

Golder Associates Ltd.

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



**FOUNDATION INVESTIGATION REPORT
CULVERTS
HIGHWAY 410 EXTENSION FROM
SANDALWOOD PARKWAY TO MAYFIELD ROAD
W.P. 101-00-00**

Submitted to:

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

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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 proposed structural culverts, as well as selected non-structural culverts extending into the swamp located south of Mayfield Road, associated with the Phase 2 extension of Highway 410. A foundation investigation has been carried out to determine the subsurface conditions at each of the proposed culvert locations, as identified in the following table:

<i>Station</i>	<i>Approximate Location</i>
Station 20+770 Highway 410 Mainline	Approximately 300 m north of Countryside Drive
Station 21+110 Highway 410 Mainline	Approximately 650 m north of Countryside Drive
Station 21+680 Highway 410 Mainline	About 40 m south of existing Mayfield Road, in swamp
Station 10+175 Mayfield W-S Ramp	About 50 m south of existing Mayfield Road, within swamp
Station 9+780 Mayfield Road	About 200 m west of Highway 410, outside of swamp
Station 9+885 Mayfield Road	About 100 m west of Highway 410, extending from Stormwater Pond No. 2 on north side of Mayfield Road, to swamp on south side
Station 10+130 Mayfield Road	About 100 m east of Highway 410 extending into Mayfield Road swamp
Station 10+190 Mayfield E-S Ramp	Approximately 100 m north of Mayfield Road, extending into Stormwater Pond No. 2

The terms of reference for the scope of work are outlined in the MTO's Request for Proposal and in Golder's Proposal No. P01-1166, dated June 2000.

2.0 SITE DESCRIPTION

The Phase 2 portion of the Highway 410 extension is located about 400 m to 500 m east of the existing Heart Lake Road, extending Sandalwood Parkway to about 400 m north of Mayfield Road, predominantly through farmland. The surface topography in the area is flat to slightly undulating, and in general slopes gradually and fairly uniformly to the south.

From Countryside Drive northward to Mayfield Road, the ground surface rises from about Elevation 248 m to 254 m. A relatively deep swamp is present in the low-lying area that is located immediately south/southeast of Mayfield Road; this swamp extends toward the north/northeast, passing under the existing Mayfield Road embankment. The ground surface within this swamp is at about Elevation 248 m to 250 m. Four of the proposed structural culverts will be located within, or extend into, this swamp.

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

Subsurface investigation were carried out by Golder at the culvert locations in May to July 2001, and in November and December 2003. A total of twenty-two boreholes were advanced at the culvert locations as part of these investigations. The borehole locations are shown on the Borehole Location and Soil Strata drawings contained in the Contract Documents.

The boreholes were drilled using bombardier-mounted drill rigs supplied and operated by Master Soil Investigations Ltd. of Toronto, Ontario, Geo-Environmental Drilling Inc. of Milton, Ontario, and Walker Drilling Ltd. of Utopia, Ontario. The boreholes were advanced using hollow stem augers (in the Mayfield Road swamp area) or solid stem augers (elsewhere). Samples of the overburden soils were obtained at 0.75 m to 1.5 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. Where softened cohesive soils were encountered within the Mayfield swamp, in situ vane testing was carried out using "N"-size vanes, and relatively undisturbed, thin-walled Shelby tube samples were obtained to permit oedometer (consolidation) testing. The water level in the open boreholes was observed throughout the drilling operations, and a standpipe piezometer was installed in two of the boreholes to monitor the groundwater level(s) at the proposed culvert locations.

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 limits tests, and grain size distribution tests) and oedometer tests were carried out on selected soil samples.

The borehole locations and ground surface elevations were established by Callon Dietz, Ontario Land Surveyors (OLS), or were determined by Golder relative to points staked by Callon Dietz OLS. The borehole locations, including MTM NAD83 northing and easting coordinates and ground surface elevations referenced to geodetic datum, are summarized in the following table and are shown on the Borehole Location and Soil Strata drawings contained in the Contract Documents.

<i>Culvert Location</i>	<i>Borehole Number</i>	<i>MTM NAD83 Northing (m)</i>	<i>MTM NAD83 Easting (m)</i>	<i>Ground Surface Elevation (m)</i>
Station 20+770 Highway 410 Mainline	C1-1	4,845,701.9	281,416.7	247.3
	E-2	4,845,730.8	281,378.0	247.9
Station 21+110 Highway 410 Mainline	E-9	4,846,034.3	281,204.0	251.0
	HML-2	4,845,992.8	281,231.8	249.5
Station 21+680 Highway 410 Mainline	03-09	4,846,367.4	280,808.5	248.6
	C-M4-2-1	4,846,293.4	280,740.2	249.5
	F-1	4,846,335.0	280,781.8	248.3
Station 10+175 Mayfield W-S Ramp	03-04	4,846,211.2	280,729.0	249.8
	WS-3	4,846,237.8	280,724.9	248.6
	C-M4-2-2	4,846,271.2	280,722.3	248.7
Station 9+780 Mayfield Road	03-1	4,846,194.2	280,556.7	255.1
	03-2	4,846,180.3	280,618.8	253.4
	03-3	4,846,169.9	280,656.5	249.9
	03-3A	4,846,169.6	280,658.5	249.9
Station 9+885 Mayfield Road	03-04	4,846,211.2	280,729.0	249.8
	ES-1	4,846,252.1	280,629.1	257.3
	MR-2	4,846,256.6	280,677.6	248.8
	WS-2	4,846,220.6	280,686.1	249.3
Station 10+130 Mayfield Road	03-10	4,846,410.5	280,841.9	248.9
	03-11	4,846,427.1	280,819.5	251.9
	C-M3-1	4,846,487.2	280,799.1	250.8
Station 10+190 Mayfield E-S Ramp	03-05	4,846,299.8	280,567.1	261.8
	03-06	4,846,339.2	280,524.1	263.9

4.0 SITE GEOLOGY AND STRATIGRAPHY

4.1 Regional Geological Conditions

The Phase 2 extension of Highway 410 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 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, as for example in the swamp south of Mayfield Road. In general, 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.

The subsurface investigations carried out for the Phase 2 extension of Highway 410 confirm the general regional geological conditions described above, except to the north/northwest of Mayfield Road where a partially buried esker ridge is present. In this area, the glacial till soils are underlain by cohesionless soils consisting of sands, silts, and gravels.

4.2 Subsoil Conditions: Culverts at Stations 20+770 and 21+110

The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of the in situ and laboratory testing are given on records for Boreholes C1-1, E-2, E-9 and HML-2, and on Figures 1 and 3 following the text of this report. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

In summary, the soils encountered in Boreholes C1-1, E-2, E-9 and HML-2 consist of a relatively thin surficial layer of clayey silt or sandy silt, overlying a stiff to hard clayey silt till deposit. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections, and a stratigraphic profile at the culvert locations is shown on the Borehole Location and Soil Strata drawing contained in the Contract Documents.

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.

4.2.1 Surficial Clayey Silt and Sandy Silt

Below 0.2 m of topsoil in Borehole E-9, a 0.6 m thick layer of sandy silt was encountered. Below 0.2 m to 0.3 m of topsoil in Boreholes C1-1, E-2 and HML-2, a 1.1 m to 1.3 m thick surficial deposit of clayey silt was encountered atop the clayey silt till deposit. The clayey silt contains trace to some sand, and silt partings were observed in one of the recovered samples. Grain size distribution test results for two samples of this surficial clayey silt are presented on Figure 1. The surficial clayey silt has a firm to stiff consistency, based on measured SPT “N” values of 4 to 14 blows per 0.3 m of penetration.

4.2.2 Clayey Silt Till

The surficial soils are underlain by a glacial till deposit that consists of clayey silt with sand to trace sand, and trace gravel; the results of two grain size distribution tests are shown on Figure 2. An interlayer of silty sand was encountered within the till in Borehole E-9, and an interlayer of sand and gravel, containing some silt, was encountered at the base of Borehole E-2; this layer is at least 0.4 m thick.

Atterberg limit testing was conducted on four selected samples of the glacial till from Boreholes C1-1 and HML-2. The results, presented on Figure 2, confirm that this till is a clayey silt of low plasticity, based on plastic limits of 14 to 16 per cent, liquid limits of 21 to 28 per cent, and plasticity indices of 7 to 12 per cent.

The measured SPT “N” values in the clayey silt till encountered in Boreholes C1-1, E-2, E-9 and HML-2 range from 12 to 58 blows per 0.3 m of penetration, but are generally above 20 blows per 0.3 m of penetration. These results indicate that the clayey silt till at this location has a stiff to hard, but typically very stiff to hard, consistency. One SPT “N” value of 34 blows per 0.3 m of penetration was measured within the sand and gravel interlayer; this interlayer has a dense relative density.

4.3 Subsoil Conditions: Culverts at Mayfield Road Interchange

The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of the in situ and laboratory testing are given on the Record of Borehole sheets and on Figures 4 to 10 following the text of this report. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

The following table summarizes the subsurface conditions encountered in the boreholes at the proposed culvert locations at the Mayfield Road interchange:

<i>Culvert Location</i>	<i>Borehole Number</i>	<i>Summary of Subsurface Conditions Encountered in Boreholes</i>
Station 21+680 Highway 410 Mainline	03-09 C-M4-2-1 F-1	Between 2.3 m and 9.9 m of peat and organic silty clay, overlying a layer of very soft to firm clayey silt to silty clay that is up to 5 m thick, in turn underlain by loose silty sand and/or stiff to hard clayey silt till.
Station 10+175 Mayfield W-S Ramp	03-04 WS-3 C-M4-2-2	Between 3 m and 5.2 m of peat, overlying a 0.3 m to 1.4 m thick layer of very soft to soft silty clay. The silty clay is underlain by loose to compact sand to sandy silt and/or firm to hard clayey silt till.
Station 9+780 Mayfield Road	03-01 03-02 03-03 03-03A	The predominant subsoils consist of stiff to very stiff clayey silt till, overlying compact to dense sand, sand and gravel, and sand and silt. These subsoils are overlain by the following surficial materials: <ul style="list-style-type: none"> • North end: Borehole 03-01 encountered about 2.7 m of fill (associated with the existing Mayfield Road embankment) overlying the till deposit. • Central area: Borehole 03-02 encountered a 1.5 m thick surficial layer of soft to firm clayey silt, overlying the glacial till. • South end: Boreholes 03-03 and 03-03A encountered between 0.5 m and 1.5 m of organic sandy silt soil. However, the south end of this culvert is located outside of the limits of the swamp.
Station 9+885 Mayfield Road	03-04 ES-1 MR-2 WS-2	North of Mayfield Road, about 3.1 m of variable fill overlying an extensive deposit that ranges in composition from sand to silt. South of Mayfield Road, between 0.8 m and 4.6 m of peat overlying a thin layer of very soft to firm silty clay or very loose to compact sandy silt to silty sand, in turn underlain by a deposit of silty sand to sand, or a clayey silt till deposit.
Station 10+130 Mayfield Road	03-10 03-11 C-M3-1	Between 3 m and 4.6 m of peat/organic soils, overlying stiff to hard clayey silt till or loose to compact silty sand to sand and gravel. About 2.3 m of fill (associated with the existing Mayfield Road embankment) was encountered in Borehole 03-11, directly overlying a thin layer of firm clayey silt, over very stiff to hard clayey silt till; no peat or organic soil was encountered below the existing fill in this borehole.
Station 10+190 Mayfield E-S Ramp	03-05 03-06	About 1.8 m and 3.8 m of clayey silt fill, overlying 2.8 m to 5.3 m of very stiff to hard clayey silt till, in turn underlain by a dense to very dense sand to sand and silt deposit.

A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections, and stratigraphic profiles at those culvert locations which are located within or extend into the swamp are shown on the Borehole Location and Soil Strata drawing contained in the Contract Documents.

4.3.1 Fill

About 2.3 m to 3.1 m of fill material was encountered in Boreholes 03-01, 03-11, and ES-1, which were drilled adjacent to the existing Mayfield Road embankment. The existing

embankment fill material encountered in these boreholes consists of firm to stiff (based on SPT “N” values of 4 to 13 blows per 0.3 m of penetration) clayey silt, and very loose to compact (based on SPT “N” values of 3 to 14 blows per 0.3 m of penetration) silty sand to sand and gravel.

