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**FOUNDATION INVESTIGATION REPORT
HIGH MAST LIGHTS
HIGHWAY 410
FROM 800 M SOUTH OF COUNTRYSIDE DRIVE
TO 400 M NORTH OF MAYFIELD ROAD
W.P. 101-00-00**

Submitted to:

URS Canada Inc.
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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 the following components associated with the Phase 2 extension of Highway 410 from Sandalwood Parkway to Mayfield Road, in Brampton, Ontario:

- Underpass structures at Countryside Drive and Mayfield Road;
- New structural culverts;
- High fill embankments along Highway 410, on Mayfield Road and Countryside Drive, and on the Mayfield Road interchange ramps;
- High mast light poles; and
- Overhead signs.

This report addresses the foundations for twenty-two high mast light poles that are to be constructed along Highway 410, between approximately 800 m south of Countryside Drive and 400 m north of Mayfield Road (the “Phase 2” extension). Foundation investigations have been carried out by Golder between 2001 and 2004 as part of the assignment to determine the subsurface conditions within the limits of the Phase 2 extension. Use has also been made of two boreholes (Boreholes 129 and 34) that were advanced as part of the Highway 410 feasibility study and the Phase 1 design work, respectively; the records of these boreholes were obtained from the following reports:

- Borehole 129: *Supplementary Foundation Feasibility Investigation, Proposed Highway 410 Extension, Bovaird Drive to Highway 10, W.P. 22-79-00*, prepared by Golder Associates Ltd., dated April 1999.
- Borehole 34: *Foundation Investigation Report, Proposed High Mast Lighting, Proposed Highway 410 Extension from Bovaird Drive to Sandalwood Parkway, Brampton, Ontario, W.P. 130-99-00*, prepared by Shaheen & Peaker Ltd., dated February 2000 (GEOCREs No. 30M12-244).

The terms of reference for the scope of work are outlined in Golder’s Proposal No. P01-1228, dated August, 2000. Changes to the scope of work for the foundation engineering component are outlined in Golder’s letter dated November 13, 2003, February 12, 2004, and June 14, 2004.

2.0 SITE DESCRIPTION

The Highway 410 extension is located about 400 m to 500 m east of the existing Heart Lake Road. The Phase 2 portion of the Highway 410 alignment extends from about 800 m south of Countryside Drive to about 400 m north of Mayfield Road, predominantly through farmland. The surface topography in the area is relatively flat to slightly undulating, and in general slopes gradually and fairly uniformly to the south, toward Lake Ontario.

From south of Countryside Drive to Mayfield Road, the ground surface generally rises from about Elevation 247 m to 254 m. A relatively deep swamp is located in the low-lying area (ground surface between about Elevations 248 m and 250 m) immediately south of Mayfield Road; this swamp extends toward the north/northeast, passing under the existing Mayfield Road embankment. Another small swamp is present about 200 m to 300 m south of Mayfield Road; in this area, the general ground surface is at about Elevation 254 m, and the ground surface within the swamp is at about Elevation 251 m to 252 m.

A localized topographic high, associated with an esker ridge, is present to the northwest of Mayfield Road. The ground surface rises from approximately Elevation 251 m to 254 m immediately north of Mayfield Road, to about Elevation 266 m at the highest point along the proposed Highway 410 alignment.

3.0 INVESTIGATION PROCEDURES

Borehole investigations have been carried out by Golder between 2001 and 2004 for the extension of Highway 410 between approximately Stations 19+550 (about 800 m south of Countryside Drive) and 21+100 (about 400 m north of Mayfield Road). The following boreholes have been used in the preparation of this report:

- Boreholes C-3 and C-04-2, which were advanced for the proposed Countryside Drive underpass structure;
- Boreholes C1-1, C1-2, E-6, and SWM-1, which were advanced for a proposed structural culvert, high fill embankment and stormwater management pond, all located between Countryside Drive and Mayfield Road;
- Boreholes 03-05, 03-06, 03-10 and WS-5, which were advanced for proposed structural culverts and/or high fill embankments at the Mayfield Road interchange;
- Boreholes HML-1 to HML-4, which were located to provide additional coverage beyond that obtained from boreholes that were advanced for specific structures or high fill embankments (as noted above).

In addition, use has been made of the following two boreholes from previous investigations related to the Highway 410 extension project:

- Borehole 129, which was advanced for an alternative alignment of Mayfield Road as part of a feasibility study in 1999 (*Supplementary Foundation Feasibility Investigation, Proposed Highway 410 Extension, Bovaird Drive to Highway 10, W.P. 22-79-00*, prepared by Golder Associates Ltd., dated April 1999).
- Borehole 34, which was drilled in 1999 as part of the Phase 1 work on the Highway 410 extension project (*Foundation Investigation Report, Proposed High Mast Lighting, Proposed Highway 410 Extension from Bovaird Drive to Sandalwood Parkway, Brampton, Ontario, W.P. 130-99-00*, prepared by Shaheen & Peaker Ltd., dated February 2000, GEOCREs No. 30M12-244).

The 2001 to 2004 boreholes were drilled using bombardier-mounted drill rigs supplied and operated by Geo-Environmental Drilling Inc. of Milton, Ontario, Walker Drilling of Utopia, Ontario and Groundworks Drilling Inc. of Etobicoke, Ontario. The boreholes were advanced using either hollow stem or solid stem augers, as indicated on the individual borehole records. Samples of the overburden were obtained at 0.75 m and 1.50 m intervals of depth using 50 mm outside diameter split-spoon samplers driven with an automatic hammer, in accordance with the Standard Penetration Test (SPT) procedure. The water level in the open boreholes was observed throughout the drilling operations, and a total of three piezometers were installed in the boreholes that are included in this report.

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 testing. Index and classification tests (water content determinations, Atterberg limit tests, and grain size distribution analyses) were carried out on selected soil samples.

The borehole locations and ground surface elevations were established by Golder relative to points staked along the alignment and at proposed structure locations by Callon Dietz, Ontario Land Surveyors, of London, Ontario. It should be noted that the locations of some of the boreholes completed in 2001 were not accurately surveyed due to the work stoppage in July 2001; the location coordinates of the boreholes completed as part of the 2001 investigations are, therefore, considered accurate to within approximately 5 m. The borehole locations (MTM NAD83 northing and easting coordinates) and the ground surface elevations referenced to geodetic datum are shown on Drawings 1 to 3 and are summarized in the following table:

| <i>Borehole Number</i> | <i>MTM NAD83 Northing (m)</i> | <i>MTM NAD83 Easting (m)</i> | <i>Ground Surface Elevation (m)</i> |
|------------------------|-------------------------------|------------------------------|-------------------------------------|
| 03-05 | 4846299.8 | 280567.1 | 261.8 |
| 03-06 | 4846339.2 | 280524.1 | 263.9 |
| 03-10 | 4846410.5 | 280841.9 | 248.9 |
| C1-1 (2001) | 4845701.9 | 281416.7 | 247.3 |
| C1-2 (2001) | 4845766.4 | 281339.0 | 249.7 |
| C-3 | 4845373.6 | 281574.2 | 249.7 |
| C-04-2 | 4845411.2 | 281553.5 | 250.8 |
| E-6 (2001) | 4845906.1 | 281281.7 | 250.4 |
| HML-1 (2001) | 4845015.7 | 281788.6 | 248.3 |
| HML-2 (2001) | 4845992.8 | 281231.8 | 249.5 |
| HML-3 (2001) | 4846211.6 | 281029.2 | 250.3 |
| HML-4 (2001) | 4846329.1 | 280306.9 | 266.3 |
| SWM-1 | 4846299.3 | 280946.6 | 251.5 |
| WS-5 | 4846255.2 | 280811.7 | 254.2 |
| 34 (1999) | 4844632 | 282082 | 246.6 |
| 129 (1999) | 4846359.7 | 280669.1 | 259.0 |

It is noted that Borehole 129, which was completed as part of the 1999 feasibility study in the Mayfield Road area, was surveyed using the NAD83 UTM datum (as shown on the borehole record contained in Appendix A). These coordinates have been converted to the NAD83 MTM system for presentation in this report.

4.0 SITE GEOLOGY AND STRATIGRAPHY

4.1 Regional Geological Conditions

This portion of the Highway 410 extension is located in the physiographic region known as the Peel Plain, which covers the central portions of York, Peel and Halton Regions, as delineated in *The Physiography of Southern Ontario*¹. The surface topography of the Peel Plain is relatively flat, and slopes gradually and fairly uniformly towards Lake Ontario.

The soils within the Peel Plain physiographic region are characterized by relatively thick deposits of clayey silt till to silty clay till, that are overlain by lacustrine deposits (the “Peel ponds” deposits) consisting of relatively thin, localized accumulations of sand, silt and clay; organic deposits may also be present in low-lying areas. The glacial till deposits are underlain by shale bedrock of the Georgian Bay Formation; in this formation, the shale is interbedded with limestone, siltstone, sandstone and dolostone layers.

4.2 Site Stratigraphy

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, on Figures 1 to 6, and in Appendices A and B. 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. Subsoil conditions will vary between and beyond the borehole locations.

The predominant soil deposit encountered along this portion of the Highway 410 extension is a clayey silt till. Localized variations occur along the alignment, as follows:

- From Countryside Drive to Mayfield Road (excluding the swamp areas), the glacial till deposit is overlain by a shallow surficial deposit of generally firm to stiff clayey silt to silty clay. At some locations within this area, cohesionless surficial soils (silty sand to sandy silt) are also present.
- In the two swampy areas south of Mayfield Road, the glacial till is overlain by organic deposits. In the smaller swamp, about 0.8 m of organic soil has been encountered in the two boreholes included in this report. In the larger swamp, up to several metres of peat and organic soils are present, underlain by silty clay and silty sand to sandy silt deposits, in turn overlying the glacial till deposit.

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

- To the north of Mayfield Road, the glacial till is underlain by a deposit of generally very dense silty sand to sandy silt, associated with the esker ridge in this area.

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

4.2.1 Fill

Between 0.2 m and 3.8 m of fill material was encountered in the immediate vicinity of the existing Countryside Drive and Mayfield Road embankments, as well as to the north of Mayfield Road where some reworking of the native soils was observed (as in Boreholes 03-05 and 03-06). The fill materials generally consist of clayey silt containing trace to some sand, trace gravel, and trace organic matter. The measured Standard Penetration Test (SPT) “N” values range from 4 to 20 blows per 0.3 m of penetration, indicating that the fill has a variable, firm to very stiff consistency.

4.2.2 Peat / Organic Soils

Peat and organic soils are present within the two swamp areas that are located south of Mayfield Road, as follows:

- A 4.6 m thickness of peat and organic silt was encountered in Borehole 03-10, located within the larger swamp immediately south of Mayfield Road; the thickness of the peat and organics varies throughout this swamp. The measured SPT “N” values within the peat and organic silt in this borehole vary from 0 (weight of hammer) to 2 blows per 0.3 m of penetration. One in situ vane test measured an undrained shear strength in excess of 100 kPa within the organic silt. The result of one Atterberg limit test conducted on a sample of the organic silt is shown on Figure 2.
- About 0.8 m of organic clayey silt to silty clay was encountered in Boreholes HML-3 and SWM-1, located in the smaller swamp between 200 m and 300 m south of Mayfield Road. Measured SPT “N” values within this layer of 2 and 3 blows per 0.3 m of penetration indicate a soft consistency.

4.2.3 Surficial Soils (Clayey Silt to Silty Clay, and Silty Sand to Sandy Silt)

In the majority of the boreholes located south of Mayfield Road and the Mayfield Road area swamps, a 0.6 m to 3.0 m thick layer of surficial soil was encountered atop the glacial till deposit. The surficial soils are typically comprised of clayey silt to silty clay containing trace to some sand and trace gravel, although surficial silty sand to sandy silt was also encountered in three of the boreholes. A grain size distribution test result for one selected sample of the clayey silt to silty clay material is shown on Figure 1.

Atterberg limit testing was conducted on one selected sample of the surficial soil. The result, presented on Figure 2, shows that this material is a clayey silt of low plasticity, based on a plastic limit of 15 per cent, a liquid limit of 24 per cent, and a plasticity index of about 9 per cent. These results are consistent with (but at the low end of the range of) other plasticity testing carried out on samples of the surficial clayey silt to silty clay from this area.

The measured SPT “N” values in the surficial clayey silt to silty clay range from 4 to 25 blows per 0.3 m of penetration, with an average of 13 blows per 0.3 m of penetration; these results indicate that the clayey silt to silty clay varies from firm to very stiff in consistency, but is typically stiff to very stiff. In the silty sand to sandy silt layers, SPT “N” values of 14 and 16 blows per 0.3 m of penetration were measured; these results indicate that the surficial silty sand to sandy silt has a compact relative density.

