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DRAFT

FOUNDATION INVESTIGATION AND DESIGN REPORT

HIGH FILL EMBANKMENTS

**HIGHWAY 7 TWINNING FROM 0.7 KM WEST OF
JINKINSON ROAD WESTERLY 10.5 KM TO
2.5 KM WEST OF ASHTON STATION ROAD**

W.P. 251-99-00

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PART A

**FOUNDATION INVESTIGATION REPORT
HIGH FILL EMBANKMENTS
HIGHWAY 7 TWINNING FROM 0.7 KM WEST OF JINKINSON ROAD
WESTERLY 10.5 KM TO 2.5 KM WEST OF ASHTON STATION ROAD
W.P. 251-99-00**

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Marshall Macklin Monaghan (MMM) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out foundation investigations associated with the twinning of Highway 7 from two to four lanes in the former West Carleton Township which is now part of the City of Ottawa, and in Beckwith Township in Lanark County. The section of Highway 7 included in this assignment (W.P. 251-99-00) extends from 0.7 km west of Jinkinson Road westerly for 10.5 km, to 2.5 km west of Ashton Station Road, and includes service roads to accommodate future construction on Highway 7.

This report addresses the proposed high fill embankments along Highway 7 and at the Dwyer Hill Road and Ashton Station Road interchanges, as follows:

- | | |
|---------------------------------|--|
| Highway 7 | • Highway 7 EBL, Station 10+740 to 11+080 |
| Dwyer Hill Road Interchange | <ul style="list-style-type: none">• Dwyer Hill Road, Station 9+680 to 10+100• E-NS Ramp, Station 13+600 to 13+775• N-E Ramp, Station 13+275 to 13+280• N-E Ramp, Station 13+475 to 13+500• S-E Ramp, Station 13+720 to 13+840• S-W Ramp, Station 14+025 to 14+175 |
| Ashton Station Road Interchange | <ul style="list-style-type: none">• Ashton Station Road, Station 9+880 to 10+280• N-E Ramp, Station 9+520 to 9+720• N-W Ramp, Station 9+820 to 10+020• S-E Ramp, Station 9+770 to 10+040• S-W Ramp, Station 10+460 to 10+500• W-NS Ramp, Station 9+900 to 10+030 |

The terms of reference for the original scope of work are outlined in MTO's Request for Proposal (RFP) dated July 2002, and in Section 5.8 of MMM's *Technical Proposal* for this project.

2.0 SITE DESCRIPTION

2.1 Highway 7 Near Trans-Canada Trail Crossing

The section of Highway 7 is located between about 680 m and 1,040 m east of Ashton Station Road, in the vicinity of the abandoned CP Rail line (now Trans-Canada Trail).

The terrain in the vicinity of the site is flat to gently undulating, with the natural ground surface varying from about Elevation 136.5 m to 137.5 m, rising eastward. The existing Trans-Canada Trail grade at the site is at about Elevation 137 m to 137.5 m, slightly above the surrounding natural grade.

2.2 Dwyer Hill Road Interchange

The existing Dwyer Hill Road (Regional Road 3)-Highway 7 intersection is located approximately 8 km southwest of Highway 417, in West Carleton Township in the Regional Municipality of Ottawa-Carleton.

West Carleton Township is generally flat-lying; however, the topography at the Highway 7-Dwyer Hill Road site is dominated by a southwest-northeast trending "ridge" that passes through the southwest, southeast and northeast quadrants of the intersection. The ground surface along the ridge is at about Elevation 139 m, while the natural ground surface outside of the ridge varies from about Elevation 131 m to 134 m. The existing intersection has been constructed in a cut through the ridge that is up to about 6 m deep.

To the west of the existing Dwyer Hill Road intersection, Highway 7 passes through a large, low-lying swamp. Another swamp is present to the north/northeast of the existing Dwyer Hill Road intersection.

2.3 Ashton Station Road Interchange

The existing Ashton Station Road-Highway 7 intersection is located in the village of Ashton Station, approximately 7 km east of the Town of Carleton Place. Ashton Station Road is located at the boundary between the former West Carleton Township in the City of Ottawa, and the Township of Beckwith in Lanark County.

The new Highway 7 alignment will be located approximately 500 m south of the existing intersection, on the existing Ashton Station Road alignment. The terrain in the vicinity of the site is relatively flat, with the natural ground surface varying from about Elevation 135.5 m to 130.0 m, generally declining toward the south. A swampy area is present over the southern portion of the site.

3.0 INVESTIGATION PROCEDURES

The field work for this subsurface investigation was carried out between October 2004 and February 2005. The boreholes were advanced using track-mounted and portable drill rigs supplied and operated by Marathon Drilling Company Ltd. of Ottawa, Ontario. Further information regarding the borehole depth, sampling intervals, piezometer installation and borehole abandonment is provided in the subsections that follow.

All of 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 and bedrock samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Ottawa for further examination and laboratory testing. Index and classification tests consisting of water content determinations, Atterberg limit testing and grain size distribution analyses were carried out on selected soil samples. Laboratory oedometer (consolidation) testing was carried out on one sample of the silty clay deposit.

The borehole locations and ground surface elevations were determined by Golder relative to points staked in the field by MMM. The borehole locations, including MTM NAD83 northing and easting coordinates and ground surface elevations referenced to geodetic datum, are summarized in the tables of the respective sections and are shown on the Record of Borehole sheets and Drawings 1 to 3.

3.1 Highway 7 Near Trans-Canada Trail Crossing

Eight boreholes (Boreholes 04-1 to 8) were advanced along Highway 7 in the vicinity of the Trans-Canada Trail crossing, at the locations shown on Drawing 1. The borehole locations (MTM NAD83 northing and easting coordinates) and ground surface elevations referenced to geodetic datum 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>
04-1	5,004,236.9	340,434.7	136.7
04-2	5,004,301.0	340,444.9	136.7
04-3	5,004,351.2	340,449.1	136.8
04-4	5,004,400.7	340,447.5	137.0
04-5	5,004,449.4	340,459.7	137.0
04-6	5,004,500.1	340,460.3	137.4
04-7	5,004,549.6	340,463.2	137.2
04-8	5,004,592.8	340,463.2	137.6

The boreholes were advanced using a full-size track-mounted rig, and extended to refusal which occurred at depths varying from 0.2 m to 1.5 m below the existing ground surface. The groundwater conditions were observed in the open boreholes during drilling; no piezometers were installed in these boreholes due to the shallow depth to bedrock at this site. Following completion, all of the boreholes were backfilled to ground surface using bentonite pellets.

3.2 Dwyer Hill Road Interchange

A total of thirty-one³¹ boreholes (Boreholes D-1 to D-6, DENS-1 to DENS-7, DNE-1, DNE-1A, DNE-2, DNE-3, DNE-3A, DNE-3B, DSE-1 to DSE-5, and DSW-1 to DSW-7) were drilled at the locations shown on Drawing 2.

The boreholes were advanced to refusal using either 108 mm internal diameter hollow stem augers (where a track-mounted drill rig was used) or BW-sized casing (where swampy ground conditions required that a portable drill rig be used). Refusal occurred at depths varying from about 2.0 m to 5.9 m below the existing ground surface. Three of the boreholes (Boreholes D-2, D-3 and DNE-1A) that were drilled using portable drilling equipment were extended about 0.2 m to 0.5 m into the bedrock using BQ-size coring equipment; this shallow bedrock coring was carried out to confirm that the bedrock surface had been reached.

Samples of the overburden were obtained at 0.75 m intervals of depth in the boreholes advanced using a track-mounted drill rig, and continuously or semi-continuously in the boreholes advanced using portable drilling equipment, using 50 mm outside diameter split-spoon samplers in accordance with the Standard Penetration Test (SPT) procedure. In situ vane testing was carried out in the silty clay layer that was encountered in Boreholes D-3, D-4, D-5 and DNE-3A to measure the undrained shear strength of this material.

The groundwater levels were observed in the open boreholes during drilling, and single piezometers were installed within six selected boreholes (Boreholes D-2, DENS-1, DENS-5, DNE-3B, DSE-4 and DSW-5) in order to provide broad coverage for monitoring of the groundwater levels at the site. The piezometers consist of 50 mm diameter PVC tubing and slotted screen, installed in a filter sand pack, and backfilled to ground surface using bentonite pellets; the specific details of each piezometer installation (i.e. tip elevation, thickness of filter sand pack) are shown on the borehole records. The remaining boreholes in which no piezometers were installed were backfilled to ground surface using bentonite pellets, mixed in places with soil cuttings. Care was taken to ensure that full bentonite seals were placed in the boreholes through cohesive soil deposits and, where soil cuttings were used, care was taken to ensure that the cuttings were replaced over the same interval from which they were removed.

The borehole locations (referenced to the MTM NAD83 coordinate system) and ground surface elevations (referenced to geodetic datum) are summarized in the following table and are also shown on Drawing 2.

<i>Embankment Location</i>	<i>Borehole Number</i>	<i>MTM NAD83 Northing (m)</i>	<i>MTM NAD83 Easting (m)</i>	<i>Ground Surface Elevation (m)</i>
Dwyer Hill Road	D-1	5,007,286.1	340,686.4	132.6
	D-2	5,007,270.0	340,729.8	131.5
	D-3	5,007,255.7	340,779.8	131.4
	D-4	5,007,236.0	340,821.7	131.3
	D-5	5,007,212.4	340,866.3	132.0
	D-6	5,007,095.8	341,063.6	137.6
E-N/S Ramp	DENS-1	5,007,252.4	340,829.8	131.2
	DENS-2	5,007,264.6	340,834.9	132.5
	DENS-3	5,007,291.8	340,847.4	132.2
	DENS-4	5,007,314.0	340,858.4	133.0
	DENS-5	5,007,333.6	340,869.8	132.6
	DENS-6	5,007,353.6	340,888.3	133.8
	DENS-7	5,007,366.0	340,909.7	134.2
N-E Ramp	DNE-1	5,007,099.0	341,036.2	133.3
	DNE-1A	5,007,084.7	341,020.1	133.0
	DNE-2	5,006,947.4	341,025.4	131.9
	DNE-3	5,006,946.5	341,003.7	131.3
	DNE-3A	5,006,947.0	341,001.3	131.3
	DNE-3B	5,006,947.5	340,998.7	131.2
S-E Ramp	DSE-1	5,007,072.1	341,137.1	137.2
	DSE-2	5,007,093.2	341,125.1	134.1
	DSE-3	5,007,117.7	341,111.5	133.7
	DSE-4	5,007,147.6	341,103.3	134.1
	DSE-5	5,007,167.1	341,104.8	132.2
S-W Ramp	DSW-1	5,007,333.1	340,889.9	132.1
	DSW-2	5,007,312.9	340,874.5	131.7
	DSW-3	5,007,287.9	340,866.2	132.7
	DSW-4	5,007,269.4	340,864.7	133.0
	DSW-5	5,007,239.4	340,871.4	132.4
	DSW-6	5,007,220.0	340,885.1	132.5
	DSW-7	5,007,202.4	340,901.6	132.9

3.3 Ashton Station Road Interchange

A total of fifty-two boreholes (Boreholes A-1 to A-13, ANE-1, ANE-3 to ANE-10, ANE-10A, ANW-1 to ANW-10, AWNS-1 to AWNS-4, AWNS-4A, AWNS-5, AWNS-6, ASE-1 to ASE-11, and ASW-1) were advanced at this site at the locations shown on Drawing 3.

The boreholes were advanced to refusal using either 108 mm internal diameter hollow stem augers (where a track-mounted drill rig was used) or BW-sized casing (where swampy conditions required that a portable drill rig be used). Refusal occurred at depths varying from about 1.0 m to 3.9 m below the existing ground surface. Twenty-one of the boreholes (Boreholes A-2 to A-8, A-10, A-12 ANW-10, and ASE-1 to ASE-11) that were drilled using portable drilling equipment were extended about 0.3 m to 0.8 m into the bedrock using BQ-sized coring equipment; this shallow bedrock coring was carried out to confirm that the bedrock surface had been reached.

Samples of the overburden were obtained at 0.75 m intervals of depth in the boreholes advanced using a track-mounted drill rig, and continuously or semi-continuously in the boreholes advanced using portable drilling equipment, using 50 mm outside diameter split-spoon samplers in accordance with the Standard Penetration Test (SPT) procedure. In situ vane testing was carried out in the silty clay layer encountered in Boreholes A-11, ANE-4 and AWNS-4A to measure the undrained shear strength of this material.

The groundwater levels were observed in the open boreholes during drilling, and single piezometers were installed within four selected boreholes (Boreholes A-4, A-12, ANW-1 and AWNS-2) in order to provide broad coverage for monitoring of the groundwater levels at the site. The piezometers consist of 50 mm diameter PVC tubing and slotted screen, installed in a filter sand pack, and backfilled to ground surface using bentonite pellets. The remaining boreholes in which no piezometers were installed were backfilled to ground surface using bentonite pellets, mixed in places with soil cuttings. Care was taken to ensure that full bentonite seals were placed in the boreholes through cohesive soil deposits and, where soil cuttings were used, care was taken to ensure that the cuttings were replaced over the same interval from which they were removed.

The borehole locations (referenced to the MTM NAD83 coordinate system) and ground surface elevations (referenced to geodetic datum) are summarized in the following table, and are also shown on Drawing 3.

<i>Embankment Location</i>	<i>Borehole Number</i>	<i>MTM NAD83 Northing (m)</i>	<i>MTM NAD83 Easting (m)</i>	<i>Ground Surface Elevation (m)</i>
Ashton Station Road	A-1	5,003,699.2	340,052.4	135.6
	A-2	5,003,649.0	340,072.4	134.8
	A-3	5,003,537.3	340,193.7	131.9
	A-4	5,003,509.0	340,200.0	132.6
	A-5	5,003,490.4	340,230.3	133.0
	A-6	5,003,464.3	340,238.1	132.5
	A-7	5,003,454.8	340,265.3	131.2
	A-8	5,003,438.1	340,259.9	132.5
	A-9	5,003,425.6	340,270.8	132.4
	A-10	5,003,418.3	340,298.1	131.3

<i>Embankment Location</i>	<i>Borehole Number</i>	<i>MTM NAD83 Northing (m)</i>	<i>MTM NAD83 Easting (m)</i>	<i>Ground Surface Elevation (m)</i>
Ashton Station Road	A-11	5,003,388.1	340,304.1	134.2
	A-12	5,003,370.7	340,319.2	129.5
	A-13	5,003,295.2	340,387.3	132.8
N-E Ramp	ANE-1	5,003,524.1	340,185.9	132.5
	ANE-3	5,003,463.1	340,230.9	132.3
	ANE-4	5,003,438.8	340,239.2	132.3
	ANE-5	5,003,414.6	340,241.3	132.3
	ANE-6	5,003,394.5	340,236.5	132.3
	ANE-7	5,003,369.6	340,221.8	132.3
	ANE-8	5,003,354.6	340,201.9	132.3
	ANE-9	5,003,346.2	340,178.6	132.3
	ANE-10	5,003,346.6	340,153.9	132.3
	ANE-10A	5,003,347.1	340,150.8	132.3
N-W Ramp	ANW-1	5,003,471.5	339,989.9	132.4
	ANW-2	5,003,489.1	340,005.9	132.3
	ANW-3	5,003,508.5	340,023.4	132.5
	ANW-4	5,003,528.9	340,038.4	132.5
	ANW-5	5,003,550.5	340,050.2	132.7
	ANW-6	5,003,573.7	340,057.4	132.8
	ANW-7	5,003,599.0	340,061.2	134.0
	ANW-8	5,003,623.9	340,059.5	133.8
	ANW-9	5,003,648.3	340,054.5	134.3
	ANW-10	5,003,671.2	340,044.1	134.2
W-N/S Ramp	AWNS-1	5,003,328.1	340,189.0	132.3
	AWNS-2	5,003,337.0	340,212.2	132.3
	AWNS-3	5,003,350.9	340,233.1	132.3
	AWNS-4	5,003,366.5	340,251.5	132.2
	AWNS-4A	5,003,367.5	340,253.2	132.2
	AWNS-5	5,003,383.5	340,271.0	132.4
S-E Ramp	ASE-1	5,003,355.0	340,360.9	130.8
	ASE-2	5,003,376.4	340,345.9	130.7
	ASE-3	5,003,394.6	340,330.4	131.0
	ASE-4	5,003,417.2	340,318.8	131.5
	ASE-5	5,003,436.9	340,303.7	131.3
	ASE-6	5,003,462.7	340,299.9	131.5
	ASE-7	5,003,483.2	340,285.2	131.4
	ASE-8	5,003,508.6	340,290.6	131.0
	ASE-9	5,003,532.3	340,276.2	130.6
	ASE-10	5,003,554.6	340,282.5	130.6
	ASE-11	5,003,313.4	340,390.4	130.8
S-W Ramp	ASW-1	5,003,680.7	340,069.7	134.6

4.0 SITE GEOLOGY AND STRATIGRAPHY

4.1 Overview of Regional Geological Conditions

The study area for this assignment lies within the Smith Falls Limestone Plain, as delineated in *The Physiography of Southern Ontario*¹, that lies within the major physiographic region of the Ottawa-St. Lawrence Lowland.

The Smiths Falls Limestone Plain is characterized by shallow overburden deposits overlying sedimentary bedrock consisting of limestones, dolostones, sandstones and shales. The shallow overburden soils are typically between 1 m and 3 m in thickness and are commonly comprised of sandy to gravelly till derived from the Precambrian Shield to the north, overlain by glaciofluvial sediments that consist of layered sands and gravels. In the vicinity of and north of Carleton Place, clay has been deposited within depressions in the bedrock that have been caused by faulting. Large areas of the plain are covered with peat and muck, due to poor drainage as a consequence of the relatively flat topography and shallow depth to bedrock.¹

4.2 Highway 7 Near Trans-Canada Trail Crossing

As part of the subsurface investigation at this site, eight boreholes were advanced at the locations shown on Drawing 1. The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of in situ and laboratory testing are given on the Record of Borehole sheets and on Figure A1 in Appendix A. 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.

In summary, the soils encountered immediately below ground surface at this site consist of topsoil overlying a thin layer of sandy silt till, in turn underlain by bedrock. The surface of the bedrock, as inferred based on auger refusal, was encountered between Elevations 135.5 and 137.0 m (about 0.2 m to 1.3 m depth) in the boreholes. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

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

4.2.1 Topsoil

Between 150 mm and 400 mm of topsoil was encountered immediately below ground surface in all of the boreholes.

4.2.2 Sandy Silt Till

A glacial till deposit was encountered in the boreholes between 0.2 m and 0.4 m depth, immediately below the topsoil layer. The till ranges in thickness from about 0.1 m to 0.5 m, except in Borehole 04-3 where the deposit is about 1 m thick.

The till consists of sandy silt to silt, some sand, and contains some gravel and trace to some clay. The results of two grain size distribution tests are shown on Figure A1 in Appendix A.

The measured Standard Penetration Test (SPT) "N" values in this deposit range from 1 to greater than 100 blows per 0.3 m of penetration. The lower SPT "N" values of 1 to 5 blows are considered to be more representative of the topsoil layer, through which these values were partially measured; however, these results do indicate that the upper portion of the till at some of the borehole locations has a loose relative density. Typically, however, the sandy silt till has a compact to very dense relative density.

4.2.3 Shale Bedrock

Bedrock was encountered underlying the till deposit, between Elevations 135.5 m and 137.0 m (approximately 0.2 m to 1.3 m depth), as summarized in the table below. The surface of the bedrock was inferred from refusal to auger advance in the majority of the boreholes. However, the augers penetrated into black shale bedrock in Borehole 04-3. In addition, shale bedrock was encountered at similar depths/elevations in the boreholes advanced as part of a previous investigation at the Trans-Canada Trail crossing (which transects this site); the bedrock was confirmed in that investigation by coring.

<i>Borehole No.</i>	<i>Depth to Bedrock</i>	<i>Bedrock Surface Elevation</i>
04-1	0.5 m	136.2 m
04-2	0.9 m	135.7 m
04-3	1.3 m	135.5 m
04-4	0.2 m	136.8 m
04-5	0.7 m	136.3 m
04-6	1.0 m	136.3 m
04-7	0.7 m	136.5 m
04-8	0.6 m	137.0 m

4.2.4 Groundwater Conditions

Six of the eight boreholes were dry upon completion of drilling in October 2004. In Borehole 04-2, water was encountered during drilling at 0.8 m depth (approximately Elevation 135.9 m), which is about 0.1 m above the bedrock surface at this location; and in Borehole 04-5, water was encountered during drilling at about 0.3 m depth (approximately Elevation 136.7 m), which is about 0.4 m above the bedrock surface at this location.

Piezometers were not installed as part of this investigation due to the shallow depth to bedrock. However, piezometers were installed at the Trans-Canada Trail crossing as part of a previous investigation at that site. The water level at that site was encountered between about 0.7 m and 0.9 m depth (about Elevation 136.3 m to 136.7 m) during drilling in November 2002, and the water level in the piezometers varied from Elevation 136.9 m to 137.1 m (about 0.2 m to 0.4 m depth) in April 2003.

Based on the above, the groundwater level is expected to fluctuate seasonally and should be expected to rise to about Elevation 137 m during the spring and other wet periods of the year.

4.3 Dwyer Hill Road Interchange

As part of the subsurface investigation at this site, thirty-one boreholes were advanced at the locations shown on Drawing 2. The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of in situ and laboratory testing are given on the Record of Borehole sheets and on Figures B1 to B5 in Appendix 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.

In summary, the Dwyer Hill Road interchange site is covered by either fill, associated with the existing roadways and commuter parking lot, or topsoil and peat, outside of the existing roadway and parking lot areas. The native subsoils at the site are as follows:

- In the investigated areas in the immediate vicinity of the existing intersection (i.e. the S-E Ramp, and Dwyer Hill Road and the N-E Ramp immediately south of Highway 7), the existing roadways have been cut into a "till ridge" that runs southwest-northeast across the site. A dense to very dense sand and silt till (including granular interlayers) is present immediately below the topsoil or fill.
- In the investigated areas north of Highway 7 (i.e. Dwyer Hill Road and the E-NS and S-W Ramps) and at the southernmost area of the N-E Ramp (Boreholes DNE-2 and DNE-3/A/B), the fill or topsoil overlies glaciofluvial or glaciolacustrine deposits consisting of loose to compact silty sand to sand and gravel underlain by a firm to

very stiff silty clay layer. These deposits are underlain by till, similar to that encountered in the "till ridge" in the southeastern portion of the site.

These overburden soils are underlain by dolomitic limestone bedrock. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.3.1 Fill

Fill, associated with the existing Dwyer Hill Road, was encountered in Boreholes D-1, DENS-2, DSE-2, DSE-3, and DSW-4. The fill is between 0.6 m and 2.5 m thick, as encountered at the borehole locations.

The fill typically consists of an upper layer of sand and gravel containing trace silt, overlying silty sand to sandy silt containing trace to some gravel and, at some locations, trace organics. The measured SPT "N" values ranged from 0 (weight of hammer) to 12 blows per 0.3 m of penetration, indicating that the existing fill has a very loose to compact relative density.

4.3.2 Peat / Topsoil

The following table summarizes the thickness of topsoil and peat encountered in the various high fill embankment areas at the Dwyer Hill Road interchange site:

High Fill Embankment	Borehole Nos.	Organics Encountered
Dwyer Hill Road Stn 9+680 to 9+850	D-1 to D-4	About 0.4 m of peat is present below existing fill in Borehole D-1, drilled through existing road shoulder at the northern limit of this high fill embankment. South of this, 0.6 m to 1.1 m of peat was encountered in Boreholes D-2 to D-4.
Dwyer Hill Road Stn 9+850 to 10+100	D-5 and D-6	Topsoil, approximately 200 mm thick
E-NS Ramp Stn 13+600 to 13+775	DENS-1 to -3 DENS-5 to -7	Topsoil, typically 100 mm to 300 mm thick, encountered in boreholes. Note that 0.7 m of topsoil is present below existing fill in Borehole DENS-2, in the vicinity of Station 13+650.
N-E Ramp Stn 13+275 to 13+280 (existing drainage ditch)	DNE-1	Topsoil, approximately 100 mm thick.
N-E Ramp Stn 13+475 to 13+500	DNE-2 and DNE-3	Topsoil, approximately 300 mm thick.
S-E Ramp Stn 13+720 to 13+840	DSE-1 to DSE-5	Topsoil, 100 mm to 400 mm thick, encountered in boreholes outside of Dwyer Hill Road embankment.
S-W Ramp Stn 14+025 to 14+175	DSW-1 to DSW-7	Topsoil, 100 mm to 300 mm thick, encountered in boreholes outside of Dwyer Hill Road embankment.

4.3.3 Silty Sand to Sand and Gravel

A silty sand to sand and gravel deposit was encountered below the fill/organic deposits outside of the "till ridge", along the Dwyer Hill Road mainline north of Highway 7, along the E-NS and S-W Ramp alignments, and at the southern portion of the N-E Ramp alignment. The deposit ranges between 0.9 m and 3.2 m in thickness, with its surface between Elevations 129.8 m and 134.1 m and its base between Elevations 128.9 m and 131.4 m, as encountered in the boreholes.

The deposit consists mainly of sand containing trace to some silt and trace gravel, although it varies in composition to a silty sand or sand and gravel. The results of three grain size distribution tests conducted on selected samples are presented on Figure B1 in Appendix B.

The measured SPT "N" values within the surficial silty sand to sand and gravel range from 1 to 42 blows per 0.3 m of penetration, indicating that this deposit has a variable relative density ranging from very loose to dense; however, the SPT "N" values are typically below 20 blows per 0.3 m of penetration, indicating that the deposit has a generally very loose to compact relative density.

4.3.4 Silty Clay

Outside of the "till ridge", the surficial silty sand to sand and gravel deposit is underlain by a silty clay deposit along Dwyer Hill Road north of Highway 7, along the E-NS and S-W Ramp alignments, and at the southern end of the N-E Ramp alignment. The deposit varies between 0.2 m and 1.7 m in thickness, with its surface between Elevations 128.9 and 131.4 m and its base between Elevations 127.3 m and 131.1 m, as encountered in the boreholes.

The silty clay deposit contains trace sand, and the results from two grain size distribution tests are shown on Figure B2 in Appendix B. The upper portion of the deposit is generally brown to grey-brown in colour and is considered to represent a "weathered crust", while the deposit at greater depths is grey and unweathered. Atterberg limit testing was conducted on twelve samples of this deposit, and measured plastic limits between 17 and 20 per cent, liquid limits between 34 and 51 per cent, and corresponding plasticity indices of 17 to 31 per cent. These results, which are plotted on a plasticity chart on Figure B3 in Appendix B, confirm that the material is generally a silty clay of intermediate plasticity.

The measured SPT "N" values within the silty clay range from 0 (weight of hammer) to 25 blows per 0.3 m of penetration. In situ field vane testing in the grey silty clay measured undrained shear strengths ranging from 25 kPa to greater than 100 kPa, and sensitivities of about 5 to 7; the silty clay is therefore considered sensitive. Considering these results in conjunction with testing from the previous investigation at this site for the underpass structure (in which undrained shear

strengths between about 50 kPa and 80 kPa were measured), and visual examination based on local experience with this deposit, the silty clay at the site typically has a stiff to very stiff consistency. However, soft to firm, unweathered grey silty clay was encountered in Boreholes DNE-3/3A/3B, where the measured undrained shear strengths were approximately 25 kPa.

Oedometer consolidation testing was carried out on one thin-walled Shelby tube sample of the silty clay deposit from Borehole DNE-3B (in which the softest/most compressible silty clay at the site was encountered). The results of that testing are provided on Figure B4 in Appendix B, and are summarized in the table below:

Borehole No.	Sample Depth	Unit Weight	σ_p'	σ_{vo}'	$\sigma_p' - \sigma_{vo}'$	OCR	C_c	C_r	e_o	C_v
DNE-3B	2.6 m	19 kN/m ³	200 kPa	28 kPa	172 kPa	7	0.55	0.055	1.27	0.01

σ_p' Apparent preconsolidation pressure

σ_{vo}' Computed existing vertical effective stress

OCR Overconsolidation Ratio

C_c Compression index

C_r Recompression index

e_o Initial void ratio

C_v Coefficient of consolidation

4.3.5 Sand and Silt Till

A glacial till deposit is present throughout the Dwyer Hill Road interchange site. About 2.2 m to 5.3 m of till (including cohesionless soil interlayers) is present immediately below the topsoil or fill in the southeastern portion of the site, where a "till ridge" is present; and approximately 0.3 m to 2.9 m (but typically less than about 1.5 m) of till is present below the silty sand to sand and gravel and silty clay deposits outside of the "till ridge", in the northern portion of the site and at the very south limit of the N-E Ramp. The surface of the till deposit was encountered between Elevations 127.3 m and 131.1 m in the northern portion of the site, where the till is overlain by glaciofluvial and glaciolacustrine deposits.