About 1.8 m and 3.8 m of fill material was encountered in Boreholes 03-05 and 03-06, respectively, in area north of Mayfield Road. This fill consists of clayey silt containing trace to some sand and trace gravel, as well as trace quantities of organics and rootlets. The fill has a firm to very stiff consistency, based on measured SPT “N” values of 4 to 20 blows per 0.3 m of penetration.

4.3.2 Peat / Organic Soils

The approximate extent of the swampy area in the vicinity of Mayfield Road is shown in the Contract Documents. Peat and/or organic soils were encountered immediately below ground surface in the following boreholes located within the limits of this swamp; in general, the peat/organic soil layer is thickest in the central portion of the swamp, and thinner toward the outer edges.

<i>Borehole Number</i>	<i>Thickness of Peat/ Organic Soils (m)</i>	<i>Elevation of Base of Peat/Organic Soils (m)</i>
03-03	0.5	249.4
03-03A	1.5	248.4
03-04	4.6	245.2
03-09	2.3	246.3
03-10	4.6	244.3
C-M3-1	3.0	247.7
C-M4-2-1	9.9	239.6
C-M4-2-2	5.2	243.5
F-1	5.0	243.3
MR-2	0.8	248.0
WS-2	0.8	248.5
WS-3	3.0	245.6

The result of Atterberg limit tests on two sample of organic silt from Boreholes 03-10 and F-1 are plotted on Figure 4. It is noted that the Atterberg limit test results from Borehole F-1 plot outside of the limits of the plasticity chart.

The measured SPT “N” values in the peat and organic silty clay vary from 0 (weight of hammer) to 2 blows per 0.3 m of penetration, indicative of a very soft to soft consistency. In the organic silt and organic sandy silt that was encountered in Boreholes 03-03, 03-03A and C-M3-1, the measured SPT “N” values range from 2 to 6 blows (but typically 2 to 4 blows) per 0.3 m of penetration, indicative of a generally very loose to loose relative density.

4.3.3 Clayey Silt to Silty Clay

A layer of clayey silt to silty clay was encountered at ground surface in Borehole 03-02, below the existing embankment fill in Borehole 03-11, and below the peat/organic soils in Boreholes 03-04, 03-09, C-M4-2-2, F-1, WS-2 and WS-3. This layer varies in thickness from about 0.3 m to 5.1 m, as encountered in the boreholes. The clayey silt to silty clay contains trace sand and gravel, and often contains trace organics in the upper portion of the layer; sand partings or seams were observed in some of the samples.

Atterberg limit testing was carried out on six samples of the clayey silt to silty clay layer. The results, plotted on the plasticity chart on Figure 5, confirm that this material is typically a clayey silt of low plasticity, based on the measured plastic limits of 12 to 18 per cent, liquid limits of 19 to 30 per cent, and plasticity indices of 7 to 12 per cent.

The measured SPT “N” values in the clayey silt to silty clay layer range from 0 (weight of hammer) to 8 blows per 0.3 m of penetration. In situ vane testing carried out within this layer measured undrained shear strengths of approximately 35 kPa to 70 kPa. Together, these results indicate that this material typically has a soft to stiff consistency.

Oedometer (consolidation) testing was carried out on one specimen of the surficial clayey silt to silty clay obtained from a thin-walled Shelby tube sample that was retrieved from Borehole 03-09. The following table and Figures 6A to 6D summarise the engineering parameters for this material as interpreted from the oedometer testing. The results of oedometer testing from two specimens of clayey silt to silty clay obtained in other boreholes in the area (advanced as part of the investigations for the Mayfield Road underpass structure) are also provided in the following table, for comparison purposes.

<i>Borehole No.</i>	<i>Sample Depth</i>	<i>Unit Wt. (kN/m³)</i>	<i>σ_p' (kPa)</i>	<i>σ_{vo}' (kPa)</i>	<i>Cc</i>	<i>Cr</i>	<i>e_o</i>	<i>OCR</i>
03-09	5.3 m	23.1	NA	64	0.07	0.02	0.27	NA
M-3	8.2	18.0	70	69	0.26	0.05	1.05	1.0
M-5	6.1	23.0	NA	138	0.06	0.02	0.31	NA

NOTES:

σ_p'	Apparent preconsolidation pressure	σ_{vo}'	Computed existing vertical effective stress
Cc	Compression index	Cr	Recompression index
e _o	Initial void ratio	OCR	Overconsolidation ratio

4.3.4 Upper Sand, Silty Sand, and Sand and Gravel

A 1.4 m to more than 10 m thick layer of sandy soil was encountered below the peat/organic soils and, where present, the clayey silt to silty clay layer, in Boreholes 03-03A, C-M3-1, C-M4-2-1, C-M4-2-2, ES-1, and WS-2. This layer ranges in composition from sand or silty sand containing trace to some gravel, to silt containing some sand, to sand and gravel containing trace silt; pockets

or lenses of clayey silt were observed within the layer in some of the recovered samples. The results of seven grain size distribution tests on selected samples of this material are presented on Figure 7.

The measured SPT “N” values within this layer of sand, silty sand, and sand and gravel range from 2 to 25 blows per 0.3 m of penetration, although the lowest measured “N” value of 2 blows is considered to have been affected by sample disturbance due to groundwater inflow to the borehole. The layer is considered, therefore, to have a generally loose to compact relative density.

4.3.5 Clayey Silt Till

A deposit of glacial till is present below the fill in Boreholes 03-01, 03-05 and 03-06, below the peat/organic soils in Borehole 03-10, below the surficial clayey silt to silty clay in Boreholes 03-02, 03-04, 03-09, 03-11, F-1, WS-2 and WS-3, and below the upper sandy deposit in Boreholes 03-03A, C-M3-1, C-M4-2-1, C-M4-2-2 and MR-2; the till was absent in Boreholes 03-03 and ES-1. The surface of the glacial till deposit was encountered in the above-noted boreholes between Elevations 260.1 m and 238.2 m.

The glacial till deposit consists of clayey silt with sand to trace sand, and trace to some gravel. The results of six grain size distribution tests conducted on selected samples of the till are shown on Figure 8. Atterberg limit testing carried out on sixteen samples of the clayey silt till measured plastic limits of 11 to 16 per cent, liquid limits of 18 to 33 per cent, and plasticity indices of 7 to 15 per cent. These results, which are summarized on the plasticity chart on Figure 9, confirm that the till is a clayey silt of low plasticity.

The measured SPT “N” values within the clayey silt till range from 6 to 64 blows per 0.3 m of penetration, but more typically 10 to 35 blows per 0.3 m of penetration; the till, therefore, typically has a stiff to hard consistency.

4.3.6 Lower Sand to Sandy Silt

A lower deposit, ranging in composition from sand, to sand and gravel, to sandy silt, was encountered below the glacial till deposit in several of the boreholes (Boreholes 03-01, 03-02, 03-03, 03-03A, 03-05, 03-06, 03-09, 03-10, 03-11, MR-2, and WS-3) that were advanced at the Mayfield Road site in the vicinity of the “esker ridge”. The results of ten grain size distribution tests conducted on selected samples of this deposit are shown on Figure 10.

The measured SPT “N” values within the lower sand to sandy silt deposit encountered in these boreholes range from 0 (weight of hammer) to greater than 100 blows per 0.3 m of penetration, although the lowest measured “N” values of 0 to 5 blows are considered to be the result of sample

disturbance due to groundwater inflow to the boreholes. The lower sand to sandy silt deposit is therefore considered to have a loose to very dense, but typically compact to dense, relative density.

4.4 Groundwater Conditions

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

<i>Borehole No.</i>	<i>Borehole Location</i>	<i>Depth to Groundwater</i>	<i>Groundwater Elevation</i>	<i>Date of Measurement</i>
03-10	Swamp south of Mayfield Road	0.8 m Above surface	249.7 m	Dec 11, 2003
C1-1	Approx. 300 m north of Countryside Drive	1.9 m	245.5 m	Feb 19, 2004

Based on the above measurements, site reconnaissance, and the results from other boreholes in the vicinity of the Mayfield Road interchange (not included with this report), the groundwater conditions at the site are summarized as follows:

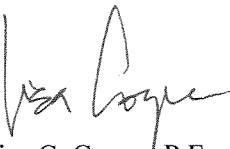
- In the low-lying swampy area south of Mayfield Road, the groundwater level is at or above the ground surface, up to about Elevation 250 m.
- To the north/northwest of Mayfield Road, the groundwater level is at about Elevation 250 m to 251 m; this groundwater level is generally within the lower sand to sand and silt deposit.
- South toward Countryside Drive, the water level declines along with the ground surface; the water level is typically between 2 m and 3 m depth below the ground surface.

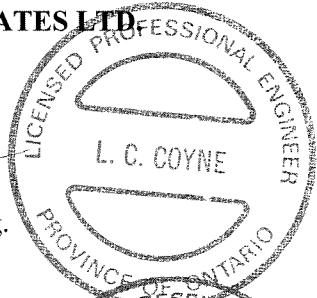
It should be noted that the groundwater levels are expected to fluctuate seasonally, and should be expected to rise during wet periods of the year.

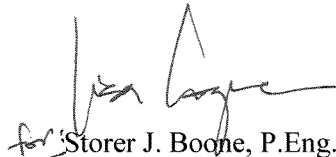
5.0 CLOSURE


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

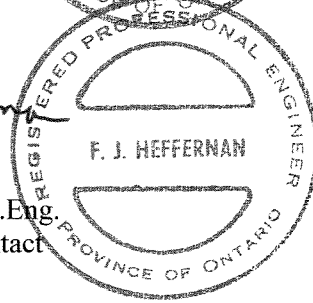
GOLDER ASSOCIATES LTD.


Lisa C. Coyne, P.Eng.
Associate




Storer J. Boone, P.Eng.
Associate


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



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N:\ACTIVE\2000\1100\001-1159\REPORTS AND MEMOS\FINAL REPORTS\001-1159-4 FIR 06FEB CULVERTS.DOC

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 = (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)

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 03-01		2 OF 2 METRIC	
W.P. <u>101-00-00</u>		LOCATION <u>N 4846194.2 ; E 280556.7</u>		ORIGINATED BY <u>GPD</u>	
DIST <u> </u> HWY <u>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 19, 2003</u>		CHECKED BY <u>LCC</u>	

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT			UNIT WEIGHT γ	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 + FIELD VANE						WATER CONTENT (%)			
	— CONTINUED FROM PREVIOUS PAGE —						● QUICK TRIAXIAL × REMOULDED	20	40	60	80	100	25	50	75			
	End of Borehole Notes: 1. Water level in open borehole at 4.6 m depth (Elev. 250.5 m) on completion of drilling.																	

PROJECT <u>001-1159-4</u>		RECORD OF BOREHOLE No 03-02		1 OF 2 METRIC	
W.P. <u>101-00-00</u>		LOCATION <u>N 4846180.3 ; E 280618.8</u>		ORIGINATED BY <u>GPD</u>	
DIST <u> </u> HWY <u>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 26, 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					W _p W W _L				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
253.4	Ground Surface																
0.0	Clayey Silt, some sand, containing rootlets Soft to firm Brown Moist		1	SS	3		253										
			2	SS	5		252										
251.9																	
1.5	Clayey Silt, trace to some sand, trace gravel (TILL) Stiff to very stiff Brown to grey Moist		3	SS	8		251										
			4	SS	13												
			5	SS	18		250										
	Becoming grey below 3.8 m depth		6	SS	28												
			7	SS	27		249										
								248									
247.3																	
6.1	Sand, trace to some silt Compact Brown Wet		8	SS	22	247											
							246										
			9	SS	18												
							245										
			10	SS	17												
						244											

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

PROJECT <u>001-1159-4</u>		RECORD OF BOREHOLE No 03-02				2 OF 2 METRIC																
W.P. <u>101-00-00</u>		LOCATION <u>N 4846180.3 ; E 280618.8</u>				ORIGINATED BY <u>GPD</u>																
DIST <u> </u> HWY <u>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 26, 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 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									
	--- CONTINUED FROM PREVIOUS PAGE ---						<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED </div>					WATER CONTENT (%)										
242.3	Sand, trace to some silt Compact Brown Wet	[Pattern]	11	SS	21		243															
11.1	End of Borehole Notes: 1. Water level in open borehole at 1.4 m depth (Elev. 252.0 m) on completion of drilling.																					