4.2.4 Glacial Till

Glacial till was encountered in all of the boreholes advanced during this investigation. South of Mayfield Road, the surface of the glacial till is typically encountered between 0.8 m and 2.4 m depth, where it is overlain by shallow surficial deposits (clayey silt to silty clay, or silty sand to sandy silt); however, within the Mayfield swamp, the till underlies the peat/organic soils at about 4.6 m depth, as encountered in Borehole 03-10 which is included in this report. North of Mayfield Road, the glacial till is present immediately below the topsoil (as in Borehole HML-4) or below about 1.8 m to 3.8 m of existing fill/reworked soil (as in Boreholes 03-05 and 03-06). Where the till was fully penetrated, in the immediate vicinity of Mayfield Road, the deposit varies in thickness from 2.8 m to 6.5 m; however, the till deposit is thicker to the south of Mayfield Road where all of the boreholes were terminated within the till.

The glacial till is typically comprised of clayey silt with some sand and trace to some gravel. However, in some locations the till grades to silty clay containing some sand and trace to some gravel, or sand and silt containing trace to some gravel and trace clay. In addition, interlayers of water-bearing cohesionless soil were observed within the glacial till in some of the boreholes. Figures 3A and 3B present the grain size distribution test results for ten selected samples of the glacial till and two selected samples of cohesionless interlayers within the till.

Atterberg limit testing was conducted on sixteen selected samples of the glacial till. The results, presented on Figures 4A and 4B, indicate that the till is typically a clayey silt of low plasticity, based on plastic limits of 12 to 18 per cent, liquid limits of 17 to 33 per cent, and plasticity indices of 6 to 16 per cent. One of the tested samples is a silty clay of intermediate plasticity (based on a measured plastic limit of 18 per cent, a liquid limit of 37 per cent, and a plasticity index of 19 per cent).

The measured SPT “N” values in the glacial till range from 8 to greater than 100 blows per 0.3 m of penetration, indicating that the till has a variable consistency. South of Mayfield Drive, the measured SPT “N” values typically range from 15 to 60 blows per 0.3 m of penetration, with an average of about 35 blows per 0.3 m of penetration; the glacial till in this area is generally very stiff to hard, although localized, near-surface zones of stiff soil are also present. North of Mayfield Drive, the glacial till is typically hard, based on SPT “N” values that are generally greater than 30 blows per 0.3 m of penetration, with an average of about 70 blows per 0.3 m of penetration.

4.2.5 Lower Sand to Sand and Silt

A deposit of sand to sand and silt was encountered below the glacial till deposit in the boreholes (03-05, 03-06, HML-4 and 129) that were advanced through the “esker ridge” located north of Mayfield Road; in these boreholes, the surface of this deposit was encountered between Elevations 252.8 m and 260.1 m. A sand to sand and silt deposit was also encountered underlying the glacial till in Boreholes 03-10 and WS-5, which are located in the immediate vicinity of the Mayfield swamp; in these boreholes, the surface of the deposit was encountered between Elevation 237.8 m and 247.2 m. The results of four grain size distribution tests conducted on selected samples of these deposits are shown on Figure 5.

In the “esker ridge” area north of Mayfield Road, the measured SPT “N” values within the lower sand to sand and silt deposit range from 39 to greater than 100 blows per 0.3 m of penetration, indicative of a dense to very dense relative density. Where this deposit was encountered in the vicinity of the Mayfield swamp (in Boreholes 03-10 and WS-5), SPT “N” values of 3 to 36 blows per 0.3 m of penetration were measured, indicative of a very loose to compact relative density; it is noted, however, that the lower sand to sand and silt deposit is below the water table in the vicinity of the Mayfield swamp, and the lower measured SPT “N” values in this area could be attributable to some disturbance due to water inflow to the borehole during sampling.

4.3 Groundwater Conditions

The groundwater conditions along this portion of the Highway 410 extension are summarized as follows:

- In the Mayfield swamp, immediately south of Mayfield Road, the groundwater level is at or above ground surface, at approximately Elevation 250 m.
- To the north/northwest of Mayfield Road in the vicinity of the esker ridge, the groundwater level is at about Elevation 250 m to 251 m (some 8 m to 14 m below ground surface), based on the results from the boreholes included in this report as well as other investigations in this area. This groundwater level is within the lower sand to sand and silt deposit.

- South of Mayfield Road, the water level declines along with the ground surface; the water level is typically between about 2 m and 3 m below the ground surface.

The following table summarizes the most recent water levels that have been measured in piezometers installed in the boreholes included in this report:

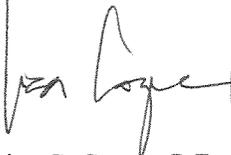
| <i>Borehole No.</i> | <i>Borehole Location</i> | <i>Depth to Groundwater Level</i> | <i>Groundwater Elevation</i> | <i>Date of Measurement</i> |
|----------------------------|---|--|-------------------------------------|-----------------------------------|
| 129 (1999) | North of Mayfield Road | 7.8 m | 251.2 m | January 21, 1999 |
| 03-10 | South of Mayfield Road | 0.8 m above surface | 249.7 m | December 11, 2003 |
| C1-1 | Between Mayfield Road and Countryside Drive | 1.9 m | 245.5 m | February 19, 2004 |

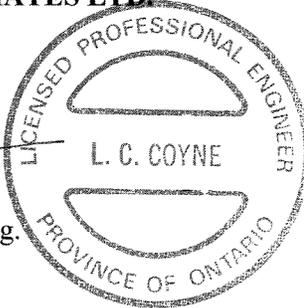
It should be noted that groundwater levels are expected to fluctuate seasonally, and should be expected to rise during wet periods of the year.

5.0 CLOSURE

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

GOLDER ASSOCIATES LTD.


Lisa C. Coyne, P.Eng.
Associate



A circular professional seal for a Licensed Professional Engineer in the Province of Ontario. The seal features a stylized 'E' in the center and contains the text 'LICENSED PROFESSIONAL ENGINEER' at the top and 'L. C. COYNE' and 'PROVINCE OF ONTARIO' at the bottom.


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



A circular professional seal for a Registered Professional Engineer in the Province of Ontario. The seal features a stylized 'E' in the center and contains the text 'REGISTERED PROFESSIONAL ENGINEER' at the top and 'F. J. HEFFERNAN' and 'PROVINCE OF ONTARIO' at the bottom.

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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.)

(b) Cohesive Soils

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 = σ'_p / σ'_{vo} |

(d) Shear Strength

| | |
|------------------|--|
| τ_p, τ_r | peak and residual shear strength |
| ϕ' | effective angle of internal friction |
| δ | angle of interface friction |
| μ | coefficient of friction = $\tan \delta$ |
| 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 = (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 <u>001-1159-4</u> | RECORD OF BOREHOLE No 03-06 | 2 OF 2 METRIC |
| W.P. <u>101-00-00</u> | LOCATION <u>N 4846339.2 ; E 280524.1</u> | ORIGINATED BY <u>GPD</u> |
| DIST <u>HWY 410</u> | BOREHOLE TYPE <u>CME 55 Bombardier, 108 mm ID Hollow Stem Augers</u> | COMPILED BY <u>KG</u> |
| DATUM <u>Geodetic</u> | DATE <u>November 18, 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 | | | | | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | 20 40 60 80 100 | ○ UNCONFINED | + FIELD VANE | ● QUICK TRIAXIAL | × REMOULDED | WATER CONTENT (%) | | | | | | |
| 251.1 | Sand, trace to some silt Very dense Brown Moist | [Pattern] | 11 | SS | 60 | 253 | | | | | | | ○ | | | | |
| 12.8 | Sand and Silt, trace to some clay, trace gravel Very dense Brown Moist | [Pattern] | 12 | SS | 58 | 252 | | | | | | | | | | | |
| 12.8 | Sand and Silt, trace to some clay, trace gravel Very dense Brown Moist | [Pattern] | 13 | SS | 78 | 250 | | | | | | | | | | | 2 55 34 9 |
| 248.2 | End of Borehole Note: 1. Open borehole dry on completion of drilling operations | [Pattern] | 14 | SS | 67 | 249 | | | | | | | ○ | | | | |
| 15.7 | End of Borehole Note: 1. Open borehole dry on completion of drilling operations | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-4-MTO.GPJ_ON_MOT.GDT 12/2/06

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

| | | |
|---------------------------|--|--------------------------|
| PROJECT <u>001-1159-4</u> | RECORD OF BOREHOLE No 03-10 | 2 OF 2 METRIC |
| W.P. <u>101-00-00</u> | LOCATION <u>N 4846410.5 ; E 280841.9</u> | ORIGINATED BY <u>GPD</u> |
| DIST <u>HWY 410</u> | BOREHOLE TYPE <u>CME 55 Bombardier, 108 mm ID Hollow Stem Augers</u> | COMPILED BY <u>KG</u> |
| DATUM <u>Geodetic</u> | DATE <u>November 20, 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 | | | | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | 20 40 60 80 100 | ○ UNCONFINED | + FIELD VANE | ● QUICK TRIAXIAL | × REMOULDED | WATER CONTENT (%) | | | | | |
| | | | | | | 20 40 60 80 100 | | | | | 25 50 75 | | | | | |
| 237.8 | Clayey Silt with sand to some sand, trace gravel (TILL) Stiff to hard Grey Moist | [Hatched pattern] | 10 | SS | 26 | 238 | | | | | | ○ | | | | |
| 11.1 | Sand and Silt, trace clay and gravel Very loose to compact Grey Wet | [Dotted pattern] | | | | 237 | | | | | | | ○ | | | |
| | | | 11 | SS | 3 | 236 | | | | | | | | | 3 45 48 4 | |
| | | | | | | 235 | | | | | | | | | | |
| | | | | | | 234 | | | | | | | | | | |
| 233.7 | Sand, trace gravel and silt Compact Brown Wet | [Dotted pattern] | 12 | SS | 16 | 233.7 | | | | | | | ○ | | | |
| 233.2 | End of Borehole | | | | | 233.2 | | | | | | | | | | |
| 15.7 | Note: 1. Water level in piezometer at 0.8 m above ground surface (at Elev. 249.7 m) on Dec 11, 2003 | | | | | 15.7 | | | | | | | | | | |

MIS-MTO 001_001-1159-4-MTO.GPJ_ON_MOT.GDT 12/2/06

RECORD OF BOREHOLE No C1-1 1 OF 2 **METRIC**

PROJECT 001-1159-3 W.P. 101-00-00 LOCATION N 4845701.9; E 281416.7 ORIGINATED BY GD

DIST HWY 410 BOREHOLE TYPE CME 55 Bombardier, 108 mm Diameter Solid Stem Augers COMPILED BY SP

DATUM Geodetic DATE May 11, 2001 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 | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | | 20 | 40 | 60 | 80 | 100 | 25 | 50 | 75 |
| 247.3 | Ground Surface | | | | | | | | | | | | | | | | | | | | | | | |
| 247.0 | Topsoil | | | | | | | | | | | | | | | | | | | | | | | |
| 0.2 | Clayey Silt, some sand, trace gravel Stiff Brown Moist | 1 | AS | - | | | | | | | | | | | | | | | | | | | | |
| 247.1 | | 2 | SS | 13 | | | | | | | | | | | | | | | | | | | 1 19 57 23 | |
| 245.8 | Clayey Silt with sand to some sand, trace gravel (TILL) Very stiff to hard Brown becoming grey below 3.1 m depth Moist | 3 | SS | 24 | | | | | | | | | | | | | | | | | | | | |
| 1.5 | | 4 | SS | 39 | | | | | | | | | | | | | | | | | | | | |
| | | 5 | SS | 22 | | | | | | | | | | | | | | | | | | | | |
| | | 6 | SS | 20 | | | | | | | | | | | | | | | | | | | | |
| | | 7 | SS | 22 | | | | | | | | | | | | | | | | | | | | |
| | | 8 | SS | 20 | | | | | | | | | | | | | | | | | | | | |
| | | 8 | SS | 31 | | | | | | | | | | | | | | | | | | | | |
| | | 9 | SS | 33 | | | | | | | | | | | | | | | | | | | | |
| | | 10 | SS | 21 | | | | | | | | | | | | | | | | | | | | |
| 237.4 | | | | | | | | | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-3-MTO.GPJ_ON_MOT.GDT 12/2/06

Continued Next Page

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



RECORD OF BOREHOLE No C1-1 2 OF 2 **METRIC**

PROJECT 001-1159-3 W.P. 101-00-00 LOCATION N 4845701.9; E 281416.7 ORIGINATED BY GD

DIST HWY 410 BOREHOLE TYPE CME 55 Bombardier, 108 mm Diameter Solid Stem Augers COMPILED BY SP

DATUM Geodetic DATE May 11, 2001 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 | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | | | | | | | | | |
| 9.9 | End of Borehole Notes: 1. Open borehole dry upon completion of drilling operations 2. Water level in piezometer at 1.9 m depth (Elev. 245.5 m) on February 19, 2004 | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-3-MTO.GPJ_ON_MOT.GDT 12/2/06

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

RECORD OF BOREHOLE No C1-2 1 OF 1 **METRIC**

PROJECT 001-1159-3 W.P. 101-00-00 LOCATION N 4845766.4 ; E 281339.0 ORIGINATED BY GD

DIST HWY 410 BOREHOLE TYPE CME 55 Bombardier, 108 mm Diameter Solid Stem Augers COMPILED BY SP