The till generally consists of sand and silt (although this varies from silty sand to sandy silt), containing trace clay and trace to some gravel. In the "till ridge" in the southern portion of the site, the till deposit contains interlayers of cohesionless soil that vary in composition from sand, to silty sand, to sandy silt, to silt. These interlayers range from 0.3 m to 1.7 m in thickness, as encountered in the boreholes. Grain size distribution test results for four samples of the sand and silt till and one sample of the sand to sandy silt interlayer are shown in Figure B5.

This till and its interlayers within the "till ridge" in the southern portion of the site typically have a very dense relative density, with the majority of the measured SPT "N" values greater than 50 blows per 0.3 m of penetration, and an average SPT "N" value of about 75 blows per 0.3 m of penetration.

Outside of the till ridge, in the northern portion of the site and at the south limit of the N-E Ramp, the till is less dense; it has a very loose to compact relative density, based on measured SPT "N" values of 3 to 26 blows per 0.3 m of penetration.

4.3.6 Dolomitic Limestone Bedrock

Bedrock was encountered below the overburden deposits, as inferred by refusal to auger advance in the majority of the boreholes. The bedrock surface was confirmed by coring in three boreholes advanced as part of the current investigation (together with rock coring carried out in the boreholes advanced as part of the previous investigation for the Dwyer Hill Road underpass structure). The depth to auger refusal / bedrock and inferred bedrock surface elevation in the various high fill embankment areas are summarized in the following table:

<i>High Fill Embankment</i>	<i>Borehole Nos.</i>	<i>Depth to Bedrock</i>	<i>Bedrock Surface Elevation</i>
Dwyer Hill Road Stn 9+680 to 9+850	D-1 to D-5	3.5 m to 5.9 m	126.7 m to 128.3 m
Dwyer Hill Road Stn 9+850 to 10+100 N-E Ramp Stn 13+275 to 13+280	D-6 DNE-1A	3.2 m to 4.9 m	129.9 m to 132.7 m
E-NS Ramp Stn 13+600 to 13+775	DENS-1 to DENS-7	3.8 m to 5.5 m	127.3 m to 128.8 m
N-E Ramp Stn 13+475 to 13+500	DNE-2 and DNE-3	4.2 m to 4.7 m	127.1 m to 127.3 m
S-E Ramp Stn 13+720 to 13+840	DSE-1 to DSE-5	2.3 m to 5.7 m	129.6 m to 131.5 m
S-W Ramp Stn 14+025 to 14+175	DSW-1 to DSW-7	3.7 m to 4.7 m	127.9 m to 128.4 m

As shown in the above table, the inferred bedrock surface elevation varies from approximately Elevation 127.1 m to 132.7 m across the site; it is seen generally slightly higher toward the southeast.

Based on the recovered rock core samples from this and previous investigations, the bedrock at the site consists of dolomitic limestone of the Ottawa Formation. The dolomitic limestone is grey in colour, slightly weathered to fresh, and weak to medium strong. The Rock Quality Designation (RQD) values measured on recovered bedrock core samples ranged from 75 to 80 per cent, indicating that the rock is generally of good quality.

4.3.7 Groundwater Conditions

A total of six piezometers were installed in selected boreholes at the Dwyer Hill Road interchange site. The water levels measured in the piezometers are summarized below:

<i>Borehole No.</i>	<i>April 6, 2005</i>		<i>May 9, 2005</i>	
	<i>Depth to Groundwater</i>	<i>Groundwater Elevation</i>	<i>Depth to Groundwater</i>	<i>Groundwater Elevation</i>
D-2	–	–	0 m	131.5 m
DENS-1	0.3 m above g.s.	131.5 m	0.2 m above g.s.	131.4 m
DENS-5	0.4 m	132.2 m	0.5 m	132.1 m
DNE-3B	0.0 m	131.2 m	0.3 m	130.9 m
DSE-4	1.0 m	133.1 m	1.9 m	132.2 m
DSW-5	0.5 m	131.9 m	0.6 m	131.8 m

Based on these measurements, and the water level observations made in the open boreholes during drilling, the water level is typically about 0.5 m to 1.5 m below the natural ground surface at the site, between about Elevations 131 m and 133 m. Water levels close to the existing ground surface have also been measured or observed, particularly where peat deposits are present in the low-lying northwestern portion of the site.

It should be noted that the groundwater level at the site is expected to fluctuate seasonally, and is expected to be higher during wet periods of the year (similar to the April 2005 measurements presented above).

4.4 Ashton Station Road Interchange

As part of the subsurface investigation at this site, fifty-two boreholes were advanced at the locations shown on Drawing 3. The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of in situ and laboratory testing are given on the Record of Borehole sheets and on Figures C1 to C4 in Appendix C. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

In summary, the subsoils at this site consist of existing fill within the existing Ashton Station Road embankment, and peat or topsoil outside of the embankment, overlying layers of clayey silt to silty clay, sand to gravel to silt, and glacial till. These surficial soils are, in turn, underlain by bedrock that was encountered between 1.0 m and 3.9 m depth (about Elevation 127.1 m to 134.5 m) in the boreholes. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.4.1 Fill

Fill was found in eight boreholes (Boreholes A-1, A-9, A-11, A-12, A-13, ANE-1, ANW-10, and A WNS-6) advanced along the existing Ashton Station Road embankment. The fill, which varies

from about 0.3 m to 1.2 m in thickness, is typically present immediately below the ground surface; however, in Borehole ANW-10, the fill was encountered below a layer of topsoil.

The fill generally consists of sand, silty sand, sandy silt, or sand and gravel, containing trace organics. In Boreholes A-10 and A-12, the fill consists of organics containing gravel and/or silty clay containing trace organics. The cohesionless fill has a very loose to loose relative density, based on visual observation and measured SPT "N" values of 2 to 10 blows per 0.3 m of penetration.

4.4.2 Topsoil / Peat

The following table summarizes the thickness of topsoil and peat encountered in the various high fill embankment areas at the Ashton Station Road interchange site:

<i>High Fill Embankment</i>	<i>Borehole Nos.</i>	<i>Organics Encountered</i>
Ashton Station Road Stn 9+880 to 10+000	A-1, A-2 ASW-1	Topsoil, 300 mm to 500 mm thick
Ashton Station Road Stn 10+000 to 10+280	A-3 to A-13, ANE-1 and AWNS-6	Peat, 0.2 m to 0.9 m thick, encountered in boreholes. Note that 0.2 m to 0.5 m of peat is present below existing fill in four boreholes advanced through existing Ashton Station Road fill.
N-E Ramp Stn 9+520 to 9+720	ANE-1, A-4, ANE-3 to ANE-10	Peat, 0.6 m to 1.1 m thick, encountered in boreholes. Note that 0.2 m of peat is present below existing fill adjacent to existing Ashton Station Road embankment in Borehole ANE-1.
N-W Ramp Stn 9+820 to 10+020	ANW-1 to ANW-10	Topsoil, 0.2 m to 0.7 m thick, encountered in boreholes.
S-E Ramp Stn 9+770 to 10+040	ASE-1 to ASE-11	Peat, 0.3 m to 0.7 m thick (below 0.6 m to 0.8 m of ice/standing water at time of investigation), encountered in boreholes.
S-W Ramp Stn 10+460 to 10+500	ASW-1, A-1	Topsoil, approximately 300 mm thick
W-NS Ramp Stn 9+900 to 10+030	AWNS-1 to AWNS-6	Peat, 0.8 m to 0.9 m thick. Note that 0.2 m of peat is present below existing fill in Borehole AWNS-6, adjacent to existing Ashton Station Road embankment.

4.4.3 Clayey Silt to Silty Clay

A layer of clayey silt to silty clay was encountered below the embankment fill or peat in the southern portion of the site, along the Ashton Station Road mainline (Boreholes A-3 to A-13), the N-E Ramp (Boreholes ANE-1 to ANE-10A), the S-E Ramp (Boreholes ASE-1 to ASE-11) and the W-NS Ramp (Boreholes AWNS-1 to AWNS-6). A silty clay layer was also encountered in the two southernmost boreholes (Boreholes ANW-1 and ANW-2) along the N-W Ramp. The silty clay layer is absent in the northern portion of the site, along the Ashton Station Road mainline (Boreholes A-1 and A-2), north of Borehole ANW-3 along the N-W Ramp, and at the

S-W Ramp. The clayey silt to silty clay is about 0.2 m to 1.8 m thick as encountered in the boreholes, with its base between Elevations 127.5 m and 131.4 m.

In most areas of the site, the upper portion of the deposit is generally brown to grey-brown in colour and is interpreted to represent a "weathered crust", while the deposit at greater depths is typically grey and unweathered. The clayey silt to silty clay contains trace sand, and sand seams were noted within the deposit in some recovered samples. The results from ten grain size distribution tests carried out on selected samples of the clayey silt to silty clay are shown on Figure C1, contained in Appendix C.

Atterberg limit testing was conducted on fifteen samples, and measured plastic limits between 20 and 24 per cent, liquid limits between 34 and 48 per cent, and plasticity indices of 14 to 25 per cent. These results, which are plotted on a plasticity chart on Figure C2 in Appendix C, confirm that the material is generally a silty clay of intermediate plasticity, although a portion of the deposit is a clayey silt of low plasticity.

The measured SPT "N" values within the silty clay range from 1 to 7 blows per 0.3 m of penetration. In situ field vane testing in the grey silty clay measured undrained shear strengths ranging from 80 kPa to greater than 100 kPa, and a sensitivity (based on limited testing) of about 5; the silty clay is therefore considered sensitive. Considering these results in conjunction with visual examination based on local experience with this deposit, the weathered silty clay at the site typically has a stiff to very stiff consistency, and the grey silty clay has a firm to stiff consistency.

4.4.4 Gravel to Sand to Silt

A cohesionless soil layer was encountered immediately above the till (or, where the till is absent, immediately above the bedrock) in some of the boreholes advanced at the Ashton Station Road site, as follows:

- In the northern portion of the site, this layer was encountered only in Borehole A-2, where it is present immediately below the topsoil; at this location, the deposit is 0.8 m thick and consists of sand containing some silt.
- In the southern portion of the site, this deposit was encountered in the majority of the boreholes along the Ashton Station Road and S-E Ramp alignments, in one borehole (Borehole ANE-4) along the N-E Ramp, and in one borehole (Borehole AWNS-5) along the W-NS Ramp. At these locations, the layer is typically present below the silty clay, and it ranges between 0.1 m and 1.5 m in thickness.

The layer varies in composition from sand containing trace silt, to a silty sand, to a sandy silt, to silt containing trace sand; trace quantities of gravel and organics were also noted in some of the

samples. At one location (Borehole A-7), the layer consists of gravel containing some sand and trace silt. The result of a grain size distribution test on this material from Borehole A-7 is presented on Figure C3 in Appendix C.

The measured SPT “N” values within this layer range from 3 to more than 20 blows per 0.3 m of penetration, indicating that the gravel to sand to silt layer has a very loose to compact relative density.

4.4.5 Silty Sand Till to Sandy Silt Till

A glacial till deposit immediately overlies the bedrock at this site, although the till is absent in a minority of boreholes. The glacial till is present immediately below the topsoil (or, where present in Borehole A-2, the sand layer) in the northern portion of the site. In the southern portion of the site, including the south limit of the proposed high fill embankments at the N-W Ramp (Boreholes ANW-1 and ANW-2), the glacial till deposit is present below the clayey silt to silty clay and gravel to sand to silt deposits. The till ranges between 0.1 m and 2.9 m in thickness, but it is typically between about 0.5 m and 1.5 m thick. The surface of the till deposit was encountered in the boreholes between about Elevations 130.0 m and 135.2 m in the northern portion of the site, and between about Elevations 128.2 m and 131.6 m in the southern portion of the site.

The glacial till deposit varies in composition from a silty sand to a sandy silt, containing trace to some gravel and trace clay. Sand seams were noted within some of the recovered samples. The results of three grain size distribution tests are shown on Figure C4 in Appendix C.

The measured SPT “N” values within the silty sand to sandy silt till vary from 1 to greater than 100 blows per 0.3 m of penetration, indicative of a highly variable relative density ranging from very loose to very dense. The deposit is, however, typically loose to dense, with typical SPT “N” values between about 6 and 40 blows per 0.3 m of penetration.

4.4.6 Dolomitic Limestone Bedrock

The bedrock surface was encountered between 1.0 m and 3.9 m depth (Elevations 127.1 m to 134.5 m) in the boreholes advanced as part of this investigation; the bedrock was cored in twenty-one boreholes that were advanced using portable drilling equipment, and was inferred by refusal to auger advance in the remainder of the boreholes. The depth to auger refusal / bedrock and the inferred or encountered bedrock surface elevations in the various high fill embankment areas are summarized in the following table:

<i>High Fill Embankment</i>	<i>Borehole Nos.</i>	<i>Depth to Bedrock</i>	<i>Bedrock Surface Elevation</i>
Ashton Station Road Stn 9+880 to 10+000	A-1, A-2 ASW-1	1.1 m to 1.4 m	133.0 m to 134.5 m
Ashton Station Road Stn 10+000 to 10+280	A-3 to A-13, ANE-1 and AWNS-6	2.0 m to 3.5 m	127.1 m to 131.2 m
N-E Ramp Stn 9+520 to 9+720	ANE-1, A-4, ANE-3 to ANE-10	1.7 m to 3.6 m	128.7 m to 130.6 m
N-W Ramp Stn 9+820 to 10+020	ANW-1 to ANW-10	1.0 m to 1.9 m	130.5 m to 134.0 m
S-E Ramp Stn 9+770 to 10+040	ASE-1 to ASE-11	1.9 m to 3.0 m	127.8 m to 129.4 m
S-W Ramp Stn 10+460 to 10+500	ASW-1, A-1	1.1 m to 1.6 m	133.0 m to 134.5 m
W-NS Ramp Stn 9+900 to 10+030	AWNS-1 to AWNS-6	1.6 m to 3.9 m	128.4 m to 133.0 m

Based on the recovered rock core samples, the bedrock at the site generally consists of dolomitic limestone of the Ottawa Formation, which contains shale seams or interlayers. In Borehole ANW-2 in the northwestern portion of the site, approximately 0.3 m of shale bedrock was encountered immediately below the overburden soils; the presence of this upper shale layer is consistent with the results of rock coring during a previous investigation for the Ashton Station Road underpass structure.

The dolomitic limestone bedrock is typically grey, although it ranges to grey-green at some locations. It is slightly weathered to fresh, and weak to medium strong. Based on the relatively short core runs (i.e. only shallow penetration into the bedrock), the Rock Quality Designation (RQD) values measured on the core samples – which were obtained from only the upper 0.3 m to 0.8 m of the bedrock – range from 0 to 79 per cent. The 0 per cent values were measured in six boreholes where the bedrock was observed to be fractured. Elsewhere, the RQD values are typically above 30 per cent, indicating that the upper portion of the bedrock is of poor to good quality.

4.4.7 Groundwater Conditions

A total of four piezometers were installed in selected boreholes at the Ashton Station Road interchange site. The water levels measured in the piezometers are summarized in the following table:

<i>Borehole No.</i>	<i>May 9, 2005</i>	
	<i>Depth to Groundwater</i>	<i>Groundwater Elevation</i>
A-4	0.4 m above g.s.	133.0 m
A-12	0.7 m above g.s.	130.6 m
ANW-1	0.1 m above g.s.	132.5 m
AWNS-2	0.1 m above g.s.	132.4 m


The water levels at the site are typically at or near the ground surface, and have been measured or observed to be above the ground surface in many areas of the site during the spring and fall (i.e. periods of heavy precipitation and/or snow melt). In the swampy area that covers the southern portion of the site, outside of the existing Ashton Station Road embankment, the water levels have been observed during drilling to be up to about 0.8 m above the surface of the peat.

5.0 CLOSURE

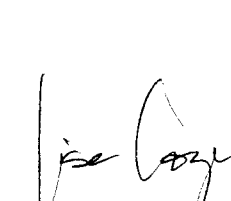
This Foundation Investigation Report was prepared by Ms. Beng Lay Teh and reviewed by Ms. Lisa Coyne, P.Eng., an Associate and Senior Engineer with Golder. Mr. Fintan Heffernan, a Designated MTO Contact for Golder, conducted an independent review of the report.

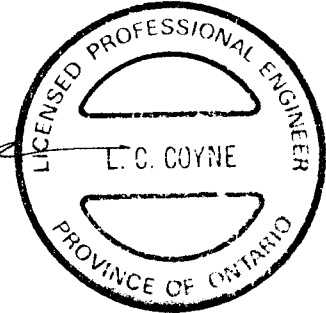
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PART B

**FOUNDATION DESIGN REPORT
HIGH FILL EMBANKMENTS
HIGHWAY 7 TWINNING FROM 0.7 KM WEST OF JINKINSON ROAD
WESTERLY 10.5 KM TO 2.5 KM WEST OF ASHTON STATION ROAD
W.P. 251-99-00**

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

This section of the report provides foundation design recommendations for the proposed high fill embankments along Highway 7 near the Trans-Canada Trail crossing, and at Dwyer Hill Road and Ashton Station Road interchanges. The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the subsurface investigation at these sites. The interpretation and recommendations provided are intended only to provide the designers with sufficient information to assess the feasible embankment configurations, to design the proposed embankments, and to prepare the Contract Documents. As such, where comments are made on construction they are provided only in order to highlight those aspects which could affect the design of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods, scheduling and the like.

6.1 General

The overall project under W.P. 251-99-00 involves the twinning of the existing two-lane Highway 7 from 0.7 km west of Jinkinson Road, westerly 10.5 km to 2.5 km west of Ashton Station Road, including new interchanges at Dwyer Hill Road and Ashton Station Road. As part of this work, foundation recommendations are required for three separate area of high fill embankments, along the new Highway 7 embankment at the Trans-Canada Trail crossing, and for portions of the local roads and ramps at the Dwyer Hill Road and Ashton Station Road interchanges. A retaining wall has been considered during the design adjacent to the Dwyer Hill Road S-E Ramp, to minimize impacts on the adjacent property.

The following sections of this report address subgrade preparation (topsoil stripping and peat removal) requirements, embankment stability under both static and seismic conditions, embankment settlement, and construction concerns (supplemented with appropriate Non-Standard Special Provisions or Operational Constraints) for the proposed high fill embankments. Recommendations are also provided for the retaining wall adjacent to the Dwyer Hill Road S-E Ramp. It is understood that a wall is no longer required at this location; however, the recommendations developed during the design process have been included herein for completeness.

6.2 Subgrade Preparation Requirements

Surficial organic layers, consisting of relatively thin topsoil or thicker deposits of peat/organic soils, are present along many of the proposed high fill embankment alignments. The thickness of the topsoil and peat/organic soils as encountered in the boreholes is summarized in Tables 1 to 3, following the text of this report, for each of the high fill embankment areas. Tables 1 to 3 also summarize the topsoil stripping and/or peat removal requirements at each of the proposed high fill embankment areas.

6.2.1 Topsoil Stripping

OPSS 206 requires stripping of topsoil below embankments of less than 1.2 m in height. For this project, regardless of the height, it is recommended that all topsoil be stripped from within the footprint of the new embankment construction, in order to minimize settlement and stability issues and improve the long-term performance of the new embankments and roadways.

6.2.2 Peat Removal

Between 0.3 m and 1.1 m of peat is present in swamps located near the north end of the proposed Dwyer Hill Road embankment, over the southern portion of the Ashton Station Road embankment, and along the N-E, S-E and W-NS Ramps at the Ashton Station Road interchange.

In areas where the high fill embankments are being constructed on new alignments, away from existing roadways, construction procedures should implement the guidelines of Ontario Provincial Standard Drawing (OPSD) 203.010.

In areas where the new high fill embankments will be constructed immediately adjacent to, or on top of, the existing Dwyer Hill Road or Ashton Station Road embankments, construction procedures should implement the guidelines of OPSD 203.020. This will apply between Stations 9+680 and 9+850 of the Dwyer Hill Road embankment (as noted in Table 2), and south of approximately Station 10+000 on Ashton Station Road (as noted in Table 3). At these locations, peat was encountered below the existing roadway fill, and the new high fill embankments will be constructed atop the existing road alignments. The guidelines in OPSD 203.020 require that the slopes of the existing Dwyer Hill Road or Ashton Station Road embankments be temporarily excavated to a 1H:1V profile to allow for removal of a larger extent of organic material from below the existing embankment fill in these areas. This requirement also applies where the new N-E, S-E and W-NS Ramps tie into the Ashton Station Road alignment. Where Dwyer Hill Road E-NS and S-W Ramps cross the old alignment, the fill and the underlying peat should be sub-excavated for the full footprint of the ramp.

If these portions of Dwyer Hill Road (Station 9+680 to 9+850) or Ashton Station Road (south of about Station 10+000) are required to remain open during construction, subexcavation of peat from beneath the existing embankment side slopes should be controlled as follows:

- The removal of the peat should be carried out in short sections perpendicular to the roadway alignment, with the base of the excavation not wider than 3 m at any time. Excavation and backfilling operations should be carried out simultaneously in such a manner that the excavation is not left open for more than 3 m in length at any time.
- The sub-excavation should be carried out such that the base of the excavation is maintained outside a zone defined by a line drawn downward at 1 horizontal to 1 vertical (1H:1V) from the crest of the existing roadway embankment to the base of the excavation.

Since some distress to the existing roadway may occur during such staged excavation works, provision for traffic control measures must be included in the Contract to maintain the safe operation of these portions of Dwyer Hill Road and Ashton Station Road during the excavation and backfilling operations, if these portions of the roadways are to remain open.

6.3 Embankment Stability

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

The analyses were carried out based on the embankment heights determined from the profiles provided by MMM on October 5, 2004 and March 15, 2005. Further details of the analyses are provided in the following subsections; however, the main conclusions are as follows:

- Earth/granular fill embankments can be designed with 2 horizontal to 1 vertical (2H:1V) side slopes for all high embankment locations.
- Where property constraints exist adjacent to the N-W, S-E and W-NS Ramps at the Ashton Station Road interchange, rock fill embankments can be designed with 1.25H:1V side slopes.

It should be noted that, where earth fill embankments are greater than 8 m in height, a mid-height berm with a minimum width of 2 m is required. Where rock fill embankments exceed a height of 10 m, 2 m wide berms or benches are required so that the uninterrupted rock fill slope never exceeds a height of 10 m. Requirements for mid-height berms on earth fill embankments are indicated in Tables 1 to 3 following the text of this report.

6.3.1 Highway 7 Near Trans-Canada Trail Crossing

Along the new Highway 7 EBL between about Stations 10+740 and 11+080, the subsoils encountered in the boreholes consist of 0.2 m to 0.4 m of topsoil overlying about 0.1 m to 1.0 m of loose to dense sand and silt to sandy silt till. The till is underlain by shale bedrock, as proven in Borehole 04-3 in this investigation, and in the boreholes advanced by Golder as part of a previous investigation at the Trans-Canada Trail crossing site, which is located within this high fill embankment section.

Static Global Stability

Limit equilibrium slope stability analyses have been performed using SLOPE/W, produced by Geo-Slope International Ltd., employing the Morgenstern-Price method of analysis. The following parameters have been used in the slope stability analyses, based on accepted correlations with the measured SPT "N" values:

<i>Soil Type</i>	<i>Bulk Unit Weight</i>	<i>Effective Friction Angle</i>	<i>Undrained Shear Strength</i>
Earth fill (range of parameters assuming earth and granular fill)	20 – 22 kN/m ³	30° – 35°	–
Sand and silt to sandy silt till	21 kN/m ³	32°	–

The piezometric conditions used in the stability analyses were based on the groundwater conditions noted during drilling and in the piezometers installed during the foundation investigation for the Trans-Canada Trail crossing. Based on this, a water level up to 0.3 m above the ground surface was used in the stability analyses.

The analysis results indicate that the 4 m to 5 m high embankment with side slopes maintained at 2H:1V will have a factor of safety of greater than 1.3 against global instability, assuming appropriate subgrade preparation and proper placement and compaction of the embankment fill materials.

Stability Under Seismic Loading

The liquefaction potential of the soils below the Highway 7 embankment under seismic loading has been considered using the empirical method outlined in Section C.4.6.2 of the *CHBDC Commentary*, which correlates the cyclic resistance ratio of the soils with their normalized penetration resistance and fines content. Based on this assessment, a factor of safety of greater than 1.1 against liquefaction for an earthquake of magnitude 6.2 is obtained for the sandy silt till soils below the water table.

Although these site soils are not considered to be liquefiable, there will still be some deformation of the soils under seismic loading conditions. Pseudo-static methods of slope stability analysis indicate a yield acceleration of approximately 0.2g is required to reduce the factor of safety against slope instability to 1.0. Using this result and the simplified Newmark method, embankment deformations as a result of the design earthquake event are anticipated to be less than 25 mm.

Surficial Stability

To reduce surface water erosion on the embankment side slopes, placement of topsoil and seeding or pegged sod is recommended. It is noted that ditching alongside the new Highway 7 embankment may extend below the groundwater level at the site during wet periods of the year (i.e. spring-time). The ditch cuts should be inspected after completion to check for evidence of water seepage that could affect the surficial stability. It is recommended that remedial measures, such as a granular blanket, be placed on the ditch slopes where seepage is present.

6.3.2 Dwyer Hill Road Interchange

The Dwyer Hill Road interchange is dominated by a sand and silt till "ridge" that passes through the southwest, southeast and northeast quadrants of the site. The existing Highway 7 – Dwyer Hill Road intersection has been constructed in a cut through the ridge that is up to about 6 m deep. Outside of this till ridge, the native soils consist of topsoil or peat (where a swamp is present along the northern portion of Dwyer Hill Road) over loose to compact silty sand to sand and gravel, underlain by a soft to very stiff silty clay layer, which is in turn underlain by sand and silt till. The overburden soils are underlain by interlayered limestone and dolomitic limestone bedrock that was confirmed by the core drilling or inferred (based on split-spoon and auger refusal) between 2.0 m and 5.9 m depth.

Static Global Stability

Limit equilibrium slope stability analyses were carried out (using SLOPE/W) for each embankment area, based on the highest embankment height and the “worst case” soil conditions encountered along each of the high fill embankment areas. The following parameters have been used in the analyses, based on accepted correlations with the measured SPT “N” values and Atterberg limit test results:

<i>Soil Type</i>	<i>Bulk Unit Weight</i>	<i>Effective Friction Angle</i>	<i>Undrained Shear Strength</i>
Earth fill (range of parameters assumed for earth and granular fill)	20 – 22 kN/m ³	30° - 35°	–
Rock fill	19 kN/m ³	38°	–
Silty sand to sand and gravel	20 kN/m ³	28°	–
Weathered silty clay crust	19 kN/m ³	35°	100 kPa
Unweathered silty clay	19 kN/m ³	35°	25 kPa
Sand and silt till	21 kN/m ³	32°	–

The piezometric conditions used in the stability analyses were based on the groundwater levels measured in April and May 2005, with readings close to the existing ground surface outside of the “till ridge”.

The results of the analyses indicate that for earth fill embankments of up to 9 m height with side slopes maintained at 2H:1V, a factor of safety of greater than 1.3 against global instability can be attained, assuming appropriate subgrade preparation and proper placement and compaction of embankment fill materials. As previously indicated, a 2 m wide mid-height berm is required where the embankment height exceeds 8 m; this requirement is noted where applicable in Table 2.

Due to property constraints adjacent to a portion of the S-E Ramp (Stations 13+775 to 13+850), a retaining wall has been considered during the design; foundation recommendations for such a wall are provided in Section 6.5.