[illegible]


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

MIS-MTO 001 001-1159-4-MTO.GPJ ON MOT.GDT 12/2/06

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

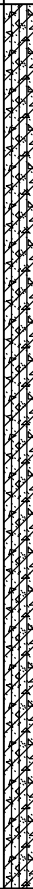
PROJECT <u>001-1159-4</u>		RECORD OF BOREHOLE No 03-03A		2 OF 2 METRIC	
W.P. <u>101-00-00</u>		LOCATION <u>N 4846169.6 ; E 280658.5</u>		ORIGINATED BY <u>GPD</u>	
DIST <u> </u> HWY <u>410</u>		BOREHOLE TYPE <u>CME 55 Bombardier, 108 mm ID Hollow Stem Augers</u>		COMPILED BY <u>KG</u>	
DATUM <u>Geodetic</u>		DATE <u>November 25, 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 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		
								<div><div><div>20 40 60 80 100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × REMOULDED</div></div></div>									
								WATER CONTENT (%)									
								<div><div>20 40 60 80 100</div><div></div></div>					<div><div>25 50 75</div><div></div></div>				
235.7	Sand, some silt, trace gravel Loose to compact Grey Wet		11	SS	18		239									0 82 15 3	
							238										
			12	SS	14		237										

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

MIS-MTO 001 001-1159-4-MTO.GPJ ON MOT.GDT 12/2/06



PROJECT <u>001-1159-4</u>		RECORD OF BOREHOLE No 03-04		2 OF 2 METRIC	
W.P. <u>101-00-00</u>		LOCATION <u>N 4846211.2 ; E 280729.0</u>		ORIGINATED BY <u>PKS</u>	
DIST <u> </u> HWY <u>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>December 09, 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			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								<div><div></div><div>20406080100</div></div> <div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED</div>					<div><div></div><div>255075</div></div> <div>W_p W W_L</div>				
--- CONTINUED FROM PREVIOUS PAGE ---																	
234.0 15.9	Clayey Silt, some sand, trace to some gravel (TILL) Firm to hard Grey Moist to wet		12	SS	34		239									6 36 42 16	
							238										
							237										
							236										
							235										
							15	SS	64								
										234							
	End of Borehole																
	Note: 1. Water level in open borehole at ground surface (Elevation 249.8 m) on completion of drilling.																

MIS-MTO 001 001-1159-4-MTO.GPJ ON MOT.GDT 12/2/06



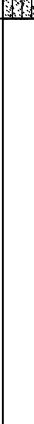
+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>001-1159-4</u>		RECORD OF BOREHOLE No 03-05		2 OF 2 METRIC	
W.P. <u>101-00-00</u>		LOCATION <u>N 4846299.8 ; E 280567.1</u>		ORIGINATED BY <u>PKS / GPD</u>	
DIST <u> </u> HWY <u>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 13, 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			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				W _p W W _L					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
--- CONTINUED FROM PREVIOUS PAGE ---																	
246.1 15.7	Sand and Silt to Sand, some silt, trace clay and gravel Dense to very dense Brown Dry to moist		11	SS	58		251									2 61 33 4	
			12	SS	39												
			13	SS	51												
			14	SS	55		247										
	End of Borehole																
	Note: 1. Water level in open borehole at 12.2 m depth (Elev. 249.6 m) on completion of drilling.																

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

MIS-MTO 001 001-1159-4-MTO.GPJ ON MOT.GDT 12/2/06

PROJECT 001-1159-4		RECORD OF BOREHOLE No 03-06				2 OF 2 METRIC											
W.P. 101-00-00		LOCATION N 4846339.2 ; E 280524.1				ORIGINATED BY GPD											
DIST _____ HWY 410		BOREHOLE TYPE CME 55 Bombardier, 108 mm ID Hollow Stem Augers				COMPILED BY KG											
DATUM Geodetic		DATE November 18, 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 (%)
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100						
251.1	Sand, trace to some silt Very dense Brown Moist		11	SS	60												
			12	SS	58												
12.8	Sand and Silt, trace to some clay, trace gravel Very dense Brown Moist																
			13	SS	78												
248.2																	
15.7	End of Borehole		14	SS	67												
	Note: 1. Open borehole dry on completion of drilling operations																

MIS-MTO 001 001-1159-4-MTO.GPJ ON MOT.GDT 12/2/06

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

PROJECT 001-1159-4			RECORD OF BOREHOLE No 03-09			2 OF 2 METRIC											
W.P. 101-00-00			LOCATION N 4846367.4 ; E 280808.5			ORIGINATED BY GPD											
DIST _____ HWY 410			BOREHOLE TYPE CME 55 Bombardier, 108 mm ID Hollow Stem Augers			COMPILED BY KG											
DATUM Geodetic			DATE November 12, 2003			CHECKED BY LCC											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m ³	GR SA SI CL
							20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	25 50 75					
	--- CONTINUED FROM PREVIOUS PAGE ---																
	Clayey Silt, trace to some sand, trace to some gravel (TILL) Stiff to hard Grey Moist		11	SS	21		238										
							237										
			12	SS	34		236										
	Sand seam between 12.8 and 14 m depth																
			13	SS	22		235										
							234										
233.4																	
15.2	Silty Sand, trace to some clay and gravel Dense Grey Wet		14	SS	30		233										
232.9																	
15.7	End of Borehole																
	Note: 1. Approximately 0.2 m standing surface water present at borehole location prior to drilling. Water level in open borehole at 4.6 m depth (Elev. 244.0 m) on completion of drilling.																

MIS-MTO 001 001-1159-4-MTO.GPJ ON_MOT.GDT 12/2/06

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

MIS-MTO 001 001-1159-4-MTO.GPJ ON MOT.GDT 12/2/06




PROJECT 001-1159-4		RECORD OF BOREHOLE No 03-10				2 OF 2 METRIC												
W.P. 101-00-00		LOCATION N 4846410.5 ; E 280841.9				ORIGINATED BY GPD												
DIST _____ HWY 410		BOREHOLE TYPE CME 55 Bombardier, 108 mm ID Hollow Stem Augers				COMPILED BY KG												
DATUM Geodetic		DATE November 20, 2003				CHECKED BY LCC												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m ³	GR SA SI CL	
							20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	25 50 75						
	--- CONTINUED FROM PREVIOUS PAGE ---							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED										
237.8	Clayey Silt with sand to some sand, trace gravel (TILL) Stiff to hard Grey Moist		10	SS	26		238											
11.1	Sand and Silt, trace clay and gravel Very loose to compact Grey Wet						237											
			11	SS	3		236											
							235											
							234											
233.7	Sand, trace gravel and silt Compact Brown Wet		12	SS	16													
233.2	End of Borehole																	
15.7	Note: 1. Water level in piezometer at 0.8 m above ground surface (at Elev. 249.7 m) on Dec 11, 2003																	

MIS-MTO 001 001-1159-4-MTO.GPJ ON_MOT.GDT 12/2/06

MIS-MTO 001 001-1159-4-MTO.GPJ ON MOT.GDT 12/2/06

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

PROJECT <u>001-1159-4</u>		RECORD OF BOREHOLE No 03-11				2 OF 2 METRIC														
W.P. <u>101-00-00</u>		LOCATION <u>N 4846427.1 ; E 280819.5</u>				ORIGINATED BY <u>GPD</u>														
DIST <u> </u> HWY <u>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 21, 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 ---						<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE </div> <div style="display: flex; justify-content: space-between;"> ● QUICK TRIAXIAL × REMOULDED </div>					<div style="display: flex; justify-content: space-between;"> 25 50 75 </div>								
241.2	Sand and Silt, trace clay, trace to some gravel Very dense Grey Moist																			
10.7	Sand, trace silt Loose		11	SS	0*	241														
240.8	Brown Wet																			
11.1	End of Borehole																			
	Notes: 1. Water level in open borehole at 3.7 m depth (Elev. 248.2 m) on completion of drilling. * SPT "N" value considered to have been affected by sample disturbance, due to groundwater inflow to borehole.																			

PROJECT <u>001-1159-3</u>		RECORD OF BOREHOLE No C1-1		1 OF 2 METRIC	
W.P. <u>101-00-00</u>		LOCATION <u>N 4845701.9 ; E 281416.7</u>		ORIGINATED BY <u>GD</u>	
DIST <u> </u> HWY <u>410</u>		BOREHOLE TYPE <u>CME 55 Bombardier, 108 mm Diameter Solid Stem Augers</u>		COMPILED BY <u>SP</u>	
DATUM <u>Geodetic</u>		DATE <u>May 11, 2001</u>		CHECKED BY <u>LCC</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL 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 (%)				
								20 40 60 80 100					W _p	W	W _L		
247.3	Ground Surface																
247.1	Topsoil																
0.2	Clayey Silt, some sand, trace gravel Stiff Brown Moist		1	AS	-												
			2	SS	13										1 19 57 23		
245.8																	
1.5	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												
			4	SS	39							H					
			5	SS	22							H					
			6	SS	20												
			7	SS	22												
			8	SS	31												
			9	SS	33												
			10	SS	21												
237.4																	

Continued Next Page

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

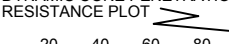
PROJECT <u>001-1159-3</u>		RECORD OF BOREHOLE No C1-1				2 OF 2 METRIC										
W.P. <u>101-00-00</u>		LOCATION <u>N 4845701.9 ; E 281416.7</u>				ORIGINATED BY <u>GD</u>										
DIST <u> </u> HWY <u>410</u>		BOREHOLE TYPE <u>CME 55 Bombardier, 108 mm Diameter Solid Stem Augers</u>				COMPILED BY <u>SP</u>										
DATUM <u>Geodetic</u>		DATE <u>May 11, 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								
	--- 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															

PROJECT <u>001-1159-3</u>		RECORD OF BOREHOLE No C-M3-1		1 OF 2 METRIC	
W.P. <u>101-00-00</u>		LOCATION <u>N 4846487.2 ; E 280799.1</u>		ORIGINATED BY <u>PKS</u>	
DIST <u> </u> HWY <u>410</u>		BOREHOLE TYPE <u>CME 55 Bombardier, 108 mm ID Hollow Stem Augers</u>		COMPILED BY <u>JDR</u>	
DATUM <u>Geodetic</u>		DATE <u>June 28, 2001</u>		CHECKED BY <u>LCC</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL 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 (%)				
250.8	Ground Surface						20 40 60 80 100										
0.0	Organic Silty Sand, containing zones of clayey silt and peat Loose Black/grey Wet		1	SS	4												
			2	SS	2												
			3	SS	3												
			4	SS	2												
247.7																	
3.0	Silty Sand, trace gravel to Sand and Gravel, trace silt, containing clayey silt lenses Loose to compact Grey Wet		5	SS	9												
			6	SS	2*												
			7	SS	16												
			8	SS	17												
			9	SS	14												

Continued Next Page

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

PROJECT 001-1159-3			RECORD OF BOREHOLE No C-M3-1				2 OF 2 METRIC				
W.P. 101-00-00		LOCATION N 4846487.2 ; E 280799.1				ORIGINATED BY PKS					
DIST _____ HWY 410		BOREHOLE TYPE CME 55 Bombardier, 108 mm ID Hollow Stem Augers				COMPILED BY JDR					
DATUM Geodetic		DATE June 28, 2001				CHECKED BY LCC					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × 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						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Clayey Silt, some sand, trace gravel (TILL) Hard Grey Wet to moist		11	SS	34		240		H		
							239				
			12	SS	37						
238.0							238				
12.8	End of Borehole Notes: 1. Water level in open borehole at 0.4 m depth (Elev. 250.4 m) upon completion of drilling. * SPT "N" value considered to be affected by sample disturbance due to groundwater inflow to borehole.										