DATUM Geodetic DATE May 11, 2001 CHECKED BY LCC

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | | | |
|--------------|---|------------|--------|------|-------------------------|-----------------|--|----|----|----|----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-----|----|----|----|----|-----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | 20 | 40 | 60 | 80 | | | | | | 100 | 20 | 40 | 60 | 80 | 100 | 25 | 50 |
| 249.7 | Ground Surface | | | | | | | | | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | | | | | | | | | | | | | | | | | | | | | | | |
| 249.5 | | | 1 | AS | - | | | | | | | | | | | | | | | | | | | |
| 0.2 | Silty Sand, containing rootlets Brown Moist | | | | | | | | | | | | | | | | | | | | | | | |
| 248.9 | | | 2 | SS | 17 | | | | | | | | | | | | | | | | | | | |
| 0.8 | Clayey Silt with sand to some sand, trace gravel (TILL) Very stiff to hard Brown becoming grey below 3.1 m depth Moist | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 3 | SS | 25 | | | | | | | | | | | | | | | | | | | |
| | | | 4 | SS | 61 | | | | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 37 | | | | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 38 | | | | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 35 | | | | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 34 | | | | | | | | | | | | | | | | | | | |
| | | | 9 | SS | 34 | | | | | | | | | | | | | | | | | | | |
| 243.1 | End of Borehole | | | | | | | | | | | | | | | | | | | | | | | |
| 6.6 | Note: 1. Open borehole dry upon completion of drilling operations | | | | | | | | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-3-MTO.GPJ ON_MOT.GDT 12/2/06

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|---|--|-------------------------|
| PROJECT <u>001-1159-2</u> | RECORD OF BOREHOLE No C-3 | 1 OF 2 METRIC |
| W.P. <u>101-00-00</u> | LOCATION <u>N 4845373.6 ; E 281574.2</u> | ORIGINATED BY <u>SB</u> |
| DIST <u> </u> HWY <u>410</u> | BOREHOLE TYPE <u>CME 55 Bombardier, 108 mm ID Hollow Stem Augers</u> | COMPILED BY <u>LCC</u> |
| DATUM <u>Geodetic</u> | DATE <u>October 20, 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 | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|--------------|---|------------|--------|------|-------------------------|-----------------|--|--------------------|----|-----|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) |
| | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | |
| 249.7 0.0 | Ground Surface Topsoil | | | | | | | | | | | | | | | | |
| 249.0 0.7 | Silty Clay, trace sand and gravel, containing sand seams Stiff to very stiff Brown to grey-brown Moist | | 1 | SS | 8 | | | | | | | | | | | | |
| 248.0 1.7 | Clayey Silt, with sand to some sand, trace to some gravel (TILL) Hard Brown, becoming grey below 3.8 m depth Moist | | 2 | SS | 22 | | | | | | | | | | | | |
| | | | 3 | SS | 43 | | | | | | | | | | | | |
| | | | 4 | SS | 54 | | | | | | | | | | | | |
| | | | 5 | SS | 41 | | | | | | | | | | | | |
| | | | 6 | SS | 25 | | | | | | | | | | | | |
| | | | 7 | SS | 25 | | | | | | | | | | | | |
| 244.1 5.6 | Sand, some silt, trace clay Compact Moist to wet Grey | | 7 | SS | 25 | | | | | | | | | | | | 0 74 24 2 |
| 242.5 7.2 | Silt, some sand, trace gravel and clay Compact Grey Wet | | 8 | SS | 24 | | | | | | | | | | | | 1 13 79 7 |
| 241.0 8.7 | Silty Clay to Clayey Silt, some sand, trace gravel (TILL) Very stiff Grey Moist | | 9 | SS | 19 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-2-MTO.GPJ_ON_MOT.GDT 12/2/06

Continued Next Page

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

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|---------------------------|--|--------------------------|
| PROJECT <u>001-1159-2</u> | RECORD OF BOREHOLE No C-04-2 | 1 OF 3 METRIC |
| W.P. <u>101-00-00</u> | LOCATION <u>N 4845411.2 ; E 281553.5</u> | ORIGINATED BY <u>PKS</u> |
| DIST <u>HWY 410</u> | BOREHOLE TYPE <u>D-50 Bombardier, 108 mm I.D. Hollow Stem Augers</u> | COMPILED BY <u>LCC</u> |
| DATUM <u>Geodetic</u> | DATE <u>September 9-10, 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 | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|--------------|--|------------|--------|------|-------------------------|-----------------|--|--------------------|----|-----|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-------------------|
| ELEV. DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) |
| | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | | |
| 250.8 | Ground Surface | | | | | | | | | | | | | | | | |
| 250.0 | Sand and gravel (FILL) | | | | | | | | | | | | | | | | |
| 250.6 | Compact Topsoil | | 1 | SS | 16 | | | | | | | | | | | | |
| 250.2 | Silty Clay to Clayey Silt, some sand, trace to some gravel, containing sand and silt layers Stiff to very stiff Brown Moist | | 2 | SS | 25 | | | | | | | | | | | | |
| 249.6 | | | 3 | SS | 13 | | | | | | | | | | | | |
| 248.3 | | | 4 | SS | 33 | | | | | | | | | | | | |
| 248.3 | Clayey Silt with sand to some sand, trace to some gravel (TILL) Very stiff to hard Grey Moist | | 5 | SS | 52 | | | | | | | | | | | | |
| 247.7 | | | 6 | SS | 50 | | | | | | | | | | | | |
| 247.1 | | | 7 | SS | 44 | | | | | | | | | | | | |
| 246.5 | | | 8 | SS | 36 | | | | | | | | | | | | |
| 245.9 | | | 9 | SS | 40 | | | | | | | | | | | | |
| 245.3 | | | 10 | SS | 21 | | | | | | | | | | | | |
| 241.7 | | | | | | | | | | | | | | | | | 6 24 47 23 |

MIS-MTO 001_001-1159-2-MTO.GPJ ON_MOT.GDT 12/2/06

Continued Next Page

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

PROJECT 001-1159-2 **RECORD OF BOREHOLE No C-04-2** 2 OF 3 **METRIC**
 W.P. 101-00-00 LOCATION N 4845411.2 ; E 281553.5 ORIGINATED BY PKS
 DIST HWY 410 BOREHOLE TYPE D-50 Bombardier, 108 mm I.D. Hollow Stem Augers COMPILED BY LCC
 DATUM Geodetic DATE September 9-10, 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 | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | | | | | |
| | --- CONTINUED FROM PREVIOUS PAGE --- | | | | | | | | | | | | | | |
| | Clayey Silt with sand to some sand, trace to some gravel (TILL) Very stiff to hard Grey Moist | 11 | SS | 40 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 237.5 | | | | | | | | | | | | | | | |
| 13.3 | Sand and Silt, trace to some gravel, trace clay (TILL) Very dense Grey Moist to wet | 13 | SS | 107 | | | | | | | | | | | |
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| 230.9 | | | | | | | | | | | | | | | |
| 19.9 | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-2-MTO.GPJ_ON_MOT.GDT 12/2/06

Continued Next Page

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



PROJECT 001-1159-2 **RECORD OF BOREHOLE No C-04-2** 3 OF 3 **METRIC**
 W.P. 101-00-00 LOCATION N 4845411.2 ; E 281553.5 ORIGINATED BY PKS
 DIST HWY 410 BOREHOLE TYPE D-50 Bombardier, 108 mm I.D. Hollow Stem Augers COMPILED BY LCC
 DATUM Geodetic DATE September 9-10, 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 | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|--------------|--|-------------------|------|------------|-------------------------|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | | 25 |
| | End of Borehole Note: 1. Water level in open borehole at 12.2 m depth (Elev. 238.6 m) upon completion of drilling. | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-2-MTO.GPJ ON_MOT.GDT 12/2/06

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

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|---------------------------|---|--------------------------|
| PROJECT <u>001-1159-5</u> | RECORD OF BOREHOLE No HML-1 | 1 OF 2 METRIC |
| W.P. <u>101-00-00</u> | LOCATION <u>N 4845015.7 ; E 281788.6</u> | ORIGINATED BY <u>PKS</u> |
| DIST <u>HWY 410</u> | BOREHOLE TYPE <u>CME-55 Bombardier, 150 mm Solid Stem Auger</u> | COMPILED BY <u>SP</u> |
| DATUM <u>Geodetic</u> | DATE <u>May 30, 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 | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | | | | | | |
|--------------|---|------------|--------|------|-------------------------|-----------------|--|--------------------|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-------------------|----|----|--|----|----|----|----|--|--|--|
| ELEV. DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | WATER CONTENT (%) | | | | | | | | | | |
| | | | | | | 20 | 40 | 60 | 80 | 100 | 20 | 40 | 60 | 80 | 100 | 25 | 50 | 75 | | GR | SA | SI | CL | | | |
| 248.3 0.0 | Ground Surface Topsoil | | 1 | SS | 8 | | | | | | | | | | | | | | | | | | | | | |
| 247.5 0.8 | Clayey Silt with sand to some sand, trace to some gravel (TILL) Hard Brown becoming grey below 2.1 m depth Moist | | 2 | SS | 42 | | | | | | | | | | | | | | | | | | | | | |
| | | | 3 | SS | 54 | | | | | | | | | | | | | | | | | | | | | |
| | | | 4 | SS | 94 | | | | | | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 90 | | | | | | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 76 | | | | | | | | | | | | | | | | | | | | | |
| | | | 7 | SS | 50 | | | | | | | | | | | | | | | | | | | | | |
| | | | 8 | SS | 64 | | | | | | | | | | | | | | | | | | | | | |
| | | | 9 | SS | 41 | | | | | | | | | | | | | | | | | | | | | |
| | | | 10 | SS | 35 | | | | | | | | | | | | | | | | | | | | | |
| 238.5 9.8 | | | | | | | | | | | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-5-MTO.GPJ ON_MOT.GDT 12/2/06

Continued Next Page

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



PROJECT 001-1159-5 **RECORD OF BOREHOLE No HML-1** 2 OF 2 **METRIC**
 W.P. 101-00-00 LOCATION N 4845015.7 ; E 281788.6 ORIGINATED BY PKS
 DIST HWY 410 BOREHOLE TYPE CME-55 Bombardier, 150 mm Solid Stem Auger COMPILED BY SP
 DATUM Geodetic DATE May 30, 2001 CHECKED BY LCC

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|--------------|---|-------------------|------|------------|-------------------------|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|----|
| ELEV. DEPTH | DESCRIPTION | STRAT PLOT NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | | 25 |
| | End of Borehole Note: 1. Open borehole dry upon completion of drilling operations | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-5-MTO.GPJ ON_MOT.GDT 12/2/06

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

| | | |
|---------------------------|---|--------------------------|
| PROJECT <u>001-1159-5</u> | RECORD OF BOREHOLE No HML-2 | 1 OF 2 METRIC |
| W.P. <u>101-00-00</u> | LOCATION <u>N 4845992.8 ; E 281231.8</u> | ORIGINATED BY <u>PKS</u> |
| DIST <u>HWY 410</u> | BOREHOLE TYPE <u>CME-55 Bombardier, 150 mm Solid Stem Auger</u> | COMPILED BY <u>SP</u> |
| DATUM <u>Geodetic</u> | DATE <u>May 30, 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 | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|---|-------------------|--------|------|-------------------------|-----------------|--|--------------------|----|-----|--|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| ELEV. DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | |
| | | | | | | 20 | 40 | 60 | 80 | 100 | | | | | | |
| 249.5 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | | | | | | | | | | | | | | | |
| 249.2 | Clayey Silt, trace sand and gravel Firm to stiff Brown Moist | [Hatched Pattern] | 1 | SS | 4 | | | | | | | | | | | |
| 0.3 | | | 2 | SS | 8 | | | | | | | | | | | |
| 248.1 | Clayey Silt with sand to some sand, trace to some gravel (TILL) Very stiff to hard Brown becoming grey below 3.1 m depth Moist | [Hatched Pattern] | 3 | SS | 40 | | | | | | | | | | | |
| 1.4 | | | 4 | SS | 59 | | | | | | | | | | | |
| | | | 5 | SS | 66 | | | | | | | | | | | |
| | | | 6 | SS | 44 | | | | | | | | | | | |
| | | | 7 | SS | 44 | | | | | | | | | | | |
| | | | 8 | SS | 34 | | | | | | | | | | | |
| | | | 9 | SS | 29 | | | | | | | | | | | |
| | | | 10 | SS | 29 | | | | | | | | | | | |
| 239.8 | | | | | | | | | | | | | | | | |
| 9.8 | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-5-MTO.GPJ ON_MOT.GDT 12/2/06

Continued Next Page

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



PROJECT 001-1159-5 **RECORD OF BOREHOLE No HML-2** 2 OF 2 **METRIC**
 W.P. 101-00-00 LOCATION N 4845992.8 ; E 281231.8 ORIGINATED BY PKS
 DIST HWY 410 BOREHOLE TYPE CME-55 Bombardier, 150 mm Solid Stem Auger COMPILED BY SP
 DATUM Geodetic DATE May 30, 2001 CHECKED BY LCC