Stability Under Seismic Loading

The liquefaction potential of the soils below the Dwyer Hill Road interchange embankments under seismic loading has been considered using the empirical method outlined in Section C.4.6.2 of the *CHBDC Commentary*, which correlates the cyclic resistance ratio of the soils with their normalized penetration resistance and fines content. Based on this assessment, a factor of safety of less than 1.1 against liquefaction is obtained for magnitude 6.2 earthquake events for localized areas along the E-NS Ramp, the S-W Ramp and Dwyer Hill Road embankments, all north of the

proposed bridge location. This localized liquefaction occurs under portions of the embankment toes, where the surficial sandy deposit has a low fines content, low SPT "N" values representative of a loose state of packing, and low confining stresses (under less than about 2 m of embankment fill).

Pseudo-static methods of slope stability analysis indicate a yield acceleration of approximately 0.2g is required to reduce the factor of safety against slope instability to 1.0. Based on this yield acceleration and the correlation proposed by Makdisi and Seed, it is estimated that between 50 mm and 300 mm of deformation of the embankment could result under the design earthquake event. Localized failures at the embankment toes, resulting in steepening of the embankment side slopes, could occur. Since deep-seated global instability is not anticipated under the design earthquake event, localized toe failures would be mainly a maintenance issue. This should be considered in the life cycle costing when assessing the relative costs of the works.

Surficial Stability

To reduce surface water erosion on the embankment side slopes, placement of topsoil and seeding or pegged sod is recommended. It is noted that ditching alongside the new Dwyer Hill Road embankment north of the bridge, and along the E-NS and S-W Ramps, may extend below the groundwater level at the site, particularly during wet periods of the year. The ditch cuts should be inspected after completion to check for evidence of water seepage that could affect the surficial stability. It is recommended that remedial measures, such as a granular blanket, be placed on the ditch slopes where seepage is present.

6.3.3 Ashton Station Road Interchange

The overburden soils at the Ashton Station Road interchange site consist of fill or peat overlying relatively thin layers of silty sand, silty clay, and silty sand to sandy silt till. Dolomitic limestone bedrock was encountered below the overburden soils between about 1.0 m and 3.9 m depth. There is a low-lying swamp covering the southern portion of the site, south of about Station 10+000 on Ashton Station Road, where the high fill embankments for Ashton Station Road and the N-E, S-E and W-NS Ramps will be constructed.

Static Global Stability

Limit equilibrium slope stability analyses were carried out using SLOPE/W for sections where the highest embankment and/or thickest clay deposit was encountered. The following parameters have been used in the slope stability analyses:

<i>Soil Type</i>	<i>Bulk Unit Weight</i>	<i>Effective Friction Angle</i>	<i>Undrained Shear Strength</i>
Earth fill (range of parameters assuming earth or granular fill)	20 – 22 kN/m ³	30° - 35°	–
Rock fill	19 kN/m ³	38°	–
Silty sand to sandy silt	20 kN/m ³	32°	–
Silty clay to clayey silt	19 kN/m ³	35°	40 kPa
Sand and silt till	21 kN/m ³	32°	–

The piezometric conditions used in the stability analyses were based on the levels observed in the low-lying southern portion of the site, where the groundwater level was at or above the ground surface.

It should be noted that the field vane tests measured in situ undrained shear strengths in the stiff to very stiff silty clay deposit to be greater than 70 kPa. A design value of 40 kPa for this silty clay deposit was used in the analyses, which reflects a lower bound based on experience and correlations with Atterberg limit testing.

The results of the analyses indicated that earth fill embankment with side slopes maintained at 2H:1V will have factor of safety of greater than 1.3 against global instability, assuming appropriate subgrade preparation and proper placement and compaction of embankment fill materials.

It is understood that, in order to avoid impact on properties adjacent to several high fill embankments, consideration is being given to the use of rock fill embankments with steeper side slopes (1.25H:1V) than conventional earth fill embankments.

Assuming that all peat or organic soils are stripped or subexcavated prior to construction of the above embankments, the stability analyses indicate that a factor of safety of greater than 1.3 is obtained for the “worst case” rock fill embankment configurations – i.e. the thickest and weakest silty clay stratum, in conjunction with the highest embankment loading. Therefore, 4.5 m to 7.5 m high rock fill embankments with side slopes at 1.25H:1V may be used for construction of the N-W, S-E and W-NS Ramp embankments at the Ashton Station Road interchange.

Stability Under Seismic Loading

The liquefaction potential of the soils below the Ashton Station Road interchange embankments under seismic loading has been considered using the empirical method outlined in Section C.4.6.2 of the *CHBDC Commentary*, which correlates the cyclic resistance ratio of the soils with their normalized penetration resistance and fines content. Based on this assessment, a factor of safety of greater than 1.1 against liquefaction for an earthquake of magnitude 6.2 is obtained for the surficial sand and glacial till soils below the water table.

Although these site soils are not considered to be liquefiable, there will still be some deformation of the soils under seismic loading conditions. Pseudo-static methods of slope stability analysis indicate a yield acceleration of approximately 0.2g is required to reduce the factor of safety against slope instability to 1.0. Using this result and the simplified Newmark method, embankment deformations as a result of the design earthquake event are anticipated to be less than 25 mm.

Surficial Stability

To reduce surface water erosion on the embankment side slopes, placement of topsoil and seeding or pegged sod is recommended. It is noted that ditching in the southern portion of the site may extend below the groundwater level, particularly during wet periods of the year (i.e. spring-time); this applies particularly alongside the new Ashton Station Road embankment (south of about Station 10+000), and along the N-E, S-E and W-NS Ramps. The ditch cuts in these areas should be inspected after completion to check for evidence of water seepage that could affect the surficial stability. It is recommended that remedial measures, such as a granular blanket, be placed on the ditch slopes where seepage is present.

6.4 Embankment Settlement

Settlement of the high fill embankments will occur as a result of compression of the new embankment fill itself, as well as short-term compression of the cohesionless soils that underlie the embankments, and longer-term consolidation settlement within cohesive soils of limited thickness that underlie the embankments.

6.4.1 Settlement of Embankment Fill

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

Where rock fill is used, settlement of the rock fill itself will depend on the type of rock, and on the method and sequence of placement and compaction of the fill. Assuming that the rock fill is not end-dumped into its final position and that it is placed in accordance with the requirements outlined in the Special Provision Amendment to OPSS 206, the settlement of rock fill in embankments up to 10 m high is estimated to be about 1 per cent of the embankment height. Therefore, for the 4.5 m to 7.5 m high rock fill embankments that could be adopted at the Ashton Station Road interchange, the settlement of the rock fill itself is expected to be about 45 mm to

75 mm. It is anticipated that the majority of this settlement will occur during the first year following construction.

6.4.2 Settlement of Foundation Soils

Settlement analyses for the foundation soils were carried out using the commercially available computer program Unisettle. The immediate compression of cohesionless soil strata, including surficial sands and the sand and silt to sandy silt till deposit, was modelled using elastic deformation moduli, based on correlations with the measured SPT "N" values. The consolidation settlement of the silty clay strata, where present, was modelled based on the results of one oedometer (consolidation) test and estimates of consolidation parameters from correlations with the vane shear strength and Atterberg limit test results. The following parameters were used in the analyses:

<i>Location</i>	<i>Soil Type</i>	<i>Bulk Unit Weight</i>	<i>Elastic Modulus</i>	<i>P_c'</i>	<i>e_o</i>	<i>C_c</i>	<i>C_r</i>
Highway 7	Sand and silt till	21 kN/m ³	30 MPa	—	—	—	—
Dwyer Hill	Silty sand to sand	20 kN/m ³	10 – 15 MPa	—	—	—	—
	Weathered silty clay	19 kN/m ³	—	200	1.27	0.2 to 0.3	0.03 to 0.055
	Unweathered silty clay	19 kN/m ³	—	200	1.27	0.55	0.055
	Sand and silt till	21 kN/m ³	30 – 40 MPa	—	—	—	—
Ashton Station	Sand	20 kN/m ³	10 – 15 MPa	—	—	—	—
	Weathered silty clay	19 kN/m ³	—	200	1.27	0.2 to 0.3	0.03
	Unweathered silty clay	19 kN/m ³	—	200	1.27	0.2 to 0.3	0.03
	Sand and silt till	21 kN/m ³	30 – 40 MPa	—	—	—	—

The total estimated settlement of the foundation soils under each of the high fill embankment areas is provided in Tables 1 to 3 following the text of this report.

Provided that proper subgrade preparation is carried out, the settlement of cohesionless soils under the high fill embankments will generally be less than 25 mm and will occur relatively quickly during construction. Longer-term consolidation settlement of the silty clay strata totalling 25 mm or more will occur under the following high fill embankment areas:

- Dwyer Hill Road embankment north of underpass structure (up to about 40 mm of consolidation settlement).
- Dwyer Hill Road E-NS Ramp (up to about 25 mm of consolidation settlement).
- Dwyer Hill Road S-W Ramp (up to about 25 mm of consolidation settlement).
- Dwyer Hill Road N-E Ramp (up to about 25 mm of consolidation settlement).

- Ashton Station Road embankment (about 50 mm to 75 mm of consolidation settlement).
- Ashton Station N-E Ramp (about 50 mm to 100 mm of consolidation settlement).
- Ashton Station S-E Ramp (about 50 mm to 75 mm of consolidation settlement).
- Ashton Station W-NS Ramp (about 50 mm to 75 mm of consolidation settlement).

Considering the relatively high coefficient of consolidation (C_v) and considering the relatively limited thickness of the silty clay layers at the embankment locations, it is expected that 90 per cent of the primary consolidation settlement at the above-noted locations would be completed within about three to five months following construction. Therefore, it is recommended that consideration be given in the construction staging, and Operational Constraints included in the Contract, to require construction of the above-noted high fill embankments approximately three to six months in advance to allow the majority of the consolidation settlement to be completed prior to paving. Operational Constraints for this preloading are addressed further in Section 6.6 and Appendix D.

t = 3 to 6 mos

6.5 Retaining Wall at Dwyer Hill Road S-E Ramp

It is understood that a retaining wall could be required adjacent to the Dwyer Hill Road S-E Ramp, between about Stations 13+775 and 13+850, to minimize impacts on the property southeast of the ramp. At this location, a cut up to about 3 m deep is required for the S-E Ramp and drainage ditches. The subsurface conditions encountered in Boreholes DSE-3, DSE-4 and DSE-5, which are located along the S-E Ramp in this area, consist of fill (associated with the existing roadways) or topsoil overlying a generally dense to very dense silty sand to sandy silt till deposit that contains interlayers of compact to very dense sand to silt. The surface of the bedrock (as inferred from refusal to split-spoon and auger advance) was encountered between 2.3 m and 4.1 m depth (about Elevation 129.6 m to 130.1 m) in the boreholes.

Based on these subsurface conditions, consideration could be given to the use of a concrete gravity type wall founded on spread footings, or a mechanically-reinforced soil retaining wall (retained soil system, or RSS wall). Consideration could also be given to the use of a cantilever-type retaining wall, but this option would require socketting of piles into the bedrock due to the shallow rock depth at this location.

Of the above options, the RSS wall is considered the most economical and the most advantageous from a foundations perspective. Recommendations for RSS walls and concrete gravity walls supported on spread footings are presented in the following sections. The requirements for temporary open-cut excavation and groundwater control associated with the retaining wall construction are addressed in Section 6.5.3.

6.5.1 RSS Walls

The reinforced earth mass should be placed after excavation to the required depth adjacent to the ramp cut. Based on the borehole results, the RSS wall will be founded on the ~~generally~~ dense to very dense silty sand to sandy silt till, which contains interlayers of compact to very dense sand to silt. The base of the RSS wall would be down to about 2 m below the groundwater level in this area, and groundwater control could be provided by pumping from sumps outside of the foundation area. In order to prevent the migration of fine native soil particles into the granular fill of the RSS wall due to groundwater seepage, **it is recommended that the RSS wall mass be wrapped in geotextile filter fabric.** It is also recommended that a longitudinal drain be placed behind the RSS wall facing panels, and that consideration be given to the placement of a second longitudinal drain behind the reinforced soil mass.

Assuming that the RSS wall acts as a unit and utilizes the full width of the reinforced soil mass, which is taken as 70 per cent of the height of the wall at any given location, the factored geotechnical resistances at ULS given in the following table may be used for assessment of the reinforced mass founded on the properly prepared subgrade. It is expected that there will be less than 25 mm of settlement of the dense to very dense foundation soils under these loads; therefore, the factored geotechnical resistance at ULS will govern the design of the RSS wall.

Wall Height	Assumed Width	Factored Geotechnical Resistance at ULS
2 m	1.4 m	100 kPa
3 m	2.1 m	150 kPa

The facing panels must be placed on a granular levelling pad; based on the subsurface conditions encountered at this site, the thickness of the levelling pad may be taken as 150 mm. However, provision should be made in the contract for the subexcavation of loose materials if these are encountered at subgrade level, prior to placement of the granular levelling pad.

The resistance to lateral forces / sliding resistance between the compacted granular fill and the subgrade should be calculated in accordance with Section 6.7.5 of the CHBDC. The coefficient of friction, $\tan \phi'$, between the compacted granular fill of the RSS wall and the native sandy to silty till soils may be taken as 0.62. This represents an unfactored value; in accordance with the CHBDC, a factor of 0.8 is to be applied in calculating the horizontal resistance.

The internal stability of the mechanically-reinforced soil walls should be checked by the RSS supplier / designer. The Factor of Safety related to global stability for properly designed and constructed RSS walls at this site will be greater than 1.3.

6.5.2 Concrete Retaining Wall Supported on Spread Footings

Spread footings for support of a concrete retaining wall adjacent to the Dwyer Hill Road S-E Ramp should be founded at a minimum depth of 1.8 m below the lowest surrounding grade in order to provide adequate protection against frost penetration. Since the cut will be up to about 3 m depth in this area and the depth to bedrock is under 4.1 m depth, it is expected that the spread footings will be supported on the surface of the bedrock (which was encountered between Elevations 129.6 m and 130.1 m in the boreholes).

It will be necessary to subexcavate and remove any loosened portions of the bedrock exposed at the base of the footing excavation prior to construction of the retaining wall foundations. MTO's Special Provision SP902S01 should be included in the Contract Documents requiring inspection and approval of the foundation area by the Quality Verification Engineer prior to footing construction, to ensure that all loose and/or fractured rock has been removed from the foundation area. In order to accommodate variation in the bedrock surface (as indicated based on the borehole results), it is recommended that a founding level of Elevation 130.0 m be adopted, and that provision be made in the Contract Documents for the placement of mass concrete on top of the cleaned and inspected bedrock surface, to raise the grade to founding level.

NSSP
For
mass
concrete

Geotechnical Resistance

A spread footing placed on the surface of the properly prepared limestone / dolomitic limestone bedrock may be designed using a factored geotechnical resistance at Ultimate Limit States (ULS) of 3,000 kPa. The geotechnical resistance at Serviceability Limit States (SLS) for 25 mm of settlement will be greater than the factored resistance at ULS, since the bedrock is considered to be an unyielding material; as such the ULS conditions will govern for this foundation.

The geotechnical resistances provided above are given under the assumption that the loads will be applied perpendicular to the surface of the footings. Where the load is not applied perpendicular to the surface of the footing, inclination of the load should be taken into account in accordance with Section 6.7.4 of the *Canadian Highway Bridge Design Code (CHBDC)* and its *Commentary*.

Resistance to Lateral Loads

Resistance to lateral forces / sliding resistance between the concrete footings and the subgrade should be calculated in accordance with Section 6.7.5 of the *CHBDC*. The coefficient of friction, $\tan \phi'$, between cast-in-place concrete footings and the properly prepared bedrock surface may be taken as 0.7. This represents an unfactored value; in accordance with the *CHBDC*, a factor of 0.8 is to be applied in calculating the horizontal resistance.

If necessary, the sliding resistance of the footing can be supplemented by dowelling into the bedrock. The horizontal resistance of the dowels is dependent on the strength of the bedrock, grout and steel. For this site, where the rock mass is essentially as strong or stronger than concrete, the design of the dowels in the rock may be handled in the same way as the dowel embedment into the concrete. This assumes that the unconfined compressive strength of the grout will be similar to that of the concrete. The dowels should have a minimum embedded length within the bedrock of 1 m, and the structural strength of the dowel and compressive strength of the grout should not be exceeded. If dowelling into bedrock is adopted at this site, a Special Provision should be included in the Contract Documents to specify the installation, materials and testing of the dowels.

Lateral Earth Pressures for Design

The lateral earth pressures acting on the retaining wall will depend on the type and method of placement of the backfill materials, on the nature of the soils behind the backfill, on the magnitude of surcharge including construction loadings, on the freedom of lateral movement of the structure, and on the drainage conditions behind the walls. Seismic (earthquake) loading must also be taken into account in the design.

The following recommendations are made concerning the design of the wall. It should be noted that these design recommendations and parameters assume level backfill and ground surface behind the wall. Where there is sloping ground behind the wall, the coefficient of lateral earth pressure must be adjusted to account for the slope.

- Select free-draining granular fill meeting the specifications of Ontario Provincial Standard Specifications (OPSS) Granular "A" or Granular "B" but with less than 5 per cent passing the 200 sieve should be used as backfill behind the wall. This fill should be placed and compacted in accordance with MTO's Special Provision SP105S10. Longitudinal drains and weep holes should be installed to provide positive drainage of the granular backfill, in accordance with Ontario Provincial Standard Drawing (OPSD) 3506.00.
- A minimum compaction surcharge of 12 kPa should be included in the lateral earth pressures for the structural design of the wall stem, in accordance with *CHBDC* Section 6.9.3 and Figure 6.9.3. Compaction equipment should be used in accordance with MTO's Special Provision SP105S10. Other surcharge loadings should be accounted for in the design, as required.
- The granular backfill behind the retaining wall may be placed either in a zone with width equal to at least 1.8 m behind the back of the wall stem (Case I in Figure C6.9.1(I) of the *Commentary to the CHBDC*) or within the wedge-shaped zone defined by a line drawn at 1.5 horizontal to 1 vertical (1.5H:1V) extending up and back from the rear face of the footing (Case II in Figure C6.9.1(I) of the *Commentary to the CHBDC*).

- The following parameters may be used to assess the lateral earth pressure acting on the back of the retaining wall, assuming the use of Granular "A" or "B" backfill as noted above:

Soil unit weight:	22 kN/m ³
Coefficient of static lateral earth pressure:	
Active, K_a	0.27

- Seismic loading will result in increased lateral earth pressures acting on the retaining wall. The wall should be designed to withstand the combined lateral loading for the static pressure conditions given above, plus the earthquake-induced dynamic earth pressure. According to the National Building Code of Canada, this site is located in Seismic Zone 4. The site-specific zonal acceleration ratio for Ottawa is 0.18. Based on experience, for the subsurface conditions at this site, a 10 to 20 per cent amplification of the ground motion will occur, resulting in an increase in the ground surface acceleration from 0.18g to between 0.2g and 0.22g. The seismic lateral earth pressure coefficients given below have been derived based on a design zonal acceleration ratio of $A = 0.22$.
- In accordance with Sections 4.6.4 and C.4.6.4 of the *CHBDC* and its *Commentary*, for structures which do not allow lateral yielding, the horizontal seismic coefficient, k_h , used in the calculation of the seismic active pressure coefficient, is taken as 1.5 times the zonal acceleration ratio (i.e. $k_h = 0.33$). For structures which allow lateral yielding, k_h is taken as 0.5 times the zonal acceleration ratio (i.e. $k_h = 0.11$). The seismic active earth pressure coefficient is also dependent on the vertical component of the earthquake acceleration, k_v . Three discrete values of vertical acceleration are typically selected for analysis, corresponding to $k_v = +2/3 k_h$, $k_v = 0$, and $k_v = -2/3 k_h$.
- The following seismic active pressure coefficients (K_{AE}) for the two backfill cases (Case I and Case II) may be used in design; these coefficients reflect the maximum K_{AE} obtained using the k_h and three values of k_v as described above. It should be noted that these seismic earth pressure coefficients assume that the back of the wall is vertical and the ground surface behind the wall is flat.

SEISMIC ACTIVE PRESSURE COEFFICIENTS, K_{AE}

Wall Type	Case I	Case II
Yielding wall	0.40	0.32
Non-yielding wall	0.80	0.63

- The above K_{AE} values for yielding walls are applicable provided that the wall can move up to 250A (mm), where A is the design zonal acceleration ratio of 0.22. This corresponds to displacements of up to about 55 mm at this site.
- The earthquake-induced dynamic pressure distribution, which is to be added to the static earth pressure distribution, is a linear distribution with maximum pressure at the top of the wall and minimum pressure at its toe (i.e. an inverted triangular pressure distribution). The total pressure distribution (static plus seismic) may be determined as follows:

$$\sigma_h(d) = K_a \gamma' d + (K_{AE} - K_a) \gamma (H - d)$$

where $\sigma_h(d)$ is the lateral earth pressure at a given depth (kPa);
 K_a is the static active earth pressure coefficient;
 K_{AE} is the seismic active earth pressure coefficient;
 γ is the unit weight of the backfill soil (kN/m³),
as given previously;
 d is the depth below the top of the wall (m); and
 H is the total height of the wall (m).

6.5.3 Excavation and Groundwater Control

Excavations for construction of the retaining wall adjacent to the Dwyer Hill Road S-E Ramp, if required, will extend through silty sand to sandy silt till, up to about 2 m below the groundwater level in this area. Groundwater control will be required and, if a temporary construction easement is granted, it is likely that open-cut excavations could be carried out in conjunction with pumping from sumps at the base of the excavation.

Excavations should be carried out in accordance with the guidelines outlined in the Occupation Health and Safety Act (OHSA) and Regulations for Construction Activities. The water-bearing silty sand to sandy silt till is classified as a Type 2 soil, and its granular interlayers would be classified as a Type 3 soil, according to the OHSA. Temporary excavations (i.e. those which are only open for a relatively short period) through these overburden soils should be made with side slopes no steeper than 1 horizontal to 1 vertical (1H:1V) assuming that the overburden soils are dewatered. Shallower side slopes will be required if full dewatering cannot be achieved, as is likely to occur immediately above the bedrock surface.

6.6 Summary of Construction Concerns

It is recommended that the following Operational Constraints (OCs) be provided in the Contract Documents to address geotechnical/foundations concerns related to construction of the high fill embankments under W.P. 251-99-00:

- **Operational Constraint** regarding preloading of the north approach embankment at the Dwyer Hill Road site for a minimum period of six months prior to paving. It is estimated that approximately 90 per cent of the predicted 25 mm to 50 mm of consolidation settlement in this area will be completed within approximately three to five months. Therefore, since construction staging permits, a **preload period of six months is recommended**; no settlement monitoring is recommended given the available length of the preload period.

- **Operational Constraint** regarding preloading of the Dwyer Hill Road E-NS, S-W and N-E Ramps (outside of the detour alignment) for a minimum period of three months prior to paving.
- **Operational Constraint** regarding preloading of high fill embankments south of the new Ashton Station Road underpass structure, including the Ashton Station Road mainline alignment, and the Ashton Station N-E, S-E and W-NS Ramp high fill embankments. It is estimated that approximately 90 per cent of the predicted 50 mm to 75 mm of consolidation settlement along these embankment alignments will be completed within approximately four to five months. Therefore, since construction staging permits, a preload period of six months is recommended; no settlement monitoring is recommended given the available length of the preload period.

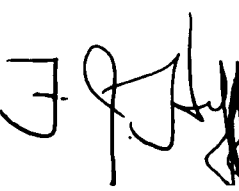
Operational Constraints addressing the above issues have been developed in conjunction with MMM, considering the proposed staging of the project, and are included in Appendix D.

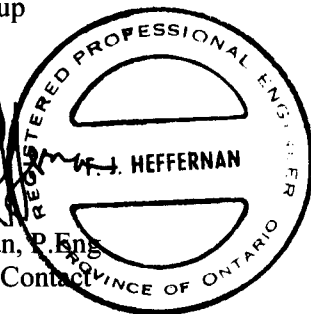
7.0 CLOSURE


This Foundation Design Report was prepared by Ms. Beng Lay Teh and reviewed by Ms. Lisa Coyne, P.Eng., an 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.


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Lisa Coyne, P.Eng.
Associate



BLT/LCC/FJH/blb/lcc

N:\ACTIVE\2004\1111\04-1111-007 MMM HWY 7\REPORTS\DRAFT REPORTS\04-1111-007 DRT02 05JUL HIGH FILL EMBANKMENTS.DOC

TABLE 1 – HIGH FILL EMBANKMENTS ON HIGHWAY 7 AT TRANS-CANADA TRAIL CROSSING

<i>High Fill Embankment Location</i>	<i>Embankment Height</i>	<i>Organics Encountered and Removal Requirements</i>	<i>Recommended Side Slopes</i>	<i>Mid-Height Berm Requirements</i>	<i>Estimated Settlement of Foundation Soil</i>
Hwy 7 EBL Stn 10+740 to 11+080	4.5 m to 6 m	Topsoil, 0.2 m to 0.4 m thick, encountered in boreholes. Remove all organics within footprint of embankment (similar to OPSS 206).	2H:1V (Earth fill)	No mid-height berm required	5 – 10 mm

TABLE 2 – HIGH FILL EMBANKMENTS AT DWYER HILL ROAD INTERCHANGE

High Fill Embankment Location	Embankment Height	Organics Encountered and Removal Requirements	Recommended Side Slopes	Mid-Height Berm Requirements	Estimated Settlement of Foundation Soils
Dwyer Hill Road Stn 9+680 to 9+850	4.5 m to 9 m	Peat, 0.6 m to 1.1 m thick encountered in boreholes. Note that 0.4 m of peat is present below existing fill in one borehole drilled through existing road shoulder. Embankment construction over swamp – widening and/or grade change at tie-in to existing Dwyer Hill Road (OPSD 203.020). Elsewhere, new embankment construction over swamp (OPSD 203.010).	2H:1V (Earth fill)	Yes, where embankment exceeds 8 m in height	25 – 50 mm
Dwyer Hill Road Stn 9+850 to 10+100	5 m to 9.5 m	Topsoil, 0.2 m thick, encountered in boreholes. Remove all organics within footprint of embankment (similar to OPSS 206).	2H:1V (Earth fill)	Yes, where embankment exceeds 8 m in height	25 – 50 mm north of bridge 10 mm south of bridge
E-NS Ramp Stn 13+600 to 13+775	4.5 m to 9 m	Topsoil, 0.1 m to 0.3 m thick, encountered in boreholes. Note that 0.7 m of topsoil is present below existing fill in vicinity of Station 13+650. Remove all organics within footprint of embankment (similar to OPSS 206).	2H:1V (Earth fill)	Yes, where embankment exceeds 8 m in height	20 – 40 mm
N-E Ramp Stn 13+275 to 13+280 (existing drainage ditch)	9 m	Topsoil, 0.1 m thick, encountered in boreholes. Remove all organics within footprint of embankment (similar to OPSS 206).	2H:1V (Earth fill)	Yes	10 – 15 mm
N-E Ramp Stn 13+475 to 13+500	4.5 m to 5 m	Topsoil, 0.3 m thick, encountered in boreholes. Remove all organics within footprint of embankment (similar to OPSS 206).	2H:1V (Earth fill)	No mid-height berm required	20 – 25 mm
S-E Ramp Stn 13+720 to 13+840	1.5 m to 6 m	Topsoil, 0.1 m to 0.4 m thick, encountered in boreholes. Remove all organics within footprint of embankment (similar to OPSS 206).	2H:1V (Earth fill)	No mid-height berm required	10 mm
S-W Ramp Stn 14+025 to 14+175	4.5 m to 8.5 m	Topsoil, 0.1 m to 0.3 m thick, encountered in boreholes. Remove all organics within footprint of embankment (similar to OPSS 206).	2H:1V (Earth fill)	Yes, where embankment exceeds 8 m in height	20 – 40 mm

TABLE 3 – HIGH FILL EMBANKMENTS AT ASHTON STATION ROAD INTERCHANGE

High Fill Embankment Location	Embankment Height	Organics Encountered and Removal Requirements	Recommended Side Slopes	Mid-Height Berm Requirements	Estimated Settlement of Foundation Soils
Ashton Station Road Stn 9+880 to 10+000	4.5 m to 9 m	Topsoil, 0.3 m to 0.5 m thick, encountered in boreholes. Remove all organics within footprint of embankment (similar to OPSS 206).	2H:1V (Earth fill)	Yes, where embankment exceeds 8 m in height	5 – 25 mm
Ashton Station Road Stn 10+000 to 10+280	4.5 m to 9 m	Peat, 0.2 m to 0.9 m thick, encountered in boreholes. Note that 0.2 m to 0.5 m of peat is present below existing fill in four boreholes advanced through existing Ashton Station Road fill. Embankment construction over swamp – widening and/or grade change (OPSD 203.020).	2H:1V (Earth fill)	Yes, where embankment exceeds 8 m in height.	50 – 75 mm
N-E Ramp Stn 9+520 to 9+720	4.5 m to 9.5 m	Peat, 0.6 m to 1.1 m thick, encountered in boreholes. Note that 0.2 m of peat is present below existing fill adjacent to existing Ashton Station Road embankment. New embankment construction over swamp (OPSD 203.010). Treat tie-in with Ashton Station Road embankment per OPSD 203.020.	2H:1V (Earth fill)	Yes, where embankment exceeds 8 m in height	50 – 100 mm
N-W Ramp Stn 9+820 to 10+020	4.5 m to 6 m	Topsoil, 0.2 m to 0.7 m thick, encountered in boreholes. Remove all organics within footprint of embankment (similar to OPSS 206).	2H:1V (Earth fill) 1.25H:1V* (Rock fill)	No mid-height berm required	5 – 15 mm
S-E Ramp Stn 9+770 to 10+040	4.5 m to 6.5 m	Peat, 0.2 m to 0.7 m thick (below 0.6 m to 0.8 m of standing water at time of investigation), encountered in boreholes. Note that 0.2 m of peat is present below the existing embankment fill in Borehole A-13. New embankment construction over swamp (OPSD 203.010). Treat tie-in with existing Ashton Station Road embankment per OPSD 203.020.	2H:1V (Earth fill) 1.25H:1V* (Rock fill)	No mid-height berm required	50 – 75 mm

TABLE 3 – HIGH FILL EMBANKMENTS AT ASHTON STATION ROAD INTERCHANGE (Continued)

<i>High Fill Embankment Location</i>	<i>Embankment Height</i>	<i>Organic Removal Requirements</i>	<i>Recommended Side Slopes</i>	<i>Mid-Height Berm Requirements</i>	<i>Estimated Settlement of Foundation Soils</i>
S-W Ramp Stn 10+460 to 10+500	4.5 m to 6 m	Topsoil, 0.3 m thick, encountered in boreholes. Remove all organics within footprint of embankment (similar to OPSS 206).	2H:1V (Earth fill)	No mid-height berm required	5 – 10 mm
W-NS Ramp Stn 9+900 to 10+030	4.5 m to 7.5 m	Peat, 0.8 m to 0.9 m thick. NOTE: 0.2 m of peat below existing fill adjacent to existing Ashton Station Road embankment. New embankment construction over swamp (OPSD 203.010). Treat tie-in with Ashton Station road per OPSD 203.020.	2H:1V (Earth fill) 1.25H:1V* (Rock fill)	No mid-height berm required	50 – 100 mm

* Rock fill embankments with steeper side slopes (1.5H:1V) may be adopted for the N-W, W-NS and S-E Ramps at the Ashton Station Road interchange in order to avoid impacts on adjacent properties.

LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

III. SOIL DESCRIPTION

(a) Cohesionless Soils

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Consistency

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

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.

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LIST OF SYMBOLS

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

I. General

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

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

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE

Fresh: no visible sign of weathering.

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

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

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

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

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

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

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

GRAIN SIZE

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

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

CORE CONDITION

Total Core Recovery

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

Solid Core Recovery (SCR)

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

Rock Quality Designation (RQD)

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

DISCONTINUITY DATA

Fracture Index

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

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

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

Description and Notes

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

Abbreviations

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

CONT No.
WP No. 251-99-00

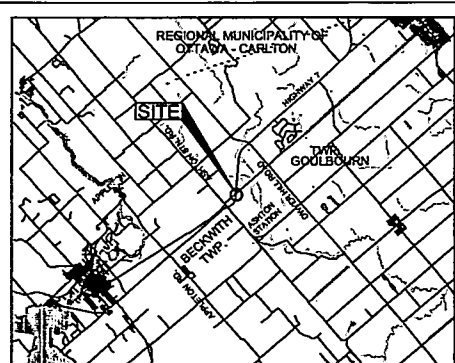


HIGHWAY 7
BOREHOLE LOCATIONS

SHEET



Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA



KEY PLAN

LEGEND

● Borehole

No.	ELEVATION	LOCATION	
		NORTHING	EASTING
04-1	136.7	5004236.9	340434.7
04-2	136.7	5004301.0	340444.9
04-3	136.8	5004351.2	340449.1
04-4	137.0	5004400.7	340447.5
04-5	137.0	5004449.4	340459.7
04-6	137.4	5004500.1	340460.3
04-7	137.2	5004549.6	340463.2
04-8	137.6	5004592.8	340463.2

NOTES

The proposed works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contract Documents.

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

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



NO.	DATE	BY	REVISION
Geocres No.			
HWY. 7		PROJECT NO. 04-1111-007	DIST.
SUBM'D. W.C.	CHKD. M.I.C.	DATE: JULY 2005	SITE:
DRAWN: J.M./M.S.M.	CHKD. W.C.	APPD. L.C.C.	DWG. 1

CONT No.
WP No. 251-99-00

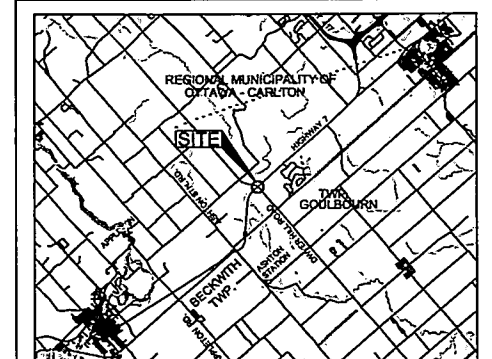


Dwyer Hill Road Interchange
Borehole Locations

SHEET



Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA



KEY PLAN

LEGEND

No.	ELEVATION	LOCATION	
		NORTHING	EASTING
D-1	132.6	5007286.1	340686.4
D-2	131.5	5007270.0	340729.8
D-3	131.4	5007255.7	340779.8
D-4	131.3	5007236.0	340821.7
D-5	132.0	5007212.4	340866.3
D-6	137.6	5007095.8	341063.6
DENS-1	131.2	5007252.4	340829.8
DENS-2	132.5	5007264.6	340834.9
DENS-3	132.2	5007291.8	340847.4
DENS-4	133.0	5007314.0	340858.4
DENS-5	132.6	5007333.6	340869.8
DENS-6	133.8	5007353.6	340888.3
DENS-7	134.2	5007366.0	340909.7
DNE-1	133.3	5007099.0	341036.2
DNE-1A	133.0	5007084.7	341020.1
DNE-2	131.9	5006947.4	341025.4
DNE-3	131.3	5006946.5	341003.7
DNE-3A	131.3	5006947.0	341001.3
DNE-3B	131.2	5006947.5	340998.7
DSE-1	137.2	5007072.1	341137.1
DSE-2	134.1	5007093.2	341125.1
DSE-3	133.7	5007117.7	341111.5
DSE-4	134.1	5007147.6	341103.3
DSE-5	132.2	5007167.1	341104.8
DSW-1	132.1	5007333.1	340889.9
DSW-2	131.7	5007312.9	340874.5
DSW-3	132.7	5007287.9	340866.2
DSW-4	133.0	5007269.4	340864.7
DSW-5	132.4	5007239.4	340871.4
DSW-6	132.5	5007220.0	340885.1
DSW-7	132.9	5007202.4	340901.6

NOTES

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METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

NO.	DATE	BY	REVISION
Geocres No.			
HWY. 7	PROJECT NO. 04-1111-007		DIST.
SUBM'D. W.C.	CHKD. M.I.C.	DATE: JULY 2005	SITE:
DRAWN: J.M./M.S.M.	CHKD. W.C.	APPD. L.C.C.	DWG. 2

CONT No.
WP No. 251-99-00

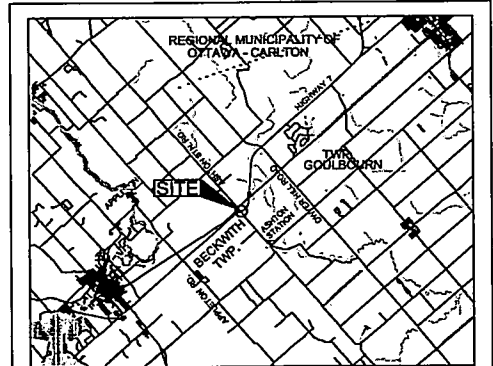


ASHTON STATION ROAD INTERCHANGE
BOREHOLE LOCATIONS

SHEET



Golder Associates Ltd.
OTTAWA, ONTARIO, CANADA



KEY PLAN

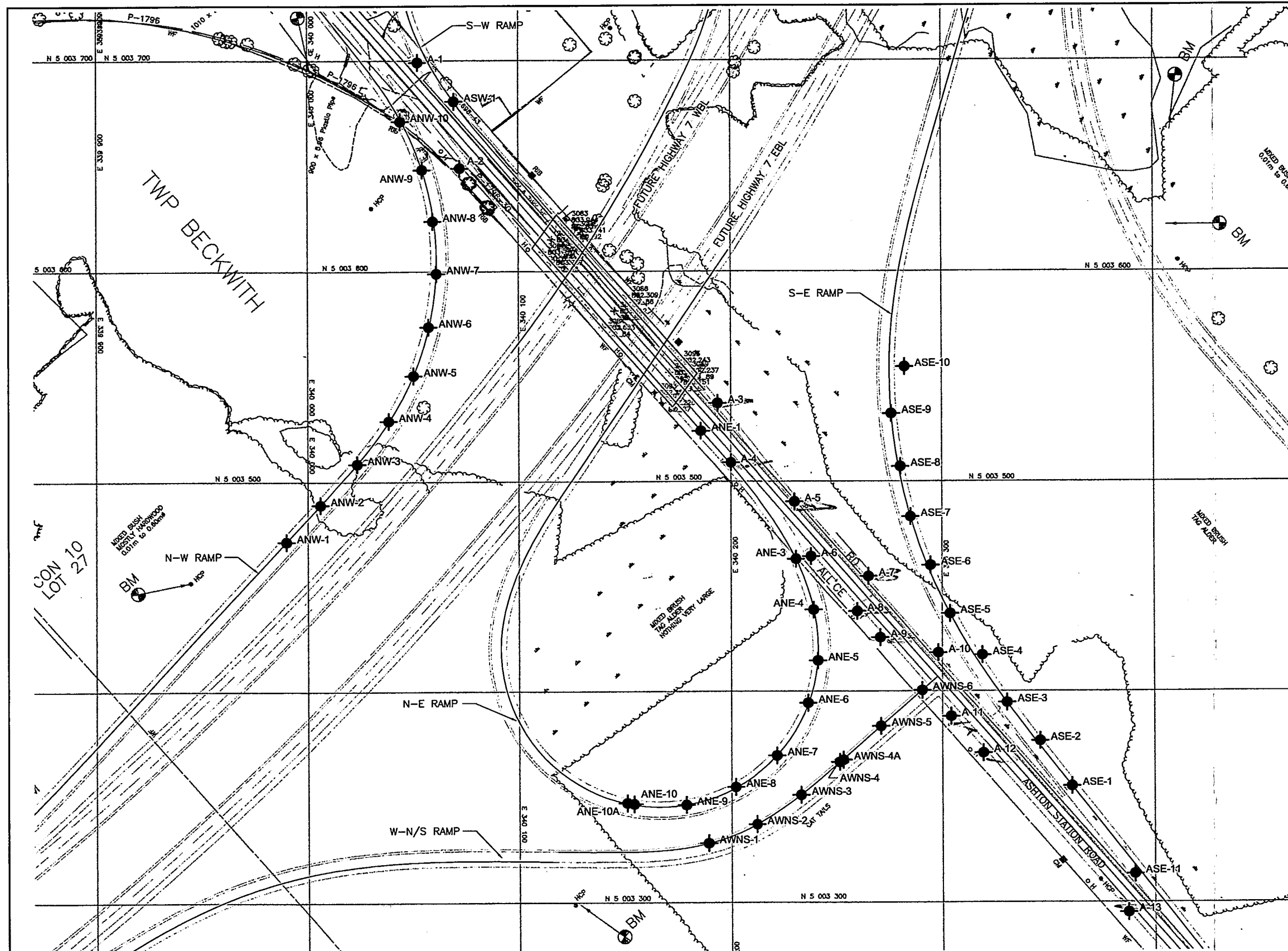


LEGEND

● Borehole

No.	ELEVATION	LOCATION	
		NORTHING	EASTING
A-1	135.6	5003699.2	340052.4
A-2	134.8	5003649.0	340072.4
A-3	131.9	5003537.3	340193.7
A-4	132.6	5003509.0	340200.0
A-5	133.0	5003490.4	340230.3
A-6	132.5	5003464.3	340238.1
A-7	131.2	5003454.8	340265.3
A-8	132.5	5003438.1	340259.9
A-9	132.4	5003425.6	340270.8
A-10	131.3	5003418.3	340298.1
A-11	134.2	5003388.1	340304.1
A-12	129.5	5003370.7	340319.2
A-13	132.8	5003295.2	340387.3
ANE-1	132.5	5003524.1	340185.9
ANE-3	132.3	5003463.1	340230.9
ANE-4	132.3	5003438.8	340239.2
ANE-5	132.3	5003414.6	340241.3
ANE-6	132.3	5003394.5	340236.5
ANE-7	132.3	5003369.6	340221.8
ANE-8	132.3	5003354.6	340201.9
ANE-9	132.3	5003346.2	340178.6
ANE-10	132.3	5003346.6	340153.9
ANE-10A	132.3	5003347.1	340150.8
ANW-1	132.4	5003471.5	339989.9
ANW-2	132.3	5003489.1	340005.9
ANW-3	132.5	5003508.5	340023.4
ANW-4	132.5	5003528.9	340038.4
ANW-5	132.7	5003550.5	340050.2
ANW-6	132.8	5003573.7	340057.4
ANW-7	134.0	5003599.0	340061.2
ANW-8	133.8	5003623.9	340059.5
ANW-9	134.3	5003648.3	340054.5
ANW-10	134.2	5003671.2	340044.1
AWNS-1	132.3	5003328.1	340189.0
AWNS-2	132.3	5003337.0	340212.2
AWNS-3	132.3	5003350.9	340233.1
AWNS-4	132.2	5003366.5	340251.5

NO.	DATE	BY	REVISION
Geocres No.			
HWY. 7		PROJECT NO. 04-1111-007	
SUBM'D. W.C.		CHKD. M.I.C.	DATE: JULY 2005
DRAWN: J.M./M.S.M.		CHKD. W.C.	APPD. L.C.C.
		DIST.	
		SITE:	
		DWG. 3	



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

NOTES

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No.	ELEVATION	LOCATION	
		NORTHING	EASTING
AWNS-4A	132.2	5003367.5	340253.2
AWNS-5	132.4	5003383.5	340271.0
AWNS-6	132.3	5003400.4	340290.5
ASE-1	130.8	5003355.0	340360.9
ASE-2	130.7	5003376.4	340345.9
ASE-3	131.0	5003394.6	340330.4
ASE-4	131.5	5003417.2	340318.8

No.	ELEVATION	LOCATION	
		NORTHING	EASTING
ASE-5	131.3	5003436.9	340303.7
ASE-6	131.5	5003462.7	340299.9
ASE-7	131.4	5003483.2	340285.2
ASE-8	131.0	5003508.6	340290.6
ASE-9	130.6	5003532.3	340276.2
ASE-10	130.6	5003554.6	340282.5
ASE-11	130.8	5003313.4	340390.4
ASW-1	134.6	5003680.7	340069.7

DRAFT

July 2005

04-1111-007-2



APPENDIX A

HIGH FILL EMBANKMENTS ON HIGHWAY 7 BOREHOLE RECORDS AND LABORATORY TEST DATA

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

MISS MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No 04-2		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5004301.0 ; E 340444.9		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE October 25, 2004		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20 40 60 80 100					w _p w w _L				
136.7	GROUND SURFACE																
0.0	TOPSOIL		1	SS	1												
136.3																	
0.4	Sandy SILT, some gravel, trace to some clay (TILL) Compact Brown Moist		2	SS	87/0.20	136									13 43 33 11		
135.7	End of Borehole Auger Refusal																
0.9	NOTE: Water level in open borehole at 0.8 m depth on completion of drilling.																




PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No 04-3				1 OF 1		METRIC							
W.P. 251-99-00		LOCATION N 5004351.2; E 340449.1		ORIGINATED BY W.C.												
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.												
DATUM Geodetic		DATE October 25, 2004		CHECKED BY L.C.C.												
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
136.8	GROUND SURFACE															
0.0	TOPSOIL															
136.5																
0.3	Sandy SILT, some gravel, trace clay (TILL) Loose to dense Brown Moist		1	SS	4											
			2	SS	40/0.23											
135.5																
135.3	SHALE (BEDROCK)															
1.5	Black End of Borehole Auger Refusal															
	NOTE: Borehole dry on completion of drilling.															

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No 04-4		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5004400.7 ; E 340447.5		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE October 25, 2004		CHECKED BY L.C.C.	

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						
137.0	GROUND SURFACE							20 40 60 80 100						
136.8	TOPSOIL		1	SS	WH			20 40 60 80 100		25 50 75				
0.2	Sandy SILT, some gravel, trace clay (TILL) Loose Brown Moist End of Borehole Auger Refusal						136							
	NOTE: Borehole dry on completion of drilling.													

MISS MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No 04-5		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5004449.4 ; E 340459.7		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE October 25, 2004		CHECKED BY L.C.C.	

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										25 50 75		
137.0	GROUND SURFACE																			
0.0	TOPSOIL		1	SS	18	▽														
136.6																				
0.4	Sandy SILT, some gravel, trace clay, containing cobbles (TILL)																			
136.3	Compact Brown Wet																			
0.7	End of Borehole Auger Refusal																			
	NOTE: Water encountered at about 0.3 m depth (Elev. 136.7 m) during drilling.																			

MISS_MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

PROJECT <u>04-1111-007-5300</u>			RECORD OF BOREHOLE No 04-6				1 OF 1		METRIC									
W.P. <u>251-99-00</u>			LOCATION <u>N 5004500.1 E 340460.3</u>				ORIGINATED BY <u>W.C.</u>											
DIST <u>HWY 7</u>			BOREHOLE TYPE <u>Power Auger 108 mm I.D. Hollow Stem Auger</u>				COMPILED BY <u>J.M.</u>											
DATUM <u>Geodetic</u>			DATE <u>October 25, 2004</u>				CHECKED BY <u>L.C.C.</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			20	40	60	80	100						25
137.4	GROUND SURFACE																	
0.0	TOPSOIL																	
137.1																		
0.3	Sandy SILT, some gravel, trace clay (TILL) Loose to dense Brown Moist to dry		1	SS	2													
136.3			2	SS	25/0.08													
1.0	End of Borehole Auger Refusal NOTE: Borehole dry on completion of drilling.																	

MISS MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

PROJECT		RECORD OF BOREHOLE				No 04-7		1 OF 1		METRIC														
W.P. 251-99-00		LOCATION				N 5004549.6 ; E 340463.2		ORIGINATED BY W.C.																
DIST HWY 7		BOREHOLE TYPE				Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.																
DATUM Geodetic		DATE				October 25, 2004		CHECKED BY L.C.C.																
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
137.2	GROUND SURFACE																							
0.0	TOPSOIL																							
137.0																								
0.2	Sandy SILT, some gravel, trace clay (TILL)		1	SS	58		137																	
	Dense to very dense																							
	Brown																							
	Dry to moist																							
136.5	End of Borehole																							
0.7	Auger Refusal																							
	NOTE: Borehole dry on completion of drilling.																							

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No 04-8		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5004592.8 ; E 340463.2		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE October 25, 2004		CHECKED BY L.C.C.	

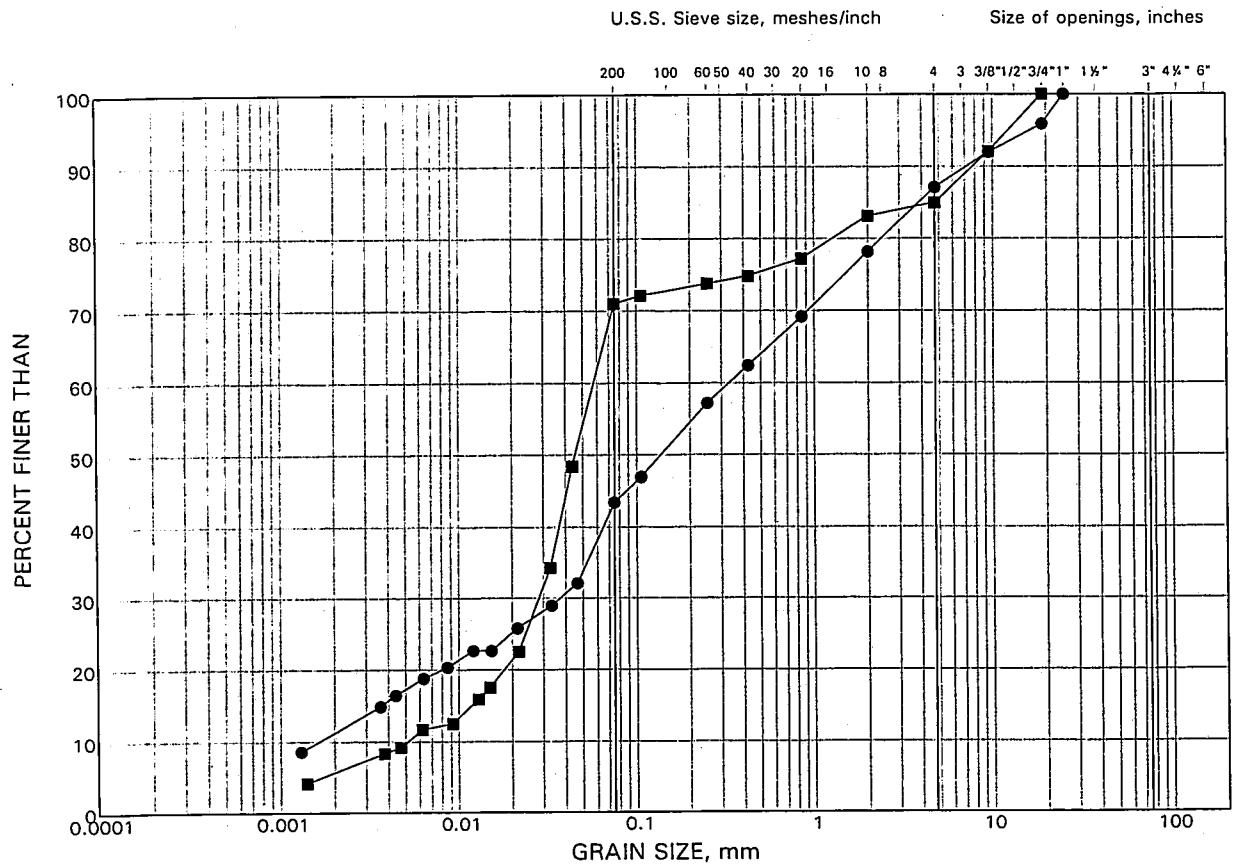
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
137.6	GROUND SURFACE							20 40 60 80 100	25 50 75					GR SA SI CL	
0.0	TOPSOIL														
137.3			1	SS	19										
0.2	Sandy SILT, some gravel, trace clay (TILL)														
137.0	Compact Brown						137								
0.6	Dry to moist End of Borehole Auger Refusal														
	NOTE: Borehole dry on completion of drilling.														

MISS MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

GRAIN SIZE DISTRIBUTION TEST RESULTS

Sand Silt Till to Sandy Silt Till
Highway 7 Near Trans-Canada Trail Crossing

FIGURE A1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	04-2	2	136.0
■	04-6	2	136.5

DRAFT

July 2005

04-1111-007-2

APPENDIX B

HIGH FILL EMBANKMENTS AT DWYER HILL ROAD INTERCHANGE BOREHOLE RECORDS AND LABORATORY TEST DATA

PROJECT 04-1111-007-5300				RECORD OF BOREHOLE No D-1				1 OF 1				METRIC				
W.P. 251-99-00				LOCATION N 5007286.1 E 340686.4				ORIGINATED BY W.C.								
DIST _____ HWY 7				BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger				COMPILED BY J.M.								
DATUM Geodetic				DATE November 11, 2004				CHECKED BY L.C.C.								
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 (%)
132.6	GROUND SURFACE						20	40	60	80	100					
0.0	Sand and gravel, trace silt (FILL) Loose Brown															
132.2	Sand, trace silt (FILL) Loose Brown															
132.0	Sandy silt, some gravel, trace clay (FILL) Very loose to loose Grey Moist to wet		1	SS	4											
0.7																
			2	SS	WH											
130.1	PEAT Wet		3	SS	5											
2.5																
129.8	Silty SAND Loose Brown Wet		4	SS	7											
2.9																
128.9	SILTY CLAY Very stiff Grey Moist		5	SS	25											
3.8																
			6	SS	20											
127.4	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Wet		7	SS	26											
5.2																
126.7	End of Borehole Auger Refusal															
5.9	NOTE: Water level in open borehole at 1.6 m depth on completion of drilling.															

MISS MTO 04-1111-007-5300.GPJ ON MOT GDT 15/7/05

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No D-2			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5007270.0 E 340729.8			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Portable Drill			COMPILED BY J.M.											
DATUM Geodetic			DATE November 9, 2004			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	25 50 75	γ	GR SA SI CL			
131.5	GROUND SURFACE																
0.0	PEAT Dark brown Wet		1	SS	WH		131										
130.4			2	SS	3												
1.1	SAND, trace to some silt Loose Brown Wet		3	SS	5		130										
129.2																	
2.3	SILTY CLAY (Weathered Crust) Very stiff Grey-brown Wet		4	SS	4		129										
			5	SS	9												
127.5			6	SS	7		128										
4.0	Sandy SILT, some gravel, trace clay (TILL) Grey Wet																
127.2																	
4.3	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey						127										
126.7																	
4.8	End of Borehole																
NOTES: 1. Bedrock cored between 4.3 m and 4.8 m depth. TCR = 100% SCR = 95% RQD = 75% 2. Water level in open borehole at 0.5 m depth on completion of drilling. 3. Water level in piezometer at ground surface on May 9, 2005.																	

MISS_MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

PROJECT 04-1111-007-5300				RECORD OF BOREHOLE No D-3				1 OF 1				METRIC				
W.P. 251-99-00				LOCATION N 5007255.7 E 340779.8				ORIGINATED BY W.C.								
DIST HWY 7				BOREHOLE TYPE Portable Drill				COMPILED BY J.M.								
DATUM Geodetic				DATE November 10, 2004				CHECKED BY L.C.C.								
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								
131.4	GROUND SURFACE															
0.0	PEAT Wet		1	SS	WH											
130.8																
0.6	Silty SAND Loose to compact Brown Wet		2	SS	1											
			3	SS	10											
129.3			4	SS	11											
2.1	SAND Compact Grey-brown Wet															
129.0																
128.7	SILTY CLAY Very stiff Grey-brown Wet		5	SS	4											
2.7																
	SILTY CLAY Very stiff Grey Wet		6	SS	4											
127.3																
4.1	DOLOMITIC LIMESTONE (BEDROCK) Fresh															
126.9	Grey															
4.5	End of Borehole															
<p>NOTES:</p> <p>1. Bedrock cored between 4.1 m and 4.5 m depth.</p> <p>TCR = 100% SCR = 93% RQD = 67%</p> <p>2. Water level in open borehole at 0.5 m depth on completion of drilling.</p>																

MISS_MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No D-4			1 OF 1			METRIC																					
W.P. 251-99-00			LOCATION N 5007236.0 : E 340821.7			ORIGINATED BY W.C.																								
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.																								
DATUM Geodetic			DATE October 27, 2004			CHECKED BY L.C.C.																								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			ELEVATION SCALE			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			SHEAR STRENGTH kPa			WATER CONTENT (%)			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES																									
131.3 0.0	GROUND SURFACE PEAT																													
130.8 0.6	SAND, trace silt, trace organics Compact Brown Wet		1	SS	13																									
129.2 2.1	SILTY CLAY Stiff to very stiff Grey Wet		2	SS	10																									
128.1 3.2	SANDY SILT, some gravel, trace clay (TILL) Loose Grey Wet		3	SS	4																									
127.8 3.5	End of Borehole Auger Refusal NOTE: Water level in open borehole at 0.5 m depth on completion of drilling.		4	SS	4																									

PROJECT <u>04-1111-007-5300</u>		RECORD OF BOREHOLE No D-5		1 OF 1	METRIC
W.P. <u>251-99-00</u>	LOCATION <u>N 5007212.4 ; E 340866.3</u>	ORIGINATED BY <u>W.C.</u>			
DIST <u>HWY 7</u>	BOREHOLE TYPE <u>Power Auger 108 mm I.D. Hollow Stem Auger</u>	COMPILED BY <u>J.M.</u>			
DATUM <u>Geodetic</u>	DATE <u>October 26, 2004</u>	CHECKED BY <u>L.C.C.</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										
132.0	GROUND SURFACE																	
0.0	TOPSOIL																	
0.2	SAND, trace silt Very loose to compact Brown Wet																	
			1	SS	2													
			2	SS	11													
129.5	SAND and GRAVEL, trace silt Compact Brown Wet		3	SS	15													
2.7	SILTY CLAY Very stiff Grey-brown Wet																	
128.6	SILTY CLAY Stiff to very stiff Grey Wet		4	SS	7													
3.4																		
128.3																		
3.7	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Wet End of Borehole Auger Refusal																	
	NOTE: Water level in open borehole at 0.6 m depth on completion of drilling.																	