PROJECT <u>001-1159-1</u>		RECORD OF BOREHOLE No C-M4-2-1		1 OF 2 METRIC	
W.P. <u>101-00-00</u>		LOCATION <u>N 4846293.4 ; E 280740.2</u>		ORIGINATED BY <u>PKS</u>	
DIST <u> </u> HWY <u>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>July 3, 2001</u>		CHECKED BY <u>SP</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL 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 (%)				
249.5	Ground Surface															
0.0	Fibrous to Amorphous Peat, containing shells and layers of marl Very soft Dark brown to black Wet		1	SS	1											
			2	SS	1											
			3	SS	1											
			4	SS	WH											
			5	SS	WH											
			6	SS	WH											
			7	SS	WH											
			8	SS	WH											
			9	SS	WH											
242.6	Organic Silty Clay, trace sand Very soft Brown/black Wet		10	SS	WH											
6.9			11	SS	WH											
			12	TO	PH											
			13	TO	PH											
239.6																

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

MIS-MTO 001 001-1159-1-MTO.GPJ ON_MOT.GDT 12/2/06

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

MIS-MTO 001 001-1159-1-MTO.GPJ ON MOT.GDT 12/2/06

PROJECT <u>001-1159-1</u>		RECORD OF BOREHOLE No C-M4-2-2		1 OF 2 METRIC	
W.P. <u>101-00-00</u>		LOCATION <u>N 4846271.2 ; E 280722.3</u>		ORIGINATED BY <u>PKS</u>	
DIST <u> </u> HWY <u>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>July 4, 2001</u>		CHECKED BY <u>SP</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL 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		W _p W W _L				
248.7	Ground Surface						20	40	60	80	100					
0.0	Peat, containing shells Fibrous to amorphous Very soft Black/brown Wet		1	SS	1		248									
			2	SS	1		247									
			3	SS	1		246									
			4	SS	WH		245									
			5	SS	WH		244									
			6	SS	WH		243									
			7	SS	WH		242									
							241									
							240									
243.5																
5.2	Silty Clay, trace sand															
243.2	Soft Grey															
5.5	Wet		8	SS	5											
	Sand, some silt and gravel															
	Compact Grey-brown		9	SS	14											
	Wet															

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

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

MIS-MTO 001 001-1159-1-MTO.GPJ ON MOT.GDT 12/2/06

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


MIS-MTO 001 001-1159-3-MTO.GPJ ON MOT.GDT 12/2/06

PROJECT 001-1159-3		RECORD OF BOREHOLE No E-9				1 OF 1 METRIC											
W.P. 101-00-00		LOCATION N 4846034.3 ; E 281204.0				ORIGINATED BY AR											
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			SHEAR STRENGTH kPa									
251.0	Ground Surface																
0.0	Topsoil																
250.8																	
0.2	Sandy Silt, trace organics, trace clay Brown Moist		1	AS	-												
250.3																	
0.8	Clayey Silt, some sand, trace gravel (TILL) Very stiff to hard Brown to grey Moist		2	SS	24												
	Silty Sand layer at 1.7 m depth		3	SS	31												
			4	SS	58												
			5	SS	47												
			6	SS	40												
			7	SS	23												
246.0	End of Borehole																
5.0	Notes: 1. Open borehole dry upon completion of drilling operations.																

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

MIS-MTO 001 001-1159-3-MTO.GPJ ON MOT.GDT 12/2/06


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

PROJECT <u>001-1159-3</u>		RECORD OF BOREHOLE No ES-1				2 OF 2 METRIC											
W.P. <u>101-00-00</u>		LOCATION <u>N 4846252.1 ; E 280629.1</u>				ORIGINATED BY <u>PKS</u>											
DIST <u> </u> HWY <u>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 25, 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 ---																	
	Sand, some silt, trace gravel Compact Brown and grey Wet		11	SS	19		247									o	0 78 22 0
							246										
							245										
			12	SS	19		244										
							243										
			13	SS	25		242										
			14	SS	23												
241.5	End of Borehole																
15.9	Notes: 1. Water encountered at about depth 3.8 m (Elev. 253.5 m) during drilling																

MIS-MTO 001 001-1159-1-MTO.GPJ ON MOT.GDT 12/2/06

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

PROJECT <u>001-1159-1</u>		RECORD OF BOREHOLE No F-1				2 OF 2 METRIC												
W.P. <u>101-00-00</u>		LOCATION <u>N 4846335.0 ; E 280781.8</u>				ORIGINATED BY <u>PKS</u>												
DIST <u> </u> HWY <u>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>June 11, 2001</u>				CHECKED BY <u>SP</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 ---																		
238.4 10.1	Clayey Silt with sand to some sand, trace gravel (TILL) Stiff to hard Grey Wet					238												
			11	SS	18		237											
							236											
			12	SS	26		235											
							234											
			13	SS	32													
234.0 14.3	End of Borehole																	
	Notes: 1. Approximately 100 mm of standing water present at ground surface prior to start of drilling. 2. Water level in open borehole at 4.6 m depth (Elev. 243.7 m) upon completion of drilling.																	

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> </u> HWY <u>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>	

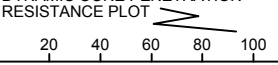
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20 40 60 80 100					W _p W W _L				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
249.5	Ground Surface																
0.0	Topsoil																
249.2			1	SS	4												
0.3	Clayey Silt, trace sand and gravel Firm to stiff Brown Moist																
			2	SS	8												
248.1																	
1.4	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																
			3	SS	40												
			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																	

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

PROJECT <u>001-1159-5</u>		RECORD OF BOREHOLE No HML-2				2 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> </u> HWY <u>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 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 ---							<div style="display: flex; justify-content: space-between; font-size: small;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between; font-size: x-small;"> ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED </div>												
	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

PROJECT 001-1159-3			RECORD OF BOREHOLE No MR-2			1 OF 2 METRIC					
W.P. 101-00-00			LOCATION N 4846256.6 ; E 280677.6			ORIGINATED BY PKS					
DIST _____ HWY 410			BOREHOLE TYPE CME 55 Bombadier, 108 mm ID Hollow Stem Augers			COMPILED BY JDR					
DATUM Geodetic			DATE December 8, 2003			CHECKED BY LCC					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
248.8	Ground Surface										
0.0	Peat, containing sand seams. Very soft Brown Wet		1	SS	1						
248.0							248				
0.8	Sandy Silt to Silty Sand, containing trace organics. Very loose to compact Grey Moist to wet		2	SS	1						
			3	SS	12		247				Organic Content: 0.7%
246.7											
2.1	Silty Sand to Sand, trace clay, trace gravel Compact Grey to brown Wet		4	SS	12		246		○		
			5	SS	16						0 55 39 6
			6	SS	13		245		○		
			7	SS	12		244				
							243				
			8	SS	12		242		○		0 63 31 6
							241				
			9	SS	16		240				
							239		○		

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

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

PROJECT 001-1159-3			RECORD OF BOREHOLE No MR-2			2 OF 2 METRIC											
W.P. 101-00-00			LOCATION N 4846256.6 ; E 280677.6			ORIGINATED BY PKS											
DIST HWY 410			BOREHOLE TYPE CME 55 Bombadier, 108 mm ID Hollow Stem Augers			COMPILED BY JDR											
DATUM Geodetic			DATE December 8, 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 (%)
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					25 50 75 W _p W W _L				GR SA SI CL	
238.1	Clayey Silt, some sand, trace to some gravel. (TILL) Very stiff Grey Wet		11	SS	24												
				12	SS	28											
				13	SS	28											
233.1	Sand and Gravel. Compact Grey Wet End of Borehole		14	SS	10												
15.9	Note: 1. Water level in open borehole 0.5 m above ground surface (Elev. 249.3 m) upon completion of drilling.																

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

MIS-MTO 001 001-1159-3-MTO.GPJ ON MOT.GDT 12/2/06

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

PROJECT <u>001-1159-3</u>		RECORD OF BOREHOLE No WS-2		2 OF 2 METRIC													
W.P. <u>101-00-00</u>		LOCATION <u>N 4846220.6 ; E 280686.1</u>		ORIGINATED BY <u>PKS</u>													
DIST <u> </u> HWY <u>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 1, 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 (%)
	--- CONTINUED FROM PREVIOUS PAGE ---																
	Clayey Silt, trace sand and gravel (TILL) Hard Grey Moist																
			11	SS	36												
236.5			12	SS	32												
12.8	End of Borehole Notes: 1. Water level in open borehole at depth 6.1 m (Elev. 243.2 m) upon completion of drilling operations																

MIS-MTO 001 001-1159-3-MTO.GPJ ON MOT.GDT 12/2/06

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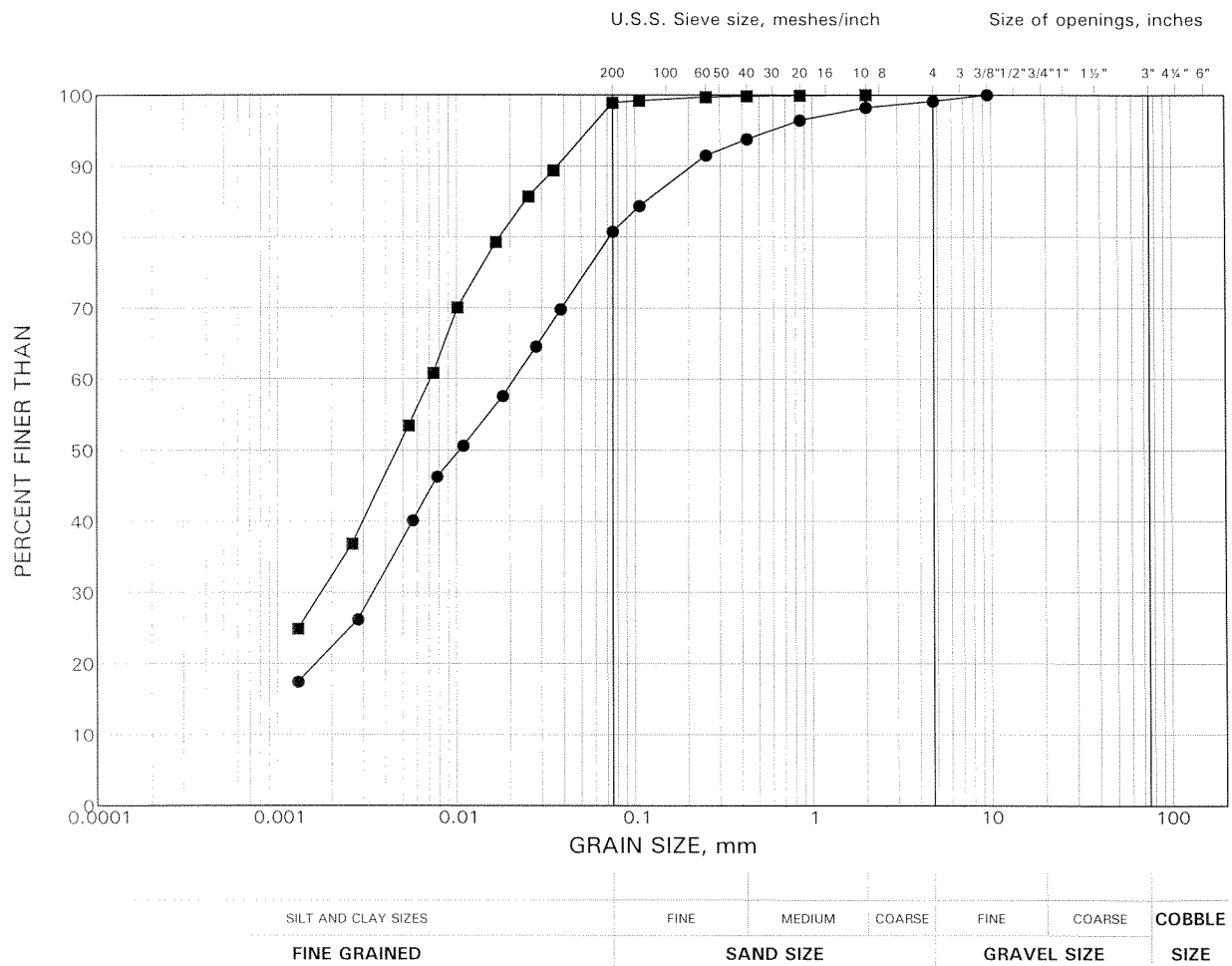
+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>001-1159-3</u>		RECORD OF BOREHOLE No WS-3				2 OF 2 METRIC												
W.P. <u>101-00-00</u>		LOCATION <u>N 4846237.8 ; E 280724.9</u>				ORIGINATED BY <u>PKS</u>												
DIST <u> </u> HWY <u>410</u>		BOREHOLE TYPE <u>CME 55 Bombardier, 108 mm ID Hollow Stem Augers</u>				COMPILED BY <u>JDR</u>												
DATUM <u>Geodetic</u>		DATE <u>December 9, 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 ---						<div style="display: flex; justify-content: space-between; font-size: small;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between; font-size: x-small;"> ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED </div>											
	Silty Sand to Sand, trace gravel Loose to compact Brown to grey Wet	[Strat Plot Diagram]																
			11	SS	10													
			12	SS	10													
235.8																		
12.8	End of Borehole																	
	Notes: 1. Water level in open borehole at ground surface upon completion of drilling operations. * SPT "N" values considered to have been affected by sample disturbance due to groundwater inflow to borehole.																	