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|--------------|--|-------------------|------|------------|-------------------------|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|----|
| ELEV. DEPTH | DESCRIPTION | STRAT PLOT NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | | 25 |
| | End of Borehole Note: 1. Water level in open borehole at 9.7 m depth (Elev. 239.8 m) upon completion of drilling operations | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-5-MTO.GPJ_ON_MOT.GDT 12/2/06

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



PROJECT 001-1159-5 **RECORD OF BOREHOLE No HML-3** 2 OF 2 **METRIC**
 W.P. 101-00-00 LOCATION N 4846211.6 ; E 281029.2 ORIGINATED BY PKS
 DIST HWY 410 BOREHOLE TYPE CME-55 Bombardier, 150 mm Solid Stem Auger COMPILED BY SP
 DATUM Geodetic DATE May 30, 2001 CHECKED BY LCC

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|--------------|---|-------------------|------|------------|-------------------------|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|----|
| ELEV. DEPTH | DESCRIPTION | STRAT PLOT NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | | 25 |
| | End of Borehole Note: 1. Water level in open borehole at 1.2 m depth (Elev. 249.6 m) upon completion of drilling operations | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-5-MTO.GPJ ON_MOT.GDT 12/2/06

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



PROJECT 001-1159-5 **RECORD OF BOREHOLE No HML-4** 1 OF 2 **METRIC**

W.P. 101-00-00 LOCATION N 4846329.1 ; E 280306.9 ORIGINATED BY PKS

DIST HWY 410 BOREHOLE TYPE CME-55 Bombardier, 150 mm Solid Stem Auger COMPILED BY SP

DATUM Geodetic DATE June 13, 2001 CHECKED BY LCC

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|--------------|---|------------|--------|------|-------------------------|-----------------|--|----|----|----|----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|-----|----|----|
| ELEV. DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | 20 | 40 | 60 | 80 | | | | | | 100 | 25 | 50 |
| 266.3 | Ground Surface | | | | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | | | | | | | | | | | | | | | | | | |
| 266.1 | | | | | | | | | | | | | | | | | | | |
| 0.2 | Clayey Silt with sand to some sand, trace gravel (TILL) Very stiff to hard Brown Moist | | 1 | SS | 19 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | 2 | SS | 74 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | 3 | SS | 66 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | 4 | SS | 80 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | 5 | SS | 111 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 115 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| 260.1 | Silty Sand to Sand, some silt, trace gravel Dense to very dense Brown Moist | | 7 | SS | 121 | | | | | | | | | | | | | | |
| 6.3 | | | | | | | | | | | | | | | | | | | |
| | | | | | 8 | SS | 109 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | 9 | SS | 50/0.15 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | 10 | SS | 50/0.13 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-5-MTO.GPJ_ON_MOT.GDT 12/2/06

Continued Next Page

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



PROJECT 001-1159-3 **RECORD OF BOREHOLE No WS-5** 2 OF 2 **METRIC**

W.P. 101-00-00 LOCATION N 4846255.2 ; E 280811.7 ORIGINATED BY PKS

DIST HWY 410 BOREHOLE TYPE CME 55 Bombardier, 108 mm ID Hollow Stem Augers COMPILED BY JDR

DATUM Geodetic DATE December 11, 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 | 20 | 40 | 60 | 80 | | | | | | 100 | 25 | 50 |
| 241.4 | Silty Sand to Sand, some silt, trace gravel Compact to dense Brown to grey Wet --- CONTINUED FROM PREVIOUS PAGE --- | | 11 | SS | 16 | | | | | | | | | | | | | | |
| | | | | | | | 243 | | | | | | | | | | | | |
| | | | | | 12 | SS | 17 | | | | | | | | | | | | |
| 12.8 | End of Borehole Note: 1. Water level in open borehole at 7.6 m depth (Elev. 246.6 m) upon completion of drilling. | | | | | | | | | | | | | | | | | | |

MIS-MTO 001_001-1159-3-MTO.GPJ ON_MOT.GDT 12/2/06

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

METRIC
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.
 DATUM: NAD83 (3" MTM) ZONE 10

CONT No.
 WP No.101-00-00

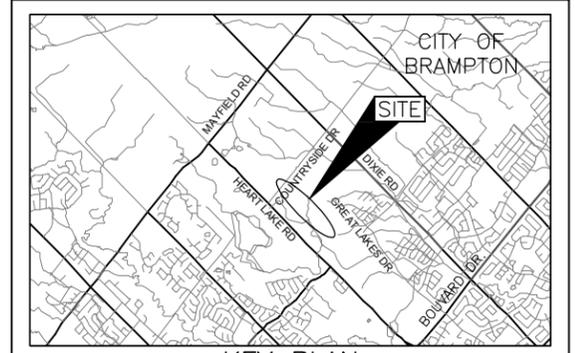


HIGHWAY 410
 STA. 19+500 TO 20+650
 HIGH MAST LIGHT POLES
 BOREHOLE LOCATIONS

SHEET



Golder Associates Ltd.
 MISSISSAUGA, ONTARIO, CANADA



KEY PLAN



LEGEND

- Borehole - 2001 to 2004 Investigations
- Borehole - 1999 Investigation (Golder Associates Ltd)
- Borehole - 1999 Investigations (Shaheen and Peaker Ltd.)

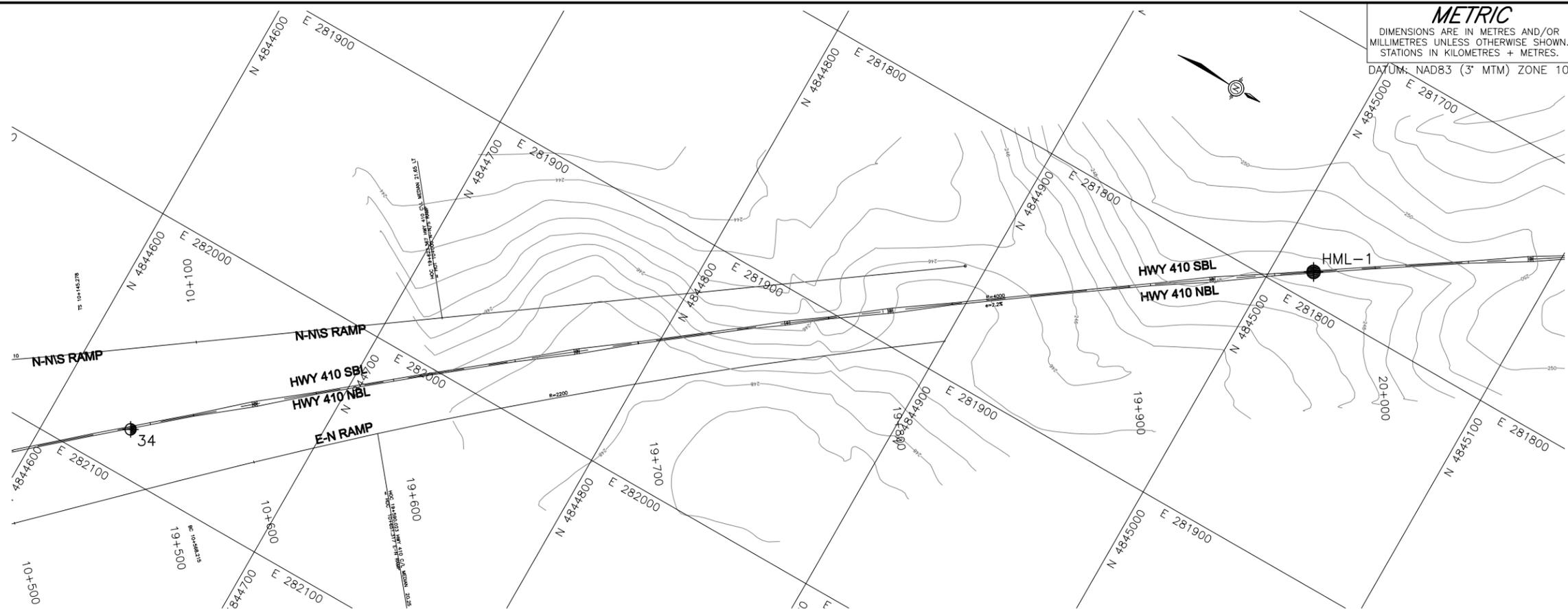
| No. | ELEVATION | CO-ORDINATES | |
|--------|-----------|--------------|----------|
| | | NORTHING | EASTING |
| 34 | 246.6 | 4844632.0 | 282082.0 |
| C-04-2 | 250.8 | 4845411.2 | 281553.5 |
| C-3 | 249.7 | 4845373.6 | 281574.2 |
| HML-1 | 248.3 | 4845015.7 | 281788.6 |

NOTES

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.

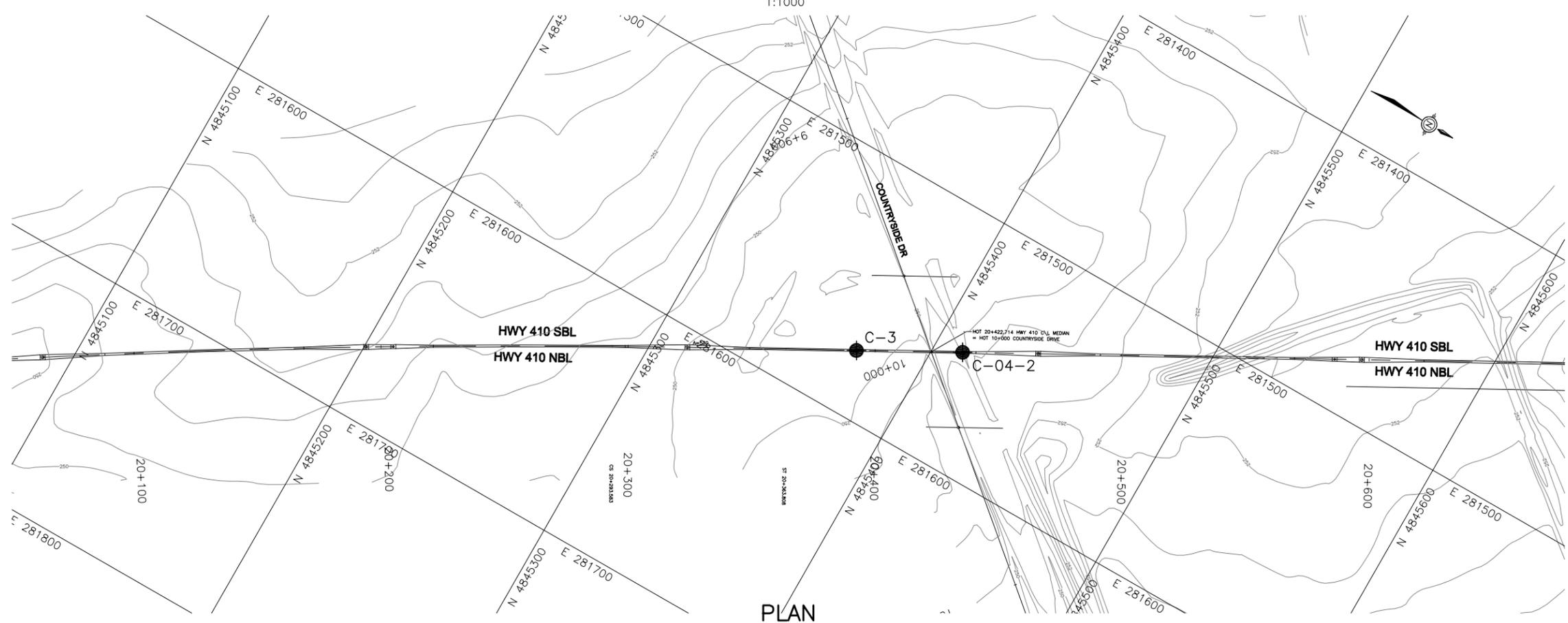
REFERENCE

Base plans provided in digital format by URS Canada Inc., on October 20, 2004.