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No D-6			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5007095.8 E 341063.6			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.											
DATUM Geodetic			DATE November 1, 2004			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED					WATER CONTENT (%) W _p — W — W _L			γ	GR SA SI CL
137.6	GROUND SURFACE							20 40 60 80 100									
137.4	TOPSOIL																
0.2	Sandy SILT, some gravel, trace clay (TILL) Compact to very dense Brown Moist to wet		1	SS	16		137										
			2	SS	21		136										
			3	SS	17/0.10		135										
			4	SS	87		134										
			5	SS	110		133										
			6	SS	44/0.28												
			7	SS	93/0.15												
132.7	End of Borehole Auger Refusal																
4.9	NOTE: Borehole dry on completion of drilling.																

MISS MTO 04-1111-007-5300 GPJ ON MOT.GDT 15/7/05

PROJECT 04-1111-007-5300				RECORD OF BOREHOLE No DENS-1				1 OF 1				METRIC					
W.P. 251-99-00				LOCATION N 5007252.4 ; E 340829.8				ORIGINATED BY W.C.									
DIST HWY 7				BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger				COMPILED BY J.M.									
DATUM Geodetic				DATE October 27, 2004				CHECKED BY L.C.C.									
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 (%)
131.2	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL																
0.1	SAND, trace silt Compact Brown Wet		1	SS	13		131										
			2	SS	16		130										
129.1	SILTY CLAY Stiff Grey Wet		3	SS	6		129										
128.1	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Wet		4	SS	17		128										
127.4	End of Borehole Auger Refusal																
3.8	NOTE: Water level in piezometer at 0.3 m above ground surface on April 6, 2005, and at 0.2 m above ground surface on May 9, 2005.																

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No DENS-2		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5007264.6 ; E 340834.9		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 11, 2004		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED							W _P	W	W _L
							20	40	60	80	100	25	50	75			
132.5	GROUND SURFACE																
0.0	Sand and gravel, trace silt (FILL) Loose Brown																
132.2																	
131.9	Sand, some gravel, trace silt (FILL) Loose Brown																
0.6	TOPSOIL Wet		1	SS	6												
131.3																	
1.3	Silty SAND Very loose to compact Grey-brown Wet		2	SS	16												
			3	SS	2												
129.1			4	SS	5												
3.4	SILTY CLAY (Weathered Crust) Firm to stiff Grey-brown Wet																
128.8																	
3.7	SILTY CLAY, trace sand Stiff Grey Wet		5	SS	5												
127.9																	
4.6	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Wet		6	SS	23												
127.3																	
5.2	End of Borehole Auger Refusal NOTE: Water encountered at about 0.6 m depth during drilling.																



RECORD OF BOREHOLE No DENS-3

1 OF 1

METRIC

PROJECT 04-1111-007-5300

W.P. 251-99-00

LOCATION N 5007291.8 ; E 340847.4

ORIGINATED BY W.C.

DIST HWY 7

BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger

COMPILED BY J.M.

DATUM Geodetic

DATE October 27, 2004


CHECKED BY L.C.C.

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
132.2	GROUND SURFACE																							
0.0	TOPSOIL																							
132.0																								
0.3	SAND, trace silt, trace organics Loose Brown Wet		1	SS	4																			
131.1																								
1.2	SAND, trace silt Loose to compact Grey-brown Wet		2	SS	4																			
129.8																								
2.5	SILTY CLAY Very stiff Grey Wet		3	SS	15																			
129.2																								
3.1	Sandy SILT, some gravel, trace clay (TILL) Loose Grey Wet		4	SS	8																			
128.5																								
3.8	End of Borehole Auger Refusal																							
	NOTE: Water level in open borehole at 0.8 m depth on completion of drilling.																							

MISS MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

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

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No DENS-4		1 OF 1	METRIC
W.P. 251-99-00	LOCATION N 5007314.0 ; E 340858.4	ORIGINATED BY W.C.			
DIST HWY 7	BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger	COMPILED BY J.M.			
DATUM Geodetic	DATE October 27, 2004	CHECKED BY L.C.C.			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED										
							20	40	60	80	100							
133.0	GROUND SURFACE																	
0.0	SAND, trace silt, trace organics Loose Brown Moist		1	SS	5	▽	132											
			2	SS	4		131											
			3	SS	1													
130.2	SAND, trace silt Loose Brown Wet		4	SS	9		130											
129.1	SILTY CLAY Stiff Grey Wet		5	SS	6		129											
128.6	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Wet		6	SS	15		128											
127.6	End of Borehole Auger Refusal																	
5.4	NOTE: Water level in open borehole at 1.6 m depth on completion of drilling.																	

MISS_MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

PROJECT <u>04-1111-007-5300</u>		RECORD OF BOREHOLE No DENS-5		1 OF 1	METRIC
W.P. <u>251-99-00</u>	LOCATION <u>N 5007333.6 E 340869.8</u>	ORIGINATED BY <u>W.C.</u>			
DIST <u>HWY 7</u>	BOREHOLE TYPE <u>Power Auger 108 mm I.D. Hollow Stem Auger</u>	COMPILED BY <u>J.M.</u>			
DATUM <u>Geodetic</u>	DATE <u>October 28, 2004</u>	CHECKED BY <u>L.C.C.</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			20	40						60	80	100	20	40
132.6	GROUND SURFACE																		
0.0	TOPSOIL																		
132.4																			
0.2	SAND, trace silt Loose to compact Brown Moist to wet																		
			1	SS	4														
			2	SS	7														
			3	SS	29														
129.7																			
129.5	SILTY CLAY (Weathered Crust) Very stiff Grey-brown Wet																		
3.1																			
129.1	SILTY CLAY Very stiff Grey Wet		4	SS	24														
3.4																			
	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Wet																		
			5	SS	17														
			6	SS	9/0.15														
127.7																			
4.9	End of Borehole Auger Refusal																		
	NOTE: Water level in standpipe at 0.4 m depth on April 6, 2005, and at 0.5 m depth on May 9, 2005.																		

MISS_MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

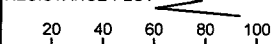
PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No DENS-6		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5007353.6 ; E 340888.3		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE October 27, 2004		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
133.8	GROUND SURFACE					▽											
0.9	TOPSOIL SAND, trace silt Loose to compact Brown Moist to wet		1	SS	5		133										
			2	SS	10		132										
131.5																	
2.3	SAND, some gravel Compact to dense Brown Wet		3	SS	32												
131.0																	
2.7	SILTY CLAY, trace sand and gravel Very stiff to hard Grey-brown Wet		4	SS	10	131											
130.2																	
3.6	Sandy SILT, some gravel, trace clay (TILL) Loose to compact Grey Wet		5	SS	10	130											
128.8			6	SS	13/0.10	129											
5.0	End of Borehole Auger Refusal NOTE: Water level in open borehole at 1.6 m depth on completion of drilling.																

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No DENS-7			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5007366.0 ; E 340909.7			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.											
DATUM Geodetic			DATE October 28, 2004			CHECKED BY L.C.C.											
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 (%)
134.2	GROUND SURFACE																
0.0	TOPSOIL																
0.1	SAND, trace silt Very loose to loose Brown Moist		1	SS	4	▽	134										
			2	SS	3		133										
							132										
131.9	SAND, some gravel, trace silt Dense Brown Wet		3	SS	42		131										
131.4	SILTY CLAY Hard Grey Wet		4	SS	61		130										
131.1	Sandy SILT, trace gravel, trace clay (TILL) Compact to very dense Grey Wet		5	SS	23												
3.1			6	SS	12		129										
128.7	End of Borehole Auger Refusal		7	SS	30/108												
5.5	NOTE: Water level in open borehole at 1.8 m depth on completion of drilling.																

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No DNE-1		1 OF 1		METRIC											
W.P. 251-99-00		LOCATION N 5007099.0 ; E 341036.2		ORIGINATED BY W.C.													
DIST _____ HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.													
DATUM Geodetic		DATE October 29, 2004		CHECKED BY L.C.C.													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	 20 40 60 80 100			W _p	W	W _L	γ	GR SA SI CL		
133.3	GROUND SURFACE																
0.0	TOPSOIL																
0.1	Sandy SILT, some gravel, trace clay (TILL) Compact Grey-brown Wet		1	SS	14		133										
132.4																	
0.9	Sandy SILT, some gravel, trace clay (TILL) Dense to very dense Grey Wet		2	SS	36/0.15		132										
131.3																	
			3	SS	91/0.20												
2.0	End of Borehole																
NOTES: 1. Borehole terminated without auger refusal due to angle at which rig was set up. Additional Borehole DNE-1A advanced adjacent to Borehole DNE-1 to confirm auger refusal. 2. Water level in open borehole at 1.2 m depth on completion of drilling.																	

MISS_MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05


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

MISS_MTO 04-1111-007-5300.GPJ ON_MOT.GDT 15/7/05

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No DNE-2			1 OF 1			METRIC														
W.P. 251-99-00			LOCATION N 5006947.4 E 341025.4			ORIGINATED BY W.C.																	
DIST _____ HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.																	
DATUM Geodetic			DATE November 1, 2004			CHECKED BY L.C.C.																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			SHEAR STRENGTH kPa			WATER CONTENT (%)			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	γ	GR SA SI CL									
131.9	GROUND SURFACE																						
0.0	TOPSOIL																						
131.7																							
0.3	SAND and SILT, some gravel, trace clay Compact Brown Wet		1	SS	11		131																
130.7																							
1.3	SILTY CLAY Stiff to very stiff Grey-brown Wet		2	SS	19		130																
130.1																							
1.8	Sandy SILT, some gravel, trace clay (TILL) Loose to compact Grey Wet		3	SS	25		129																
			4	SS	8		128																
			5	SS	5																		
127.3			6	SS	15/115																		
4.7	End of Borehole Auger Refusal NOTE: Water encountered during drilling at about 0.6 m depth.																						

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No DNE-3			1 OF 1			METRIC									
W.P. 251-99-00			LOCATION N 5006946.5 E 341003.7			ORIGINATED BY W.C.												
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.												
DATUM Geodetic			DATE November 1, 2004			CHECKED BY L.C.C.												
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		
131.3	GROUND SURFACE							20 40 60 80 100					25 50 75			GR SA SI CL		
0.0	TOPSOIL							20 40 60 80 100					25 50 75					
131.0								20 40 60 80 100					25 50 75					
0.3	Silty SAND to SAND, trace silt, trace gravel Loose Brown to grey-brown Wet		1	SS	3		131											
129.5							130											
1.8	SILTY CLAY Very stiff Grey-brown Wet		2	SS	9													
129.2							129											
2.1	SILTY CLAY Soft Grey Wet		3	SS	WH													
128.4							128											
2.9	Silty SAND, some gravel, trace clay (TILL) Loose Grey Wet		4	SS	6													
127.1			5	SS	7/0.25													
4.2	End of Borehole Auger Refusal																	
NOTES:																		
1. Water level in open borehole at 0.8 m depth on completion of drilling.																		
2. Adjacent Boreholes DNE-3A and DNE-3B advanced to carry out in situ vane shear strength testing and obtain a Shelby tube sample within the soft silty clay stratum.																		

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No DNE-3A		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5006947.0; E 341001.3		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 1, 2004		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED					WATER CONTENT (%) w _p w w _L					
131.3	GROUND SURFACE							20	40	60	80	100		25	50	75		
0.0	For soil stratigraphy refer to Record of Borehole DNE-3.						131											
							130											
129.1											+							
2.1	SILTY CLAY Soft Grey Wet						129				+							
128.5								x	+									
2.7	End of Borehole							x	+									

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PROJECT		RECORD OF BOREHOLE				No DNE-3B		1 OF 1		METRIC					
W.P. 251-99-00		LOCATION N 5006947.5 ; E 340998.7				ORIGINATED BY W.C.									
DIST _____ HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger				COMPILED BY J.M.									
DATUM Geodetic		DATE November 1, 2004				CHECKED BY L.C.C.									
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL 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					
131.2 0.0	GROUND SURFACE For soil stratigraphy refer to Record of Borehole DNE-3.						131								
							130								
							129								
128.6 2.6	End of Borehole NOTE: Water level in piezometer at ground surface on April 6, 2005, and at 0.3 m depth on May 9, 2005.		1	TP	PH										





MISS MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No DSE-1			1 OF 1			METRIC					
W.P. 251-99-00			LOCATION N 5007072.1 E 341137.1			ORIGINATED BY W.C.								
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.								
DATUM Geodetic			DATE October 29, 2004			CHECKED BY L.C.C.								
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	UNIT WEIGHT γ	GR SA SI CL	
137.2 0.0	GROUND SURFACE TOPSOIL													
136.8 0.4	SAND and SILT, some gravel, trace clay (TILL) Compact Brown Moist		1	SS	20		137						15 41 38 6	
			2	SS	19		136							
135.1 2.1	Sandy SILT, some gravel, trace clay (TILL) Very dense Brown Moist		3	SS	54		135							
			4	SS	51		134							
			5	SS	84/0.18		133							
132.2 5.0	Sandy SILT, some gravel, trace clay (TILL) Very dense Grey Wet		6	SS	62	▽	132							
131.5 5.7	End of Borehole Auger Refusal NOTE: Water encountered at about 5.0 m depth during drilling.		7	SS	85/0.18									

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No DSE-2			1 OF 1			METRIC							
W.P. 251-99-00			LOCATION N 5007093.2 E 341125.1			ORIGINATED BY W.C.										
DIST _____ HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.										
DATUM Geodetic			DATE November 10, 2004			CHECKED BY L.C.C.										
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 (%)
134.1	GROUND SURFACE							20	40	60	80	100				
0.0	Silty sand, some gravel, trace organics (FILL)															
133.8	Dark brown															
0.3	Sandy silt, trace organics (FILL)															
133.5	Grey-brown															
0.6	Silty SAND, some gravel, trace clay (TILL) Very dense Brown Wet		1	SS	57											
132.7																
1.4	SAND, trace silt Dense to very dense Brown Wet		2	SS	74											
			3	SS	36											
131.1																
3.1	Sandy SILT, trace gravel Very dense Grey Wet		4	SS	105											
130.4																
3.7	Sandy SILT, some gravel, trace clay (TILL) Very dense Grey Wet		5	SS	78											
129.9																
4.2	End of Borehole Auger Refusal															
	NOTE: Water encountered at about 0.6 m depth during drilling.															

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No DSE-3		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5007117.7 E 341111.5		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 10, 2004		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	20						40	60	80
133.7	GROUND SURFACE																			
0.0	Sand and gravel (FILL) Grey Wet					▽	133													
132.6			1	SS	12															
1.1	Silty SAND, some gravel, trace clay (TILL) Compact to very dense Brown Wet						132													
			2	SS	90															
131.6																				
2.1	Silty SAND, trace gravel Very dense Brown Wet					131														
			3	SS	88															
130.6																				
3.1	Silty SAND, some gravel, trace clay (TILL) Very dense Grey Wet					130														
			4	SS	50/0.20															
			5	SS	05/0.20															
129.6																				
4.1	End of Borehole Auger Refusal NOTE: Water encountered at about 0.5 m depth during drilling.																			

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No DSE-4		1 OF 1		METRIC	
W.P. 251-99-00		LOCATION N 5007147.6 E 341103.3		ORIGINATED BY W.C.			
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.			
DATUM Geodetic		DATE October 29, 2004		CHECKED BY L.C.C.			
SOIL PROFILE			SAMPLES		DYNAMIC CONE PENETRATION RESISTANCE PLOT		REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	
134.1	GROUND SURFACE						
0.0	TOPSOIL						
133.9							
0.2	Sandy SILT, some gravel, trace clay (TILL) Dense to very dense Grey-brown Moist to wet		1	SS	59		
			2	SS	>100		
			3	SS	80		
			4	SS	61		
130.4			5	SS	16/110		
3.7	Sandy SILT, some gravel, trace clay (TILL) Very dense Grey Wet						
130.1							
4.0	End of Borehole Auger Refusal						
NOTE: Water level in piezometer at 1.0 m depth on April 6, 2005 and at 1.9 m depth on May 9, 2005.							

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No DSE-5		1 OF 1		METRIC							
W.P. 251-99-00		LOCATION N 5007167.1; E 341104.8		ORIGINATED BY W.C.									
DIST _____ HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.									
DATUM Geodetic		DATE October 29, 2004		CHECKED BY L.C.C.									
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	γ	GR SA SI CL	
132.2	GROUND SURFACE												
0.0	TOPSOIL												
0.1	SAND, trace gravel, trace silt Very dense Grey-brown Wet		1	SS	71		132						
131.0													
1.2	Sandy SILT, trace gravel, trace clay (TILL)						131						
130.7	Very dense Grey-brown Wet		2	SS	119								
130.4													
1.8	SILT, some sand Very dense Grey Wet		3	SS	27		130						
129.9	Sandy SILT, trace clay, some gravel (TILL)												
2.3	Compact Grey Wet End of Borehole Auger Refusal												
NOTE: Water level in open borehole at 0.9 m depth on completion of drilling.													

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No DSW-1			1 OF 1			METRIC						
W.P. 251-99-00			LOCATION N 5007333.1 ; E 340889.9			ORIGINATED BY W.C.									
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.									
DATUM Geodetic			DATE October 28, 2004			CHECKED BY L.C.C.									
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					
132.1	GROUND SURFACE														
0.0	TOPSOIL														
0.2	SAND, trace silt, trace to some gravel Loose to compact Brown Wet		1	SS	20										
130.6															
1.5	SILTY CLAY (Weathered Crust) Stiff to very stiff Grey-brown Wet		2	SS	14										
130.2															
1.9	SANDY SILT, some gravel, trace clay (TILL) Compact Grey Wet		3	SS	19										
			4	SS	10										
128.4															
3.7	End of Borehole Auger Refusal NOTE: Water level in open borehole at 0.2 m depth on completion of drilling.														

PROJECT 04-1111-007-5300				RECORD OF BOREHOLE No DSW-2				1 OF 1		METRIC							
W.P. 251-99-00				LOCATION N 5007312.9; E 340874.5				ORIGINATED BY W.C.									
DIST _____ HWY 7				BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger				COMPILED BY J.M.									
DATUM Geodetic				DATE October 28, 2004				CHECKED BY L.C.C.									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
131.7	GROUND SURFACE																
0.0	TOPSOIL																
131.5																	
0.2	SAND, trace silt Compact to dense Grey Wet		1	SS	12												
			2	SS	40												
129.6																	
129.4	SILTY CLAY (Weathered Crust) Very stiff to hard Grey-brown Wet		3	SS	25												
2.4	SANDY SILT, some gravel, trace clay (TILL) Compact Grey Wet		4	SS	13												
127.9																	
3.8	End of Borehole Auger Refusal																
	NOTE: Water level in open borehole at 0.1 m depth on completion of drilling.																

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No DSW-3			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5007287.9; E 340866.2			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.											
DATUM Geodetic			DATE October 28, 2004			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED			WATER CONTENT (%) w _p w w _L			γ	GR SA SI CL		
132.7	GROUND SURFACE							20 40 60 80 100									
0.0	TOPSOIL																
0.2	SAND, trace silt Loose Brown to grey Moist to wet		1	SS	5		132										
			2	SS	4		131										
130.4	SILTY CLAY (Weathered Crust) Very stiff Grey-brown Wet		3	SS	13		130										0 3 61 36
2.3																	
130.0	SILTY CLAY Very stiff Grey Wet		4	SS	11		129										
2.7																	
129.7	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Wet		5	SS	19												
3.1																	
128.2	End of Borehole Auger Refusal																
4.5	NOTE: Water level in open borehole at 1.1 m depth on completion of drilling.																

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No DSW-4		1 OF 1		METRIC													
W.P. 251-99-00		LOCATION N 5007269.4 E 340864.7		ORIGINATED BY W.C.															
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.															
DATUM Geodetic		DATE November 11, 2004		CHECKED BY L.C.C.															
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED			WATER CONTENT (%) w _p w w _L			Y kN/m ³			GR SA SI CL		
133.0 0.0	GROUND SURFACE Sand and gravel, trace silt (FILL) Loose Brown							20 40 60 80 100											
132.1 0.9	Silty SAND to SAND, trace silt Loose to compact Brown to grey Moist to wet		1	SS	13		132												
			2	SS	19		131											0 86 9 5	
			3	SS	6		130												
			4	SS	7														
129.1 3.9	Sandy SILT, some gravel, trace clay (TILL) Grey Wet						129												
128.3 4.7	End of Borehole Auger Refusal NOTE: Water level in open borehole at 1.7 m depth on completion of drilling.																		

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No DSW-5			1 OF 1			METRIC				
W.P. 251-99-00			LOCATION N 5007239.4 : E 340871.4			ORIGINATED BY W.C.							
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.							
DATUM Geodetic			DATE October 26, 2004			CHECKED BY L.C.C.							
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID UNIT WEIGHT REMARKS & GRAIN SIZE DISTRIBUTION				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	γ	GR SA SI CL
132.4	GROUND SURFACE												
0.0	TOPSOIL												
132.1	SAND, trace silt Loose to compact Brown Moist to wet		1	SS	4		132						
			2	SS	10		131						
			3	SS	23		130						
			4	SS	8		129						
129.4	SILTY CLAY Very stiff Grey Wet												
128.9	Sandy SILT, some gravel, trace clay, containing cobbles (TILL) Compact Grey Wet		5	SS	19								
128.1	End of Borehole Auger Refusal												
4.4	NOTE: Water level in piezometer at 0.5 m depth on April 6, 2005, and at 0.6 m depth on May 9, 2005.												

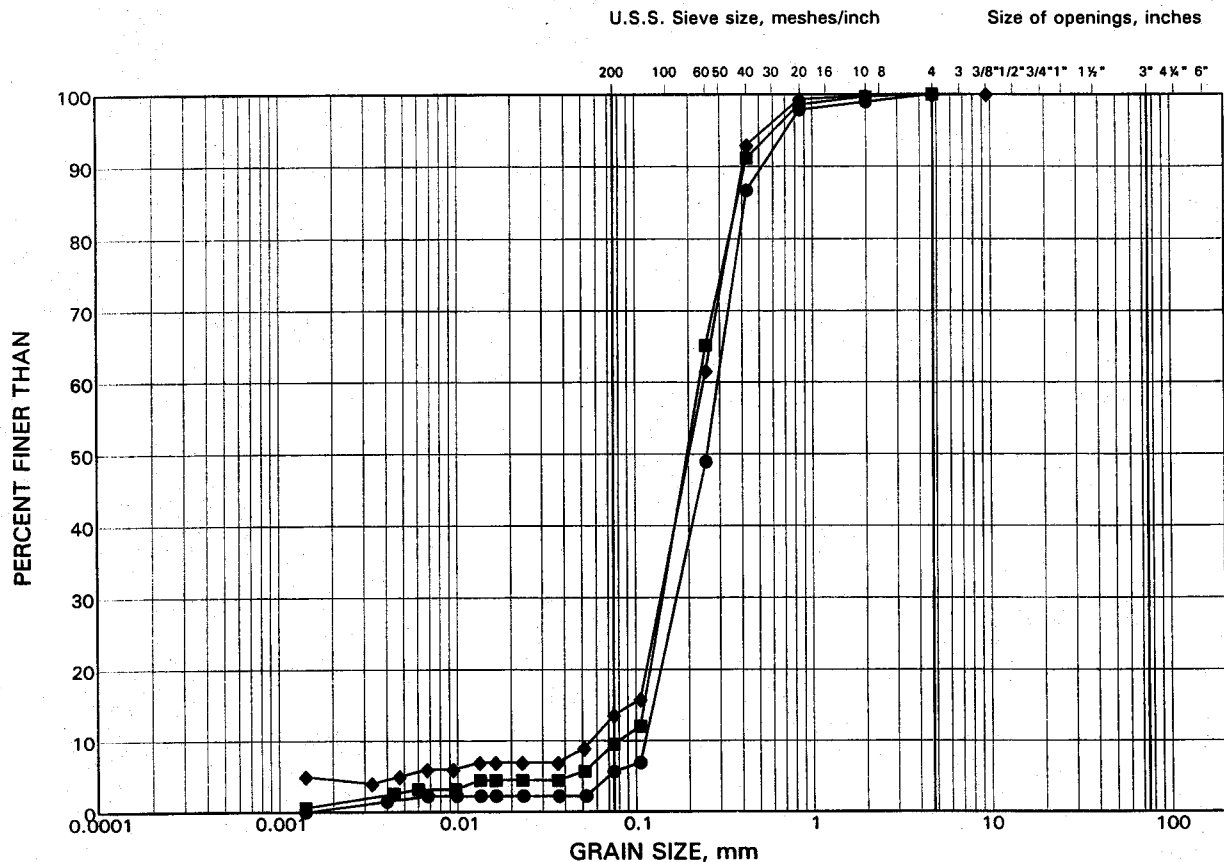
PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No DSW-6			1 OF 1			METRIC										
W.P. 251-99-00			LOCATION N 5007220.0 E 340885.1			ORIGINATED BY W.C.													
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.													
DATUM Geodetic			DATE October 26, 2004			CHECKED BY L.C.C.													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED 20 40 60 80 100					W _p W W _L 25 50 75			γ	GR SA SI CL		
132.5	GROUND SURFACE																		
129.8	TOPSOIL SAND, trace silt Loose to compact Brown Moist to wet		1	SS	4	▽	132												
			2	SS	8		131												
			3	SS	18		130												
129.5	SILTY CLAY (Weathered Crust) Stiff Grey-brown Wet		4	SS	4		129												
128.9	Sandy SILT, some gravel, trace clay (TILL) Loose Grey Wet		5	SS	3														
128.2	End of Borehole Auger Refusal NOTE: Water level in open borehole at 1.0 m depth on completion of drilling.																		

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No DSW-7			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5007202.4, E 340901.6			ORIGINATED BY W.C.											
DIST _____ HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.											
DATUM Geodetic			DATE October 26, 2004			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	25 50 75	γ	GR SA SI CL			
132.9	GROUND SURFACE																
129.9	TOPSOIL SAND, trace silt Very loose to compact Brown Moist to wet		1	SS	3		132										
			2	SS	11		131										
			3	SS	25		130										
129.7	SILTY CLAY (Weathered Crust) Very stiff Grey-brown Wet		4	SS	8		129										
129.2	SAND and SILT, some gravel, trace clay (TILL) Loose Grey Wet		5	SS	8									18 38 34 10			
128.3	End of Borehole Auger Refusal																
4.6	NOTE: Water level in open borehole at 1.3 m depth on completion of drilling.																