GRAIN SIZE DISTRIBUTION TEST RESULTS

Surficial Clayey Silt
Culverts at Stations 20 + 770 and 21 + 110

FIGURE 1



LEGEND

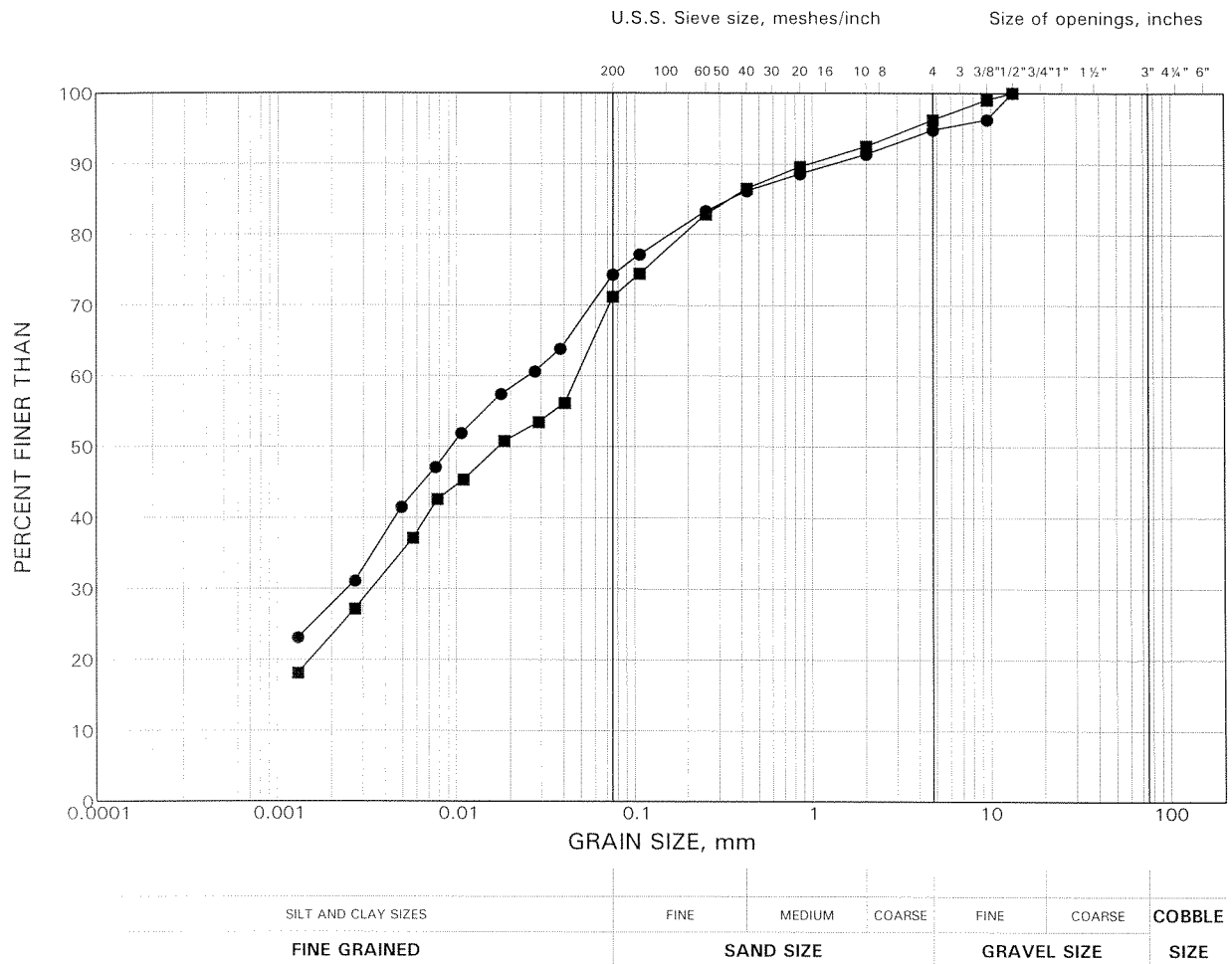
SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	C1-1	2	246.3
■	E2	2	246.8

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt Till

Culverts at Stations 20+770 and 21+110

FIGURE 2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	E9	6	247.0
■	HML-2	5	246.2