PLAN

SCALE
 20 0 20 40 m
 1:1000



PLAN

SCALE
 20 0 20 40 m
 1:1000

| NO. | DATE | BY | REVISION |
|-----|------|----|----------|
| | | | |

Geocres No. _____ PROJECT NO. 001-1159 DIST. _____

| | | | |
|----------|-----------|-----------------|--------|
| HWY. 410 | CHKD. | DATE: NOV. 2004 | SITE: |
| SUBM'D. | CHKD. LCC | APPD. LCC | DWG. 1 |

METRIC
 DIMENSIONS ARE IN METRES AND/OR
 MILLIMETRES UNLESS OTHERWISE SHOWN.
 STATIONS IN KILOMETRES + METRES.
 DATUM: NAD83 (3° MTM) ZONE 10

CONT No.
 WP No.101-00-00

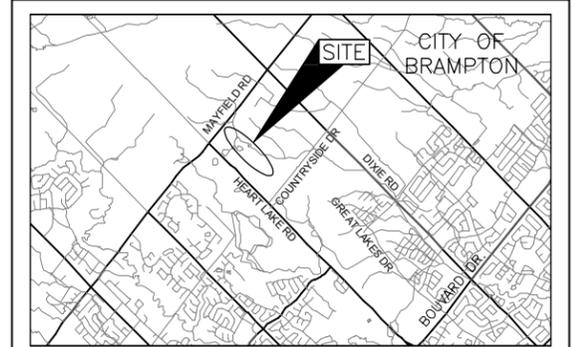


HIGHWAY 410
 STA. 20+650 TO 21+550
 HIGH MAST LIGHT POLES
 BOREHOLE LOCATIONS

SHEET



Golder Associates Ltd.
 MISSISSAUGA, ONTARIO, CANADA



KEY PLAN

LEGEND

- Borehole - 2001 to 2004 Investigations
- Borehole - 1999 Investigation (Golder Associates Ltd.)
- Borehole - 1999 Investigations (Shaheen and Peaker Ltd.)

| No. | ELEVATION | CO-ORDINATES | |
|-------|-----------|--------------|----------|
| | | NORTHING | EASTING |
| C1-1 | 247.3 | 4845701.9 | 281416.7 |
| C1-2 | 149.7 | 4845766.4 | 281339.0 |
| E-6 | 250.4 | 4845906.1 | 281281.7 |
| HML-2 | 249.5 | 4845992.8 | 281231.8 |

NOTES

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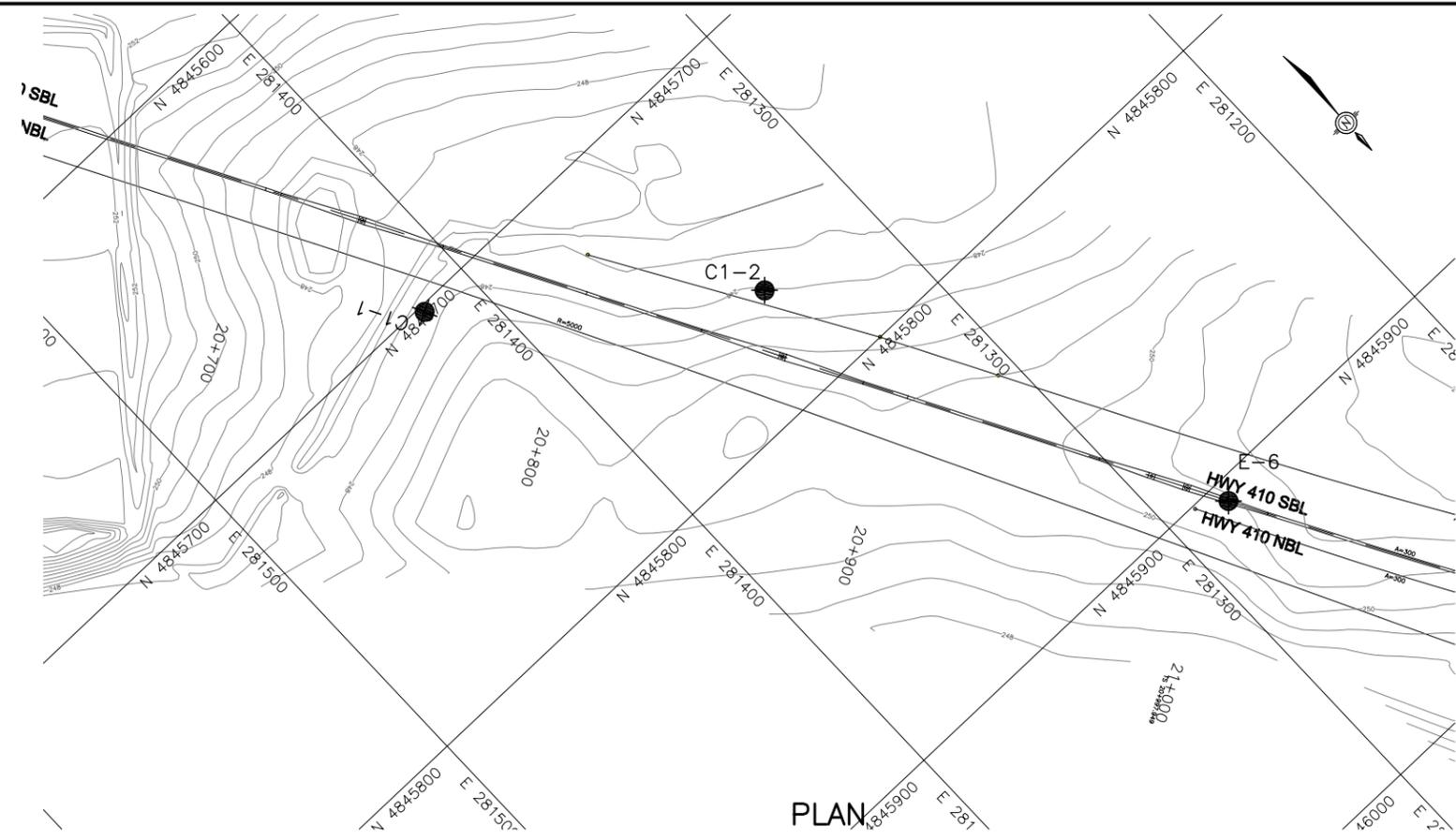
REFERENCE

Base plans provided in digital format by URS Canada Inc., on October 20, 2004.

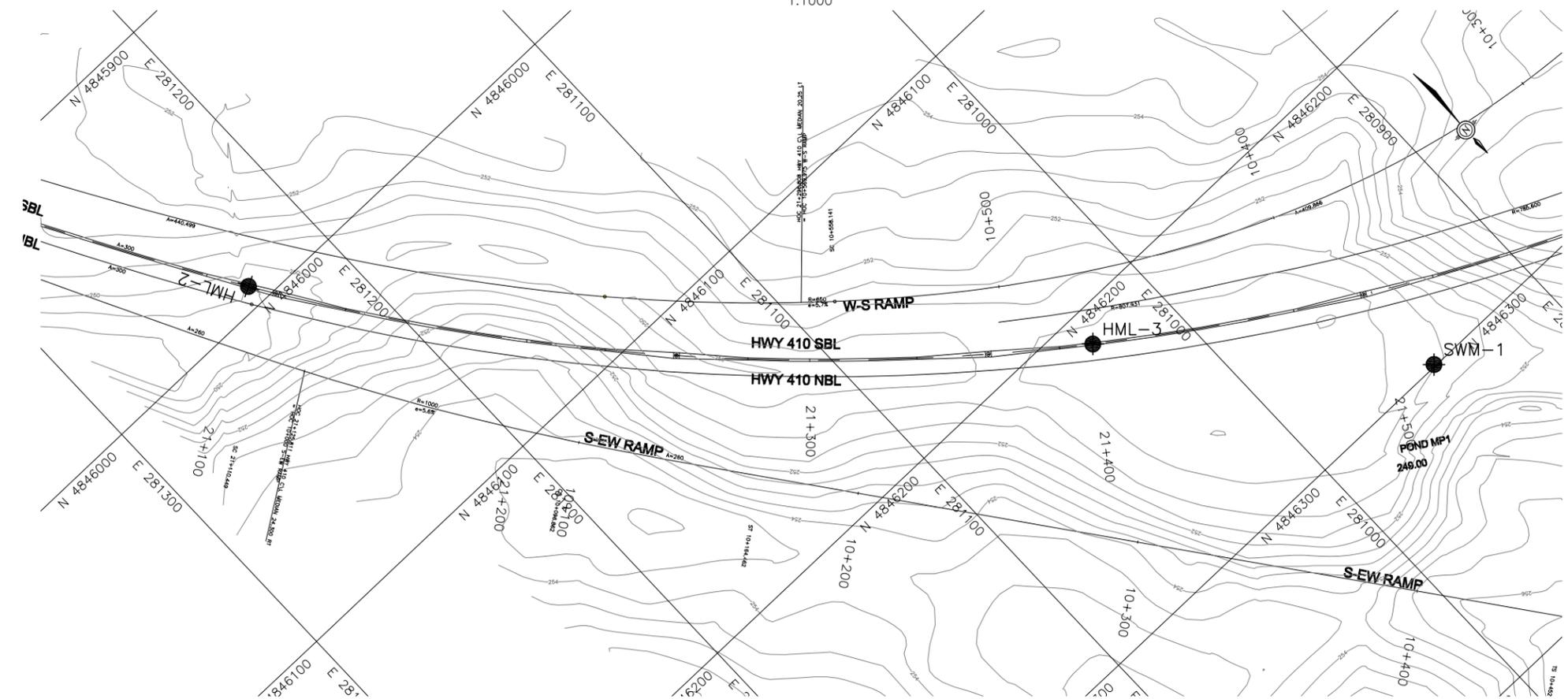
| NO. | DATE | BY | REVISION |
|-----|------|----|----------|
| | | | |
| | | | |

Geocres No. _____ PROJECT NO. 001-1159 DIST. _____

| | | | |
|----------|-----------|-----------------|--------|
| HWY. 410 | CHKD. | DATE: NOV. 2004 | SITE: |
| SUBM'D. | CHKD. LCC | APPD. LCC | DWG. 2 |



PLAN
 SCALE
 0 20 40 m
 1:1000



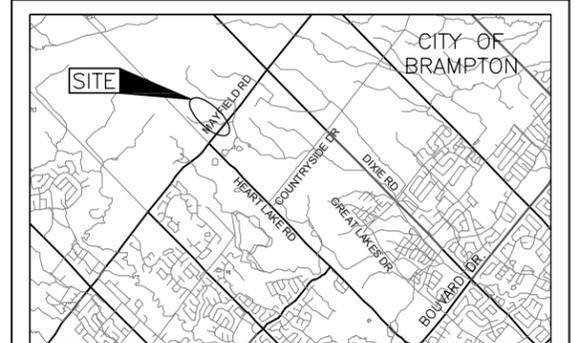
PLAN
 SCALE
 0 20 40 m
 1:1000

METRIC
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.
 DATUM: NAD83 (3° MTM) ZONE 10

CONT No.
 WP No.101-00-00

HIGHWAY 410
 STA. 21+550 TO 22+250
 HIGH MAST LIGHT POLES
 BOREHOLE LOCATIONS

SHEET



LEGEND

- Borehole - 2001 to 2004 Investigations
- ⊕ Borehole - 1999 Investigation (Golder Associates Ltd.)
- ⊕ Borehole - 1999 Investigations (Shaheen and Peaker Ltd.)

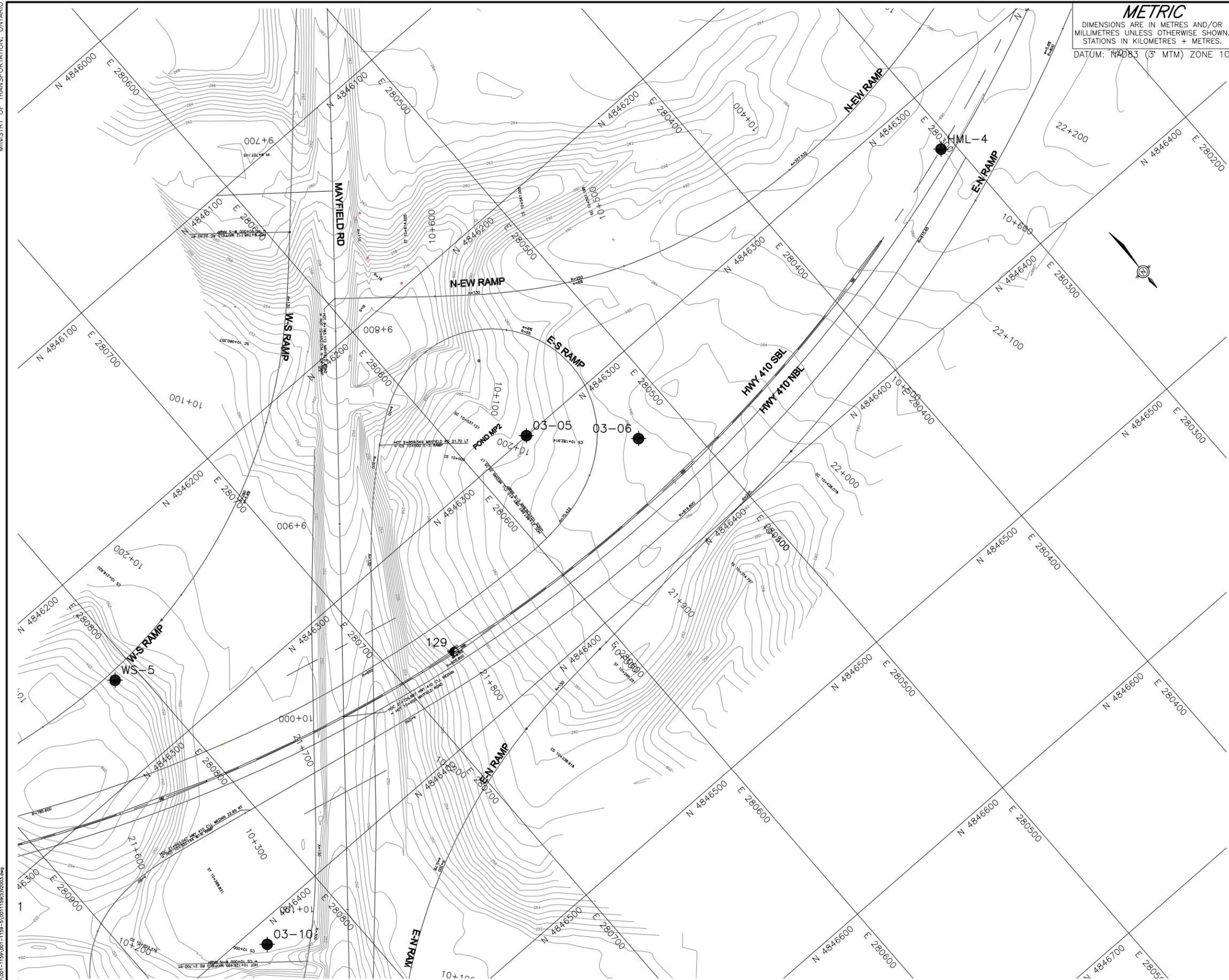
| No. | ELEVATION | CO-ORDINATES | |
|-------|-----------|--------------|----------|
| | | NORTHING | EASTING |
| 129 | 259.0 | 4846359.7 | 280669.1 |
| 03-05 | 261.8 | 4846299.8 | 280567.1 |
| 03-06 | 263.9 | 4846339.2 | 280524.1 |
| 03-10 | 248.9 | 4846410.5 | 280841.9 |
| HML-3 | 250.8 | 4846211.6 | 281029.2 |
| HML-4 | 266.3 | 4846329.1 | 280306.9 |
| SWM-1 | 251.5 | 4846299.3 | 280946.6 |
| WS-5 | 254.2 | 4846255.2 | 280811.7 |

