO.GPJ ON_MOT.GDT 14/3/05

PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No C-2003-04		1 OF 1	METRIC
W.P. <u>19-95-00</u>	LOCATION <u>N 4795733.6 ; E 272053.6</u>	ORIGINATED BY <u>PKS</u>			
DIST <u>Central</u> HWY <u>6</u>	BOREHOLE TYPE <u>Continuous Split-Spoon Sampling</u>	COMPILED BY <u>LCC</u>			
DATUM <u>Geodetic</u>	DATE <u>May 6, 2003</u>	CHECKED BY <u>LCC</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)					
								20 40 60 80 100		10 20 30					
						○ UNCONFINED + FIELD VANE									
						● QUICK TRIAXIAL X REMOULDED									
137.8	Ground Surface														
0.0	Silty Clay, trace to some sand and gravel, containing organics, wood pieces, and pockets of sand Very soft to firm Brown Wet		1	SS	1		137								
			2	SS	3										
136.4			3	SS	25/15										
1.5	Clayey Silt, trace sand and gravel, containing shale and limestone pieces (TILL) Hard Red Moist End of Borehole Notes: 1. Water level in open borehole at 0.6 m depth (Elev. 137.2 m) on completion of drilling. 2. Borehole advanced using portable drilling equipment with a half-weight hammer. The SPT "N" values have been adjusted on this log to reflect the value that would be obtained using a standard-weight hammer.														

MISS_MTO 0011141FAAMTO.GPJ ON MOT.GDT 14/3/05

PROJECT 001-1141F		RECORD OF BOREHOLE No DP-01		1 OF 1	METRIC
W.P. 19-95-00		LOCATION N 4795711.9 ; E 272148.2		ORIGINATED BY PKS	
DIST Central HWY 6		BOREHOLE TYPE 108mm Diameter Solid Stem Augers		COMPILED BY KG	
DATUM Geodetic		DATE November 8, 2004		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								
140.2	Ground Surface						20 40 60 80 100									
0.0	Clayey Silt, some sand, trace gravel, organics and topsoil (FILL) Stiff Brown and black Moist		1	SS	12											
139.4																
0.8	Clayey Silt, some sand, trace to some gravel, shale and limestone fragments (TILL) Hard Brown to red-brown Moist		2	SS	32											
			3	SS	39											
			4	SS	49											
			5	SS	54											
			6	SS	91											
135.7																
4.5	Clayey Silt, some sand, trace gravel, shale and limestone fragments (TILL/RESIDUAL SOIL) Hard Red-brown Moist		7	SS	78											
134.1																
133.8	Clayey Silt containing sand partings Hard Grey Moist		8	SS	56											
6.4	Clayey Silt, some sand, trace gravel, shale and limestone fragments (TILL/RESIDUAL SOIL) Hard Red-brown to grey Moist															
			9	SS	65											
132.0	End of Borehole															
8.2	Notes: 1. Open hole dry upon completion of drilling.															

MISS_MTO 0011141FAAMTO.GPJ ON_MOT_GDT 14/3/05

PROJECT 001-1141F		RECORD OF BOREHOLE No DP-02		1 OF 1	METRIC
W.P. 19-95-00		LOCATION N 4795767.0 ; E 272137.0		ORIGINATED BY PKS	
DIST Central HWY 6		BOREHOLE TYPE 108mm Diameter Solid Stem Augers		COMPILED BY KG	
DATUM Geodetic		DATE November 8, 2004		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						
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED			
142.0	Ground Surface													
0.0	Sand and gravel (FILL)													
0.2	Loose to compact Brown Moist		1	SS	14						○			
	Clayey Silt, some sand, trace gravel, shale and limestone fragments (TILL) Hard Brown to red-brown Moist		2	SS	34									
			3	SS	42						○	┌───┐		
			4	SS	43									
			5	SS	31						○	┌───┐		2 17 53 28
			6	SS	56									
137.5														
4.5	Clayey Silt, some sand, trace gravel, shale and limestone fragments (TILL/RESIDUAL SOIL) Hard Reddish-grey Moist		7	SS	100/20						○			
135.9														
6.2	End of Borehole		8	SS	100/05									
	Notes: 1. Open hole dry upon completion of drilling.													

MISS_MTO_0011141FAAMTO.GPJ ON MOT.GDT 14/3/05

PROJECT 001-1141F		RECORD OF BOREHOLE No E1		1 OF 1	METRIC
W.P. 19-95-00		LOCATION N 4,796,235.1 E 271,437.6		ORIGINATED BY AS/GM	
DIST Central HWY 6		BOREHOLE TYPE 108mm Diameter Solid Stem Augers		COMPILED BY LCC	
DATUM Geodetic		DATE Nov.21&23/00		CHECKED BY ASP	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
188.9	GROUND SURFACE													
0.0	Gravel and cobbles, some sand and silt (Fill) Compact Brown Dry		1	SS	16									
			2	SS	26									
184.9														
4.0	Clayey Silt, trace to some sand, gravel and shale fragments (Fill) Stiff to hard Brown Moist		3	SS	11									
	Cobbles/boulders inferred from 5.2m to 6.1m and from 6.7m to 7.6m due to slow advance and grinding of augers.		4	SS	66									
			5	SS	38									
			6	SS	18									
178.7														
10.2	Clayey Silt, trace sand, gravel and rootlets Very stiff Brown													
178.1	Moist		7	SS	28									
10.8	Clayey Silt, some sand, trace gravel (Till) Very stiff to hard Brown Moist													
			8	SS	73									
176.1														
12.8	END OF BOREHOLE													
	Note: Borehole dry on completion of drilling operations.													

ON_MOT 0011141F.GPJ ON_MOT.GDT 19/12/02



PROJECT 001-1141F		RECORD OF BOREHOLE No E2		1 OF 1	METRIC
W.P. 19-95-00		LOCATION N 4796240.2 ; E 271463.4		ORIGINATED BY AS	
DIST Central HWY 6		BOREHOLE TYPE 108mm Diameter Solid Stem Augers		COMPILED BY LCC	
DATUM Geodetic		DATE November 15, 2000		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 (%)
								○ UNCONFINED	+ FIELD VANE						
187.5	Ground Surface													GR SA SI CL	
0.0	Clayey silt to silty clay, some sand, some gravel and shale fragments, containing cobbles (FILL) Stiff to hard Red-brown to green-brown Dry to moist														
			1	SS	9										
			2	SS	11										
			3	SS	8										
	Cobbles/boulders inferred between 4.6m and 6.1m depth due to heavy grinding and slow advance of augers.														
			4	SS	13										
			5	SS	66										
			6	SS	22										
177.1															
10.4	Clayey Silt, some sand, trace gravel and shale fragments (TILL) Hard Brown to red-brown Moist		7	SS	53									1 25 44 30	
			8	SS	104/26										
174.9															
12.7	End of Borehole Note: Water level in open borehole on completion of drilling at 10.7m depth (Elevation 176.8m).														

MISS_MTO_0011141FAAMTO.GPJ ON_MOT_GDT 14/3/05

PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No E3		1 OF 1 METRIC	
W.P. <u>19-95-00</u>	LOCATION <u>N 4796225.0; E 271508.5</u>	ORIGINATED BY <u>GM</u>			
DIST <u>Central</u> HWY <u>6</u>	BOREHOLE TYPE <u>Continuous Split-Spoon Sampling</u>	COMPILED BY <u>JDR</u>			
DATUM <u>Geodetic</u>	DATE <u>October 11, 2002</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 γ kN/m³	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 _P W W _L	10 20 30				
175.6	Ground Surface														
0.0	Clayey Silt to Silty Clay, trace sand and gravel, trace organics Very stiff Brown Dry to moist		1	SS	15 17 19										
174.4			2	SS	19 10										
174.1	Silty Sand Loose to compact Brown Moist		3	SS	20 34 57										
173.4	Silty Clay, trace sand and gravel Very stiff to hard Brown Moist		4	SS	35/10										
2.1															
173.0															
2.5	Clayey Silt, trace sand and gravel (TILL) Hard Brown Moist End of Borehole														
Notes: 1. Borehole dry on completion of drilling. 2. Borehole advanced using portable drilling equipment with a half-weight hammer. The SPT N values have been adjusted on this log to reflect the values that would be obtained using a standard-weight hammer.															


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	20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	γ	GR SA SI CL				
183.5 0.0	Ground Surface Sand and gravel, containing cobbles (FILL) Compact Brown Dry						183										
			1	SS	14		182										
181.1 2.4	Clayey silt, some sand, some gravel and shale fragments, containing cobbles (FILL) Stiff to very stiff Brown to red-brown Moist						181										
			2	SS	17		180										
			3	SS	11		179										
			4	SS	22		178										
							177										
							176										
							175										
							174										
							173										
							172										
							171										
							170										
							169										
172.1 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												

MISS_MTO_0011141FAAMTO.GPJ ON_MOT_GDT_3/8/05

Continued Next Page

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

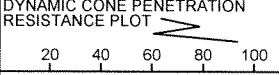
PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No E4		2 OF 2 METRIC	
W.P. <u>19-95-00</u>	LOCATION <u>N 4796199.8 ; E 271473.0</u>	ORIGINATED BY <u>AS</u>			
DIST <u>Central</u> HWY <u>6</u>	BOREHOLE TYPE <u>108mm Diameter Solid Stem Augers</u>	COMPILED BY <u>LCC</u>			
DATUM <u>Geodetic</u>	DATE <u>November 20-21, 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 γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								W _p	W	W _L
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL								
— CONTINUED FROM PREVIOUS PAGE —								20	40	60	80	100						
167.7	Clayey Silt, trace to some sand, gravel and shale fragments (TILL)		10	SS	77		168											
15.9	End of Borehole Note: Water level in open borehole at 14m depth (Elevation 169.5m) on completion of drilling.																	

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

PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No E5		1 OF 1 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4796157.0 ; E 271455.4</u>		ORIGINATED BY <u>GM</u>	
DIST <u>Central</u> HWY <u>6</u>		BOREHOLE TYPE <u>Continuous Split-Spoon Sampling</u>		COMPILED BY <u>LCC</u>	
DATUM <u>Geodetic</u>		DATE <u>October 17, 2002</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 γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					
165.7	Ground Surface												
0.0	Topsoil												
165.2			1	SS	1		165						
0.5	Clayey Silt, trace sand and gravel, trace organics Soft to firm Moist Brown to dark brown		2	SS	2								
			2	SS	5								
164.2					6								
1.5	Clayey Silt, trace sand, trace gravel and shale fragments (TILL) Stiff to hard Brown to red-brown Dry to moist		3	SS	9		164						
					23								
163.1			4	SS	38								
2.6	End of Borehole												
<div>Notes:</div> <div>1. Water level at ground surface on completion of drilling.</div> <div>2. Borehole advanced using portable drilling equipment with a half-weight hammer. The SPT N values have been adjusted on this log to reflect the values that would be obtained using a standard-weight hammer.</div>													

PROJECT 001-1141F		RECORD OF BOREHOLE No E6				1 OF 2 METRIC					
W.P. 19-95-00		LOCATION N 4796167.7 ; E 271504.6				ORIGINATED BY GM					
DIST Central HWY 6		BOREHOLE TYPE 108mm I.D. Hollow Stem Augers				COMPILED BY LCC					
DATUM Geodetic		DATE November 20-21, 2000				CHECKED BY LCC					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
181.5 0.0	Ground Surface Sand and gravel, trace silt (FILL) Compact Brown Dry	X	1	SS	16		181				
							180				
							179				
	Cobbles/boulders inferred between 3.8m and 4.3m depth due to heavy grinding.	2	SS	27		178					
176.9 4.6	Clayey silt, some sand and gravel, containing cobbles (FILL) Hard Brown Dry	3	SS	45		177					
						176					
175.4 6.1	Gravel, some sand and silt, containing cobbles (FILL) Very dense Brown Dry	4	SS	55		175					
						174					
173.9 7.6	Clayey silt, trace sand and gravel, containing cobbles (FILL) Stiff Brown Moist	5	SS	14		173					
	Cobbles/boulders inferred between 8.2m and 8.8m due to heavy grinding of augers.					172					
172.4 9.1	Sand and gravel, trace silt (FILL) Compact Brown Moist	6	SS	20		171					
	Cobbles/boulders inferred between 9.8m and 10.5m depth due to heavy grinding of augers.					170					
170.8 10.7	Clayey silt, some weathered shale fragments, trace sand and gravel (FILL) Very stiff Brown Moist	7	SS	22		169					
	Cobbles/boulders inferred from 11.6m to 13.3m depth due to heavy grinding and slow advance rate.	8	SS	30		168					
167.2 14.3		9	SS	20		167					

MISS_MTO_0011141FAAMTO.GPJ ON_MOT_GDT_12/5/05

Continued Next Page

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

PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No E6		2 OF 2 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4796167.7 ; E 271504.6</u>		ORIGINATED BY <u>GM</u>	
DIST <u>Central</u> HWY <u>6</u>		BOREHOLE TYPE <u>108mm I.D. Hollow Stem Augers</u>		COMPILED BY <u>LCC</u>	
DATUM <u>Geodetic</u>		DATE <u>November 20-21, 2000</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							WATER CONTENT (%)
--- CONTINUED FROM PREVIOUS PAGE ---									○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED						
	Clayey Silt, some sand, trace gravel (TILL) Hard Mottled brown and grey Moist		10	SS	156		166								
							165								
			11	SS	114/25										
							164								
162.8			12	SS	140		163								
18.8	End of Borehole Note: Borehole dry on completion of drilling operations.														