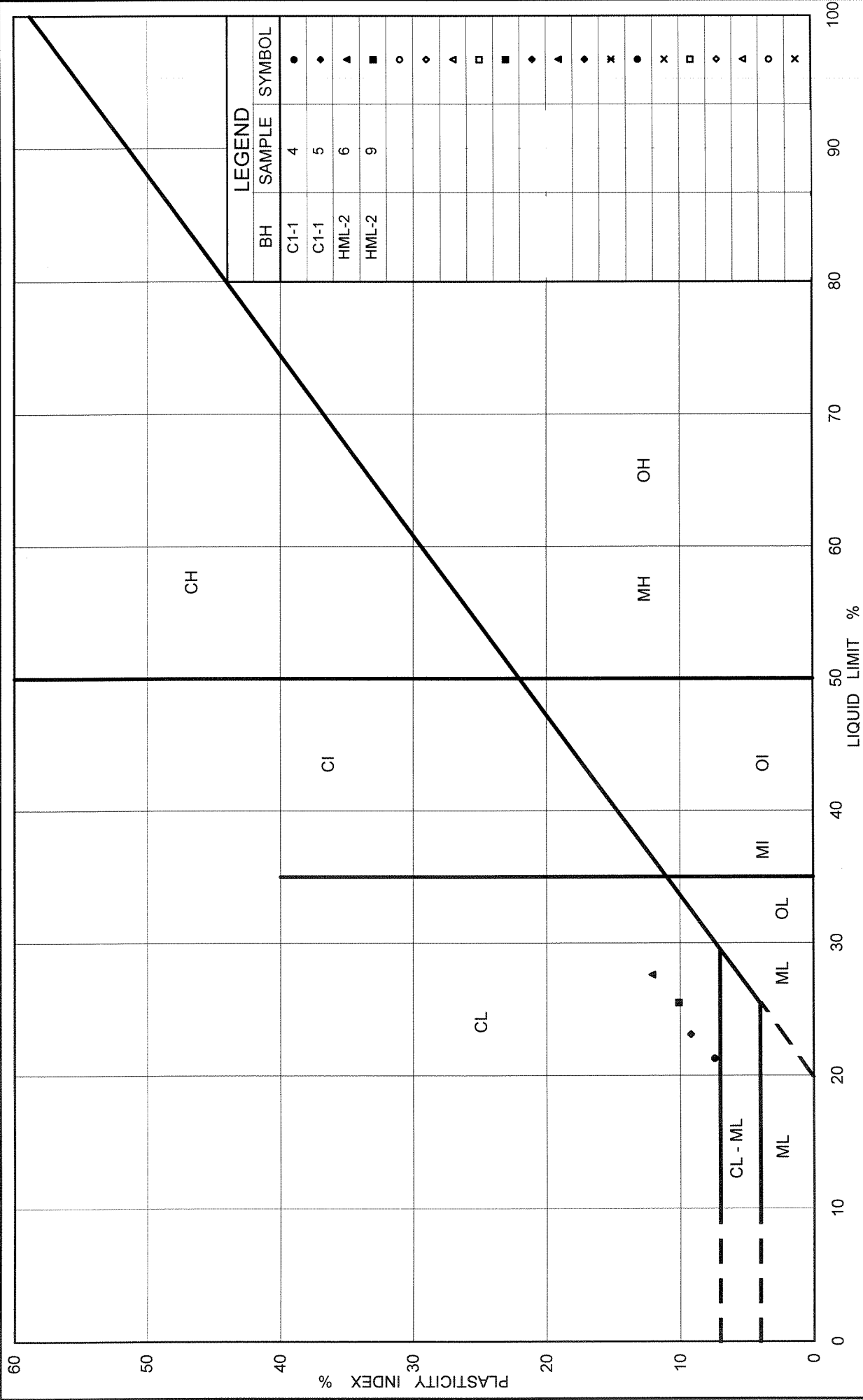


FIGURE 3
PLASTICITY CHART
Clayey Silt Till

Project No. 001-1159-4

Culverts at Stations 20+770 and 21+110

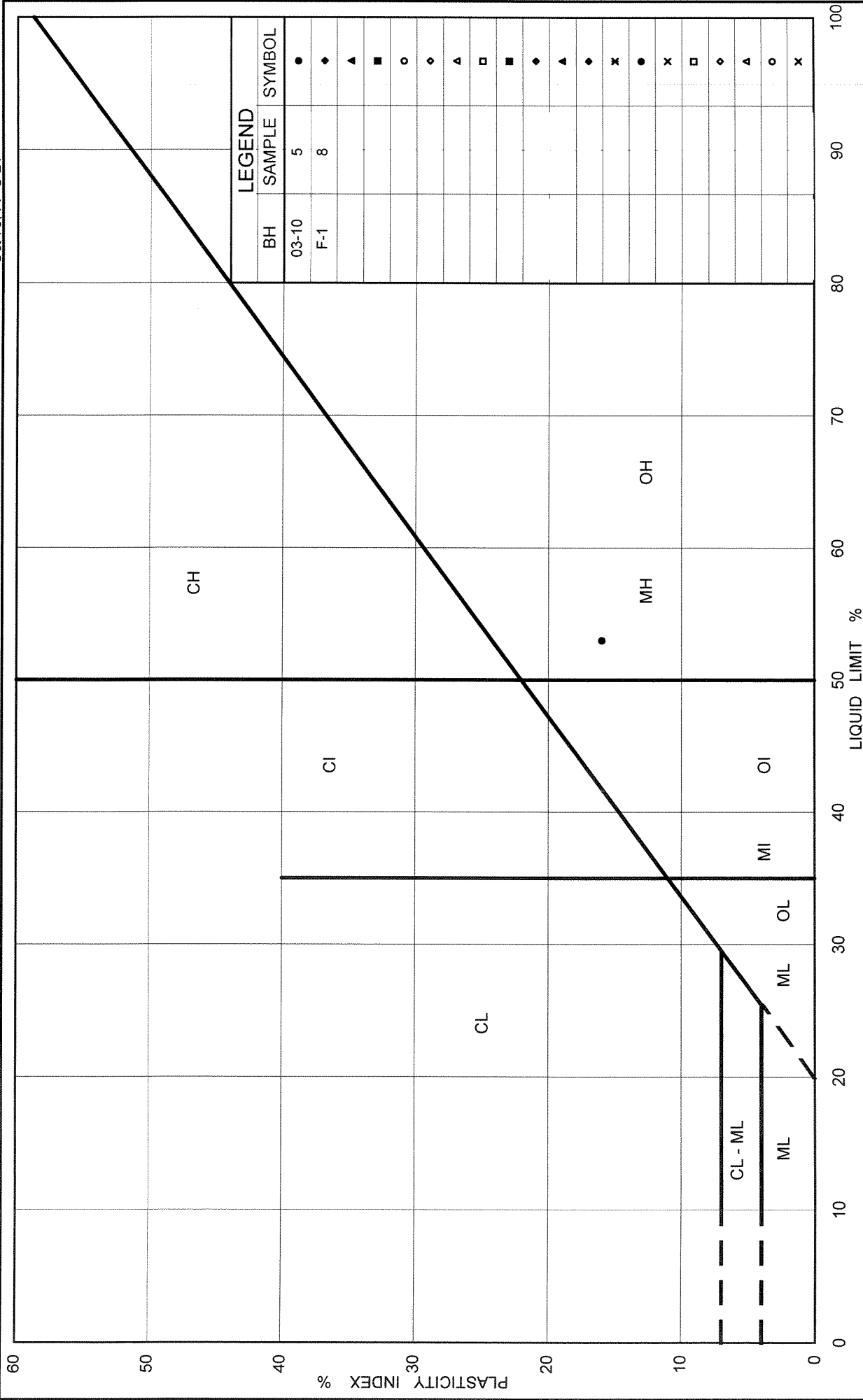


FIGURE 4

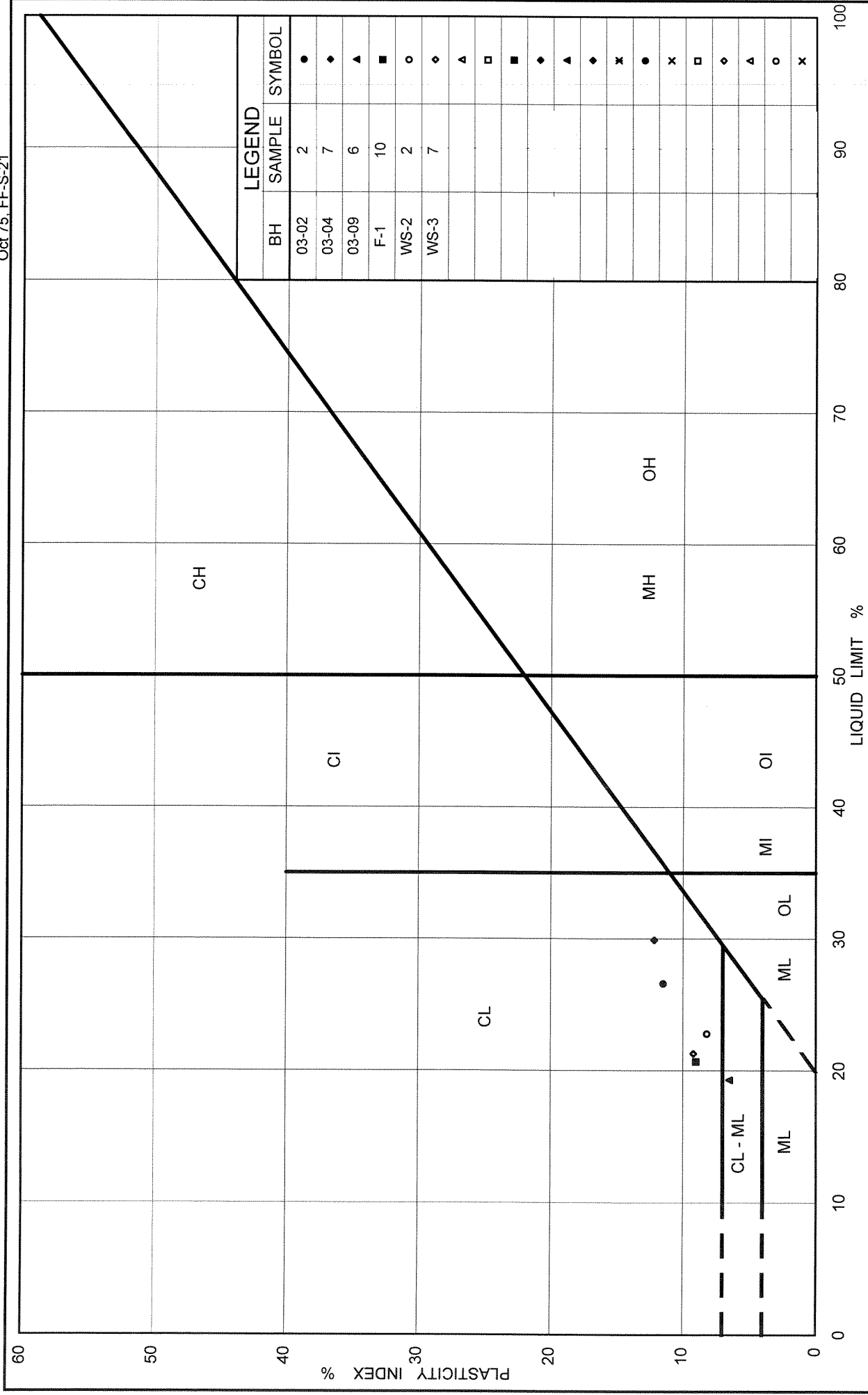
PLASTICITY CHART

Organic Silt

Culverts at Mayfield Road Interchange

Project No. 001-1159-4







**Golder
Associates**

PLASTICITY CHART
 Clayey Silt to Silty Clay
 Culverts at Mayfield Road Interchange

FIGURE 5
 Project No. 001-1159-4

**CONSOLIDATION TEST SUMMARY
CLAYEY SILT TO SILTY CLAY
CULVERTS AT MAYFIELD ROAD INTERCHANGE**

FIGURE 6A

SAMPLE IDENTIFICATION

Project Number	001-1159	Sample Number	7
Borehole Number	03-9	Sample Depth, m	5.3-5.9

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	6		
Date Started	12/8/2003		
Date Completed	12/19/2003		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m ³	23.13
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m ³	20.94
Area, cm ²	31.67	Specific Gravity, measured	2.72
Volume, cm ³	60.17	Solids Height, cm	1.492
Water Content, %	10.45	Volume of Solids, cm ³	47.24
Wet Mass, g	141.93	Volume of Voids, cm ³	12.93
Dry Mass, g	128.5	Degree of Saturation, %	103.9

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	cv, cm ² /s	mv m ² /kN	k cm/s
0.00	1.900	0.274	1.900				
4.75	1.886	0.264	1.893	4860	1.56E-04	1.55E-03	2.38E-08
9.54	1.878	0.259	1.882	2940	2.55E-04	8.79E-04	2.20E-08
19.25	1.868	0.252	1.873	1181	6.30E-04	5.42E-04	3.35E-08
38.68	1.852	0.241	1.860	960	7.64E-04	4.33E-04	3.24E-08
77.38	1.835	0.230	1.844	271	2.66E-03	2.31E-04	6.02E-08
154.68	1.819	0.219	1.827	171	4.14E-03	1.09E-04	4.42E-08
309.73	1.790	0.200	1.805	171	4.04E-03	9.84E-05	3.89E-08
619.07	1.765	0.183	1.778	140	4.78E-03	4.25E-05	1.99E-08
1237.37	1.736	0.164	1.751	135	4.81E-03	2.47E-05	1.16E-08
2472.95	1.697	0.138	1.717	60	1.04E-02	1.66E-05	1.69E-08
1237.37	1.707	0.144	1.702				
309.73	1.721	0.154	1.714				
77.38	1.736	0.164	1.729				
19.25	1.755	0.176	1.746				
4.75	1.772	0.188	1.764				

Notes:
k calculated using cv based on t₉₀ values.

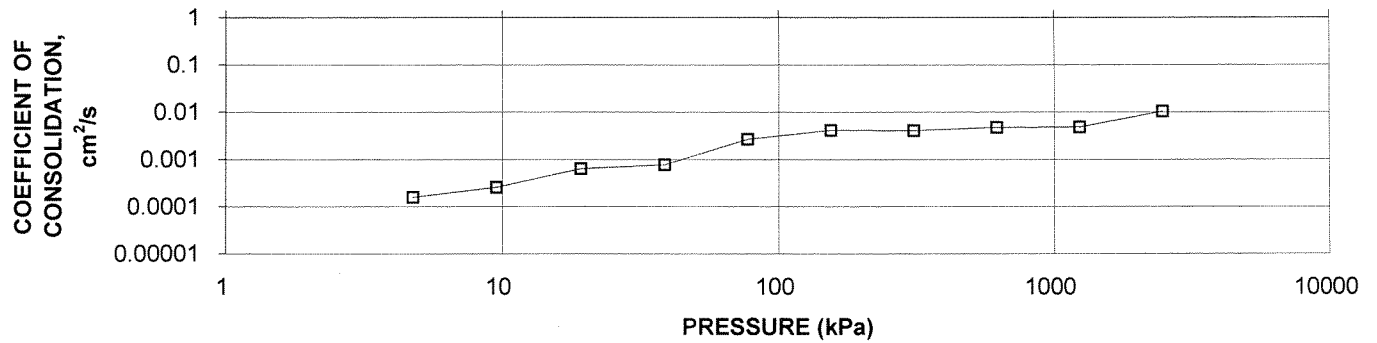
SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.77	Unit Weight, kN/m ³	24.33
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m ³	22.46
Area, cm ²	31.67	Specific Gravity, measured	2.72
Volume, cm ³	56.12	Solids Height, cm	1.492
Water Content, %	8.34	Volume of Solids, cm ³	47.24
Wet Mass, g	139.22	Volume of Voids, cm ³	8.88
Dry Mass, g	128.5		

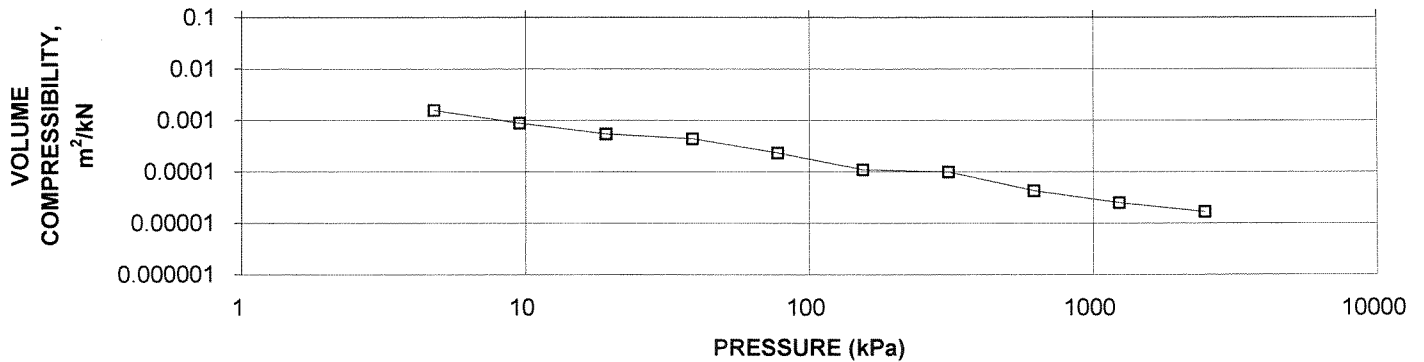
CONSOLIDATION TEST SUMMARY
CLAYEY SILT TO SILTY CLAY
CULVERTS AT MAYFIELD ROAD INTERCHANGE

FIGURE 6B

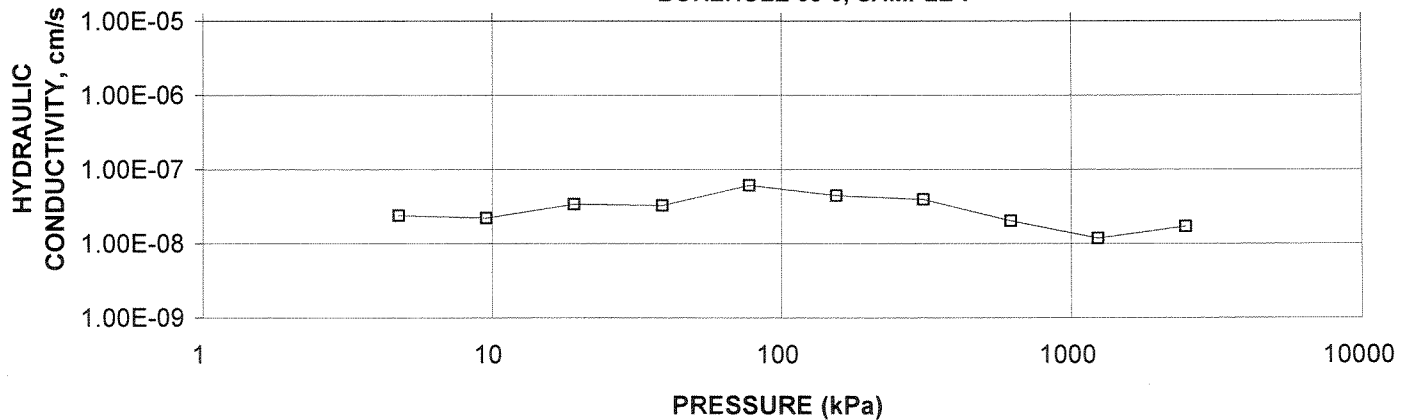
CONSOLIDATION TEST
CV (cm^2/s) VS PRESSURE (kPa)
BOREHOLE 03-9, SAMPLE 7