NOTES

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., on October 20, 2004.



| NO. | DATE | BY | REVISION |
|-----|------|----|----------|
| | | | |

Geocres No. _____ PROJECT NO. 001-1159 DIST. _____

| | | | |
|----------|-----------|-----------------|--------|
| HWY. 410 | CHKD. | DATE: NOV. 2004 | SITE: |
| SUBM'D. | CHKD. LCC | APPD. LCC | DWG. 3 |

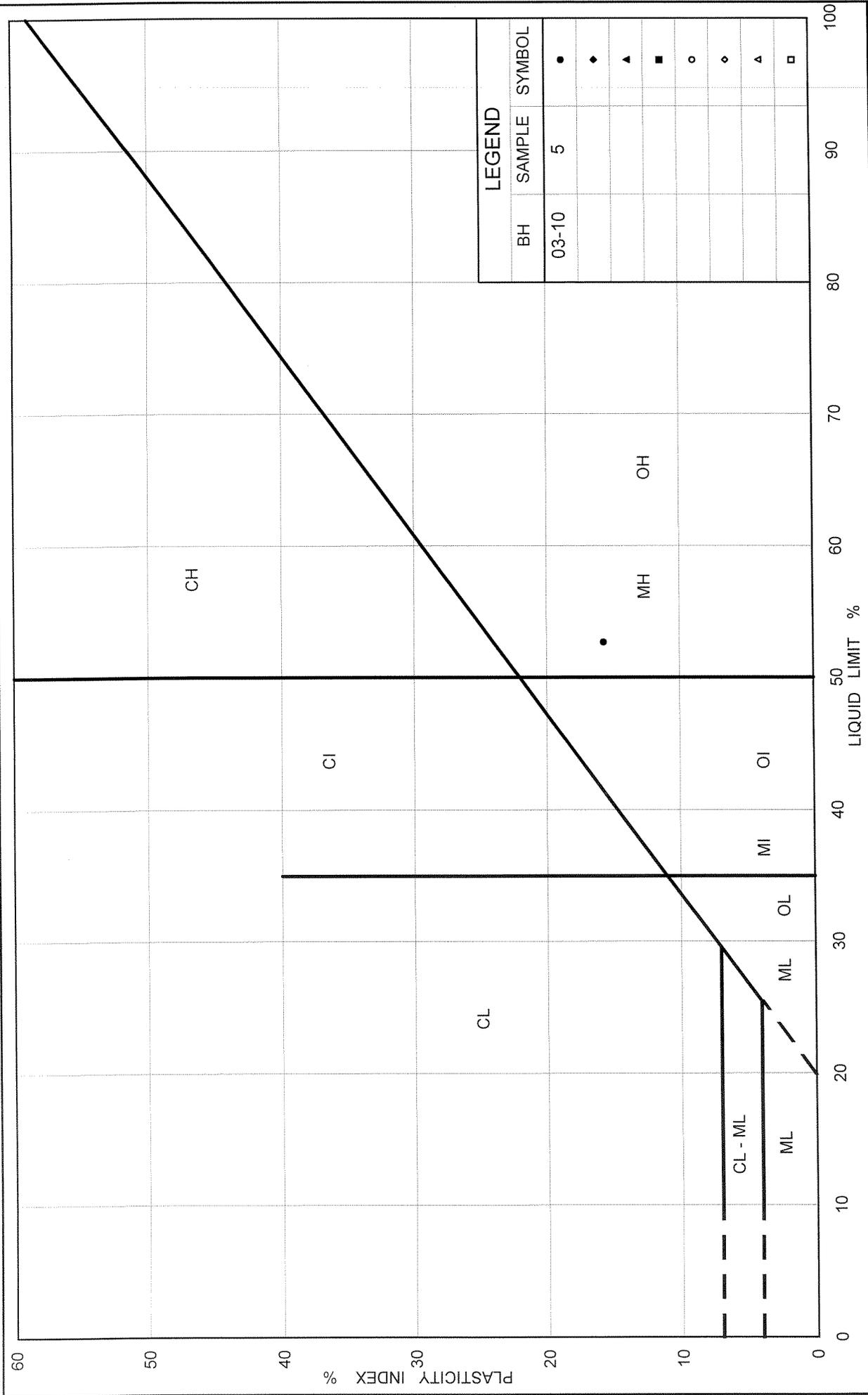


FIG No. 1
 Project No. 001-1159

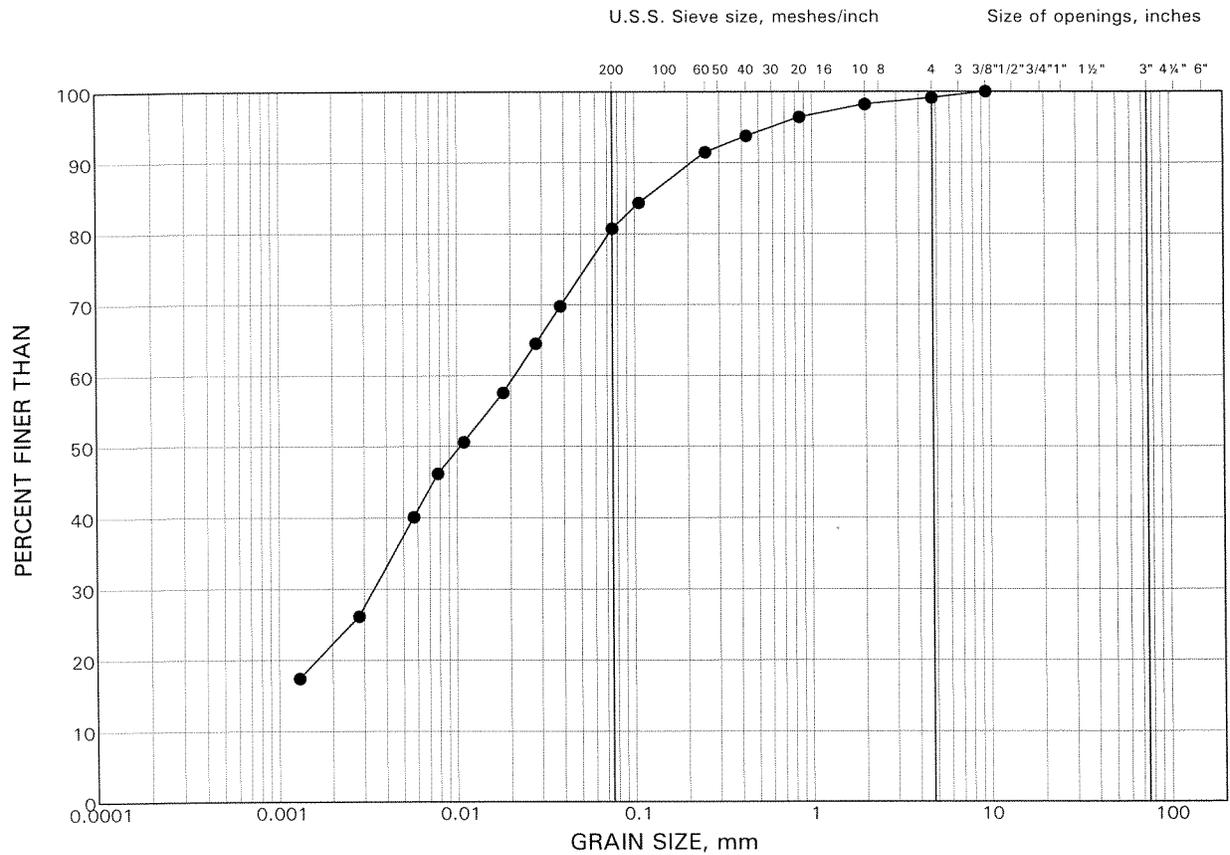
PLASTICITY CHART
 Organic Silt



GRAIN SIZE DISTRIBUTION TEST RESULT

Surficial Clayey Silt to Silty Clay

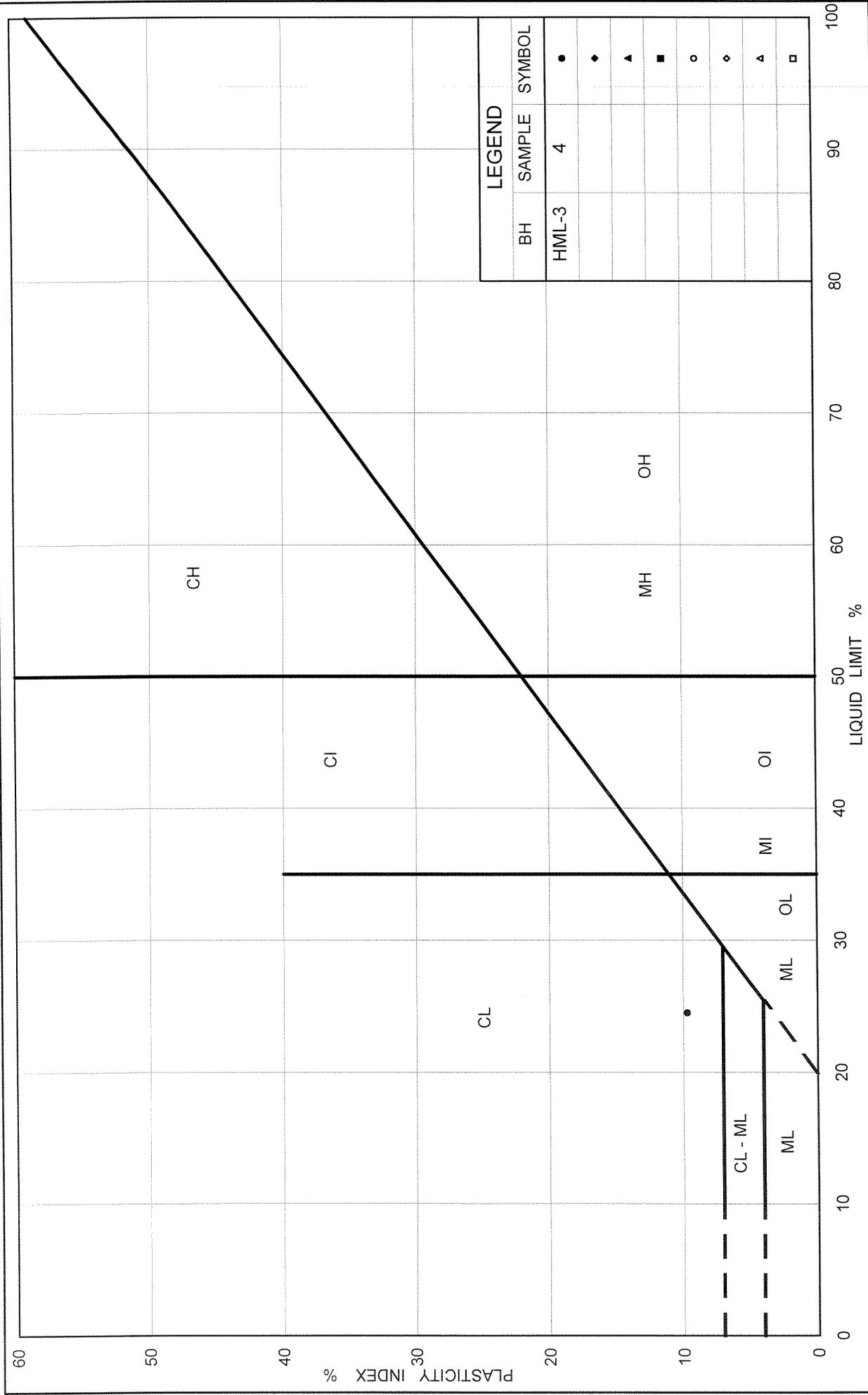
FIGURE 2



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

LEGEND

| SYMBOL | BOREHOLE | SAMPLE | ELEVATION (m) |
|--------|----------|--------|---------------|
| ● | C1-1 | 2 | 246.3 |



| LEGEND | | |
|--------|--------|--------|
| BH | SAMPLE | SYMBOL |
| HML-3 | 4 | ● |
| | | ◆ |
| | | ▲ |
| | | ■ |
| | | ○ |
| | | ◇ |
| | | △ |
| | | □ |