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silty Sand to Sand and Gravel
Dwyer Hill Road Interchange

FIGURE B1



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

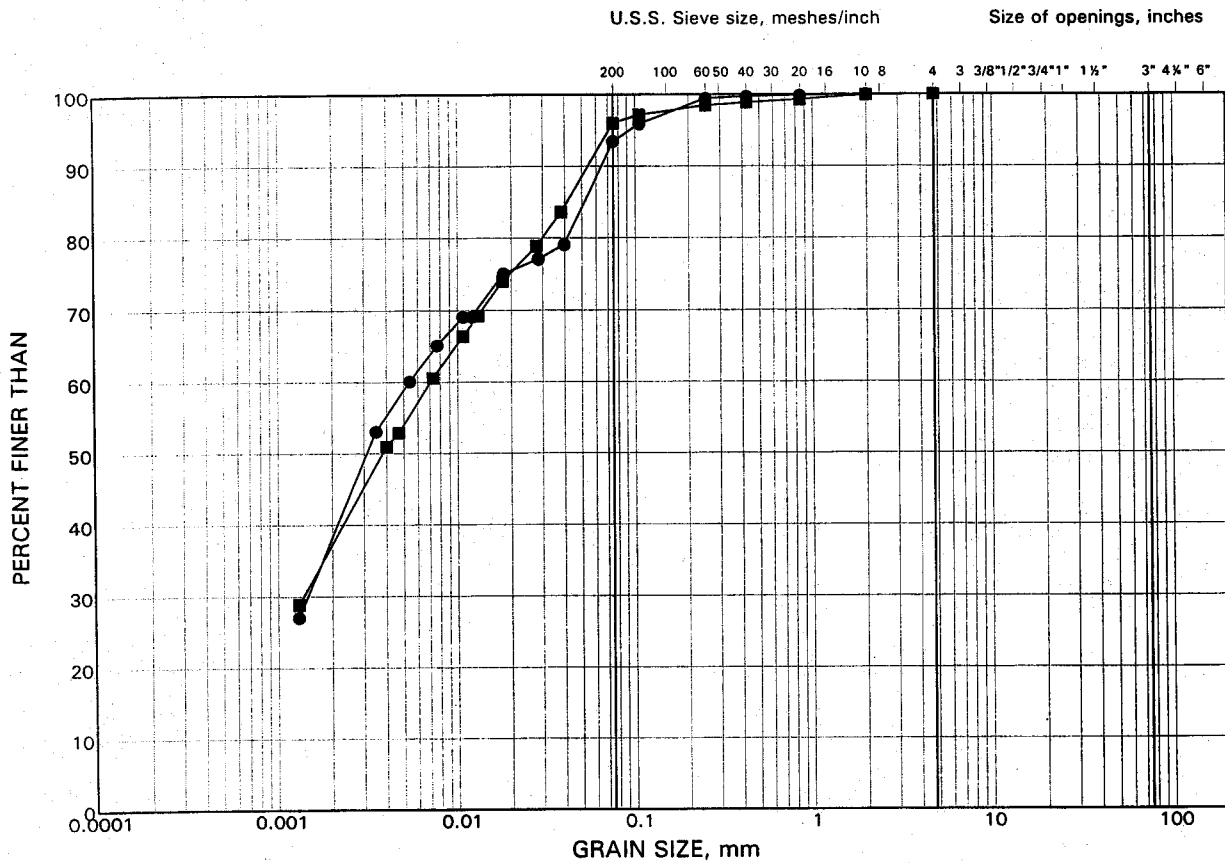
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	D-5	2	130.2
■	DENS-6	2	132.0
◆	DSW-4	2	131.2

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silty Clay
Dwyer Hill Road Interchange

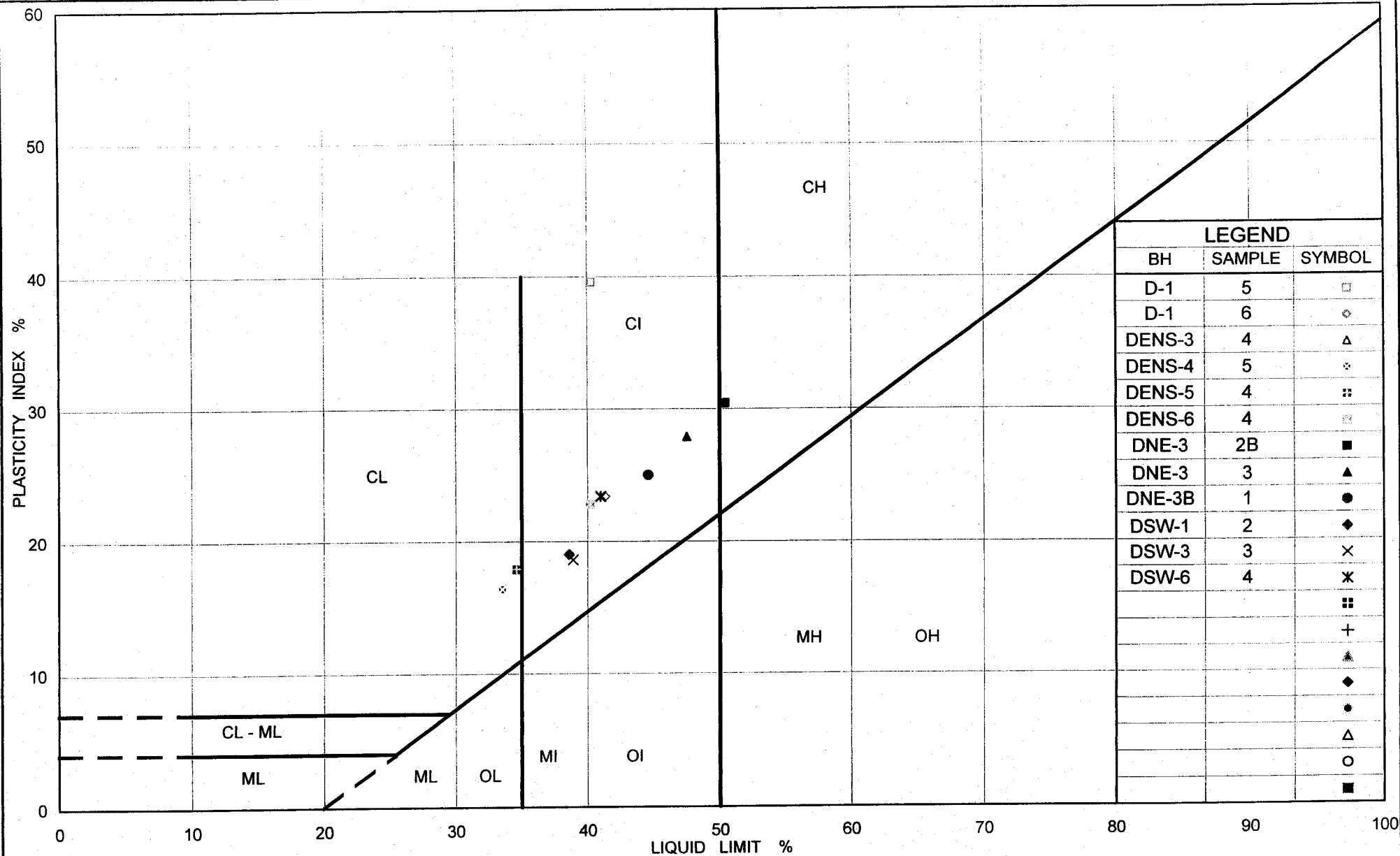
FIGURE B2



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	D-4	3	128.7
■	DSW-3	3	130.1



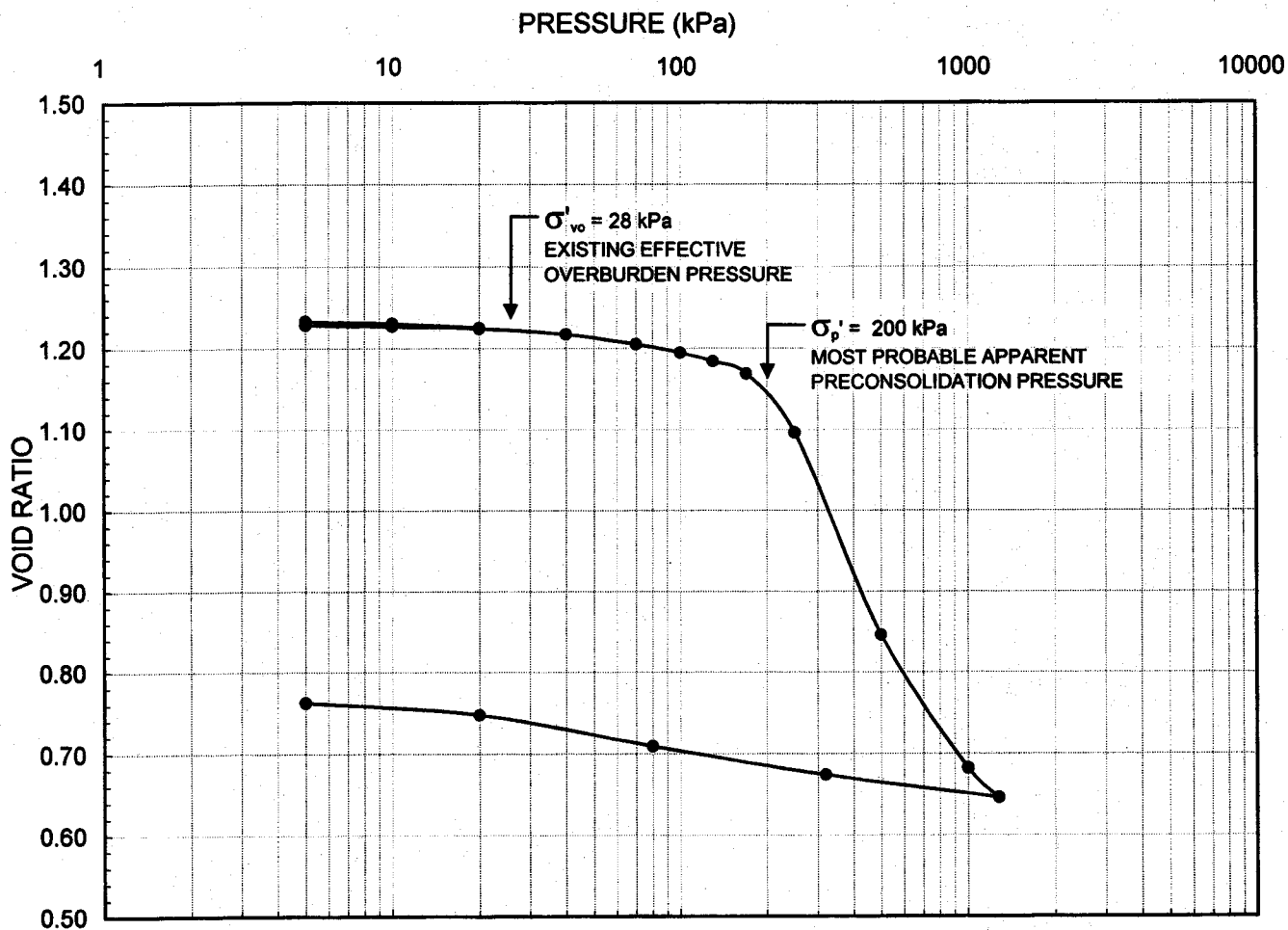
Ministry of Transportation

Ontario

PLASTICITY CHART
 Silty Clay
 Dwyer Hill Road Interchange

FIG No. B3

Project No. 04-1111-007



LEGEND

Borehole: DNE-3B	$w_l = 44.0\%$	$S_o = 97\%$
Sample: Sa 1	$w_f = 28.6\%$	$C_c = 0.55$
Depth (m): 2.59	$w_l = 44.6\%$	$C_r = 0.055$
	$w_p = 19.6\%$	



SCALE	AS SHOWN
DATE	04/12/05
DESIGN	NA
CADD	NA
CHECK	EWK
REVIEW	MIC

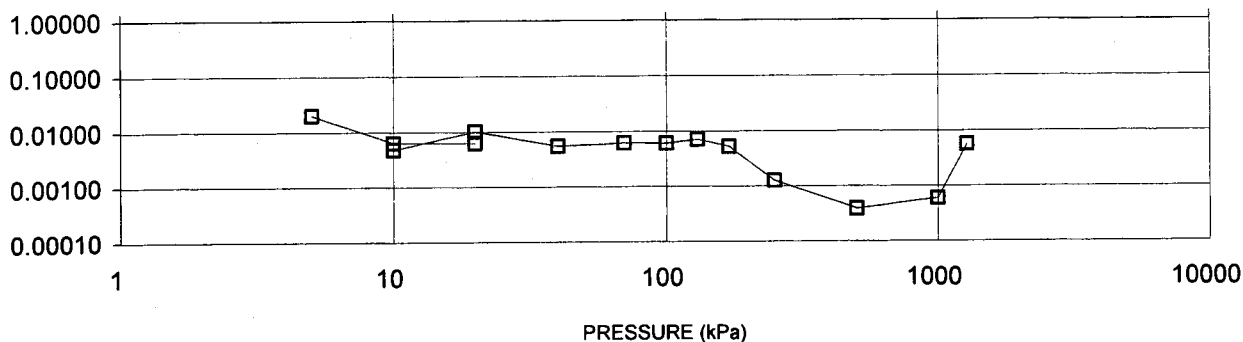
CONSOLIDATION TEST RESULTS SILTY CLAY DWYER HILL ROAD INTERCHANGE

FILE No. Consolidation summary
PROJECT No. 04-1111-007 5200 REV. 0

FIGURE B4-A

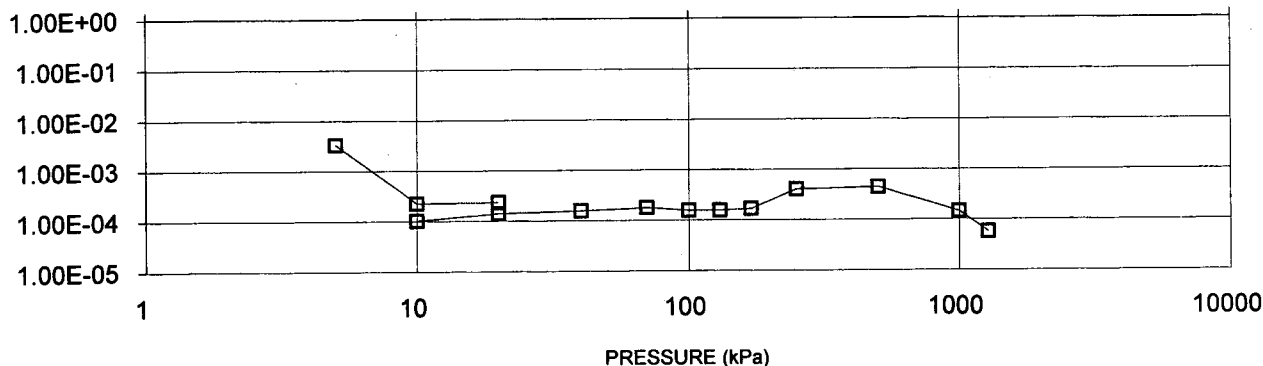
COEFFICIENT OF CONSOLIDATION
(cm²/s)

c_v (cm²/s) vs PRESSURE (kPa)



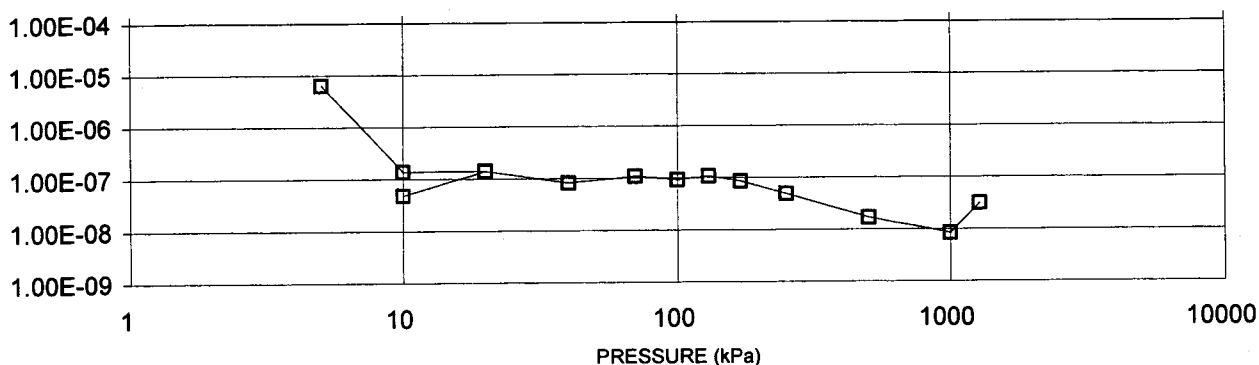
VOLUME COMPRESSIBILITY
(m²/kN)

m_v (m²/kN) vs PRESSURE (kPa)



HYDRAULIC CONDUCTIVITY
(cm/s)

HYDRAULIC CONDUCTIVITY (cm/s) vs PRESSURE (kPa)



LEGEND

Borehole: DNE-3B Sample: Sa 1 Depth (m): 2.59



SCALE	AS SHOWN
DATE	04/12/05
DESIGN	NA
CADD	NA
CHECK	EWK
REVIEW	MIC

**CONSOLIDATION TEST RESULTS
SILTY CLAY
DWYER HILL ROAD INTERCHANGE**

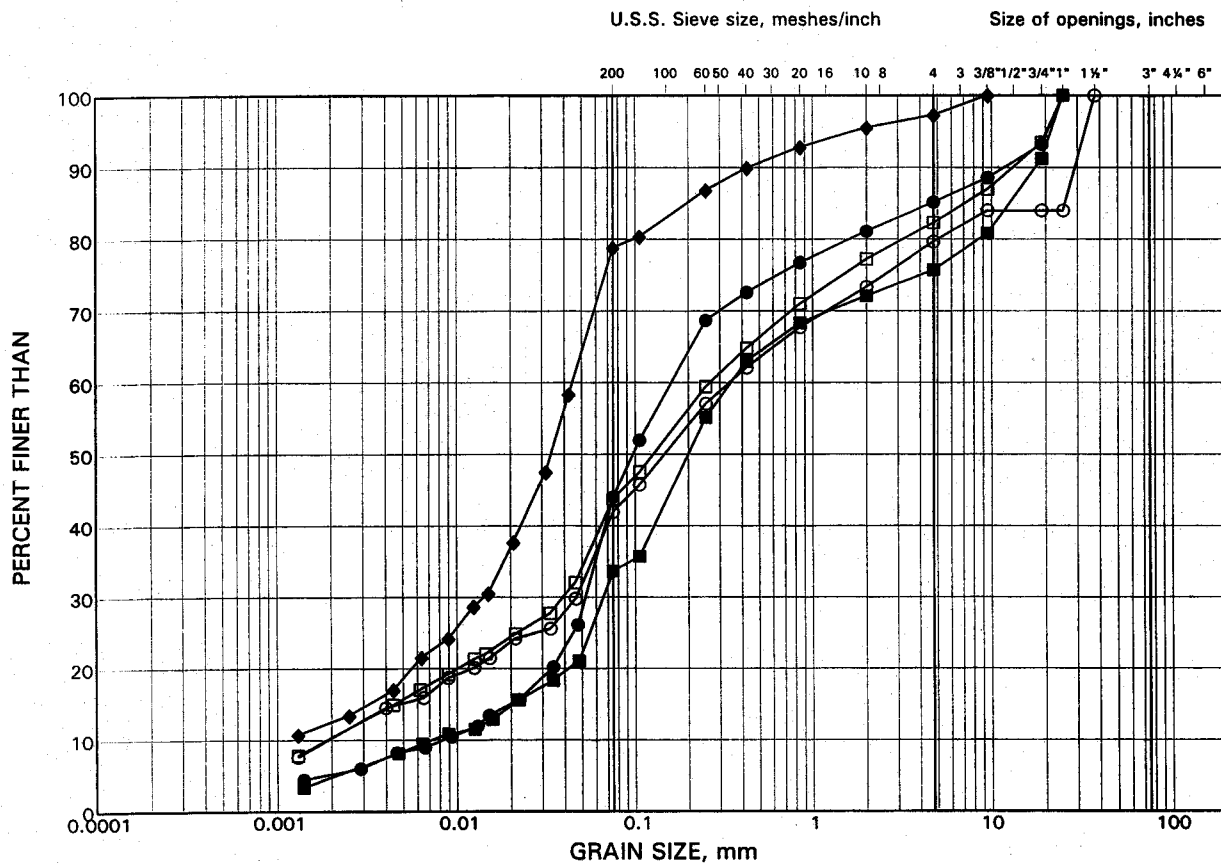
FILE No. Consolidation summary
PROJECT No. 04-1111-007 5200 REV. 0

FIGURE B4-B

GRAIN SIZE DISTRIBUTION TEST RESULTS

Sand and Silt Till
Dwyer Hill Road Interchange

FIGURE B5



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	DSE-1	1	136.1
■	DSE-4	2	132.3
◆	DSE-5	2B	130.5
○	DSW-5	5	128.3
□	DSW-7	5	128.8

July 2005

DRAFT

04-1111-007-2

APPENDIX C

HIGH FILL EMBANKMENTS AT ASHTON STATION ROAD INTERCHANGE BOREHOLE RECORDS AND LABORATORY TEST RESULTS

RECORD OF BOREHOLE No A-1

1 OF 1

METRIC

PROJECT 04-1111-007-5300

W.P. 251-99-00

LOCATION N 5003699.2 ; E 340052.4

ORIGINATED BY W.C.

DIST HWY 7

BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger

COMPILED BY J.M.

DATUM Geodetic

DATE November 9, 2004

CHECKED BY L.C.C.

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									
135.6	GROUND SURFACE							20	40	60	80	100					
0.0	Sand, trace organics (FILL) Loose Brown																
135.2	Silty SAND, some gravel, trace clay (TILL) Compact Brown Dry																
0.3			1	SS	>100		135										
134.5																	
1.1	End of Borehole Auger Refusal NOTE: Borehole dry on completion of drilling.																

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No A-2			1 OF 1			METRIC											
W.P. 251-99-00			LOCATION N 5003649.0 ; E 340072.4			ORIGINATED BY W.C.														
DIST HWY 7			BOREHOLE TYPE Portable Drill			COMPILED BY J.M.														
DATUM Geodetic			DATE November 15, 2004			CHECKED BY L.C.C.														
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH KPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED					WATER CONTENT (%) W _P — W — W _L			γ	GR	SA	SI	CL
134.8 0.0	GROUND SURFACE TOPSOIL		1	SS	1															
134.3 0.5	SAND, some silt Loose Red-brown to brown Moist		2	SS	4		134													
133.5	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Moist to wet		3	SS	11		133													
132.6 2.2	DOLOMITIC LIMESTONE (BEDROCK) Slightly weathered Grey End of Borehole																			
NOTES: 1. Bedrock cored between 1.4 m and 2.2 m depth. TCR = 100% SCR = 64% RQD = 0% 2. Borehole dry on completion of overburden drilling.																				

PROJECT 04-1111-007-5300				RECORD OF BOREHOLE No A-3				1 OF 1		METRIC							
W.P. 251-99-00				LOCATION N 5003537.3 E 340193.7				ORIGINATED BY W.C.									
DIST HWY 7				BOREHOLE TYPE Portable Drill				COMPILED BY J.M.									
DATUM Geodetic				DATE November 16, 2004				CHECKED BY L.C.C.									
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 (%)
132.2	TOP OF WATER																
0.0	WATER																
131.9																	
0.3	PEAT Wet		1	SS	2												
131.3																	
0.9	SILTY CLAY (Weathered Crust) Firm Grey-brown Wet		2	SS	2												
130.7																	
1.5	Sandy SILT, some gravel, trace clay (TILL) Loose to compact Grey Wet		3	SS	6												
			4	SS	22												
129.6																	
2.6	DOLOMITIC LIMESTONE (BEDROCK) containing shale interbeds																
129.2	Fractured Grey																
3.0	End of Borehole																
NOTE: Bedrock cored between 2.6 m and 3.0 m depth. TCR = 100% SCR = 90% RQD = 0%																	

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PROJECT 04-1111-007-5300				RECORD OF BOREHOLE No A-4				1 OF 1		METRIC						
W.P. 251-99-00		LOCATION N 5003509.0 ; E 340200.0		ORIGINATED BY W.C.												
DIST _____ HWY 7		BOREHOLE TYPE Portable Drill		COMPILED BY J.M.												
DATUM Geodetic		DATE November 15, 2004		CHECKED BY L.C.C.												
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								
132.6 0.0	GROUND SURFACE PEAT Wet		1	SS	PM											
131.9 0.7	SILTY CLAY (Weathered Crust) Firm Grey-brown Wet		2	SS	2											
131.4 1.2	Sandy SILT Loose Grey Wet		3	SS	9											
130.9 1.7	Sandy SILT, some gravel, trace clay (TILL) Dense to very dense Grey Wet		4	SS	37											
			5	SS	59											
129.3 3.3	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey		6	SS	100											
129.0 3.6	End of Borehole															
NOTES: 1. Bedrock cored between 3.3 m and 3.6 m depth. TCR = 100% SCR = 71% RQD = 0% 2. Water level at ground surface in open borehole. 3. Water level in piezometer at 0.4 m above ground surface on May 9, 2005.																

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PROJECT 04-1111-007-5300				RECORD OF BOREHOLE No A-5				1 OF 1		METRIC									
W.P. 251-99-00				LOCATION N 5003490.4 ; E 340230.3				ORIGINATED BY W.C.											
DIST HWY 7				BOREHOLE TYPE Portable Drill				COMPILED BY J.M.											
DATUM Geodetic				DATE November 17, 2004				CHECKED BY L.C.C.											
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
133.3	TOP OF WATER																		
0.0	WATER																		
133.0							133												
0.3	PEAT Wet		1	SS	WH														
132.1			2	SS	1		132												
1.2	SILTY CLAY (Weathered Crust) Firm to stiff Grey-brown Wet		3	SS	5														
131.1							131												
130.9	Silty SAND Loose Grey Wet		4	SS	10														
2.4																			
130.4	SILTY CLAY Very stiff Grey Wet		5	SS	26/0.23														
2.9																			
130.0	Sandy SILT, some gravel, trace clay, containing cobbles (TILL) Dense Grey Wet						130												
3.3																			
129.4	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey End of Borehole																		
3.9																			
<p>NOTE:</p> <p>Bedrock cored between 3.3 m and 3.9 m depth.</p> <p>TCR = 100% SCR = 96% RQD = 79%</p>																			

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No A-6			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5003464.3 : E 340238.1			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Portable Drill			COMPILED BY J.M.											
DATUM Geodetic			DATE November 12, 2004			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100			W _p	W	W _L	γ	GR SA SI CL		
132.5	GROUND SURFACE																
0.0	PEAT Wet		1	SS	1		132										
131.9																	
0.6	SILTY CLAY (Weathered Crust) Firm to very stiff Grey-brown Wet		2	SS	1												
			3	SS	7		131										
130.6																	
1.8	SILTY CLAY, some sand Stiff Grey Wet		4	SS	9												
130.2																	
2.3	Sandy SILT, some gravel, trace clay (TILL) Loose Grey Wet		5	SS	7		130										
129.6																	
	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey End of Borehole																
129.3																	
3.2																	
NOTES: 1. Bedrock cored between 2.9 m and 3.2 m depth. TCR = 100% SCR = 91% RQD = 50% 2. Water level at ground surface during drilling.																	

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No A-7			1 OF 1			METRIC									
W.P. 251-99-00			LOCATION N 5003454.8 ; E 340265.3			ORIGINATED BY W.C.												
DIST _____ HWY 7			BOREHOLE TYPE Portable Drill			COMPILED BY J.M.												
DATUM Geodetic			DATE November 17, 2004			CHECKED BY L.C.C.												
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L			GR
131.7	TOP OF WATER																	
0.0	WATER																	
131.2	PEAT		1	SS	PM													
0.5	Wet																	
130.6	SILTY CLAY (Weathered Crust)		2	SS	2													
1.1	Stiff Grey-brown Wet		3	SS	3													
129.5	GRAVEL, some sand, trace silt		4	SS	10													
2.2	Loose to compact Grey Wet		5	SS	11/0.15													
128.8	DOLOMITIC LIMESTONE (BEDROCK)																	
2.9	Fresh Grey																	
128.4	End of Borehole																	
3.3																		
<p>NOTES:</p> <p>* Split-spoon sampler bouncing after 11 blows.</p> <p>2. Bedrock cored between 2.9 m and 3.3 m depth.</p> <p>TCR = 100% SCR = 87% RQD = 33%</p>																		

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No A-8		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003438.1 E 340259.9		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Portable Drill		COMPILED BY J.M.	
DATUM Geodetic		DATE November 12, 2004		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED								+ FIELD VANE		● QUICK TRIAXIAL
132.5	GROUND SURFACE						20	40	60	80	100	25	50	75	GR SA SI CL			
0.0	PEAT Wet		1	SS	WH													
131.8																		
0.6	SILTY CLAY (Weathered Crust) Stiff Grey-brown Wet		2	SS	2													
			3	SS	3													
130.6																		
1.8	Clayey SILT, trace sand																	
130.3	Stiff Grey		4	SS	4													
2.1	Wet																	
130.0	SAND, trace silt																	
	Loose Grey		5	SS	4/0.08													
2.6	Wet																	
	Sandy SILT, some gravel, trace clay (TILL)																	
129.4	Compact Grey Wet																	
3.0	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey End of Borehole																	
NOTES: 1. Bedrock cored between 2.6 m and 3.0 m depth. TCR = 100% SCR = 88% RQD = 53% 2. Water level at ground surface during drilling.																		

NOTES:

- Bedrock cored between 2.6 m and 3.0 m depth.

TCR = 100%
SCR = 88%
ROD = 53%

- Water level at ground surface during drilling.

PROJECT		LOCATION		1 OF 1		METRIC											
04-1111-007-5300		N 5003425.6 E 340270.8				ORIGINATED BY W.C.											
W.P. 251-99-00		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger				COMPILED BY J.M.											
DIST HWY 7		DATE November 8, 2004				CHECKED BY L.C.C.											
DATUM Geodetic																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	25 50 75	W _p W W _L	γ	GR SA SI CL				
132.4	GROUND SURFACE																
0.0	Silty sand, some gravel (FILL)																
0.2	Loose Brown																
	Sand and gravel (FILL)																
	Loose Brown																
131.6	Sandy silt (FILL)																
0.8	Loose Brown																
131.4	Moist PEAT		1	SS	3												
1.2	Moist SILTY CLAY																
	Stiff to very stiff Grey Moist		2	SS	3												
130.0	SAND, trace to some silt																
2.4	Loose to compact Grey Moist		3	SS	10												
129.5	End of Borehole Auger Refusal																
2.9	NOTE: Water level in open borehole at 0.3 m depth on completion of drilling.																

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No A-10		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003418.3 E 340298.1		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Portable Drill		COMPILED BY J.M.	
DATUM Geodetic		DATE November 19, 2004		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT LIMIT CONTENT CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L				
SHEAR STRENGTH kPa								WATER CONTENT (%)						
○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED														
131.7 0.0	TOP OF WATER WATER													
131.3 0.5	PEAT, some gravel Dark brown Wet		1	SS	PM									
130.8 0.9	SILTY CLAY, trace organics Stiff Grey-brown Wet		2	SS	PM									
130.2 1.5	SILTY CLAY (Weathered Crust) Very stiff Grey-brown Wet		3	SS	5									
129.6 2.1	Silty SAND Compact Grey Wet		4	SS	17									
129.2 2.5	DOLOMITIC LIMESTONE (BEDROCK) Fresh													
128.8 2.9	Dark grey End of Borehole													
NOTE: Bedrock cored between 2.5 m and 2.9 m depth. TCR = 100% SCR = 87% RQD = 37%														

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No A-11		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003388.1; E 340304.1		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 8, 2004		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								20 40 60 80 100										
134.2	GROUND SURFACE																	
0.0	Silty sand and gravel, trace organics (FILL)																	
134.0	Dark brown						134											
133.8	Sand and gravel (FILL)																	
0.5	Brown																	
	Sandy silt, some gravel, trace organics (FILL)																	
133.3	Very loose		1	SS	2													
1.0	Brown						133											
	Moist																	
	PEAT																	
132.7	Dark brown																	
	Moist to wet																	
1.5	SILTY CLAY		2	SS	3		132							0 2 66 32				
	Very stiff																	
	Grey																	
	Wet																	
131.4																		
	Sandy SILT, some gravel, trace clay																	
131.2	(TILL)		3	SS	10													
3.1	Compact																	
	Grey																	
	Wet																	
	End of Borehole																	
	Auger Refusal																	

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No A-12				1 OF 1		METRIC					
W.P. 251-99-00		LOCATION N 5003370.7 E 340319.2				ORIGINATED BY W.C.							
DIST HWY 7		BOREHOLE TYPE Portable Drill				COMPILED BY J.M.							
DATUM Geodetic		DATE November 19, 2004				CHECKED BY L.C.C.							
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L	25 50 75	γ	GR SA SI CL	
129.9 0.0	TOP OF WATER WATER												
129.5 0.5	Organics containing gravel (FILL) Dark brown Wet		1	SS	PM		129						
128.9 1.1	Silty clay, trace sand and organics (FILL) Grey-brown Wet		2	SS	PM								
128.4 1.5	SILTY CLAY (Weathered Crust) Very stiff Grey-brown Wet		3	SS	4		128						
127.8 2.1	SILTY CLAY, trace organics Stiff Black Wet		4	SS	5								
127.5 2.4	Silty SAND Loose Grey Wet												
127.1 2.8	DOLOMITIC LIMESTONE (BEDROCK) Fresh Dark grey						127						
126.6 3.3	Bedrock cored between 2.8 m and 3.3 m depth. TCR = 100% SCR = 92% RQD = 58% End of Borehole												
NOTE: 1. Bedrock cored between 2.8 m and 3.3 m depth. TCR = 100% SCR = 92% RQD = 58% 2. Water level in piezometer at 0.7 m above ground surface on May 9, 2005.													

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No A-13			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5003295.2 E 340387.3			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.											
DATUM Geodetic			DATE November 8, 2004			CHECKED BY L.C.C.											
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									
132.8	GROUND SURFACE																
0.0	Sand and gravel (FILL) Brown																
132.0	PEAT																
131.8			1	SS	2												
1.0	SILTY CLAY Firm Grey Moist																
			2	SS	1												
130.7																	
2.1	SILTY CLAY, trace to some sand Very stiff Grey Wet																
			3	SS	7												
129.9																	
	SAND, some silt																
129.6	Loose		4a	SS	5												
3.2	Grey																
	Wet		4b	SS	>100												
129.3	Sandy SILT, some gravel, trace clay (TILL)																
3.5	Compact																
	Grey																
	Wet																
	End of Borehole Auger Refusal																

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ANE-1			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5003524.1 E 340185.9			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.											
DATUM Geodetic			DATE November 9, 2004			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED 20 40 60 80 100					W _p W W _L 25 50 75			γ kN/m ³	GR SA SI CL
132.5	GROUND SURFACE																
0.0	Sand, trace organics (FILL)																
132.2	Loose																
0.2	Brown																
	Sand and gravel (FILL)																
	Loose																
	Brown																
131.6																	
0.9	PEAT																
131.3	Wet		1	SS	3												
1.1	SILTY CLAY																
	Stiff																
	Grey																
	Wet		2	SS	3												
130.3																	
2.2	Sandy SILT, some gravel, trace clay, containing cobbles (TILL)																
	Dense to very dense																
	Grey		3	SS	36												
	Moist																
			4	SS	54												
129.0																	
3.5	End of Borehole Auger Refusal																

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ANE-3		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003463.1 ; E 340230.9		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 4, 2004		CHECKED BY L.C.C.	

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
132.3 0.0	GROUND SURFACE PEAT																		
131.6 0.6	SILTY CLAY Firm Grey Wet		1	SS	2														
130.9 1.4	SILTY CLAY Stiff to very stiff Grey Wet		2	SS	7														
130.0	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Wet		3	SS	610.00														
129.7 2.6	End of Borehole Auger Refusal NOTE: Water level at ground surface during drilling.																		

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ANE-4			1 OF 1			METRIC									
W.P. 251-99-00			LOCATION N 5003438.8 E 340239.2			ORIGINATED BY W.C.												
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.												
DATUM Geodetic			DATE November 4, 2004			CHECKED BY L.C.C.												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED			WATER CONTENT (%) W _P — W — W _L			γ	GR SA SI CL			
132.3 0.0	GROUND SURFACE PEAT						132											
131.5 0.7	SILTY CLAY Firm Grey Wet		1	SS	2		131											
130.7 1.5	SILTY CLAY Very stiff Grey Wet		2	SS	10													
130.4 2.0	SAND, trace silt Loose to compact Grey Wet																	
	SANDY SILT, some gravel, trace clay (TILL) Compact to dense Grey Wet		3	SS	39		130											
129.3 2.9	End of Borehole Auger Refusal																	
NOTE: Water level at ground surface during drilling.																		

PROJECT		RECORD OF BOREHOLE		No ANE-5		1 OF 1		METRIC															
W.P. 251-99-00		LOCATION		N 5003414.6 E 340241.3		ORIGINATED BY		W.C.															
DIST _____ HWY 7		BOREHOLE TYPE		Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY		J.M.															
DATUM Geodetic		DATE		November 4, 2004		CHECKED BY		L.C.C.															
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
132.3 0.0	GROUND SURFACE PEAT																						
131.5 0.9	SILTY CLAY Firm Grey Wet Sandy SILT, some gravel, trace clay (TILL) Compact to dense Grey Wet		1	SS	2																		
			2	SS	11																		
			3	SS	48																		
129.3 3.0	End of Borehole Auger Refusal NOTE: Water level at ground surface during drilling.																						

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ANE-6				1 OF 1		METRIC							
W.P. 251-99-00		LOCATION N 5003394.5 E 340236.5				ORIGINATED BY W.C.									
DIST _____ HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger				COMPILED BY J.M.									
DATUM Geodetic		DATE November 4, 2004				CHECKED BY L.C.C.									
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							
132.3	GROUND SURFACE														
0.0	PEAT														
131.5															
131.3	SILTY CLAY														
1.0	Firm Grey Wet		1	SS	1										
	Sandy SILT, some gravel, trace clay (TILL) Compact to dense Grey Wet														
			2	SS	21										
			3	SS	42										
129.3	End of Borehole Auger Refusal														
3.0	NOTE: Water level at ground surface during drilling.														

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PROJECT		RECORD OF BOREHOLE				No ANE-7		1 OF 1		METRIC					
W.P. 251-99-00		LOCATION		N 5003369.6 ; E 340221.8		ORIGINATED BY		W.C.							
DIST _____ HWY 7		BOREHOLE TYPE		Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY		J.M.							
DATUM Geodetic		DATE		November 4, 2004		CHECKED BY		L.C.C.							
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							
132.3 0.0	GROUND SURFACE PEAT							20 40 60 80 100							
131.4 0.9	SILTY CLAY Firm Grey Moist to wet		1	SS	1										0 4 63 33
130.9 1.4	Sandy SILT, some gravel, trace clay (TILL) Compact to very dense Grey Moist to wet		2	SS	87										
129.6 2.7	End of Borehole Auger Refusal NOTE: Water level at ground surface during drilling.		3	SS	17/0.20										

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


PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ANE-8			1 OF 1			METRIC									
W.P. 251-99-00			LOCATION N 5003354.6 E 340201.9			ORIGINATED BY W.C.												
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.												
DATUM Geodetic			DATE November 3, 2004			CHECKED BY L.C.C.												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED			WATER CONTENT (%) W _p W W _L 25 50 75			γ	GR	SA	SI	CL
132.3 0.0	GROUND SURFACE PEAT						132											
131.4 1.0	Sandy SILT Loose Grey Wet Sandy SILT, some gravel, trace clay, containing cobbles (TILL) Loose to very dense Grey Wet		1	SS	2		131											
			2	SS	62		130											
			3	SS	40													
129.2 3.1	End of Borehole Auger Refusal NOTE: Water level at ground surface during drilling.																	

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ANE-9			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5003346.2 E 340178.6			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.											
DATUM Geodetic			DATE November 2, 2004			CHECKED BY L.C.C.											
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									
132.3	GROUND SURFACE							20	40	60	80	100					
0.0	PEAT																
131.6																	
0.7	Sandy SILT, some gravel, trace clay (TILL) Loose to very dense Grey Wet		1	SS	WH												
			2	SS	62												
			3	SS	99												
			4	SS	52												
128.7																	
3.6	End of Borehole Auger Refusal NOTE: Water level at ground surface during drilling.																

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PROJECT <u>04-1111-007-5300</u>		RECORD OF BOREHOLE No ANE-10		1 OF 1	METRIC
W.P. <u>251-99-00</u>	LOCATION <u>N 5003346.6 E 340153.9</u>	ORIGINATED BY <u>W.C.</u>			
DIST <u>HWY 7</u>	BOREHOLE TYPE <u>Power Auger 108 mm I.D. Hollow Stem Auger</u>	COMPILED BY <u>J.M.</u>			
DATUM <u>Geodetic</u>	DATE <u>November 5, 2004</u>	CHECKED BY <u>L.C.C.</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			20	40	60	80	100					
132.3 0.0	GROUND SURFACE PEAT																
131.2 1.1	Sandy SILT, some gravel, trace clay, containing cobbles (TILL) Loose to dense Grey Wet		1	SS	WH												
130.6 1.7	End of Borehole Auger Refusal		2	SS	48												

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PROJECT <u>04-1111-007-5300</u>										RECORD OF BOREHOLE No ANE-10A										1 OF 1		METRIC	
W.P. <u>251-99-00</u>					LOCATION <u>N 5003347.1 ; E 340150.8</u>					ORIGINATED BY <u>W.C.</u>													
DIST <u> </u> HWY <u>7</u>					BOREHOLE TYPE <u>Power Auger 108 mm I.D. Hollow Stem Auger</u>					COMPILED BY <u>J.M.</u>													
DATUM <u>Geodetic</u>					DATE <u>November 5, 2004</u>					CHECKED BY <u>L.C.C.</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		25	50	75		GR SA SI CL					
132.3 0.0	GROUND SURFACE For soil stratigraphy refer to Record of Borehole ANE-10						132																
130.6 1.7	End of Borehole Auger Refusal						131																

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ANW-1			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5003471.5 :E 339989.9			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.											
DATUM Geodetic			DATE November 3, 2004			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	25 50 75	γ	GR SA SI CL			
132.4	GROUND SURFACE																
0.0	TOPSOIL																
132.1	SILTY CLAY Stiff to very stiff Grey-brown Wet						132										
0.3																	
131.2	Sandy SILT, some gravel, trace clay (TILL) Loose to compact Grey Wet		1	SS	5		131							1 12 70 17			
1.2																	
130.5			2	SS	6/0.15												
1.9	End of Borehole Auger Refusal																
	NOTES: 1. Water level in open borehole at 0.6 m depth on completion of drilling. 2. Water level in piezometer at 0.1 m above ground surface on May 9, 2005.																

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ANW-2		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003489.1; E 340005.9		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 3, 2004		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20 40 60 80 100					25 50 75				
132.3	GROUND SURFACE																
0.0	TOPSOIL Wet		1	SS	1		132										
132.0																	
0.3	SILTY CLAY Firm Grey-brown Wet																
131.4																	
0.9	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Wet		2	SS	17		131										
130.6																	
	SHALE (BEDROCK)		3	SS	38/0.16												
130.3																	
2.0	End of Borehole Auger Refusal NOTE: Water level in open borehole at 0.8 m depth on completion of drilling.																

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ANW-3		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003508.5 E 340023.4		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 3, 2004		CHECKED BY L.C.C.	

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			20	40	60	80	100	W _p	W	W _L		
132.5	GROUND SURFACE																
0.0	TOPSOIL Wet		1	SS	2											6 15 54 25	
132.1	Sandy SILT, some gravel, trace clay (TILL) Loose to compact Grey-brown Wet		2	SS	11/0.25											18 54 25 3	
131.3	End of Borehole Auger Refusal																
1.2	NOTE: Water level in open borehole at 0.1 m depth on completion of drilling.																

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ANW-4		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003528.9 E 340038.4		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 2, 2004		CHECKED BY L.C.C.	

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										25 50 75		
132.5	GROUND SURFACE																			
0.0	TOPSOIL																			
132.3																				
0.3	Sandy SILT, some gravel, trace clay (TILL) Compact to dense Grey-brown Moist to wet		1	SS	2															
			2	SS	22											9 45 33 13				
131.0																				
1.6	End of Borehole Auger Refusal NOTE: Water level in open borehole at 1.0 m depth on completion of drilling.																			

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ANW-5				1 OF 1		METRIC										
W.P. 251-99-00			LOCATION N 5003550.5 E 340050.2				ORIGINATED BY W.C.												
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger				COMPILED BY J.M.												
DATUM Geodetic			DATE November 2, 2004				CHECKED BY L.C.C.												
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 (%)	
132.7	GROUND SURFACE																		
0.0	TOPSOIL																		
132.4	Sandy SILT, some gravel, trace clay (TILL) Loose to dense Brown Moist wet		1	SS	2		132												
0.3																			
			2	SS	34/0.13														
131.2	End of Borehole Auger Refusal																		
1.5	NOTE: Water level in open borehole at 0.8 m depth on completion of drilling.																		

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

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ANW-6			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5003573.7 E 340057.4			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.											
DATUM Geodetic			DATE November 2, 2004			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED			WATER CONTENT (%) W _p W W _L			γ	GR SA SI CL		
132.8	GROUND SURFACE							20 40 60 80 100									
0.0	TOPSOIL																
132.8	Sandy SILT, some gravel, trace clay (TILL) Loose to compact Brown Moist		1	SS	2	▽	132										
0.2																	
131.8			2	SS	13/0.03												
1.0	End of Borehole Auger Refusal																
	NOTE: Water level in open borehole at 0.8 m depth on completion of drilling.																

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ANW-7			1 OF 1			METRIC										
W.P. 251-99-00			LOCATION N 5003599.0; E 340061.2			ORIGINATED BY W.C.													
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.													
DATUM Geodetic			DATE November 2, 2004			CHECKED BY L.C.C.													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED			W _p	W	W _L	WATER CONTENT (%)	γ	GR	SA	SI	CL
134.0	GROUND SURFACE							20 40 60 80 100											
0.0	TOPSOIL																		
133.8	Moist																		
0.2	Sandy SILT, some gravel, trace clay (TILL) Compact to very dense Brown Moist		1	SS	20														
			2	SS	98/0.15														
						▽	133												
132.5																			
1.6	End of Borehole Auger Refusal Note: Water level in open borehole at 1.1 m depth on completion of drilling.																		



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PROJECT <u>04-1111-007-5300</u>		RECORD OF BOREHOLE No ANW-8		1 OF 1	METRIC
W.P. <u>251-99-00</u>		LOCATION <u>N 5003623.9; E 340059.5</u>		ORIGINATED BY <u>W.C.</u>	
DIST <u> </u> HWY <u>7</u>		BOREHOLE TYPE <u>Power Auger 108 mm I.D. Hollow Stem Auger</u>		COMPILED BY <u>J.M.</u>	
DATUM <u>Geodetic</u>		DATE <u>November 2, 2004</u>		CHECKED BY <u>L.C.C.</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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED					WATER CONTENT (%) w _p w w _L				
133.8	GROUND SURFACE																
0.0	TOPSOIL Moist		1	SS	8												
133.5																	
0.3	Sandy SILT, some gravel, trace clay (TILL) Loose to compact Brown Moist		2	SS	6/0.13	▽	133										
132.5																	
1.3	End of Borehole Auger Refusal NOTE: Water level in open borehole at 0.9 m depth on completion of drilling.																

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ANW-9		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003648.3 E 340054.5		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 2, 2004		CHECKED BY L.C.C.	

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
134.3 0.0	GROUND SURFACE TOPSOIL																							
133.7 0.7	Sandy SILT, some gravel, trace clay, containing cobbles (TILL) Compact Brown Moist		1	SS	8/0.20																			
133.1 1.3	End of Borehole Auger Refusal NOTE: Water level in open borehole at 0.7 m depth on completion of drilling.																							

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ANW-10			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5003671.2; E 340044.1			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Portable Drill			COMPILED BY J.M.											
DATUM Geodetic			DATE November 16, 2004			CHECKED BY L.C.C.											
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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED								WATER CONTENT (%)	
134.2	GROUND SURFACE							20	40	60	80	100					
0.0	Topsoil																
133.9																	
0.3	Sandy silt, some gravel, trace clay (FILL) Loose Brown Moist to wet		1	SS	3												
133.0																	
1.2	Sandy SILT, some gravel, trace clay (TILL) Loose to compact Brown		2	SS	10												
132.6																	
1.7	Wet DOLOMITIC LIMESTONE (BEDROCK) Slightly weathered Brown and grey		3	BQ RC	-												
131.7																	
2.6	End of Borehole																
NOTE: Bedrock cored between 1.7 m and 2.6 m depth. TCR = 100% SCR = 89% RQD = 58%																	

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ASE-1		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003355.0 ; E 340360.9		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Portable Drill		COMPILED BY J.M.	
DATUM Geodetic		DATE January 24, 2005		CHECKED BY L.C.C.	

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										
131.4	TOP OF ICE																	
0.0	ICE																	
131.0							131											
	WATER																	
0.6	PEAT																	
130.5																		
0.9	SILTY CLAY (Weathered Crust) Firm to stiff Grey-brown Wet		1	SS	PM													
			2	SS	2		130											
129.3																		
2.1	SILTY CLAY containing sand seams Very stiff Dark grey and grey-brown Wet		3	SS	5		129											
128.8																		
2.6	SAND Loose to dense Grey Wet																	
128.5																		
2.9	SANDY SILT, some gravel, trace clay (TILL) Dense Grey Wet		4	SS	32													
128.2																		
3.2							128											
127.8	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey End of Borehole																	
3.7																		
NOTE: Bedrock cored between 3.2 m and 3.7 m depth. TCR = 100% SCR = 94% RQD = 67%																		

NOTE:

Bedrock cored between 3.2 m
and 3.7 m depth.

TCR = 100%
SCR = 94%
RQD = 67%

PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ASE-2		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003376.4 ; E 340345.9		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Portable Drill		COMPILED BY J.M.	
DATUM Geodetic		DATE January 26, 2005		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT Y kN/m³	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 x REMOULDED											
131.3	TOP OF ICE																
0.0	ICE																
130.9							131										
	WATER																
0.6	PEAT																
130.4																	
0.9	SILTY CLAY (Weathered Crust) Stiff Grey-brown Wet		1	SS	PM												
			2	SS	3		130										
129.2			3	SS	3												
2.1	SILTY CLAY, containing sand seams Very stiff Dark grey Wet						129										
128.8																	
128.6	Silty SAND Loose Grey Wet		4	SS	7												
2.7			5	SS	8/0.15												
128.1	Sandy SILT, some gravel and clay (TILL) Loose to compact Grey Wet						128										
3.2																	
127.7	DOLOMITIC LIMESTONE (BEDROCK) Fresh Dark grey to grey-green End of Borehole																
3.7																	
NOTE: Bedrock cored between 3.2 m and 3.7 m depth. TCR = 100% SCR = 94% RQD = 65%																	

NOTE:

Bedrock cored between 3.2 m and 3.7 m depth.

TCR = 100%
SCR = 94%
RQD = 65%

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ASE-3			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5003394.6 ; E 340330.4			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Portable Drill			COMPILED BY J.M.											
DATUM Geodetic			DATE January 31, 2005			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED			WATER CONTENT (%) W _p W W _L			UNIT WEIGHT γ	GR SA SI CL		
131.6	TOP OF ICE							20 40 60 80 100									
0.0	ICE																
131.2	WATER																
131.0	PEAT						131										
0.6																	
130.6	SILTY CLAY (Weathered Crust) Stiff to very stiff Grey-brown Wet		1	SS	WH												
1.1																	
			2	SS	1		130										
			3	SS	5												
129.2	SILTY CLAY, trace sand and organics Dark grey Wet																
128.8	Silty SAND Loose Grey Wet		4	SS	2		129										
2.9																	
128.4	SANDY SILT, some gravel, trace clay (TILL) Loose to compact Grey Wet																
3.3	DOLOMITIC LIMESTONE (BEDROCK) Slightly weathered Dark grey-green End of Borehole																
NOTE: Bedrock cored between 2.9 m and 3.3 m depth. TCR = 100% SCR = 79% RQD = 46%																	

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PROJECT <u>04-1111-007-5300</u>		RECORD OF BOREHOLE No ASE-4		1 OF 1	METRIC
W.P. <u>251-99-00</u>	LOCATION <u>N 5003417.2 E 340318.8</u>	ORIGINATED BY <u>W.C.</u>			
DIST <u>HWY 7</u>	BOREHOLE TYPE <u>Portable Drill</u>	COMPILED BY <u>J.M.</u>			
DATUM <u>Geodetic</u>	DATE <u>January 31, 2005</u>	CHECKED BY <u>L.C.C.</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20 40 60 80 100					w _p w w _L				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED										
132.1	TOP OF ICE						132										
0.0	ICE																
131.6																	
131.5	WATER																
0.6	PEAT		1	SS	2												
131.0							131										
1.1	SILTY CLAY (Weathered Crust) Stiff Grey-brown Wet		2	SS	3												
							130										
129.8			3	SS	5												
	SILTY CLAY containing silty sand seams Stiff to very stiff Dark grey Wet															0 1 66 33	
129.4			4	BQ RC	-												
2.7	Sandy SILT, some gravel, trace clay (TILL) Loose to compact Grey Wet																
128.9							129										
3.2	DOLOMITIC LIMESTONE (BEDROCK) Fresh Dark grey End of Borehole																
NOTE: Bedrock cored between 2.6 m and 3.2 m depth. TCR = 100% SCR = 89% RQD = 71%																	

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ASE-5			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5003436.9 ; E 340303.7			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Portable Drill			COMPILED BY J.M.											
DATUM Geodetic			DATE February 1, 2005			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	25 50 75	W _p W W _L	γ	GR SA SI CL				
132.1	TOP OF ICE																
0.0	ICE						132										
131.8																	
0.3	WATER																
131.3																	
131.0	PEAT																
1.1	SILTY CLAY (Weathered Crust) Stiff Grey-brown Wet		1	SS	1		131										
			2	SS	3												
130.0																	
2.1	SILTY CLAY, trace sand, trace organics Stiff Grey Wet		3	SS	3		130										
129.5																	
2.7	Silty SAND Loose Grey Wet																
128.9																	
3.2	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey End of Borehole						129										
NOTE: Bedrock cored between 2.7 m and 3.3 m depth. TCR = 95% SCR = 76% RQD = 29%																	

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ASE-6			1 OF 1			METRIC							
W.P. 251-99-00			LOCATION N 5003462.7 E 340299.9			ORIGINATED BY W.C.										
DIST HWY 7			BOREHOLE TYPE Portable Drill			COMPILED BY J.M.										
DATUM Geodetic			DATE February 1, 2005			CHECKED BY L.C.C.										
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								
132.1 0.0	TOP OF ICE															
131.7	ICE															
131.5	WATER															
131.5 0.6	PEAT															
130.8	SILTY CLAY (Weathered Crust) Stiff to very stiff Grey-brown Wet		1	SS	WH											
130.8 1.3			2	SS	3											
130.0	SILTY CLAY, trace organics Stiff Grey Wet		3	SS	2											
130.0 2.1																
129.4	Silty SAND															
129.4 2.7	Loose Grey Wet															
128.9	DOLOMITIC LIMESTONE (BEDROCK)															
128.9 3.3	Fresh Grey End of Borehole															
NOTE: Bedrock cored between 2.7 m and 3.3 m depth. TCR = 100% SCR = 76% RQD = 0%																

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ASE-7		1 OF 1		METRIC											
W.P. 251-99-00		LOCATION N 5003483.2 E 340285.2		ORIGINATED BY W.C.													
DIST HWY 7		BOREHOLE TYPE Portable Drill		COMPILED BY J.M.													
DATUM Geodetic		DATE February 2, 2005		CHECKED BY L.C.C.													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _P W W _L	25 50 75	γ	GR SA SI CL				
132.0	TOP OF ICE																
0.0	ICE																
131.6																	
0.6	WATER PEAT																
130.9			1	SS	1		131										
1.1	SILTY CLAY (Weathered Crust) Stiff to very stiff Grey-brown Wet		2	SS	2												
129.9			3	SS	3		130										
129.7	SILTY CLAY, trace sand, trace organics Stiff Grey		4	SS	20/0.15												
2.4	Wet																
129.4																	
2.7	Silty SAND, some gravel Loose to compact Grey																
128.9	Wet						129										
3.1	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey End of Borehole																
NOTE: Bedrock cored between 2.7 m and 3.1 m depth. TCR = 100% SCR = 67% RQD = 22%																	

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No ASE-8			1 OF 1			METRIC							
W.P. 251-99-00			LOCATION N 5003508.6 ; E 340290.6			ORIGINATED BY W.C.										
DIST HWY 7			BOREHOLE TYPE Portable Drill			COMPILED BY J.M.										
DATUM Geodetic			DATE February 3, 2005			CHECKED BY L.C.C.										
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								
131.6	TOP OF ICE															
0.0	ICE															
131.3	WATER															
131.0	PEAT															
0.6																
130.4			1	SS	WH											
1.2	SILTY CLAY (Weathered Crust) Stiff to very stiff Grey-brown Wet		2	SS	2											
129.6																
2.0	SILT, trace sand, trace clay, trace organics Loose Grey Wet		3	SS	6											
129.3																
128.9	Silty SAND Loose Grey Wet		4	SS	10/0.08											
2.7																
128.4	Sandy SILT, some gravel, trace clay (TILL) Compact Grey Wet															
3.2	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey End of Borehole															
NOTE: Bedrock cored between 2.7 m and 3.2 m depth. TCR = 100% SCR = 67% RQD = 0%																

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ASE-9		1 OF 1		METRIC											
W.P. 251-99-00		LOCATION N 5003532.3; E 340276.2		ORIGINATED BY W.C.													
DIST HWY 7		BOREHOLE TYPE Portable Drill		COMPILED BY J.M.													
DATUM Geodetic		DATE February 3, 2005		CHECKED BY L.C.C.													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	25 50 75	W _p W W _L	γ	GR SA SI CL				
131.3	TOP OF ICE																
0.0	ICE																
130.9							131										
0.4	WATER																
130.6																	
0.7	PEAT																
130.1			1	SS	WH												
1.2	SILTY CLAY (Weathered Crust) Stiff to very stiff Grey-brown Wet		2	SS	4		130										
129.1																	
128.9	SILT, trace sand, trace organics Loose Grey Wet		3	SS	3		129										
128.6																	
2.7	SAND, trace silt Loose to compact Grey Wet																
128.1	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey End of Borehole																
3.2																	
NOTE: Bedrock cored between 2.7 m and 3.2 m depth. TCR = 96% SCR = 70% RQD = 40%																	

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ASE-10		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003554.6 :E 340282.5		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Portable Drill		COMPILED BY J.M.	
DATUM Geodetic		DATE February 4, 2005		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED										
131.2	TOP OF ICE							20	40	60	80	100	25	50	75	kN/m ³	GR SA SI CL	
0.0	ICE																	
130.8																		
130.6	WATER																	
0.7	PEAT																	
130.2																		
1.0	SILTY CLAY (Weathered Crust) Stiff to very stiff Grey-brown Wet		1	SS	3													
			2	SS	4													
129.0																		
128.8	SILTY CLAY, trace organics Stiff Grey		3	SS	3													
2.5	Wet																	
128.5	Silty SAND, trace clay, trace gravel (TILL)		4	SS	20/0.15													
2.8	Loose to compact Grey																	
128.0	Wet																	
3.2	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey End of Borehole																	
	Bedrock cored between 2.8 m and 3.2 m depth.																	
	TCR = 100% SCR = 67% RQD = 0%																	

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ASE-11		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003313.4 ; E 340390.4		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Portable Drill		COMPILED BY J.M.	
DATUM Geodetic		DATE February 4, 2005		CHECKED BY L.C.C.	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT Y kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _P W W _L	25 50 75			
131.4	TOP OF ICE													
0.0	ICE													
131.0							131							
130.8	WATER													
0.6	PEAT													
130.2														
1.2	SILTY CLAY (Weathered Crust) Stiff to very stiff Grey-brown Wet		1	SS	2		130							
			2	SS	4									
129.3														
2.1	SILTY CLAY, trace sand, trace organics Stiff Grey Wet		3	SS	4		129							
128.8														
2.6	Silty SAND Loose to compact Grey Wet		4	SS	16									
128.3														
3.1	Silty SAND, some gravel, trace clay (TILL) Compact Grey Wet		5	SS	25/0.15		128							
127.8														
3.6	DOLOMITIC LIMESTONE (BEDROCK) Fresh Grey													
127.2														
4.2	End of Borehole Bedrock cored between 3.6 m and 4.2 m depth. TCR = 96% SCR = 71% RQD = 33%													

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No ASW-1		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003680.7 ; E 340069.7		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 9, 2004		CHECKED BY L.C.C.	

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					
134.6	GROUND SURFACE																
0.0	TOPSOIL																
134.3																	
0.3	Sandy SILT, some gravel, trace clay (TILL) Loose to compact Brown Moist		1	SS	3												
133.0			2	SS	40												
1.6	End of Borehole Auger Refusal																

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PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No AWNS-1			1 OF 1			METRIC											
W.P. 251-99-00			LOCATION N 5003328.1; E 340189.0			ORIGINATED BY W.C.														
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.														
DATUM Geodetic			DATE November 4, 2004			CHECKED BY L.C.C.														
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED					W _p W W _L WATER CONTENT (%)			γ kN/m ³	GR SA SI CL			
							20 40 60 80 100					25 50 75								
132.3 0.0	GROUND SURFACE PEAT						132													
131.4 0.9	Sandy SILT, some gravel, trace clay (TILL) Very loose to very dense Grey Moist to wet		1	SS	1		131													
			2	SS	108															
130.2 2.1	End of Borehole Auger Refusal NOTE: Water level in open borehole at ground surface on completion of drilling.																			

PROJECT 04-1111-007-5300			RECORD OF BOREHOLE No AWNS-2			1 OF 1			METRIC								
W.P. 251-99-00			LOCATION N 5003337.0; E 340212.2			ORIGINATED BY W.C.											
DIST HWY 7			BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger			COMPILED BY J.M.											
DATUM Geodetic			DATE November 4, 2004			CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100			W _p	W	W _L	γ	GR SA SI CL		
132.3 0.0	GROUND SURFACE PEAT						132										
131.4 1.1	SILTY CLAY Firm Grey Wet Sandy SILT, some gravel, trace clay (TILL) Loose to very dense Grey Moist		1	SS	5		131										
			2	SS	55		130										
			3	SS	154												
129.3 3.1	End of Borehole Auger Refusal NOTE: 1. Water level in piezometer at 0.1 m above ground surface on May 9, 2005.																

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No AWNS-3				1 OF 1		METRIC					
W.P. 251-99-00		LOCATION N 5003350.9; E 340233.1				ORIGINATED BY W.C.							
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger				COMPILED BY J.M.							
DATUM Geodetic		DATE November 4, 2004				CHECKED BY L.C.C.							
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L				
132.3 0.0	GROUND SURFACE PEAT						132						
131.5 0.8	SILTY CLAY Firm to stiff Grey Wet		1	SS	10	▽	131						
131.1 1.2	SANDY SILT, some gravel, trace clay (TILL) Loose to very dense Grey Moist to wet		2	SS	43		130						
			3	SS	27		129						
			4	SS	25/0.25								
128.4 3.9	End of Borehole Auger Refusal NOTE: Water level in open borehole at 1.3 m depth on completion of drilling.												

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No AWNS-4				1 OF 1		METRIC										
W.P. 251-99-00		LOCATION N 5003366.5, E 340251.5				ORIGINATED BY W.C.												
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger				COMPILED BY J.M.												
DATUM Geodetic		DATE November 4, 2004				CHECKED BY L.C.C.												
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
132.2	GROUND SURFACE																	
0.0	PEAT																	
131.5																		
0.8	SILTY CLAY Stiff Grey Wet		1	SS	4													0 0 64 36
130.8																		
1.4	SILTY CLAY Very stiff Grey Wet		2	SS	24													0 3 46 51
130.1																		
2.1	Sandy SILT, some gravel, trace clay (TILL) Dense Grey Wet		3	SS	46													
129.3																		
2.9	End of Borehole Auger Refusal																	
	NOTE: Water level in open borehole at 0.5 m depth on completion of drilling.																	

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No AWNS-4A		1 OF 1	METRIC
W.P. 251-99-00		LOCATION N 5003367.5 ; E 340253.2		ORIGINATED BY W.C.	
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.	
DATUM Geodetic		DATE November 4, 2004		CHECKED BY L.C.C.	

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
132.2 0.0	GROUND SURFACE PEAT						132								
131.5 0.8	SILTY CLAY Stiff Grey Wet														
131.1 1.2	End of Borehole														
NOTE: This borehole advanced in order to conduct in situ vane shear test in silty clay stratum.															

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PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No AWNS-5		1 OF 1	METRIC
W.P. 251-99-00	LOCATION N 5003383.5 ; E 340271.0	ORIGINATED BY W.C.			
DIST HWY 7	BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger	COMPILED BY J.M.			
DATUM Geodetic	DATE November 4, 2004	CHECKED BY L.C.C.			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
132.4	GROUND SURFACE						20	40	60	80	100	25	50	75	GR SA SI CL	
0.0	PEAT															
131.5																
0.9	SILTY CLAY															
131.1	Soft to firm		1	SS	1											
1.2	Grey															
1.2	Wet															
	SILT															
	Loose to compact															
130.5	Grey															
	Wet															
130.3	Silty SAND		2	SS	20											
2.1	Compact															
2.1	Grey															
2.1	Wet															
129.8	Silty SAND, some gravel, trace clay (TILL)		3	SS	10/0.05											
2.6	Compact to dense															
	Grey															
	Wet															
	End of Borehole															
	Auger Refusal															
NOTE: Water level in open borehole at 0.4 m depth on completion of drilling.																

MISS_MTO 04-1111-007-5300.GPJ ON_MOT.GDT 15/7/05

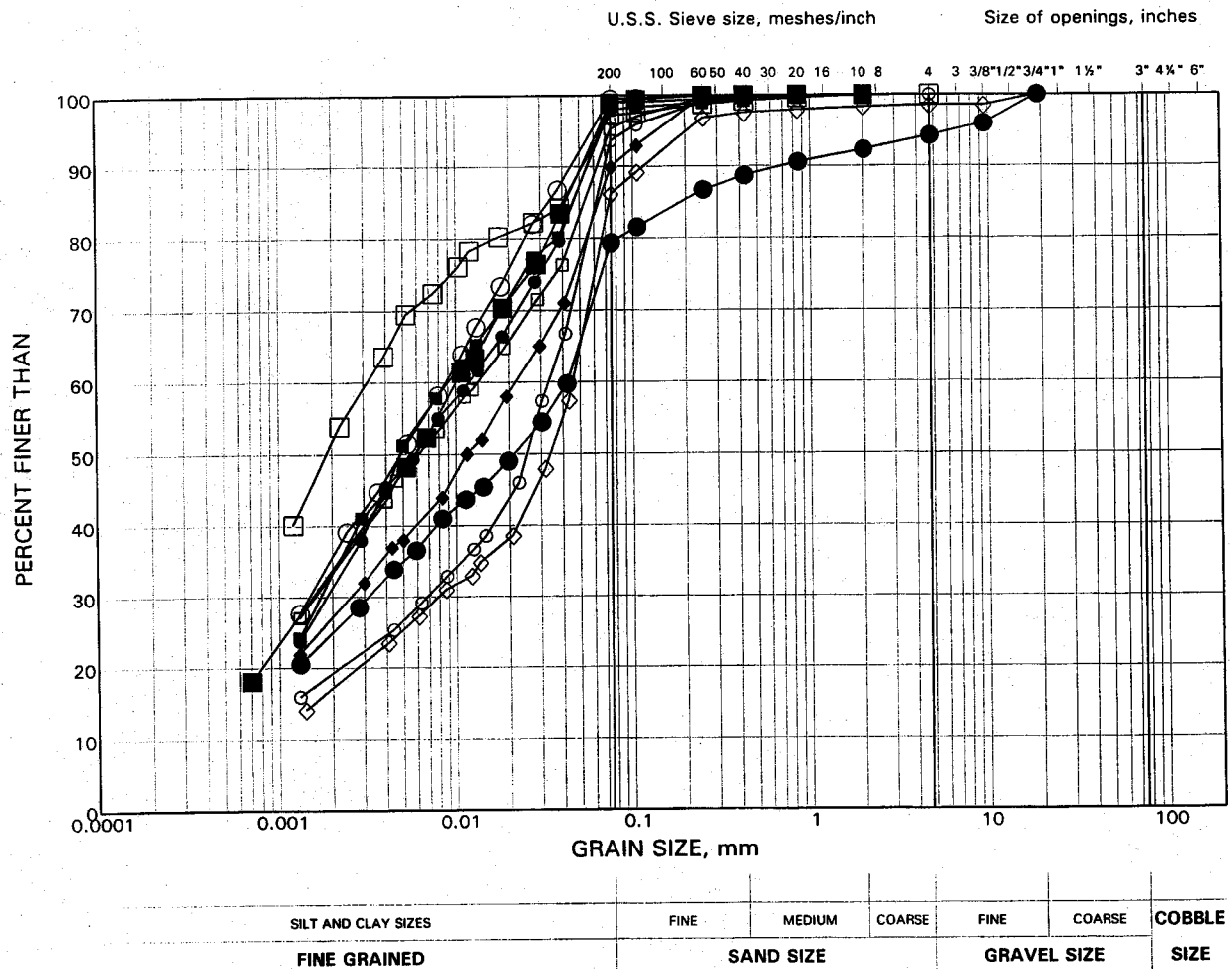
PROJECT 04-1111-007-5300		RECORD OF BOREHOLE No AWNS-6		1 OF 1		METRIC									
W.P. 251-99-00		LOCATION N 5003400.4 E 340290.5		ORIGINATED BY W.C.											
DIST HWY 7		BOREHOLE TYPE Power Auger 108 mm I.D. Hollow Stem Auger		COMPILED BY J.M.											
DATUM Geodetic		DATE November 8, 2004		CHECKED BY L.C.C.											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	25 50 75	γ	GR SA SI CL		
132.3	GROUND SURFACE														
0.0	Silty sand, some gravel, trace organics (FILL)														
0.2	Dark brown Sand and gravel (FILL)														
131.8	Brown														
0.6	Sandy silt, some gravel, trace organic matter (FILL)														
131.3	Brown		1	SS	2										
131.1	PEAT														
	Moist														
1.2	SILTY CLAY														
	Very stiff														
	Grey		2	SS	5										
	Moist to wet														
129.8															
2.6	Silty SAND		3	SS	8										
129.5	Loose														
2.9	Grey														
	Wet														
	End of Borehole Auger Refusal														

MISS MTO 04-1111-007-5300.GPJ ON MOT.GDT 15/7/05

GRAIN SIZE DISTRIBUTION TEST RESULTS

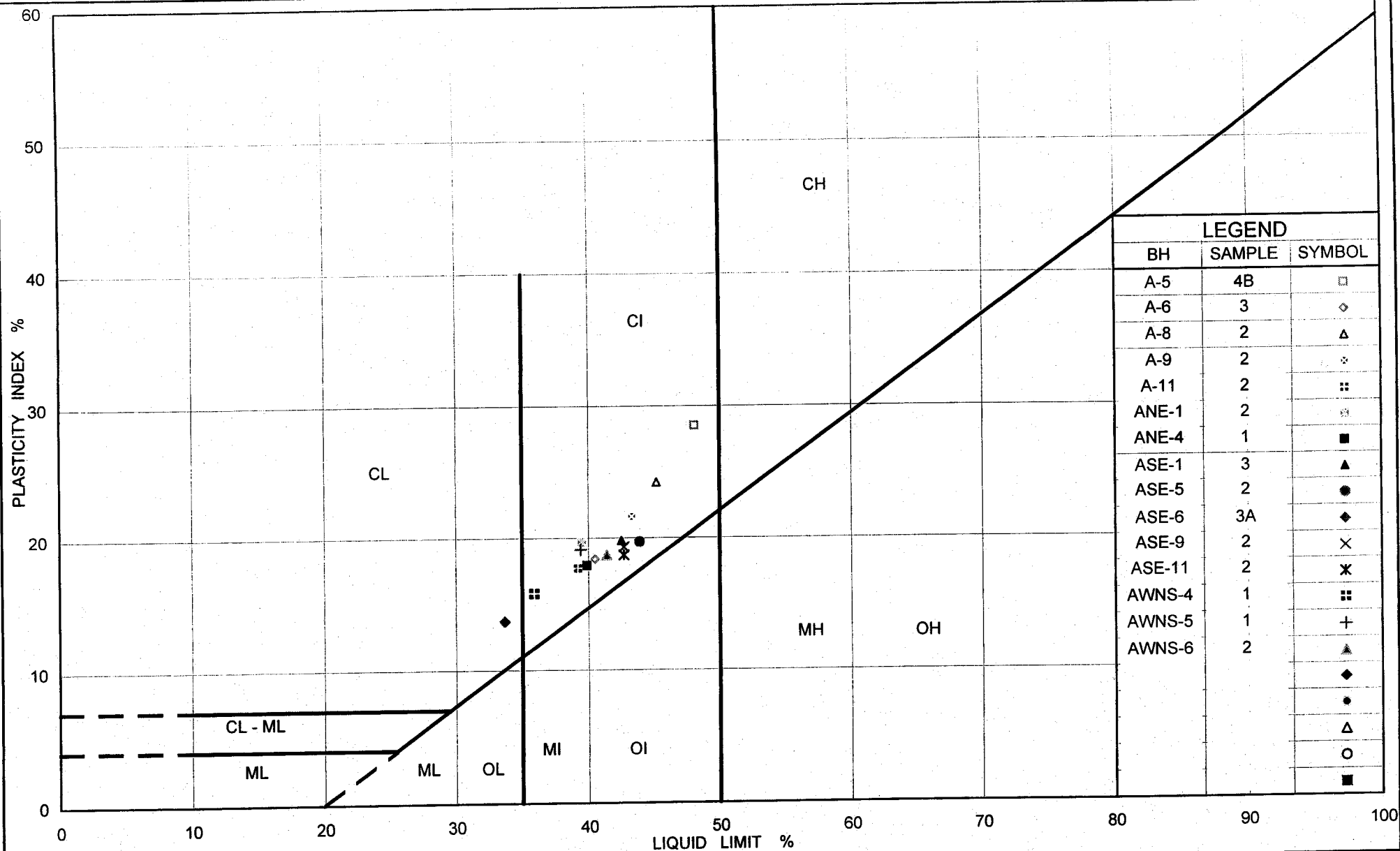
Clayey Silt to Silty Clay
Ashton Station Road Interchange

FIGURE C1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	A-9	2	130.6
■	A-11	2	132.5
◆	A-13	3	130.4
○	ANE-4	2A	130.7
□	ANE-7	1	131.2
◇	ANW-1	1A	131.3
●	ANW-3	1	132.2
■	ASE-4	3	129.8
○	AWNS-4	1	131.1
□	AWNS-4	2	130.4



Ministry of Transportation

Ontario

PLASTICITY CHART
 Silty Clay to Clayey Silt
 Ashton Station Road Interchange

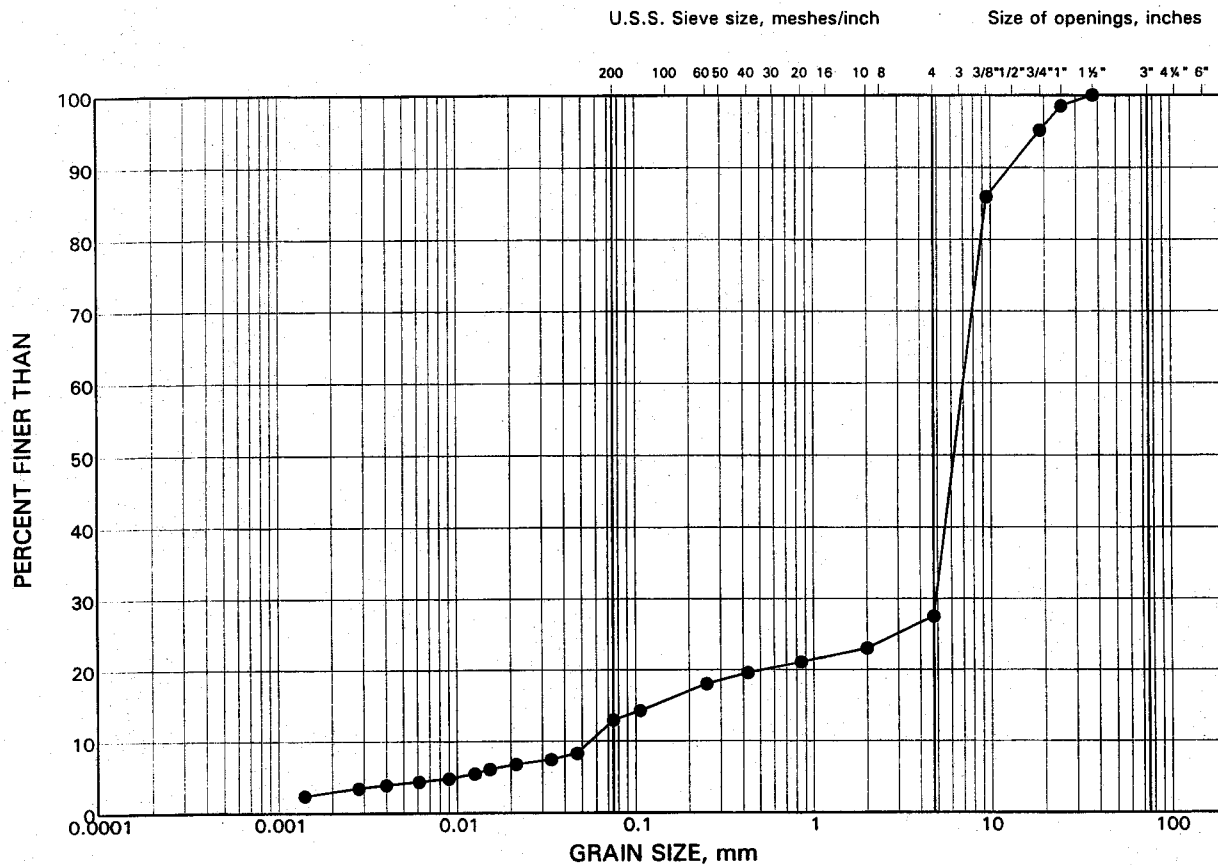
FIG No. C2

Project No. 04-1111-007

GRAIN SIZE DISTRIBUTION TEST RESULT

Gravel to Sand to Silt
Ashton Station Road Interchange

FIGURE C3



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

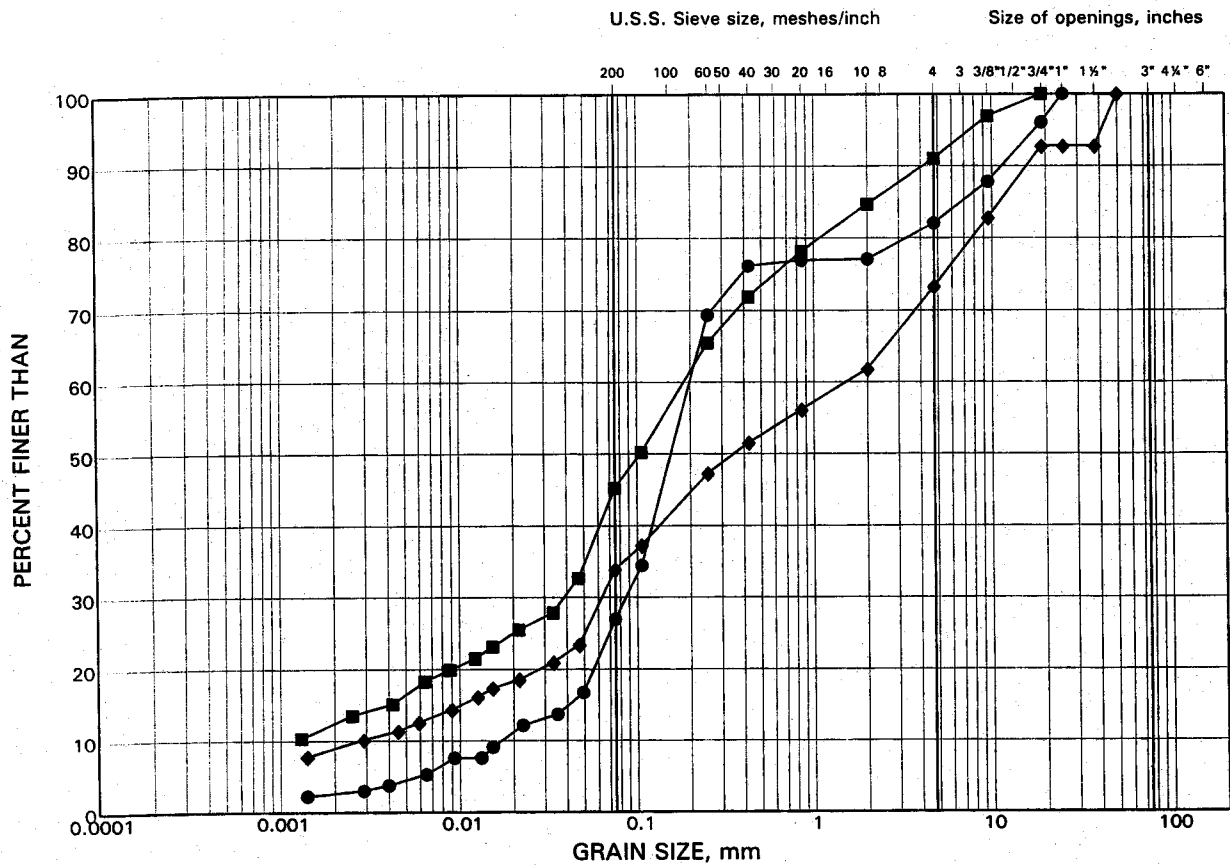
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
•	A-7	4	129.3

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silty Sand Till to Sandy Silt Till
Ashton Station Road Interchange

FIGURE C4



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	ANW-3	2	131.6
■	ANW-4	2	131.5
◆	AWNS-1	2	130.5

DRAFT

July 2005

04-1111-007-2

APPENDIX D
OPERATIONAL CONSTRAINTS

OPERATIONAL CONSTRAINT

Special Provision

Preload Requirements – High Fill Embankments

North Approach Embankment at the Highway 7/Dwyer Hill Road Underpass

The Contractor shall preload the north approach fill embankment immediately north of new Highway 7/Dwyer Hill Road Underpass structure, from Station 9+840 to Station 9+947, in Stage 1. The preload embankment shall be constructed with earth fill to the final grade as shown elsewhere in the contract drawings. Following completion of the preload construction, the preload fills shall remain in place for a minimum period of six (6) months before paving of Dwyer Hill Road. Dwyer Hill Road shall be paved in Stage 3, at which time the earth fill shall be stripped to the level of the base of the pavement structure, and the pavement (including granular base/sub-base) constructed.

High Fill Embankments at Dwyer Hill Road Interchange Ramps

The Contractor shall preload the high fill embankments for the Dwyer Hill Road E-NS Ramp and S-W Ramp, within the following limits, in Stage 1.

- E-NS Ramp, Station 13+660 to Station 13+775;
- N-E Ramp, Station 13+475 to 13+500; and
- S-W Ramp, Station 14+025 to Station 14+080, and Station 14+120 to Station 14+175.

The preload embankments shall be constructed with earth fill to the final grade, as shown elsewhere in the contract drawings. Following construction of the preload embankments, the fills shall remain in place for a minimum period of three (3) months before paving. The Dwyer Hill Road interchange ramps shall be paved in Stage 3, at which time the preload fill shall be stripped to the pavement subgrade level, and the pavement (including granular base/sub-base) constructed.

High Fill Embankments at Ashton Station Road Interchange

The Contractor shall preload the following high fill embankments for Ashton Station Road Interchange in Stage 2 following the diversion of traffic from Ashton Station Road to the Ashton Station Road detour:

- Ashton Station Road, Station 9+880 to 10+280;
- N-E Ramp, Station 9+520 to 9+720; and
- S-E Ramp, Station 9+770 to 10+040.

The preload embankments shall be constructed with earth fill to the final grade, as shown elsewhere in the contract drawings. Following construction of the preload embankments, the fills shall remain in place for a minimum period of six (6) months before paving. Ashton Station Road and the N-E and S-E Ramps shall be paved in Stage 3, at which time the preload fill shall be stripped to the pavement subgrade level, and the pavement (including granular base/sub-base) constructed.

From the limits of preload, fills shall be placed at 2:1 slopes both transversely and longitudinally.