CONSOLIDATION TEST
MV (m^2/kN) vs PRESSURE (kPa)
BOREHOLE 03-9, SAMPLE 7



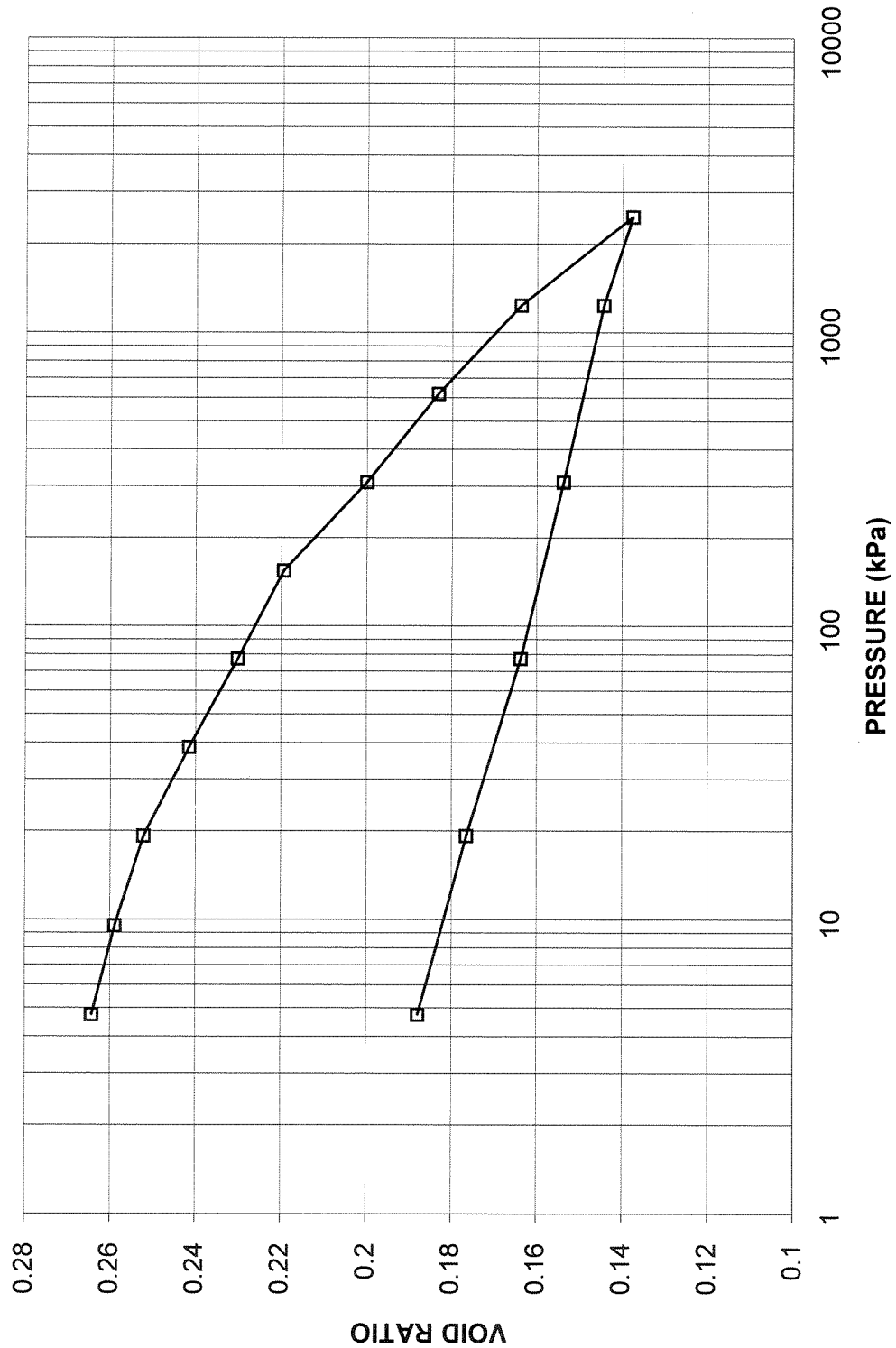
CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs PRESSURE
BOREHOLE 03-9, SAMPLE 7



CONSOLIDATION TEST RESULTS
CLAYEY SILT TO SILTY CLAY

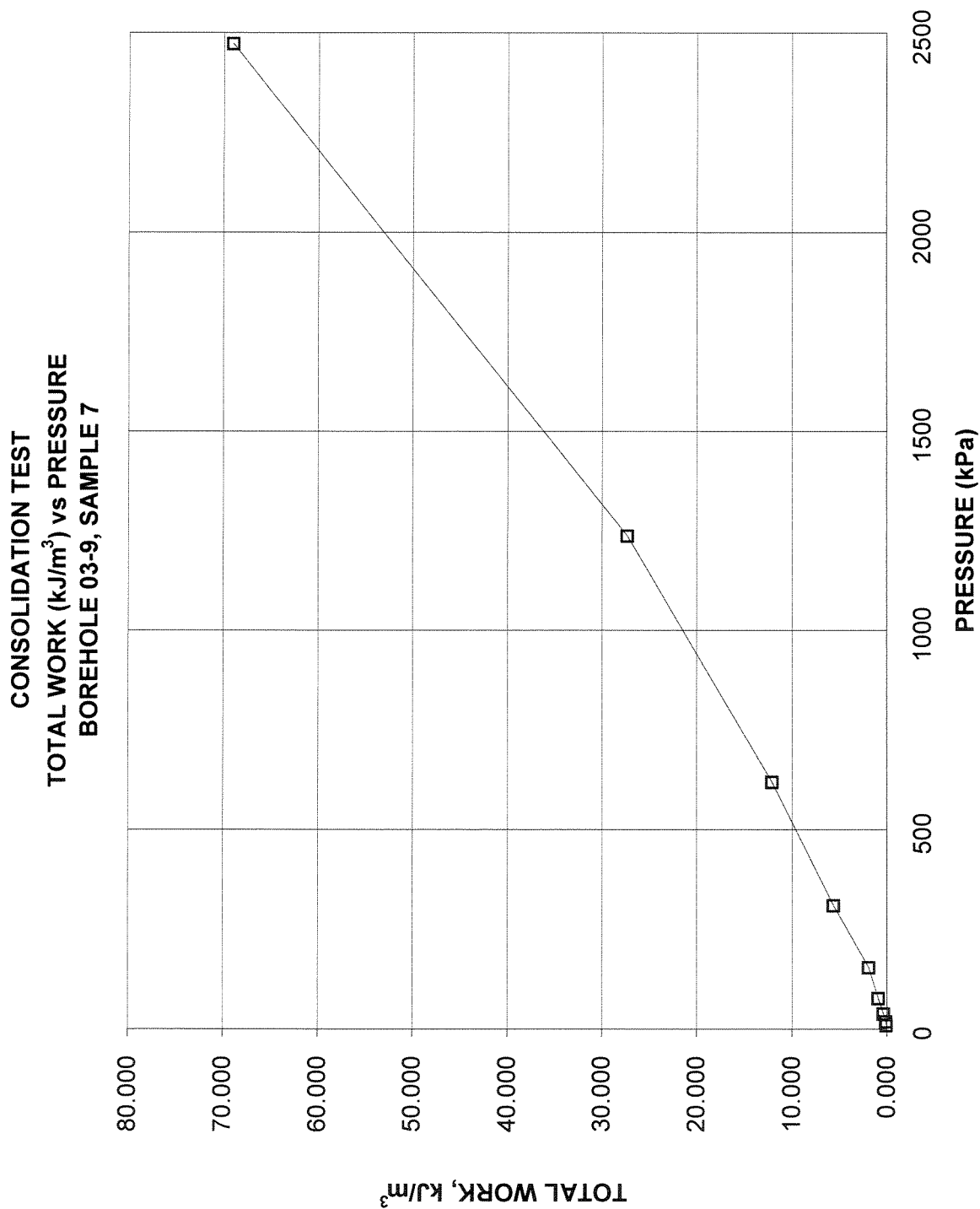
FIGURE 6C

CONSOLIDATION TEST
VOID RATIO vs LOG PRESSURE
BOREHOLE 03-9, SAMPLE 7



CONSOLIDATION TEST RESULTS
CLAYEY SILT TO SILTY CLAY
CULVERTS AT MAYFIELD ROAD INTERCHANGE

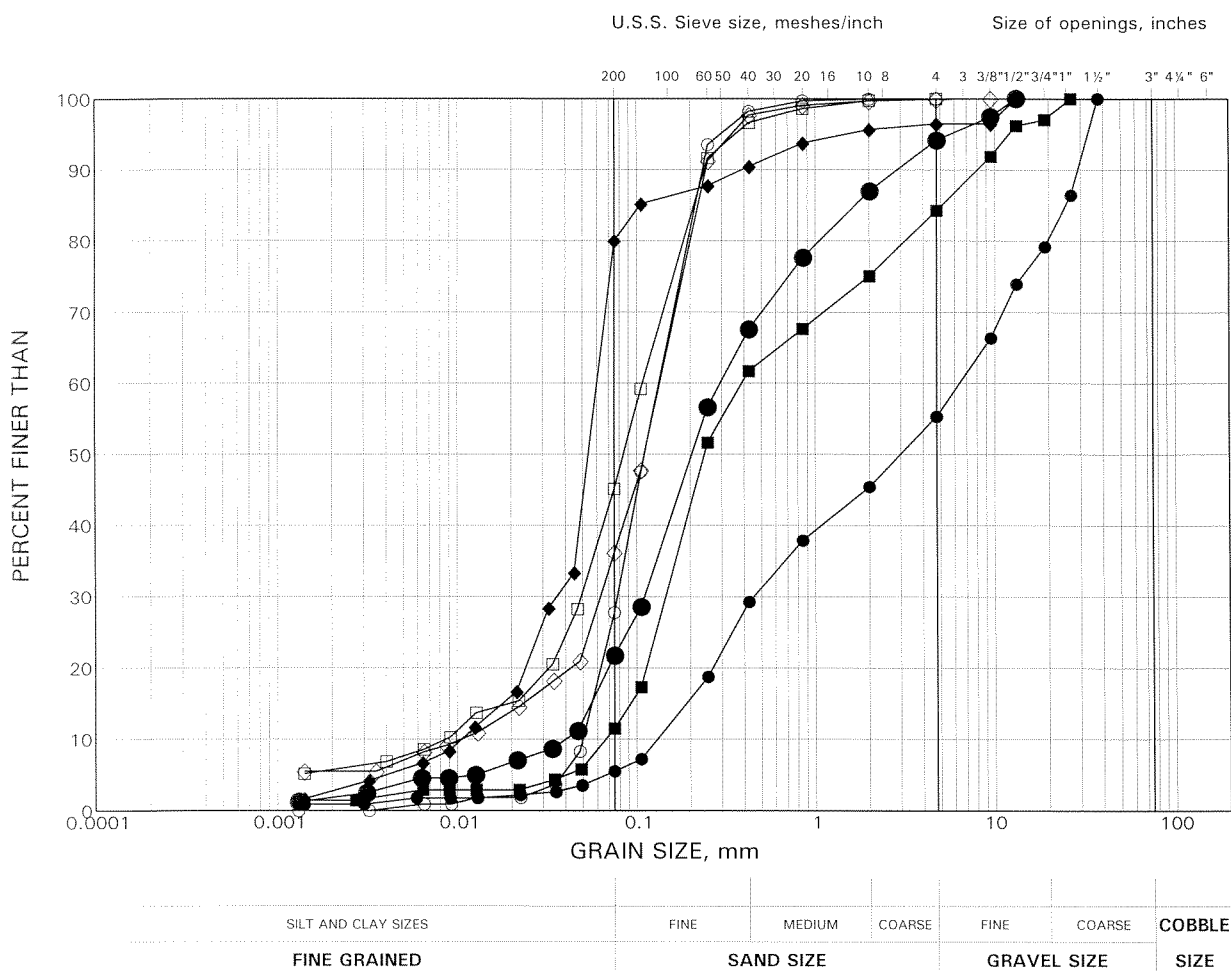
FIGURE 6D



GRAIN SIZE DISTRIBUTION TEST RESULTS

Upper Sand Silty Sand and Sand and Gravel
Culverts at Mayfield Road Interchange

FIGURE 7



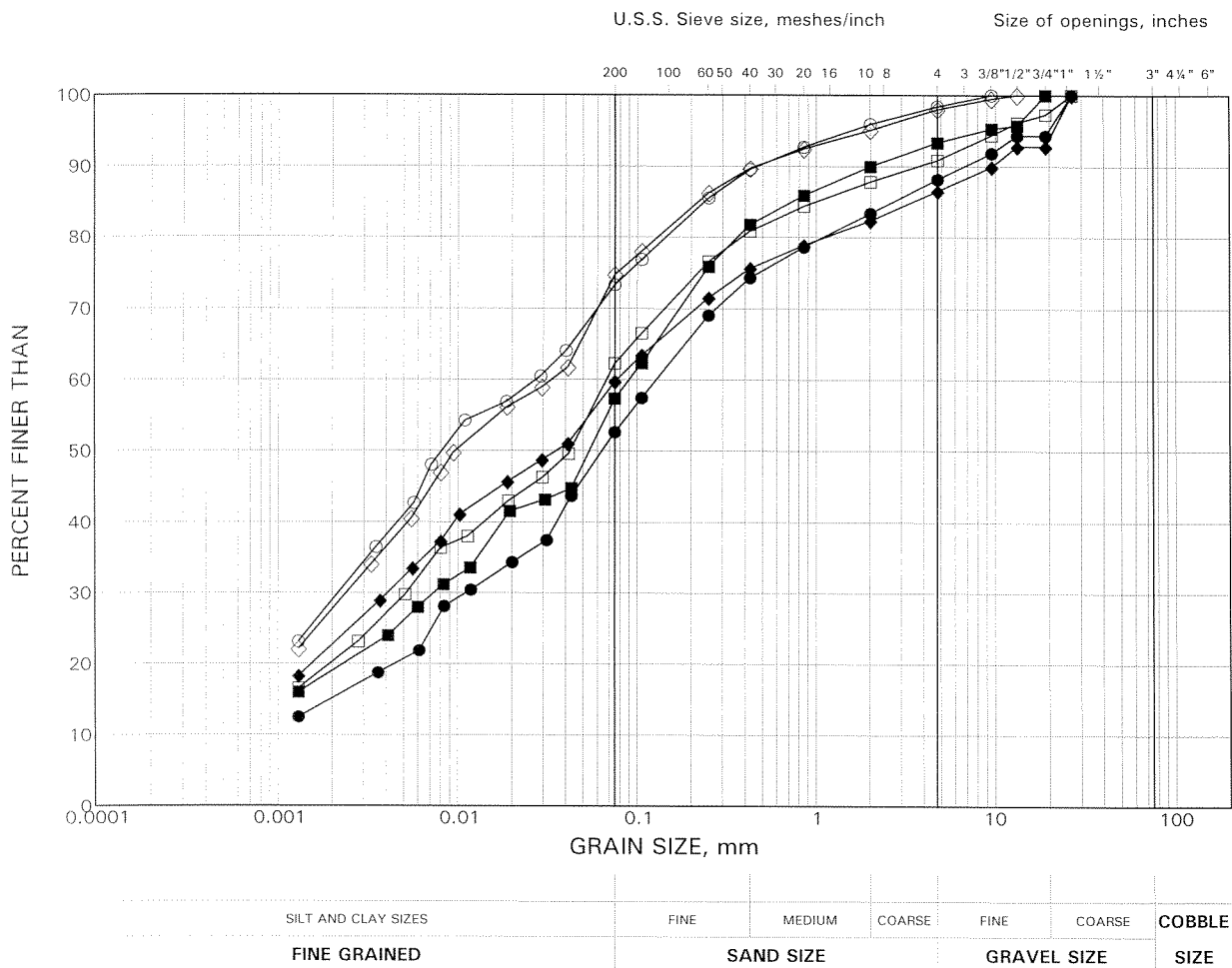
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	C-M3-1	9	242.9
■	C-M4-2-2	10	240.8
◆	ES-1	5	253.9
○	ES-1	10	247.8
□	MR-2	5	245.4
◇	MR-2	8	242.4
●	WS-2	4	246.7

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt Till
Culverts at Mayfield Road Interchange

FIGURE 8



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	03-02	7	248.6
■	03-04	12	238.8
◆	03-06	8	257.6
○	03-10	8	241.1
□	C-M4-2-2	13	236.2
◇	WS-3	8	242.2

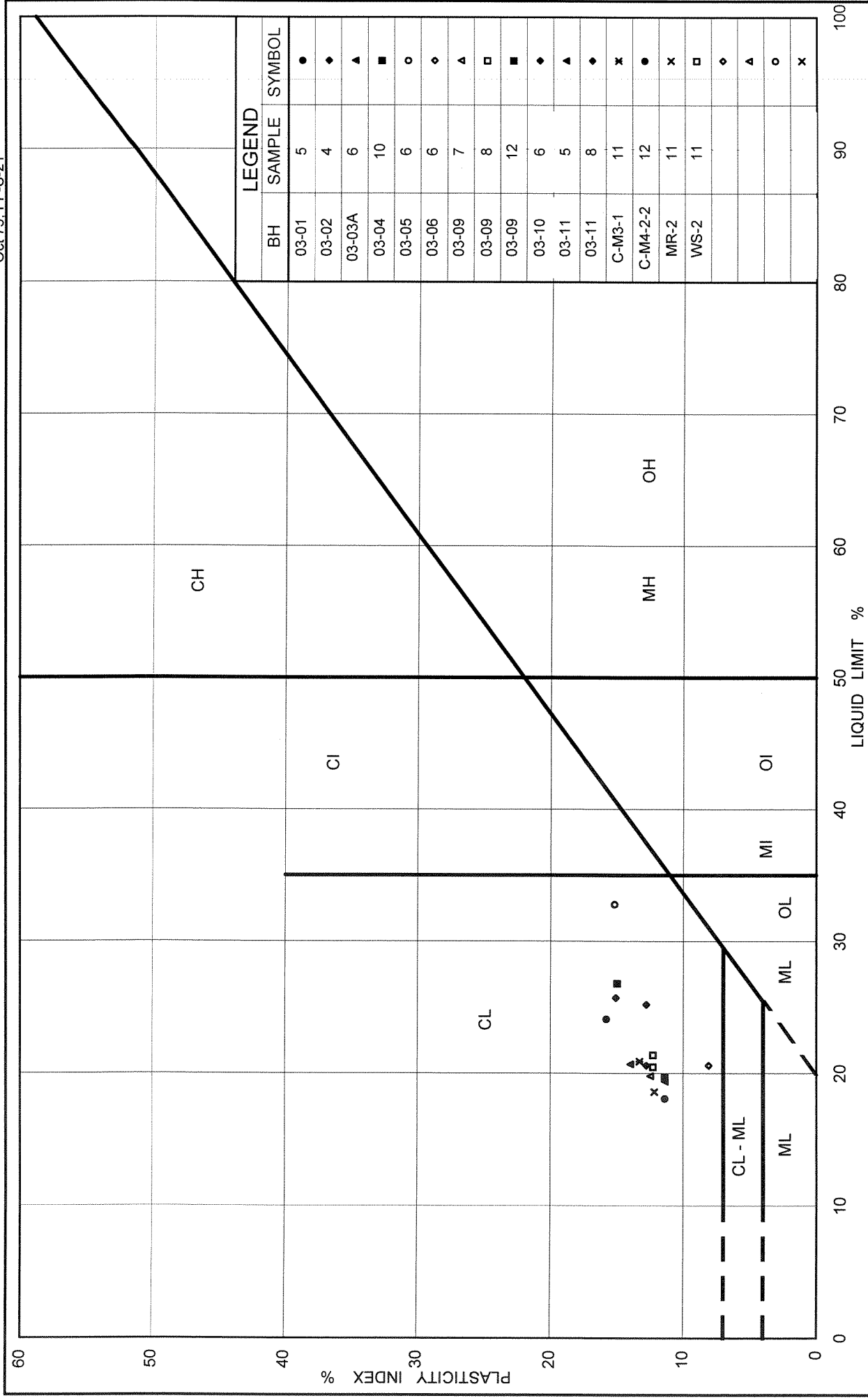


FIGURE 9

PLASTICITY CHART

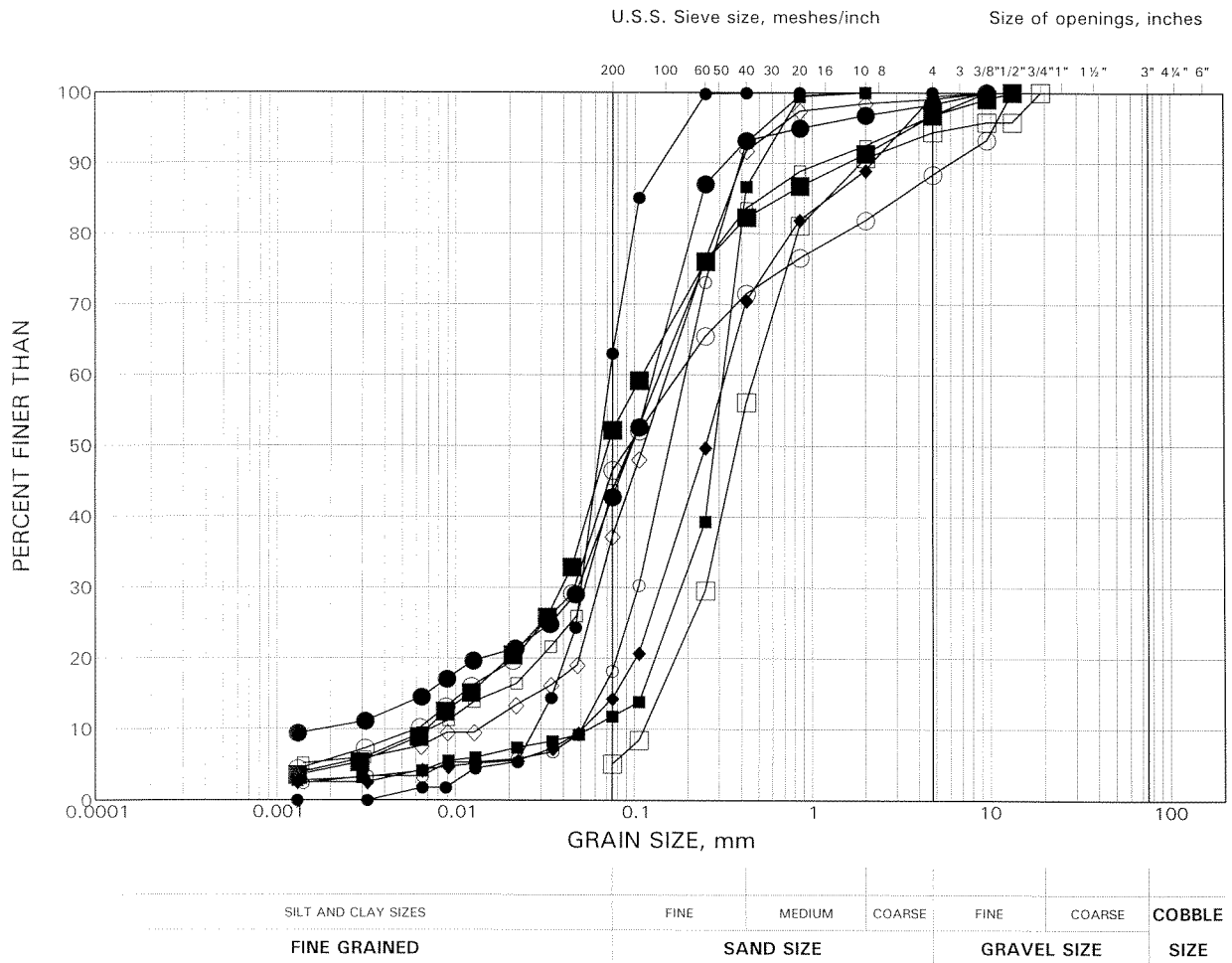
Clayey Silt Till

Culverts at Mayfield Road Interchange

GRAIN SIZE DISTRIBUTION TEST RESULTS

Lower Sand to Sandy Silt
Culverts at Mayfield Road Interchange

FIGURE 10



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	03-1	8	248.8
■	03-02	10	244.0
◆	03-03	9	242.0
○	03-3A	11	239.0
□	03-05	7	257.0
◇	03-05	12	249.4
●	03-6	13	250.0
■	03-10	11	236.5
○	03-11	10	242.5
□	WS-3	10	239.2