FIG No. 3
 Project No. 001-1159

PLASTICITY CHART

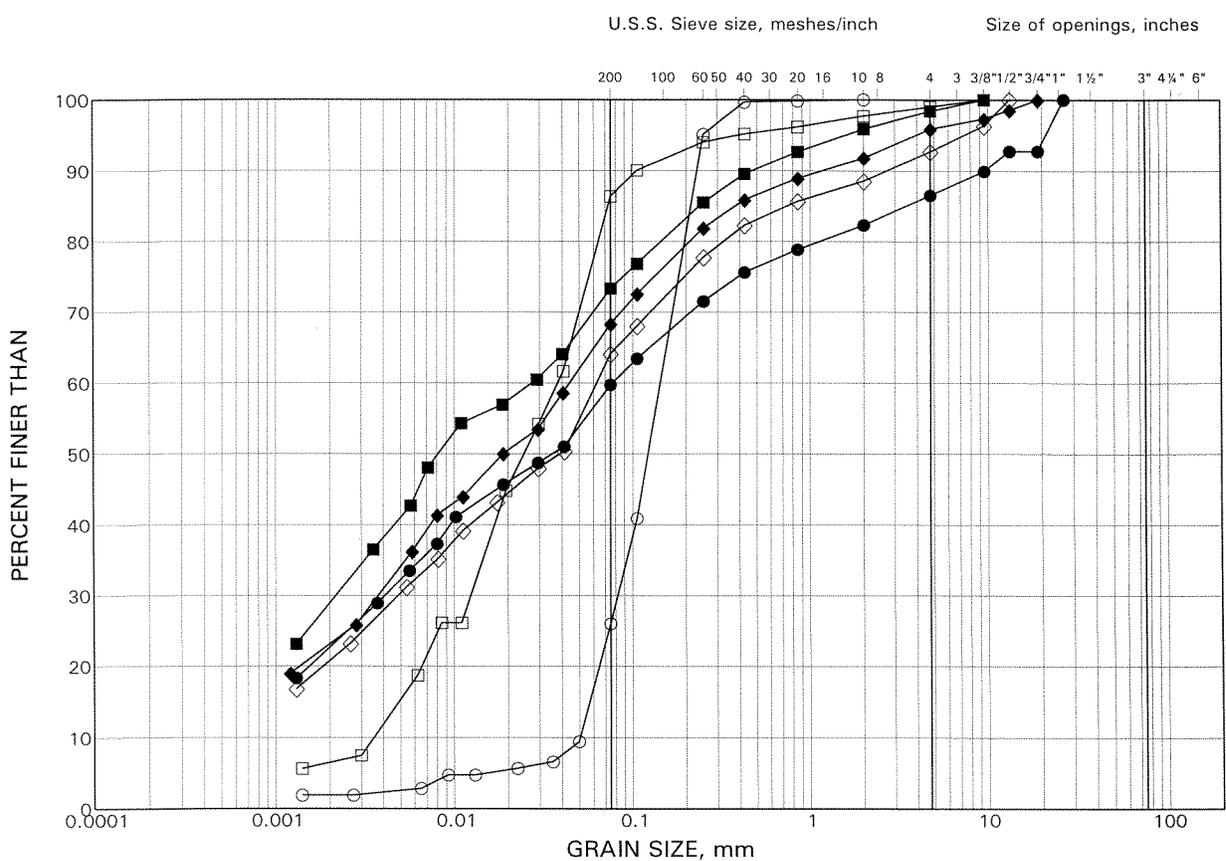
Surficial Clayey Silt to Silty Clay

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt Till to Silty Clay Till

(Including Interlayers)

FIGURE 4A



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

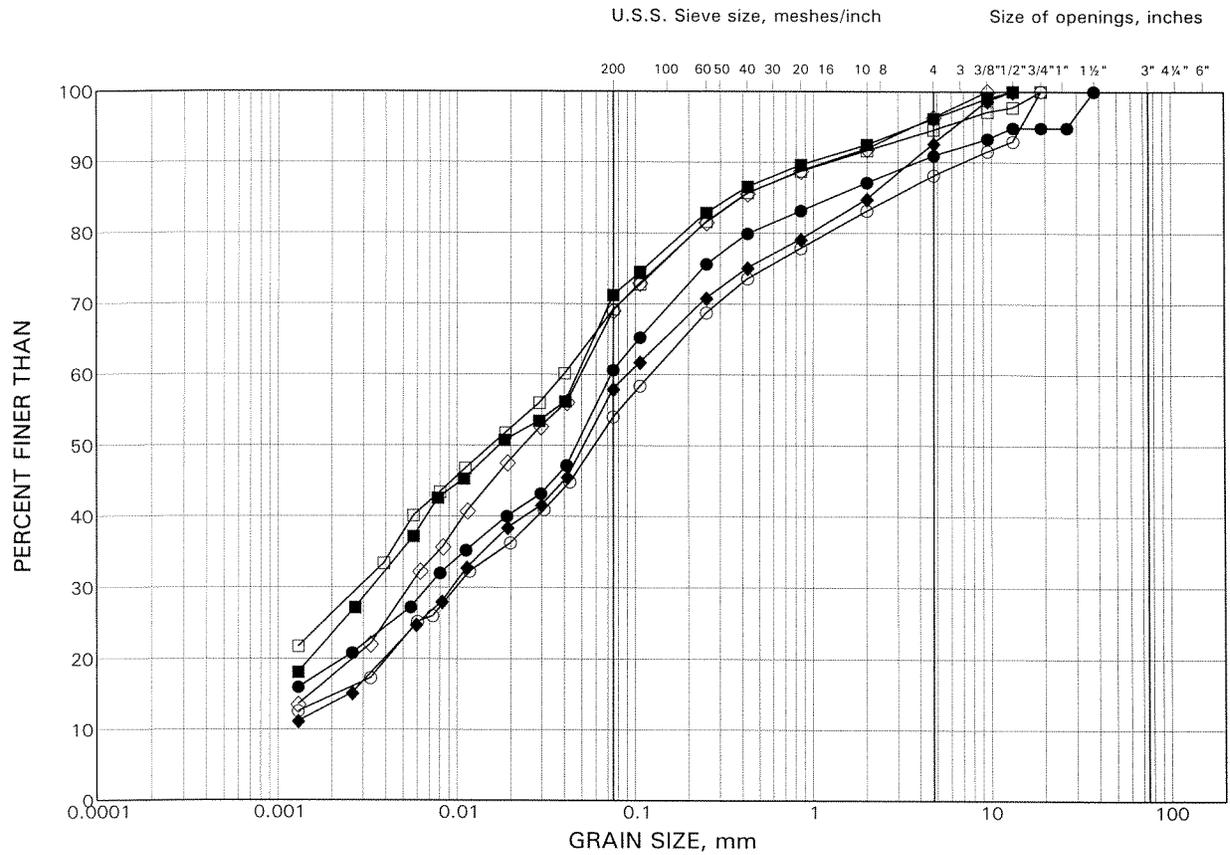
LEGEND

| SYMBOL | BOREHOLE | SAMPLE | ELEVATION (m) |
|--------|----------|--------|---------------|
| ● | 03-06 | 8 | 257.6 |
| ■ | 03-10 | 8 | 241.1 |
| ◆ | C1-2 | 4 | 247.2 |
| ○ | C-3 | 7 | 243.4 |
| □ | C-3 | 8 | 241.8 |
| ◇ | E6 | 4 | 247.9 |

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt Till to Silty Clay Till

FIGURE 4B



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

LEGEND

| SYMBOL | BOREHOLE | SAMPLE | ELEVATION (m) |
|--------|----------|--------|---------------|
| ● | HML-1 | 3 | 246.5 |
| ■ | HML-2 | 5 | 246.2 |
| ◆ | HML-3 | 7 | 245.9 |
| ○ | SWM-1 | 3 | 249.7 |
| □ | SWM-1 | 8 | 245.1 |
| ◇ | WS-5 | 8 | 247.8 |