MISS_MTO 0011141FAAMTO GPJ ON MOT.GDT 12/5/05

PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No E7		1 OF 1 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4796169.7 :E 271534.3</u>		ORIGINATED BY <u>AS</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 15, 2000</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							WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE							
						● QUICK TRIAXIAL × REMOULDED									
178.5	Ground Surface						20 40 60 80 100								
0.0	Clayey silt, some sand, gravel and shale fragments, containing weathered shale cobbles/boulders (FILL) Stiff to hard Mottled brown, grey and red Dry to moist		1	SS	12										
	Heavy grinding and slow advance between 1.5m and 4.5m depth.		2	SS	15										
			3	SS	17										
			4	SS	80/18										
	Heavy grinding and slow advance between 6m and 9m depth.		5	SS	32										
169.1	Clayey Silt, some sand, trace gravel and shale fragments (TILL) Hard Brown Moist		6	SS	38										
9.5			7	SS	96										
			8	SS	95										
165.9	End of Borehole														
12.7	Note: Borehole dry on completion of drilling operations.														

MISS. MTO 0011141FAAMTO.GPJ ON MOT.GDT 12/5/05


PROJECT 001-1141F		RECORD OF BOREHOLE No E8		1 OF 2 METRIC	
W.P. 19-95-00		LOCATION N 4796128.2 ; E 271544.2		ORIGINATED BY GM	
DIST Central HWY 6		BOREHOLE TYPE 108mm Diameter Solid Stem Augers		COMPILED BY LCC	
DATUM Geodetic		DATE November 23, 2000		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 (%)				
								○ UNCONFINED								+ FIELD VANE		● QUICK TRIAXIAL	
177.5	Ground Surface						20	40	60	80	100	10	20	30	GR SA SI CL				
0.0	Sand and gravel, trace silt, containing cobbles (FILL) Compact to dense Brown Dry		1	SS	34														
175.4	Clayey silt, trace sand and gravel, containing weathered shale and limestone cobbles/boulders (FILL) Firm to hard Brown Dry to moist		2	SS	15														
2.1	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														
			4	SS	29														
			5	SS	16														
			6	SS	6														
			7	SS	37														
			8	SS	20														
163.9	Clayey Silt, trace sand and gravel, containing rootlets Very stiff Brown Moist		9	SS	15														
13.6																			
162.9																			
14.6																			

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

Continued Next Page

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

PROJECT 001-1141F			RECORD OF BOREHOLE No E8			2 OF 2 METRIC													
W.P. 19-95-00			LOCATION N 4796128.2 ; E 271544.2			ORIGINATED BY GM													
DIST Central HWY 6			BOREHOLE TYPE 108mm Diameter Solid Stem Augers			COMPILED BY LCC													
DATUM Geodetic			DATE November 23, 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			WATER CONTENT (%) W _P — W — W _L			γ			GR SA SI CL		
--- CONTINUED FROM PREVIOUS PAGE ---								20 40 60 80 100											
160.2 17.3	Clayey Silt, trace sand, trace gravel and shale fragments (TILL) Hard Brown to red-brown Moist		10	SS	64		162												
							161												
	End of Borehole		11	SS	57														
	Note: Borehole dry on completion of drilling operations.																		

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PROJECT 001-1141F		RECORD OF BOREHOLE No E9		1 OF 2 METRIC	
W.P. 19-95-00		LOCATION N 4796129.4 E 271574.7		ORIGINATED BY GM	
DIST Central HWY 6		BOREHOLE TYPE 108mm Diameter Solid Stem Augers		COMPILED BY LCC	
DATUM Geodetic		DATE November 15, 2000		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 (%)					
176.4	Ground Surface													
0.0	Sand and gravel, trace clay (FILL) Compact Brown Dry		1	SS	17									
173.7	Clayey silt, trace sand and gravel, trace shale and limestone fragments (FILL) Stiff to hard Brown Dry to moist		2	SS	12									
			3	SS	12									
			4	SS	22									
			5	SS	55									
			6	SS	61									
			7	SS	37									
			8	SS	100									

Continued Next Page

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

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PROJECT 001-1141F				RECORD OF BOREHOLE No E9				2 OF 2 METRIC							
W.P. 19-95-00				LOCATION N 4796129.4 : E 271574.7				ORIGINATED BY GM							
DIST Central HWY 6				BOREHOLE TYPE 108mm Diameter Solid Stem Augers				COMPILED BY LCC							
DATUM Geodetic				DATE November 15, 2000				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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED							
161.2	--- CONTINUED FROM PREVIOUS PAGE ---		9	SS	46		161								
15.2	Clayey Silt, trace sand, gravel and shale fragments (TILL) Hard Brown Moist		10	SS	100/15		160								
			11	SS	100/08		159								
							158								
156.7			12	SS	100/08		157								
19.7	End of Borehole Note: Water level in open borehole at approximately 15m depth (Elevation 161.4m) on completion of drilling.														

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PROJECT 001-1141F		RECORD OF BOREHOLE No E10		1 OF 1	METRIC
W.P. 19-95-00		LOCATION N 4796115.3 ; E 271622.2		ORIGINATED BY GM	
DIST Central HWY 6		BOREHOLE TYPE Continuous Split-Spoon Sampling		COMPILED BY LCC	
DATUM Geodetic		DATE October 15, 2002		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 × REMOULDED		WATER CONTENT (%) w _p w w _L					
161.3	Ground Surface														
0.0	Clayey Silt, trace sand and gravel, trace organics		1	SS	5	161									
160.7	Soft to firm Dark brown Moist		2	SS	18										
0.6	Clayey Silt, trace sand and gravel (TILL) Stiff to hard Brown Moist		2	SS	23		160								
159.4	End of Borehole	3	SS	30											
1.9	Note: 1. Borehole dry on completion of drilling operations. 2. Borehole advanced using portable drilling equipment a half-weight hammer. The SPT N values have been adjusted on this log to reflect the values that would be obtained using a standard-weight hammer.														

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PROJECT 001-1141F		RECORD OF BOREHOLE No E11		1 OF 2 METRIC	
W.P. 19-95-00	LOCATION N 4796059.4 ; E 271636.2	ORIGINATED BY GM			
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 _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 (%)
170.4	Ground Surface		1	SS	9											
0.0	Sand and gravel, trace to some silt, trace clay, containing cobbles (FILL) Loose to dense Brown to grey Dry to moist		2	SS	13											
			3	SS	13											
			4	SS	21											
			5	SS	31											
			6	SS	30											
			7	SS	26											
162.0	Clayey silt, trace to some sand, trace to some gravel and shale fragments (FILL) Stiff to very stiff Brown Moist		8	SS	14											
8.4			9	SS	10											
			10	SS	12											
			11	SS	20											
155.8																
14.6																

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Continued Next Page

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

PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No E11		2 OF 2 METRIC	
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 NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _P W W _L	10 20 30				
--- CONTINUED FROM PREVIOUS PAGE ---								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED		WATER CONTENT (%)					
	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 E12

1 OF 2 METRIC

W.P. 19-95-00

LOCATION N 4796027.3 : E 271674.5

ORIGINATED BY GM

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 _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						
167.3 0.0	Ground Surface Sand and gravel, some clay, containing cobbles (FILL) Loose to compact Brown Dry to moist													
			1	SS	11									
			2	SS	7									
	Cobbles/boulders inferred between 3.8m and 4.6m depth due to heavy grinding and slow advance.													
			3	SS	14									
161.2 6.1	Cobbles/boulders inferred between 5.8m and 6.1m depth due to heavy grinding and slow advance. Clayey silt, trace sand and gravel, containing cobbles (FILL) Very stiff Brown Moist		4	SS	21									
159.7 7.6	Clayey Silt, trace sand and gravel (TILL) Stiff to hard Brown Moist		5	SS	23									
				6	SS	11								
				7	SS	75/15								
			8	SS	79									
			9	SS	100									

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+³, X³

Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No E12		2 OF 2 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4796027.3 ; E 271674.5</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>	

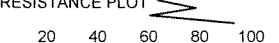




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100	W _p	W	W _L		
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × REMOULDED									
								20	40	60	80	100	10	20	30		
150.2	Clayey Silt, trace sand and gravel (TILL) Stiff to hard Brown Moist		10	SS	100/23		152										
							151										
17.1	End of Borehole Note: Borehole dry on completion of drilling.		11	SS	100/15												

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 _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					
163.5	Ground Surface												
0.0	Sand and gravel (FILL) Compact		1	SS	29								
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 Becoming grey below 7.2m depth.		4	SS	55								
2.3			5	SS	61								
			6	SS	68								
			7	SS	56								
			8	SS	43								
			9	SS	28								
			10	SS	24								
			11	SS	33								
152.4	End of Borehole												
11.1	Note: Borehole dry on completion of drilling.												

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PROJECT 001-1141F		RECORD OF BOREHOLE No E14				1 OF 1 METRIC								
W.P. 19-95-00		LOCATION N 4796020.6; E 271711.6				ORIGINATED BY GM								
DIST Central HWY 6		BOREHOLE TYPE Continuous Split-Spoon Sampling				COMPILED BY LCC								
DATUM Geodetic		DATE October 17, 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						
155.7	Ground Surface													
0.0	Topsoil/Organic Silt		1	SS	1									
154.3			2	SS	4									
1.4	Silty Clay, some sand and gravel Firm to Stiff Brown Moist		3	SS	8									
153.3					9									
2.4	Clayey Silt, trace sand and gravel (TILL) Stiff to hard Brown		4	SS	12									
152.7					37									
3.1	Moist End of Borehole				28/ 15									
Notes: 1. Water level in open borehole at 0.2m depth (Elevation 155.5m) on completion of drilling. 2. Borehole advanced using portable drilling equipment with a half-weight hammer. The SPT N values have been adjusted on this log to reflect the value that would be obtained using a standard-weight hammer.														

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PROJECT 001-1141F		RECORD OF BOREHOLE No E16				1 OF 1 METRIC					
W.P. 19-95-00		LOCATION N 4795918.1 : E 271786.1				ORIGINATED BY GM					
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  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT  WATER CONTENT (%)	UNIT WEIGHT  γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
156.5	Ground Surface										
0.0	Sand and gravel, some silt, trace to some clay (FILL) Dense Brown Dry to moist		1	SS	75		156				
155.7	Silty clay, some sand and gravel (FILL) Hard Brown Moist		2	SS	40/08		155				
0.8			3	SS	50						
154.2	Clayey Silt, trace sand and gravel (TILL) Hard Brown to grey-brown Moist		4	SS	77		154				
2.3			5	SS	90		153				
			6	SS	85		152				
151.5	End of Borehole										
5.0	Note: Borehole dry on completion of drilling.										

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PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No E18		1 OF 1 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4795794.6 :E 272030.9</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 1, 2001</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								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						× REMOULDED		
146.7	Ground Surface																	
0.0	Asphalt																	
146.2	Sand and gravel (FILL)		1	SS	34													
	Dense Grey																	
145.9	Silty Clay, trace sand																	
0.8	Very stiff Brown		2	SS	16													
	Clayey Silt, trace sand, trace gravel and shale fragments (TILL)																	
	Very stiff to hard Brown Moist		3	SS	40													
			4	SS	63													
			5	SS	67													
			6	SS	44													
			7	SS	50													
			8	SS	39													
			9	SS	108													
138.6	End of Borehole																	
8.1	Note: Borehole dry on completion of drilling.																	

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PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No E22		1 OF 1 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4796128.2 :E 271504.2</u>		ORIGINATED BY <u>GM</u>	
DIST <u>Central</u> HWY <u>6</u>		BOREHOLE TYPE <u>Continuous Split-Spoon Sampling</u>		COMPILED BY <u>LCC</u>	
DATUM <u>Geodetic</u>		DATE <u>October 17, 2002</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 x REMOULDED						
163.5	Ground Surface													
0.0	Topsoil													
163.0			1	SS	1									
162.7	Silty Clay, trace to some sand				3									
0.8	Firm Brown Moist													
162.0	Clayey Silt, trace sand, some gravel and shale fragments (TILL)		2	SS	20									
1.5	Very stiff to hard Brown Moist				43									
	End of Borehole													
Notes: 1. Water level in open borehole at ground surface on completion of drilling. 2. Borehole advanced using portable drilling equipment with a half-weight hammer. The SPT N values have been adjusted on this log to reflect the values that would be obtained using a standard-weight hammer.														





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PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No E-2003-01		1 OF 1 METRIC	
W.P. <u>19-95-00</u>	LOCATION <u>N 4796062.3 ; E 271673.1</u>	ORIGINATED BY <u>PKS</u>			
DIST <u>Central</u> HWY <u>6</u>	BOREHOLE TYPE <u>Portable Drilling Equipment</u>	COMPILED BY <u>LCC</u>			
DATUM <u>Geodetic</u>	DATE <u>May 6, 2003</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 γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _P W W _L	WATER CONTENT (%)	GR SA SI CL		
157.4	GROUND SURFACE													
0.0	Silty Clay, trace to some sand, trace organics, containing pockets of sand Very soft to firm Brown to dark brown Wet		1	SS	1 1	157								
			2	SS	1 1									
155.9			3	SS	6 24		156							
1.5	Clayey Silt, trace sand and gravel (TILL)	4	SS	23/0 15										
155.4	Very stiff													
2.0	Brown to brown/red Moist End of Borehole													
Notes: 1. Water level in open borehole at ground surface on completion of drilling. 2. Borehole advanced using portable drilling equipment with a half-weight hammer. The SPT "N" values have been adjusted on this log to reflect the values that would be obtained using a standard-weight hammer.														

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PROJECT 001-1141F		RECORD OF BOREHOLE No E-2003-02		1 OF 1 METRIC	
W.P. 19-95-00		LOCATION N 4796099.5 ; E 271534.8		ORIGINATED BY PKS	
DIST Central HWY 6		BOREHOLE TYPE Portable Drilling Equipment		COMPILED BY LCC	
DATUM Geodetic		DATE May 7, 2003		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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED						
161.4	GROUND SURFACE													
0.0	Clayey Silt to Silty Clay, trace to some sand, gravel and organics Very soft to firm Black Wet		1	SS	1 1	 161								
160.3			2	SS	3 7									
1.1	Clayey Silt, trace sand and gravel (TILL) Very stiff to hard Brown/red Moist		3	SS	17 40									
159.6	End of Borehole													
1.8	Notes: 1. Water level in open borehole at 0.15m depth (Elevation 161.25m) on completion of drilling. 2. Borehole advanced using portable drilling equipment with a half-weight hammer. The SPT "N" values have been adjusted on this log to reflect the values that would be obtained using a standard-weight hammer.													

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PROJECT 001-1141F		RECORD OF BOREHOLE No RW-1		1 OF 2	METRIC
W.P. 19-95-00		LOCATION N 4795657.1 ; E 272113.9		ORIGINATED BY GPD	
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 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		W _p	W	W _L		
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED					
145.7	Ground Surface							20 40 60 80 100						
145	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									
			6	SS	27									
			7	SS	17									
			8	SS	32									
			9	SS	50									
			10	SS	46									
135.5	Becoming grey-brown at 3.8 m depth													
135	Becoming reddish-grey at 9.1 m depth													
135.2	Clayey Silt, some sand, trace to some gravel, shale and limestone fragments (TILL / RESIDUAL SOIL) Hard Grey to red-brown Dry to moist		11	SS	67/15									
			12	SS	66									
			13	SS	103									

MISS_MTO 0011141FAAMTO.GPJ ON_MOT.GDT 28/4/05

Continued Next Page

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

PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No RW-1				2 OF 2		METRIC							
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 _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 X REMOULDED 20 40 60 80 100							
130.3	— CONTINUED FROM PREVIOUS PAGE —		14	SS	57/15		130								
15.4	End of Borehole 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.														

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PROJECT 001-1141F		RECORD OF BOREHOLE No RW-2A		1 OF 1	METRIC
W.P. 19-95-00		LOCATION N 4795692.4 ; E 272073.9		ORIGINATED BY GPD	
DIST Central HWY 6		BOREHOLE TYPE 108mm Diameter Solid Stem Augers		COMPILED BY LCC	
DATUM Geodetic		DATE September 22, 2003		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 ● QUICK TRIAXIAL	+ FIELD VANE X REMOULDED							
147.1	Ground Surface							20 40 60 80 100								
0.0	Topsoil															
0.2	Clayey Silt, trace sand and gravel, containing shale pieces (TILL) Stiff to hard Brown Dry to moist		1	SS	13											
			2	SS	22											
			3	SS	42											
			4	SS	33											
			5	SS	36											
			6	SS	39											
			7	SS	40											
			8	SS	32											
140.4	Becoming grey-brown at 6.1 m depth.															
6.7	End of Borehole Note: Borehole dry on completion of drilling operations.															

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PROJECT 001-1141F		RECORD OF BOREHOLE No RW-3		1 OF 1	METRIC
W.P. 19-95-00		LOCATION N 4795728.7 ; E 272049.3		ORIGINATED BY GPD	
DIST Central HWY 6		BOREHOLE TYPE Continuous Split-Spoon Sampling		COMPILED BY LCC	
DATUM Geodetic		DATE September 5, 2003		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 (%)					
140.3	Ground Surface													
0.0	Clayey Silt, trace sand and gravel (TILL) Stiff to very stiff Brown Dry to moist		1	SS	8									
			2	SS	23									
138.5			3	SS	31/1.15									
1.8	End of Borehole													
	Notes: 1. Borehole dry on completion of drilling operations. 2. Borehole advanced using portable drilling equipment with a half-weight hammer. The SPT "N" values have been adjusted on this log to reflect the value that would be obtained using a standard-weight hammer.													

PROJECT <u>001-1141F</u>				RECORD OF BOREHOLE No Y6				1 OF 1		METRIC					
W.P. <u>19-95-00</u>				LOCATION <u>N 4795710.8 ; E 272029.2</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>January 11, 2001</u>				CHECKED BY <u>ASP</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							
145.5	Road Surface														
0.0	Asphalt														
145.0	Sand and gravel (FILL) Compact		1	AS			145								
0.5	Silty clay, trace sand and gravel, trace organics (FILL) Stiff to very stiff Mottled grey-brown Moist		2	SS	19										
			3	SS	18		144								
			4	SS	14		143								
142.6	Clayey Silt, trace to some sand, trace gravel and shale fragments (TILL) Very stiff to hard Brown Moist		5	SS	27		142								
2.9			6	SS	60		141								
			7	SS	65		140								
138.9			8	SS	66		139								
6.6	End of Borehole Note: Borehole dry on completion of drilling operations.														


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PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No Y9		1 OF 1	METRIC
W.P. <u>19-95-00</u>	LOCATION <u>N 4795628.5 ; E 272015.5</u>	ORIGINATED BY <u>PKS</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 20, 2002</u>	CHECKED BY <u>ASP</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	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED						W _P	W
147.8	Road Surface																	
0.0	Asphalt																	
0.2	Sand and gravel (Fill)																	
147.2	Compact																	
146.9	Silty Clay, trace sand, gravel and rootlets																	
0.9	Stiff		1	SS	16													
	Mottled grey-brown																	
	Clayey Silt, trace to some sand, trace gravel (TILL)		2	SS	29													
	Very stiff to hard																	
	Brown to grey-brown		3	SS	33													
	Moist																	
			4	SS	32													
			5	SS	33													
			6	SS	36													
142.8	End of Borehole																	
5.0	Note: Borehole dry on completion of drilling operations.																	

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PROJECT 001-1141F		RECORD OF BOREHOLE No Y11		1 OF 1 METRIC	
W.P. 19-95-00		LOCATION N 4795652.5 ; E 272001.5		ORIGINATED BY PKS	
DIST Central HWY 6		BOREHOLE TYPE 108mm Diameter Solid Stem Augers		COMPILED BY KG	
DATUM Geodetic		DATE November 9, 2004		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/m³	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						
148.1	Ground Surface														
0.0	Topsoil														
0.2	Clayey Silt, trace to some sand, trace gravel, shale and limestone fragments (TILL) Stiff to hard Brown to grey Moist		1	SS	11										
			2	SS	36										
			3	SS	46										
			4	SS	36										
			5	SS	31										
			6	SS	24										
			7	SS	23										
			8	SS	34										
141.4	End of Borehole														
6.7	NOTE: 1. Borehole dry upon completion of drilling.														

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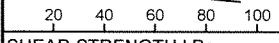
PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No BH Z1		1 OF 1 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4795144.1 ; E 272240.1</u>		ORIGINATED BY <u>PKS</u>	
DIST <u>Central</u> HWY <u>6</u>		BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>		COMPILED BY <u>KG</u>	
DATUM <u>Geodetic</u>		DATE <u>November 2, 2004</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						
							20 40 60 80 100	20 40 60 80 100						
131.8	GROUND SURFACE													
0.0	Topsoil													
0.1	Clayey Silt, trace sand, gravel and organics Firm Brown to dark brown Moist		1	SS	4									
130.4			2	SS	8									
1.4	Clayey Silt, some sand, trace gravel and shale fragments (TILL) Very stiff to hard Red-brown Moist		3	SS	22									
128.9			4	SS	46									
2.9	Clayey Silt, trace to some sand, trace gravel (TILL/RESIDUAL SOIL) Hard Red-brown Dry to moist		5	SS	100/25									
			6	SS	135									
126.9			7	SS	100/25									
4.8	End of Borehole Notes: Open borehole dry upon completion of drilling.													

PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No BH Z1A		1 OF 1 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4795152.3 :E 272222.5</u>		ORIGINATED BY <u>PKS</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>November 4, 2004</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										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED												
132.5	GROUND SURFACE							20	40	60	80	100								
0.9	Topsoil		1	SS	8		132													
131.8	Clayey Silt, some sand, trace gravel, shale and limestone fragments (TILL)																			
0.7	Firm Red-brown Moist		2	SS	26															
	Clayey Silt with sand, trace gravel and shale fragments (TILL)						131													
	Very stiff Brown Moist		3	SS	26															
130.3	End of Borehole																			
2.1	Notes: Open borehole dry upon completion of drilling.																			



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PROJECT 001-1141F		RECORD OF BOREHOLE No BH Z2				1 OF 1 METRIC					
W.P. 19-95-00		LOCATION N 4795179.1; E 272204.4				ORIGINATED BY PKS					
DIST Central HWY 6		BOREHOLE TYPE 108 mm Diameter Solid Stem Augers				COMPILED BY KG					
DATUM Geodetic		DATE November 2, 2004				CHECKED BY LCC					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED	PLASTIC LIMIT w _p NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L WATER CONTENT (%)	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
132.1	GROUND SURFACE										
0.0	Topsoil										
0.2	Clayey Silt, some sand, trace gravel and organics		1	SS	6						
131.4	Firm										
0.7	Brown to dark brown Moist		2	SS	43						
	Clayey Silt, some sand, trace gravel, shale and limestone fragments (TILL)										
	Hard		3	SS	40						
	Red-brown Moist										
129.9	Clayey Silt, trace to some sand, trace gravel (TILL/RESIDUAL SOIL)		4	SS	63						
2.2	Hard										
	Red-brown to brown		5	SS	90						
	Dry to moist										
			6	SS	110						
			7	SS	100/23						
127.3	End of Borehole										
4.8	Notes: Open borehole dry upon completion of drilling operations.										

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

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PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No BH Z-8		1 OF 1 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4795252.7 ; E 272129.4</u>		ORIGINATED BY <u>PKS</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>November 5, 2004</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							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
134.3	GROUND SURFACE														
0.0	Topsoil														
0.2	Clayey Silt, some sand, trace gravel, shale and limestone fragments (TILL) Firm to hard Red-brown Moist		1	SS	6										
			2	SS	28										
			3	SS	38										
			4	SS	45										
			5	SS	48										
130.6	Clayey Silt, trace sand, gravel, shale and limestone fragments (TILL/RESIDUAL SOIL) Hard Red-grey Moist		6	SS	87										
7			SS	84											
127.9			8	SS	100										
6.4	End of Borehole														
	Notes: Open borehole dry upon completion of drilling.														

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PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No BH Z9		1 OF 1 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4795294.6 ; E 272086.7</u>		ORIGINATED BY <u>PKS</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>November 5, 2004</u>		CHECKED BY <u>LCC</u>	

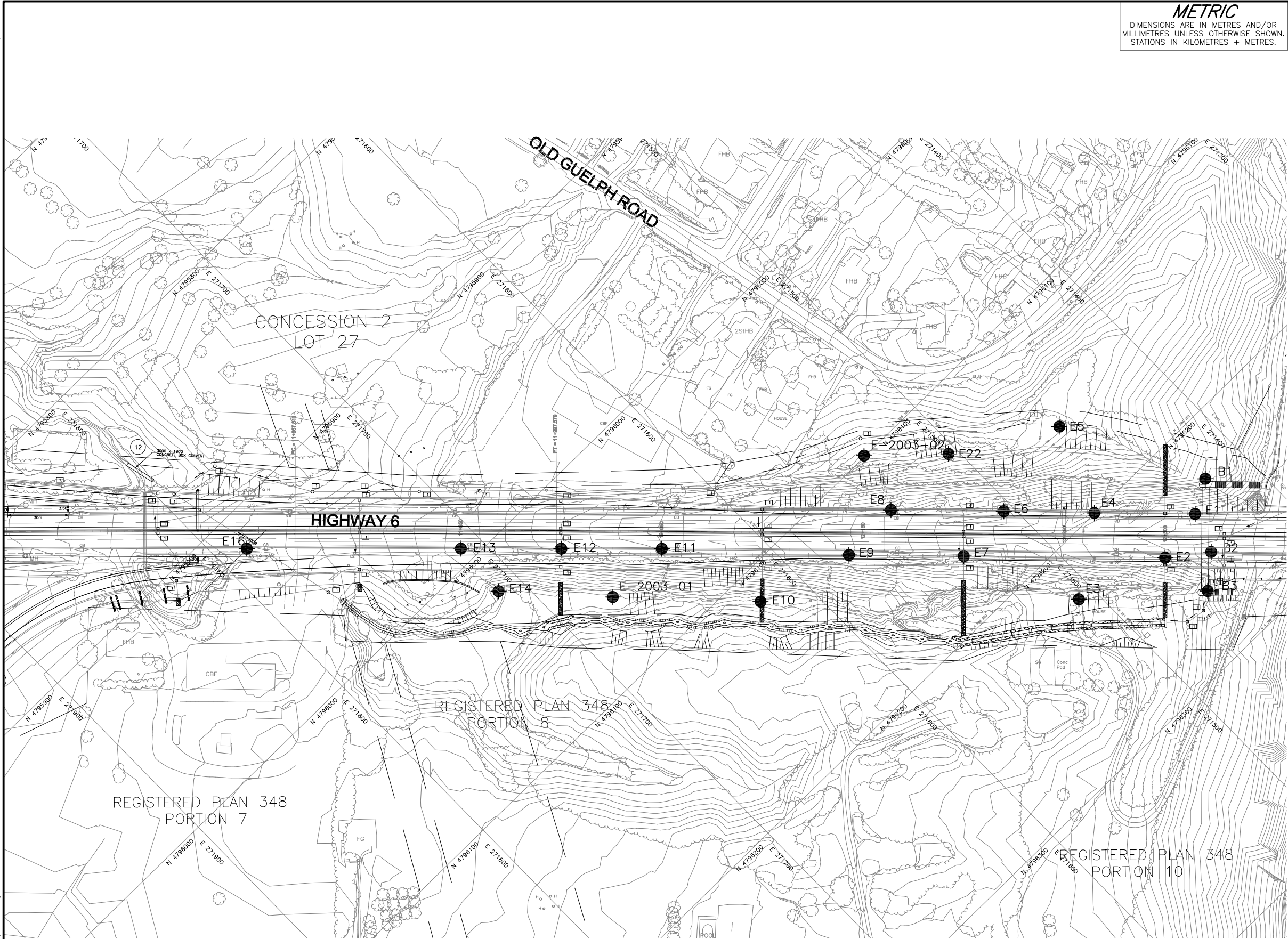
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED								
135.9	GROUND SURFACE															
0.0	Topsoil															
0.2	Clayey Silt, some sand, trace gravel, shale and limestone fragments (TILL) Firm to hard Red-brown Moist		1	SS	9											
			2	SS	36											
			3	SS	37											
			4	SS	40											
			5	SS	46											
			6	SS	31											
			7	SS	52											
130.8	End of Borehole															
5.2	Notes: Open borehole dry upon completion of drilling.															

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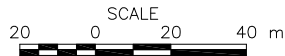
PROJECT <u>001-1141F</u>		RECORD OF BOREHOLE No BH Z10		1 OF 1 METRIC	
W.P. <u>19-95-00</u>		LOCATION <u>N 4795329.7 ; E 272050.9</u>		ORIGINATED BY <u>PKS</u>	
DIST <u>Central</u> HWY <u>6</u>		BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>		COMPILED BY <u>KG</u>	
DATUM <u>Geodetic</u>		DATE <u>November 5, 2004</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	WATER CONTENT (%)					
139.3	GROUND SURFACE													
0.0	Topsoil													
0.2	Clayey Silt, some sand, trace gravel, shale and limestone fragments (TILL) Firm to hard Grey to brown Moist		1	SS	8									
			2	SS	34								42	
			3	SS	37									
			4	SS	43									
			5	SS	41									
			6	SS	51									
			7	SS	43									
134.1	End of Borehole													
5.2	Notes: Open borehole dry upon completion of drilling.													

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PLAN



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

CONT No.
WP No. 19-95-01

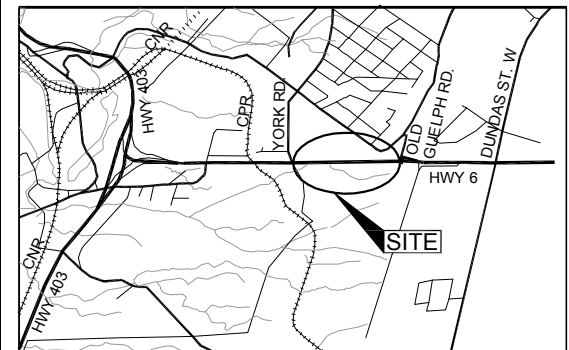
HILL FILL EMBANKMENTS
HIGHWAY 6 WIDENING
BOREHOLE LOCATIONS



SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN



LEGEND

● Borehole - Current Investigation

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
B1	179.8	4796226.2	271421.8
B2	189.4	4796254.2	271445.1
B3	186.1	4796266.8	271459.9
E1	188.9	4796235.1	271437.6
E2	187.5	4796240.2	271463.4
E3	175.6	4796225.0	271508.5
E4	183.5	4796199.8	271473.0
E5	165.7	4796157.0	271455.4
E6	181.5	4796167.7	271504.6
E7	178.5	4796169.7	271534.3
E8	177.5	4796128.2	271544.2
E9	176.4	4796129.4	271574.7
E10	161.3	4796115.3	271622.2
E11	170.4	4796059.4	271636.2
E12	167.3	4796027.3	271674.5
E13	163.5	4795889.1	271706.9
E14	155.7	4796020.6	271711.6
E16	156.5	4795918.1	271786.1
E22	163.5	4796128.2	271504.2
E-2003-01	157.4	4796062.3	271673.1
E-2003-02	161.4	4796099.5	271534.8

NOTES

This drawing is for subsurface information only. The proposed 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 GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by URS Canada Inc., drawing received on September 30, 2004.

NO.	DATE	BY	REVISION
Geocres No.			
HWY. HWY 6	PROJECT NO. 001-1141F		DIST.
SUBM'D. PKS	CHKD. LCC	DATE: DEC., 2005	SITE:
DRAWN: JFC	CHKD. PKS	APPD. LCC	DWG. 1

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

CONT No.
WP No. 19-95-01

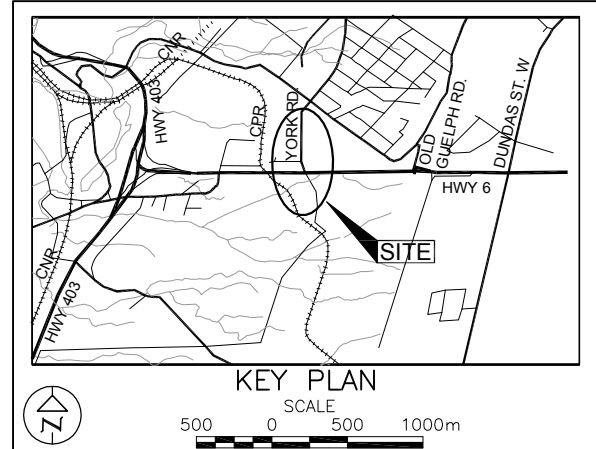
HILL FILL EMBANKMENTS
YORK ROAD AND PLAINS ROAD
BOREHOLE LOCATIONS



SHEET



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MISSISSAUGA, ONTARIO, CANADA



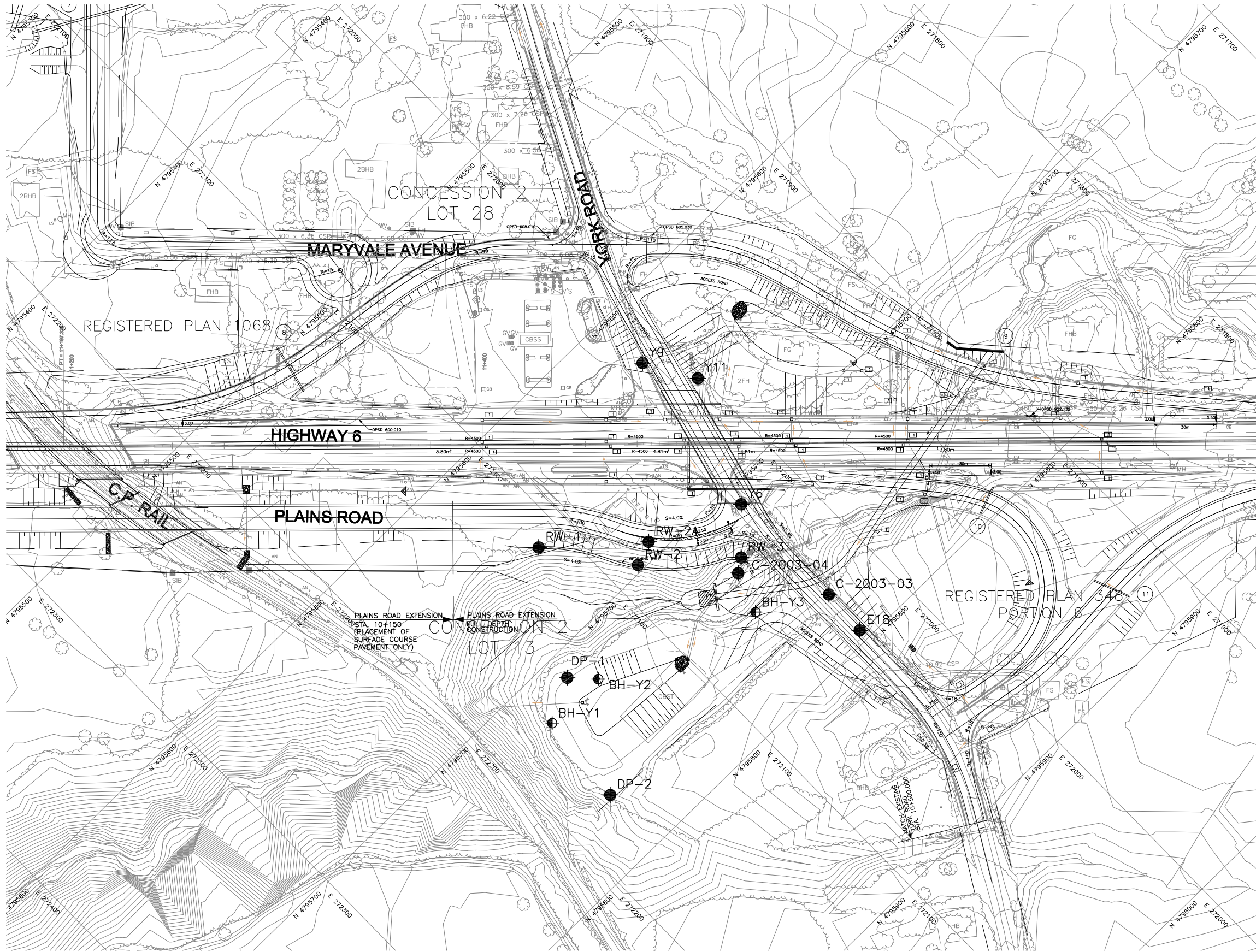
LEGEND			
	Borehole - Current Investigation		
	Borehole - Previous Investigation		
No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
DP-1	140.2	4795711.9	272148.2
DP-2	142.0	4795767.0	272173.0
C-2003-03	145.8	4795771.7	272029.4
C-2003-04	137.8	4795733.6	272053.6
E18	146.7	4795794.6	272030.9
RW-1	145.7	4795657.1	272113.9
RW-2A	147.1	4795692.4	272073.9
RW-3	140.3	4795728.7	272047.3
Y6	145.5	4795710.8	272029.2
Y9	147.8	4795628.5	272015.5
Y11	148.1	4795652.5	272001.5
BH-Y1	-	4795722.5	272168.8
BH-Y2	-	4795722.9	272137.9
BH-Y3	-	4795752.9	272060.7

NOTES

This drawing is for subsurface information only. The proposed 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 GC 2.01 of OPS General Conditions.

REFERENCE			
Base plans provided in digital format by URS Canada Inc., drawing received on September 30, 2004.			
NO.	DATE	BY	REVISION
Geocres No.			
HWY. HWY 6	PROJECT NO. 001-1141F		DIST.
SUBM'D. PKS	CHKD. LCC	DATE: DEC., 2005	SITE:
DRAWN: JFC	CHKD. PKS	APPD. LCC	DWG. 2



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. 19-95-01



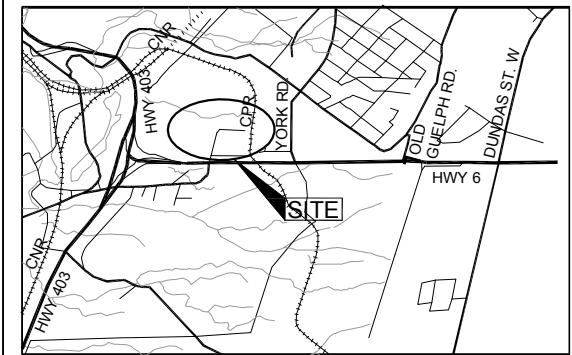
HIGH FILL EMBANKMENTS
ZELLENS ROAD

BOREHOLE LOCATIONS

SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN

SCALE

500 0 500 1000m



LEGEND

Borehole - Current Investigation

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
Z-1	131.8	4795144.1	272240.1
Z-1A	132.5	4795152.3	272222.5
Z-2	132.1	4795179.1	272204.4
Z-3	133.2	4795210.7	272172.3
Z-8	134.3	4795252.7	272129.4
Z-9	135.9	4795294.6	272086.7
Z-10	139.3	4795329.7	272050.9

NOTES

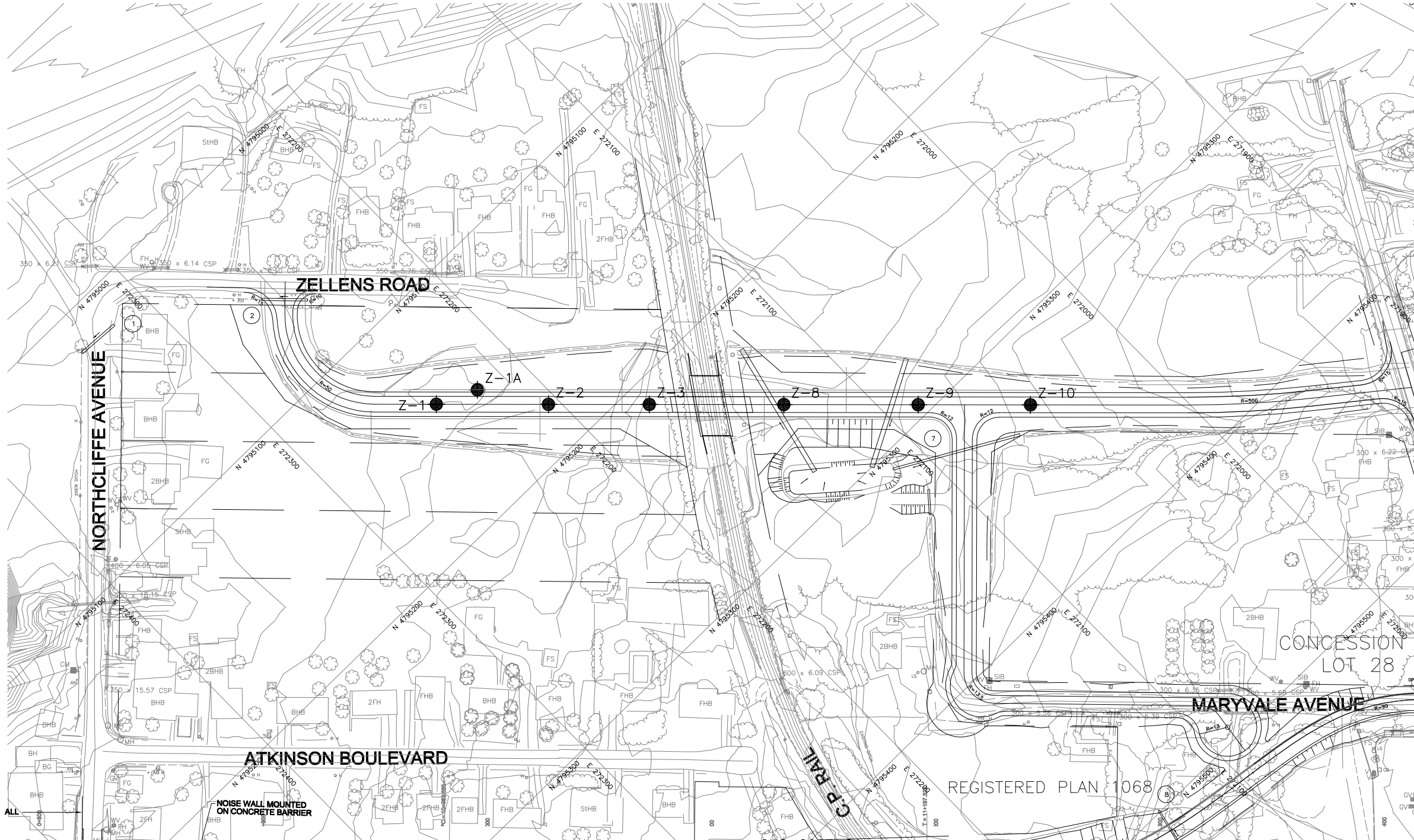
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NO.	DATE	BY	REVISION
Geocres No.			
HWY. HWY 6	PROJECT NO. 001-1141F		DIST.
SUBM'D. PKS	CHKD. LCC	DATE: DEC., 2005	SITE:
DRAWN: JFC	CHKD. PKS	APPD. LCC	DWG. 3



PLAN

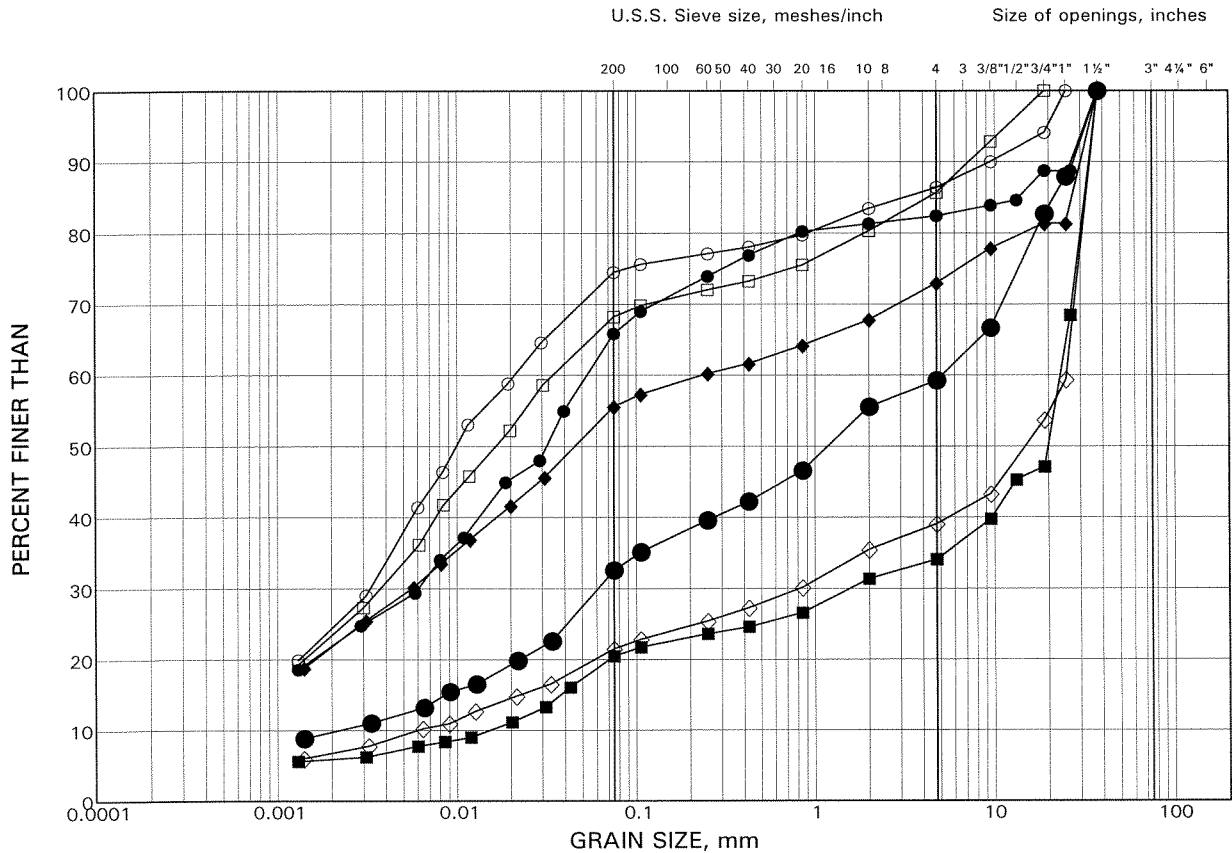
SCALE

20 0 20 40 m

GRAIN SIZE DISTRIBUTION TEST RESULTS

Embankment Fill

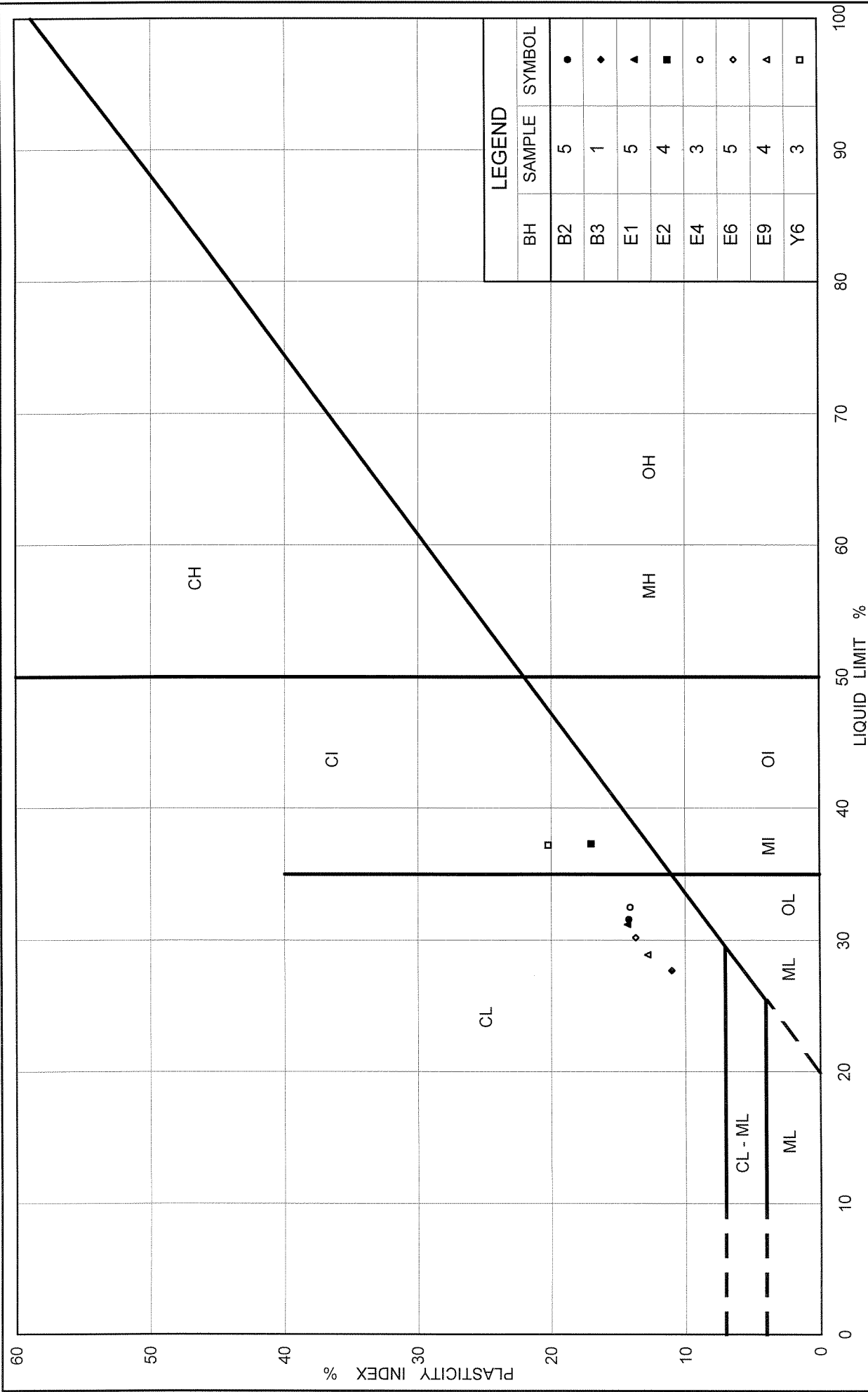
FIGURE 1



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

LEGEND

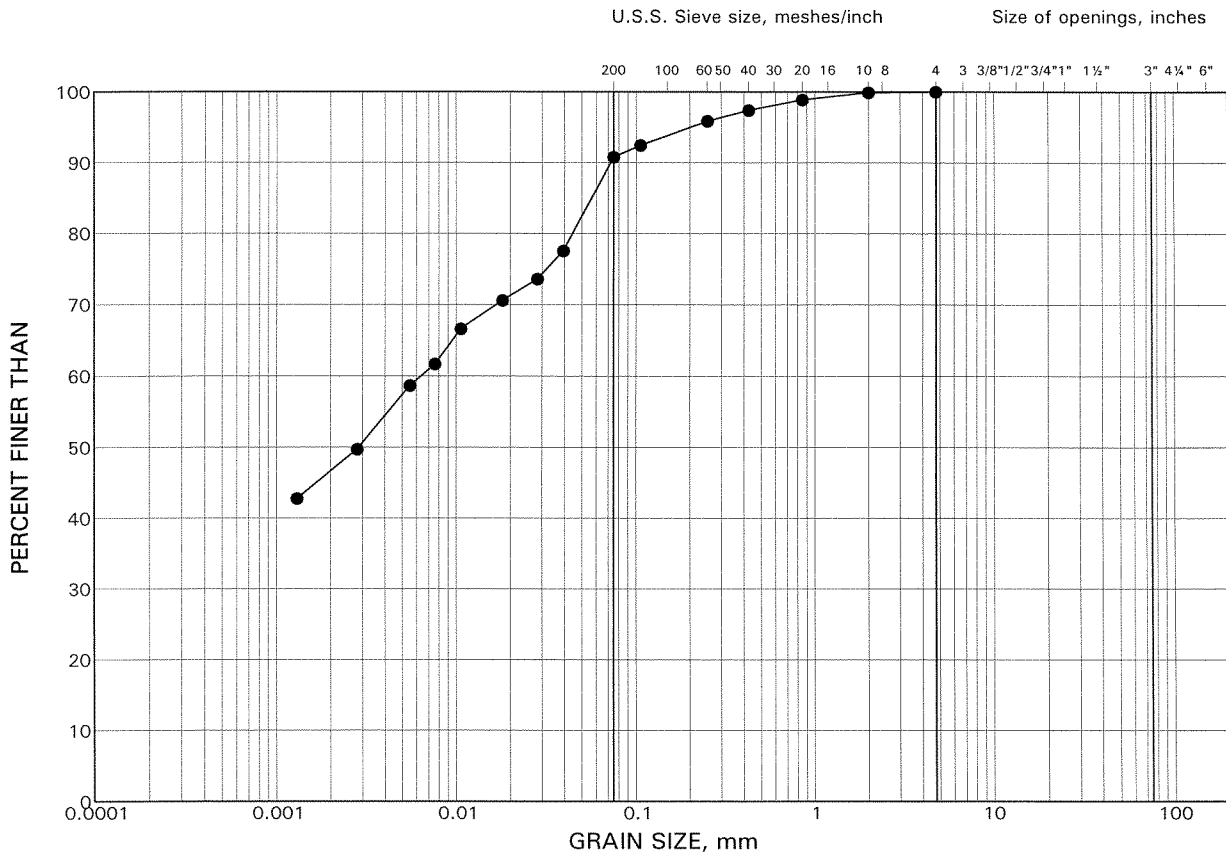
SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	B2	5	185.4
■	B2	7	183.1
◆	E1	5	181.0
○	E2	4	181.1
□	E4	3	178.6
◇	E6	4	175.2
●	E7	5	170.6



GRAIN SIZE DISTRIBUTION TEST RESULT

Surficial Clayey Silt to Silty Clay

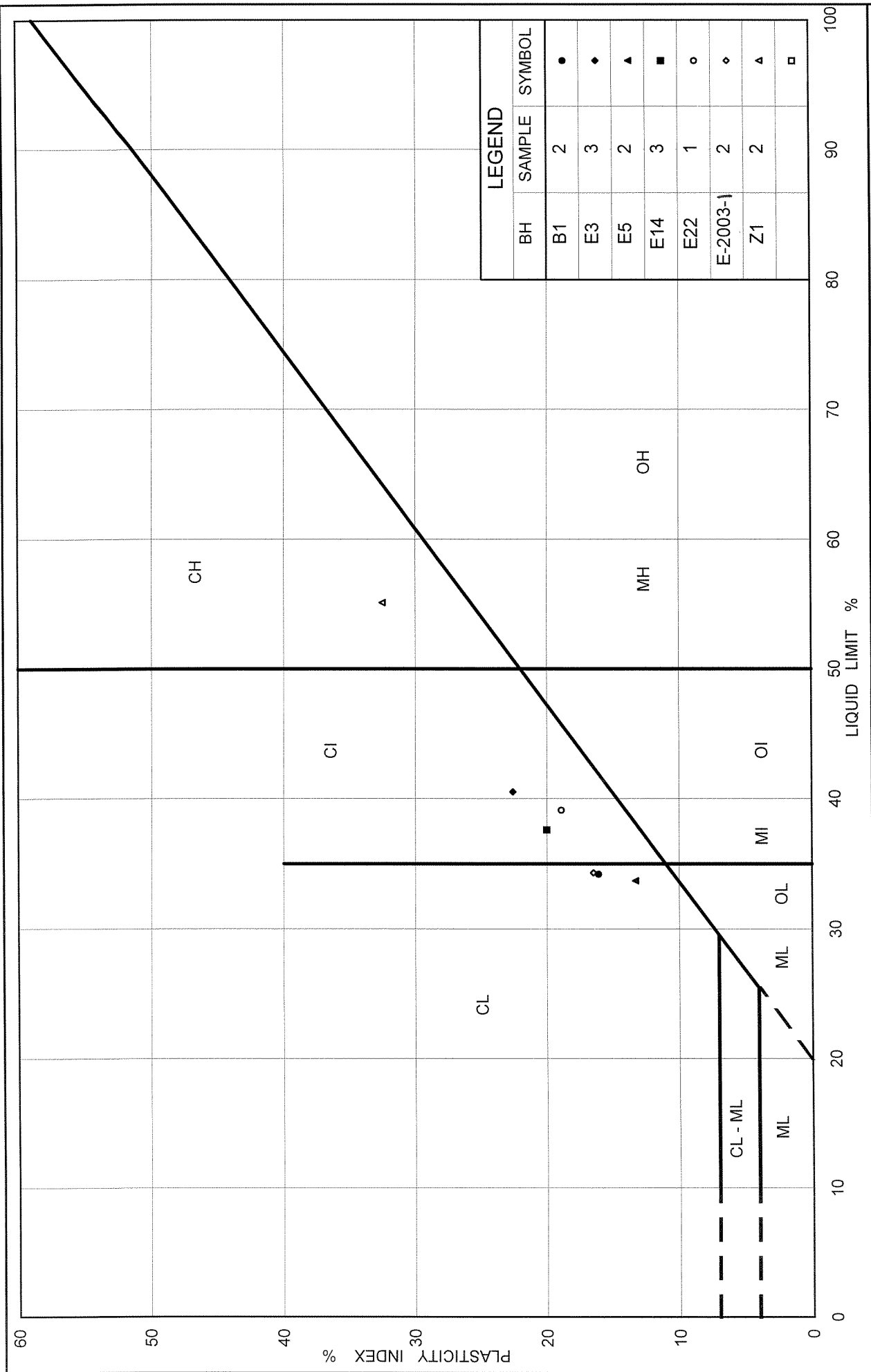
FIGURE 3



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

LEGEND

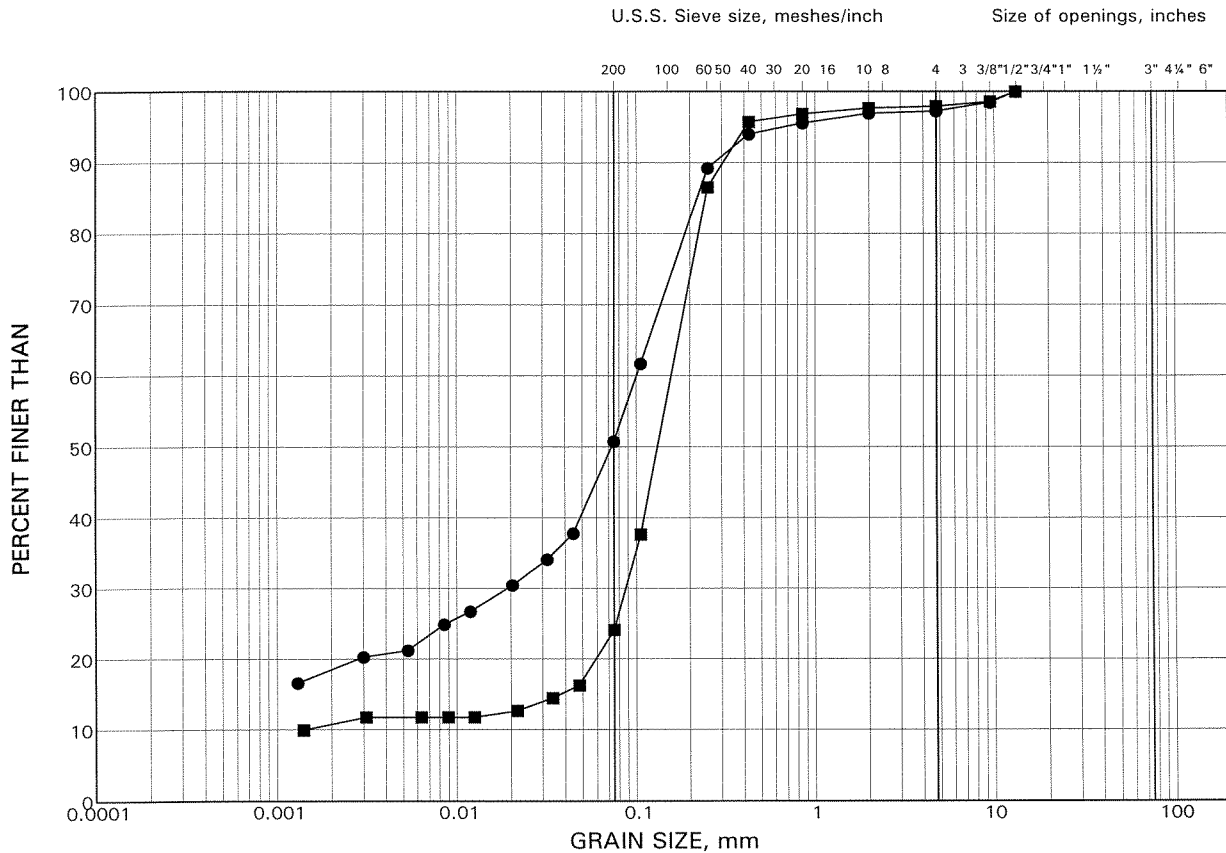
SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
•	Z1	2	130.7



GRAIN SIZE DISTRIBUTION TEST RESULTS

Surficial Sand and Silt to Silty Sand

FIGURE 5



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

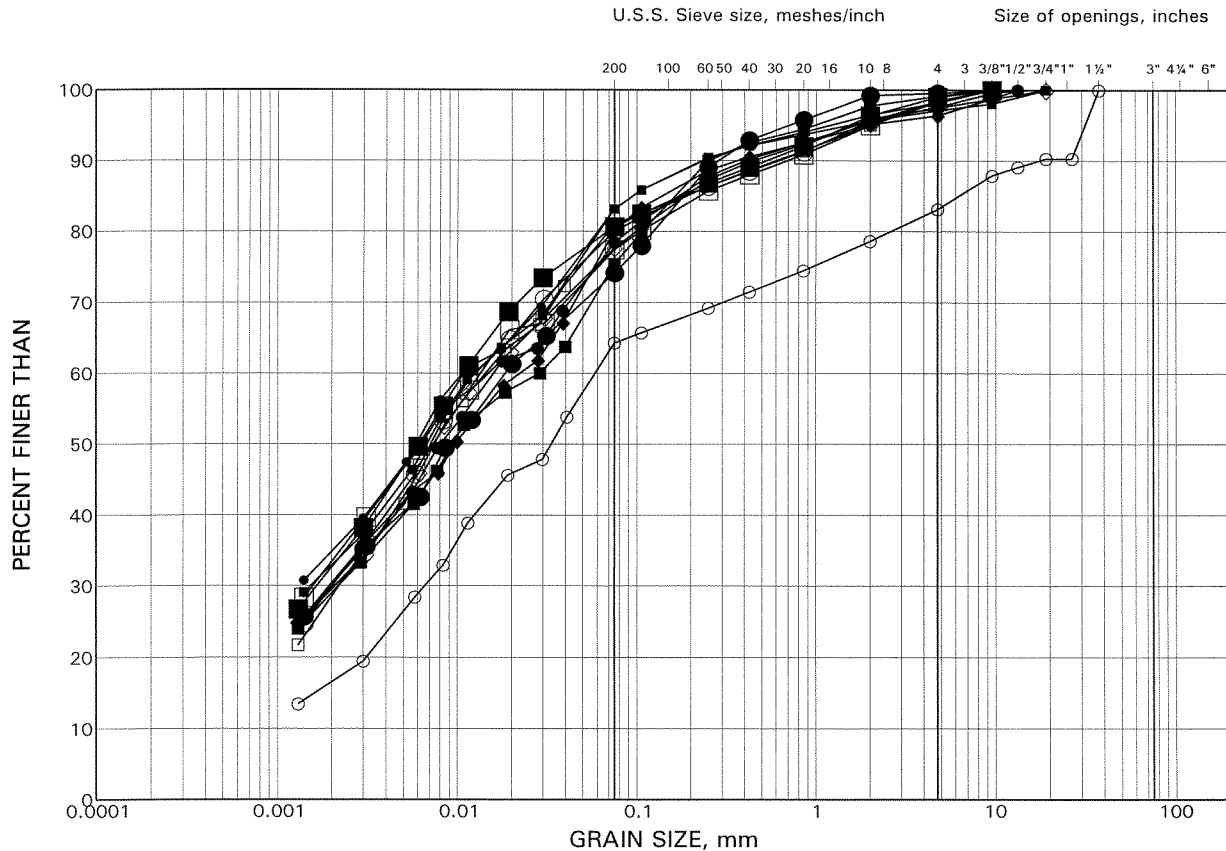
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	B1	3A	178.2
■	B3	3	184.2

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt

FIGURE 6A



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

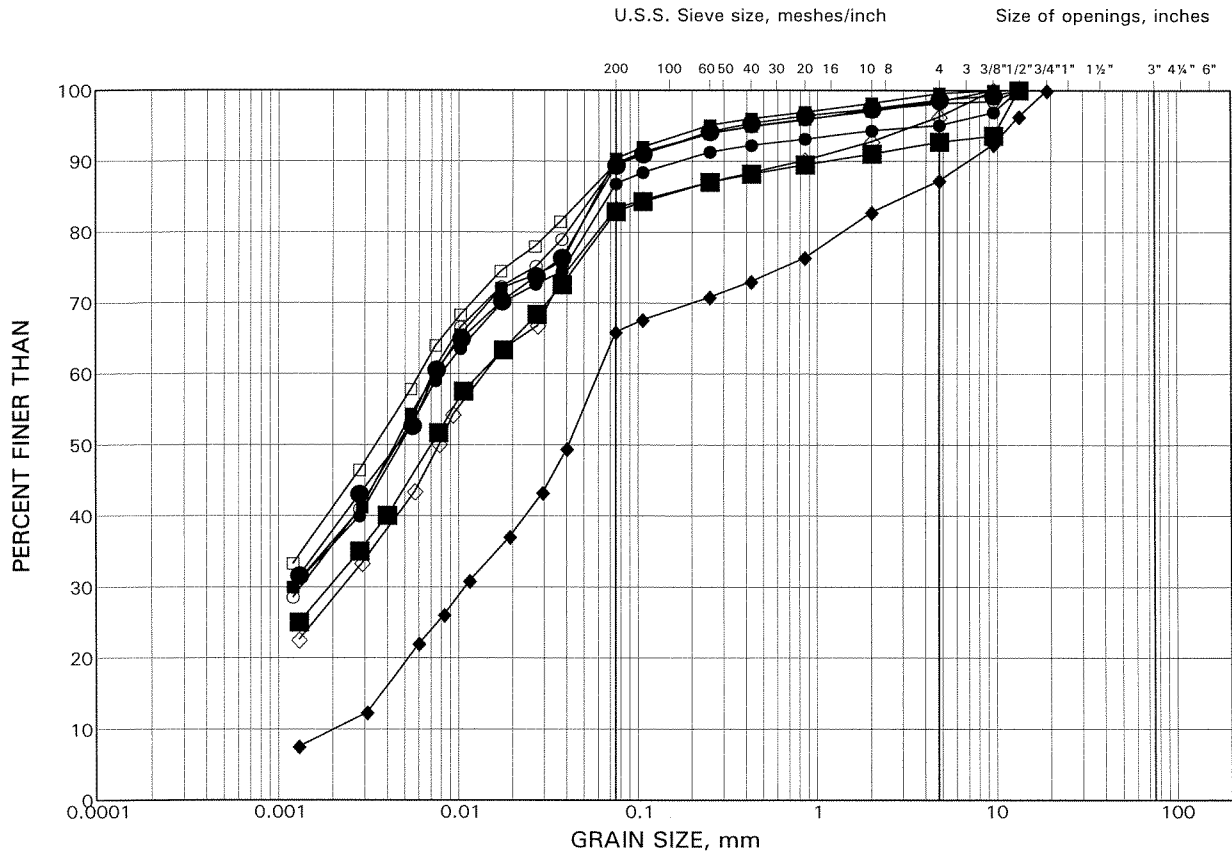
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	B1	3C	177.5
■	B2	9	179.8
◆	B3	6	182.0
○	DP-01	6	136.1
□	DP-O2	5	138.7
◇	E1	7B	177.8
●	E2	7	176.5
■	E4	9	169.6
○	E6	11	164.5
□	E7	7	167.6
•	E13	7	158.7
▪	E13	9	155.7

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt

FIGURE 6B



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	RW-1	5	142.4
■	RW-1	7	140.8
◆	RW-1	13	131.7
○	RW-2A	4	144.5
□	Y11	4	145.5
◇	Z2	4	129.5
●	Z3	3	131.3
■	Z9	3	134.1

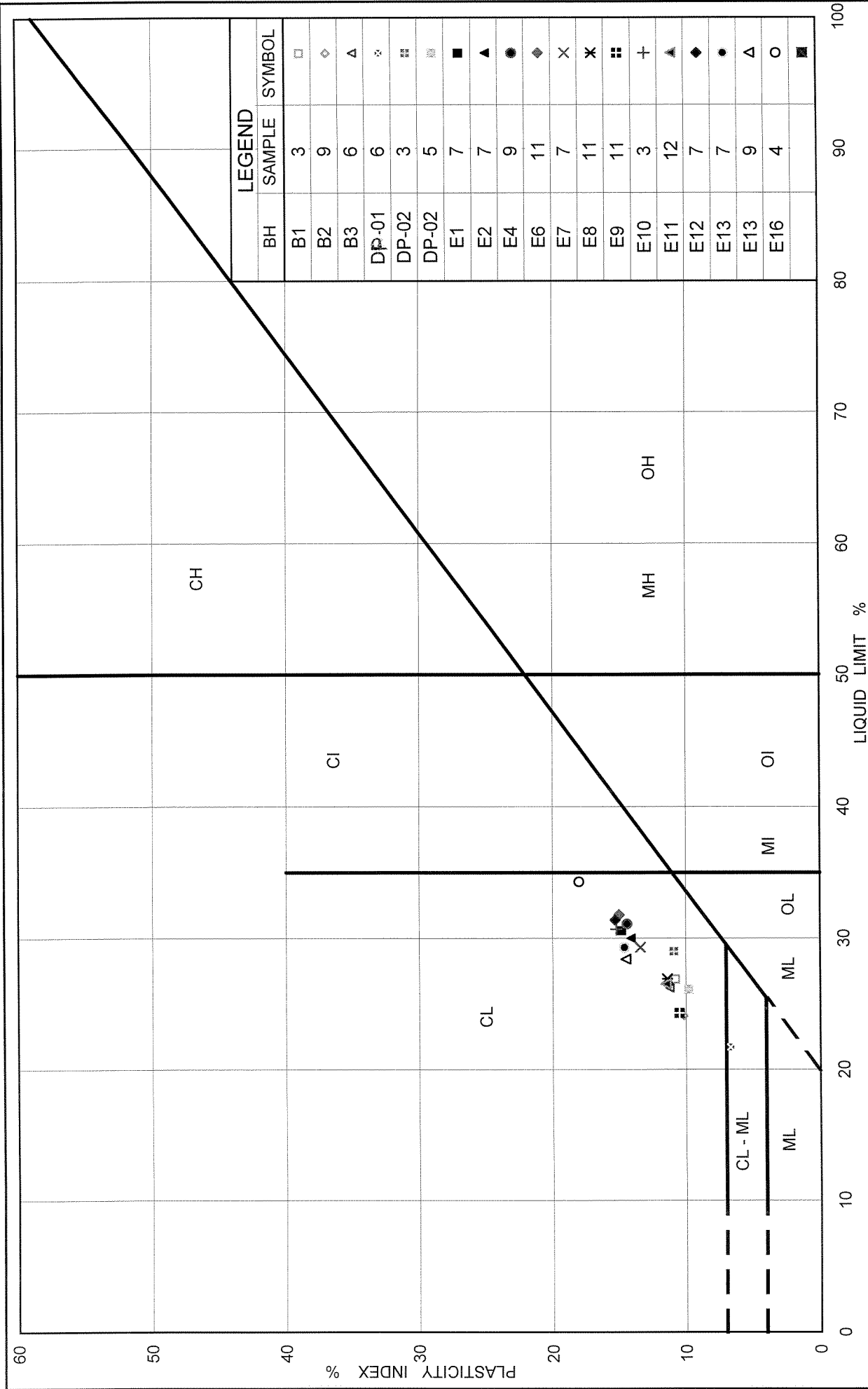


FIG No. 7A

Project No. 001-1141F

PLASTICITY CHART
Clayey Silt Till

Ministry of Transportation



Ontario

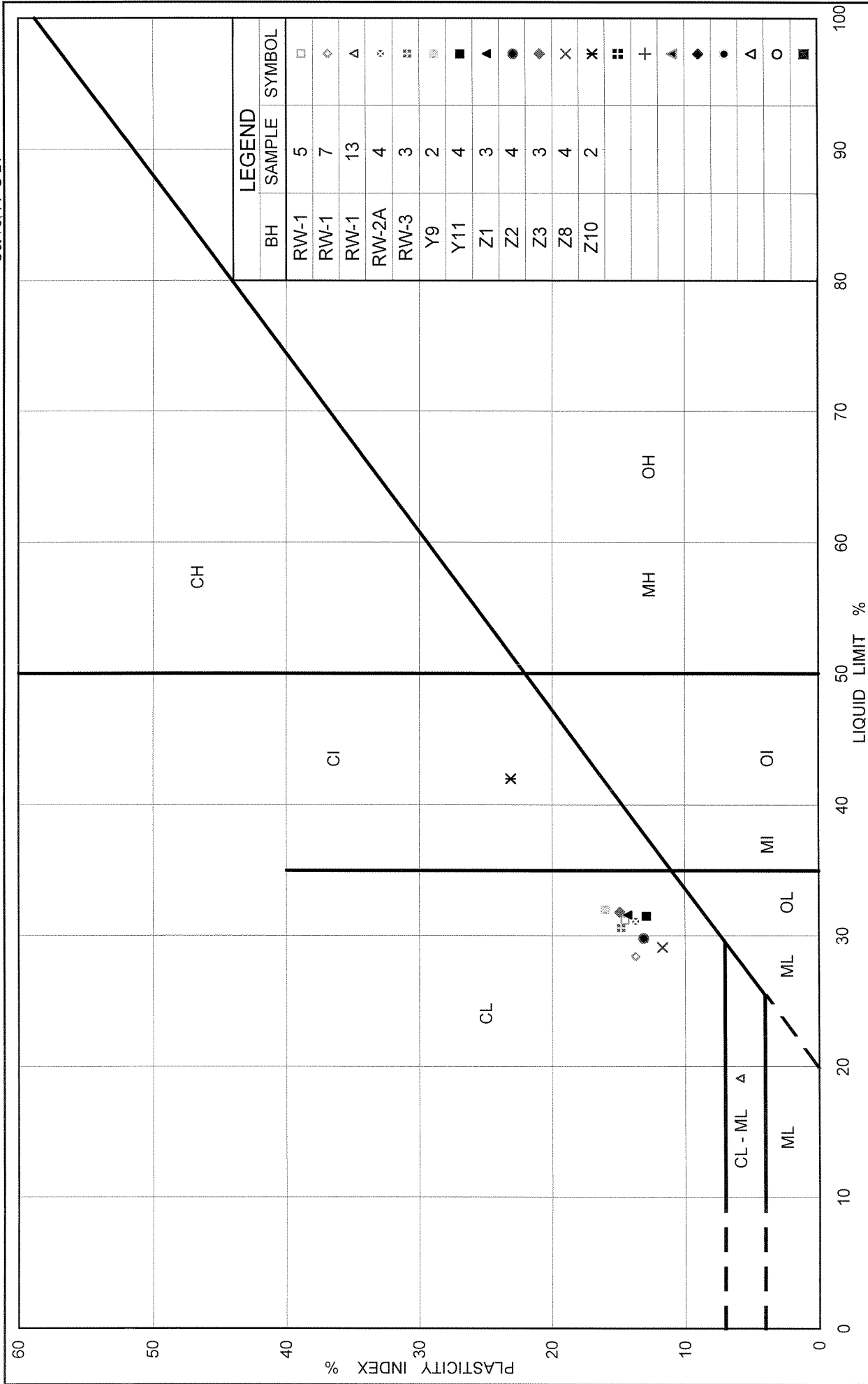


FIG No. 7B

PLASTICITY CHART Clayey Silt Till

Ministry of Transportation



Ontario

Project No. 001-1141F

APPENDIX A

RECORDS OF BOREHOLES BH-Y1, BH-Y2 AND BH-Y3

**NOTE: GROUND SURFACE ELEVATIONS
REFERENCED TO LOCAL DATUM**

PROJECT: 011-8229 Y

RECORD OF BOREHOLE BH-Y1

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: October 15, 2002

DATUM: LOCAL

SAMPLER HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			ELEVATION	Gas Concentration (ppm)				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		100	200	300	400	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³		
0	TRUCK MOUNTED CME-75 POWER AUGER 108 mm I.D. Hollow Stem Augers	GROUND SURFACE		96.45													
		Compact to loose, brown to reddish-brown sand, trace to some silt, trace gravel, occasional clayey silt layers, occasional dark grey to black cinders (FILL)		0.00	1	50 DO	15										Backfill
1					2	50 DO	25										Bentonite Seal
					3	50 DO	8										Metals
2					4	50 DO	18										Backfill
					5A	50 DO	11										Bentonite Seal
3		Compact, reddish-brown, moist to wet silty sand (FILL)		93.71	5B	50 DO	11										
		Stiff to firm, reddish-brown, moist, clayey silt, some sand, occasional gravel, occasional rootlets, occasional grey black wet gravel (FILL)		2.74	6	50 DO	9										
4				93.40	7	50 DO	6										
				3.05	8	50 DO	50										Silica Sand
5		Hard, brown to grey, moist CLAYEY SILT, trace to some sand, trace gravel, occasional oxidation (TILL)		91.65	9	50 DO	30										
				4.80	10	50 DO	42										Cave
6																	
7		END OF BOREHOLE		89.74													Groundwater level in monitoring well at El. 91.58 m (4.87 m bgs) on October 30, 2002
				6.71													
8																	
9																	
10																	

DEPTH SCALE

1 : 50



LOGGED: TDM

CHECKED: *[Signature]*

PROJECT: 011-8229 Y

RECORD OF BOREHOLE BH-Y2

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: October 15, 2002

DATUM: LOCAL

SAMPLER HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			ELEVATION	Gas Concentration (ppm)				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	100	200	300	400	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³		
0	TRUCK MOUNTED CME-75 POWER AUGER 108 mm I.D. Hollow Stem Augers	GROUND SURFACE		96.87													
		Firm, reddish-brown, moist clayey silt, trace gravel, trace sand, gravel lense at 0.28 m (FILL)		0.00													
		Stiff to very stiff, reddish-brown, moist, CLAYEY SILT, trace gravel, trace sand, occasional reddish-brown shale (TILL)		96.57	1	50 DO	8										Cuttings
				0.30													Bentonite Seal
1					2	50 DO	10										Cuttings
2					3	50 DO	20										Bentonite Seal
3		Hard reddish-grey, moist CLAYEY SILT, trace gravel, trace sand, occasional reddish-grey shale (TILL)		93.90	4	50 DO	12										
				2.97	5	50 DO	59										
4					6	50 DO	25										Silica Sand Pack
5					7	50 DO	48										
		Hard, grey, moist CLAYEY SILT, some fine sand, occasional reddish-grey clayey silt layers (TILL)		91.61	8	50 DO	35										
				5.26													
6		END OF BOREHOLE		90.93													Monitoring well dry on Oct.30, 2002
				5.94													
7																	
8																	
9																	
10																	

DEPTH SCALE

1 : 50



LOGGED: TDM

CHECKED: *W*

LDN_BHS 011-8229Y.GPJ GLDR_LDN.GDT 30/12/02 DATA INPUT: ph 11/2002

PROJECT: 011-8229 Y

RECORD OF BOREHOLE BH-Y3

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: October 15, 2002

DATUM: LOCAL

SAMPLER HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			ELEVATION	Gas Concentration (ppm)				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m		100	200	300	400	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³		
0	TRUCK MOUNTED CME-76 POWER AUGER 108 mm I.D. Hollow Stem Augers	GROUND SURFACE	100.00				100										
		Compact, brown, moist sand, some gravel (FILL)	0.00														
		Very stiff to firm, brown clayey silt, trace sand, trace gravel, occasional sand seams, occasional sand and gravel seams (FILL)	0.20	1	50 DO	28											Bentonite Seal
1			98.93	2	50 DO	6	99										Backfill
		Firm to soft, brown, moist clayey silt, trace to some sand, trace gravel (FILL)	1.07														Metals
2				3	50 DO	6	98										Bentonite Seal
3				4	50 DO	7											
4				5	50 DO	6	97										
		Soft, grey, moist to wet CLAYEY SILT, trace sand, occasional gravel	96.39														
5			95.50	6	50 DO	4	96										Silica Sand
		Very stiff, brown, moist CLAYEY SILT, trace gravel, trace sand, grey fissures 4.88 m - 5.18 m (TILL)	4.50														
6			94.74	7	50 DO	22	95										
		Hard, reddish-brown, moist, CLAYEY SILT, trace gravel, trace sand (TILL)	5.26														
		END OF BOREHOLE	94.21	8	50 DO	70											
			5.79														

Groundwater level in monitoring well at El. 95.29 m (4.71 m bgs) on October 30, 2002

DEPTH SCALE

1 : 50



LOGGED: TDM

CHECKED: *W*