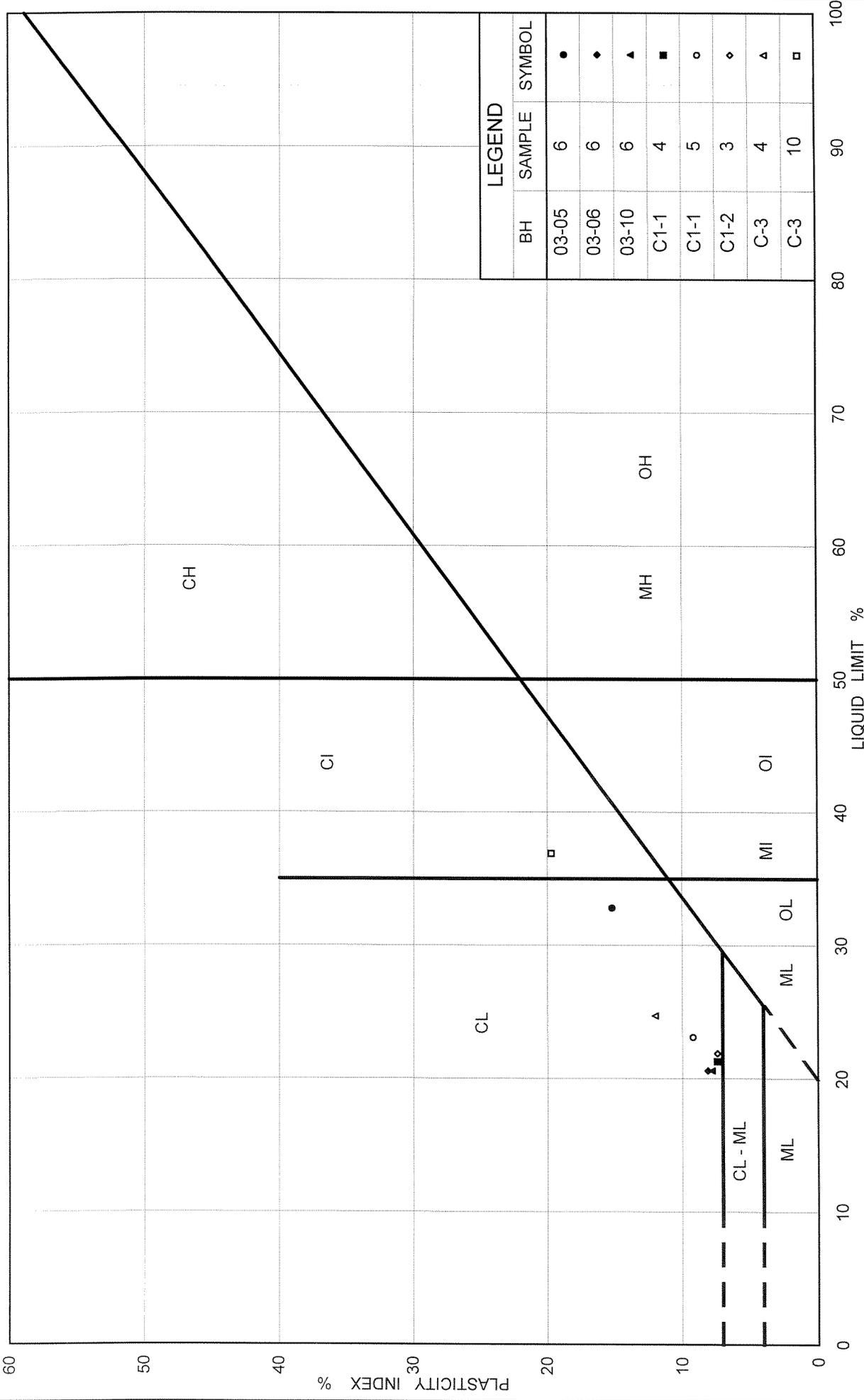


FIG No. 5A

Project No. 001-1159

PLASTICITY CHART
Clayey Silt Till to Silty Clay Till

Ministry of Transportation



Ontario

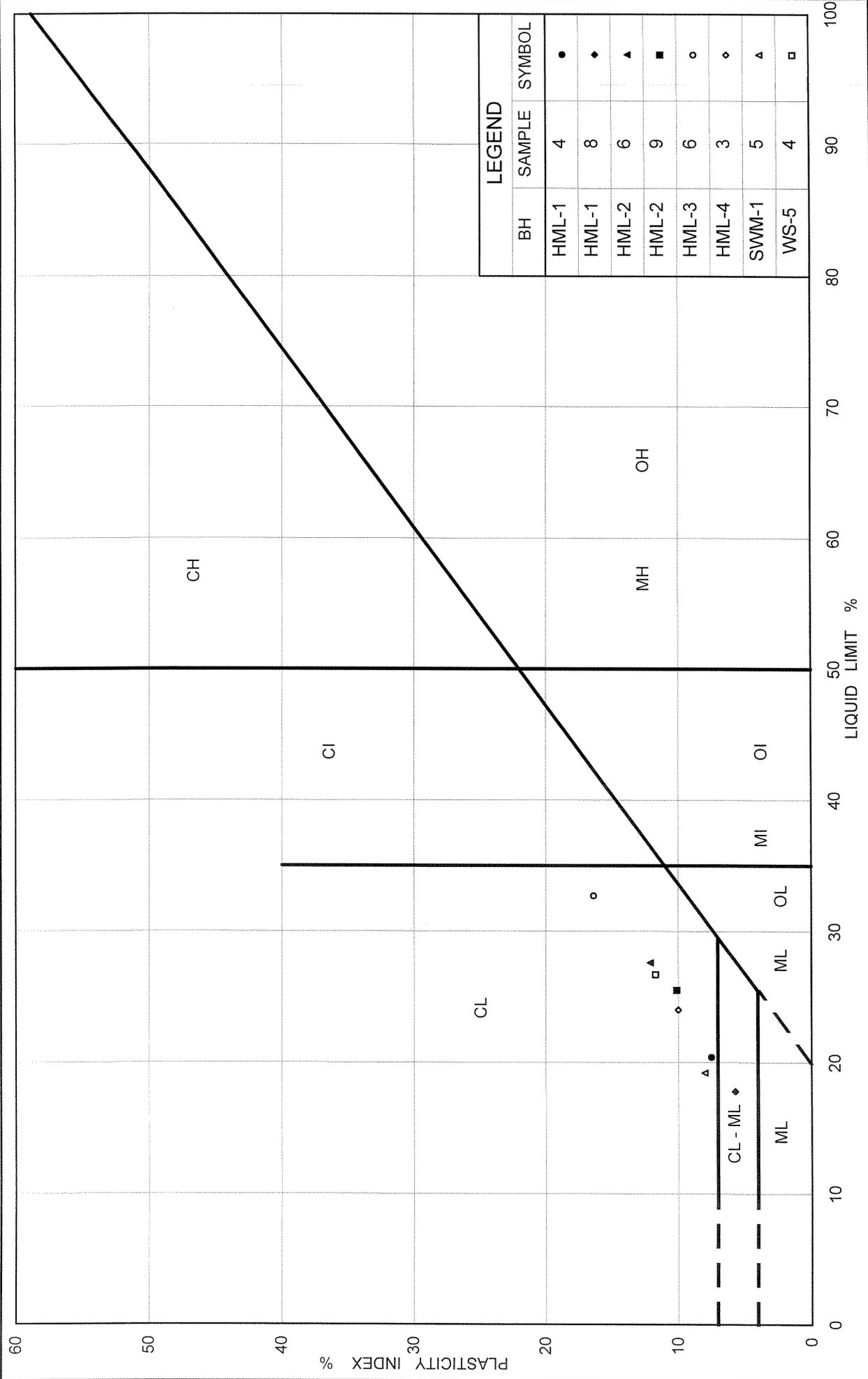


FIG No. 5B

Project No. 001-1159

PLASTICITY CHART

Clayey Silt Till to Silty Clay Till

Ministry of Transportation

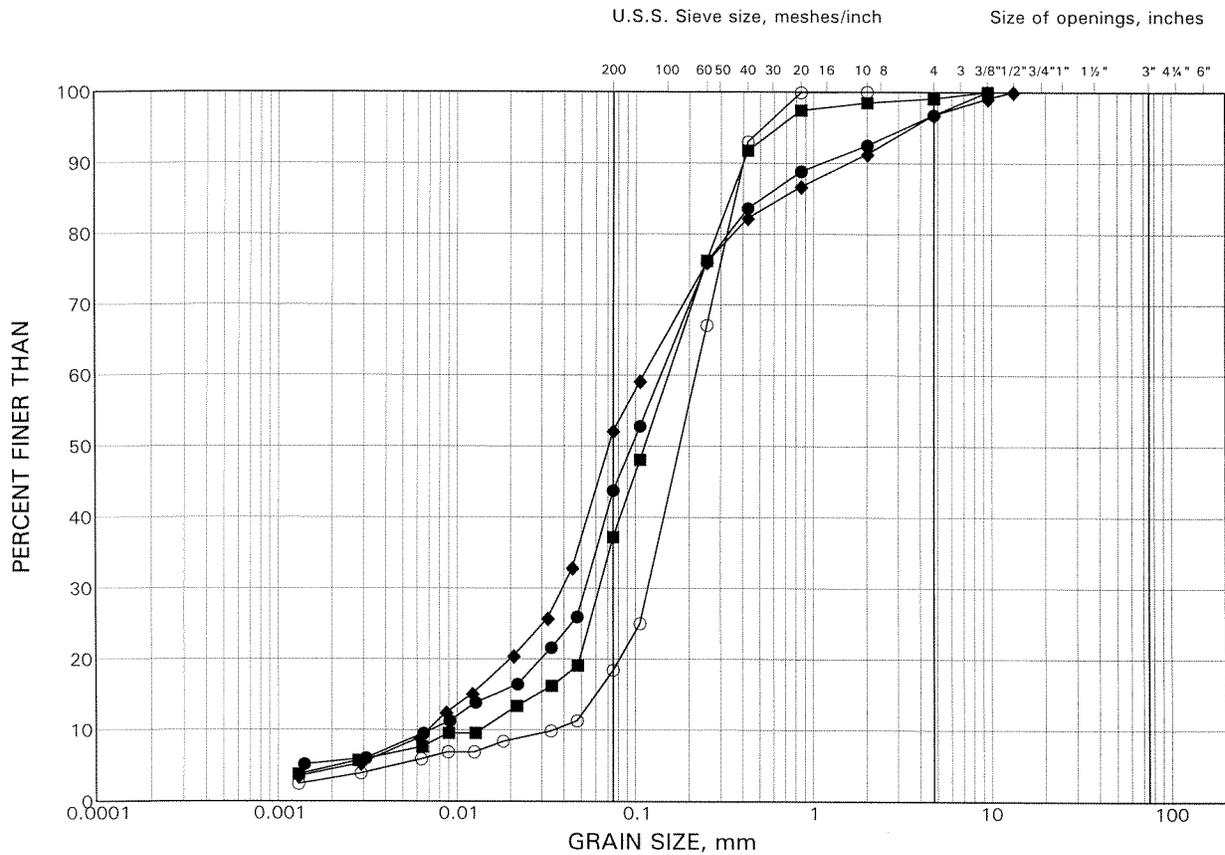


Ontario

GRAIN SIZE DISTRIBUTION TEST RESULTS

Sand to Sand and Silt

FIGURE 6



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

LEGEND

| SYMBOL | BOREHOLE | SAMPLE | ELEVATION (m) |
|--------|----------|--------|---------------|
| ● | 03-05 | 7 | 257.0 |
| ■ | 03-05 | 12 | 249.4 |
| ◆ | 03-10 | 11 | 236.5 |
| ○ | HML-4 | 7 | 259.8 |

APPENDIX A

**RECORD OF BOREHOLE 34
1999 INVESTIGATION
SHAHEEN & PEAKER LTD.**

RECORD OF BOREHOLE No 34

1 OF 1

METRIC

W.P. 130-99-00 LOCATION 4844632N;282062E ORIGINATED BY M.T
 DIST Central HWY 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY G.T
 DATUM Geodetic DATE 22.10.99 CHECKED BY Z.O

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | |
|---------------|---|------------|--------|------|----------------------------|-----------------|---|--------------------|----|-----|---|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|-------------------|----|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | SHEAR STRENGTH kPa | | | | | | | | | WATER CONTENT (%) | | | |
| | | | | | | 20 | 40 | 60 | 80 | 100 | | 20 | 40 | 60 | GR | SA | SI | CL | | |
| 248.6 | Ground Surface | | | | | | | | | | | | | | | | | | | |
| 0.0 | 400 mm TOPSOIL | | 1 | SS | 7 | | | | | | | | | | | | | | | |
| 248.2 | | | 2 | SS | 17 | | | | | | o | | | | 21.6 | 9 | 40 | 41 | 10 | |
| 0.4 | | | 3 | SS | 32 | | | | | | | | | | | | | | | |
| | Heterogeneous mixture of Clayey Silt some sand and gravel (CLAYEY SILT TILL) with Sandy Silt Till zones, some sand and silt seams/lenses, occasional cobbles and boulders, brown to 3.3 m, grey below, firm to stiff to 1.1 m, very stiff to hard below, damp to moist to 7.0 m, moist to wet below | | 4 | SS | 42 | | | | | | o | | | | 21.3 | | | | | |
| | | | 5 | SS | 52 | | | | | | | | | | | | | | | |
| | | | 6 | SS | 66/25 | | | | | | | o | | | | 21.5 | | | | |
| | | | 7 | SS | 36 | | | | | | | | | | | | 7 | 37 | 44 | 12 |
| | | | 8 | SS | 30 | | | | | | | o | | | | 22.8 | | | | |
| | | | 9 | SS | 26 | | | | | | | | | | | | | | | |
| | | | 10 | SS | 30 | | | | | | | o | | | | 21.6 | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| 237.0 | | | | 11 | SS | 68 | | | | | | | | | | | | | | |
| 9.6 | End of borehole Water level on completion at 6.8 m Water level not stabilized | | | | | | | | | | | | | | | | | | | |

APPENDIX B

**RECORD OF BOREHOLE 129
1999 INVESTIGATION
GOLDER ASSOCIATES LTD.**

W.P. 22-79-00

RECORD OF BOREHOLE 129

SHEET 1 OF 2

DIST. Stn 5+515

BORING DATE: Jan. 18, 1999

DATUM: Geodetic

LOCATION: N 4845562 E 596628 (NAD 83)

PROJECT: 981-8057



NB057129.BH

DATA INPUT: ph.n8057129.bh.1/99
SOILM6

| DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE | | SAMPLES | | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m | HYDRAULIC CONDUCTIVITY, k, cm/s | | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION |
|--------------------|---------------|---|-------------|-----------------|--------|--|---------------------------------|------------|-------------------------|--------------------------------------|
| | | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | NUMBER | | TYPE | BLOWS/0.3m | | |
| 0 | | GROUND SURFACE | | 259.00 | | | | | | |
| | | TOPSOIL | | 0.00 | | | | | | |
| | | CLAYEY SILT, some sand, trace gravel, trace organics Hard Brown Moist Some oxidation noted (TILL) | | 0.10 | 1 | AS | | | | |
| 1 | | | | | 2 | 50 DO | 75 | | | MH |
| | | | | | 3 | 50 DO | 50/10 | | | |
| 2 | | SAND and SILT, trace to some gravel, trace clay, cobbles Very dense Brown Moist Some oxidation noted (TILL) | | 257.04 | 4 | 50 DO | 95 | | | MH |
| | | | | 1.96 | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | 6 | 50 DO | 50/15 | | | |
| 6 | | | | | | | | | | |
| 7 | | SAND, some silt to SILTY SAND, trace gravel Very dense Brown Moist, becoming wet below 7.5 m depth | | 252.75 | 7 | 50 DO | 50/15 | | | |
| | | | | 6.25 | | | | | | |
| 8 | | | | | 8 | 50 DO | 98 | | | MH |
| 9 | | | | | | | | | | |
| | | | | | 9 | 50 DO | 83 | | | |
| 10 | | | | | | | | | | |

CONTINUED ON NEXT PAGE

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: MG

CHECKED:

W.P. 22-79-00
 DIST. Stn 5+515
 LOCATION: N 4845562 E 596628 (NAD 83)

RECORD OF BOREHOLE 129

BORING DATE: Jan. 18, 1999

SHEET 2 OF 2

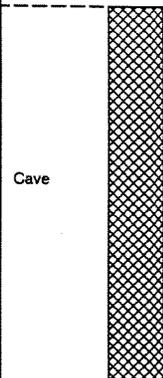
DATUM: Geodetic

PROJECT: 981-8057



N8057129 BH

| DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE | | SAMPLES | | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m | HYDRAULIC CONDUCTIVITY, k, cm/s | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION |
|--------------------|--|---|---------------|-----------------|------------------------|--|---------------------------------|-------------------------|--------------------------------------|
| | | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | NUMBER TYPE BLOWS/0.3m | | | | |
| 10 | POWER AUGER 115 mm Dia. Solid Stem Augers | CONTINUED FROM PREVIOUS PAGE | [Strata Plot] | | | | | | |
| 11 | | SAND, some silt to SILTY SAND, trace gravel Very dense Brown Moist, becoming wet below 7.5 m depth | | 10 | 50 DO 60/.15 | | | | |
| 12 | | | | 11 | 50 DO 50/.15 | | | | |
| 13 | | END OF BOREHOLE | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |



Water level in open borehole at 8.0 m depth upon completion of drilling

Borehole caved to 9.1 m depth upon completion of drilling

Water level in piezometer at 7.8 m depth on Jan. 21, 1999

SOIL.M6 DATA INPUT: ph n8057129.bh 1/99

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: MG
CHECKED: